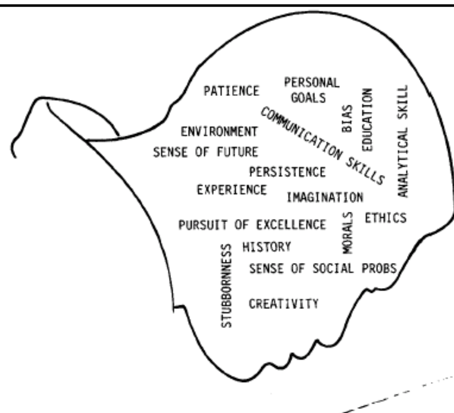


Engineering Drawing ME 111 1-0-3-5

Instructors: Dr. Sreeja P. (CE),
Dr. S. Senthilvelan (ME) and
Dr D. Sharma (ME)

Course Credits

- 1-0-3-5
  - 1: One lecture per week. However, we need more lectures per week for better understanding of this course
  - 0: No tutorial
  - 3: one lab of three hours
  - 5: Total credits for this course

Course Information

- Lectures
  - **FN (D slot)** Division I by Dr. S. Senthilvelan (ME) and Division II by Dr. Sreeja P. (CE)
    - **Lecture schedule: Monday: 11-11:55AM, Thursday: 9-9:55AM, Friday: 10-10:55AM**
    - **Venue: Lecture Hall – L1 (Div I), and L2 (Div II)**
  - **AN (D1 slot) Divisions III by Dr. D. Sharma (ME)** and Division IV by Dr. Sreeja P. (CE)
    - **Lecture schedule: Monday: 2-2:55PM, Thursday: 4-4:55PM, Friday: 3-3:55PM**
    - **Venue: Lecture Hall – L1 (Div III), and L2 (Div IV)**
  - **Lecture slides**
    - **On moodle under "Mechanical Engineering".**
      - The course name is "Engineering Drawing 2014" and password is "ed2014".
    - **For first two weeks only, the slides will also be available at "http://shilloi.iitg.ernet.in/~dsharma/me111.html"**

3

Lab Sessions

- Drawing halls: 1205 and 1206, Core 1

FN Lab session (9-12noon)	AN Lab session (2-5PM)
ME111 (L8)	ME111 (L3)
ME111 (L6)	ME111 (L1)
ME111 (L9)	ME111 (L4)
ME111 (L7)	ME111 (L2)
ME111 (L10)	ME111 (L5)

- Tables in both drawing halls will be arranged with registration number on it.
- Details of seating arrangement will be uploaded on http://shilloi.iitg.ernet.in/~dsharma/me111.htm l

4

Tutors

Rooms	Monday	
	9 – 12 Noon	2 – 5 PM
1205	Dr. Nandakishore (CL)	Prof. S. K. Dwivedy (ME)
1206	Dr. V. Prabu (CL)	Dr. Senthil Murugan (CL)
	Tuesday	
1205	Dr. Pankaj Tiwari (CL)	Dr. S. S. Gautam (ME)
1206	Dr. Ajay Kalamdhad (CE)	Dr. Sreedeep S. (CE)
	Wednesday	
1205	Dr. D. Sharma (ME)	Dr. D. N. Basu (ME)
1206	Dr. R. Prasanna (CL)	Prof. Jawed (CE)
	Thursday	
1205	Dr. Nageswara Rao Peela (CL)	Dr. M. Das (ME)
1206	Dr. G. Indu (CE)	Prof. M. Pandey (ME)
	Friday	
1205	Dr. Abhishek Sharma (CE)	Dr. Raghvendra Gupta (CL)
1206	Dr. R. Anandalakshmi (CL)	Dr. Mallikarjuna (CE)

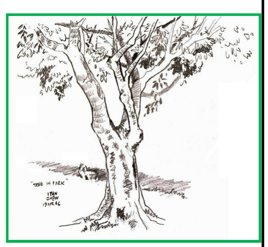
5

Why Drawing for Engineers?

Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience and practice is applied with judgment to develop ways to utilize economically the material and forces of nature for the benefit of mankind- **ABET** **(Accreditation Board for Engineering and Technology).**

- **In a process of product development, two steps are involved:**
  - **Product specification**
  - **Product drawing**

Although the works of artists (or photography and other method of reproduction) may provide pictorial representation, they cannot serve as engineering descriptions.



Why this Banyan tree drawing is not engineering drawing?

6

A new machine, structure, product must exist in the mind of the engineers before it can become a reality.

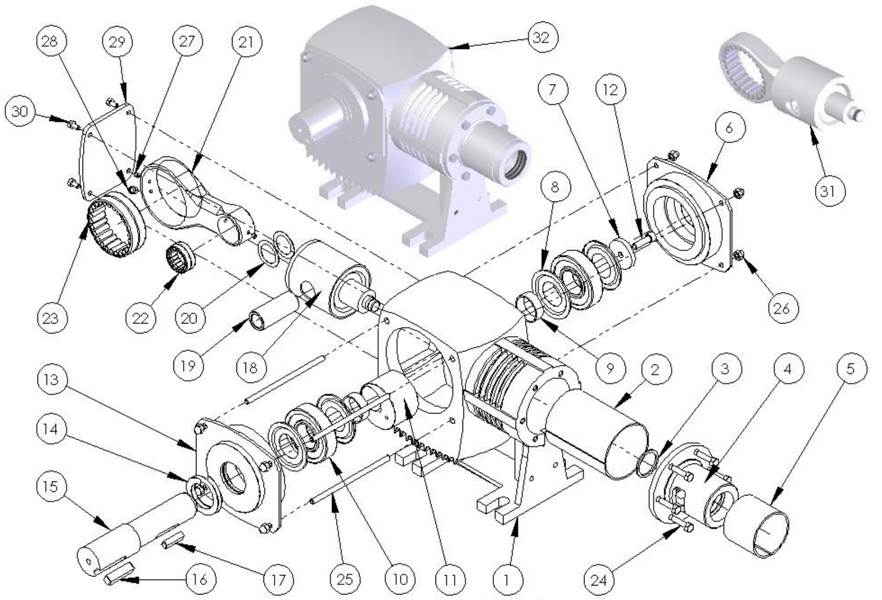
- Original concept or idea is usually placed on paper or as an image on a computer screen and,
- Communicated to others by way of the graphic language in the form of freehand sketches.
- These free hand sketch are followed by other, more exact, sketches as the idea is developed more fully.

The engineer must understand how to read and write in the graphic language

7

Engineers must be able to create idea sketches, calculate stresses, analyze motions, size parts, specify materials and production methods, make design layouts and supervise the preparation of drawings and specifications that will control the numerous details of product manufacture, assembly and maintenance

8



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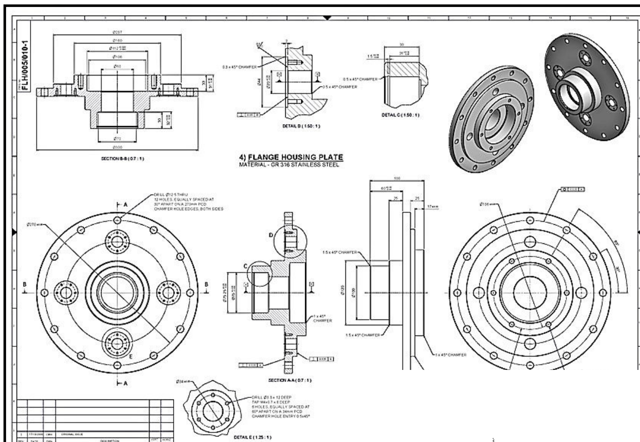

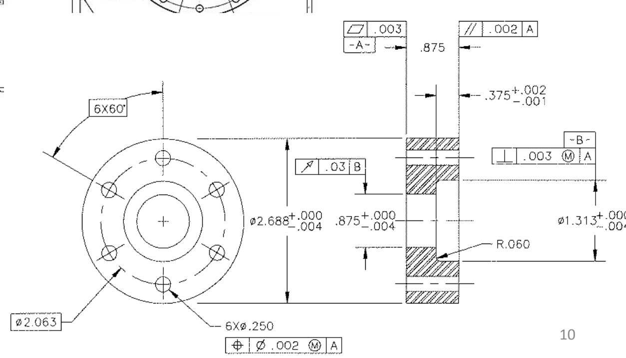

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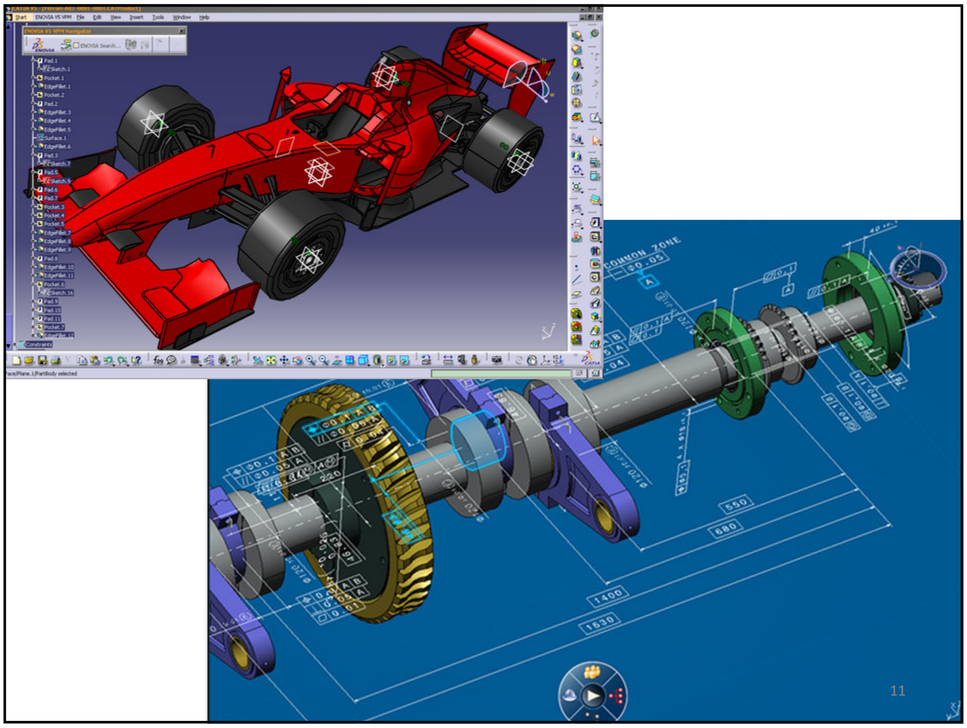
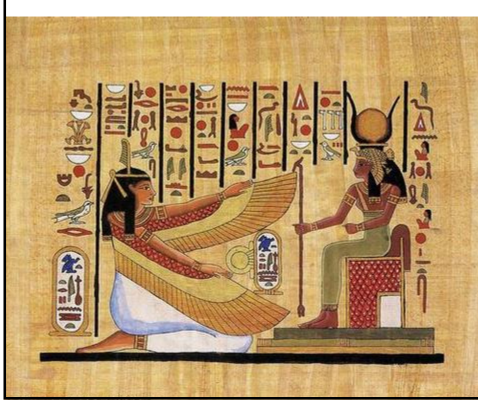


11

Although people around the world speak different language(about 7000), a universal graphic language has existed since the earliest of times.

The earliest forms of writing were through picture forms such as ***Egyptian hieroglyphics.*** Later these forms were simplified and became the abstract symbols used in our writing today



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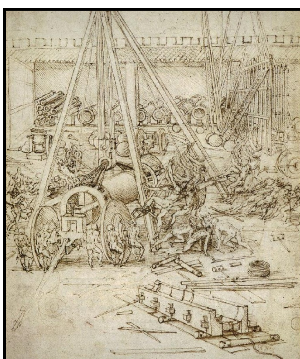
Drawing is a graphic representation of:

- a real thing,
- an idea or,
- a proposed design for later manufacture or construction.

Graphic representation:

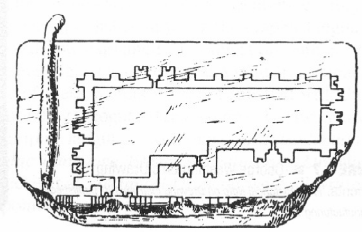
1. Artistic: to express aesthetic, philosophic or other abstract ideas
2. Technical: to represent the design of objects to be built or constructed

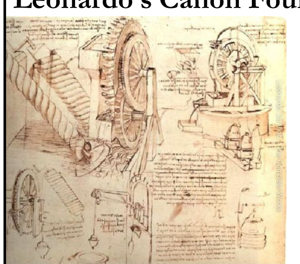
Early Technical Drawing



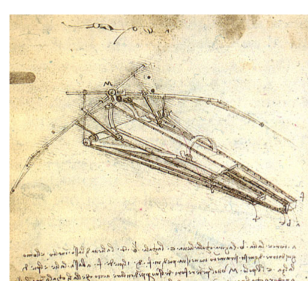
Leonardo's Canon Foundry 1500 AD

■ FIGURE 1.5 ■ Plan of a Fortress. This stone tablet is part of a statue now in the Louvre, in Paris, and is classified in the earliest period of Chaldean art, about 4000 B.C. *From Transactions ASCE, May 1891.*





Water lifting device



1488 Design for a Flying Machine

What Engineering Students Should Know?

- For any product design or development, graphical language is always required with technical knowledge
  - Today the intimate connection between engineering and science, and the universal graphic language is more vital that even before
- Artistic talent is no longer a prerequisite to learning the fundamentals of the graphic language.
  - Instead today's graphics student needs the same aptitudes, abilities and computer skills that are needed in science and engineering courses
- A well trained engineers must be able to make and read correct graphics representations of engineering structures, designs and data relationships.
  - Understand the fundamental principles or the grammar of the language and be able to execute the work with reasonable skill

What Engineering Students Should Know?

- Students will learn the meaning of neatness, speed, and accuracy for the first time in a drawing course. These are basic and necessary habits for every successful engineer
- The ability to think in three dimensions
  - Learning to visualize objects in space, to use the constructive imagination is one of the principal values to be obtained from a study of the graphic language

Projections

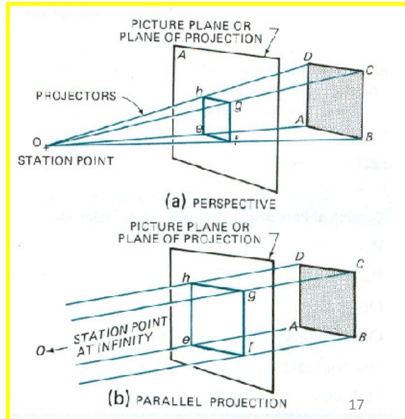
Behind every drawing of an object is a space relationship involving four imaginary things

- ➢The observer's eye or the station point
- ➢The object
- ➢The plane of projection
- ➢The projectors also called visual rays or lines of sight

If the observer's eye is imagined as infinitely distant from the object and the plane of projection, the projection will be parallel

If the projectors, in addition to being parallel to each other, are perpendicular (normal) to the plane of projection, the result is an orthographic

If the projectors are parallel to each other but oblique to the plane of projection, the result is an oblique projection



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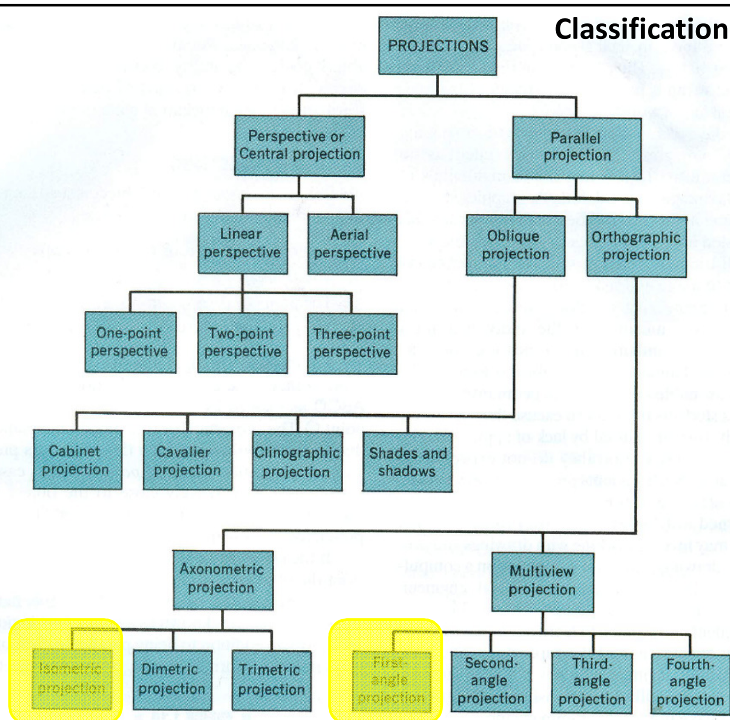
Classification of Projections



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Engineering Drawing ME 111 1-0-3-5

Syllabus: Importance of engineering drawing; Conventions and standards: ISO; Scales; Curves; Orthographic projections: points, lines, planes and solids; Sections of solids; Isometric projections; Development of surfaces; Intersection of solids

Texts:

N. D. Bhatt, Engineering drawing, Charotar Publishing, 50th Edition, 2011

Dhananjay A. Jolhe, Engineering Drawing, Tata McGraw Hill,2011

M. B. Shah and B. C. Rana, Engineering Drawing, 2nd Ed., Pearson Education,2009

References:

T E French, C J Vierck and R J Foster, Graphic Science and Design,4th Ed., McGraw Hill,1984

W J Luzadder and J M Duff, Fundamentals of Engineering Drawing,11th Ed., PHI,1995

K Venugoapl, Engineering Drawing and Graphics,5th Ed, New Age International,2011

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Weightage

50 % Lab sessions

20 % Mid-semester exam (20th September 2014)

30 % End-semester exam (08th and 09th November 2014)

Normalization

a. Group wise for lab sessions.

b. Session wise for end semester exam.

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Lab sessions

Lab No	Topic
1	**Lettering, Dimensioning and Engineering Curves:** Parabola, Ellipse Hyperbola, Cycloids and Involutes
2	**Scales:** Plain, Vernier and Diagonal scales
3	**Orthographic projections:**
4	**Projection of straight lines I:** Lines inclined to any one of the plane
5	**Projection of straight lines II**: lines inclined to both HP and VP., traces
6	**Projection of solids I**: Projections of solids in simple positions
7	**Projection of solids II:** Solids inclined in to one and both the planes
8	**Sections of solids**: Section of standard solids and True shape Section of standard machine elements
9	**Development of surfaces**: Development of standard solids full and sectioned solids
10	**Isometric projections**: Isometric projections of simple solids, simple and complex positions

- Common questions will be discussed in the lecture.
- Sheets will be graded out of 100 marks.

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	Monday Lecture:11-12 noon/ 2-3 PM Lab:9-12 AM / 2-5 PM	**Tuesday** No Lecture Lab:9-12 AM / 2-5 PM	**Wednesday** No Lecture Lab: 9-12 AM/ 2-5 PM	**Thursday** Lecture: 9-10 AM/ 4-5 PM Lab:9-12 AM / 2-5 PM	**Friday** Lecture: 10-11 AM/ 3-4 PM Lab:9-12 AM / 2-5 PM	
Week 1			30.07.14	31.07.14 **Lecture 1** Introduction, Lettering and Dimensioning	01.08.14 **Lecture 2** Engineering Curves	
			No-Lab	No-Lab	No-Lab	
Week 2	04.08.14 **Lecture 3** Engineering Curves	05.08.14	06.08.14 (Friday Time Table)	07.08.14 **Lecture 4** Scales	08.08.14 **Lecture 5** Orthographic Projections	
	04.08.14 No-Lab	05.08.14 Lab 1 Engineering Curves	06.08.14 (Friday Time Table) Lab 1 Engineering Curves	07.08.14 Lab 1 Engineering Curves	08.08.14 Lab 2 Scales	
Week 3	11.08.14 **Lecture 6** Orthographic Projections	12.08.14	13.08.14	14.08.14 **Lecture 7** Orthographic Projections	15.08.14 Holiday	
	11.08.14 Lab 1 Engineering Curves	12.08.14 Lab 2 Scales	13.08.14 Lab 1 Engineering Curves	14.08.14 Lab 2 Scales		
Week 4	18.08.14 **Lecture 8** Projection of Lines I	19.08.14	20.08.14	21.08.14 **Lecture 9** Projection of Lines I	22.08.14	
	18.08.14 Lab 2 Scales	19.08.14 Lab 3 Orthographic Projections	20.08.14 Lab 2 Scales	21.08.14 Lab 3 Orthographic Projections	22.08.14 Lab 3 Orthographic projections	
Week 5	25.08.14 **Lecture 10** Projection of Lines I	26.08.14	27.08.14	28.08.14 **Lecture 11** Projection of Lines-II	29.08.14	
	25.08.14 Lab 3 Orthographic Projections	26.08.14 Lab 4 Projection of Lines-I	27.08.14 Lab 3 Orthographic Projections	28.08.14 Lab 4 Projection of Lines-I	29.08.14 Lab 4 Projection of Lines-I	
Week 6	01.09.14 **Lecture 12** Projection of Lines-II	02.09.14	03.09.14	04.09.14 **Lecture 13** Projection of Solids I	05.09.14 Techniche	
	01.09.14 Lab 4 Projection of Lines I	02.09.14 Lab 5 Projection of Lines II	03.09.14 Lab 4 Projection of Lines I	04.09.14 Lab 5 Projection of Lines II		
Week 7	08.09.14 **Lecture 14** Projection of Solids I	09.09.14	10.09.14	11.09.14 **Lecture 15** Projection of Solids I	12.09.14	
	08.09.14 Lab 5 Projection of Lines II	09.09.14 No-Lab	10.09.14 Lab 5 Projection of Lines II	11.09.14 No-Lab	12.09.14 Lab 5 Projection of Lines II	
Week 8	15.09.14 **Lecture 16** Projection of Solids II	16.09.14	17.09.14	18.09.14 **Lecture 17** Projection of Solids II	19.09.14 **Lecture 18** Section of Solids	
	15.09.14 Lab 6 Projection of Solids I	16.09.14 Lab 6 Projection of Solids I	17.09.14 Lab 6 Projection of Solids I	18.09.14 Lab 6 Projection of Solids I	19.09.14 Lab 6 Projection of Solids I	
Week 9	ME 111 Mid-semester examination (20/09/2014, Saturday)					
Week 10	22 to 29 September Mid semester week	30.09.14	01.10.14 (Thursday Time Table) **Lecture 19** Section of Solids	02.10.14 Holiday	03.10.14 Holiday	
		30.09.14 No-Lab	01.10.14 (Thursday Time Table) Lab 7 Projection of Solids II			
Week 11	06.10.14 Holiday	07.10.14	08.10.14	09.10.14	10.10.14	11.10.14 (Friday Time Table)
		07.10.14 Lab 7 Projection of Solids II	08.10.14 Lab 7 Projection of Solids II	09.10.14 Lab 8 Section of Solids	10.10.14 Lab 7 Projection of Solids II	11.10.14 (Friday Time Table) No-Lab
Week 12	13.10.14 **Lecture 20** Development of Surfaces	14.10.14	15.10.14	16.10.14 **Lecture 21** Isometric Projections	17.10.14	18.10.14 (Friday Time Table)
	13.10.14 Lab 7 Projection of Solids II	14.10.14 Lab 8 Section of Solids	15.10.14 Lab 8 Section of Solids	16.10.14 Lab 9 Development of Surfaces	17.10.14 Lab 8 Section of Solids	18.10.14 (Friday Ti Table) No-Lab
Week 13	20.10.14 **Lecture 22** Isometric Projection	21.10.14	22.10.14	23.10.14 Holiday	24.10.14 Holiday	
	20.10.14 Lab 8 Section of Solids	21.10.14 Lab 9 Development of Surfaces	22.10.14 Lab 9 Development of Surfaces			
Week 14	27.10.14 **Lecture 23** Isometric Projection	28.10.14	29.10.14	30.10.14 **Lecture 24** Intersection of surfaces	31.10.14	
	27.10.14 Lab 9 Development of Surfaces	28.10.14 Lab 10 Isometric Projection	29.10.14 Lab 10 Isometric Projection	30.10.14 Lab 10 Isometric Projection	31.10.14 Lab 9 Development of Surfaces	
Week 15	03.11.14 **Lecture 25** Intersection of surfaces	04.11.14 Holiday	05.11.14	06.11.14 Holiday	07.11.14 **Lecture 26** Computer Aided Drawing	
	03.11.14 Lab 10 Isometric Projection		05.11.14 No-Lab		07.11.14 Lab 10 Isometric Projection	
	End semester exam: 08/11/2014 (Saturday) Session 1: 08:30AM-10:30AM, Session 2: 11:00AM-1PM, Session 3: 2PM-4PM 09/11/2014 (Sunday) Session 4: 08:30AM-10:30AM, Session 5: 11:00AM-1PM, Session 6: 2PM-4PM					

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Attendance

- Minimum 75% compulsory attendance in lectures and labs separately
- Four times updates of attendance will be available on moodle

Prerequisite For Engineering Drawing

Table 1.1 Recommended Sizes of Drawing Sheets and Drawing Boards

Drawing Sheet (IS 10711:2001)		*Drawing Board (IS 1444:1989)*	
Designation	*Size (mm) Length × Width*	*Designation*	*Size (mm) Length × Width*
A0	1189 × 841	D0	1270 × 920
A1	841 × 594	D1	920 × 650
A2	594 × 420	D2	650 × 470
A3	420 × 297	D3	500 × 350
A4	297 × 210		

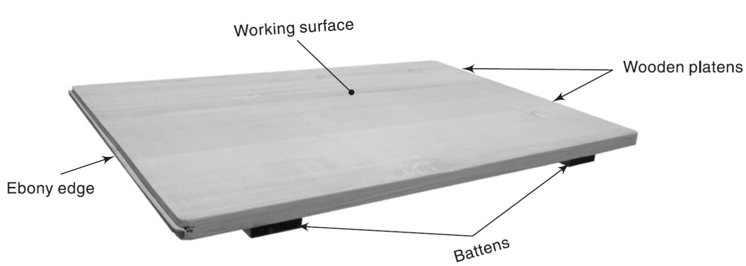
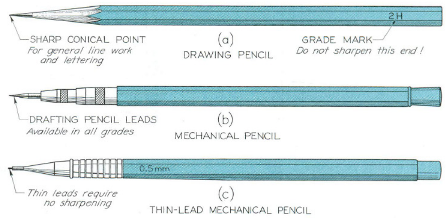
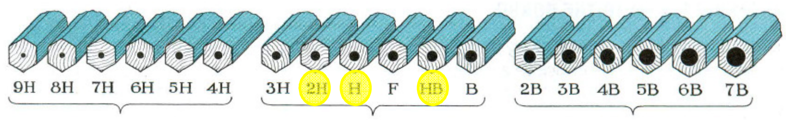


Fig. 1.2 Drawing board

Prerequisite For Engineering Drawing



Lead Grade Sheet



Hard

The hard leads in this group (left) are used where extreme accuracy is required, as on graphical computations and charts and diagrams. The softer leads in this group (right) are sometimes used for line work on engineering drawings, but their use is restricted because the lines are apt to be too light.

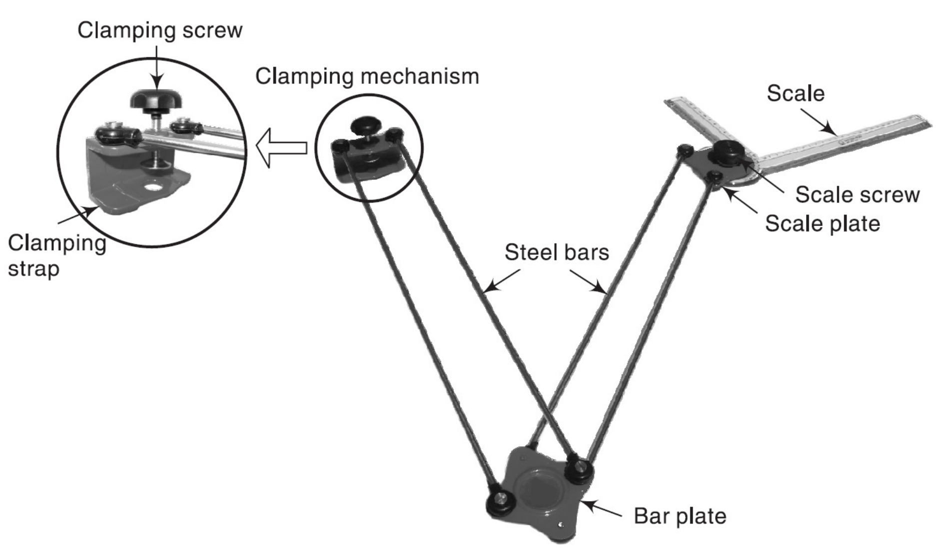
Medium

These grades are for general purpose work in technical drawing. The softer grades (right) are used for technical sketching, for lettering, arrowheads, and other freehand work on mechanical drawings. The harder leads (left) are used for line work on machine drawings and architectural drawings. The H and 2H leads are widely used on pencil tracings for reproduction.

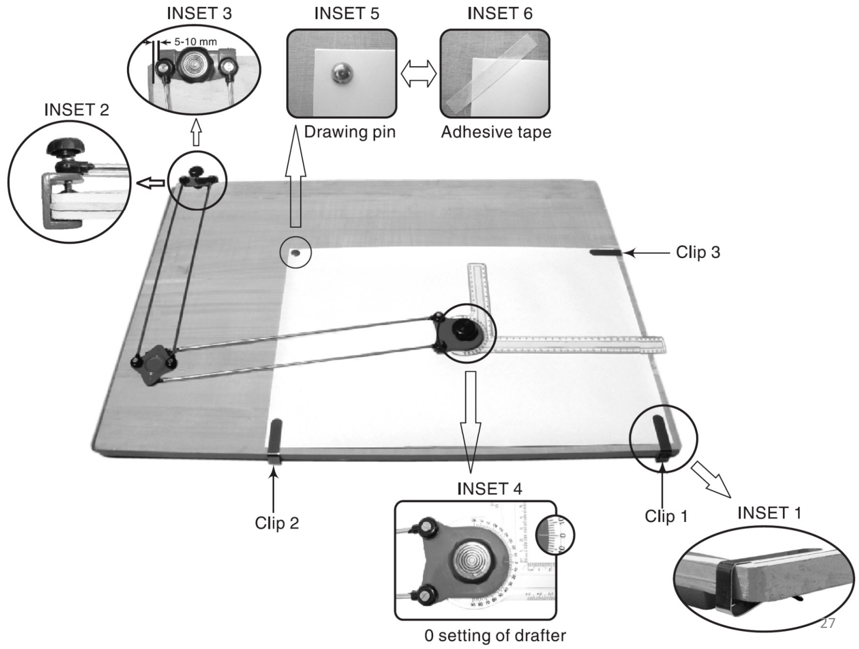
Soft

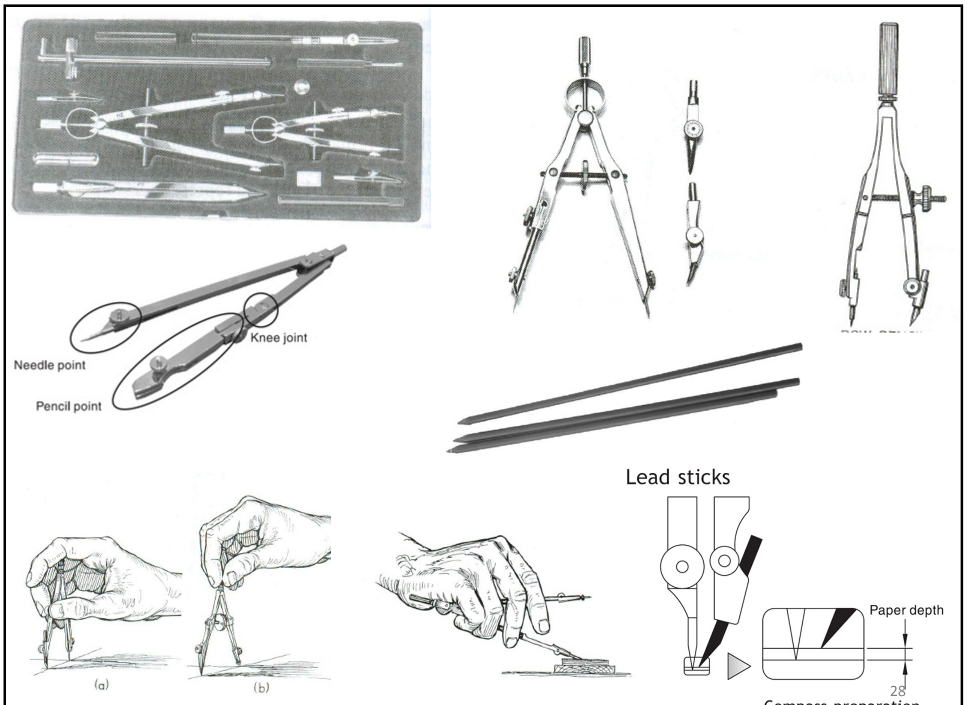
These leads are too soft to be useful in mechanical drafting. Their use for such work results in smudged, rough lines that are hard to erase, and the lead must be sharpened continually. These grades are used for art work of various kinds, and for full-size details in architectural drawing.

Prerequisite For Engineering Drawing

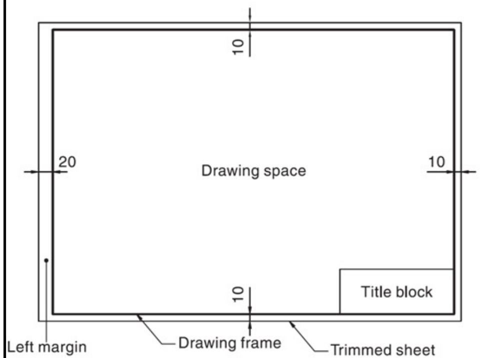


Prerequisite For Engineering Drawing

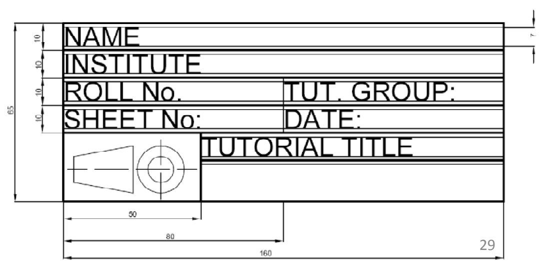




Prerequisite For Engineering Drawing



Drawing margins and location of tit



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Lettering

- Lettering means
  - Writing of titles, dimensions, notes and other important particulars
- Types
  - Single stroke letters
  - Double stroke letters
- Single Stroke
  - Thickness of the line of the letter should be such as is obtained in one stroke of the pencil.
  - Does not mean that the letter should be made in one stroke without lifting the pencil.

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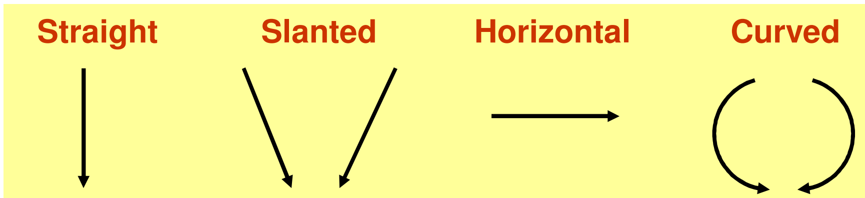
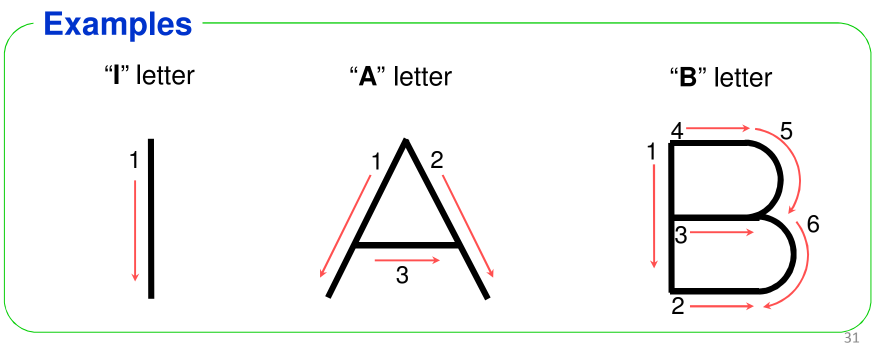
Basic Strokes





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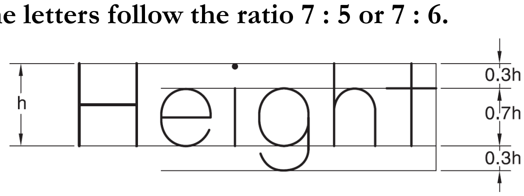
Height and Width of Letters

- BIS (SP 46: 2003) has recommended the heights of letters as:
  - 1.8 mm, 2.5 mm, 3.5 mm, 5 mm, 7 mm, 10 mm, 14 mm and 20 mm.
  - Large-sized letters are used for main titles and headings,
  - Medium-sized letters for subtitles and important notes and
  - Small-sized letters for dimensions and general notes.
  - The height-to-width ratio varies from letter to letter. Most of the letters follow the ratio 7 : 5 or 7 : 6.



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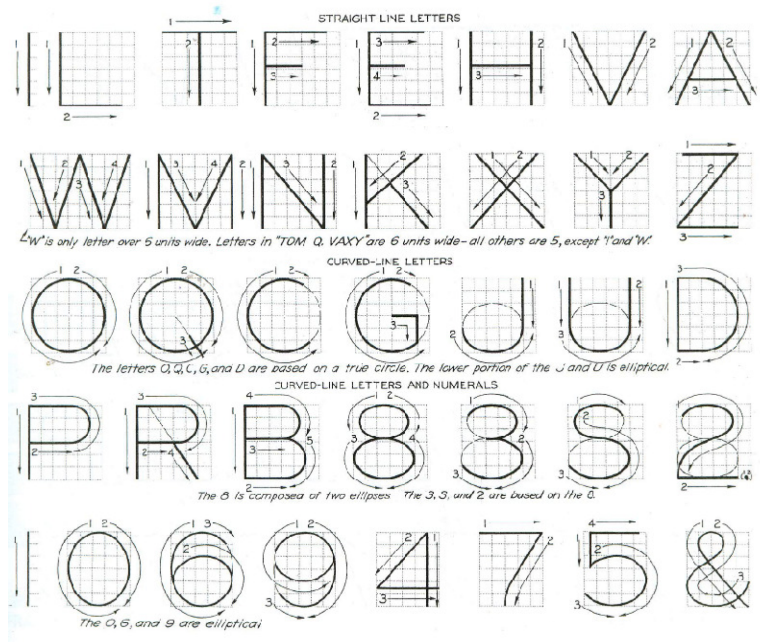
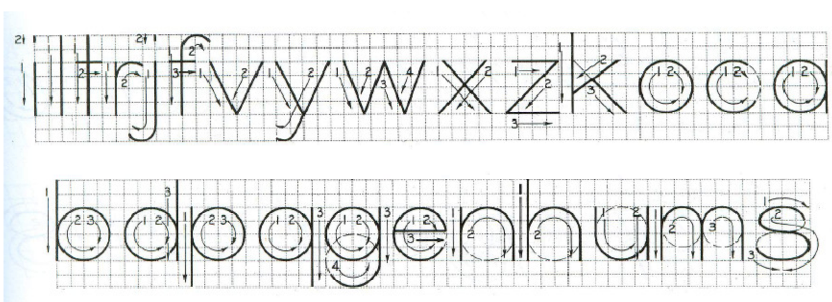


Vertical Capital Letters and Numerical



Vertical Lowercase Letters

Double Stroke Lettering

- More thickness is given to single stroke letters, it is known as double stroke or gothic letters.

A B C D

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Lettering Rules

1. Draw letters as simple as possible. Artistic or cursive lettering should be strictly avoided.
2. Draw letters symmetrical about the vertical axis or horizontal axis. Asymmetric letters like, F, R, Z, 4, etc., may be drawn as they are.
3. Round-off the sharp corners wherever necessary, e.g., D, P, S, etc.
4. Draw all letters legible and uniform.
5. The height of all the letters in one line should be the same.
6. Use single stroke vertical CAPITAL letters as much as possible.

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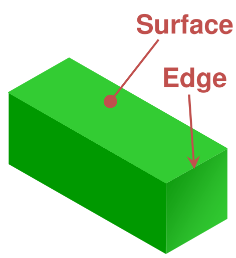
Graphic Language in Engineering Drawing

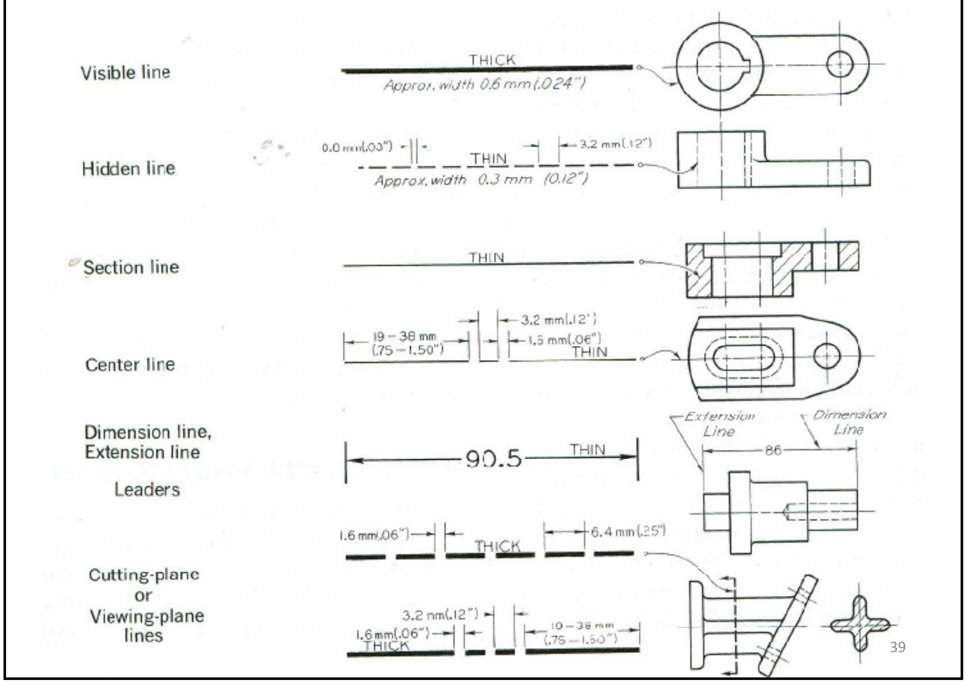
- "**Engineering drawing**" or "**blueprint**" uses ***lines*** to represent the ***features*** of an object.
- Features of an object are ***surface*** (include ***plane***) and ***edge***.



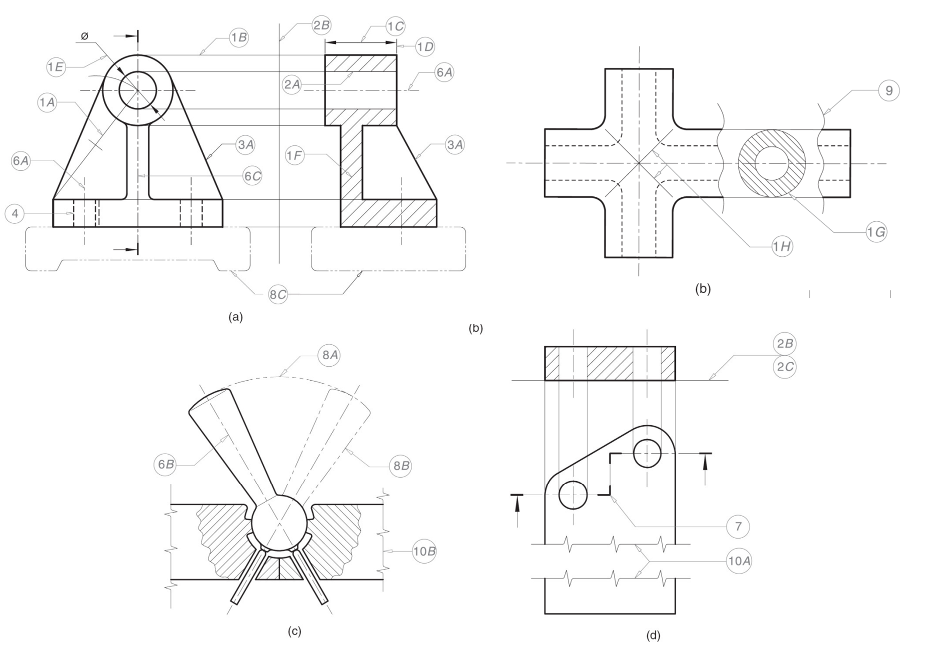
Lines

Line	Description	General applications
A	Continuous thick or Continuous wide	Visible outlines, visible edges; crests of screw threads; limits of length of full deph thread,lines of cuts and section arrows; parting lines of moulds in views; main representations in diagrams, maps, flow charts; system lines(structural metal engg.)
B	Continuous thin (narrow) (straight or curved)	Imaginary lines of intersection; grid, dimension, extension, projection, short centre, leader, reference lines; hatching; outlines of revolved sections; root of screw threads; interpretation lines of tapered features; framing of details; indication of repetitiv details;
C	Continuous thin (narrow) freehand	Limits of partial or interrupted views and sections, if the limit is not a chain thin line
D	Continuous thin (narrow) with zigzags (straight)	Long-break line
E	Dashed thick (wide)	Line showing permissible of surface treatment
F	Dashed thin (narrow)	Hidden outlines; hidden edges
G	Chain thin Long-dashed dotted (narrow)	Centre line; lines of symmetry; trajectories; pitch circle of gears, pitch circle of holes,
H THICK THIN THICK	Chain thin (narrow) with thick (wide) at the ends and at changing of position	Cutting planes
J	Chain thick or Long-dashed dotted (wide)	Indication of lines or surfaces to which a special requirement applies
K	Chain thin double-dashed or long-dashed double-dotted (narrow)	Outlines of adjacent parts Alternative and extreme positions of movable parts Centroidal lines Initial outlines prior to forming Parts situated in front of the cutting plane

Lines



Visible line
THICK
Approx. width 0.6 mm (.024")
Hidden line
THIN
3.2 mm (.12")
Approx. width 0.3 mm (0.12")
Section line
THIN
Center line
19 – 38 mm
(.75 – 1.50")
3.2 mm (.12")
1.6 mm (.06")
THIN
Dimension line,
Extension line
Leaders
90.5
THIN
Extension Line
Dimension Line
86
Cutting-plane
or
Viewing-plane
lines
1.6 mm (.06")
THICK
6.4 mm (.25")
3.2 mm (.12")
1.6 mm (.06")
THICK
10 – 38 mm
(.75 – 1.50")



1B
2B
1C
1D
1E
6A
2A
1A
3A
1F
3A
6A
6C
4
8C
(a)
(b)
9
1G
1H
(b)
8A
6B
8B
10B
(c)
2B
2C
7
10A
(d)

Dimensioning

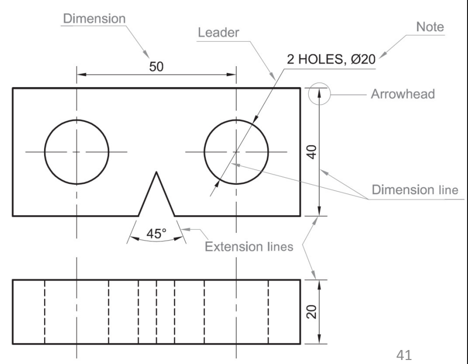
BIS (SP 46: 2003) defines dimension as ***a numerical value expressed in appropriate units of measurement and indicated graphically on technical drawings with lines, symbols and notes.***

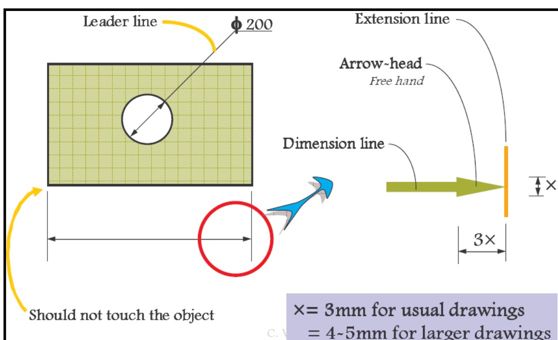
The important aspects of dimensioning are as follows:

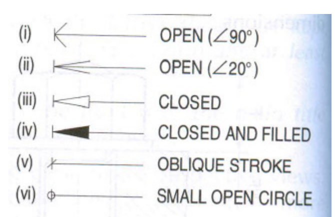
- **Units of Measurement The most convenient unit for length is millimeter. Angles are shown in degrees. Symbols are incorporated to indicate specific geometry wherever necessary.**

Dimensioning is often done by a set of elements, which includes

- **extension lines,**
- **dimension lines,**
- **leader lines,**
- **arrowheads and**
- **dimensions.**







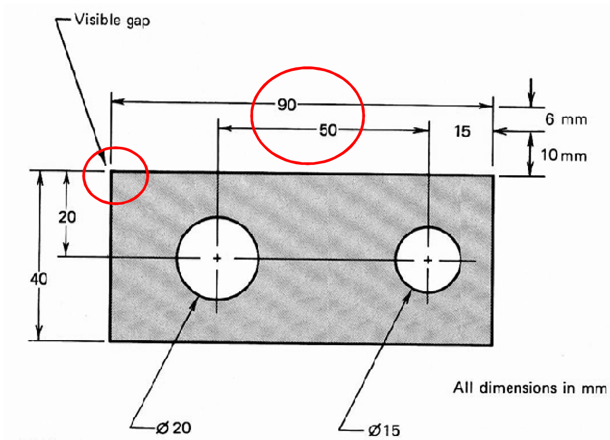
Dimension line: Dimension line is a thin continuous line. It is terminated by arrowheads touching the outlines, extension lines or centre lines

Extension lines: An extension line is also a thin continuous line drawn in extension of on outline. It extends by about 3 mm beyond the dimension line

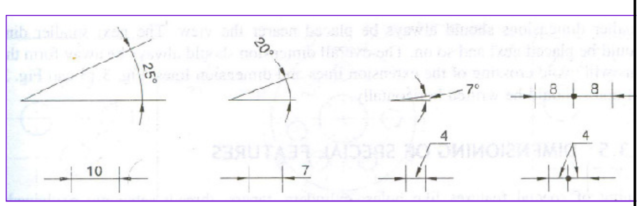
Arrowheads: An arrowhead is placed at each end of a dimension line. Its pointed end touches an outline, an extension line or a center line. The size of an arrowhead should be proportional to the thickness of the outlines. The length of the arrowhead should be about three times its maximum width

Leader: A leader or a pointer is a thin continuous line connecting a note or a dimension figure with the feature to which it applies.

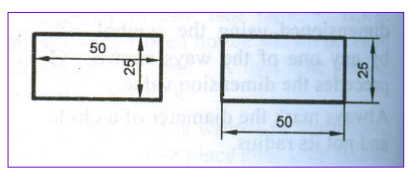
- Dimension lines should be drawn at least 10 mm away from the outlines
- Smaller dimensions should be placed nearer the view and the larger further away so that extension lines do not cross dimension lines
- As far as possible, all the dimensions should be placed outside the views. Inside dimensions are preferred only if they are clearer and more easily readable



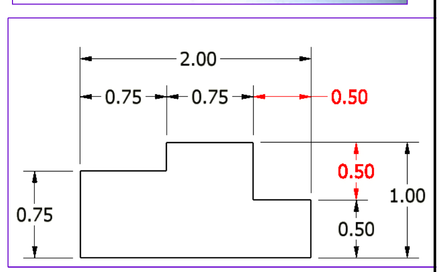
Arrowheads should ordinarily be drawn within the limits of the dimensioned feature. But when the space is too narrow, they may be placed outside



Dimensions should be placed outside the views

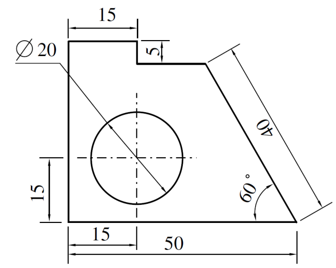


Each dimension should be given only once. No dimension should be redundant

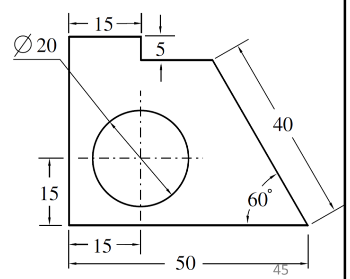


All the dimensions on a drawing must be shown using either Aligned System or Unidirectional System. Two systems be mixed on the same drawing.

Aligned System: Dimensions are placed perpendicular to the dimension line so that they may be read from the bottom or right-hand side of the drawing sheet. Dimensions are placed at the middle and above of the dimension lines.



Unidirectional System: Dimensions are placed in such a way that they can be read from the bottom edge of the drawing sheet. Dimension lines are broken near the middle for inserting the dimensions.



The unit should not be written after each dimension, but a note mentioning the unit should be placed below the drawing.

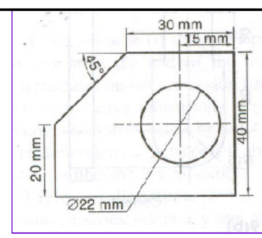
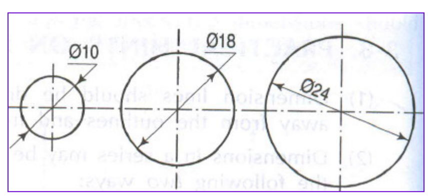
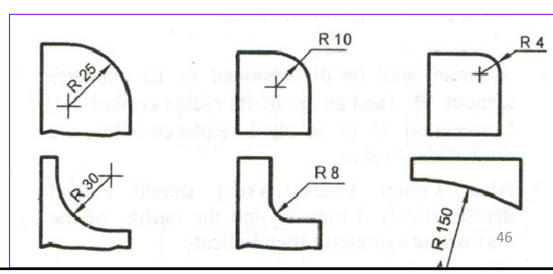


Figure shows various methods of dimensioning different sizes of circles

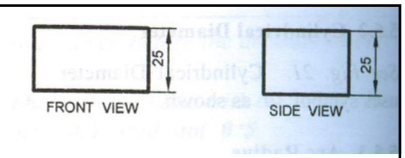


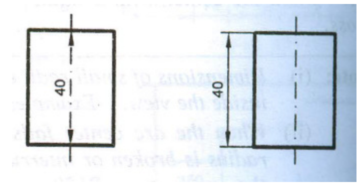
Arc Radius: An arc is dimensioned by its radius R by any one of the ways. Only one arrowhead with its point on the arc end of the dimension line is used

Dimension lie of a radius should pass thorough the center of the arc. Mark the center with a small cross



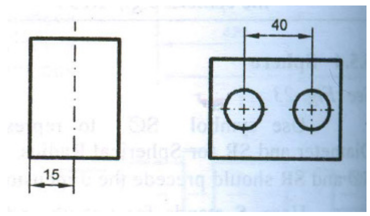
Do not repeat the same dimension in different views

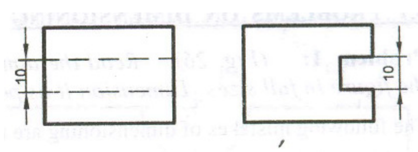




Center line(axis) itself shall not be used as a dimension line with arrowheads as its ends

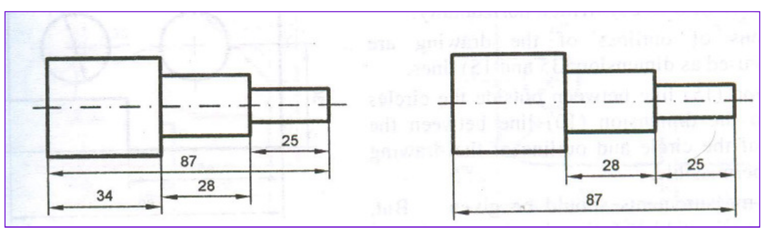
Center line(axis) itself shall not be used as a dimension line with arrowheads as its ends

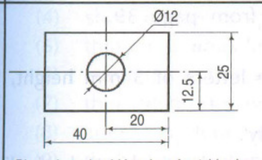
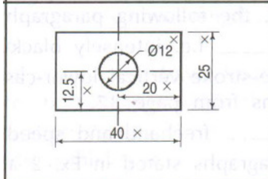
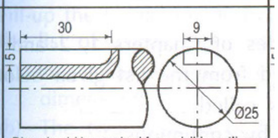
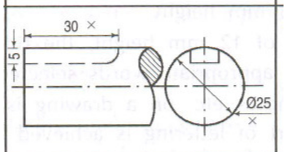
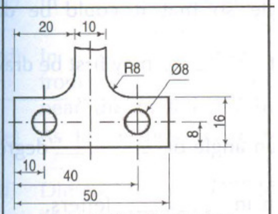
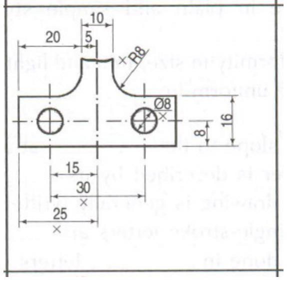


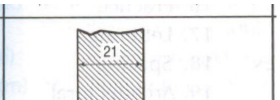
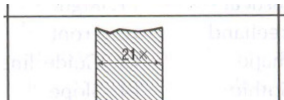
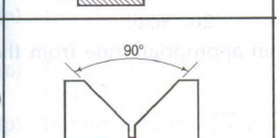
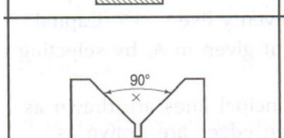
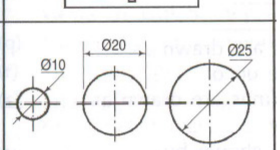
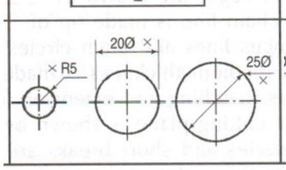


Dimensions shall be given to visible lines and not to hidden lines

Overall dimension shall be placed outside the intermediate dimensions. i.e smaller dimensions shall be placed nearer the view and the larger farther away so that extension lines do not cross dimension lines



	CORRECT	INCORRECT	REASONS FOR INCORRECT
(i)	 Dimensions should be placed outside view		1. Arrow head not proportionate. 2. Hole dimension shown in figure. Leader line not ends horizontally. 3. Dimension '40' is too close. 4. Placing dimensions methods mix. Dimension '40' is according to aligned method.
(ii)	 Dim. should be marked from visible outlines		1. A key-way is shown with dotted line where the dimensions are placed. 2. Leader line for the shaft diameter is drawn horizontal touching the boundary line.
(iii)	 Dimensions should be given from the outlines (finished surface) or a centre line of a hole		1. Dimensions are given form the mid-line of the object. 2. Dimensions of holes are shown inside the figure. 3. Dimensions are shown in vertical line. 4. Smaller dimensions (25 mm) precedes the larger dimensions (30 mm). 5. Fillet radius is not shown.

(v)			Section overlap the dimension 21.
(vi)			The outlines of the object are used as the extension lines.
(vii)			1. Smaller circle is designated with radius. 2. Convention 'Ø' for diameter is placed after dimension. 3. Leader has arrow and it is drawn horizontal.

Summary

- Course Information
- Introduction to ED
- Drawing instruments
- Lettering
- Lines
- Dimensioning

Reading task: revise all above contents from the book.

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