

# CHAPTER 4

## Sketching and Drafting Orthographically— Theory

### OBJECTIVE

- This chapter discusses how to sketch and draft orthographic views of furniture pieces.

### KEY TERMS

elevations

foreshortened

multiview drawings

orthographic drawing

orthographic projection

perspective

picture plane

plans

projection line

sketching

true length

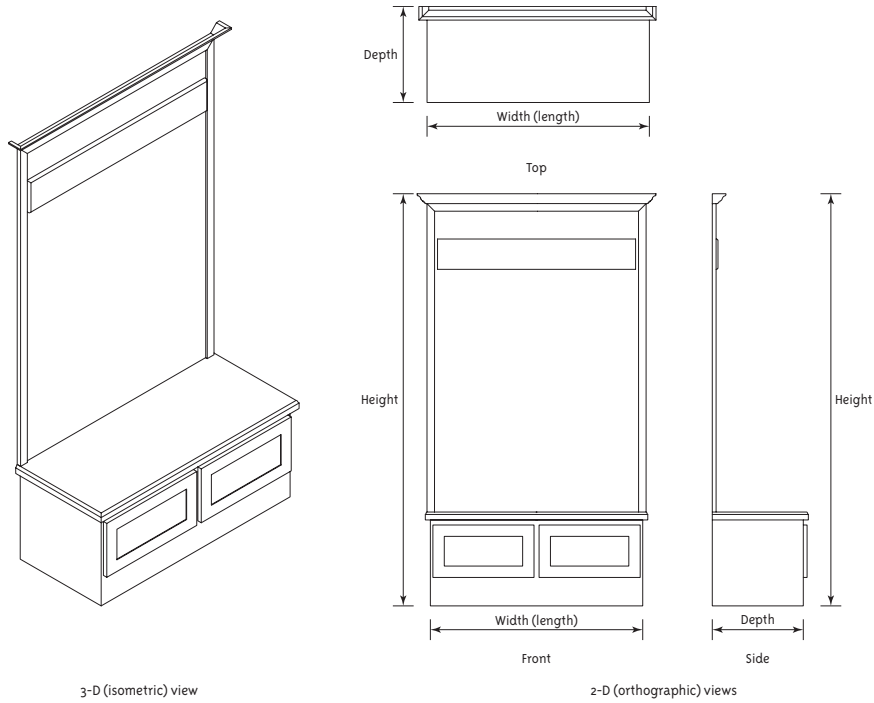
All objects have three physical dimensions: height, depth, and width (or length). An **orthographic drawing** is one that shows two of an object's three dimensions. Interior designers frequently draw orthographic views of rooms and furniture (Figure 4-1). These drawings are created via **orthographic projection**, a drawing technique that deconstructs a 3-D object into multiple 2-D views (Figure 4-2). They are also called **multiview drawings** because multiple views are typically needed to describe the object.

Visualize an object suspended in a glass cube. Each side of the cube is a **picture plane**, a flat surface onto which the suspended object is projected. Think of the object as exploding apart with each side projected (thrown straight ahead) onto the picture plane facing it. **Elevations** are orthographic views projected onto vertical planes. **Plans** are orthographic views projected onto the horizontal plane. These views are flat and depthless, like the planes they're projected onto. This is because only two of the object's three dimensions are shown.

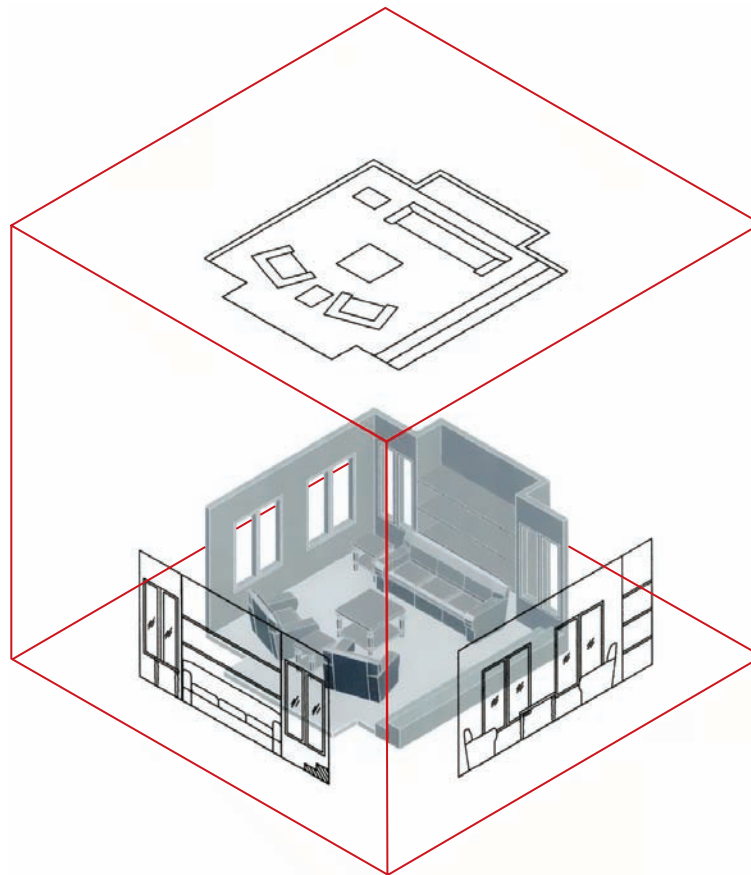
*Ortho* is a prefix with Greek origins. It means *straight, perpendicular, vertical, or correct*. *Orthodoxy* (meaning *correct teaching*) and *orthodontist* are modern usage examples. In drafting, *ortho* means at a 90-degree angle to the picture plane. To project orthographically means to project perpendicular to something.

### Why Orthographic Drawings Are Used for Construction Purposes

Orthographic drawing technique is used because it produces drawings that document space and objects in a way that is measurable and proportionately accurate, unlike the way we see it. Because of the way our brains perceive depth, we see things in **perspective**; objects appear to be smaller as they get farther away, and sets of parallel lines appear to converge to a common point.



**Figure 4-1**  
3-D and 2-D views of a hall bench. The multiple 2-D views show its size and shape. The front view shows height and width. The top shows width and depth. The side view shows depth and height.



**Figure 4-2**  
Orthographic drawings are made by deconstructing a 3-D object into multiple 2-D views.

Furthermore, each time we change our position relative to the object, we see a new shape and new proportions. Although perspective drawings are good for visualization, they are unsuitable to build from. Orthographic drawings best communicate the details needed for construction, because they provide views that correspond to the subject's actual, or measurable, proportions.

## How Many Drawings Are Required?

The number of drawings required depends on the project. If the goal is to design a very simple object, one view plus a note might suffice. However, most projects require more than this. Buildings can require hundreds of drawings. The number needed is the number that completely describes the project.

### Sketching

**Sketching** is freehand drawing. It is used to think a problem through and solve it. Hence, it is helpful to sketch an object before hard-lining it. Attempting to problem-solve while simultaneously hard-lining slows down both processes.

Sketching is not synonymous with sloppy work. Sketched lines should be neat, long, and continuous, not short and overlapped. Tip the pencil in the direction of movement. A dark pencil and eraser work well, although using a light lead first and darkening later also works. Keep your eye on the point where the line ends to help draw lines straight.

### Orthographic Sketching

Visualize a cube with its sides unglued, lying flat on a table, each plane containing a view of the object (Figure 4-3). When the views are drawn, they will be carefully placed within each plane so the object edges will align. Object lines that are parallel to the picture plane show up **true length**, which means actual length. Object lines that are skewed to the picture plane show up **foreshortened** length, which means shorter than actual length. Object lines that are perpendicular to the picture plane show up as points. An object (or a feature on an object) whose boundaries consist entirely of true length lines shows up true shape and size. An object whose boundaries contain foreshortened lines does not show up true shape and size, and hence is not measurable.

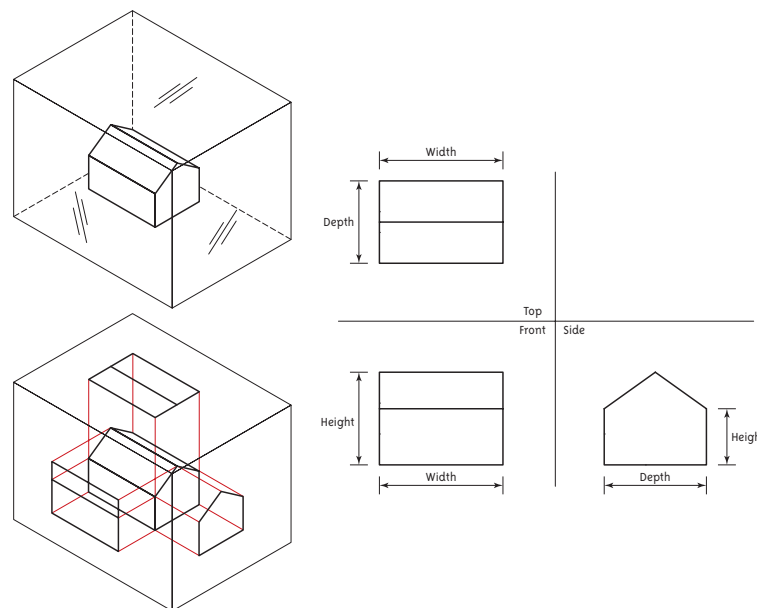


Figure 4-3  
3-D view of a house suspended inside a "glass box" of picture planes, and the corresponding 2-D views.

## Square Table

Figure 4-4 is a perspective drawing of a square table. Let's sketch two orthographic views of it (Figure 4-5).

The top view is sketched from a birds-eye view; that is, the viewer is looking straight down on it. Its overall dimensions are measured and an outline is drawn. Details are measured and added. All edges are parallel to the top picture plane, so all lines are true length, making the view true in shape and size. Note that it is oriented so lines can be projected down to create the frontal view directly below.

**Projection lines** are construction lines along which points and features are transferred from one plane to another. They are drawn lightly and at 90 degrees (perpendicular) to a picture plane, never at any other angle.

The front view is sketched with the viewer standing on the floor, looking straight at the table. The projection lines from the top view define the table's width. All edges are parallel to the frontal picture plane, so this view is also true in shape and size.

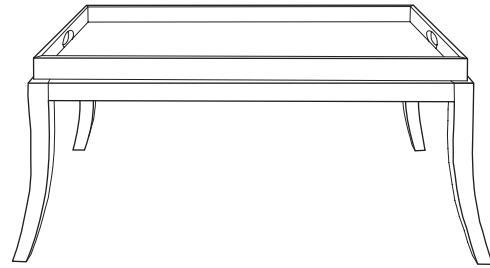


Figure 4-4  
3-D (perspective) drawing of a square table.

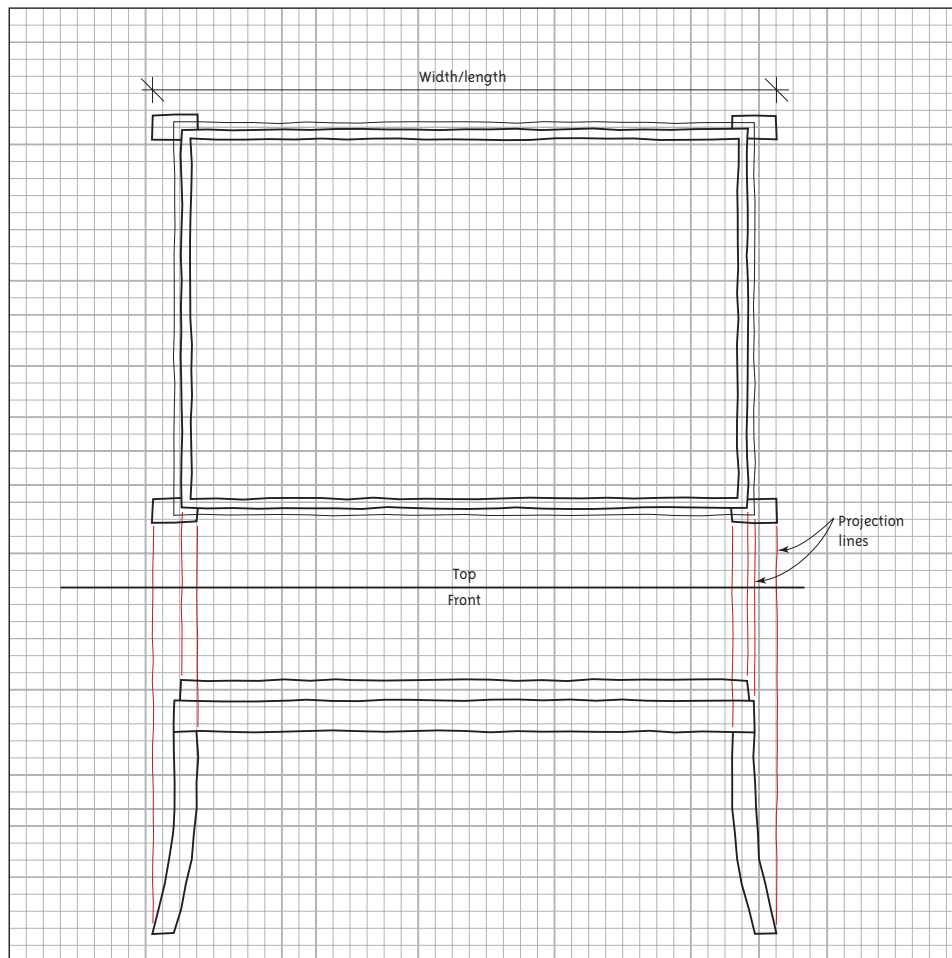


Figure 4-5  
Top and front orthographic views of the square table from Figure 4-4. All lines are parallel to the picture planes they are in, making the views true in shape and size.

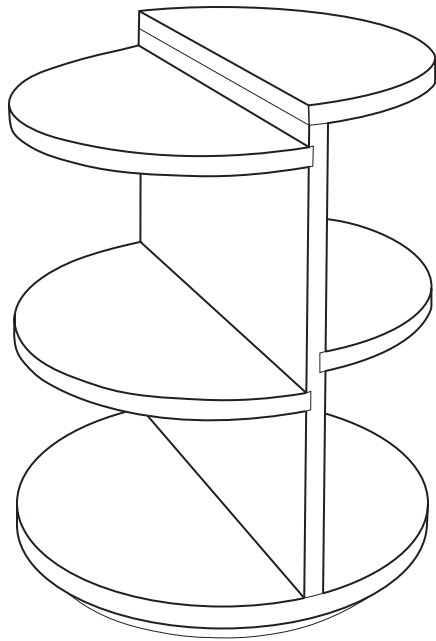


Figure 4-6  
3-D (perspective) drawing of a round table.

## Round Table

Figure 4-6 is a perspective drawing of a round table. Let's sketch two orthographic views of it.

The table top is measured and sketched in the top view of Figure 4-7. Because its circular lines are parallel to the top picture plane it is true in shape and size. The hidden line represents the round platform underneath the table, which cannot be seen from the top. Projection lines are drawn down to the front view, which define the table's width. However, since the shelves' curved lines are not parallel to the frontal picture plane, they appear **foreshortened**, meaning shorter than their true length. Since a shape with boundaries of foreshortened lines does not appear true in shape and size, we cannot see that the shelves are round.

Once the problem of constructing these tables orthographically has been solved, drafting them with straight-edged tools becomes easier, because the sketches, which is where the problem-solving occurred, serve as a reference. Precise, hard-lined drawings, are needed for construction, and for them, straight-edged tools are brought out.

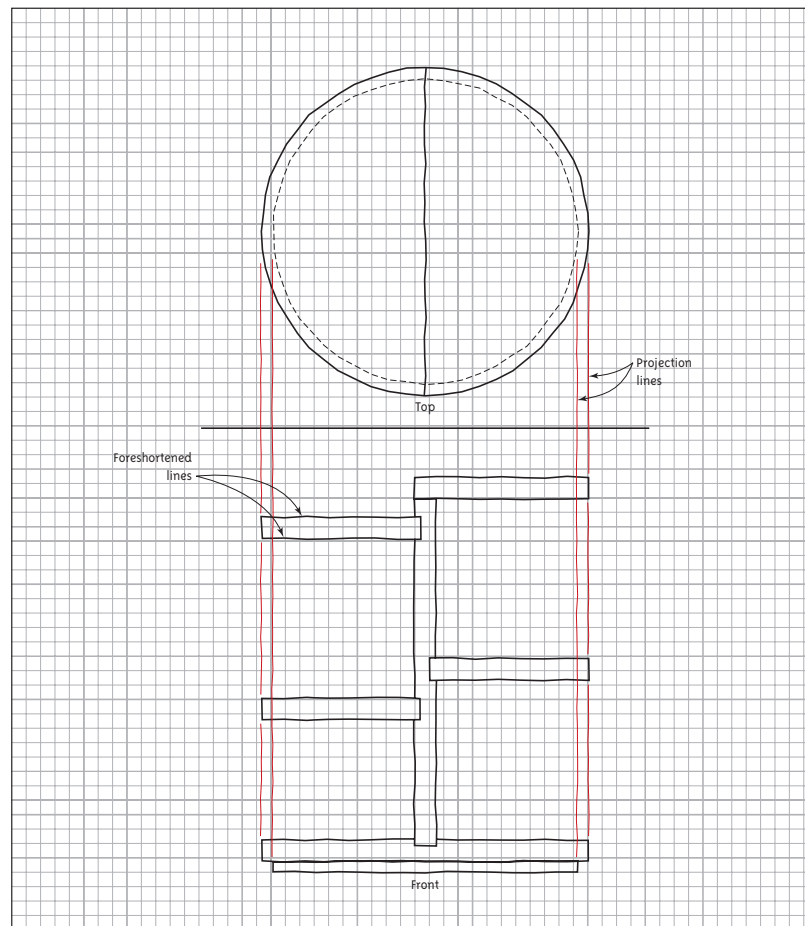


Figure 4-7  
Top and front orthographic views of the round table from Figure 4-6. The shelves in the front view are foreshortened, because they are not parallel to the frontal picture plane.

# Orthographic Drafting

## Cabinet

Figure 4-8 shows an isometric drawing of a cabinet. Let's draft three orthographic views of it.

**Top** This image is drawn from a birds-eye view, looking straight down. Measure the cabinet's length and width, and then draw a rectangle with those dimensions. Note the orientation. It is oriented so lines can be projected down to the frontal plane to create a frontal view. Add a door and knob at the front.

**Front** This view is drawn standing on the floor, looking directly at it. Projection lines from the top plane define the cabinet's width, so there is no need to measure it again. Measure and mark the cabinet's height. Draw a rectangle with these measurements. Then measure and mark the individual drawers and knobs.

**Side** This is drawn standing on the floor, facing one side of the cabinet and looking directly at it. Projecting lines from the front view will define the cabinet's height. Its width must be measured again and marked off.

Notice the line weights in Figure 4-9. The strongest, most predominant feature is drawn with the heaviest lines. Here, that feature is the outline. The eye is led to the outline, reading it first, and then is led to the thinner drawer and knob lines.

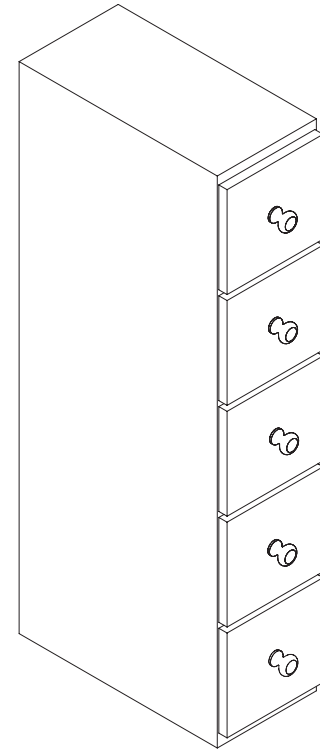


Figure 4-8  
3-D (isometric) drawing of a cabinet.

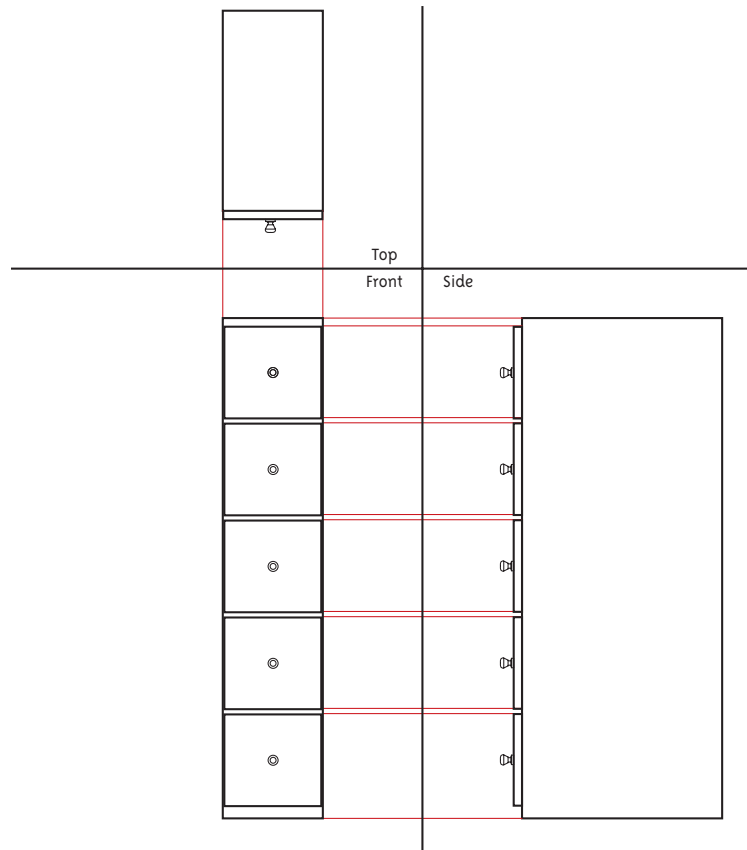


Figure 4-9  
Top, front, and side orthographic views of the cabinet from Figure 4-8.

## Chest of Drawers

Let's construct orthographic views of a more detailed item, the chest of drawers shown in Figure 4-10.



Figure 4-10  
Perspective drawing of a chest of drawers.

**Top** Measure and mark the chest's length and width, the top overhang, and the plate rail. Draw the outline first, then add detail. Note the hidden (dashed) lines. Hidden lines represent features that can't be seen in a view but must still be acknowledged. In this case they represent the chest's perimeter, which can't be seen because of the lid overhang, and the legs (Figure 4-11). Hidden lines for the drawers are left out for clarity.

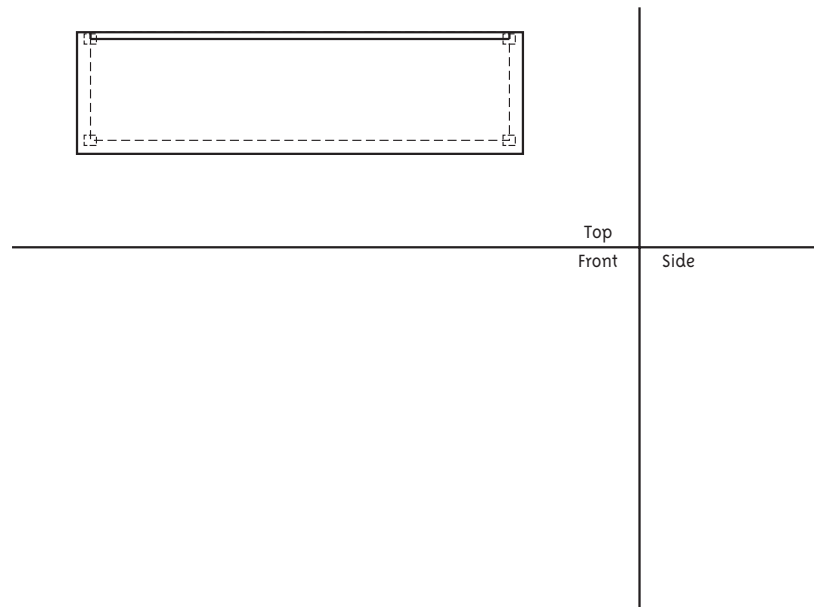


Figure 4-11  
Top view of the chest of drawers from Figure 4-10.

**Front** Project the chest, plate rail, and overhang's width down from the top view. Measure and mark the chest's height, then all measure and mark the heights of all the details (here, the apron rail, handles, and plate rail). Look at the overhang. You can see its thickness and how much it projects at the sides, but because of the lack of depth you can't see how much it projects at the front (or if it overhangs at all). It's only in the side view that the front overhang is visible. There are no hidden features in the front view, so there are no hidden lines (see Figure 4-12).

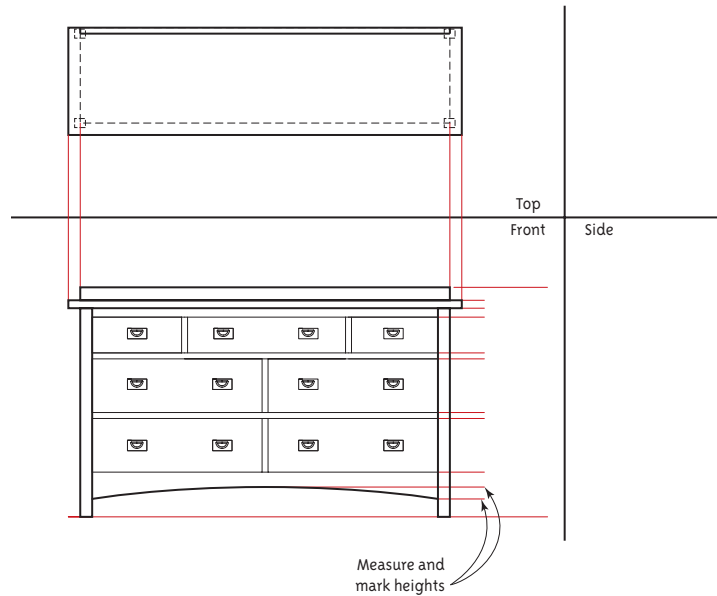


Figure 4-12  
Front view of the chest of drawers from Figure 4-10 projected from the top view.

**Side** Project the heights of the chest, plate rail, and drawers horizontally over from the front view. Note that in Figure 4-13 the drawers are indicated with hidden lines because they can't be seen.

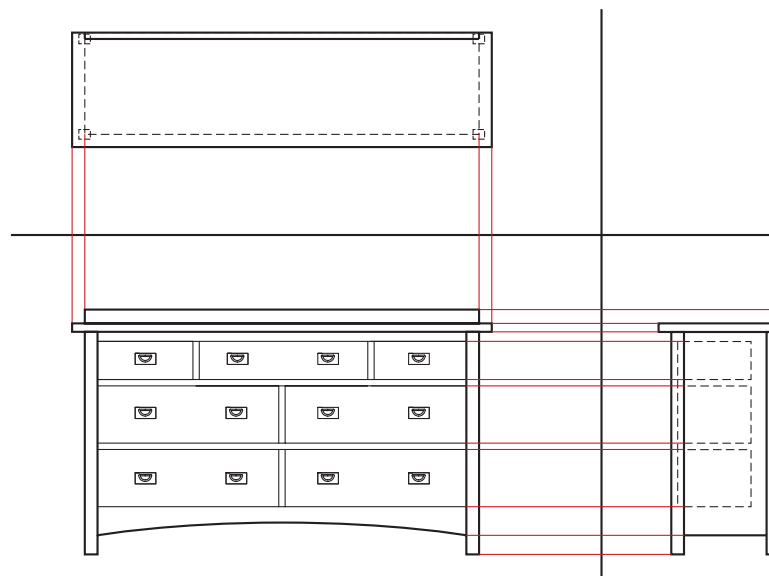


Figure 4-13  
Side view of the chest of drawers from Figure 4-10 projected from the side view.

## Drawing a Third View

At times a drafter might have two views of an object and be asked to create a third. Although a third view of any object can be created by measuring the width and depth in the available views with a scale or dividers, constructing it orthographically is an easier option if the object is detailed.

If you have top and side views, creating a front view is straightforward; simply project information down from the top view and horizontally from the side view. But if you only have front and side views, how do you construct the top (or, if you only have top and front views, how do you construct the side)? Figure 4-14 shows front and side views of a hope chest. Figures 4-15 and 4-16 show how to construct the top view.

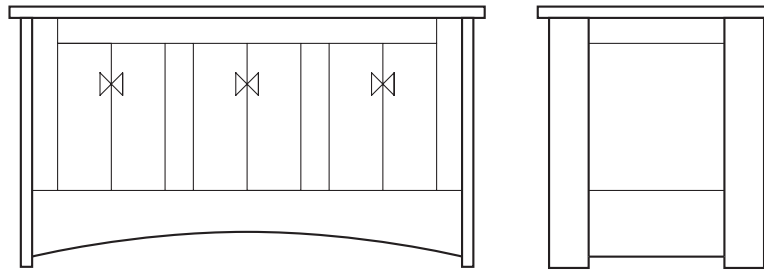


Figure 4-14  
Front and side views of a hope chest.

1. Draw lines that delineate the picture planes. Since no partial top view already exists, these lines can be drawn anywhere between the views. Project lines straight up from the front view to the top.
2. Information from the side view must now be transferred to the top. To do this, the quadrant directly above the side view must be bisected with a 45-degree angle. (When a 90-degree angle is bisected, the result is two 45-degree lines. This is why a 45-degree line is used.)

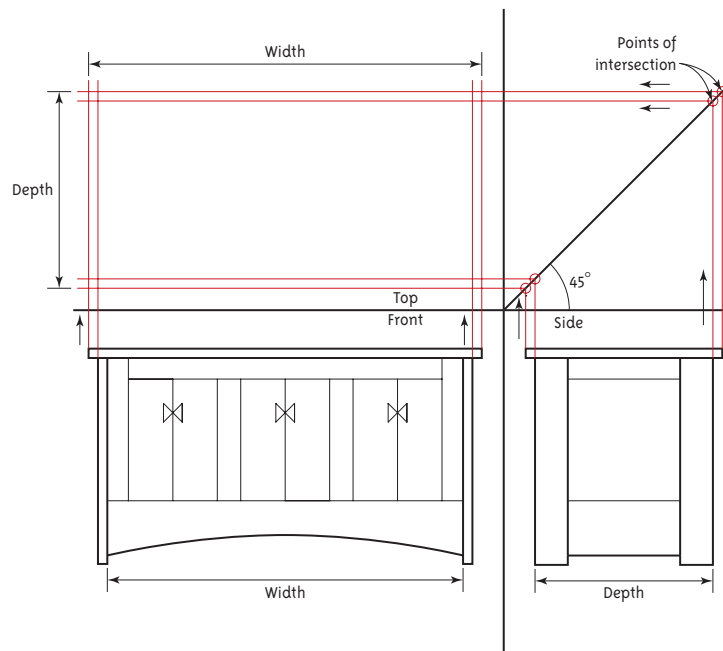
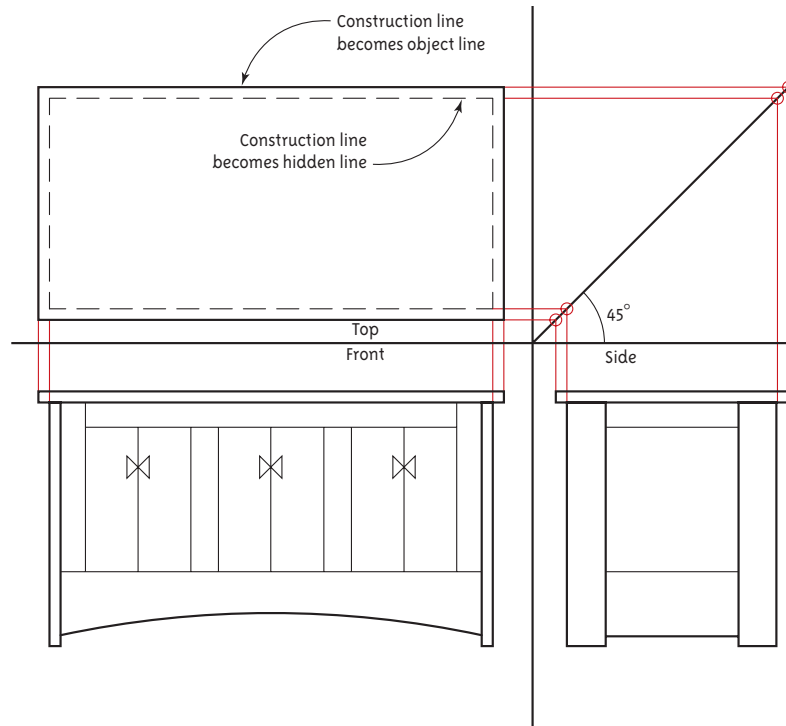
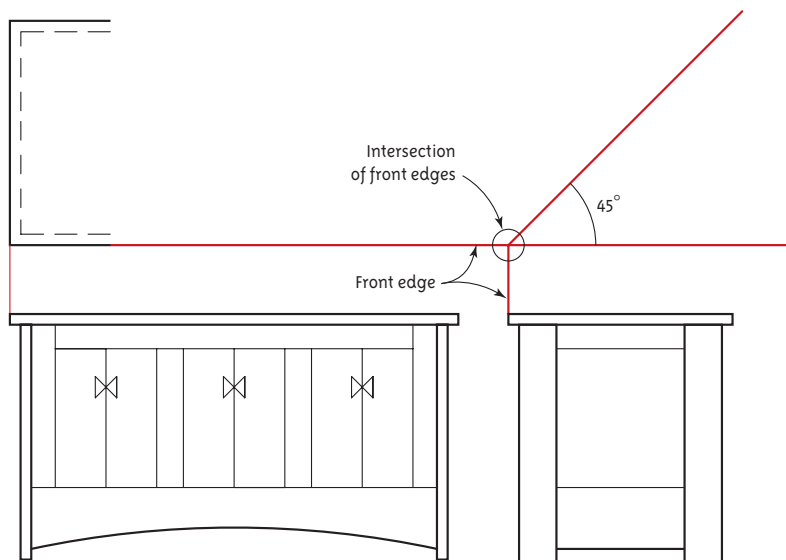


Figure 4-15  
Construction of the third view starts with drawing cross-lines to represent the picture planes, and a 45° angle line at their intersection. Lines are then projected from the front view up to the top, and from the side view to the angle, then horizontally to the top.



**Figure 4-16**  
Darken the object lines and turn the appropriate construction lines into hidden lines.



**Figure 4-17**  
When partial views exist in all three picture planes, connect the front edge in two views. Where those edges intersect, draw the 45-degree line.

3. Project lines from the side view up to the angle and, where they intersect, project lines horizontally to the top view. Alternatively, the width and depth from the existing views could simply be measured with dividers and transferred to the top view.
4. All the lines needed to draw the top view now exist. Darken the perimeter, which represents the chest lid. Darken the hidden line, which represents the edge of the chest.

Note that if a partial view of the top exists in addition to the other two views, the intersecting lines that represent the picture planes and the 45-degree angle line cannot be placed randomly between the views. Instead, they must be placed precisely. As shown in Figure 4-17, a line from the chest's front edge in the top view and a line from the chest's front edge in the side view must intersect; place the 45-degree angle at that intersection.

## Corner Cabinet

Figures 4-18 and 4-19 present an isometric view and two orthographic views of a corner cabinet. The top view shows the cabinet's true shape and size, because all edges are parallel to the picture plane. But in the front view, the sides of the cabinet skew away, hence they appear foreshortened. Only the middle section appears in its true shape and size.

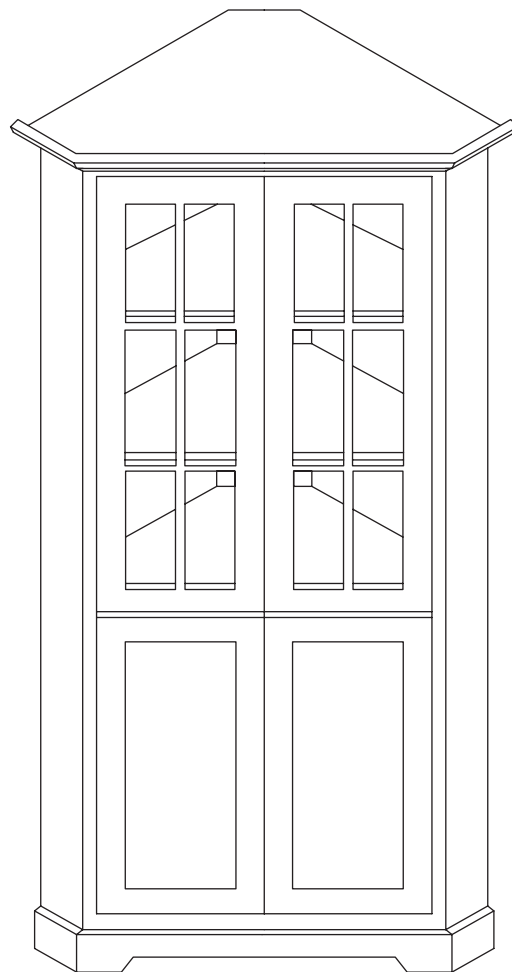


Figure 4-18  
3-D (oblique) view of a corner cabinet.

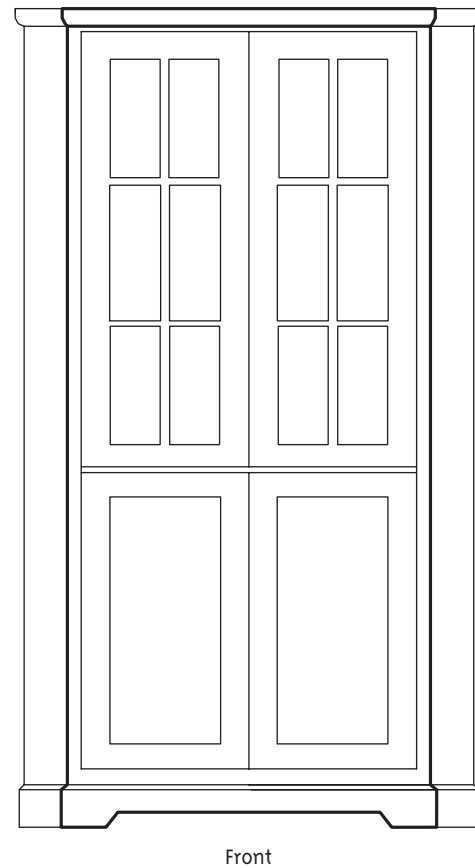
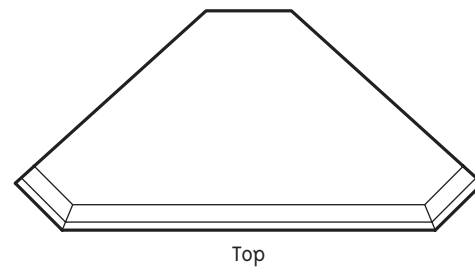


Figure 4-19  
Top and front orthographic views of the cabinet from Figure 4-18. The angled sides are foreshortened. The middle section has the thickest line weights because it is closest to the viewer.

## Summary

Orthographic drawing is the method by which architectural drawings are created. Views are created by projecting points and lines from one plane to another. In theory these drawings are called top, front, and side views; architecturally, these drawings are usually floor plans, interior elevations, and sections. The benefit of orthographic drawings is that the originals are measurable and accurate portrayals of what the item looks like.

## Suggested Activities

1. Measure and draw top, front, and side views of small objects in your classroom. Remember to include dashed lines for hidden features.
2. Connect Lego Duplo® blocks in random arrangements and sketch their top, front, and side views to strengthen your understanding of orthographic drawing (Figure 4-20). Use differently shaped blocks for true length and foreshortened lines. Sketch 3-D pictures of the arrangements and apply different colors to the top, front, and side views to clarify what features go in which view.
3. Obtain photos of furniture and their measurements from catalogs. Using this information, draw orthographic views of the furniture.

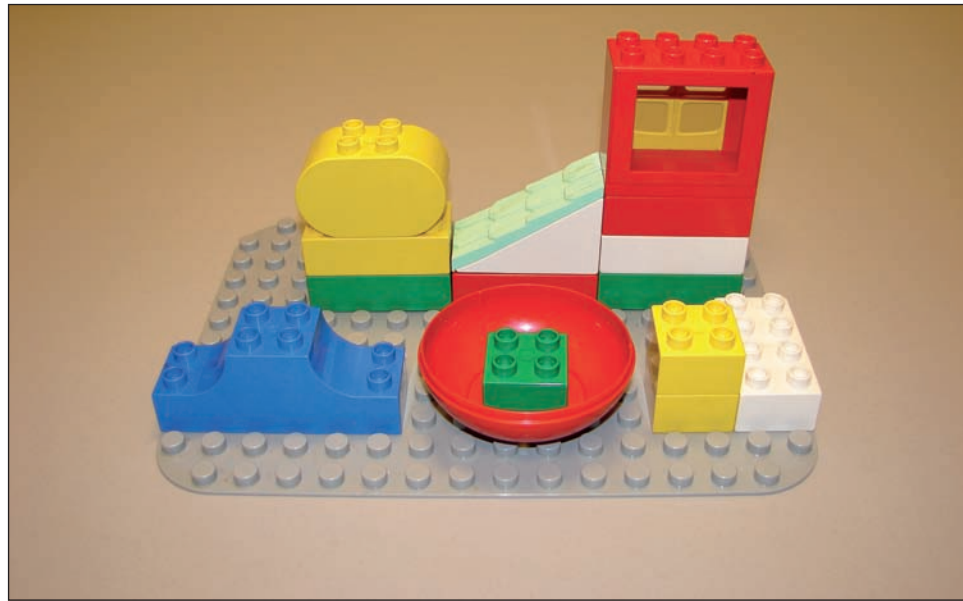


Figure 4-20  
Lego blocks are useful for orthographic sketching practice.

## Questions

1. What is orthographic projection?
2. What is the advantage of orthographic views over perspective views?
3. How must a line be oriented to a picture plane to show its true length?
4. How must a line be oriented to a picture plane to appear foreshortened?
5. How are features not visible in a view portrayed?