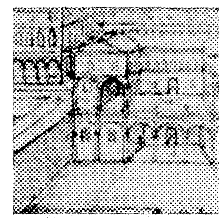
AUXILIARY VIEWS

Chapter 12



LEARNING OBJECTIVES

Upon completion of this chapter you will be able to:

1. Identify the need for auxiliary views in order to show the actual shape, size, and relationship of an angled part feature.
2. Differentiate between and be able to produce primary and secondary auxiliary views using the fold line method and the reference plane method.
3. Solve for the true shape of an angled surface using an auxiliary view.
4. Produce partial, broken, half, and sectional auxiliary views.
5. Discern two- and three-dimensional CAD capabilities to generate auxiliary projections.

12.1 INTRODUCTION

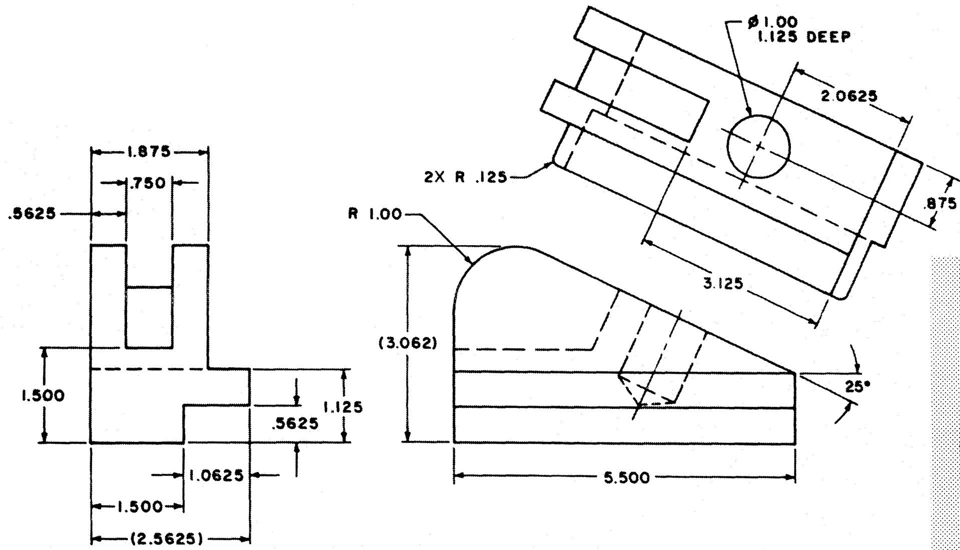
Auxiliary views show the true shape/size of a feature or the relationship of part features that are not parallel to any of the principal planes of projection. The basic method of multiview drawing, described in Chapter 10, is adequate to draw parts composed of horizontal and vertical surfaces and for parts with simple inclined features. However, many parts have inclined surfaces and features that cannot be adequately displayed and described through principal views alone. To provide a clear description of these features, it is necessary to draw a view that will show them true shape/size.

The anchor in Figure 12.1 has an inclined surface that cannot be seen in its true shape in a principal view. The detail of the part uses a front view, a left side view, and an auxiliary view to show the inclined surface and the hole's true shape/size. The shaded image pictures the angled surface and the hole.

Besides showing features true size, auxiliary views are used to dimension features that are distorted in principal views and to solve graphically a variety of engineering problems. *Auxiliary views enable you to check the interference between two parts or clearances between pieces of an assembly.* In these cases, the view may or may not display the true shape of an inclined surface, depending on the part's features and the view direction selected.

12.1.1 Selection and Alignment of Views

The proper selection of views, view orientation, and view alignment is determined by a part's features and its natural or assembled position. Normally, the front view is the primary view, and the top view is obvious based on the position of the part in space or when assembled. The choice of additional views is determined by the part's features and the minimum number of views necessary to describe the part and show its dimensions. The detail of the anchor in Figure 12.1 required three views: front, left side, and auxiliary; the top view was not needed. The detail of the



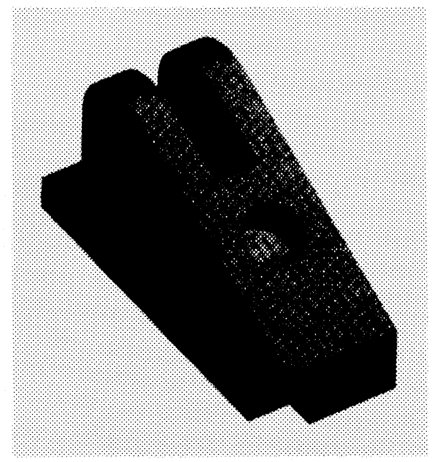


FIGURE 12.1 Detail of Anchor Showing Auxiliary View, Along with Shaded Image

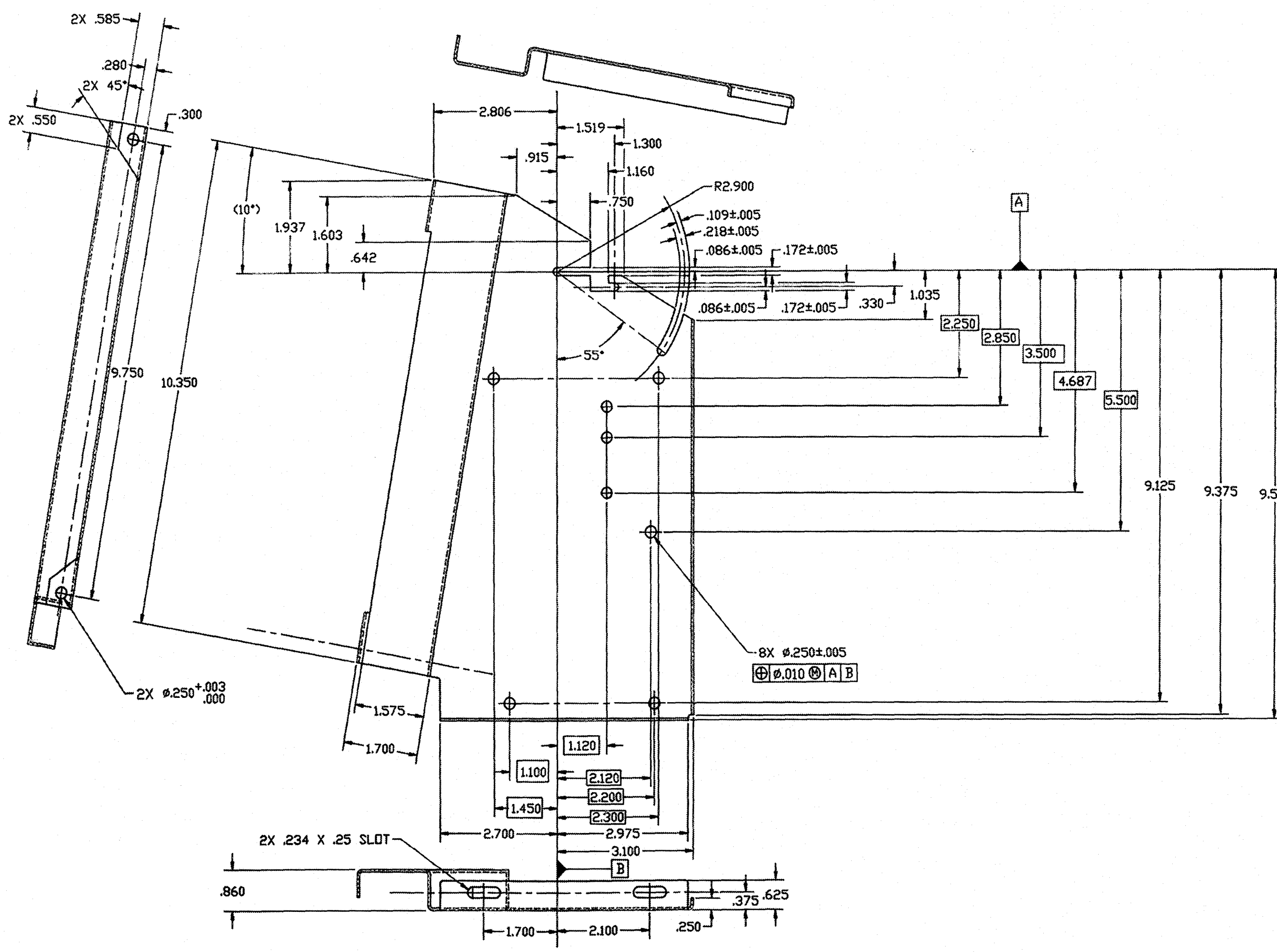


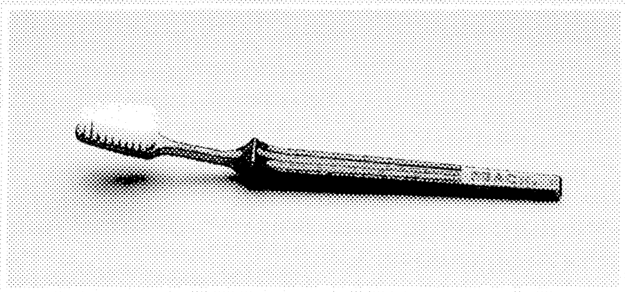
FIGURE 12.2 Bracket Detail with Two Auxiliary Views

Focus On . . .

HAND TOOLS AND DEVICES

There is evidence that hand tools and other devices were used by primates nearly a million years ago. It could be assumed that hand tools, after evolving with mankind for a million years or so, would now be specifically adapted for human use. In fact, this is not the case. Until recently, human biomechanical factors have been mostly ignored in the design of hand tools.

The human hand and wrist are complex structures of bones, nerves, ligaments, tendons, and arteries. Movement of the wrist occurs in two planes. The hand is flexed up and down in the first plane. Side-to-side movement, or ulnar deviation, occurs in the second plane. Continued use of tools that call for motions along these planes can injure the hand and wrist.



Ergonomically designed toothbrush.

Recent studies have shown how to design tools that avoid these types of motion. Using x-rays of the wrist and computer-generated wireframe auxiliary models, designers are able to configure tools that require a relatively straight wrist motion. For example, by bending or rotating the handle of a pair of pliers or a hammer about 19°, grip strength is increased while fatigue is reduced. This bent-handle design is now found in softball bats and is approved for regulation play. Golf clubs and fishing rods also incorporate this technology into their designs.

The most common hand-held device is probably the toothbrush. The only major development since it was introduced in 1780 was nylon bristles, which replaced hog hair in the 1930s.

Johnson and Johnson, Inc., designed a new toothbrush based on human-factor and time-motion research data. Prototypes were developed with different handle shapes and bristle head rotations. These prototypes were tested, and the optimal features found from the testing were incorporated into the final design. The result was the Reach toothbrush, which has a small, bilevel bristle head in an angled, countered handle for easier handling, better gum stimulation, and better plaque removal.

The new toothbrush is one example of design with human factors. Future tool designs will require these research studies to produce hand tools specifically adapted for human use. Without auxiliary views, projections, and models, none of this would have been possible.

bracket in Figure 12.2 shows the front view, the bottom view, and two auxiliary views.

As with all multiview drawings, auxiliary views are aligned with the views from which they are projected. In many cases, a centerline or a projection line continues between adjacent views to indicate the proper alignment (Fig. 12.3).

12.2 AUXILIARY VIEWS

Any view that lies in a projection plane other than the horizontal (top), frontal (front), or profile (side) plane (or a plane parallel to one of these three—bottom, back, opposite side) is an **auxiliary view.** This type of projection is essential if the part to be drawn is complex and has a variety of lines or surfaces that are not parallel to one of the three principal planes.

Auxiliary views are classified by the view from which they are projected. **Primary auxiliary views** are projected from one of the principal views. A primary auxiliary view is perpendicular to one of the three principal planes and inclined to the other two. **Secondary auxiliary views** are projected from a primary auxiliary view and are inclined to

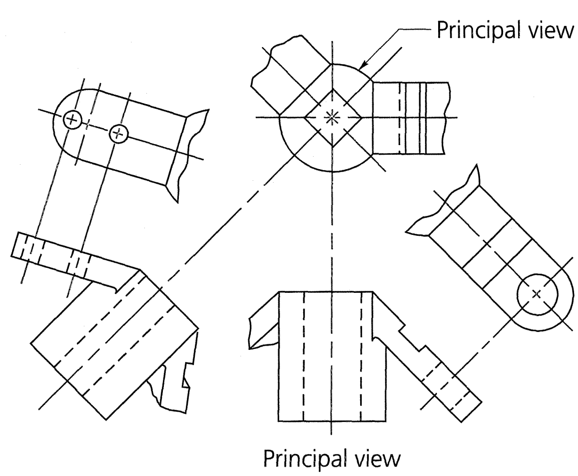


FIGURE 12.3 Principal and Auxiliary Views of a Part

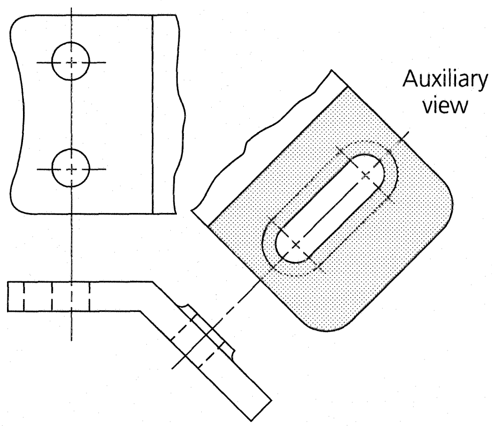


FIGURE 12.4 Full Front View, Partial Top View, and Partial Auxiliary View of a Simple Part

all three principal planes of projection. **Successive auxiliary views** are projected from secondary auxiliary views.

In most cases, only **partial auxiliary views** are constructed, as in Figure 12.4, where only the features that appear true shape are drawn. Features that appear distorted are left off the view or are shown partially and cut off using break lines. In Figure 12.4, the top view is also a partial view.

12.2.1 Primary Auxiliary Views

A **primary auxiliary view** is one that is adjacent to and aligned with one of the principal views. A primary auxiliary view is identified as **front-adjacent, top-adjacent,** or **side-adjacent** to indicate the principal view with which it is aligned (and projected from). In industry, auxiliary views show aspects of a mechanical part or portions of a system such as piping configurations or structural bracing that cannot be adequately represented in the three principal views. The machined block shown in Figure 12.5 required auxiliary views to clarify the shape of the angled surfaces and the positions of the holes and the slots. For this part, the three principal views (top, front, side) do not provide true-shape/size views of each surface. It is necessary to project three primary auxiliary views to describe the angled surfaces in detail.

Primary auxiliary views are divided into three types, depending on the principal view from which they are projected. Primary auxiliary views projected from the top (top-adjacent) view are **horizontal auxiliary views.** Primary auxiliary views projected from the front (front-adjacent) view are **frontal auxiliary views.** Primary auxiliary views projected from the side (side-adjacent) view are **profile auxiliary views.** These three types are represented in Figure 12.5. Here, auxiliary view A is projected from the top (horizontal) view, auxiliary view B is projected from the front (frontal) view, and auxiliary view C is projected from the side (profile) view. The auxiliary projections in this figure are partial views, showing only the inclined surfaces as true shape. This is normal industry practice, since the projection of the total part not only would add little to an understanding of the part's configuration, but might actually confuse the view. For the same reason, hidden lines that fall behind the true-shape surface in an auxiliary view can normally be eliminated for the same reason.

Each primary auxiliary view, besides being projected from one of the three principal views, will have one dimension in common with at least one other principal view. The height dimension (*H*) in the front view is used to establish the limits of auxiliary view A. The depth (*D*) of the part can be found in the top view (and side view) and establishes dimension *D* in auxiliary view B. Dimension *A* in auxiliary view C is taken from the view where the width of the slot is drawn true size (the front view).

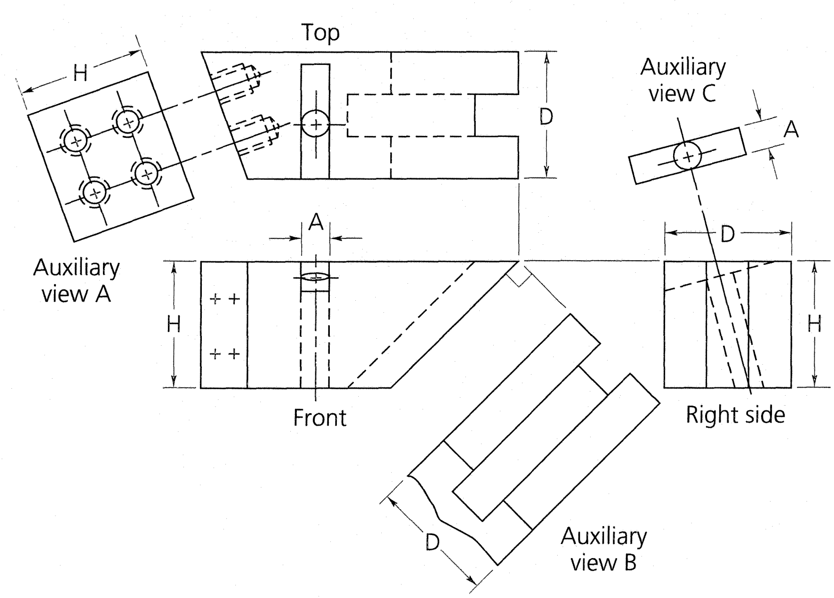
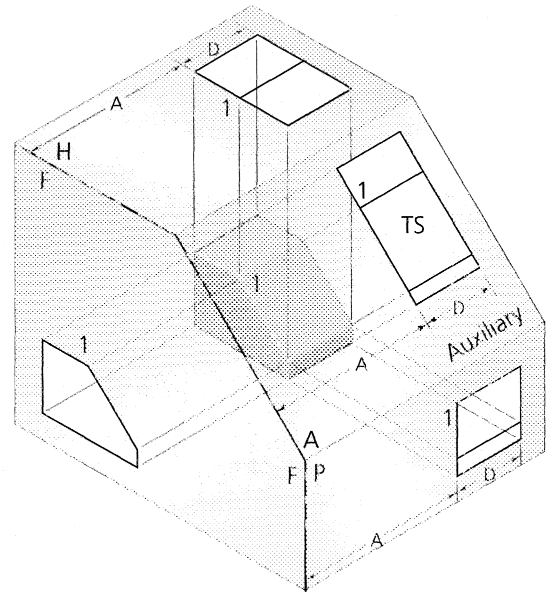
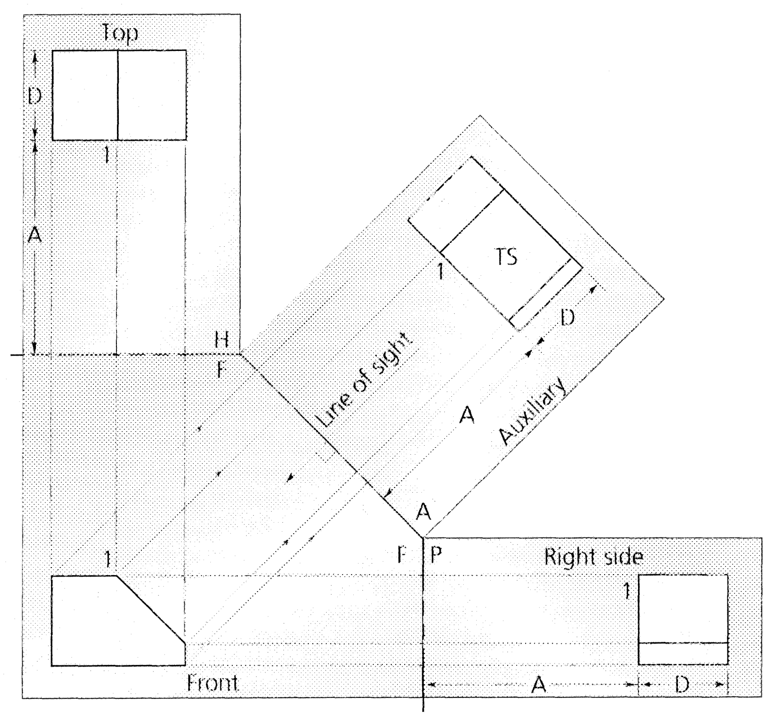


FIGURE 12.5 Auxiliary Views

FIGURE 12.6 Auxiliary View Projection from the Front View



(a) Glass box method



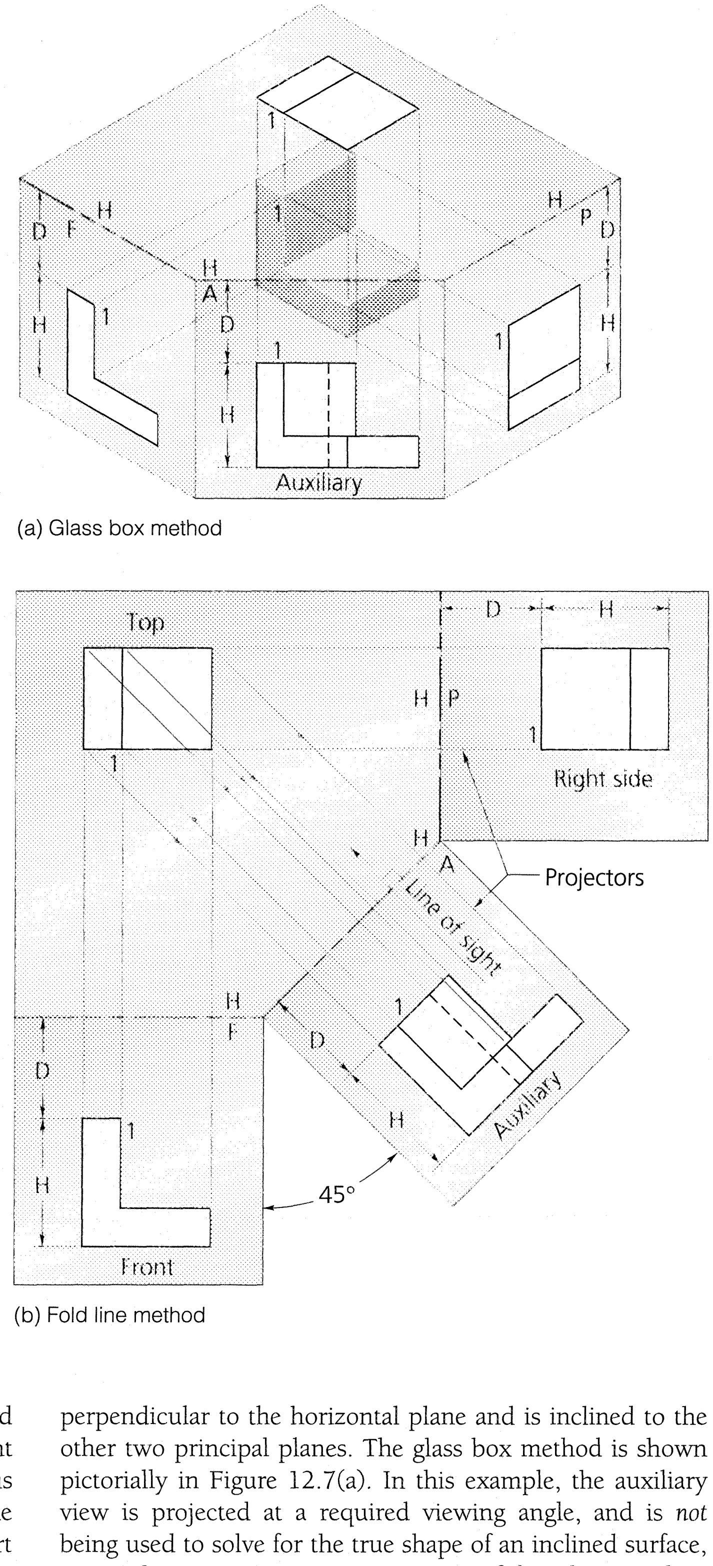
(b) Fold line method

12.2.2 Frontal Auxiliary Views (Fold Line Method)

The true shape of an inclined plane that appears as an edge in the front view must be projected from that view. The **glass box method** is pictorially illustrated in Figure 12.6(a). The following steps (using the fold line method) describe the projection of the frontal auxiliary view shown in Figure 12.6(b).

1. The line of sight for a frontal auxiliary view is perpendicular to the inclined surface, which appears as an edge in the frontal view.
2. Fold line F/A is established perpendicular to the line of sight and parallel to the inclined surface (edge view).
3. Projectors are drawn from all points in the front view perpendicular to the fold line. (Hidden lines were omitted in this example.)

FIGURE 12.7 Auxiliary View Projection from the Top View



(a) Glass box method

(b) Fold line method

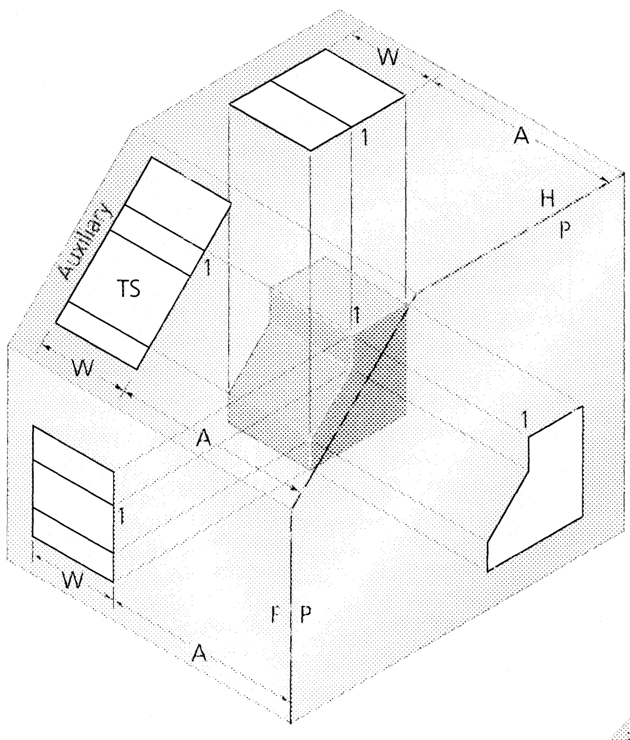
4. Measurements are taken (using dividers for speed and accuracy) from fold line H/F or P/F to establish the front face of the part in the auxiliary view. Dimension *A* is transferred from the top or side view to establish the distance from the F/A fold line to the front face of the part in the auxiliary view. The depth dimension (*D*) of the part is then transferred.

12.2.3 Horizontal Auxiliary Views (Fold Line Method)

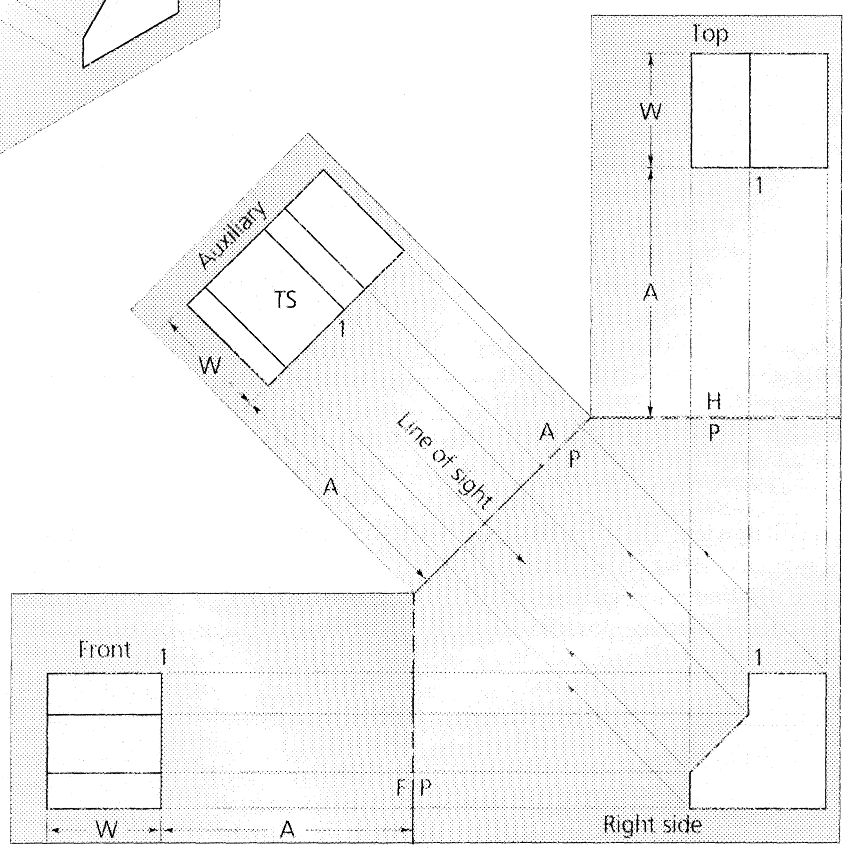
The second type of primary auxiliary view is the **horizontal auxiliary view.** In this case, the auxiliary view is taken perpendicular to the horizontal plane and is inclined to the other two principal planes. The glass box method is shown pictorially in Figure 12.7(a). In this example, the auxiliary view is projected at a required viewing angle, and is *not* being used to solve for the true shape of an inclined surface, as was the case in Figure 12.6. Because of this, the view does not show the true shape of a surface but instead provides a different viewing angle. The following steps describe the process of projecting a horizontal auxiliary view using the fold line method shown in Figure 12.7(b).

1. Establish a line of sight at a required angle of viewing. (45° was used here.)

FIGURE 12.8 Auxiliary View Projection from the Side View



(a) Glass box method



(b) Fold line method

2. Draw fold line H/A perpendicular to the line of sight.
3. From each point in the top (horizontal) view, extend a projector parallel to the line of sight and perpendicular to the fold line. (In this example, hidden lines are shown.)
4. Transfer dimension *D* from the side or front view to establish the distance from the H/A fold line to the top of the part. Then transfer the height dimension (*H*) to locate the bottom of the part. Determine visibility, and the view is completed.

12.2.4 Profile Auxiliary Views (Fold Line Method)

The third type of primary auxiliary view is the **profile auxiliary view.** In Figure 12.8 one surface of the part is inclined to the front and top views, and appears as an edge in the side view. By projecting an auxiliary view with a line of sight perpendicular to the edge view of the inclined surface, the true shape of the surface will be seen in the

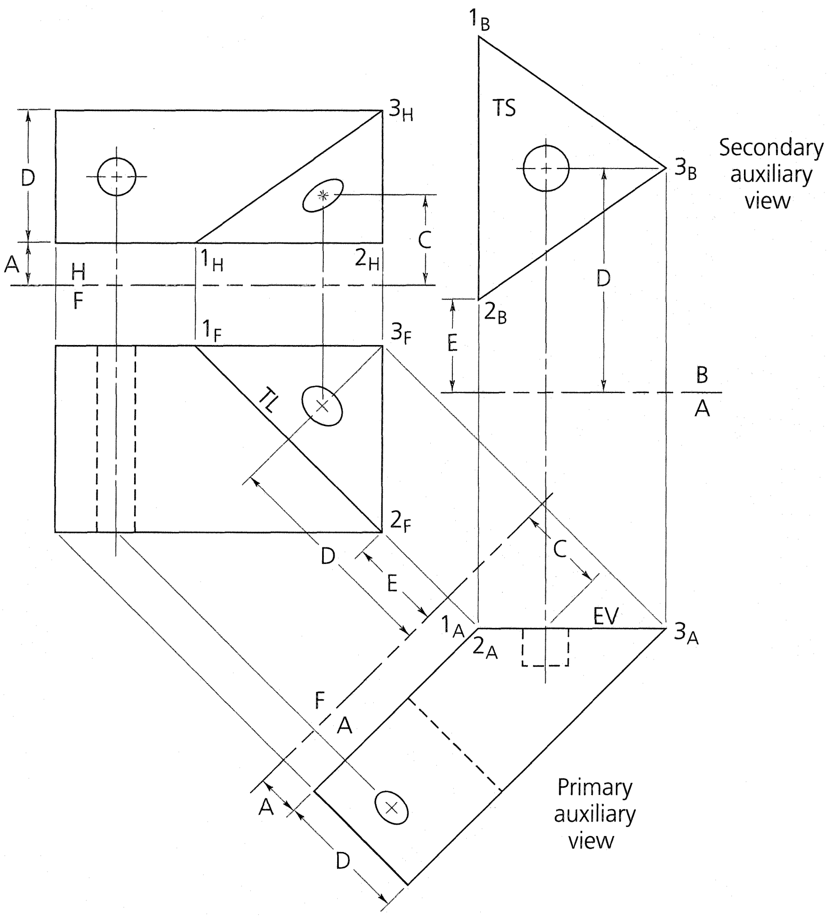


FIGURE 12.9 Secondary Auxiliary Views

profile auxiliary view. The same basic steps are used to draw profile auxiliary views as in Sections 12.3.1 and 12.3.2. Notice the need for a top view projected from the right side view. This is the alternate position for a top view.

12.2.5 Secondary Auxiliary Views Using Fold Lines

A **secondary auxiliary view** is one that is adjacent to and aligned with (projected from) a primary auxiliary view. In Figure 12.9, the part has one surface that is inclined to all three principal planes of projection. Therefore, it is not possible to solve for the true shape of the surface in a primary auxiliary view. This type of surface is normally referred to as an **oblique surface** (not to be confused with oblique projection). Since all consecutive views of a part are at right angles, secondary auxiliary views are perpendicular to primary auxiliary views. Views projected from a secondary auxiliary view are called **successive auxiliary views.** The following steps were used to draw the part in Figure 12.9.

1. Establish the line of sight parallel to true-length (TL) line 1-2 in the front view.
2. Draw fold line F/A perpendicular to the line of sight and at a convenient distance from the front view.
3. Complete the primary auxiliary view by transferring dimensions *A*, *C*, and *D* from the front view, and draw the part.
4. Establish a line of sight perpendicular to the edge view (EV) of surface 1_A-2_A-3_A in the primary auxiliary view.
5. Draw fold line A/B perpendicular to the line of sight and at a convenient distance from auxiliary view A.
6. Complete the secondary auxiliary view by transferring dimensions from the front view. Draw only plane 1-2-3, which will show true shape. Dimensions *D* and *E* establish points 3 and 2.

12.2.6 Adjacent Views

Each view and its preceding view and following view are considered **adjacent views.** An adjacent view is any view that is aligned with another view by means of a direct projection. The primary auxiliary view of the part in Figure 12.9 is projected from its adjacent principal view (the front view). Secondary auxiliary views are taken from their adjacent primary auxiliary view. Therefore the secondary auxiliary view is adjacent to the primary auxiliary view.

12.3 AUXILIARY VIEWS USING THE REFERENCE PLANE METHOD

In drawing the auxiliary view, dimensions in one direction are projected into the auxiliary view from the adjacent view. The dimensions in the other direction are transferred to the auxiliary view by measurement. To aid in the transfer of these measurements, a **reference plane** can be used instead of a fold line. The reference plane is placed perpendicular to the inclined surface that is being drawn and represented in this view by its edge, which shows as a line. All measurements are transferred from the edge view of the reference plane.

The reference line (edge) appears in the view where the inclined surface is shown as foreshortened. It will not appear in the view where the surface to be drawn is seen as an edge. In Figure 12.10, the reference plane shows as a plane surface in the front view and as an edge in the top view and the auxiliary view. Any convenient parallel position can serve to establish the reference plane. It could have been passed through the center of the part (as seen from the top) or the back plane instead of the front plane as done here.

12.3.1 Drawing an Auxiliary View

To draw the auxiliary view in Figure 12.10 using the reference plane method, first locate the reference plane for the auxiliary view so that it is parallel to the edge view of the inclined surface being drawn. Here, the plane was passed so that it coincided with the front surface of the part and shows as a reference line (edge) in the top and auxiliary views. The reference line is positioned at a distance away from the edge view of the inclined surface that is equal to the depth of the part plus the space desired between the views.

Spacing of the views can also be accomplished as when drawing standard normal views, as discussed in Chapter 10. The thickness (depth dimension 2.500 in. in Fig. 12.10) plus the space required between views determine the amount of space needed for the auxiliary view.

Place the auxiliary view (the reference line-edge) so there is sufficient space for dimensions and notes. *Do not put the auxiliary view too close to the view from which it is projected.* Since each part will have a different shape and different dimensioning requirements, it is impossible to specify a distance that could be applied to every part. You will learn through practice and experience the amount of room necessary for the view to be properly positioned.

After the extents of the view are projected (perpendicularly) from the adjacent view (the front view in Fig. 12.10), measurements for establishing the thickness of the auxiliary view are taken from the existing view (here 2.500). Measurements that can be taken perpendicular to the reference line are then transferred to the auxiliary view. At the same time, all dimensions that are parallel to the reference line are projected to the auxiliary view. This procedure (projection lines and transfer distances) is exactly the same as for the fold line method. The line of projection for each point is always perpendicular to the reference line. All features can be established in the auxiliary view by projecting one point at a time.

Note that the fold line or the reference line, depending on which method is employed, is always erased after the projection of the auxiliary view is completed. Finished drawings have only views of the part (Fig. 12.11).

12.3.2 Secondary Auxiliary Views

Secondary auxiliary views derived via the fold line method have already been presented. For typical industry drawings that require the detailing of an oblique surface, either the

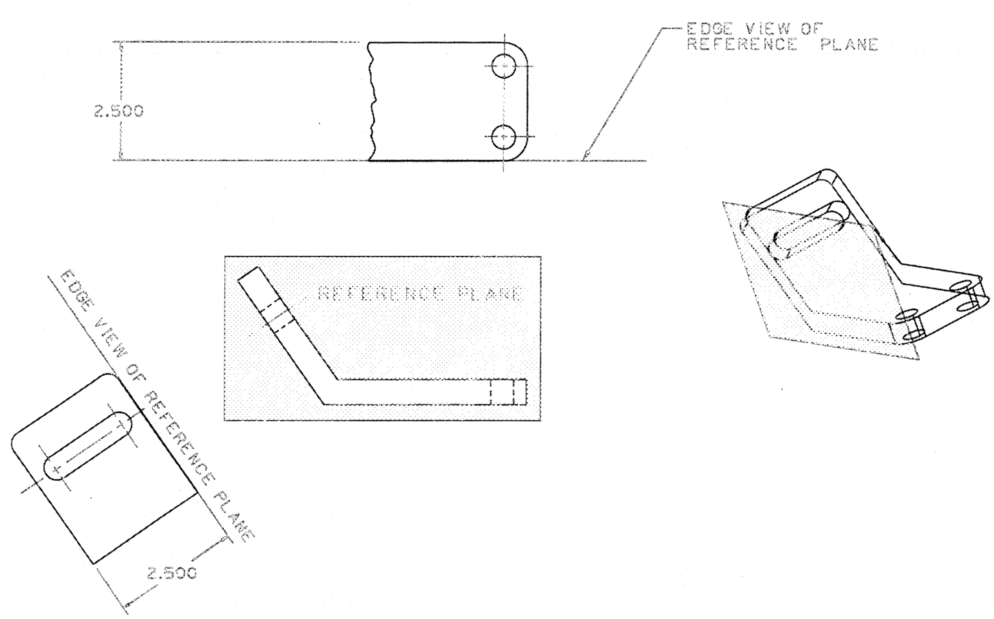
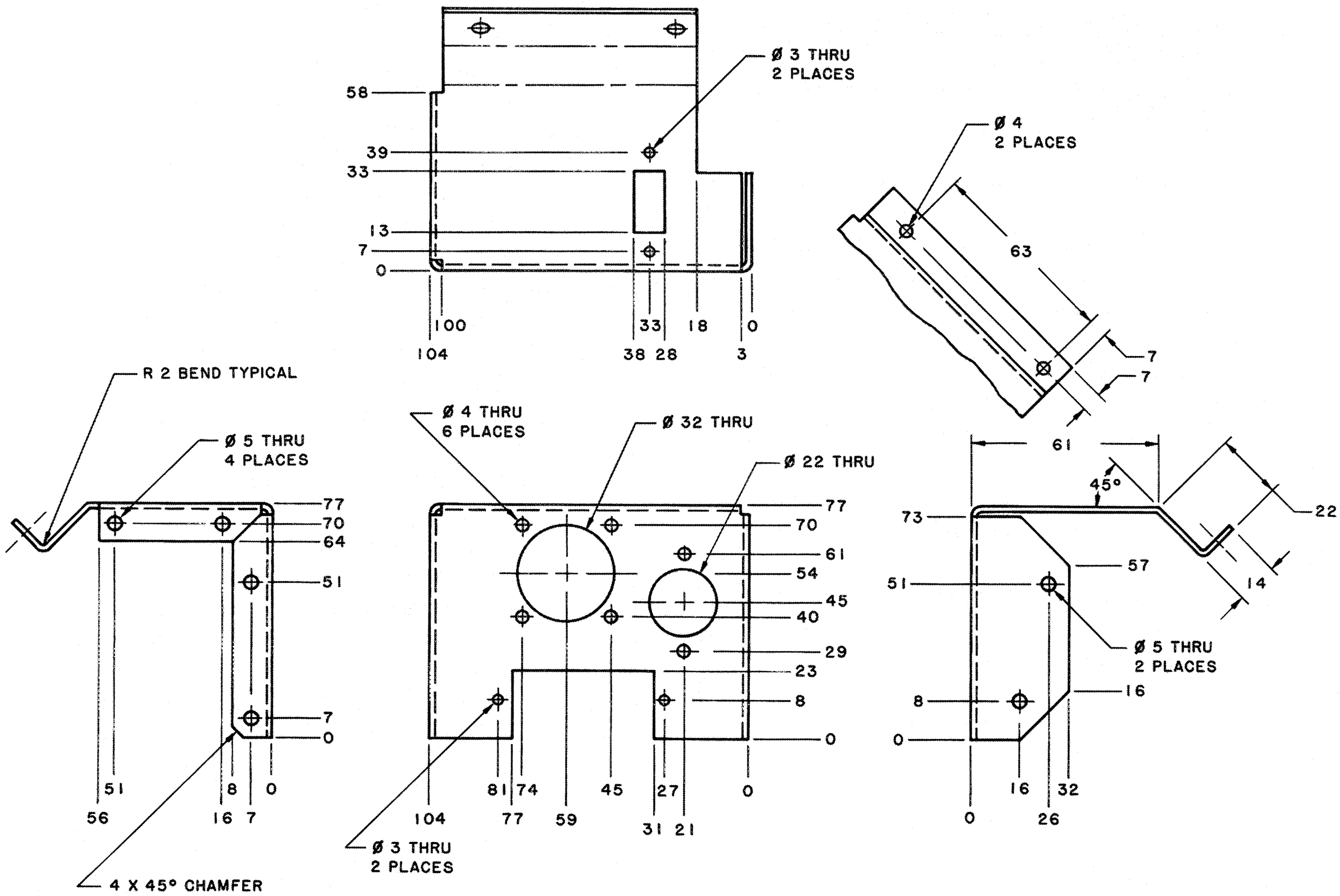
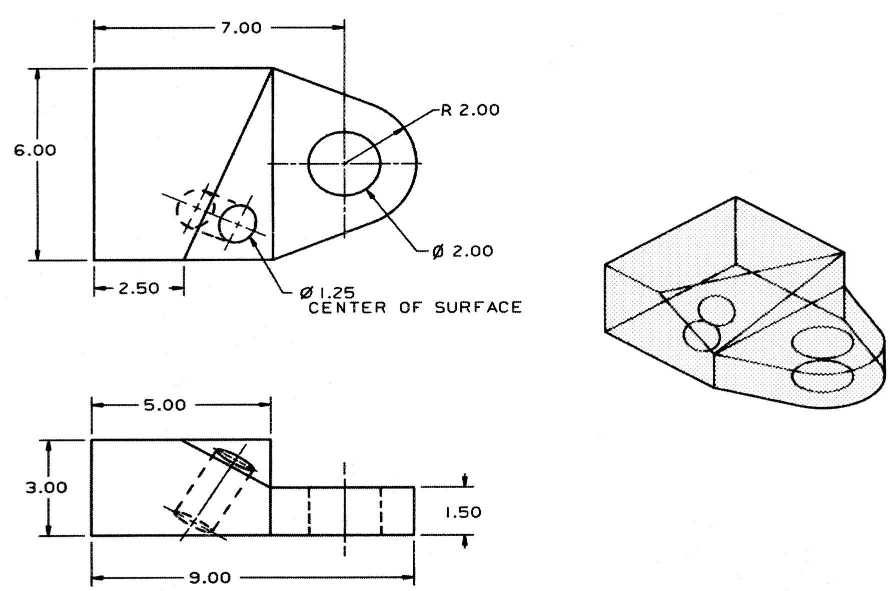


FIGURE 12.10 Auxiliary View Projection Using the Reference Plane Method



IGURE 12.11 Electronic Bracket Mount Detail

old line or the reference plane method can be implemented, with equally good results. The fold line method works best or complicated parts that require the whole part to be projected from view to view. In Figure 12.12, the part has an oblique surface with a hole centered on it. This surface and the hole do not show as true shape in any of the principal



IGURE 12.12 Oblique Surface
n a Part

views. This is an example of a part where a primary view and a secondary auxiliary view will be required in order to display and detail the part properly.

The part in Figure 12.13 has a surface that is oblique. This surface also has a slot positioned on it. To solve for the true-shape view of the surface, a primary auxiliary view showing the surface as an edge was projected first. By projecting a view perpendicular to the edge view, a true-shape secondary auxiliary view was then established. Note that fold lines and reference planes are not shown. The primary auxiliary view shows the true angle that the inclined surface makes with the base of the part.

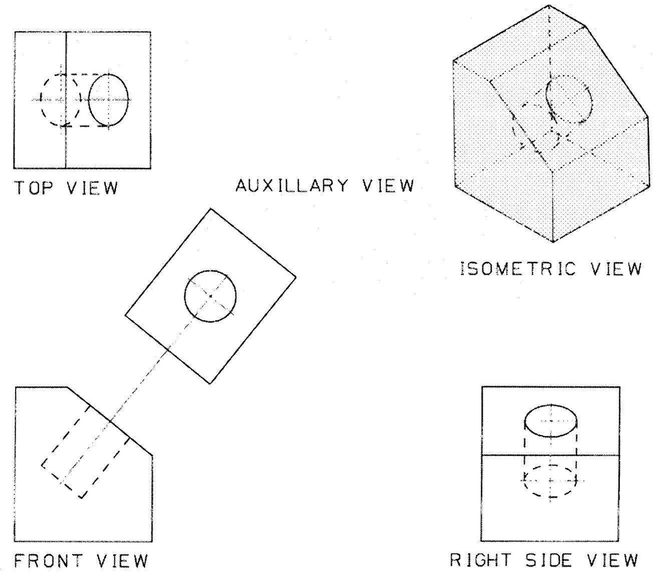


FIGURE 12.14 Front-Adjacent Auxiliary View

12.4 AUXILIARY VIEW CONVENTIONS

Auxiliary views are aligned with the views from which they are projected. A centerline or projection line (Fig. 12.13) may continue between the adjacent views to indicate this alignment. In Figure 12.14 the centerline of the hole has been extended from the front view to the auxiliary view to show alignment.

In many cases, hidden lines in auxiliary views are not shown, unless they would help clarify the view. Hidden lines are shown only when they do not complicate the auxiliary view or where they are necessary to describe the part adequately.

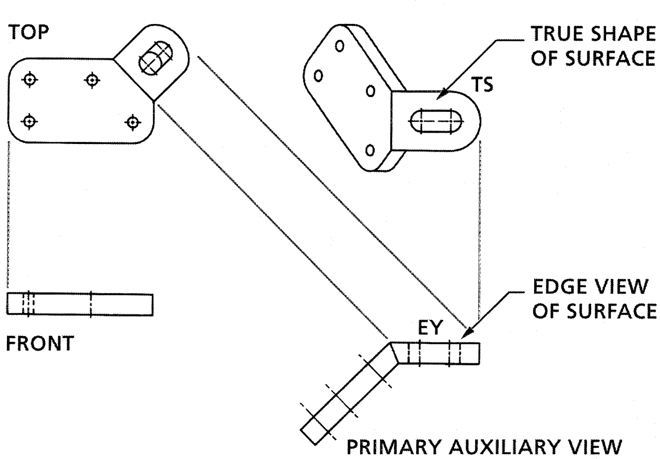


FIGURE 12.13 True Shape of an Oblique Surface by Auxiliary View

In general, the complete auxiliary view need not be drawn. Showing only the true-shape surface is normally all that is required (Fig. 12.15). The complete view may be necessary to show clearances or other information, especially when the auxiliary projection was not drawn to show the true shape of a surface.

You May Now Complete Exercises 12.1 Through 12.4

12.4.1 Partial Auxiliary Views

Partial auxiliary views (or partial principal views) may show only pertinent features not described by true projection in the principal or other views (Fig. 12.15). They are used instead of complete views to simplify the drawing. In

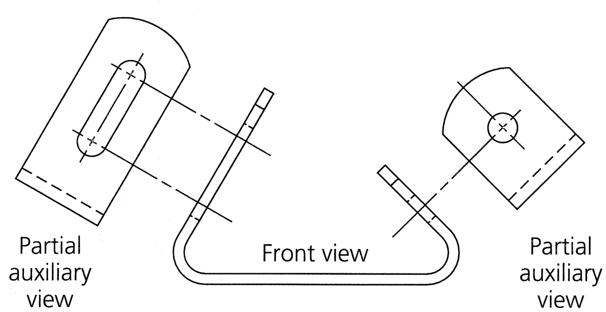


FIGURE 12.15 Front View and Two Auxiliary Views

Applying Parametric Design . . .

AUXILIARY VIEWS FROM PARAMETRIC MODELS

Auxiliary views are created by making a projection of the model perpendicular to a selected edge (see Fig. A). They normally serve to describe the true size and shape of a planar

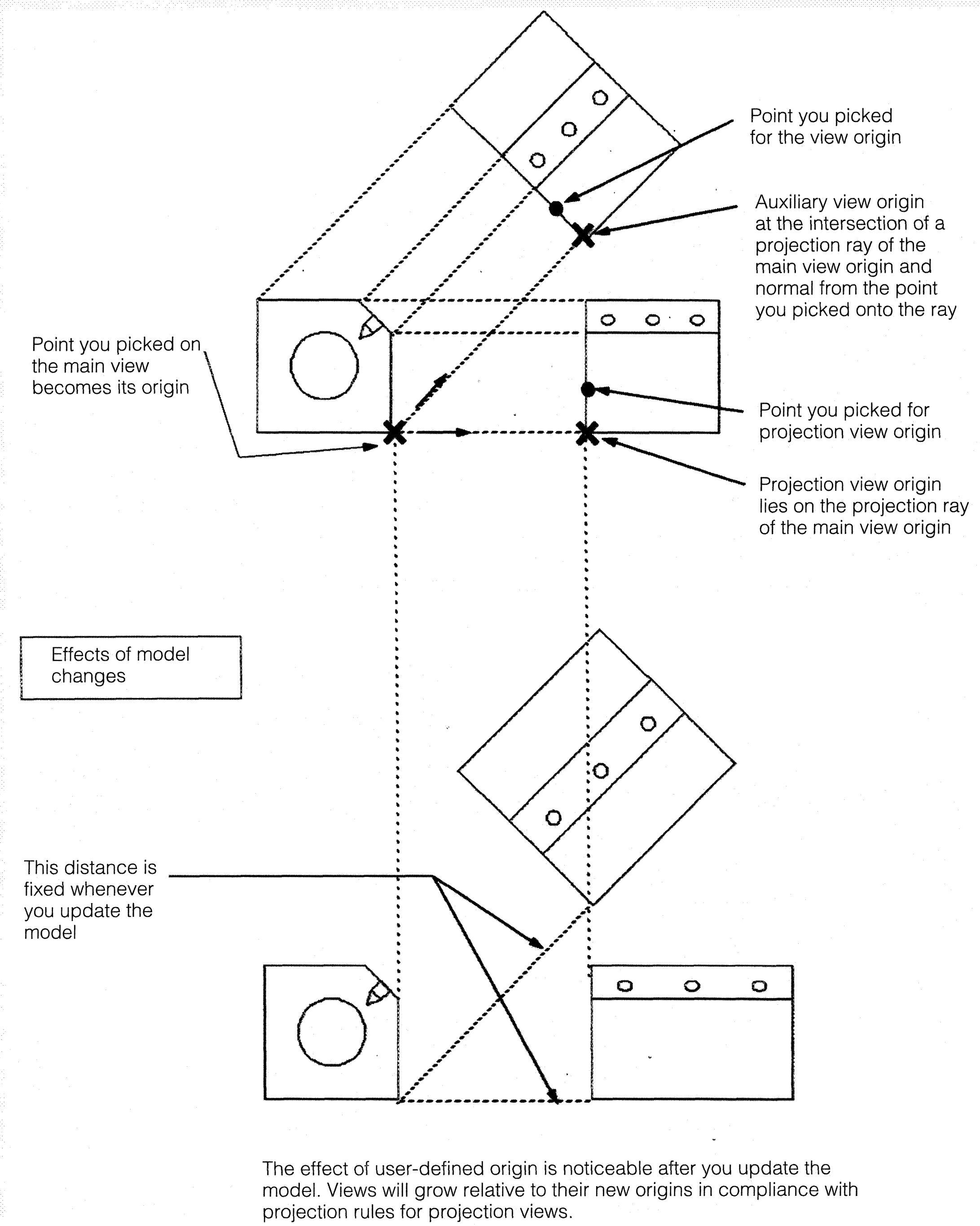


FIGURE A User-Defined Auxiliary View Origin

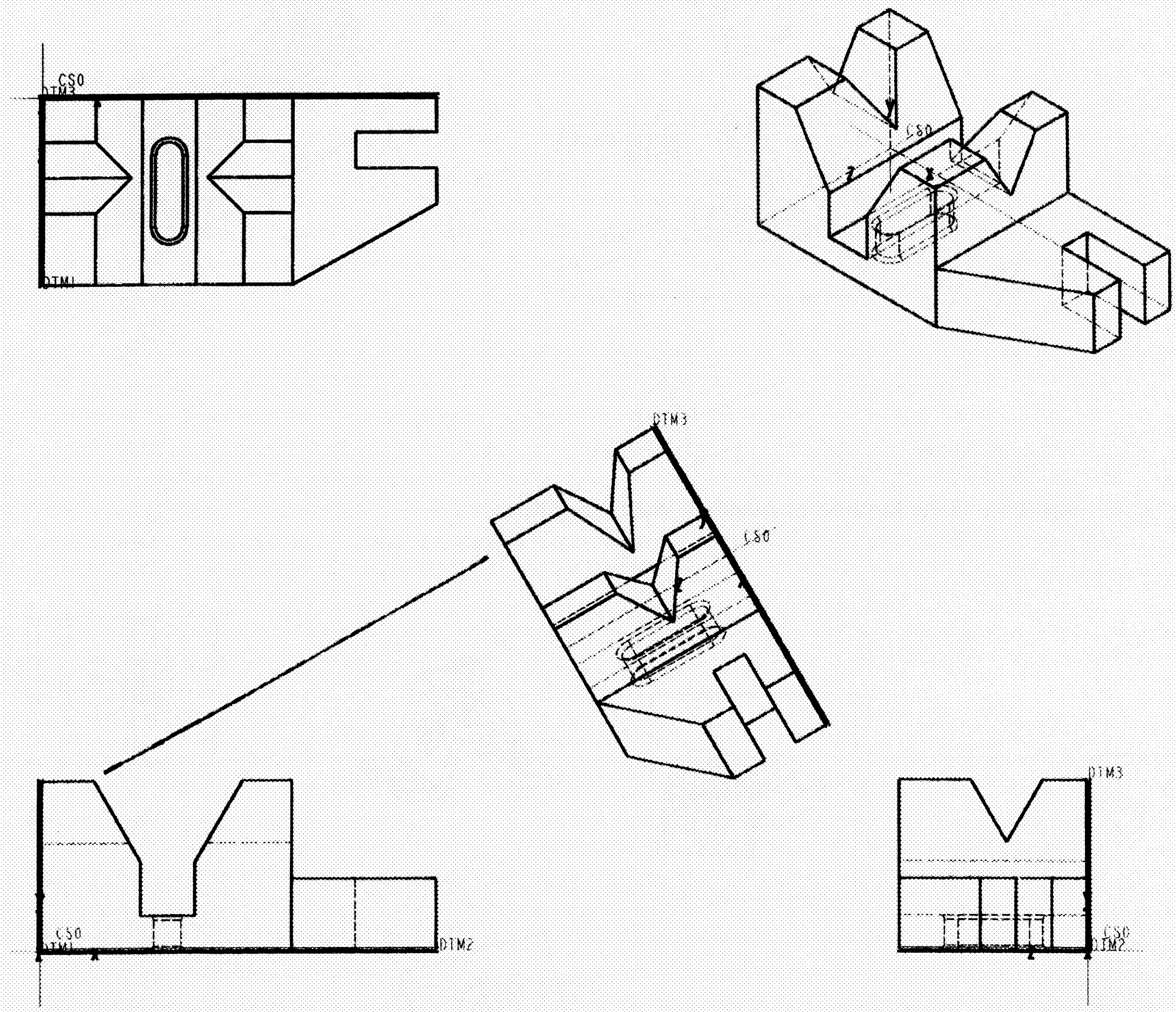


FIGURE B Auxiliary View of Model Surface

surface on a part (see Fig. B). An auxiliary view can be created from any other type of view. Auxiliary views may have arrows created for them that point back at the view(s) from which they were created. To add an auxiliary view to a drawing, use the following command options.

1. Choose **Auxiliary** and other available options from the VIEW TYPE menu.
2. Choose **Done** to accept the options, or **Quit** to quit the creation of a new view.
3. Pick the location of the new view on the drawing.
4. Pick an edge of, or axis through, the surface of the model in the view from which the auxiliary view will be developed. If the edge selected is from a view that has a pictorial (isometric-trimetric) orientation, the new view will be oriented as the base feature section was; otherwise, the view will be oriented with the selected surface parallel to the plane of the drawing.

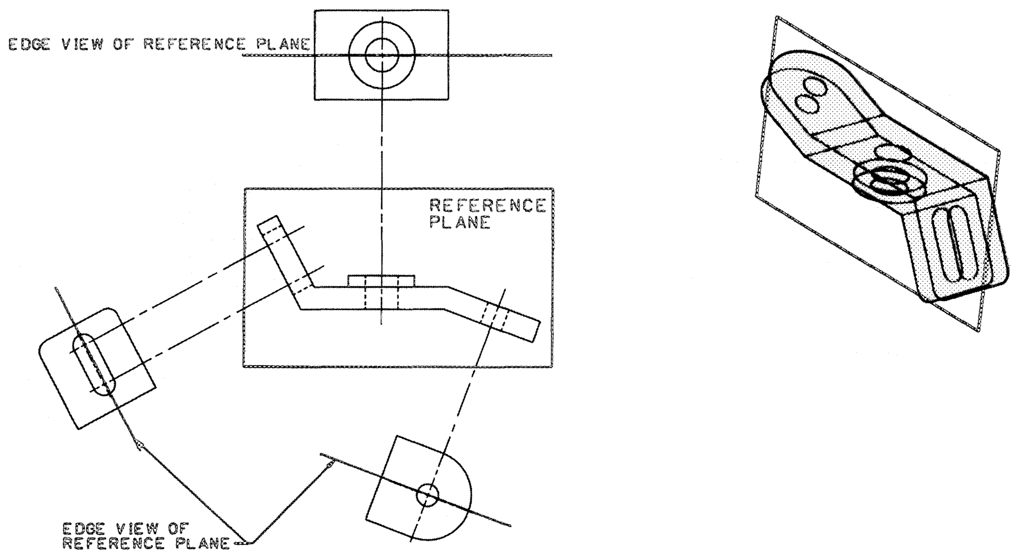


FIGURE 12.16 Reference Plane Method of Auxiliary View Projection

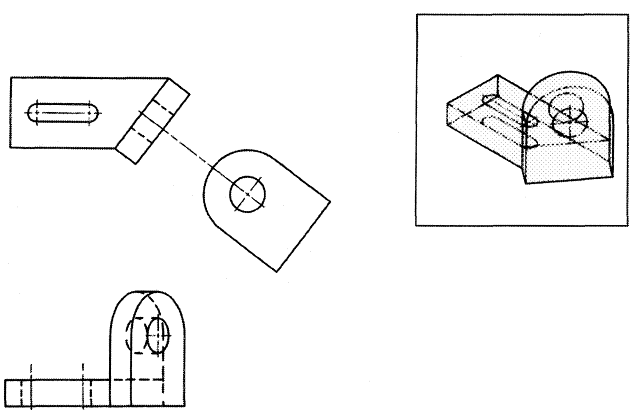


FIGURE 12.17 Partial Auxiliary View

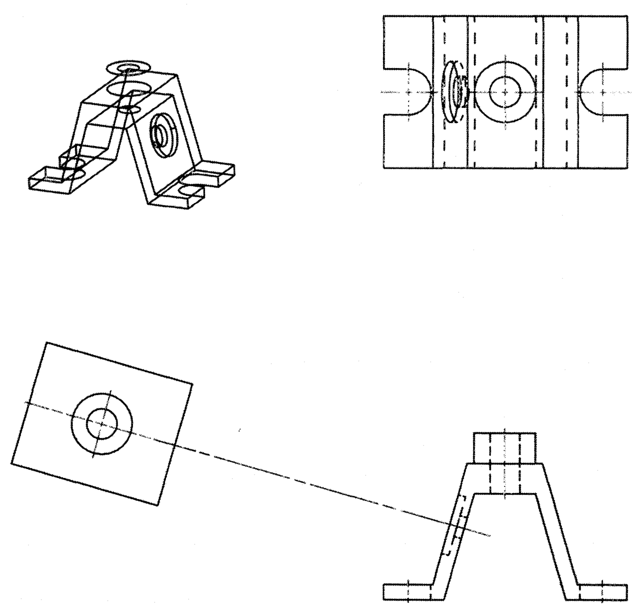


FIGURE 12.18 Partial Auxiliary View of Part

Figure 12.16, the top view of the part is only partially shown; in fact, only the front view of this example is complete. Partial top and auxiliary views were all that was required to define the part's configuration adequately. In this figure, the reference plane was passed through the center of the part, rather than along one of the edges. This method is frequently used where the part to be drawn is symmetrical about its centerline. Passing the reference plane down the centerline of a part makes it easy to transfer the dimensions.

Reference planes are not shown in Figures 12.17 and 12.18. In both cases, the auxiliary view is a partial auxiliary view. Features that would have appeared distorted (not true shape) and all hidden lines have been left off.

12.4.2 Broken and Half Auxiliary Views

In some situations, a portion of the auxiliary view must be shown, as in Figure 12.19. Here, the base is partially shown (*broken*) in the auxiliary view. This is a form of partial auxiliary view. In Figure 12.20, a **half top view** and a **half auxiliary view** are shown. The part is symmetrical about its centerline; therefore, little is gained by drawing a complete top view. The same can be said of the auxiliary views. In this example, one of the auxiliary views is shown as a full view to

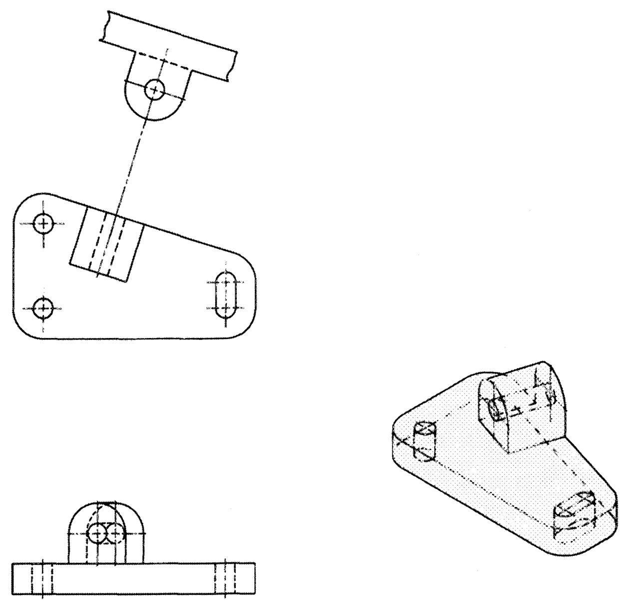


FIGURE 12.19 Broken Partial Auxiliary View

indicate the difference between the types. The only complete view in this example is the front view. The centerline dividing the part is always shown on half views.

12.4.3 Auxiliary Views of Curved Features

Circular and **curved features** are true size/shape in views where the line of sight is perpendicular to the edge view of the surface on which they lie. In the adjacent projection the plane appears as an edge and parallel to the fold line. The length of the edge view line is equal to the circle's diameter.

When a circular plane is oblique, it appears as an ellipse. An elliptical view of a circular plane along with each adjacent auxiliary view is plotted by locating a series of points along the outline of the circle in a true-size view. These points are located in each adjacent view by projection and by transferring distances to establish each individual point. The series of points is connected with a template or an irregular curve.

To locate a given circle on a plane, a true-shape view of the plane must be found. A typical problem in industry is centering a hole on a given surface. In Figure 12.21, plane 1-2-3-4 is given and a hole/circle of a specific size is to be drilled/drawn in the exact center of an oblique plane. Primary and secondary auxiliary views will be required. The following steps were used to complete the problem.

1. Line 1_H-3_H and line 2_H-4_H are horizontal lines (true length in the horizontal view). Therefore, a true-length line need not be constructed to find the edge view. Draw H/A perpendicular to the horizontal lines, and project auxiliary view A. Plane 1_A-2_A-3_A-4_A is an edge in this view [Fig. 12.21(a)].
2. Draw A/B parallel to the edge view of plane 1_A-2_A-3_A-4_A, and project auxiliary view B. This view shows the true size of the plane [Fig. 12.21(a)].
3. Locate the exact center of plane 1_B-2_B-3_B-4_B, and draw the given circle [Fig. 12.21(a)].
4. To project the centered circle back to all previous views, a series of points needs to be located along its circumference. A simple method to locate points on the circle is to divide the circle evenly by drawing lines from the corners of the plane [Fig. 12.21(b)].
5. Locate each point in auxiliary view A by projection where they fall on the edge of plane 1_A-2_A-3_A-4_A. Use dimensions D1, D2, and D3 to locate each point in the horizontal view by transferring them along their respective projection lines. Axes A (major diameter) and B (minor diameter) could also be used to locate and draw each view of the circle [Fig. 12.21(b)].

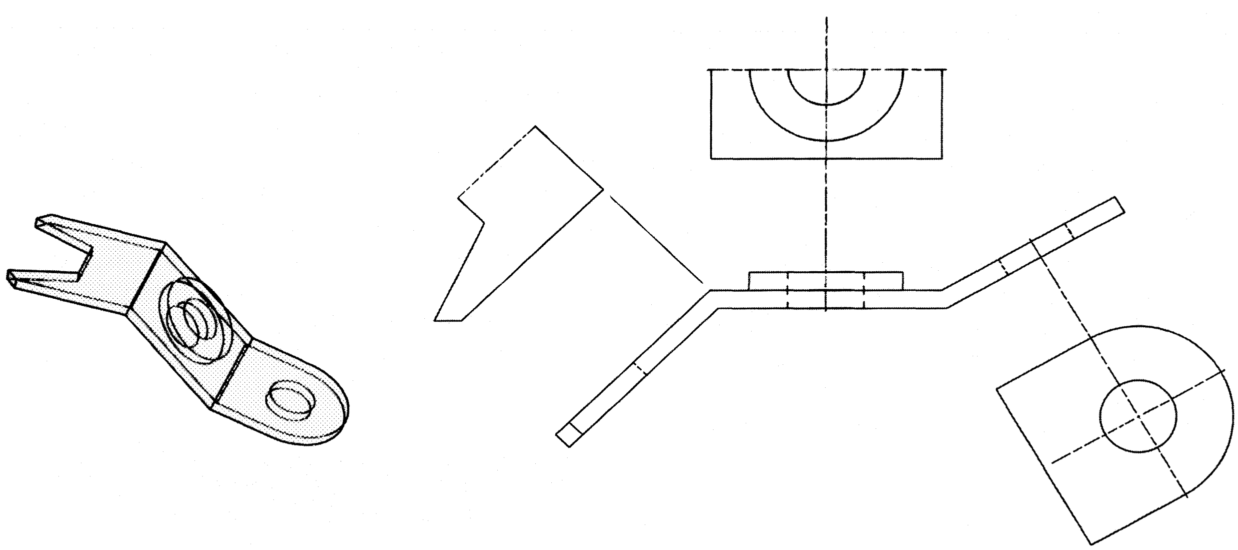


FIGURE 12.20 Half Views

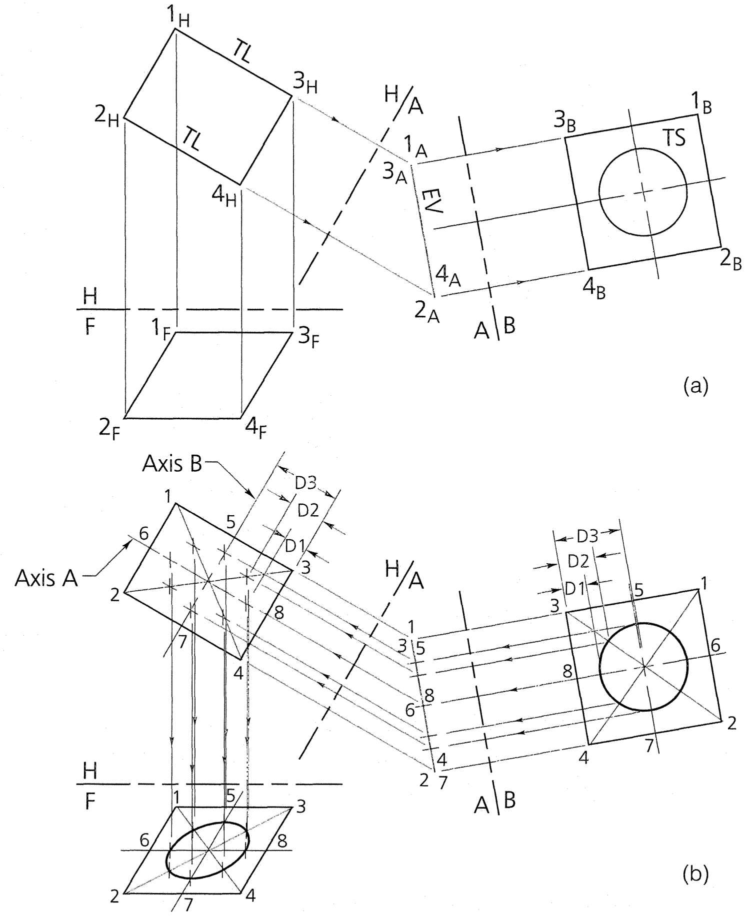


FIGURE 12.21 Reverse Construction for Plotting Curves on Views

6. Obtain the frontal view of the circle by projection and by transferring distances from auxiliary view A (from H/A to each point on the edge view).
7. Then connect the points with a smooth curve using an irregular curve.

In Figure 12.22, the part has curved features that appear oblique in the top view, show as an edge in the front view, and are true shape in the auxiliary projection. In this situation, *reverse construction* of the curved features is required if the features are to be projected back to the top view (where they appear distorted—*not true shape*). After the front view and the true-shape features of the top view are drawn, the auxiliary view is constructed as shown. Since the curved features show true shape in the auxiliary projection, a series of points is established along the curved outline. The points are then projected to the front view, where they fall along the edge view of the curved surface. The points are projected to the top view from the front view. Measurements are transferred using the dimensions taken from the auxiliary projection.

12.4.4 Auxiliary Sections

Auxiliary views that are sections are called **auxiliary sections.** In Figure 12.23 the part has a section passed through the ribs. This feature cannot be adequately defined and detailed through the top, front, or partial side view. A section was cut perpendicular through the ribs and projected as an auxiliary section view. Section lining is drawn at a different angle than that of the lines of the part features.

12.4.5 Auxiliary Views and Dimensioning

The primary reason for projecting auxiliary views is to show and dimension the shape of a part that cannot be defined in one of the principal views. In Figure 12.24 the part has a surface that is inclined. This surface needs to be shown as true shape in order to be dimensioned. The front and right side views along with an auxiliary view were used to detail the part. Dimensions were placed on each view where the part's features are shown true shape. The auxiliary view has the dimensions of the slot and the holes (see Chapter 15).

12.5 CAD-GENERATED AUXILIARY VIEWS

Two-dimensional CAD systems can rotate an axis in 2D for easier projection of an auxiliary view, but they still require

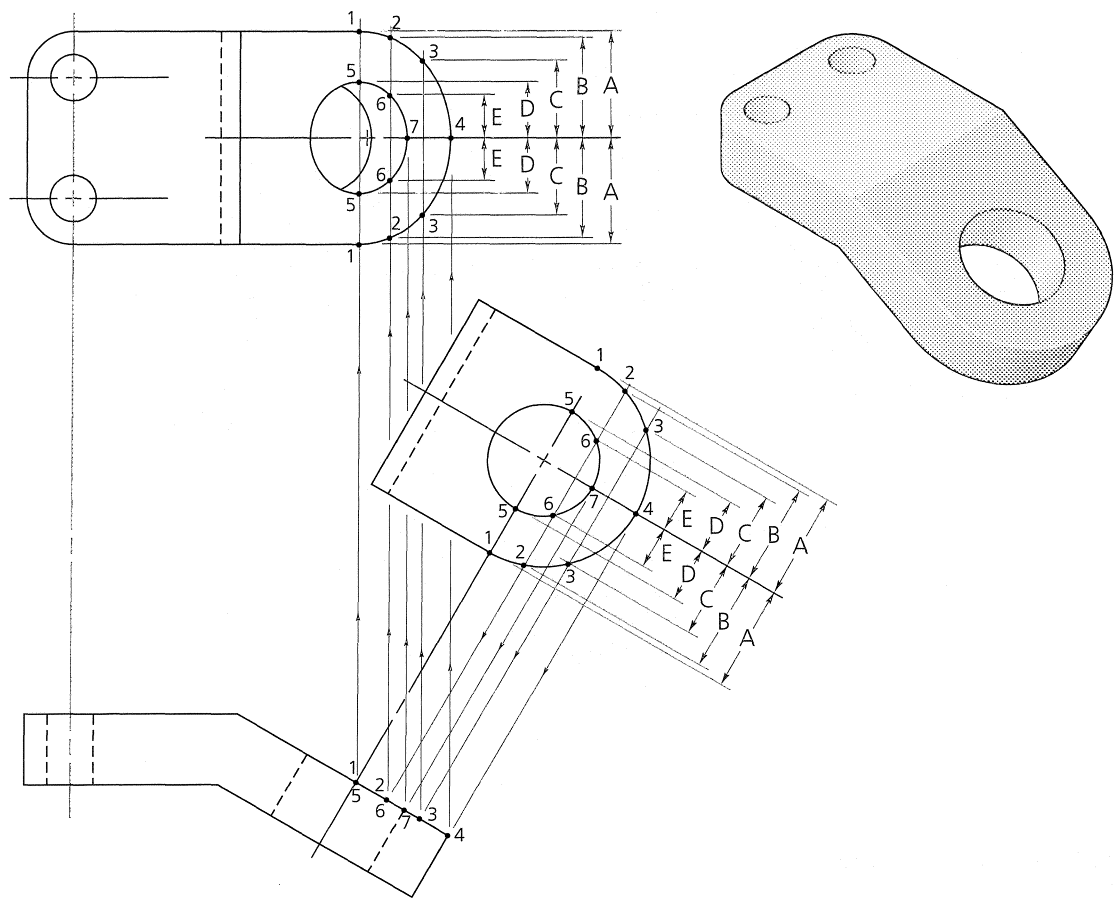


FIGURE 12.22 Projecting Curved Features into Principal Views

similar techniques for mastering and projecting auxiliary views as those previously described for manual drafting. Since a 3D system builds a database containing the complete part (not just 2D views), you can automatically display standard views as well as auxiliary views.

In Figure 12.25 the part has been modeled on a 3D CAD system. After modeling, the part's views, including a complete auxiliary view, were displayed. In Figure 12.26 the two ears of the part are at an angle to the front and top principal planes. An auxiliary view is needed to describe the part's features properly. The part had already been modeled and displayed in the top, front, and right side views as shown. A

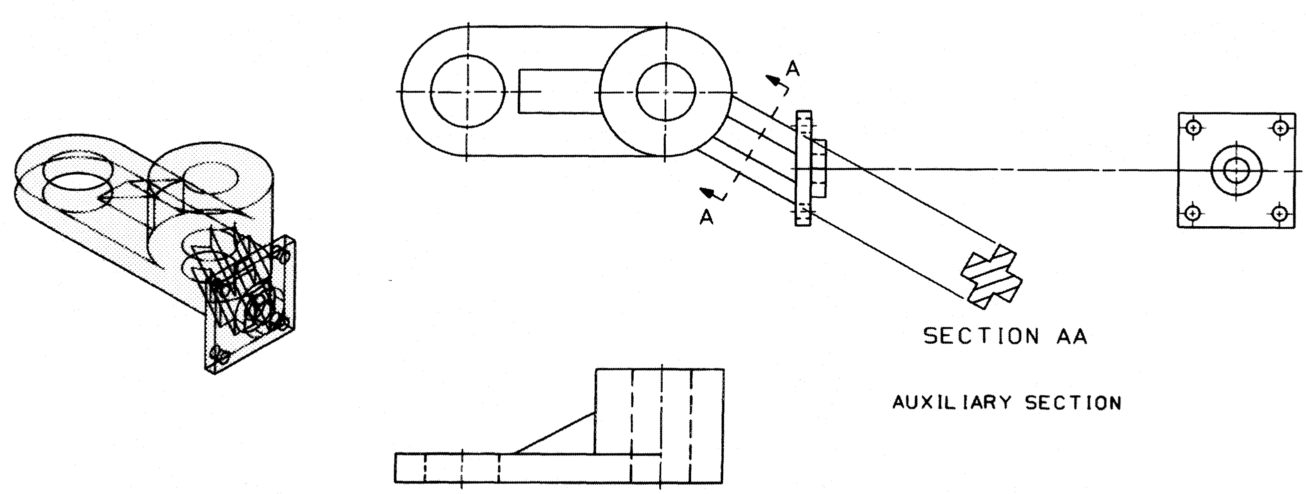


FIGURE 12.23 Auxiliary Section View

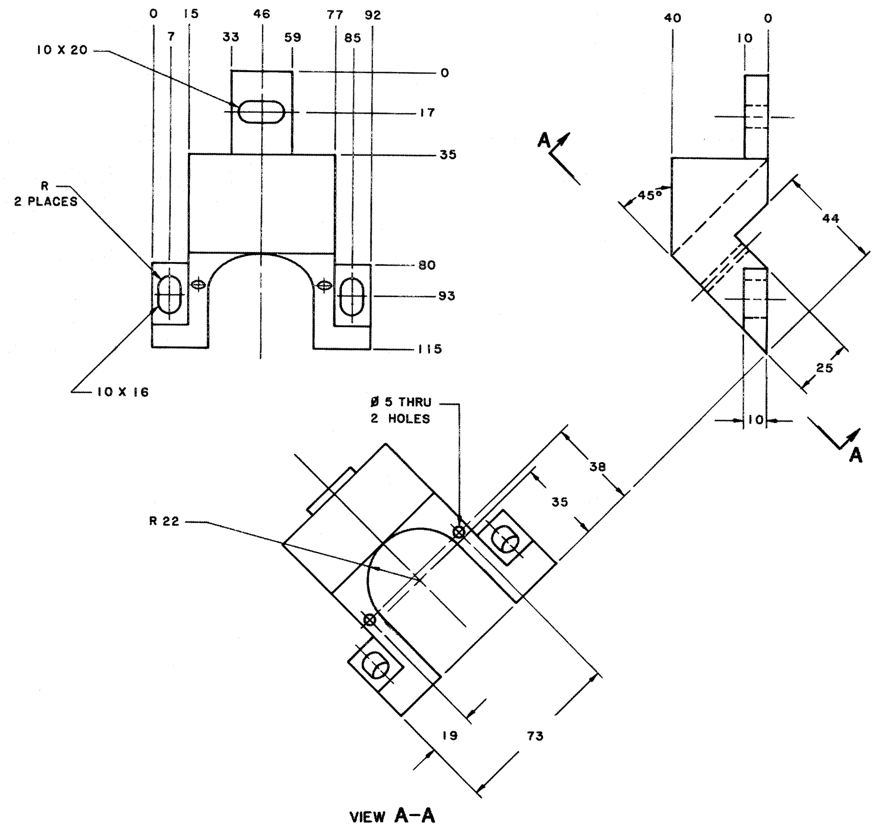


FIGURE 12.24 Auxiliary View and Dimensioning

partial view was established by folding only the inclined surfaces. All other edges of the part are not displayed in the auxiliary view. In each of these cases, the auxiliary view was generated for the sole purpose of establishing the circular features of the part that did not show as true shape in a principal view. Figure 12.27 was created on AutoCAD as a solid 3D part, displayed in appropiate views and in a drawing format placed about the drawing. The auxiliary view was created automatically by establishing a **user coordinate system (UCS)**, selecting the new UCS, and requesting a view of that surface.

You May Now Complete Exercises 12.5 Through 12.8

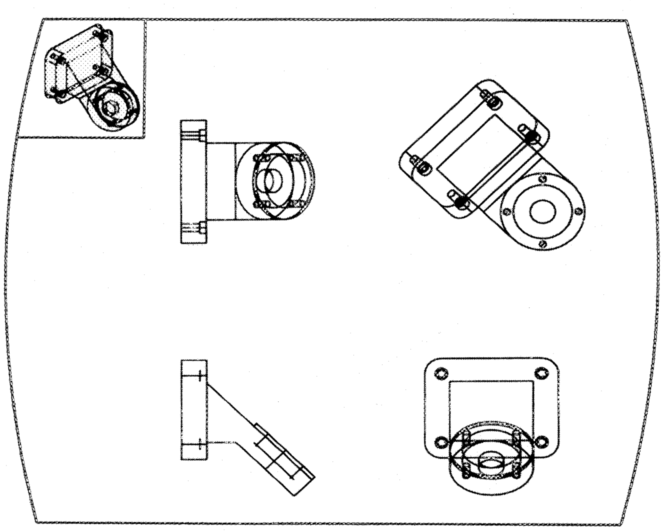


FIGURE 12.25 Auxiliary View Projection Using 3D CAD

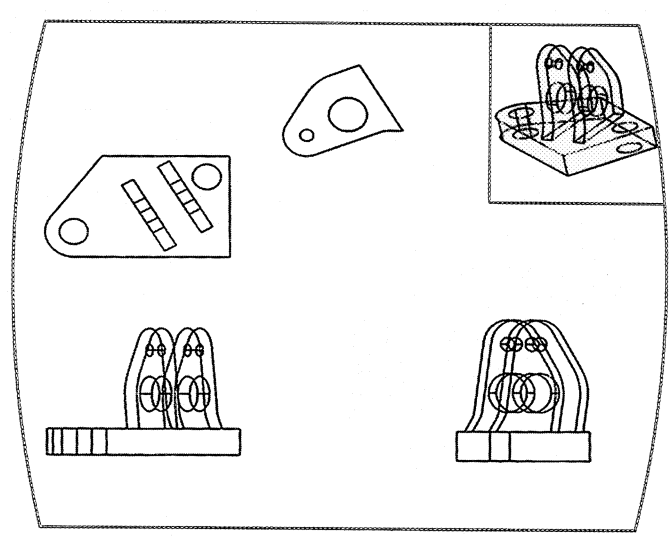


FIGURE 12.26 Partial Auxiliary View Projection Using 3D CAD

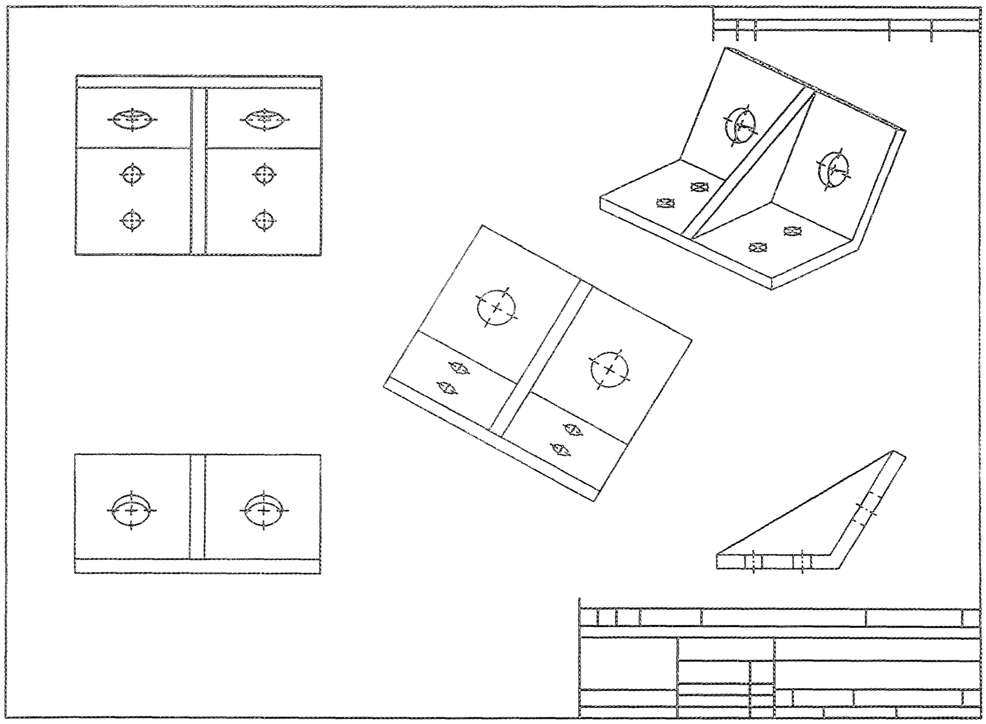


FIGURE 12.27 Angle Bracket Modeled on AutoCAD Using Solids and Displayed on a Drawing Format with Top, Front, Right Side, Auxiliary, and Pictorial Views

QUIZ

True or False

1. Most auxiliary views are only partial projections.
2. Oblique, inclined, and otherwise-distorted geometry is always shown on a view.
3. The top, front, and side views are always shown on a drawing when an auxiliary view is required to display inclined features for a part.
4. On a 2D CAD system, views can be generated automatically from existing geometry.
5. Auxiliary views may reduce the need for principal views of the part.
6. Auxiliary views are normally used for projecting a view to show the true shape of a surface that is inclined or oblique in the principal views.
7. A reference plane is always placed so that it is perpendicular to the inclined surface that is to be projected to an auxiliary view.
8. Auxiliary views are used only to display the true shape of a feature.

Fill in the Blanks

9. A __________ auxiliary view is projected from one of the standard principal views.
10. A reference plane or a fold line can be established on a part to aid in the __________ of an __________ view.
11. __________ __________ views are projected from the front views.
12. The __________ __________ is normally passed through a prominent feature of the part so as to make projection of auxiliary views easier and quicker.
13. CAD systems enable the drafter to __________ views from existing projections of a 3D part.
14. An auxiliary view can be __________ from an adjacent view when using a 3D CAD system
15. Half auxiliary views are normally used where the part is __________ about a __________ .
16. A __________ __________ view is adjacent and aligned with a secondary view.

Answer the Following

17. What is the edge view of a plane, and how is it used in the projection of a true-shape view?
18. What is the primary purpose of an auxiliary view?
19. Compare the fold line method with the reference plane method.
20. Why are partial auxiliary views more common than complete auxiliary projections?
21. How does 3D CAD affect auxiliary view projection?
22. What is a fold line, and how is it used?
23. What are half sections, and why are they used?
24. What is a broken auxiliary view?

EXERCISES

Exercises may be assigned as sketching, instrument, or CAD projects. Transfer the given information to an "A"-size sheet of .25 in. grid paper. Complete all views, and solve for proper visibility, including centerlines, object lines, and hidden lines. Exercises that are not assigned by the instructor can be sketched in the text to provide practice and to enhance understanding of the preceding instructional material.

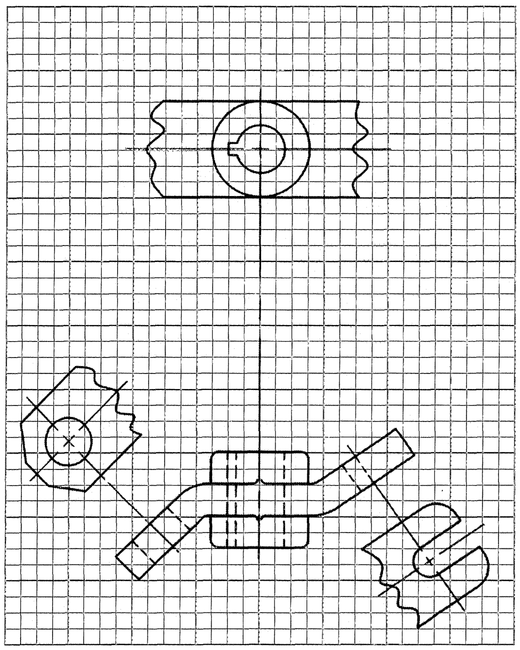
After Reading the Chapter Through Section 12.4 You May Complete the Following Exercises

Exercise 12.1 Draw the required views.

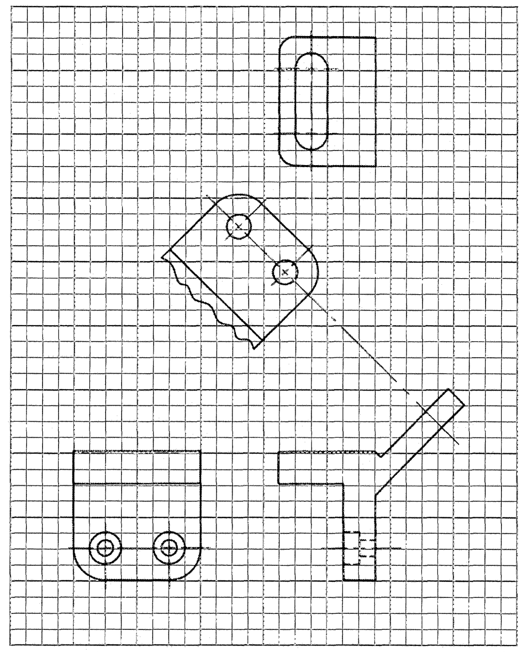
Exercise 12.2 Draw the required views as shown.

Exercise 12.3 Draw the required views. Complete a full top view.

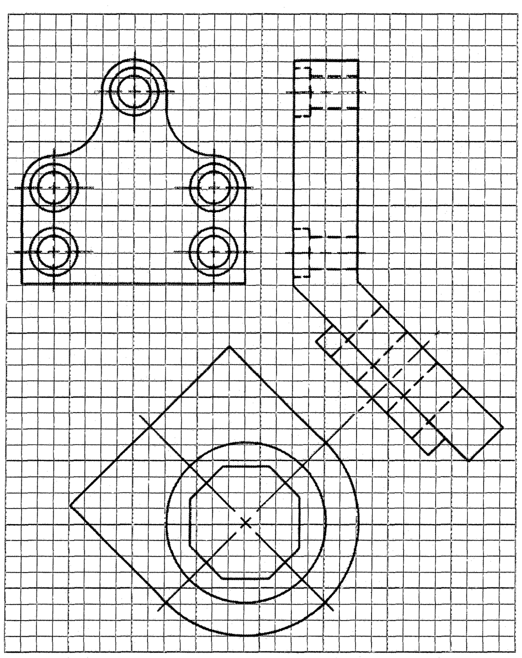
Exercise 12.4 Draw the three views as shown.



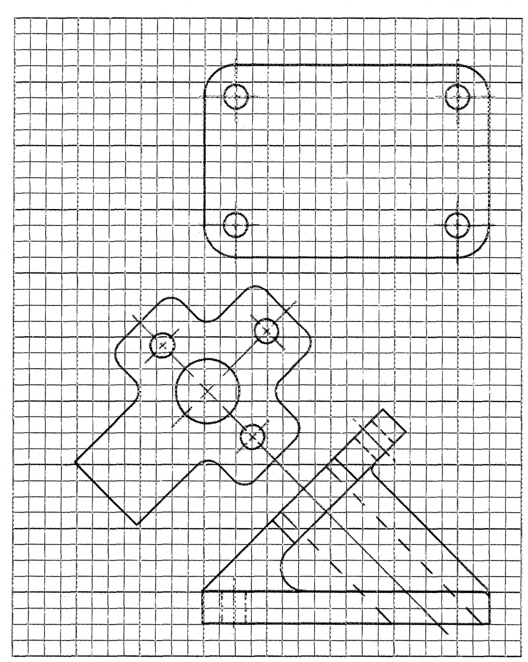
EXERCISE 12.1



EXERCISE 12.3



EXERCISE 12.2



EXERCISE 12.4

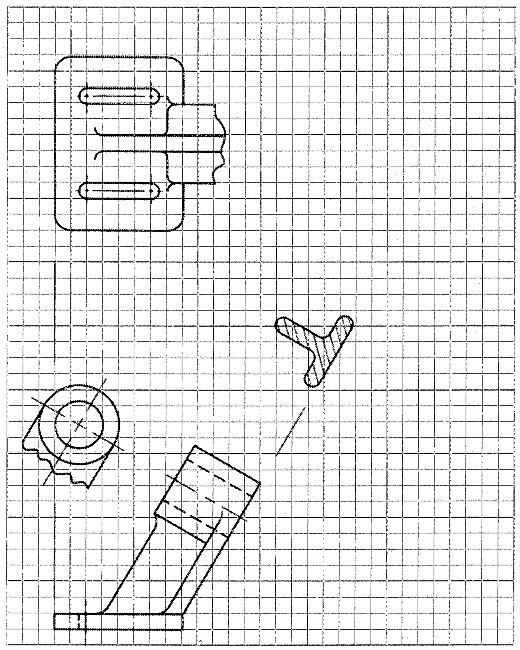
After Reading the Chapter Through Section 12.5 You May Complete the Following Exercises

Exercise 12.5 Complete the required views and the auxiliary section.

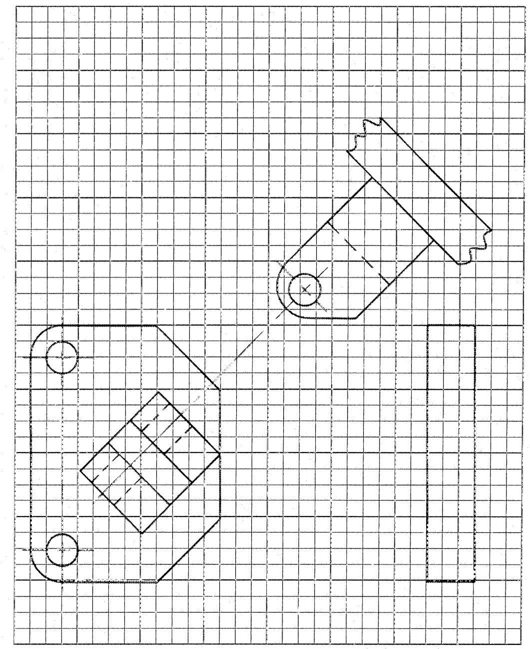
Exercise 12.6 Draw the required views.

Exercise 12.7 Complete the required views and draw a full front view.

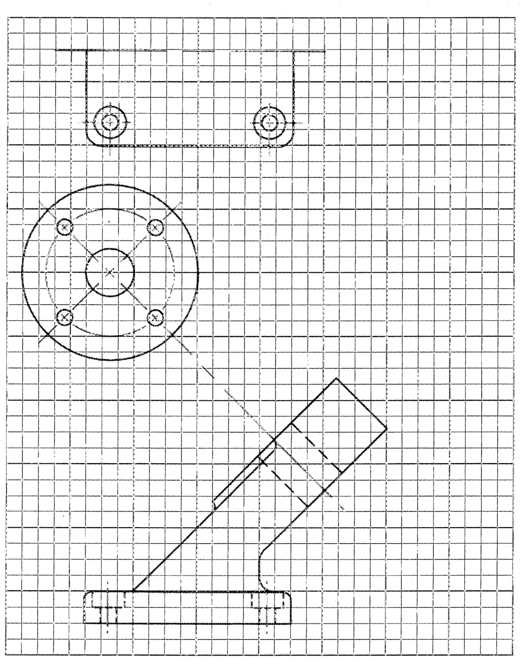
Exercise 12.8 Draw the required views. Project a secondary auxiliary view showing surface A or B as true shape/size.



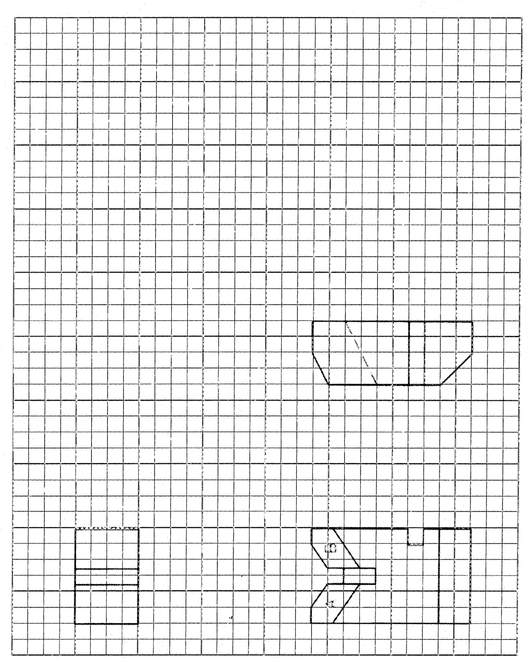
EXERCISE 12.5



EXERCISE 12.7



EXERCISE 12.6



EXERCISE 12.8

PROBLEMS

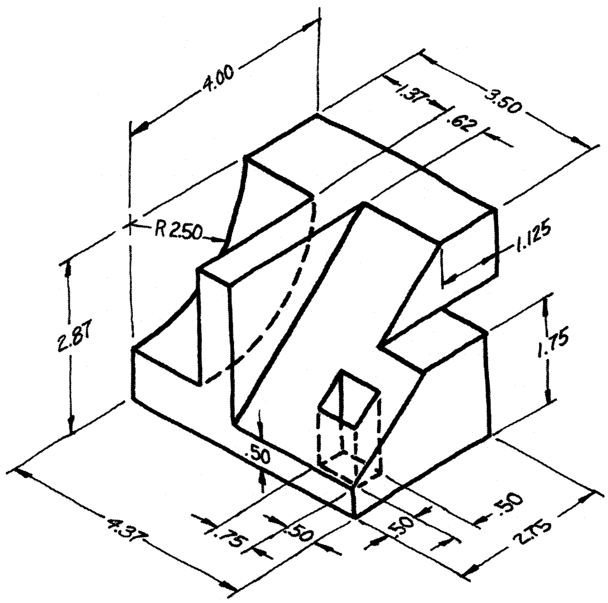
Problems may be assigned as sketching, instrument, or CAD projects. Use these projects for problems when completing Chapter 15 on dimensioning. Complete all views, and solve for proper visibility, including centerlines, object lines, and hidden lines. When laying out these projects, leave sufficient room for dimensioning. Your instructor may assign projects to be dimensioned as problems for Chapter 15.

Problem 12.1 Draw the appropriate views of the part in order to describe each of its surfaces completely. Dimension after completing Chapter 15.

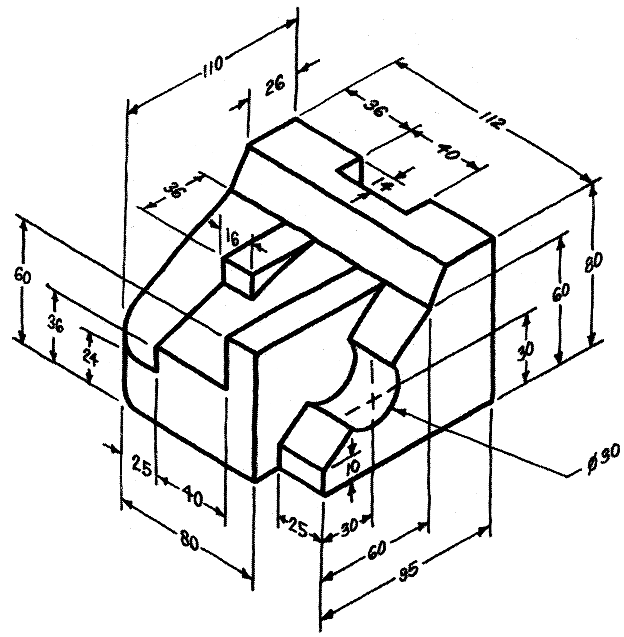
Problem 12.2 Draw the top, front, and auxiliary views of the part.

Problem 12.3 Draw the right side, top, and auxiliary views of the part in order to show each surface as true shape. Dimension after completing Chapter 15.

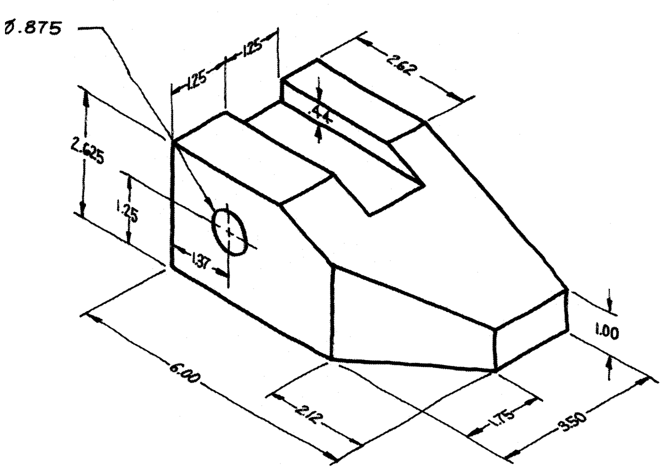
Problem 12.4 Draw the top, front, and auxiliary projections of the part.



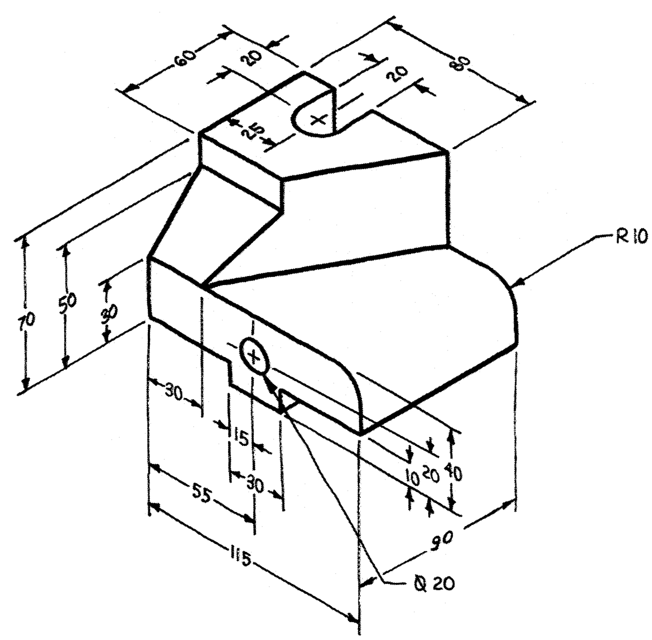
PROBLEM 12.1



PROBLEM 12.3



PROBLEM 12.2



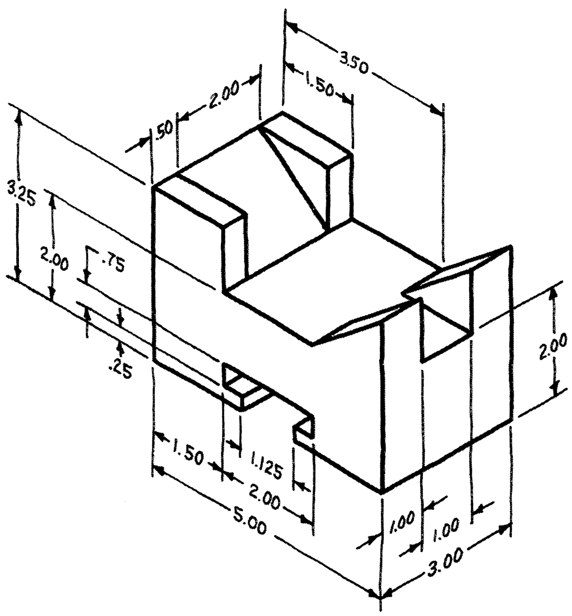
PROBLEM 12.4

Problem 12.5 Draw the front and right side views of the part. Project a true-shape view of the inclined surface. Position a 1.00 in. diameter hole near the middle of the surface, and show in all views. The hole is to be .25 in. deep with a flat bottom. Dimension after completing Chapter 15.

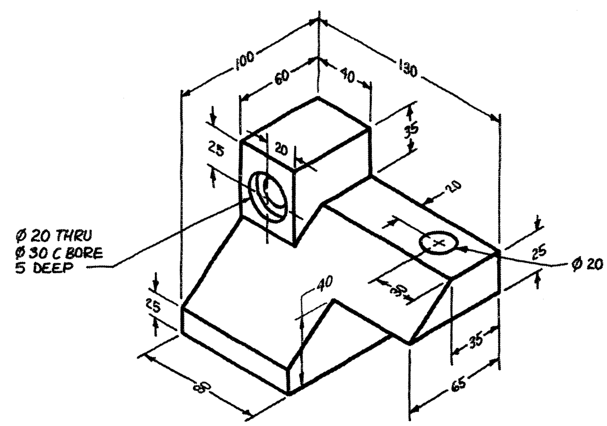
Problem 12.6 Draw the top, front, and side views and an auxiliary view projected from the top of the part. Center a 20 mm hole on the auxiliary surface. The hole is 15 mm deep with a flat bottom. Dimension after completing Chapter 15.

Problem 12.7 Draw the appropriate views needed to describe the part completely. Dimension after completing Chapter 15.

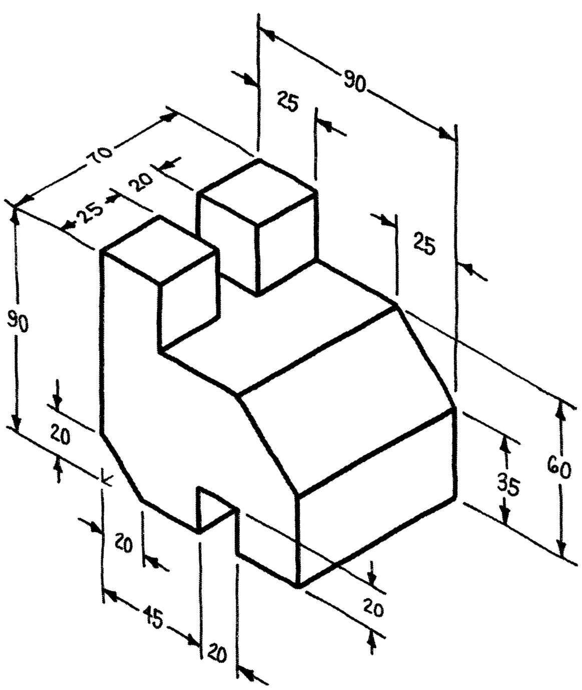
Problem 12.8 Draw the top and front views and any auxiliary views needed to display the triangular surface's true shape.



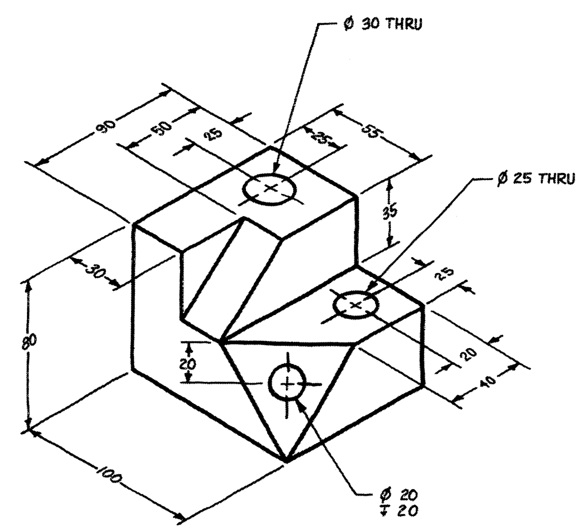
PROBLEM 12.5



PROBLEM 12.7

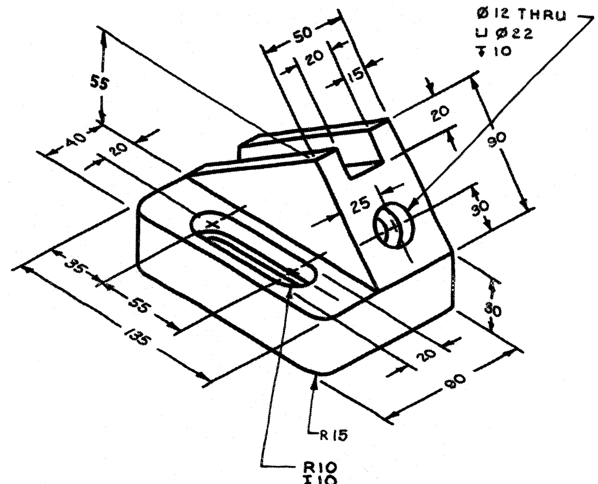


PROBLEM 12.6



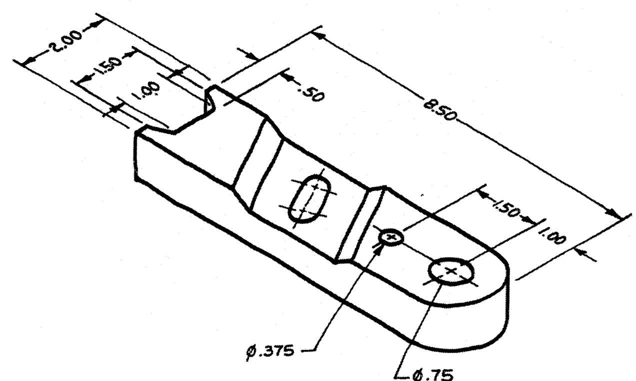
PROBLEM 12.8

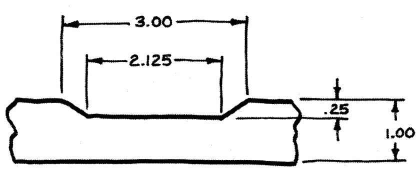
Problem 12.9 Draw the views necessary to describe the part completely. The auxiliary projection should be a complete view. Dimension after completing Chapter 15.

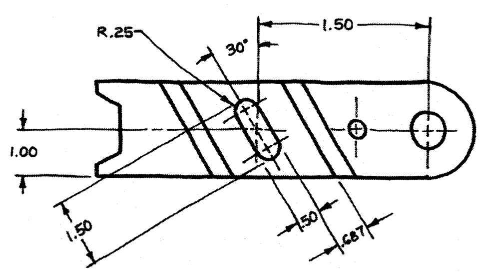


PROBLEM 12.9

Problem 12.10 Draw the views required to detail the part. Dimension after completing Chapter 15.

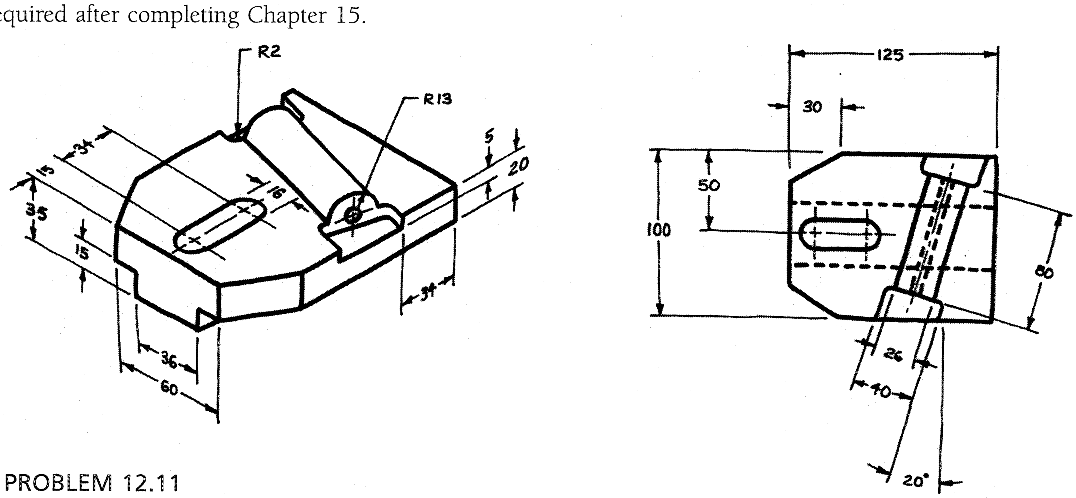






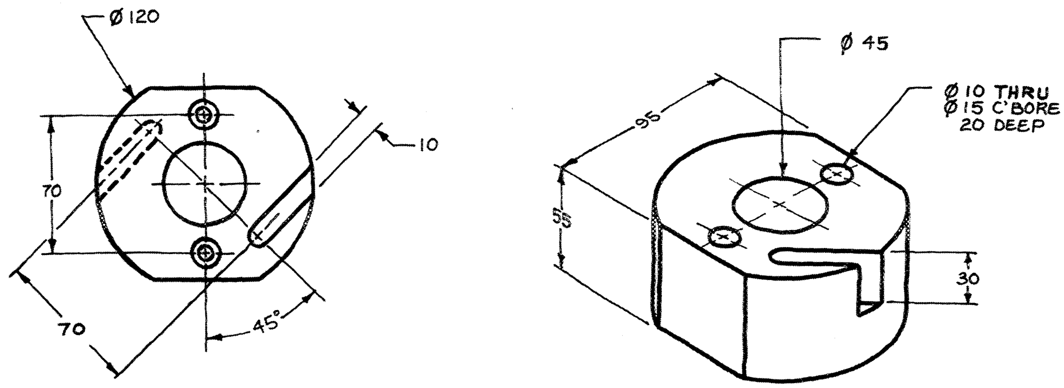
PROBLEM 12.10

Problem 12.11 Model the part in 3D, display the appropriate views, and dimension as required after completing Chapter 15.



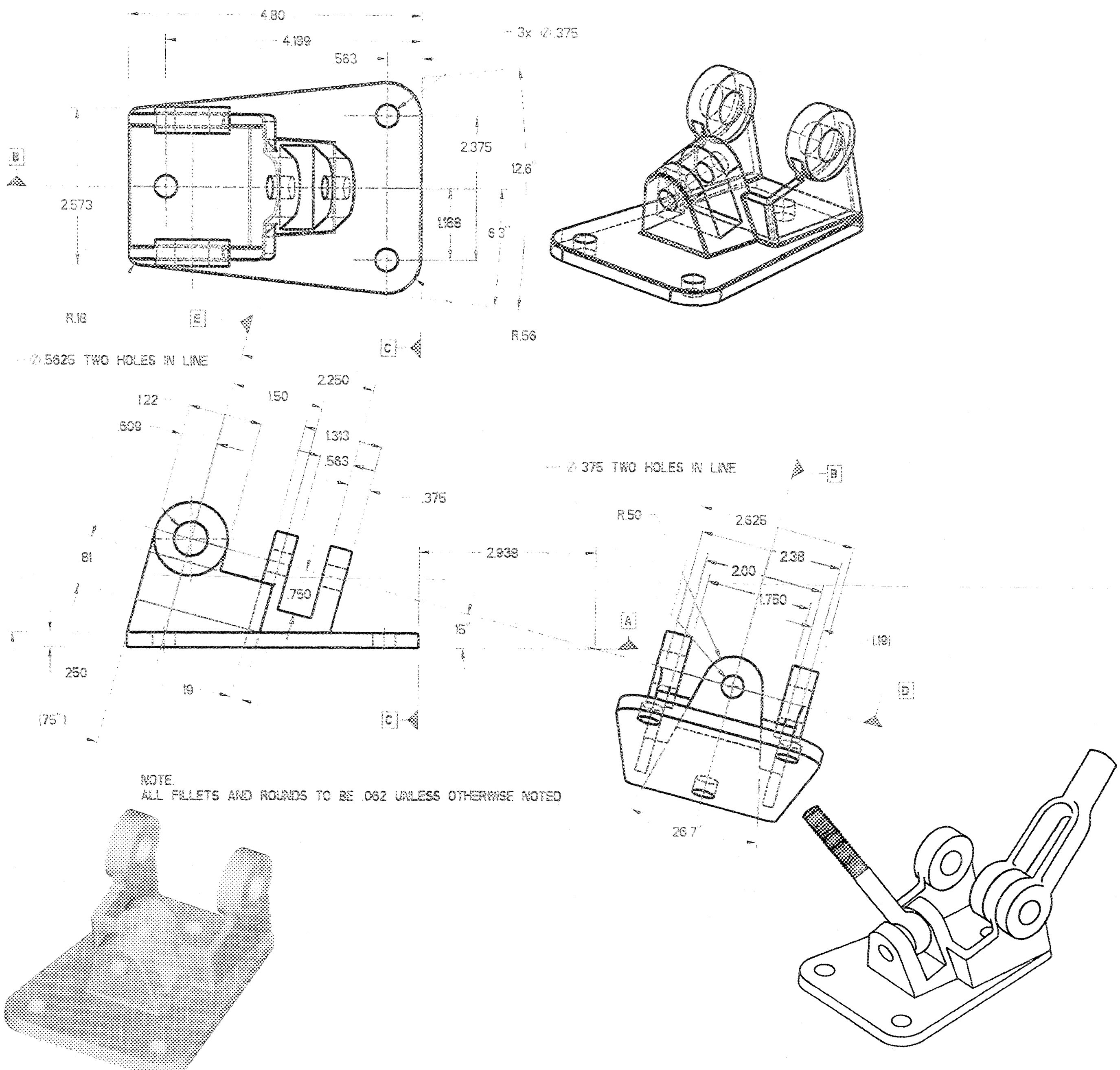
PROBLEM 12.11

Problem 12.12 Create a solid model of the part. Display the views required for dimensioning. Dimension the part as needed after completing Chapter 15.



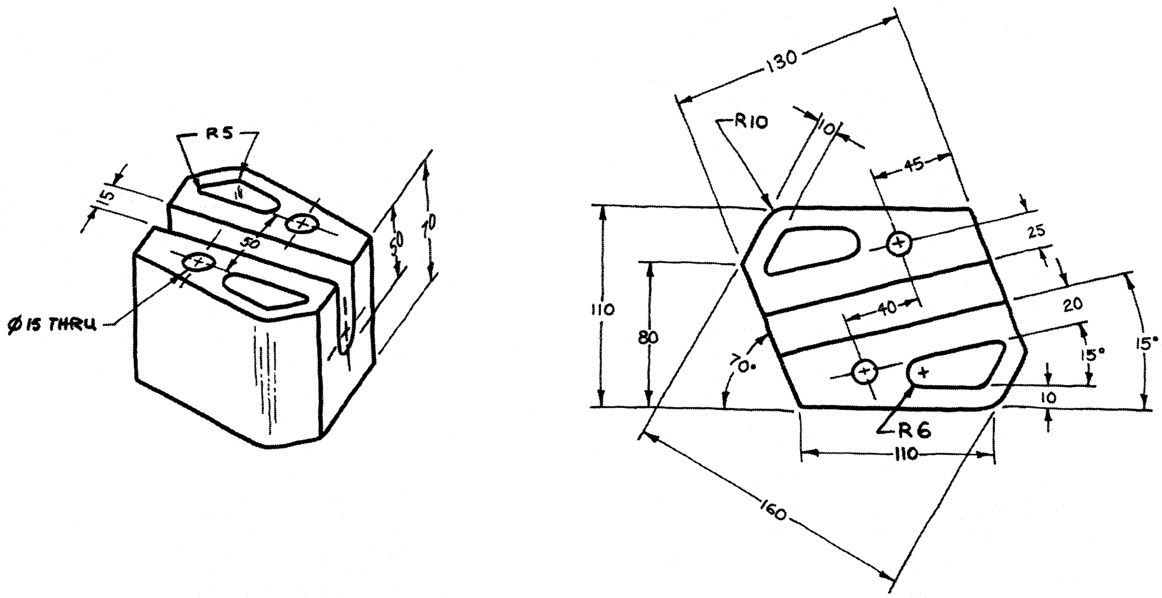
PROBLEM 12.12

Problem 12.13 Model the bracket on a 3D CAD system, and then display the proper views required for dimensioning.



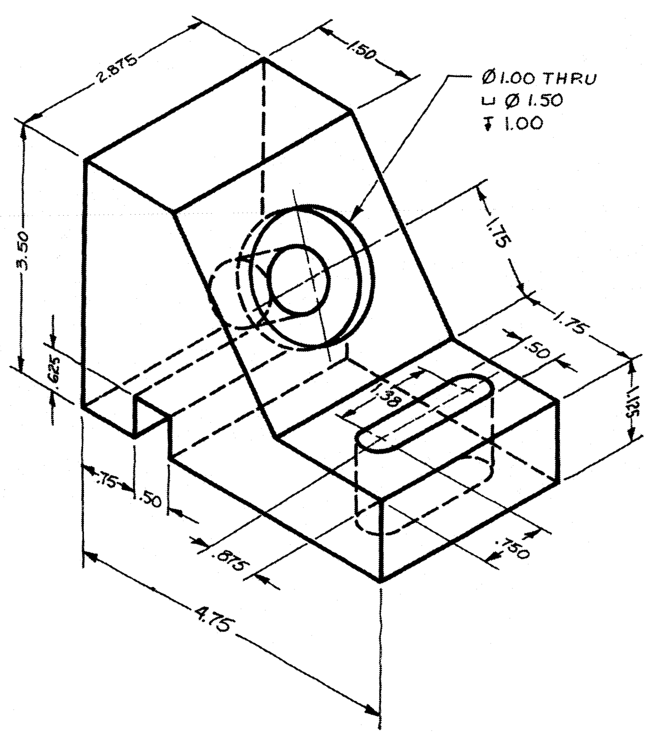
PROBLEM 12.13

Problem 12.14 Model the part, and show all required views. Dimension after completing Chapter 15.



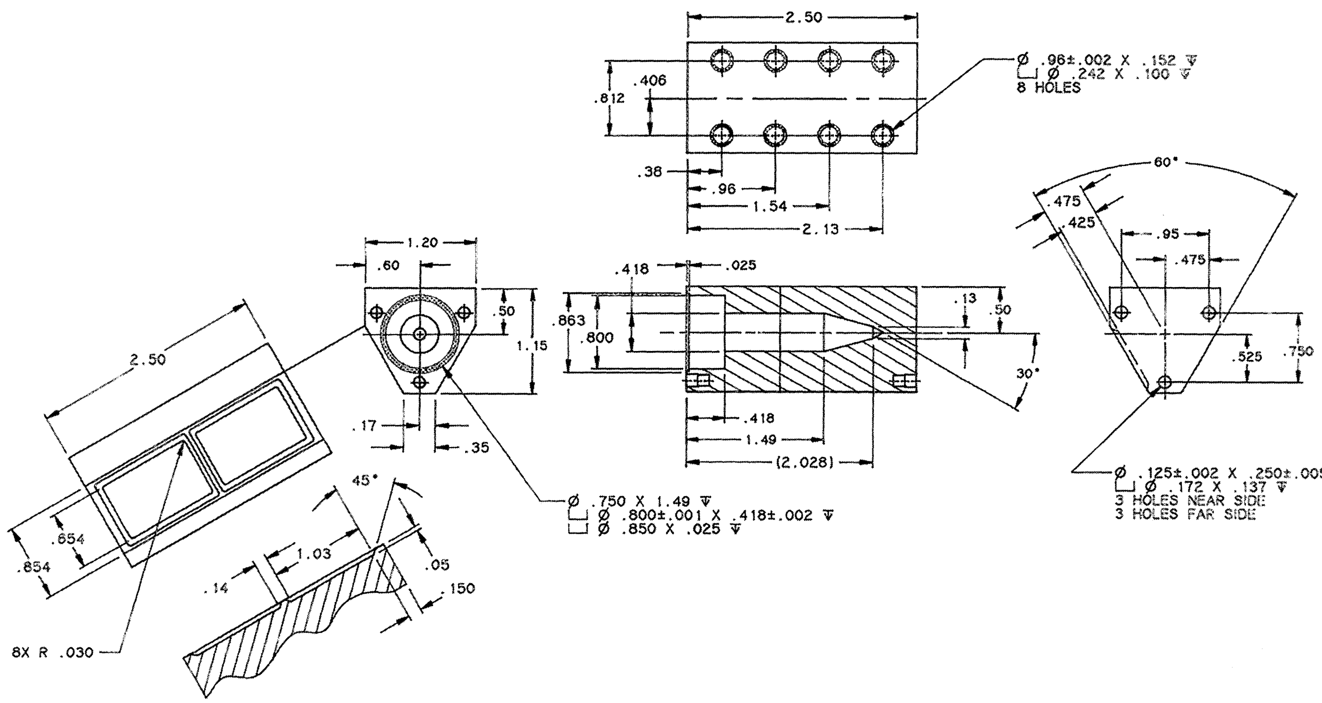
PROBLEM 12.14

Problem 12.15 Create a 3D model, and display a minimum number of views to detail the part. Dimension after completing Chapter 15.



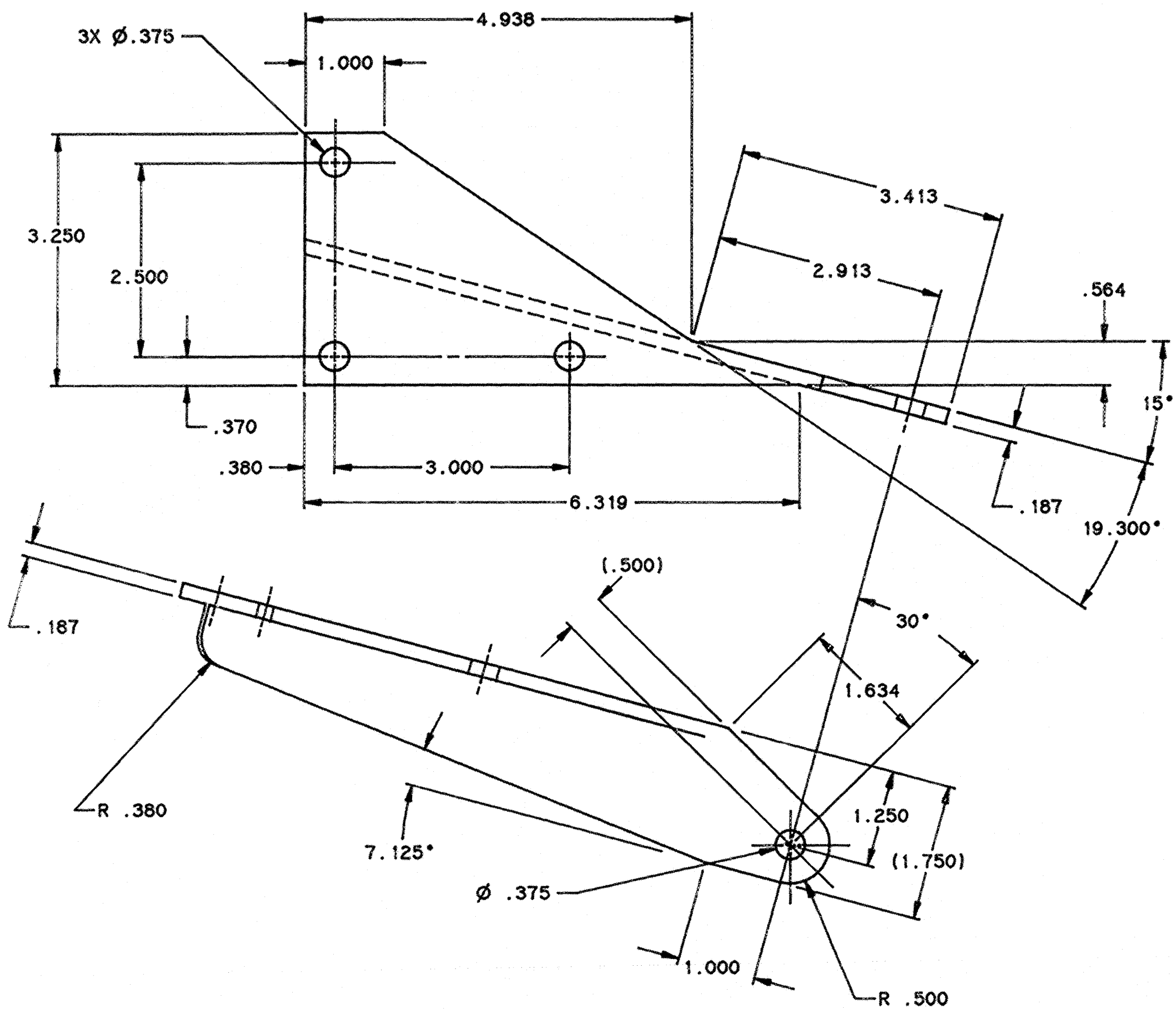
PROBLEM 12.15

Problem 12.16 Draw or model the microwave fitting. Lay out the views required to describe the part completely. Dimension after completing Chapter 15.



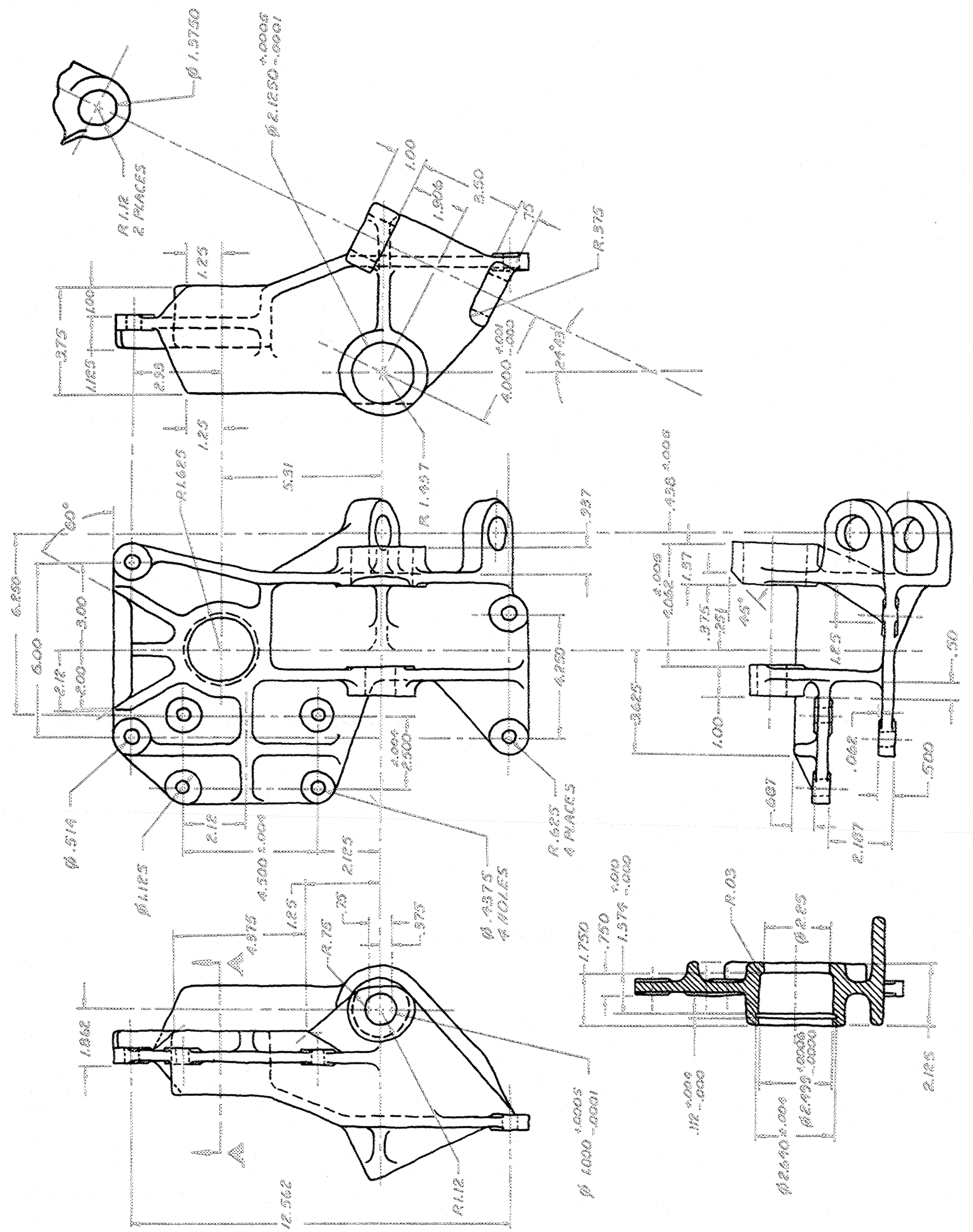
PROBLEM 12.16

Problem 12.17 Model the wind tunnel bracket in 3D, and display the required views in full. Dimension after completing Chapter 15.



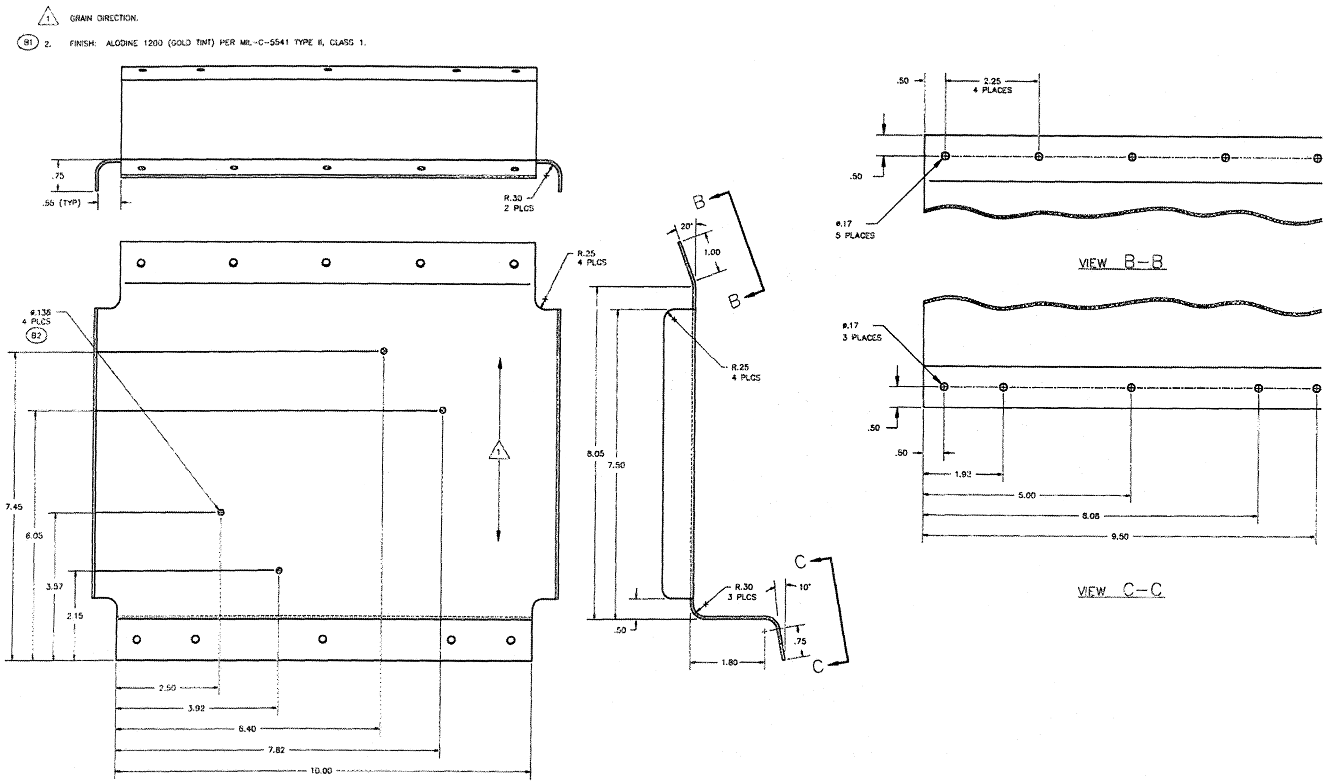
PROBLEM 12.17

Problem 12.18 Draw the views required to describe the casting. Use a .125 radius for all fillets and rounds unless sizes are called out on the drawing. Dimension after completing Chapter 15.



PROBLEM 12.18

Problem 12.19 Draw the detail of the bracket. Dimension after completing Chapter 15.



PROBLEM 12.19

Problem 12.20 Draw the part shown in Figure 12.2. Dimension after completing Chapter 15.

Problem 12.21 Draw the electronic component bracket shown in Figure 12.11. Dimension after completing Chapter 15.

Problem 12.22 Draw the part shown in Figure 12.24. Dimension after completing Chapter 15.