ME 111: Engineering Drawing

Lecture # 11 (05/09/2011)

Sections of solids

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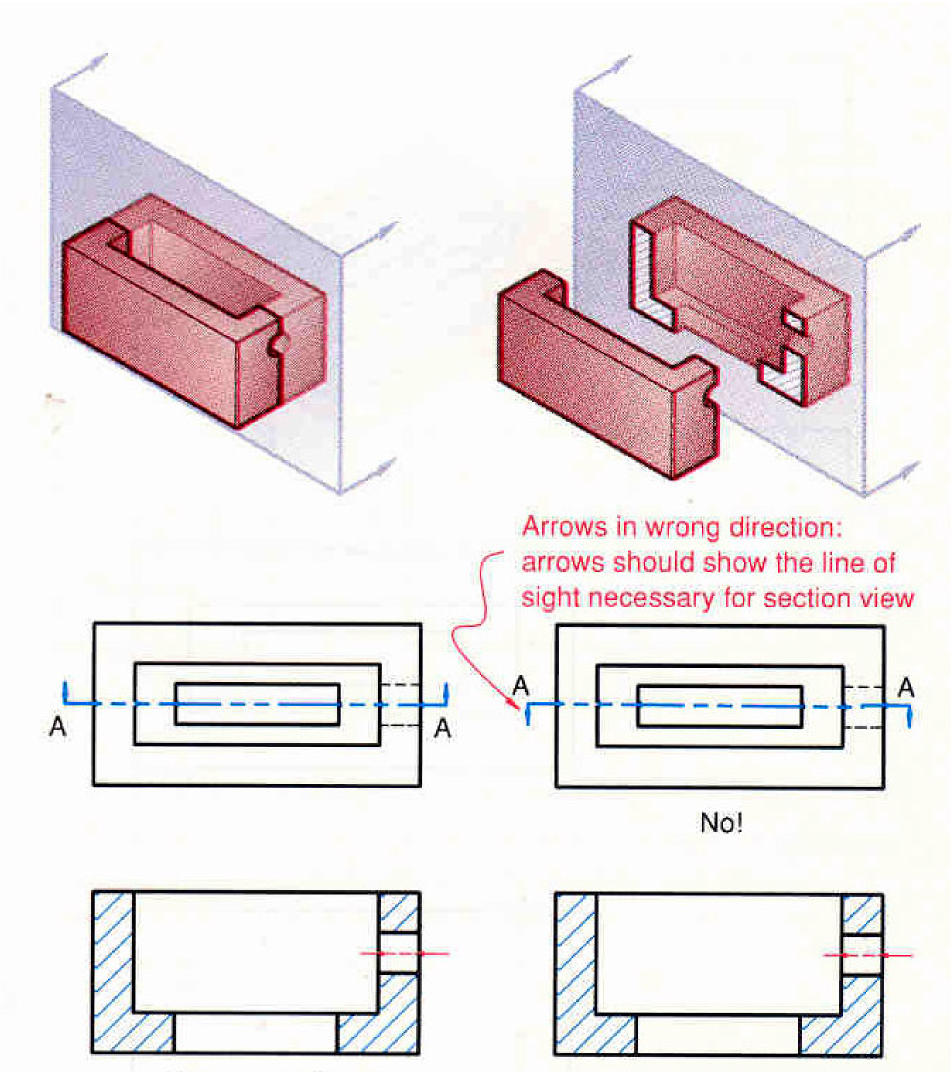
Section Views

- **Sectional drawings are multiview technical drawings that contain special views of a part or parts, views that reveal interior features.**
- **Used to improve clarity and reveal interior features of parts.**
- **Sectioned technical illustrations are used to describe interior features of complicated assemblies.**
- **A primary reason for creating a section view is the elimination of hidden lines, so that a drawing can be more easily understood or visualized.**

Section Views

- **Traditional section views are based on the use of an imaginary cutting plane that cuts through the object to reveal interior features.**
- **This imaginary cutting plane is controlled by the designer and can (a) go completely through the object (full section); (b) go half-way through the object (half section); (c) be bent to go through features that are not aligned (offset section); or (d) go through part of the object (broken-out section).**

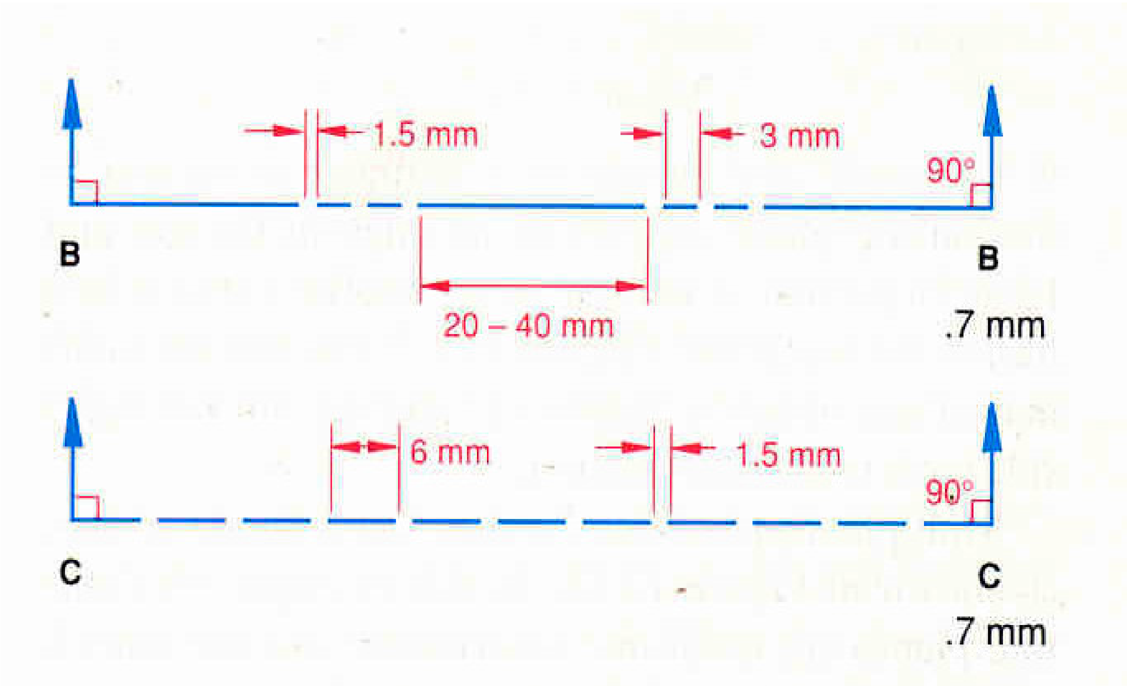
CUTTING PLANE LINES – which show where the cutting plane passes through the object, represent the *edge view* of the cutting plane and are drawn in the view(s) adjacent to the section view.

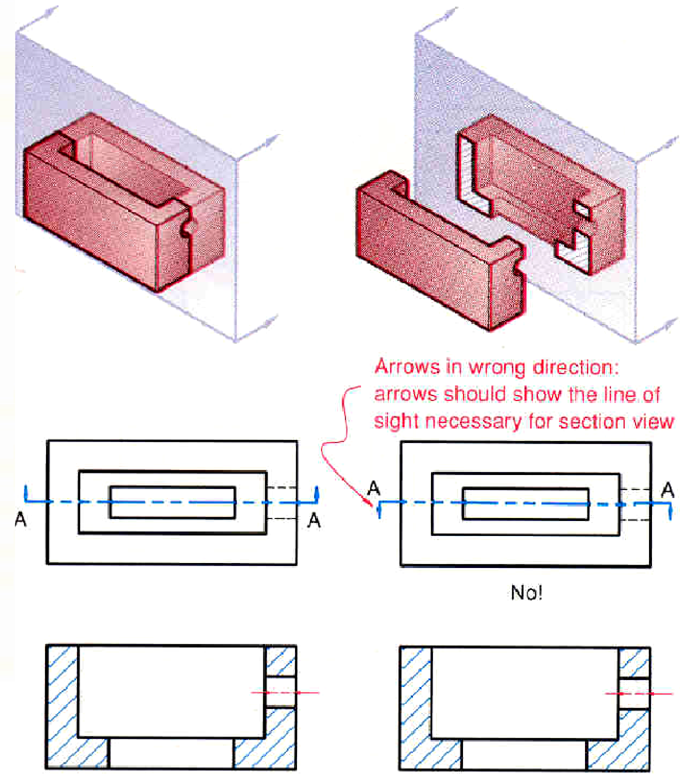


In the figure the cutting plane line is drawn in the top view, which is adjacent to the sectioned front view.

Cutting plane lines are ***thick*** **(0.7 mm) dashed lines**, that extend past the edge of the object **6 mm** and have line segments at each end drawn at **90 degrees and terminated with arrows.**

The arrows represent the direction of the line of sight for the section view and they point away from the sectioned view. Two types of lines are acceptable for cutting plane lines in multi-view drawings

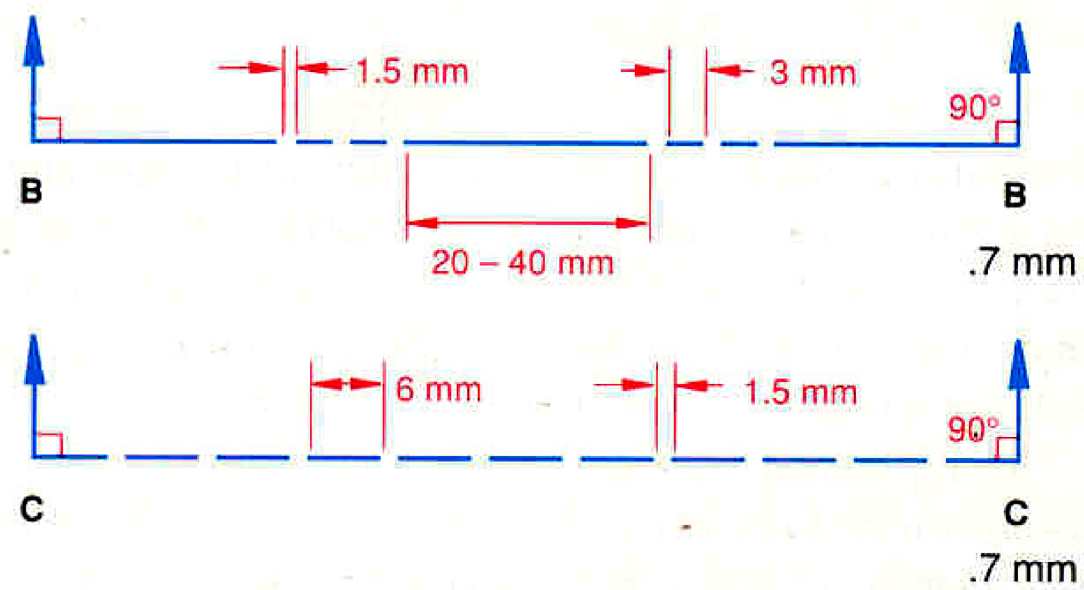




Line B-B is composed of alternating **long and two short dashes**, which is one of the two standard methods.

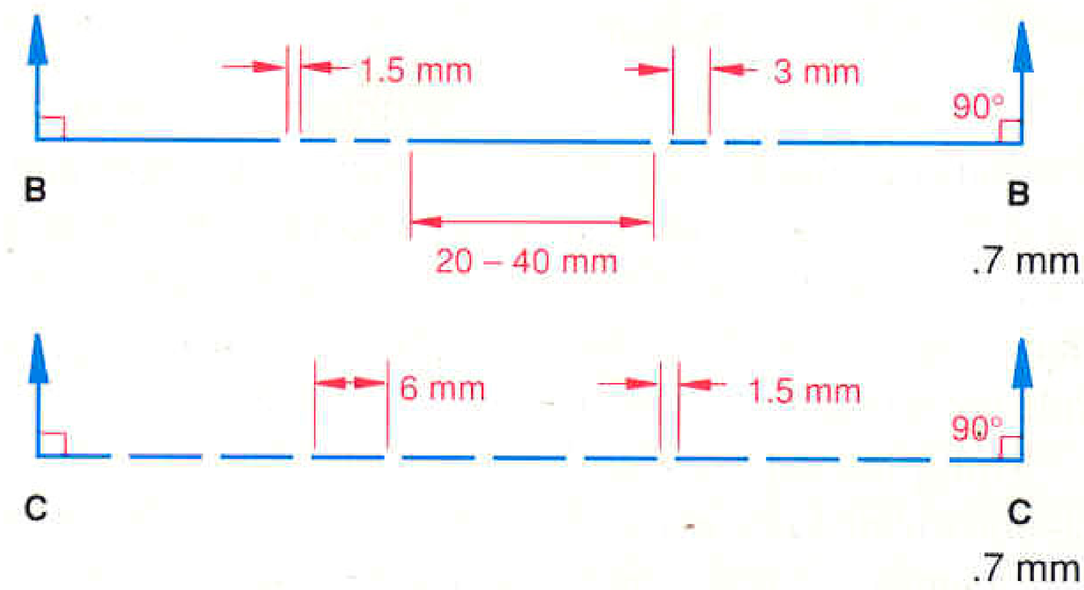
The length of the long dashes varies according to the size of the drawing, and is approximately **20 to 40** mm.

For a very large section view drawing, the long dashes are made very long to save drawing time. The short dashes are approximately **3 mm** long.

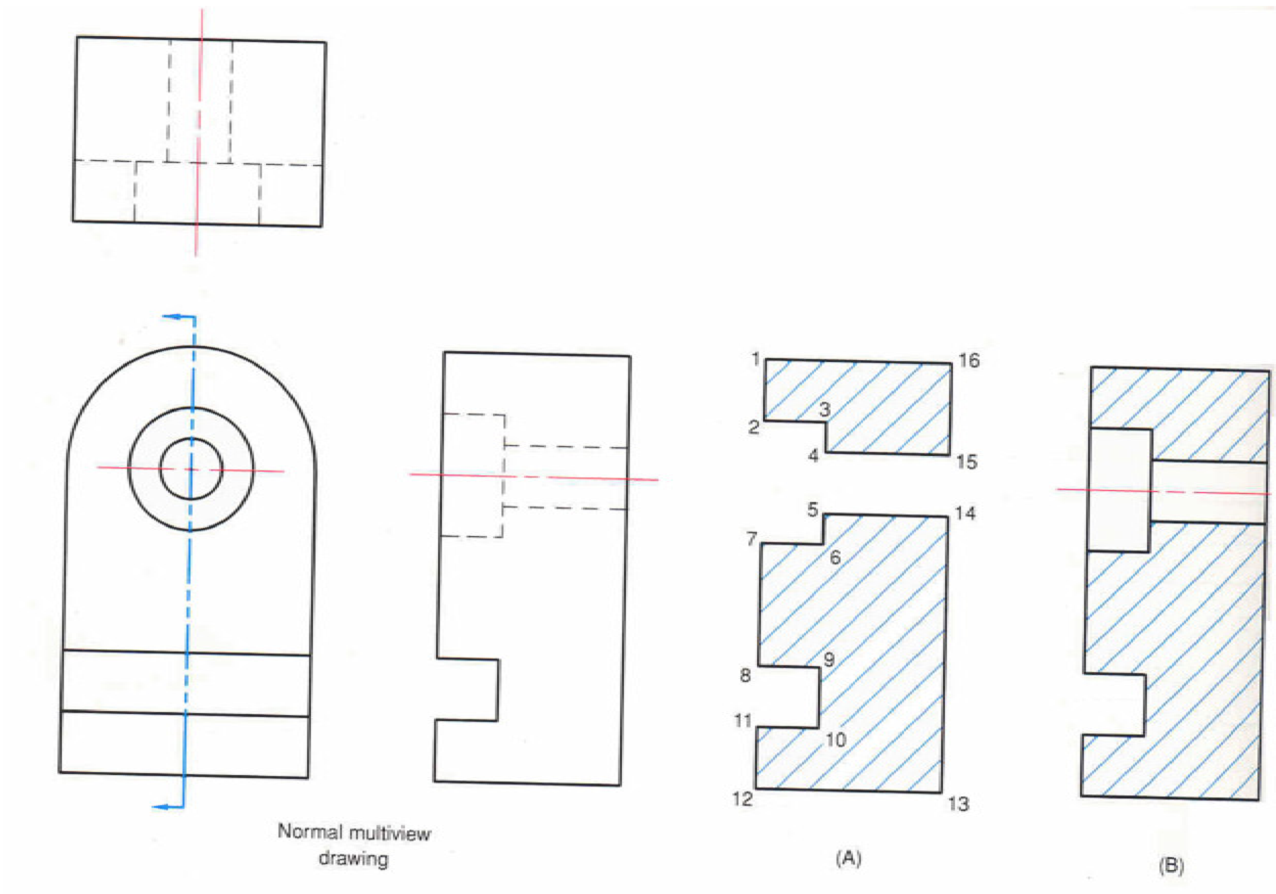


The open space between the lines is approximately 1.5 mm. **Capital letters are placed at each end of the cutting plane line, for clarity or when more than one cutting plane is used on a drawing.**

The second method used for cutting plane lines is shown by line C-C, which is composed of equal-length dashed lines. Each dash is approximately 6 mm long, with a 1.5 mm space between.

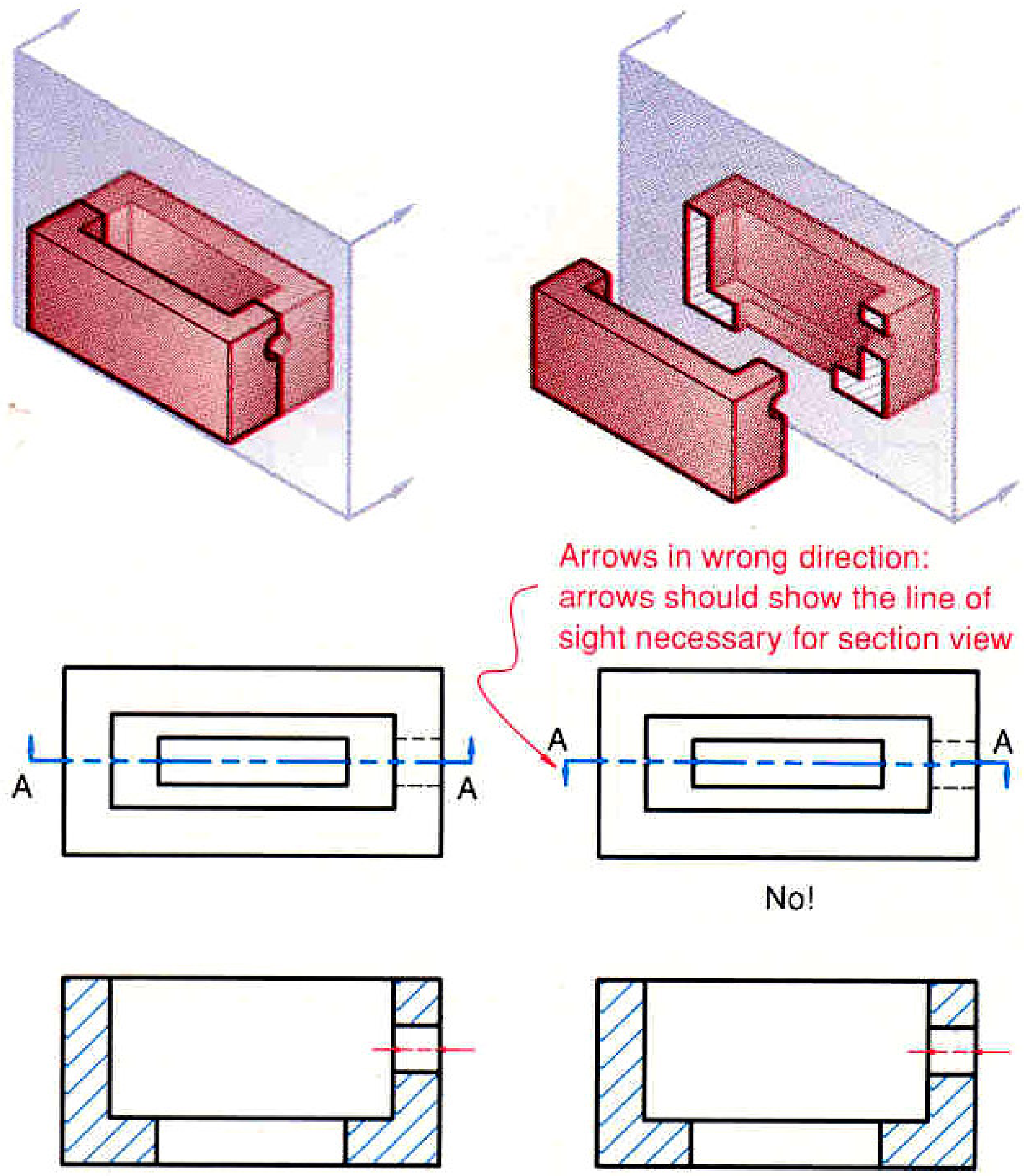


If the cutting plane line is in the same position as a center line, the cutting plane line has precedence.



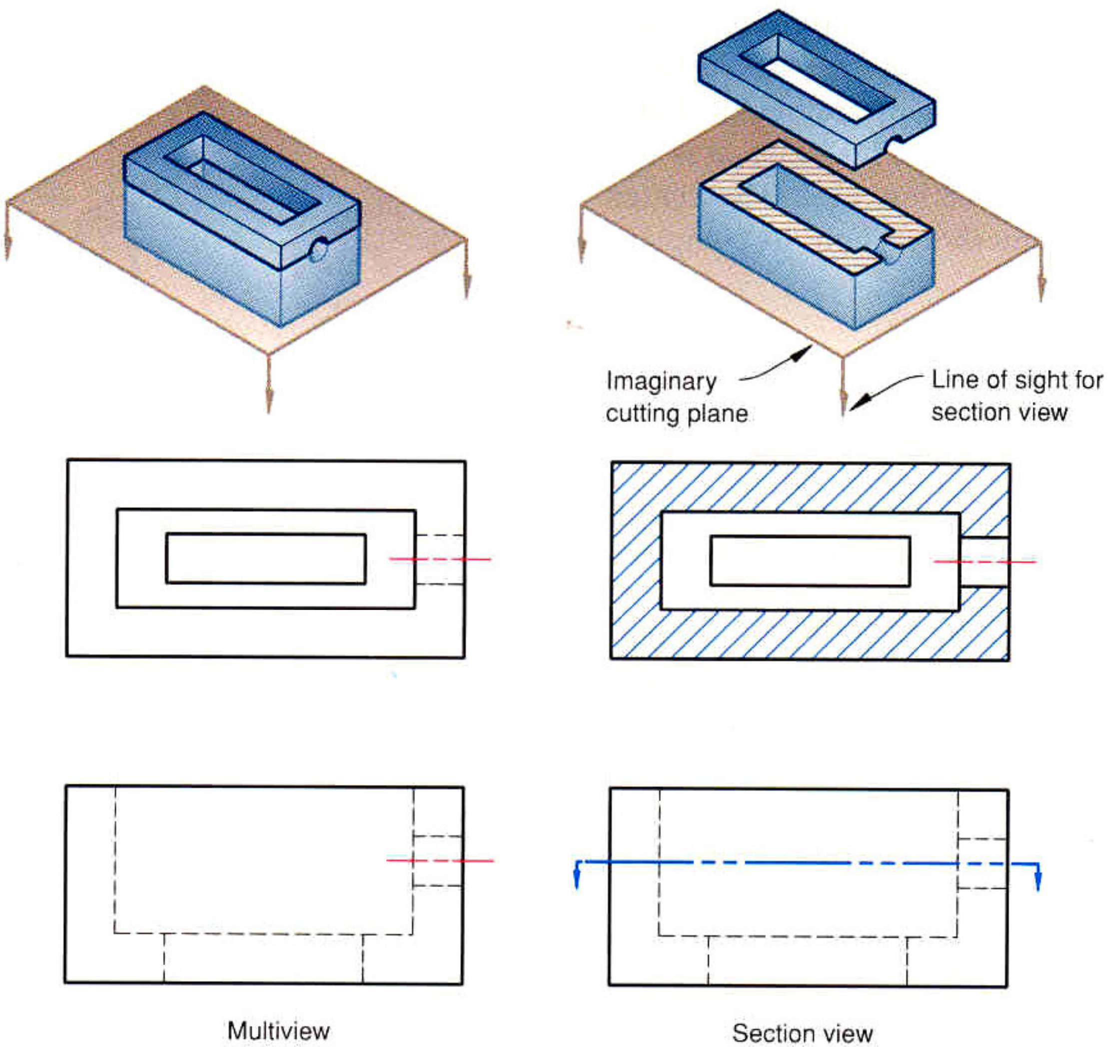
Types of Cutting Planes and Their Representation

- Frontal or Vertical Cutting/ Section Plane
- Horizontal Cutting/ Section Planes
- Profile Cutting / Section Planes
- Auxiliary Section Plane
  - Auxiliary Inclined Plane (AIP)
  - Auxiliary Inclined Plane (AVP)
- Oblique Section Plane



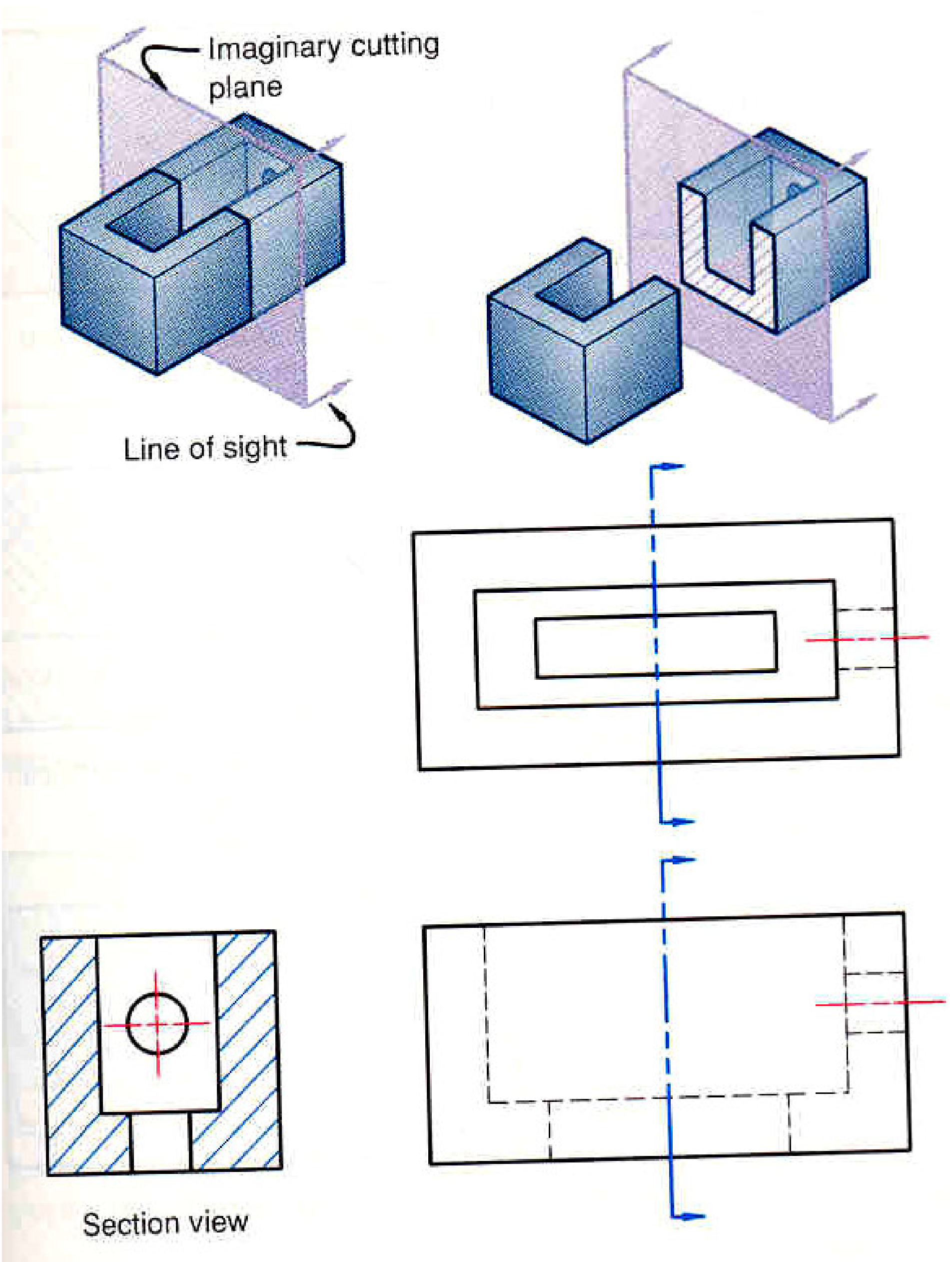
In this figure, the cutting plane appears **as an edge in the top view and is normal in the front view;** therefore, it is a ***frontal cutting plane*** *or* ***Vertical Section Plane.***

The front half of the object is "**removed**" and the front view is drawn in section.



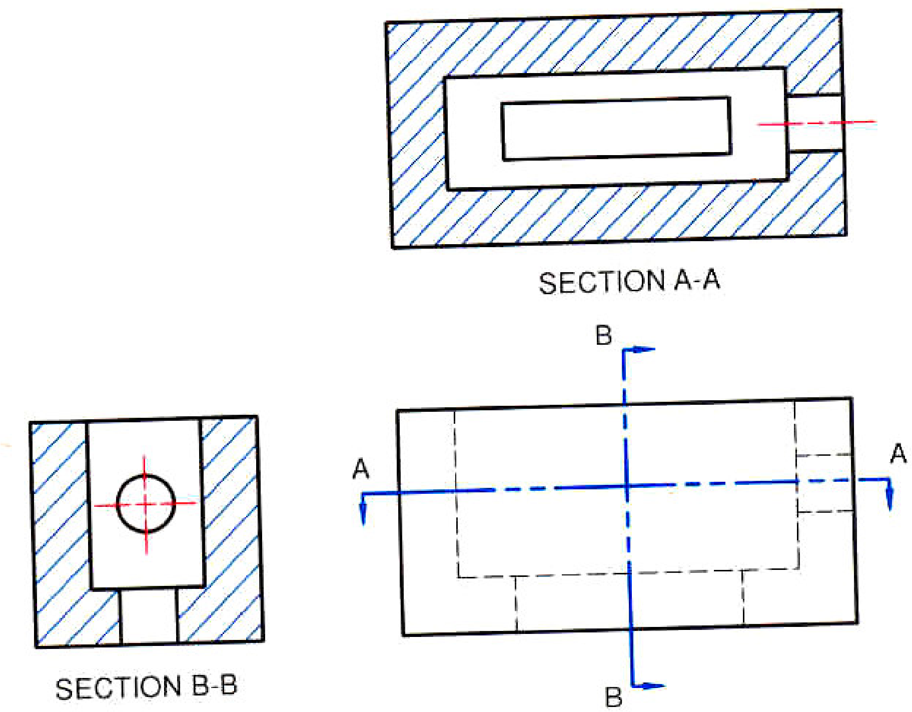
If the cutting plane appears as an **edge in the front view and is normal in the top view**, it is a **horizontal cutting/section plane**.

The top half of the object is "removed" and the top view is drawn in section.



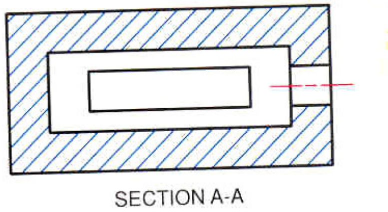
If the cutting plane appears **as an edge in the top and front views** and is **normal in the profile view**, it is a **profile cutting/section plane**.

The left (or righ) half of the object is "removed" and the left (or right) side view is drawn in section.



Multiple sections can be done on a single object, as shown in the figure. In this example, two cutting planes are used: one a horizontal and the other a profile cutting plane. Both cutting planes appear on edge in the front view, and are represented by cutting plane lines **A-A** and **B-B**, respectively. Each cutting plane will create a section view, and each section view is drawn as if the other cutting plane did not exist.

Section Line Practices



Section lines or cross-hatch lines are added to a section view to indicate the surfaces that are cut by the imaginary cutting plane.

Different section line symbols can be used to represent various types of materials.

However, there are so many different materials used in engineering design that the general symbol (i.e., the one used for cast iron) may be used for most purposes on engineering drawings.

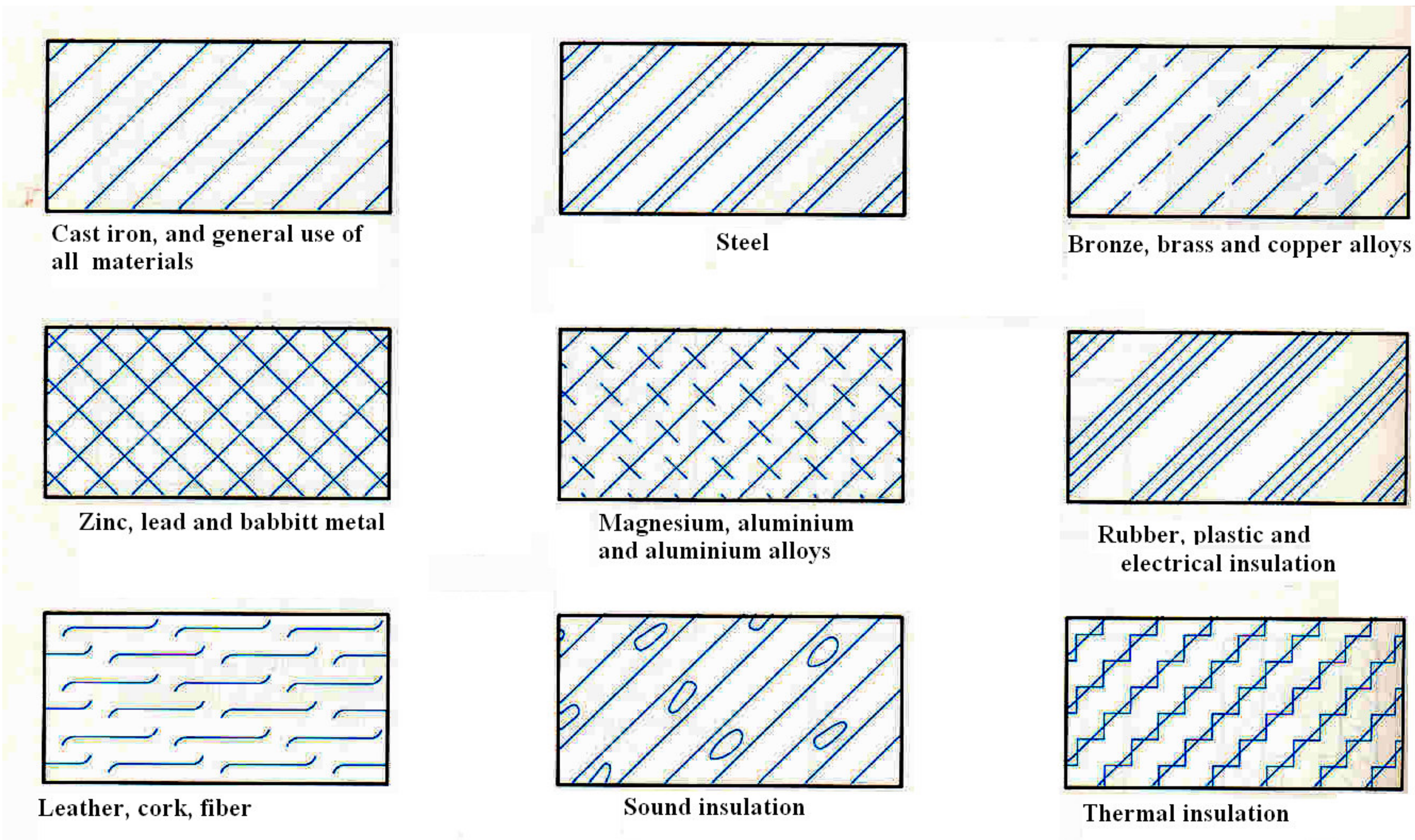
The actual type of material required is then noted in the title block or parts list or as a note on the drawing.

The angle at which lines are drawn is usually 45 degrees to the horizontal, but this can be changed for adjacent parts shown in the same section. Also the spacing between section lines is uniform on a section view.

Material Symbols

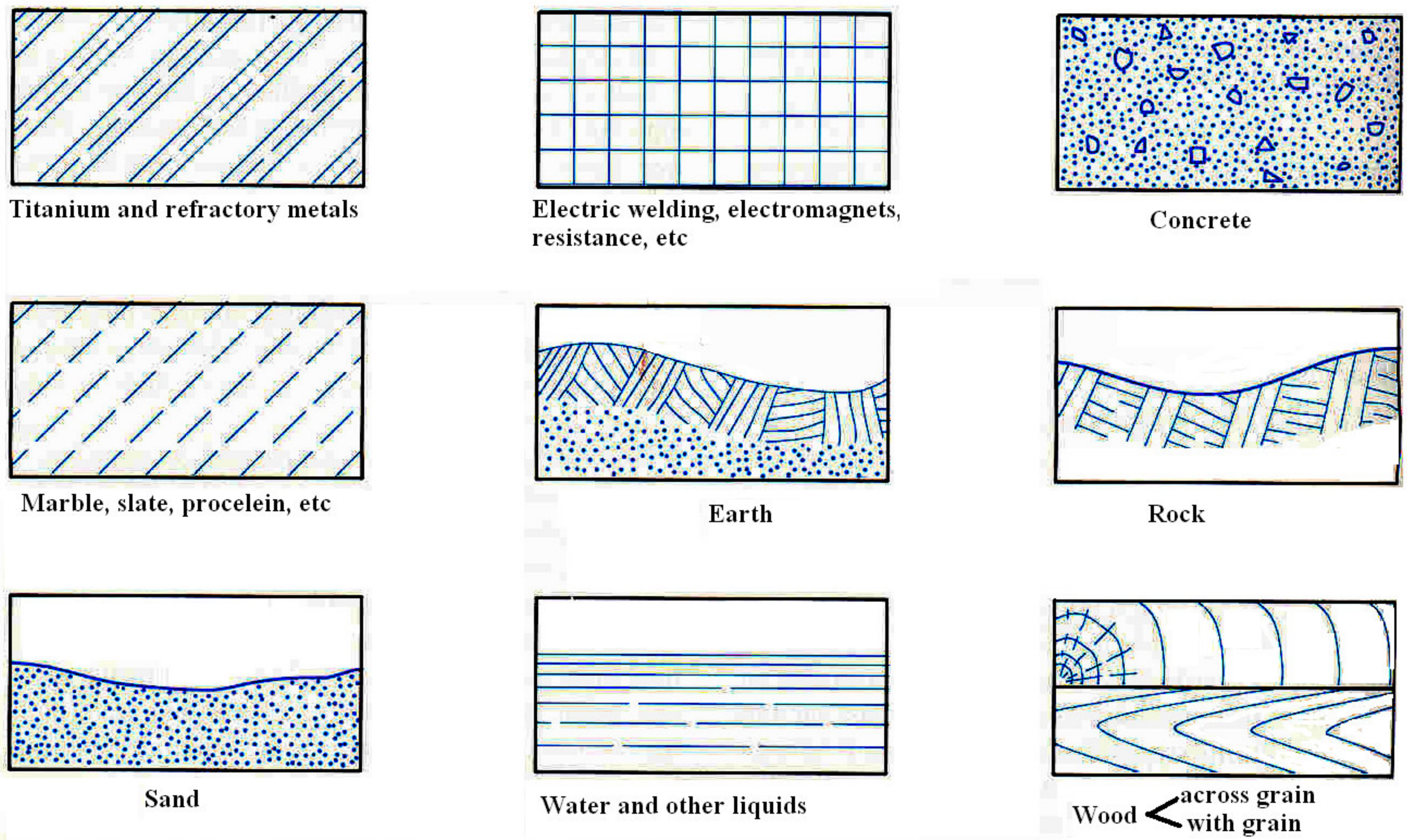
The type of section line used to represent a surface varies according to the type of material.

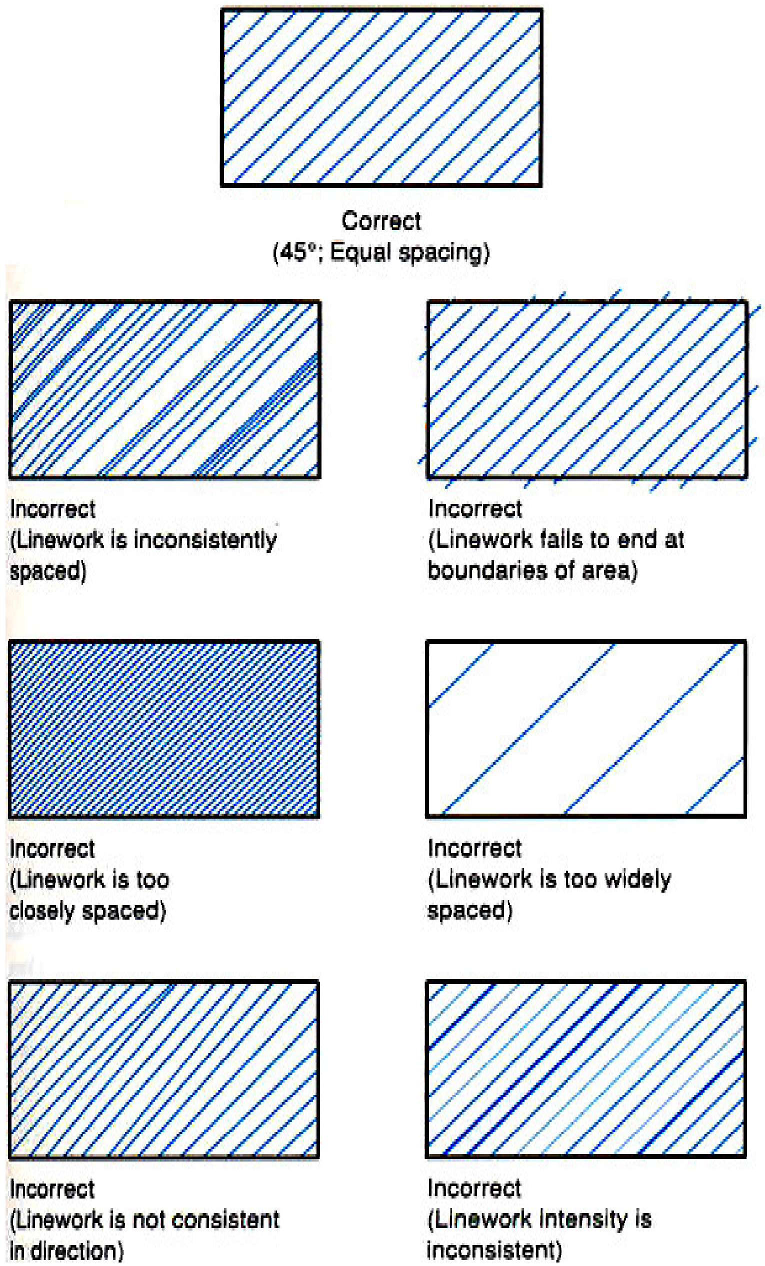
However, the general purpose section line symbol used in most section view drawings is that of *cast iron.*



The specific type of steel to be used will be indicated in the title block or parts list.

Occasionally, with assembly section views, material symbols are used to identify different parts of the assembly.





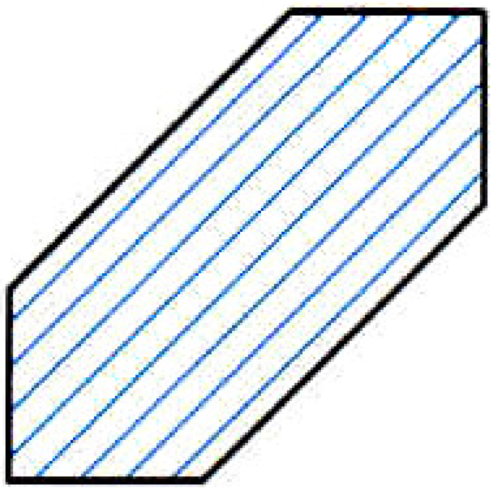
The general purpose cast iron section line is drawn at a 45-degree angle and spaced 1.5 mm to 3 mm or more, depending on the size of the drawing. As a general rule, use 3mm spacing. Section lines are drawn as thin (.35 mm) black lines, using an H or 2H pencil.

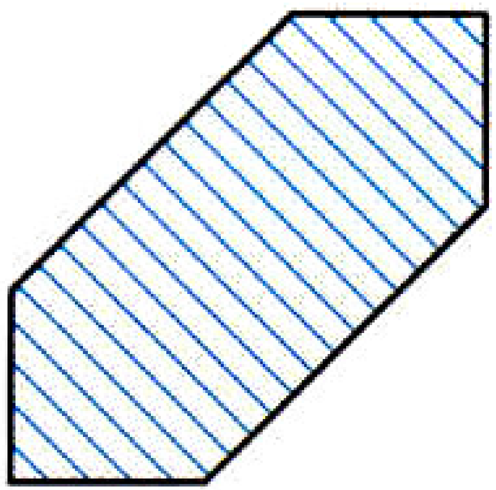
The section lines should be evenly spaced and of equal thickness, and should be thinner than visible lines

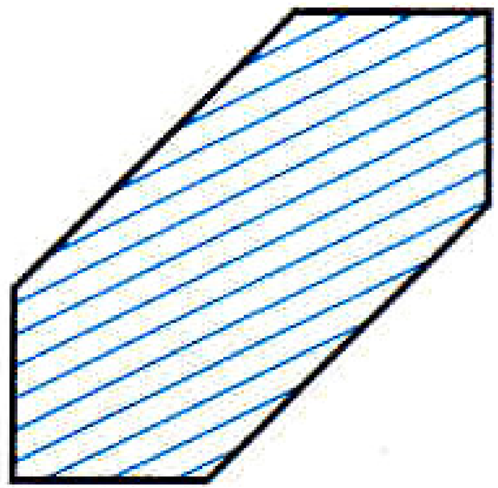
Also, do not run *section* lines beyond the visible outlines or stop them too short

Section lines should not run parallel or perpendicular to the visible outline.

If the visible outline to be sectioned is drawn at a 45-degree angle, the section lines are drawn at a different angle, such as 30 degrees.


(A) Avoid!


(B) Avoid!

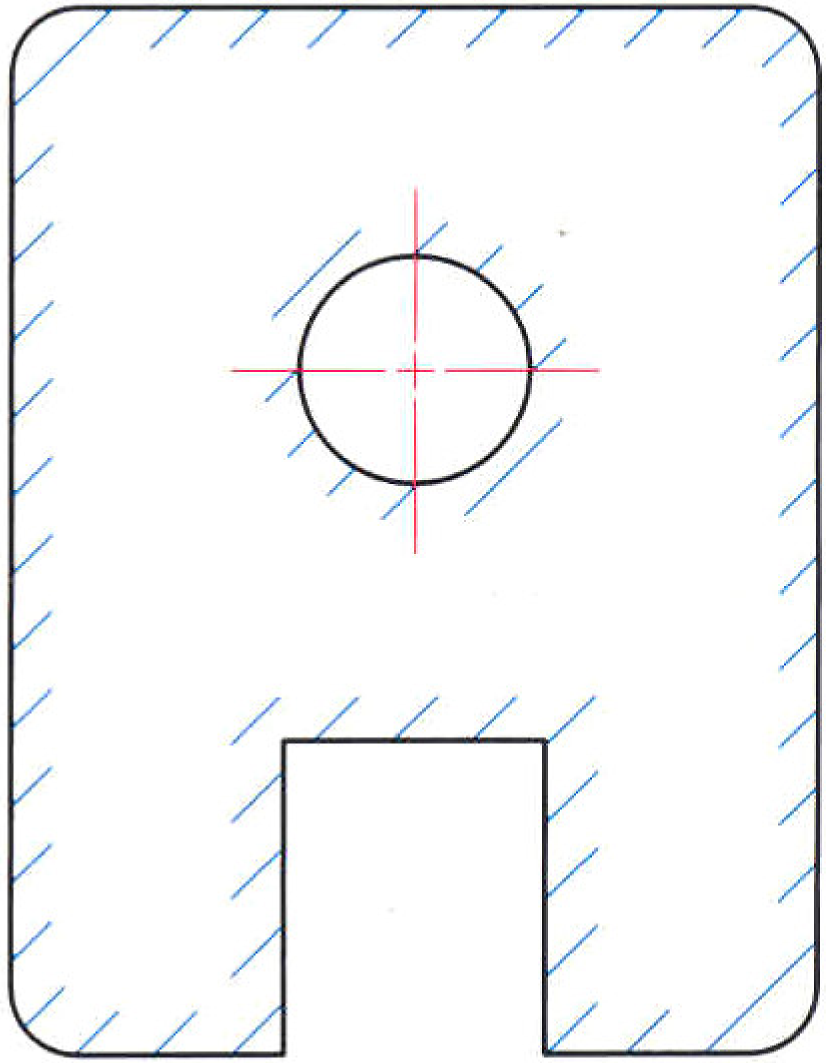

(C) Preferred

Avoid placing dimensions or notes within the section lined areas. If the dimension or note must be placed within the sectioned area, omit the section lines in the area of the note

(A) Avoid! (B) Preferred (C) Preferred

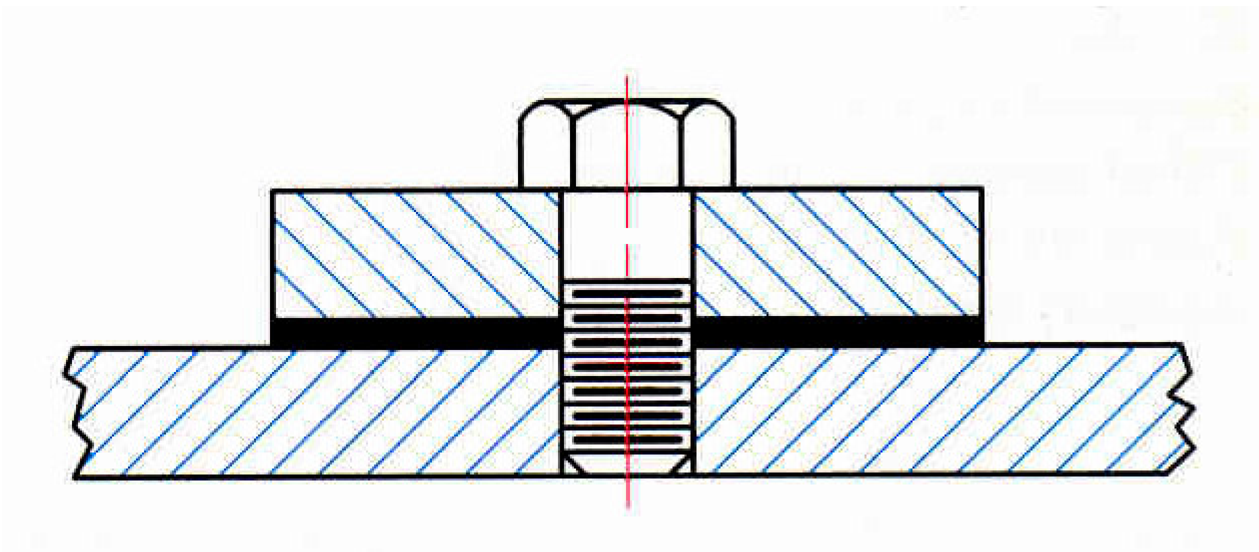
Outline Sections

An outline section view is created by drawing partial section outlines adjacent to all object lines in the section view. For large parts, outline sectioning may be used to save time.

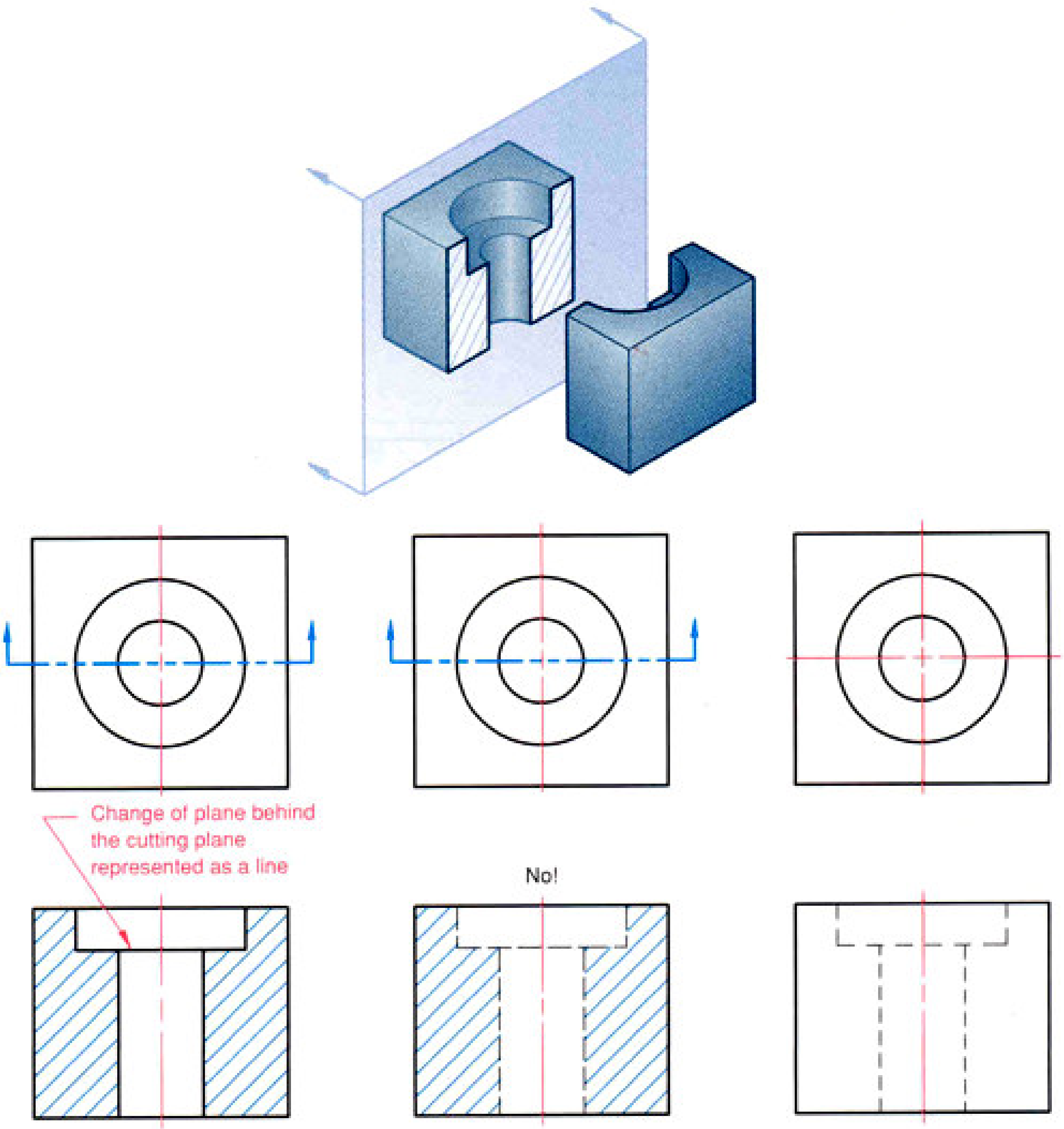


Thin Wall Sections

Very thin parts such as washers and gaskets are not easily represented with section lines, so conventional practice calls for representing the thin part in solid black.



Gasket is drawn solid black to show that it is sectioned



(A) Correct representation

(B) Incorrect representation

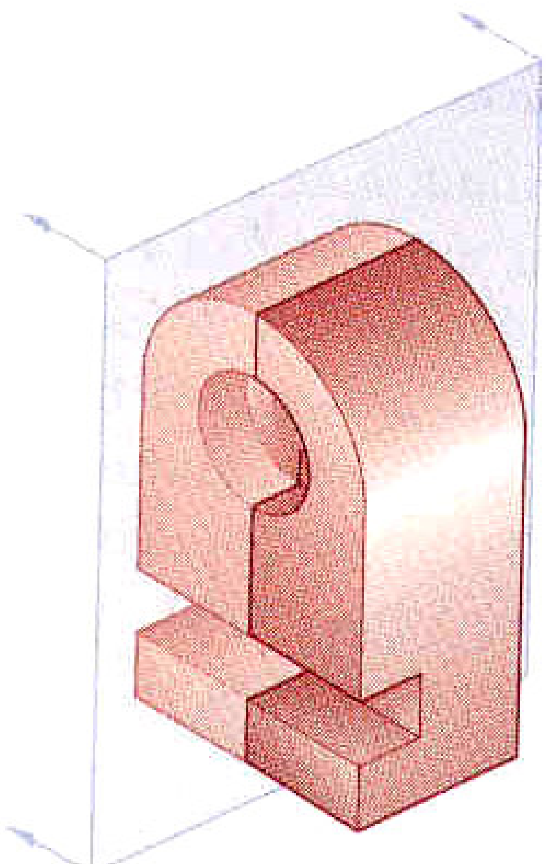
(C) Normal multiview

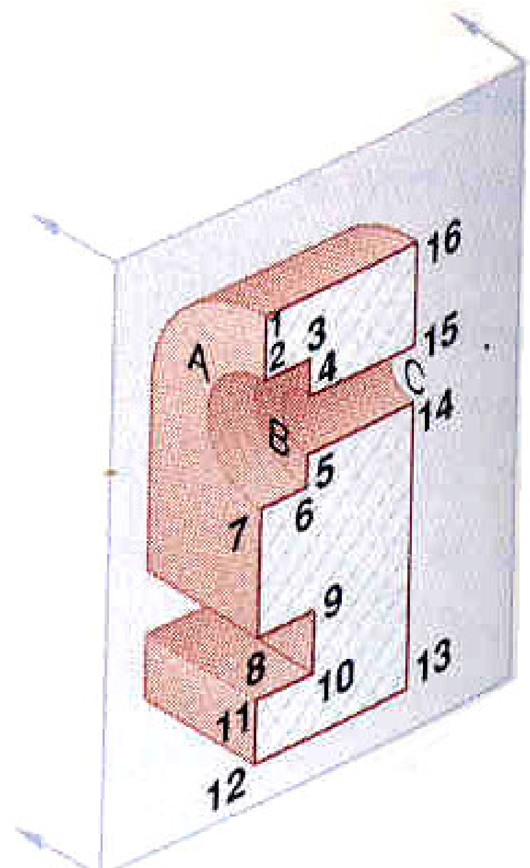
Section lined areas are bounded by visible lines, never by hidden lines, because the bounding lines are visible in the section view

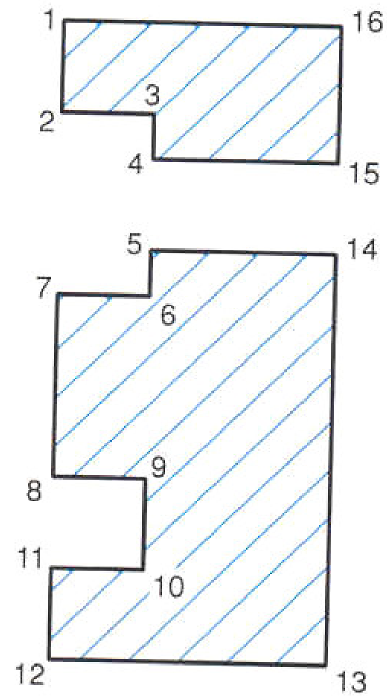
Points of Intersection (POI)

- Whenever a section plane cuts a solid, it intersects (and or coincides with) the edges of solids. The point at which the section plane intersects an edge of the solid is called the point of intersection (POI).

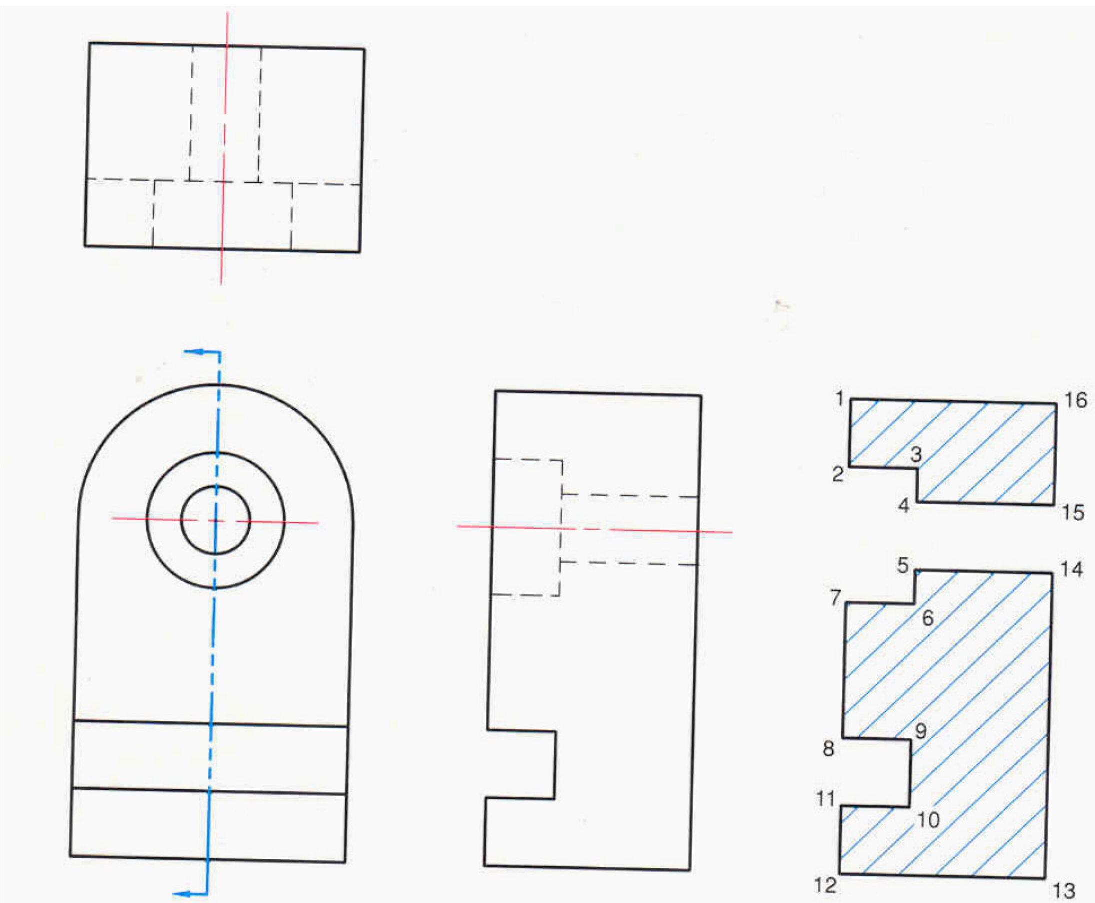
A section view is created by passing an imaginary cutting plane vertically through the center of the part. This figure is a 3D representation of the part after it is sectioned. This section view more clearly shows the interior features of the part. The corners of the section view are numbered so that they can be compared with the orthographic section view.



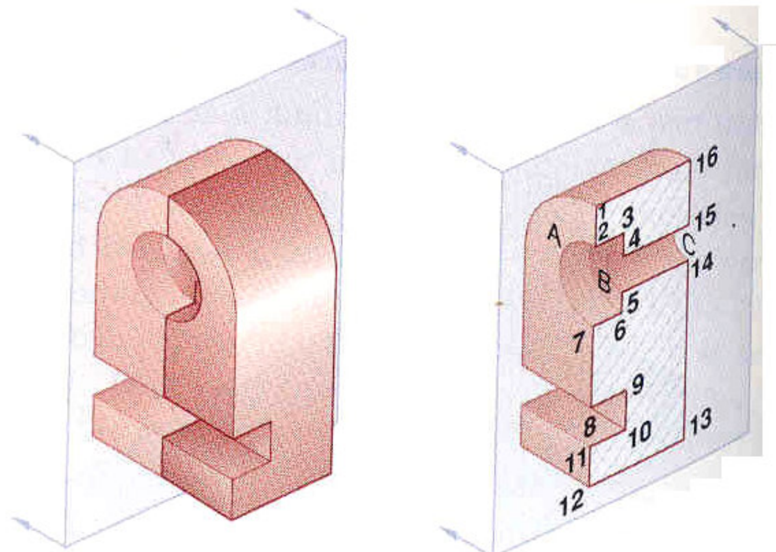




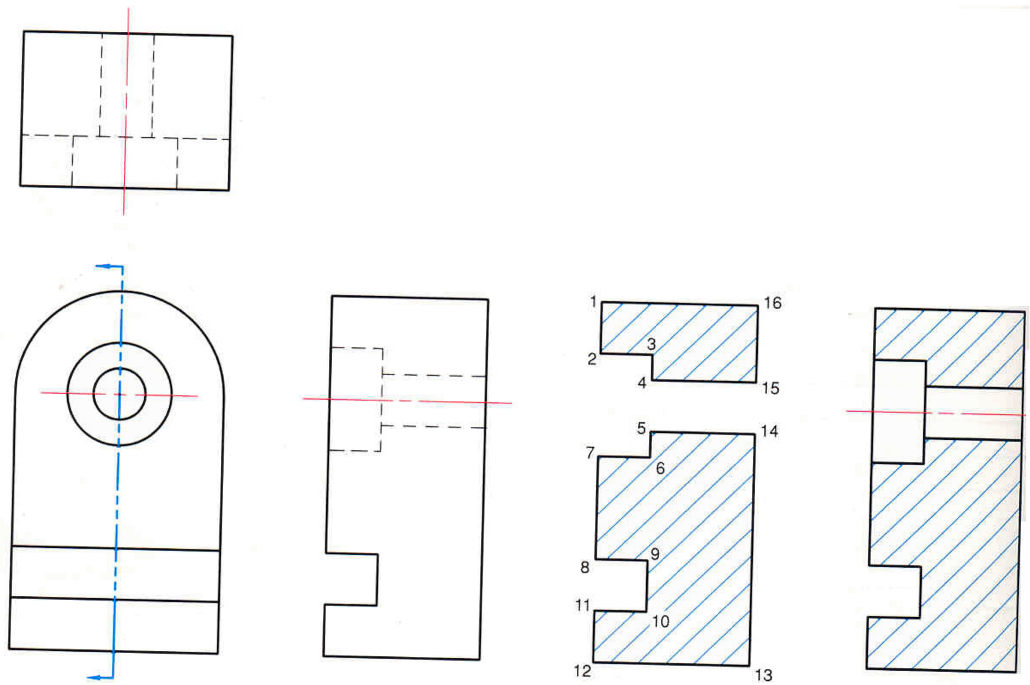
The line of sight for the section view is perpendicular to the cut surfaces, which means they are drawn true size and shape in the section view. Also, no hidden lines are drawn and all visible surfaces and edges behind the cutting plane are drawn as object lines.



Normal multiview



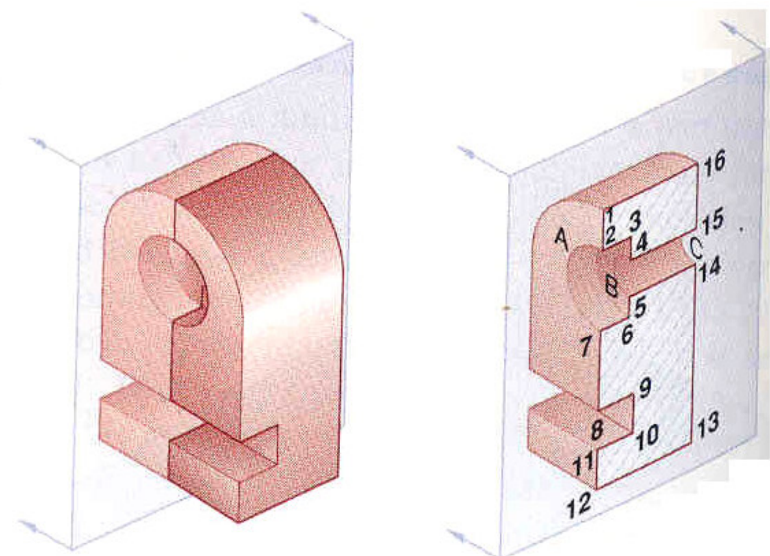
All the surfaces touched by the cutting plane are marked with section lines. Because all the surfaces are the same part, the section lines are identical and are drawn in the same direction. The center line is added to the counter bored hole to complete the section view.



Normal multiview drawing

(A)

(B)

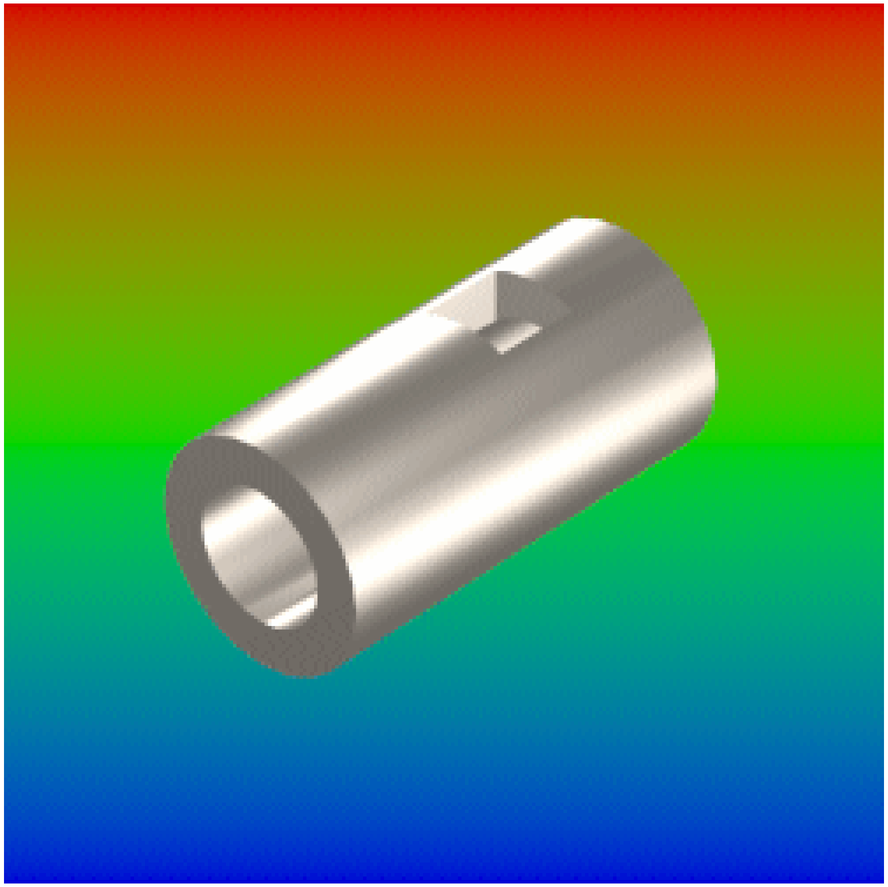


Types of Section Views

- Full sections
- Half sections
- Offset sections
- Broken-out sections
- Revolved sections
- Removed sections

Full Section View

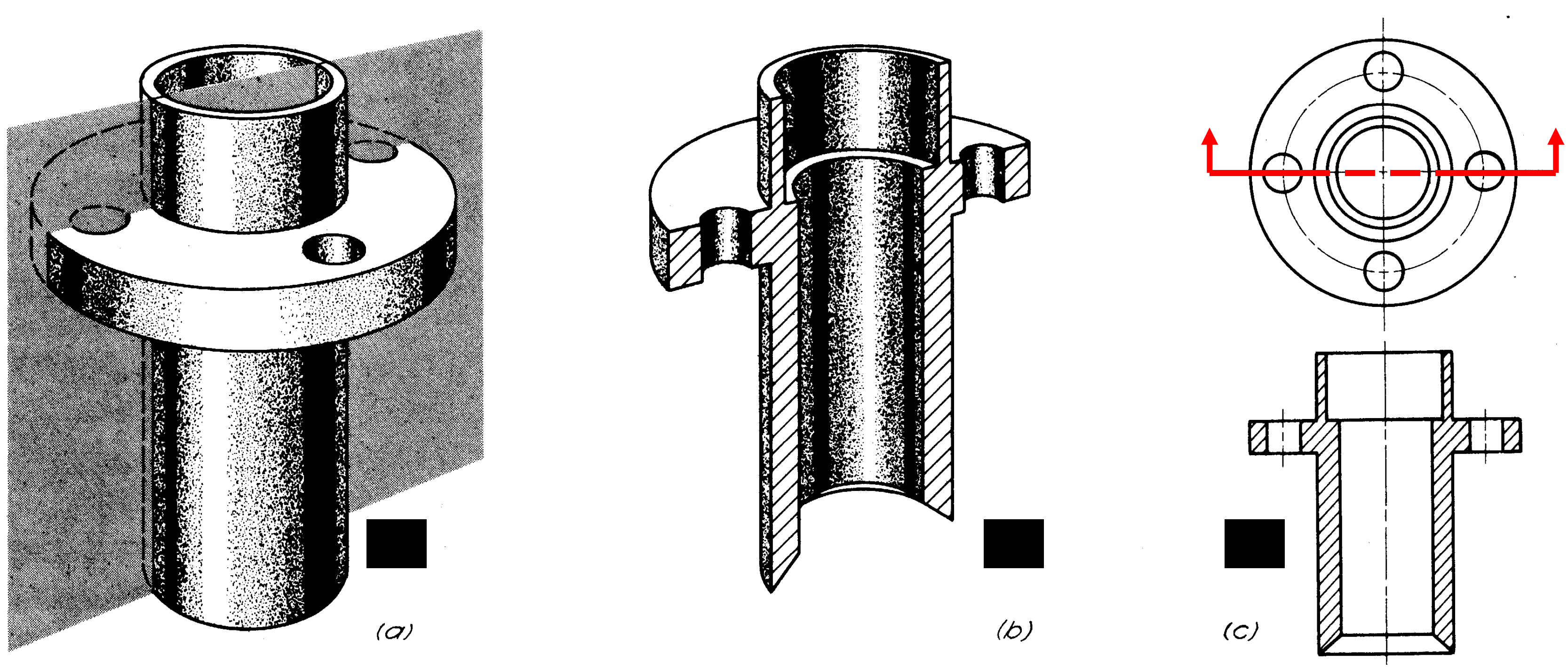
- **In a full section view, the cutting plane cuts across the entire object**
- **Note that hidden lines become visible in a section view**



Full Section View

- Show cutting plane in the top view – New line type –

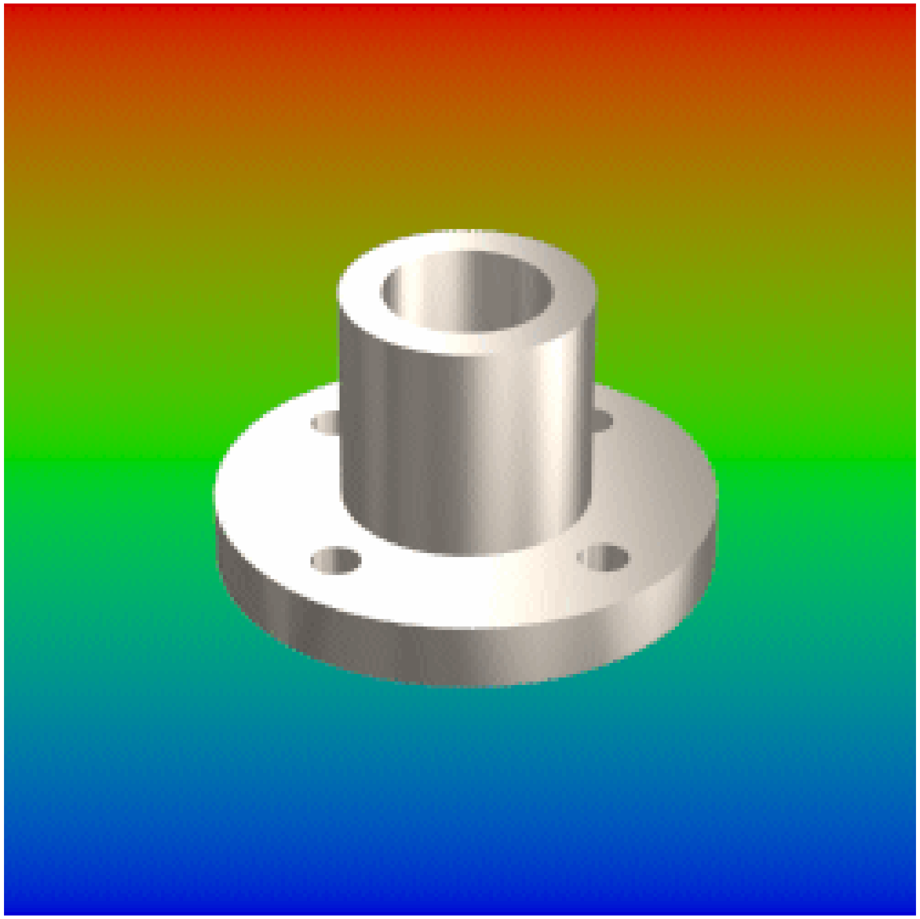
- Make a full section in the front view
- Note how the cutting plane is drawn and how the crosshatching lines mark the surfaces of material cut by the cutting plane.



Half Section View

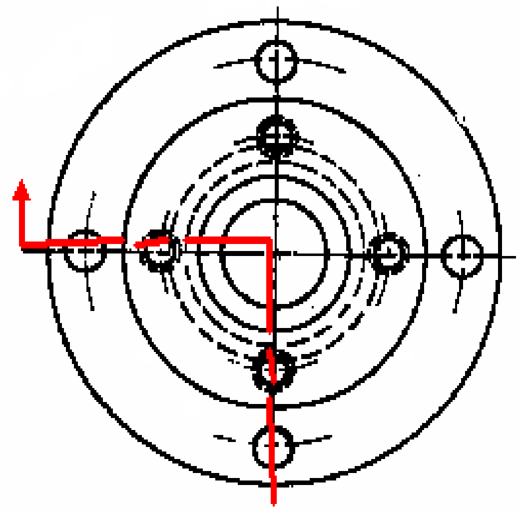
- The cutting planes do not cut all the way through to the object.

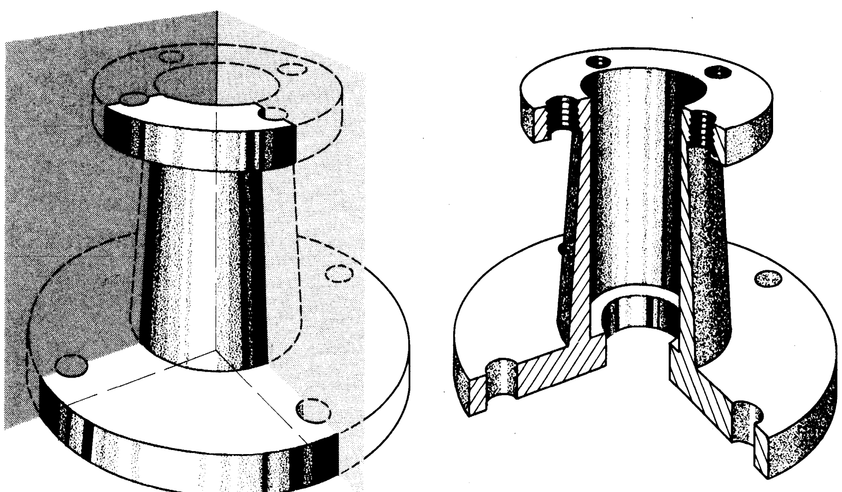
- They cut only half way and intersect at the centerline.



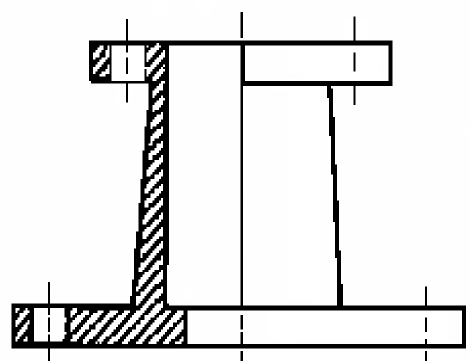
Half Section View

Half Section is used mainly for symmetric objects





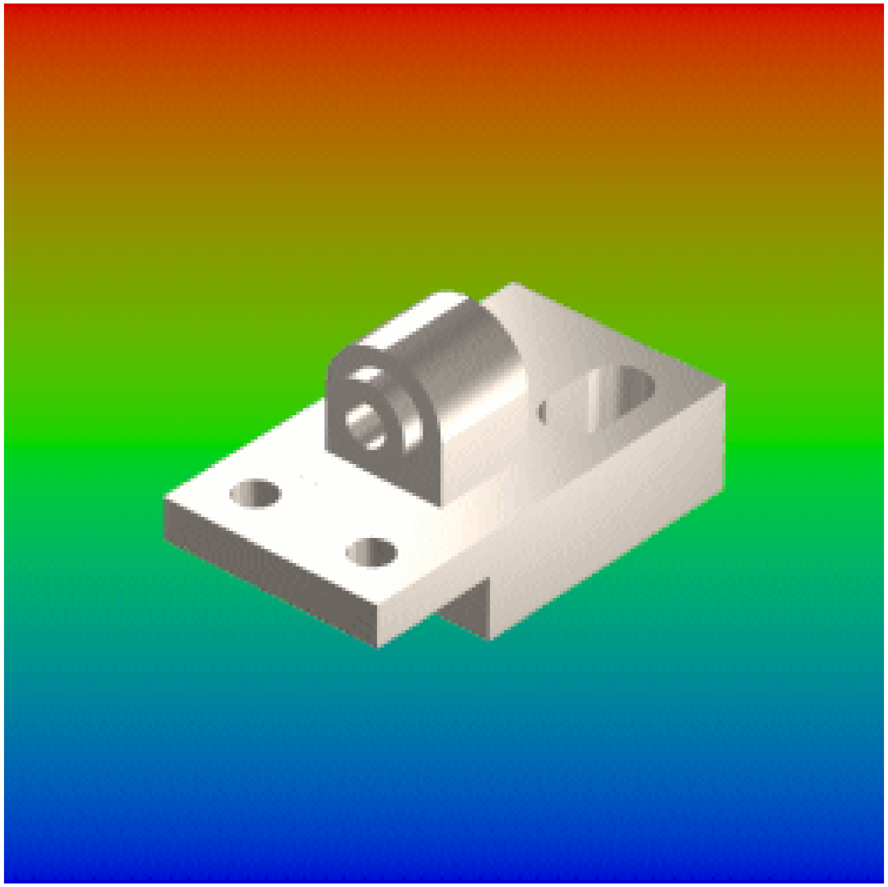
(b)



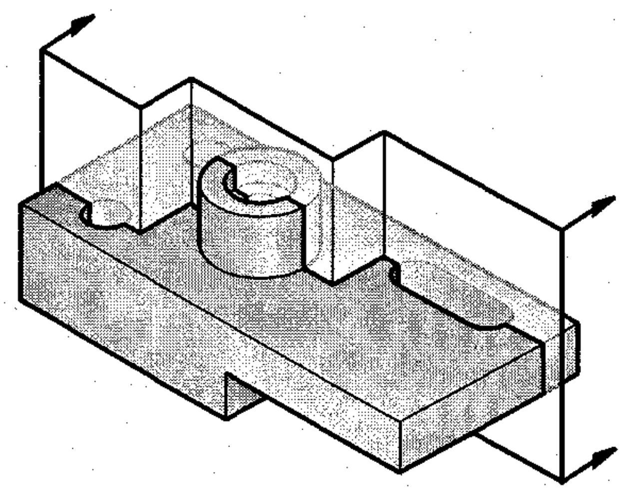
(d)

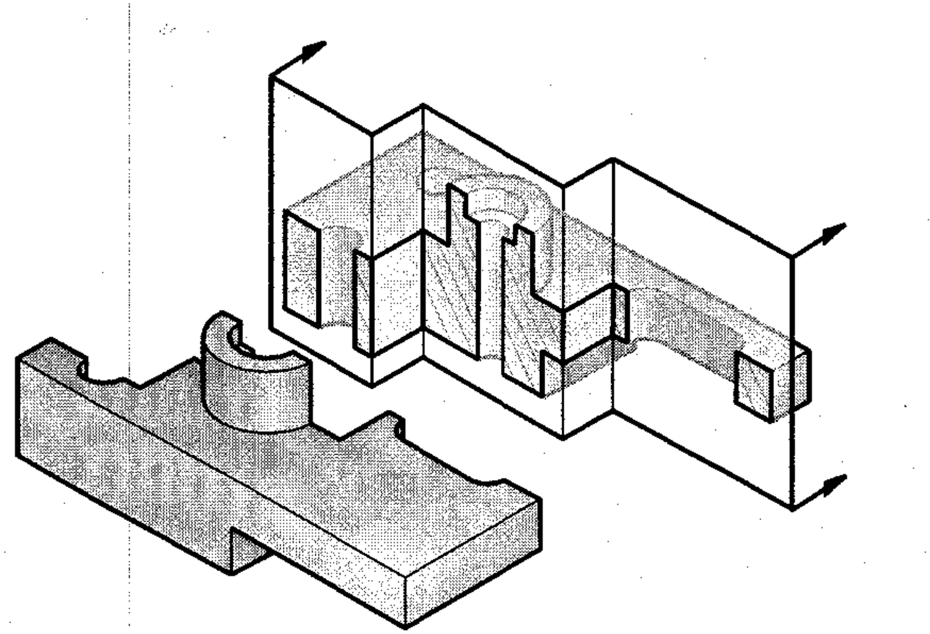
Offset Sections

Offset sections are used to show interior features that do not lie along a straight line

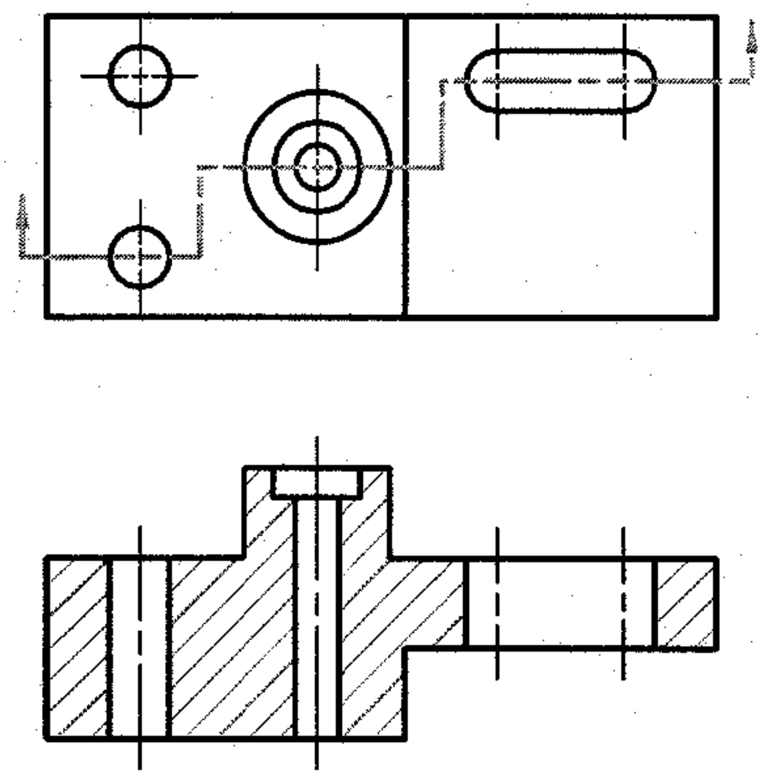


Offset Sections

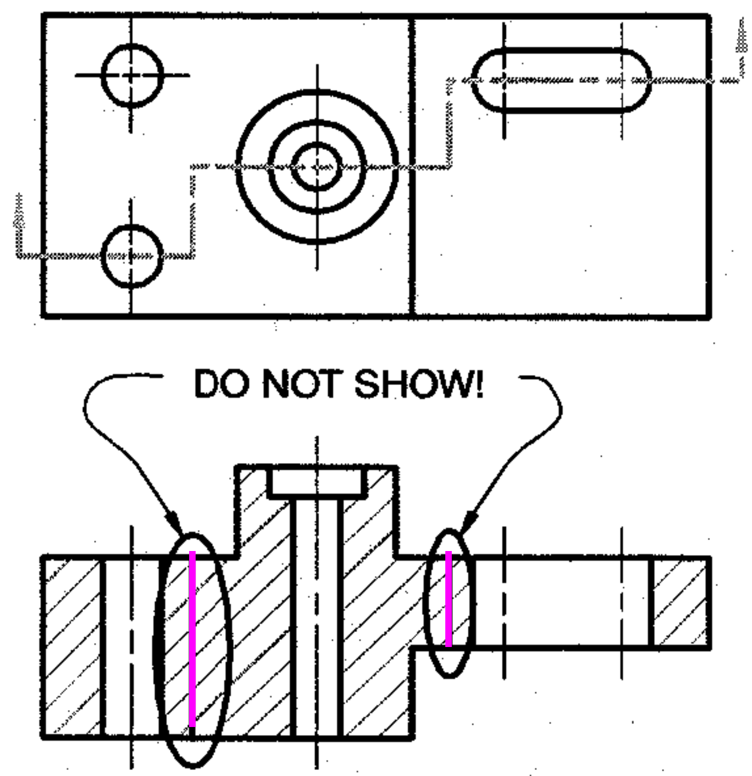




Offset Sections



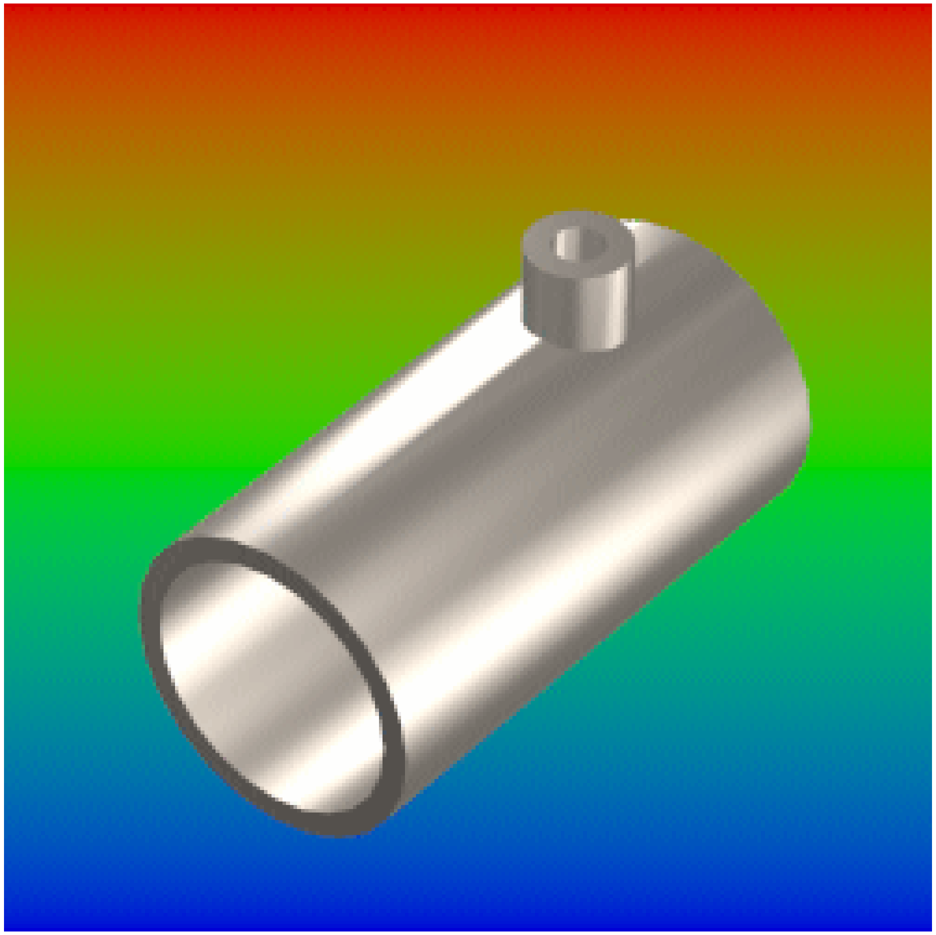
(A) Offset section view



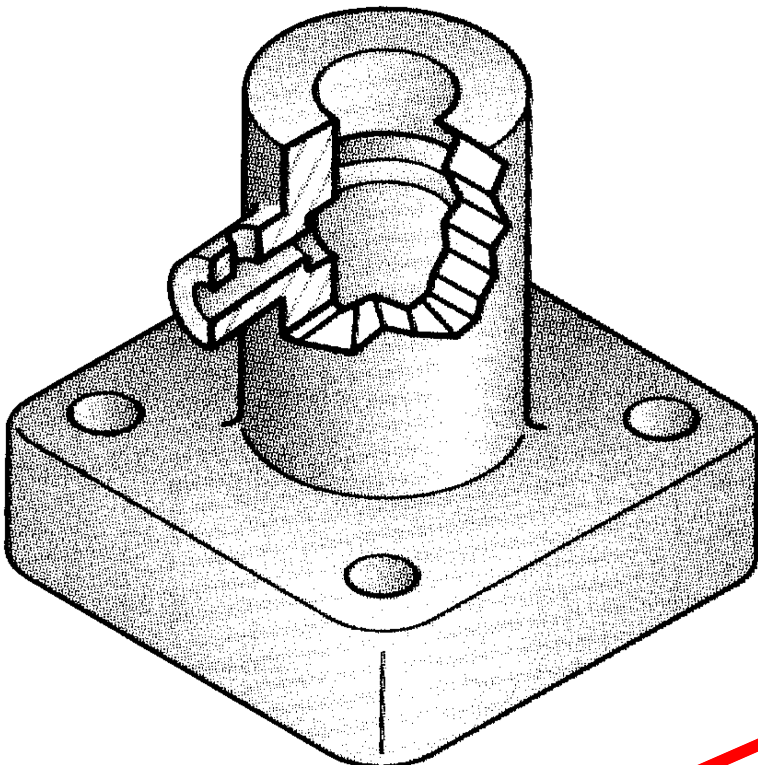
(B) No!

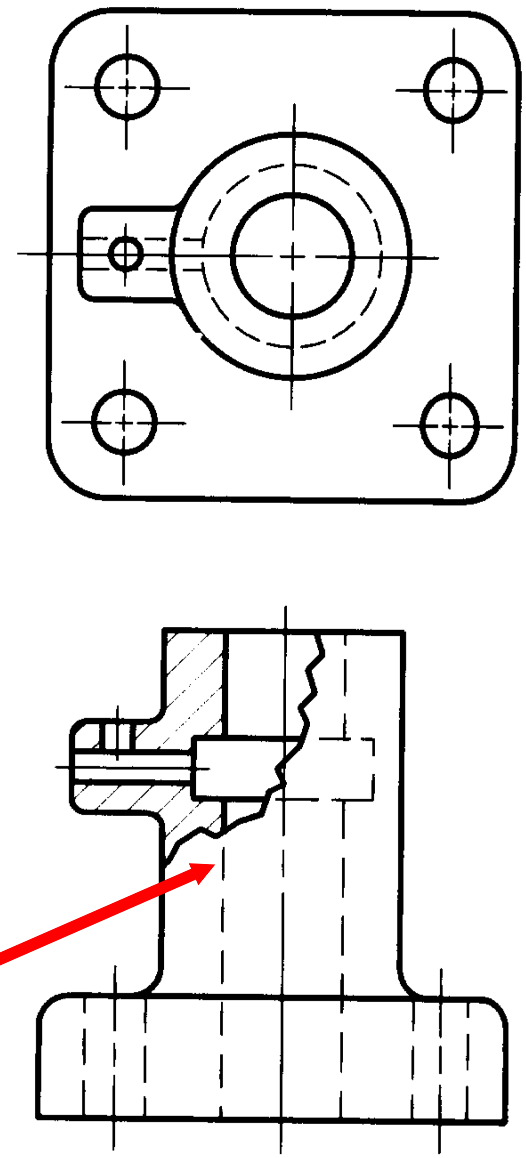
Broken Out Sections

A broken-out section view is created by breaking off part of the object to reveal interior features



Broken Out Sections



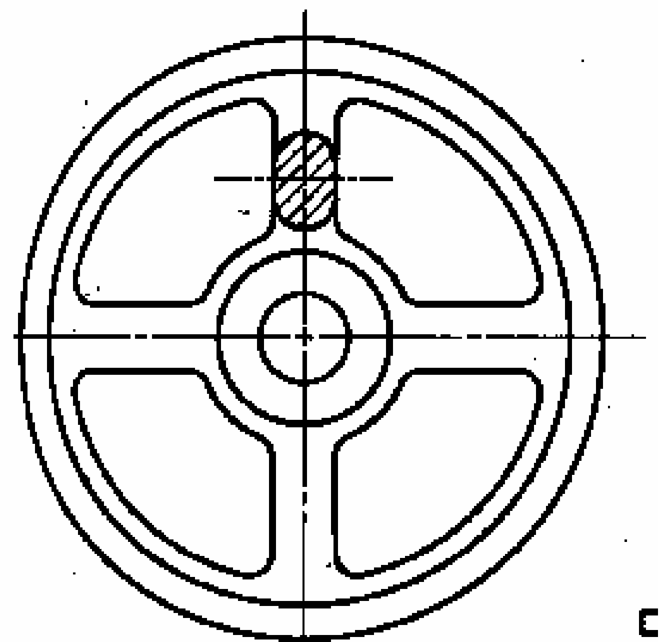


(C) Broken-out section view

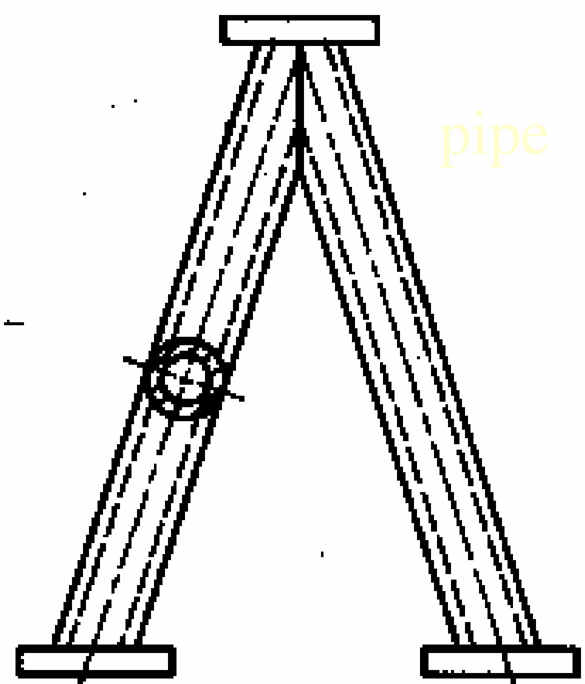
Hidden lines are used only when needed for clarity.

Revolved Sections

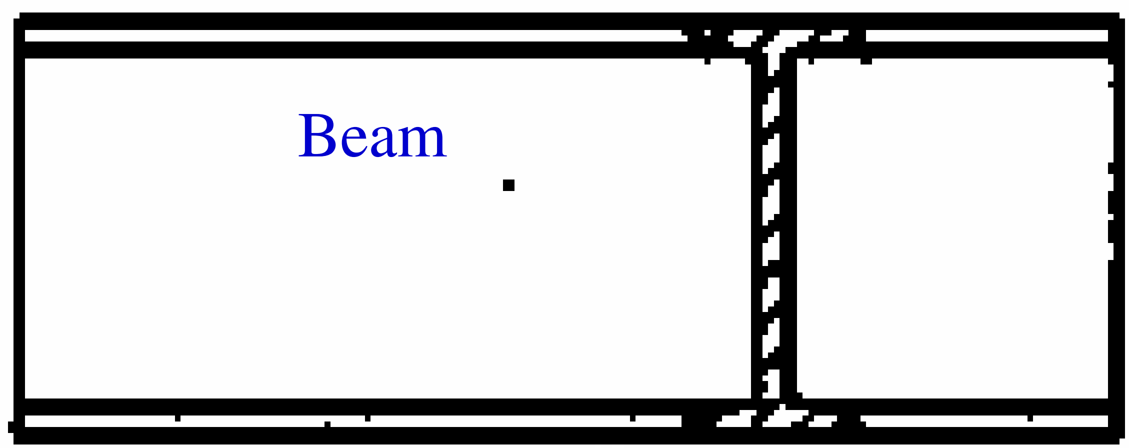
Revolved sections show the shape of an object's cross-section superimposed on a longitudinal view

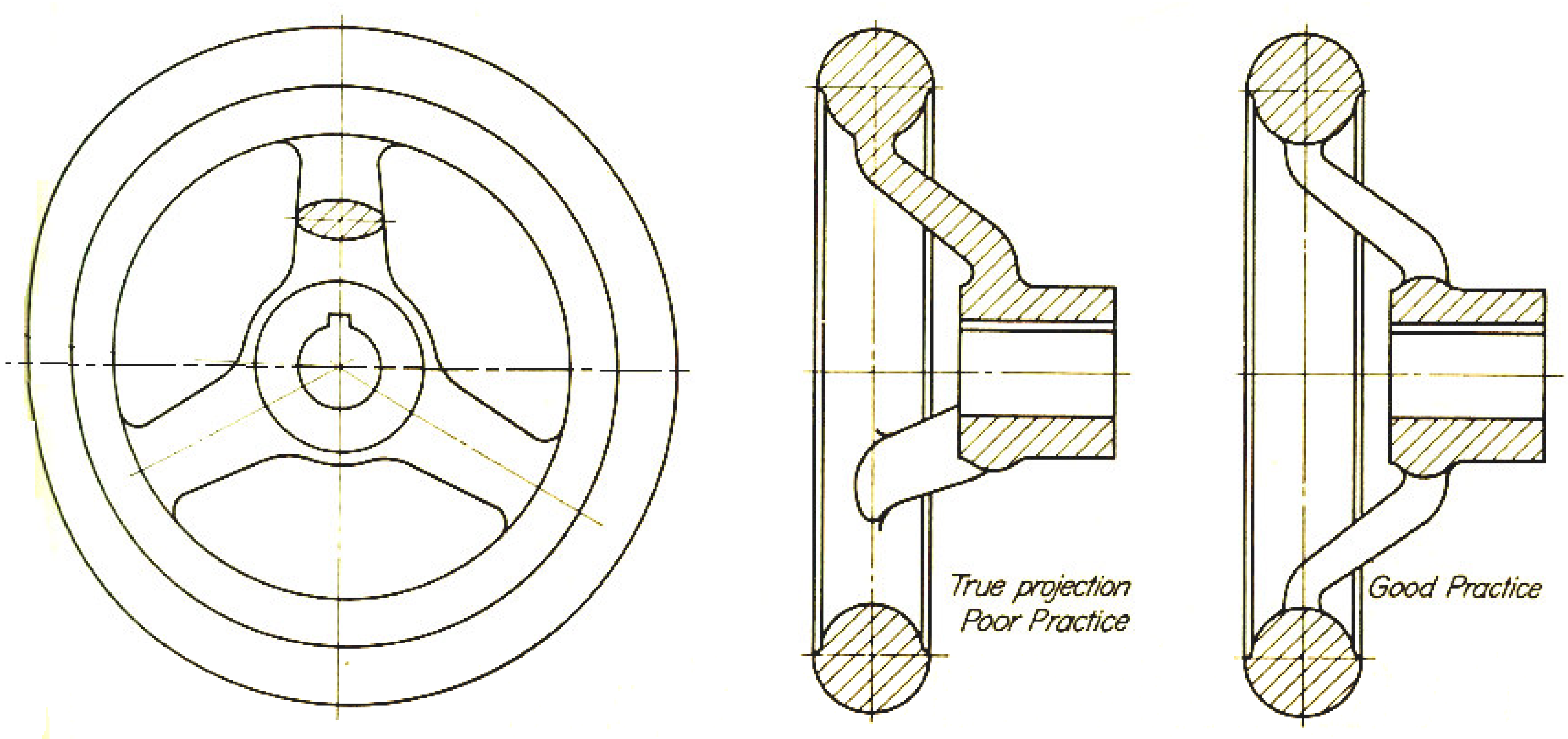


(a)



(b)

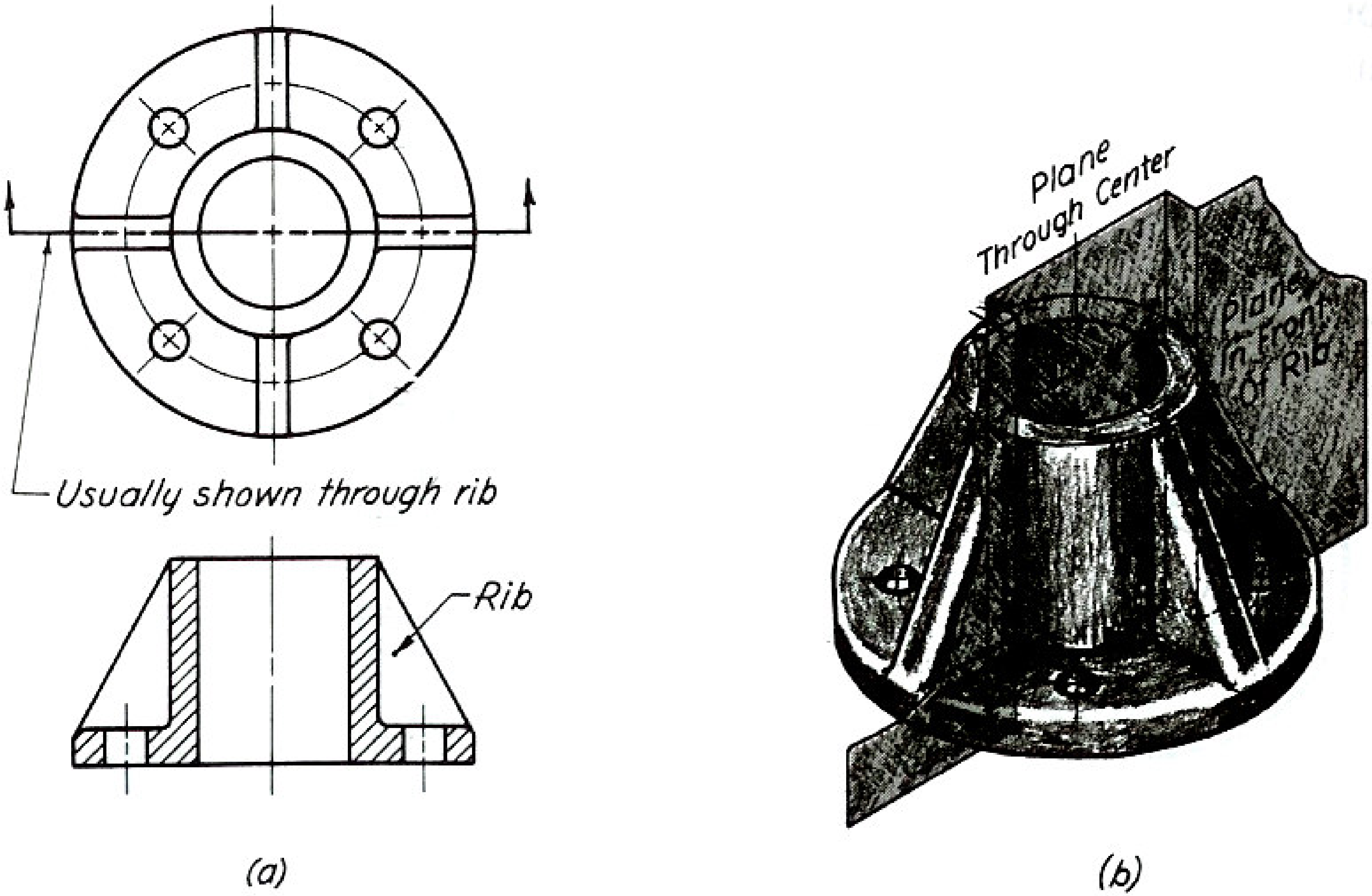




Any part with an odd number of spokes or ribs will give an unsymmetrical and misleading section if the principle of true projections are strictly adhered to.

1) The spoke is rotated to the path of the vertical cutting plane and then projected on the side view.

2) Neither of the spokes should be sectioned (hatched).



IG. 7.30 Conventional treatment of ribs in section.

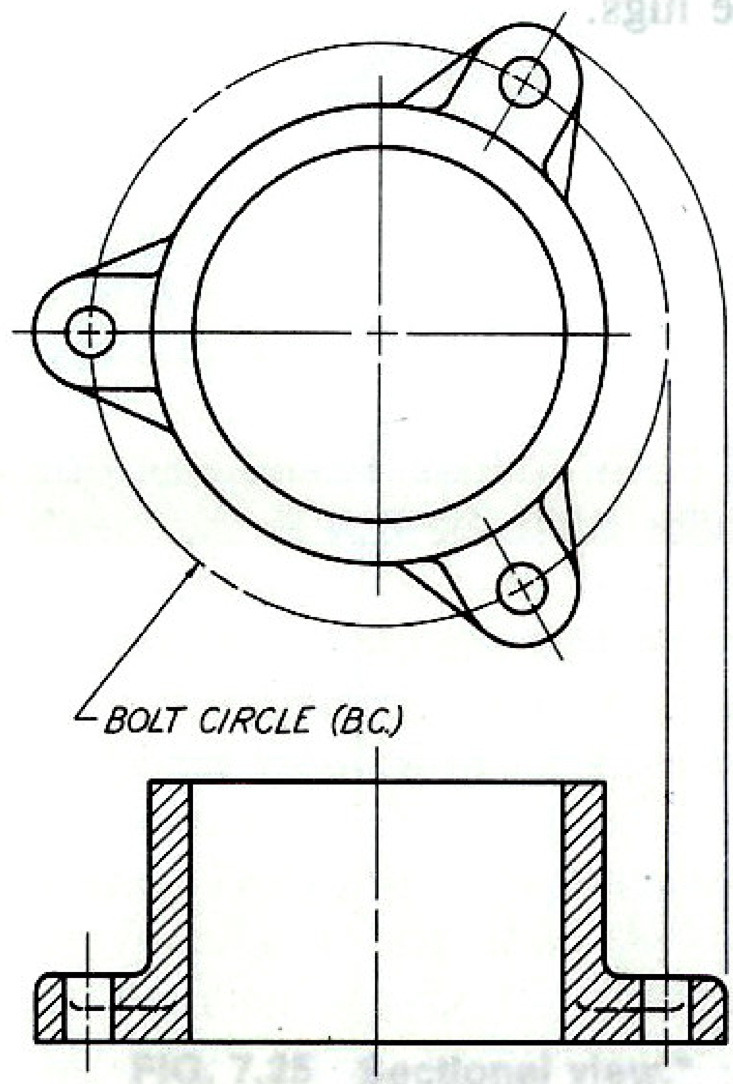


FIG. 7.29 Revolution of a portion of an object.

Section of solids

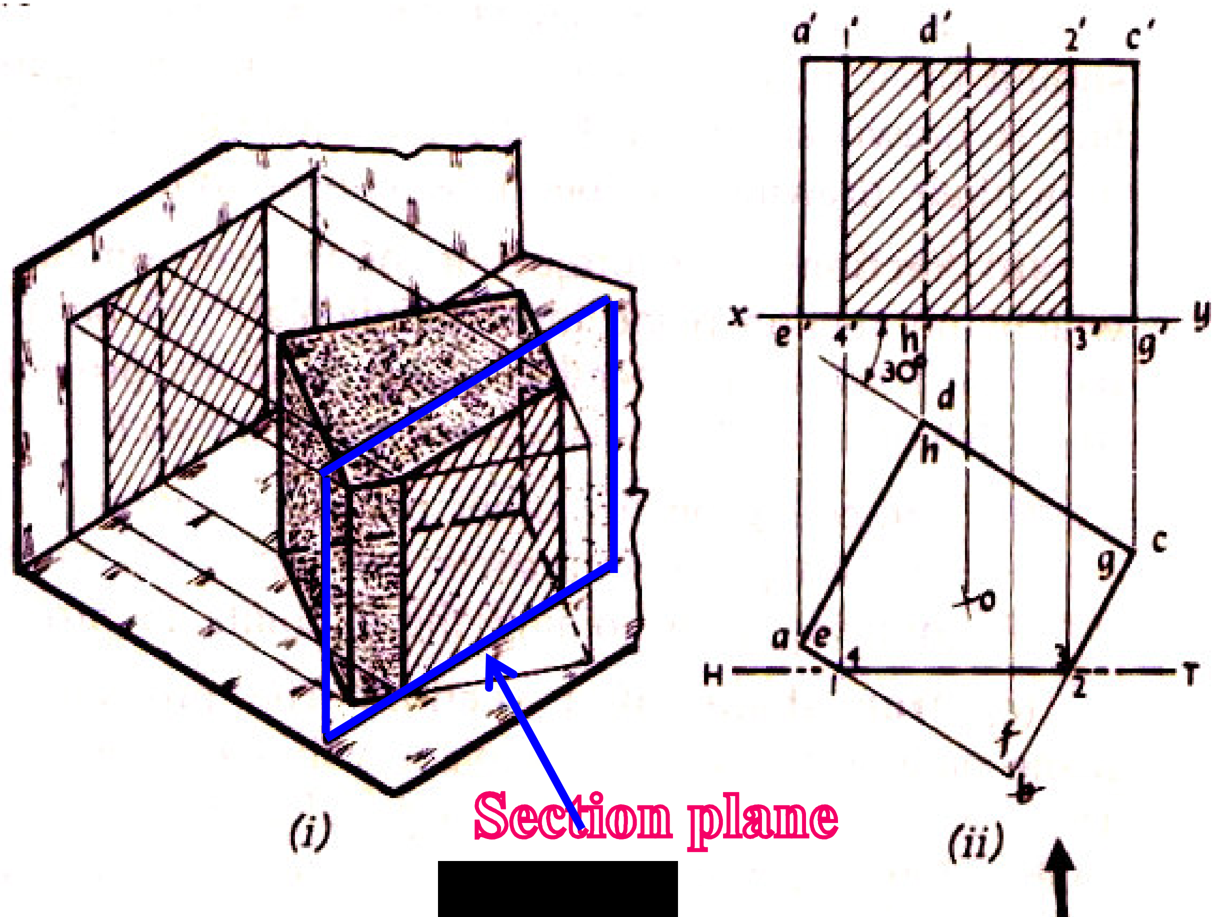
- Section plane parallel to VP (cube)
- Section plane parallel to HP (prism, pyramid)
- Section plane inclined to VP (Pyramid, cylinder)
- Section plane for which its true shape is given
- Sectional views for a complex object

Section plane parallel to VP

Draw the projection of the solid without section plane. (i.e. top view and front view according to the given conditions).

Then introduce the section plane in the top view. As it is parallel to the VP, is seen as a line in top view.

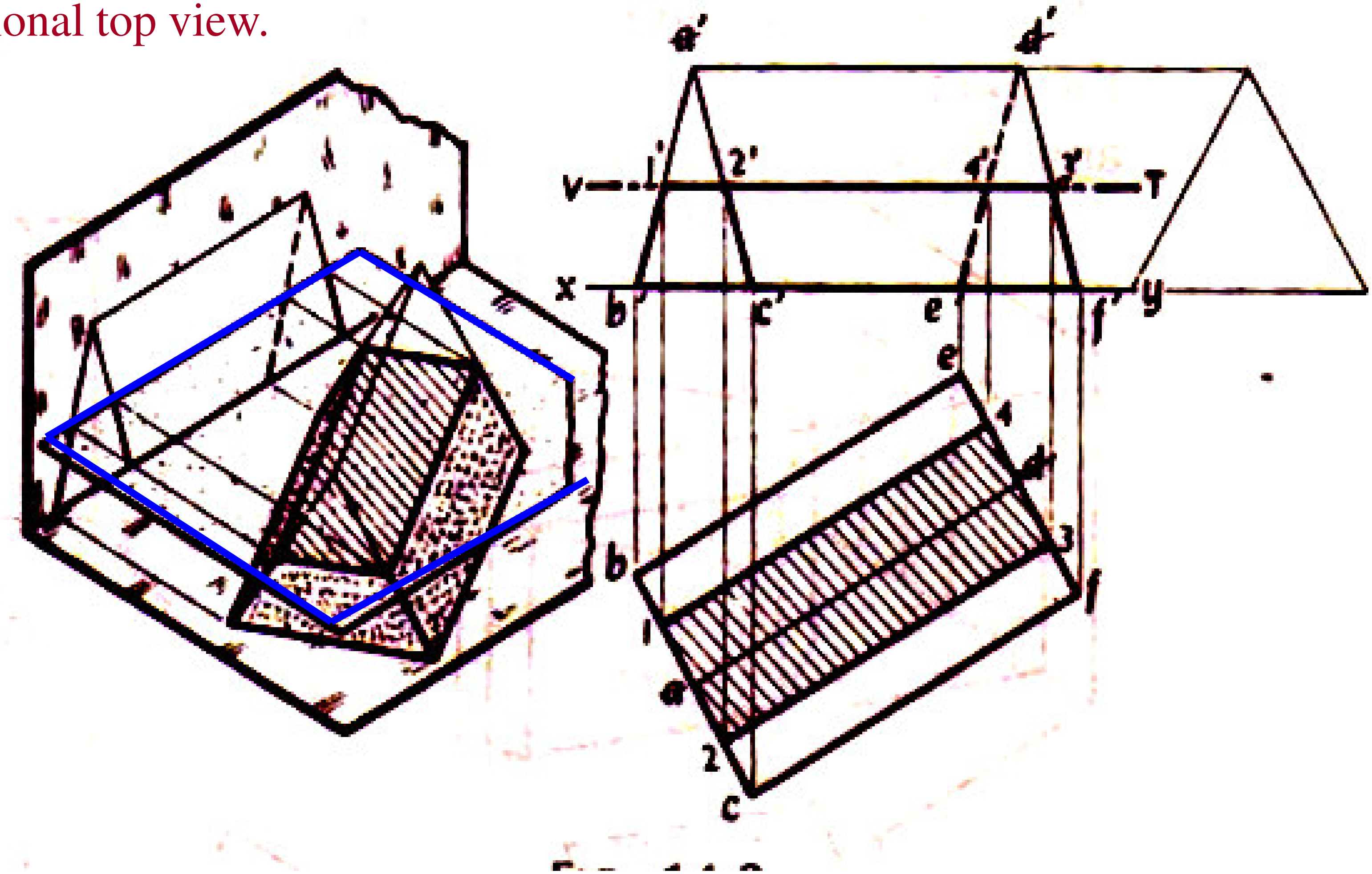
Carry it to the front view.



[redacted]

Section plane parallel to HP

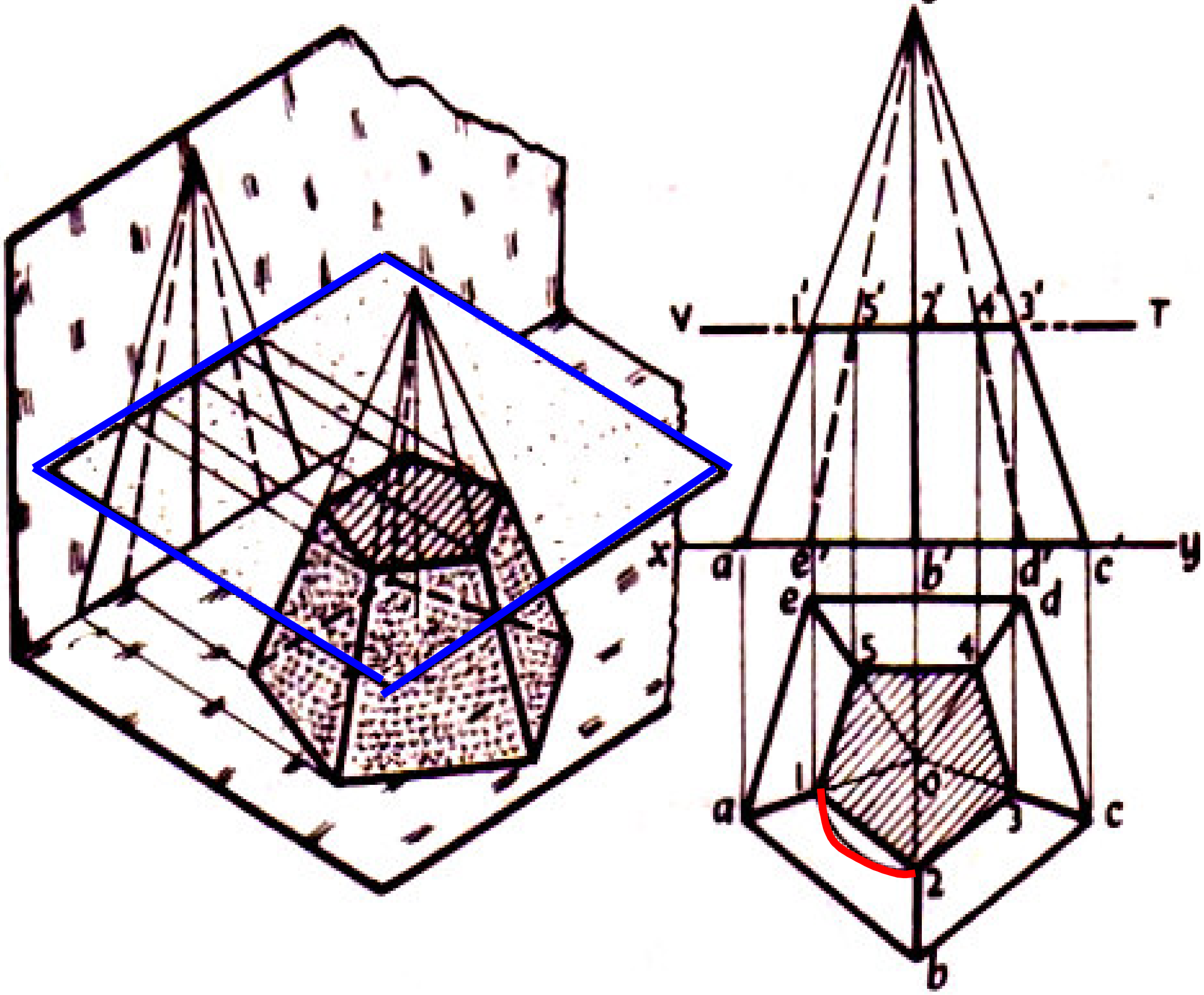
A triangular prism, side of base 30 mm and axis 50 mm long is lying on the HP on one of its rectangular faces with its axis inclined at 30° to the VP. It is cut by a horizontal section plane at a distance of 12 mm above the ground. Draw its front view, side view and sectional top view.



Draw the projections of the un-cut prism. As the section plane is parallel to HP, it will be seen as a straight line parallel to XY in the front view. Project the section to the top view.

Section plane parallel to HP…..

A pentagonal pyramid, side of base 30 mm and axis 65 mm long, has its base horizontal and an edge of the base parallel to the VP. A horizontal section plane cuts it at a distance of 25 mm above the base. Draw its front view and sectional top view.

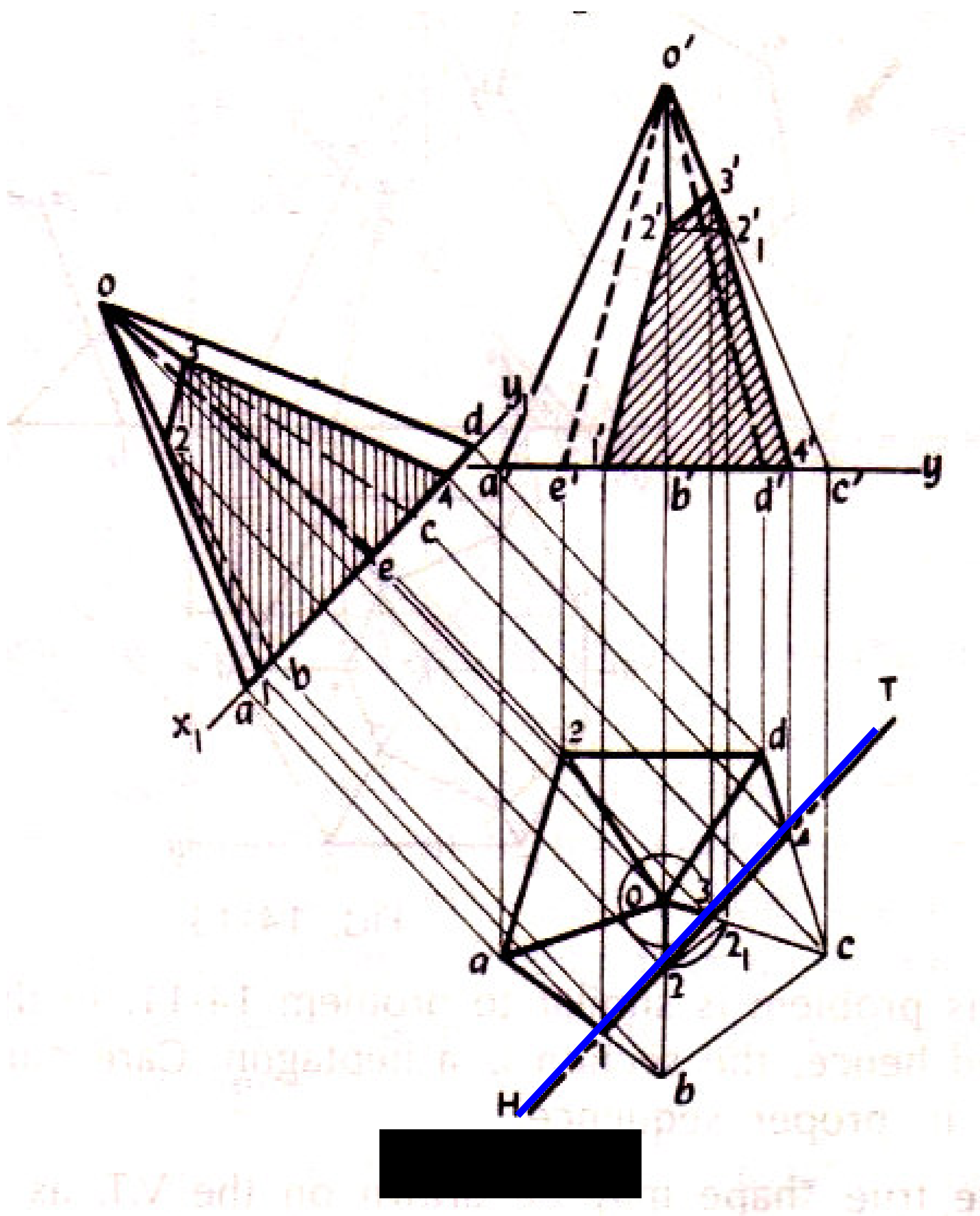


Section plane Inclined to VP

A pentagonal pyramid has its base on the HP. Base of the pyramid is 30 mm in side, axis 50 mm long. The edge of the base nearer to VP is parallel to it.

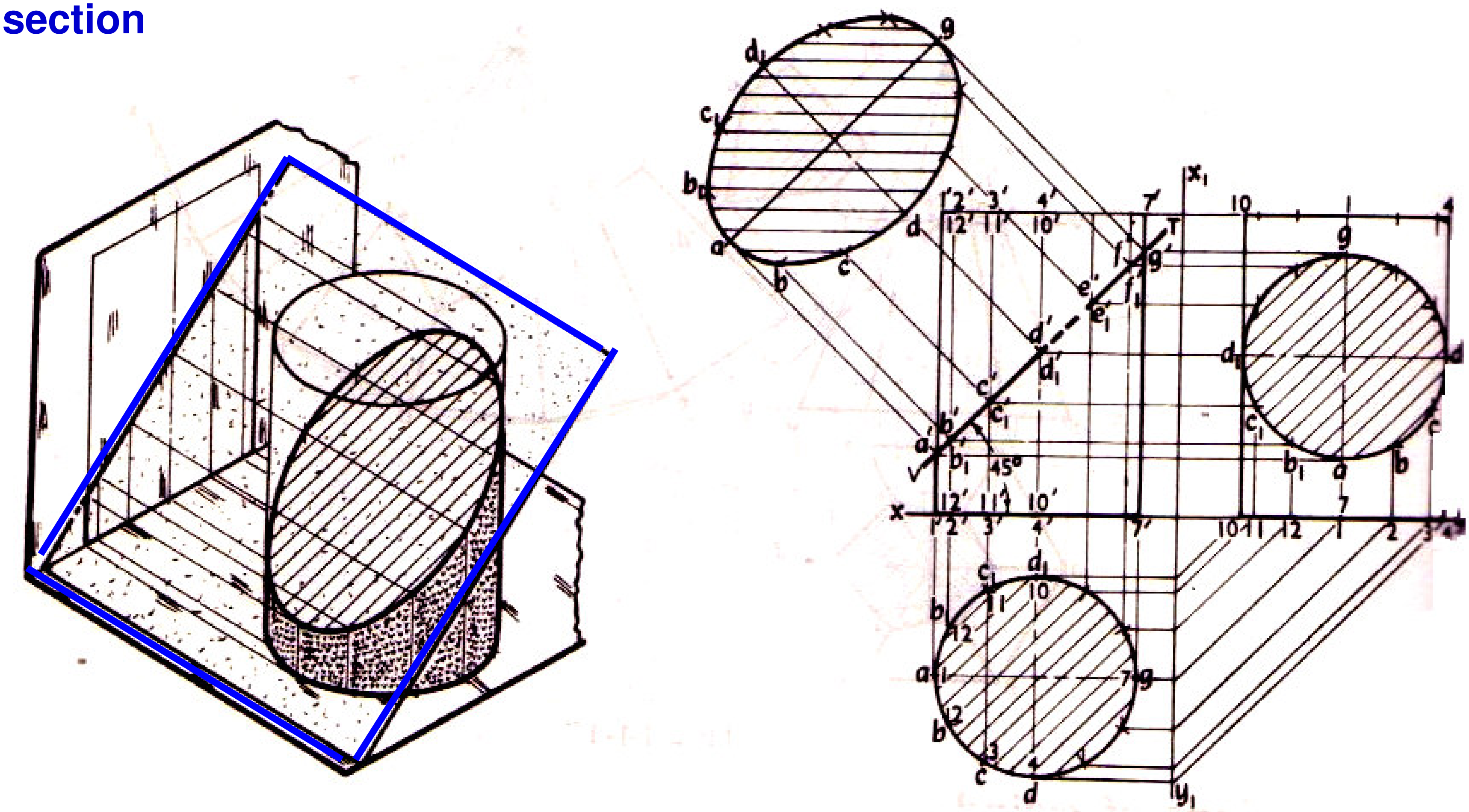
A vertical section plane, inclined at 45 to the VP, cuts the pyramid at a distance of 6 mm from the axis.

Draw the top view, sectional front view and the auxiliary front view on an AVP parallel to the section plane.



Sections of Cylinders: Section plan inclined to the base

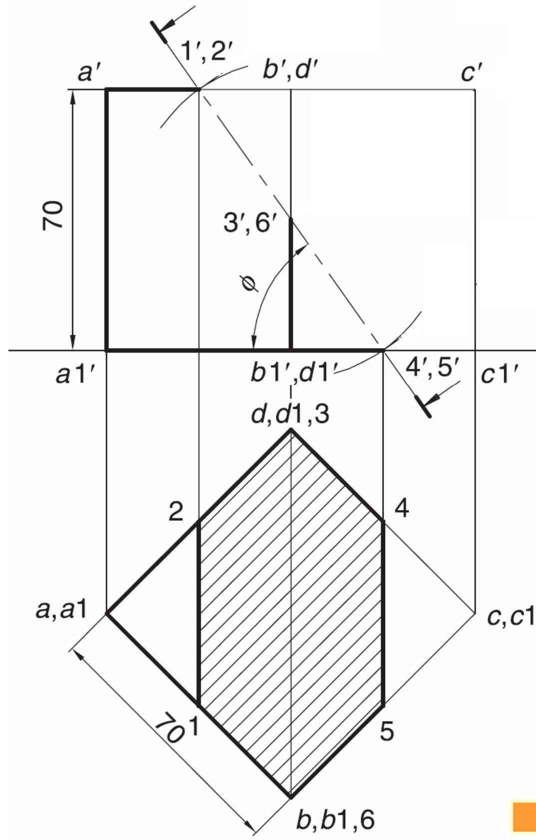
Problem.1 A cylinder of 40 mm diameter, 60 mm height and having its axis vertical is cut by a section plane, perpendicular to the VP, inclined at 45 to the HP and intersecting the axis 32 mm above the base. Draw its front view, sectional top view, sectional side view and the true shape of the section

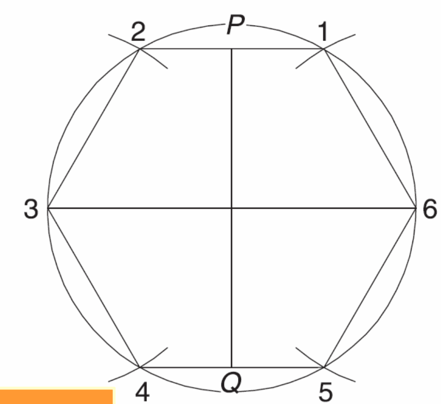


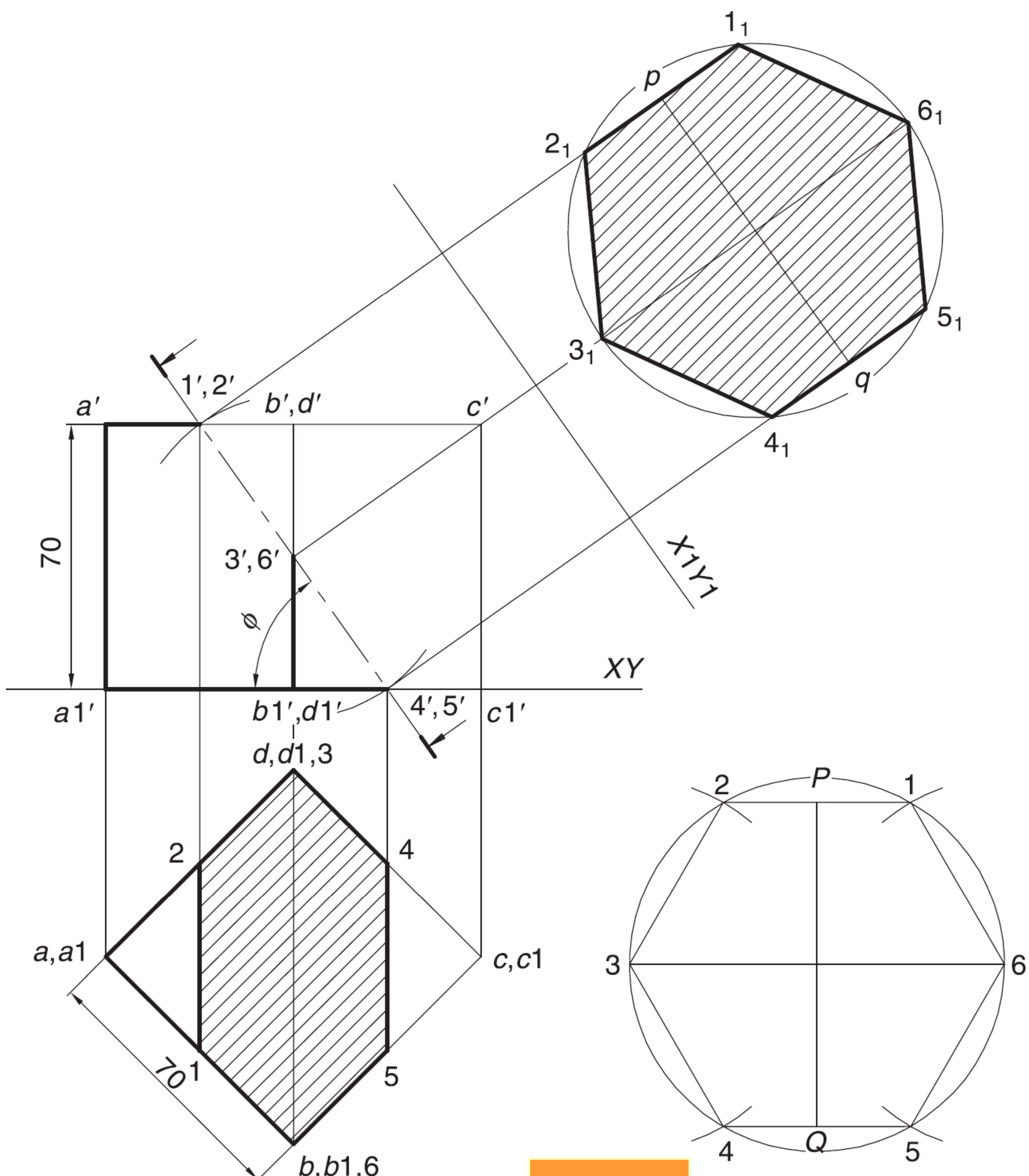
Practice Example-1: A cube of 70 mm long edges has its vertical faces equally inclined to the VP. It is cut by an AIP in such a way that the true shape of the cut part is a regular hexagon. Determine the inclination of the cutting plane with the HP. Draw FV, sectional TV and true shape of the section.

Step-1 Draw TV and FV of the cube as shown.

Step-2 As the true shape of the section is a hexagon, the cutting plane must cut the prism at 6 points. Obviously, the cutting plane will cut two edges of the top, two edges of the base and two vertical edges. The POIs at two vertical edges will be farthest from each other. These points will represent the two opposite corners of the hexagon and the distance between them will be equal to b(b1)– d(d1).

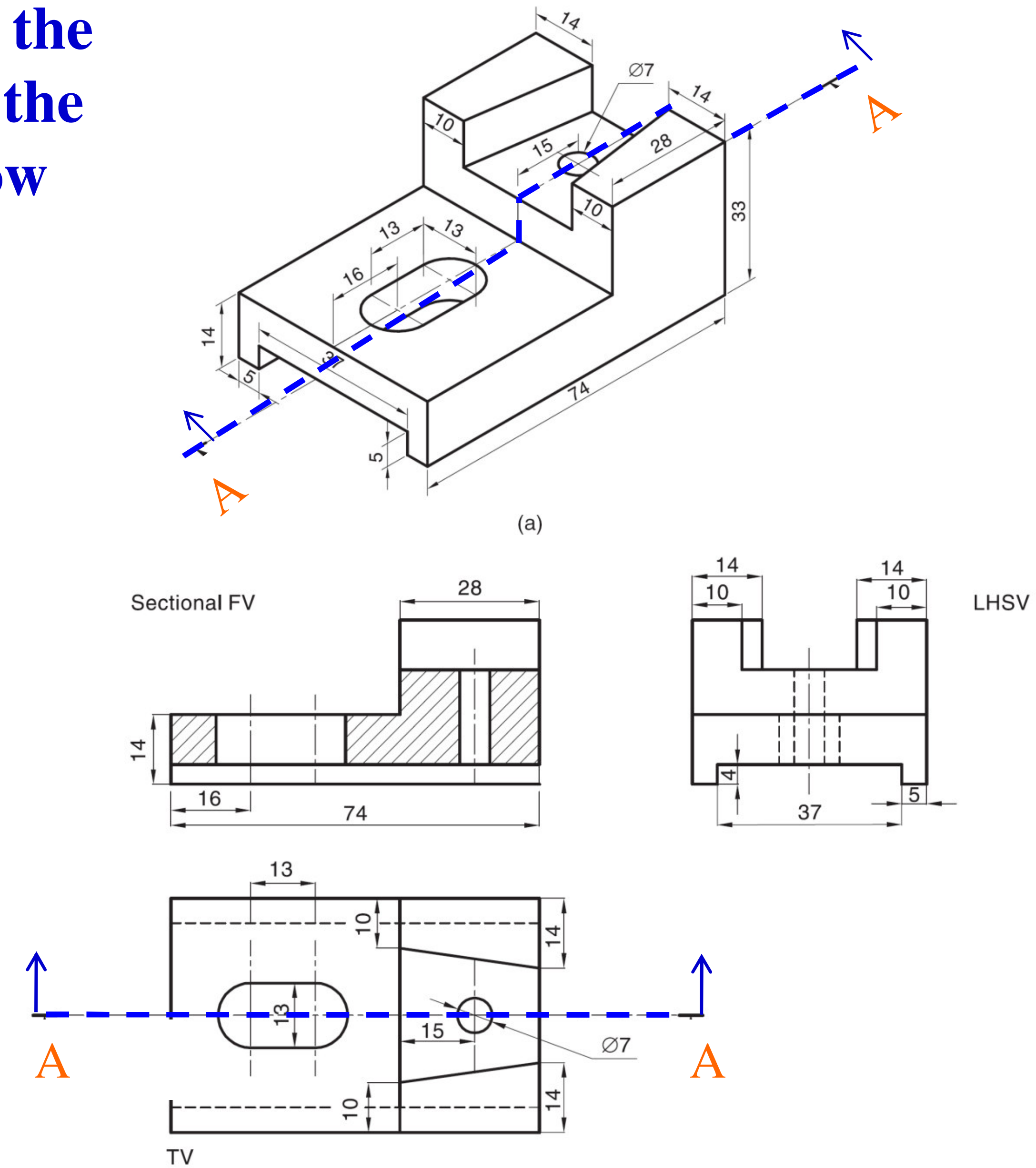






1₁
p
6₁
2₁
5₁
3₁
q
4₁
X1Y1
1′,2′
a′
b′,d′
c′
70
3′,6′
ϕ
XY
a1′
b1′,d1′
4′,5′
c1′
d,d1,3
2
4
a,a1
c,c1
70
1
5
b,b1,6
2
P
1
3
6
4
Q
5

Practice Example 2: Example for a complex object: Draw the sectional FV, TV and SV of the object shown in Figure below



THANK YOU