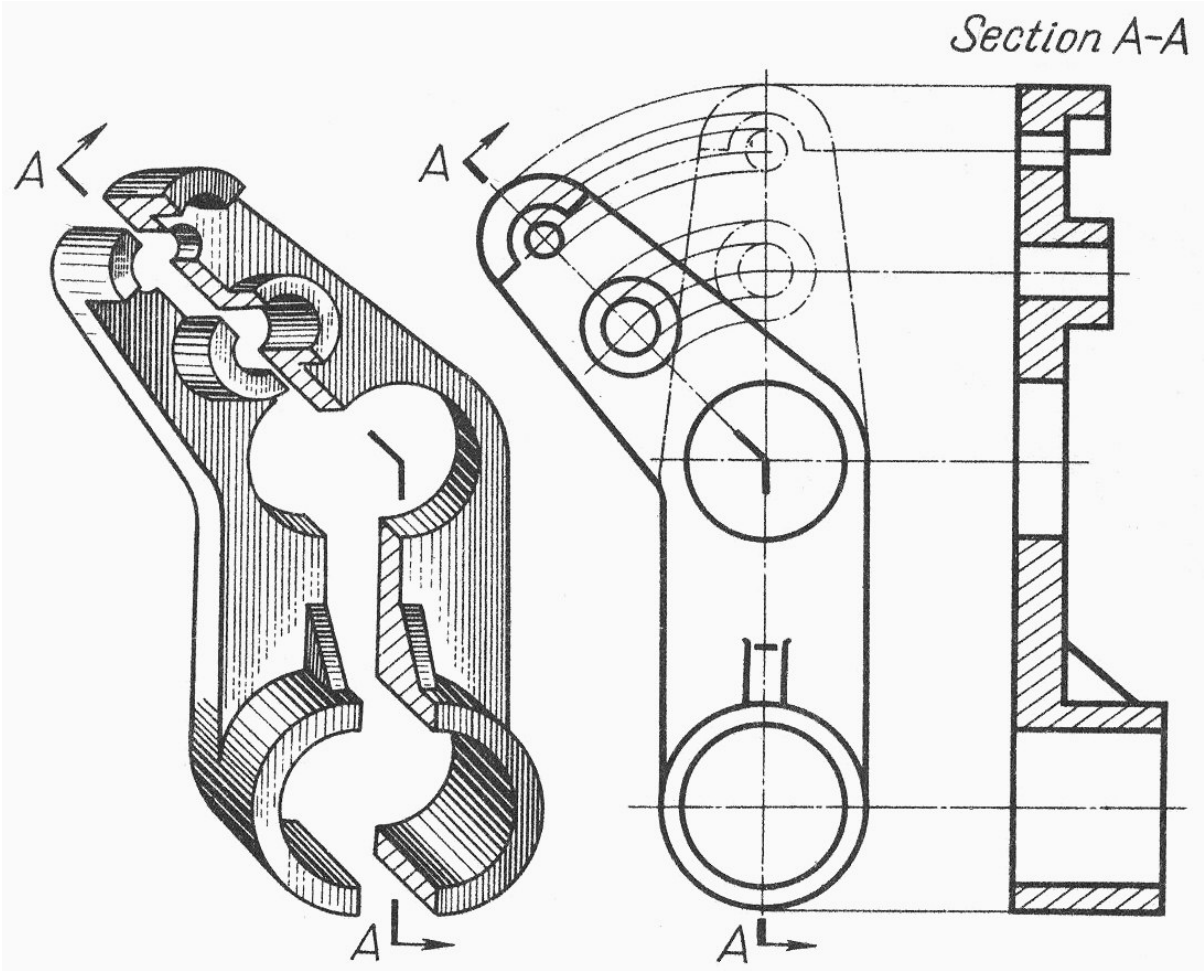
ME 114 – Engineering Drawing II

SECTIONING



Mechanical Engineering
University of Gaziantep

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Purpose of Sectioning

- On many occasions, the interior of an object is complicated or the component parts of a machine are drawn assembled.
- The interior features are represented by hidden lines in usual orthographic views, which results in confusion and difficulty in understanding the drawing **(Fig. 1a)**.
- In order to show such features clearly, one or more views are drawn as if a portion had been cut away to reveal the interior **(Fig. 1b)**.
- This procedure is called **sectioning** and the view showing the cut away picture is called **section view**.

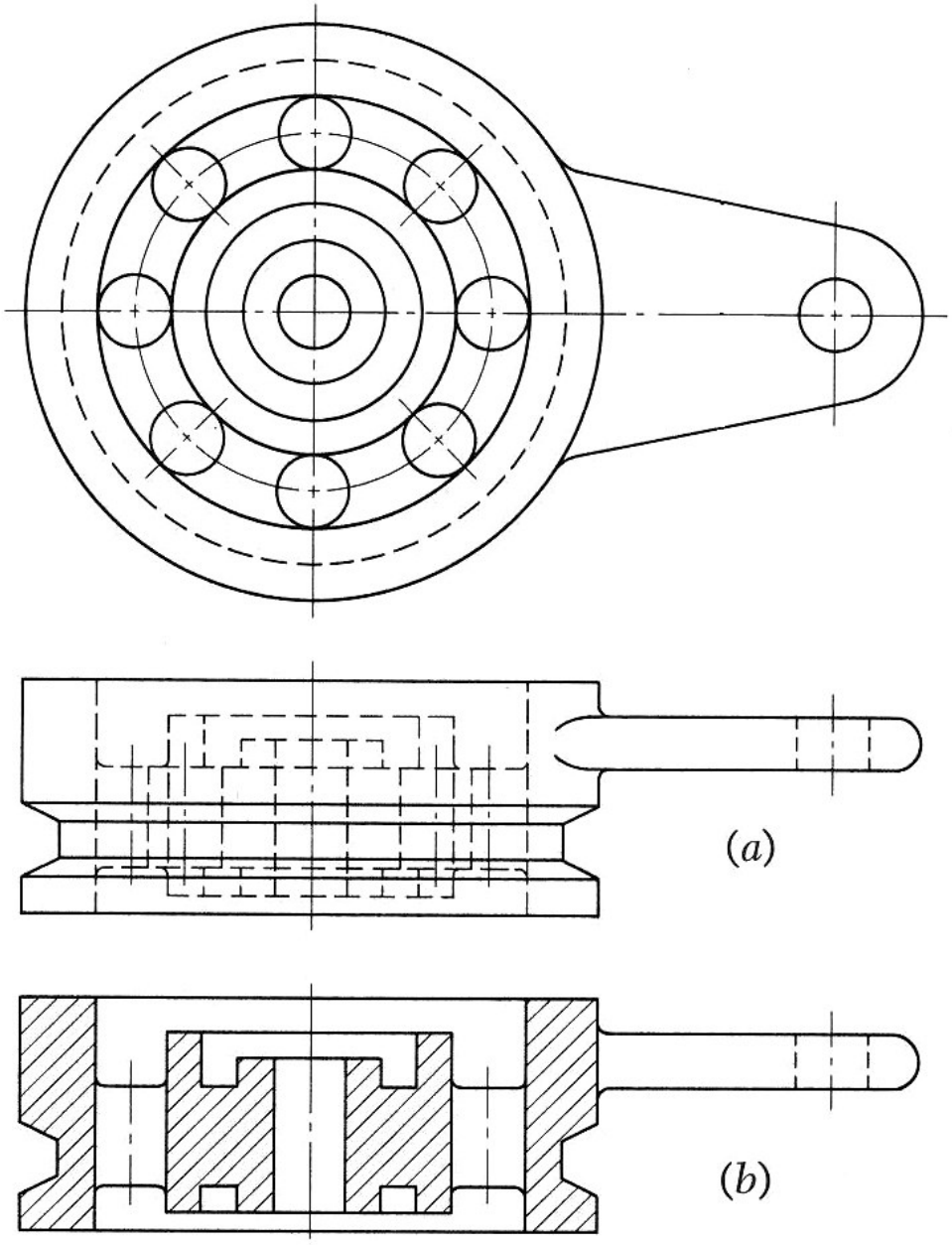
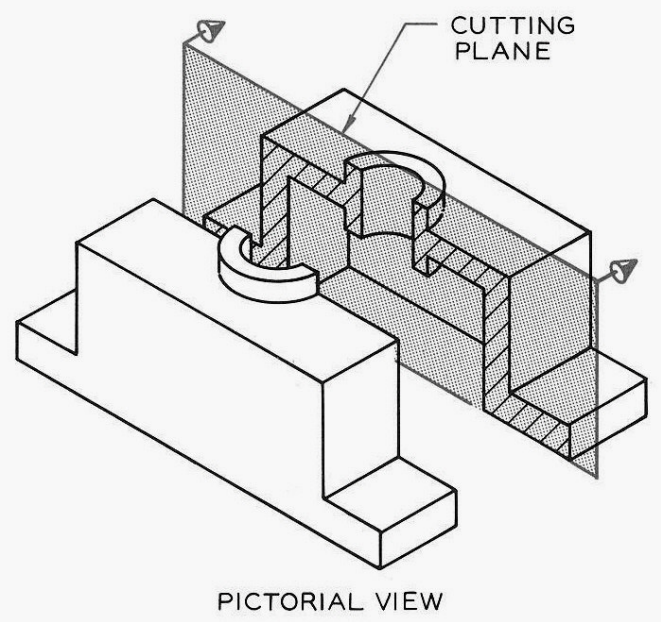


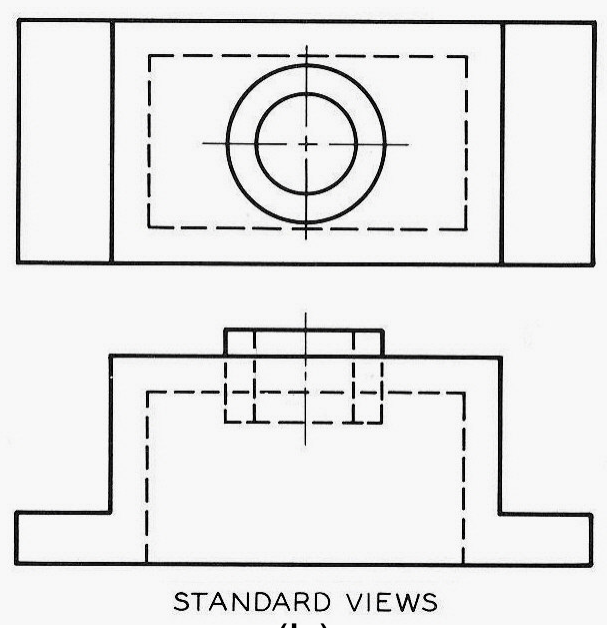
Figure 1

Definitions

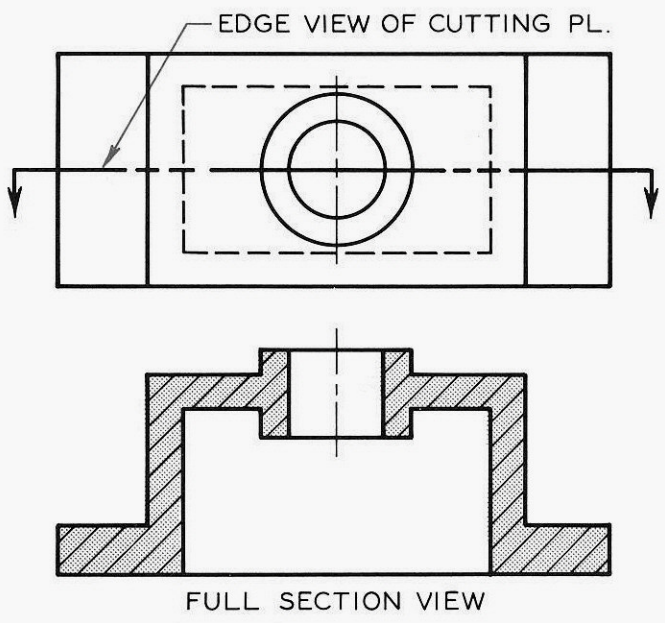
- A section is an imaginary cut taken through an object to reveal the shape or interior construction. **Fig. 2a** shows the **imaginary cutting plane** in perspective view.
- The imaginary cutting plane is projected on a standard view so that the **sectional view** with orthographic representation is obtained as shown in **Fig. 2c**.
- A sectional view must show which portions of the object are solid material and which are spaces. This is done by **section lining (cross-hatching)** the solid parts with uniformly spaced thin lines generally at 45º.



(a)



(b)



(c)

Figure 2

Cutting Planes

- Various cutting planes can be selected for obtaining clear sectional views.
- The plane may cut **straight across (Fig. 3a)** or **be offset (changing direction forward and backward)** to pass through features **(Fig. 3b, 3c and 3d)**.
- The plane may also be taken parallel to the frontal plane **(Fig. 4a)**, parallel to the profile and/or horizontal plane **(Fig. 4b and 4c)**, or at an angle.

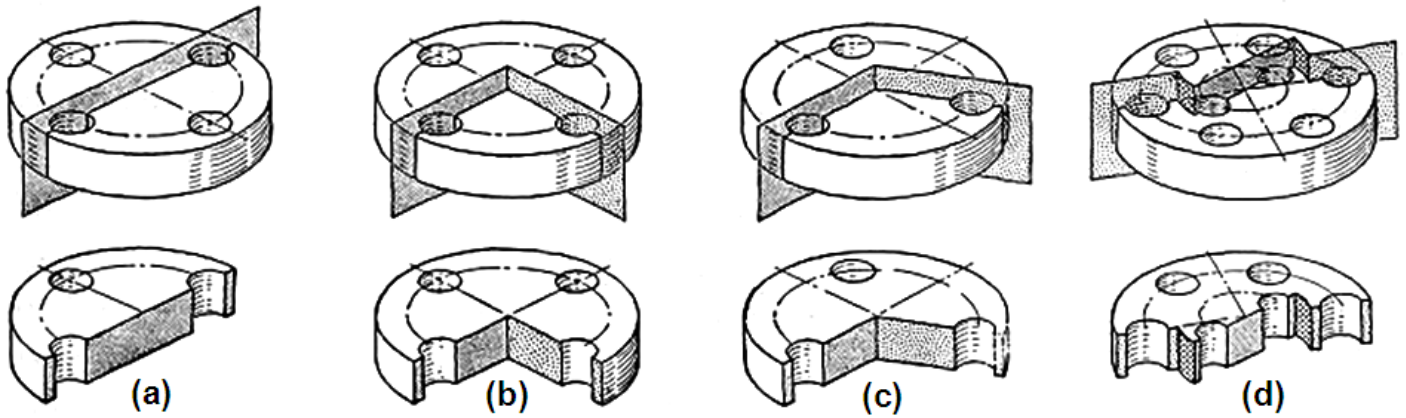


Figure 3

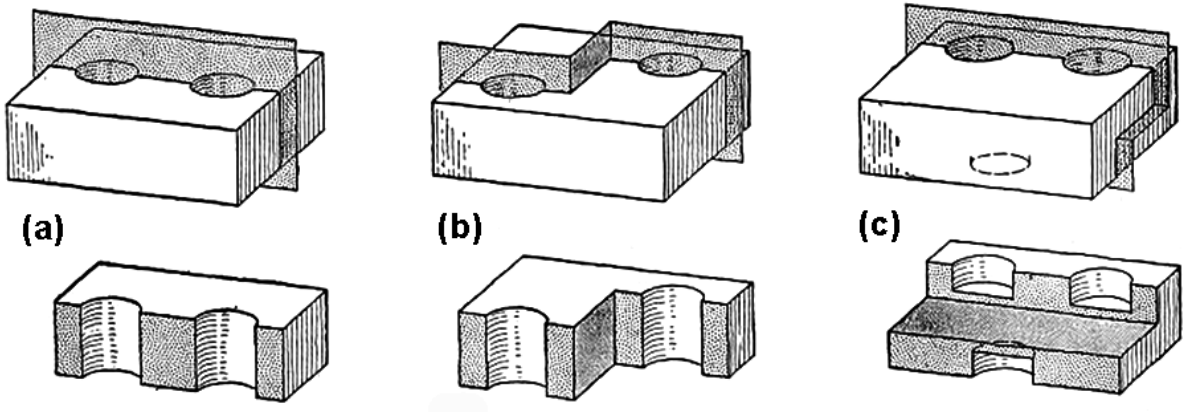


Figure 4

Type of Sections

- Depending on the number of cutting planes, sectional views can be **simple with one cutting plane (Fig. 5)** or **complex with two or more cutting planes (Fig. 6)**.
- If the cutting plane-line cuts entirely across the object, it is called a **full section**.
- If the cutting plane cuts halfway through the object, it is a **half section**.
- In addition to these, there are **broken-out sections**, **rotated sections**, **removed sections**, **auxiliary sections**, and **assembly sections**.

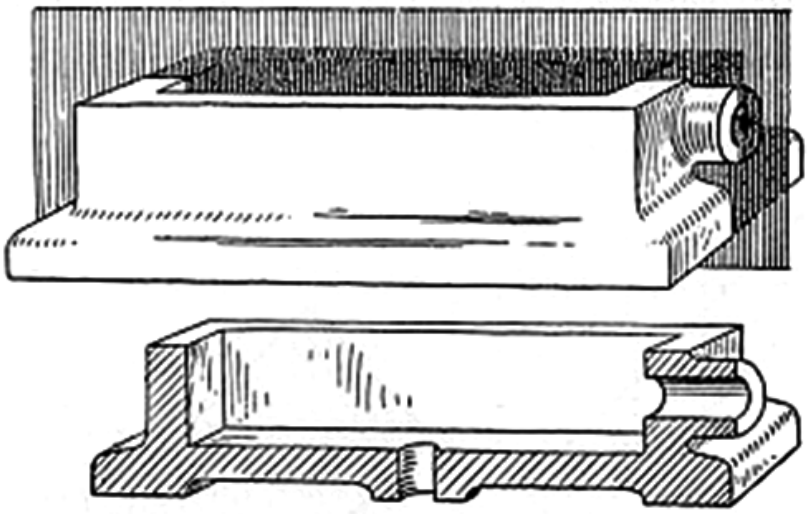


Figure 5

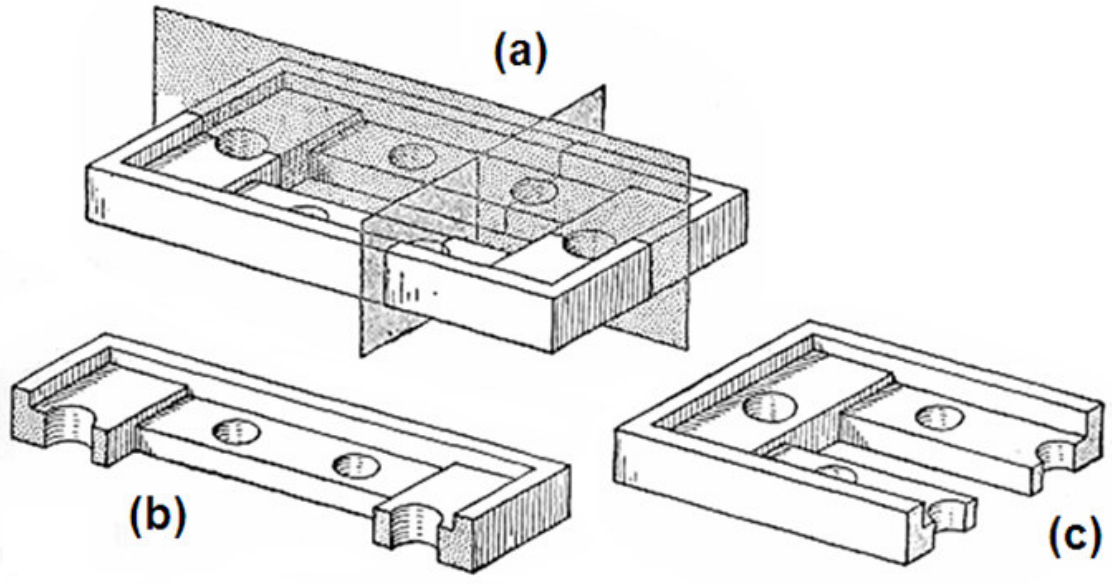


Figure 6

Full Section

➤ When cutting plane passes **fully through an object**, it is called full section **(Fig. 7)**.

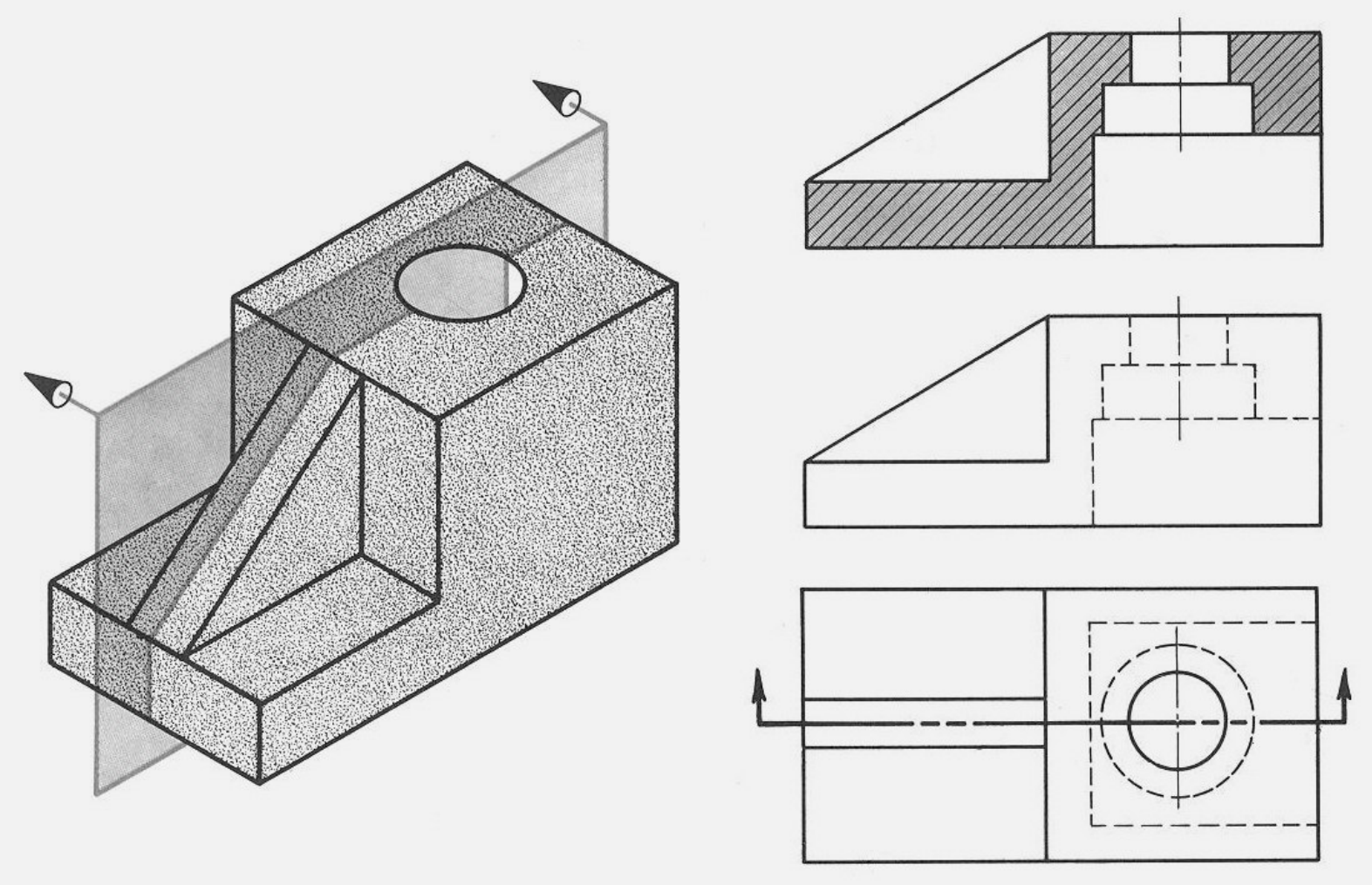


Figure 7

Full Section with Offset Planes

- The cutting plane may be offset in any portion in order to show some detail or to miss some part, as seen in **Fig. 8**.
- Note that the change in plane direction is not shown on the sectional view (i.e. **no edge is present** on the object at this position since the cut is purely imaginary).

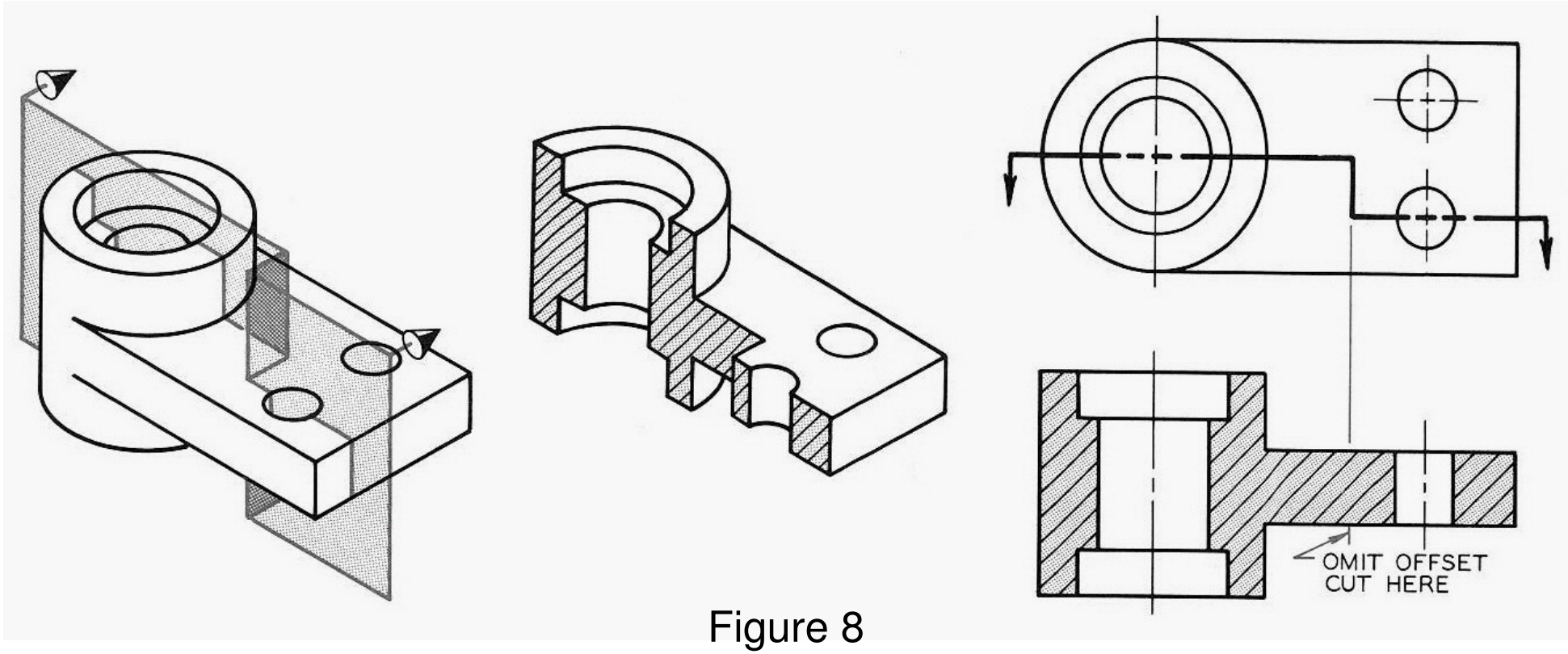


Figure 8

Full Section with Offset Planes

➤ **Fig. 9 and 10** are examples of full sections with offset cutting planes.

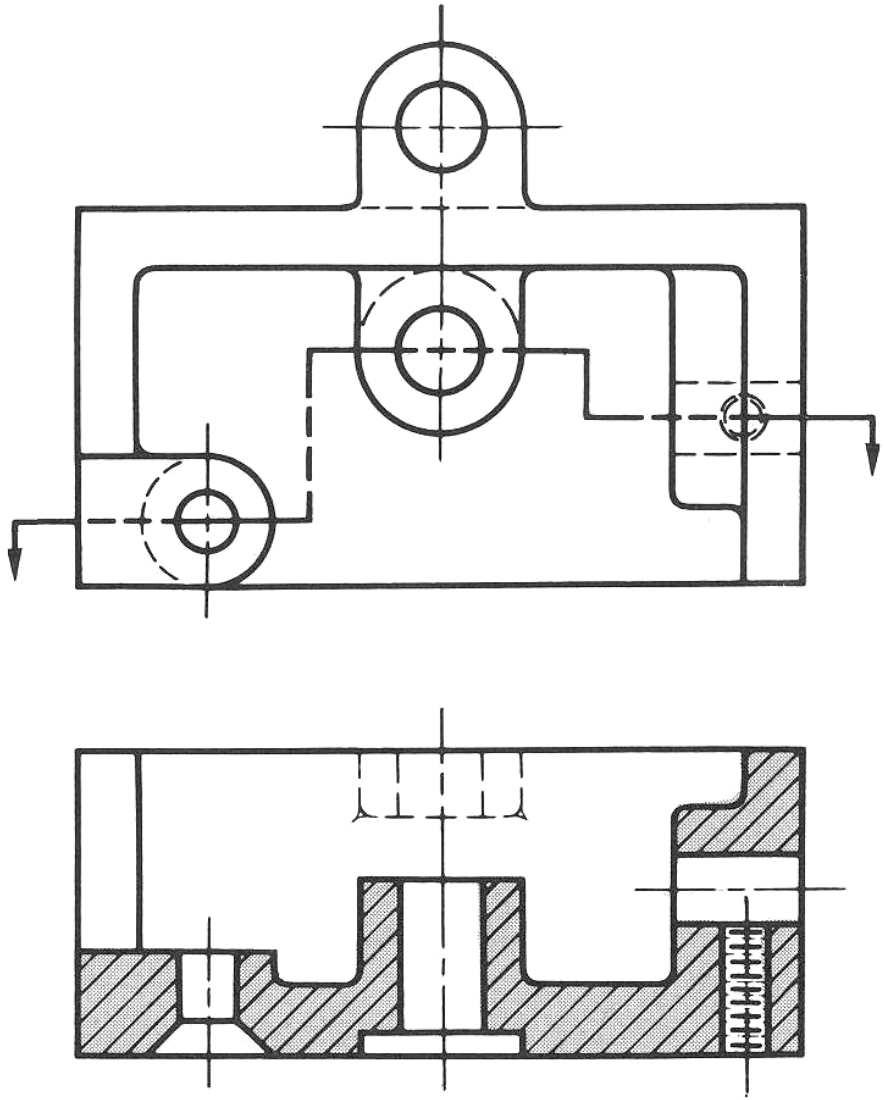


Figure 9

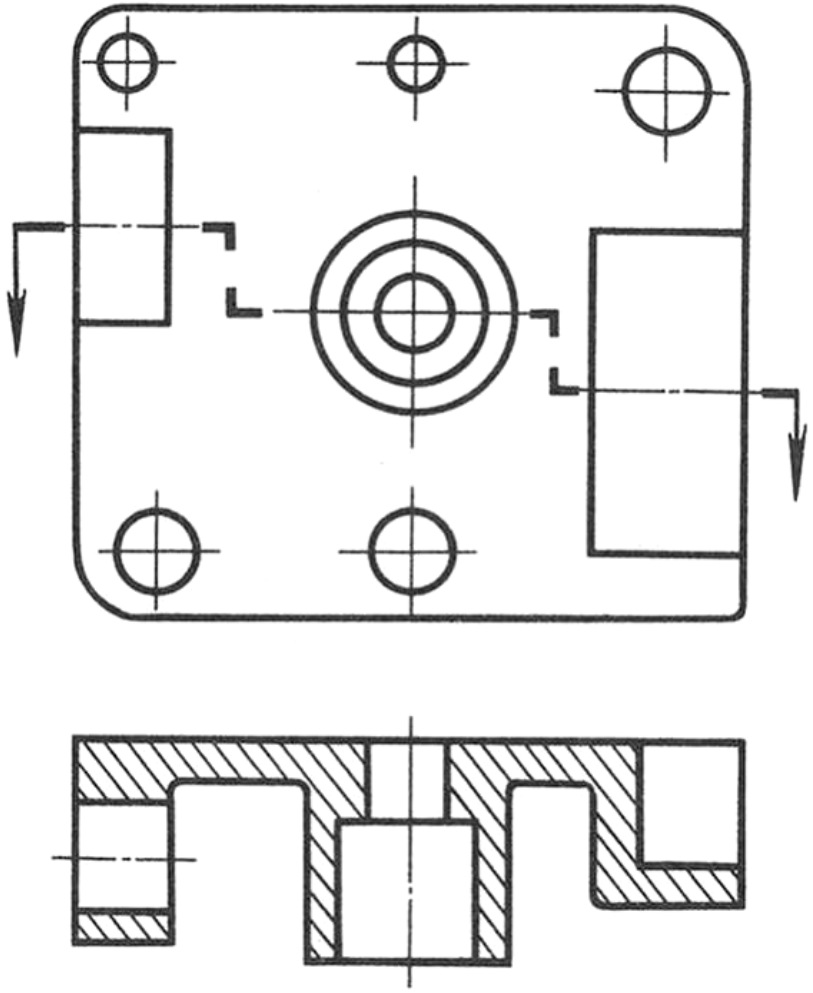


Figure 10

Half Section

- A half section is made by **cutting halfway** through an object **(Fig. 11)**.
- Thus, **one half is drawn in section** and the other half is an outside view.
- Usually, **hidden lines are not used** (inside details are visible on the section view).

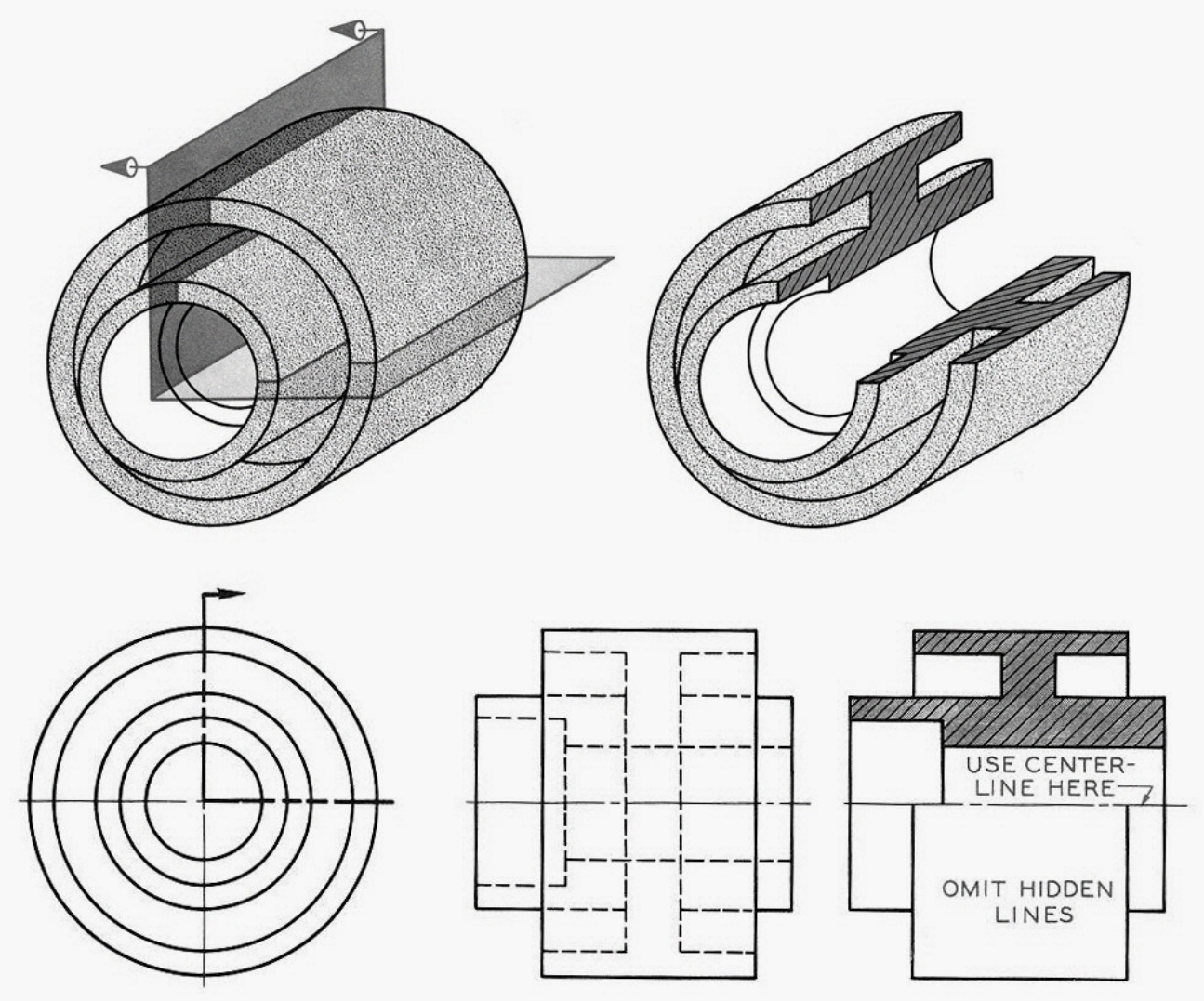


Figure 11

Half Section

- In some cases, **hidden detail on the unsectioned part** may be shown for clarity or for dimensioning purposes **(Fig. 12)**.
- Half sections can be used to have advantage with **symmetrical parts (Fig. 13)** as well as with **assemblies (Fig. 12)**.

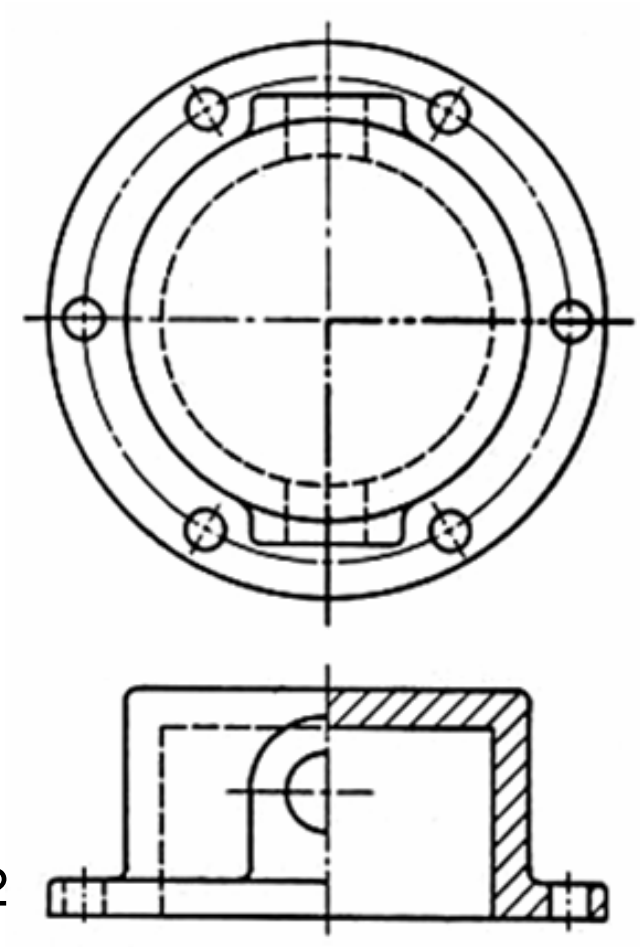


Figure 12

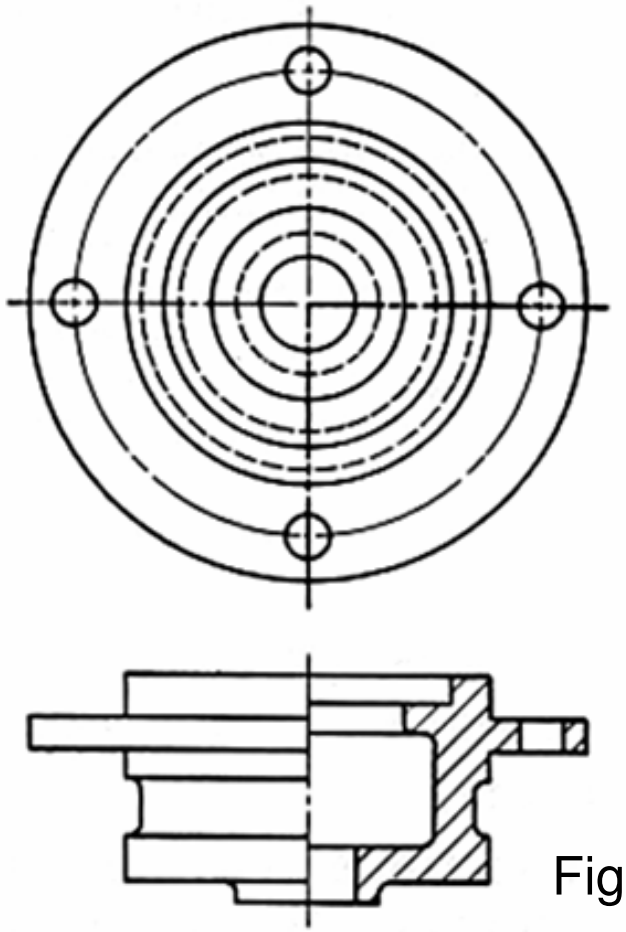


Figure 13

Broken-Out Section

- This type of section shows **only an interior portion** of the object in section.
- Cutting plane passes **partially** through the object. The area immediately in front of the plane is **broken and removed**, which reveals interior details in this area.
- At the point where the object is considered broken, an **irregular break line is used** to indicate the break.
- **Fig. 14 and 15** illustrate the advantage of the broken-out section, which eliminates the need for excessive section lining.

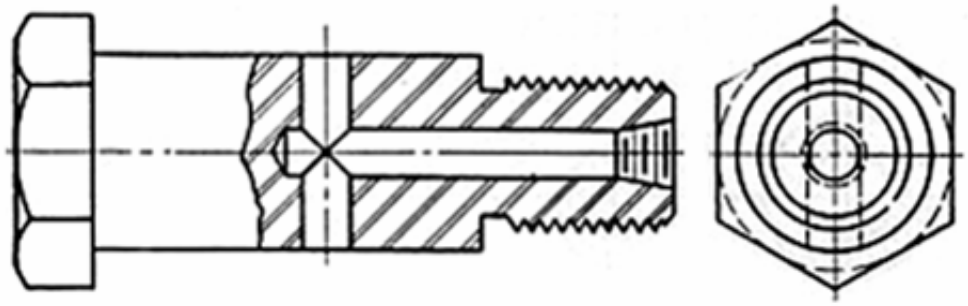


Figure 14

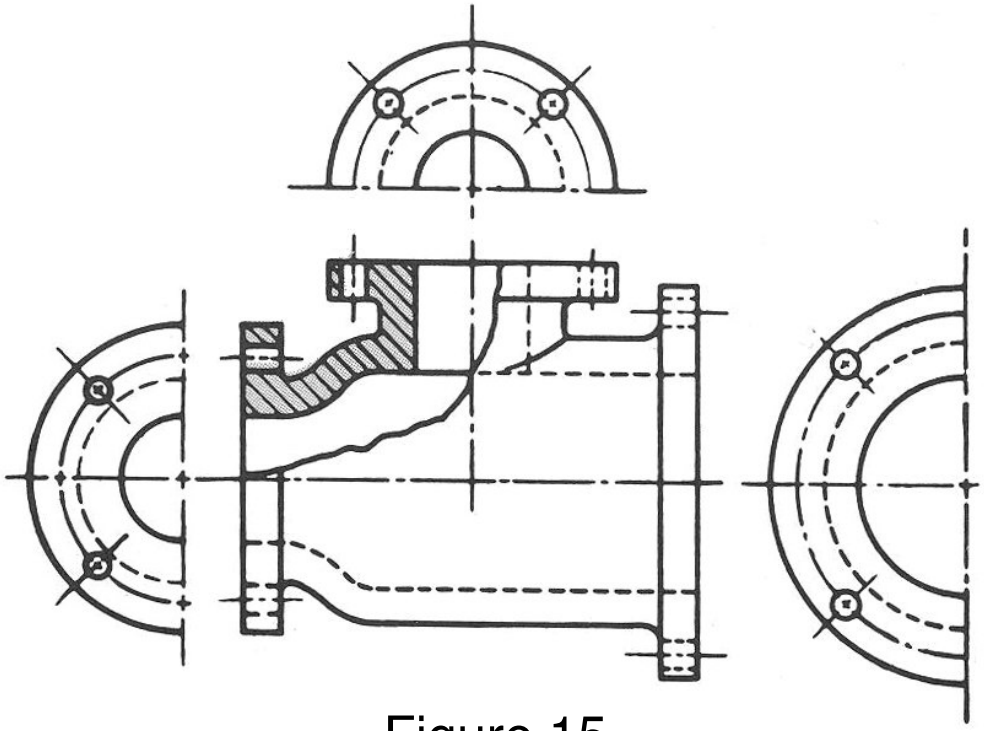


Figure 15

Rotated Section

- Some parts of an object have to be rotated to show the section.
- The cutting plane is passed **perpendicular to the axis** of the part to be cut.
- The cut portion is **revolved 90º** and drawn in this position (i.e. **turning the section until it is parallel with the plane of projection**).
- The resulting view is a rotated section.

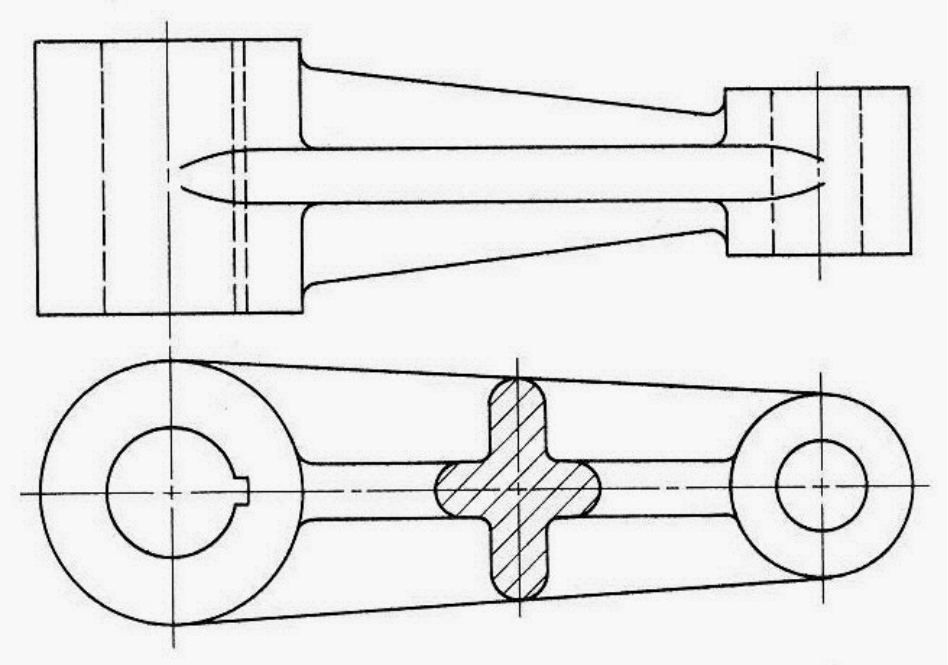


Figure 16

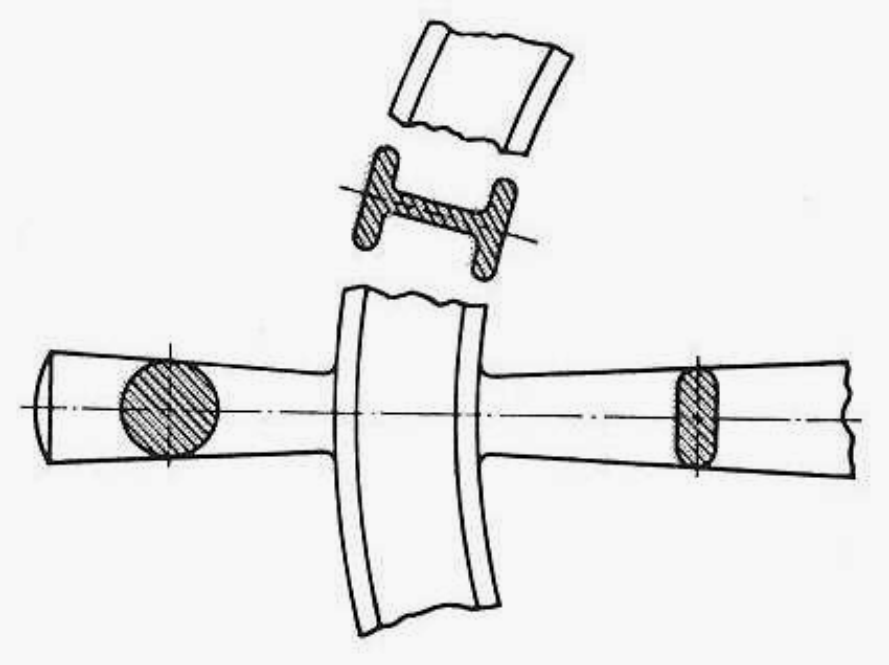


Figure 17

Removed Section

- This type of section is a revolved section **drawn outside of the normal view**.
- They are used if there is **restricted space for section** or **dimensioning prevents the use of an ordinary rotated section**.
- Several sections may be required when **shape of the part is not uniform**.
- These sections are **represented by a series of cutting planes and identifying letters** (e.g. Section A-A, B-B, C-C and so on).

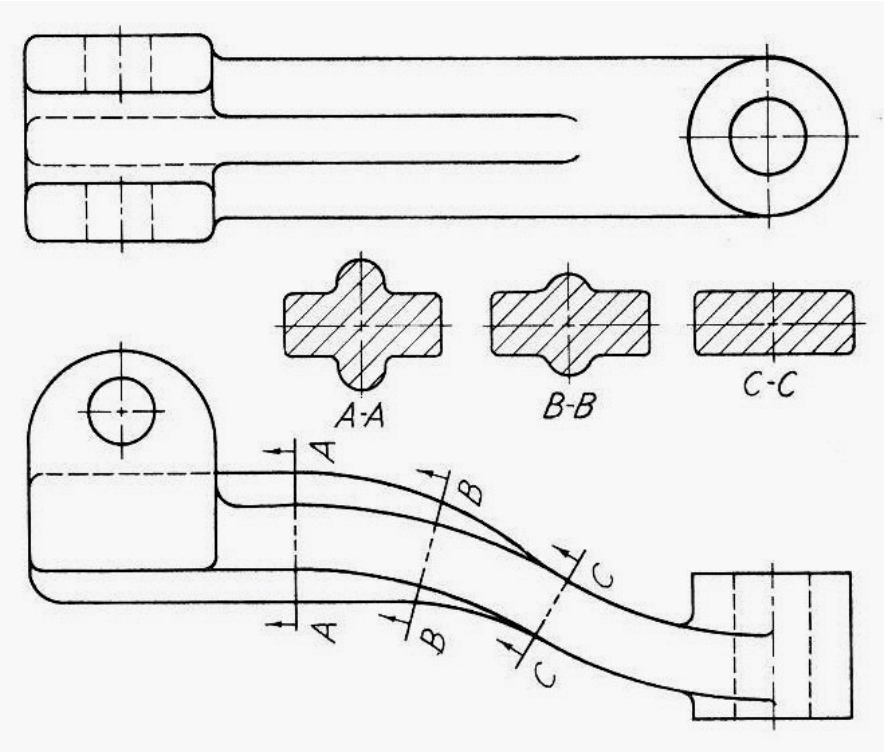


Figure 18

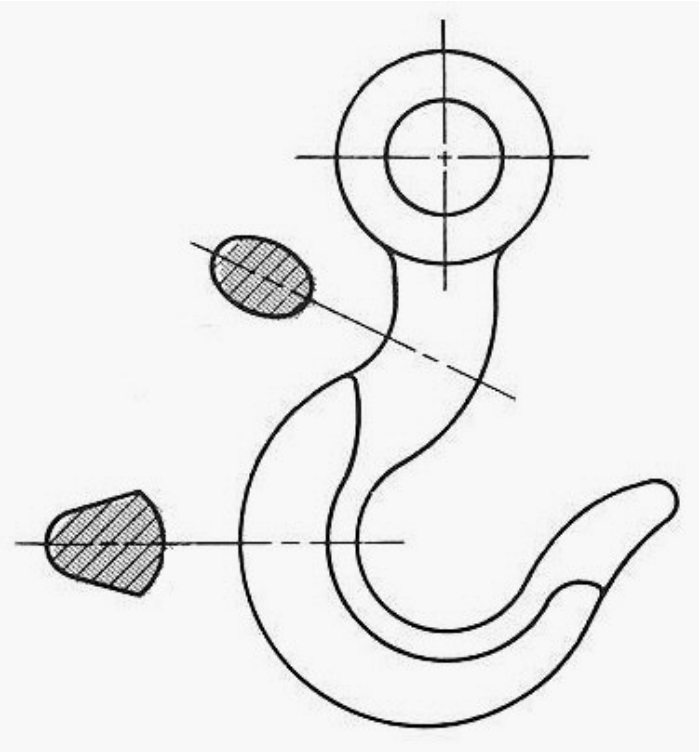


Figure 19

Removed Section

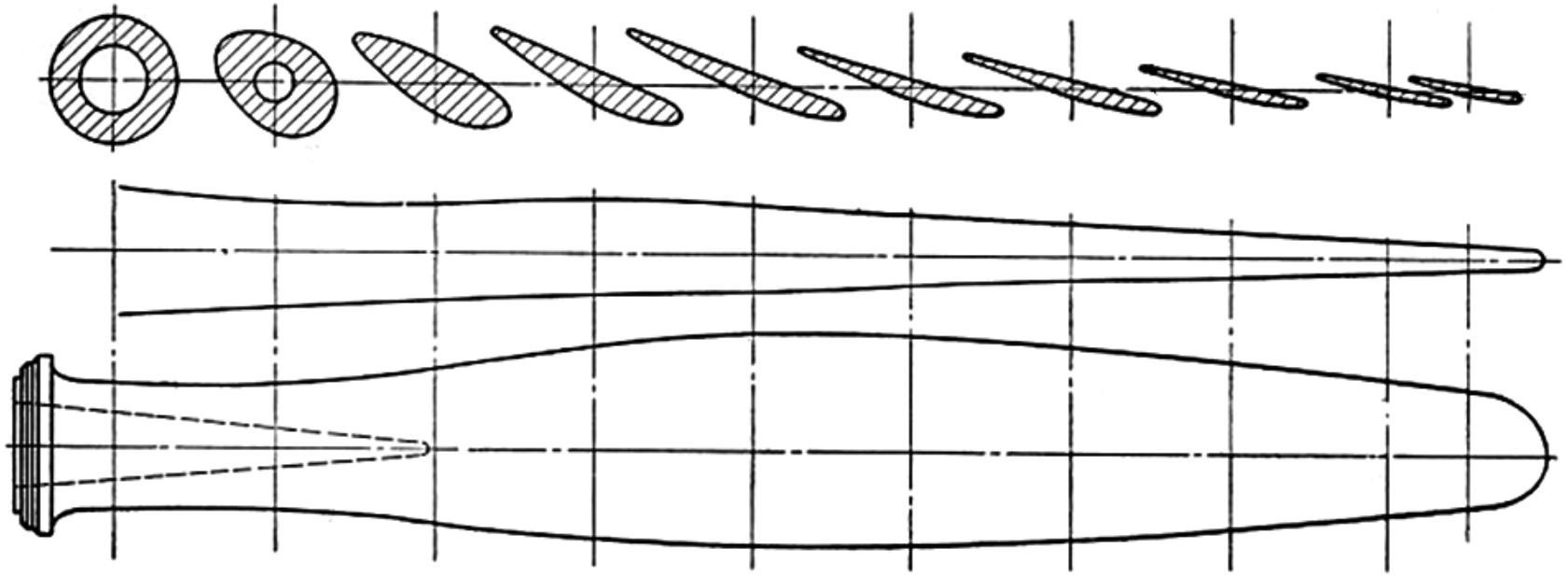


Figure 20

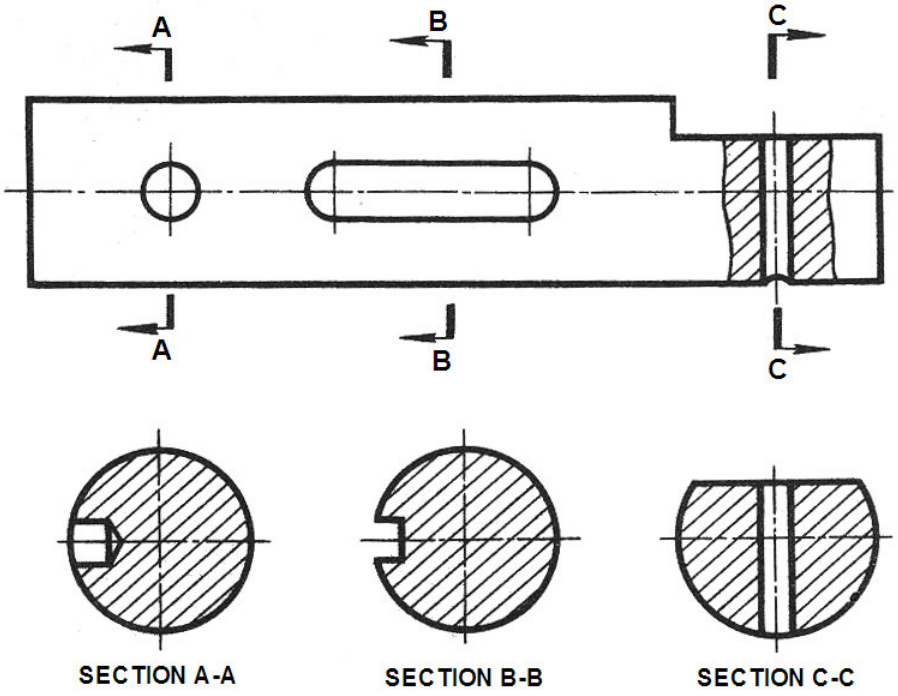


Figure 21

Assembly Sections

- Assembly sections consist of a combination of parts.
- The purpose of an assembly section is to **reveal the interior of a machine or structure** so that the separate parts can be clearly shown and identified. However, **the separate parts do not need to be completely described**.
- Small amount of clearances between mating or moving parts on assembly drawing is not shown. Even the clearance between a bolt and its hole (which may be as much as 1 mm) is rarely shown.
- On assembly drawing, only such hidden details (as needed for part identification or dimensioning) are drawn.

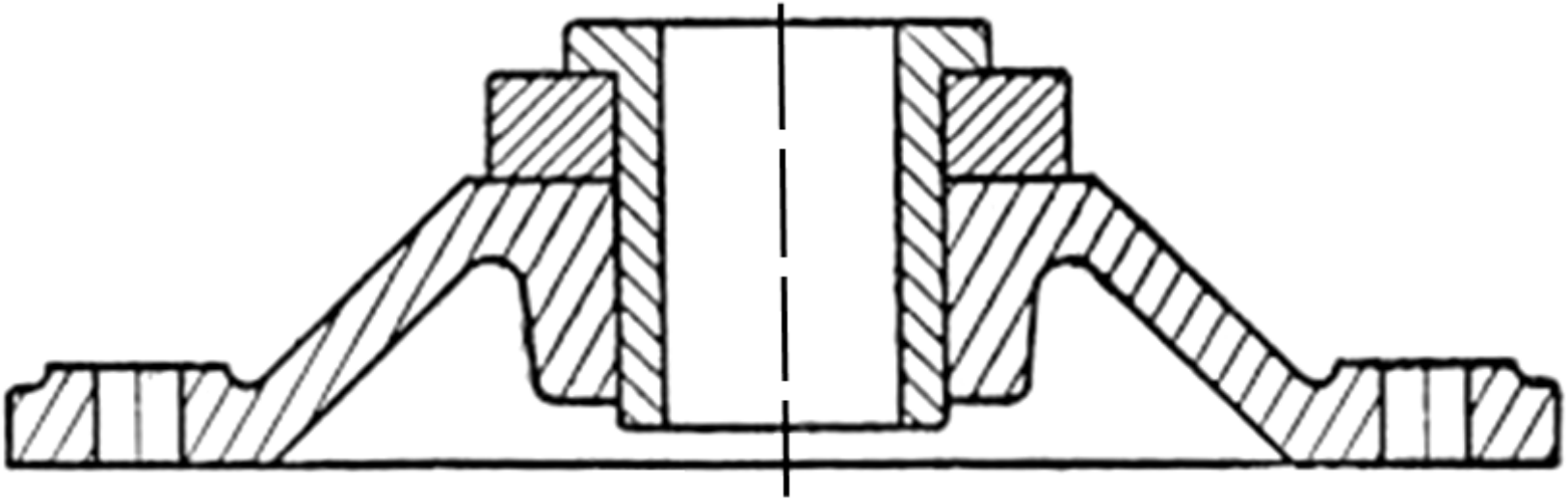


Figure 22

Hidden Edges and Surfaces in Section

- Sections are primarily used to **replace hidden lines with visible lines**. As a rule, hidden lines and surfaces should be omitted in sectional views.
- Sectional view in **Fig. 23a** is incorrect. Because, hidden lines do not clarify the drawing. Thus, preferred sectional view should be as in **Fig. 23b**.
- In some cases, hidden edges and surfaces can be shown for **describing the object** or **to omit a view**. **Fig. 24b** must be used for complete representation of the object.

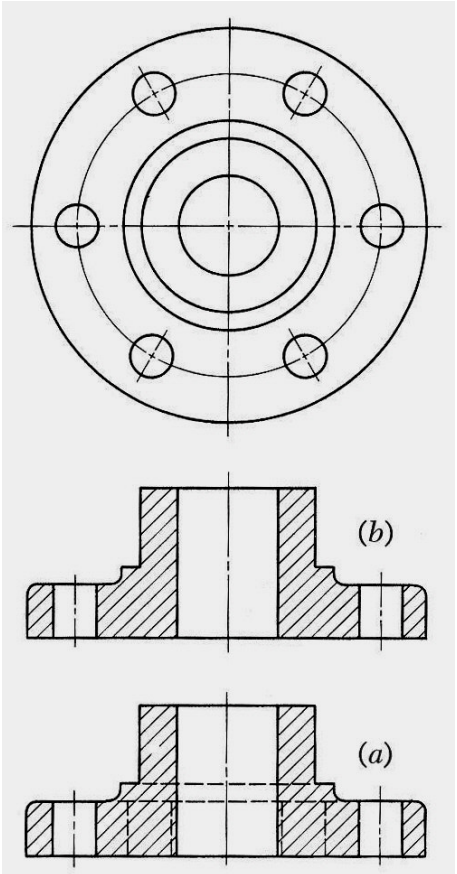


Figure 23

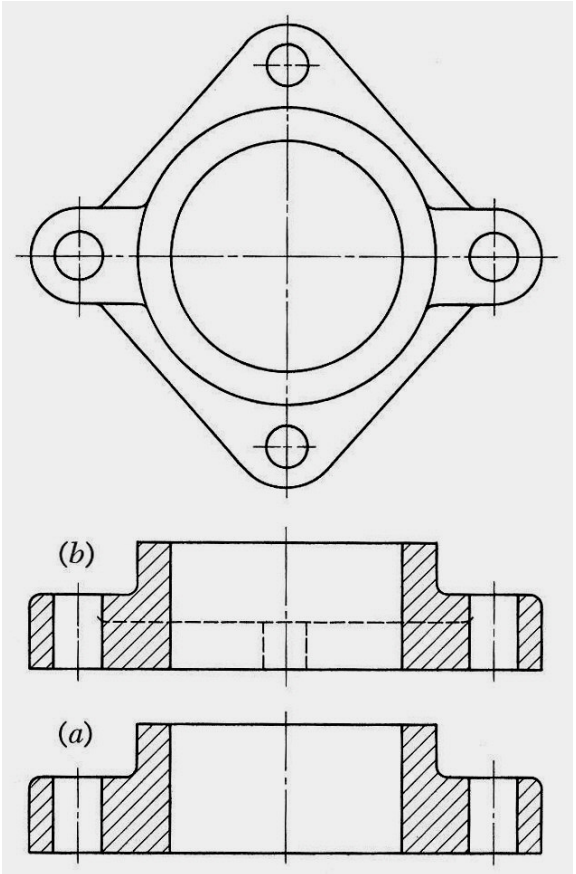


Figure 24

Visible Edges in Section

- A section-lined area is **always completely bounded by a visible outline**, never by a hidden line or edge.
- Therefore, all visible edges and contours behind the cutting plane must be shown in sectional view **(Fig. 25b)**.
- Otherwise, a section will appear to be made up of disconnected and unrelated parts (as in the case of **Fig. 25a**).

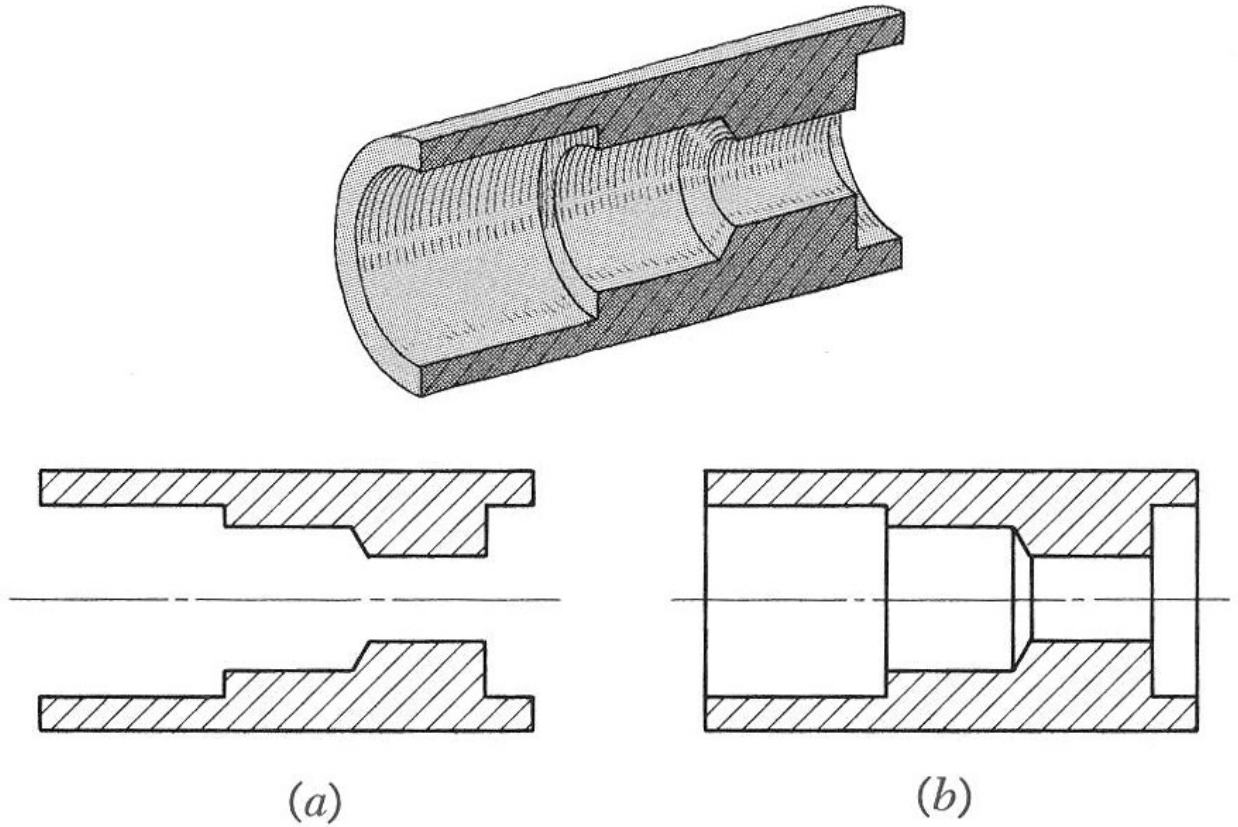


Figure 25

Section Lining (Cross-Hatching)

- Section lining of a cut surface is indicated by **fine lines**, which are drawn as continuous lines usually at **an angle of 45º** with **uniform distance (about 2 mm)**. For smaller or larger areas, distance between lines can be from 1 mm to 4 mm.

- Section lining or cross-hatching lines should not be parallel or perpendicular to any main visible line bounding the sectioned area.

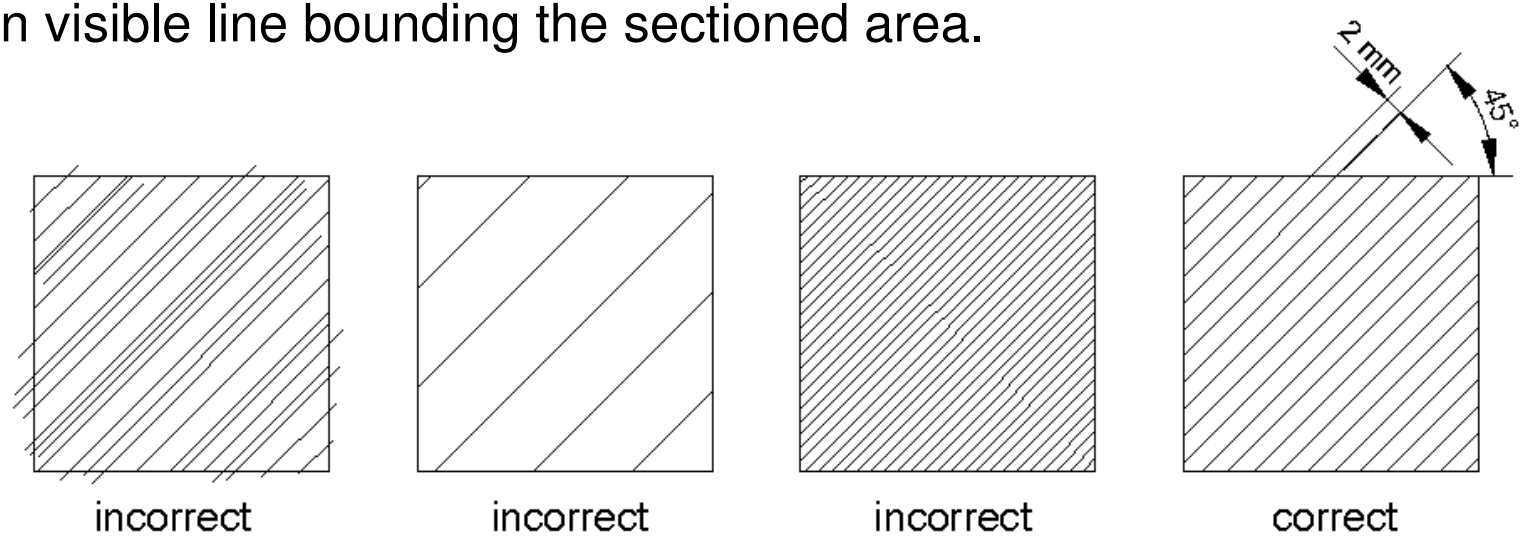


Figure 26

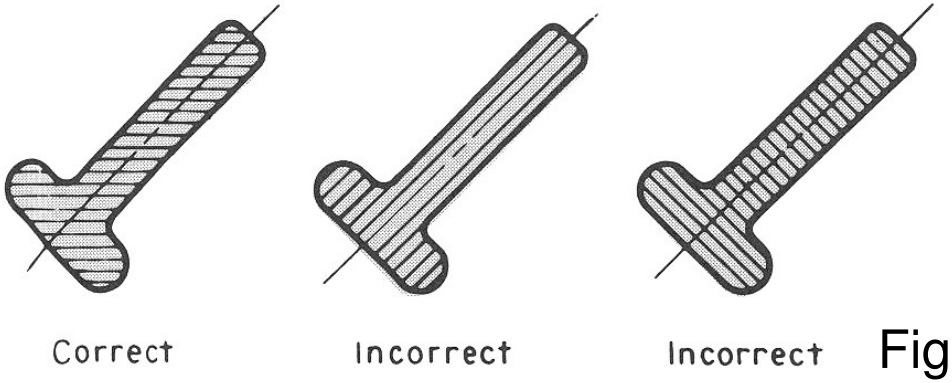


Figure 27

Cross-Hatching of Adjacent Parts

- Section lines on two adjacent pieces should slope at **45º in opposite directions**. If a third or fourth piece adjoins the other pieces (as in **Fig. 28**), they ordinarily are cross-hatched at **30º and 60º**.

- An alternate use would be to **vary the spacing without changing the angle**.

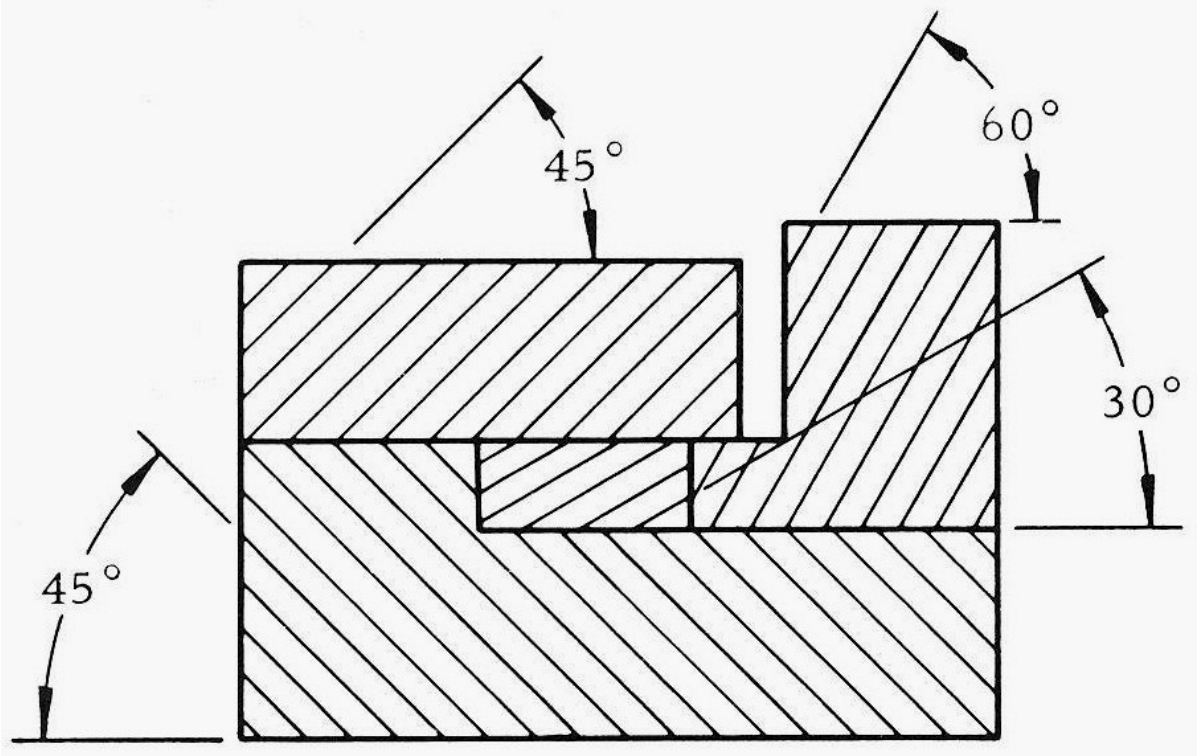


Figure 28

Cutting Plane Lines

- The cutting plane line is **an imaginary plane** passing through an object at the place where a section is to be made.
- This imaginary line is identified with **reference letters along with arrows** to show the direction in which the sectional view is taken.
- The beginning and end styles of cutting plane lines are **made bold**. This is also done at the portions where the cutting plane is offset **(Fig. 29)**.

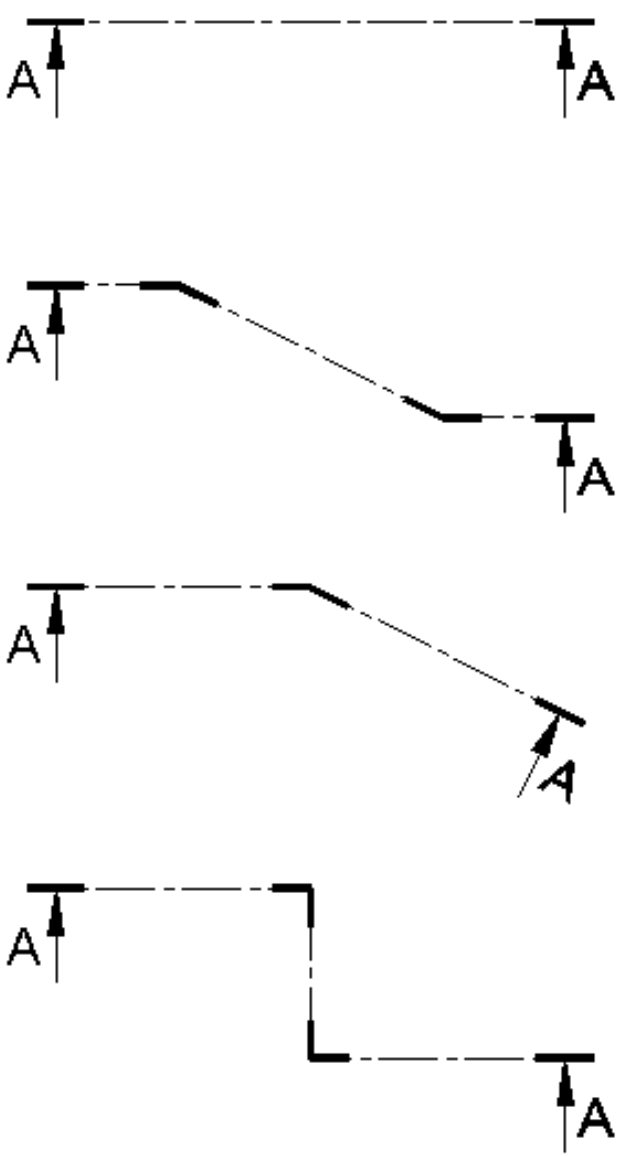


Figure 29

Thin Materials in Section

- Very thin sections (such as sheet metal parts, gaskets or structural-steel shapes to small scale) may be **shown in solid black with white spaces between the parts**.

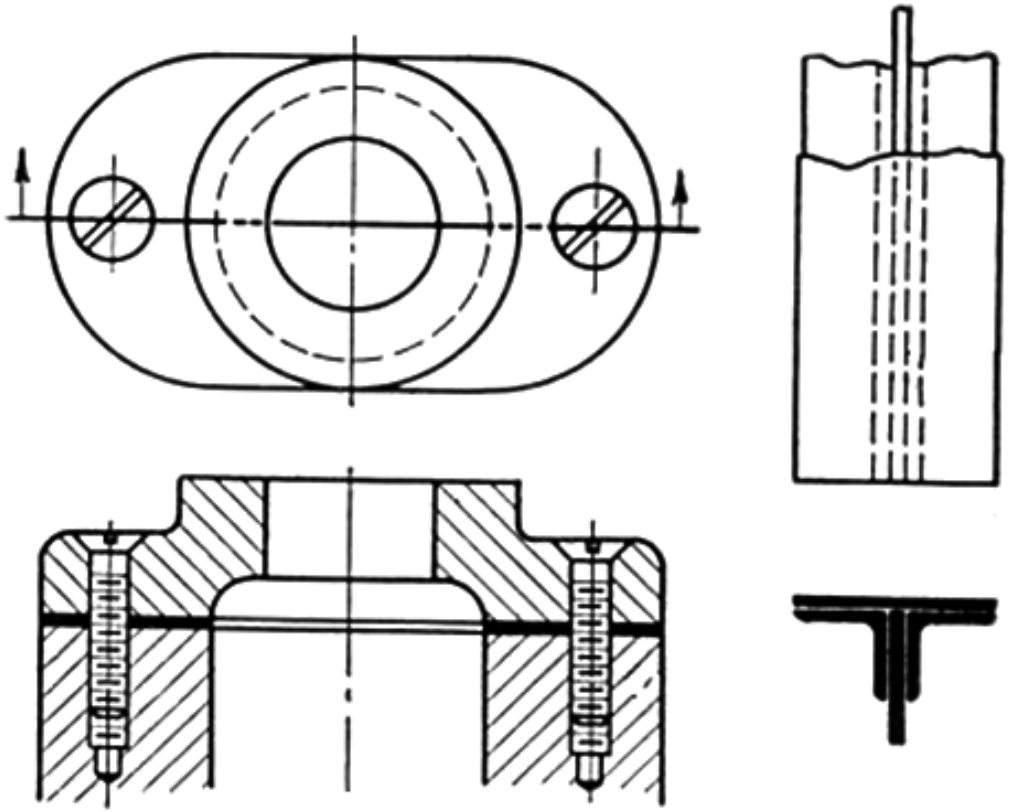


Figure 30

Ribs and Webs in Section

- Ribs and webs are used to **strengthen the parts**. When the cutting plane passes through the ribs lengthwise, cross-hatching would give the misleading impression that the section was conical **(Fig. 31b)**.

- Therefore, **cross-hatching is eliminated** from the ribs and webs (as if the cutting plane was just in front of them) when the cutting plane passes **longitudinally** through them **(Fig. 31a and 32)**.

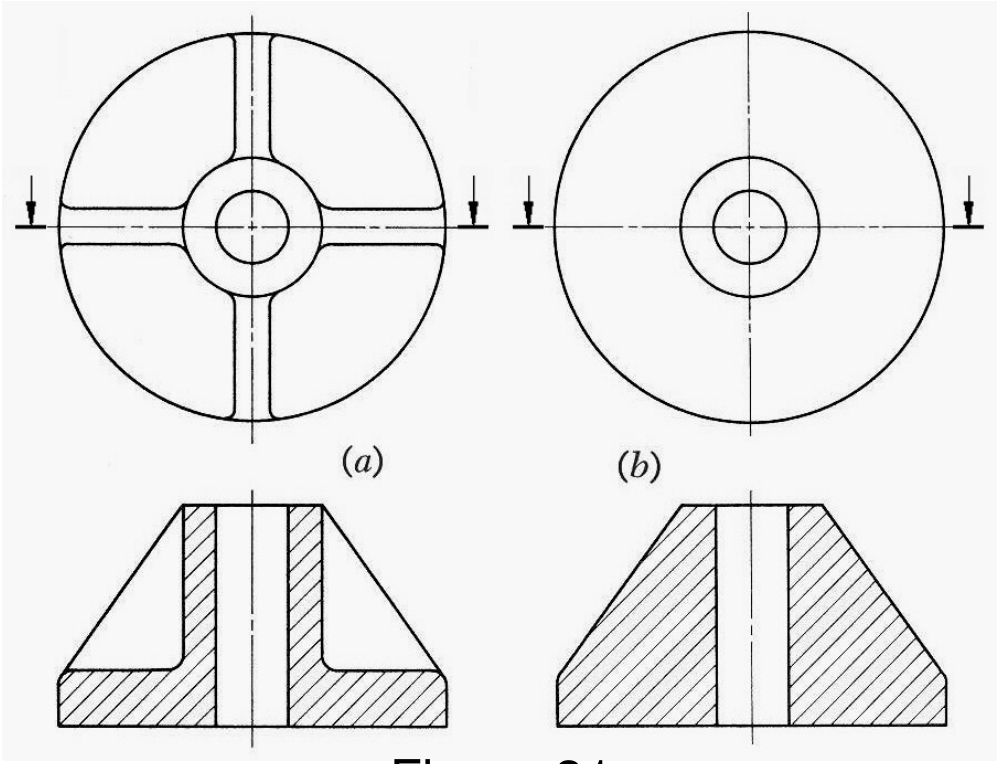


Figure 31

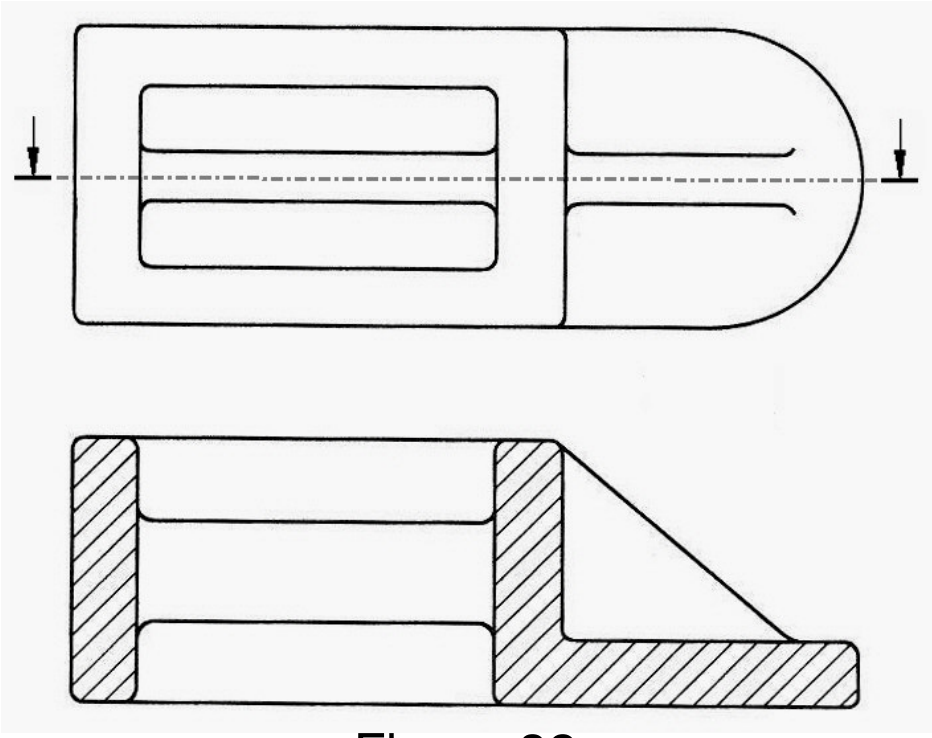


Figure 32

Ribs and Webs in Section

- However, they are **always cross-hatched** if the cutting plane cuts them at right angles to their length or axis direction **to show their thickness (Fig. 33)**.

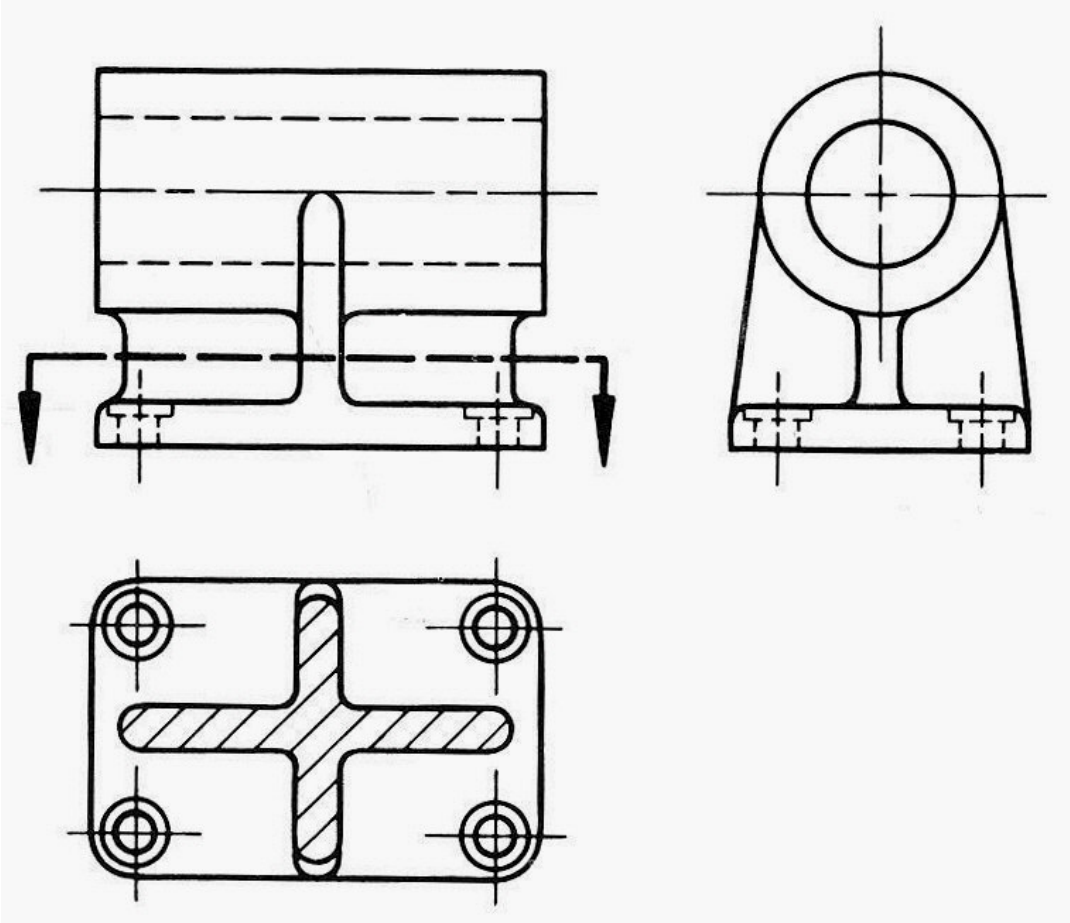


Figure 33

Spokes and Arms in Section

- When a cutting plane passes through pulley spokes or arms, **cross-hatching is eliminated** where the plane is thought of as being just in front of the spokes.

- Even though the cutting plane passes through two of the spokes in **Fig. 34**, the sectional view in **Fig. 34a** must be made **without cross-hatching** the spokes in order to avoid the appearance of a solid web as in **Fig. 34b**.

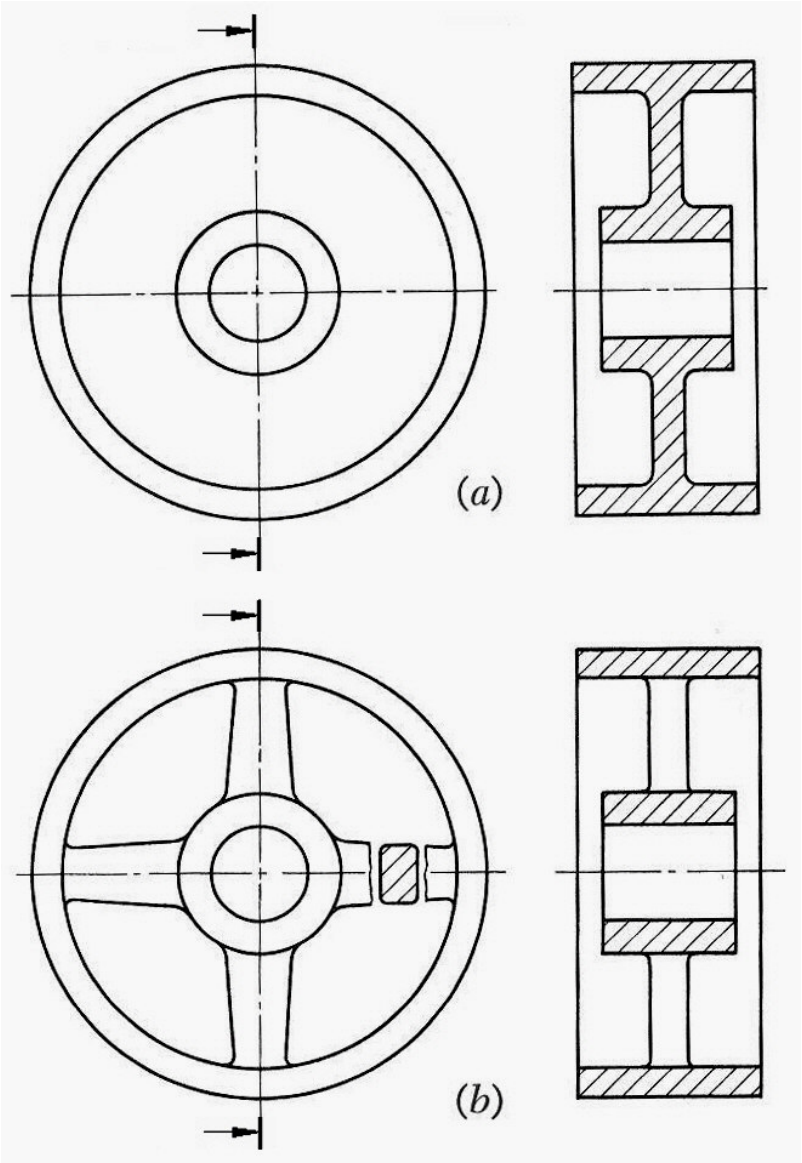


Figure 34

Lugs and Ears in Section

- Small lugs or ears are **treated like spokes and ribs**.
- **Fig. 35a** is an example in which the projecting lugs were not sectioned.

  However, large lugs are considered as the solid base of the part, and hence they are sectioned **(Fig. 35b)**.

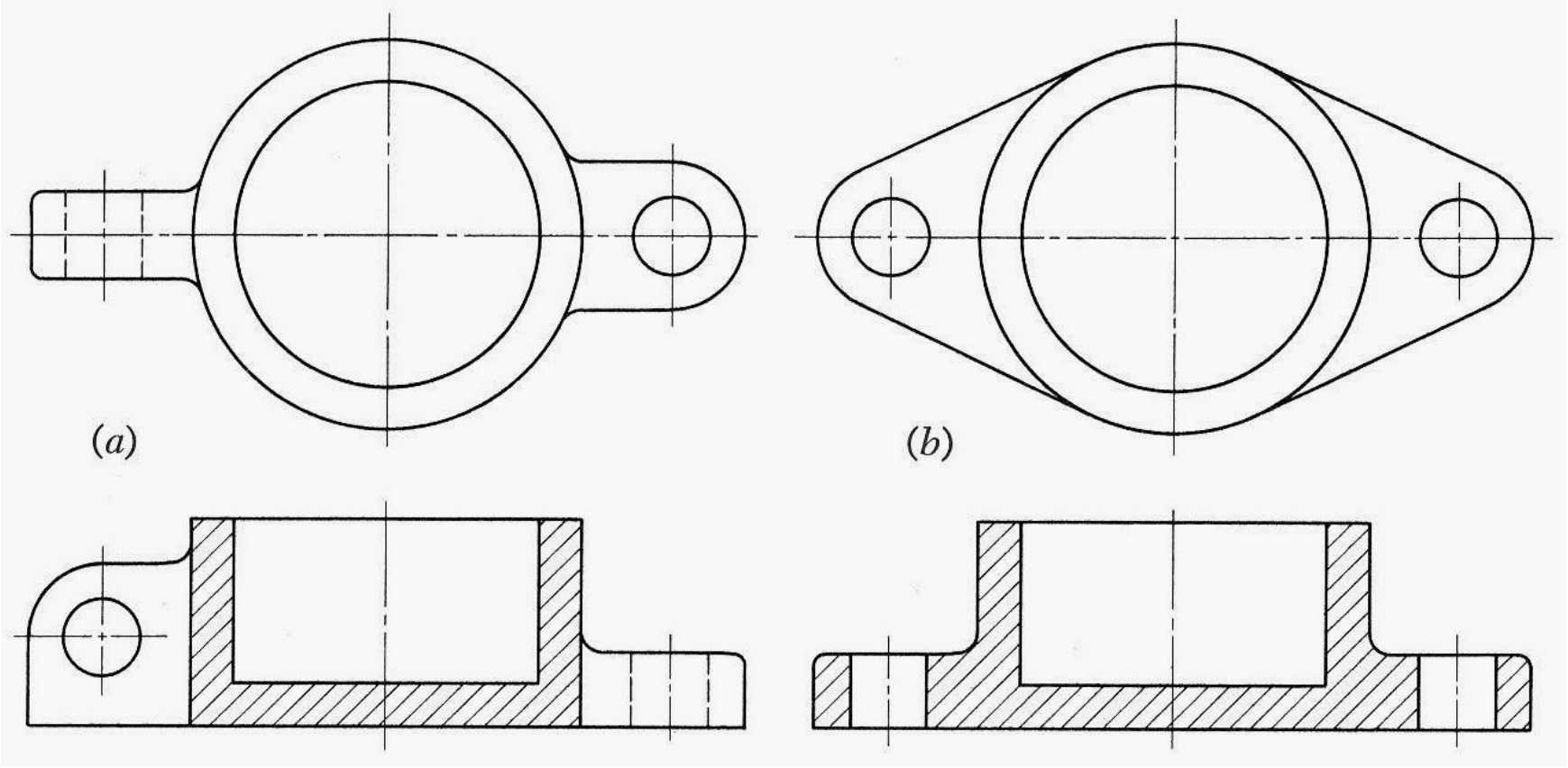


Figure 35

Aligned Ribs, Spokes, Holes and Lugs

- Ribs, spokes, holes and lugs are most common parts that may occur **in odd numbers**.
- These parts will give **an unsymmetrical and misleading section** if the principles of true projection are strictly obeyed.
- A combination of holes and ribs shown in one view is illustrated in **Fig. 35**.
- The correct projection and section is shown at **Fig. 35c** where **rib and hole are drawn as if they were aligned** (in other words, rib and hole are rotated to the path of vertical cutting plane and then projected to the top view).
- Note that neither rib or hole was cross-hatched.

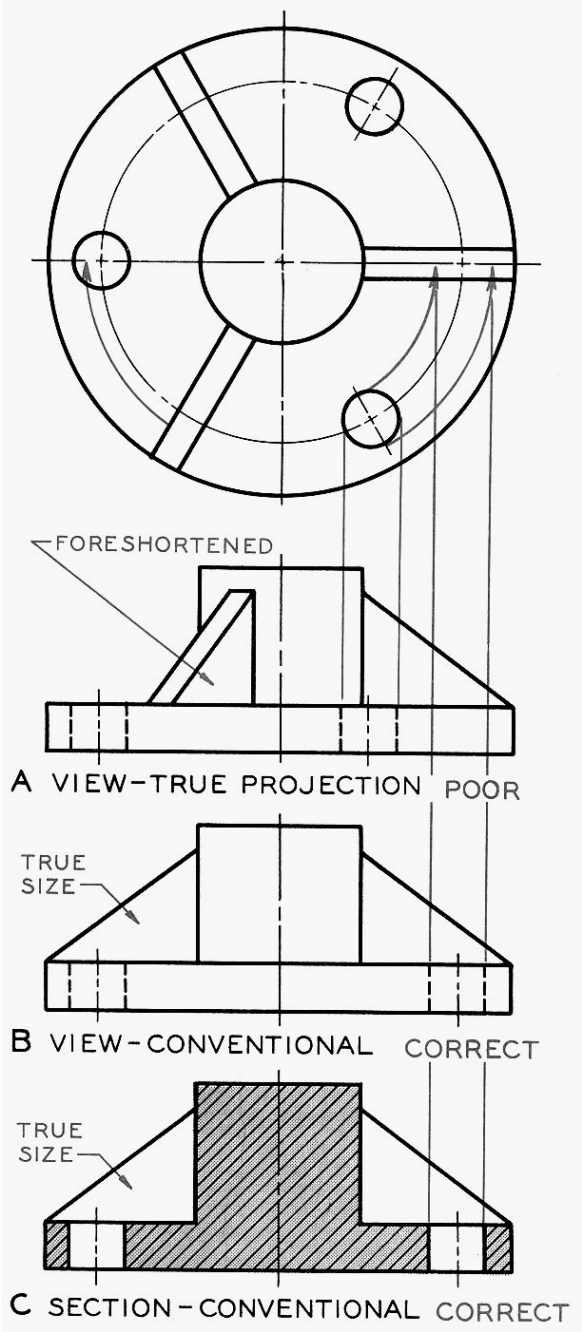


Figure 36

Aligned Ribs, Spokes, Holes and Lugs

- When there are **an odd number of spokes** in a wheel **(Fig. 37)**, they should be **shown aligned in the sectioned view** so as to reveal their true location with reference to the rim and the axis of the wheel.

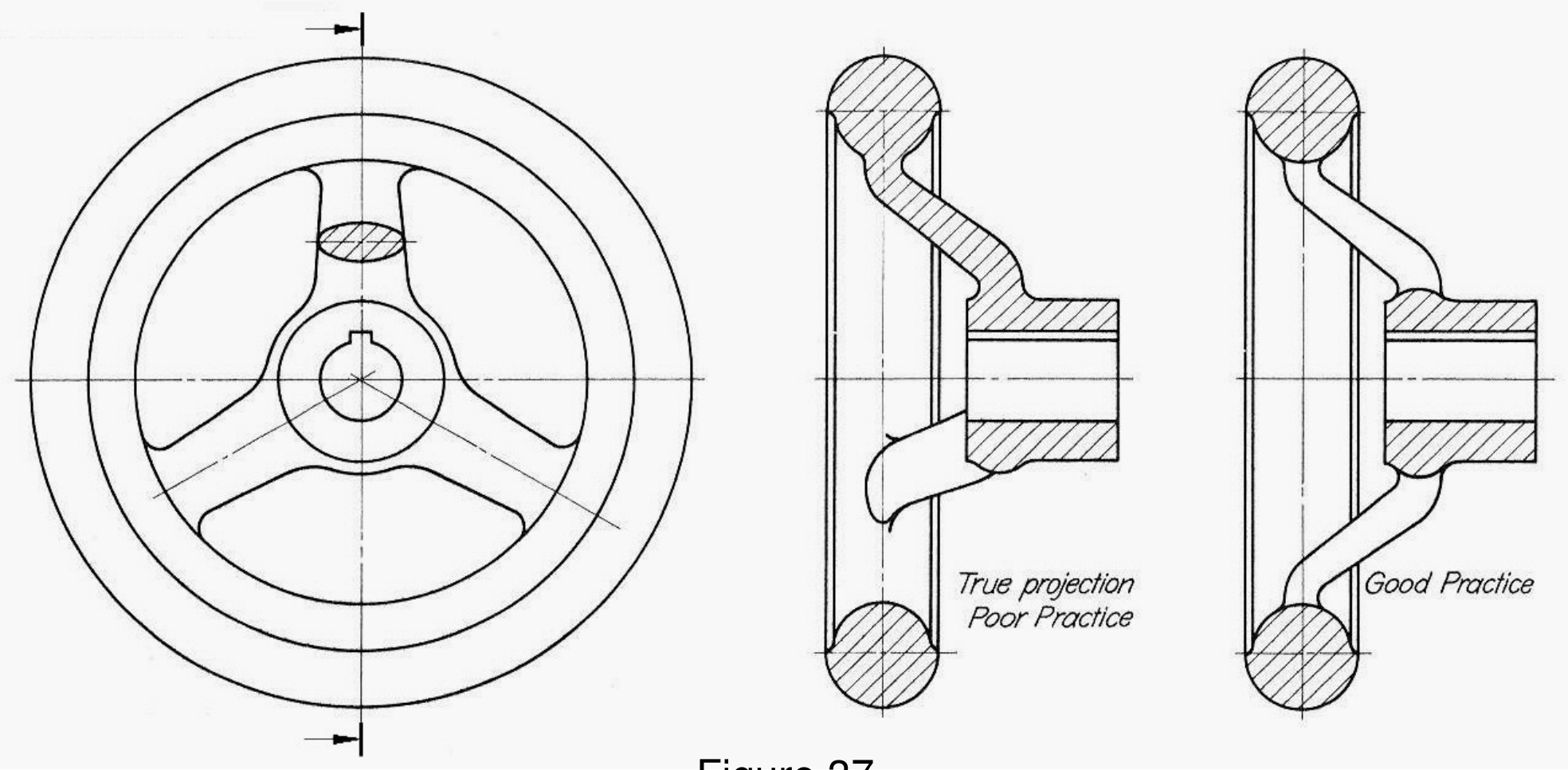


Figure 37

Aligned Ribs, Spokes, Holes and Lugs

- **Odd number of holes and lugs** must also be treated likewise.
- **Fig. 38 and 39** show other examples of conventional representation. The sectional views are drawn as if hole and lug had been swung until the portion of the cutting plane passed through them and formed a continuous plane with the other portions.

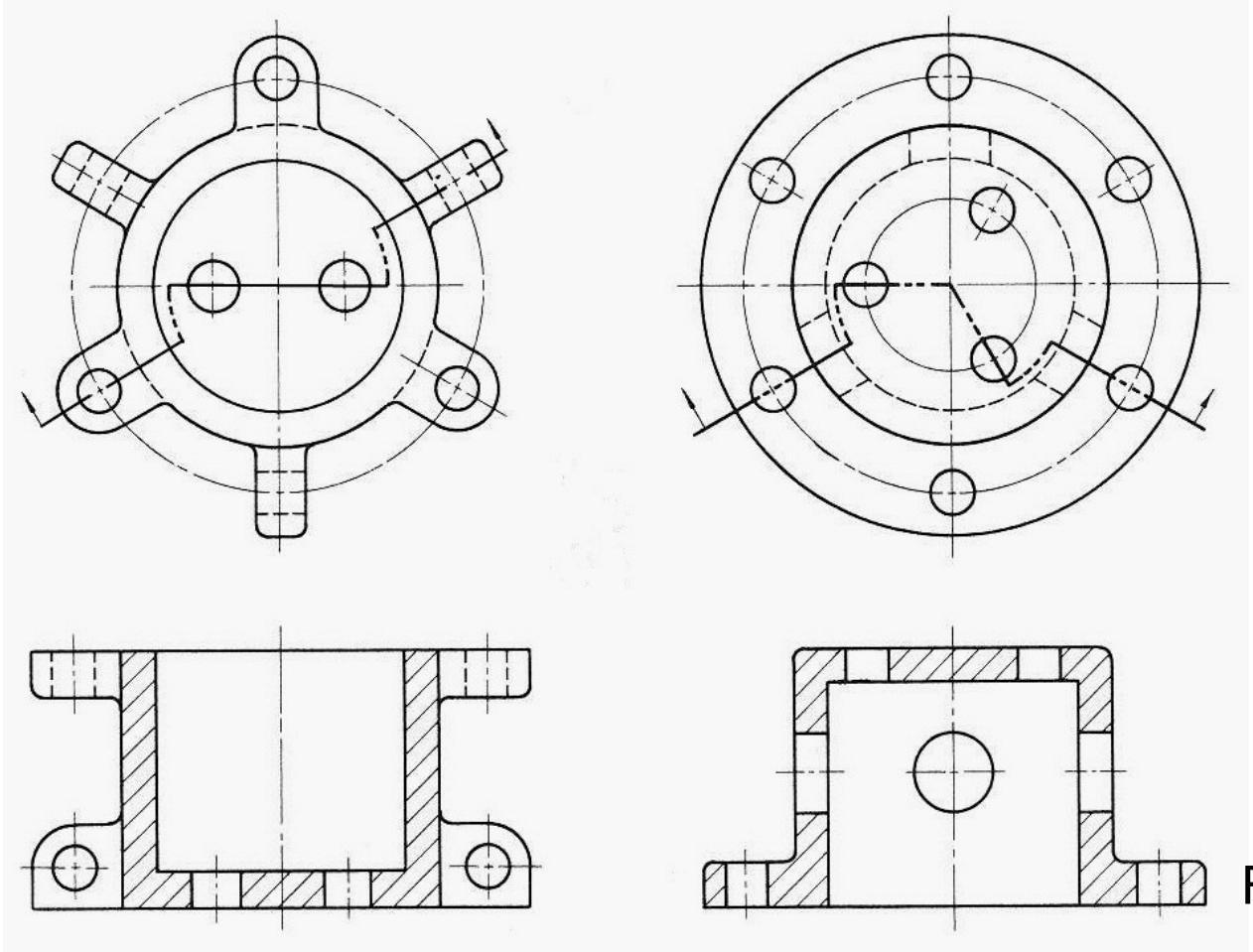


Figure 38

Figure 39

Aligned Elements in Full and Sectional Views

- In full views, as well as in sectional views, certain violations of the rules of true projection are accepted as a good practice because they add to the clearness of the drawing. **Fig. 40** may be shown **straightened out or aligned in one view**. This is **to avoid drawing in a foreshortened position**.

- When the space available is limited to allow a satisfactory scale to be used for the **representation of a symmetrical piece**, it is a good practice to make **one view a half**, as shown in **Fig. 41**.

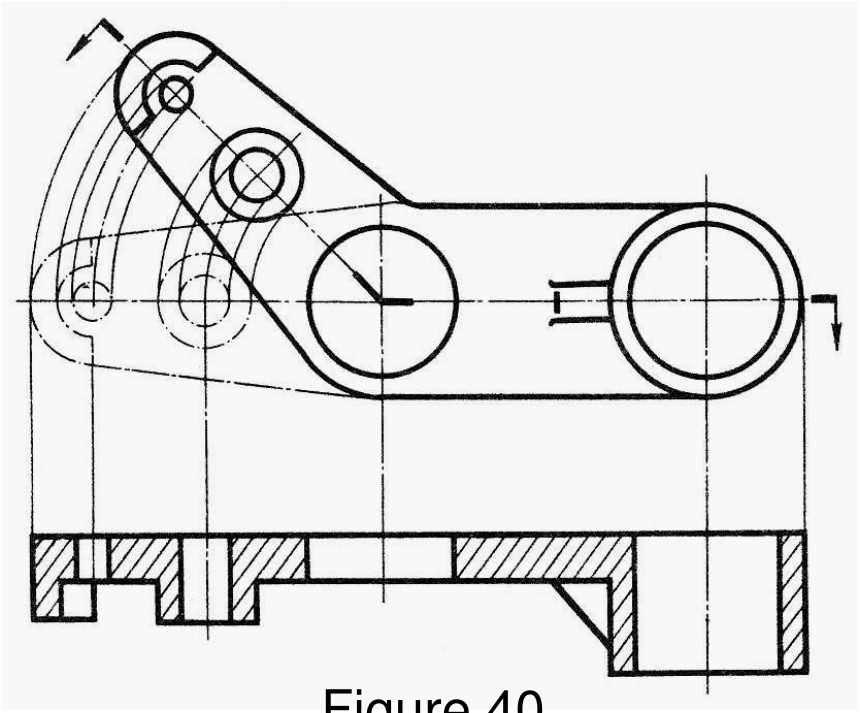


Figure 40

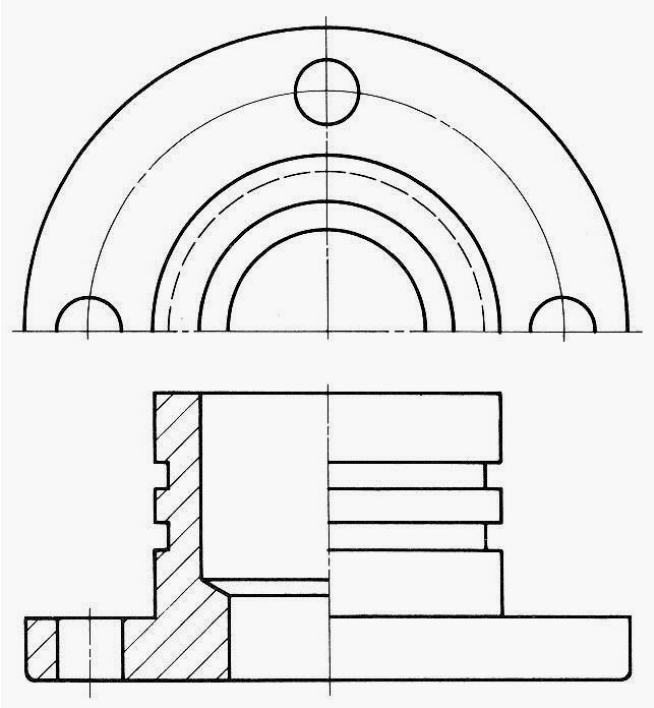


Figure 41

Conventional Breaks

- In order to **shorten certain views of long parts**, conventional breaks are recommended.
- Parts considered as broken **must have the same section throughout**, or if tapered they **must have a uniform taper**.
- The breaks used on cylindrical shafts or tubes are often referred to as **"S-breaks"** and are usually drawn entirely or partly freehand.

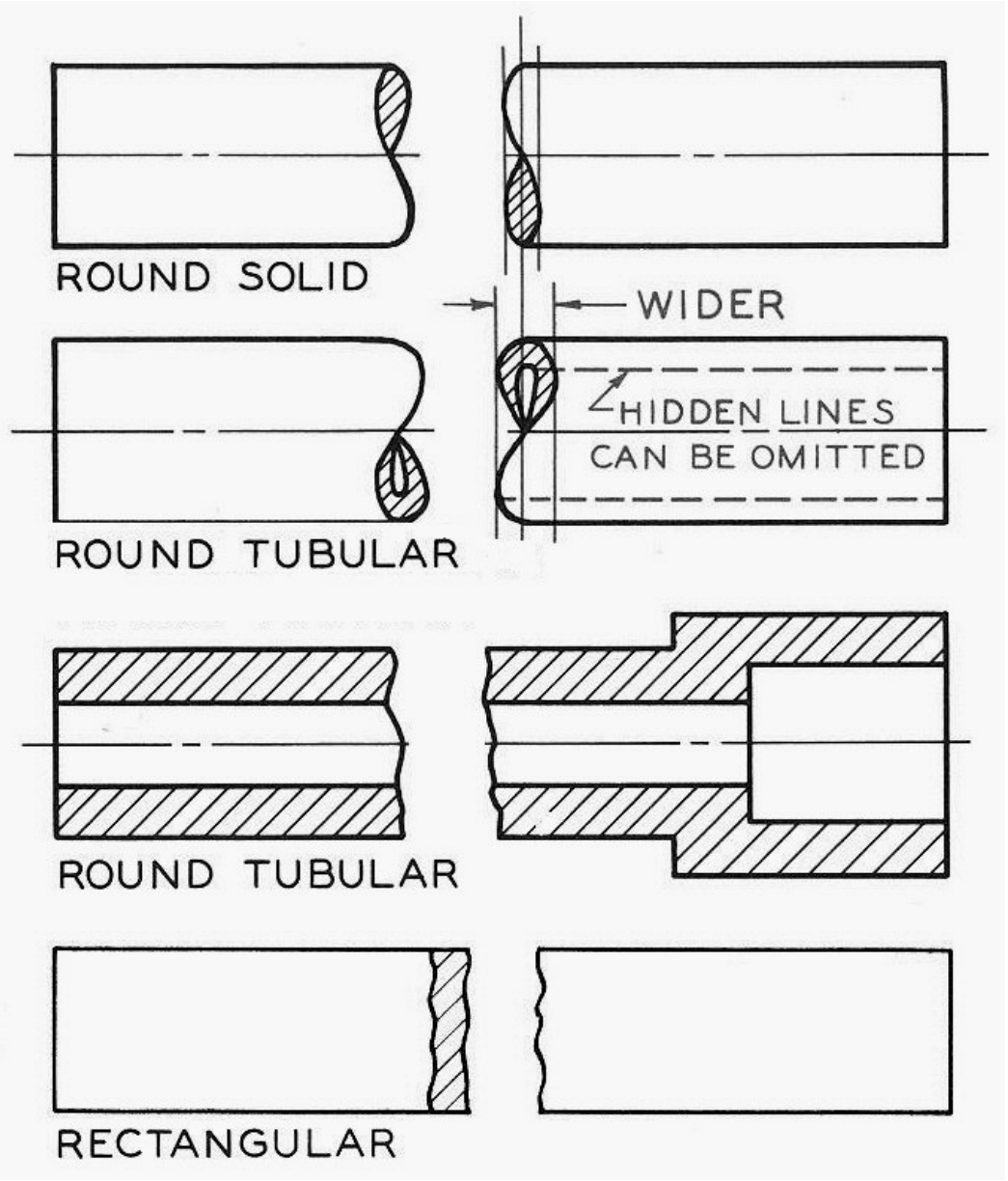


Figure 42

Various Conventions in Sectioning

