



ENGINEERING GRAPHICS (ME1001)

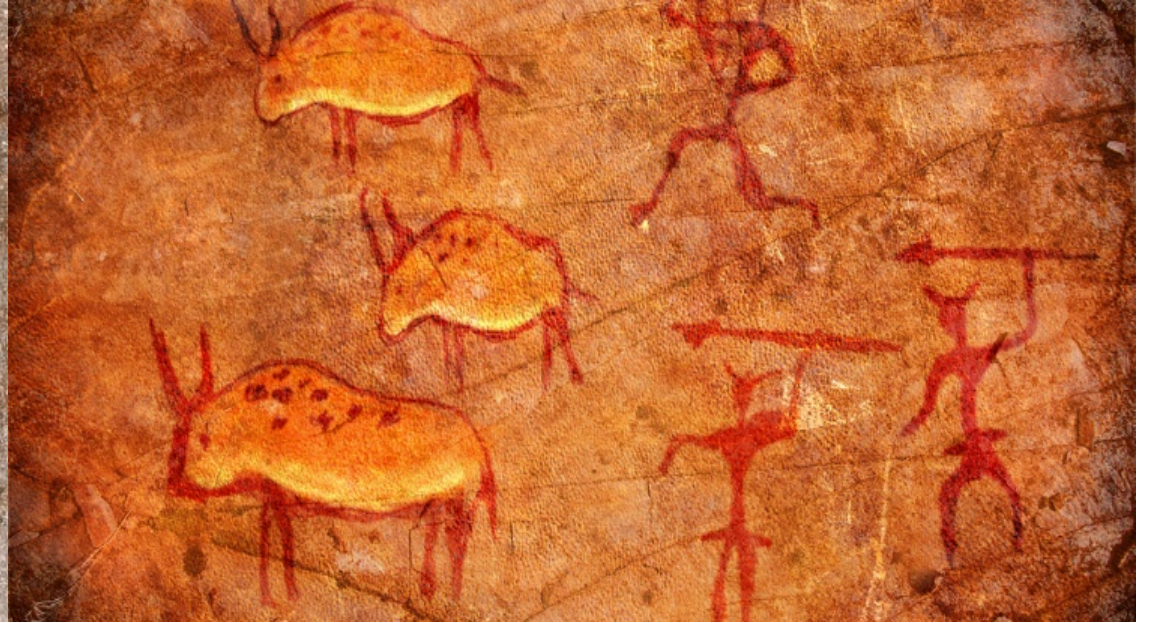
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What we are going to learn?

- How to draw lines/curves and various mechanical parts.
- Third and first angle projections.
- Orthographic projection of points, lines, planes and solids.
- Principal and auxiliary views.
- Sectional views
- Intersection of lines planes and solids.
- Development of surfaces.
- Dimensioning
- Computer aided drawing and solid modelling
- Assembly and design practice



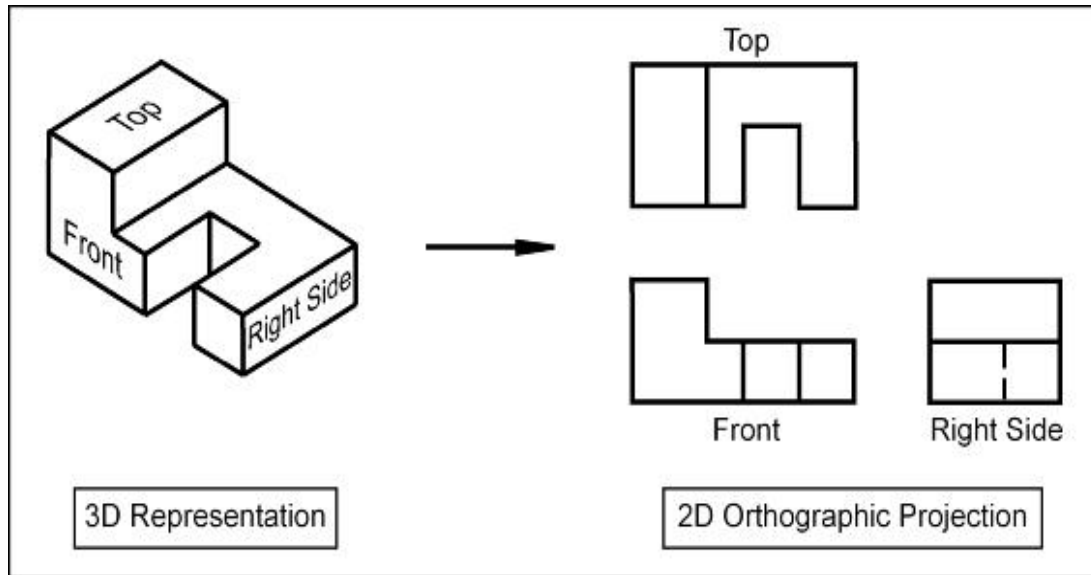
Why were drawings made?

They were meant to convey ideas or thoughts.

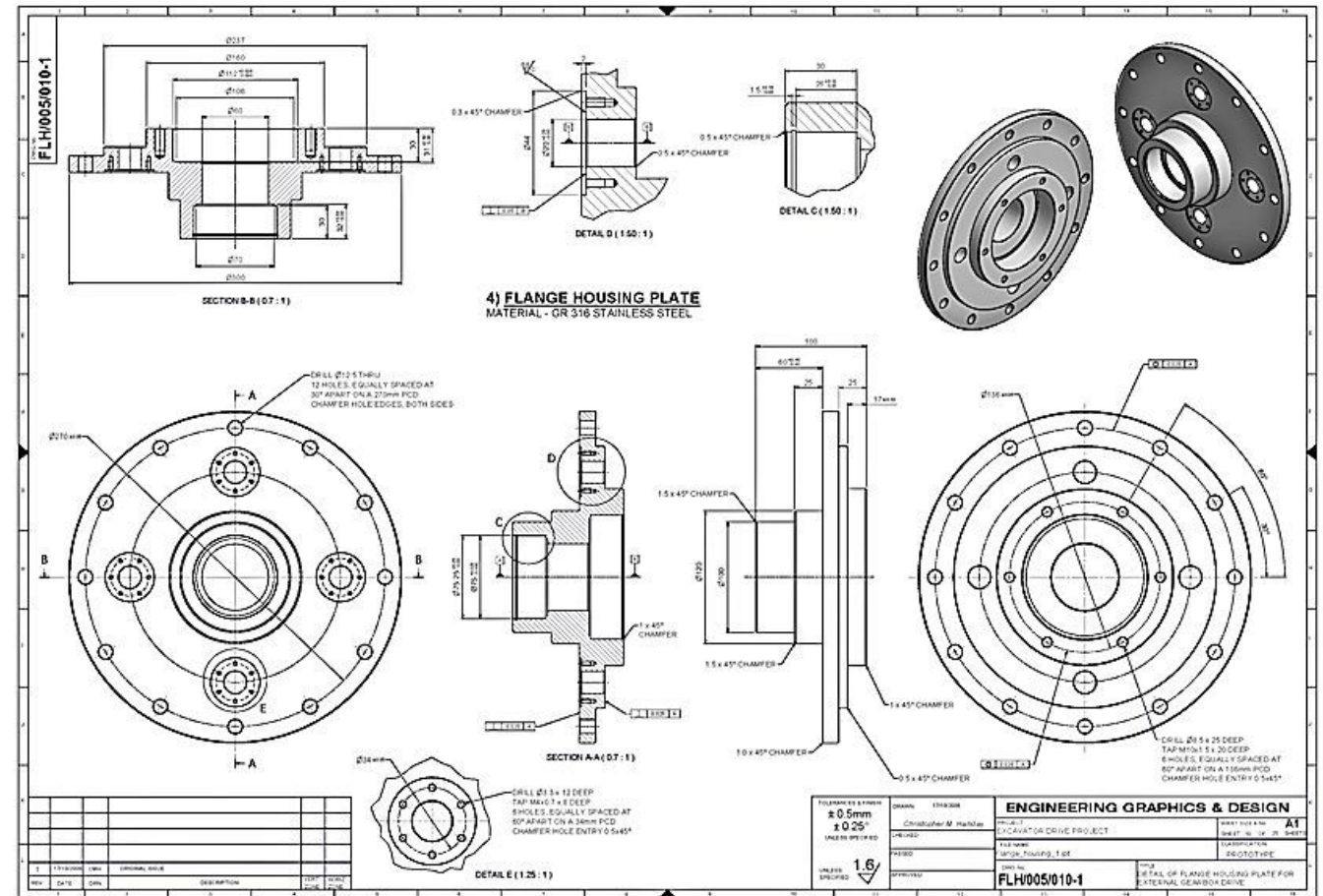
Introduction to Engineering Drawing

- What is the purpose of drawing?
 - To graphically represent physical objects and their relationships.
- What is the difference between Artistic drawings and Engineering drawings?
 - They are prepared based on certain basic principles, symbolic representations, standard conventions, notations etc.
 - It is the only universal means of communication used by engineers.

Engineering Drawing



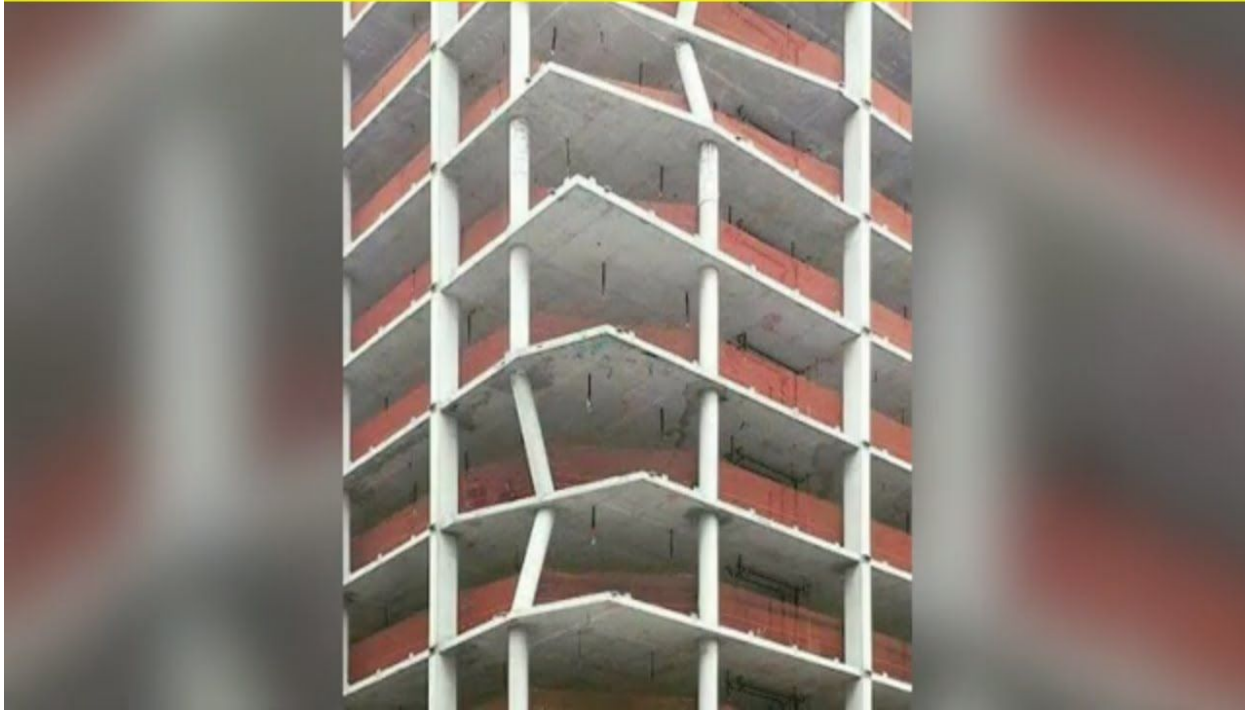
Physical representation of an object



A typical Engineering drawing

Without Engineering Drawing!!

Straight Lines Are Hard...



Role of Engg. Drawings in Product development process

- Drawings are useful in many of the product development stages.
- Product definition, prototyping, design, validation, and manufacturing all stages make use of engg. drawings to some extent.

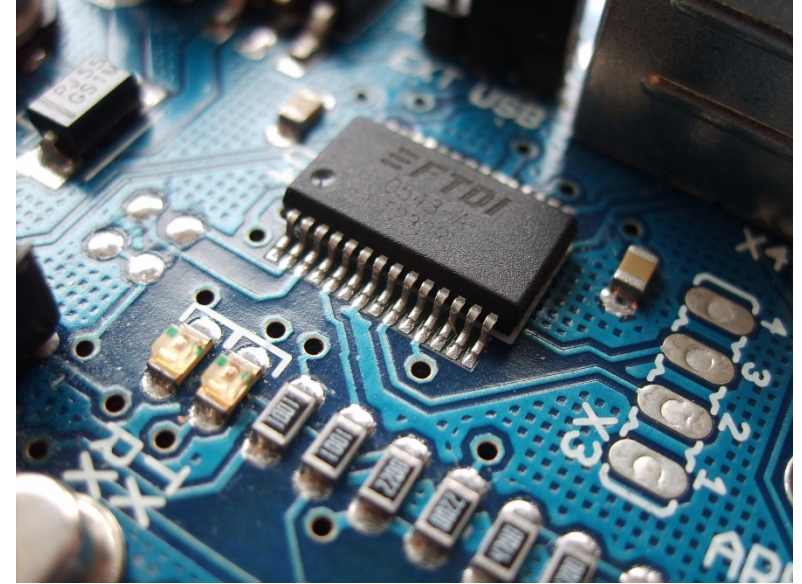
Applications of Engineering Drawing



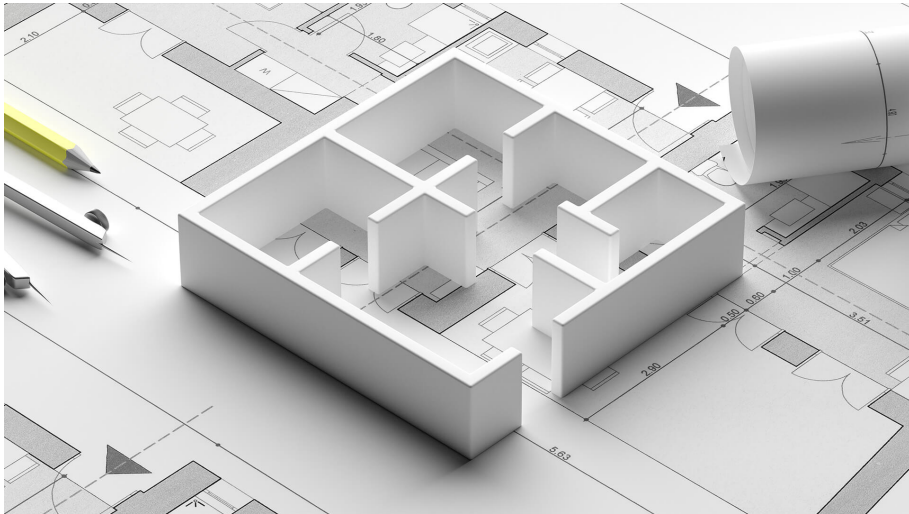
Aerospace



Mechanical



Electronics



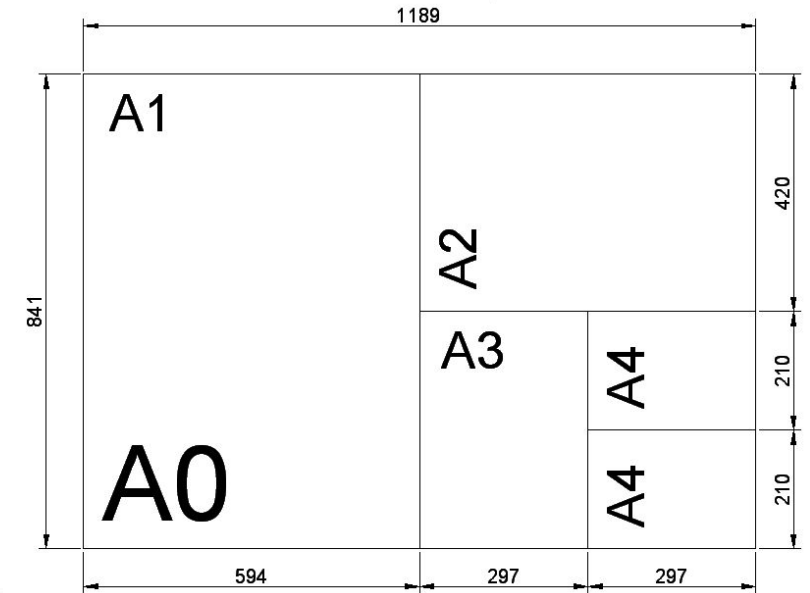
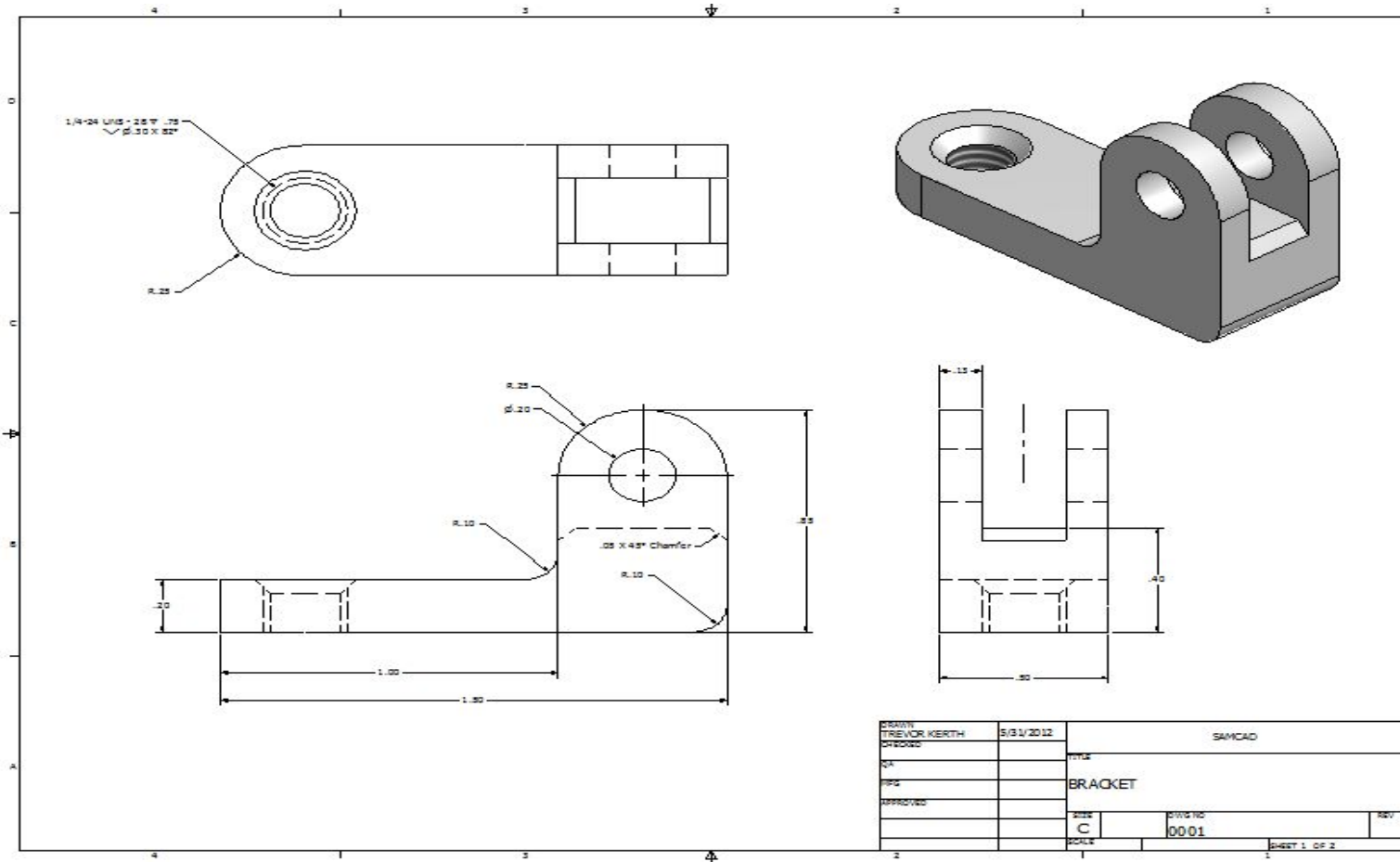
Architecture and civil

Drawing Instruments

- Drawing Sheets
- Drawing board
- Drafter and T-square
- Set-squares and protractor
- Compass and dividers
- Pencils and Eraser
- French curves
- Paper clips/pins
- Sharpner

Drawing Instruments

- Drawing sheets

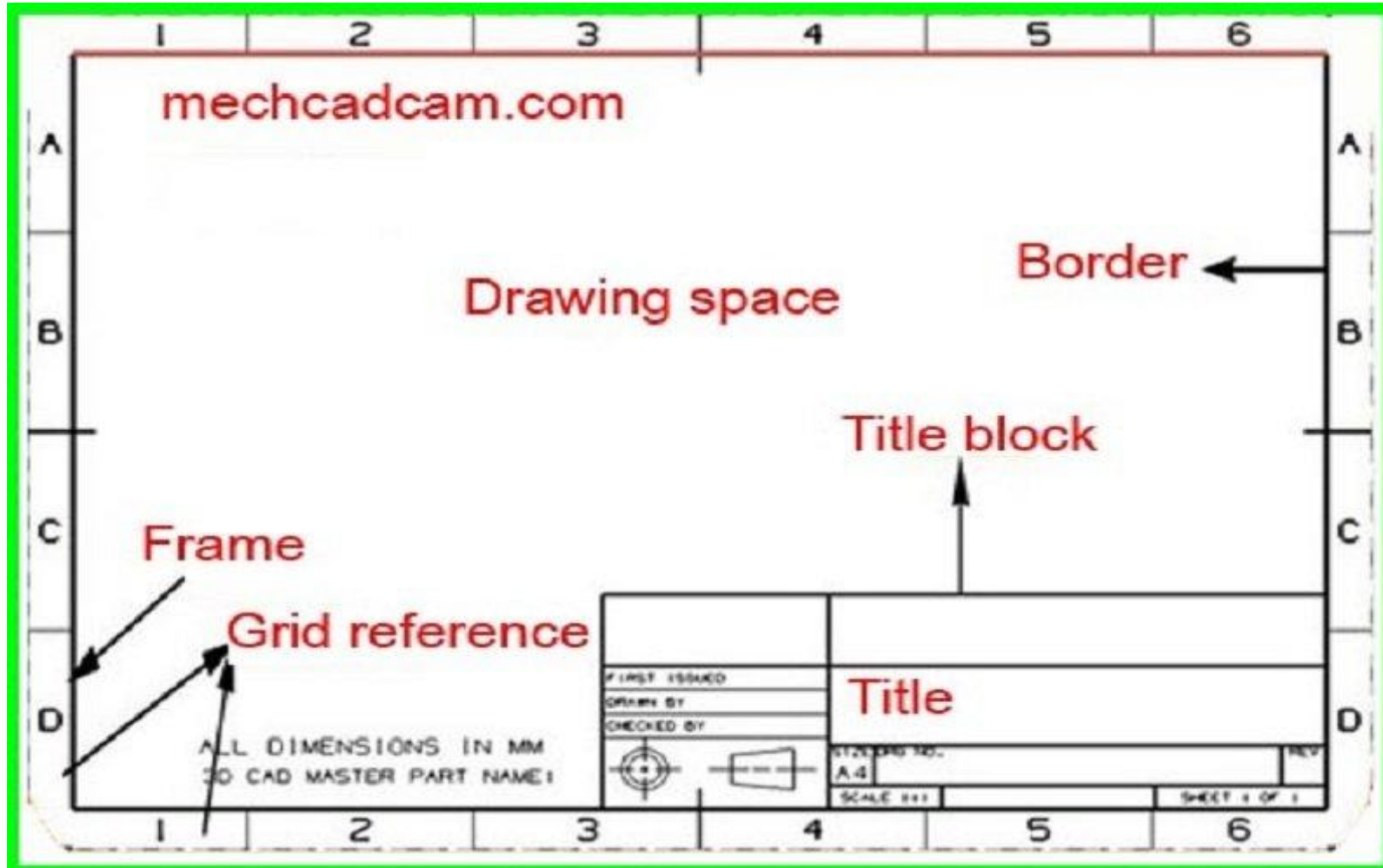


SIZE OF DRAWING SHEET AS PER B.I.S

Designation	Trimmed size (mm)	Untrimmed size (mm)
A0	841 x 1189	880 x 1230
A1	594 x 841	625 x 880
A2	420 x 594	450 x 625
A3	297 x 420	330 x 450
A4	210 x 297	240 x 330
A5	148 x 210	165 x 240

Drawing Instruments

- Drawing sheets



Drawing Instruments

- Drawing Board



Designation	Dimensions (mm)		
	Length	Width	Thickness
D0	1500	1000	25
D1	1000	700	25
D2	700	500	15
D3	500	350	15

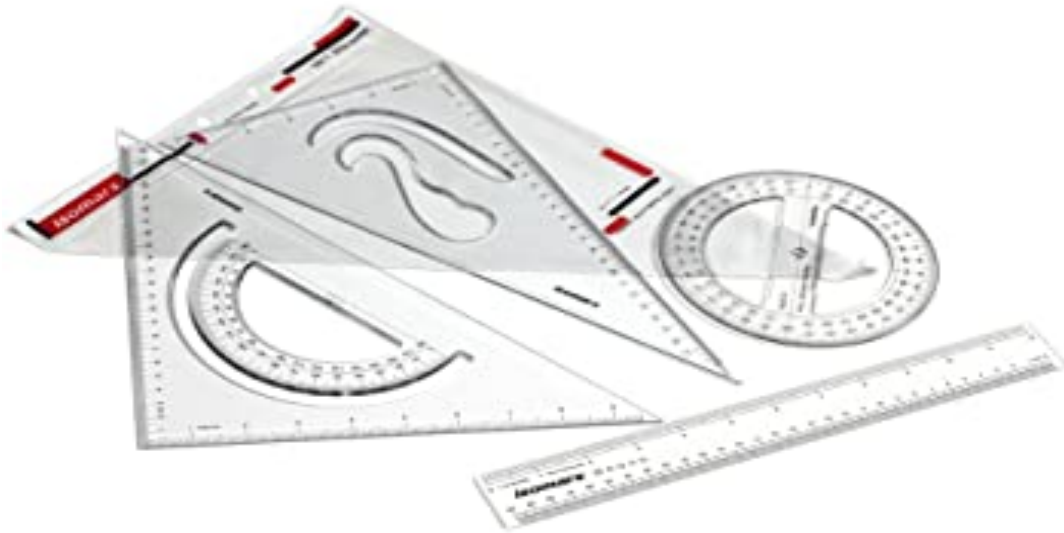
Drawing Instruments

- Drafter



Drawing Instruments

- Set squares and protractor



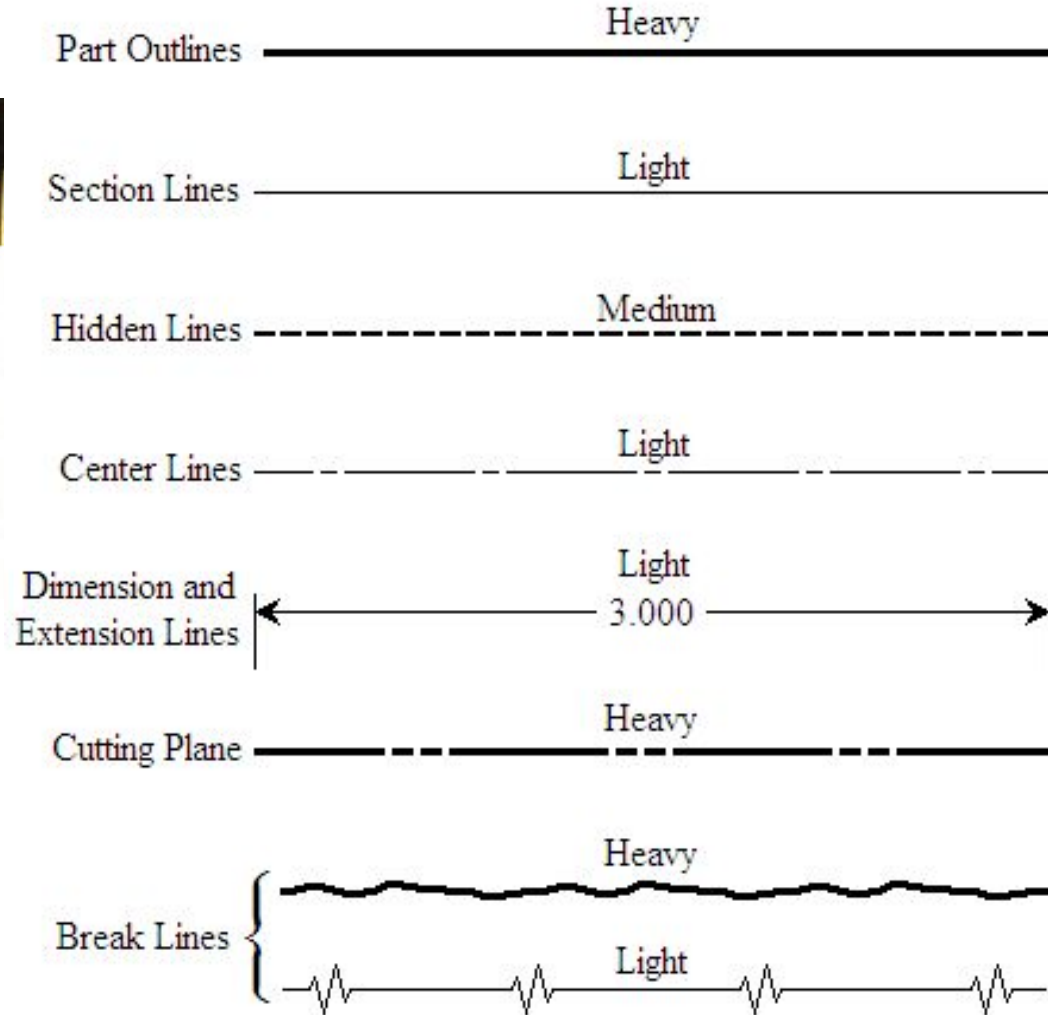
Drawing Instruments

- Pencils and lead sticks



4 grades are recommended

Grade of Pencil	Used to Draw
3H	Construction lines
2H	Dimension lines, center lines, sectional lines, hidden lines
H	Object lines, lettering
HB	Dimensioning, boundary lines



Drawing Instruments

- French curves, paper clips



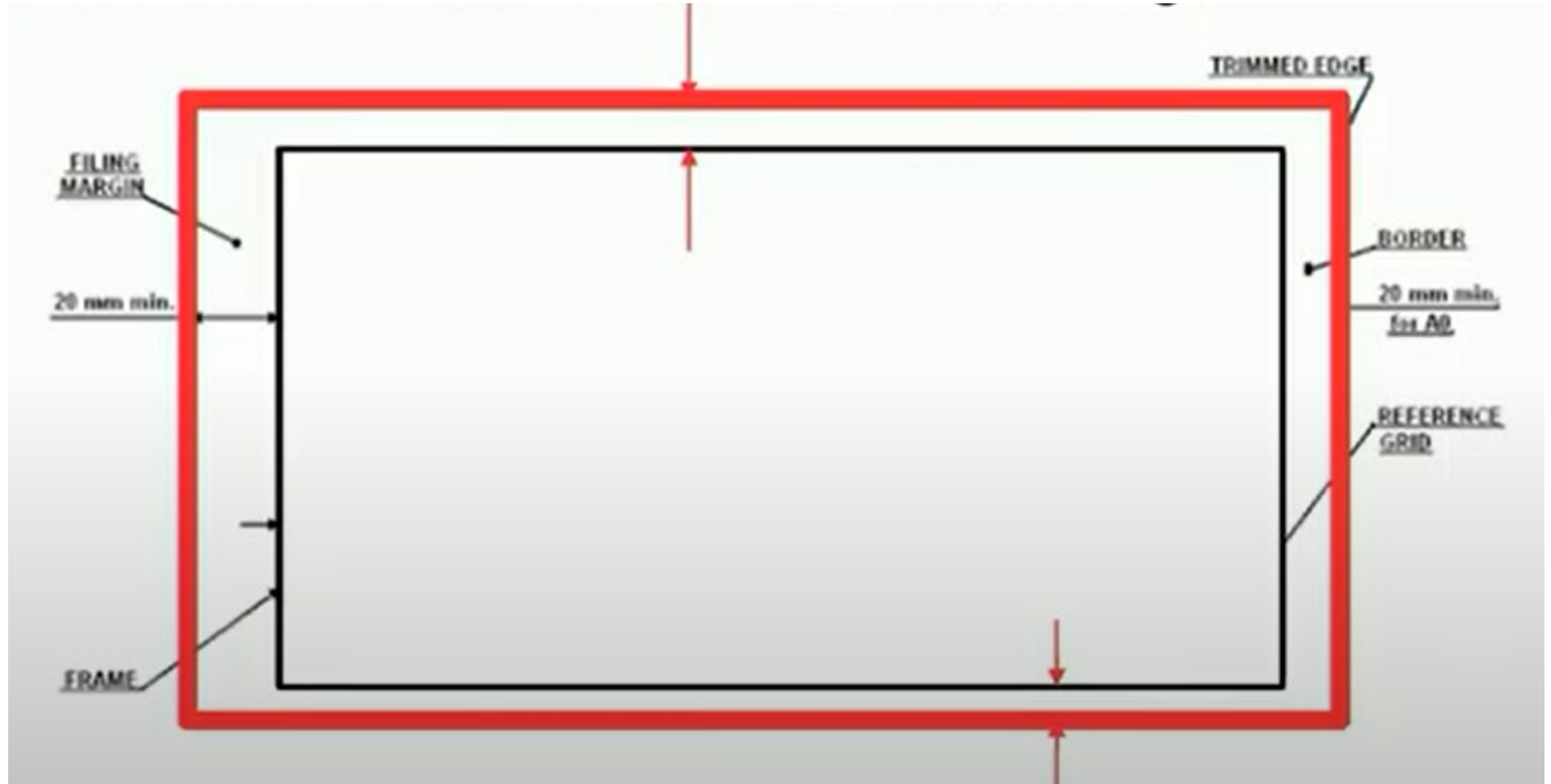
Drawing sheet layout

- Layouts for drawing sheets are provided by various standard organizations.
- A standard is a set of specifications for a parts, materials, or processes intended to achieve uniformity, efficiency and specific quality.
- Organizations that establish these standards are ISO, AISI, SAE, ASTM, ASME, ANSI, BIS.

Drawing sheet layout

• Borders

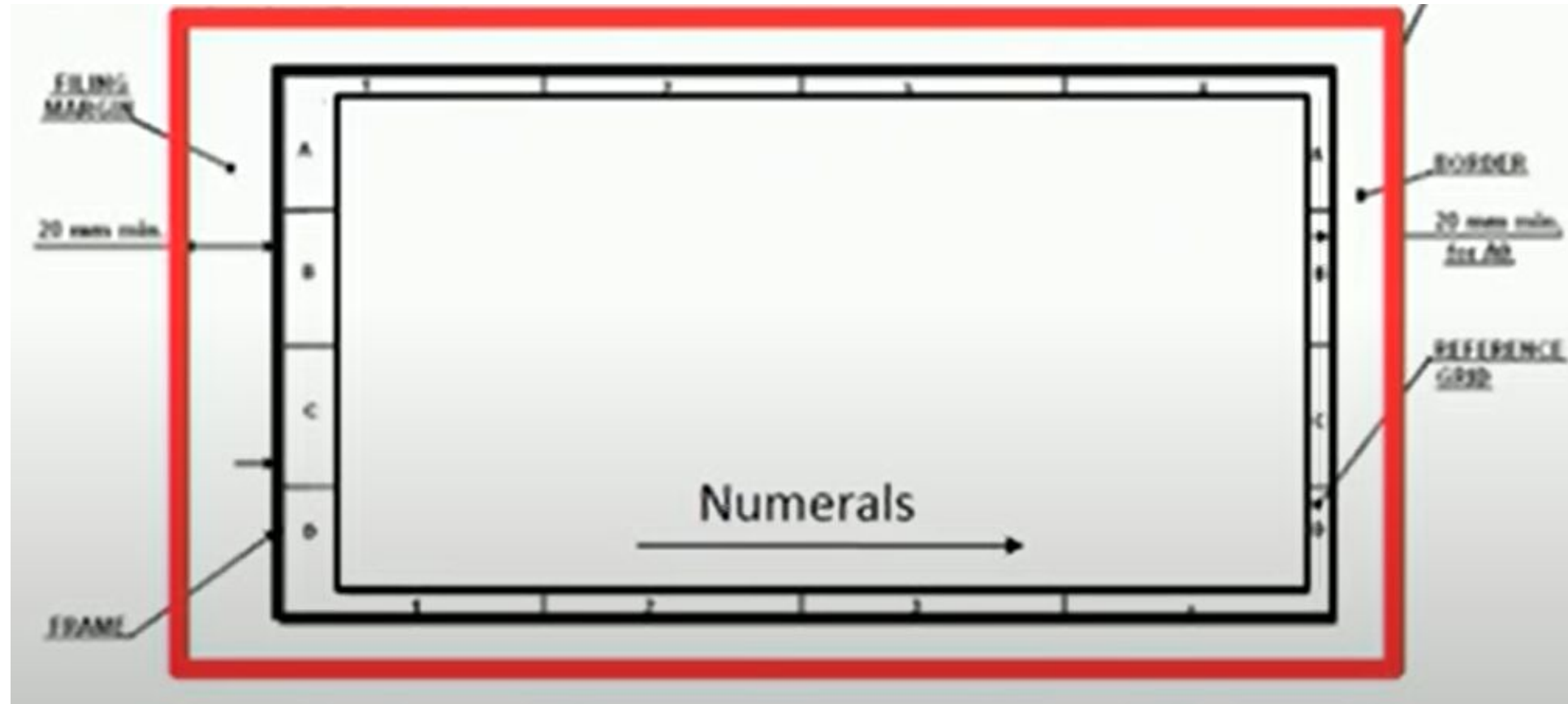
- 10 mm or more space is left all around the trimmed edge of the sheet.
- Minimum 20 mm is left on the left hand side of the sheet.



Drawing sheet layout

- Reference grid system

- Provided for easy location of drawing within the frame.
- The edges are divided into even number of divisions
- The length of the grids can be between 25 mm and 75 mm.



Drawing sheet layout

- Revision Table

- All modifications to the drawing are documented in this table.
- For drawings with many parts or an assembly drawing a **Bill of Materials** is placed just above the Title Block.





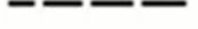







Letters and Numbers as per BIS:SP46-2003

- Types of lines
- Lettering.
- Dimensioning.

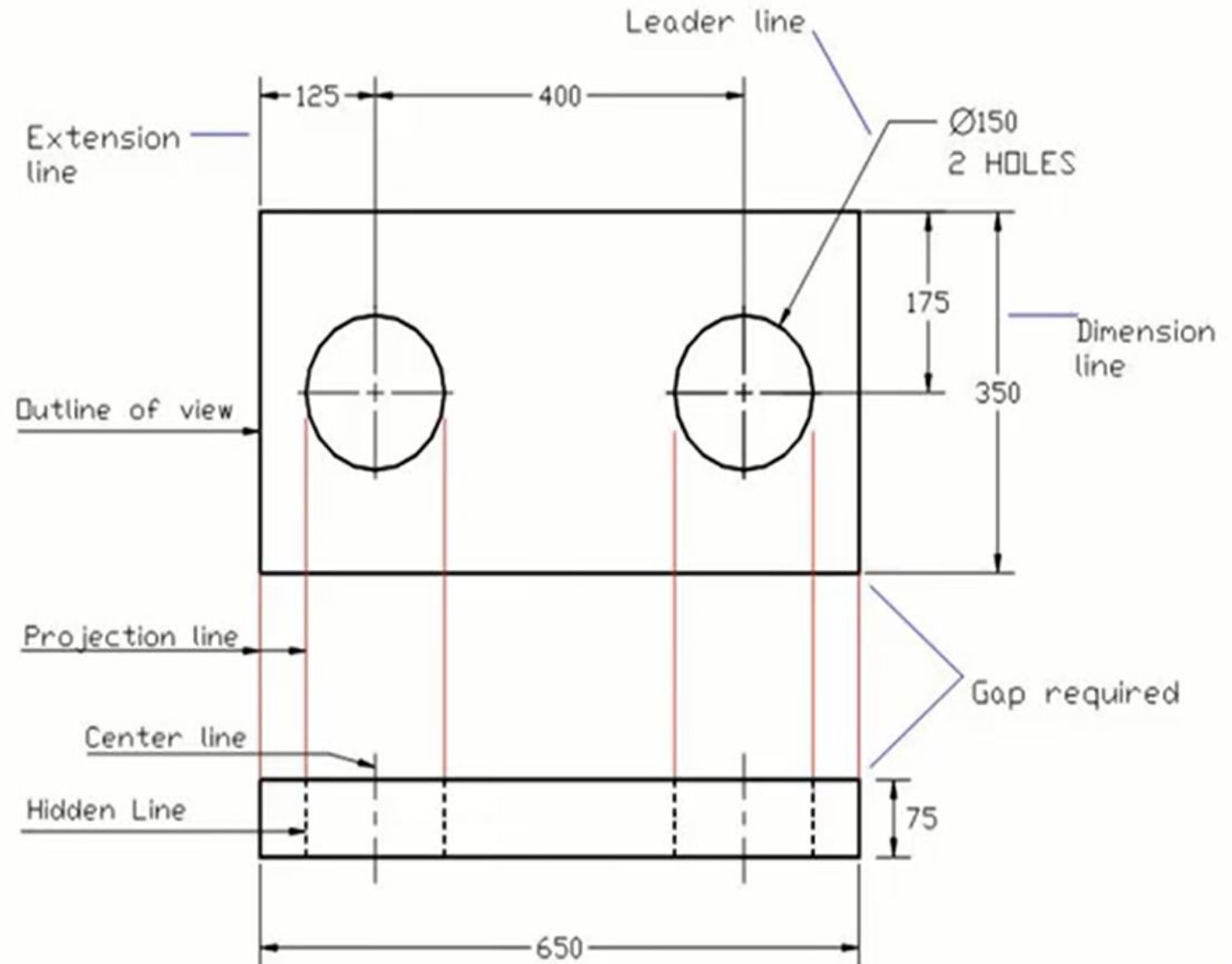
Letters and Numbers as per BIS:SP46-2003

- Types of Lines

Line		Description	General Application	
A		Continuous thick	A1	Visible outlines.
			A2	Visible edges.
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	Long break line
E		Dashed thick	E1	Hidden outlines.
			E2	Hidden edges.
F		Dashed thin	F1	Hidden outlines.
			F2	Hidden edges.
G		Chain thin	G1	Center 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.
			K1	Alternative or extreme position of movable parts.
			K3	Centroidal lines.
			K4	Initial outlines prior to forming
			K5	Parts situated in front of the cutting plane

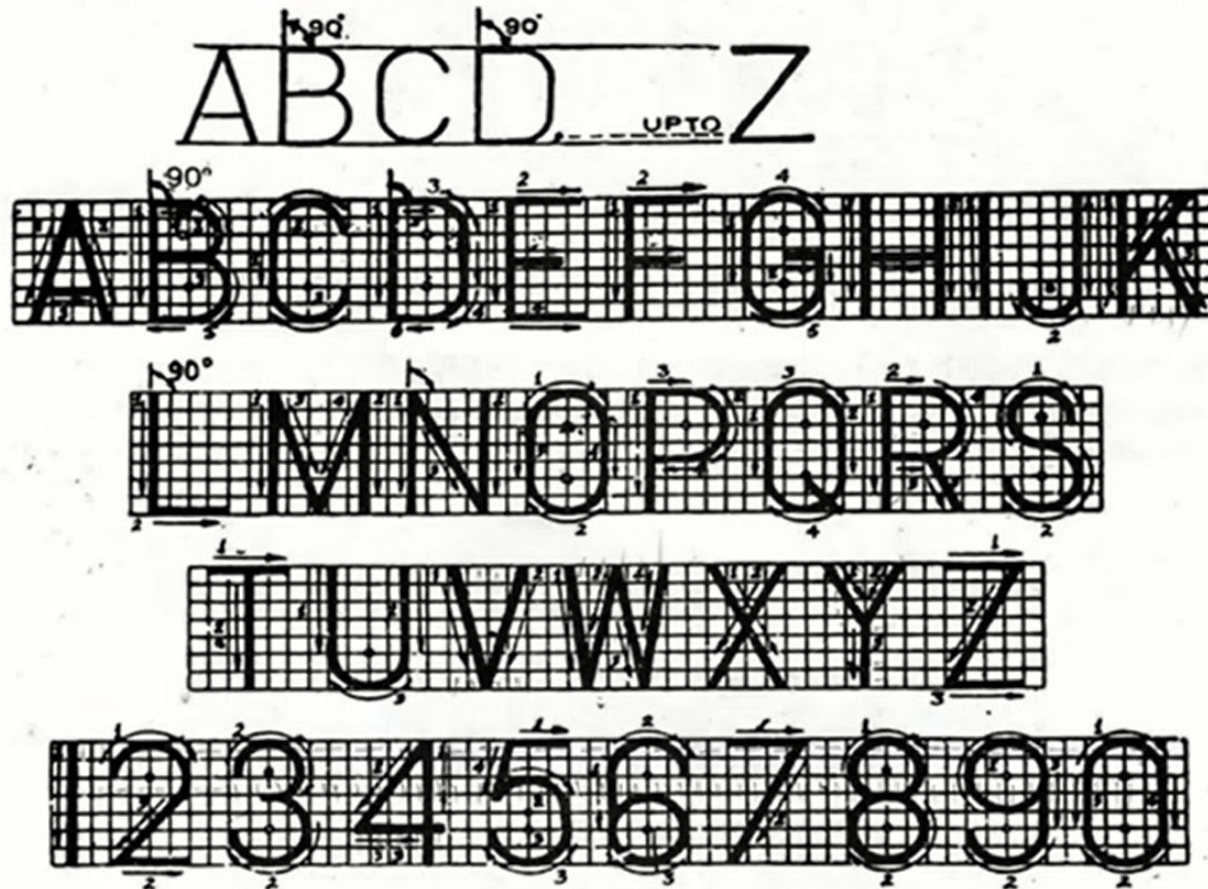
Letters and Numbers as per BIS:SP46-2(

- Types of Lines



Letters and Numbers as per BIS:SP46-2003

- Lettering

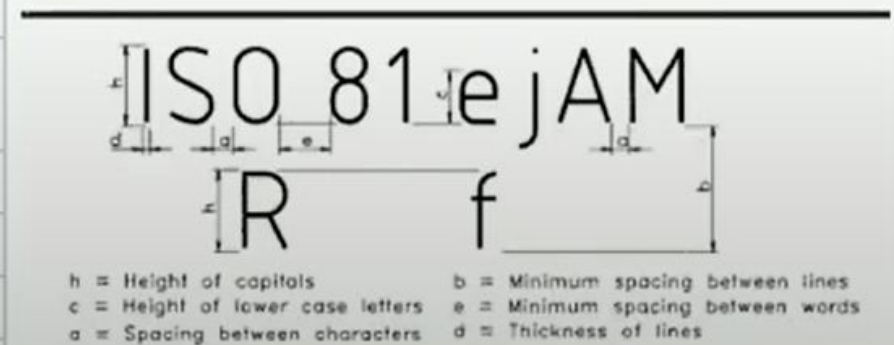


Letter styles

- Lettering is the style of writing alphabets and numerals such as A, B, C, D...Z and 1, 2, 3, 4...9.
- Most freehand lettering is done in ‘gothic’ style with constant line thickness.

To regulate lettering height, commonly 3 mm, guidelines are drawn.

Characteristic	Parameter	Ratio	Dimensions(mm)						
Lettering Height (Height of capitals)	h	$(14/14)h$	2.5	3.5	5	7	10	14	20
Height of lower case letters (without stem or tail)	c	$(10/14)h$	-	2.5	3.5	5	7	10	14
Spacing between characters	a	$(2/14)h$	0.35	0.5	0.7	1	1.4	2	2.8
Minimum spacing of base characters	b	$(20/14)h$	3.5	5	7	10	14	20	28
Minimum spacing between words	e	$(6/14)h$	1.05	1.5	2.1	3	4.2	6	8.4
Thickness of lines	d	$(1/14)h$	0.18	0.25	0.35	0.5	0.7	1	1.4



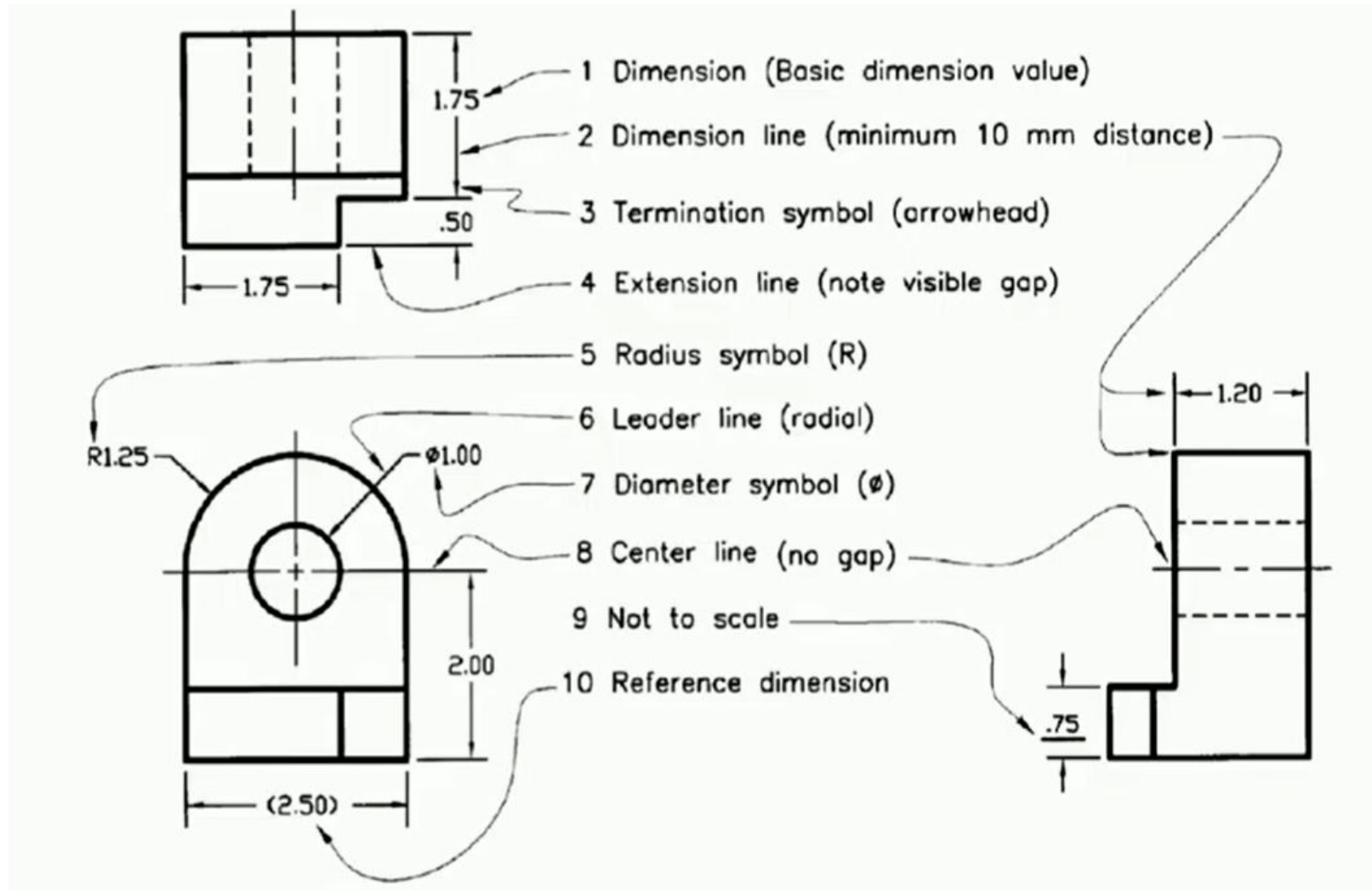
Letter styles

ITEM	SIZE h, mm
Drawing number in <u>Title Block</u> and letters denoting Cutting Plane Section	10, 12
Title of Drawing	6, 8
<u>Sub-titles and Headings</u>	3, 4, 5, 6,
Notes, such as Legends, Schedules, Material list, Dimensioning	3, 4, 5
Alteration, Enteries and Tolerances	2, 3

Letters and Numbers as per BIS:SP46-2003

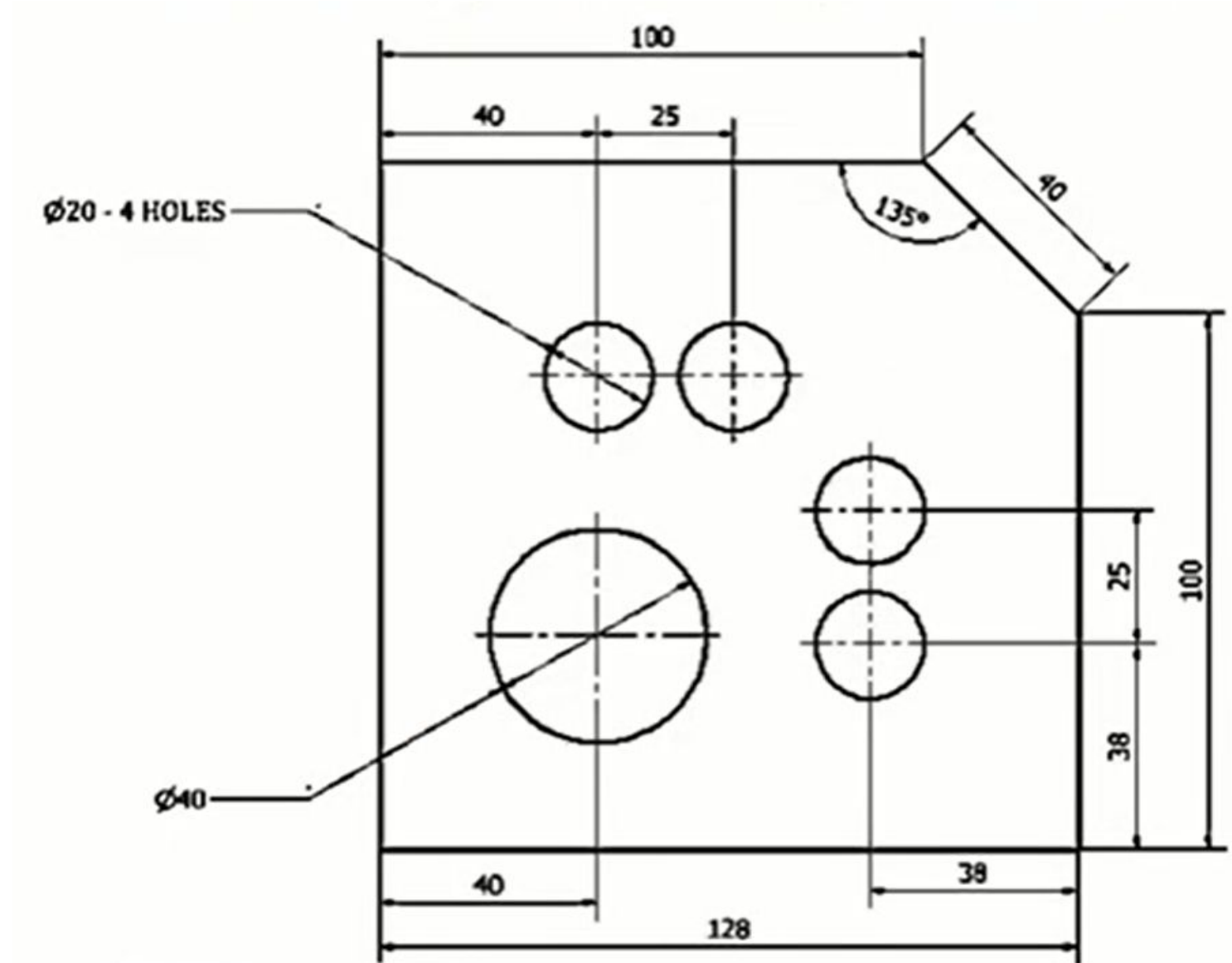
- Dimensioning, dimensions are used to represent size and position of the designed/modelled shape.
- It is a numerical value expressed in appropriate units of measurement and used to define the size, location, orientation, form, or other geometric characteristics of a part.
 - Aligned system
 - Unidirectional system

Dimensions (Basic terminology)

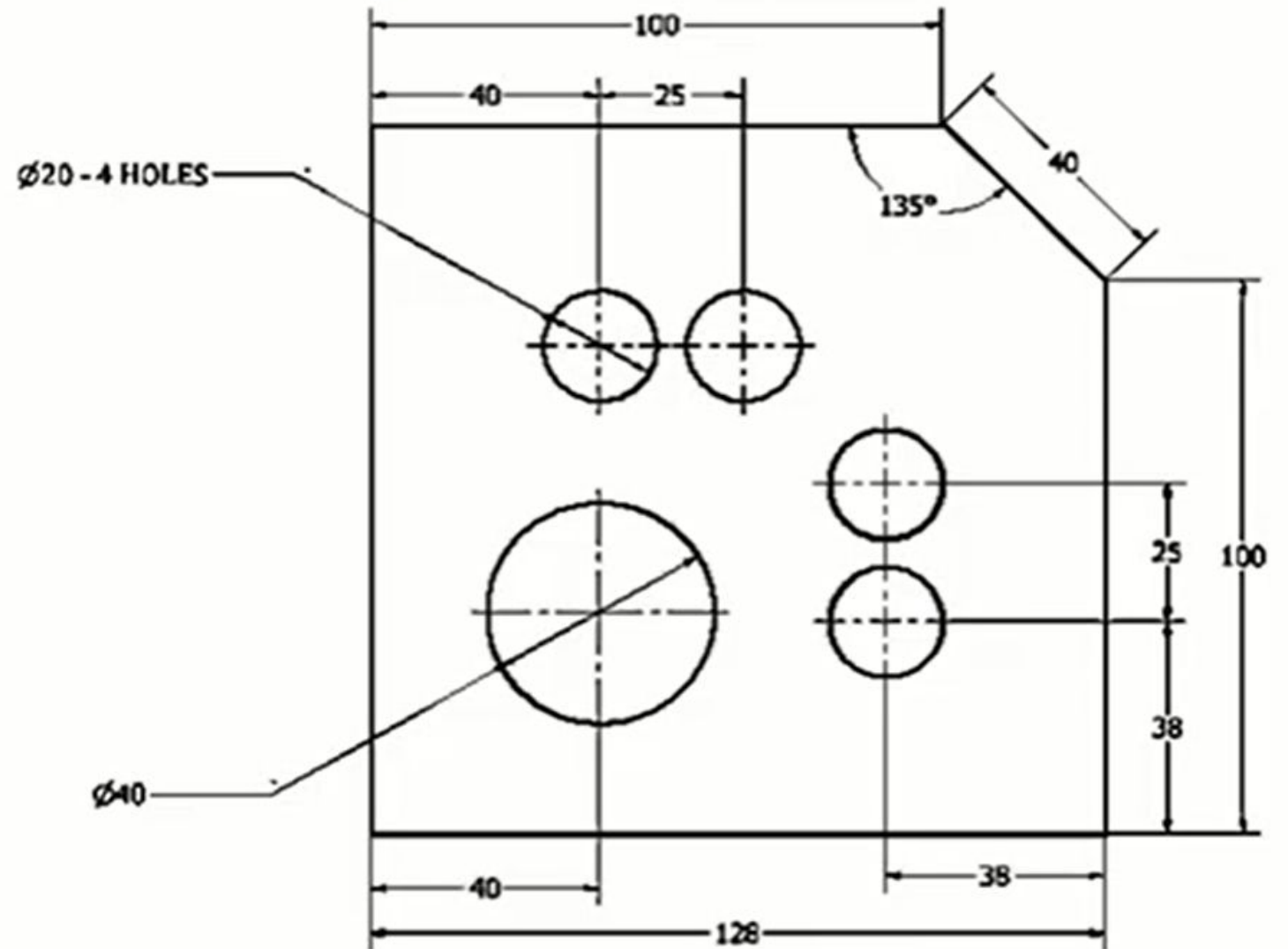


• Aligned dimensioning

In this system, the dimension is placed perpendicular to the dimension line.



- Unidirectional dimensioning



Dimensioning methods

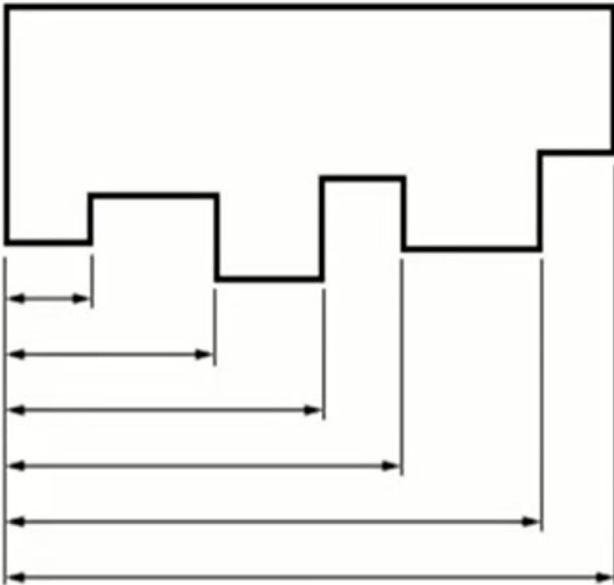


Fig. Parallel Dimensioning

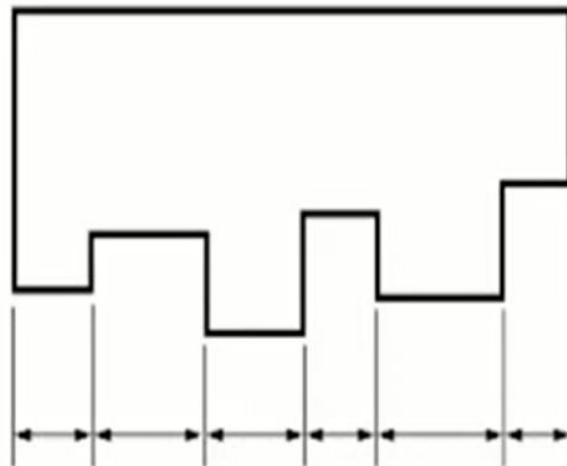


Fig. Chain Dimensioning

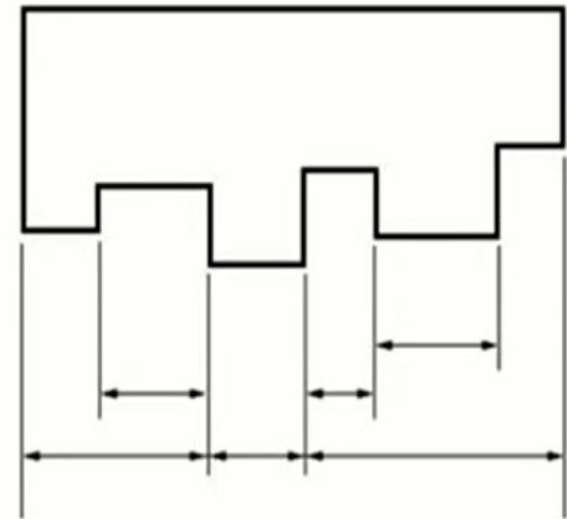
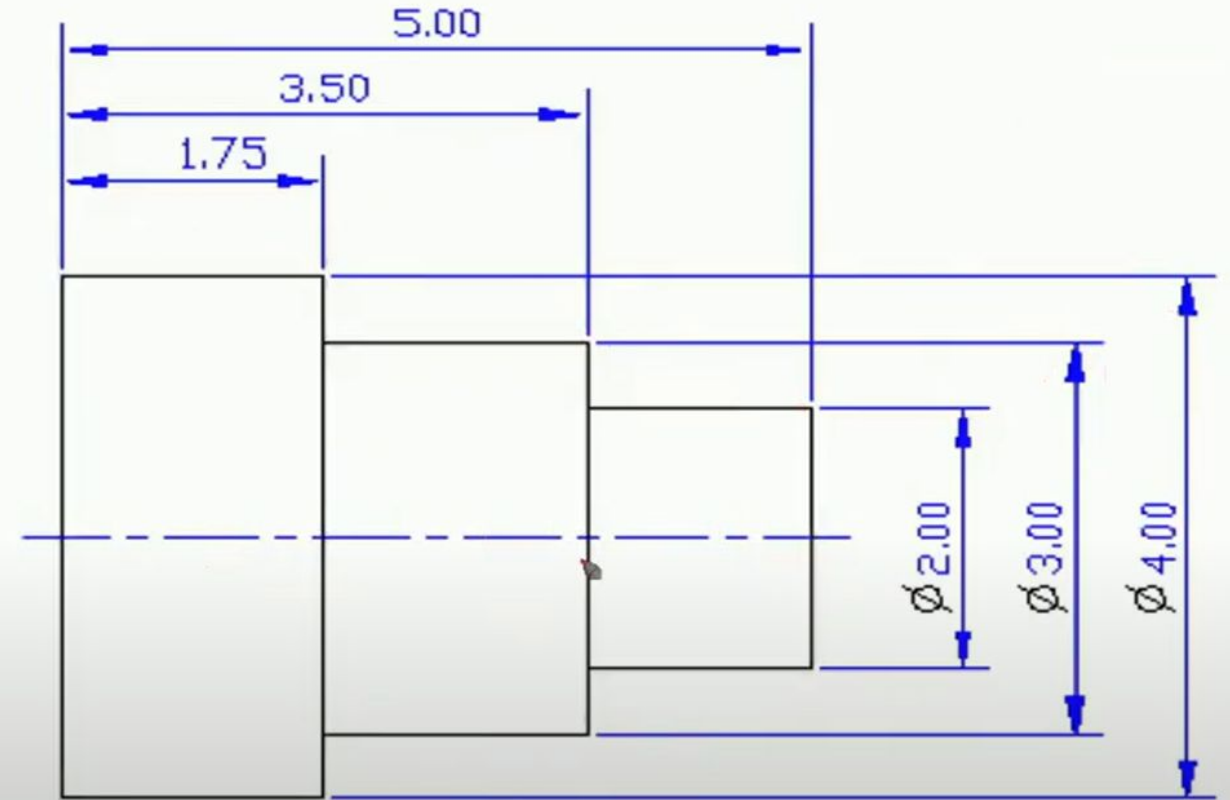
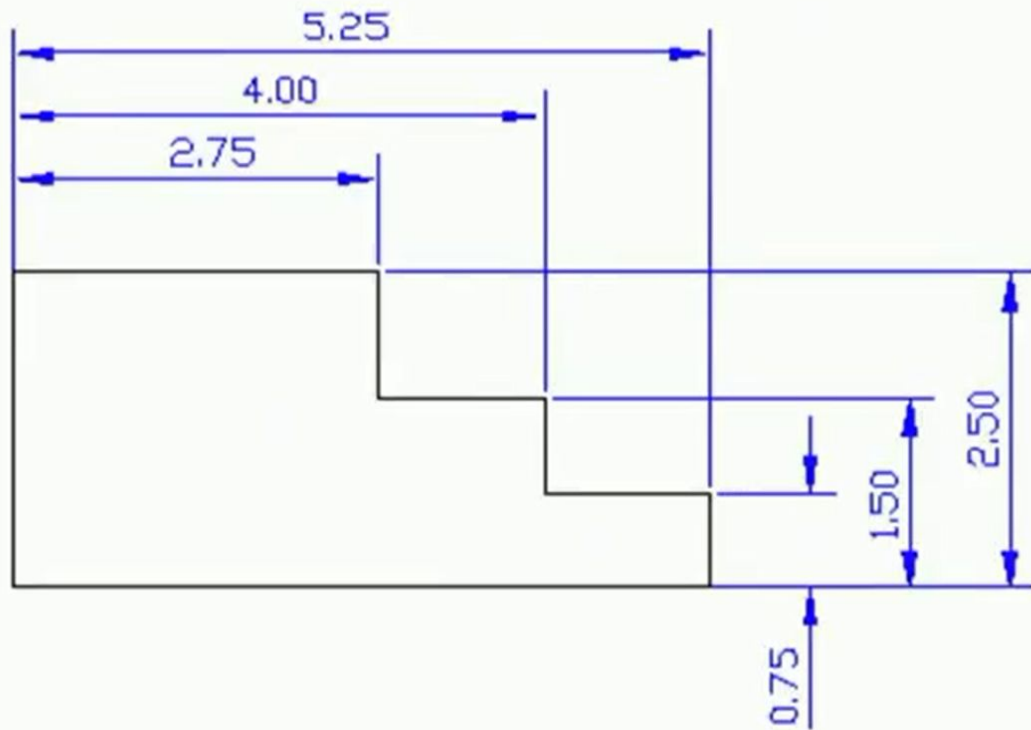


Fig. Combined Dimensioning

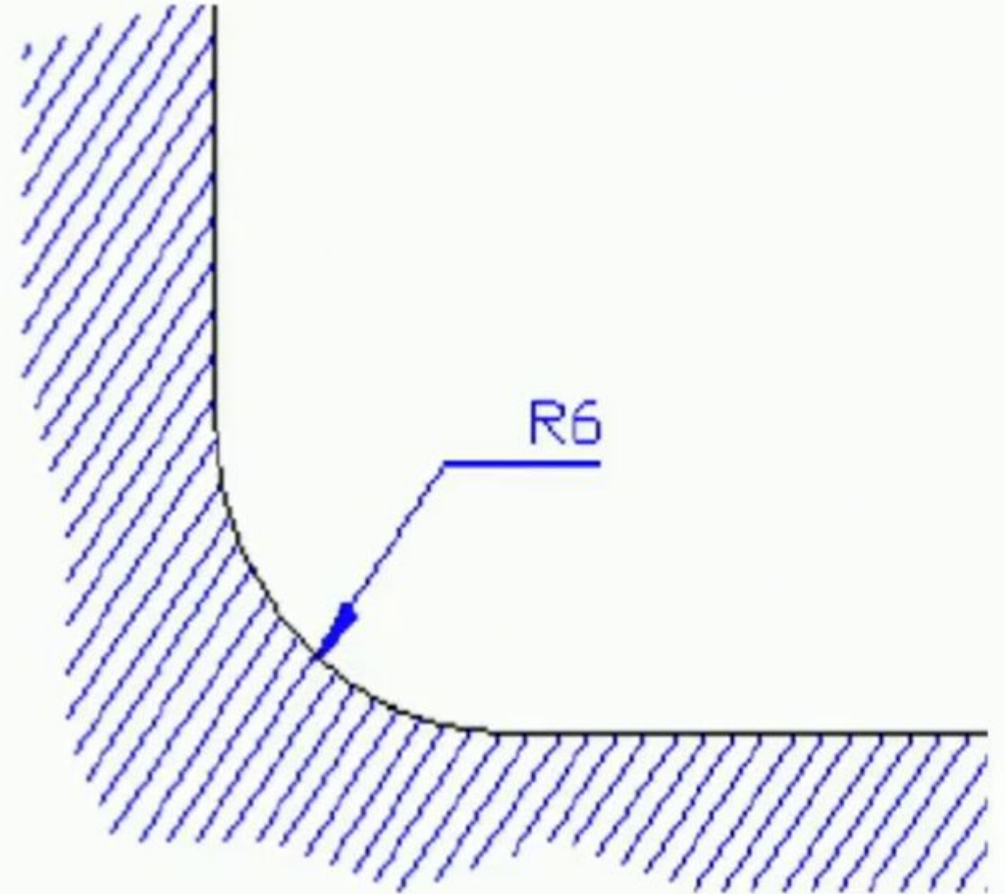
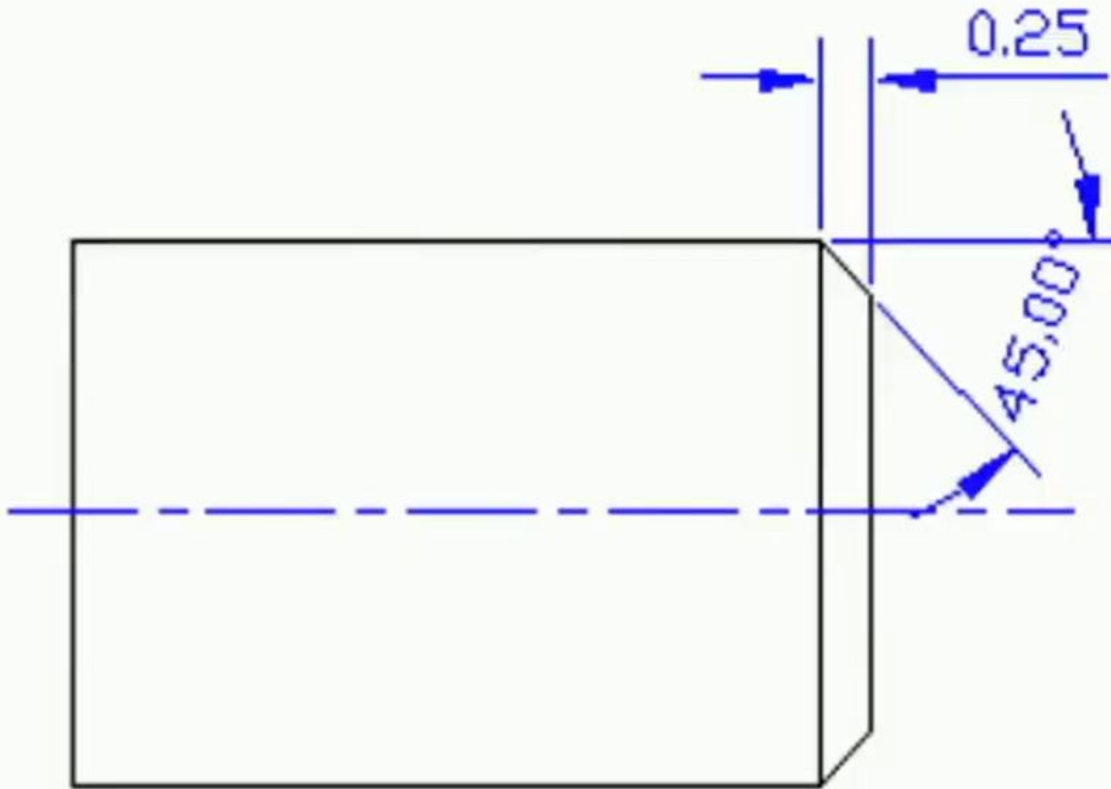
General rules on Dimensioning

- (1) Dimensioning should be done so completely that further calculation or assumption of any dimension, or direct measurement from the drawing is not necessary.
- (2) Every dimension must be given, but none should be given more than once.
- (3) A dimension should be placed on the view where its use is shown more clearly.
- (4) Dimensions should be placed outside the views, unless they are clearer and more easily read inside.
- (5) Mutual crossing of dimension lines and dimensioning between hidden lines should be avoided. Dimension lines should not cross any other line of the drawing.
- (6) An outline or a centreline should never be used as a dimension line. A centreline may be extended to serve as an extension line.
- (7) Aligned system of dimensioning is recommended.
- (8) Units for the dimensions should be provided with a note on the drawing.

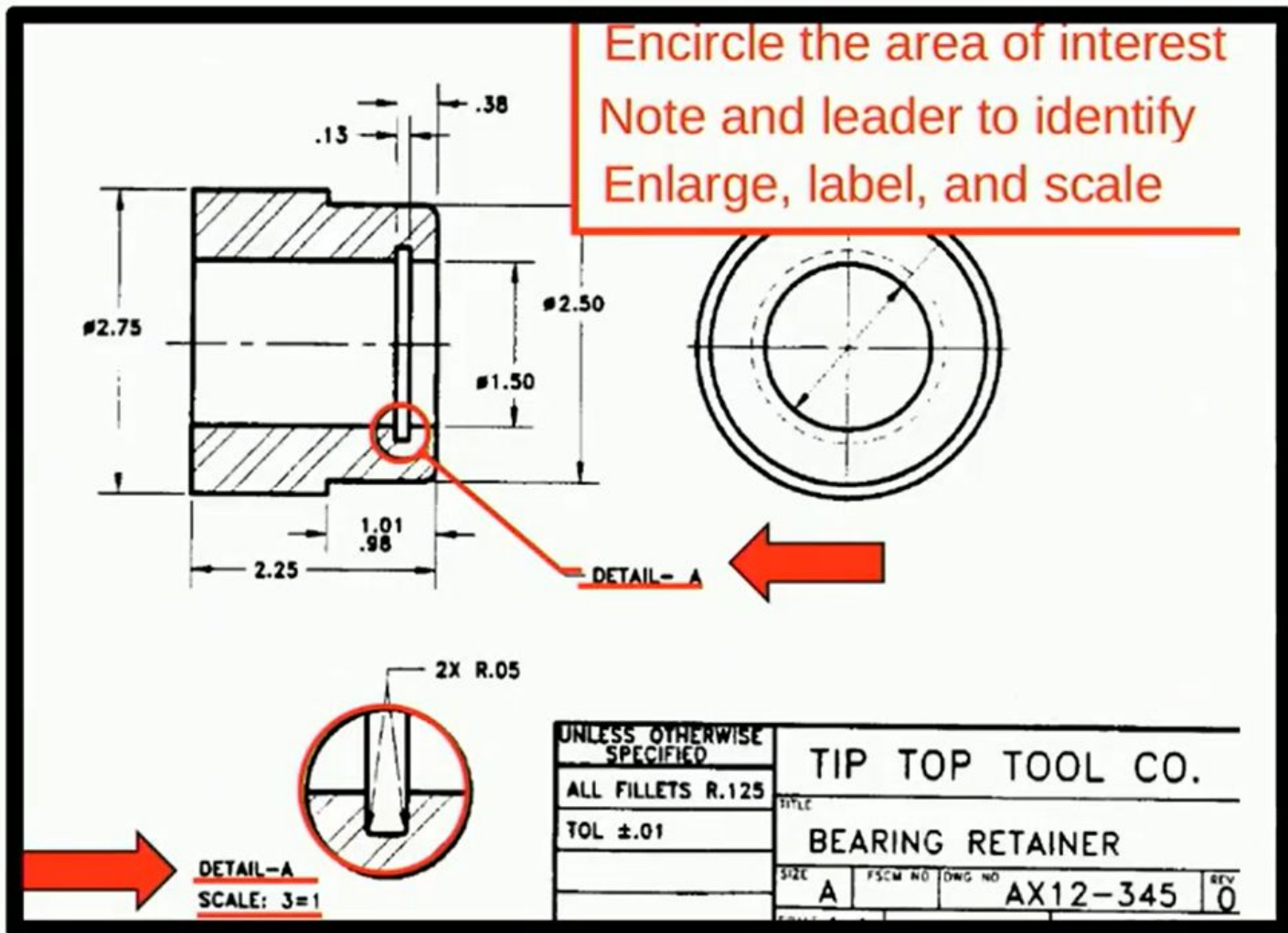
Examples of Dimensions



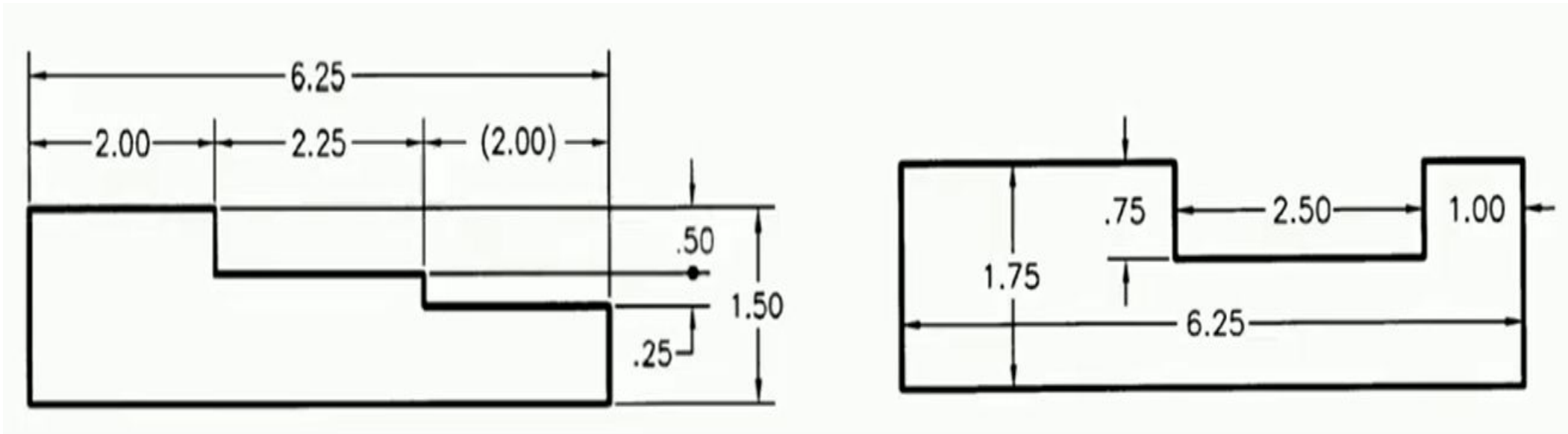
Examples of Dimensions



Examples of Dimensions (detail dimensions)



Examples of Dimensions (correct way of representation)



Scale

- Units of measurement

Metric system

$$10 \text{ mm} = 1 \text{ cm}$$

$$10 \text{ cm} = 1 \text{ dm}$$

$$10 \text{ dm} = 1 \text{ m}$$

$$10 \text{ m} = 1 \text{ decm}$$

$$10 \text{ decam} = 1 \text{ hm}$$

$$10 \text{ hm} = 1 \text{ km}$$

British system

$$2.54 \text{ cm} = 1 \text{ inch}$$

$$12 \text{ inch} = 1 \text{ foot}$$

$$3 \text{ feet} = 1 \text{ yard}$$

$$220 \text{ yard} = 1 \text{ furlong}$$

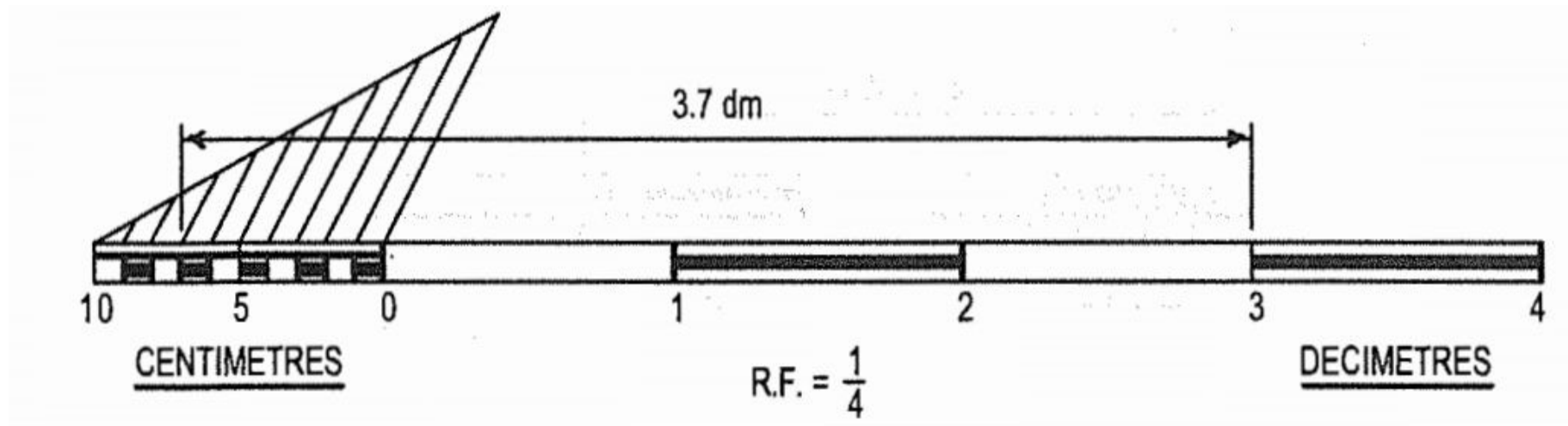
$$8 \text{ furlong} = 1 \text{ mile}$$

Scale

- Representative fraction : It is the ratio of the length of the drawing or (length of scale) on the drawing sheet to the actual length of the object.
- Scale is divided into three types on the basis of RF
 1. Reducing scale eg. 1:4, 1:2, 1:10 etc.
 2. Enlarging scale eg. 2:1, 3:1, 10:1 etc.
 3. Equal size scale eg. 1:1.

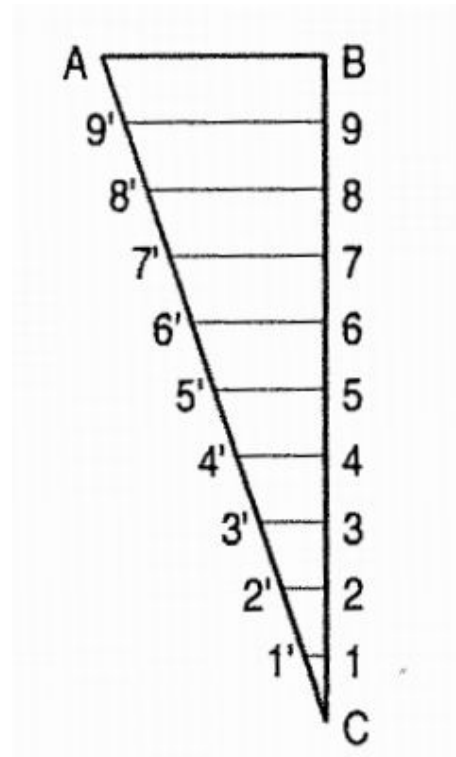
Scale

- Plane scale : It is simply a line which is divided into suitable number of equal parts or units, the first part of which is further divided into smaller parts or sub parts of main unit.



Scale

- Diagonal scale : A diagonal scale is used when very minute distance such as 0.1 mm etc. are to be accurately measured or when measurements are required in three units; for example, dm, cm and mm, or yard, foot and inch.



Questions on Plane Scale

- *Construct a scale of 1 : 4 to show centimetres and long enough to measure upto 5 decimetres.*
- *Construct a scale of 1.5 inches = 1 foot to show inches and long enough to measure upto 4 feet.*

Questions on Diagonal Scale

- *Construct a diagonal scale of R.F. = 1 : 4000 to show meters and long enough to measure upto 500 metres.*

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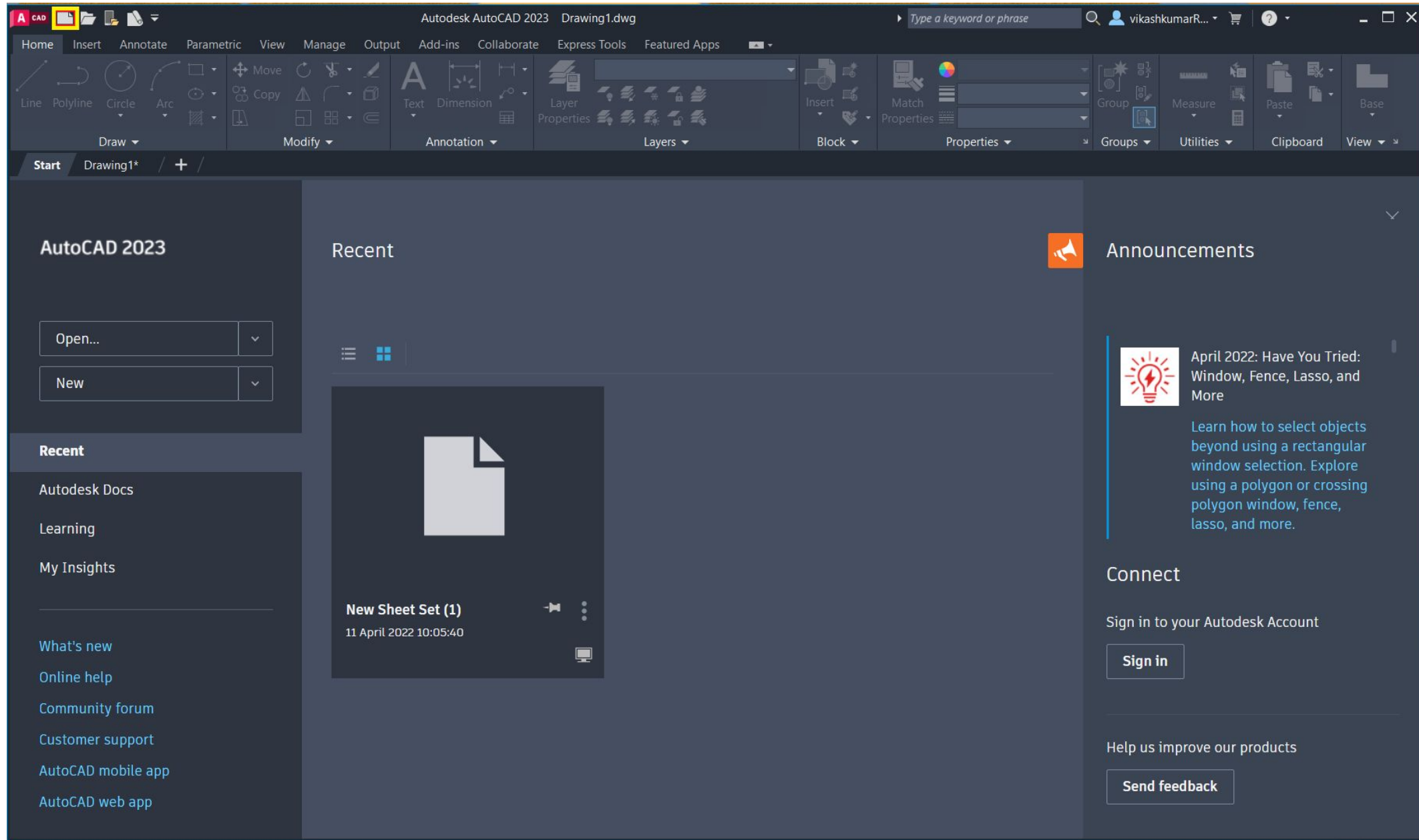
- *Construct a diagonal scale of R.F. = 1 : 32 showing yards, feet and inches and to measure upto 4 yards.*

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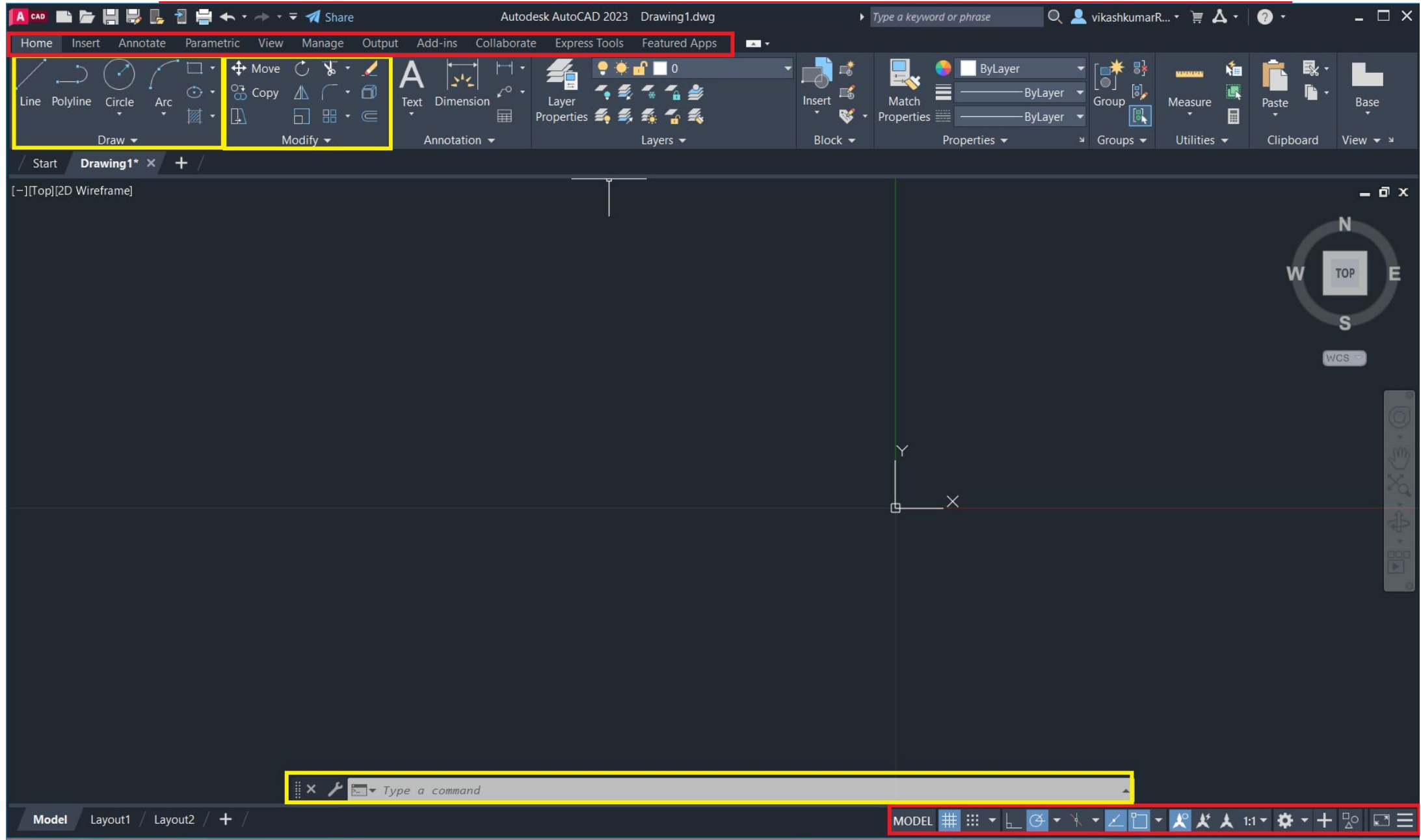
AutoCAD for Engg. Drawing

- Computer Aided Draughting systems are now replacing the conventional draughting systems.
- But for using the CAD systems, the knowledge of Engg. Drawing is essential.
- The CAD system has some advantages over the conventional techniques:
 - High productivity with reduced lead time.
 - Possibility of quick and easy modifications.
 - Automatic creation of documentations.
 - Excellent drawing quality.
 - Possibility of pre-storing commonly used components in a library.

AutoCAD Start screen



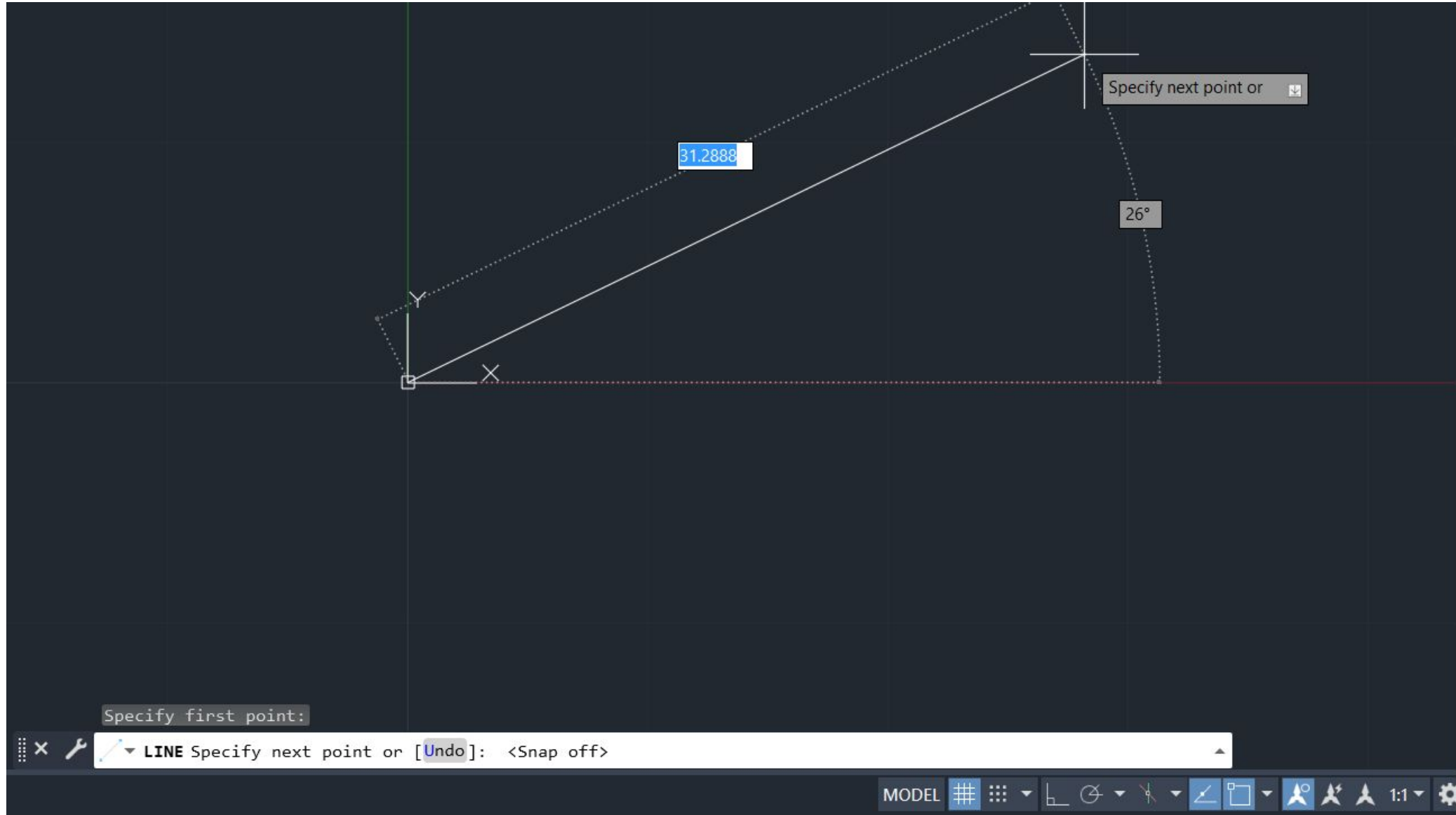
AutoCAD Basic Commands



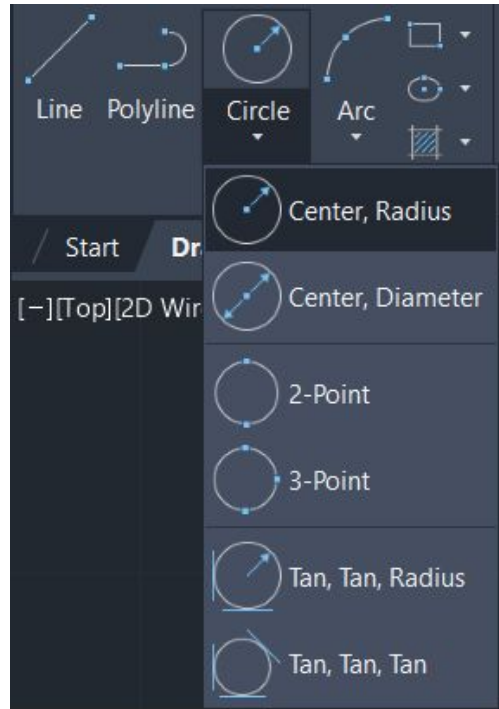
Line Command



Line Command



Circle and Arc Commands



Thank
You