


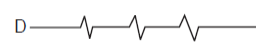





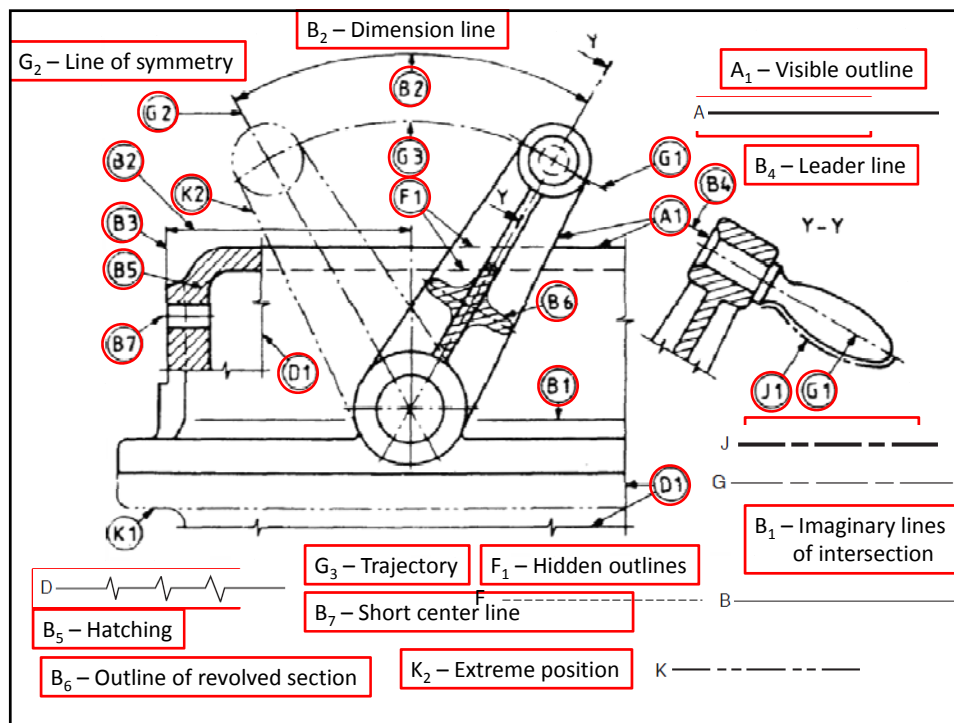
ME251A- Engineering Design and Graphics

LINES

A		Continuous thick	Visible outlines- A₁ Visible edges- A₂
B		Continuous thin (straight or curved)	Imaginary Lines of intersection- B₁ Dimension Lines- B₂ Projection lines- B₃ Leader Lines- B₄ Hatching- B₅ Outlines of revolved sections- B₆ Short center lines- B₇
C		Continuous thin freehand	Limits of partial or interrupted views- C₁
D		Continuous thin straight with Zig-Zags	
E		Dashed thick	Hidden outlines- E₁ Hidden edges- E₂
F		Dashed thin	Hidden outlines- F₁ Hidden edges- F₂

LINES

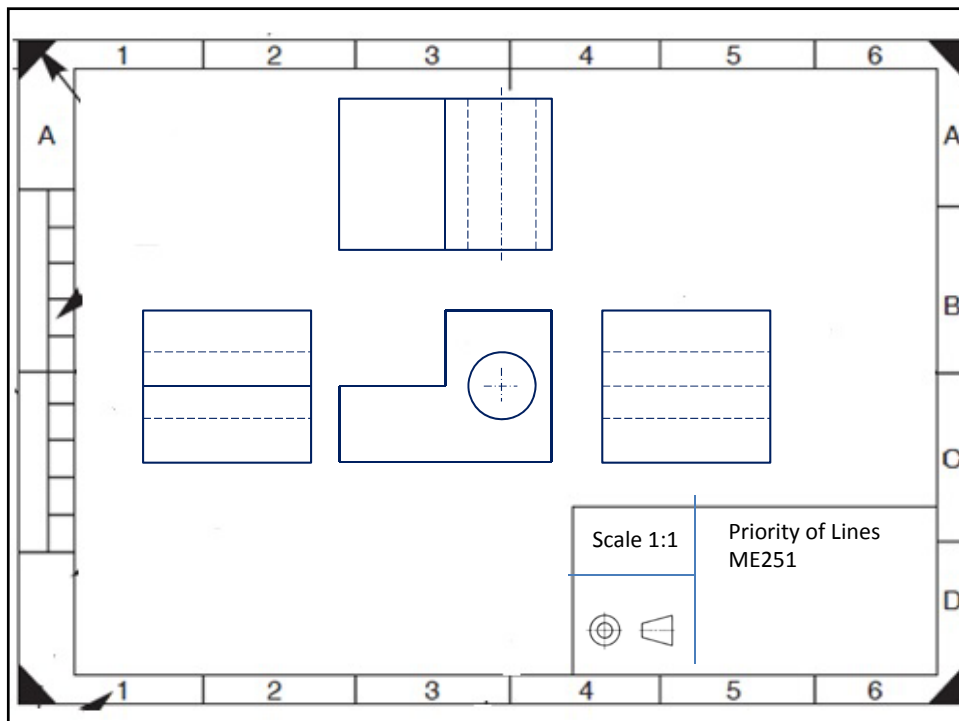
<p>G ————— Chain thin</p>	<p>Center lines- G₁ Lines of Symmetry - G₂ Trajectories- G₃</p>
<p>H  Chain thin, thick at ends and change of direction</p>	<p>Cutting planes - H₁</p>
<p>J ——— ——— Chain thick</p>	<p>Indication of lines and surfaces to which a special requirement applies - J₁</p>
<p>K ——— ——— Chain thin double dashed</p>	<p>Outlines of adjacent parts- K₁ Alternative and extreme positions of movable parts- K₂ Centroidal lines- K₃ Initial outlines prior to forming - K₄ Parts situated in front of cutting plane- K₅</p>



LINES

➤ Priority:

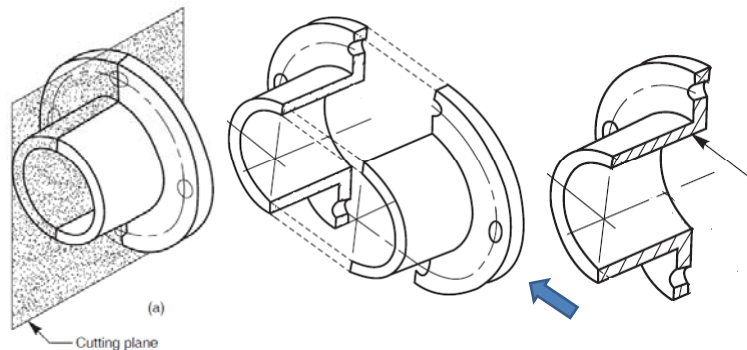
- Visible outlines and edges (A)
- Hidden outlines and edges (B)
- Cutting planes
- Centerlines and lines of symmetry
- Projection lines



Sections

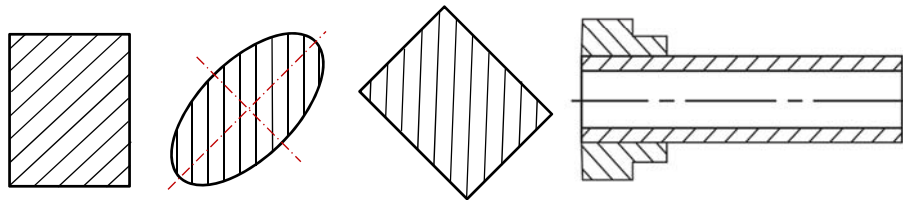
Sections

- Sectional views are required to provide internal details of complicated parts which cannot be clearly depicted otherwise
- A sectioning plane is defined and it is imagined that the object is cut by this plane
- Remove the part of the object between the observer and sectioning plane



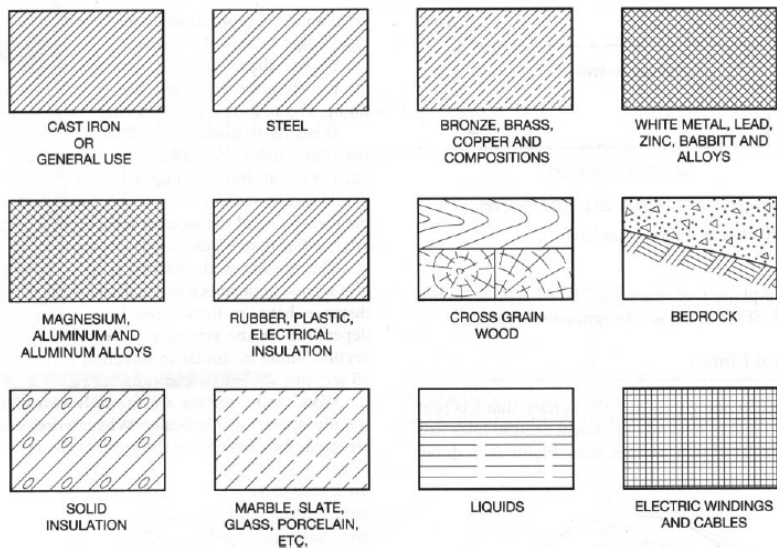
Hatching of sections

- Hatching is used to indicate sectioned areas
- Thin lines (B) are drawn at a convenient angle; preferably 45° to the **principle outlines** or **lines of symmetry** of the cross-section
- Separate areas of the section of a same component should have same line orientation and spacing
- Hatching of adjacent components should have different line orientation and/or spacing
- Line spacing should be uniform within one area ($> 0.7\text{mm}$)



Hidden edges are not to be shown in the hatched area

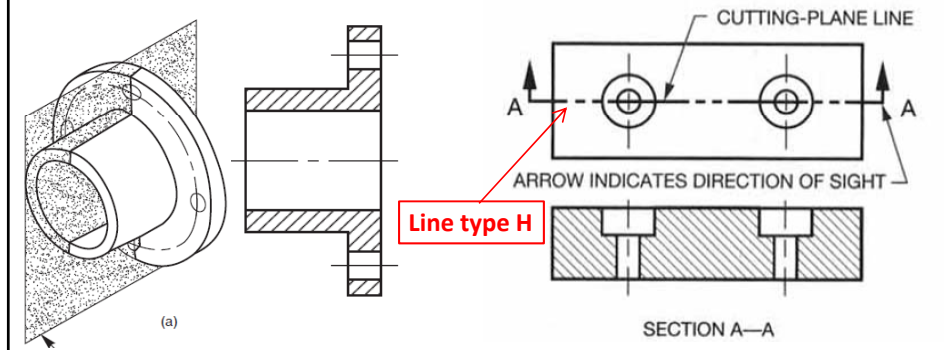
Hatching patterns



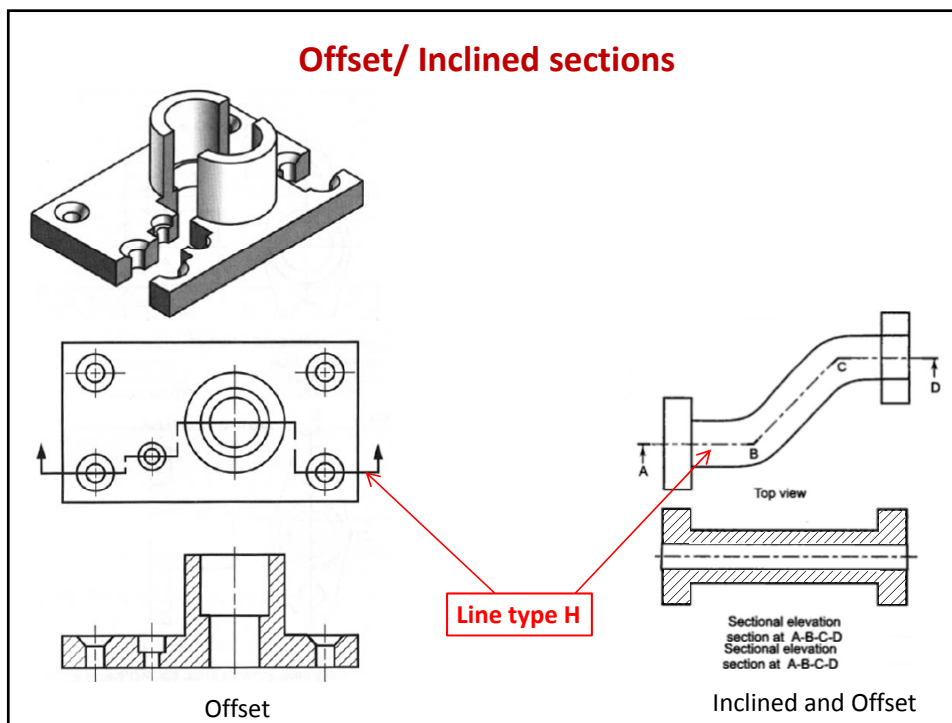
Different types of sections

- Full section
- Half section
- Revolved section
- Removed section
- Broken section
- Auxiliary section
- Assembly section

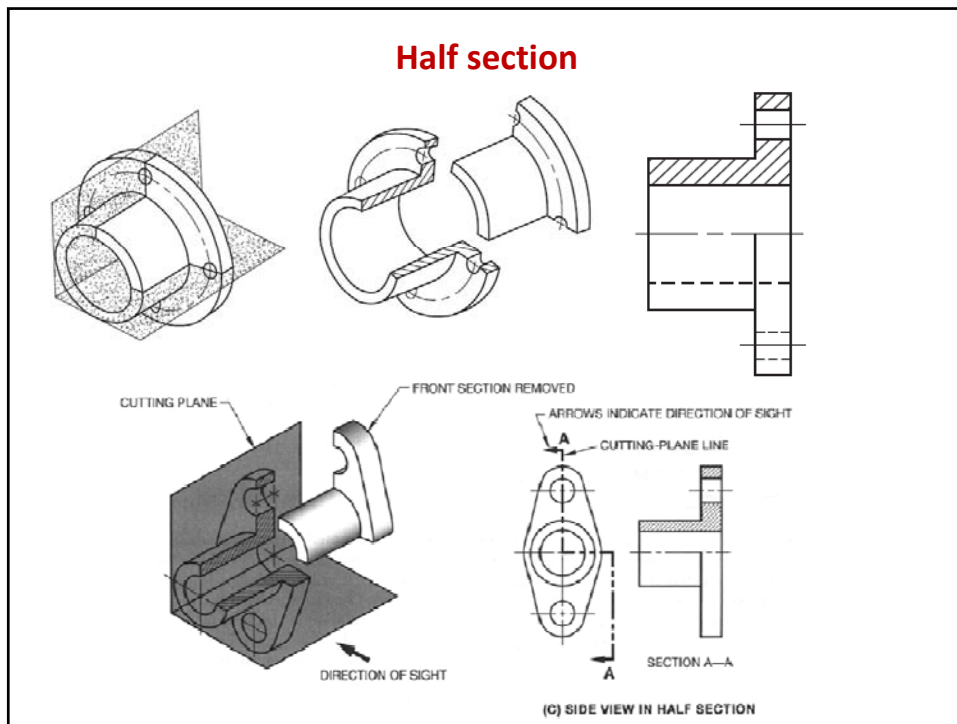
Full section: Cutting plane passes entirely through the object



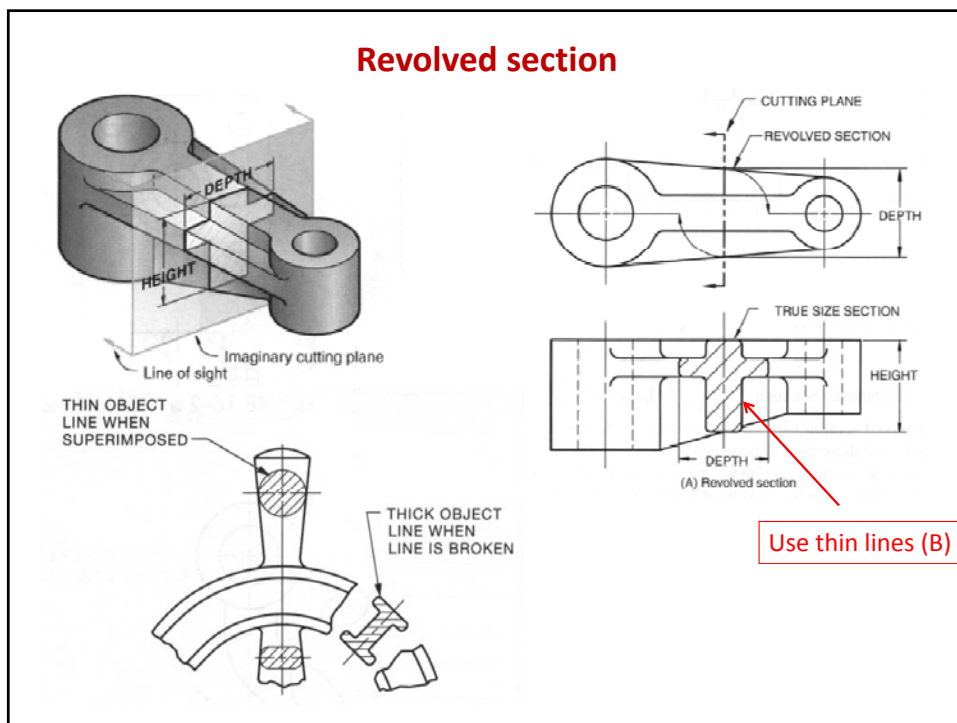
Offset/ Inclined sections



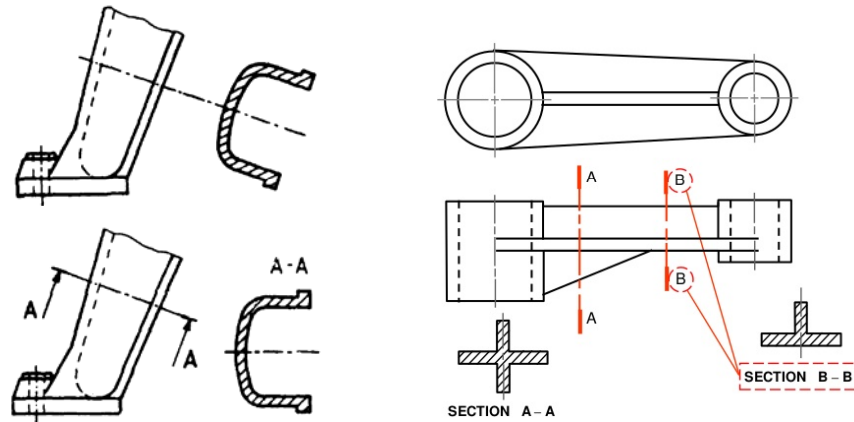
Half section



Revolved section



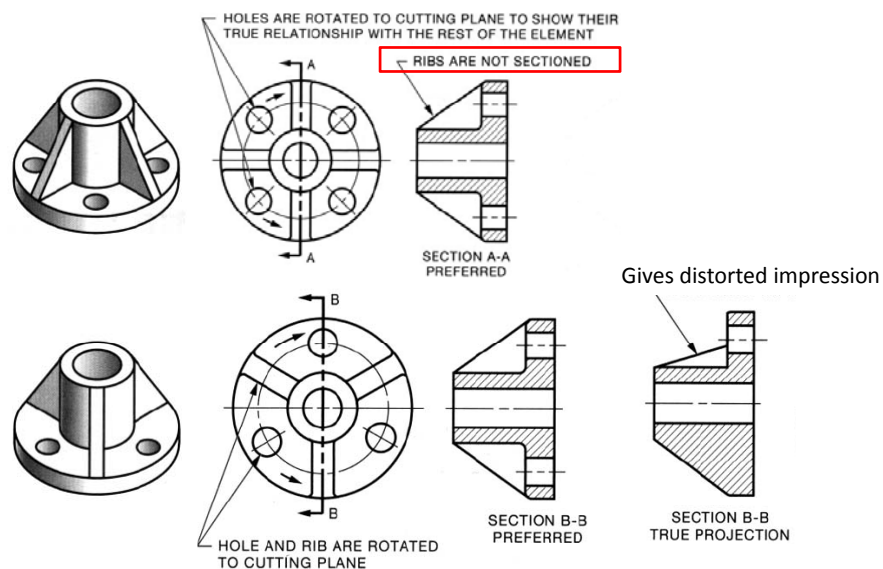
Removed section

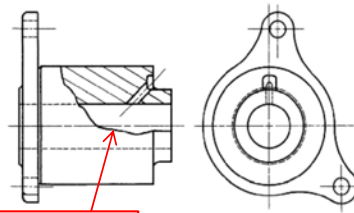
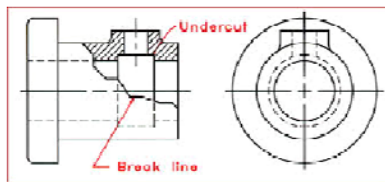
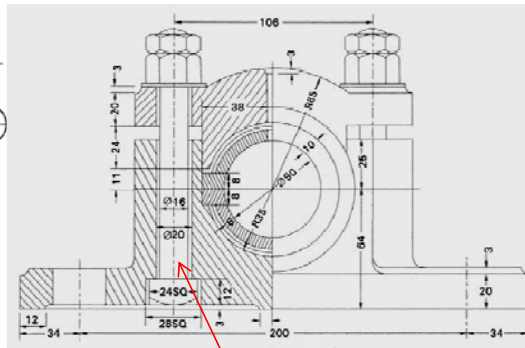


- The out lines of removed sections should be drawn with thick lines (A)
- Section is placed either near to and connected with the view by a chain thin line (G) or in a different position with identification

Aligned or revolved section

- Used when the part contains ribs, webs spokes etc

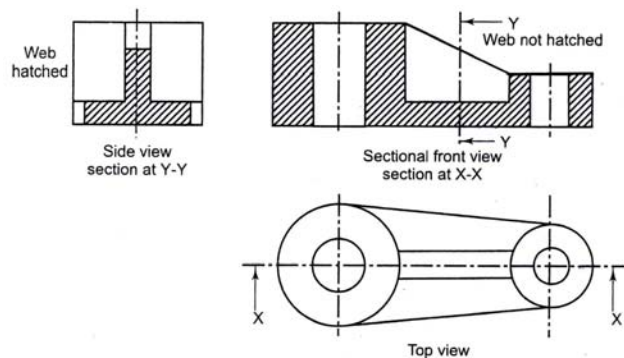


Broken or partial sectionLine type C₁**Assembly section**

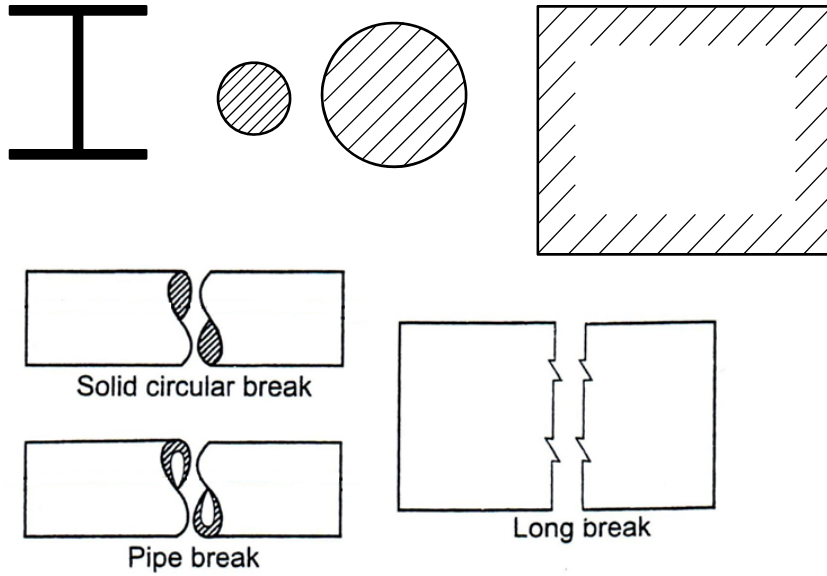
Bolt is not sectioned

Conventions in sectioning

- Cutting plane is indicated by chain line type H
- Cutting plane is named by identification letters A-A, X-X etc.
- Hidden edges inside sectioned areas should not be shown
- Thin parts like stiffeners, webs, bolts, rivets are not hatched if the cutting plane cuts at right angles to their axis



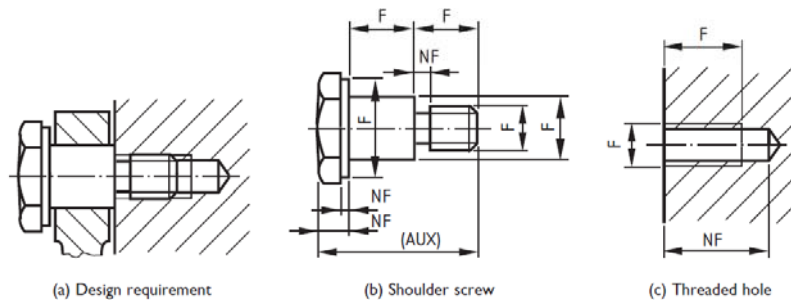
Conventions in sectioning



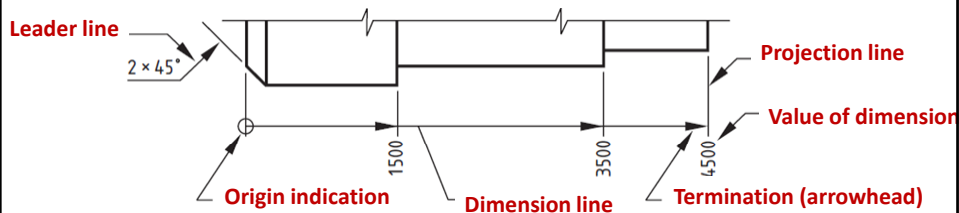
Dimensioning

Dimensions

- Dimensions are numbers written on the drawing and specify the size of the object
- **Basic dimension:** Dimensions without specifying any tolerances-
Tolerances are important in production drawings
- **Types of dimensions**
 - **Functional (F):** Essential for the functioning of the part
 - **Non-functional (NF):** Not essential for the functioning of the part
 - **Auxiliary:** Given for information purpose only



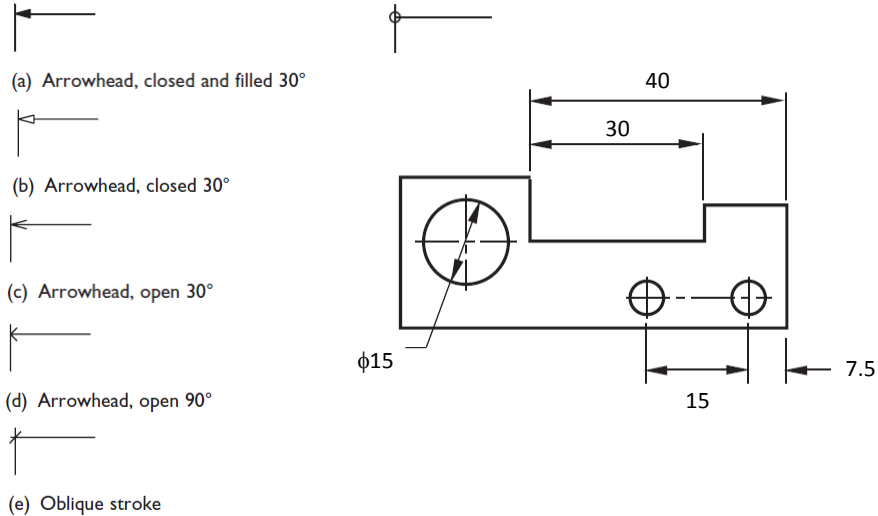
Elements of Dimensioning



- **Dimension line**
- **Projection line** (starts 1 to 2 mm away from feature and extends beyond the dimension line)
- **Leader line**
- **Origin indication**
- **Dimension line termination**
- **Dimension itself**

Elements of dimensioning

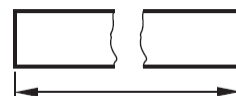
Termination indication Origin indication



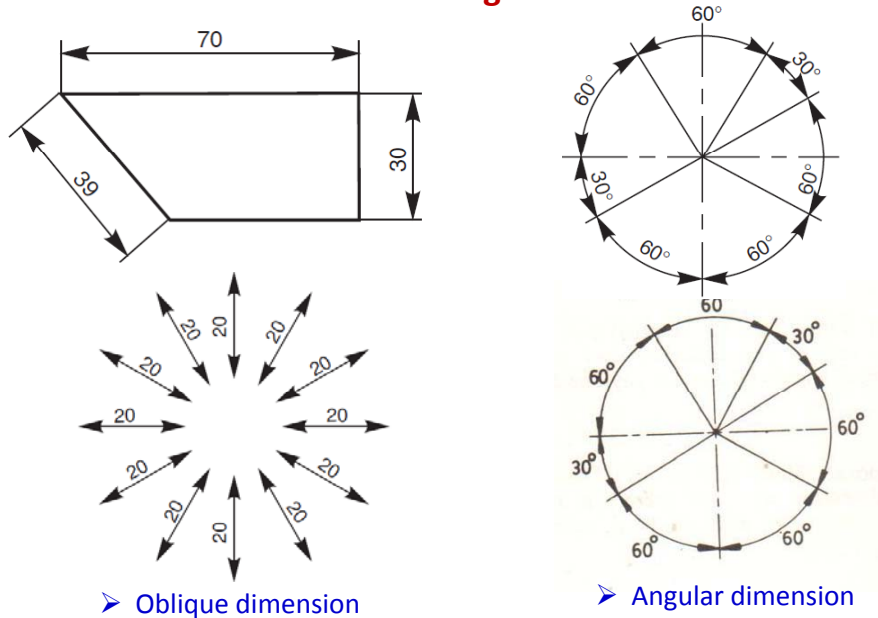
Size should be proportional to drawing size

Dimensioning

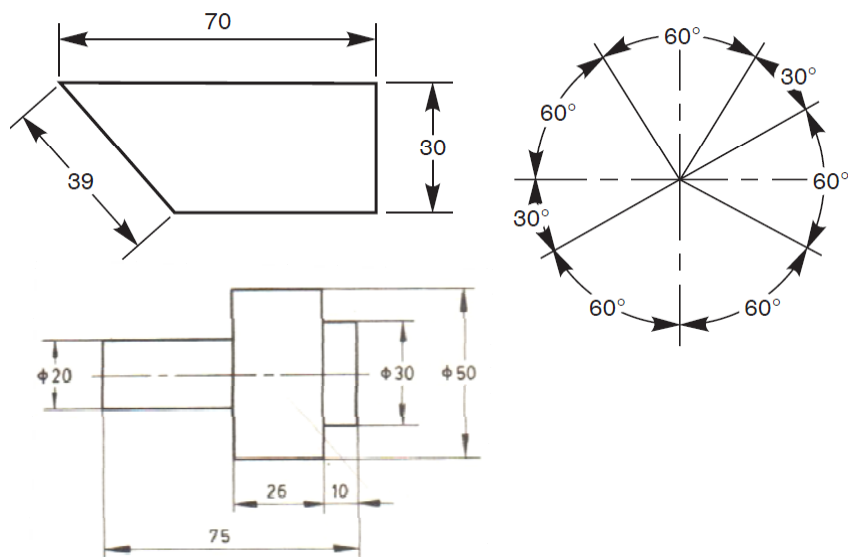
- **Features in a drawing:** Individual characteristics such as a
 - a flat surface, a cylindrical surface, two parallel surfaces
 - a shoulder, a slot, a screw thread, a profile etc.
- Each feature should be dimensioned only once in a drawing
- Dimension should be placed in the view or section that most clearly shows the feature dimensioned
- Dimension should be placed outside the view as far as possible
- Each drawing should use same units for dimensioning
- Crossing of projection lines and/or dimension lines should be avoided
- Dimension line should be unbroken even if the feature is shown broken



Orientation and placement of dimension value
Method -1 Aligned system

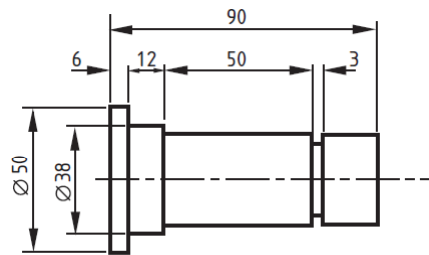


Orientation and placement of dimension value
Method 2 – Uni-directional system

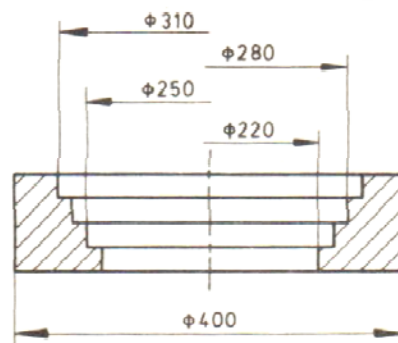


We will follow this system

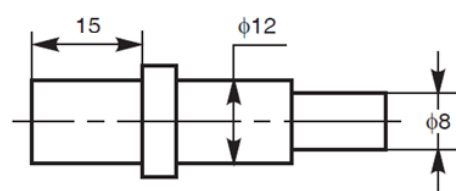
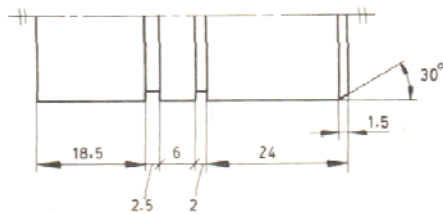
Dimensioning practices



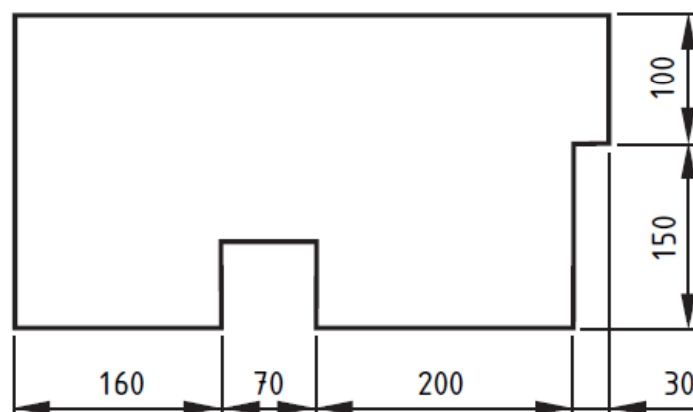
Larger dimension placed outside smaller



Due to symmetry only one termination

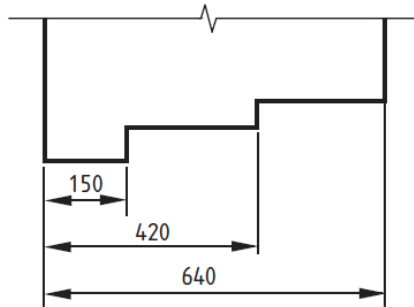


- Chain dimensioning: Should be used when accumulation of tolerances will not affect function of part

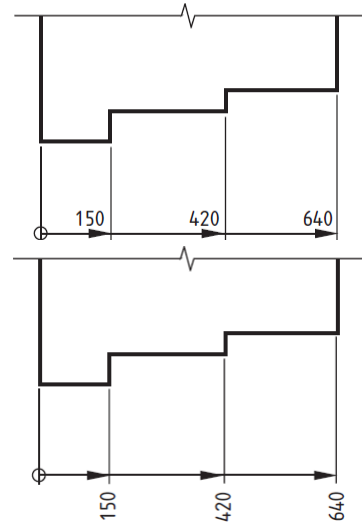


- Dimensioning from a common feature: A number of dimensions of same direction relates to a common origin

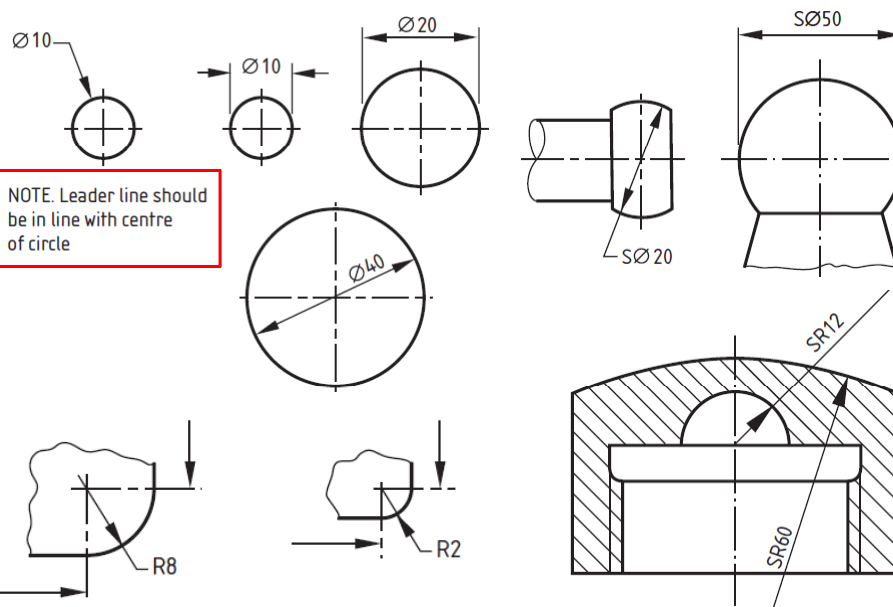
Parallel dimensioning

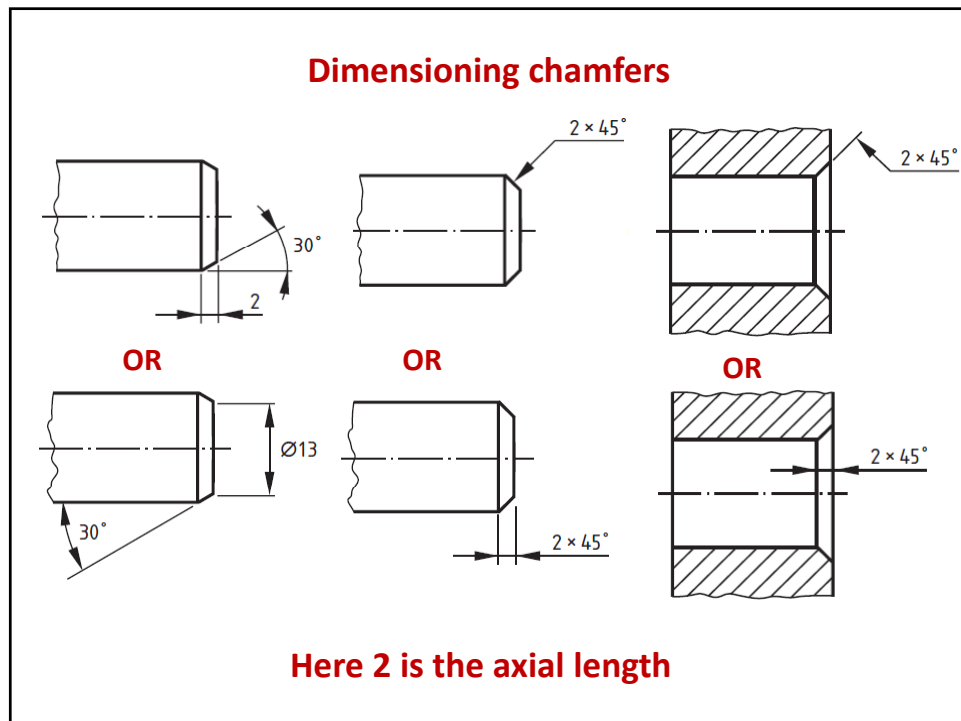
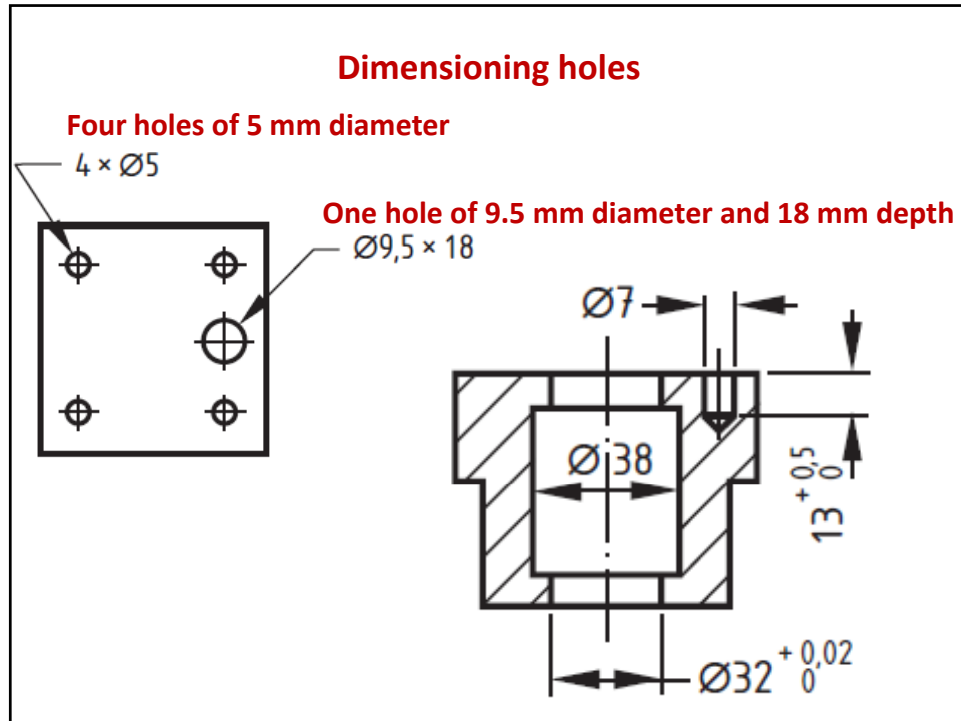


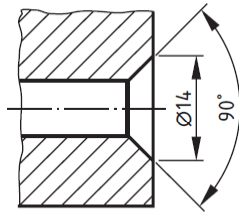
Running dimensioning



Indicating diameter and radius





Dimensioning counter sinks/repeated features**OR**