

## UNIT E: Sectional Views

### Competency: D405.00

*Demonstrate the correct techniques for preparing sectional views.*

### Objective: D405.01

*Explain the concepts and principles of sectional views.*

**Introduction:** The purpose of a section is to show interior detail or space. By means of a limited number of carefully selected views, the external features of the most complicated designs can be fully described. However, we often need to show interiors that cannot be illustrated clearly by hidden lines. We show such interiors by slicing through the object much as we cut through an apple or melon. A cutaway view of the part is then drawn; such views are called **sectional views**, **cross sections**, or simply **sections**.

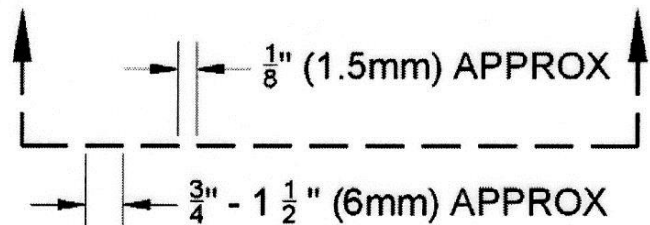
To produce a sectional view, a **cutting plane** is assumed to pass through the part. The cutting plane is then removed, and the two halves are drawn apart, exposing the interior construction. In which case, the direction of sight is towards one half of the object. The other half is then mentally discarded.

Drafters use sectional views to improve the clarity of complex objects when internal surfaces result in too many hidden lines. Special conventions are used to make a sectional view easy to understand. Creating a sectional view with CAD can be a complicated operation. Understanding thoroughly the concepts of sectional views will help the drafter create the drawing with the CAD software.

*References R1(199-228);R2(276-315);R3(252-273)*

### Sections - Explain the following:

- A. The purpose of a section is to show interior detail or space of an object or entity.
- B. Identify and explain the following concerning **cutting plane lines** (see Figure 1):
  1. Cutting plane lines are used to indicate where the section or cut is made.
  2. Arrowheads on a cutting plane line indicate the direction of sight.
  3. The two most commonly used cutting plane lines are:
    - a. A heavy line of alternating long dashes ( $3/4''$  to  $1\ 1/2''$ ) with a pair of short dashes ( $1/8''$ ) long.
    - b. Uniform length dashes ( $1/4''$ ) with uniform spacing between.
- C. Identify and explain the following concerning section lines (see Figure 2):



*Figure 1. Cutting-Plane Line.*

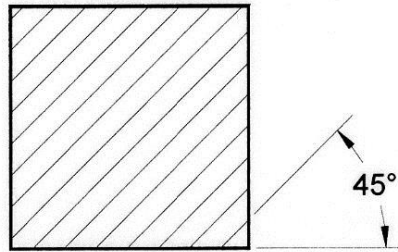


Figure 2. Section Lines.

1. Section lined areas represent materials that have actually been in contact with the cutting plane line.
2. The general universal section line symbol is uniformly spaced at 45 degrees.
3. Instead of using section lines, parts may be shaded with a solid fill or hatch.
4. Outline sectioning may be used along the perimeter of very large areas.
5. Do not draw section lines parallel or perpendicular to visible edges.
6. Vary the angles of section lining for individual parts for mating objects or when objects are shown in an assembly drawing.
7. Various material section line symbols can be used to represent different parts that are adjacent and/or joined together.
8. Section lines should be thin to contrast with visible lines.
9. The spacing between section lines should be uniform. However the amount of the space may be varied to fit the size of the drawing or the area being hatched.
10. Capital letters are used at the end of the arrowheads when necessary to identify the cutting plane with the section view.
11. In CAD, crosshatching or section lines can be created with the BHATCH or HATCH command.
12. When using CAD, you must create a closed area to allow for the hatching to fill. These closed areas are called boundaries.
13. In CAD, if you choose the ASSOCIATIVE hatching setting, once boundaries have been set and an area has been hatched, if you stretch the object, your hatching will also adjust to your new boundaries.
14. In CAD, if you choose the NON-ASSOCIATIVE hatching setting, and your boundaries have been set and an area has been hatched, if you stretch the object, your hatching will remain and will not adjust to your new boundaries.
15. In CAD, when an area has been hatched, the hatch takes on the characteristics of a BLOCK.
16. In CAD, if your hatch angle is set to 0 degrees, the resulting hatch lines will be at an angle of 45 degrees.
17. In CAD, the spacing of the hatch is determined by the **scale** of the hatch.
18. According to the American National Standards, section lines can be spaced from about .03" (1.0mm) to .12" (3.0mm).
19. Usually, all visible edges behind the cutting plane **should be shown**.
20. In a half section,  $\frac{1}{4}$  of the object is imagined to be cut away.
21. In a full section,  $\frac{1}{2}$  of the object is imagined to be cut away.
22. Two good reasons for using "partial views" are
  - a. To save drawing space
  - b. To save drafting time

D. Identify and explain the following types of sections:

1. **Full Sections** (Figure 3).

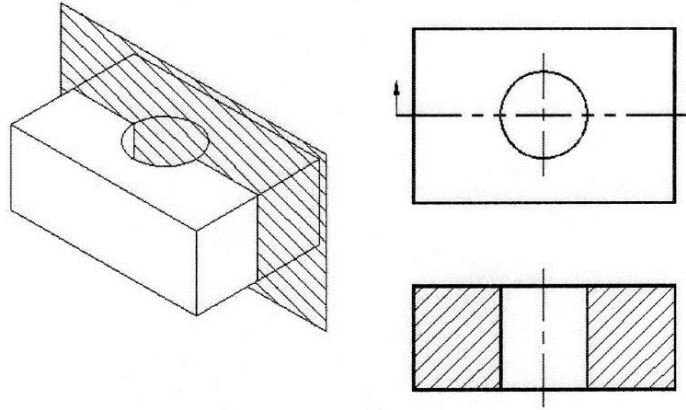


Figure 3. Full Section.

- a. The sectional view obtained by passing the cutting plane fully through the object is called a **full section**.
- b. The arrows at the end of the cutting plane line indicate the direction of sight for the sectional view.
- c. The cutting plane line may be omitted if the view is in orthographic position.
- d. All visible edges and contours behind the cutting plane should be drawn; otherwise, a section will appear made up of disconnected or unrelated parts.
- e. Hidden lines should be omitted in sectional views. In most cases, they add to confusion on a drawing. However, hidden lines may be used if necessary for clarity, or if reduce the need for an additional view.
- f. Section-lined areas are to be completely bound by visible lines-never by a hidden line.
- g. Never allow a visible line to cross over a section-lined area.

2. **Half Sections** (Figure 4).

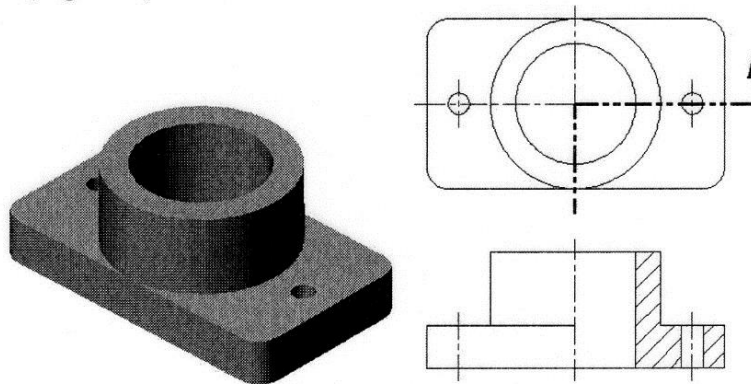


Figure 4. Half Section.

- a. If a cutting plane passes halfway through an object, the result is a **half section**.
- b. Shows the internal and external features in the same view.
- c. Two cutting planes are passed at right angles to each other with the cutting plane passing only halfway through the object and one quarter of the object being removed.
- d. Is used when the object is symmetrical.
- e. Hidden lines can be omitted from the unsectioned half by a centerline.
- f. The sectioned half is separated from the unsectioned half by a centerline.

3. **Broken-out Sections (Figure 5).**

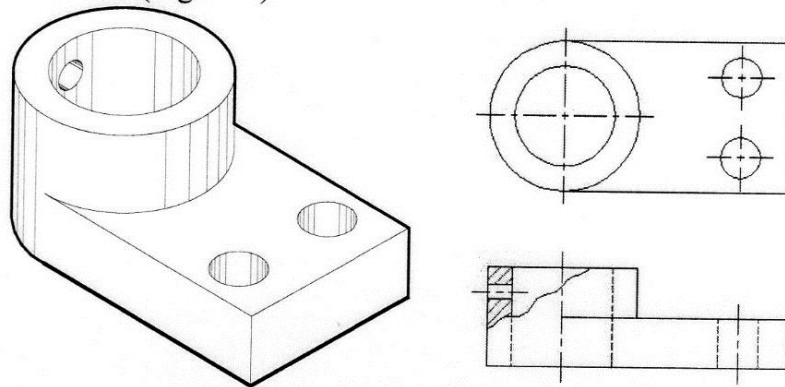


Figure 5. Broken-Out Section.

- a. Broken-out sections are used when only a portion of the object's interior shapes needs to be sectioned.
- b. A broken-out section may be used when a full section or half section is not necessary.
- c. A freehand break line is used to separate the sectioned details from the unsectioned parts.
- d. Hidden lines may be used on the unsectioned portion of omitted if not needed for clarity.
- e. Examples of details requiring a broken-out section are keyways, bolt holes, thread details, etc.

4. **Revolved or Rotated Sections (Figure 6).**

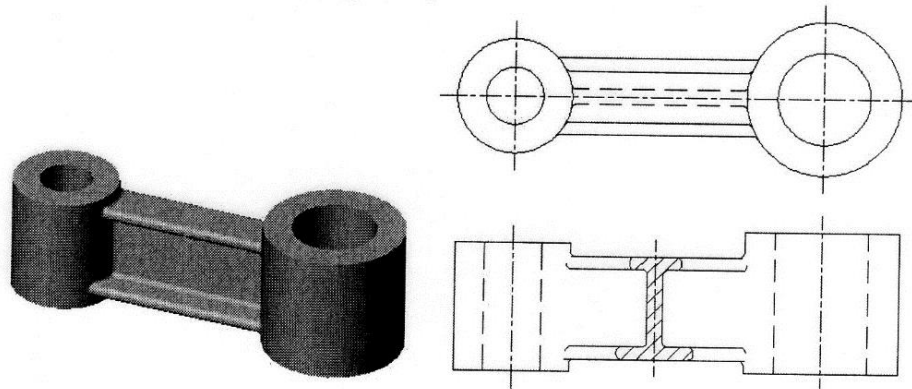


Figure 6. Revolved Section.

- a. Are used to represent the cross sectional shape of a handle, spoke, or other elongated features.
- b. Create the section by cutting through the feature and revolving the section 90 degrees.
- c. Superimpose the sectional view on the orthographic view.
- d. Make the view "stand out" by using short break lines or allow the orthographic lines to touch the sectional drawing.
- e. The cross section is not distorted to fit, but rather is drawn true size and shape unless it is also removed.

5. **Removed Sections (Figure 7).**

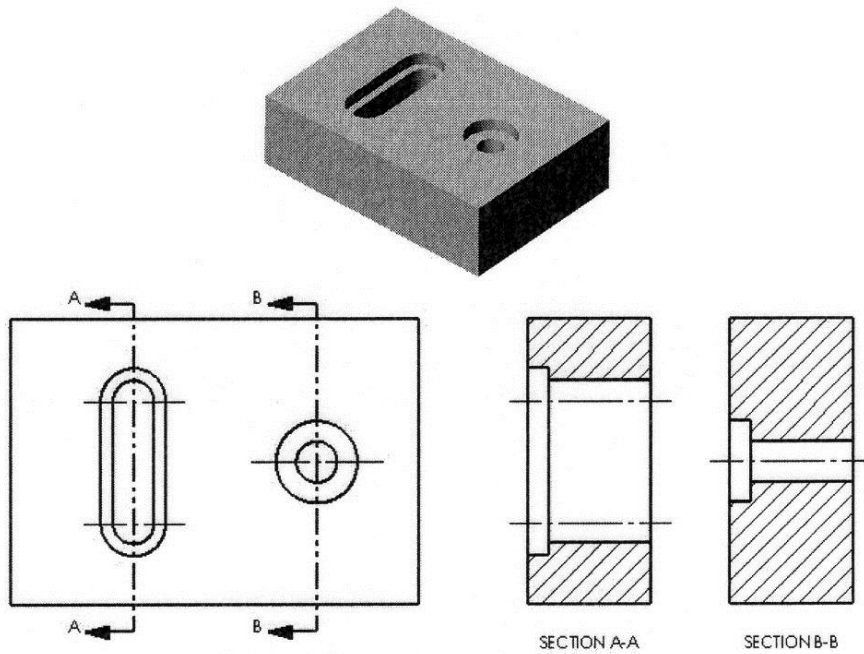


Figure 7. Removed Section.

- a. A removed section is a revolved section that is not superimposed on the orthographic view but rather is placed elsewhere in the drawing.
  - i. May be placed near the location where the section was made.
  - ii. May be moved to another location on the page or another page.
  - iii. Should be placed so that it no longer lines up in projection with any other view.
- b. May be drawn at the same scale as the drawing or at an enlarged scale to show its details more clearly.
- c. Show where the section was made by placing a labeled cutting plane at that location. Also label the sectional drawing to identify it.
- d. Should be labeled, such as SECTION A-A and SECTION B-B, corresponding to the letters at the end of the arrows on cutting plane lines.

6. **Offset Sections** (Figure 8).

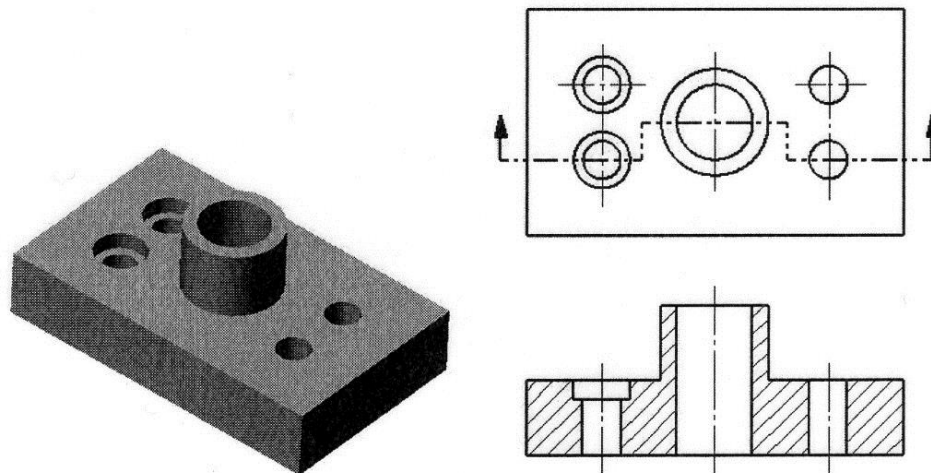


Figure 8. Offset Section.



- a. When sectioning through irregular objects, it is often desirable to show features that do not lie in a straight line by “offsetting” or bending the cutting plane. Such a section is called an **offset section**.
- b. The cutting plane is bent at one or more 90-degree angles so that it will pass through important features.
- c. The change of plane that occurs when the cutting plane is bent 90 degrees is not represented with lines in the sectional view.

7. **Aligned Sections** (Figure 9).

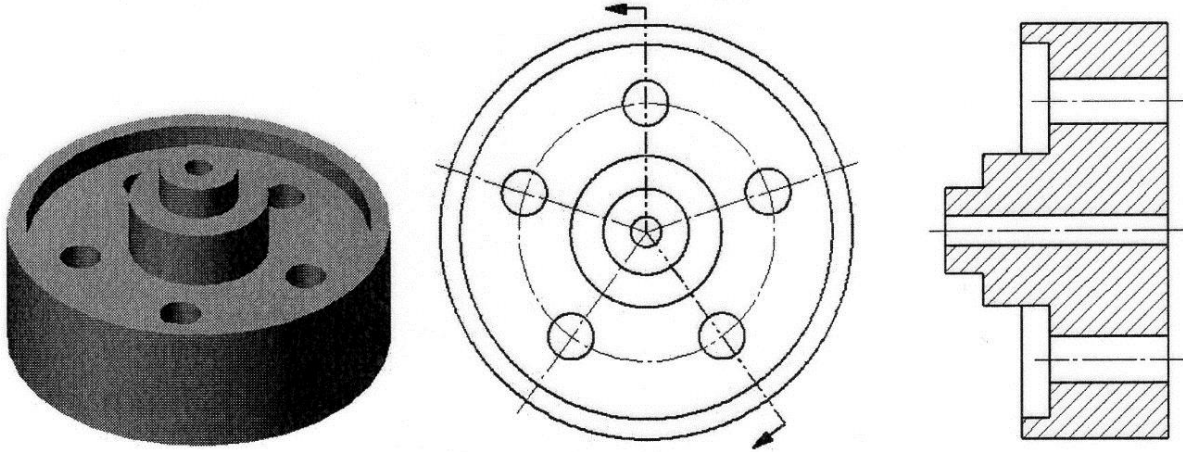


Figure 9. Aligned Section.

- a. Are used to include details of a part by “bending” the cutting plane.
- b. Normally the alignment is done along a horizontal or vertical centerline.
- c. The principles of orthographic projection are violated in order to represent the features more clearly.
- d. Do not revolve features where clarity is not improved.
- e. Identify when ribs, spokes, and webs should be sectioned. To avoid the false impression of thickness and solidity, ribs, webs, gear teeth, and other similar flat features are not sectioned, even though the cutting plane passes along the center plane of the feature.
- f. Identify features that are cut, but not section line.
  - i. Nuts, bolts, screws, keys, pins, rivets, and other fasteners.
  - ii. Ball bearings
  - iii. Shafts
- g. Identify when conventional breaks should be used and describe “breaking” techniques (Figure 10).
  - i. Objects too long to fit on a page at a reasonable scale.
  - ii. Breaks in a solid shaft.
  - iii. Breaks in a hollow shaft.
  - iv. Breaks in rectangular, solid materials.

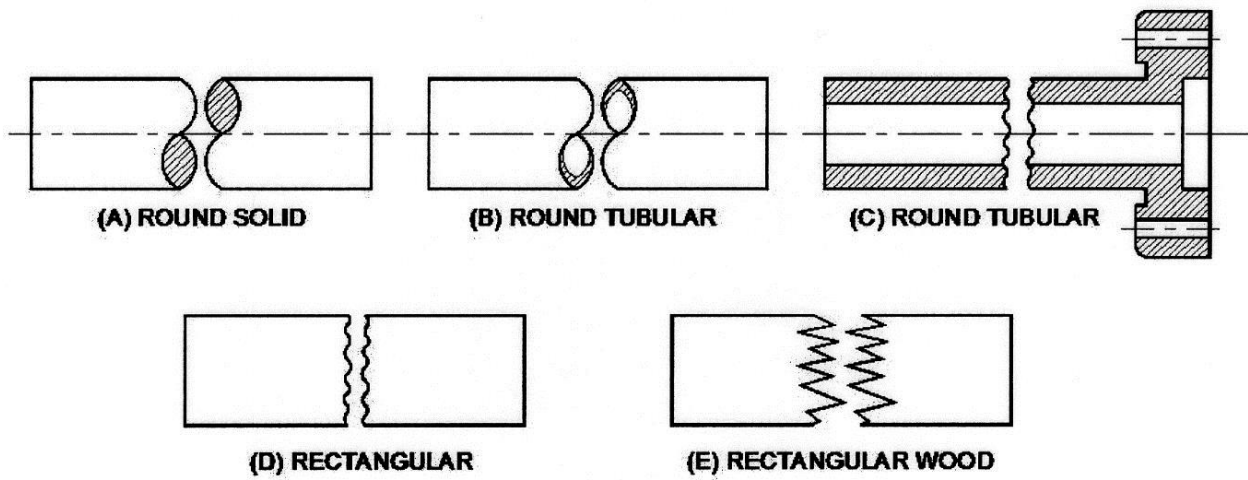


Figure 10. Conventional Breaks.