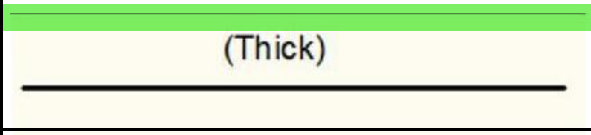
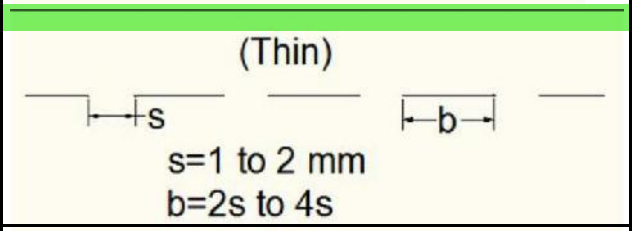
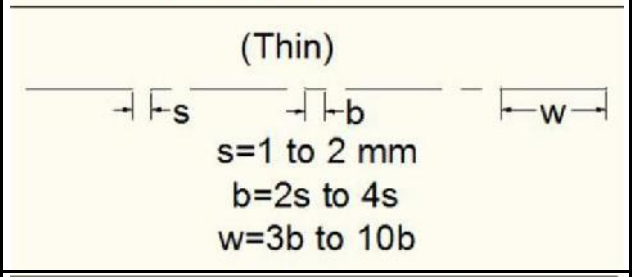
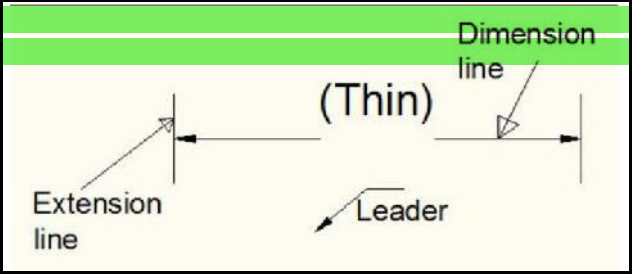
Lines and Symbols

Conventional Lines

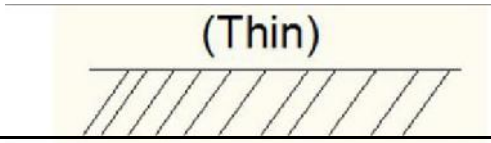
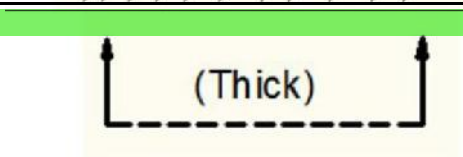
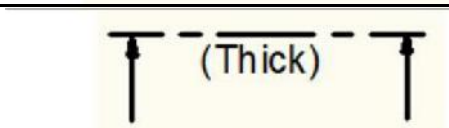
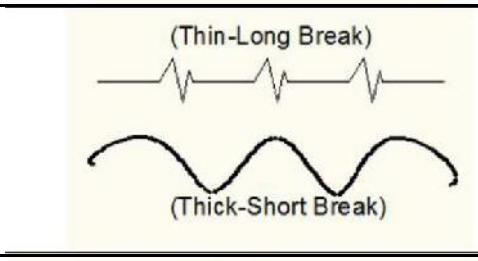
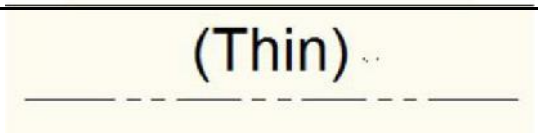
Each line on a technical drawing has a definite meaning and is drawn in certain ways. There are certain conventional lines recommended by drawing codes. Usually two types of widths are used for the lines; they are thick and thin. Thick lines are in between 0.5 mm to 0.8 mm wide while the thin lines are between 0.3 mm to 0.5 wide. However, the exact thickness may vary according to the size and type of drawing. If the size of drawing is larger, the width of the line becomes higher. There should also be a distinct contrast in the thickness of different kinds of lines, particularly between the thick lines and thin lines. Visible, cutting plane and short break lines are thick lines, on the other hand hidden, center, extension, dimension, leader, section, phantom and long break lines are thin.

Table. Conventional Lines and Their Usage

SL No.	Name of line type	Line appearance	Usage
01	Visible line/ Object line		To indicate all visible outlines/boundary of an object. It shows the shape of an object
02	Hidden line/ Dashed line		To represent hidden edge of an object. They should end on both sides by touching the visible lines and should touch themselves at intersection (if any).
03	Center line		To show a line passing through center of hole, pitch line etc.
04	Extension line, Dimension line and leaders		To show dimension of an object

Cont.

Table. Conventional Lines and Their Usage (Contd.)

SL No.	Name of line type	Line appearance	Usage
05	Section line		To indicate cut portion of an object
06	Cutting plane line		To show imaginary cutting of an object.
07	ISO cutting planeline		
08	Break lines		To show break of an object in order to shorten the view of a long part.
09	Phantom line/ Repeat line		To show alternate position of an object or the position of an adjacent part.

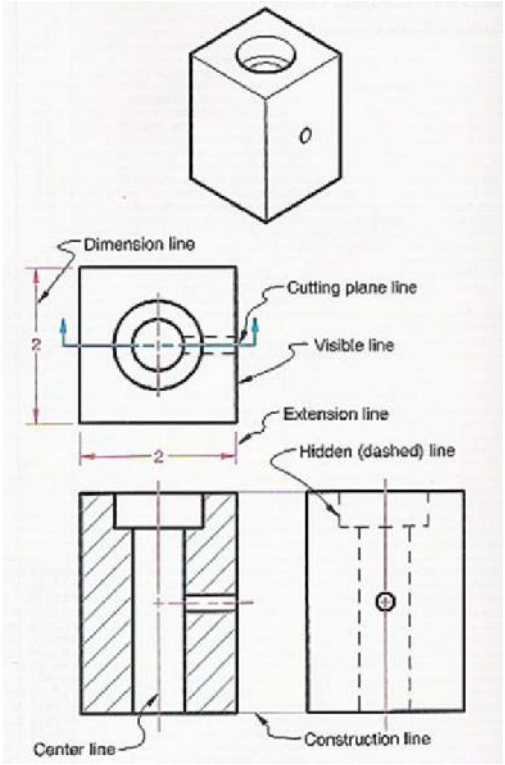


Fig. Use of Different Types of Lines

Dimensioning

Purpose of Dimensioning

The purpose of dimensioning is to provide a clear and complete description of an object. A complete set of dimensions will permit only one interpretation needed to construct the part. In some cases, engineering drawing becomes meaningless without dimensioning. Maintaining scale only does not make a drawing sufficient for manufacturer. By direct measurement from drawing according to the scale is very laborious, time-consuming and such a part cannot be manufactured accurately. In general dimensioning system provides following information-

- Sizes and locations of features
- Material's type
- Number required
- Kind of surface finish
- Manufacturing process
- Size and geometric tolerance

General Conditions for Dimensioning

- **Accuracy:** correct values must be given.
- **Clearness:** dimensions must be placed in appropriate positions.
- **Completeness**: nothing must be left out, and nothing duplicated.
- **Readability**: the appropriate line quality must be used for legibility.

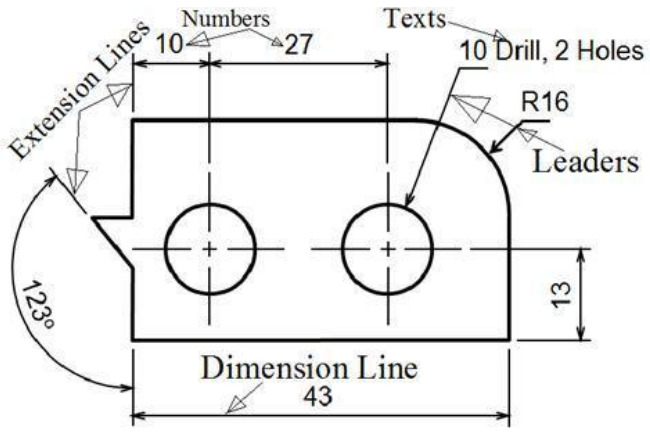


Fig. Dimensioning Elements

Elements of Dimension System

- Extension lines
- Dimension lines
- Arrowheads
- Leaders
- Texts, numbers and symbols.

Rules for Dimensioning

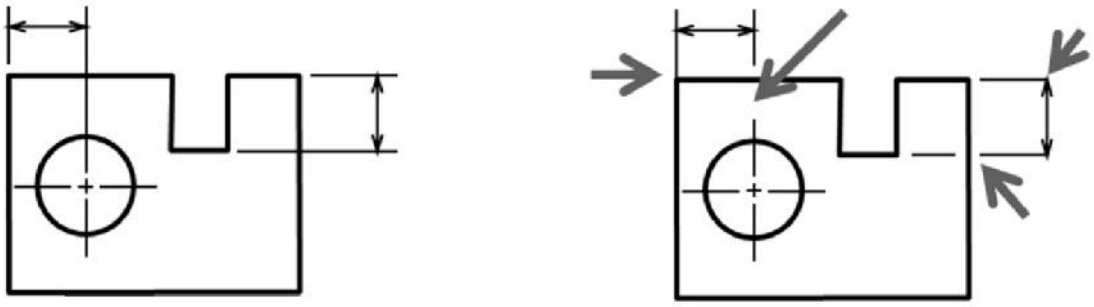
General Rules for Dimensioning

- Dimensioning should be given within the extent of the view in general.
- Dimensioning should not be duplicated in other view.
- No subtraction or addition should be required to define or locate a feature.
- Dimensioning should be inserted on relatively larger available view to make it clear.
- One system of dimensions either unidirectional or aligned has to be used throughout the drawing.
- Dimensioning to the hidden lines should be avoided, in general.
- Dimensioning should be made on the view, which represents the shape of the part best.
- A zero must be placed before decimal point.

Rules of Extension Lines

Extension lines are the lines that indicate the point or line or space on the drawing to which dimension is being applied. Following conditions should be maintained while inserting an extension line:

- A gap of 1mm has to be kept between extension line and visible line.
- An extension line should be extended about 3mm from the outmost dimension line.
- Extension lines may cross each other without break.
- Center lines can be used as extension lines.
- Extension lines are drawn usually perpendicular to dimension lines. But for overcrowded drawing they can be drawn at an oblique angle as well.



Correct **Wrong**

Fig. Extension Lines in Proper Way

Rules of Dimension Lines

Dimension lines are the lines that show the dimensions of a specific portion indicated by extension lines. Following conditions should be maintained while inserting a dimension line:

- Dimension line should be approximately 10mm away from visible line.
- Spacing between consecutive parallel dimension lines may also be kept as 10mm.
- Dimension lines are broken near the middle to allow space for dimensions.
- As far as possible dimension lines should be placed outside the view.
- Dimension lines should not cross each other.
- Center lines should never be used as dimension lines.
- If space between extension lines is very short for inserting arrows, the arrows may be provided outside the extension lines.

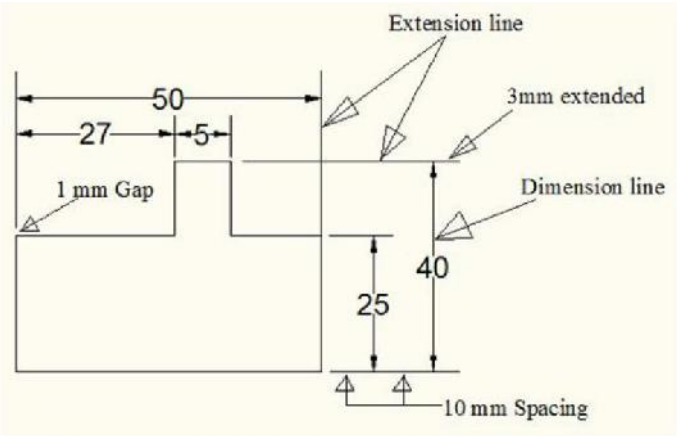


Fig. Dimension and Extension lines

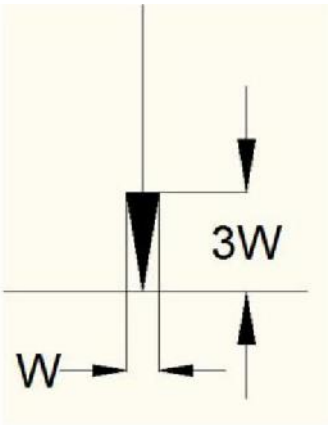


Fig. Arrowhead

Rules of Arrowhead

Arrowheads are used at both ends of dimension lines and at the ends of leaders. They are usually drawn freehand. Following conditions should be maintained while inserting an arrowhead:

- As far as possible all arrowheads should be identical in shape and size throughout the drawing.
- An approximate ratio of the length to width of arrowhead as 3:1 should be maintained.
- Arrowheads must touch the line. It must not be either away from the line or cross the line.

Rules of Leaders

Leaders are used in engineering drawing for dimensioning of arcs, circles etc. They are also used to present note, symbols, item number or part number etc. Following conditions should be maintained while inserting a leader:

- A leader should always be inclined at an angle of 60^0 preferably and 45^0 occasionally.
- The length of horizontal bar should be 3mm.
- A leader should be terminated by either an arrowhead or a small dot of about 1.5mm diameter.
- Leaders should not be drawn bent unless necessary.
- Leaders should not cross each other, however, they may be drawn parallel to each other with a common horizontal bar.
- To direct a circle or an arc the leader should be so drawn, if it is imagined to extend it must pass through the center of the circle or the arc.
- All notes, symbols and dimensions in a leader need to be provided in horizontal direction.

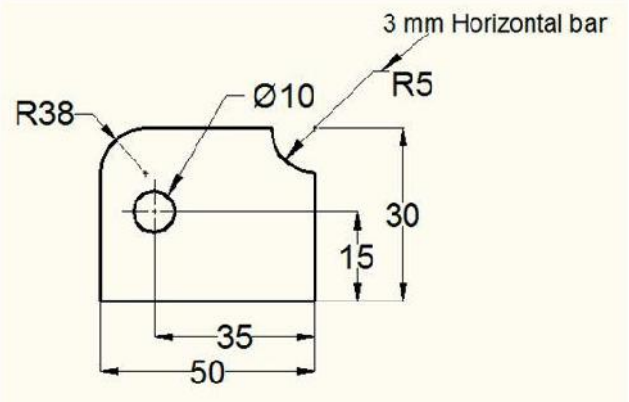


Fig. Leaders

Direction of Dimensions

Direction of dimensions is chosen in either of the two systems:

A. **Unidirectional system:** All the dimensions are oriented to be read from the bottom of drawing. It is also known as horizontal system. This system is preferred to aligned system.
B. **Aligned system:** All the dimensions are oriented to be read from the bottom or right side of the drawing.

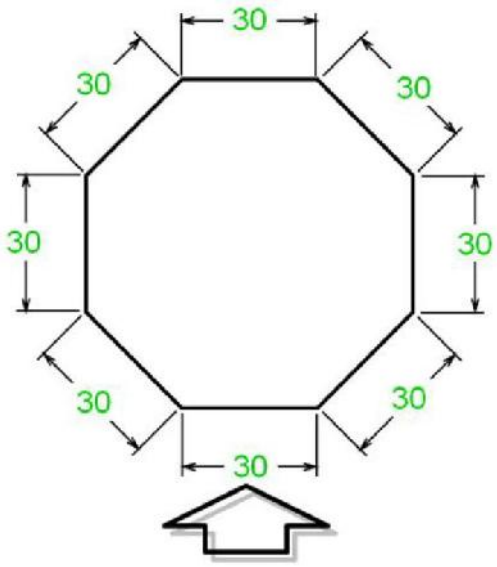


Fig. Unidirectional System

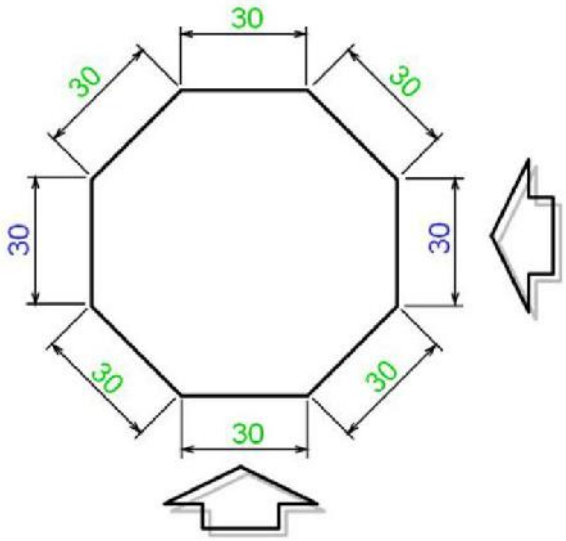


Fig. Aligned System

Technique of Dimensioning

There are two basic steps in dimensioning objects, regardless of the type of object.

- **Step 1**: Apply the size dimensions. These are dimensions which indicate the overall size of the object and the various features which make up the object.
- **Step 2:** Apply the locational dimensions. Locational dimensions are dimensions which locate various features of an object from some specified datum or surface. Figure 9-29 gives examples of size and location dimensions**.**

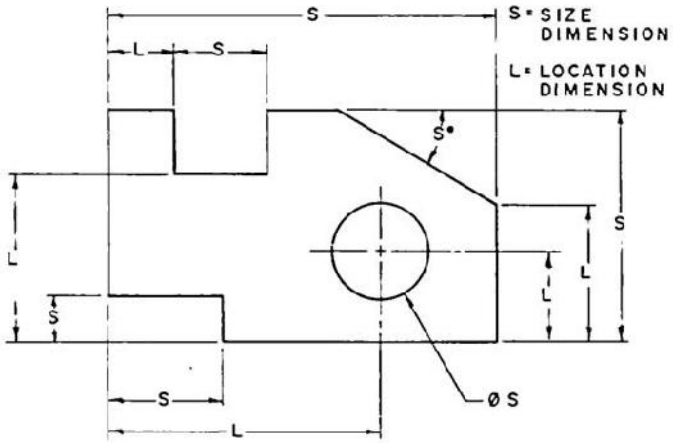


Fig. Size and Location Dimension

Dimensioning in Limited Space

If space between the extension lines is too small to insert the dimension digits, they may be provided al left or right side of extension lines. Sometimes the space may be even too small to insert arrows, in such case dimensions as well as arrows can be provided on outside of the extension lines as shown in Fig. 5.9.

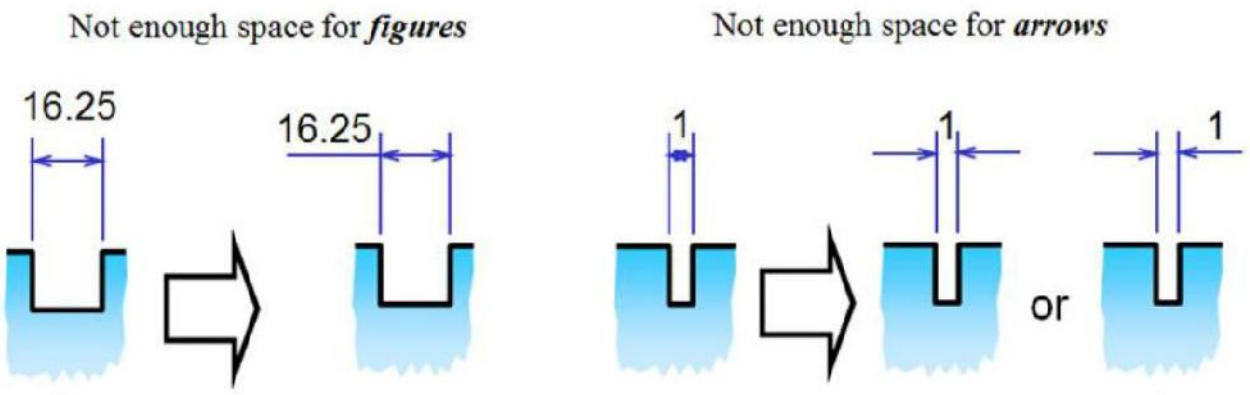
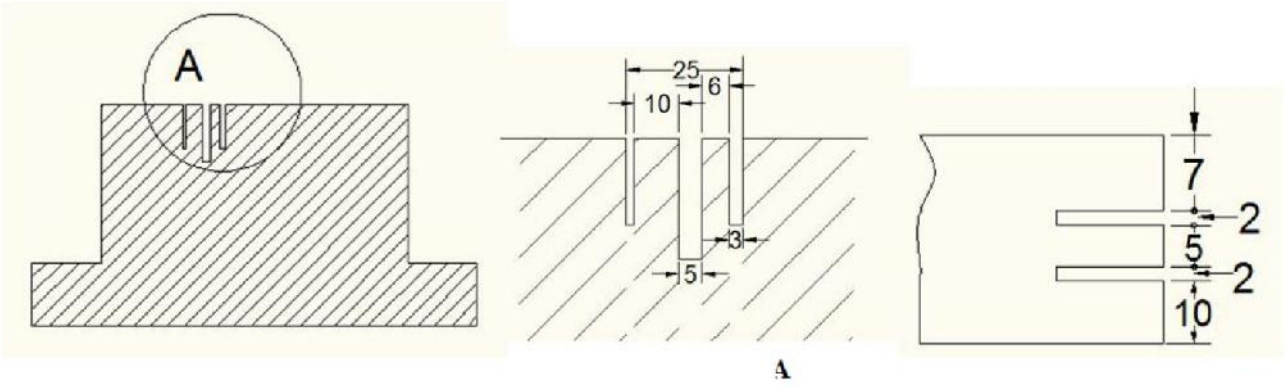


Fig. Dimensioning in Limited Space

If the space is very limited for inserting dimension lines, the portion to be dimensioned are enlarged for clear dimensioning. Sometimes smaller circular dots are used in place of arrowhead for space limitation. Figure below shows such example.



Portion to be enlarged **Enlarged view of A** **Use of small dot**

Fig. Dimensioning in Limited Space

Dimensioning of Angles

Angles are normally written in degrees, minutes, and seconds. The symbols used to depict degrees, minutes, and seconds are also shown in this figure. Angular measurements may also be stated in decimal form. This is particularly advantageous when they must be entered into an electronic digital calculator. The key to converting angular measurements to decimal form is in knowing that each degree contains 60 minutes, and each minute contains 60 seconds.

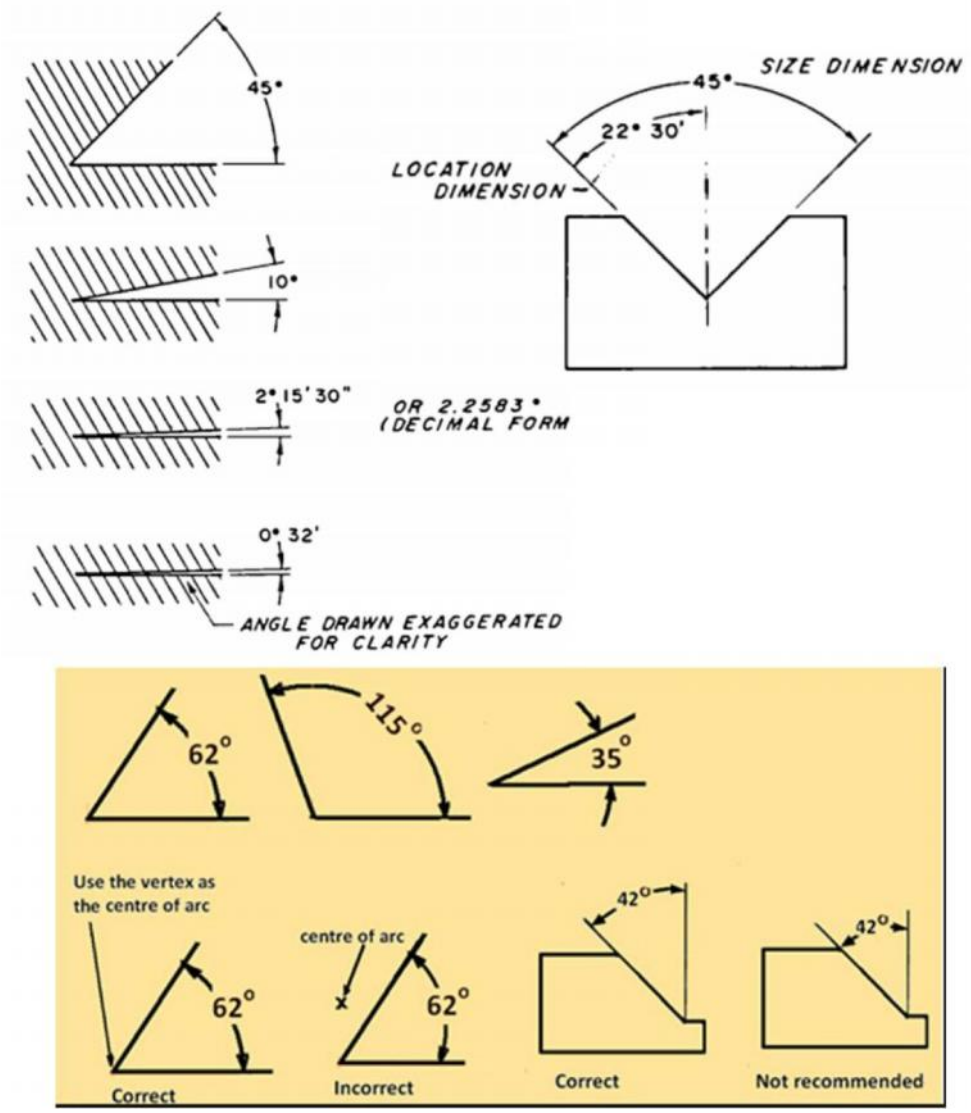


Fig. Dimensioning of Angles

Dimensioning of Arcs

The dimension figure and the arrowhead should be inside the arc, where there is sufficient space. If space is limited then leaders can be used comfortably.

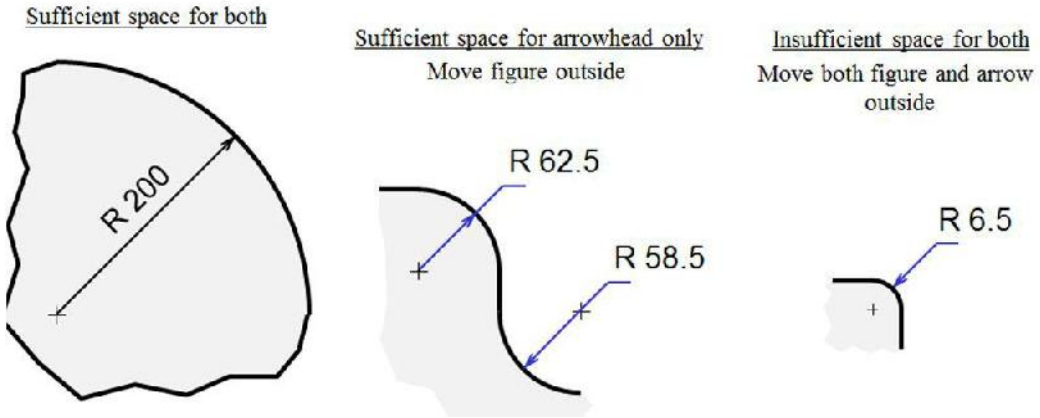


Fig. Dimensioning of Arc

Dimensioning of Chord Length, Arc Length and Angle

Chords, arcs, and angles are dimensioned in a similar manner. The difference is:

- When dimensioning a chord length, the dimension line should be perpendicular and the extension lines parallel to the chord.
- When dimensioning an arc length, the dimension line runs concurrent with the arc curve, but the extension lines are either vertical or horizontal. An arc symbol is placed above the dimension.
- When dimensioning an angle, the extension lines extend from the sides forming the angle, and the dimension line forms an arc.

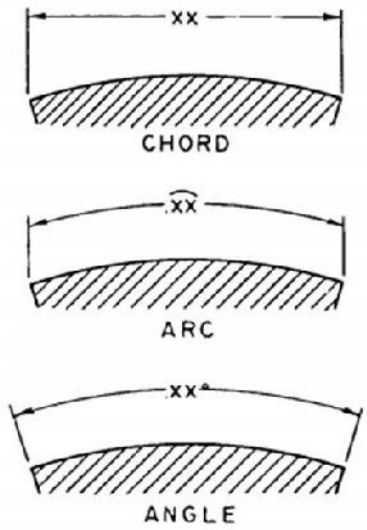


Fig. Difference among the Dimensioning Of Chord Length, Arc Length and Angle

Dimensioning of Round Holes

- Round holes are dimensioned in the view in which they appear as circles.
- Smaller holes may be dimensioned using a leader which points toward the center of the hole in which the note gives the diameter, or extension lines may be drawn from the circle with a dimension that also indicates the diameter.
- Larger circles are dimensioned with a dimension line drawn across the circle through its center at an angle with the diameter dimension shown.
- It is important when dimensioning holes to call off the diameter, not the radius.

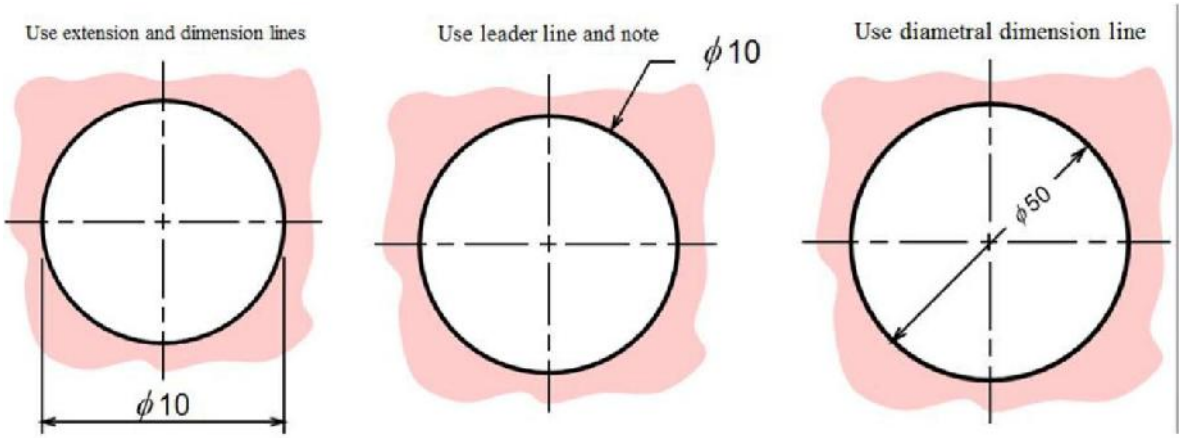


Fig. Dimensioning of Circular Holes

Dimensioning of Blind Holes

It is usual practice to use leader line and local note to specify **diameter** and **hole's depth** in the circular view.

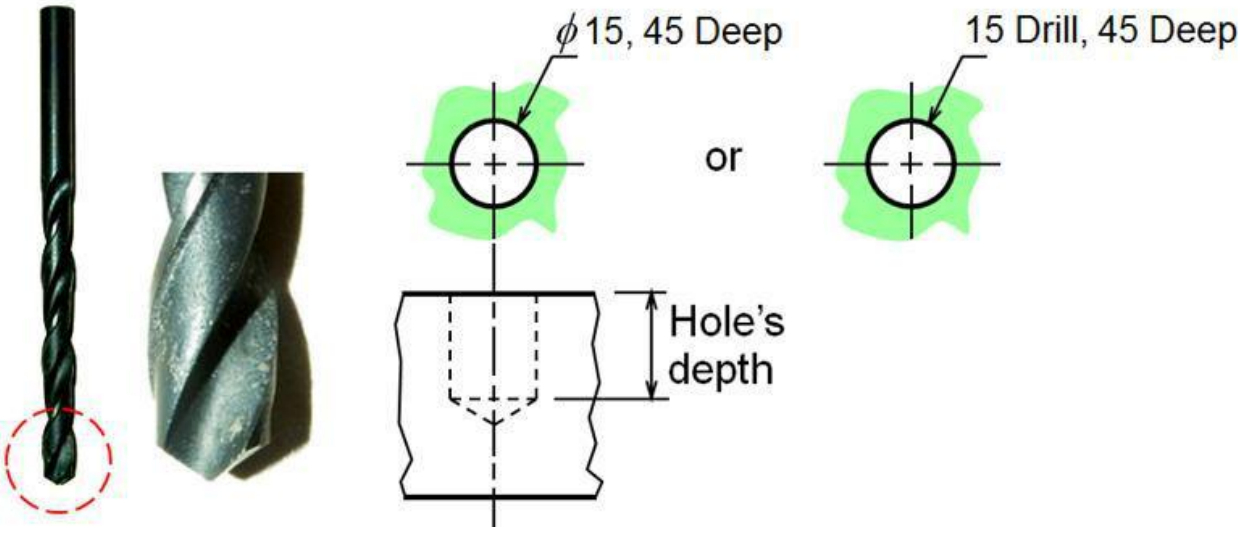


Fig. Dimensioning of Blind Holes

Dimensioning of Chamfer

It is usual practice to use leader line and note to indicate **linear distance** and **angle** of the chamfer.

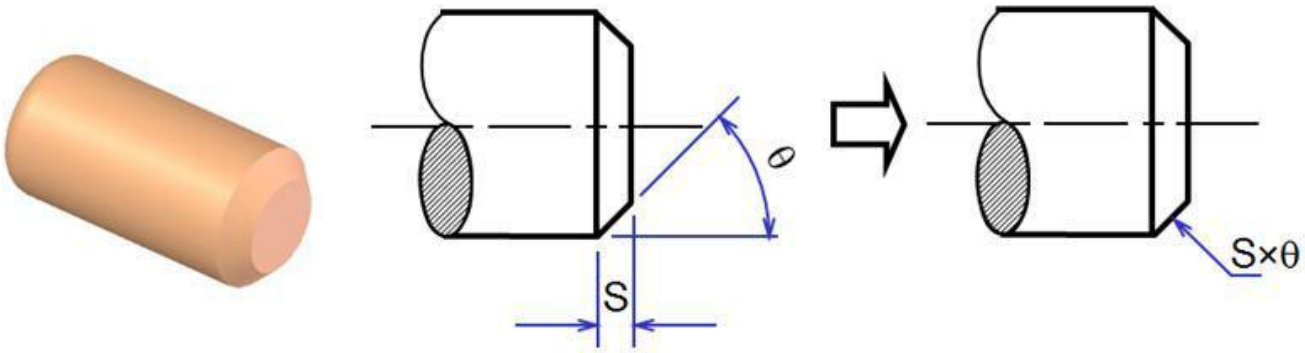
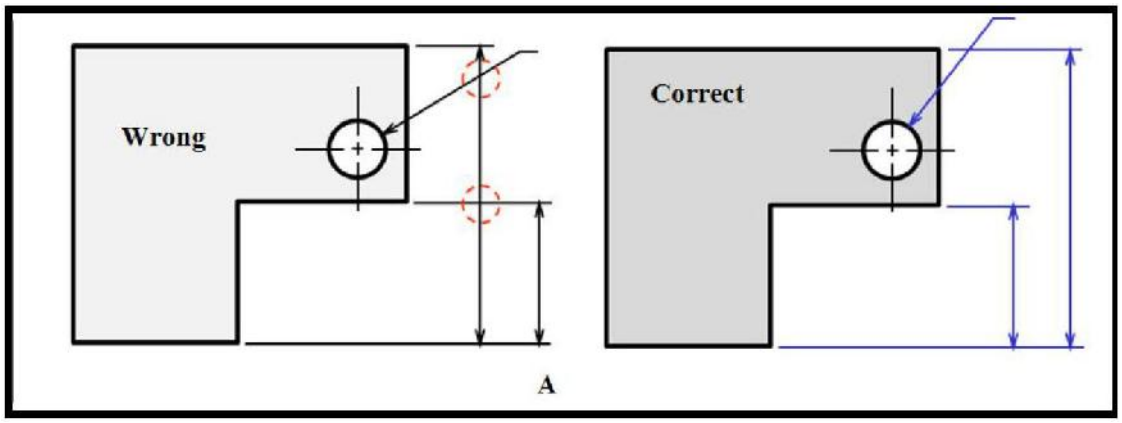
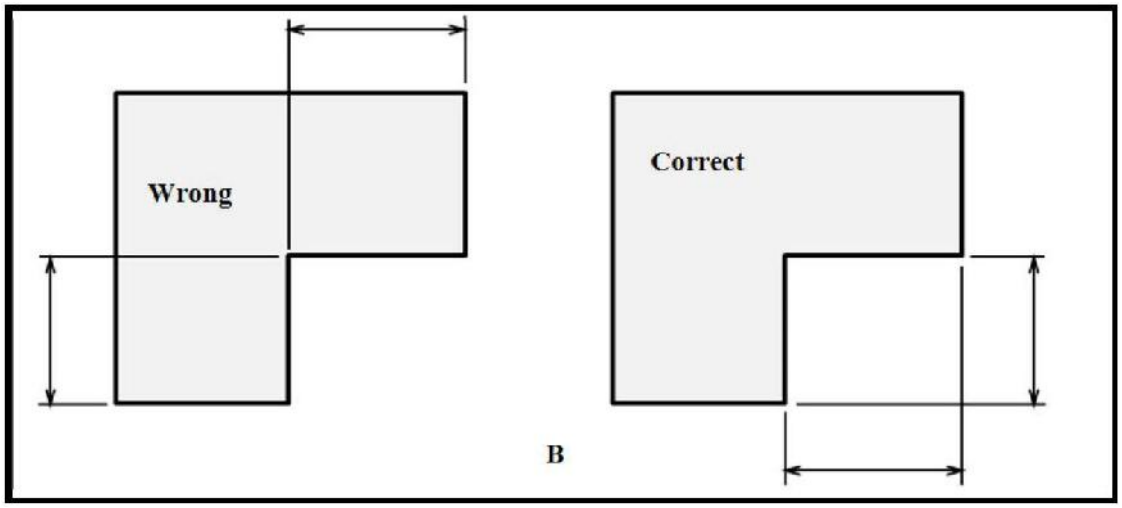
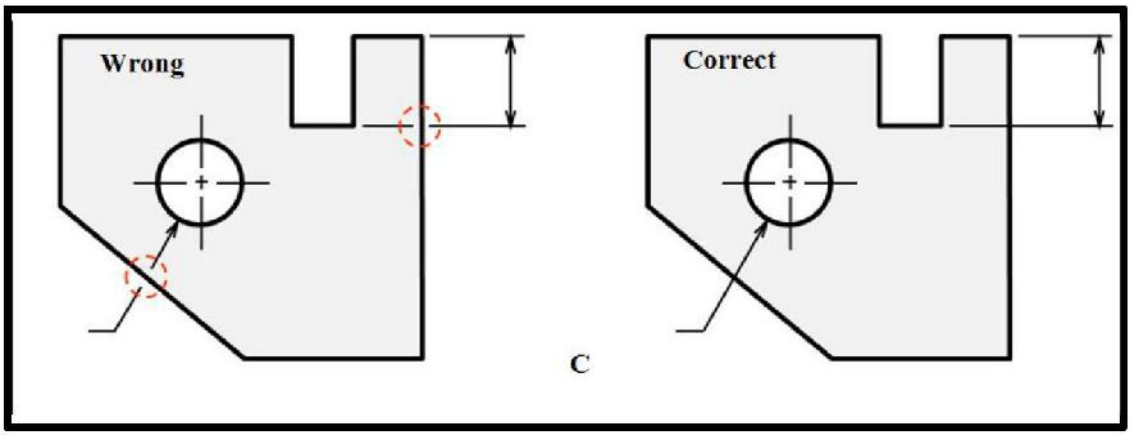


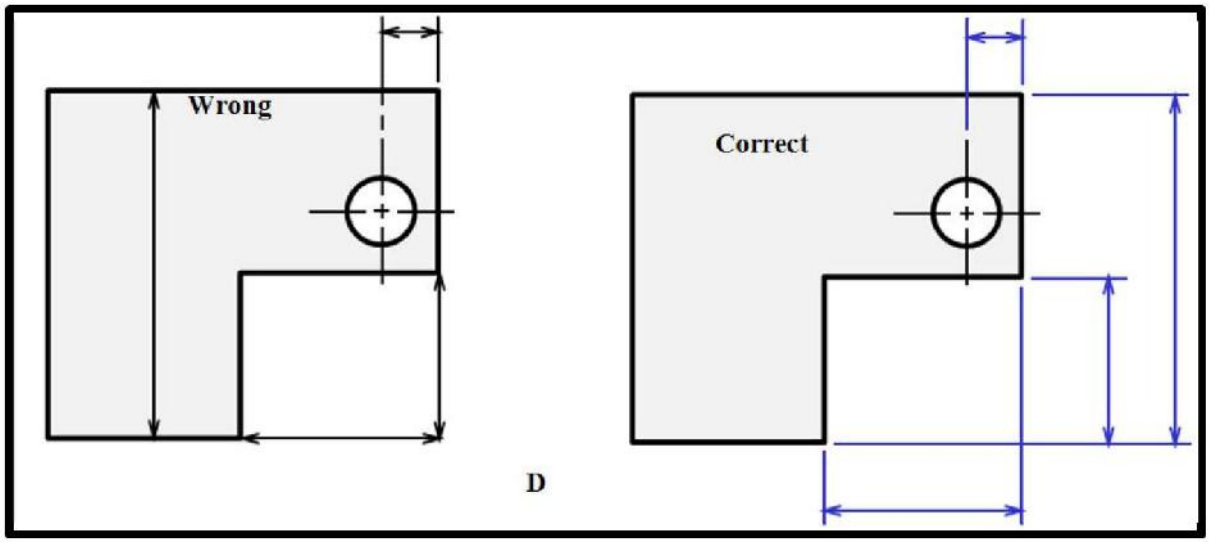
Fig. Dimensioning of a Chamfer

Common Mistakes in Dimensioning





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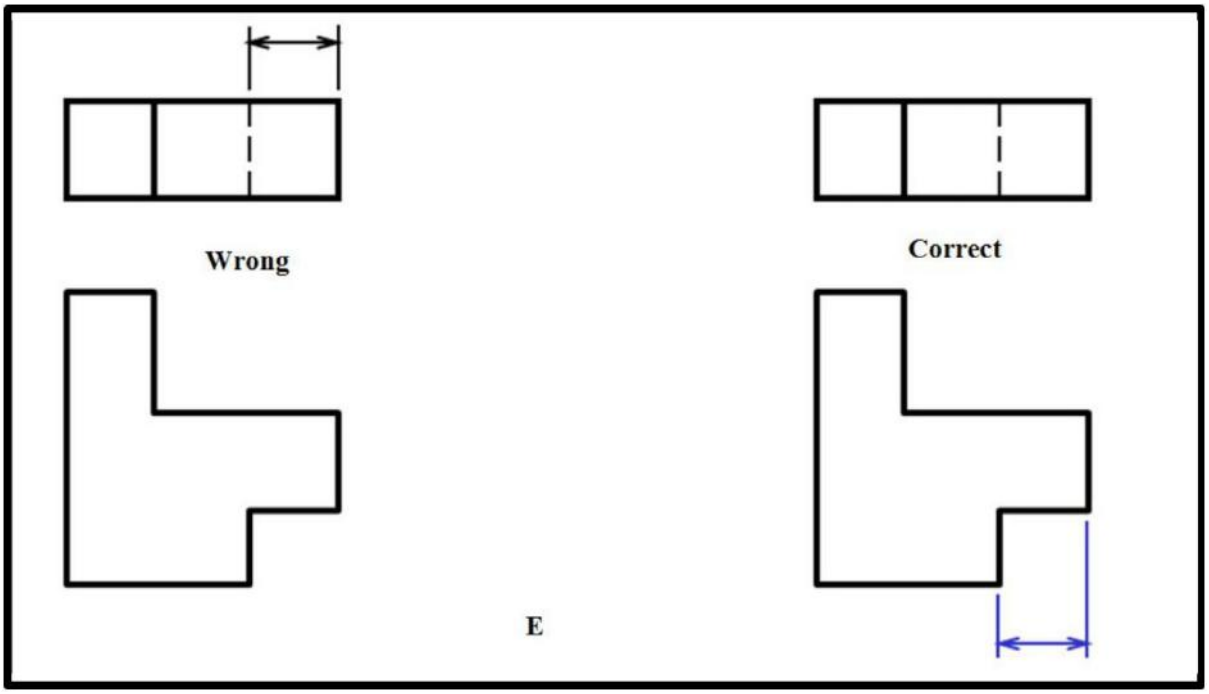
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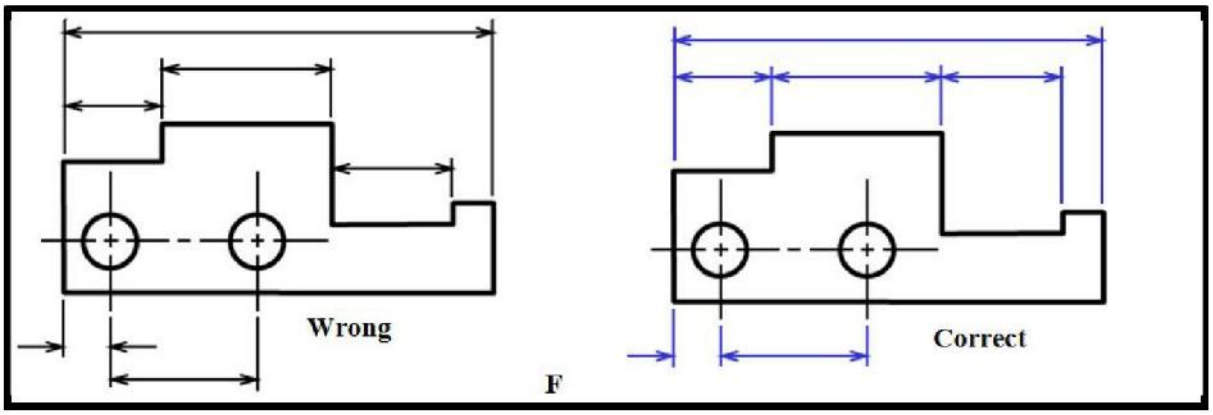
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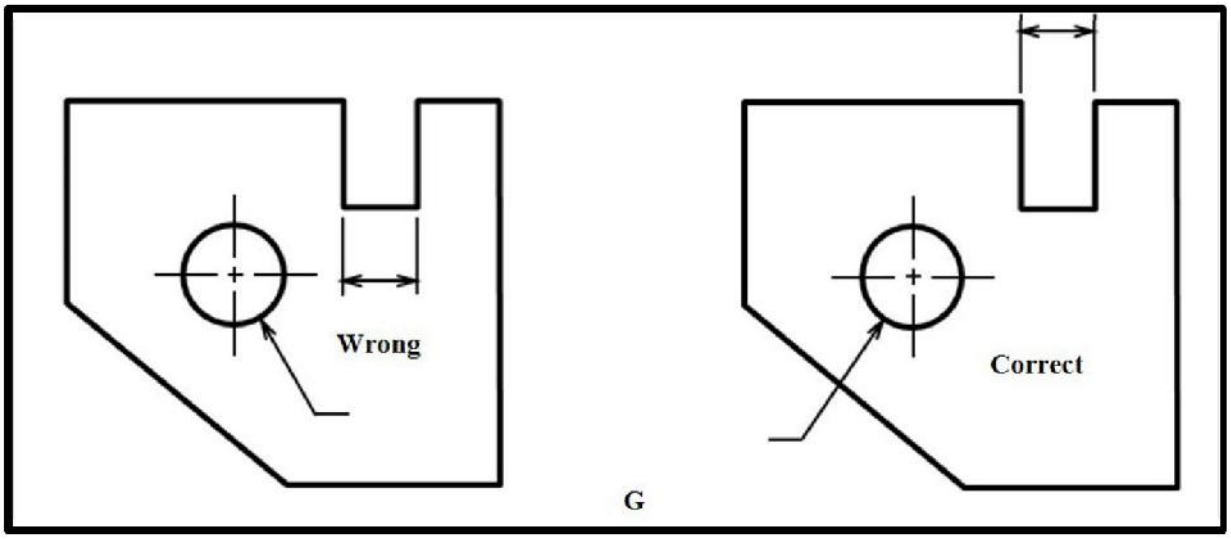
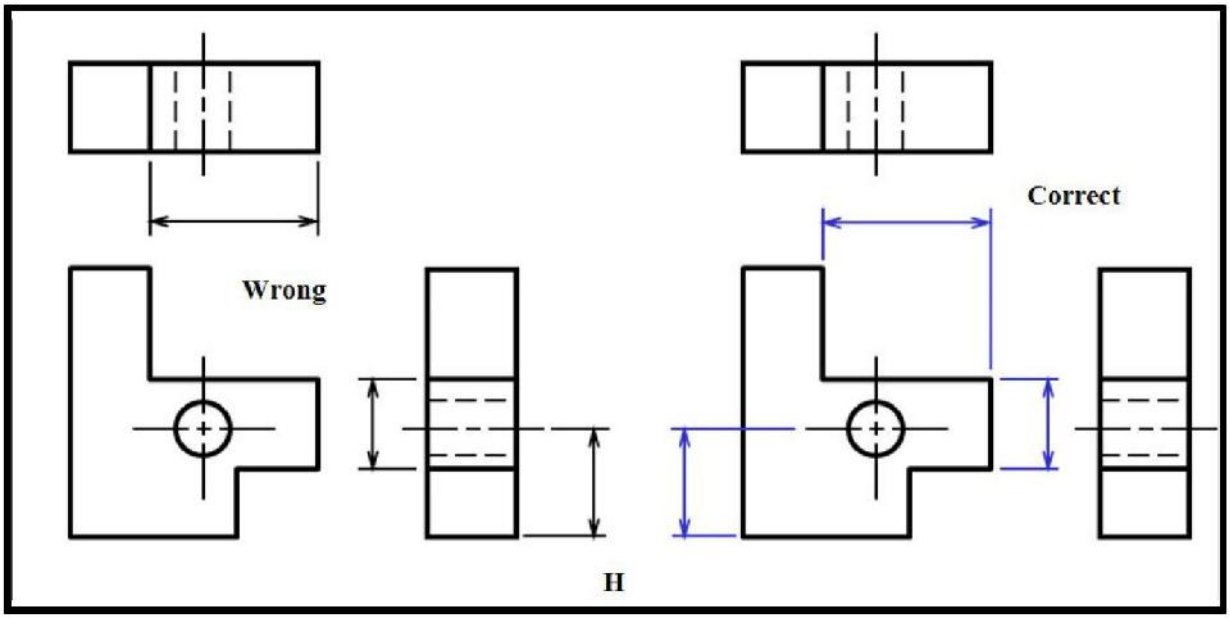




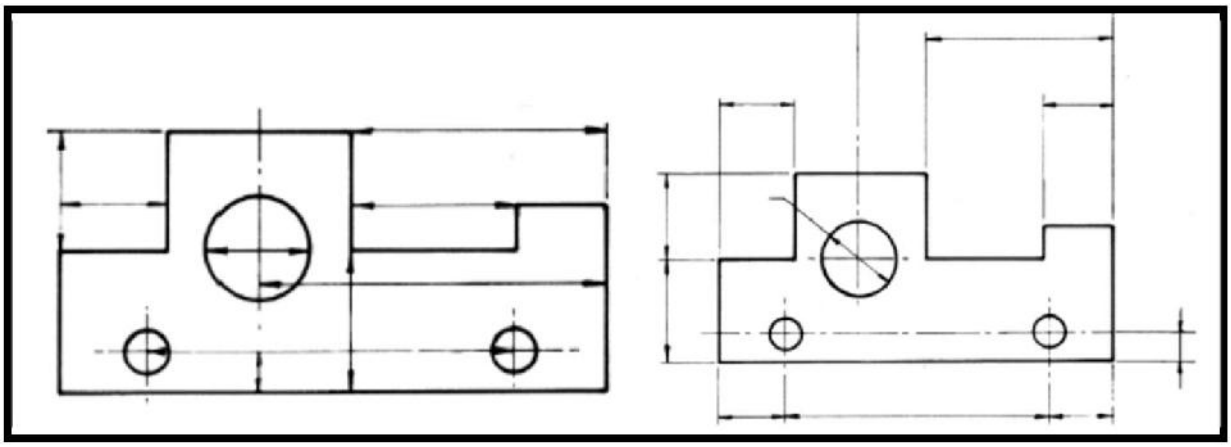
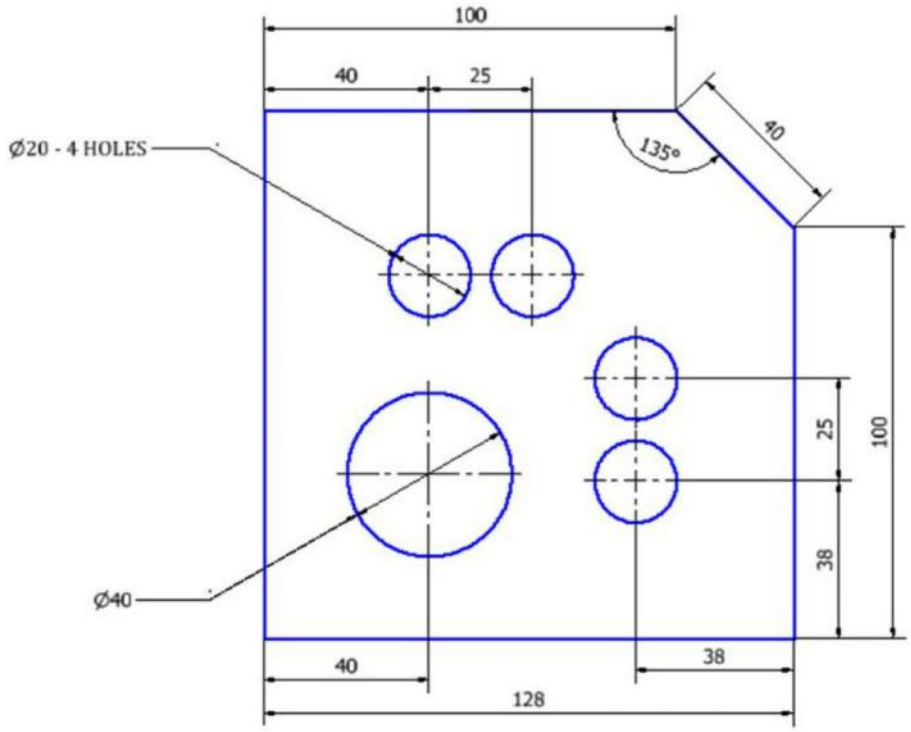
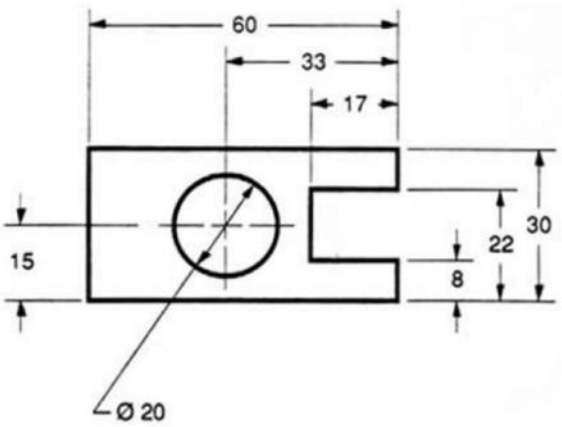
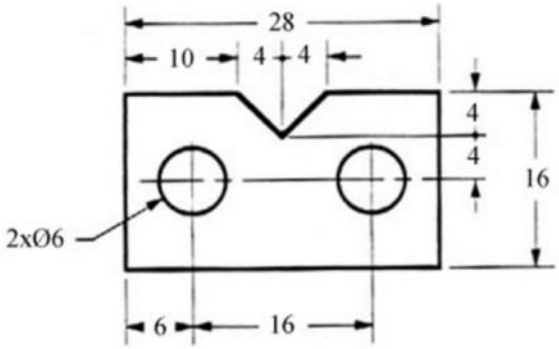


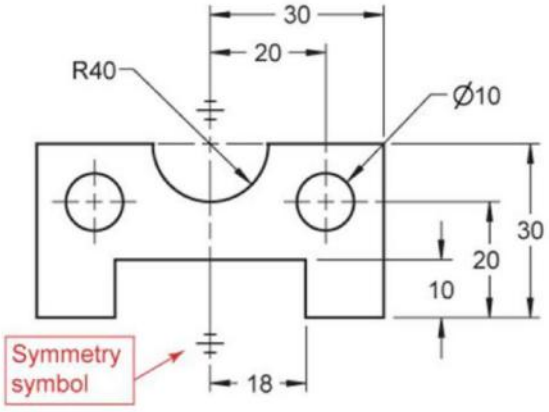
Fig. Common Mistakes in Dimensioning

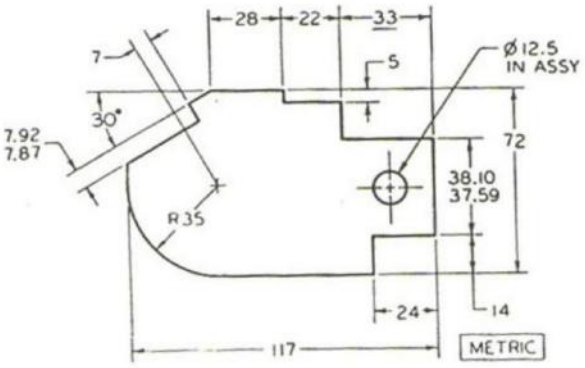
Worked-out Examples of Dimensioning

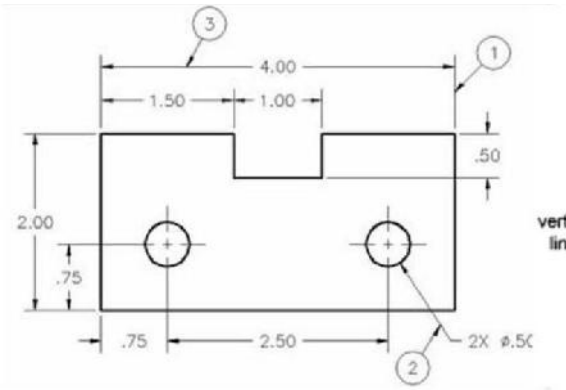








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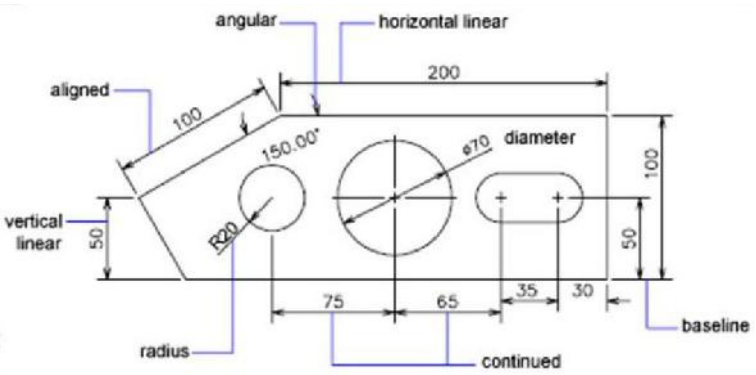
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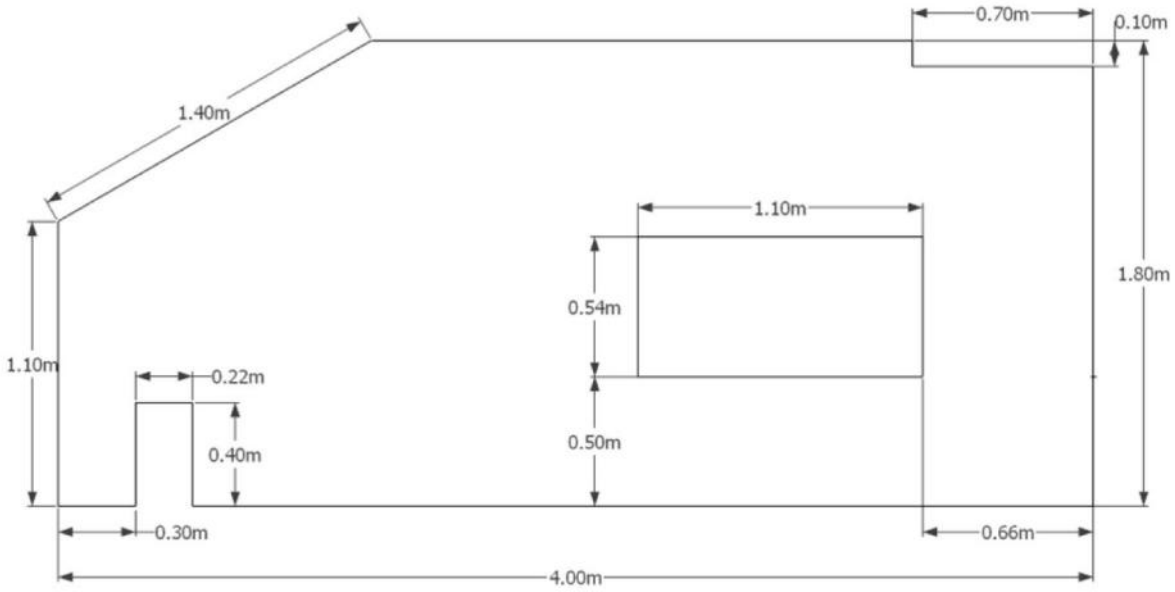
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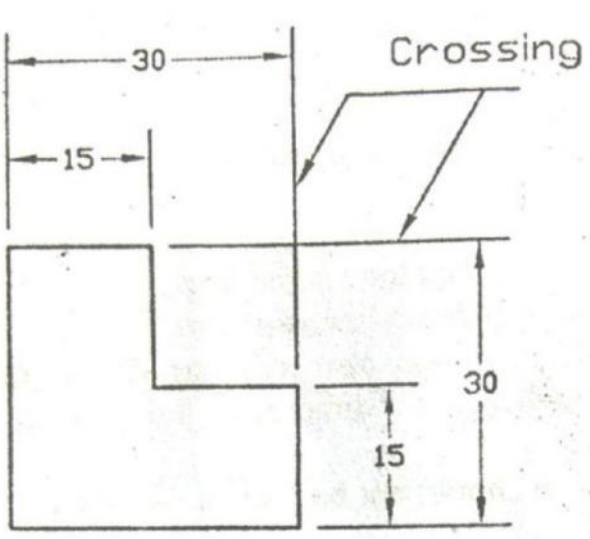
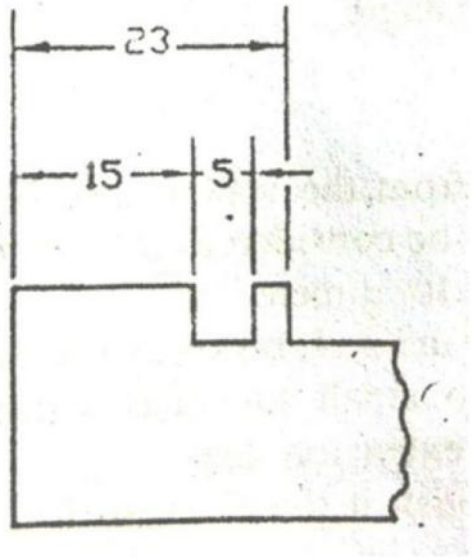
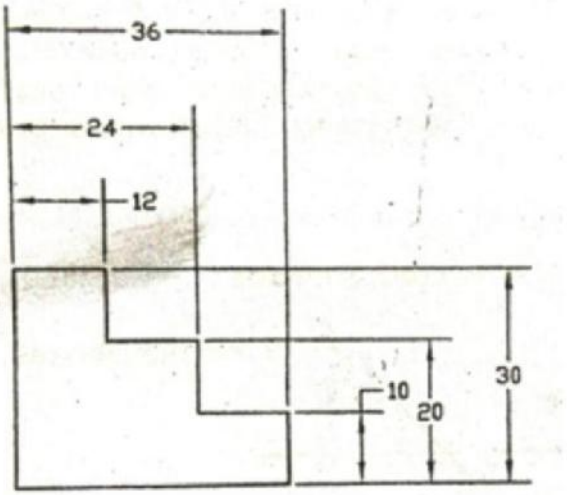
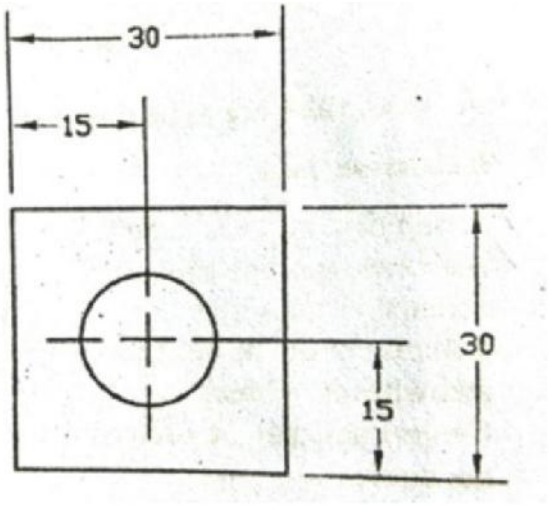
0.54m
1.10m
0.22m
0.40m
0.50m
0.30m
0.66m
4.00m


30
Crossing
15
30
15


23
15
5


36
24
12
10
20
30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15
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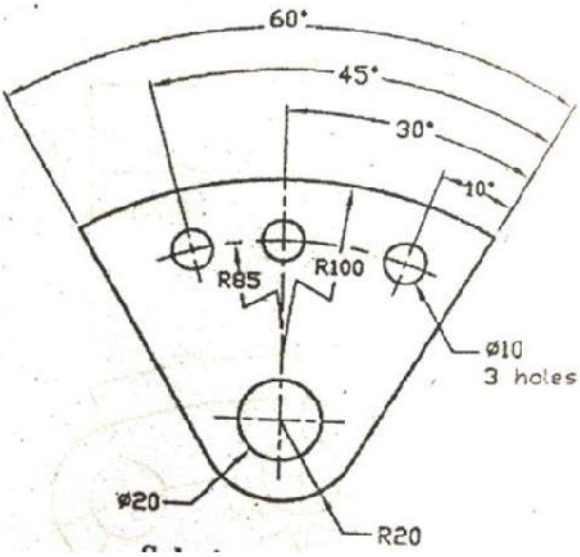
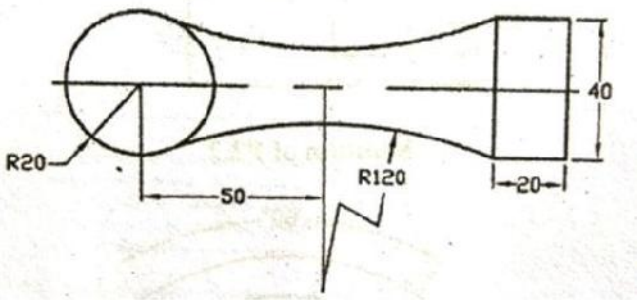
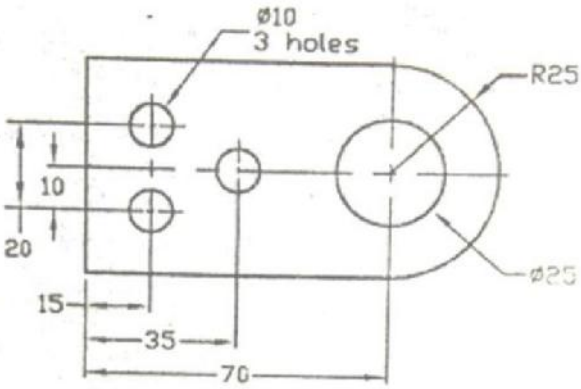
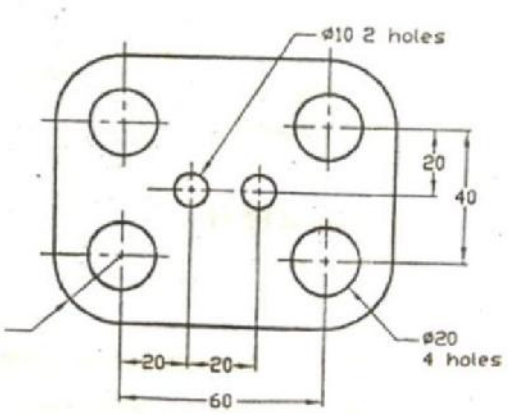
15


60°
45°
30°
10°
R85
R100
ø10
3 holes
ø20
R20

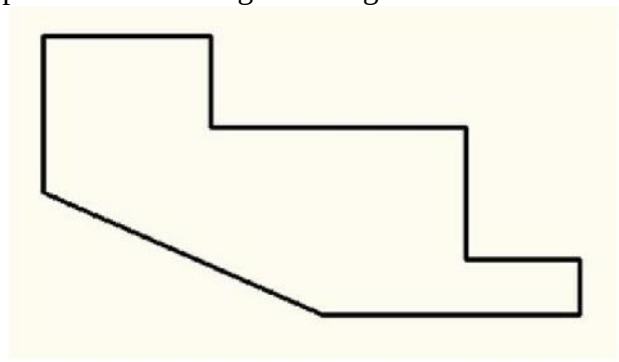

40
R20
50
R120
20


ø10
3 holes
R25
10
20
15
35
70
ø25

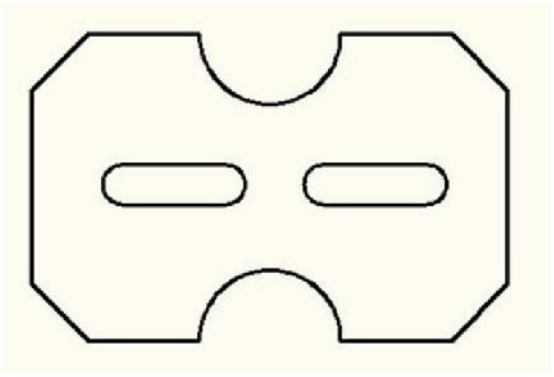

ø10 2 holes
20
40
ø20
4 holes
20
20
60

Exercise and Assignments:

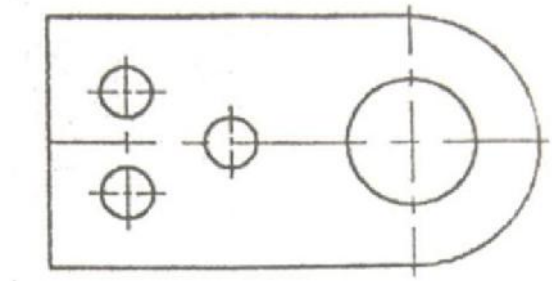
Complete Dimensioning of the figures below:



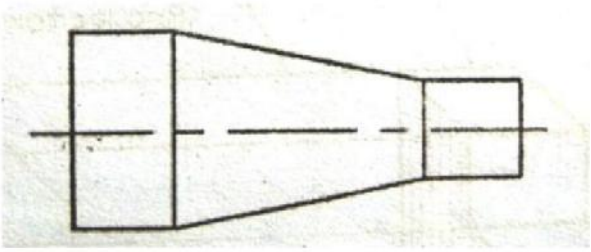
(1)



(2)



(3)



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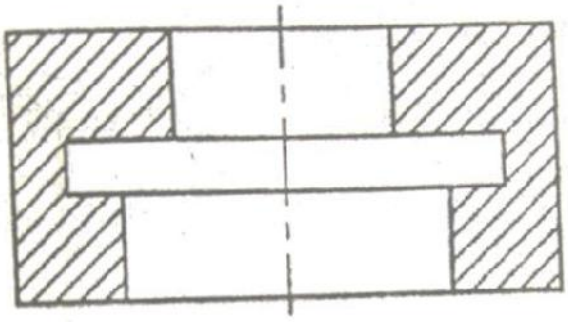
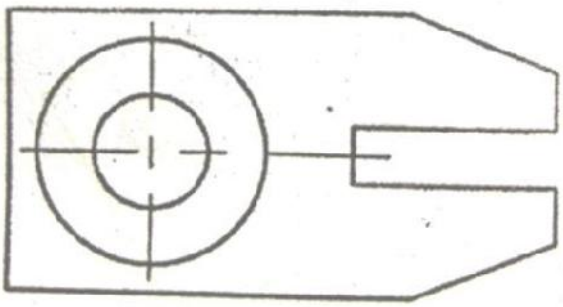
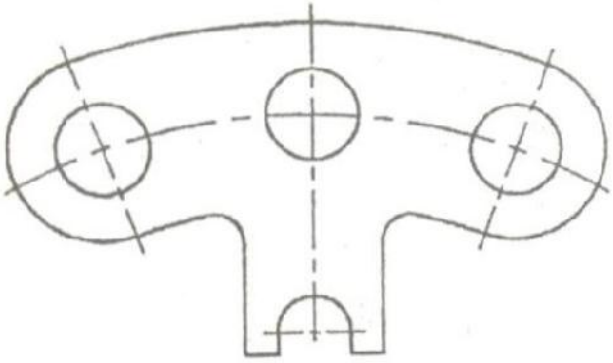


(5)



(6)



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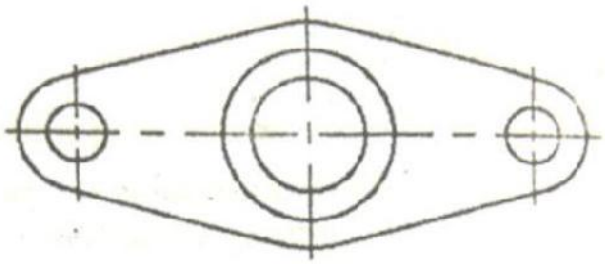

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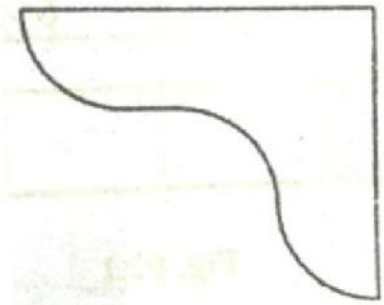
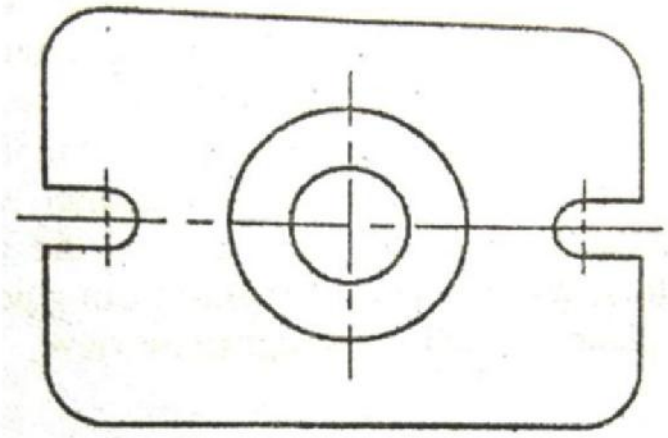
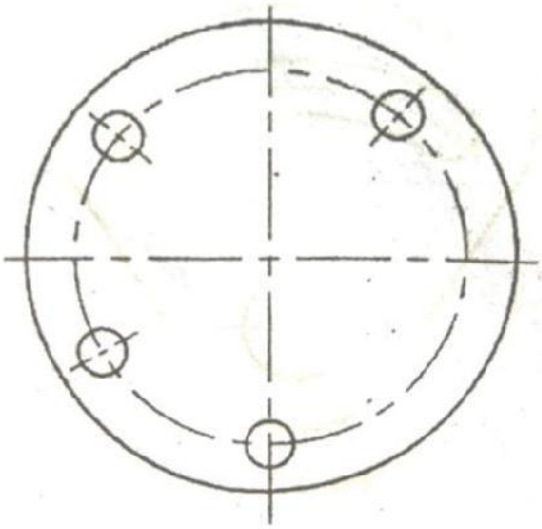


(9)



(10)



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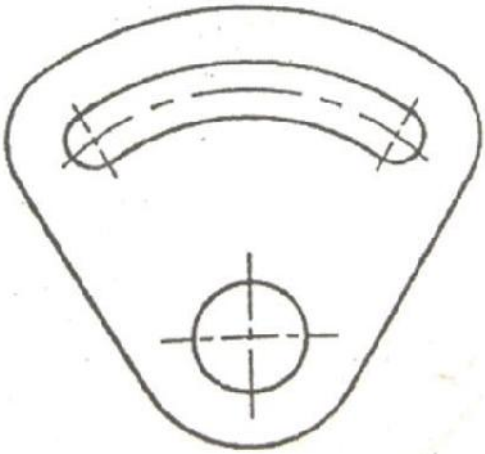

(11)