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- PPT
- NOTES
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- EXPERIMENT
- ASSIGNMENT
- TUTORIAL



# **Engineering Graphics – 102012**

F. E. - Semester II

**Department of Mechanical Engineering**

**SCOE, Vadgaon**



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# First Year Engineering - Semester II - Structure

**TABLE -2 First Engineering Structure for Semester-II**

## Teaching Scheme:

1. Theory: 1 Hr/Week
2. Practical: 2 Hrs/Week
3. Tutorial: 1 Hr/Week
4. Credits = 02  
( Theory = 01+ Tutorial/  
Practical = 01 )

## Examination Scheme:

1. In Semester:
  1. End Semester: 50 Marks  
( Unit 1 to 4 )
  2. Term Work/Practical: 25 Marks
    - TH Attendance - 5 Marks
    - PR Attendance - 5 Marks
    - Prelim Tests - 5 Marks
    - Sheet Assessment - 10 Marks



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# Course Objectives

- To acquire basic knowledge about engineering drawing language, line types, dimension methods, and simple geometrical construction
- To draw conic sections by various methods, involutes, cycloid and spiral.
- To acquire basic knowledge about physical realization of engineering objects and shall be able to draw its different views.
- To visualize three dimensional engineering objects and shall be able to draw their isometric views.
- To imagine visualization of lateral development of solids.
- To acquire basic knowledge about the various CAD drafting software's and its basic commands required to construct the engineering drawings.

# Course Outcomes

On completion of the course, learner will be able to:

- **CO1:** Draw the fundamental engineering objects using basic rules and able to construct the simple geometries.
- **CO2:** Construct the various engineering curves using the drawing instruments
- **CO3:** Apply the concept of orthographic projection of an object to draw several 2D views and its sectional views for visualizing the physical state of the object.
- **CO4:** Apply the visualization skill to draw a simple isometric projection from given orthographic views precisely using drawing equipment.
- **CO5:** Draw the development of lateral surfaces for cut section of geometrical solids.
- **CO6:** Draw fully-dimensioned 2D, 3D drawings using computer aided drafting tools.



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# **Books & Other Resources**

- Text Books**

1. Bhatt, N. D. and Panchal, V. M., (2016), “Engineering Drawing”, Charotar Publication, Anand, India
2. K. Venugopal, K, (2015), “Engineering and Graphics”, New Age International, New Delhi
3. Jolhe, D. A., (2015), “Engineering Drawing with introduction to AutoCAD”, Tata McGraw Hill, New Delhi
4. Rathnam, K., (2018), “ A First Course in Engineering Drawing”, Springer Nature Singapore Pte. Ltd., Singapore

- Reference Book**

1. Madsen, D. P. and Madsen, D. A., (2016), “Engineering Drawing and design”, Delmar Publishers Inc., USA



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# Tutorial Session (CAD Software)

- (Minimum 2 problems in each assignment)
- Assignment 1: Construct any Engineering Curve using any method
- Assignment 2: Orthographic view of any machine element along with sectional view.
- Assignment 3: Draw Isometric view for given orthographic views.
- Assignment4 :Draw the isometric or Orthographic view of a product/ object (For example Workshop Job prepared during the workshop practice or any product developed during the first year session).
- Assignment 5: Draw the development of lateral surface of a solid/ truncated solid.



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# Practical Session

- Draw minimum two problems on each assignment on the A3 size drawing sheet.
- Assignment 1: Construct any Engineering Curve by any method
- Assignment 2: Orthographic view of any machine element along with sectional view.
- Assignment 3: Draw Isometric view for given orthographic views.
- Assignment 4: Draw the development of lateral surface of a solid/truncated solid
- Assignment 5: Draw the isometric or Orthographic view of a product/object



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# Syllabus

- **Unit 1: Fundamentals of Engineering Drawing (01 Hrs)**

Need of Engineering Drawing and design, Sheet layout, Line types and dimensioning and simple geometrical constructions

- **Unit 2: Introduction to 2D and 3D computer aided drafting packages (02 Hrs)**

Evolution of CAD, Importance of CAD, Basic Commands - Edit, View, Insert, Modify, Dimensioning Commands, setting and tools etc. and its applications to construct the 2D and 3D drawings

- **Unit 3: Engineering Curves (01 Hr)**

Introduction to conic sections and its significance, various methods to construct the conic sections. Helix for cone and cylinder, rolling curves (Involutes . Cycloid) and Spiral



# Syllabus

- **Unit 4: Orthographic Projection (02 Hrs)**

Principle of projections, Introduction to First and Third angle Projection methods, Orthographic projection of point, line, plane, solid and machine elements/parts

- **Unit 5: Isometric Projection (03 Hrs)**

Introduction to isometric projection, oblique projection and perspective projection. Draw the isometric projection from the given orthographic views

- **Unit 6: Development of Lateral Surfaces (03 Hrs)**

Introduction to development of lateral surfaces and its industrial applications. Draw the development of lateral surfaces for cut section



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# **Unit 1 - Fundamentals of Engineering Drawing**

## **( 01 Hr )**

- Need of Engineering Drawing and design,
- Sheet layout,
- Line types and dimensioning
- Simple geometrical constructions



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# Introduction: Engineering Drawing

- A picture/drawing is worth a thousand words...
- Drawing : Describing any object/ Information

Diagrammatically

- Engineering Drawing OR Machine Drawing : Graphical means of expression of Technical details without the barrier of a Language.
- **Engineering graphics** is the language for Effective Communication among engineers which elaborates the details of any component, structure or circuit at its initial through drawing.



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# Need of Engineering Drawing & Design

- Drawing covers pretty much everything from a sketch on a napkin, to a blueprint. They can all be a drawing.
- Design is the process of inventing or improving something.
- An engineering drawing is a type of technical drawing that is used to convey information about an object.
- Usually, a number of drawings are necessary to completely specify even a simple component. The drawings are linked together by a master drawing or assembly drawing which gives the drawing numbers of the subsequent detailed components, quantities required, construction materials and possibly 3D images that can be used to locate individual items.



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# Introduction: Engineering Drawing



Mechanical  
machine

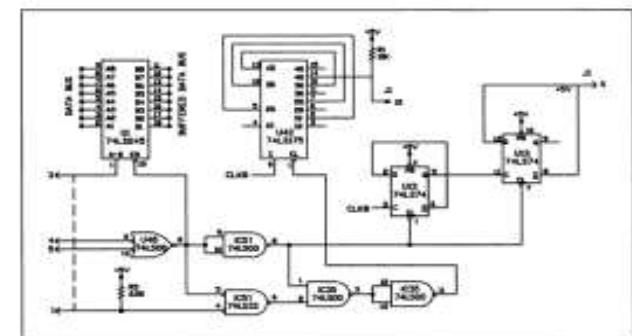
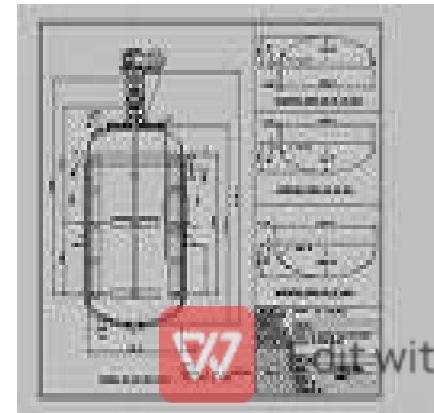


Civil structure



Chemical reactor

Important for all  
Branches

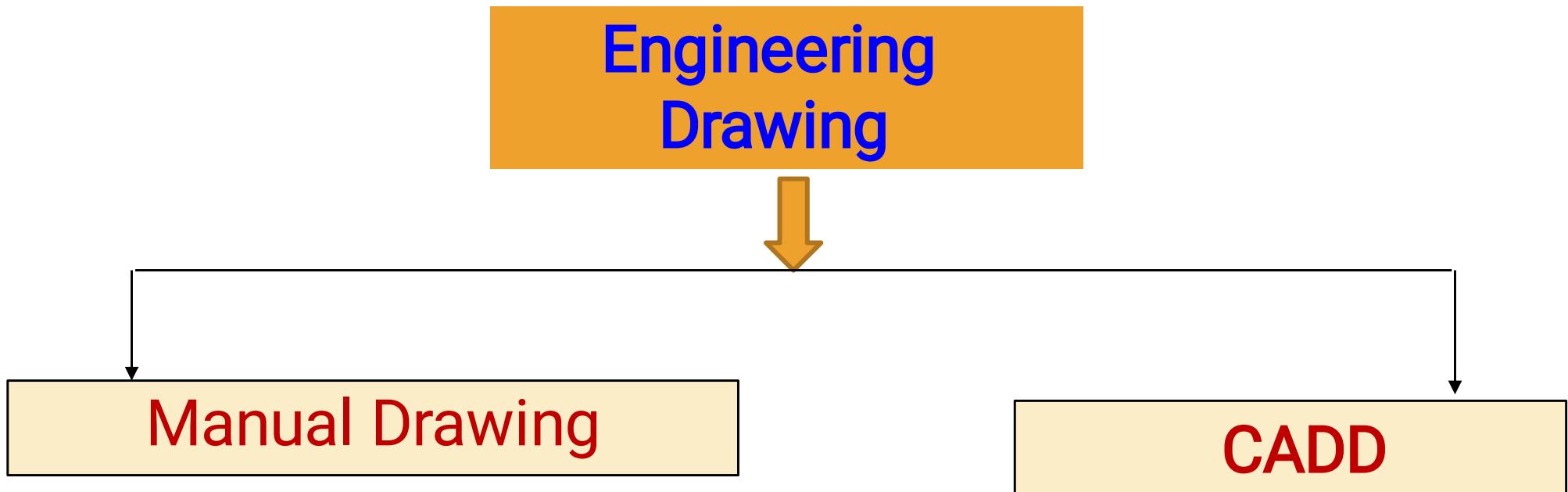


Electrical circuit



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# Introduction: Engineering Drawing



- Freehand Drawing
- Instrument Drawing
- Computer Drawing



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# Introduction: Drawing Instruments & their Uses

- Drawing pencils
- Drawing paper (Sheets)
- Drawing board and table
- Scale
- Protractor
- Set squares
- T – square
- Mini- Drafter
- Roll-N- Draw
- French Curves
- Instrument Box
  - I. Compass
  - II. Divider
- Sharpener
- Eraser
- Drawing pins



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## Drawing Pencils

- The accuracy and appearance of a Drawing depends on the quality of Pencil used to make Drawing.
- 7B, 6B, 5B, 4B, 3B, 2B, B - in decreasing order of softness and blackness.
- HB to F – Medium grade
- H, 2H, 3H, 4H, 5H, 6H, 7H, 8H, 9H – increasing order of hardness.
- Drawings are done using 2H pencils and finished with H and HB pencils – to be practiced in this course.



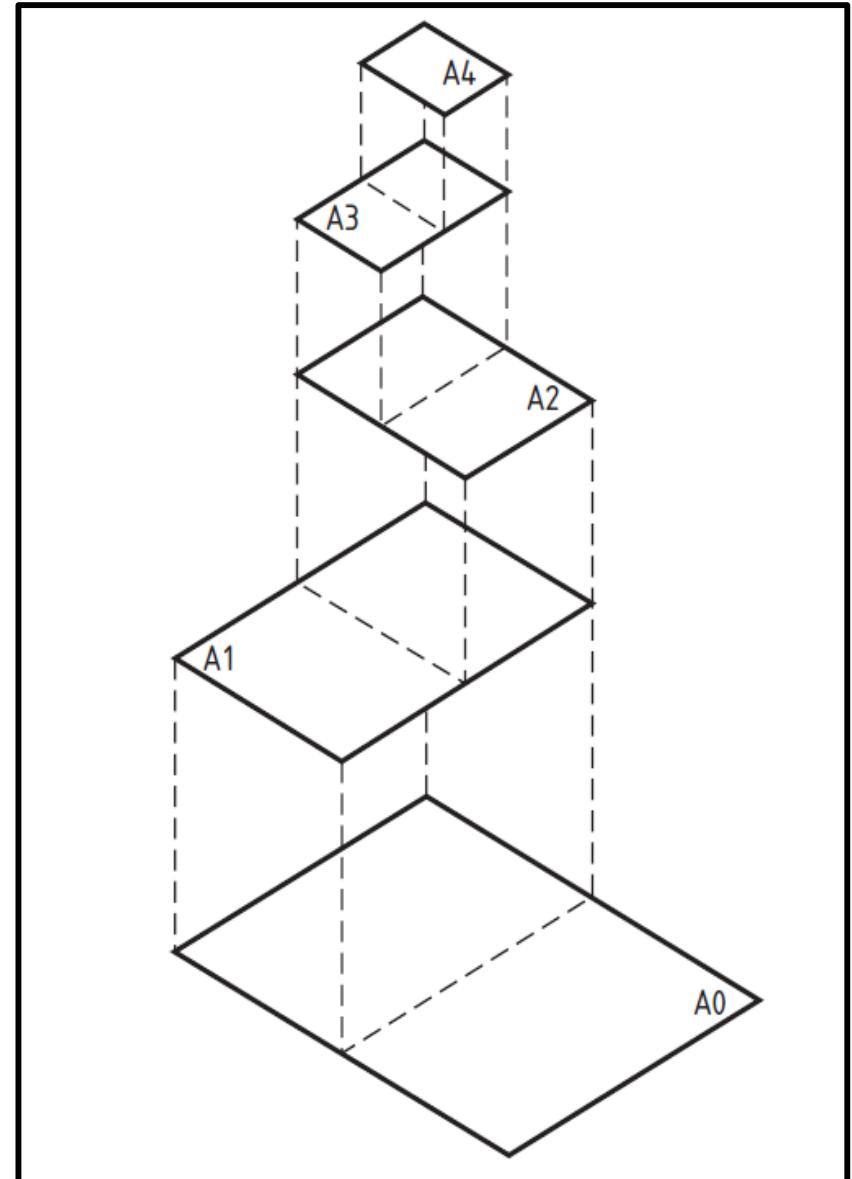
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# Drawing Paper (Drawing Sheets)

## A Series Formats (mm)

Designation	Size ( W x L)
A0	841 × 1189
A1	594 × 841
A2	420 × 594
A3	297 × 420
A4	210 × 297

- The surface area A0 size is one square metre.
- The areas of the two consecutive sizes are in the ratio 1 : 2.



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# Drawing Paper (Drawing Sheets)

## DRAWING SHEET

Paper	Size in mm	Use
A0	841 x 1149	Cinema Posters
A1	594 x 841	Flip Charts, Newspapers
A2	420 x 594	Engineering Drawings, Flip Charts
A3	297 x 420	Local Posters, Engineering Drawings
A4	210 x 297	Letters, Printouts, Common Purposes etc.
A5	148 x 210	Note Pads
A6	105 x 148	Bills
A7	74 x 105	Index Cards
A8	52 x 74	Playing Cards

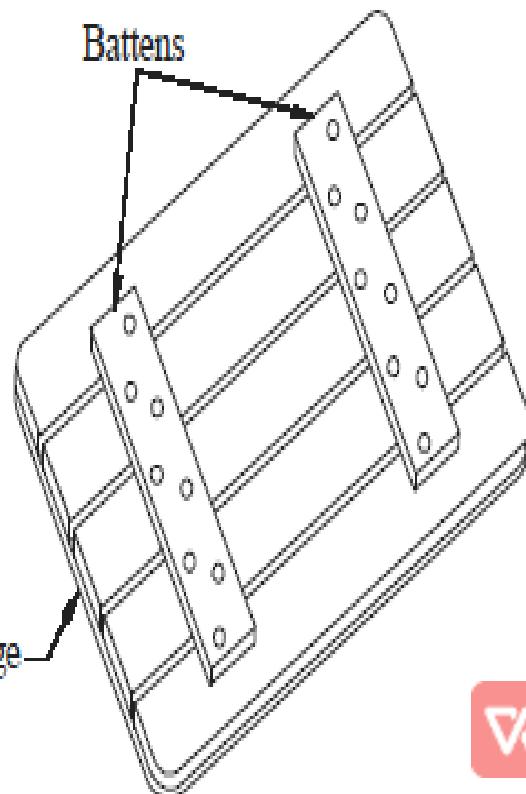


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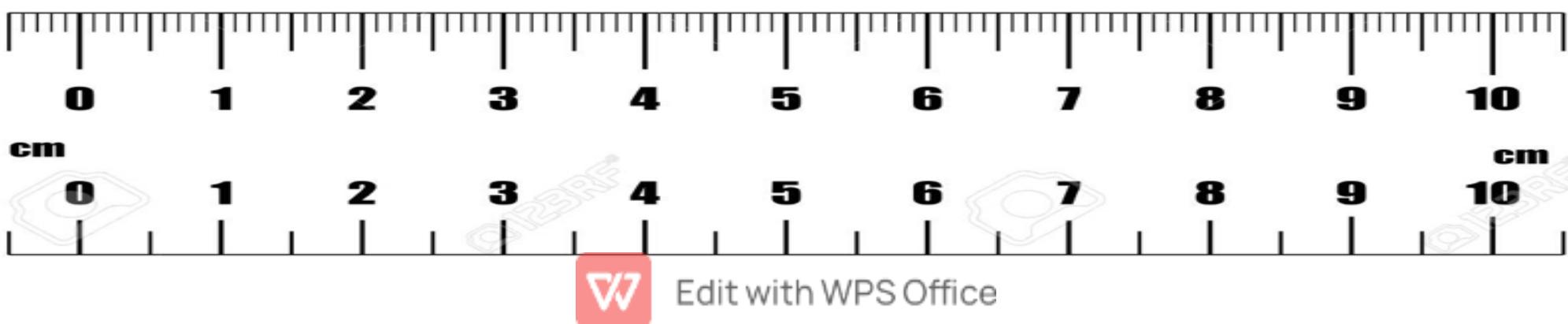
# Drawing Board and Table

- Drawing board is made from strips of well seasoned soft wood generally 25 mm thick.
- It is cleated at the back by two battens to prevent warping.
- One of the shorter edges of the rectangular board is provided with perfectly straight ebony edge which is used as working edge on which the T-square is moved while making drawings.



# Scales

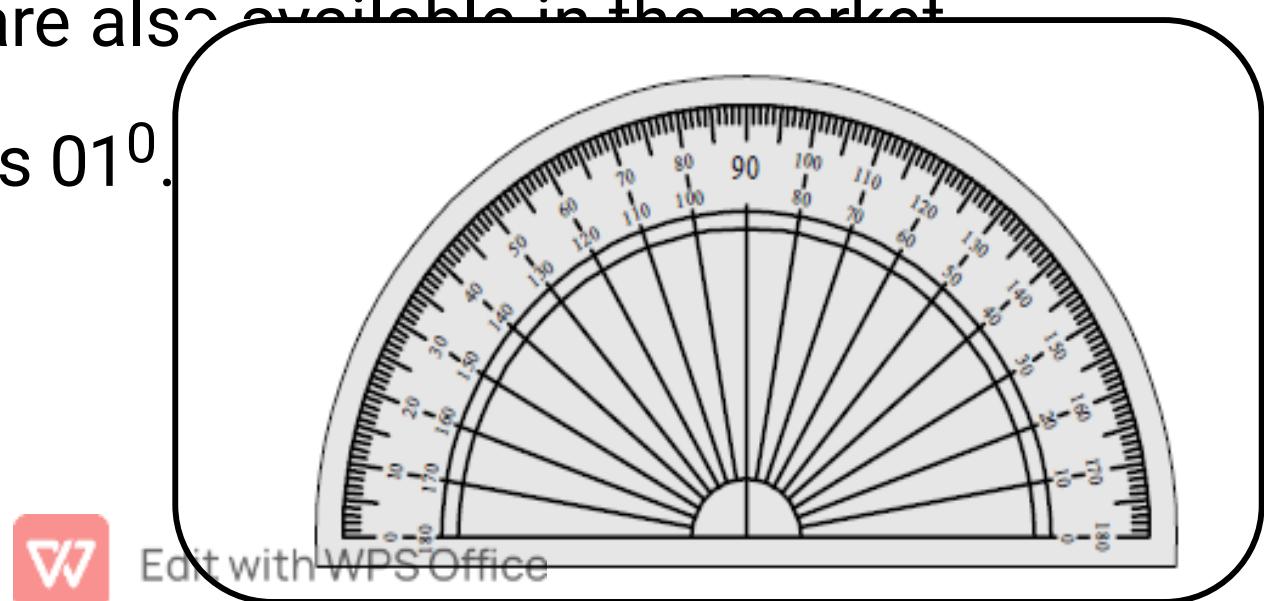
- Scales are made of steel, celluloid or plastic.
- Both the longer edges of the scales are marked with divisions of centimeters, which are sub-divided into millimeters.
- The least count (LC) is 01 mm.
- The scales of large thickness have their longer edges beveled for better readability.



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# Protractor

- Protractors are used to mark or measure angles between 0 and  $180^\circ$ .
- They are semicircular in shape ( $\varnothing 100\text{mm}$ ) and are made of Plastic or celluloid which has more life.
- Protractors with circular shape capable of marking and measuring 0 to  $360^\circ$  are also available in the market.
- The least count (LC) is  $01^\circ$ .



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# Set Squares

- Set squares are generally made from Plastic or celluloid material.
- They are triangular in shape with one corner, a right angle triangle.
- A pair of set squares ( $30^{\circ}$ – $60^{\circ}$ ) and  $45^{\circ}$  facilitate marking of angles.
- They are used directly to draw lines at  $30^{\circ}$ ,  $60^{\circ}$  and  $45^{\circ}$  to the vertical and horizontal.

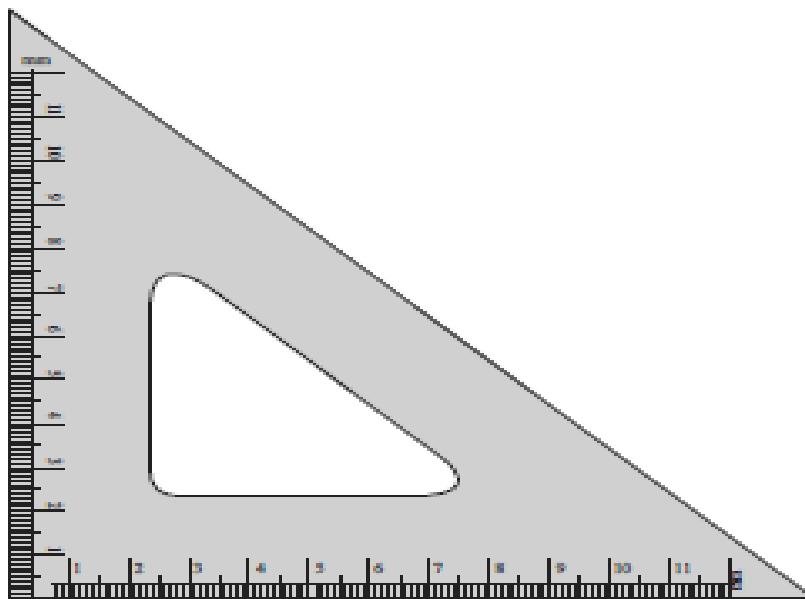


Fig :  $45^{\circ}$  Set Square

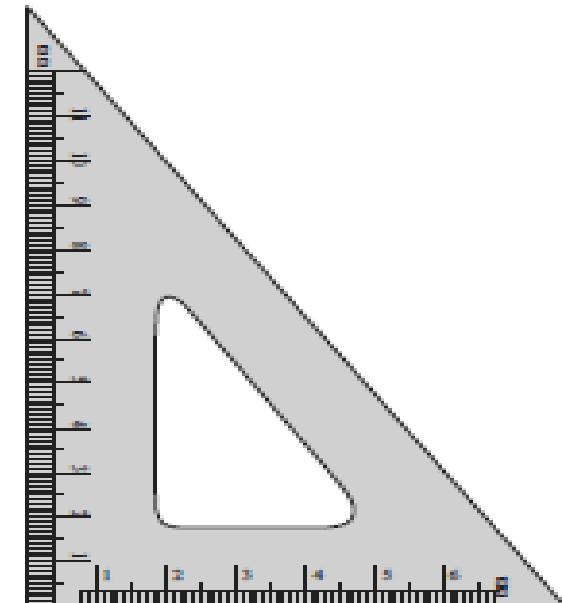


Fig :  $30^{\circ}$  -  $60^{\circ}$  Set Square



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# T – Square

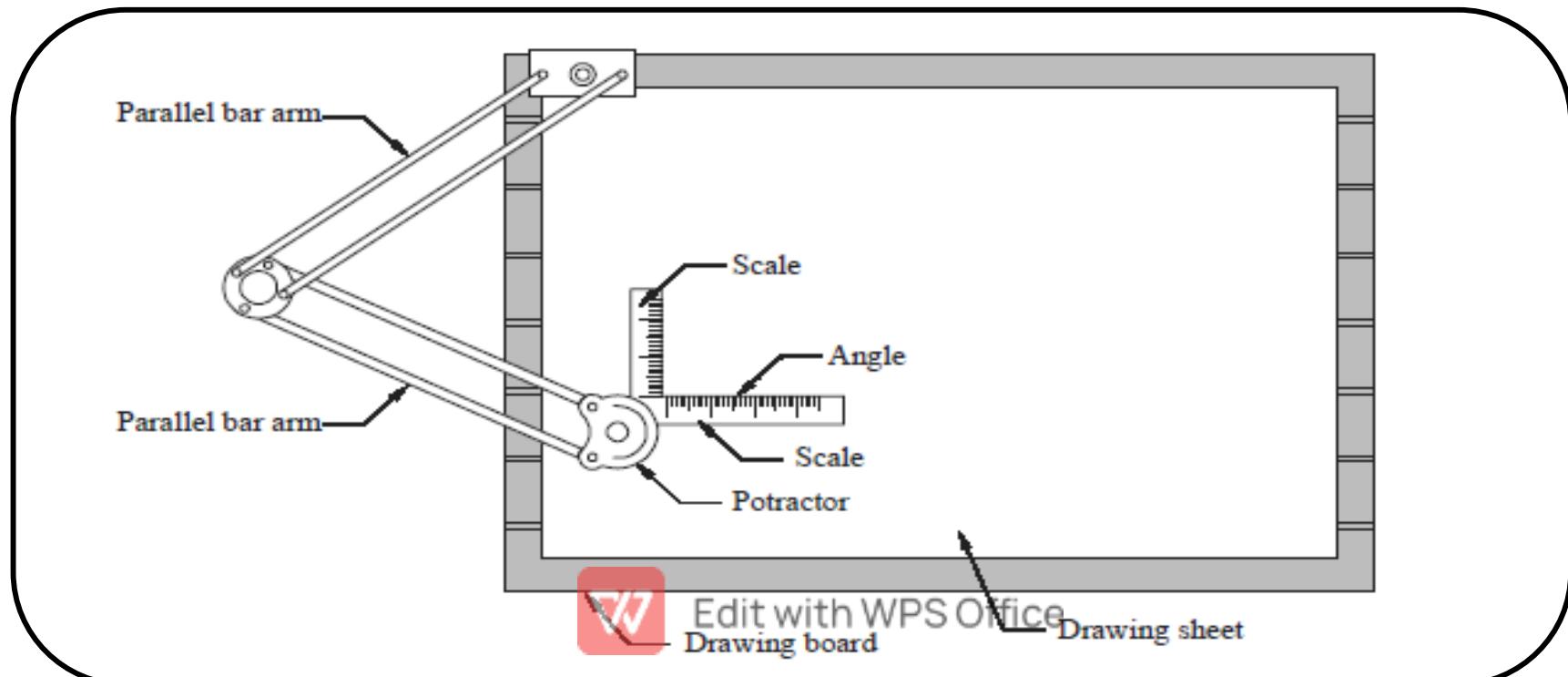
- T-squares are made from hard wood.
- A T-square consists of two parts namely the stock and the blade joined together at right angles to each other by means of screws and Pins as shown in figure.
- The stock is made to slide along the working edge and the Blade moves on the Drawing board.
- The working edge of T-square is used to draw parallel lines, vertical lines or inclined lines at  $30^\circ$ ,  $60^\circ$  to the horizontal using set squares



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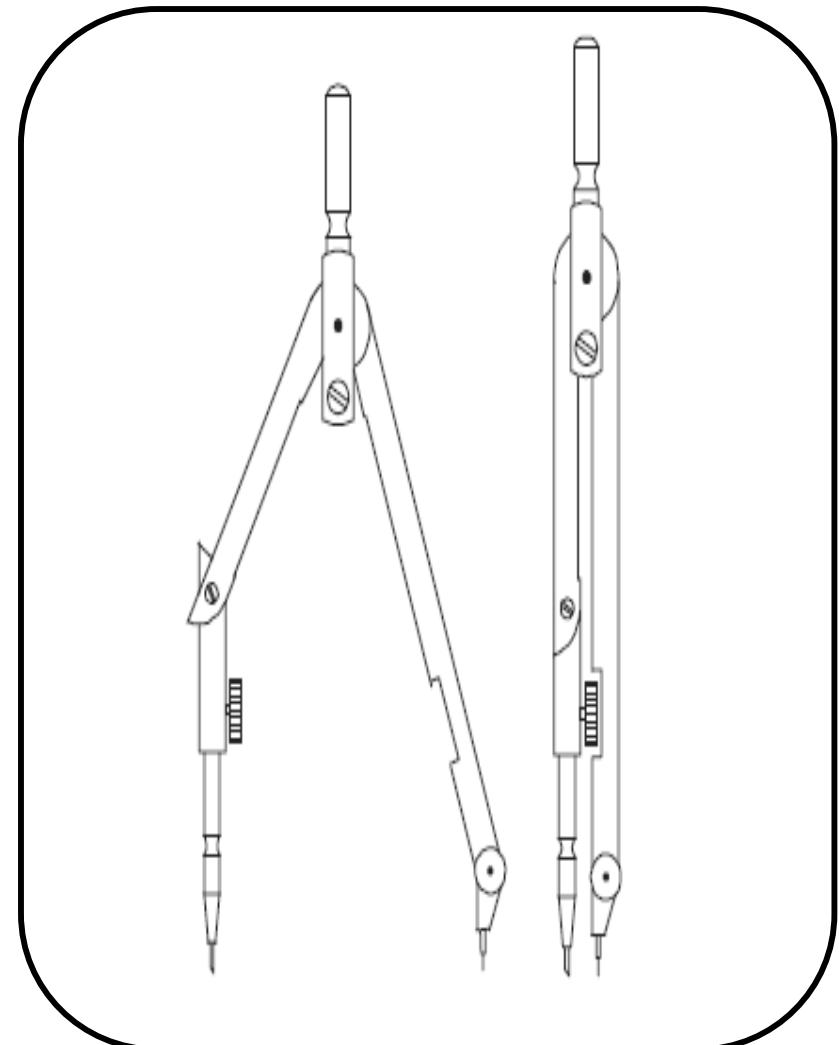
# Mini- Drafter

- In a Drafting machine, the uses and advantages of T-square, set square, scales, protractors are combined.
- These blades are used to draw parallel, horizontal, vertical and inclined lines. The blades always move parallel to the edges of the board.



# Compass

- The Compass is used for drawing circles and arcs of circles.
- The compass has two legs hinged at one end. One of the legs has a pointed needle fitted at the lower end whereas the other end has provision for inserting pencil lead.
- Circles up to 120 mm diameters are drawn by keeping the legs of compass straight.
- For drawing circles more than 150 mm radius, a lengthening bar is used.



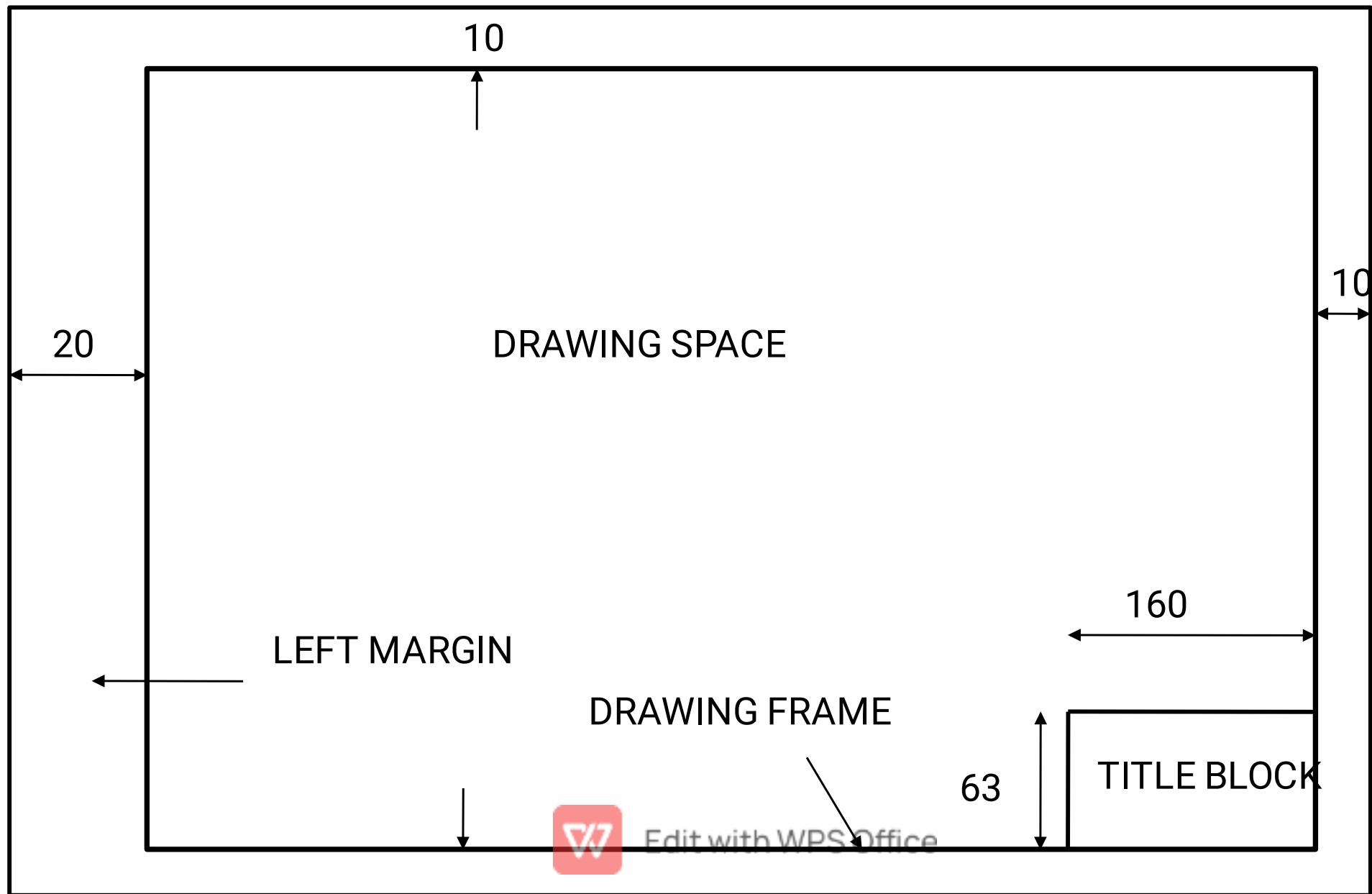
# French Curves

- French curves are used for drawing smooth curved lines that are not arcs or circles.
- These are used to draw irregular curves such as ellipse, parabola, spiral etc.

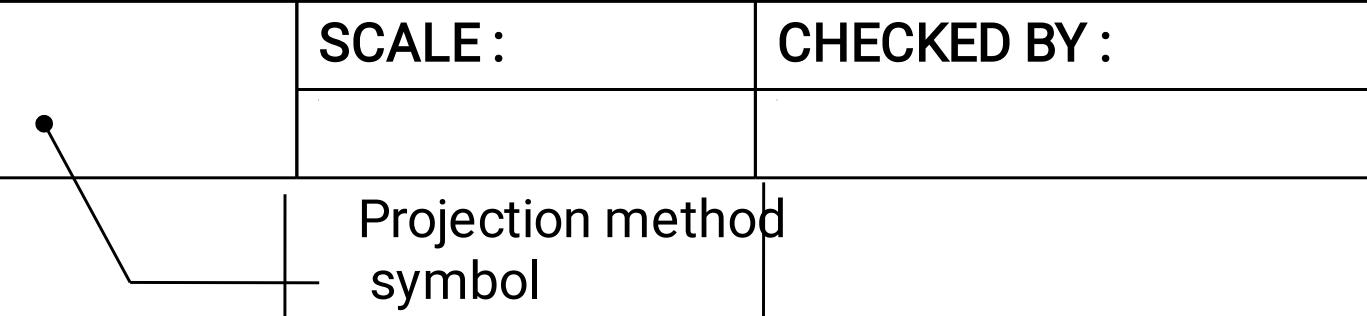


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# Drawing Sheet Layout



# Drawing Sheet Layout : Title Block

COLLEGE :			
NAME :			
DRAWING TITLE :			
SHEET NO :	SECTION :		
DATE :	ROLL NO :		
	SCALE :	CHECKED BY :	
 Projection method symbol			



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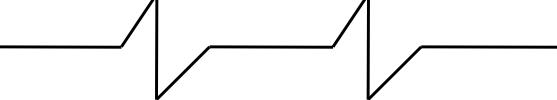
# Types of Lines

Sr. No	Types of Lines	Thickness (mm)	Illustrations	Mechanical Applications
01	Continuous Thick	0.5	—	<ul style="list-style-type: none"><li>Visible Outlines</li></ul>
02	Continuous Thin	0.2	—	<ul style="list-style-type: none"><li>Dimension Lines</li><li>Extension Lines</li><li>Projection Lines</li><li>Leader Lines</li><li>Hatching</li></ul>
03	Dashed Medium Thick	0.3	— — — — —	<ul style="list-style-type: none"><li>Hidden Lines</li></ul>
04	Chained Thin	0.2	— — — — — — —	<ul style="list-style-type: none"><li>Centre Lines</li><li>Lines of symmetry</li><li>Locus Line</li></ul>
05	Chained Thin And Thick Ends Only	0.2 & 0.5 at end	— — — — — — — —	<ul style="list-style-type: none"><li>Cutting planes</li></ul>



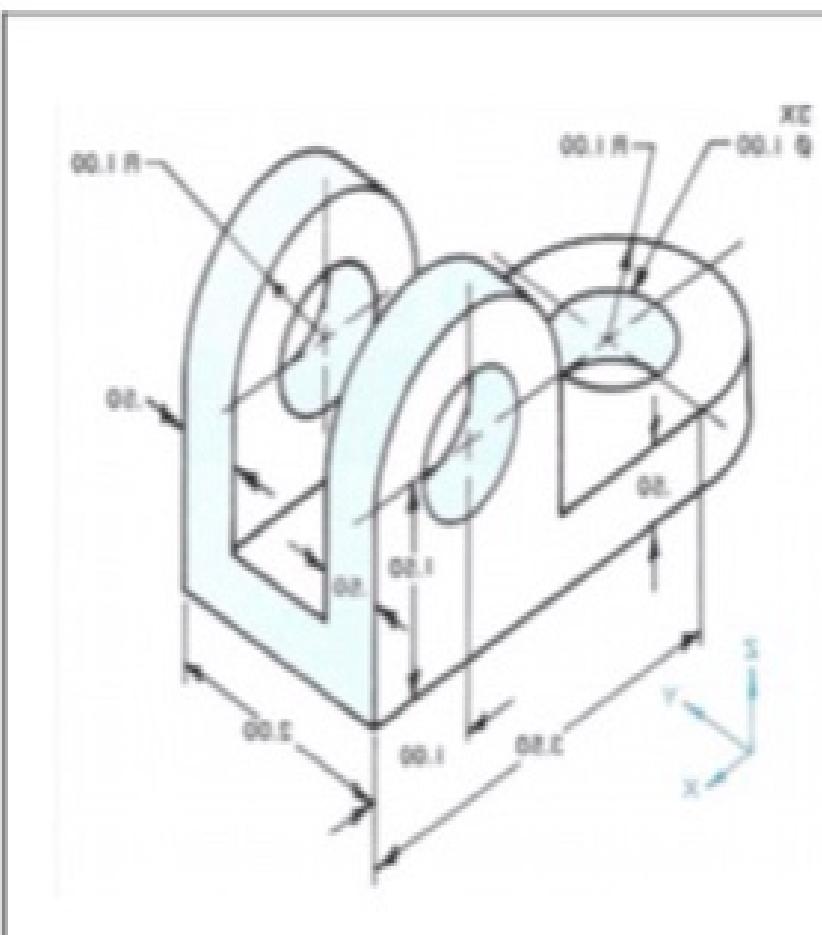
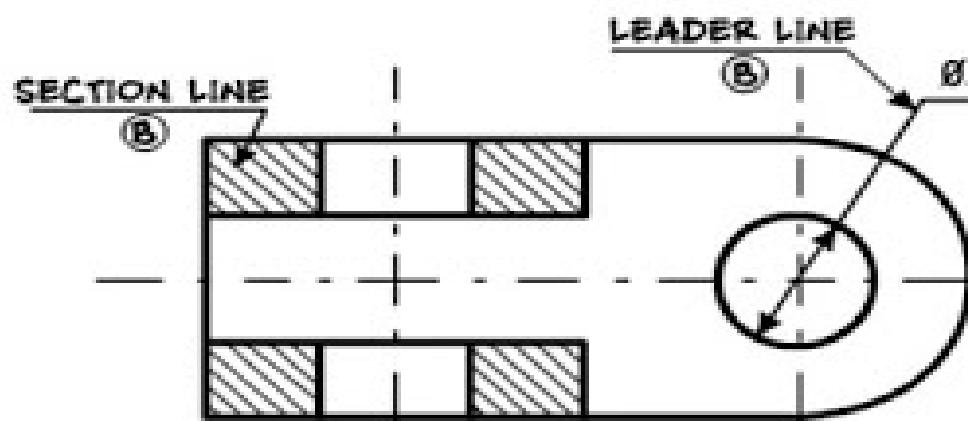
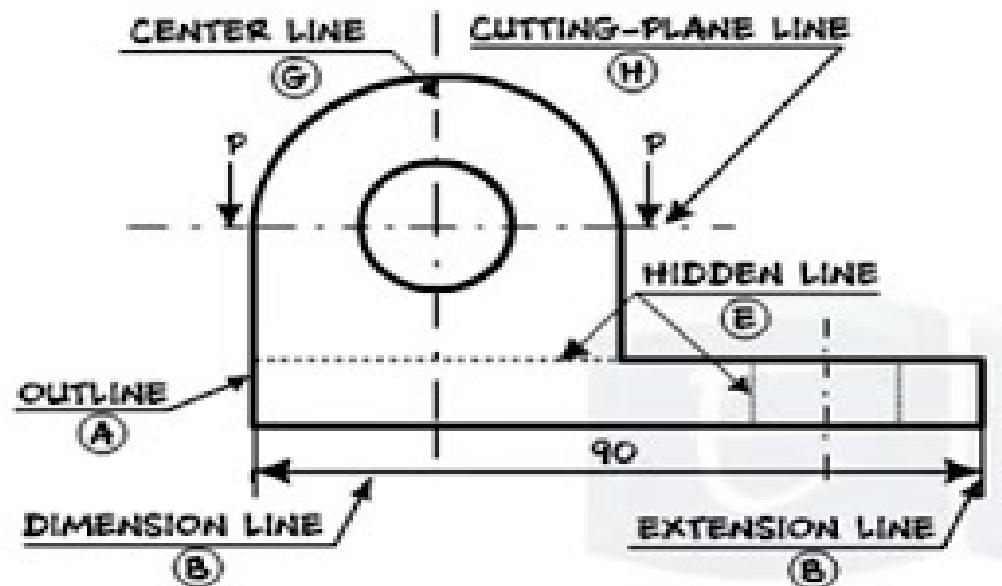
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# Types of Lines

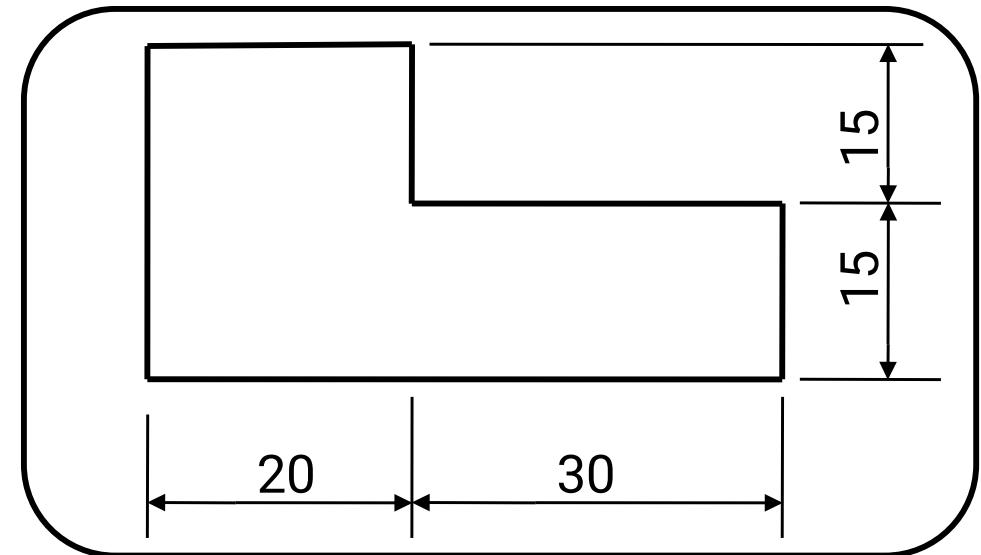
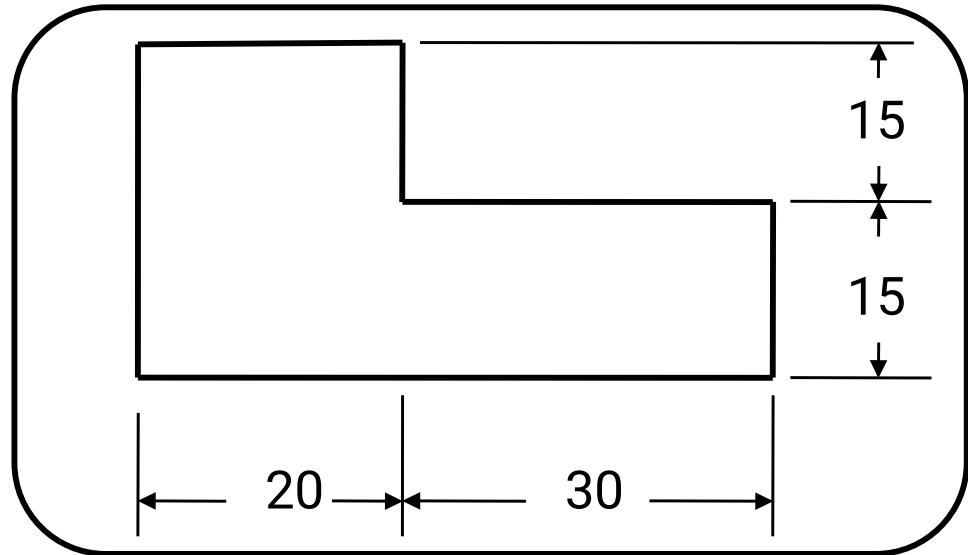
Sr. No.	Types Of Lines	Thickness (Mm)	Illustrations	Mechanical Applications
06	Chain Thin Double – Dashed	0.2	— — — — —	<ul style="list-style-type: none"><li>Outlines For Adjacent Parts</li><li>Alternative And Extreme Positions Of Movable Parts</li></ul>
07	Continuous Thin With Zig - Zags	0.2		<ul style="list-style-type: none"><li>Long Break Line</li></ul>



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# Dimensioning



- **Unidirectional System**

- The dimensions are placed so they can be read from the bottom of the drawing sheet.
- The dimension lines are broken near the middle for inserting the dimension.
- This method is commonly used in mechanical drafting.

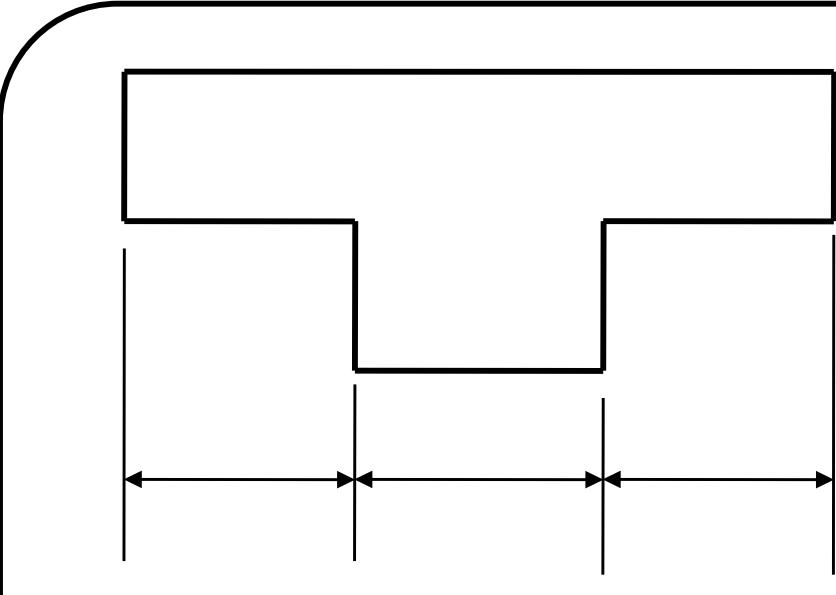
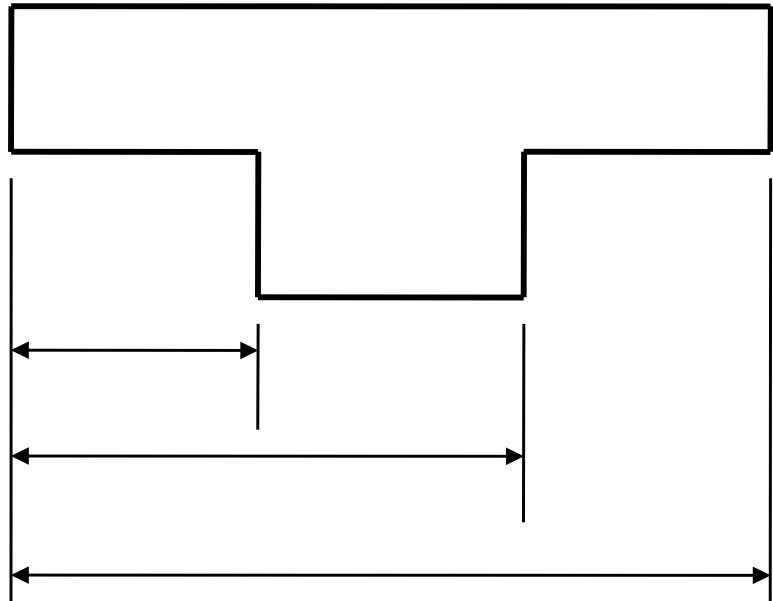
- **Aligned System**

- The dimensions are placed so the horizontal dimensions can be read from the bottom of the drawing sheet and the vertical dimensions can be read from the right side of the drawing sheet.
- This method is commonly used in architectural and structural drafting.



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# Dimensioning

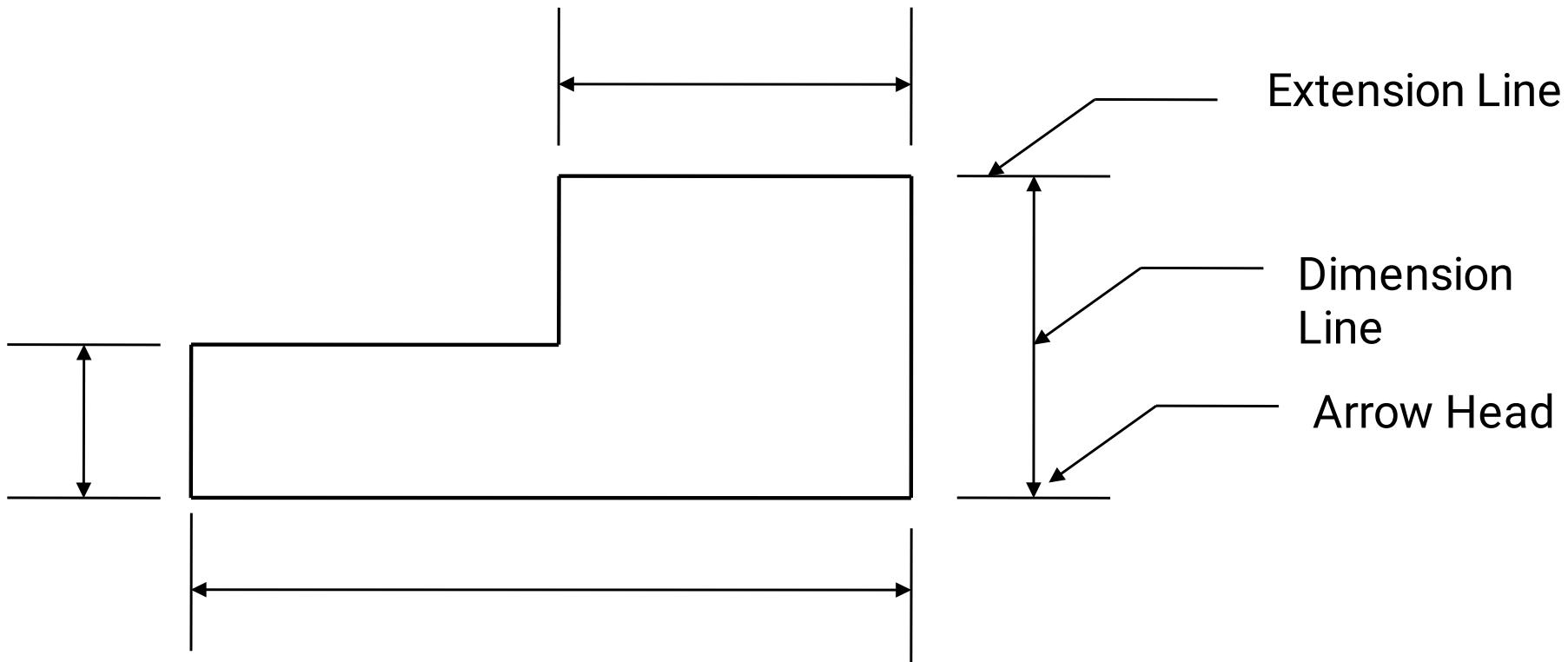


- **Parallel Dimensioning**
- It consists of several dimensioning originating from one position.
- **Chain Dimensioning**
- The dimensions are arranged in a straight line.

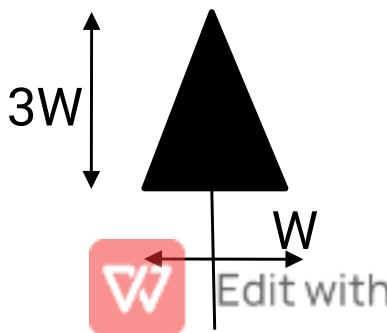


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# Methods of Dimensioning



Preferred

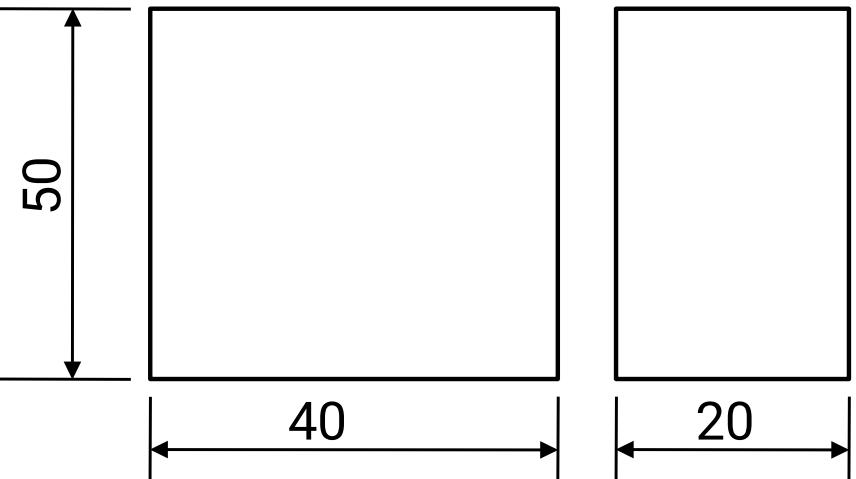


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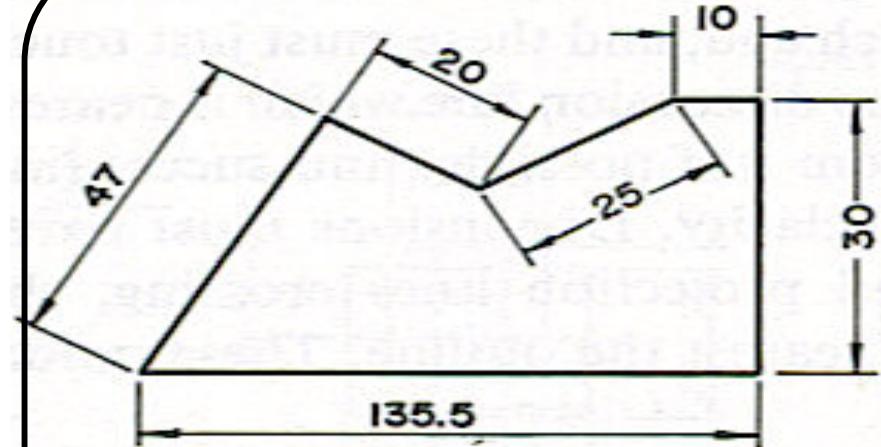


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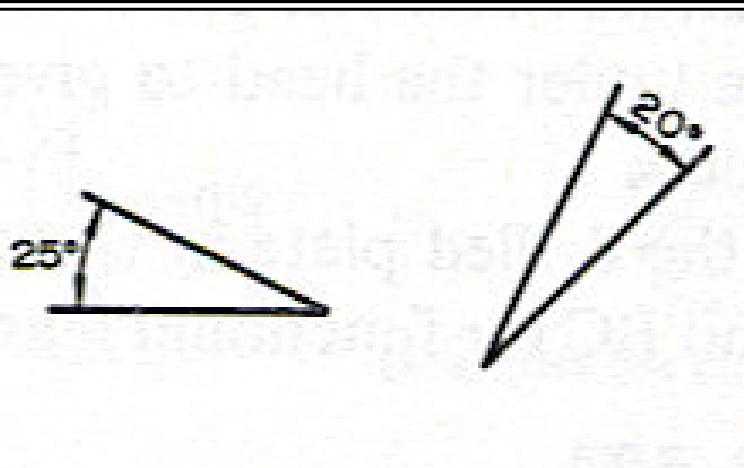
# Methods of Dimensioning :



Linear Dimensions



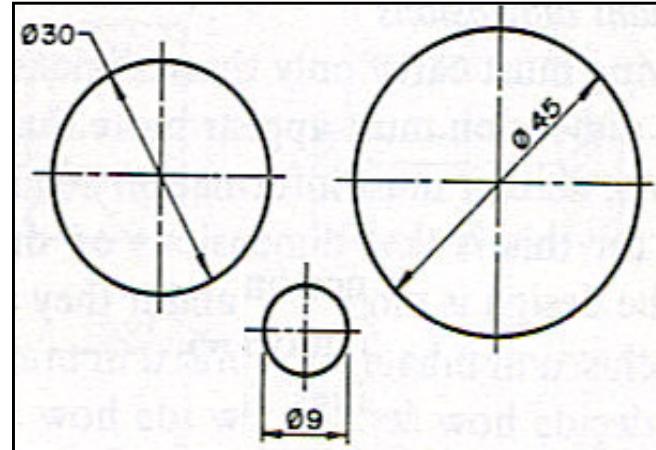
Alignment of DL



Dimensioning Angles



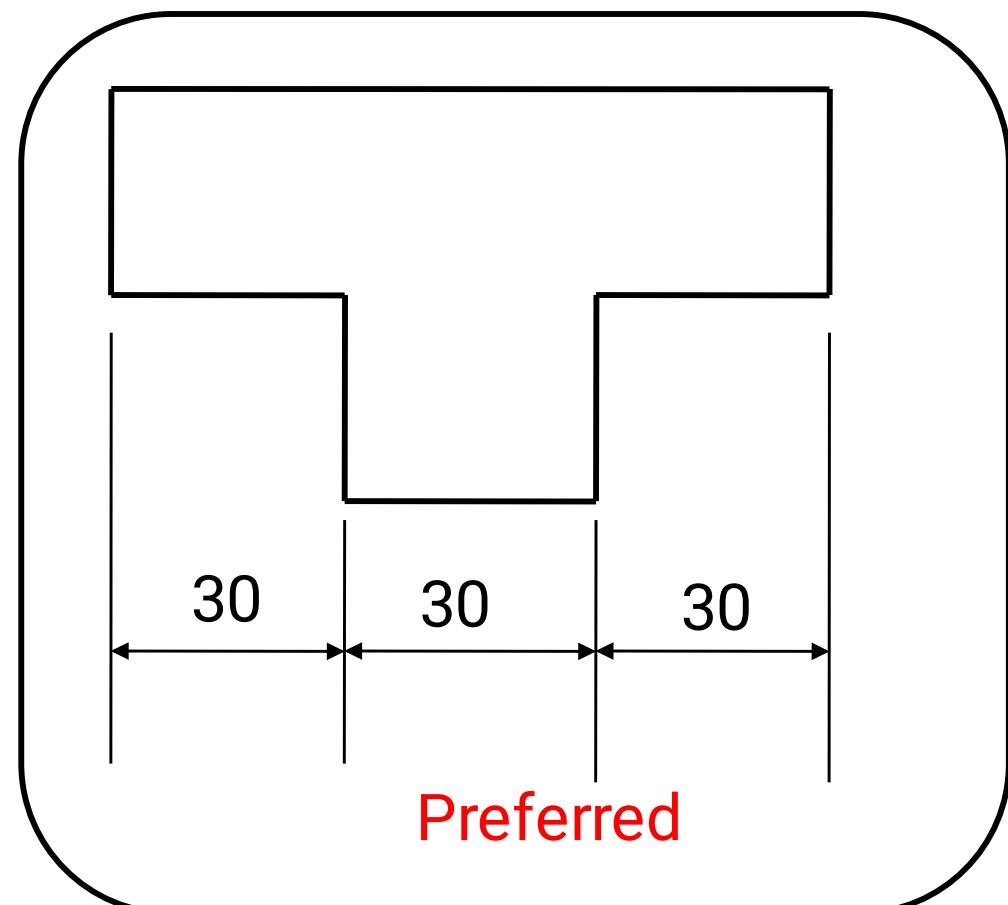
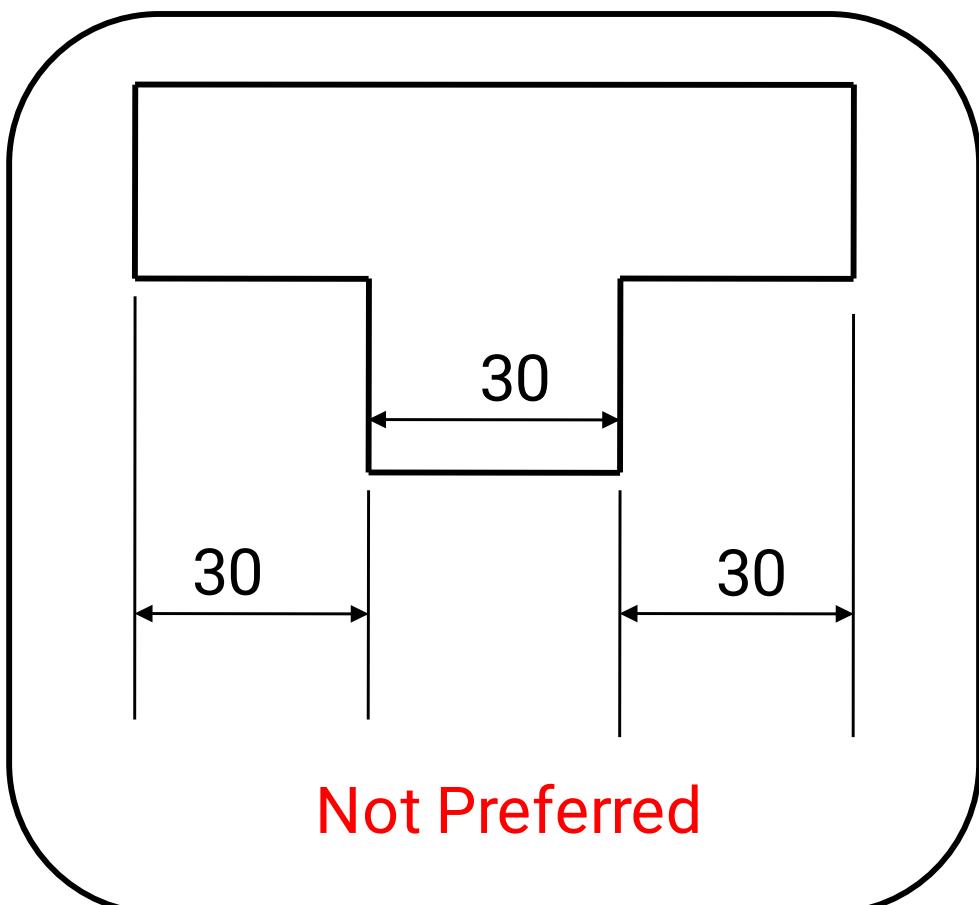
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Dimensioning Circles

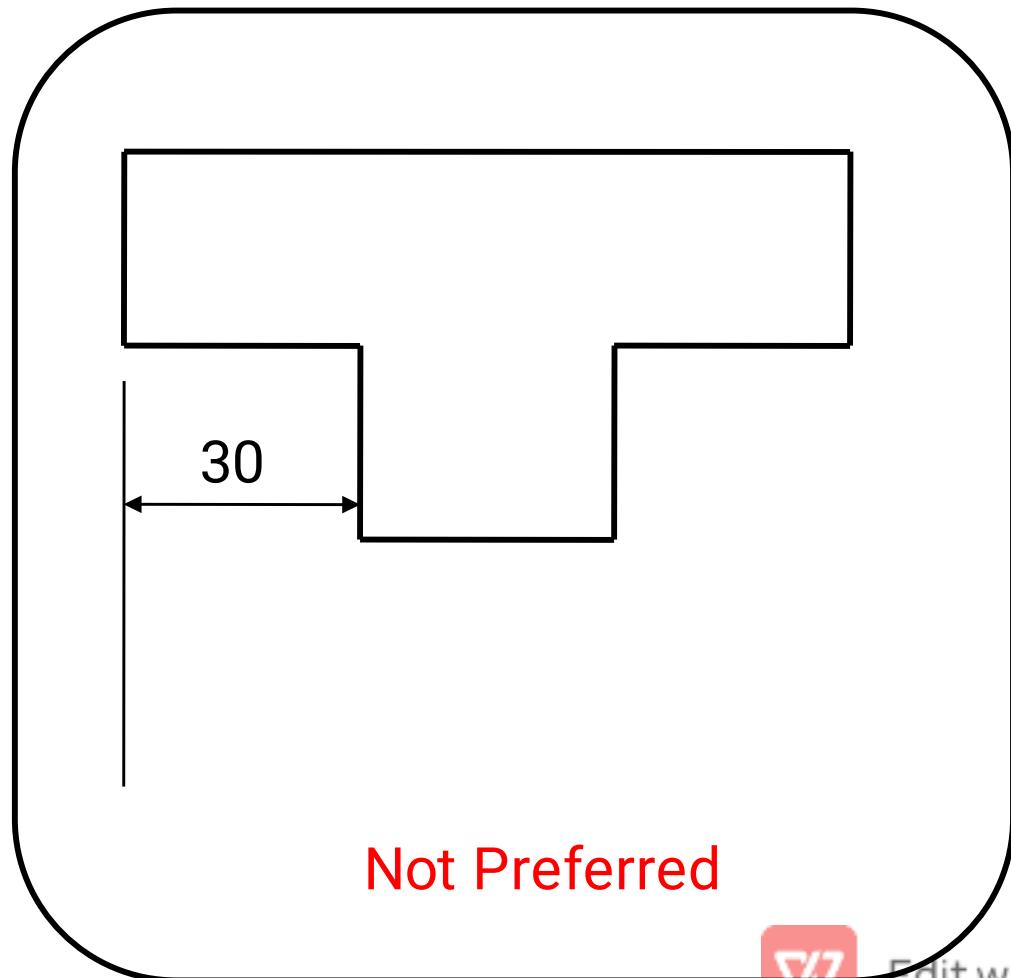
# General Rules for Dimensioning

- I. Dimension figures are never preferred to be written within the object view.

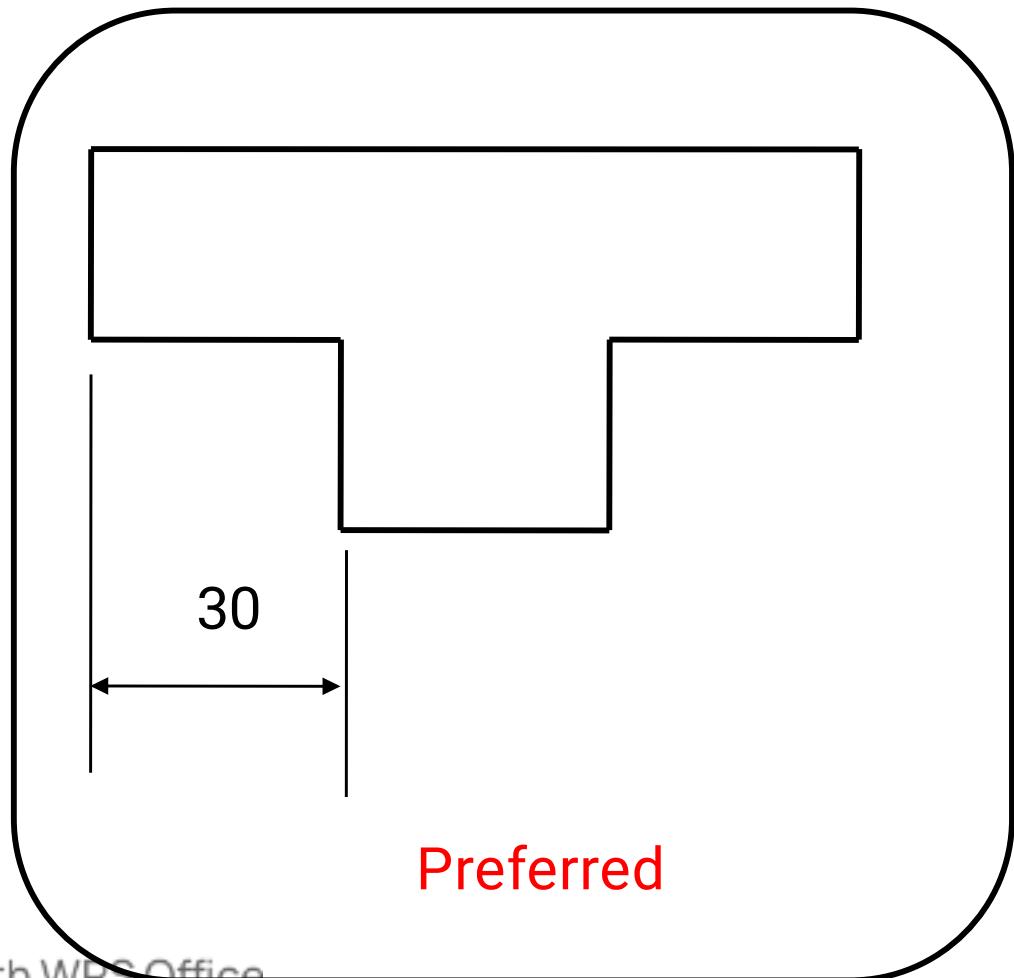


# General Rules for Dimensioning

- II. The object outline should not be used as an extension line.



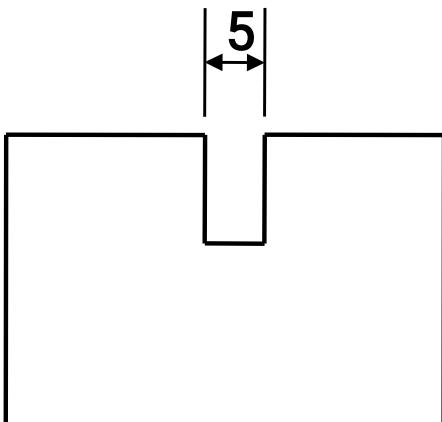
Not Preferred



Preferred

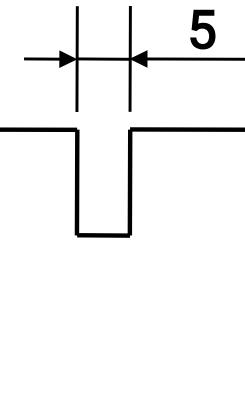
# General Rules for Dimensioning

III. If the space for writing a dimension is too small to indicate dimension line, arrows heads and the dimension number, the dimension may be mentioned externally with help of a continuing line.



Not Preferred

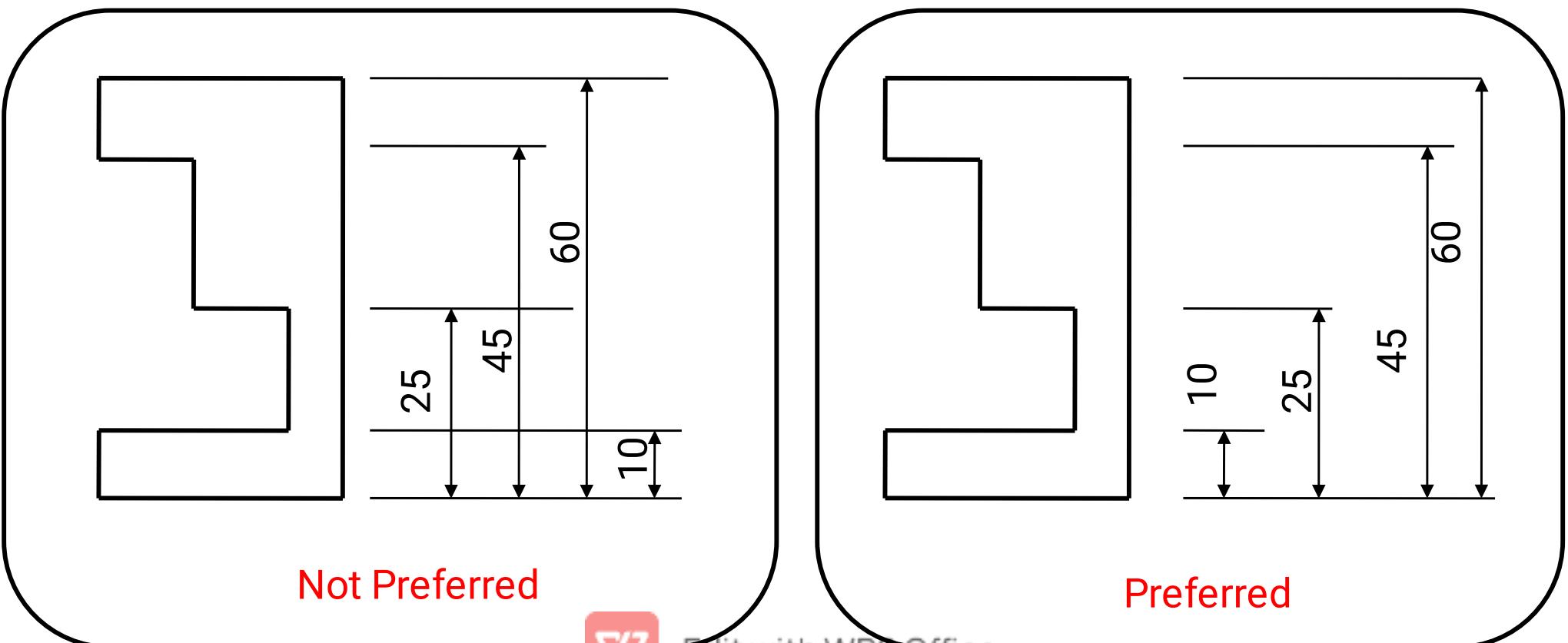
5



Preferred

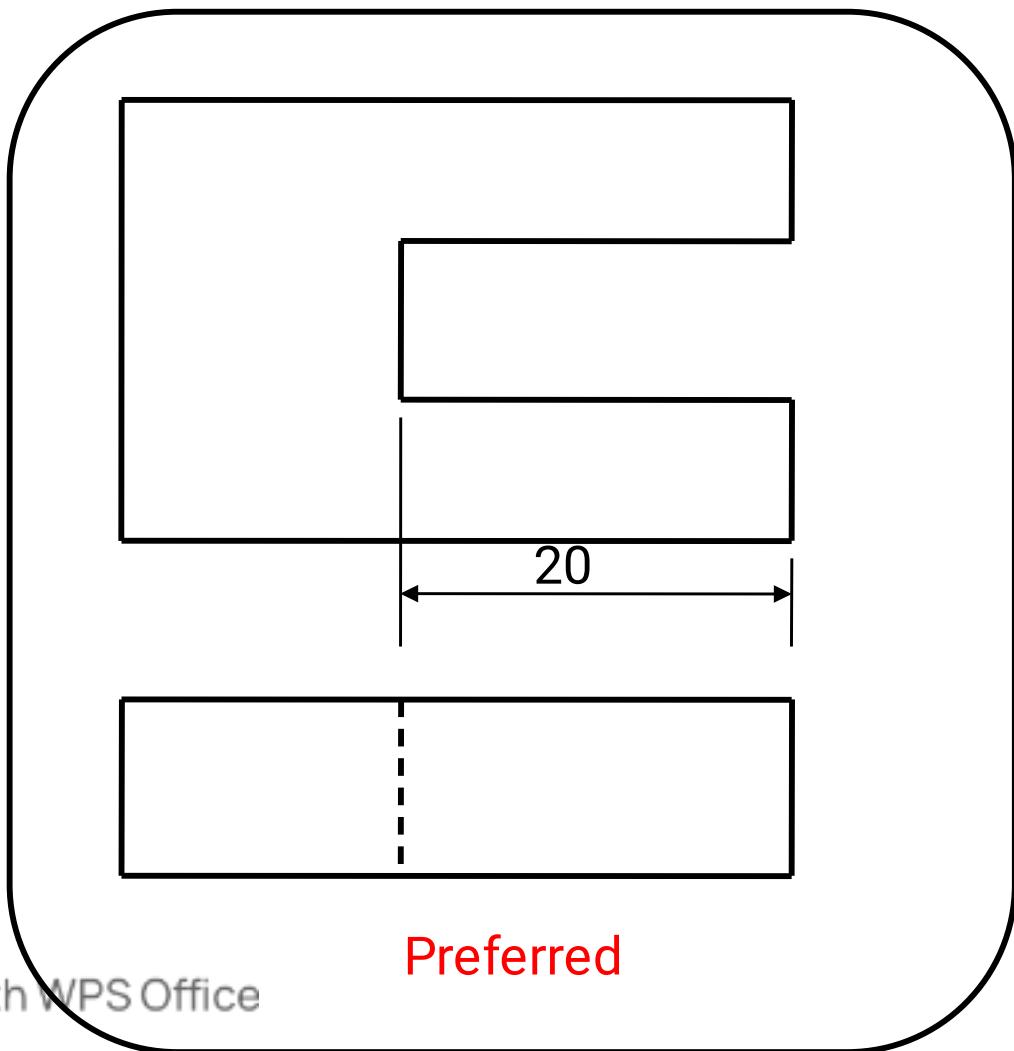
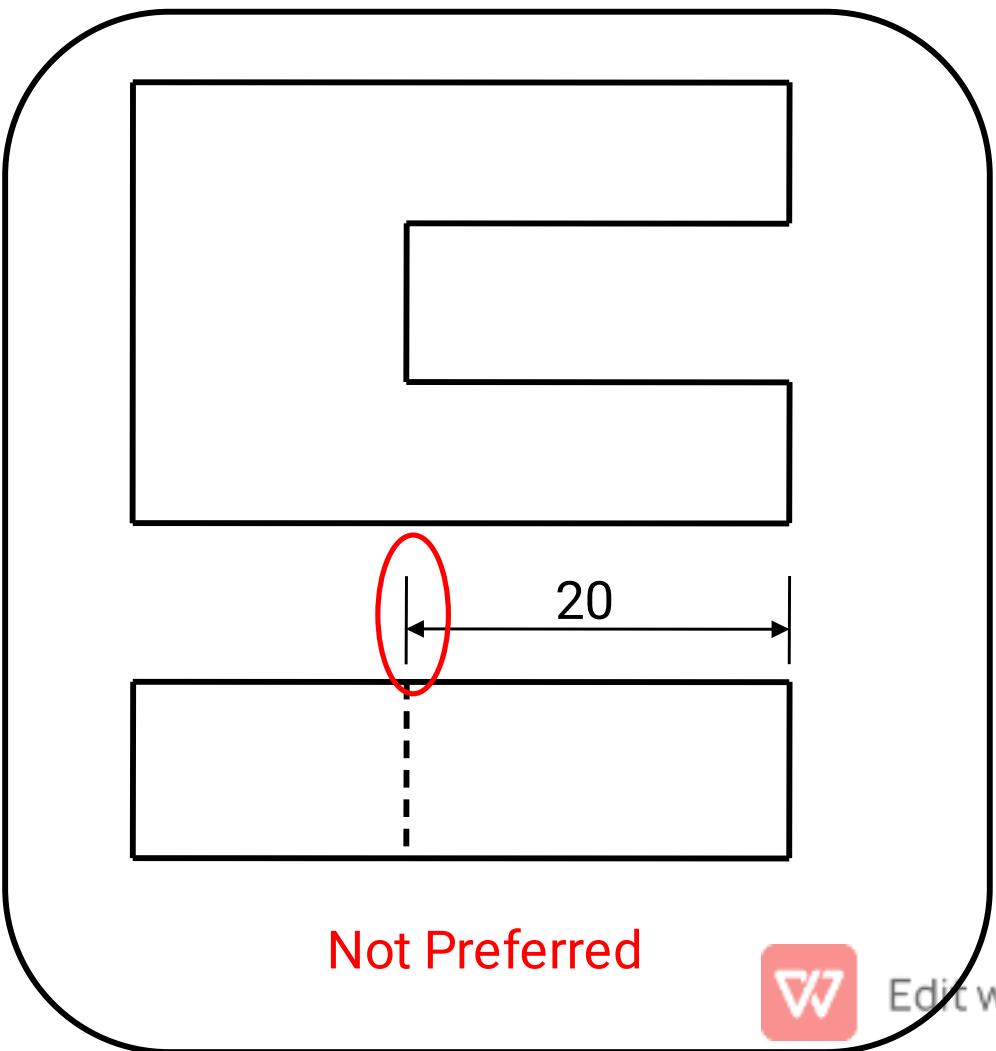
# General Rules for Dimensioning

- IV. If a single extension line is used for more number of dimensions starting from a common place, then the smaller dimensions should be written inside and larger ones outside.  
The dimension lines and the extension lines are not preferred to cross anywhere.



# General Rules for Dimensioning

V. Dimension is not preferred over dotted lines.

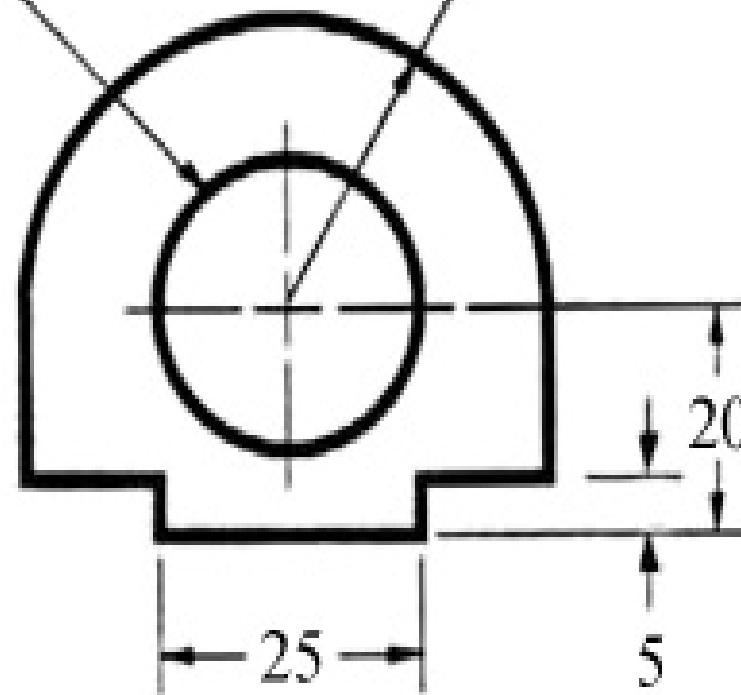


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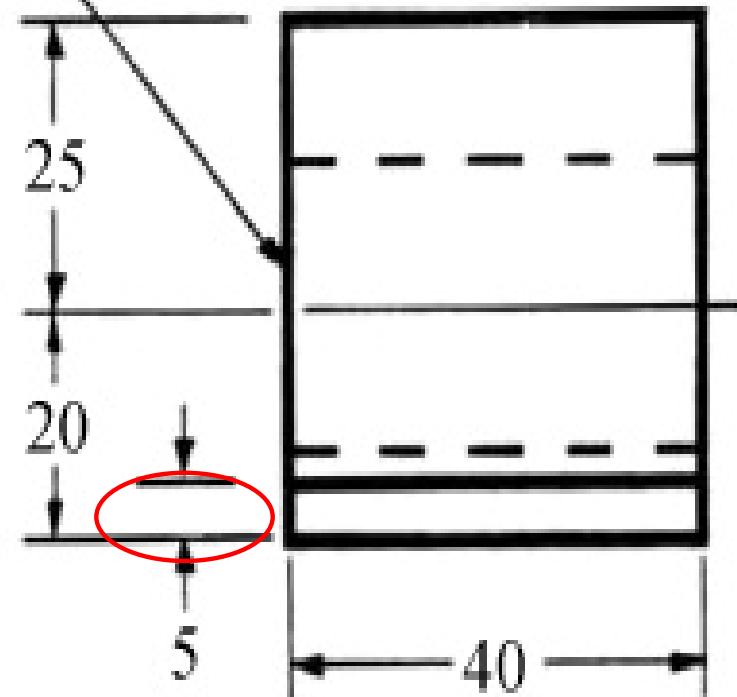
# General Rules for Dimensioning

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

$\varnothing 25 \pm 0.05$



$\varnothing 25 \pm 0.05$



CORRECT

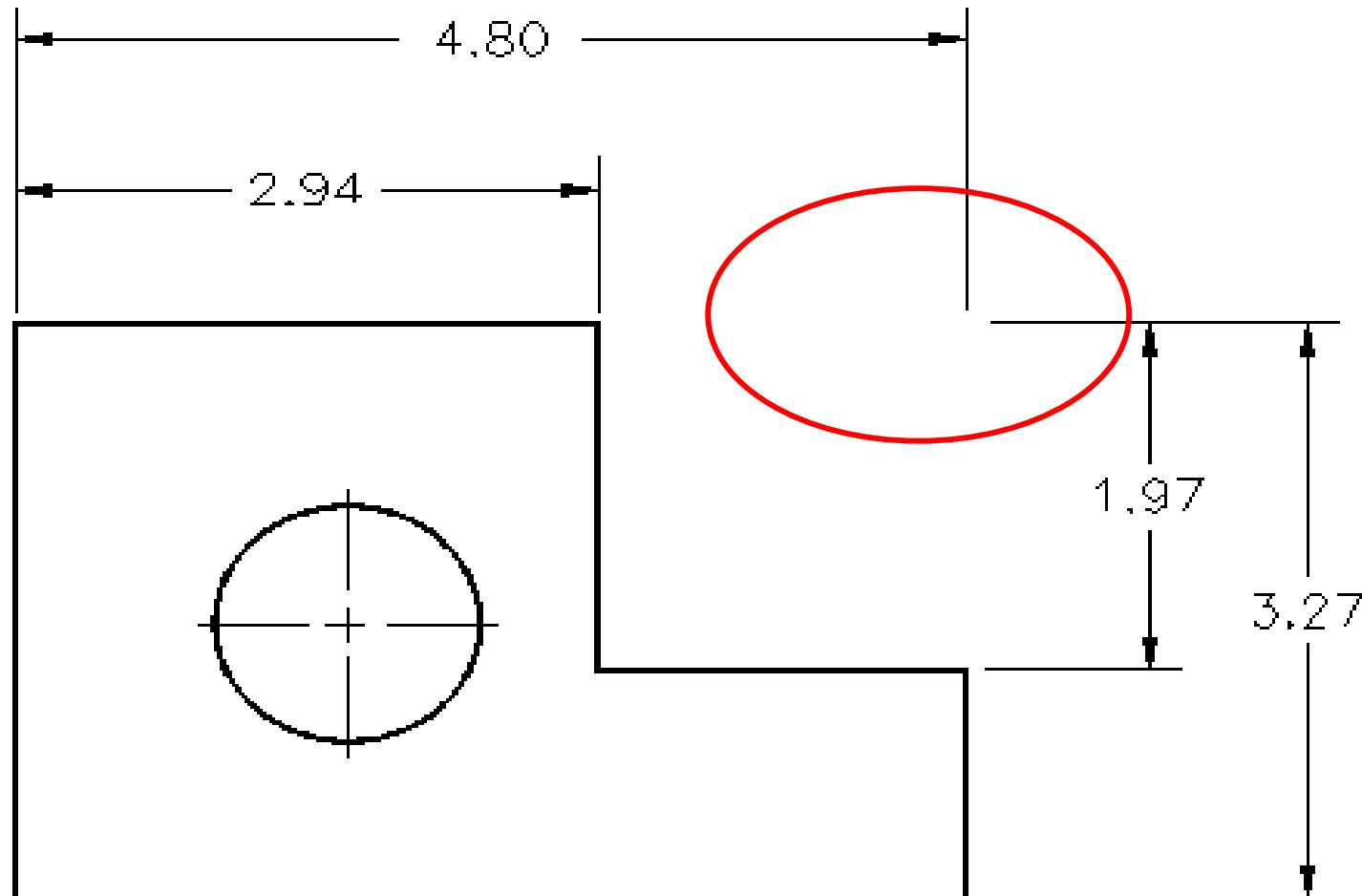


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INCORRECT

# General Rules for Dimensioning

VII. Extension lines should never be shortened.



Not Preferred  
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# General Rules for Dimensioning

VIII. Do not repeat a dimension. It will only confuse the reader and could cause errors in reading the drawing correctly.

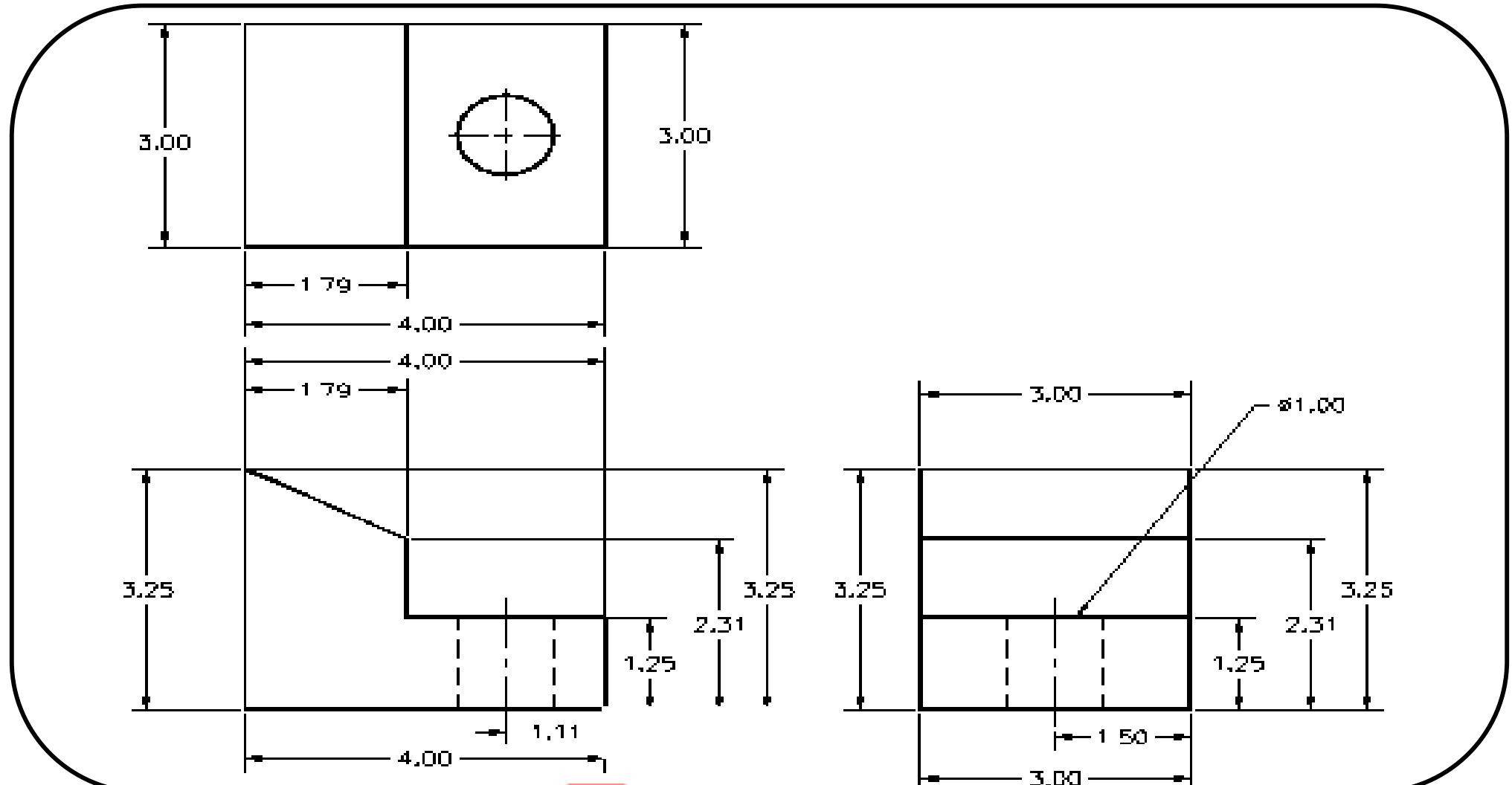
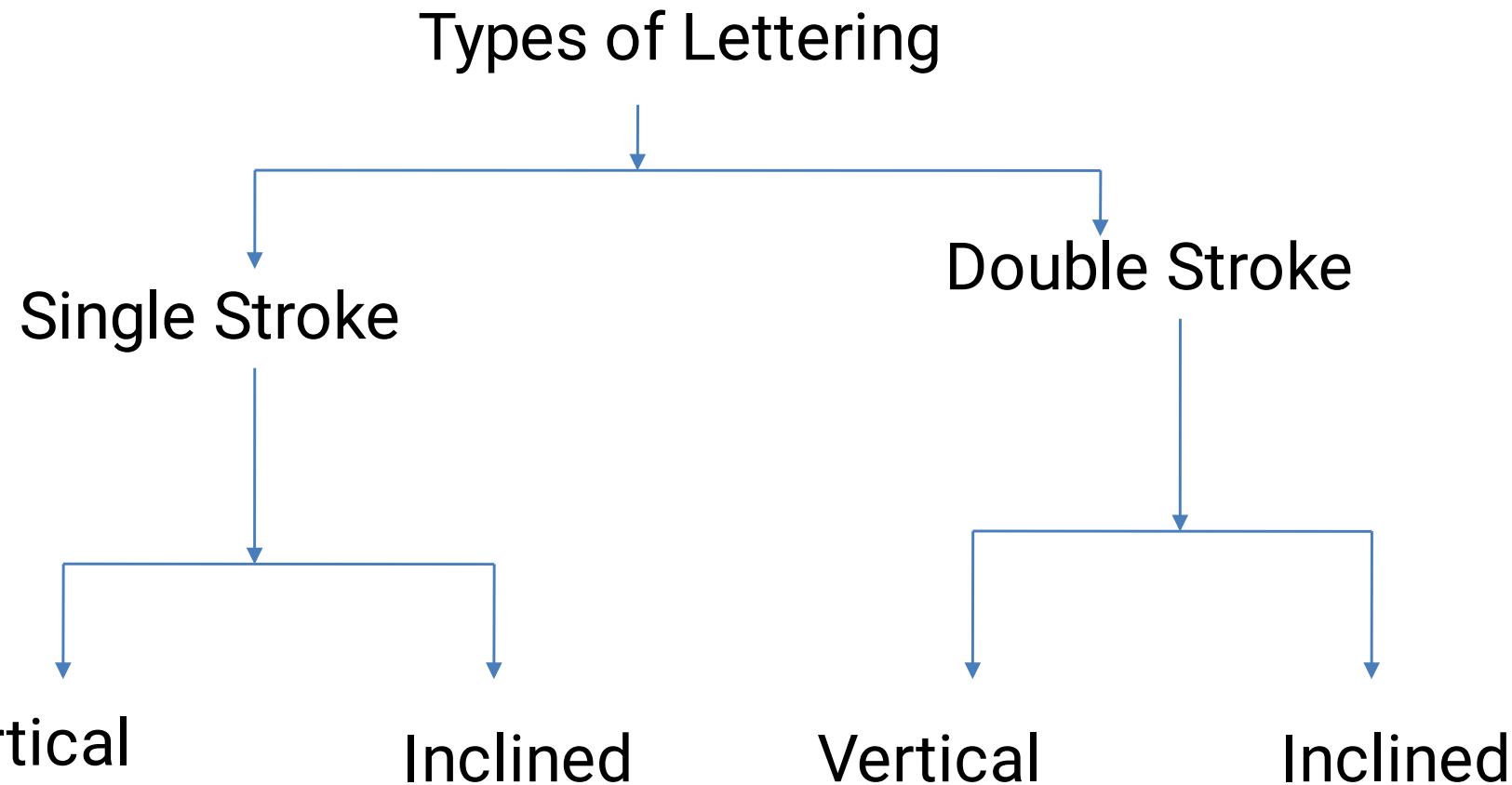


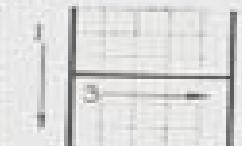
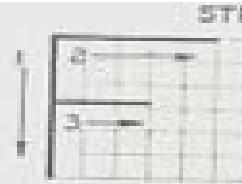
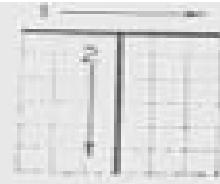
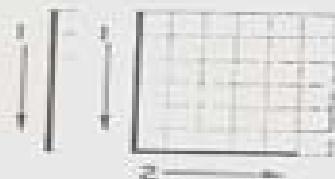
Figure 5A  
with WPS Office

# Engineering Lettering



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# Vertical Lettering

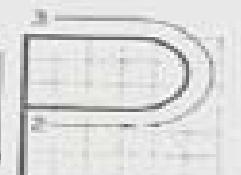


L, W is only letter over 6 units wide. Letters in "TOM Q. WAXY" are 6 units wide—all others are 5, except T and W.



CURVED-LINE LETTERS:

The letters Q, Q, C, G, and D are based on a true circle. The lower portion of the J and U is elliptical.



CURVED-LINE LETTERS AND NUMERALS

The Q is composed of two ellipses. The J, S, and 2 are based on the E.



The O, 6, and 9 are elliptical.



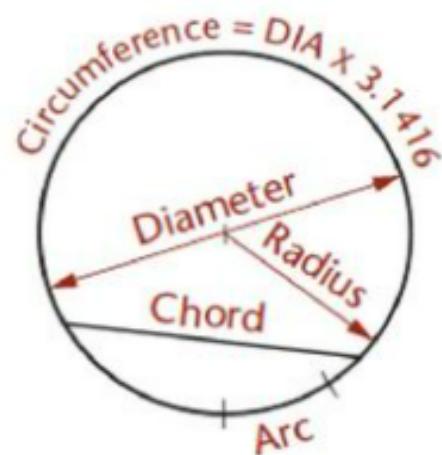
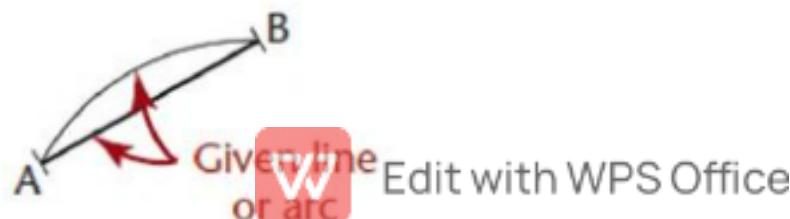
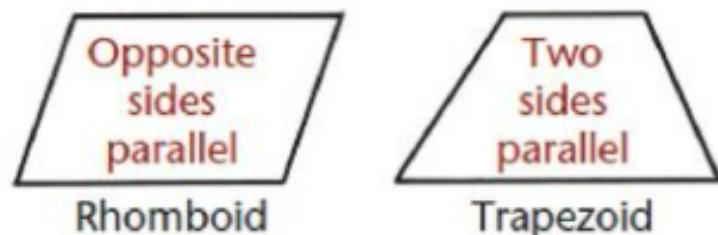
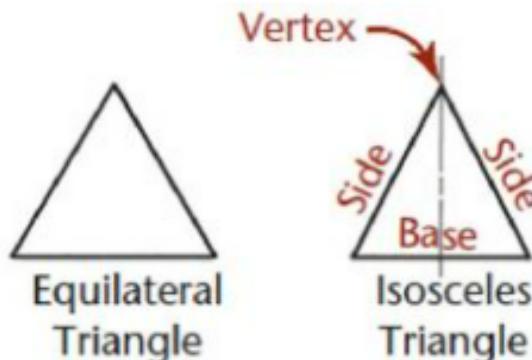
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# Inclined Lettering



# Geometry Review

- Triangles
- Quadrilaterals
- Polygons
- Circles
- Arcs



# Simple Geometrical Constructions

- To Bisect a line
- To Bisect an arc
- To Bisect an angle
- To divide a line in equal number of parts
- To draw triangles
- To draw square
- To Draw Pentagon
- To Draw Hexagon



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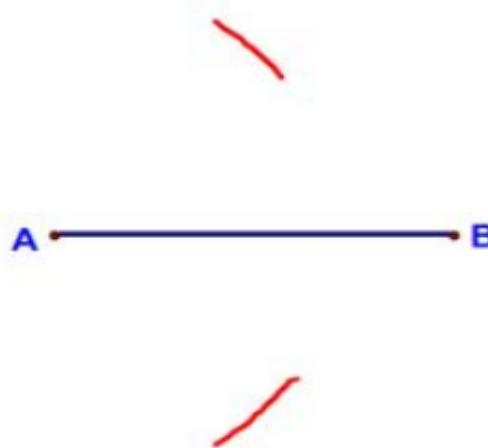
# Simple Geometrical Constructions

- To Bisect a line

Objective: Bisect  $\overline{AB}$

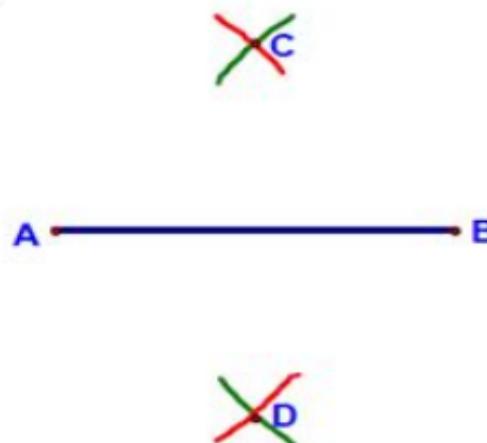


1.

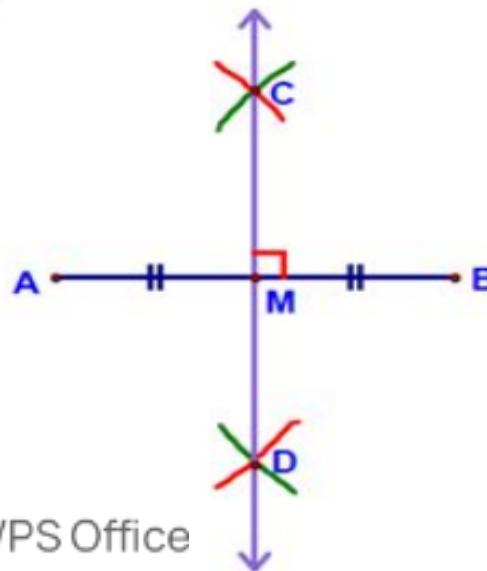


Center your compass at  $A$  and pick a hole that is more than half way to  $B$ . Now draw arcs above and below  $\overline{AB}$ .

2.



3.



Using the same hole as for Step 1, center your compass at  $B$  and draw arcs which intercept the first two arcs, creating points  $C$  and  $D$ .

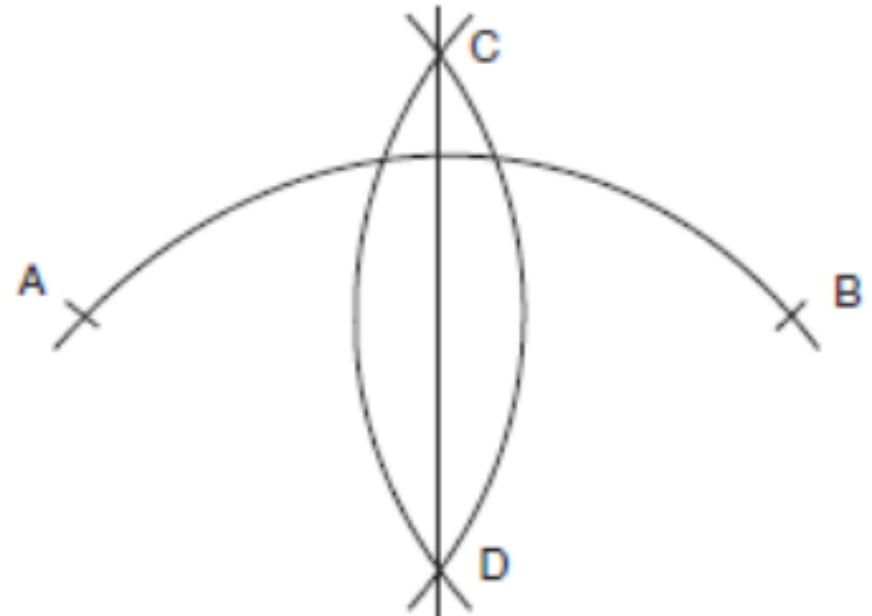
Draw  $\overline{CD}$ .  
 $\overline{AM} \cong \overline{MB}$  and  
 $\overline{CD} \perp \overline{AB}$ .  $M$  is the midpoint of  $\overline{AB}$ .



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# Simple Geometrical Constructions

- To Bisect an arc
  - With center A and radius greater than half AB, describe an arc.
  - Repeat with the same radius from B, the arcs intersecting at C and D.
  - Join C to D to bisect the arc AB.

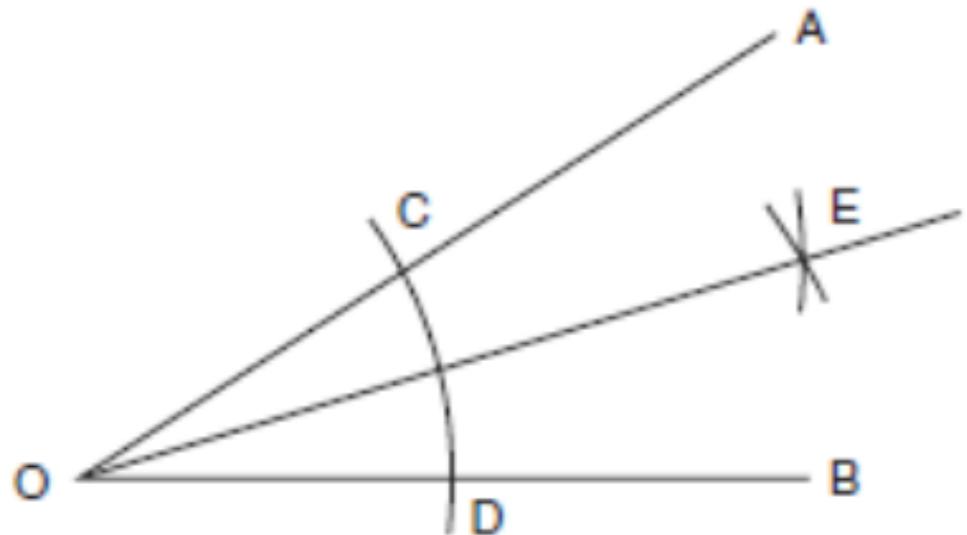


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# Simple Geometrical Constructions

- To Bisect an angle (AOB)

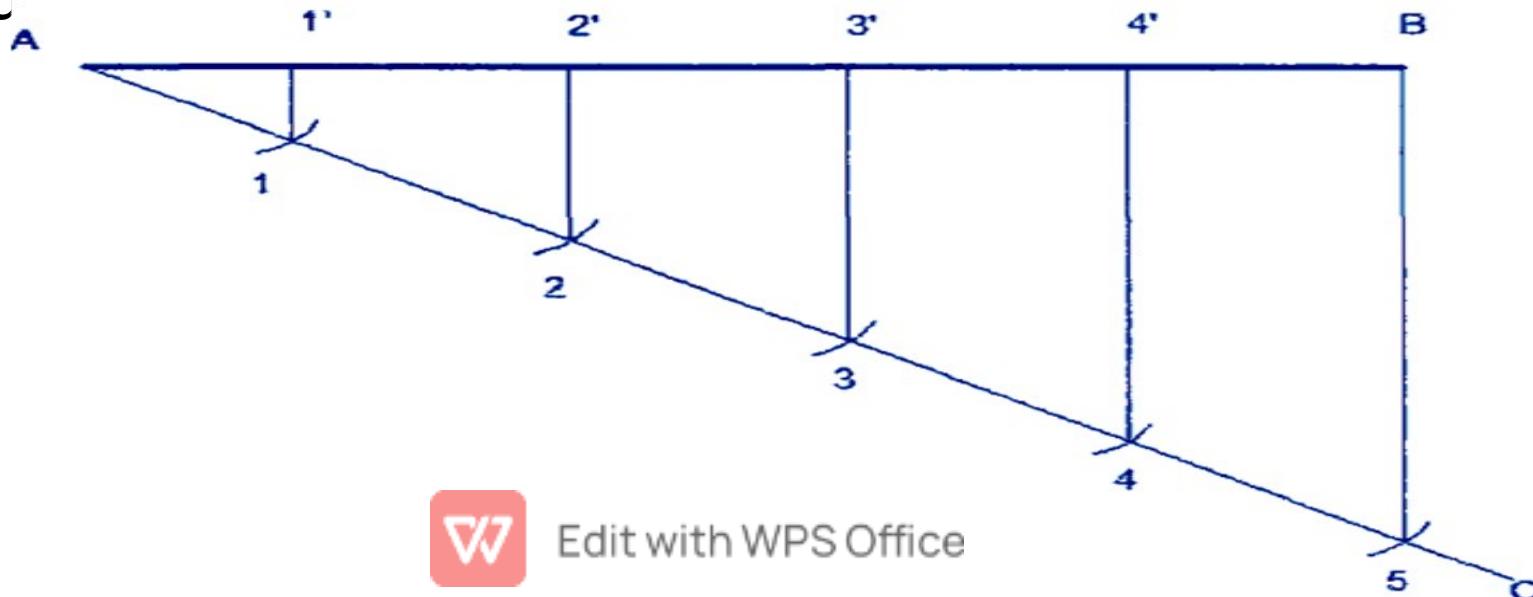
- With center O, draw an arc to cut OA at C and OB at D.
- With centers C and D, draw equal radii to intersect at E.
- Line OE bisects angle AOB.



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# Simple Geometrical Constructions

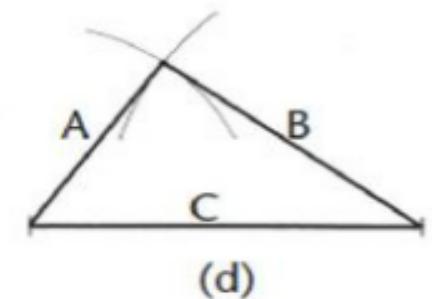
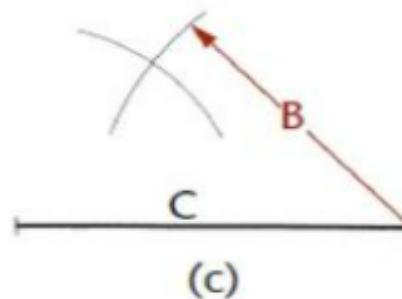
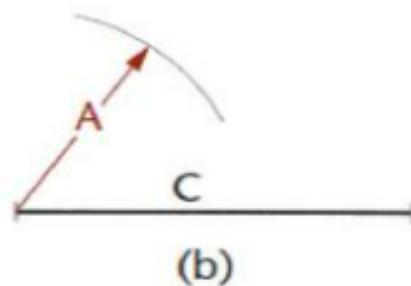
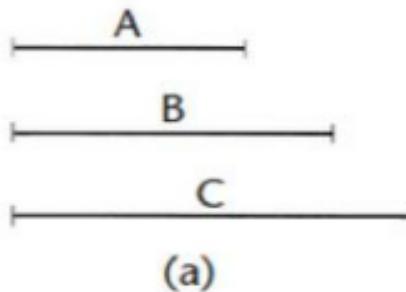
- To divide a straight line into a given number of equal parts (say 5)
  - Draw AC at any angle  $\theta$  to AB.
  - Construct the required number of equal parts of convenient length on AC like 1, 2, 3.
  - Join the last point 5 to B.
  - Through 4, 3, 2, 1 draw lines parallel to 5B to intersect AB at 4', 3', 2' and 1'



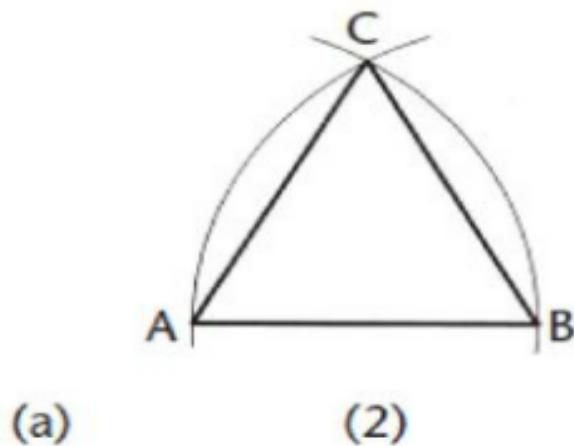
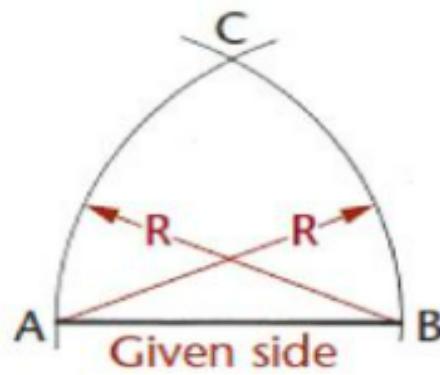
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# Simple Geometrical Constructions

- To draw triangles



- To draw an equilateral triangle



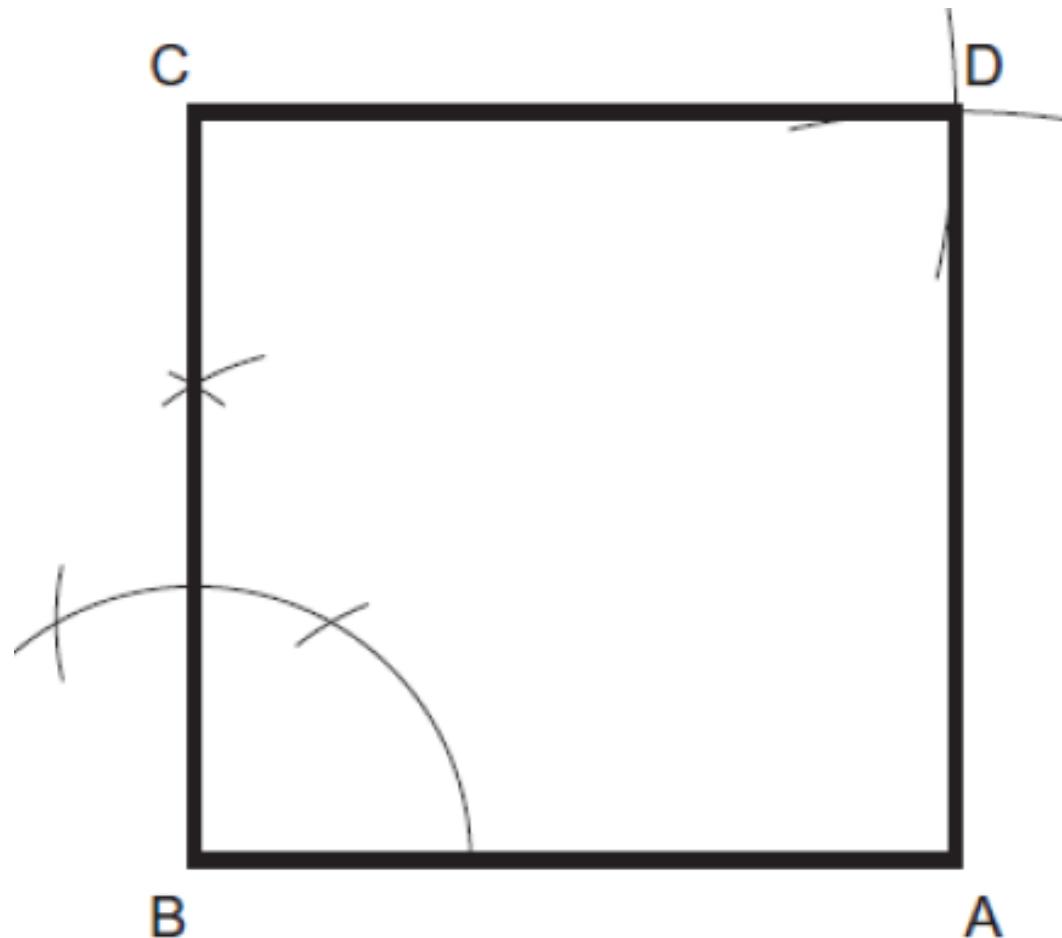
(2)



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# Simple Geometrical Constructions

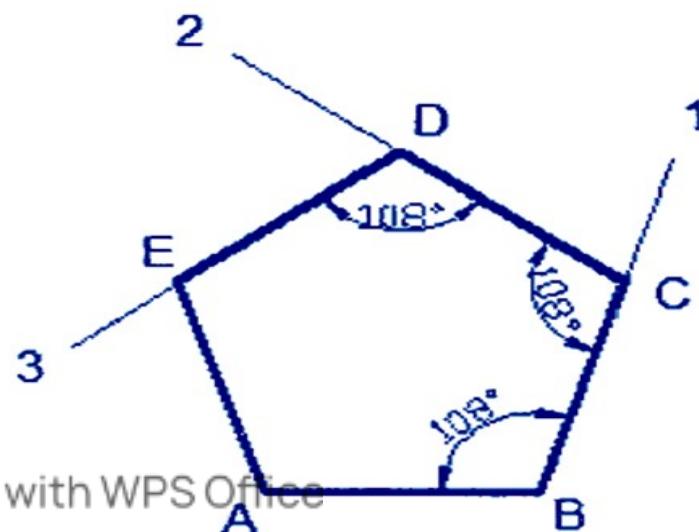
- To construct a Square given the length of the side



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# Simple Geometrical Constructions

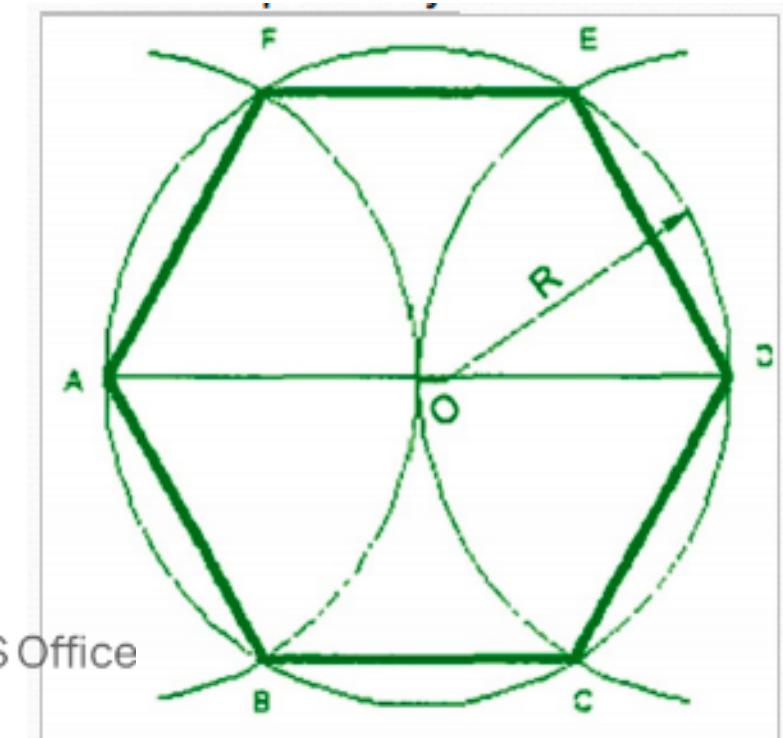
- To construct a Pentagon, given the length of side.
  - Draw a line AB equal to the length of the given side.
  - Draw a line B 1 such that  $\angle A B 1 = 108^\circ$  (included angle)
  - Mark C on B1 such that BC = AB
  - Repeat steps 2 and 3 and complete the pentagon ABCDE



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# Simple Geometrical Constructions

- To inscribe a Hexagon in a given circle.
- By using compass
  - With center O and radius R draw the given circle.
  - Draw any diameter AD to the circle.
  - With centers A and D and radius equal to the radius of the circle draw arcs intersecting the circles at B, F, C and E respectively.
  - ABC D E F is the required hexagon.



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# Simple Geometrical Constructions

- To construct a Hexagon, given the length of the side
  - By using compass
1. Draw a line AB equal to the of side of the hexagon.
  2. with centers A and B and radius AB, draw arcs intersecting at O, the center of the hexagon.
  3. With centers O and B and radius OB ( $=AB$ ) draw arcs intersecting at C.
  4. Obtain points D, E and F in a similar manner

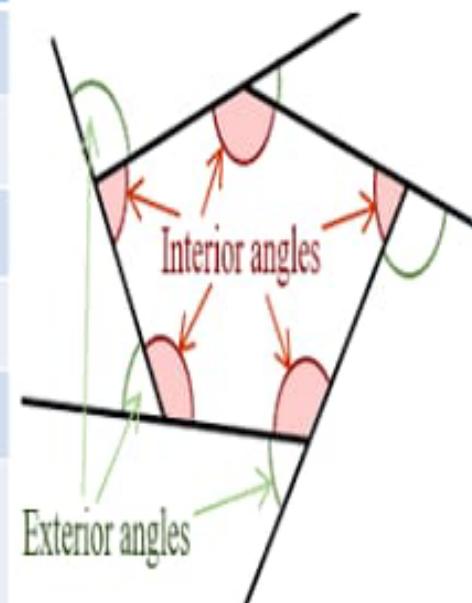


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# How to calculate Interior Angle of regular Polygon

## Interior and Exterior Angles of Polygons

Polygon	Sides	Sum of Interior Angles	Each interior angle of regular polygon	Sum of Exterior Angles
Triangle	3	180°	60°	360°
Quadrilateral	4	360°	90°	360°
Pentagon	5	540°	108°	360°
Hexagon	6	720°	120°	360°
...				
Any Polygon	$n$	$(n-2) \times 180^\circ$	$\frac{(n-2) \times 180^\circ}{n}$	360°



*Thank You...*



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