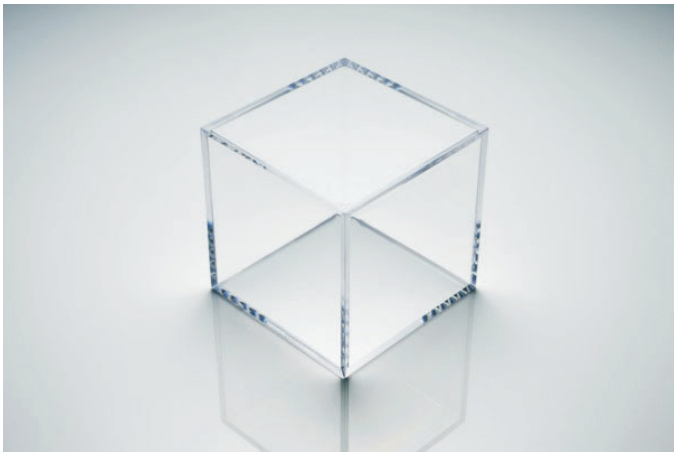
Properties of Orthographic Projection

ORTHOGRAPHIC PROJECTION communicates 3D information with 2D drawings. These drawings use principal views to detail all six sides of an object: front view, top view, right side view, bottom view, left side view, and the rear view. Techniques, such as the glass box method, help you create orthographic projections.



Objective:

Summarize the principal views used in orthographic projection and the primary and secondary views and representations of normal and inclined surfaces.

Key Terms:

feature
foreshortened
frontal plane
glass box
horizontal plane
inclined surfaces
necessary views
non-parallel surfaces
parallel surfaces
primary views
principal planes
principal views
profile plane
secondary views

Understanding Properties of Orthographic Projection

Orthographic projection is a way to represent a 3D object on a piece of paper: The object becomes 2D. No single drawing is able to show what an object truly looks like or will look like. With proper training, however, you are able to use multiple 2D drawings to visualize 3D objects. This is accomplished through the use of the six principal views.

PRINCIPAL VIEWS

The **principal views** are illustrations of key features in the following fashion: front view, top view, right side view, bottom view, left side view, and the rear view. Each of the principal views is aligned in a standard order as if it were hinged around the front view. By lining up all the views, several techniques may be employed to transfer details from one view to another.

Top View

The top view is located directly above the front view (the front edge of the object becomes the bottom of the top view).

Front View

The front view is the primary view looking directly at the object. The view is perpendicular or at 90 degrees to the object's front plane.

Right Side View

The right side view is located directly to the right of the front view, so the front edge of the object becomes the left edge of the right side.

Bottom View

The bottom view is located directly below the front view.

Left Side View

The left side view is located directly to the left of the front view.

Rear or Back View

The rear or back view is located to the left of the left side view.

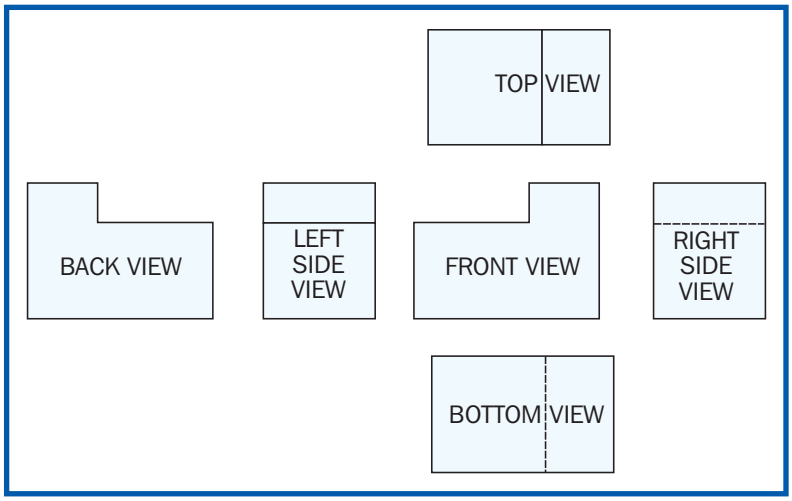


FIGURE 1. The principal views describe an object and illustrate its key features in the following fashion: front view, top view, right side view, bottom view, left side view, and the back view. Each of the principal views is aligned in a standard order as if it were hinged around the front view.

CREATING PRINCIPAL VIEWS

The glass box method is one way of creating the six principal views. The **glass box** is a method that involves visualizing or actually placing items to be drawn inside a clear box. Once

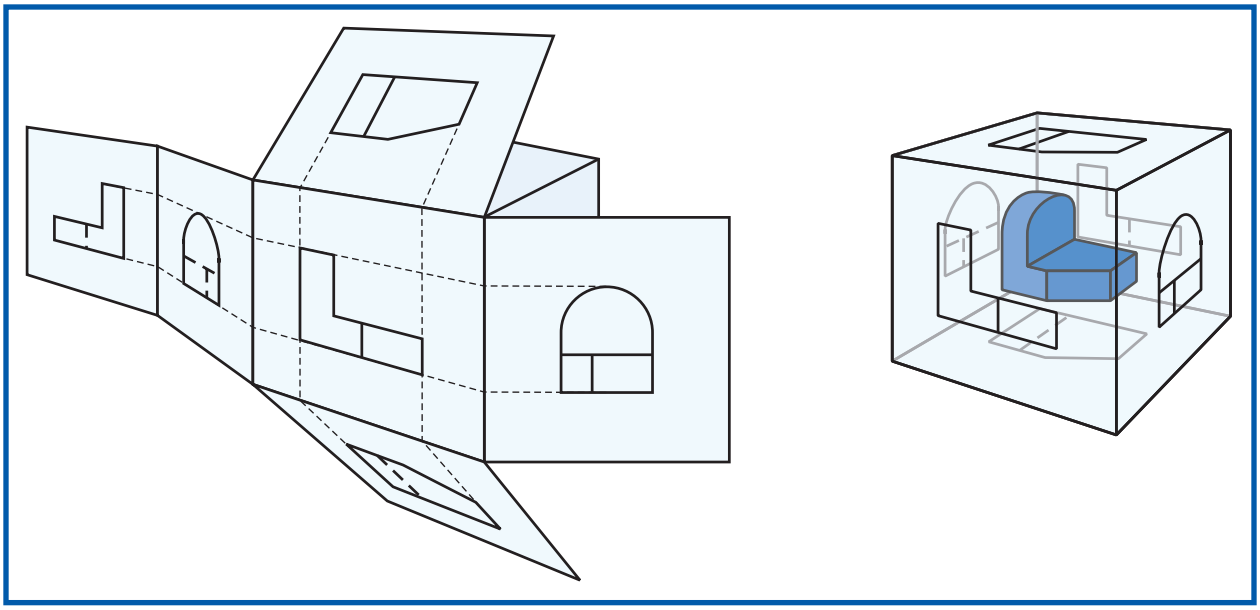


FIGURE 2. The glass box method is an easy way to see how the principal views are created. You can visualize that the object is located inside a glass box and each view is projected onto its side of the box.

the item is in the glass box (literally or figuratively), you draw the item only as it is visible from each side of the box.

Principal Planes

Projection methods rely on the use of projection planes to illustrate key details of an object. They utilize principal planes to visualize the object. The **principal planes** are the planes used to visualize and object: the frontal plane, the horizontal plane, and the profile plane.

- The **frontal plane** is a plane used to describe front and rear details.
- The **horizontal plane** is a plane used to describe an object's top and bottom details.
- The **profile plane** is a plane used to describe an object's right and left side details.

FURTHER EXPLORATION...

ONLINE CONNECTION: First Angle Orthographic Projection

Understanding all the planes and views when creating orthographic projection can be confusing. It is helpful to see a demonstration and to follow along and practice. Once you understand how the terms are used and how to create orthographic projections, you can quickly develop your skills. To learn more about creating orthographic projections, watch the video "First Angle Orthographic Projections" at http://www.youtube.com/watch?v=I-d9B9OWwhE.

KEY FEATURES

A **feature** is any distinguishing characteristic of an object. It could be a straight or curved edge, a hole, a protrusion, or any other shape that makes the object appear as it does. As you transition from simple block geometry to more complex challenges, the expectations are still the same: All key features of an object need to be shown in all views. However, each feature is not always represented in the same way.

Primary and Secondary Views

Primary views are those principal views in which a feature is shown in its true shape. **Secondary views** are views in which the feature is further defined, but not in its true shape. Primary and secondary do not necessarily imply significance or importance; both types of views are equally important in describing the features of an object.

Think about a hole drilled into a block of wood. The primary view will show the circular nature of the hole, a view looking directly at the hole in the block. The secondary view will detail the depth of the hole or whether it is a round peg protruding from the block. In the case of a hole drilled into a block of wood, only the front and rear view demonstrate that the hole is round. The side, top, and bottom views will show the hole along its depth; it will look like a square or rectangle. So you must show multiple views of an object to understand its true geometry.

Necessary Views

It is essential that you understand the concept of orthographic projection and the principal views as early as possible when working with drafting and design problems. In some cases, the principal views can be redundant, especially for simple objects. In these cases, you may need to draw a few **necessary views**—the minimum views required to fully define an object.

When developing your drawings, include only necessary views. This may result in drawings with only three views. When you create a three-view drawing, the front view is the drawing that provides the greatest level of detail and description about an object. The right (or left) view and top view provide the supporting details to fully describe the object.

Surfaces

As previously mentioned, all features of an object must be shown in all views. However, some features require a different approach. Two main distinctions exist between all the features that need to be shown in a drawing. They include object features that are parallel or non-parallel to the projection plan or its surfaces.

Parallel Surfaces

Parallel surfaces are faces shown in true shape and size in a primary view. The explanations discussed so far are based on object features parallel to one of the three projection planes.

Non-Parallel Surfaces

Non-parallel surfaces are features that do not run parallel to any of the projection planes. Some of the bigger challenges you may face in technical drawings are those object features that do not run parallel to any of the projection planes. Non-parallel surfaces are also known as **inclined surfaces**, which are faces that do not appear in true shape in any of the principal views and are never shown with a primary view.

The shape of a non-parallel surface is defined by multiple secondary views, which means the edges of these features are true size in the different views. However, the feature itself appears **foreshortened**—representative of a 3D object on a 2D drawing plane while showing height, width, and depth. Foreshortened objects appear to be receding into the paper or coming straight at you directly out of the plane of the paper. A foreshortened object has an intentionally skewed proportion.

Summary:

Orthographic projection communicates 3D information with 2D drawings. These drawings use principal views to detail all six sides of an object: front view, top view, right side view, bottom view, left side view, and the rear view. Techniques, such as the glass box method, help you create orthographic projections. No single drawing is able to show what an object truly looks like or will look like.

The glass box method involves visualizing or actually placing items to be drawn inside a clear box. Projection methods rely on the use of projection planes to illustrate key details. They utilize principal planes to visualize the object: the frontal plane, the horizontal plane, and the profile plane. All key features of an object must be shown in all views. There are primary views that display features in their true shape. In all other views, the features are further defined, but not in true shape. These are considered secondary views. When developing drawings, use only necessary views.

Checking Your Knowledge:

1. Describe the six principal views.
2. Describe the glass box method.
3. What is foreshortening?
4. How does an inclined surface appear?
5. What is described on the horizontal plane?

Expanding Your Knowledge:

A great way to expand your knowledge about orthographic projection is to follow tutorials that walk you through the process. Many print and interactive online tutorials exist. Search the Internet by keying in "Orthographic Projection Tutorial/Video," and follow along to expand your skills and knowledge. Write a two-page paper on what you learned. Turn in your paper to your instructor.

Web Links:

Orthographic Projection Exercises
http://www.engineeringessentials.com/ege/ortho/ortho_page3_ex1.htm

Orthographic Projection Video
http://www.youtube.com/watch?v=PXgkBadGHEE

The Six Principal Views
http://www.slideshare.net/djmhammond/orthographic-projection-slideshare