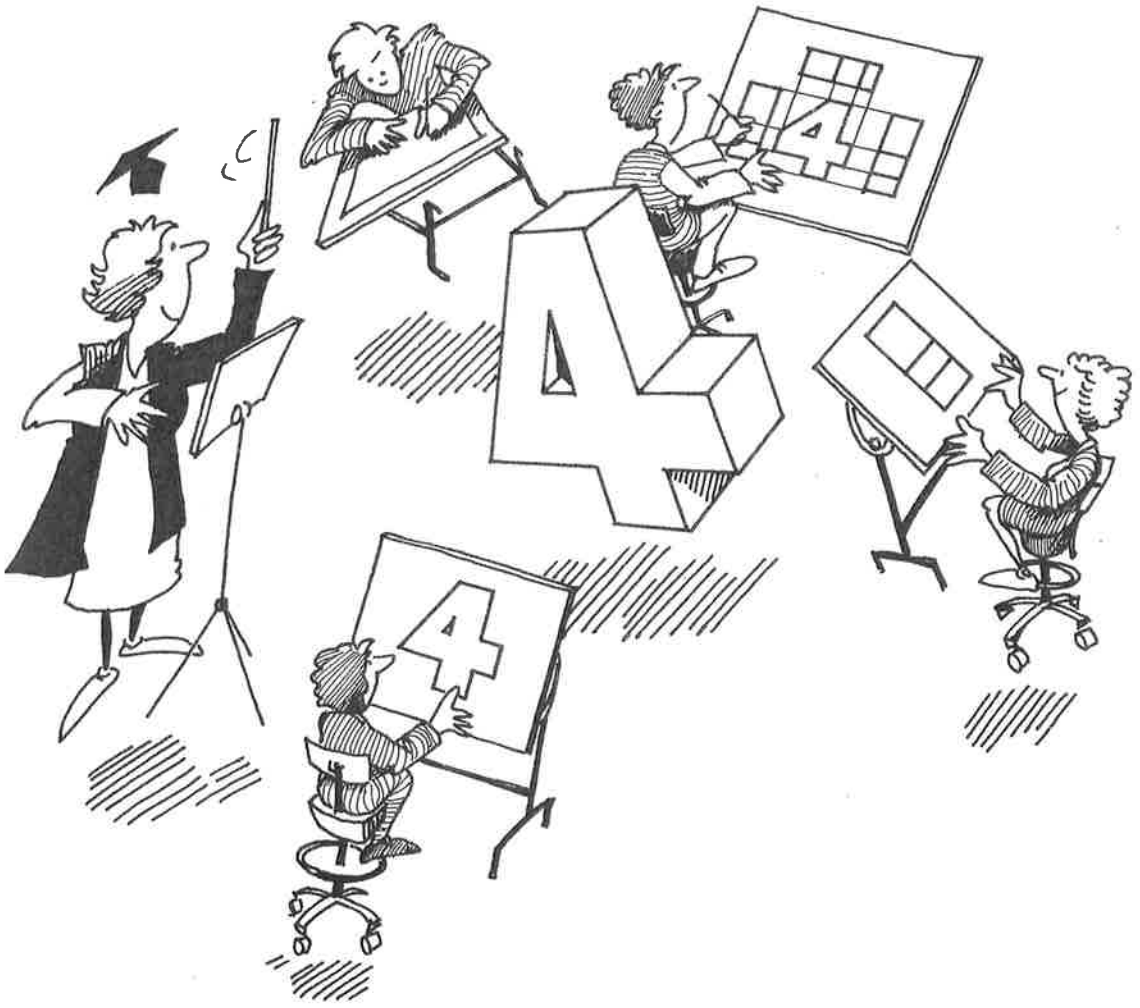
Orthogonal projection 4

First and third angle



Engineers and drafters throughout the world use the orthogonal system of projection for illustrating the shape and dimensions of many types of features. It is a multiview system in which the principal views are 90° apart in the horizontal and vertical planes, giving a total of six possible views: front, back, top, bottom and both sides.

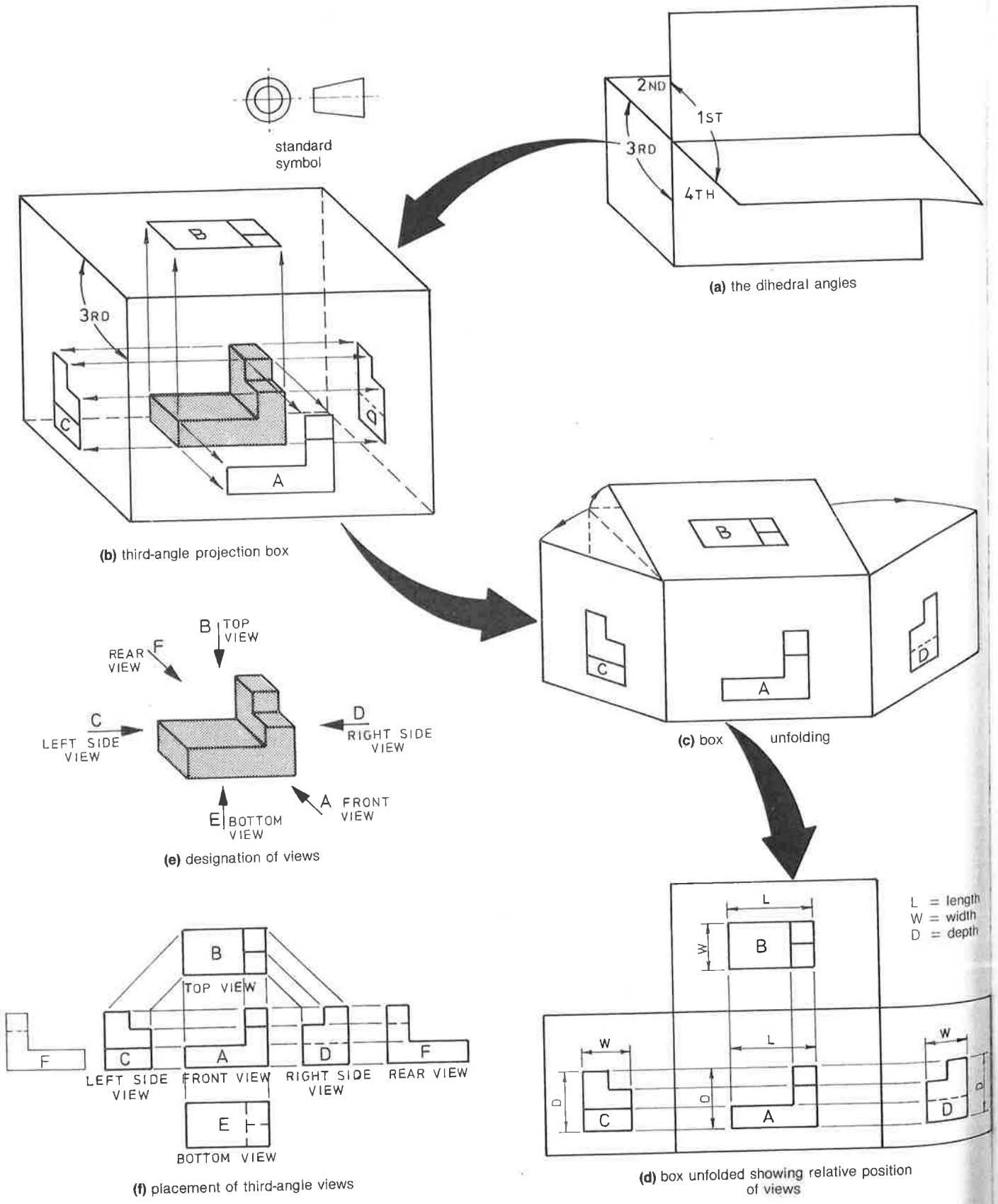


Fig. 4.1 *Third-angle projection*

Orthogonal projection

Engineering drawings are normally intended to indicate the shape and size of an object. However, all objects have three dimensions, namely length, breadth and depth, and the problem of representing these on a drawing as well as conveying an impression of shape to the reader is overcome by the use of a technique called *orthogonal projection*.

Orthogonal projection is a method of viewing an object so that a number of plane views may be obtained, each of which includes two of the object's three dimensions of length, breadth and depth.

When a horizontal and vertical plane intersect at right angles, four right angles (known as *dihedral angles*) are formed and are numbered conventionally as shown in Figure 4.1(a). Orthogonal projections are commonly based on the first and third angles and so are known as *first-angle projection* and *third-angle projection*, respectively. In the interests of standardisation, Standards Australia has recommended that the third-angle method of projection be used.

Third-angle projection

The third dihedral angle forms the basis of a six-sided transparent box (Fig. 4.1(b)), in which the object is imagined to be placed so that two of its three principal dimensions (length, breadth and depth) are contained in each of six possible views reflected onto the sides of the box. (Only four views are shown in Fig. 4.1(b); the views from underneath and from the rear are omitted for clarity.) So that the views reflected onto the sides of the box may be represented on one plane, the box is unfolded, as shown in Figure 4.1(c) and (d). Unfolding the box in this way positions the views in a unique manner with respect to each other. Such relative positioning applies universally to all views obtained by this method.

It is essential that drawings made by the third-angle method be identified, preferably by the use of the standards symbol illustrated in Figure 4.1 or by the words 'third-angle projection' printed in a conspicuous place on the drawing, usually in the title block.

Designation of third-angle views

Figure 4.1(e) illustrates the six possible viewing positions of third-angle projection, and the preferred designation of each view. However, when the method of projection is indicated by the standard symbol, the principal views shown in Figure 4.1(f) require no further identification.

Figure 4.1(f) shows the relative placement of the six designated views, which include the rear view F and the bottom view E not illustrated on the previous figures. The rear view F may be positioned as shown or on the left of the left side view C, as indicated by the light outline.

Number of views

Although six possible views may be drawn, all six are very rarely required. The number used should be just sufficient to indicate the shape of the object and to enable a clear definition of the size of all features. For most drawings, three views are adequate. However, the front view is always provided, and whatever number and combination is decided on, they should all be adjacent views. Examples of three-view, two-view and one-view drawings are shown in Figure 4.2(a), (b) and (c), respectively. In Figure 4.2(c) one view only is required because the diameter symbol defines the shape at right angles to the axis.

Other views, such as section, auxiliary, partial and revolved views, may be used in conjunction with the six principal views to more satisfactorily describe an object. They are illustrated in Chapter 1, pages 27 and 28.

Projection of orthogonal views

Because orthogonal views bear a standard relationship to each other according to the unfolding of the projection box, details such as edges, surfaces and holes located on one view may be transferred to other views by projection methods. Projecting horizontally between the front, rear and side views with the aid of a T square enables height measurements to be transferred quickly and accurately from one view to another. The front view is normally drawn first, and from it detail may be projected horizontally to the side and rear views or vertically to the top and bottom views, and vice versa.

Figure 4.3 illustrates the principle for third-angle projection, showing how detail may be projected between the two side, front and top views.

There are three methods of projecting between the top and side views: Figure 4.4(a) uses a 45° set square, Figure 4.4(b) uses compasses and Figure 4.4(c) combines horizontal and vertical projection lines from a 45° line. In Figure 4.4(a), (b) and (c), the distances between views is the same; however, the distance may be varied by moving the projection quadrant to the side, as in Figure 4.4(d). The top view may be moved further from the front view without altering the side view in a similar manner. The ability to vary the distances between views at will is necessary for proper layout of the views on the drawing sheet.

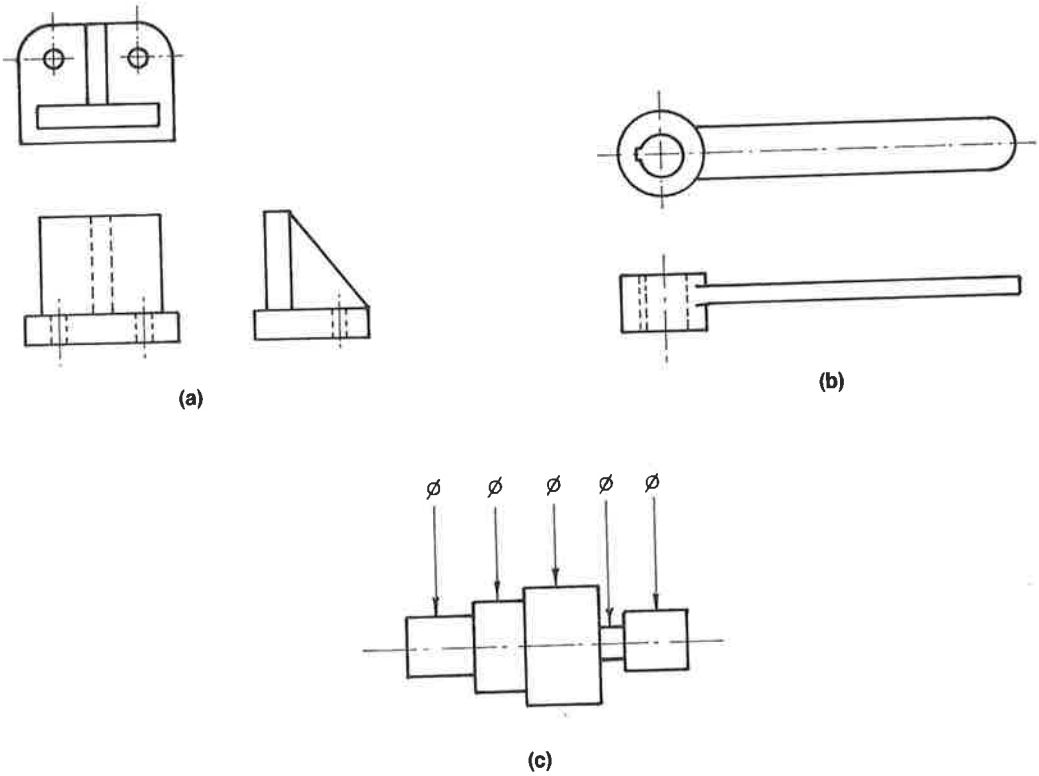


Fig. 4.2 *Choosing the number of views*

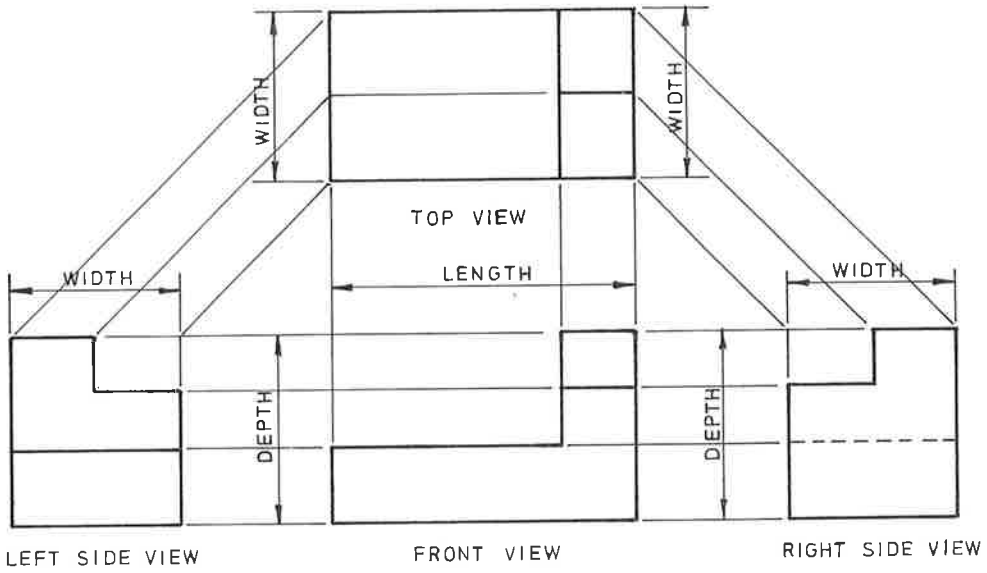


Fig. 4.3 *Relationship of orthogonal views*

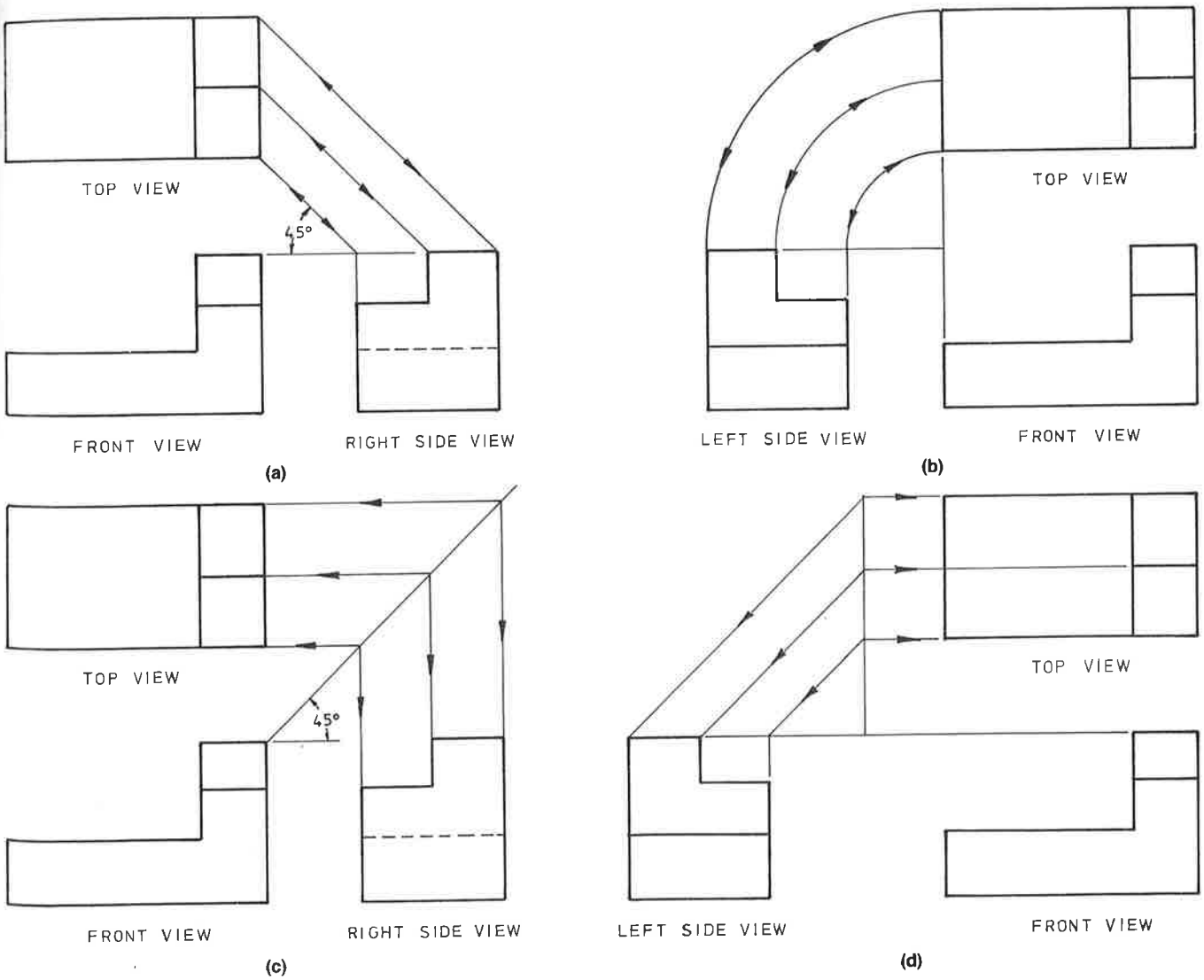


Fig. 4.4 *Methods of projection between views*

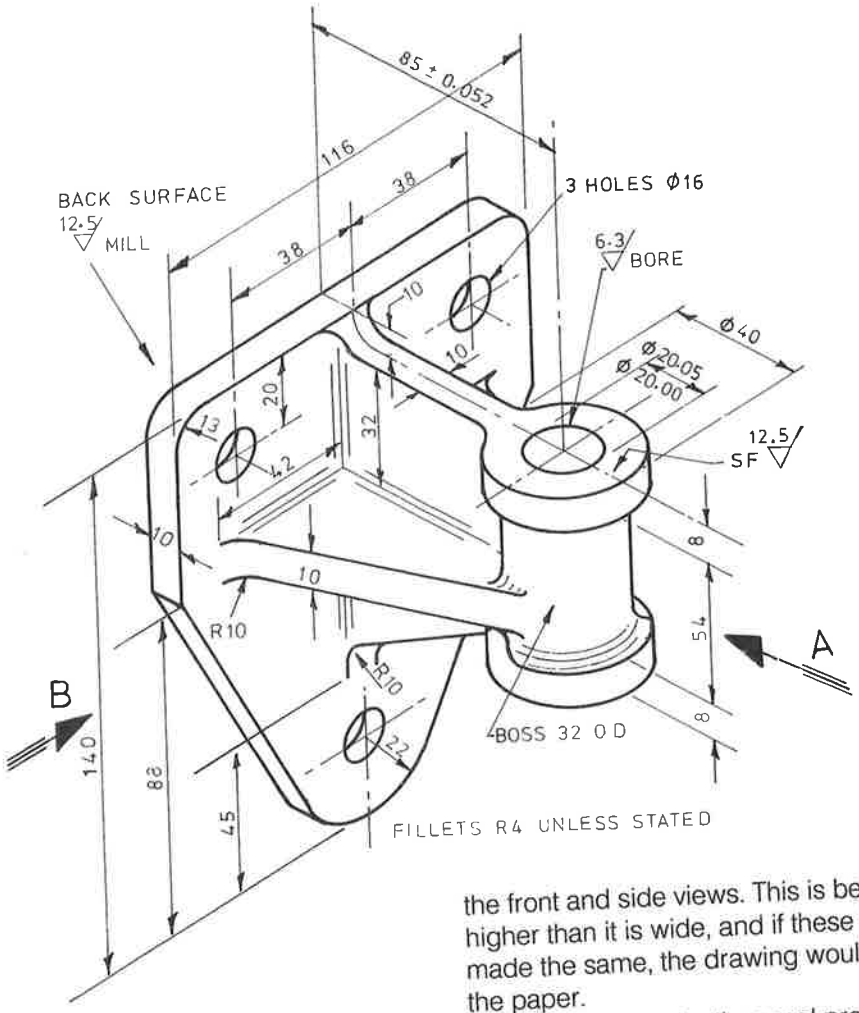


Fig. 4.12 *Wall bracket to be drawn*

Drawing of title block, parts list and revisions table

A suitable layout for these three items is given in Figure 1.6, and a general description on page 8. For this exercise a title block only is required, and it is inserted in the bottom right-hand corner of the sheet, as shown in Figures 4.9 and 4.10.

The completed orthogonal projection

Figures 4.12, 4.13 and 4.14 demonstrate the drawing of a simple mechanical component in third-angle orthogonal projection.

Figure 4.12 shows an isometric view of a cast-steel wall bracket. The following views in third-angle orthogonal projection are to be drawn:

1. a front view in direction A
2. a side view in direction B
3. a top view

The drawing is to be fully dimensioned and supplied with a suitable title block. The scale is full size.

Figure 4.13 shows the rough sketch for the calculation of the positions of the three views on the drawing sheet. Notice the space between the top and front views is 40 mm compared with 75 mm between the front and side views. This is because the bracket is higher than it is wide, and if these two spaces were made the same, the drawing would appear cramped on the paper.

The completed orthogonal projection is shown in Figure 4.14. This should be studied carefully to ensure full understanding of the relationship that exists between the detail on the views. Attempt to do the drawing within an A2 size drawing frame using the measurements given in Figures 4.12 and 4.13 and without referring to Figure 4.14.

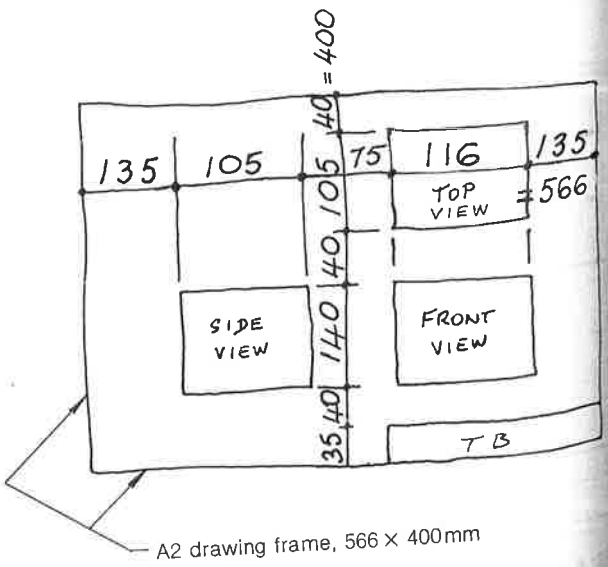


Fig. 4.13 *Calculations for view positions*

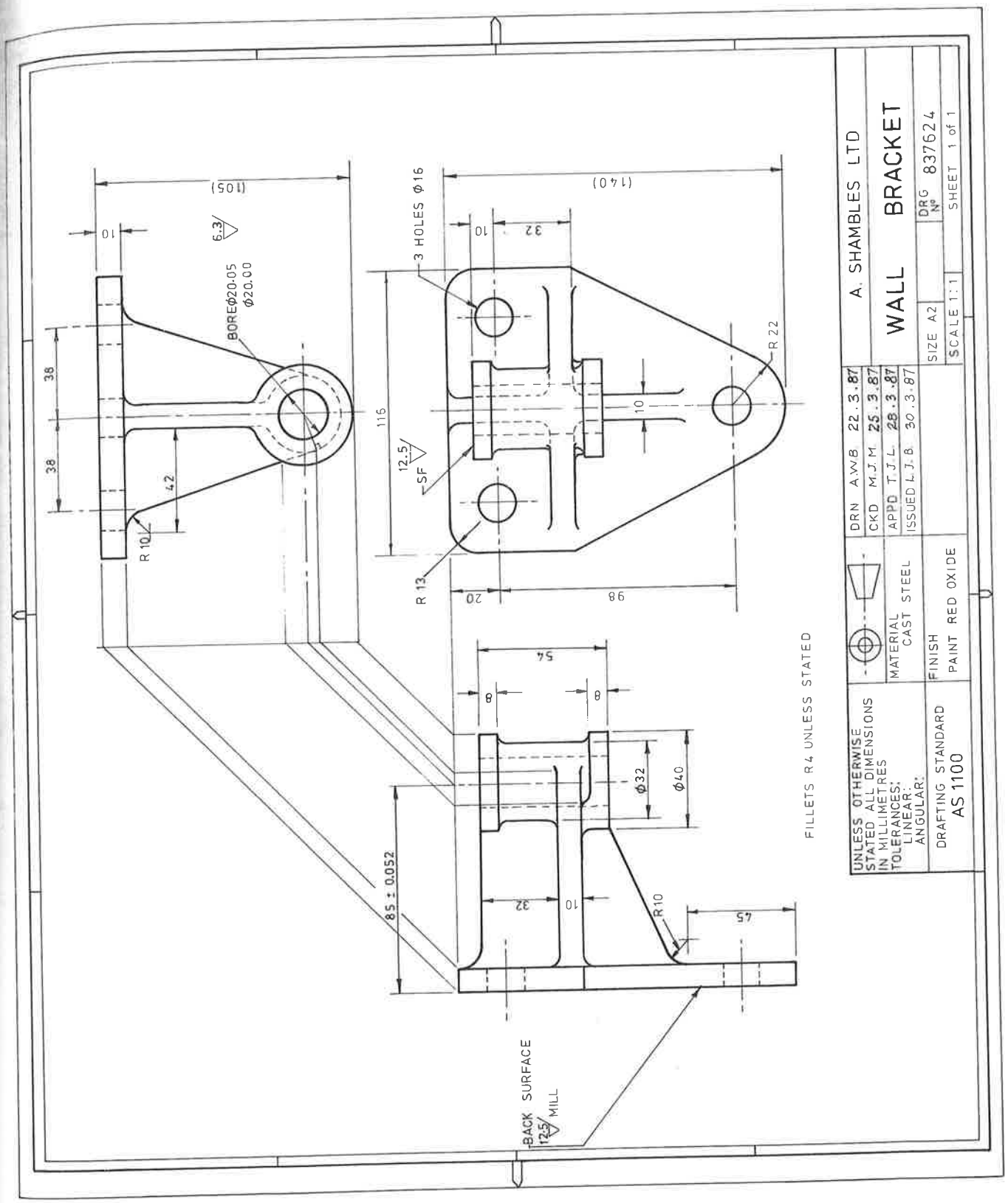


Fig. 4.14 *Completed orthogonal projection*