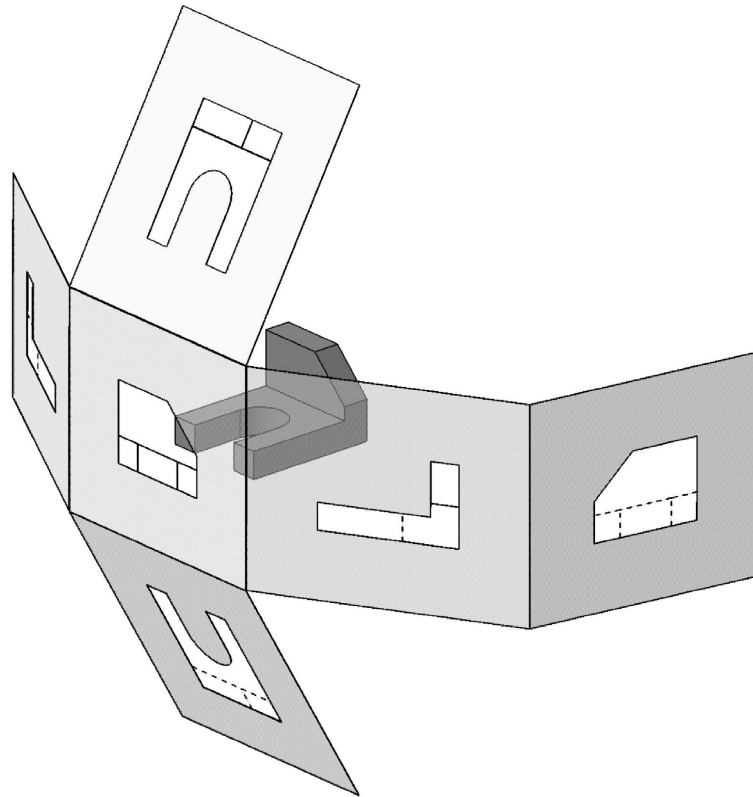
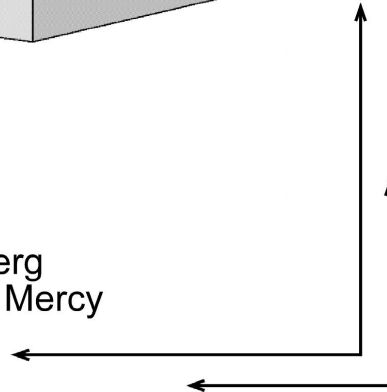


ENGINEERING GRAPHICS ESSENTIALS

(A Text and Lecture Aid)



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University of Detroit Mercy



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A rectangular box with a double-line border and a light gray fill. The word "SECTIONING" is centered inside the box in a bold, black, sans-serif font.

SECTIONING

In chapter 3 you will learn how to create various types of sectional views. Sectional views allow you to see inside an object. Using a sectional view within an orthographic projection can be very useful for parts that have complex interior geometry. By the end of this chapter, you will be able to create several different types of sectional views. You will also be able to choose which type of section is the most appropriate for a given part.

3.1) 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. It is a cut away view of an object. Often, objects are more complex and interesting on the inside than on the outside. **By taking an imaginary cut through the object and removing a portion, the inside features may be seen more clearly.** For example, a geode is a rock that is very plain and featureless on the outside, but cut into it and you get an array of beautiful crystals.

3.1.1) Creating a Section View

To produce a section view, the part is cut using an imaginary cutting plane. The portion of the part that is between the observer and the cutting plane is mentally discarded exposing the interior construction as shown in figure 3-1.

A sectional view should be projected perpendicular to the cutting plane and conform to the standard arrangement of views. If there are more than one section, they should be labeled with capital letters such as A, B or C. These letters are placed near the arrows of the cutting plane line. The sectional view is then labeled with the corresponding letter (e.g. SECTION A-A) as shown in figure 3-2. Letters that should not be used to label sections are I, O, Q, S, X and Z. These letters may lead to misinterpretation. They are often used for other purposes.

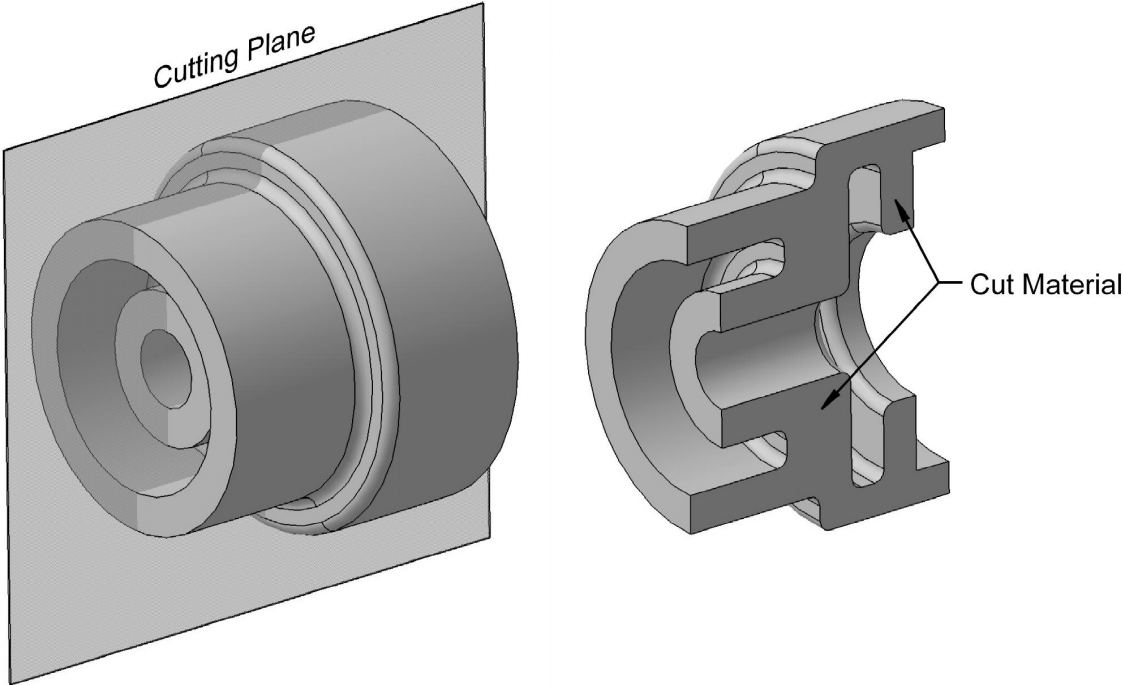


Figure 3-1: Creating a section view.

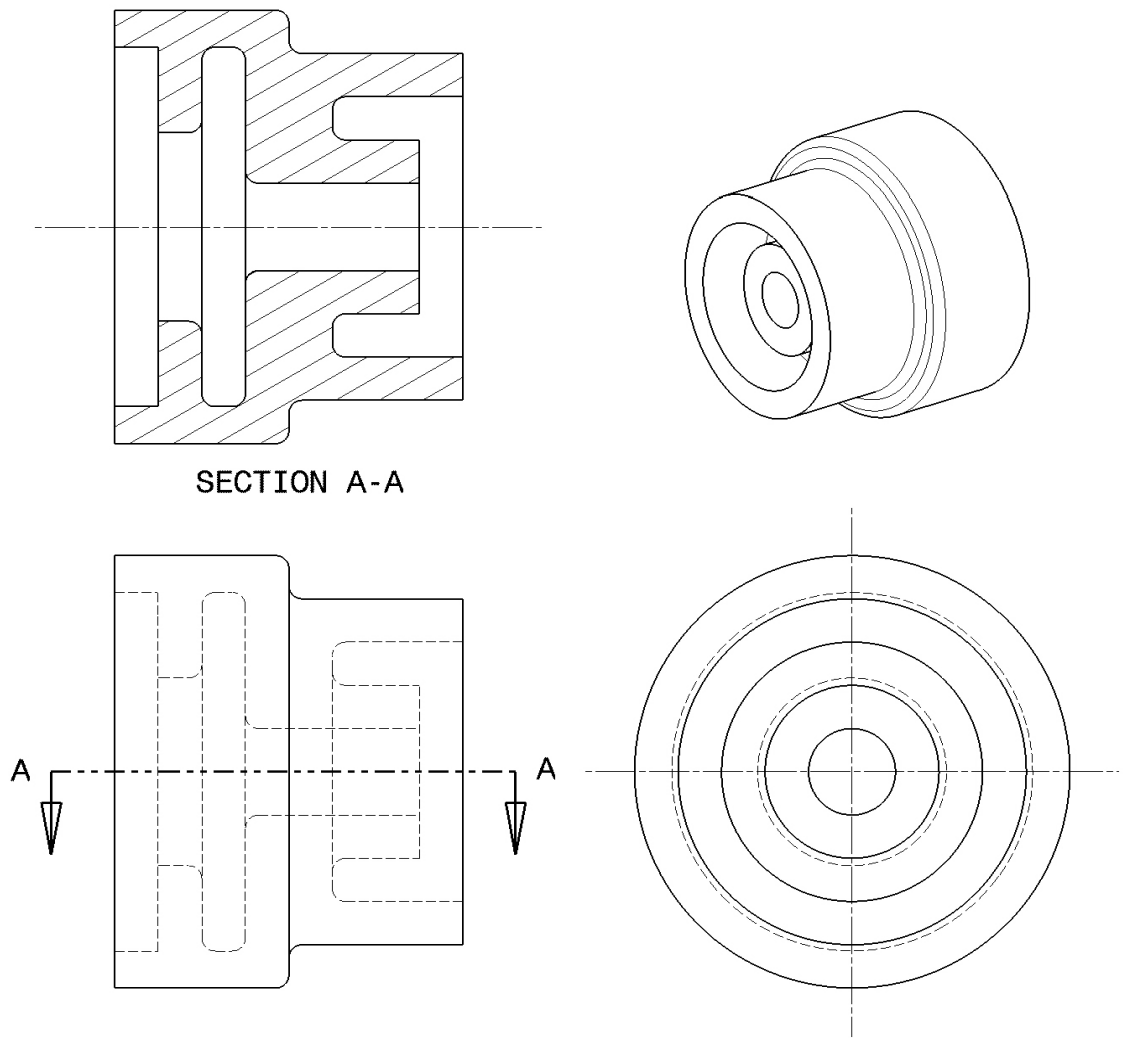


Figure 3-2: Sectional view.

3.1.2) Lines used in Sectional Views

- Cutting Plane Line

A cutting plane line is used to show where the object is being cut and represents the edge view of the cutting plane. Arrows are placed at the ends of the cutting plane line to indicate the direction of sight. The arrows point to the portion of the object that is kept. Cutting plane lines are thick (0.6 to 0.8 mm) and take precedence over centerlines. Figure 3-3 shows the two different types of cutting plane lines that are used on prints and figure 3-2 illustrates its use.

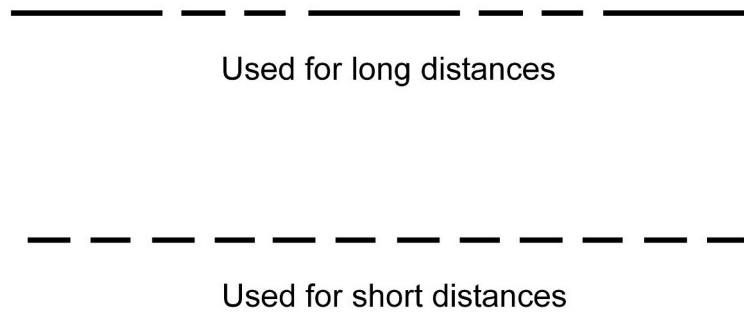


Figure 3-3: Cutting plane line.

- Section Lines

Section lines are used to indicate where the cutting plane cuts the material (see figure 3-2). Cut material is that which makes contact with the cutting plane. Section lines have the following properties.

- √ Section lines are thin lines (0.3 mm).
- √ Section line symbols (i.e. line type and spacing) are chosen according to the material that the object is made from. Figure 3-4 shows some of the more commonly used section line symbols.
- √ Section lines are drawn at a 45° angle to the horizontal unless there is some advantage in using a different angle.

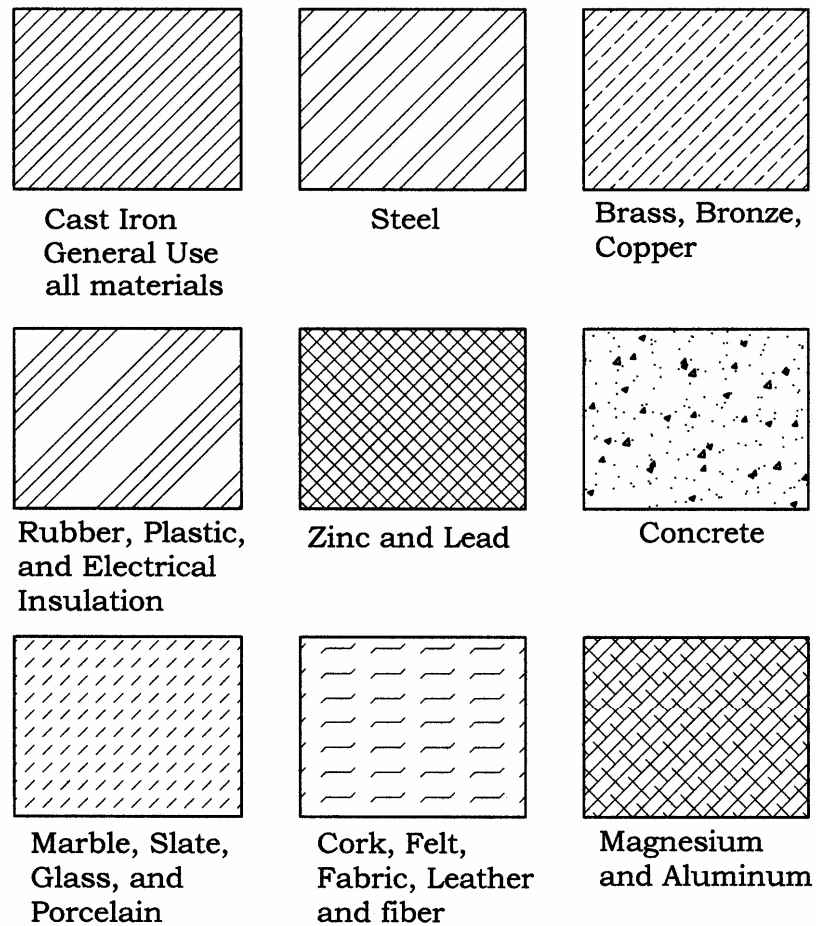


Figure 3-4: Section line symbols.

3.1.3) Rules of Sectioning

- √ A section lined area is always completely bounded by a visible outline.
- √ The section lines in all sectioned areas should be parallel. Section lines shown in opposite directions indicate a different part.
- √ All the visible edges behind the cutting plane should be shown.
- √ Hidden features should be omitted in all areas of a section view. Exceptions include threads and broken out sections.

3.2) TYPES OF SECTIONS

Many types of sectioning techniques are available to use. The type chosen depends on the situation and what information needs to be conveyed.

3.2.1) Full Section

To create a full section, the cutting plane passes fully through the object. The half of the object that is between the observer and the cutting plane is mentally removed exposing the cut surface and visible background lines of the remaining portion. Full sections are used in many cases to avoid having to dimension hidden lines as shown in figure 3-5.

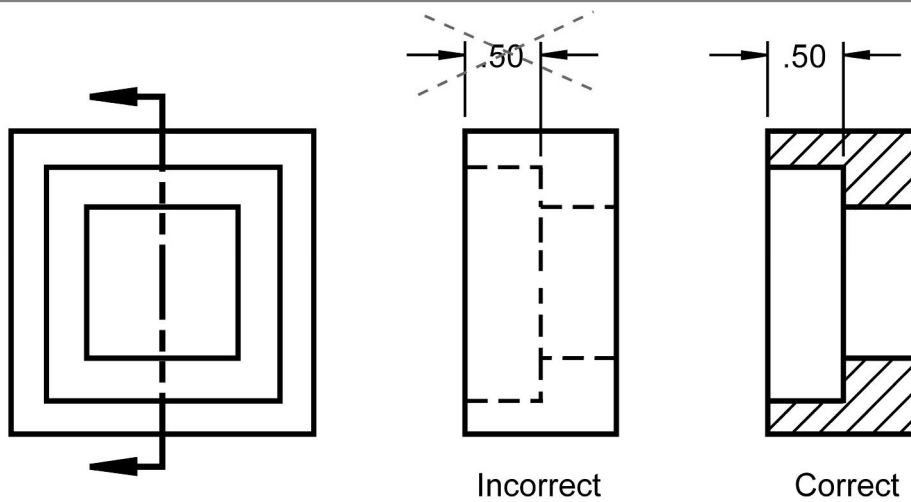
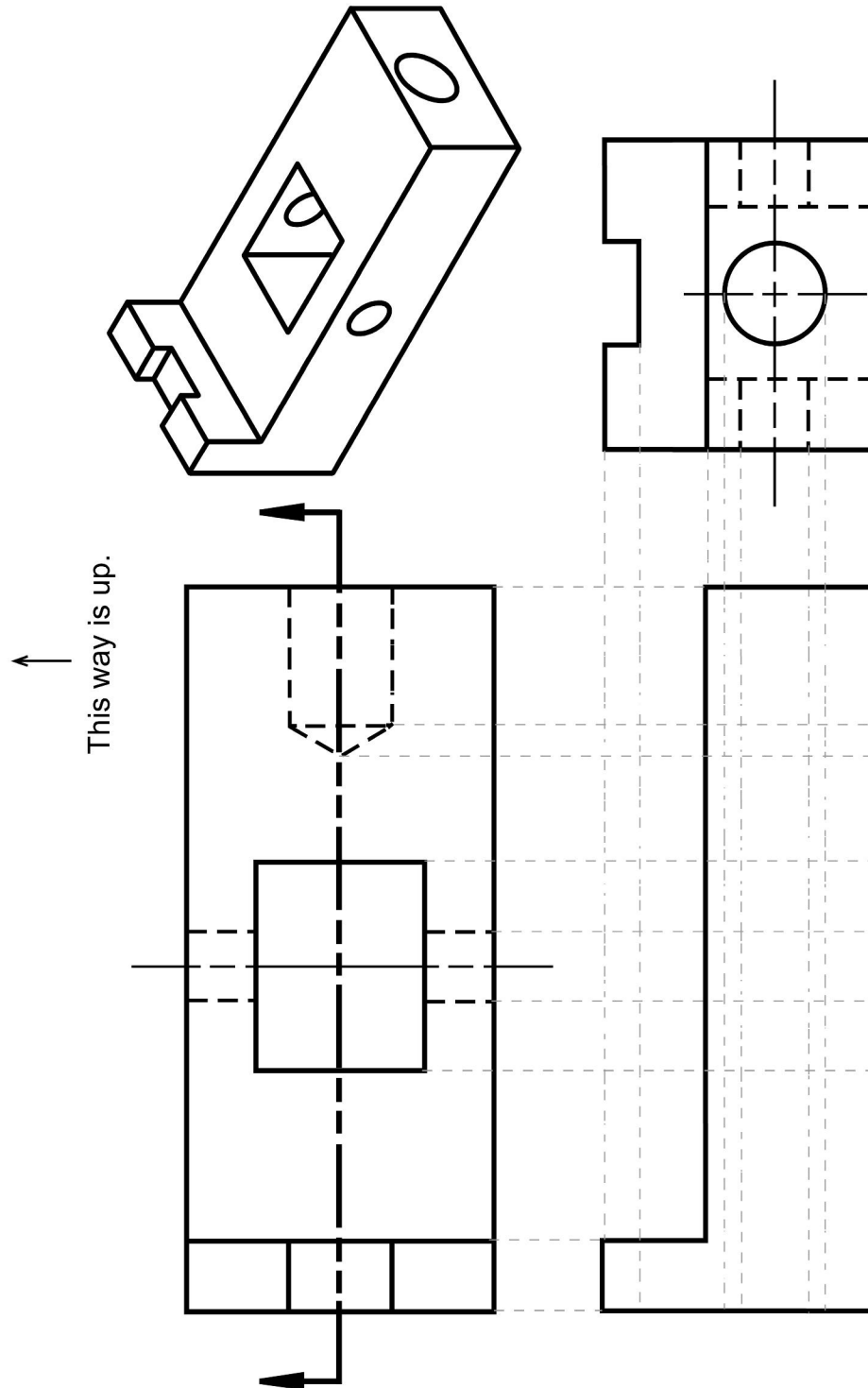


Figure 3-5: Full section.

Instructor Led Exercise 3-1: Full section

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



3.2.2) Half Section

A half section has the advantage of exposing the interior of one half of an object while retaining the exterior of the other half. Half sections are used mainly for symmetric or nearly symmetric objects or assembly drawings. The half section is obtained by passing two cutting planes through the object, at right angles to each other, such that the intersection of the two planes coincides with the axis of symmetry. Therefore, only a quarter of the object is mentally removed. On the sectional view, a centerline is used to separate the sectioned and unsectioned halves. Hidden lines should not be shown on either half. Figure 3-6 shows an example of a half section.

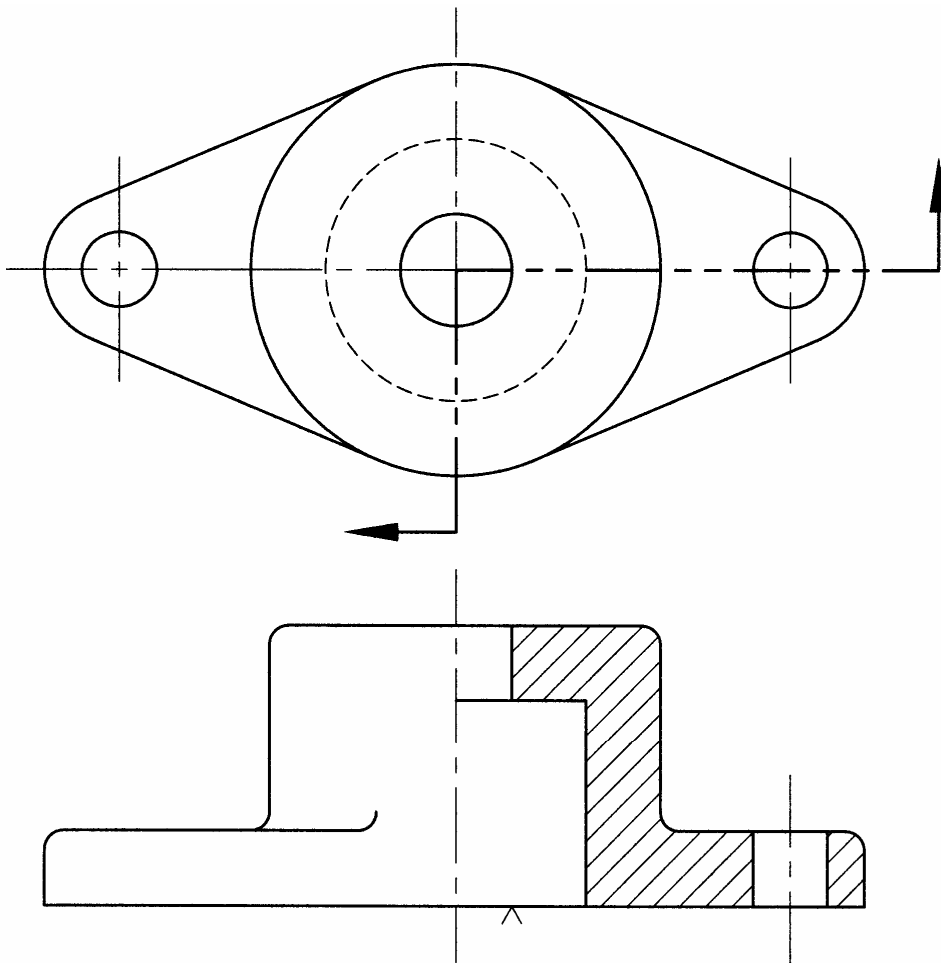
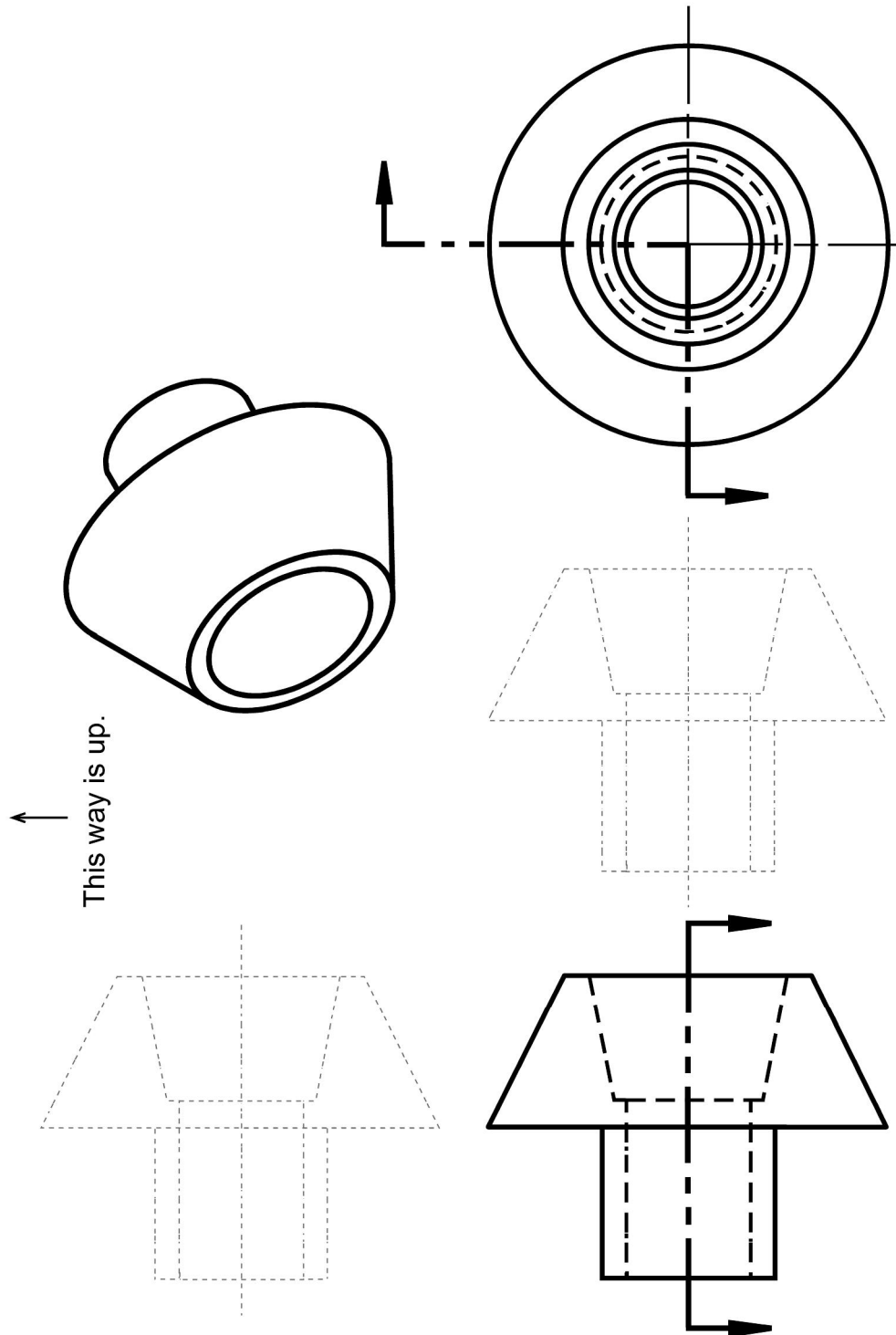


Figure 3-6: Half section.

Instructor Led Exercise 3-2: Half section

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.



3.2.3) Offset Section

An offset section is produced by bending the cutting plane to show features that don't lie in the same plane. The section is drawn as if the offsets in the cutting plane were in one plane. Figure 3-7 shows an offset section.

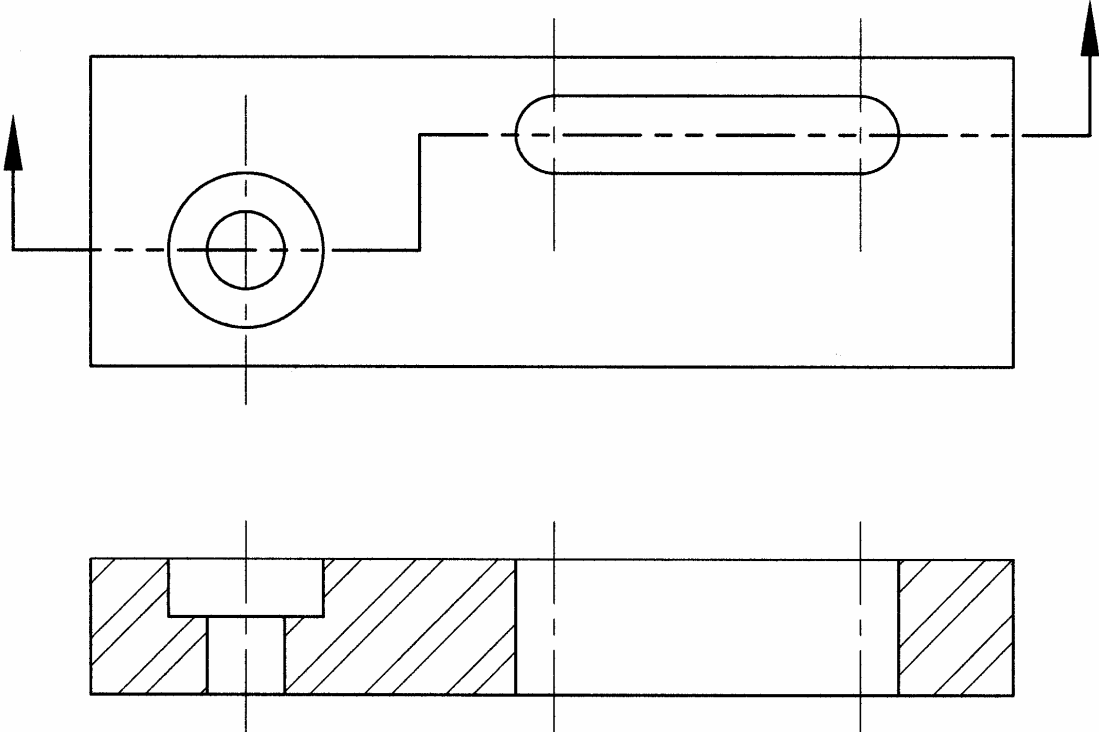
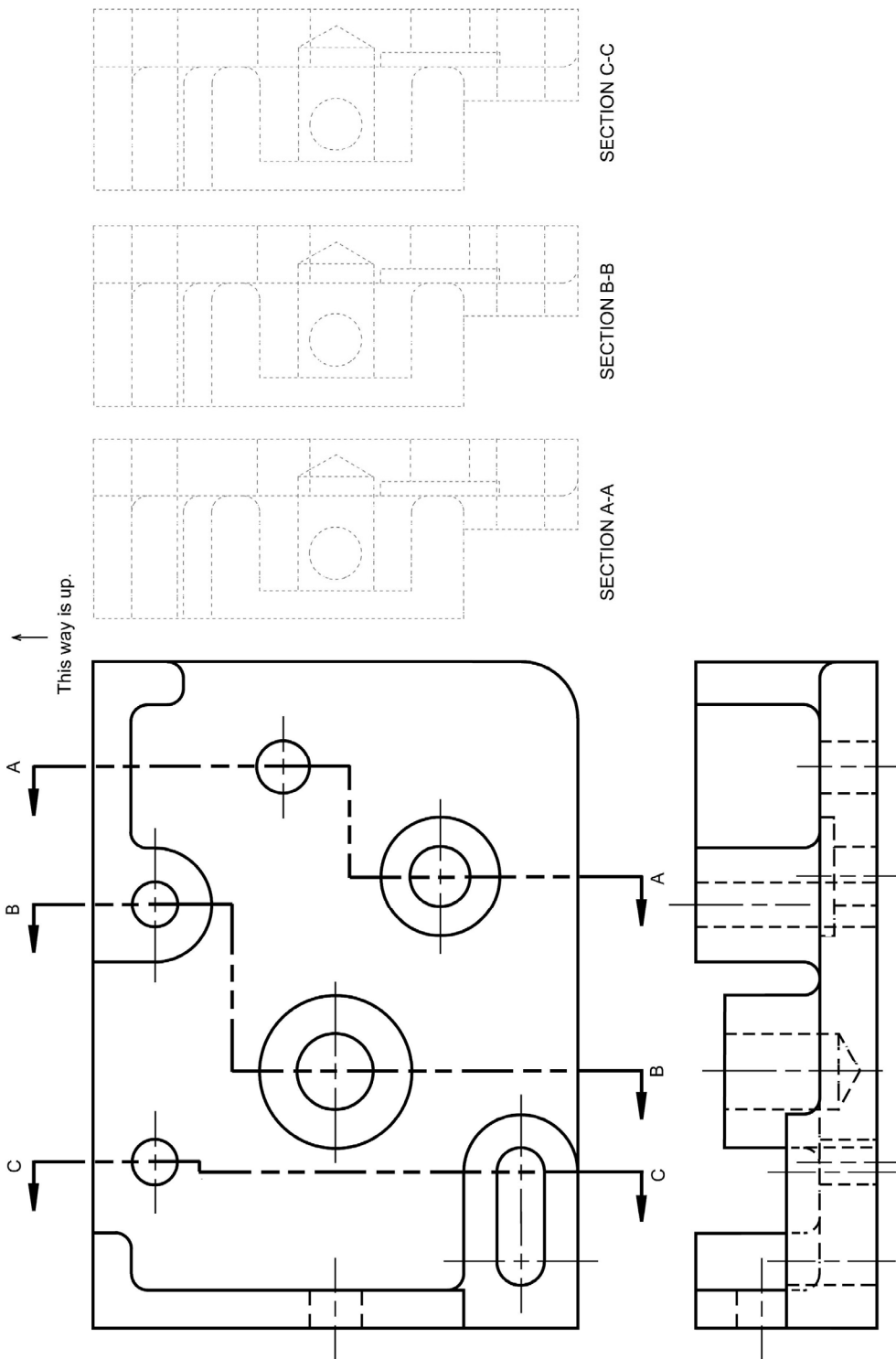


Figure 3-7: Offset section.

In Class Student Exercise 3-3: Offset section

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



NOTES:

3.2.4) Aligned Section

In order to include angled elements in a section, the cutting plane may be bent so that it passes through those features. The plane and features are then revolved, according to the conventions of revolution, into the original plane.

- Conventions of Revolution: Features are revolved into the projection plane, usually a vertical or horizontal plane, and then projected. The purpose of this is to show a true distance from a center or to show features that would otherwise not be seen. Figure 3-8 shows an aligned section employing the conventions of revolution.

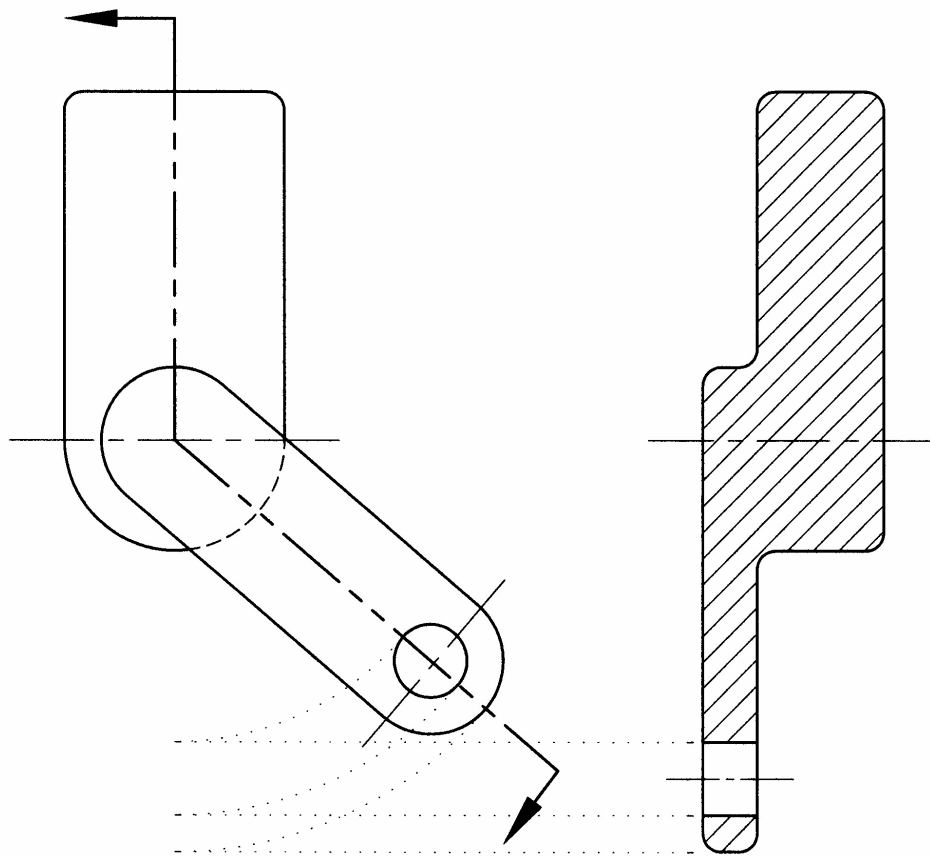
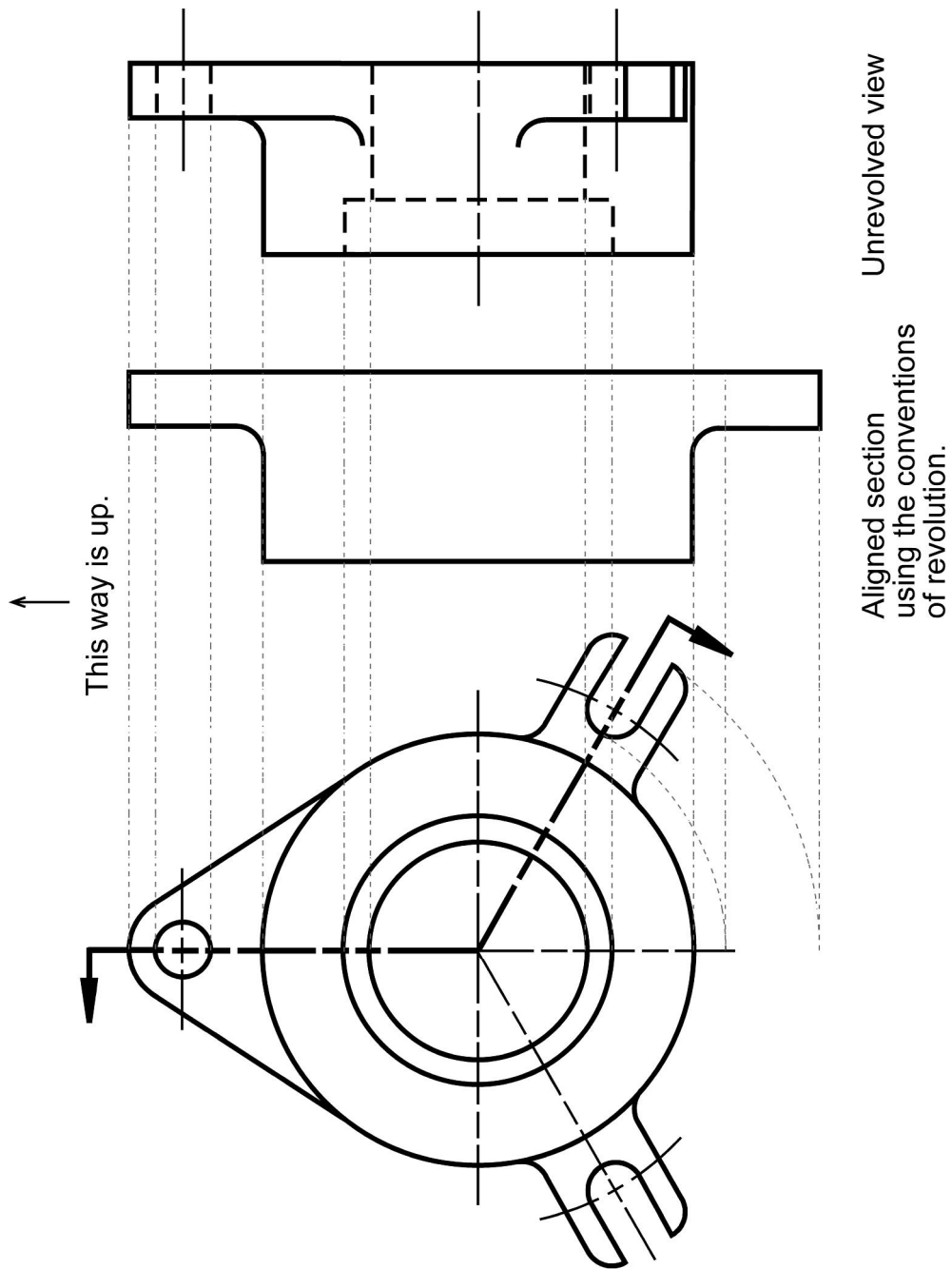


Figure 3-8: Aligned section.

Instructor Led Exercise 3-4: Aligned section

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.



3.2.5) Rib and Web Sections

To avoid a false impression of thickness and solidity, ribs and webs and other similar features are not sectioned even though the cutting plane passes along the center plane of the rib or web. However, if the cutting plane passes crosswise through the rib or web, the member is shown in section as indicated in figure 3-9.

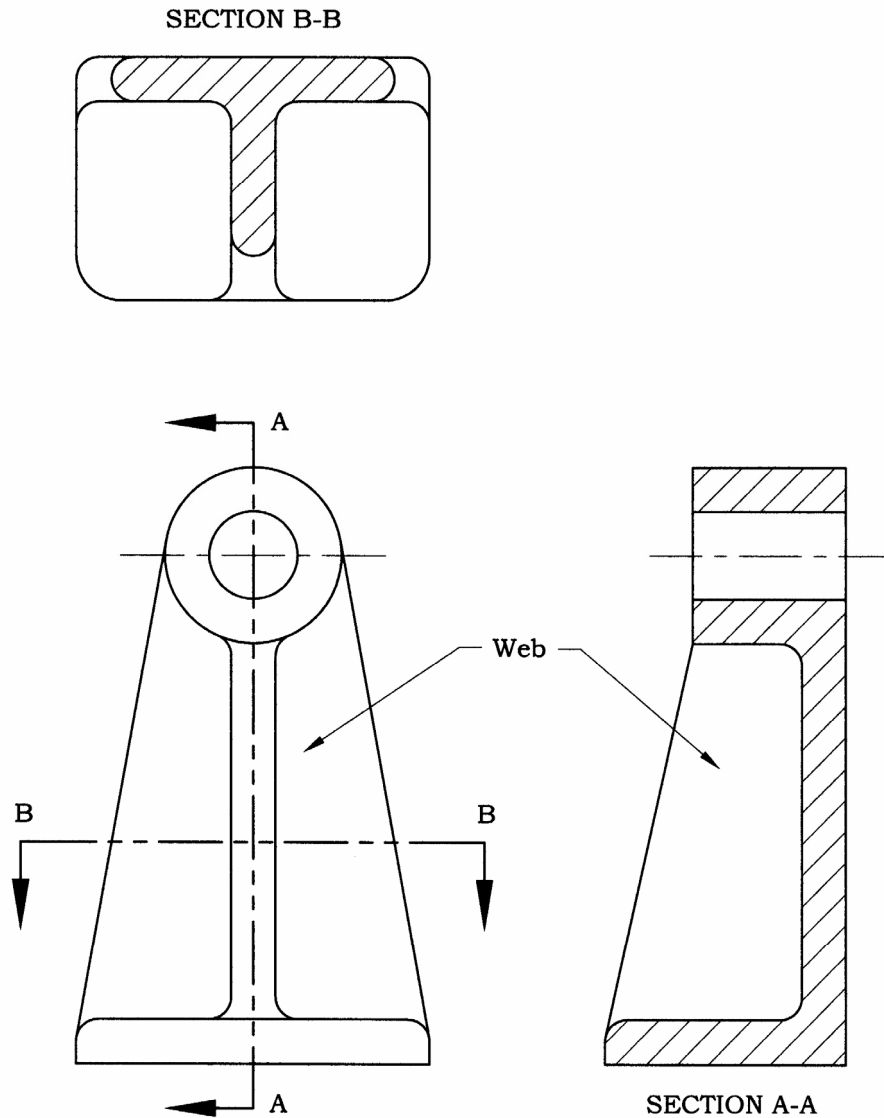


Figure 3-9: Rib and web sections.

3.2.6) Broken Section

Sometimes only a portion of the object needs to be sectioned to show a single feature of the part. In this case, the sectional area is bounded by a break line. Hidden lines are shown in the unsectioned area of a broken section. Figure 3-10 shows an example of a broken section.

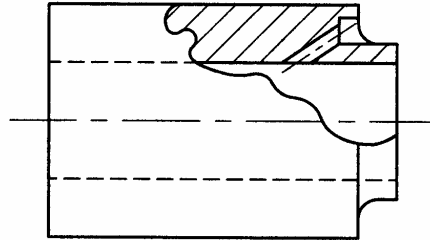


Figure 3-10: Broken section.

3.2.7) Removed Section

A removed section is one that is not in direct projection of the view containing the cutting plane. Removed sections should be labeled (i.e. SECTION A-A) according to the letters placed at the ends of the cutting plane line. They should be arranged in alphabetical order from left to right. Frequently, removed sections are drawn to an enlarged scale, which is indicated beneath the section title.

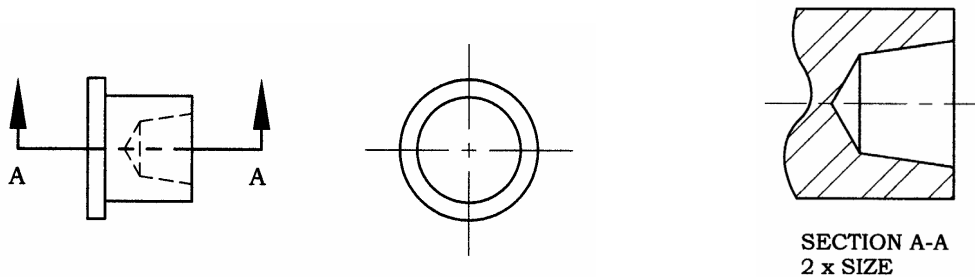


Figure 3-11: Removed section.

3.2.8) Revolved Section

The cross sectional shape of a bar, arm, spoke or other elongated objects may be shown in the longitudinal view by means of a revolved section. The visible lines adjacent to a revolved section may be broken out if desired. The super imposition of the revolved section requires the removal of all original lines covered by the section as shown in figure 3-12. The true shape of a revolved section should be retained after the revolution regardless of the direction of the lines in the view.

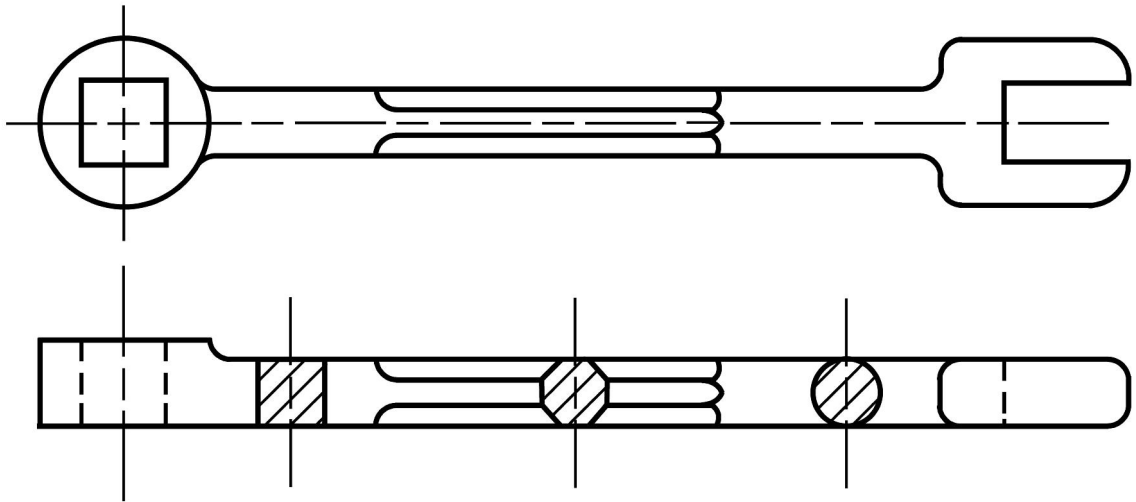


Figure 3-12: Revolved section.

3.2.9) Non-Sectioned Parts

It is common practice to show standard parts like nuts, bolts, rivets, shafts and screws 'in the round' or un-sectioned. This is done because they have no internal features. Other non-sectioned parts include bearings, gear teeth, dowels, and pins.

3.2.10) Thin Sections

For extremely thin parts of less than 4 mm thickness, such as sheet metal, washers, and gaskets, section lines are ineffective; therefore, the parts should be shown in solid black or without section lines.

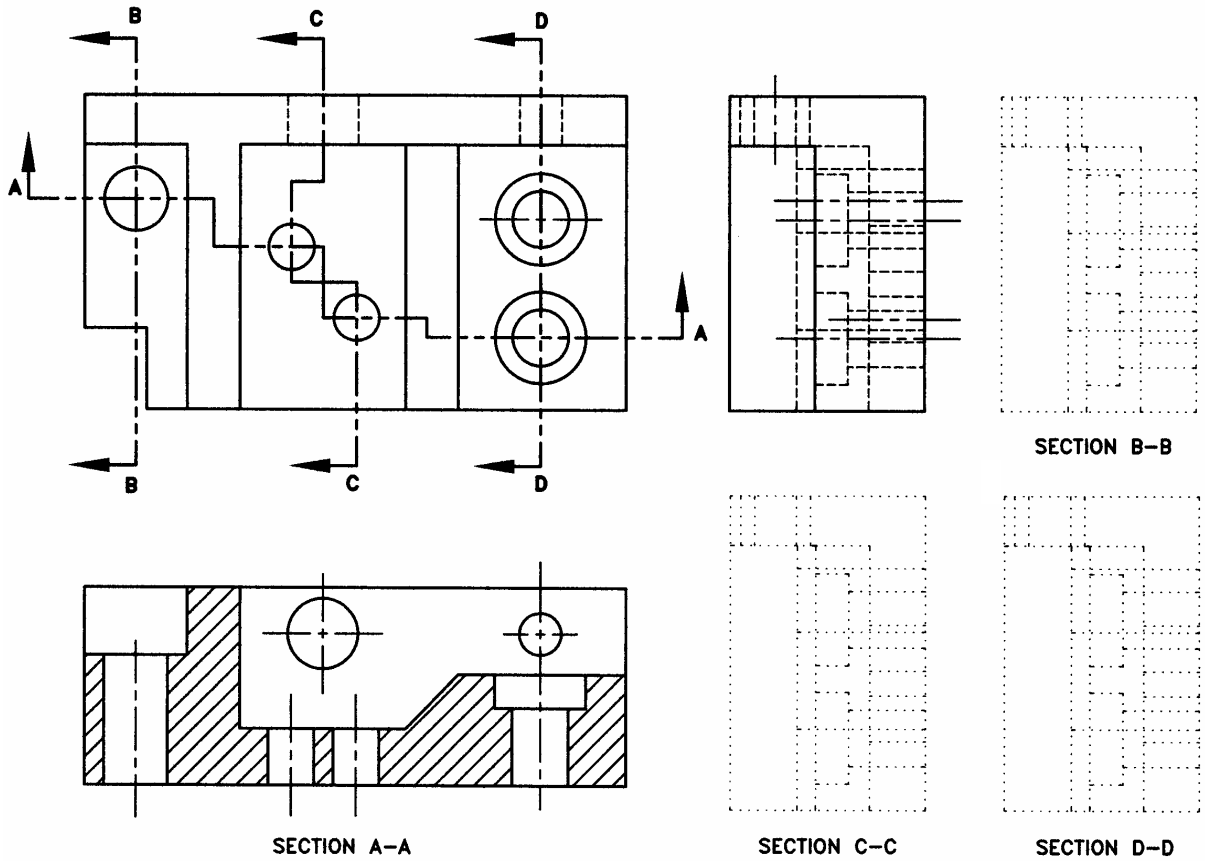
SECTIONING REVIEW QUESTIONS

- Q3-1)** Explain the purpose of a section view.
- Q3-2)** The arrows at the end of a cutting plane line point to the part of the object that is being (kept, thrown away).
- Q3-3)** What does a cutting plane line indicate?
- Q3-4)** What are section lines used to indicate?
- Q3-5)** Section line symbols depend on (type of section, type of material).
- Q3-6)** The sectioned and non-sectioned halves of a half section are separated by a (visible, center) line.
- Q3-7)** A full section removes ($\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$) of the object.
- Q3-8)** A half section removes ($\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$) of the object.
- Q3-9)** Is it permissible to show hidden lines on some portion of a half section?
- Q3-10)** Why do we use the conventions of revolution when creating an aligned section?

SECTIONING PROBLEMS

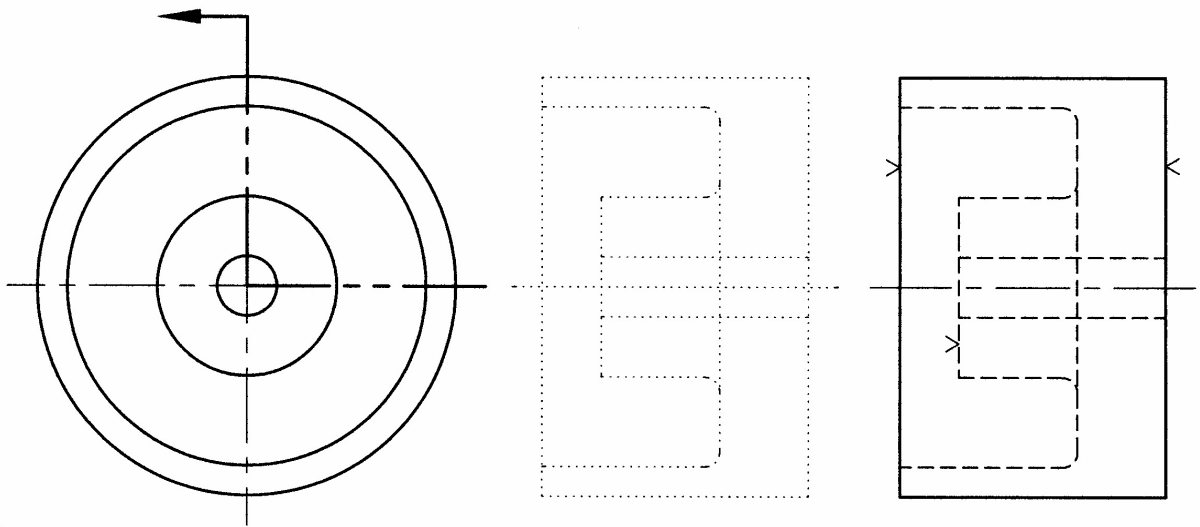
P3-1) Sketch the sectional view as indicated.

P3-1 a) Material = Steel

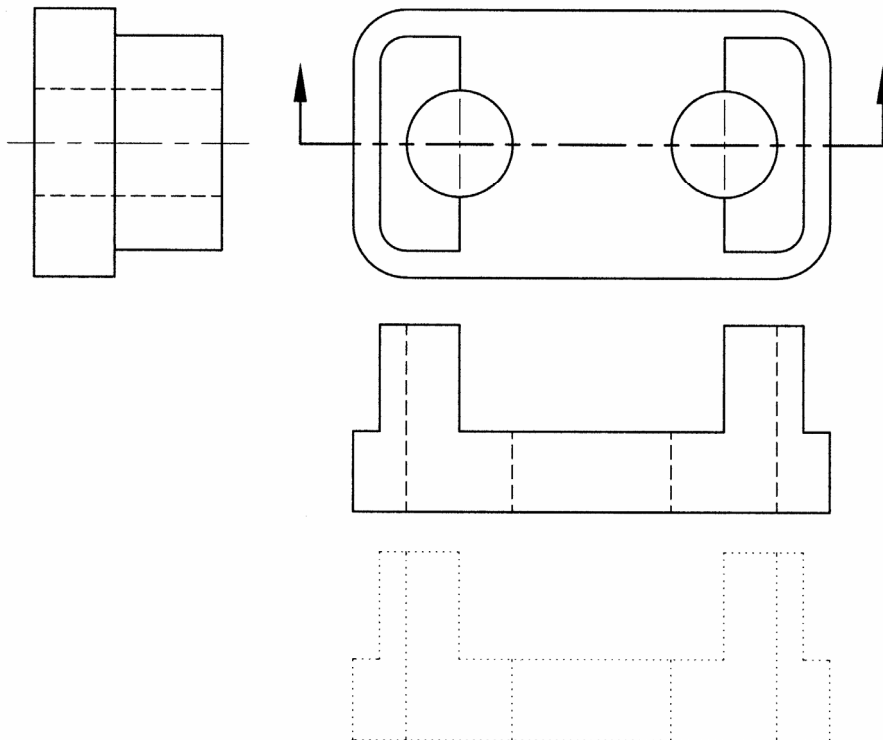


NOTES:

P3-1 c) Material = Cast Iron

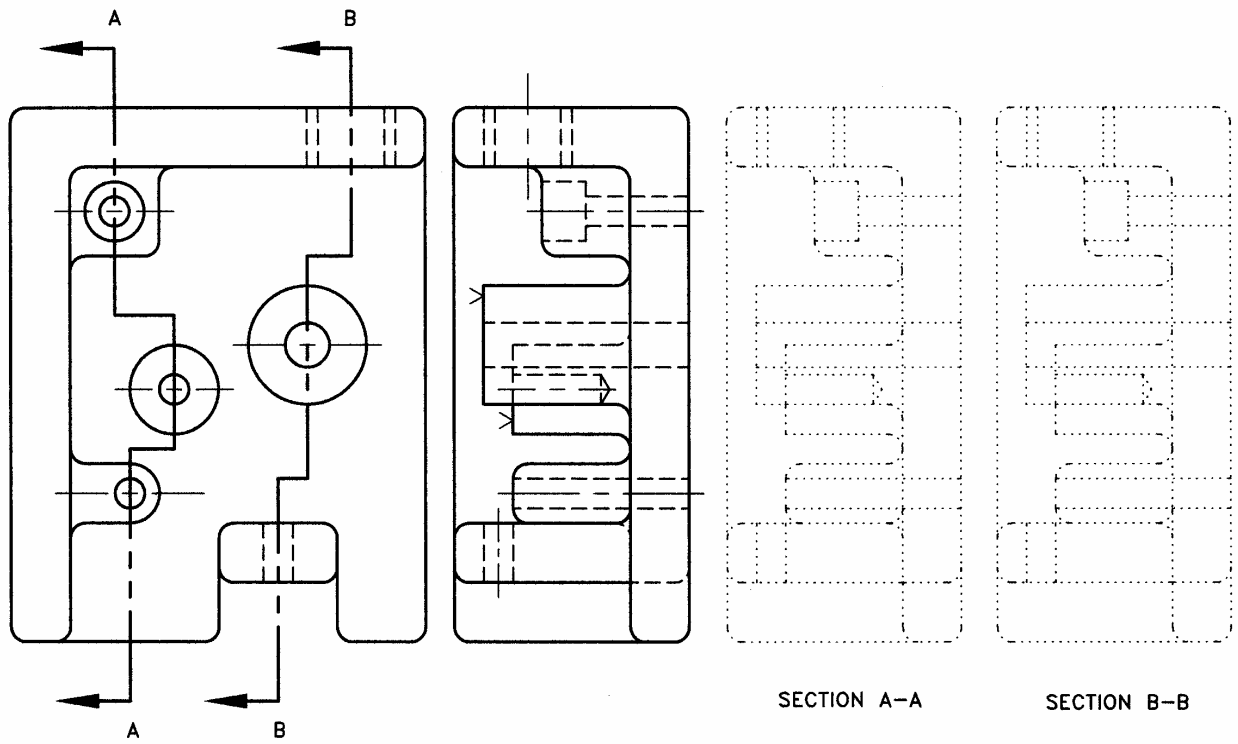


P3-1 b) Material = Plastic

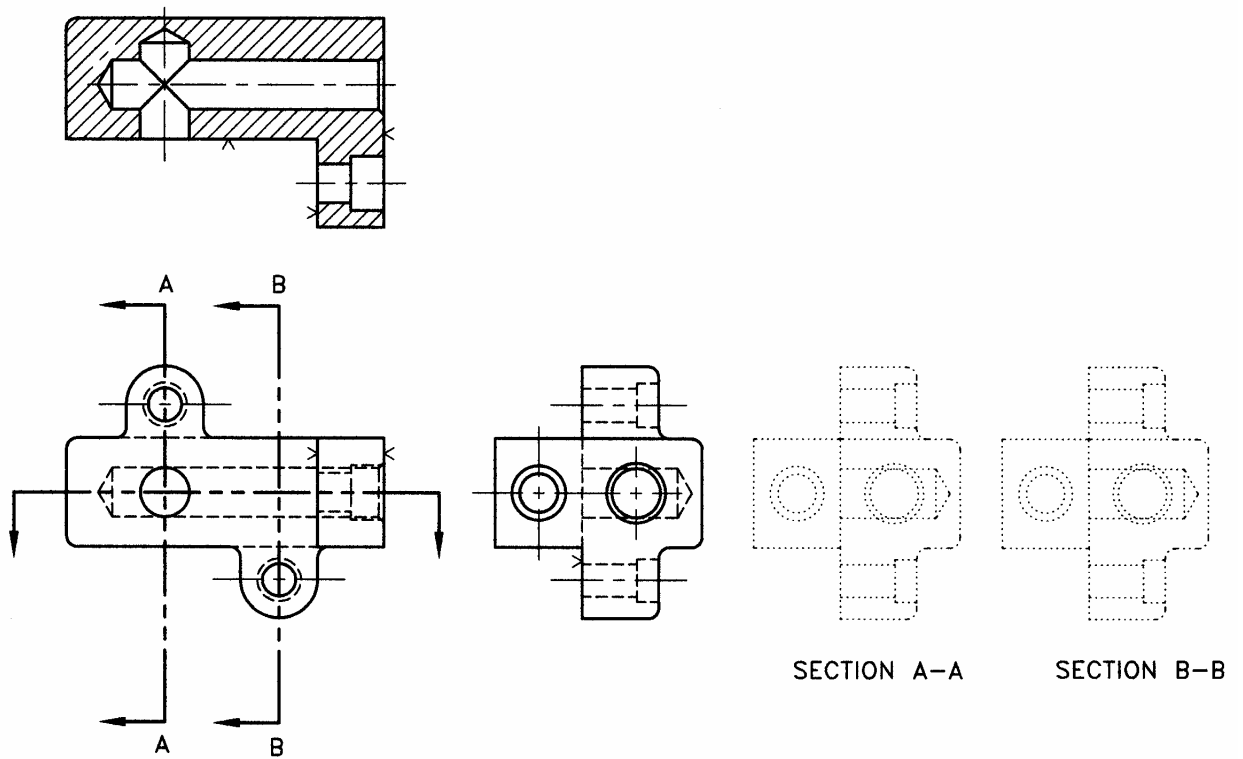


NOTES:

P3-1 d) Material = Cast Iron

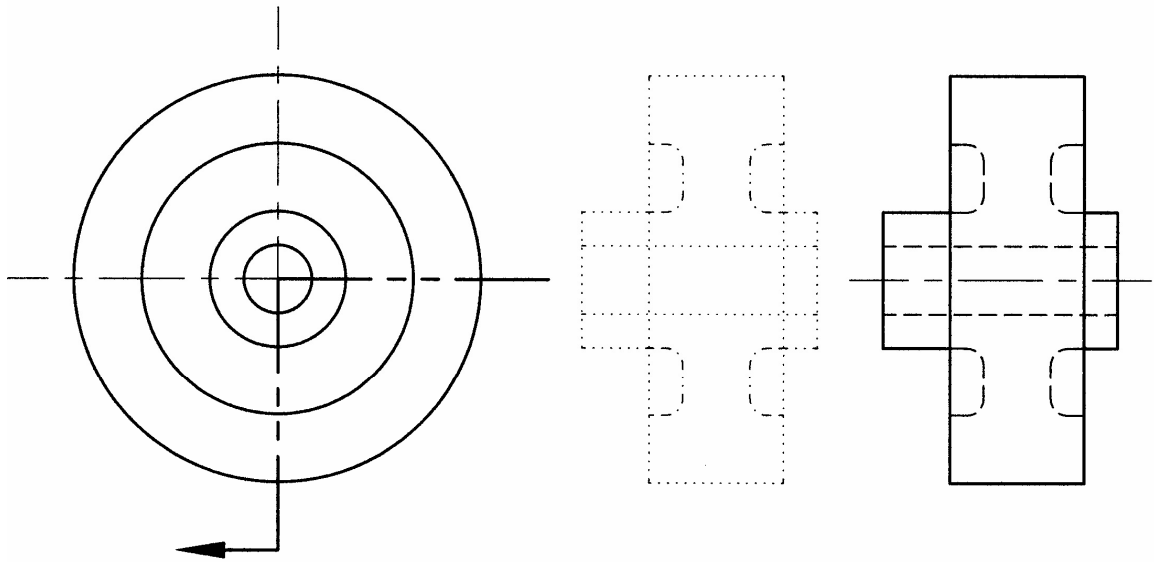


P3-1 e) Material = Cast Iron

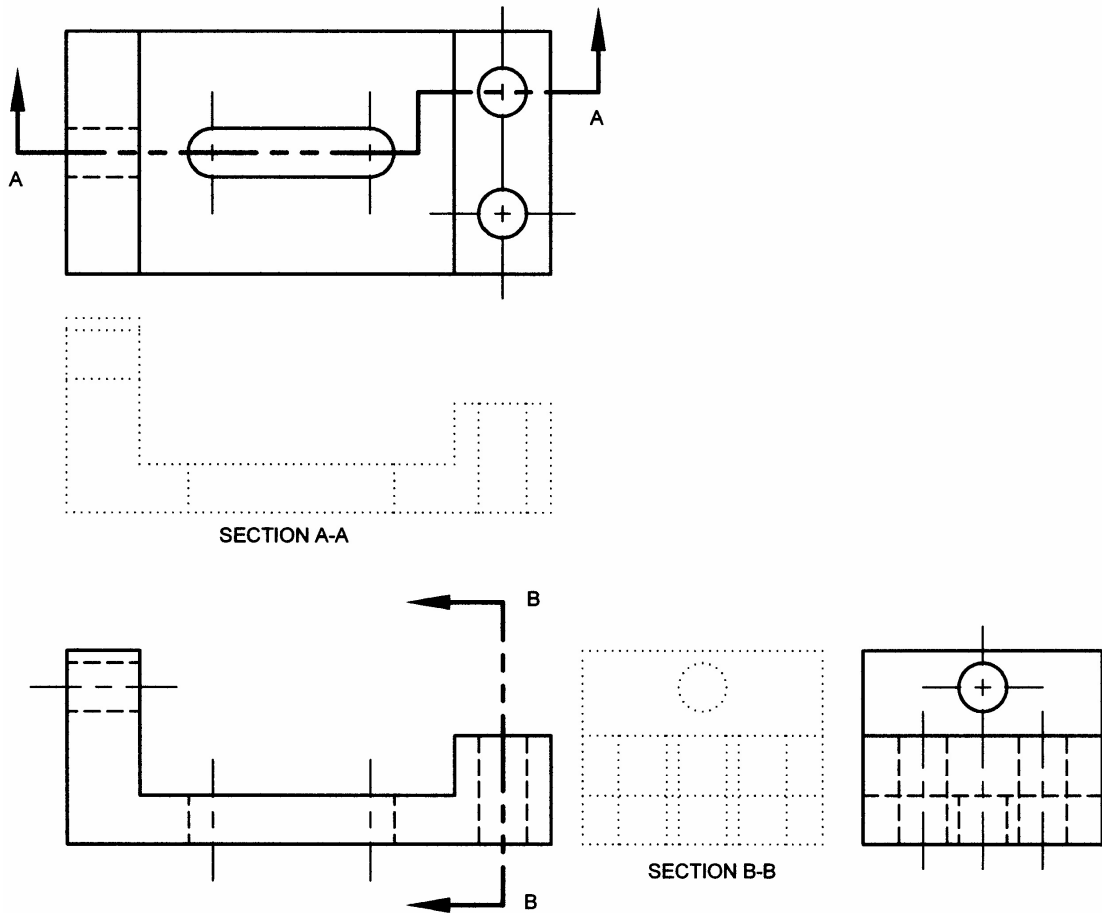


NOTES:

P3-1 f) Material = Brass



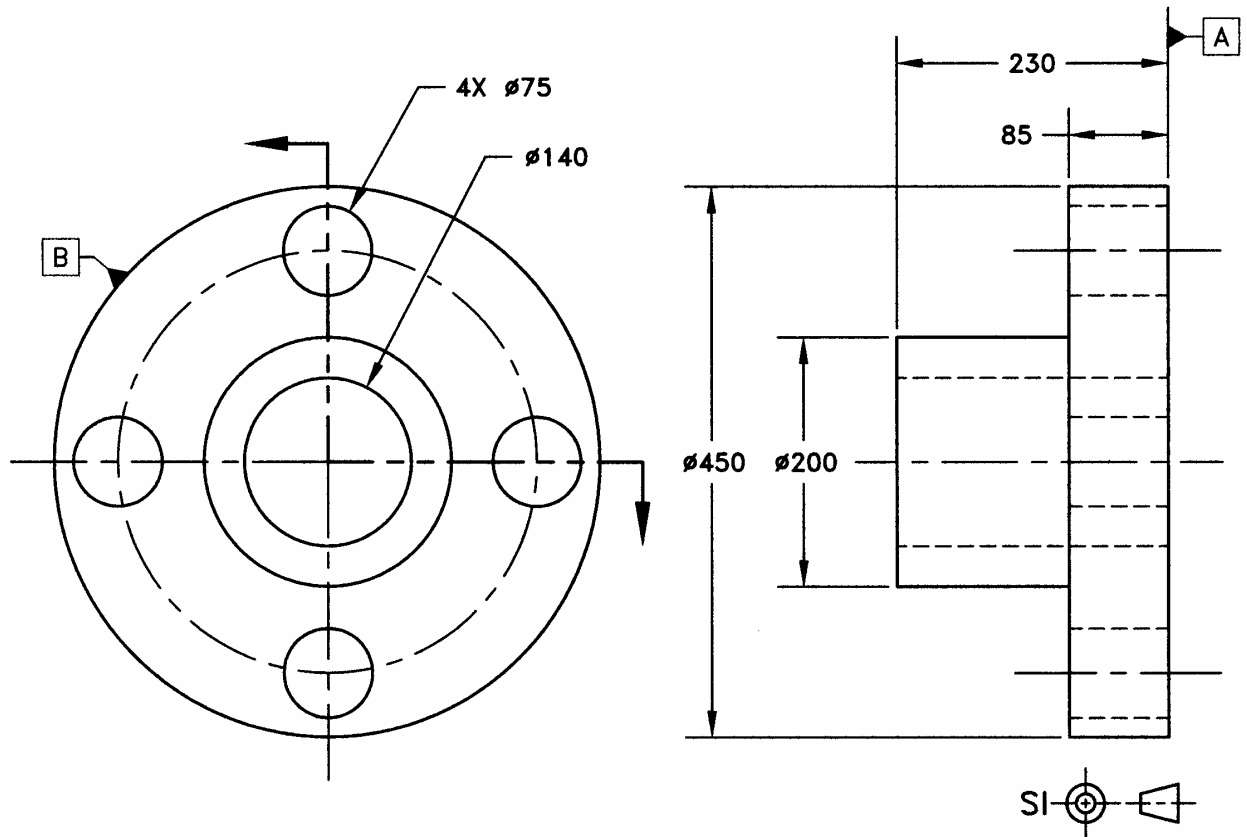
P3-1 g) Material = Steel



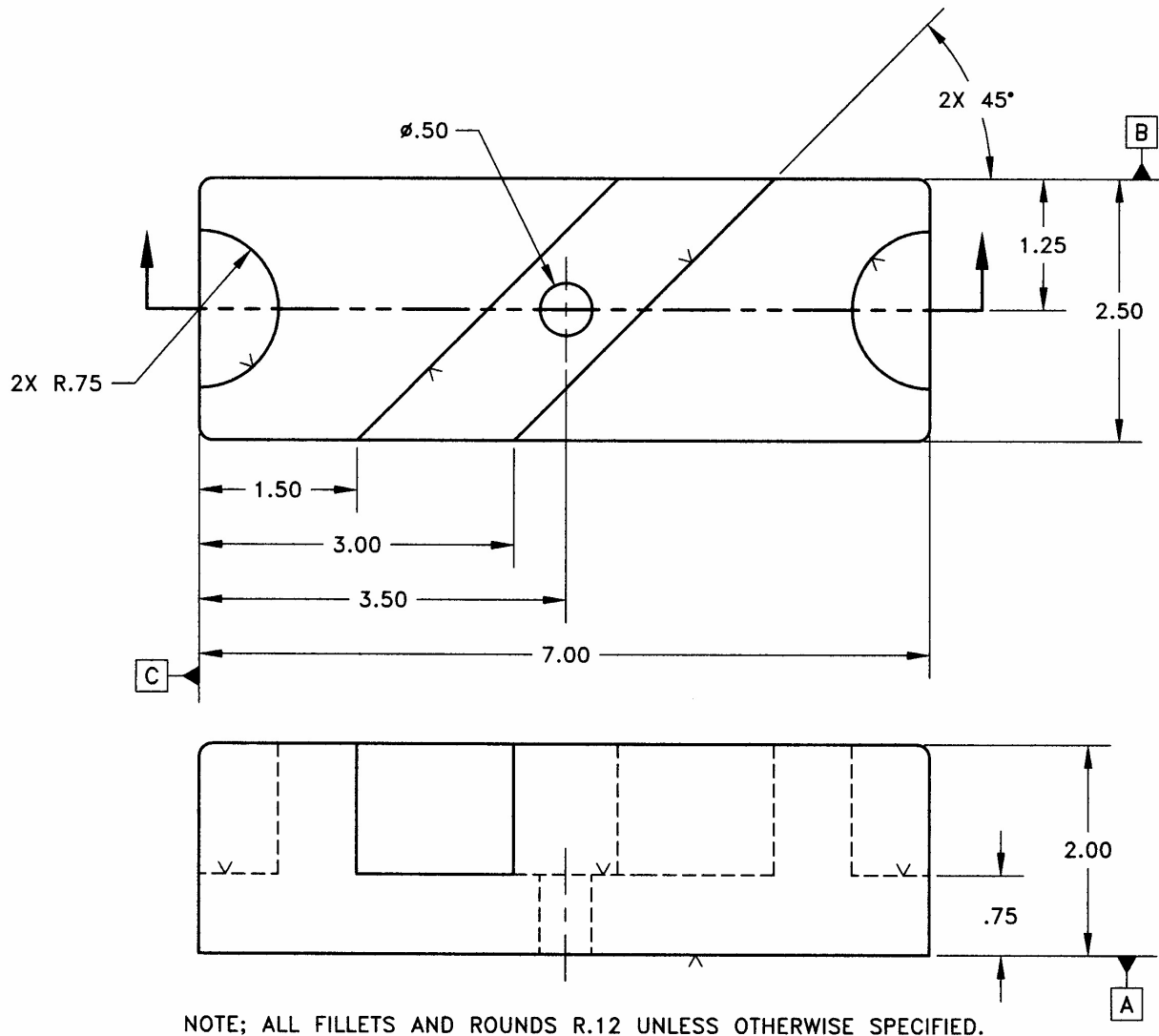
NOTES:

P3-2) Draw the following objects changing the appropriate view into a section. Do not dimension unless instructed to.

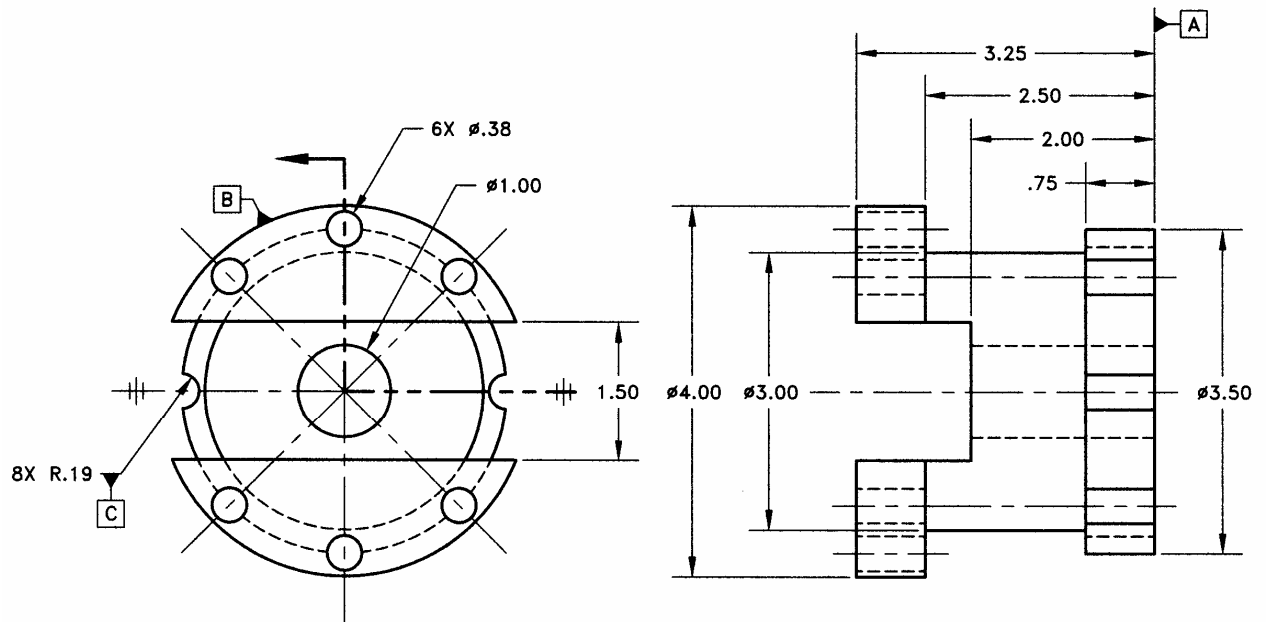
P3-2 a)



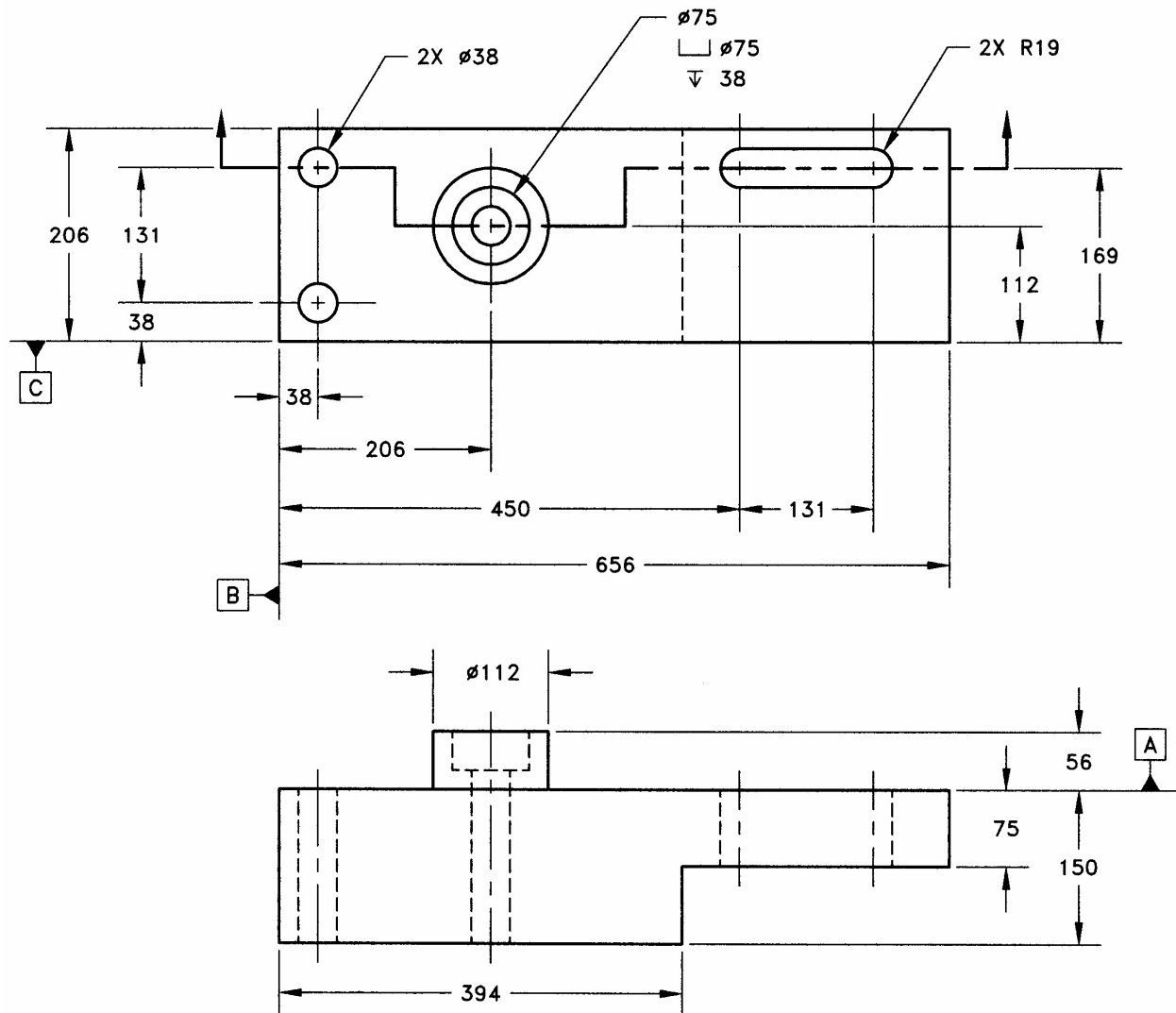
P3-2 b) Material = Cast Iron. Note that without the section view it was necessary to dimension a hidden feature.



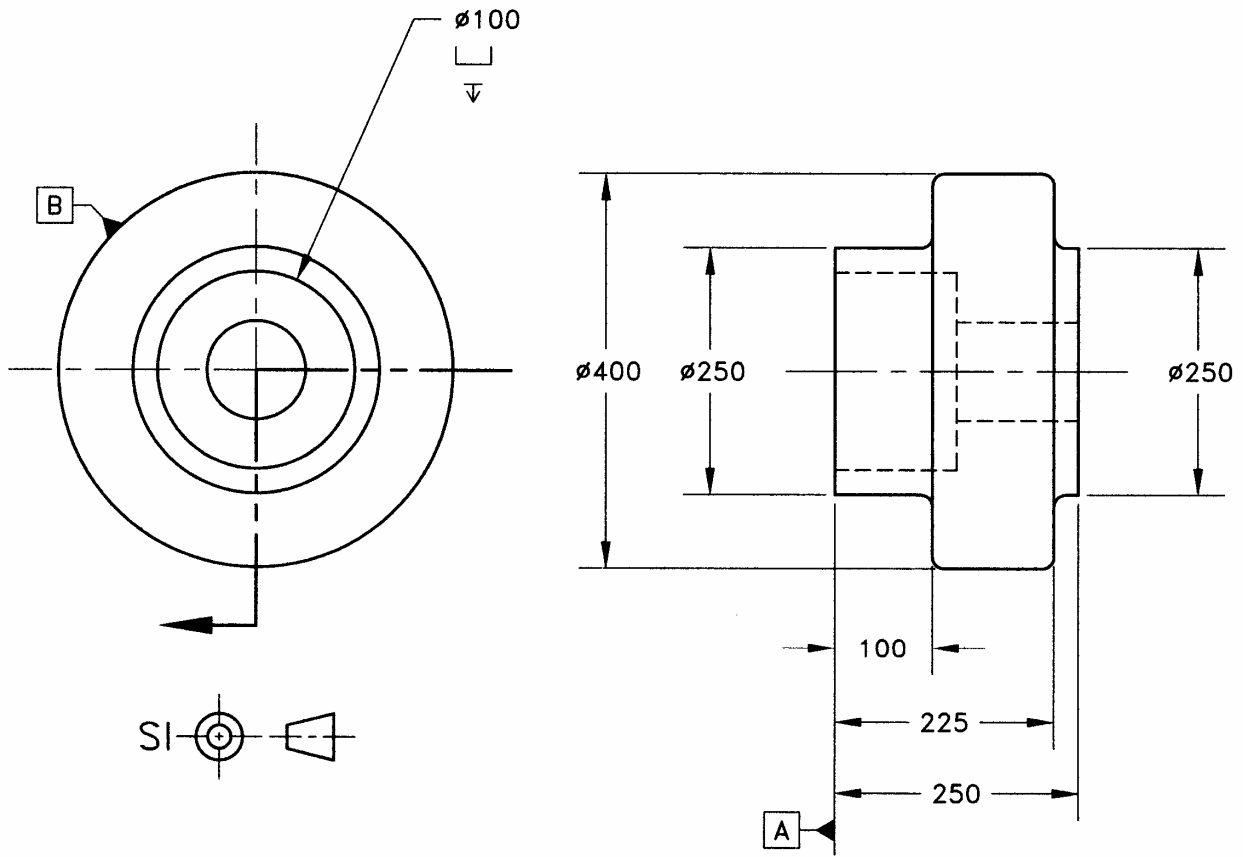
P3-2 c) Material = Aluminum



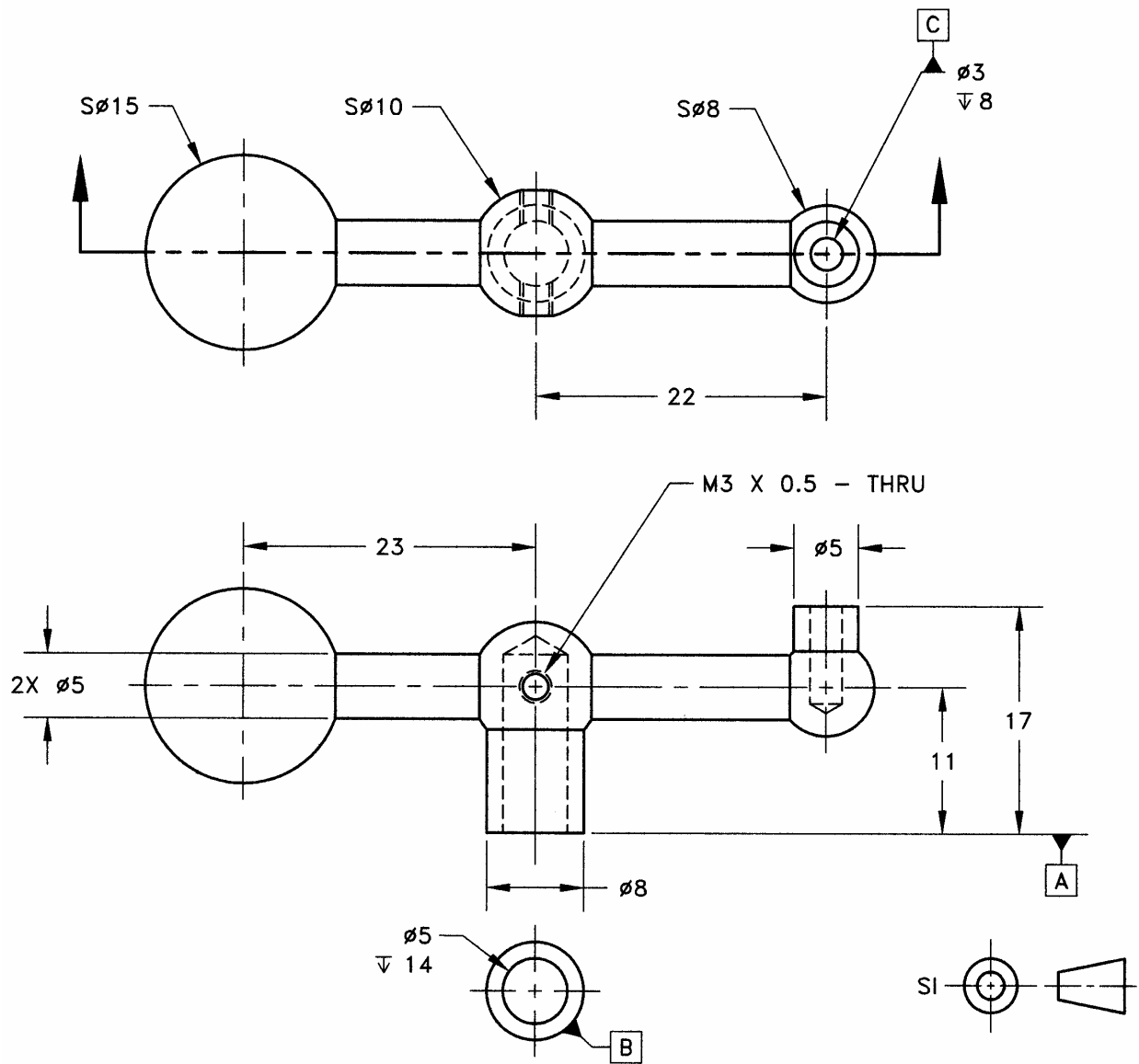
P3-2 d) Material = Steel



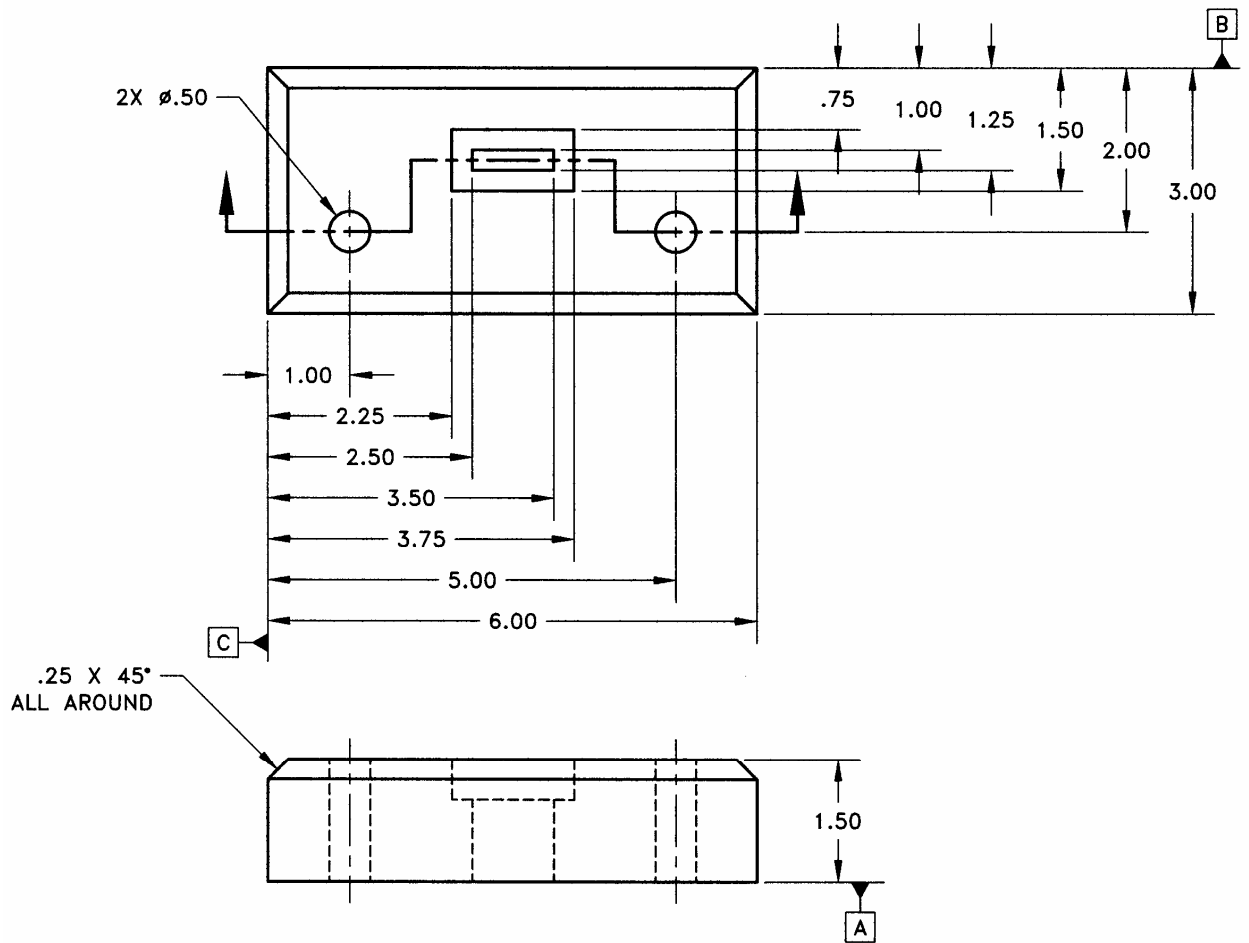
P3-2 e) Material = Aluminum



P3-2 f) Material = Plastic

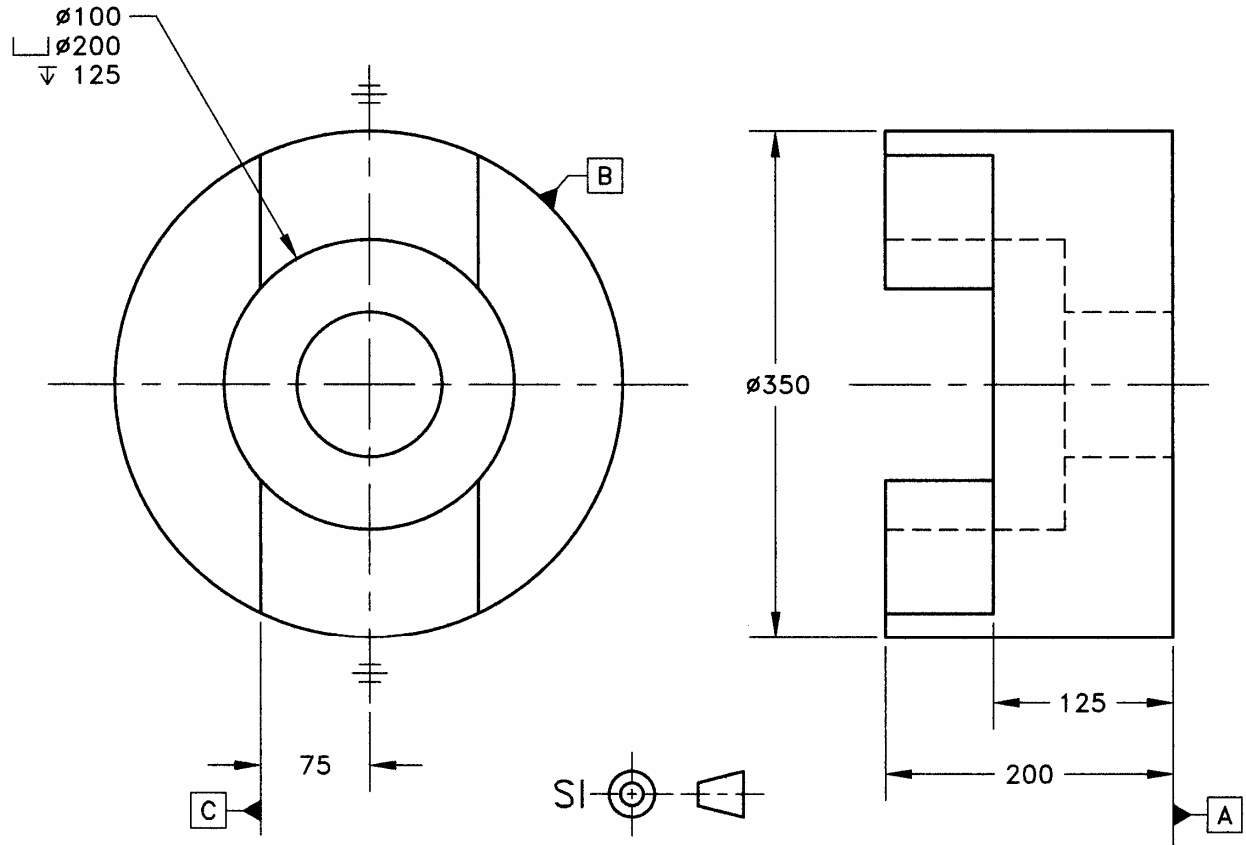


P3-2 g) Material = Steel

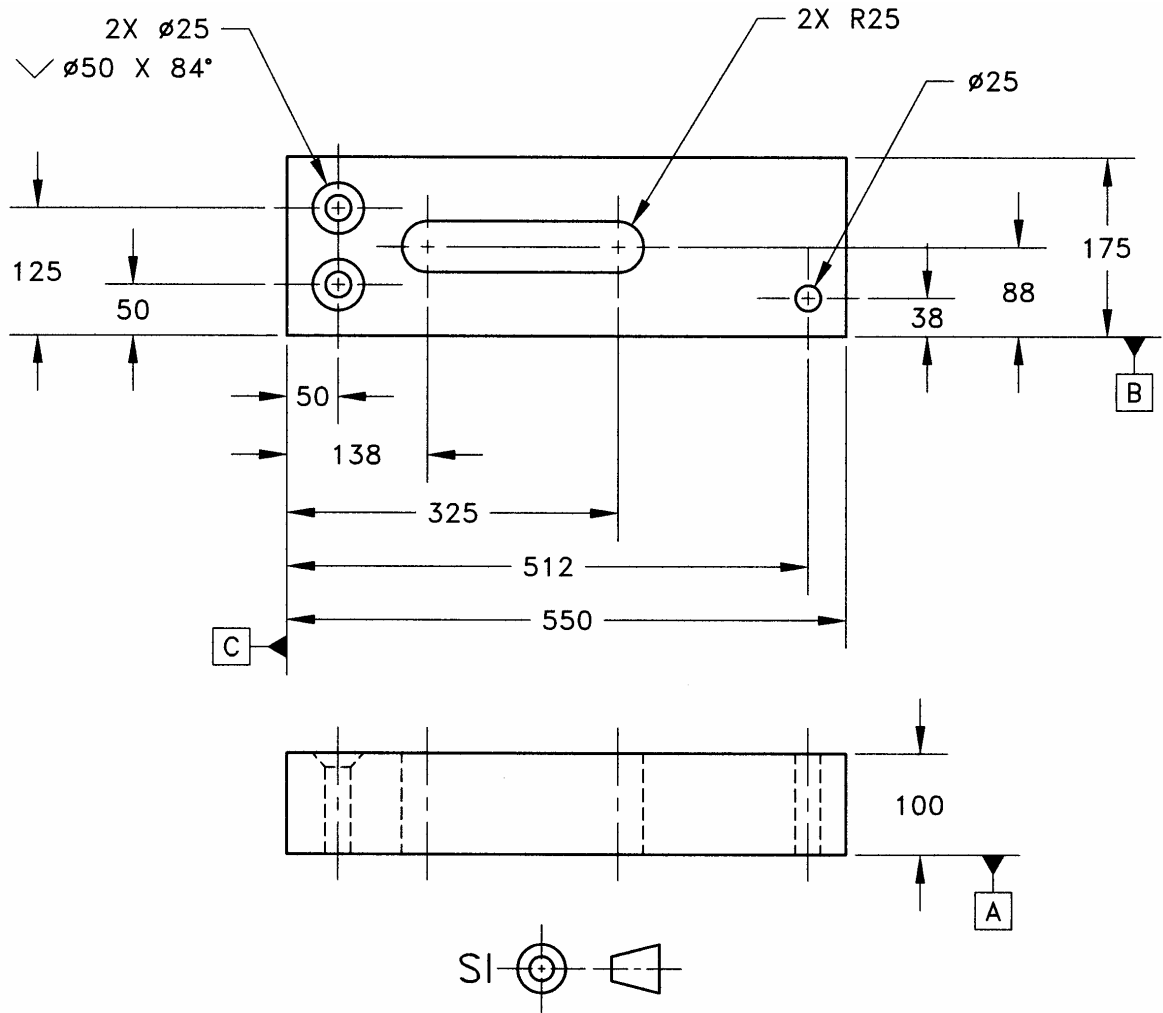


P3-3) Draw the following objects. Make use of the appropriate sectioning technique. Remember to indicate the cut plane. Do not dimension.

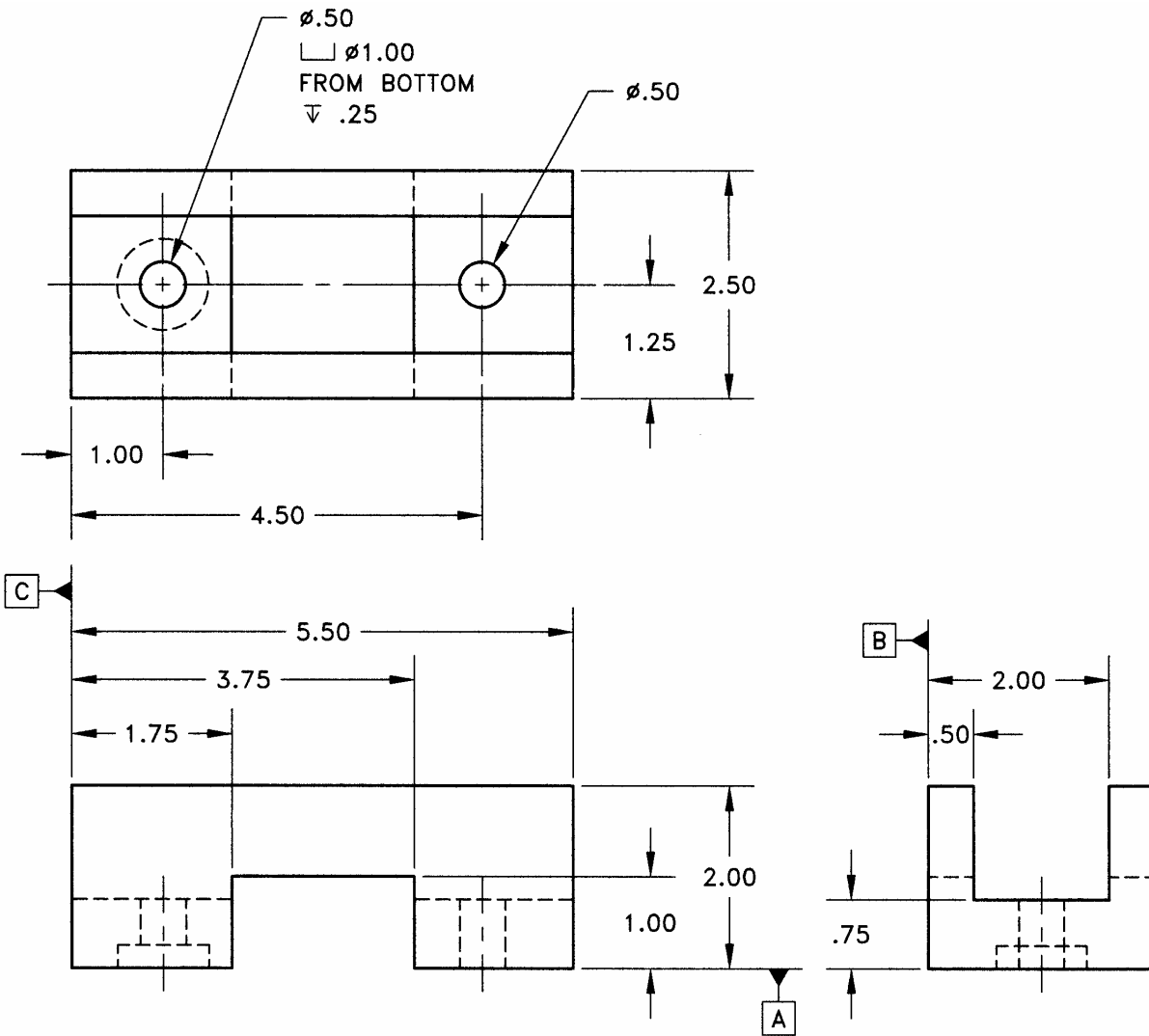
P3-3 a) Material = Steel



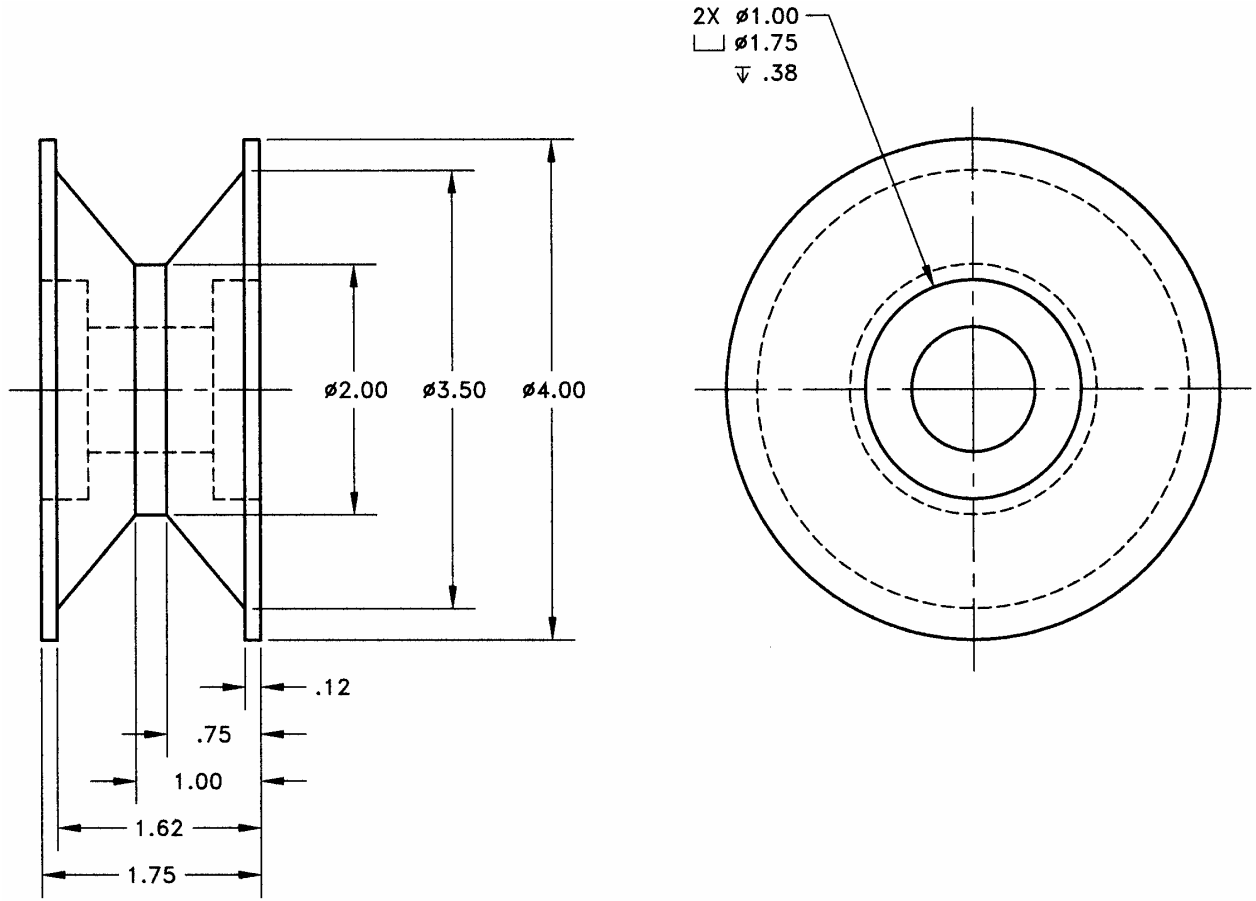
P3-3 b) Material = Aluminum



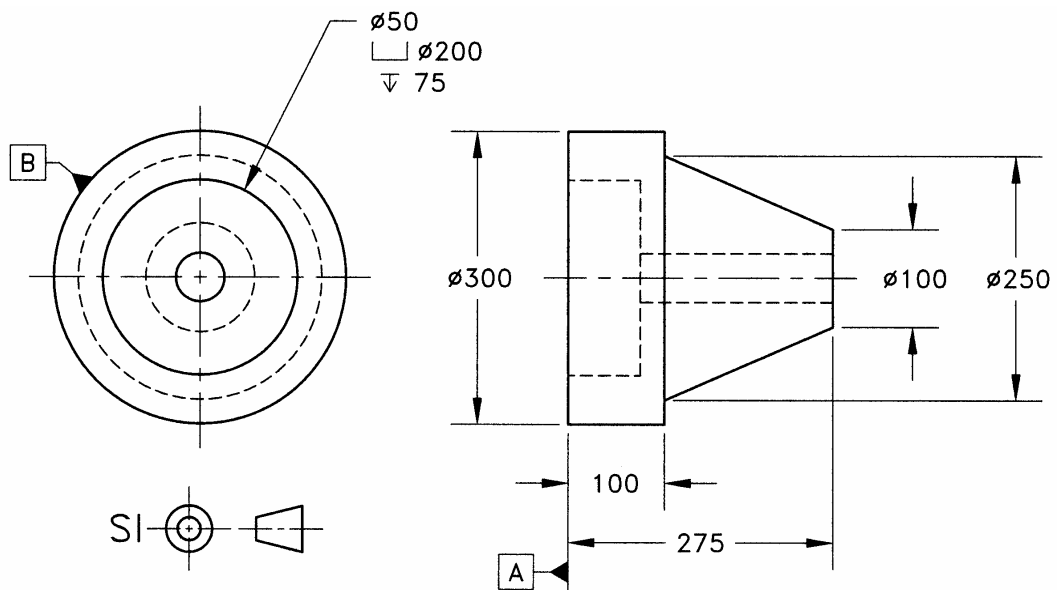
P3-3 c) Material = Steel



P3-3 d) Material = Steel



P3-3 e) Material = Brass



NOTES: