

IEM132

ENGINEERING DRAWING

B.Sc. Industrial Engineering and Management – 2nd SEMESTER (2020)
IQTM, University of the Punjab, Lahore.

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Module # 08

SECTIONAL VIEWS



Learning Objectives

- **Students should be able to learn**
 1. Some basic information about Sections
 2. Types of Sectional views



Sectional Views

- Internal **hidden** details of the **object** are shown in orthographic views by **dashed lines**.
- The **intensity** of dashed lines in orthographic views depends on the **complexity** of internal structure of the object.
- It will become more and more difficult to visualize the shape of the object as the number of dash lines in orthographic views goes on increasing.
- The numbers of dashed lines make the drawing unnecessarily **complicated** and **confusing** to interpret.
- Therefore, the general practice is to draw **sectional views** for complex objects in addition to or **instead** of simple orthographic views.



Sectional Views

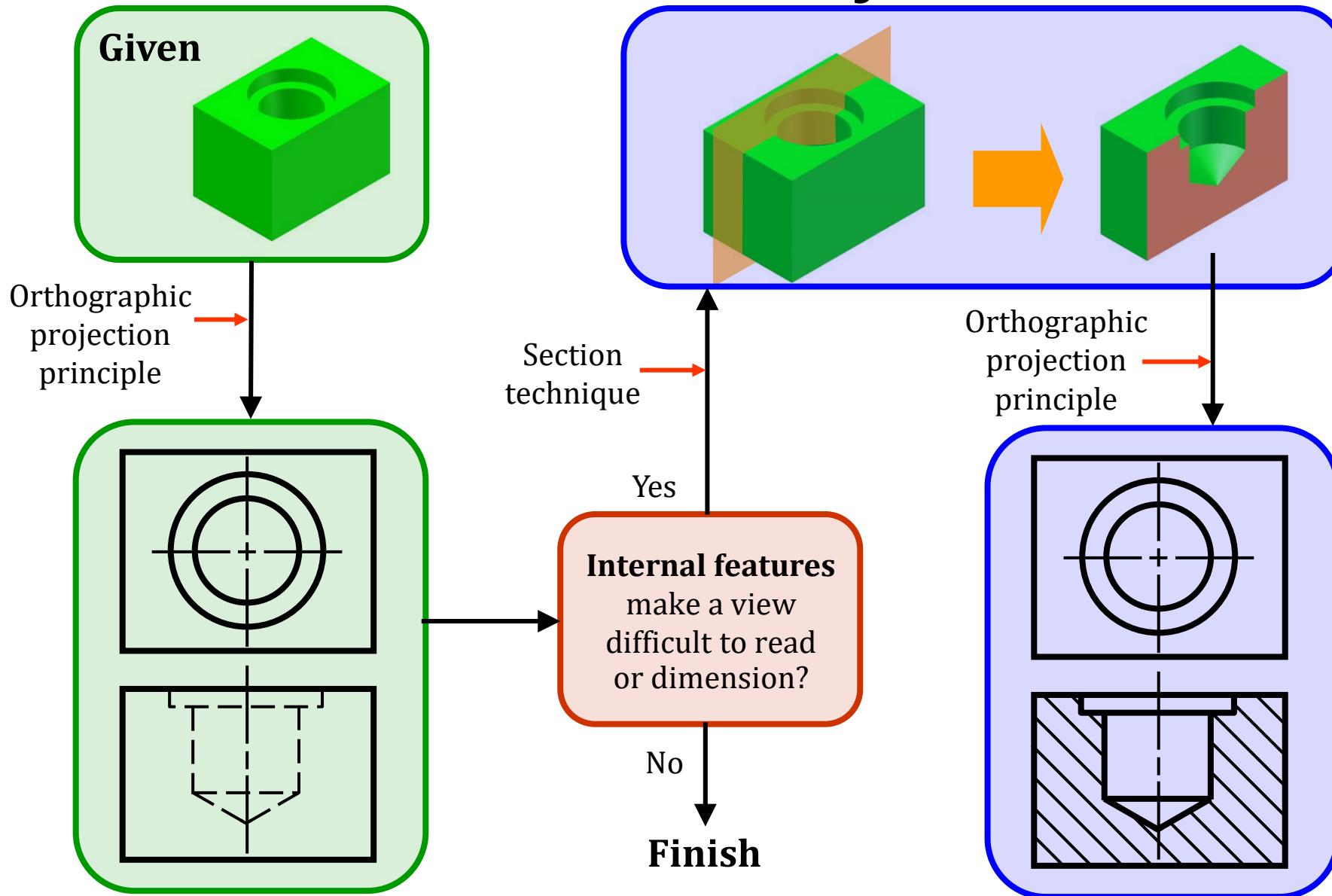
- A sectional view or section looks inside an object.
 - Sections are used to clarify the interior construction of a part that can not be clearly described by hidden lines in exterior views.
 - A sectional view, is obtained by taking the **section** of the **object** along a particular plane.
 - An **imaginary cutting plane** is used to obtain the **section** of the **object**.
 - The part of the object between the observer and the imaginary cutting plane is assumed to be removed and the view of the cut object thus obtained is called the **section view**.



Sectional Views

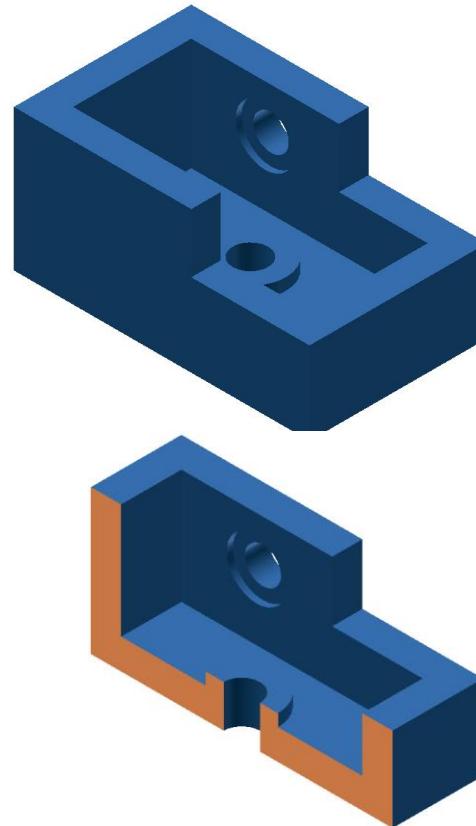
- **Section views** are an important aspect of design and documentation and are used to improve clarity and reveal interior features of parts and structures.
- Section views also are used in the ideation and refinement stages of engineering design to improve the communications and problem-solving processes.

Necessity of a Section View

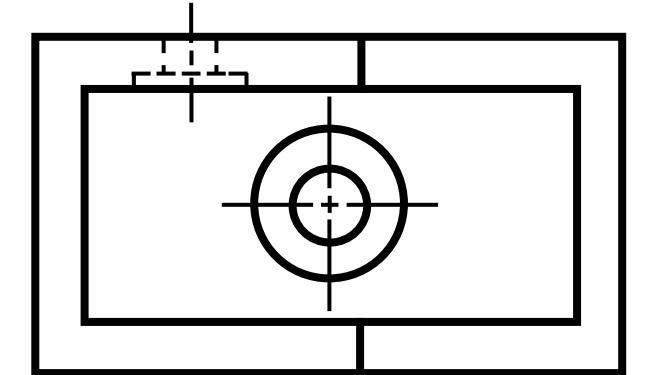


Example

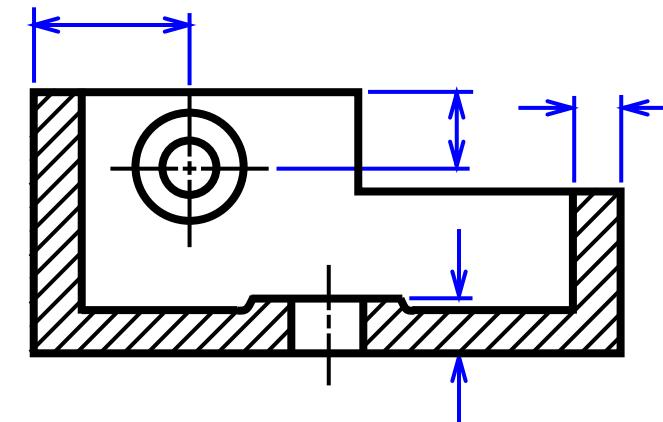
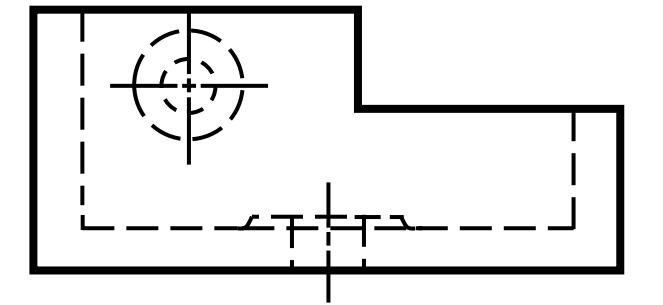
- Clarify an internal feature.
- Facilitate dimensioning.



Regular view

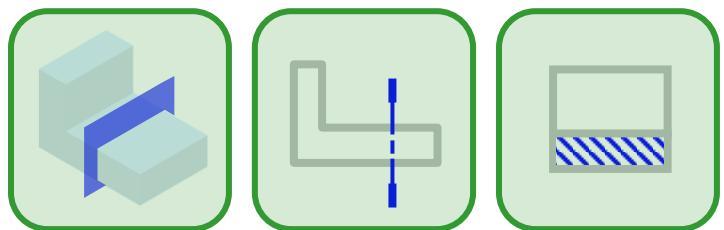


Section view





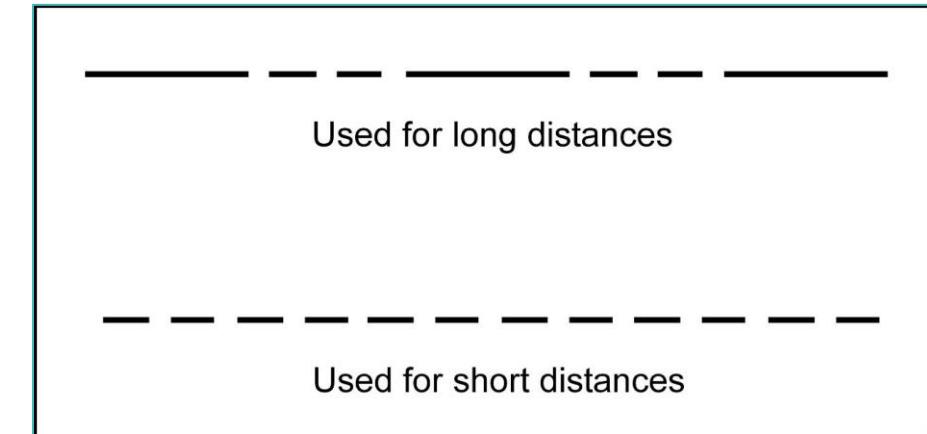
Basic Components



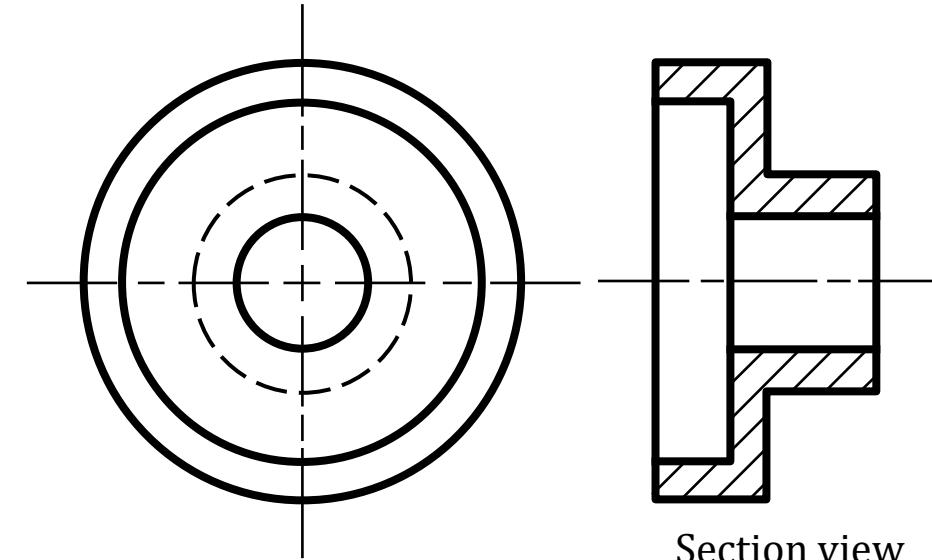
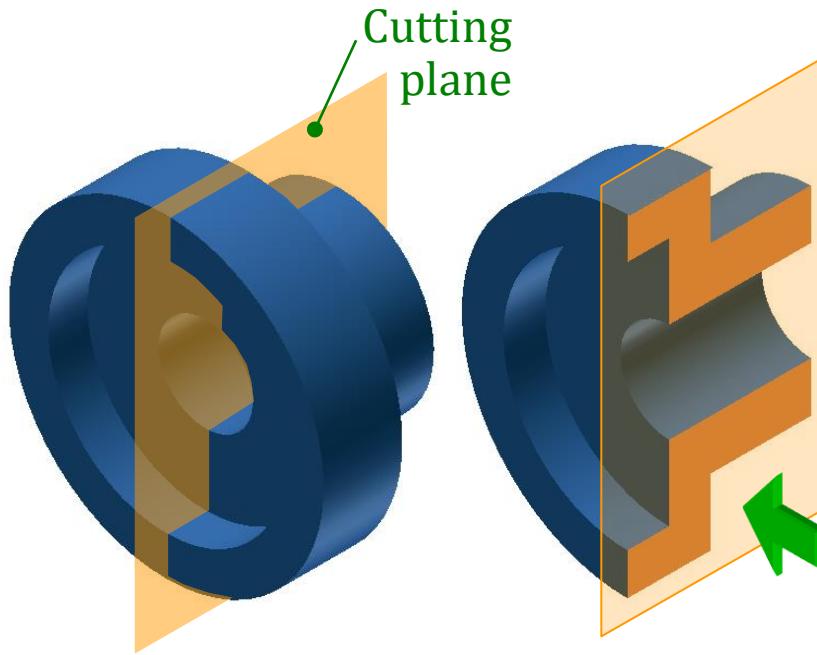


Cutting Plane

- Cutting plane is an imaginary plane that cuts through the object.
 - A section view is obtained by viewing the object after removed the cover up part in the direction normal to the cutting plane.
 - Location and direction of a cutting plane depend on a hidden feature that is needed to be revealed.
 - (Phantom line type)



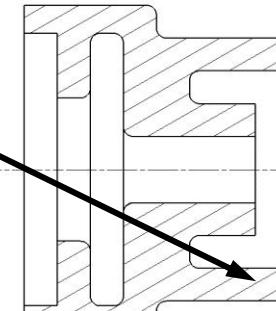
Cutting Plane



Section view

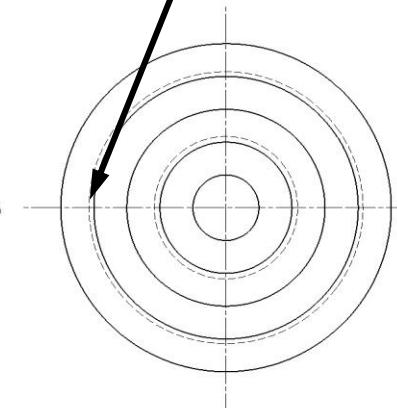
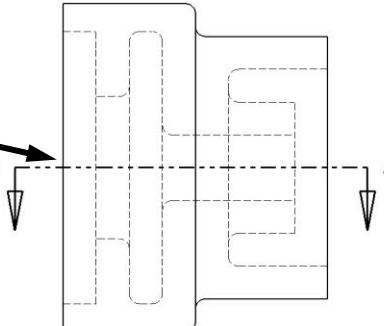
Section Example

Notice how the cut material is shown.

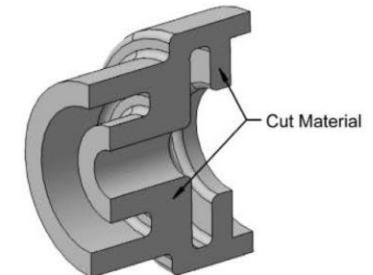
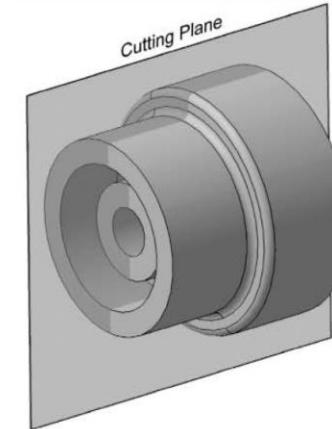


SECTION A-A

Notice how the cutting plane is indicated.

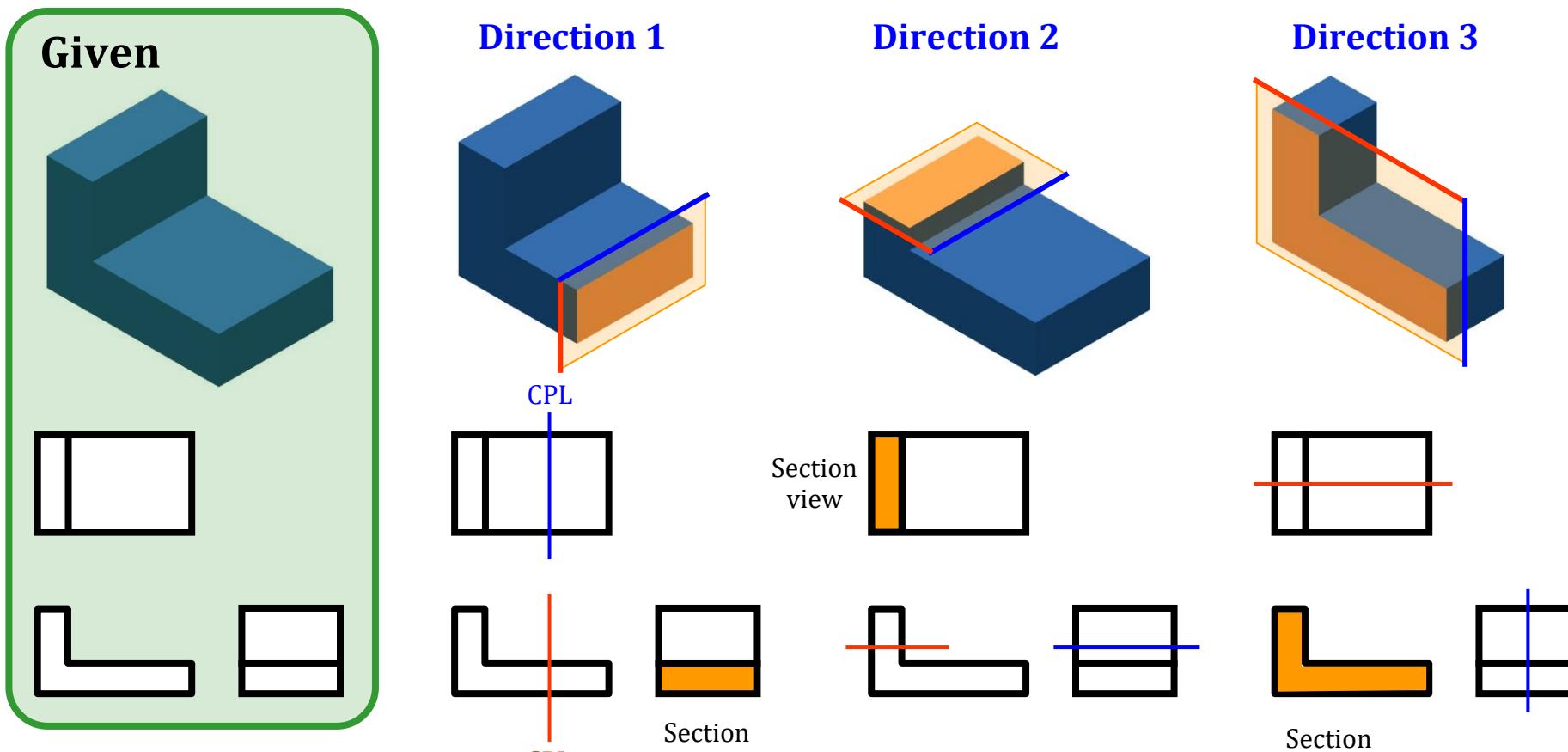


Sectional view label



Cutting Plane Line

- In an orthographic view, a cutting plane is presented as a “**cutting plane line, CPL**” and is drawn in either of an **adjacent view** of the section view.

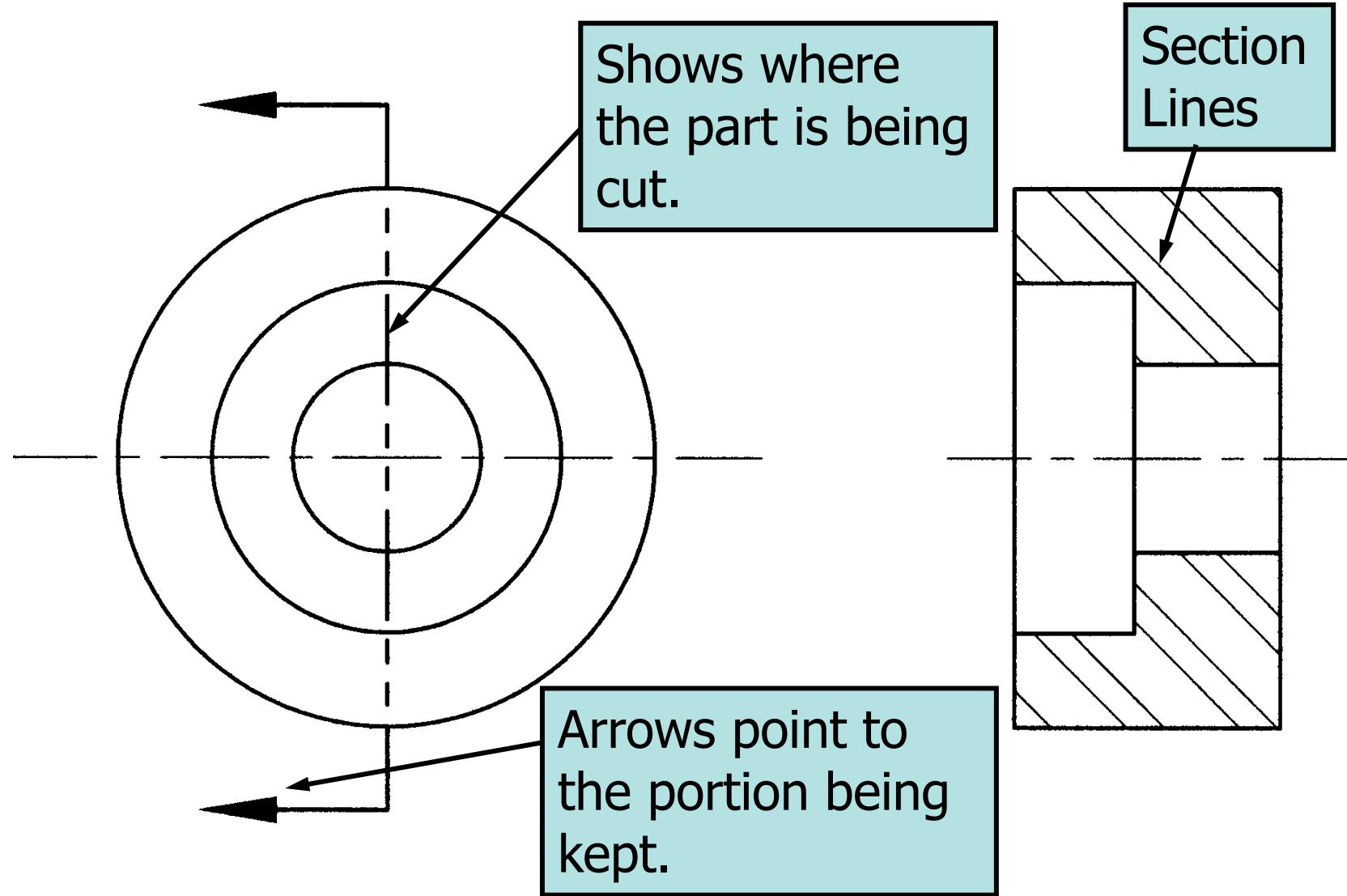




Lines Used in Section Views

- **Section Lines:** Section lines are used to indicate where the cutting plane cuts the material.
 - Section lines are thin lines.
 - Section line symbols are chosen according to the material of the object.
 - Section lines are generally drawn at a 45° angle.

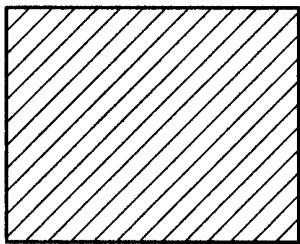
Lines Used in Section Views



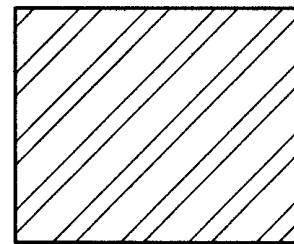


Lines Used in Section Views

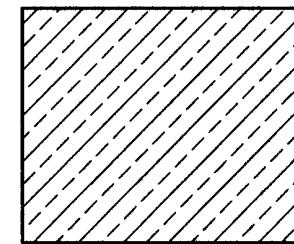
- Common Section Line Symbols



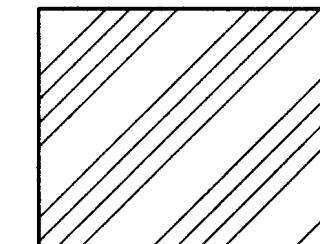
Cast Iron
General Use
all materials



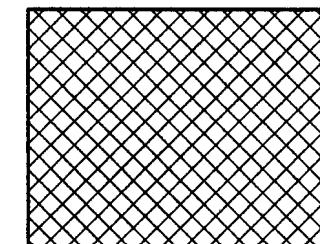
Steel



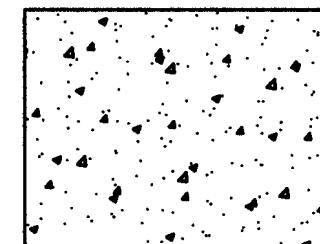
Brass, Bronze,
Copper



Rubber, Plastic,
and Electrical
Insulation



Zinc and Lead

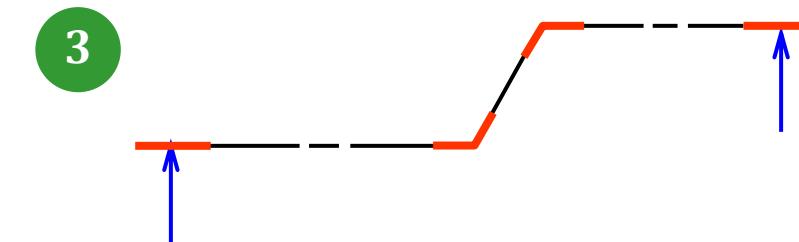
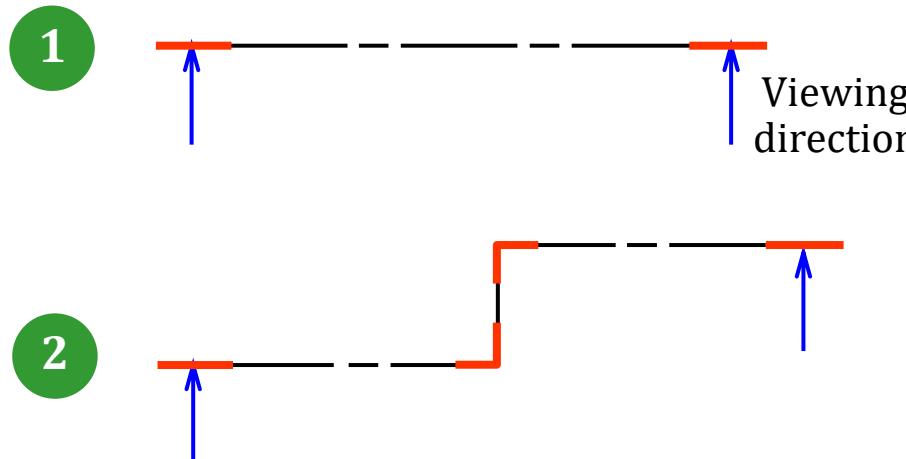


Concrete

Lines Used in Section Views

- The cutting plane line is presented by a chain line.
- **Begin** and **end** the line with a short visible line.
- Draw an arrow at about the mid-length of a short visible line, the arrow head is pointed toward to this line in a viewing direction.
- When the line **changes its direction**, draw a short visible line at that corner.

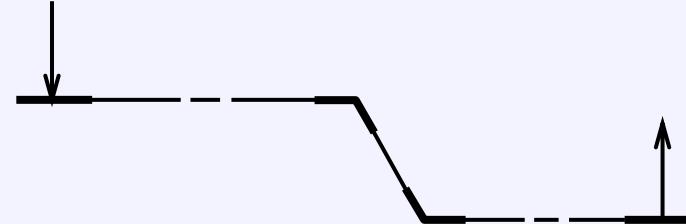
Examples



Class Activity

Do you find something **wrong** in the following cutting plane lines?

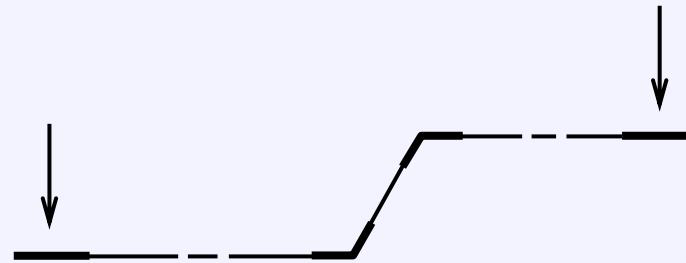
1



Yes

No

2



Yes

No

3



Yes

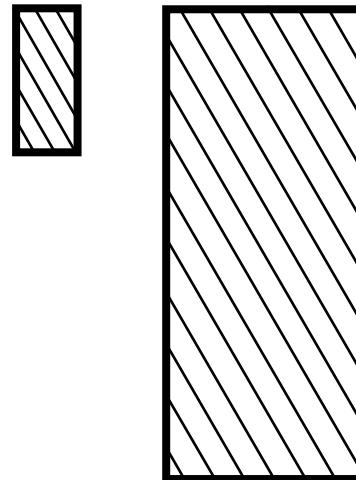
No



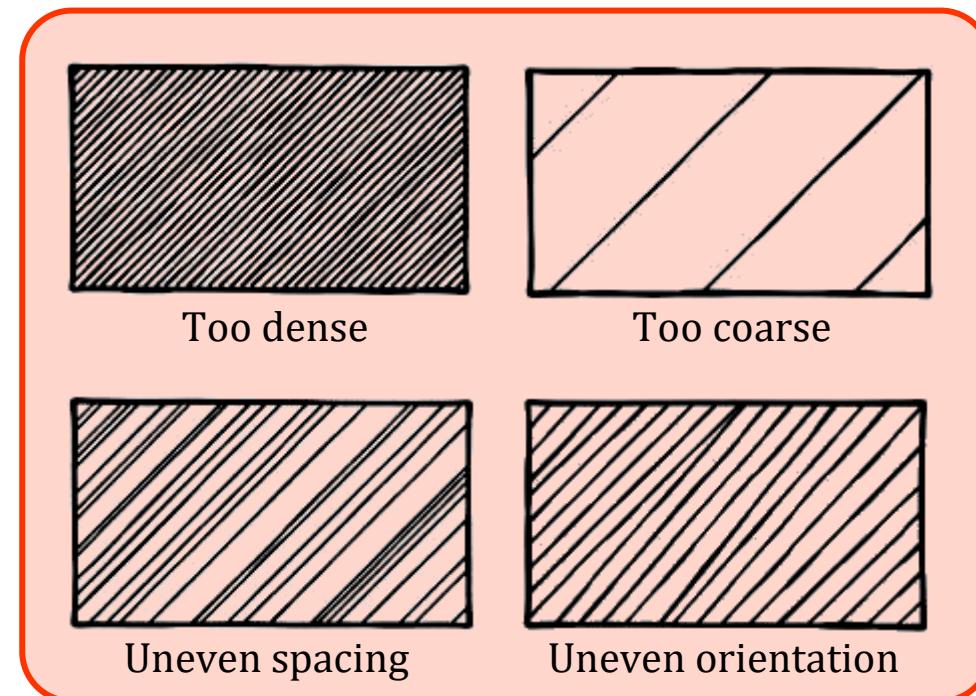
Section Lining

- The spacing between lines may vary from 1.5 mm for small sectioned areas to 3 mm for large sectioned areas.

Examples

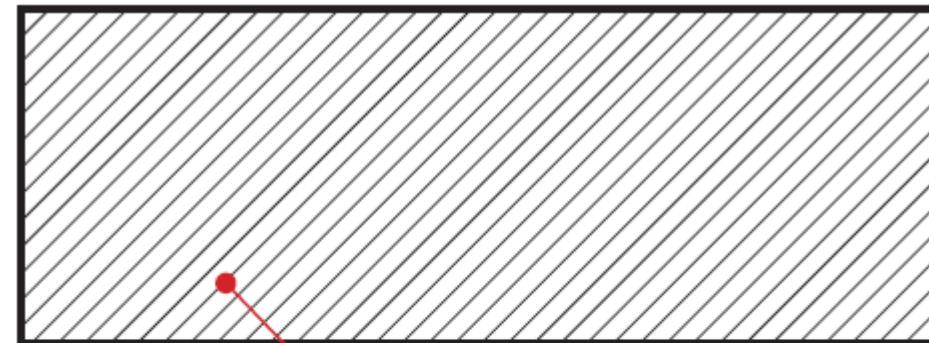


Poor Practices





Section Lining



**THIN SHARP LINES
AT 45°**

.10" AVERAGE SPACING

**.20" SPACING FOR LARGE
DRAWINGS**

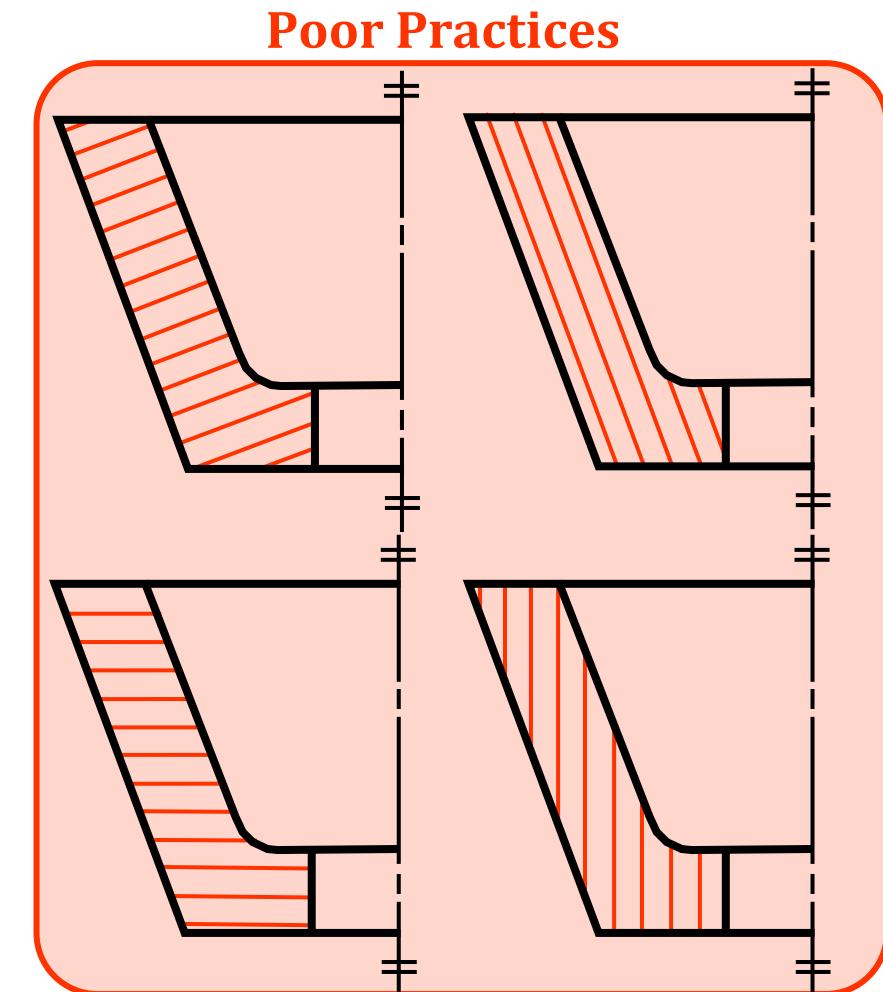
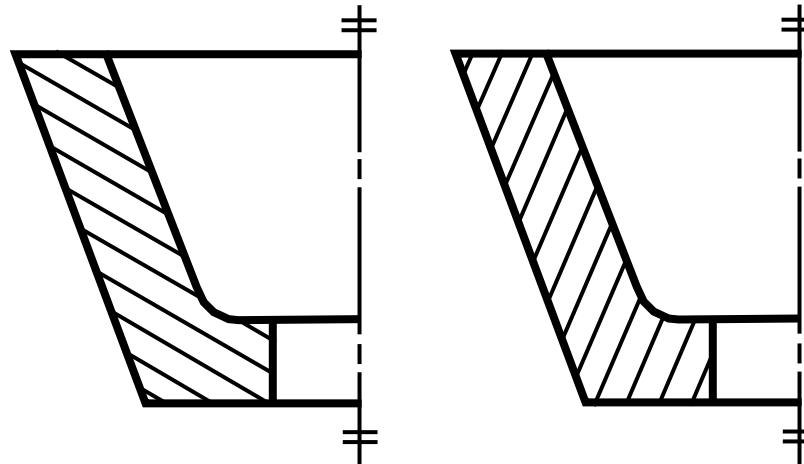
**.05" SPACING FOR SMALL
DRAWINGS**

Crosshatch spacing will vary according to the drawing size. Space the crosshatching by “eye” when drawing

Section Lining

- It should not run parallel or perpendicular to contour of the view.

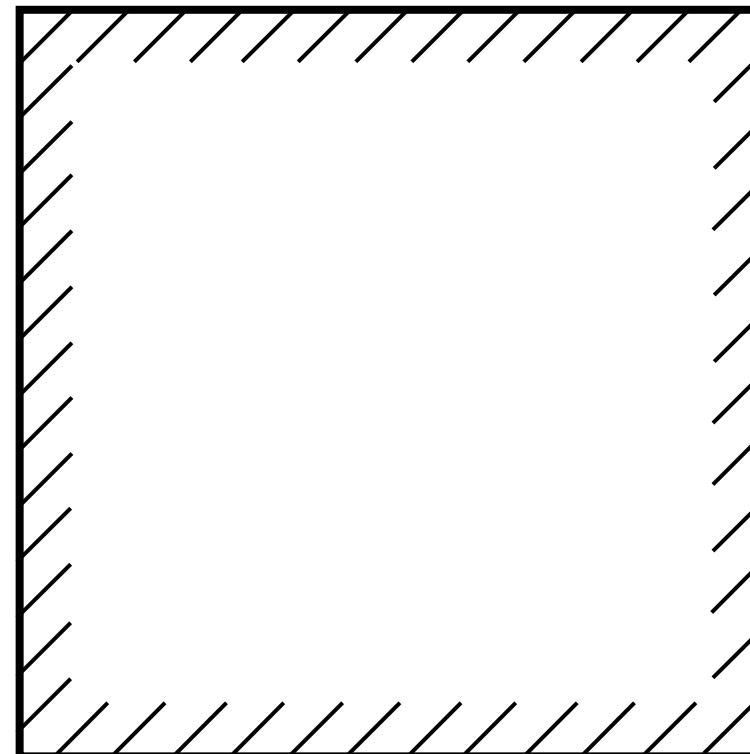
Examples





Section Lining

- When the sectioned area is large, an outline sectioning may be used to save time.





Section View Rules



Rules of Sectioning

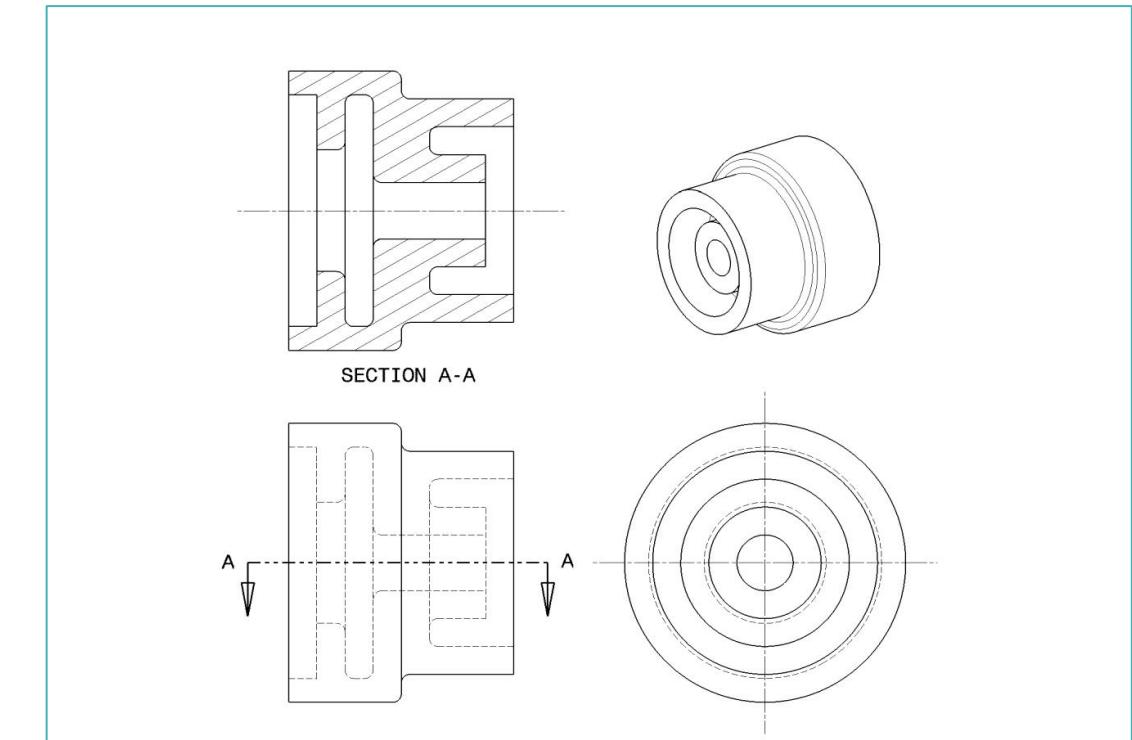
- **Rule 1:**

A section lined area is always completely bounded by a visible outline.

- **Rule 2:**

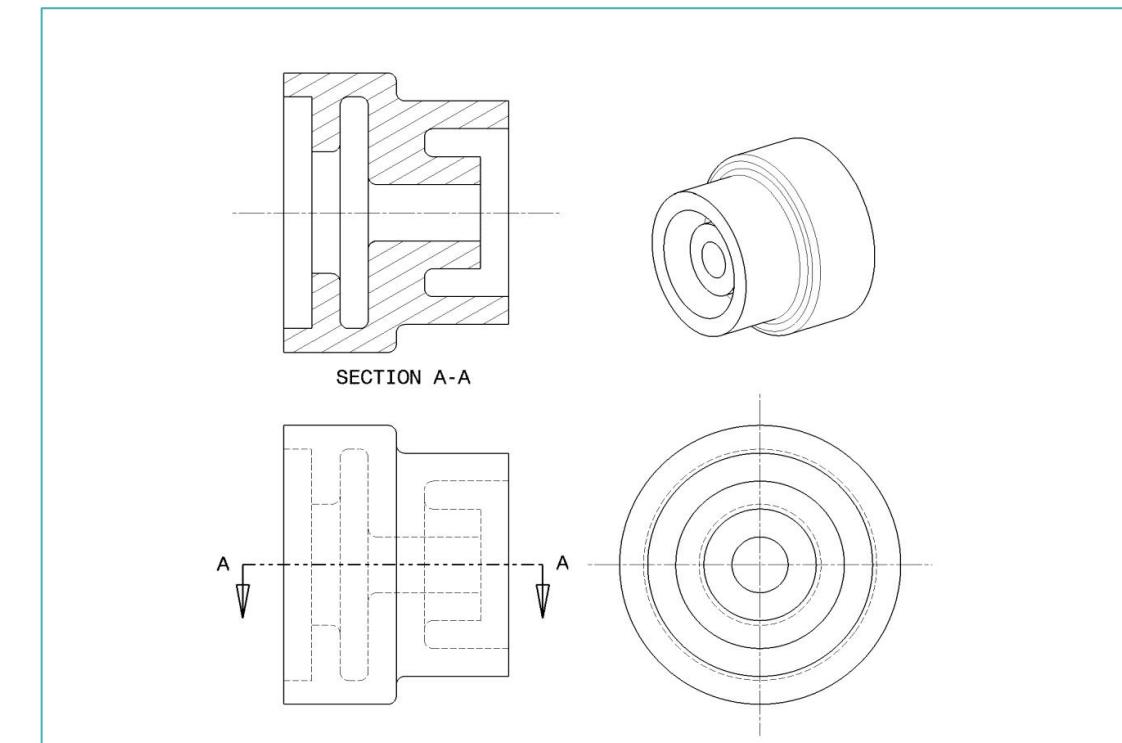
The section lines in all areas should be parallel.

- Section lines shown in opposite directions indicate a different part.



Rules of Sectioning

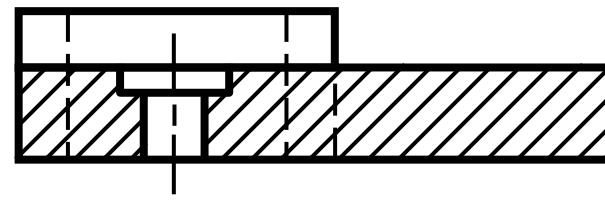
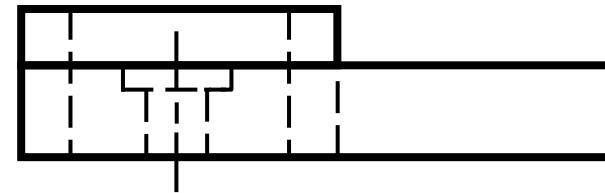
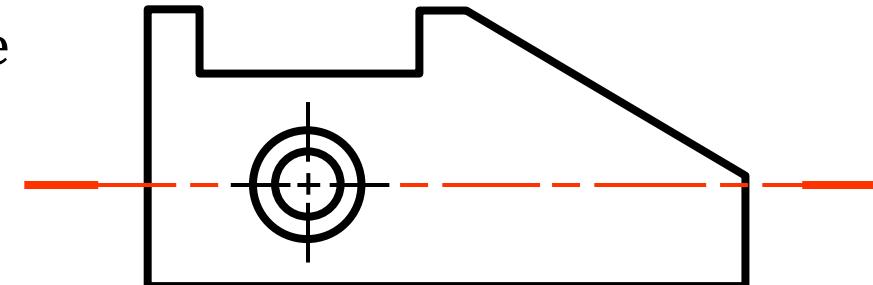
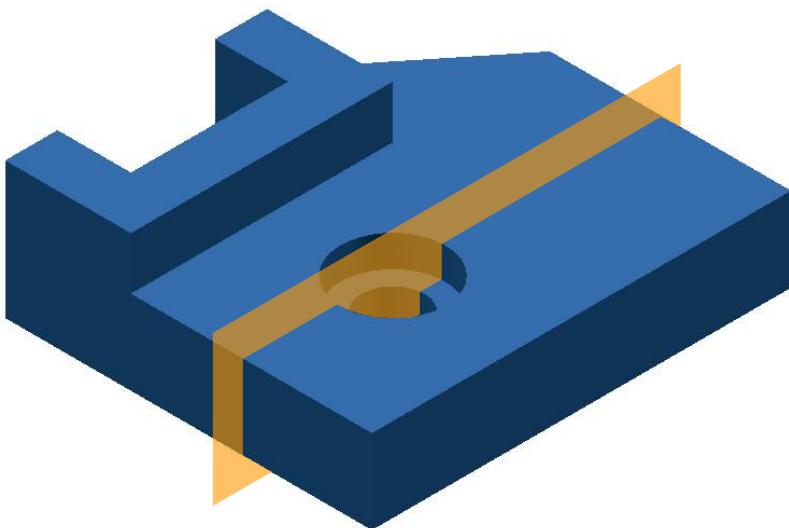
- **Rule 3:** All the visible edges behind the cutting plane should be shown.
- **Rule 4:**
 - Hidden features should be omitted in all areas of a section view.
 - Exceptions include threads and broken out sections.



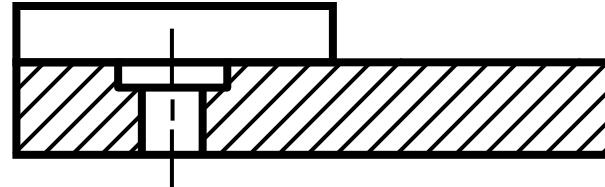


Conventional Practice: Treatment of a Hidden Line

- Hidden lines are usually **omitted** within the section lined area.



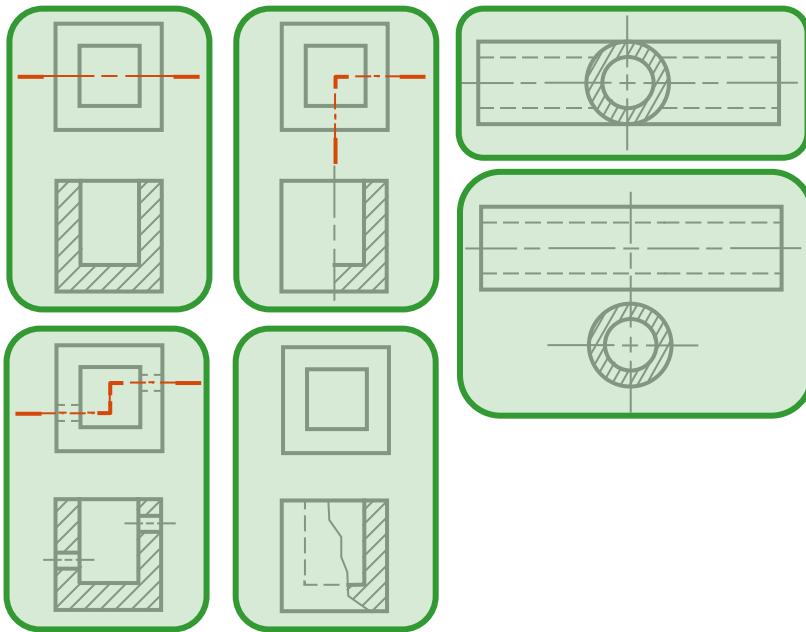
Hidden lines present.



Hidden lines are **omitted**.



Methods / Types of Sectioning





Methods / Types of Sectioning

Following are the list of section views.

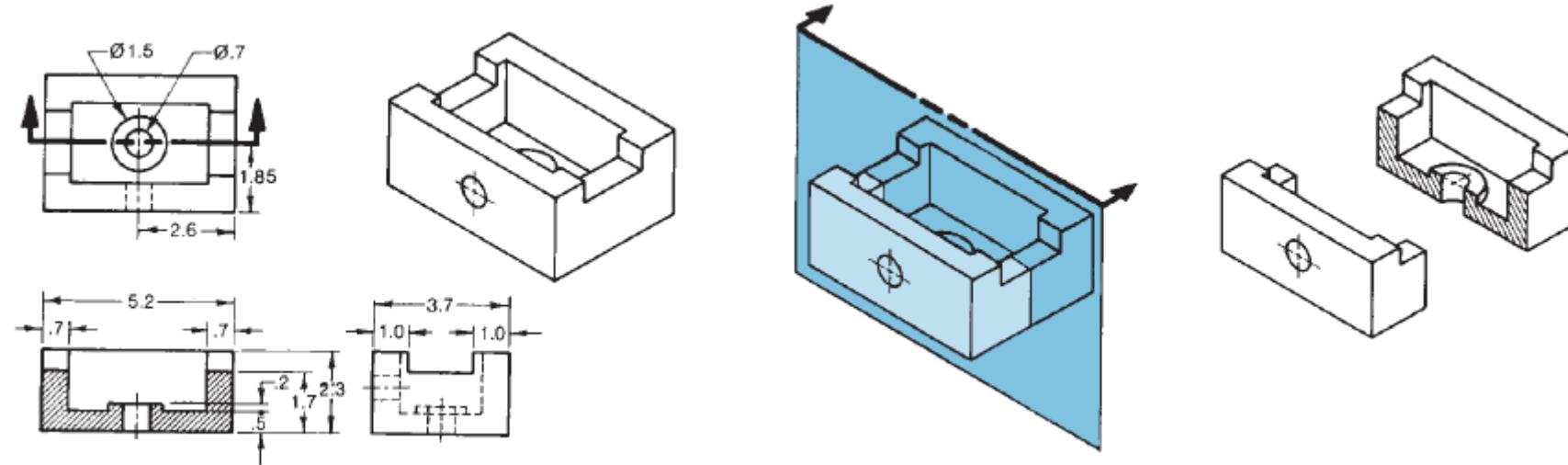
1. Full section
2. Half section
3. Offset section
4. Aligned Section
5. Broken-out section
6. Revolved section
7. Removed section
8. Assembly section
9. Thin wall section
10. Auxiliary section
11. Enlarged section
12. Rib and Web Sections



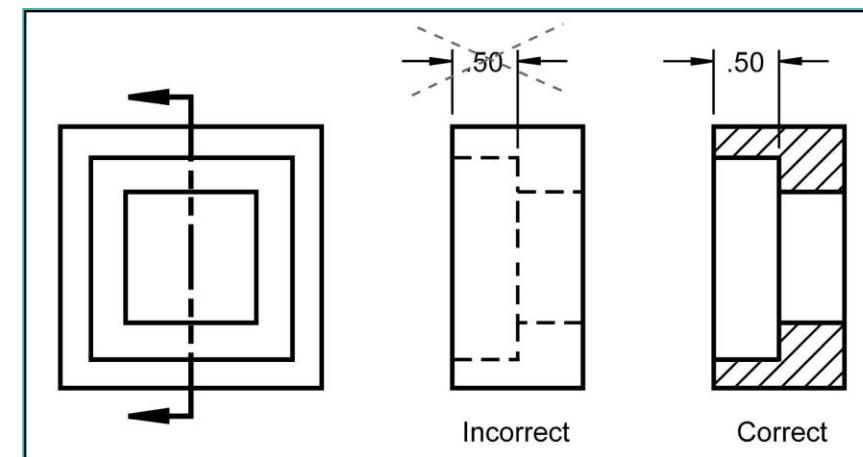
1. Full Section

- When the cutting plane extends entirely through an object, the resulting section is a **full section**.
- Figure shows a Multiview drawing with a cutting plane on the top view, and the corresponding full sectional view in the front-view position.
- Full sections of a front view will place the cutting plane on either **horizontal (top)** views or **vertical (profile)** views.
- In **architectural** drawings, a full-section **top view** is called a **plan view** or **floor plan**.
- A full section for a profile view is an elevation section.
- Used in many cases to avoid having to dimension hidden lines.

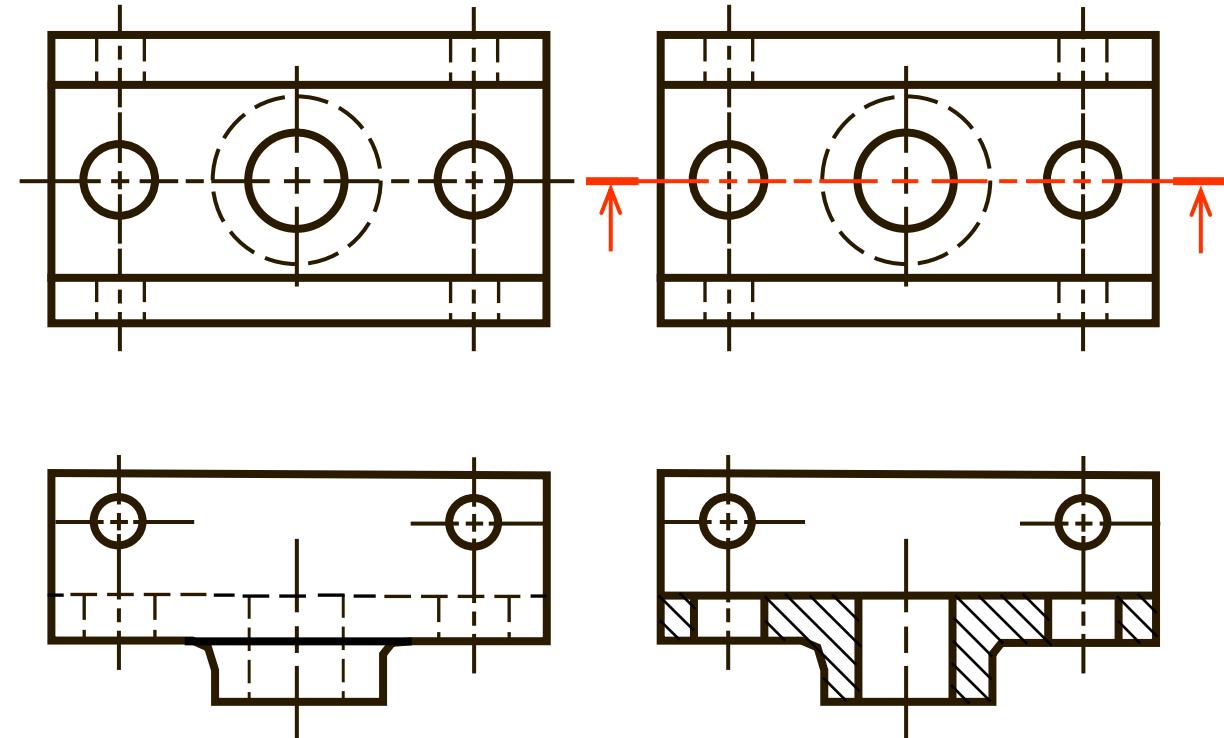
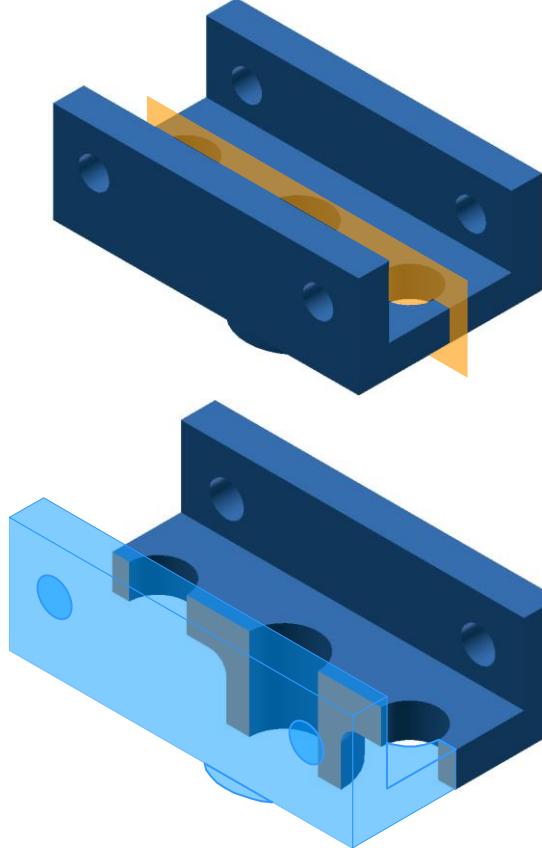
1. Full Section



Full-section working drawings for a jig base

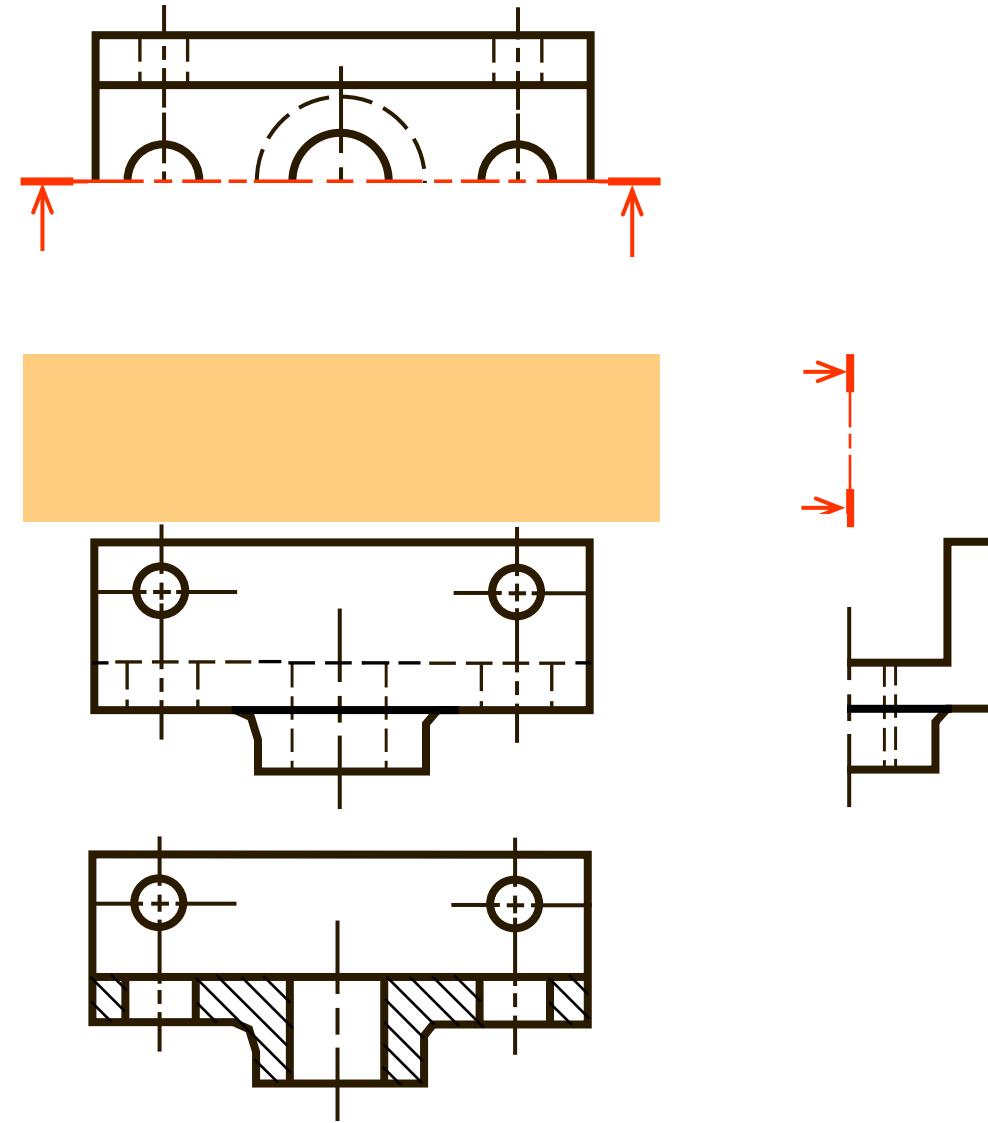
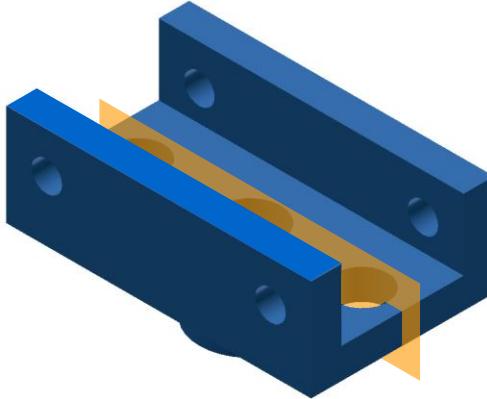


1. Full Section





1. Full Section - A Closer Look



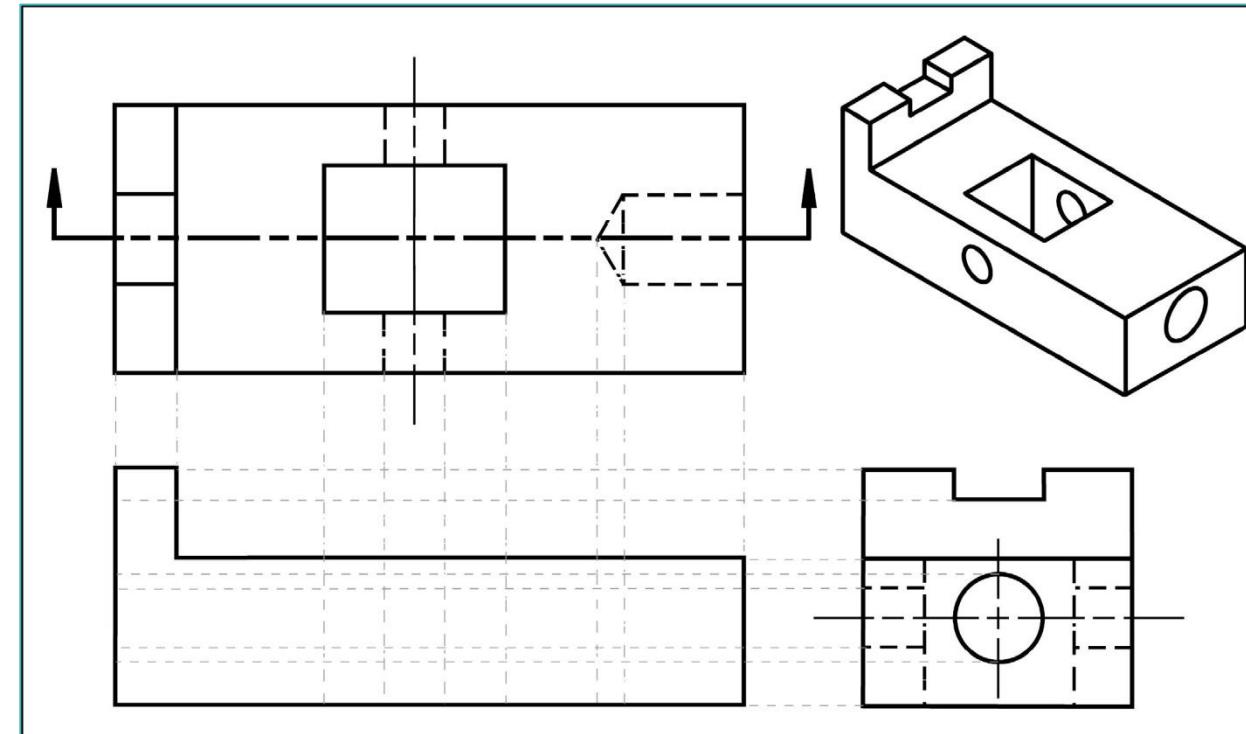


Exercise

FULL SECTION

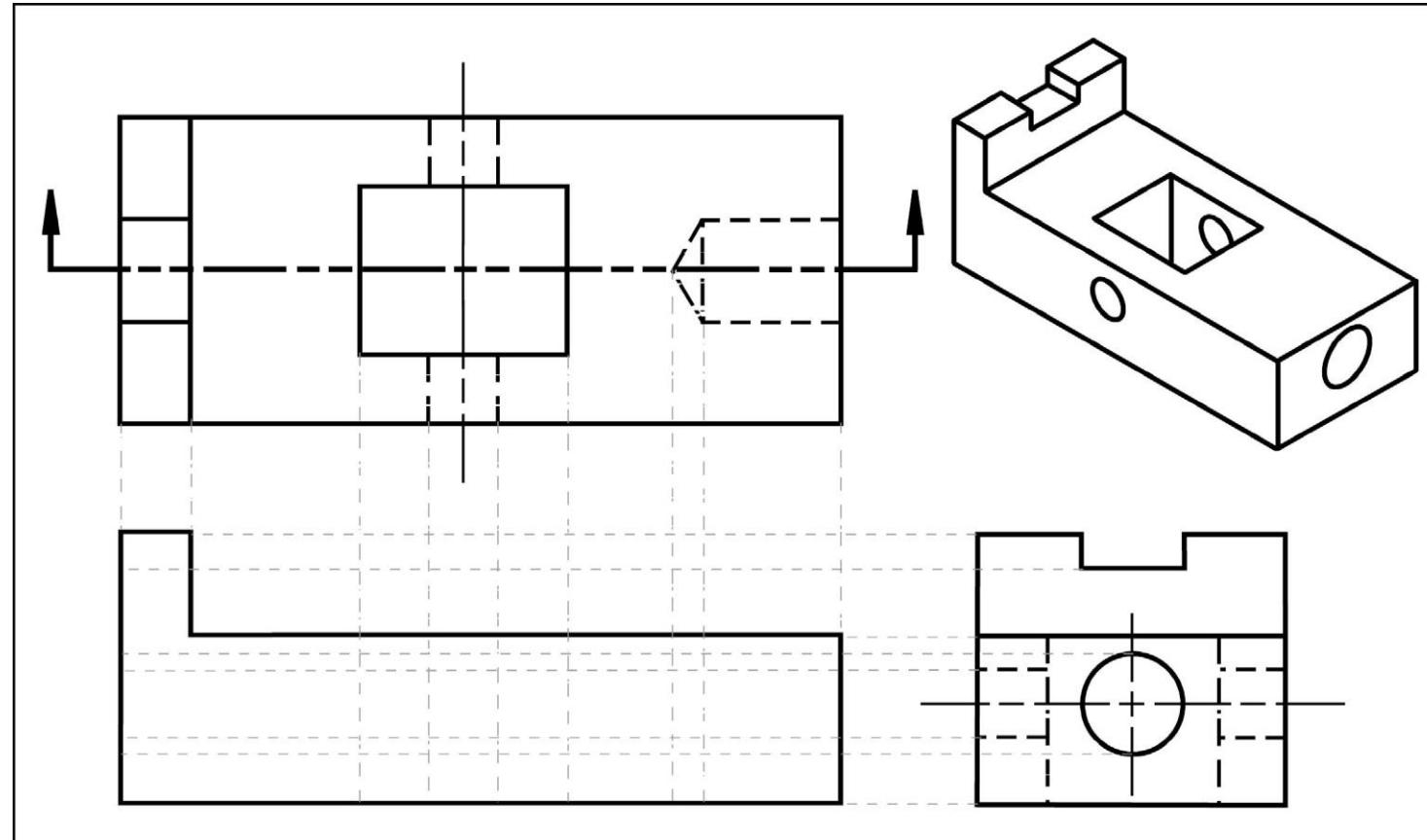
Exercise

- Given the top and right side views, sketch the front view as a full section.
 - The material used is steel.



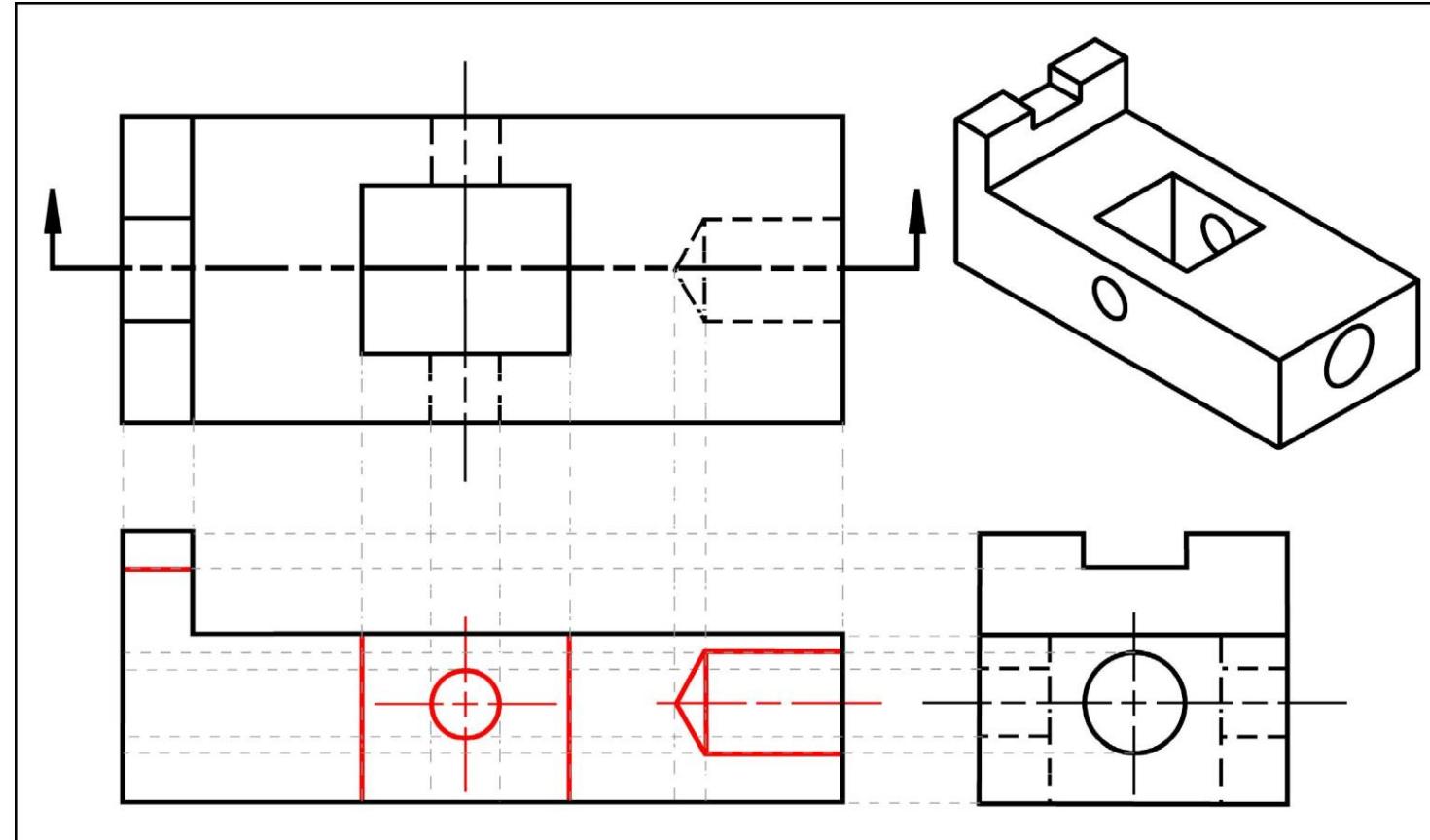


Fill in the visible lines in the front full sectional view



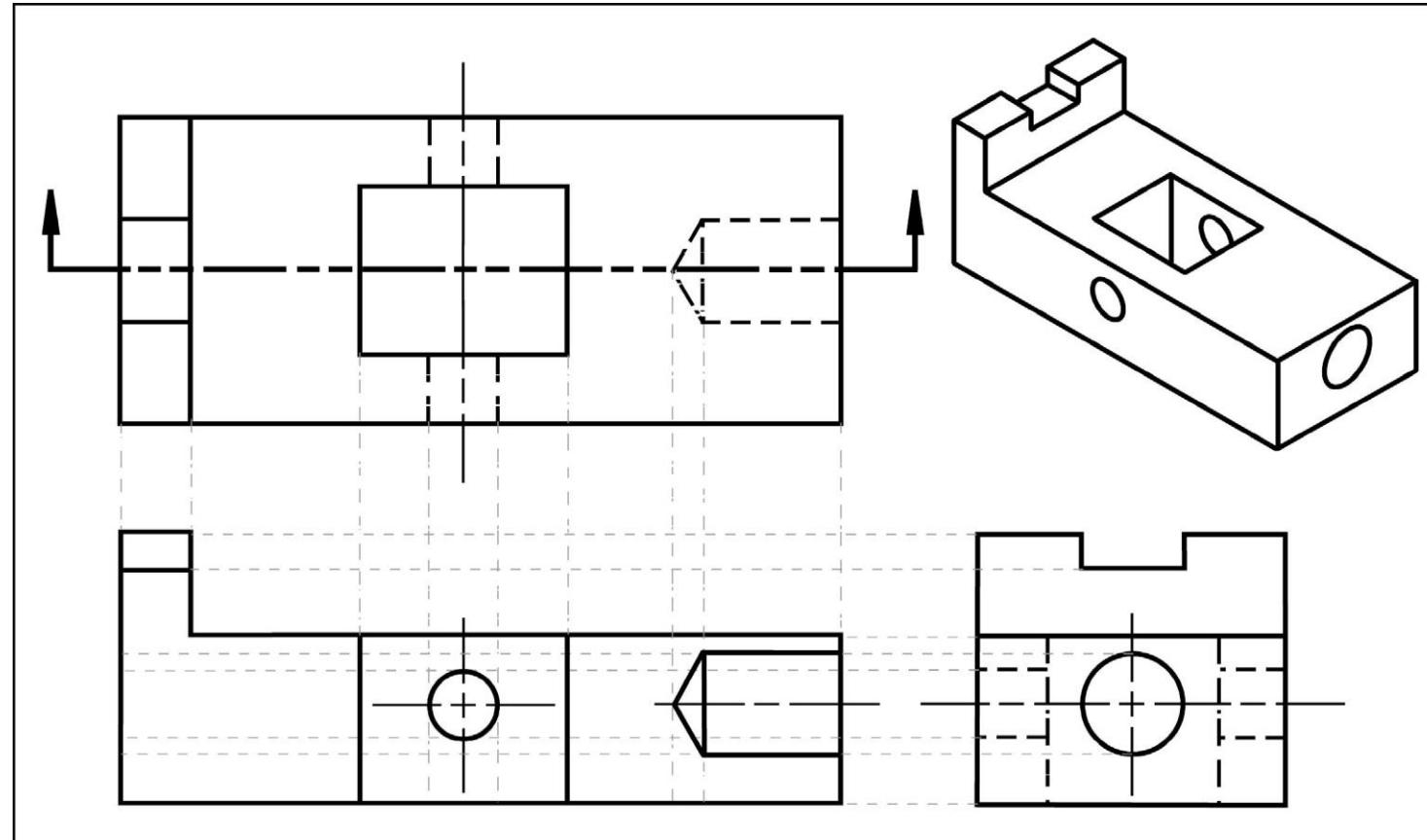


Fill in the visible lines in the front full sectional view



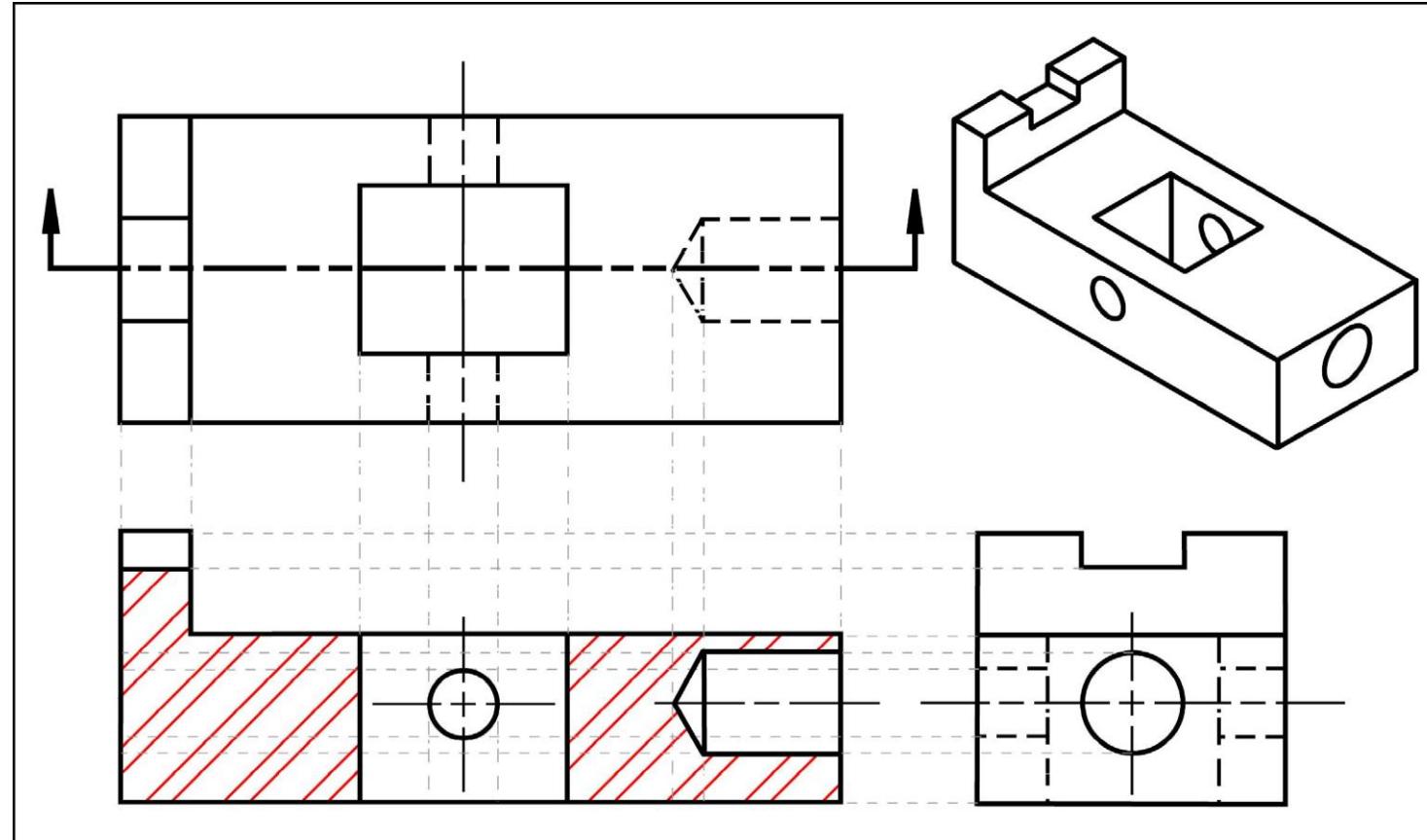


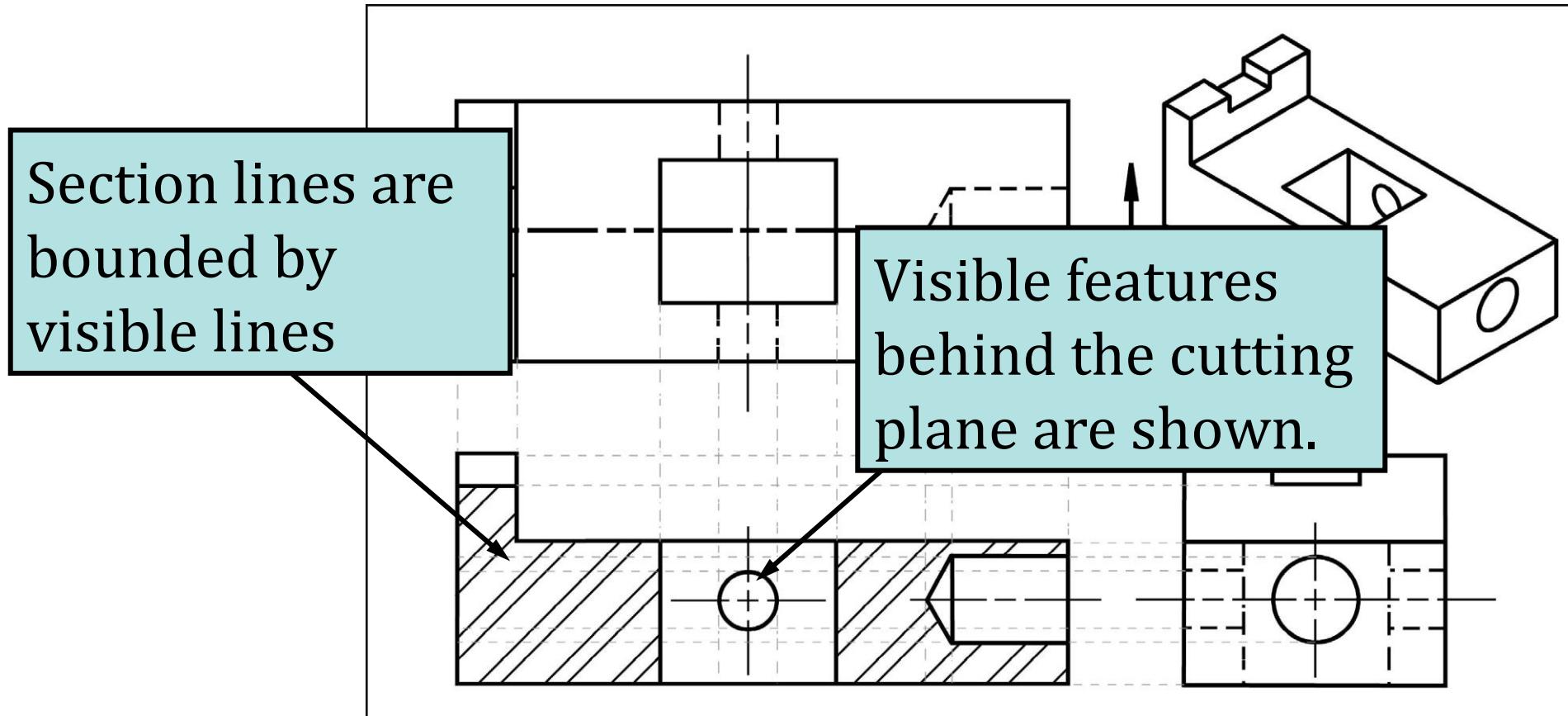
Fill in the section lines in the front full sectional view





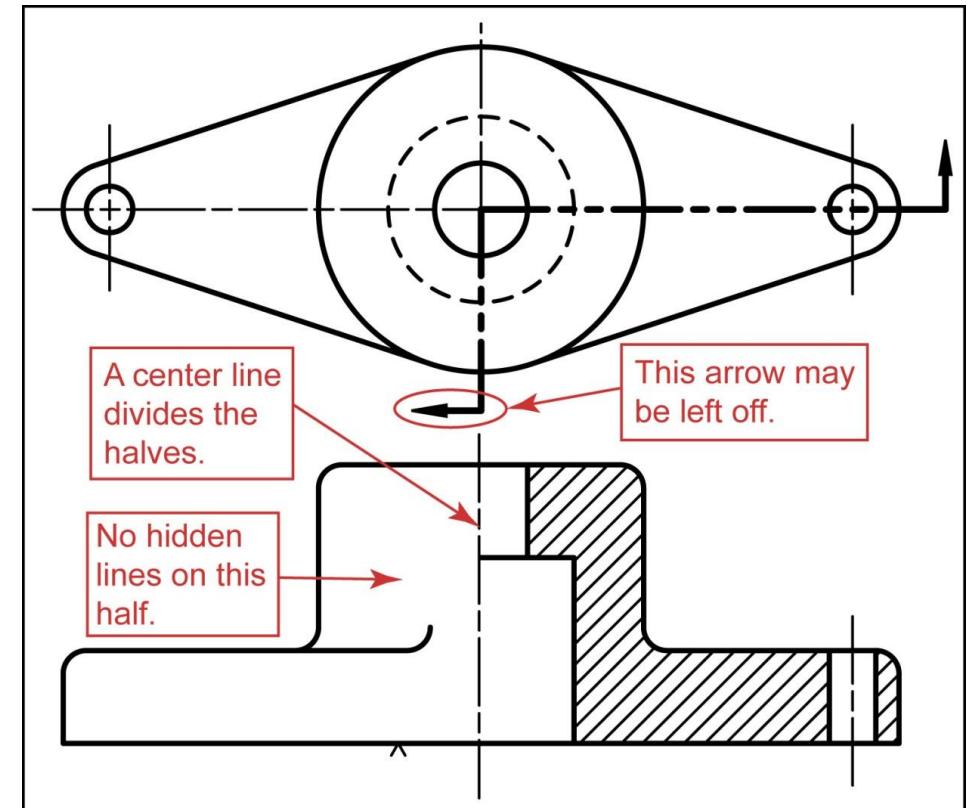
Fill in the section lines in the front full sectional view



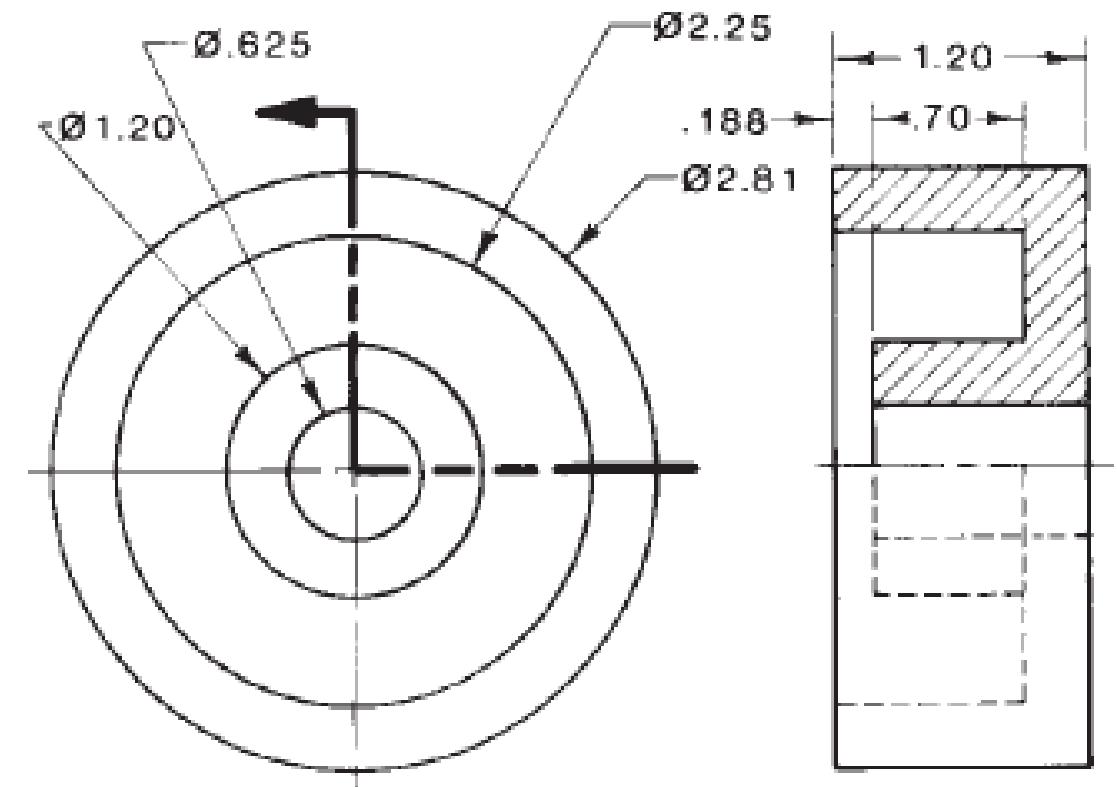
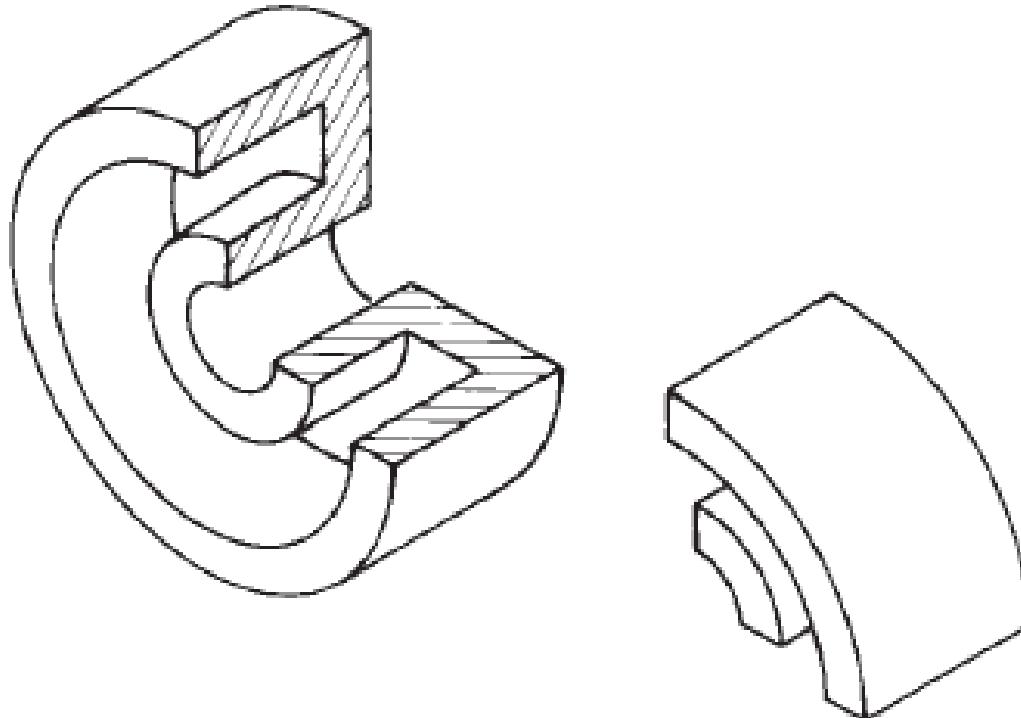


2. Half Section

- A half section exposes the interior of one half of an object while retaining the exterior of the other half.
- Half-sections are prepared for symmetrical objects where the details on both sides of a centerline are identical.
- Two perpendicular cutting plane lines, one on the vertical plane and one on the horizontal plane, define the section area.
- These align with centerlines and remove an imaginary quarter of the object.

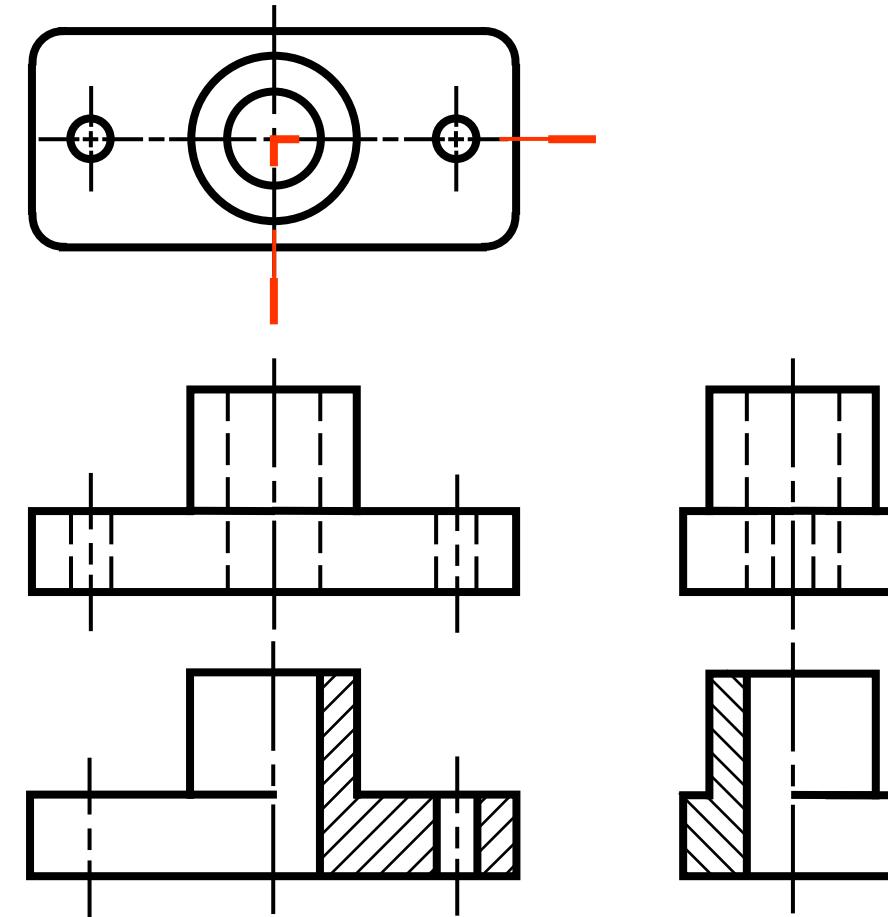
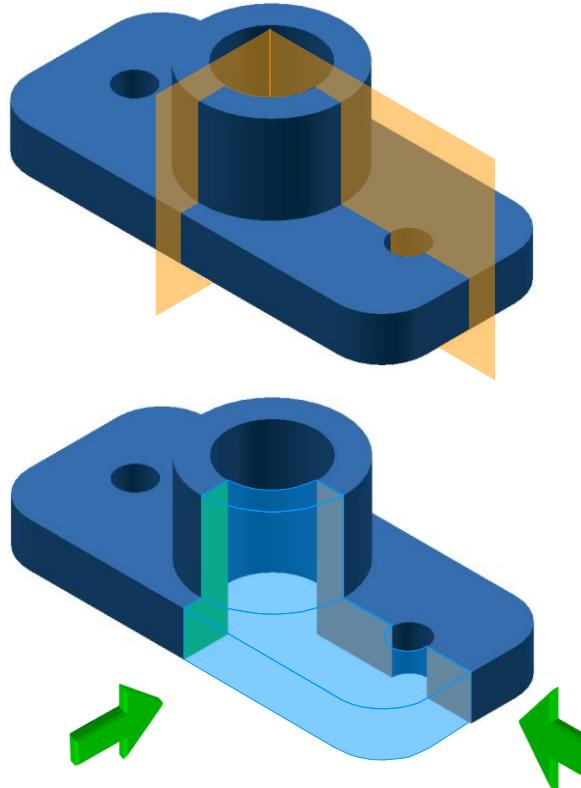


2. Half Section



Half-section working drawing of a
belt pulley

2. Half Section



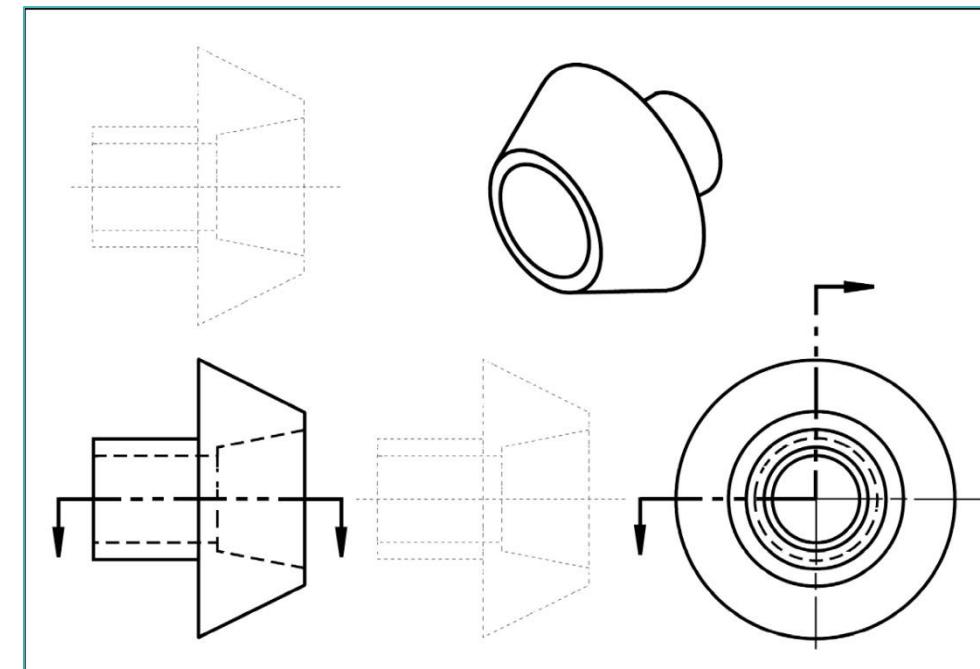


Exercise

HALF SECTION

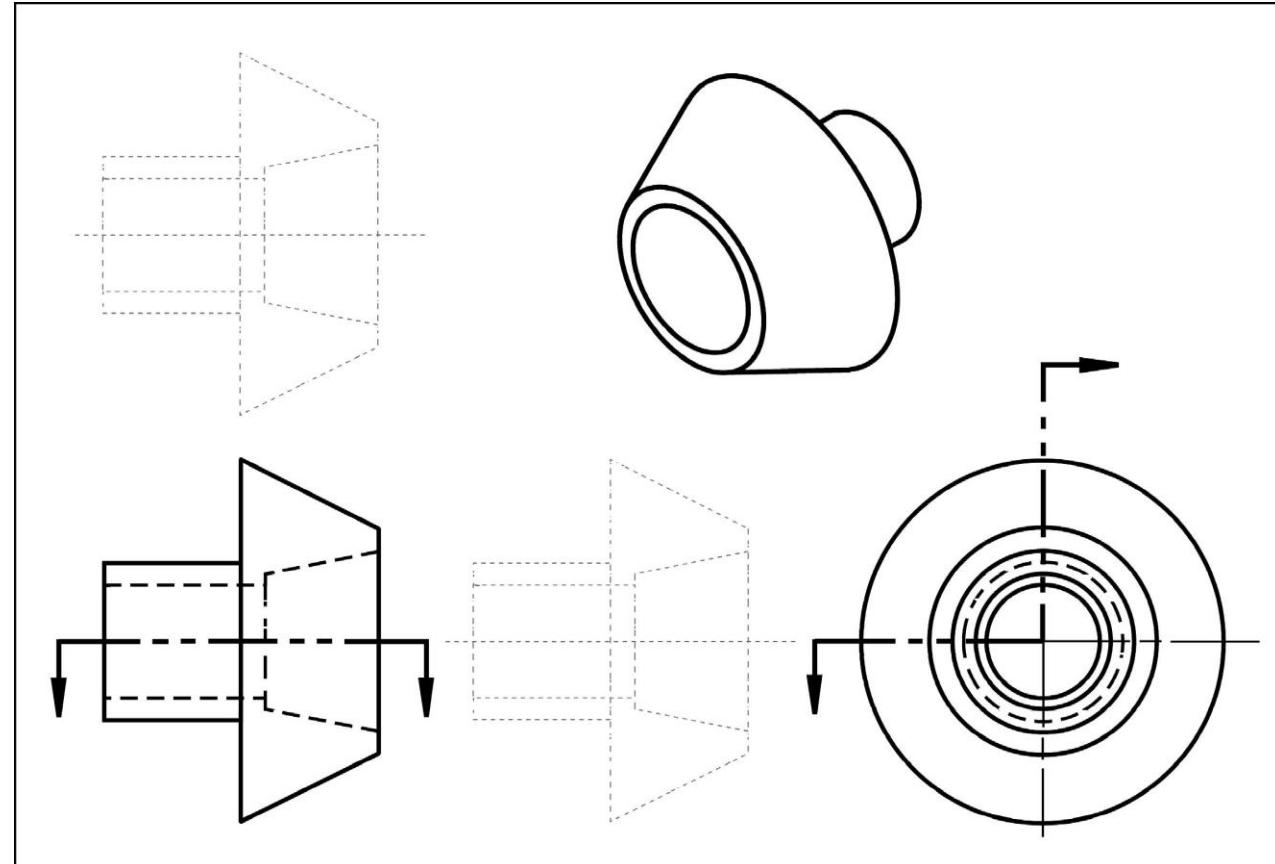
Exercise

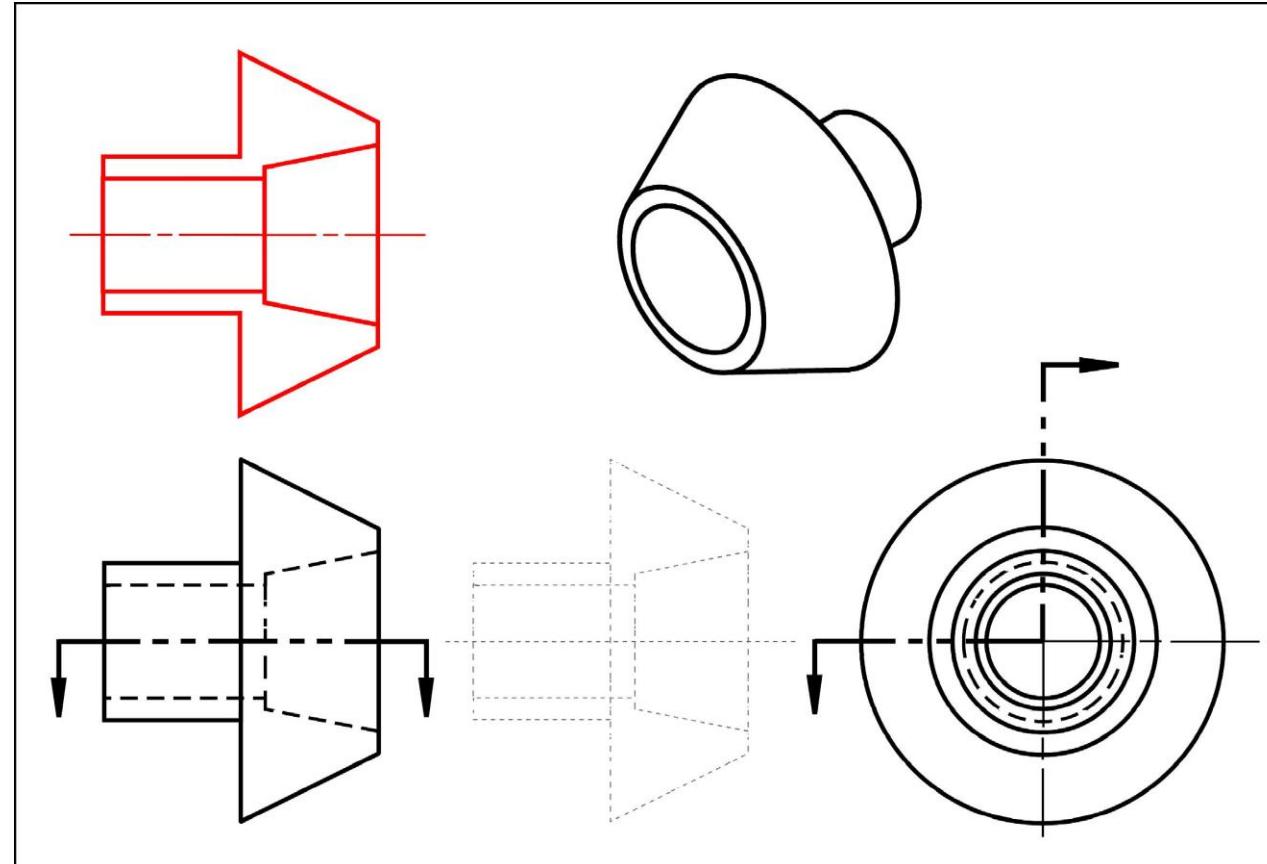
- Given the front and right side views, sketch the top view as a full section and create a half sectioned front view.
 - The material is brass.





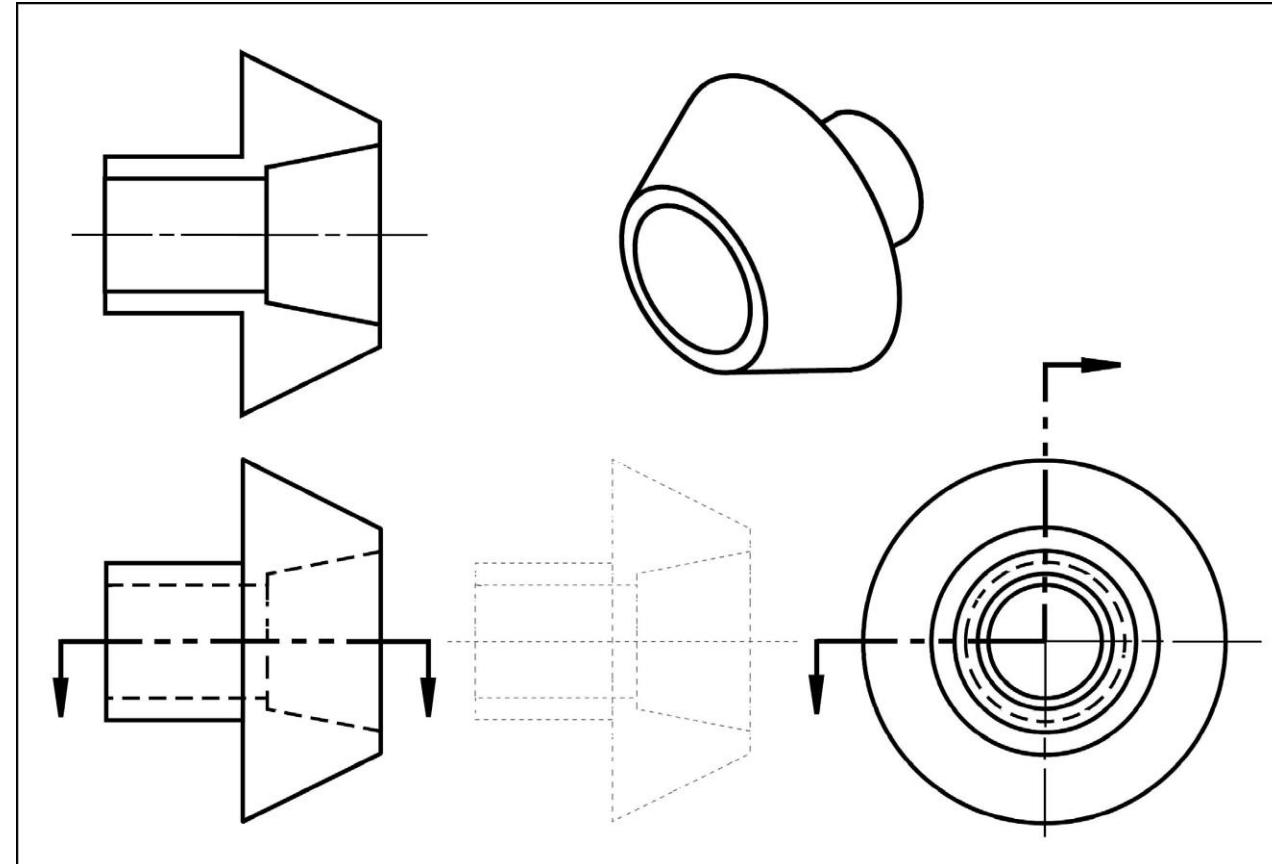
Fill in the visible lines in the top full section view.

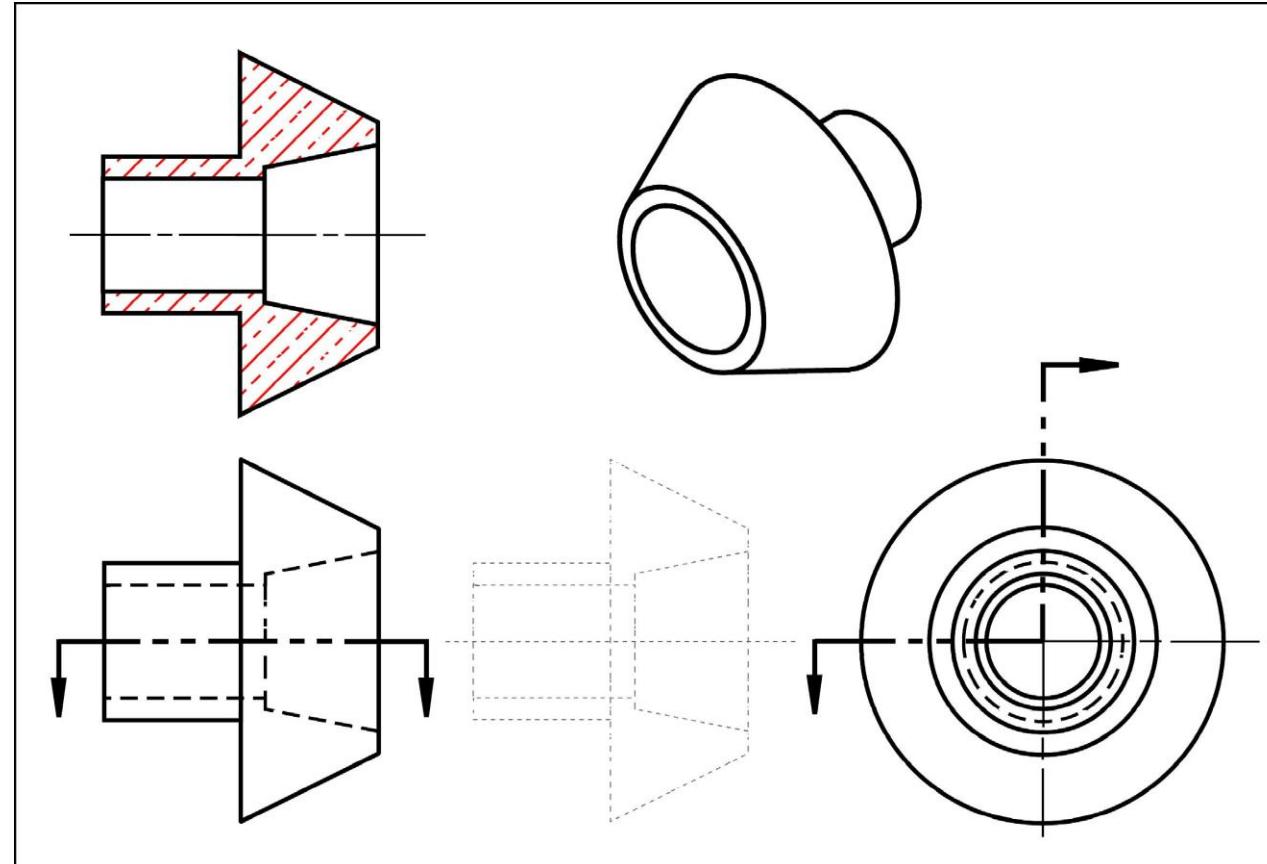






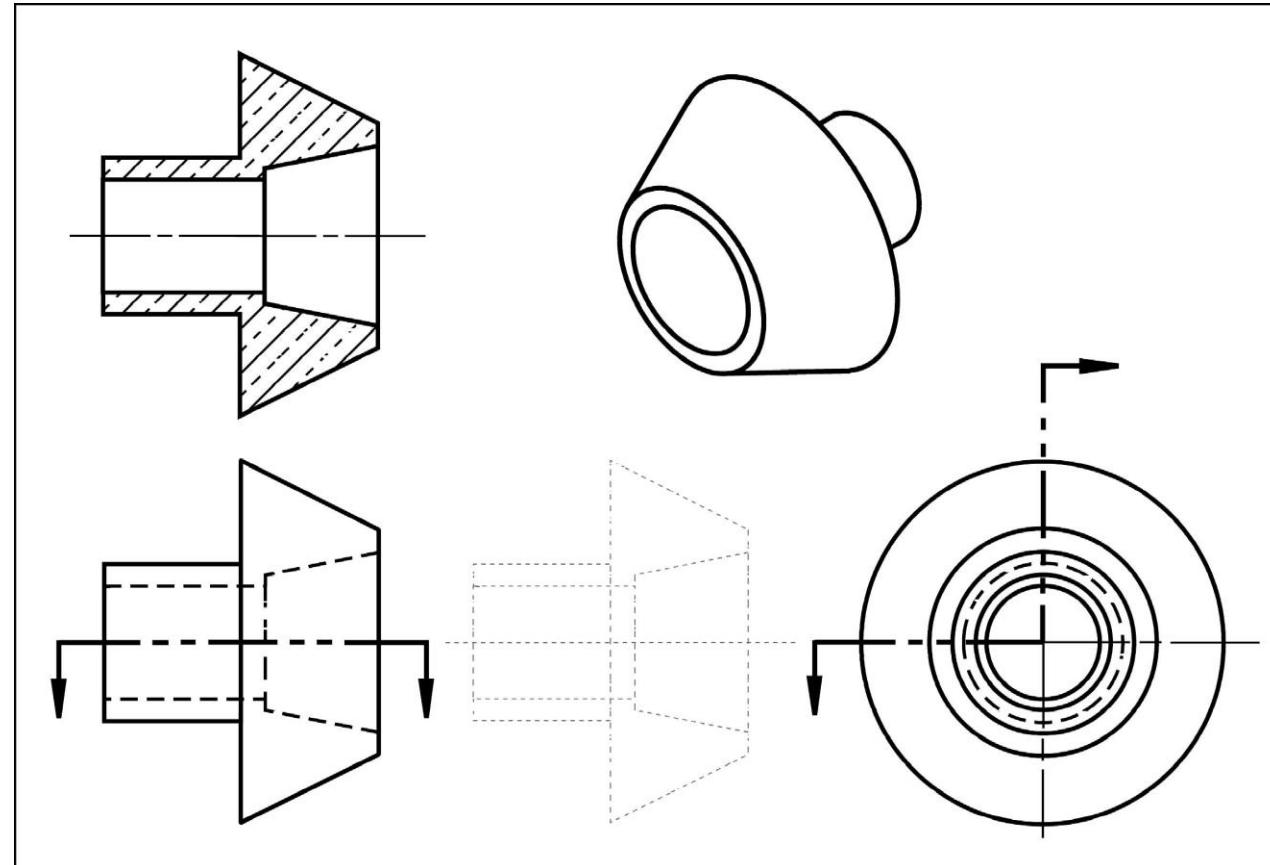
Fill in the section lines in the top full section view.

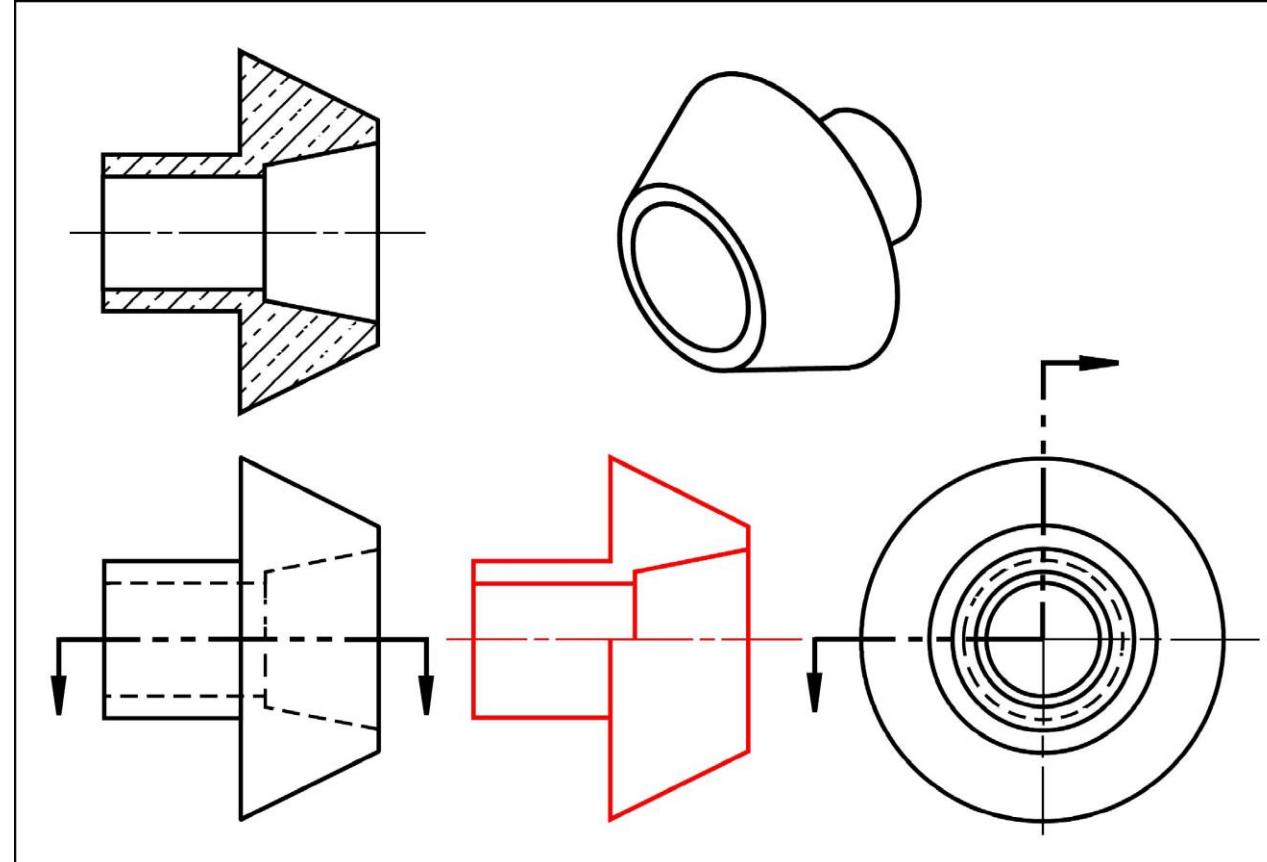






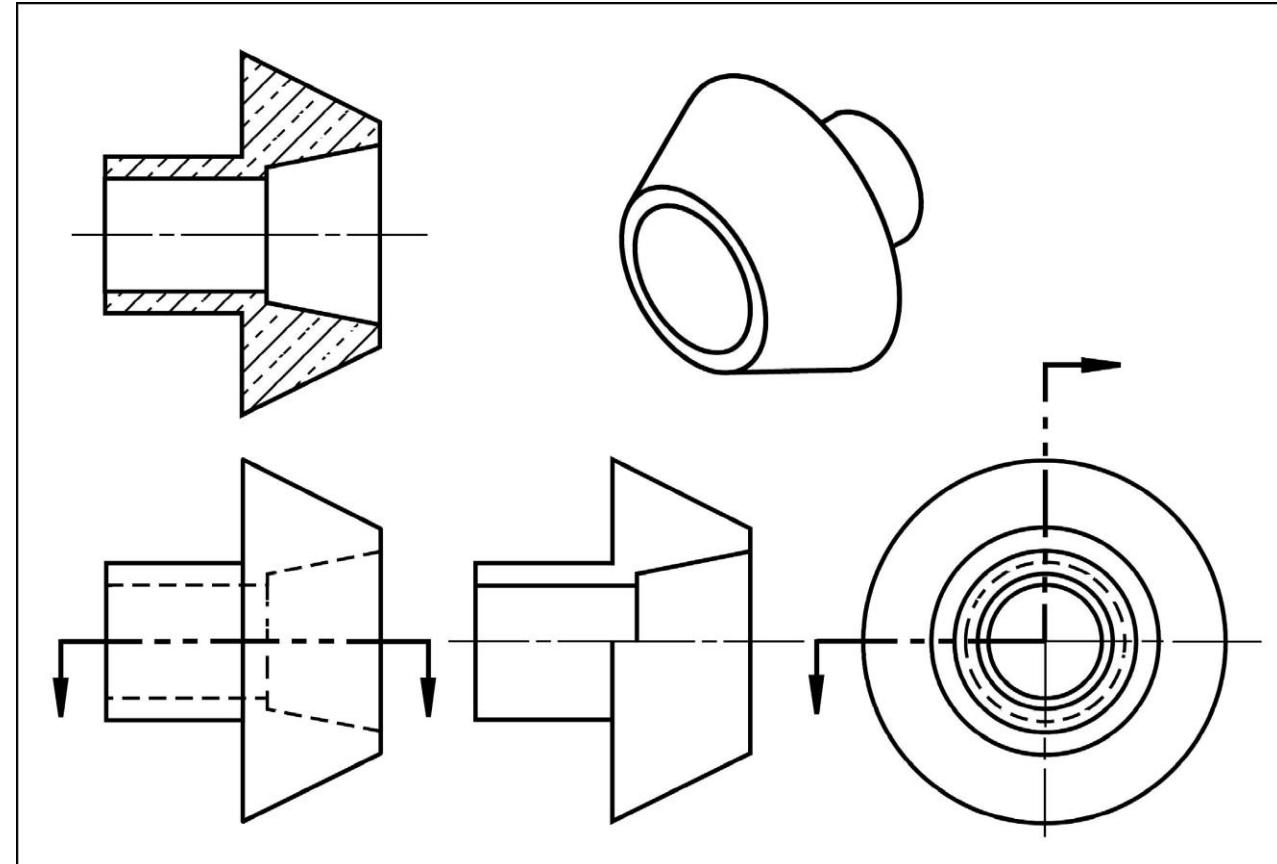
Fill in the visible lines in the right side half section view.

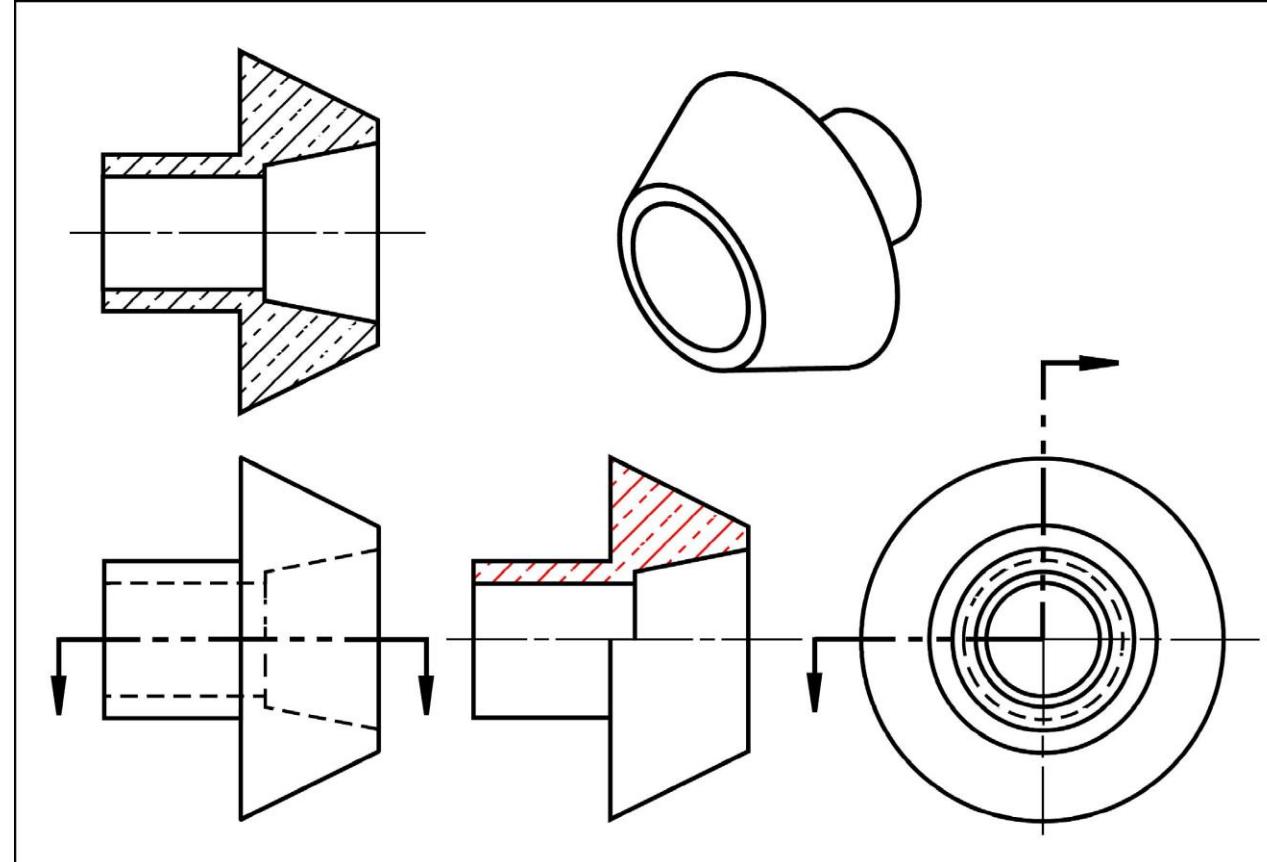


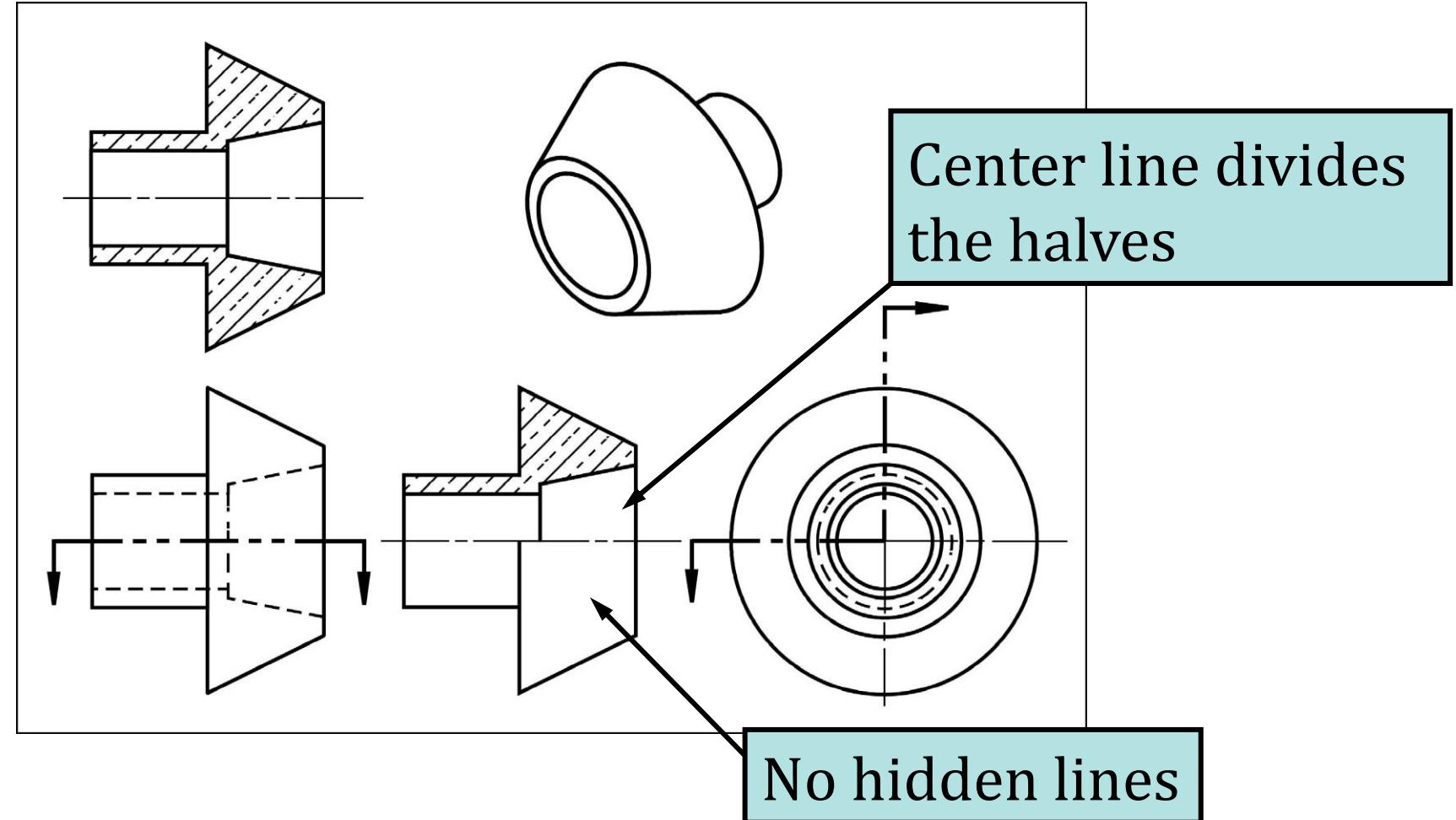




Fill in the section lines in the right side half section view.

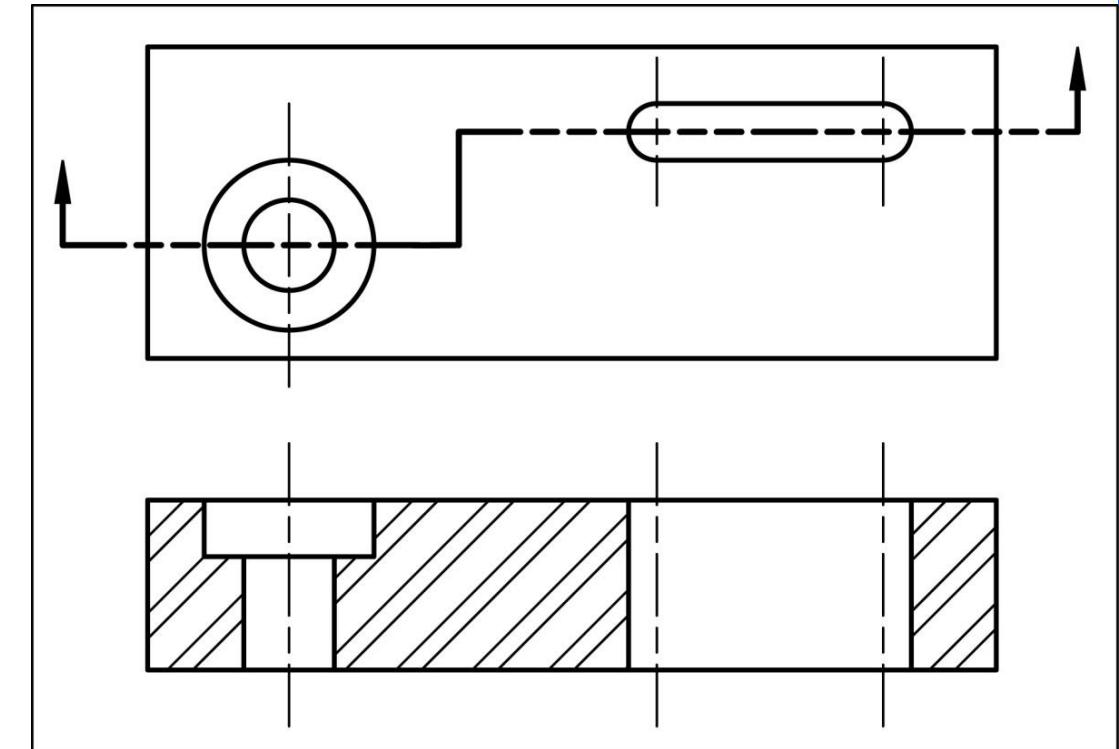






3. Offset Section

- A cutting plane normally extends through an object in a straight line.
- However, a **straight cutting plane** may miss key **features** that should be shown for maximum clarity.
- When this occurs, An offset section is produced by bending the cutting plane to show features that don't lie in the same plane.





3. Offset Section

- The cutting plane line in **Figure a** is **offset** to align with a countersunk hole, a counterbored hole, and a slot, none of which fall on a straight line.
- When offsetting cutting plane lines, always bend the line at right angles to the cutting plane and perpendicular to the plane of projection.
- Note that the bends in the cutting plane are never shown in the sectioned view (**Figure b**).

3. Offset Section

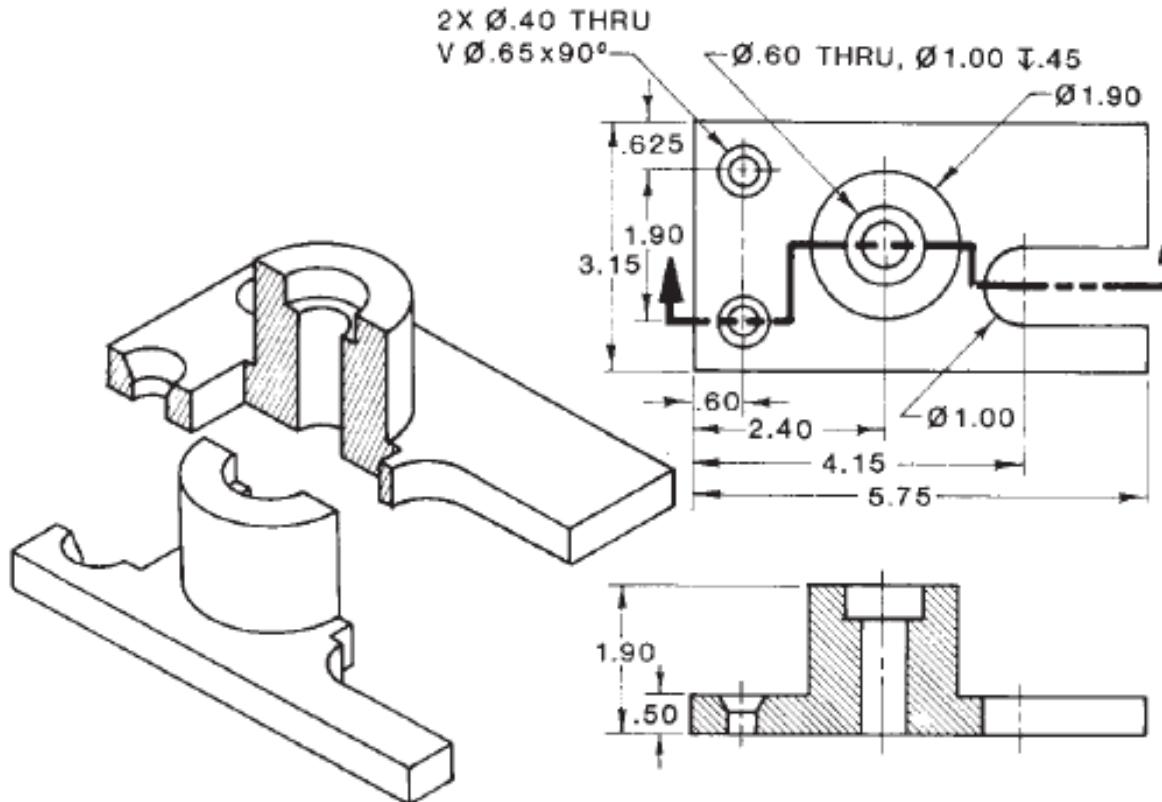


Figure a – Offset-section working drawing of a jig bearing locator

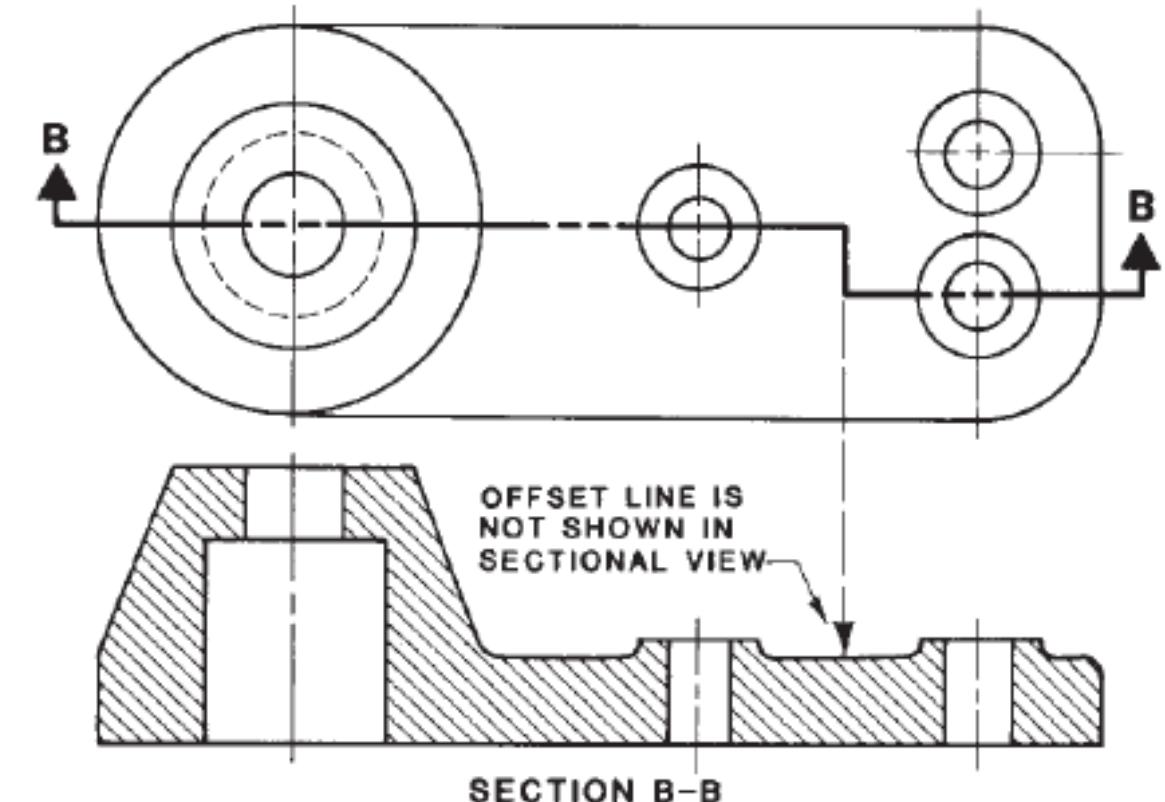
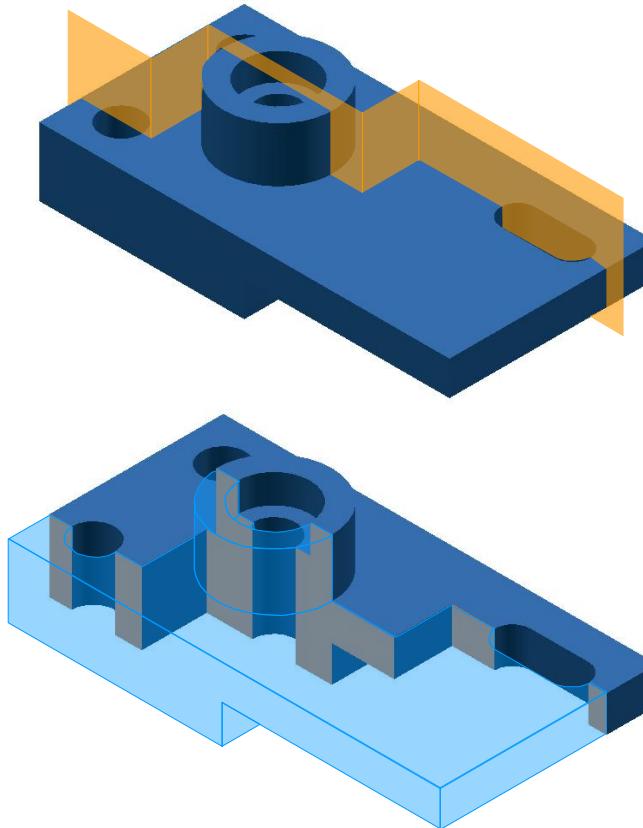
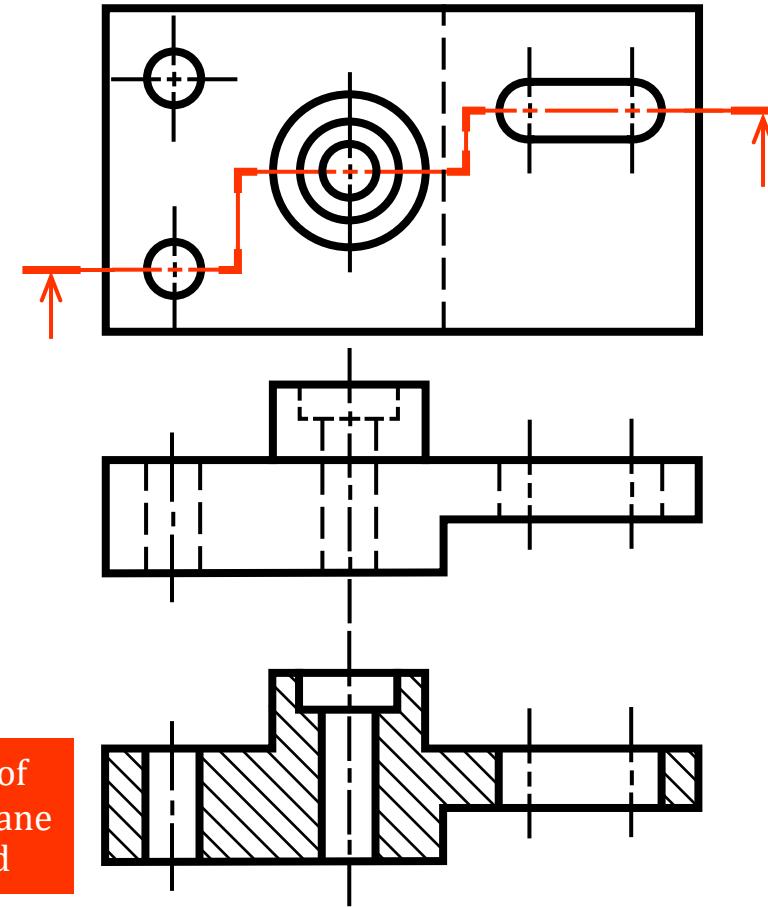


Figure b – The edge of the offset section is not shown in the section view

3. Offset Section



Edge views of
the cutting plane
are omitted



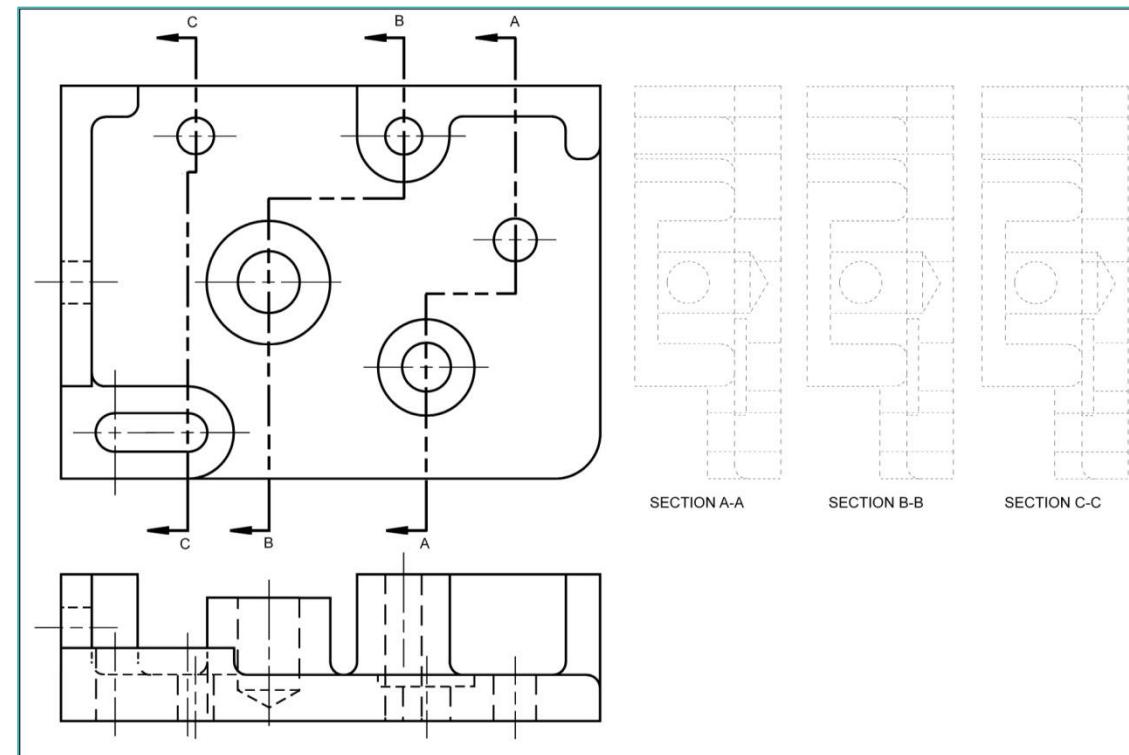


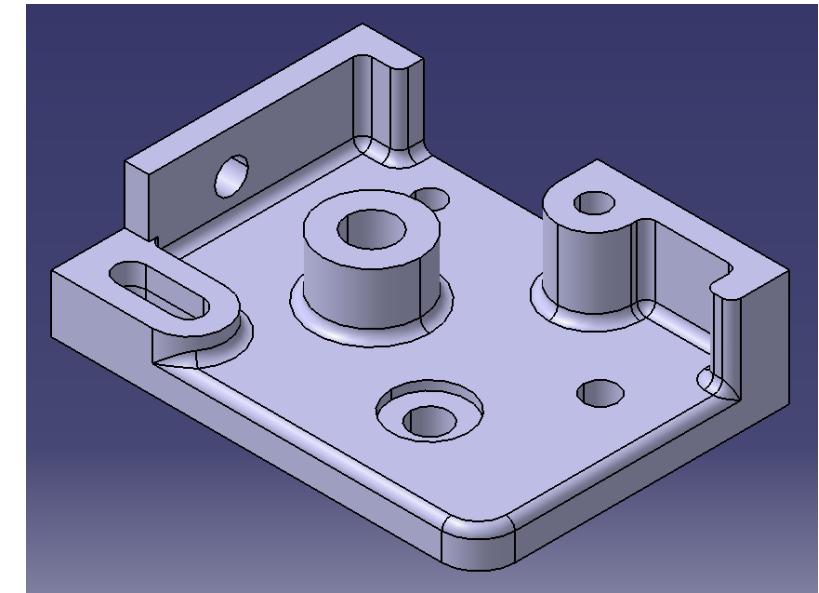
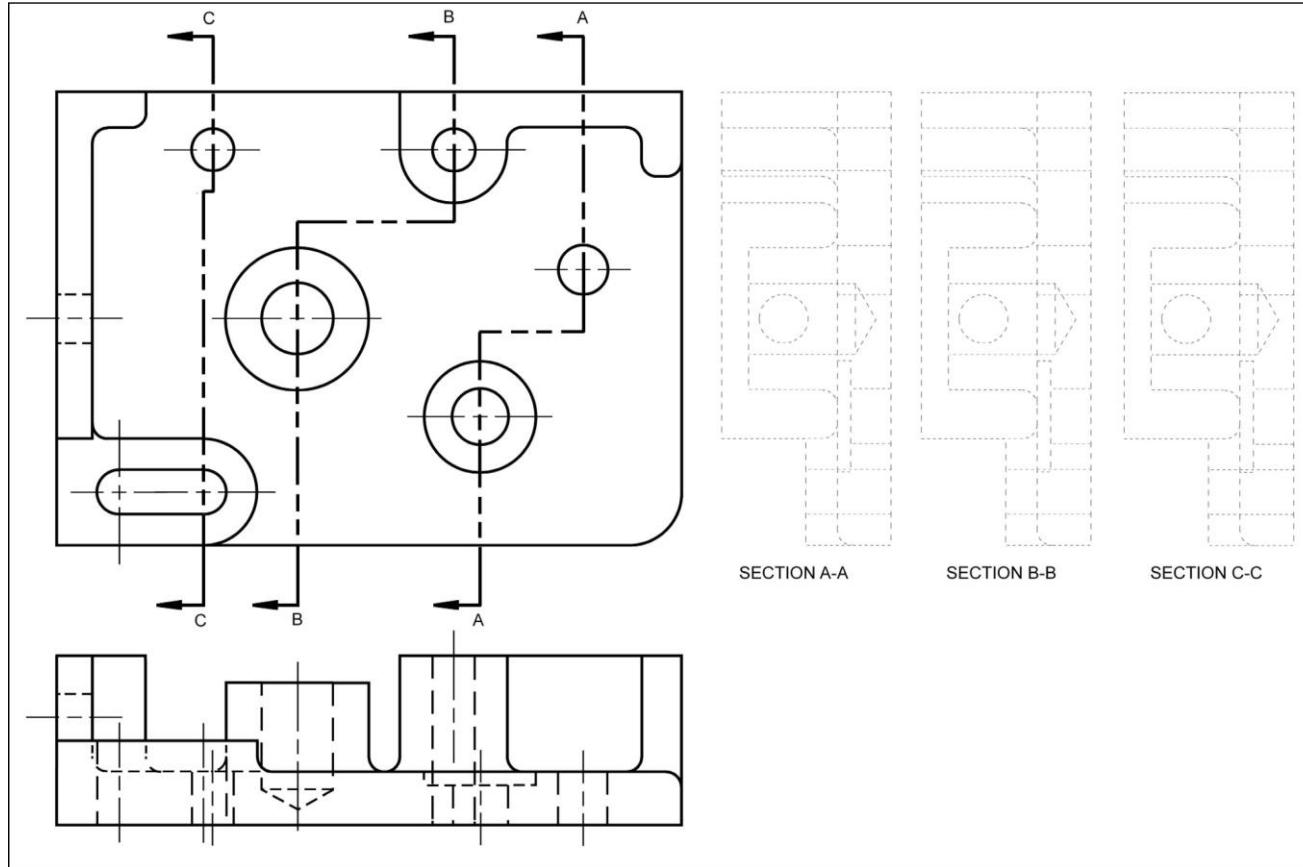
Exercise

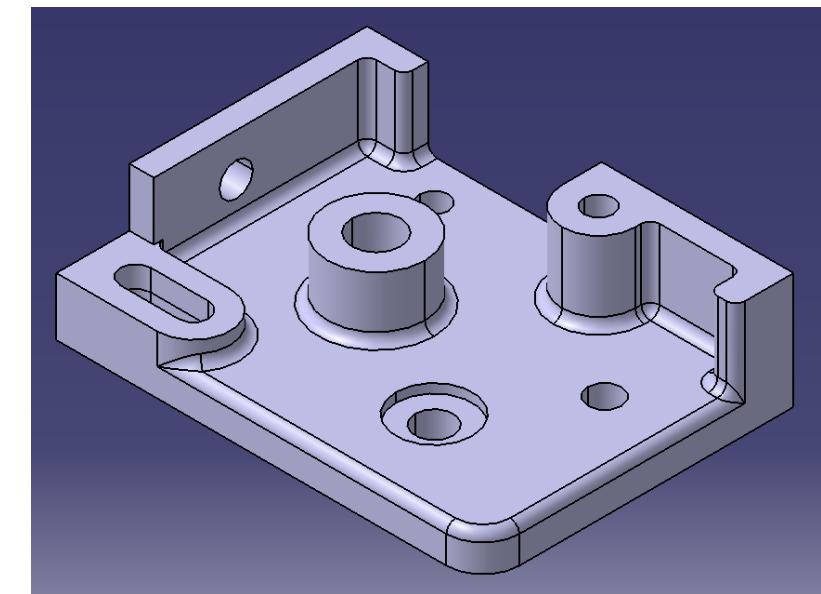
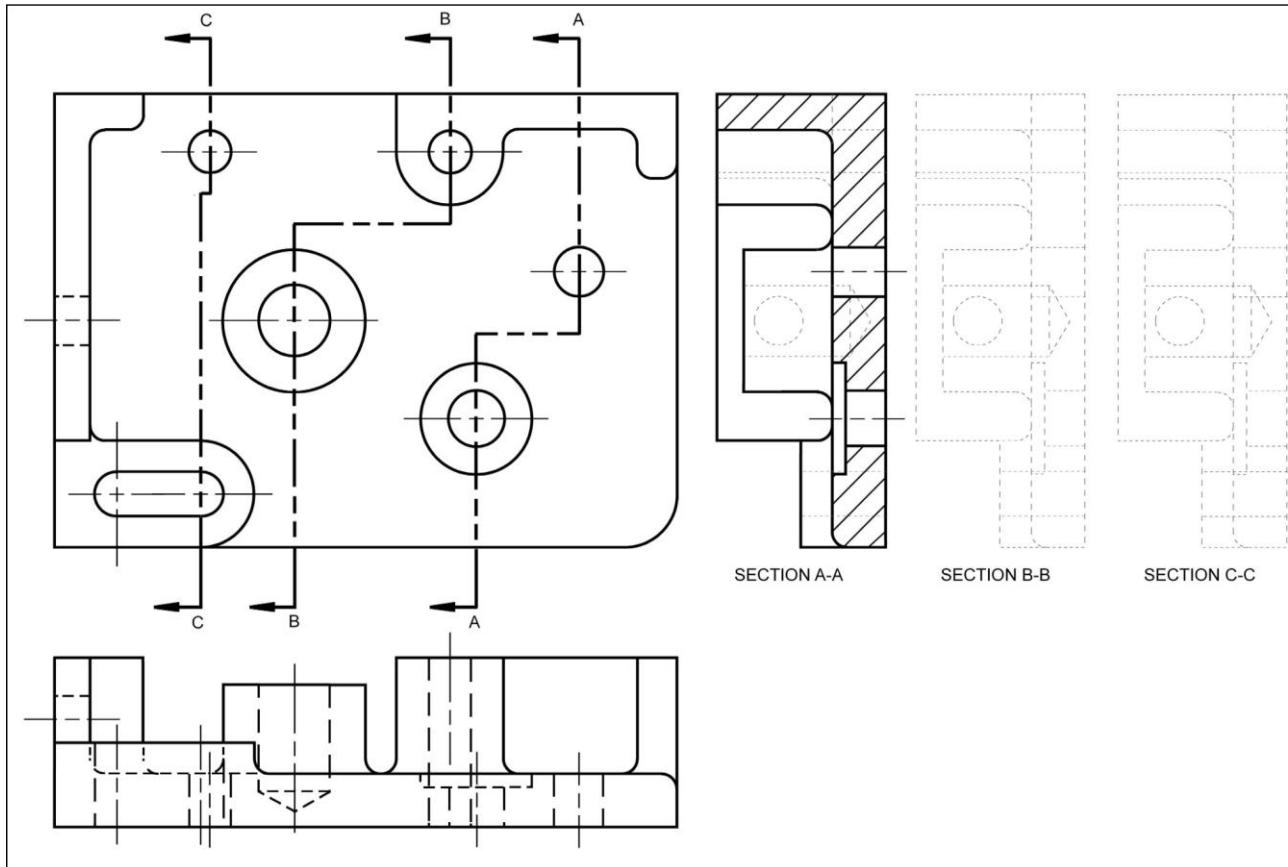
OFFSET SECTION

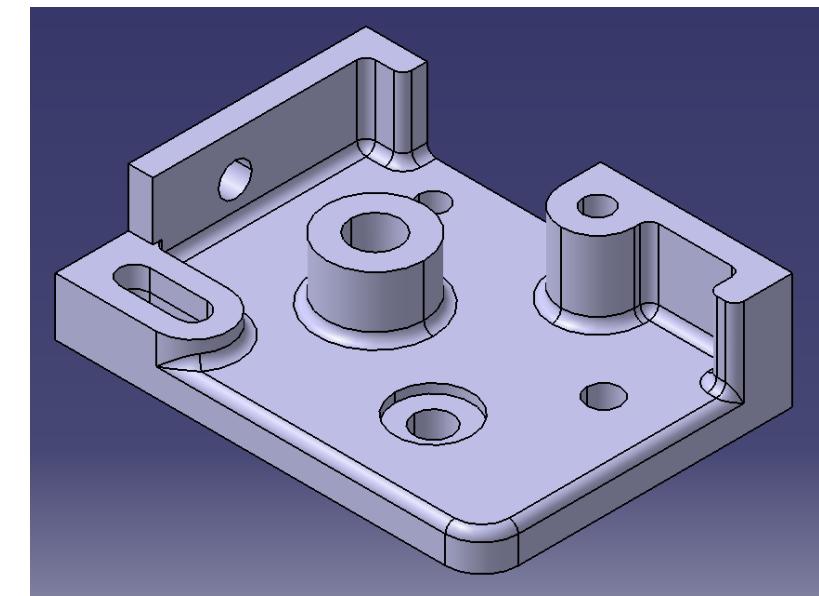
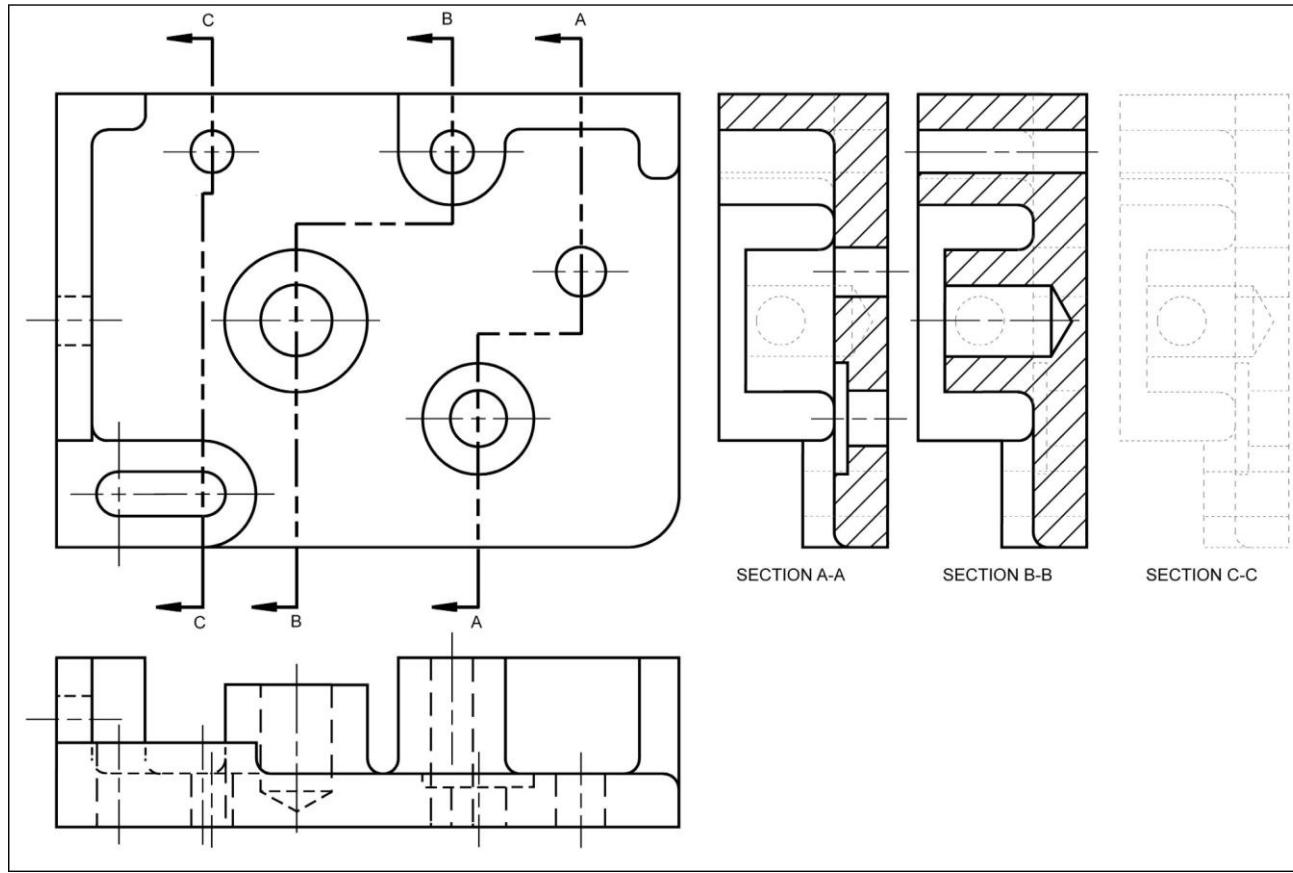
Exercise

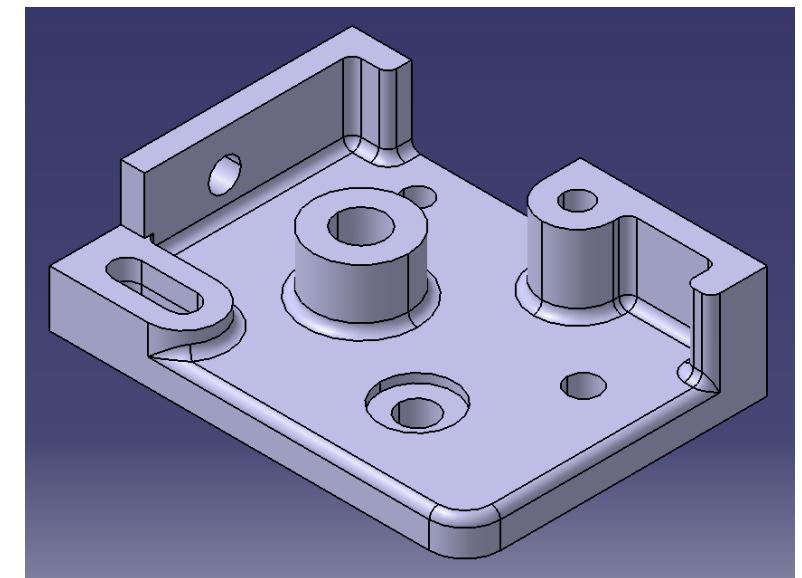
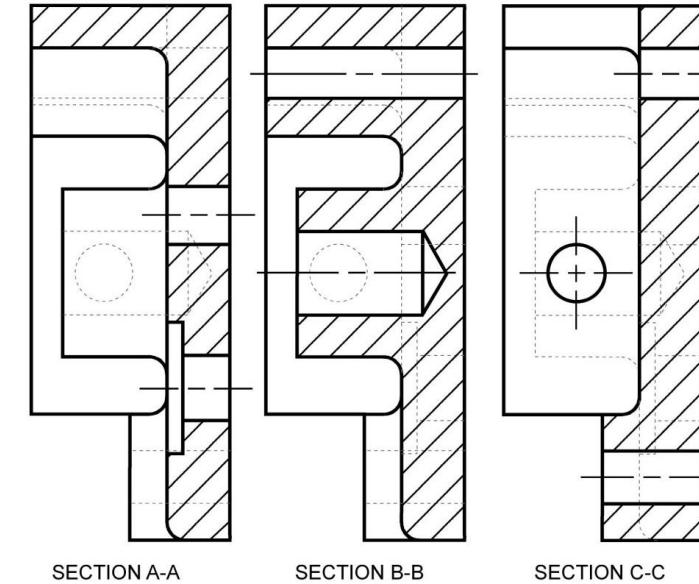
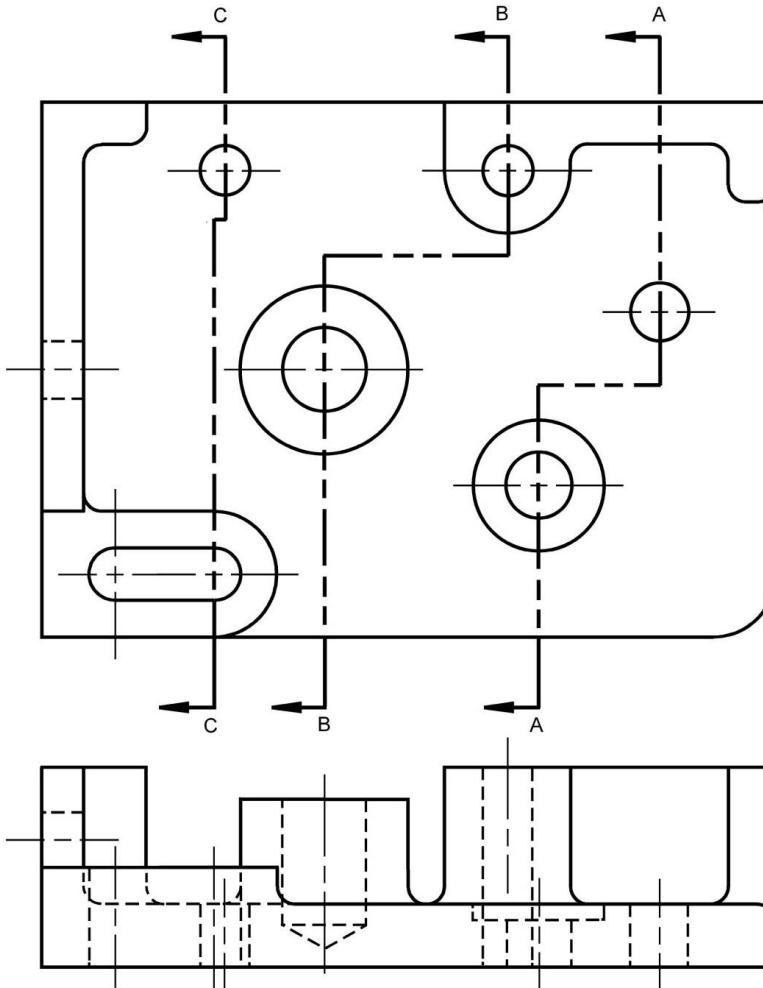
- Given the front and top views, sketch the three missing section views in their appropriate places. The material is cast iron.









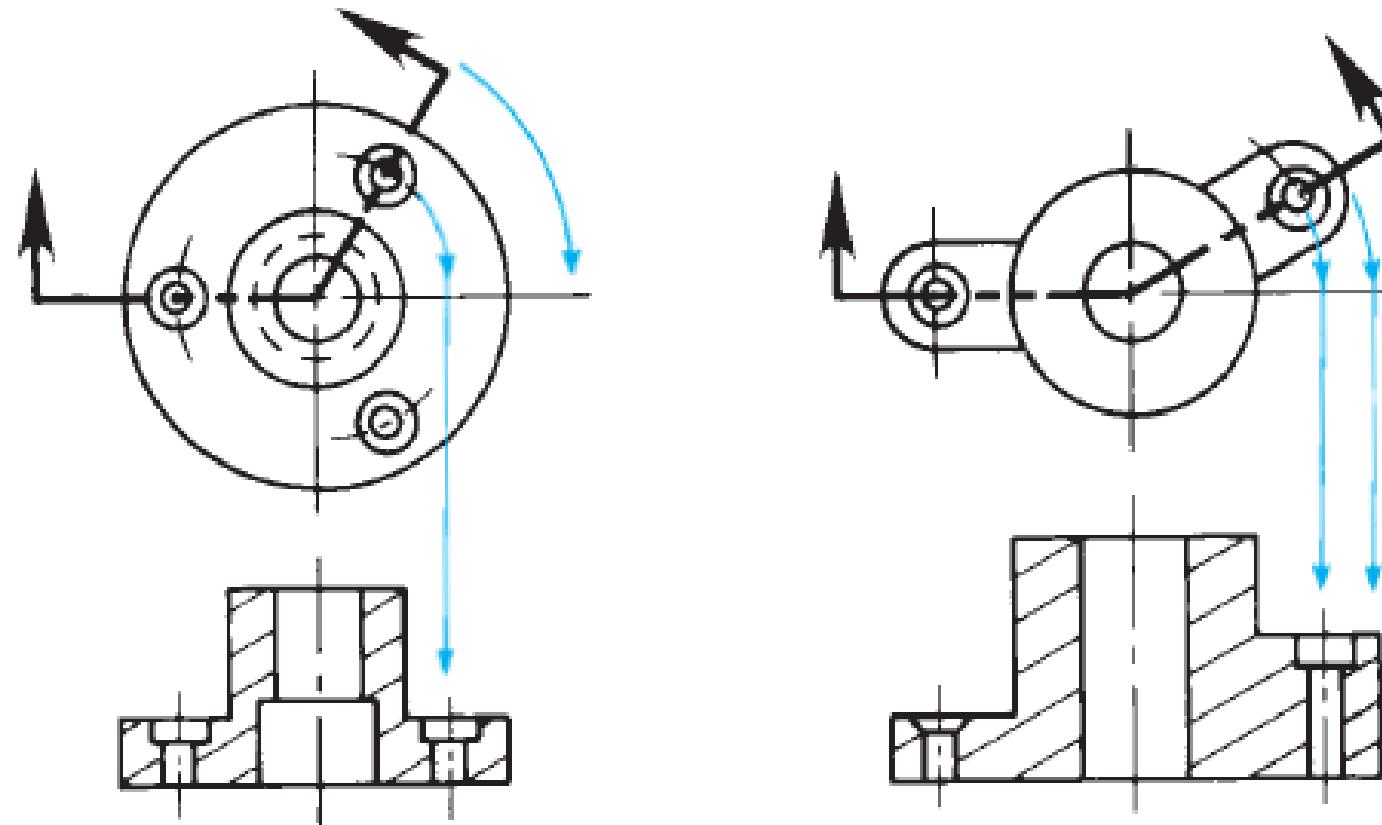




4. Aligned Section

- Similar to the offset section, the **aligned section** cutting plane line staggers to pass through offset features of an object.
- Normally the change in direction of the cutting-plane line is less than 90° in an aligned section. When this section is taken, the sectional view is drawn as if the cutting plane is rotated to a plane perpendicular to the line of sight as shown in Figure.
- A cutting-plane line is always used when the cutting plane is bent or offset or when the sectional view is nonsymmetrical.

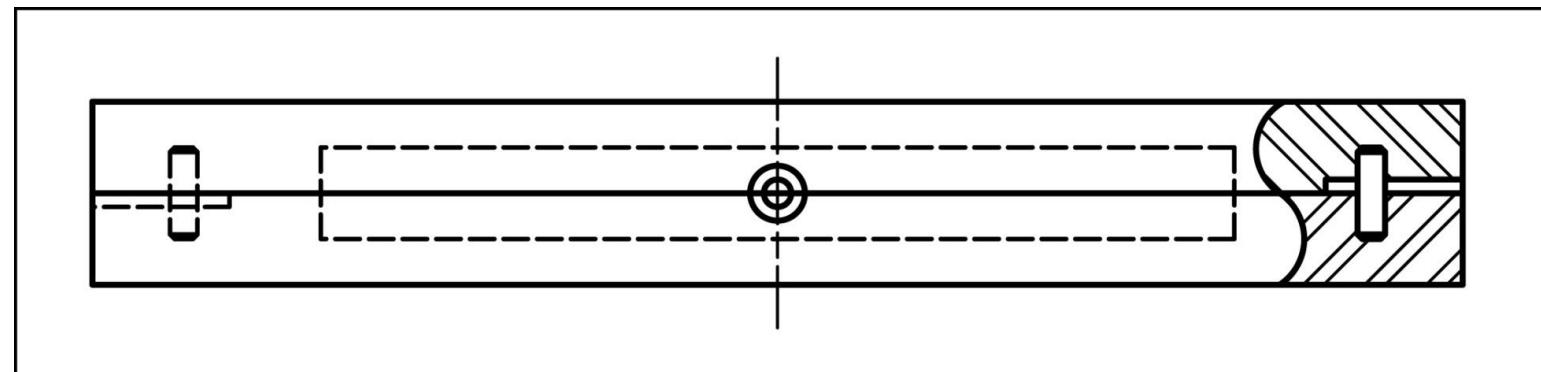
4. Aligned Section



Aligned section. The cutting-plane line offsets using less than 90° turns to go through offset features on the part. The cutting plane is rotated to align with the viewing plane to create the sectional view.

5. Broken-out Section

- When only a small part of an object needs to be sectioned, a **broken-out section** of that part is prepared.
 - Hidden lines are shown in the non-sectioned area of a broken section.
- An irregular short break line separates the sectioned area from the remainder of the drawing.
- **Figure a** shows a broken-out section in both pictorial and orthographic views.
- Note how a broken-out section facilitates the dimensions to visible lines in **Figure b**.



5. Broken-out Section

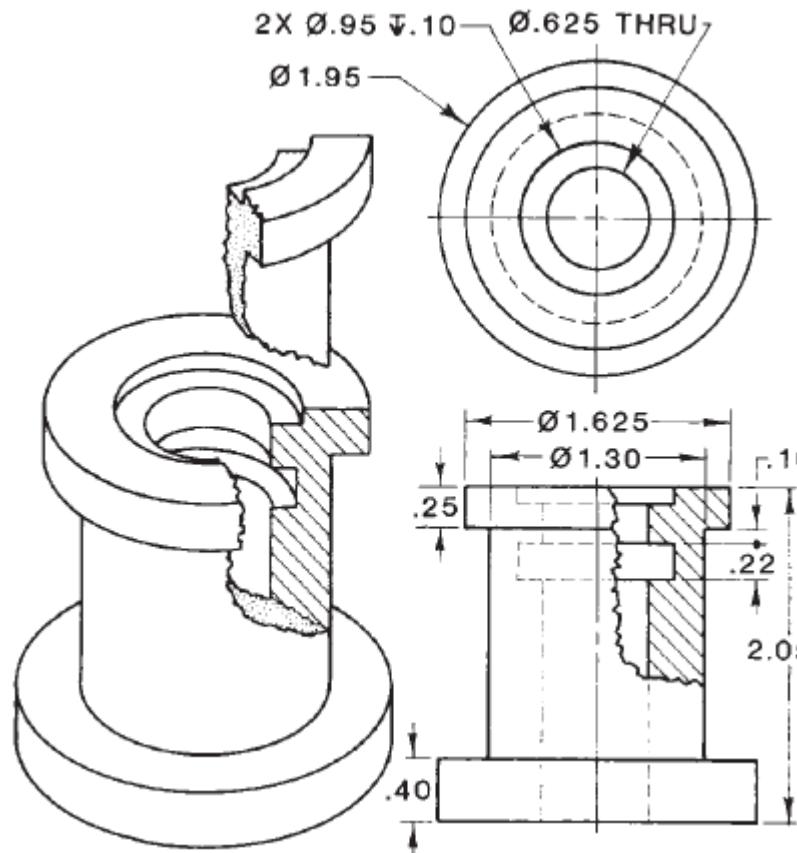


Figure a – Broken-out section working drawing of a sleeve bearing

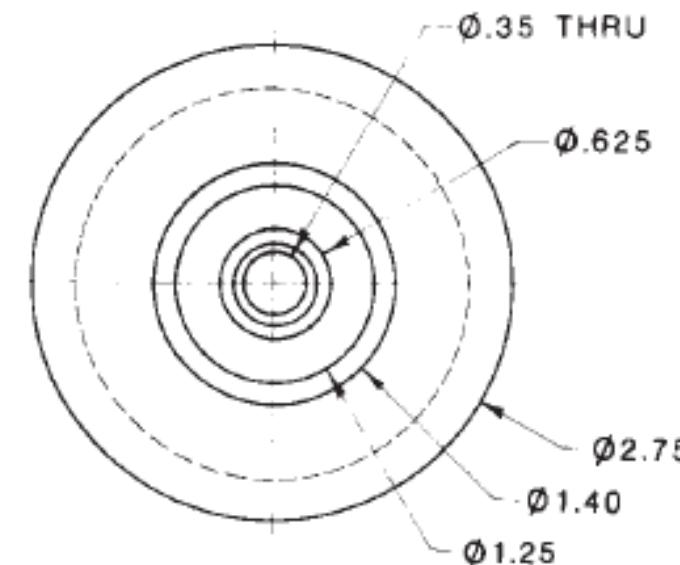
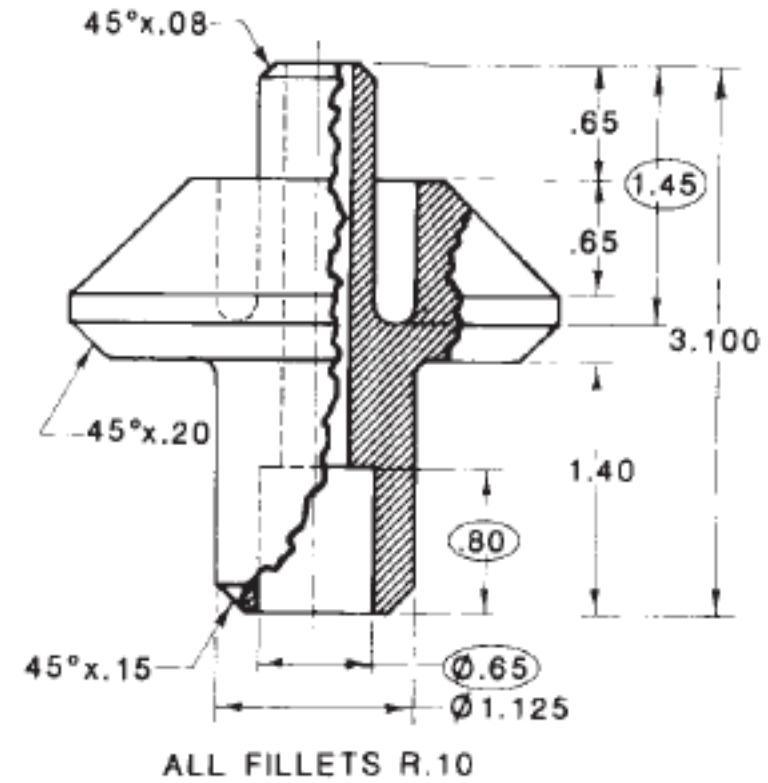
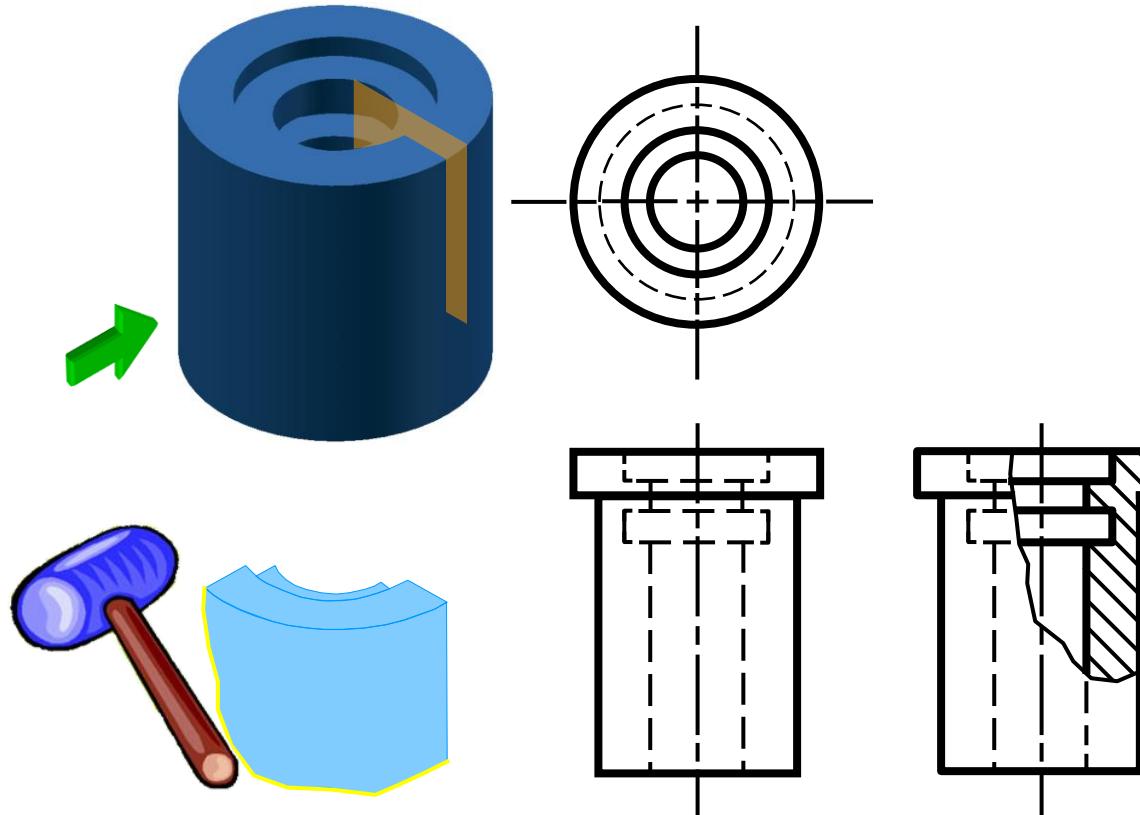


Figure b – A broken-out section will permit dimensioning to object lines instead of hidden lines



5. Broken-out Section



Conventional Practices

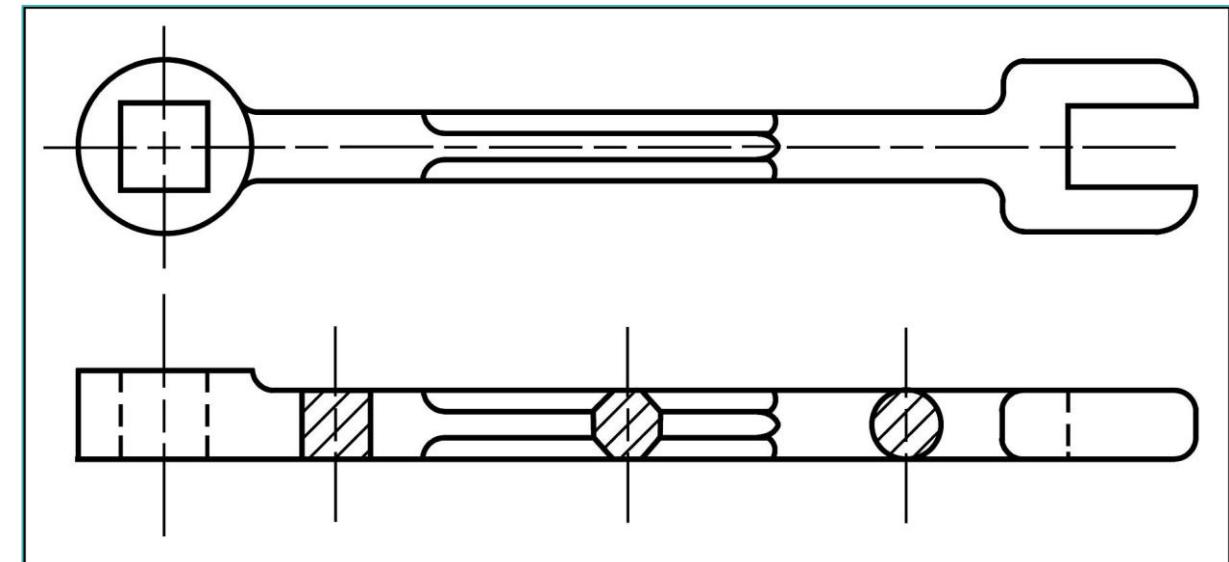
The sectioned and unsectioned portions are separated by a ***break line***.

Break line is freehand drawn as a thin continuous line (**4H**).

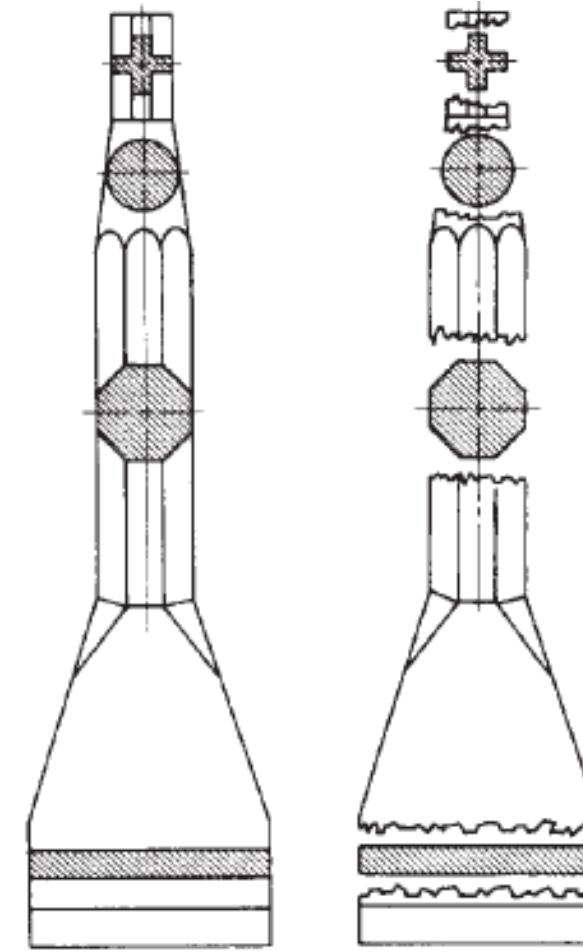
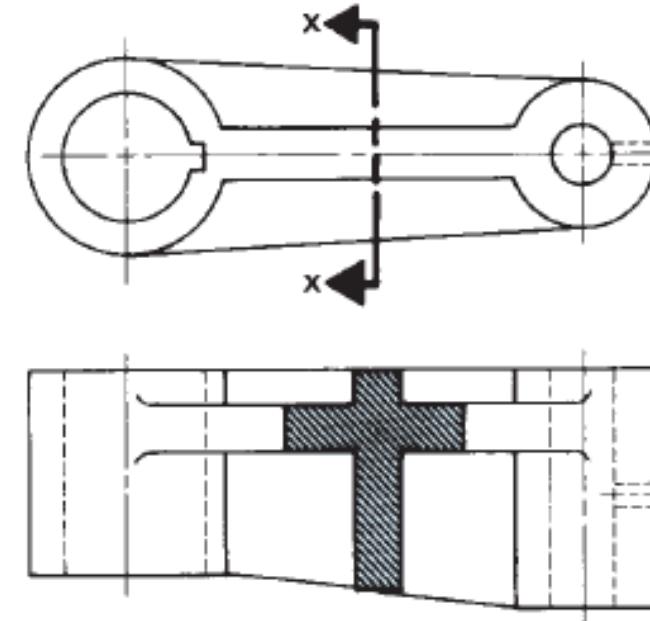
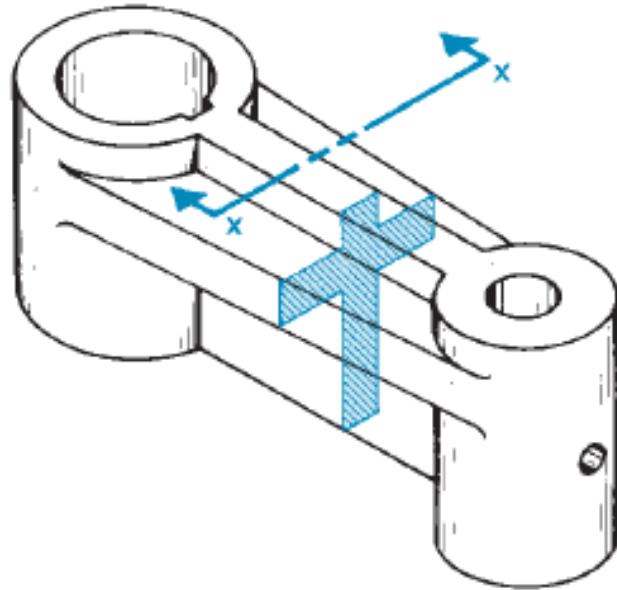
Cutting plane line is not necessary.

6. Revolved Section

- Sectional views are often revolved 90° to reveal a section of an object perpendicular to the plane of projection.
- In visualizing a revolved section, imagine a cutting plane passing through an object creating a slice of the object. Now imagine rotating the slice 90° . The rotated slice is a **revolved section**.
- Some revolved sections break the object to show the section, and others show the section directly on the view.



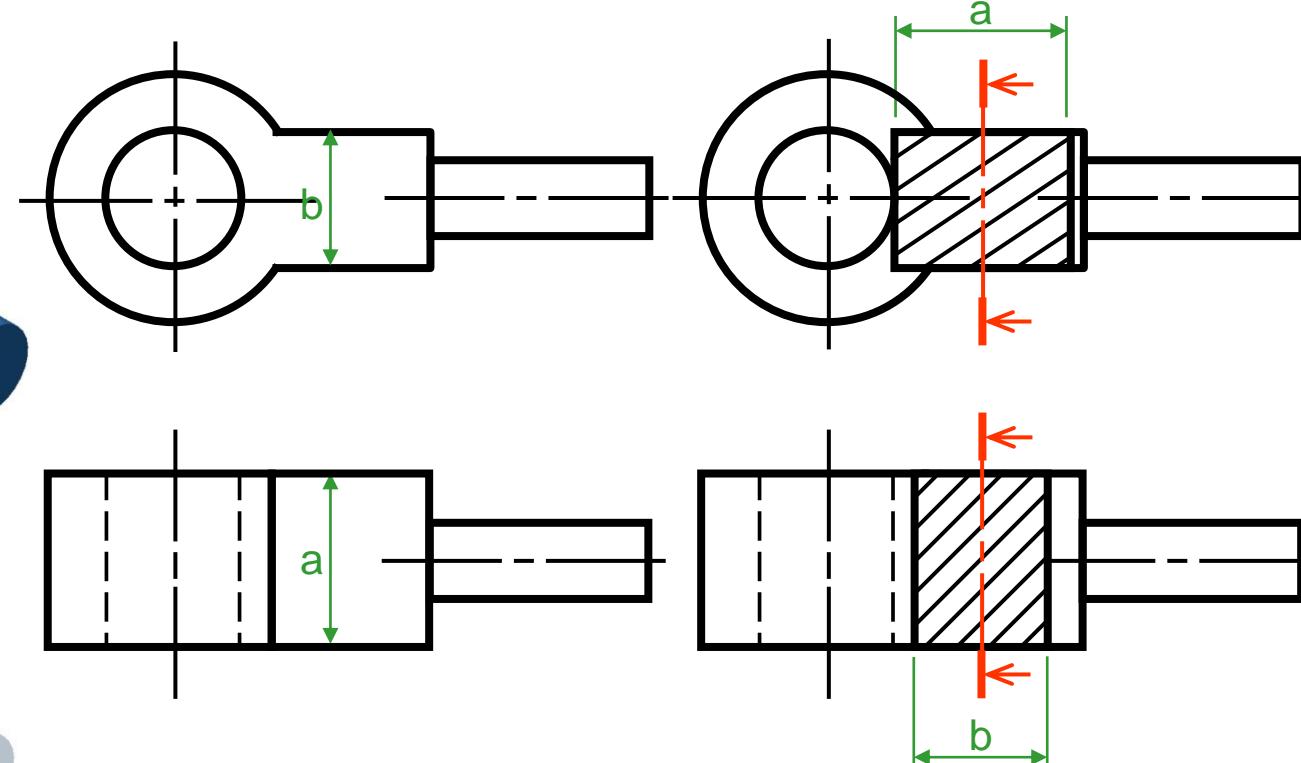
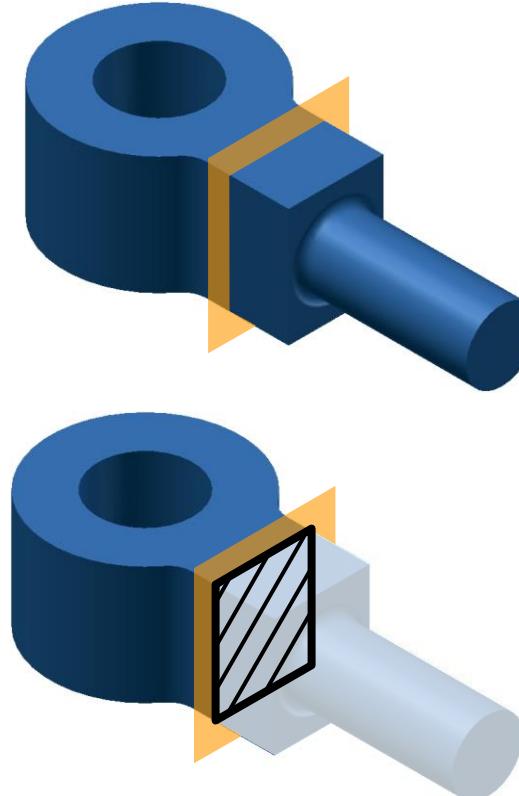
6. Revolved Section



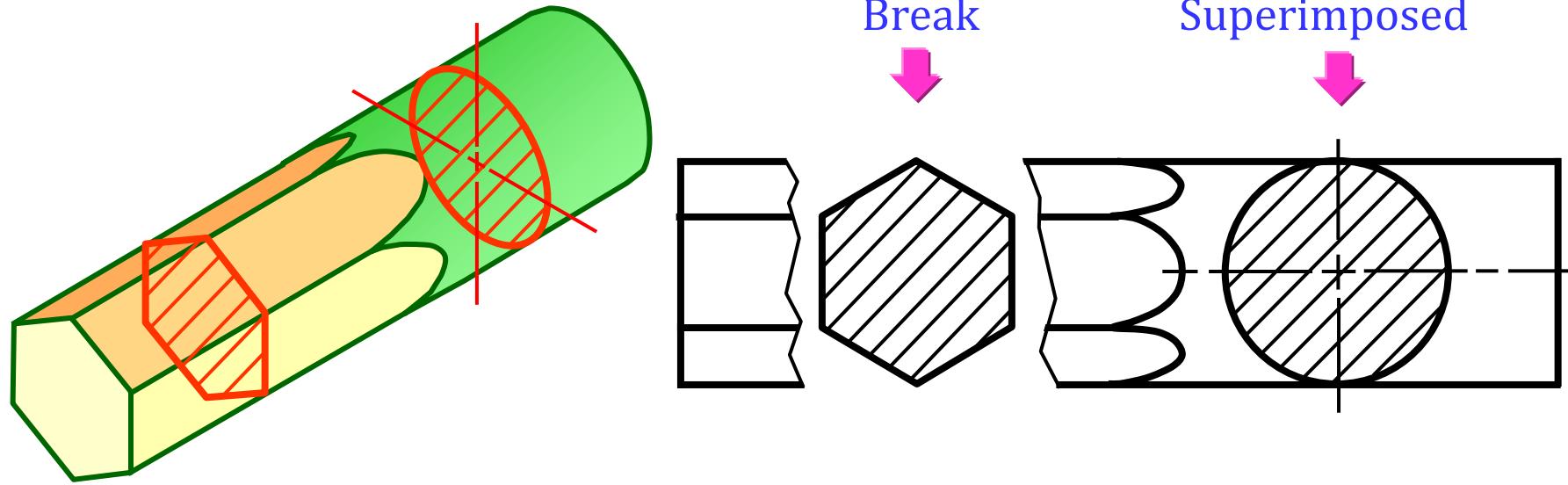
Example of a revolved section in a working drawing and an isometric drawing

Two methods for drawing revolved section views for a jackhammer chisel

6. Revolved Section

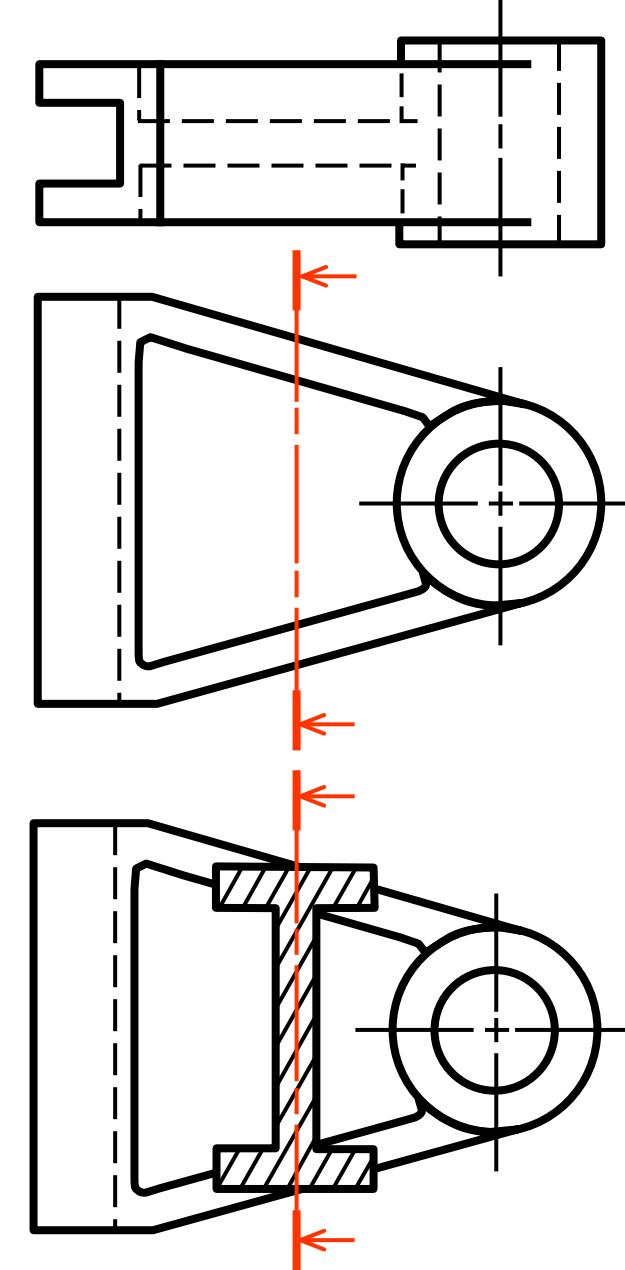
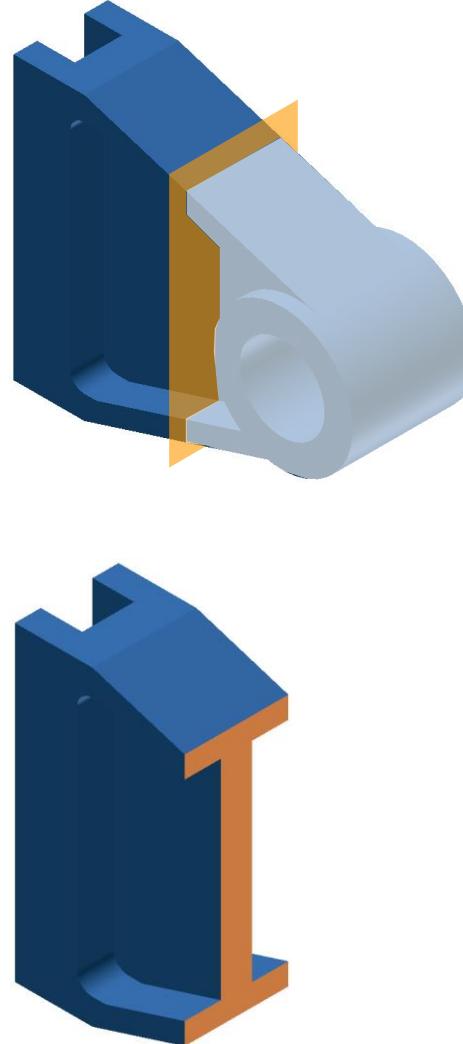


6. Revolved Section



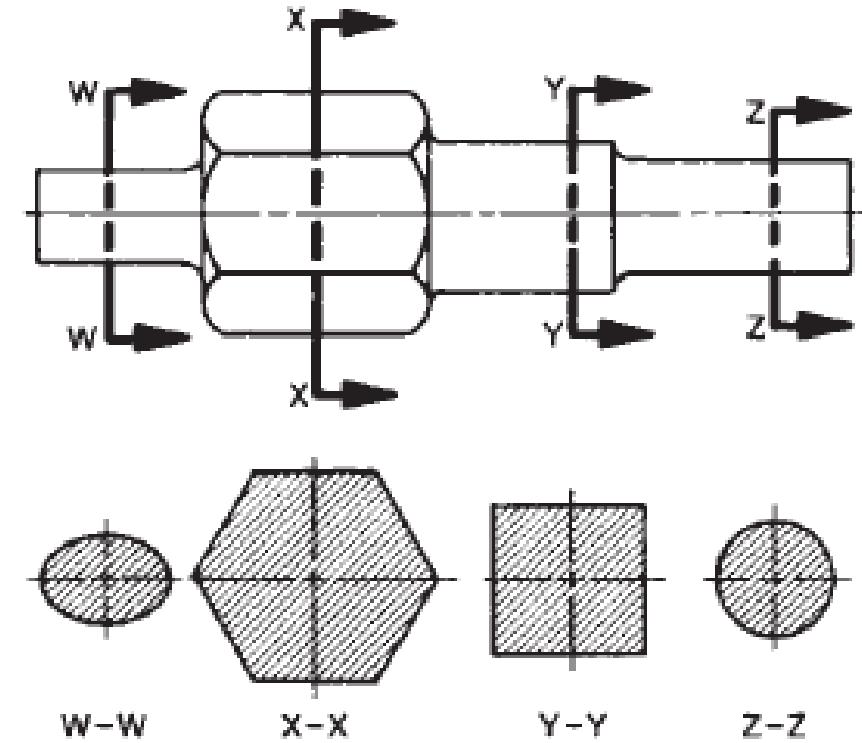


6. Revolved Section



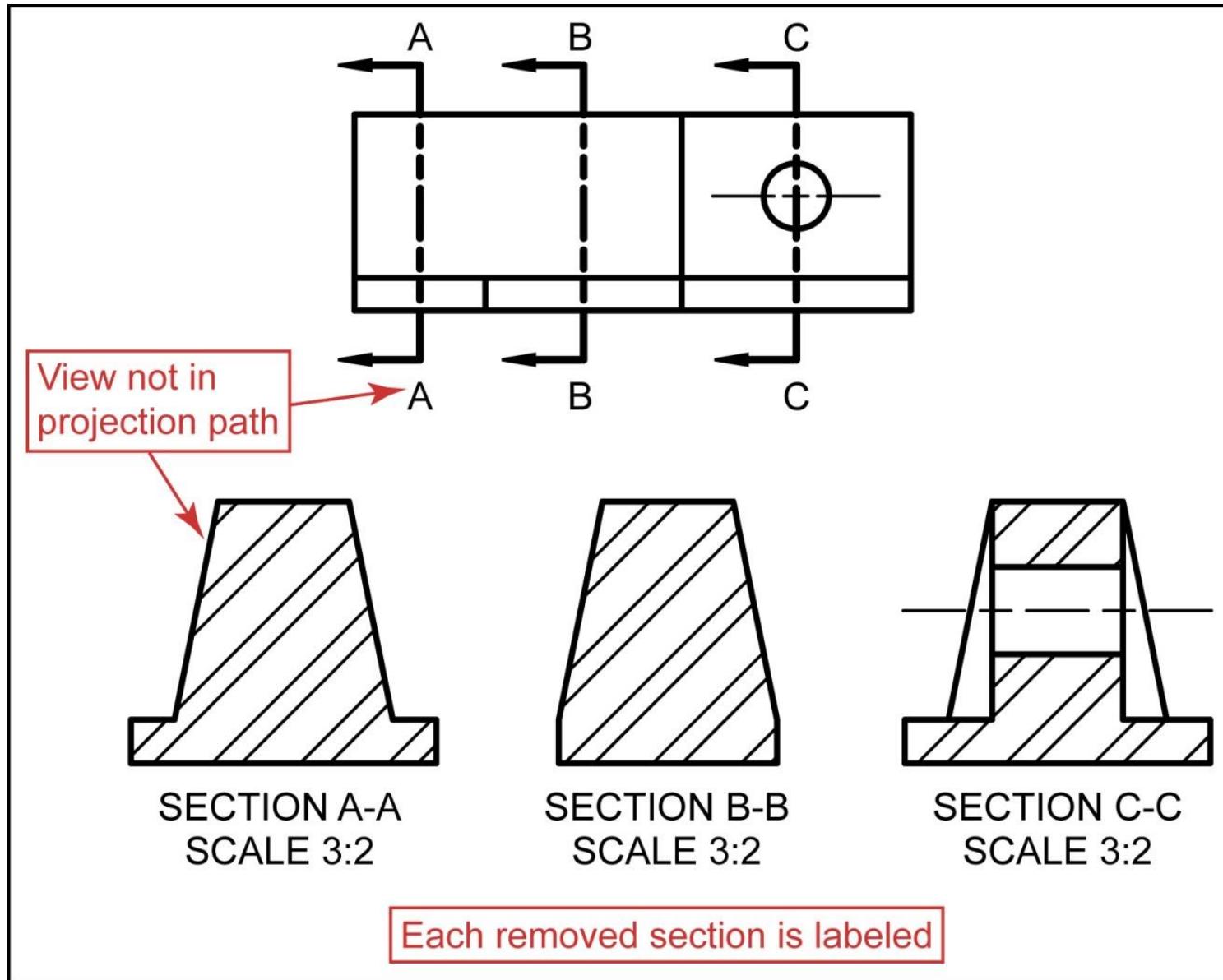
7. Removed Section

- When sections are drawn in a location other than in one of the six Multiview positions, they are **removed sections**.
- Sections are often removed to be drawn at a different scale or to dimension some portion in detail.
- When sections are removed, they must be indexed to a cutting plane line containing identifying letters.

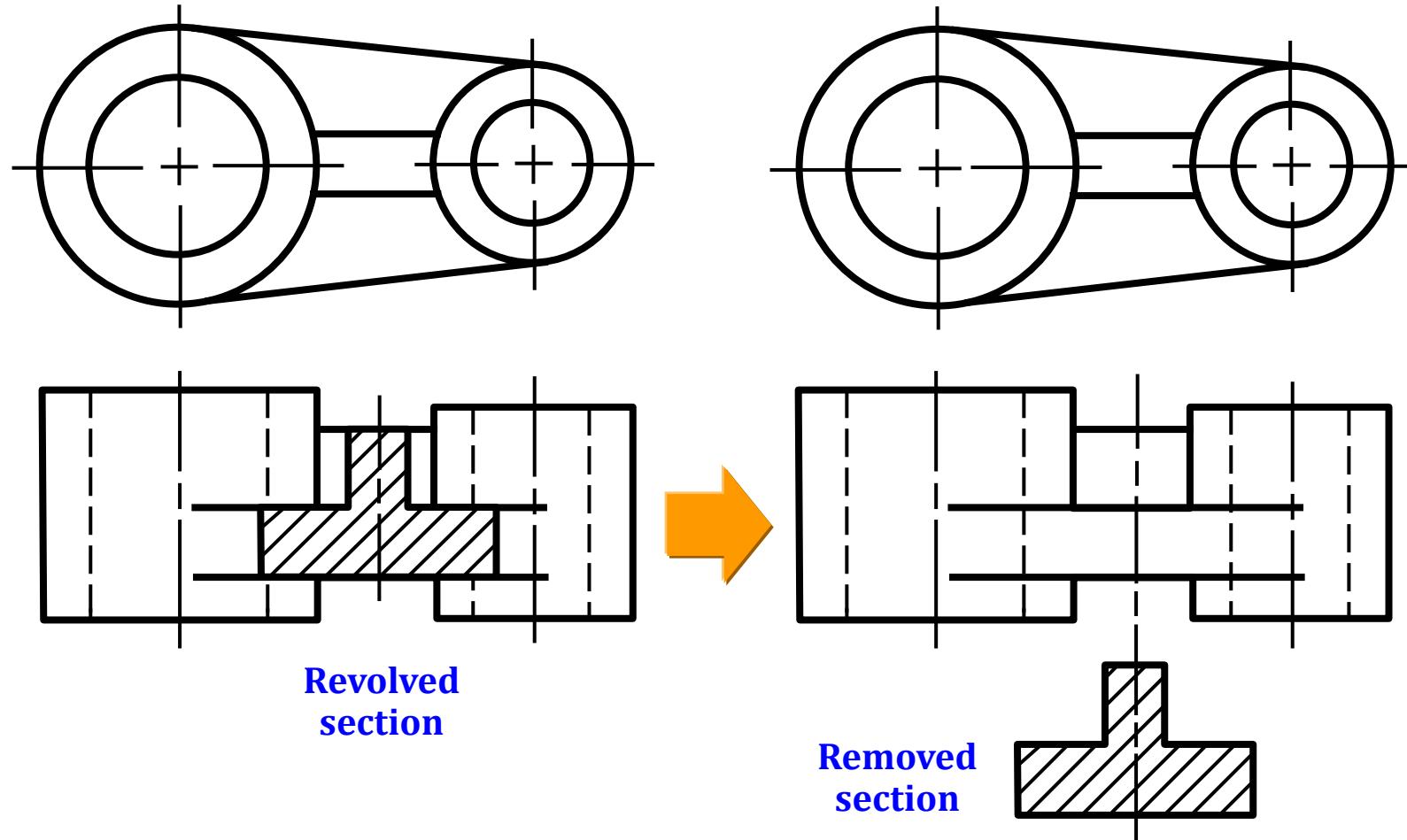


Removed sections in a drawing of a spindle arbor

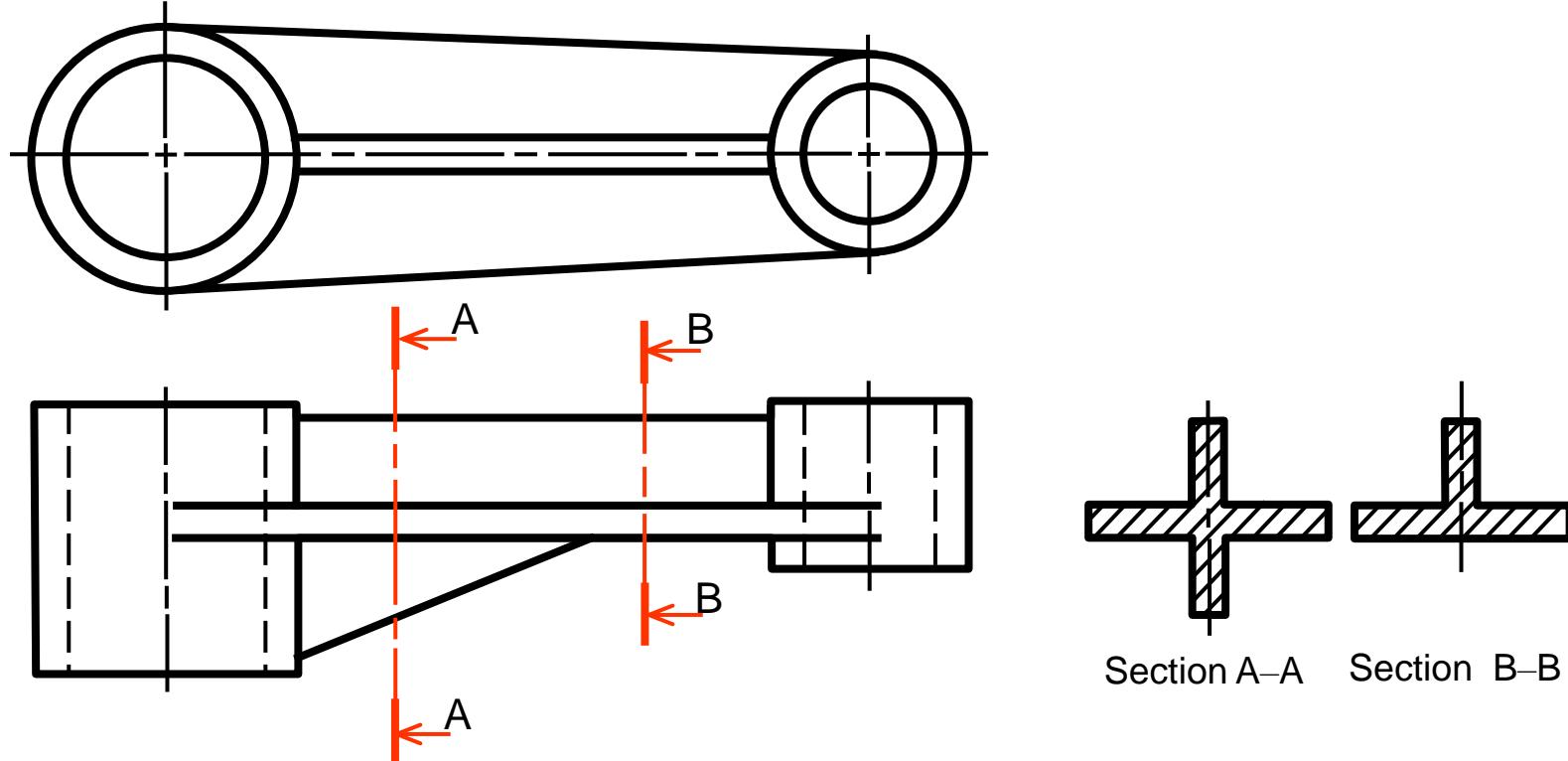
7. Removed Section



7. Removed Section



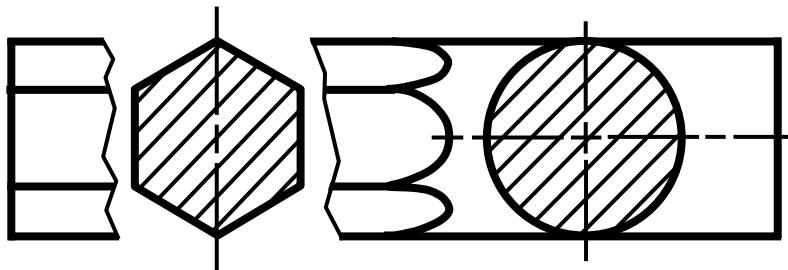
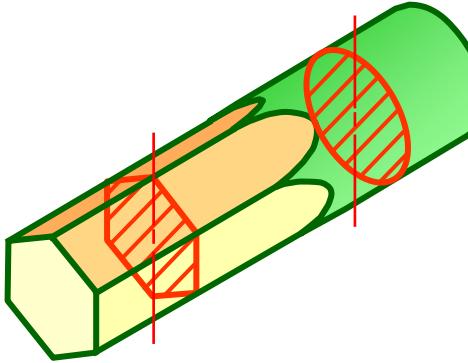
7. Removed Section



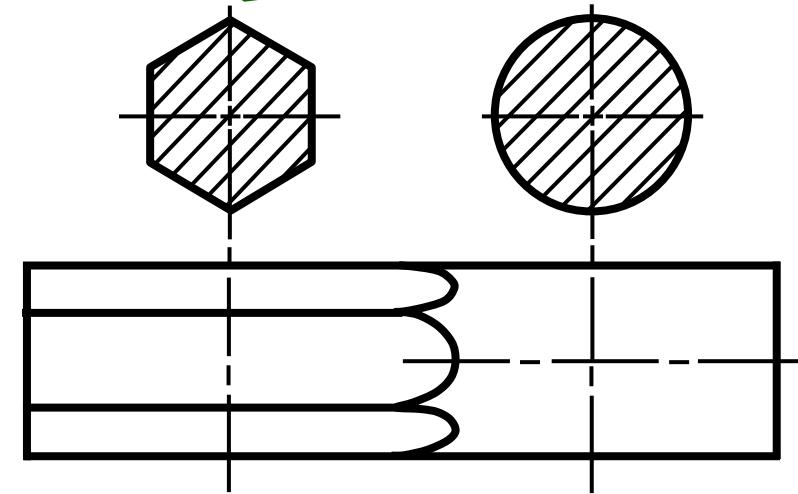
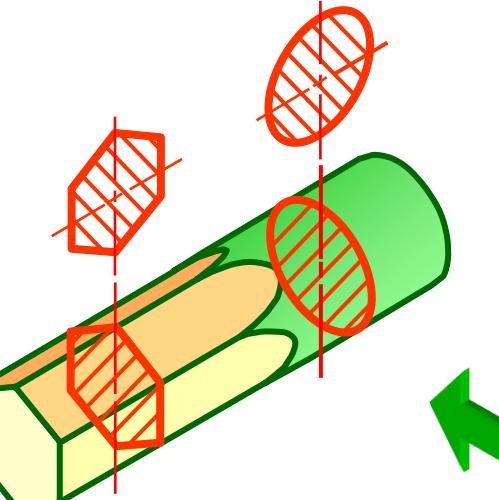
Removed section: Alternative placement of a view

Comparison

Revolved section

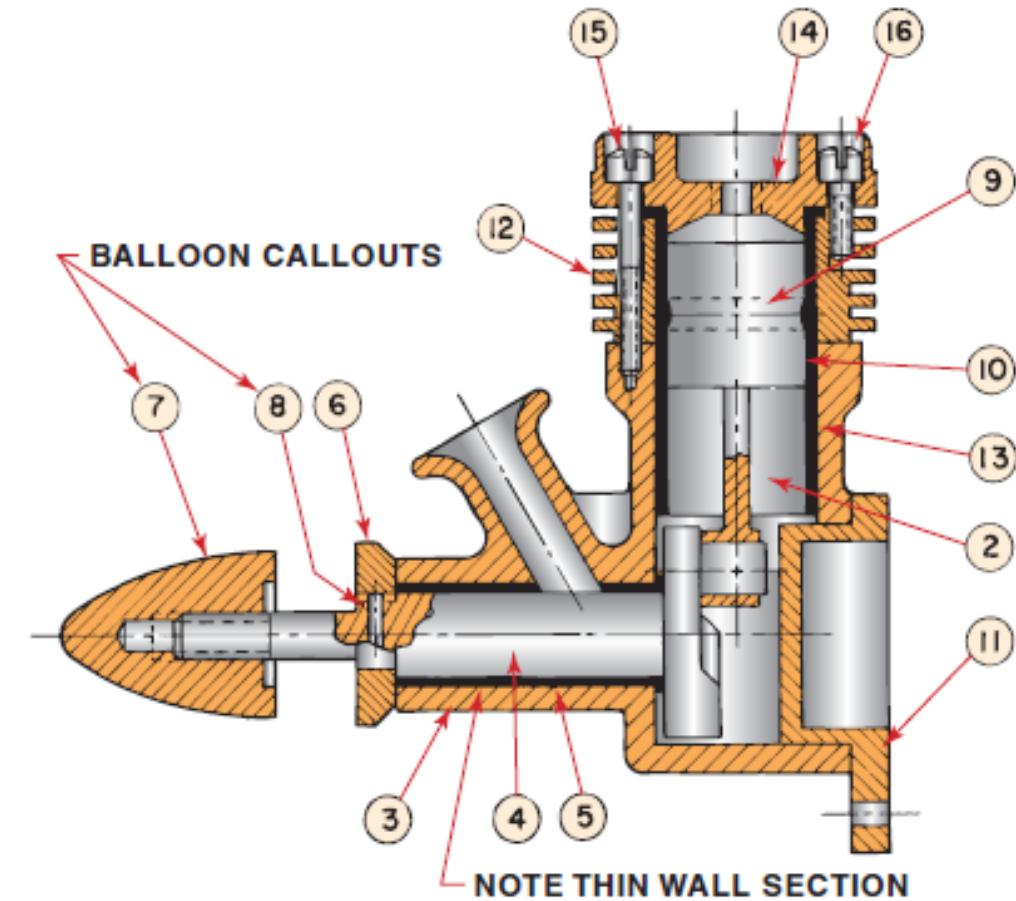


Removed section



8. Assembly Section

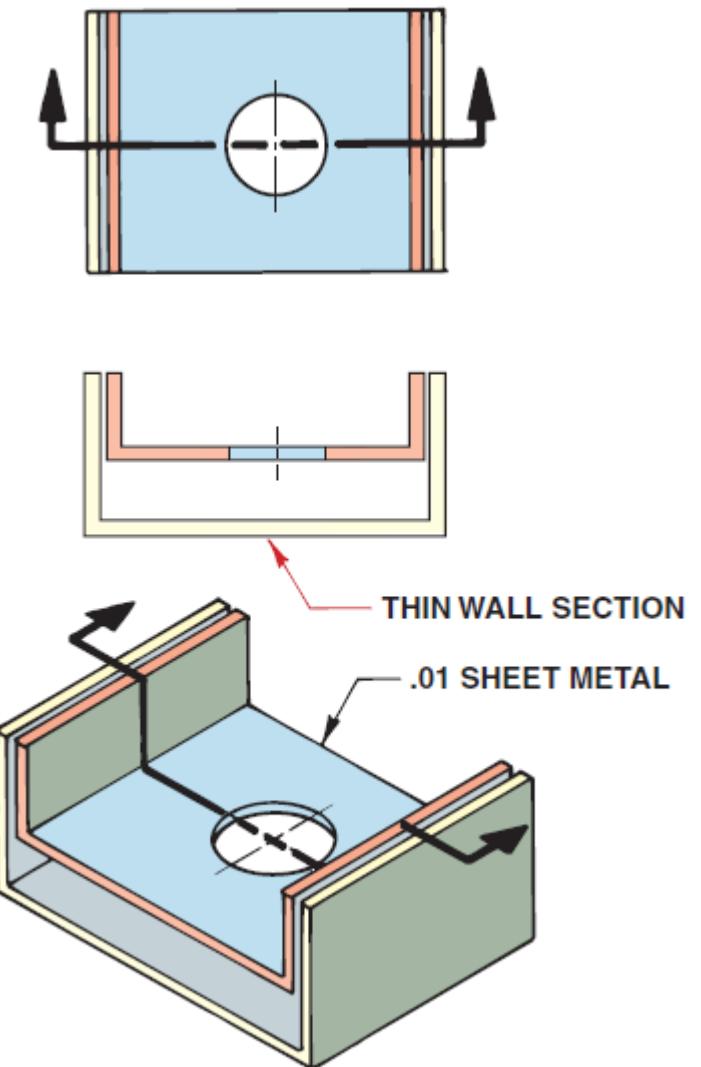
- One common use for sectional drawings is to show the assembly of parts.
- When multiple-part assembly drawings are sectioned, the adjoining parts are section lined at different angles.
- **Figure** shows an example of an **assembly section** with multiple parts sectioned.



An assembly section drawing depicting multiple sectioned parts of a model airplane motor

9. Thin Wall Section

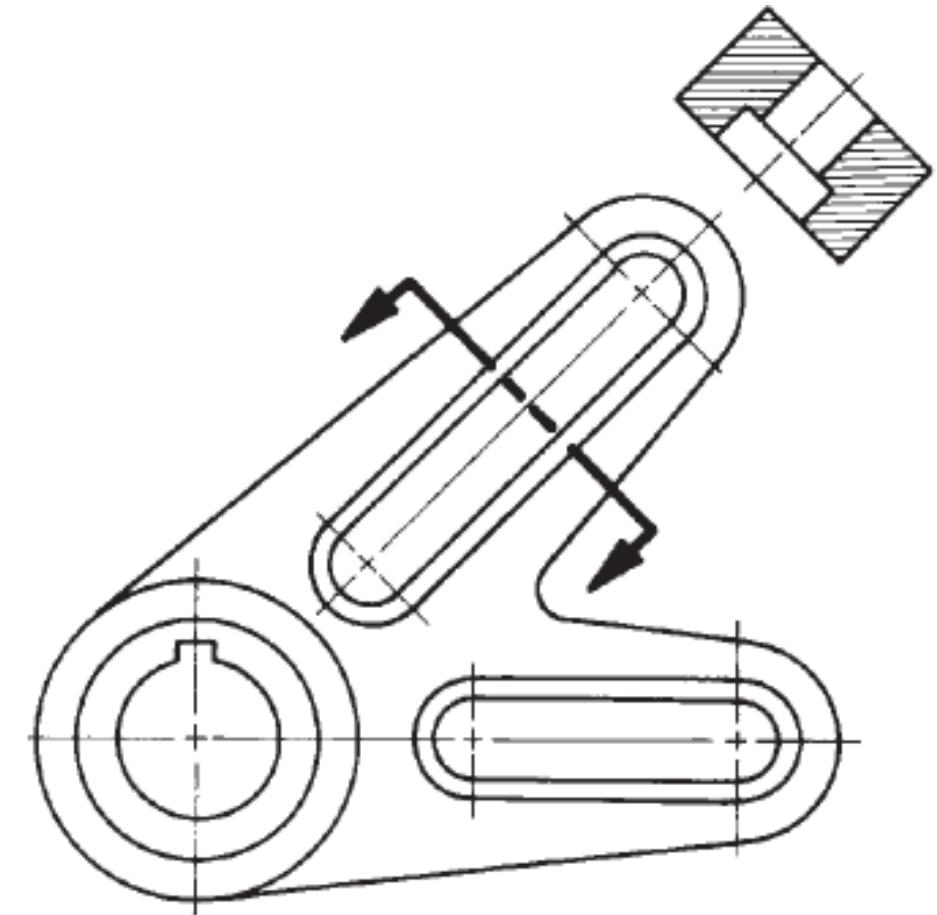
- The outlines of ribs, spokes, and other thin walls are drawn on sectional views.
- However, section lining is not added to these parts.
- **Figure** shows an example of a typical **thin wall section** for a corner bracket.
- Materials too thin to section with crosshatching, such as paper and sheet metal, are sectioned solid.



Thin wall section for a corner bracket

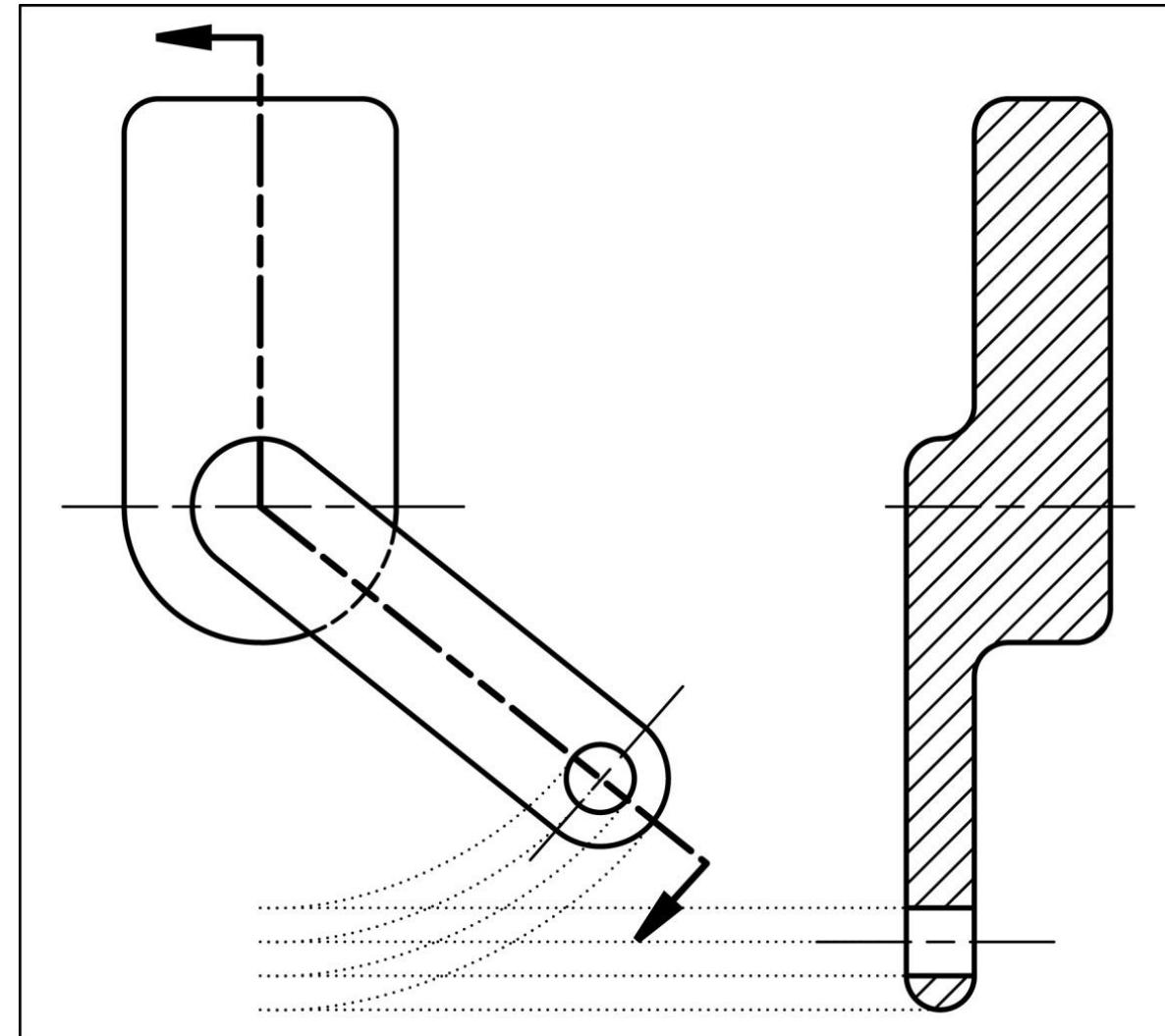
10. Auxiliary Section

- Most sectional views are aligned with the normal planes of projection.
- **Auxiliary sections** should be aligned with the projection lines of the auxiliary views.



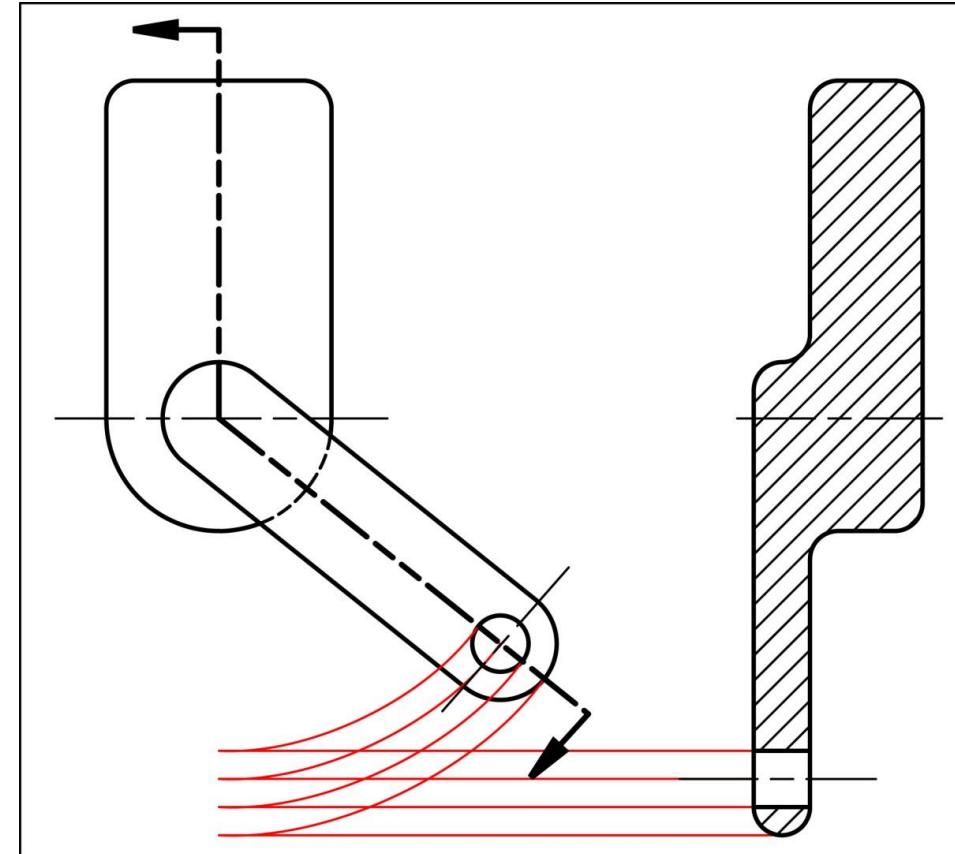
Auxiliary section for a locking lever arm

10. Auxiliary Section



Conventions of Revolution

- Features are revolved to the projection plane, and then projected over.



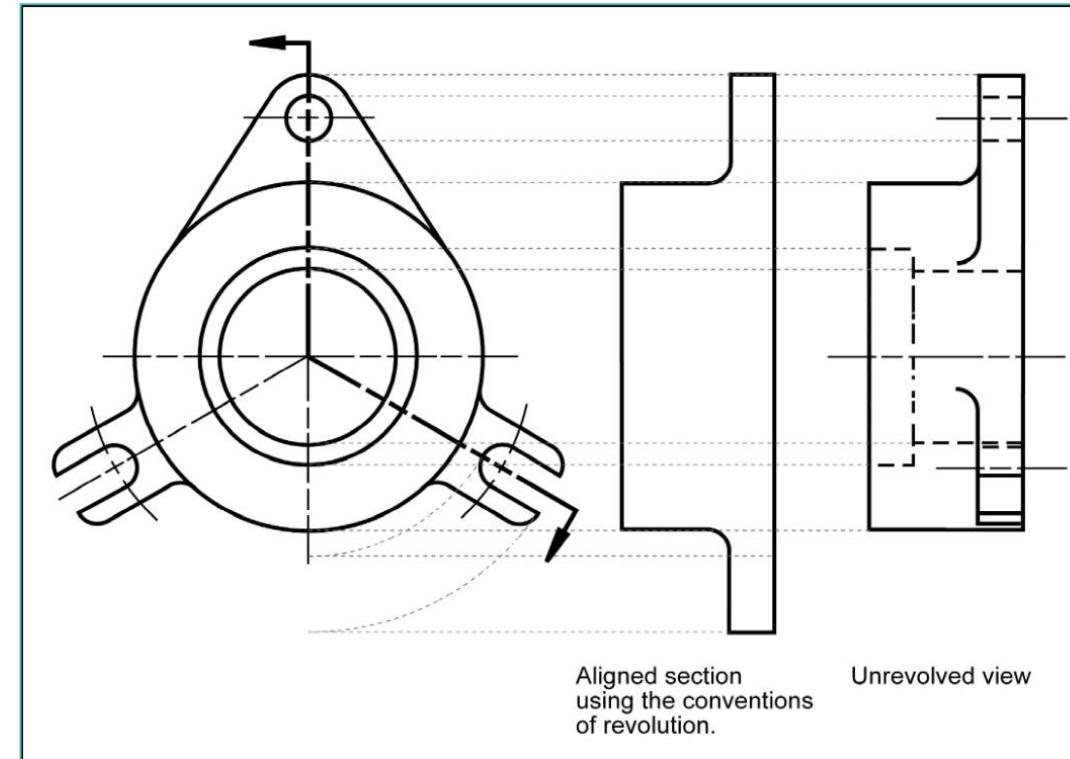


Exercise

AUXILIARY / ALIGNED SECTION

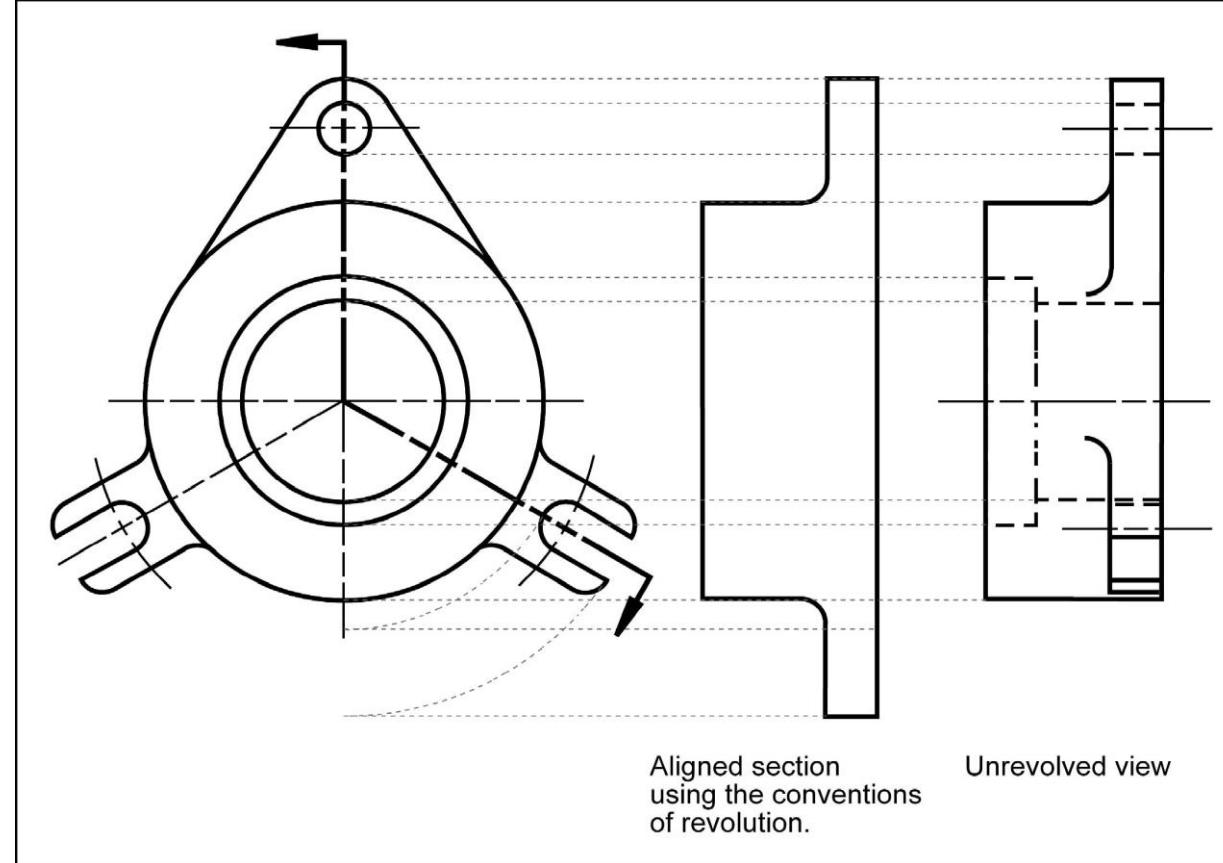
Exercise

- Given the front and unrevolved right side views, sketch the right side view as an aligned section using the conventions of revolution. The material is cast iron.



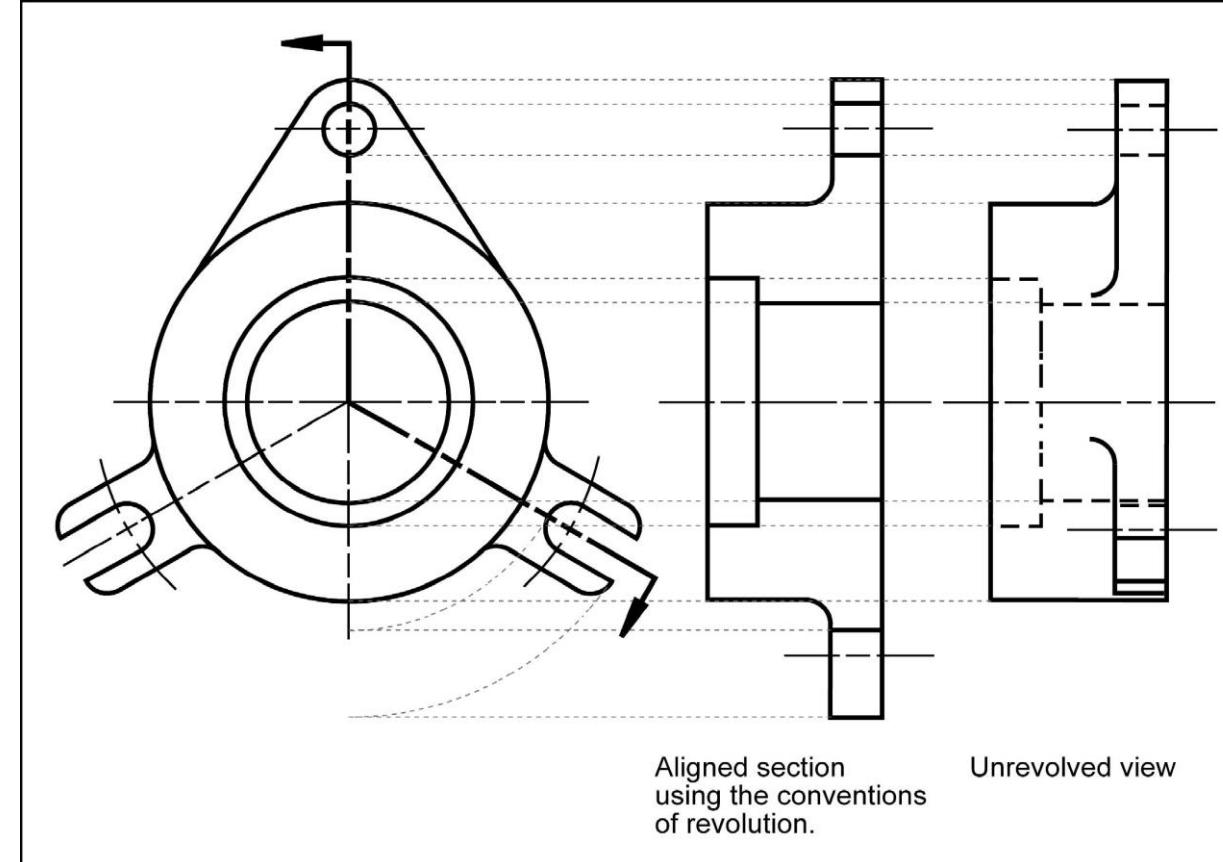


Fill in the visible lines in the sectional view.

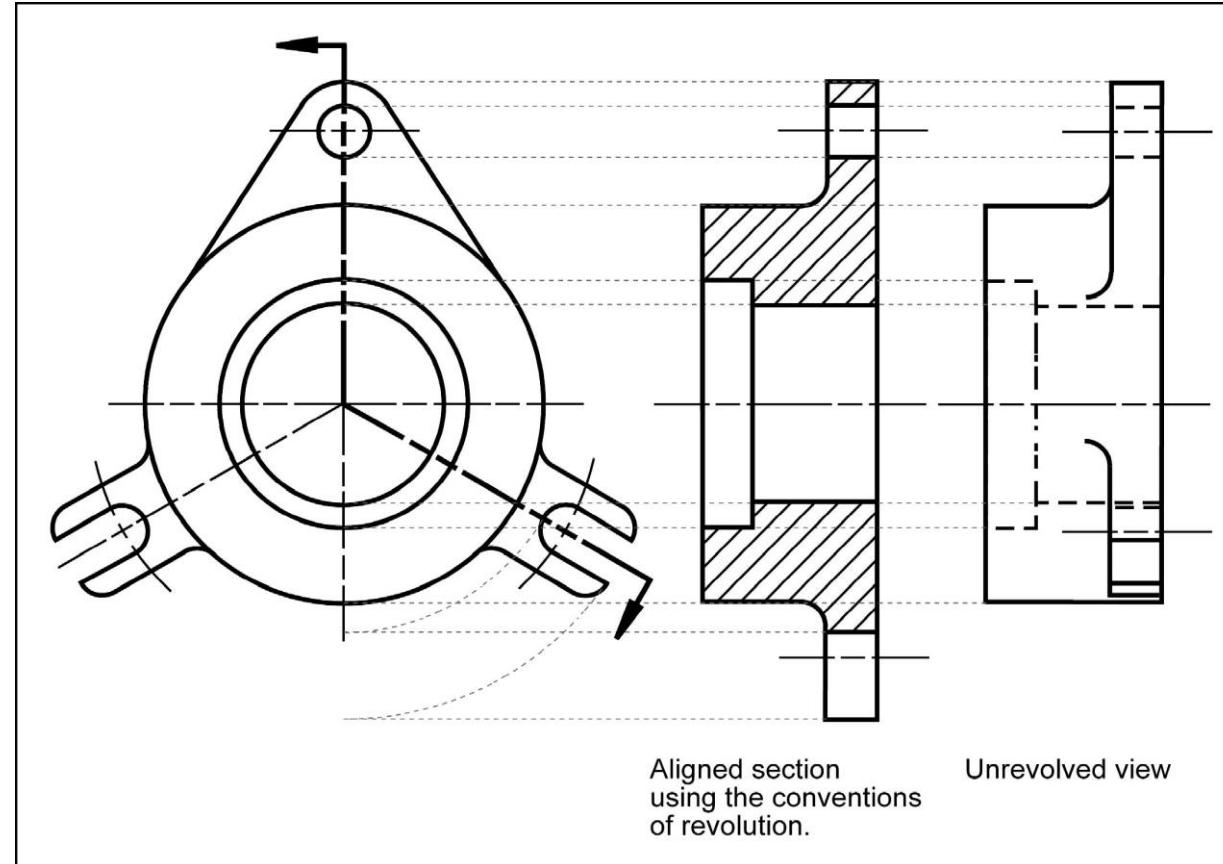




Fill in the section lines.

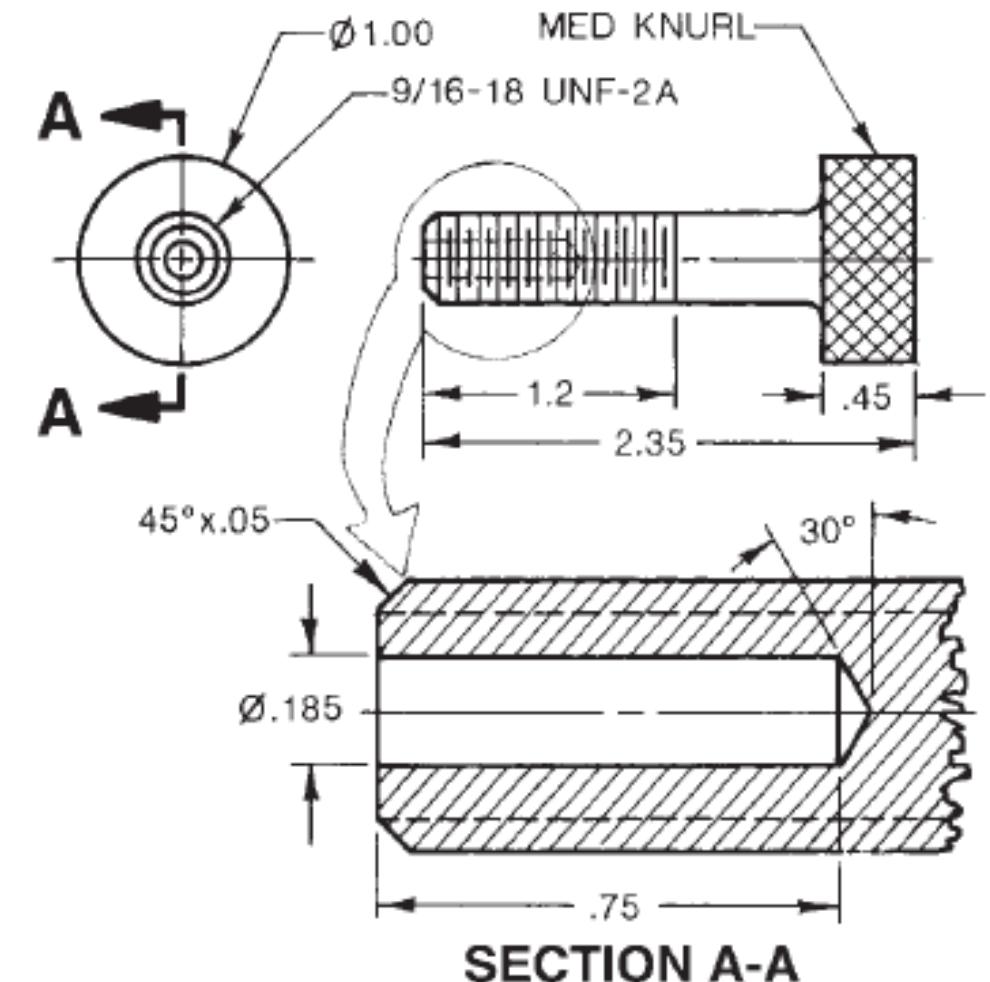


Notice how much clearer the sectional view is.



11. Enlarged Section

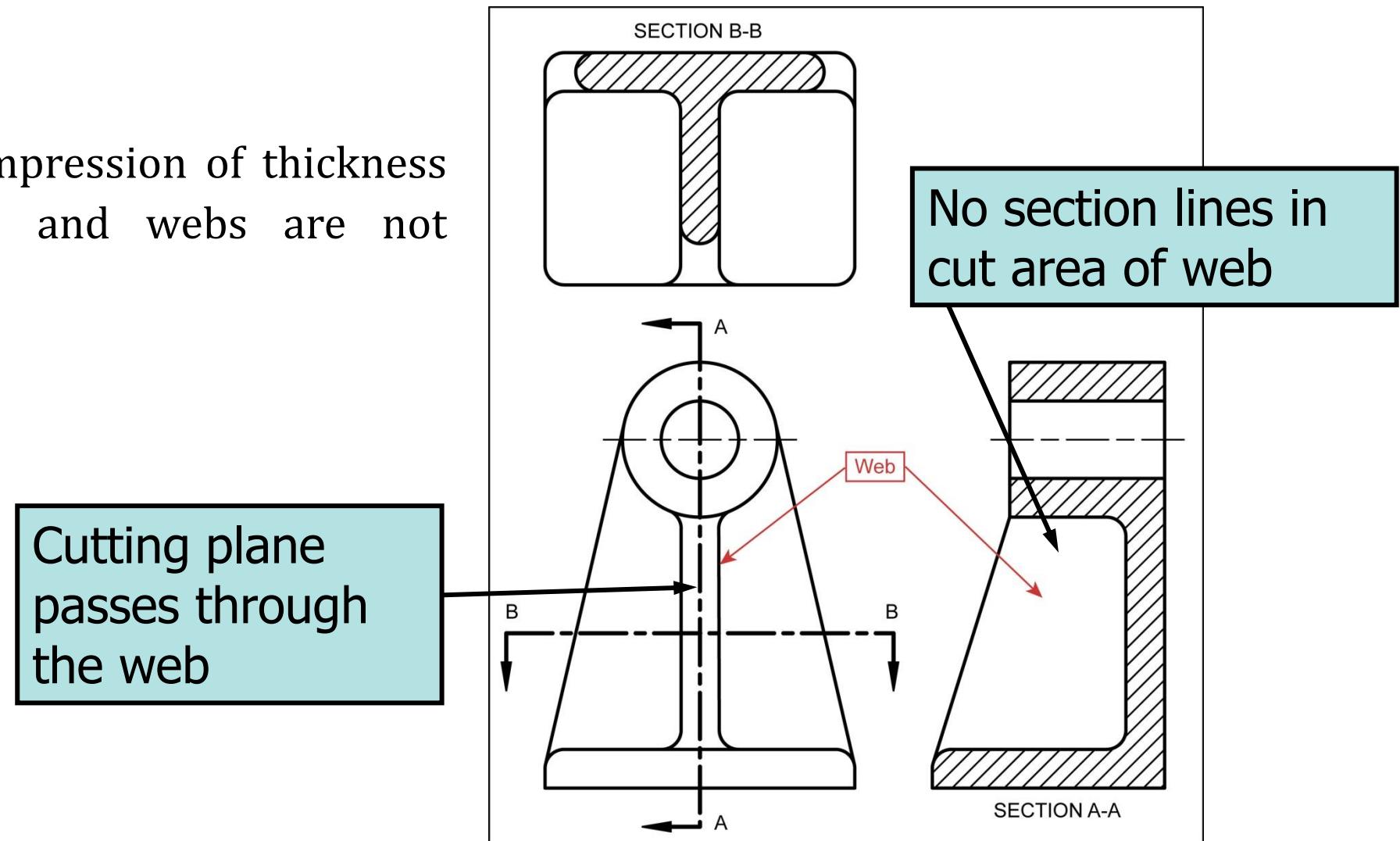
- Sectional details are often too small to be interpreted and dimensioned.
- In such a case, **enlarged sections** are prepared to clarify details and for ease of dimensioning.



Enlarged section of a screw adjuster

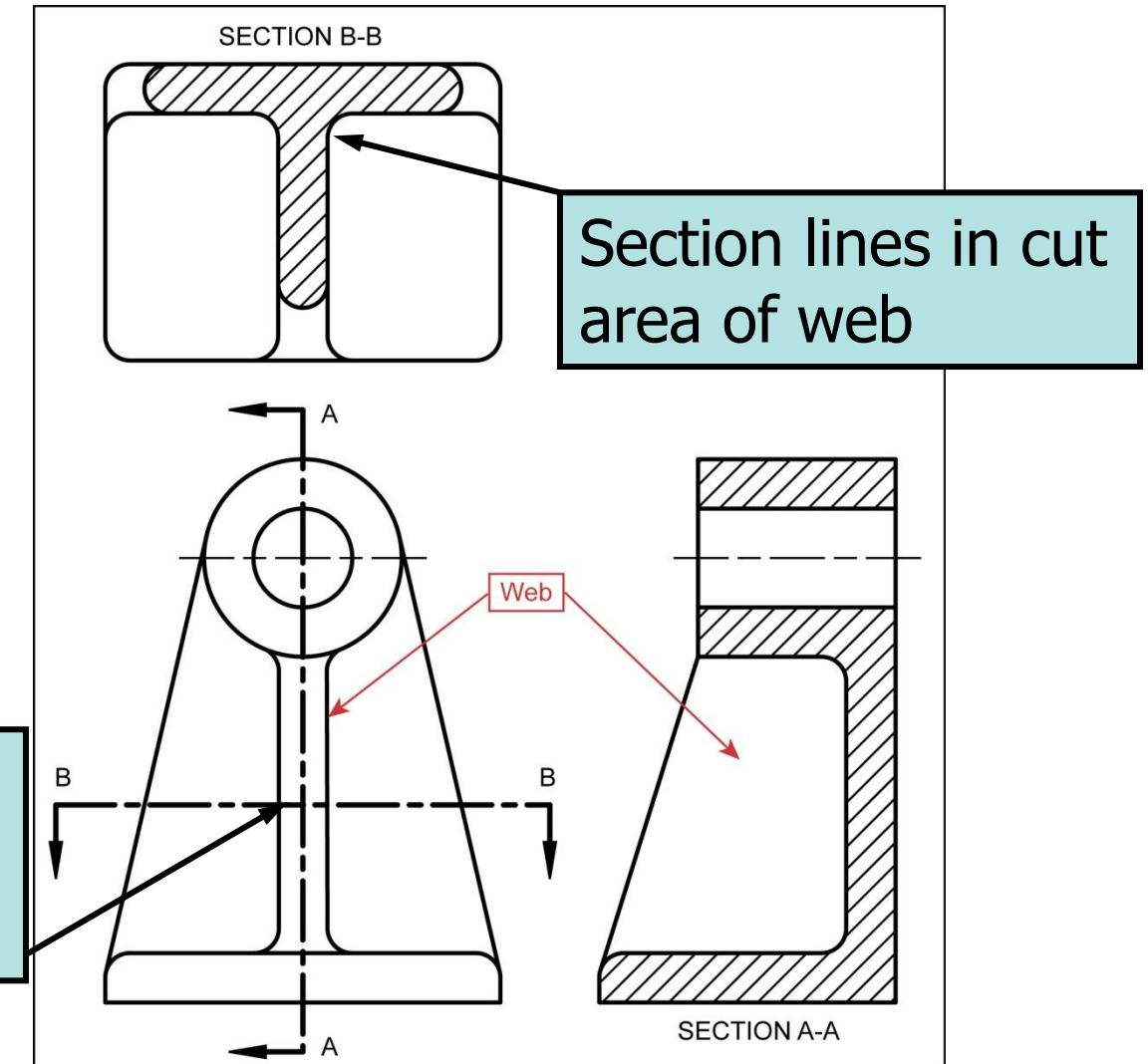
12. Rib and Web Sections

- To avoid a false impression of thickness and solidity, ribs and webs are not sectioned.



12. Rib and Web Sections

- If the cutting plane passes crosswise through the rib or web, we include section lines.



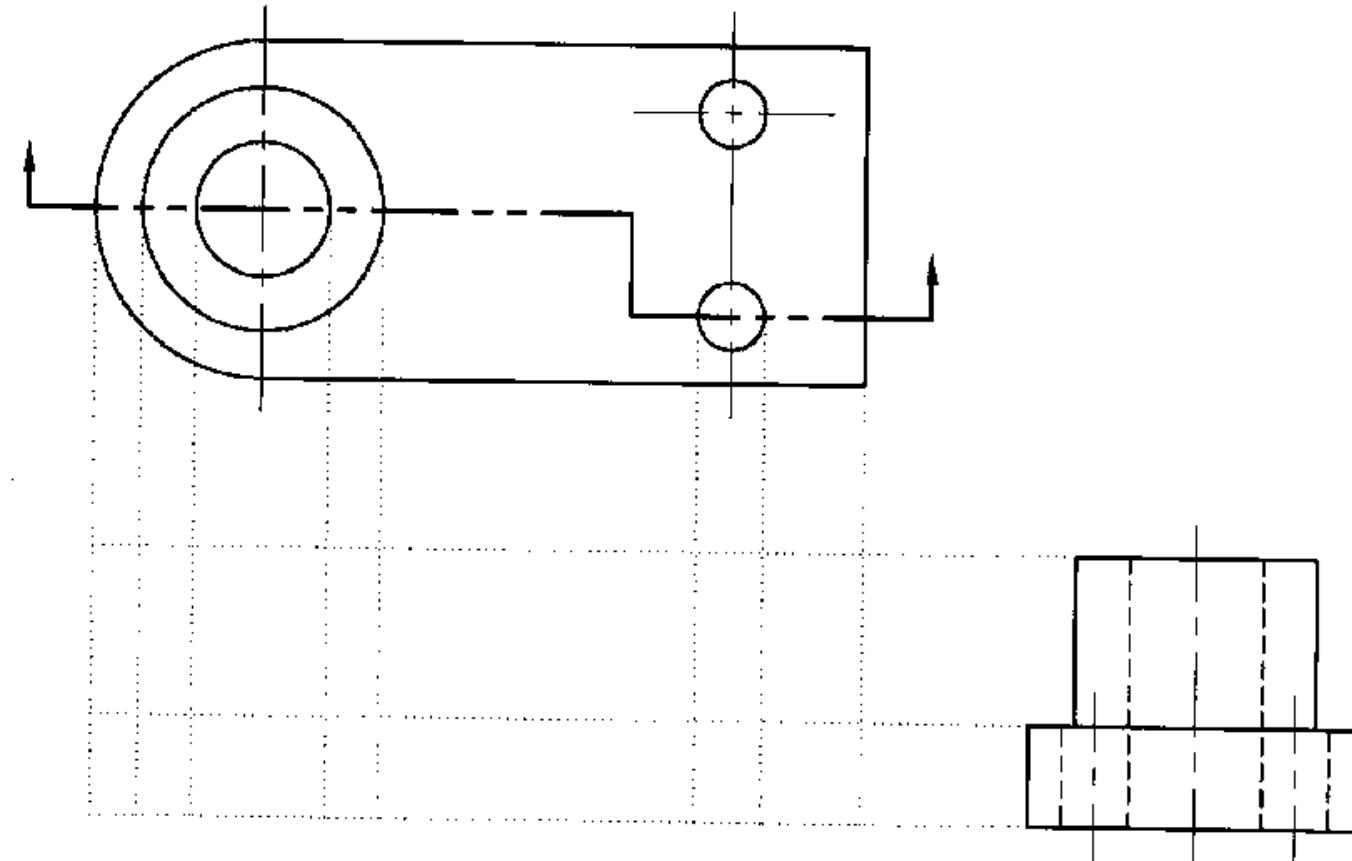


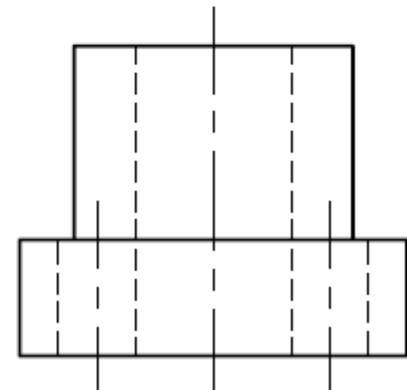
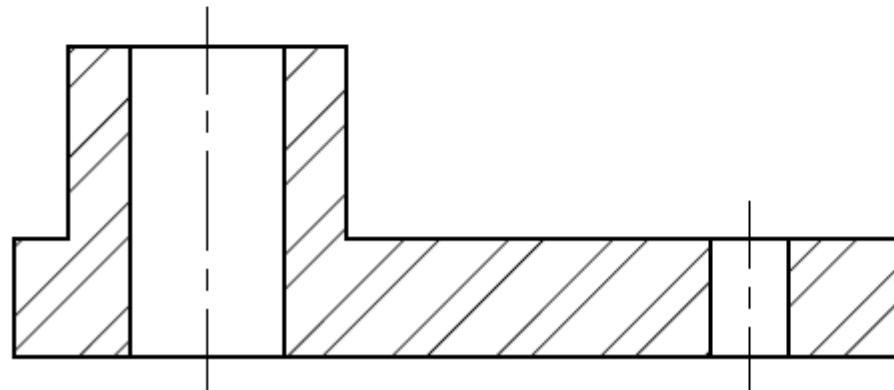
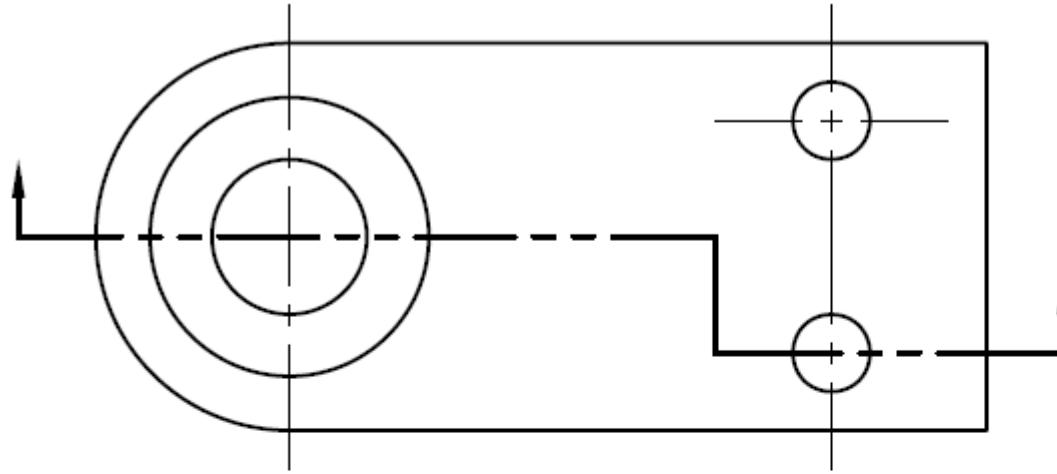
Non - Sectioned Parts

- It is common practice to show standard parts 'in the round' or un-sectioned.
 - Nuts
 - Bolts
 - Rivets
 - Shafts
 - Screws

Exercise 01

- Sketch the sectional view as indicated. The material of the part is steel.





THANK YOU!
for your attention