# Produce Proportional Views of Axonometric Projections

AXONOMETRIC PROJECTION has been used for hundreds of years to draw objects. It can be useful to understand the different types of axonometric drawings and how to create different projections. It requires only a few basic steps to set up these drawings. Although axonometric projections can be more difficult to create than other projections, they allow for more freedom and a better representation of the object.

## Objectives:

1. Define axonometric projection, and explain the purpose of each of the three types of axonometric drawings.
2. Sketch and draw isometric projections and isometric drawings from coded plans or orthographic drawings.
3. Sketch and draw diametric projections from proportional orthographic examples.
4. Create trimetric projections from multiview orthographic drawings as technical illustrations or CAD drawings.

## Key Terms:

coded plan
diametric projection
elevations
foreshortened
isometric drawing
isometric projection
receding axes
trimetric projection
visible surfaces

# Understanding Axonometric Projection

Axonometric projection rotates the object so all three dimensions may be seen in one view approximately as seen by an observer. This usually includes the front, a side, and the top. Therefore, the object is displayed as a three-dimensional drawing. In an axonometric drawing, all the planes are receding. There are three axes in an axonometric drawing: a vertical one and two diagonal, receding axes. The **receding axes** are those planes or surfaces and edges that lead away from the vertical axis (the front edge or corner of the object).

## ISOMETRIC

An **isometric drawing** is a view that uses equal-angle axes and full-scale sizes along each axis. **Isometric projection** uses equal-angle axes, but it reduces proportions along those axes to 81 percent of the real size. It is a three-dimensional pictorial representation of an object. Isometric ("equal measure") relates to the orientation of the object. The object is drawn off the horizontal axis equally for each dimension or angle. The front and the right (or the left) side recede into space at equal angles off the horizontal. The object is viewed symmetrically, so if you had a square object, you would be looking at one corner centered in your view. It makes a realistic exhibit of the object and is fairly easy to create. The object is not totally accurate, as there is a little distortion.

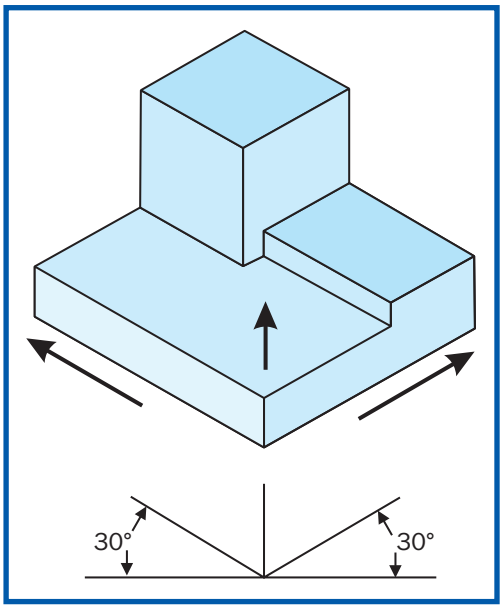


**FIGURE 1. This is a basic and simple example of an isometric drawing.**

## DIMETRIC

The **dimetric projection** is a three-dimensional pictorial representation of an object. Dimetric refers to two measures, so the object is drawn off the horizontal axis from two different dimensions or angles. The object is viewed asymmetrically. As a result, if you had a square object, you would be looking more at one side than you would the other. You would not be directly viewing the edge of the square as in an isometric drawing. The object is represented fairly realistically. You can also make adjustments to the angles to diminish the distortion. It is slightly more difficult to produce a diametric projection than an isometric drawing.

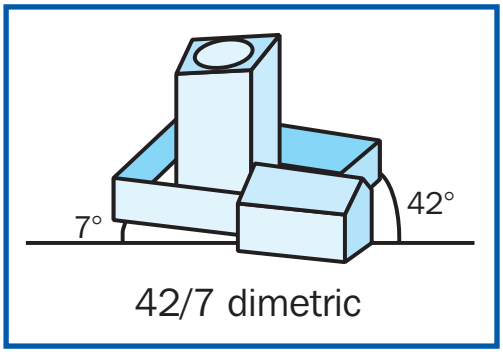


**FIGURE 2. This is a basic and simple example of a dimetric drawing that also shows the original orthographic view drawings.**

## TRIMETRIC

The **trimetric projection** is a three-dimensional pictorial representation of an object. Trimetric refers to three measures, so the object is drawn off the horizontal axis from three different dimensions or angles. The object is also viewed asymmetrically. This type of drawing is much more complete than an isometric drawing. It has an increased measure of realism. The view of the object in a trimetric drawing also allows all three sides to appear unequally foreshortened.

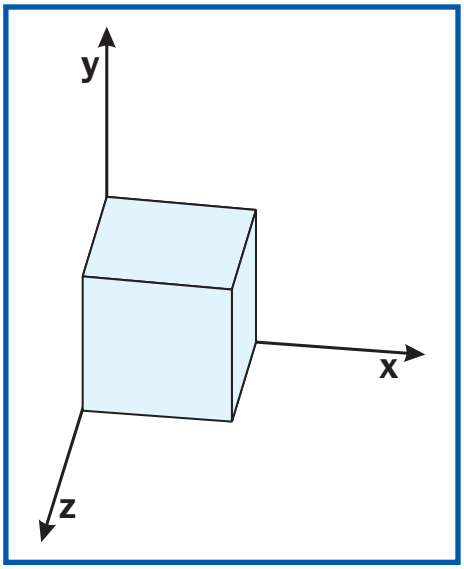


**FIGURE 3. This is a basic and simple example of a trimetric drawing.**

# Isometric Projections or Isometric Drawings

The most important or front view must be determined first to create an isometric drawing. The front view should show the most important object information. Other views are also typically required to show additional features. All the views drawn create the **visible surfaces**—those surfaces chosen by the drafter to be the principal views of the drawing. Basically, they are the surfaces you view in each drawing, displaying an overall object image. These visible surfaces are generally shown with orthographic drawings.

## ORTHOGRAPHIC DRAWINGS

Orthographic drawings define different features and dimensions of an object. They display a view of an object, looking at one side perpendicular or at 90 degrees to the surface. For instance, a cube has six sides and could require six orthographic drawings—one for each side. The side views are also called **elevations**. All elevations give the height of the object. Depending on which side they illustrate, the elevations may give the depth (length) or width.

## FURTHER EXPLORATION...

### ONLINE CONNECTION: Using Cubes and Isometric Drawings

Creating isometric drawings is a fairly simple process. However, it can greatly improve your ability to convey information about an object. Once you learn the basic steps and guidelines, you can quickly create isometric drawings. To practice the basic steps, you can use the isometric tool and follow the instructions at the link below:

http://illuminations.nctm.org/LessonDetail.aspx?ID=L607

This information can be transferred or projected to create isometric drawings. An isometric drawing is a three-dimensional view of an object. It displays the height, width, and depth (length) of the object in one drawing.

## PLAN

A top view is also called a plan. A plan shows the width and the depth (length) of the object. In some cases (e.g., architectural drawings), a plan is typically cut through the object. This allows the drawing to show the layout of the walls and space. A **coded plan** is a plan that defines three dimensions in a single view. Heights are shown as numbered units on each square of a coded plan. A coded plan may be used to create orthographic or isometric drawings by calculating the height dimensions.

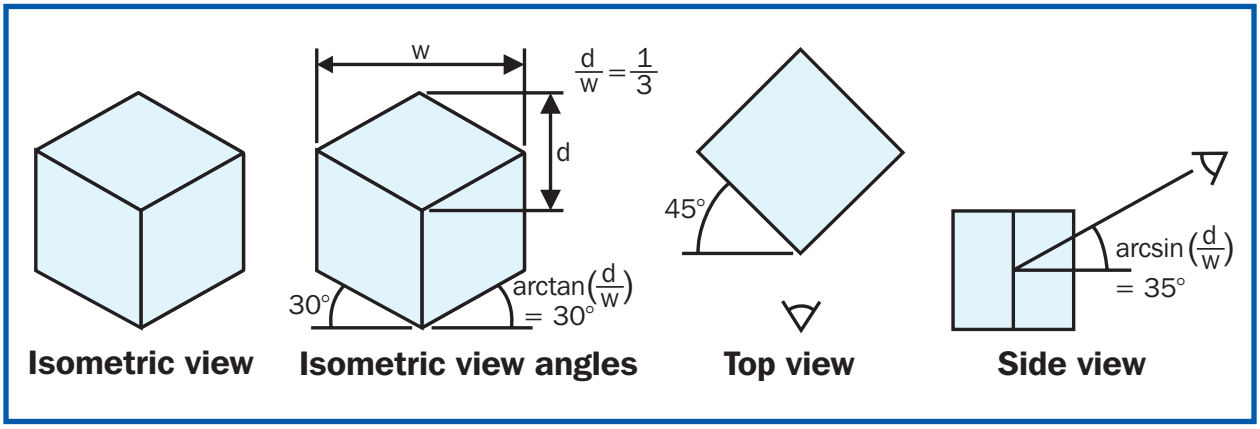


**FIGURE 4. This is a basic and simple example of an isometric drawing, including the orientation of the original top and side views.**

# Dimetric Projections

Dimetric projection uses three projection planes. One plane is the top, which shows the width and typically foreshortened length (depth). The second plane is the front. It shows the width and the height in full size. The third plane may be the right or the left side. It shows the full height and typically foreshortened length (depth). A **foreshortened** (not its true dimension; made shorter) edge, surface, or length is used to keep a drawing from looking distorted. The axis showing the length (depth) is typically the only foreshortened axis in a diametric projection. It may be as much as 50 percent its actual length.

## THREE AXES

The three projection planes revolve around three axes. The vertical axis extends up from the horizontal at 90 degrees. The right side receding axis typically extends out to the right at an

angle of 42 degrees off the horizontal. The left receding axis typically extends to the left at an angle of 7 degrees off the horizontal. Other angles are used. However, these are the most common and can be approximated.

## TRANSFERRING INFORMATION

The required dimensions and features for a diametric projection can be transferred from orthographic drawings. These drawings need to be located at their appropriate angles relative to the side they represent. Once they are properly located, the information can be projected. If the dimension is foreshortened, calculations will need to be made. Construction lines (drawn thin and light) should be used to transfer the information. Once all the information is projected or transferred, the actual object lines can be darkened or made thicker. These will designate the visible edges of the object, and the remaining lines can be erased. Typically, in a dimetric drawing, hidden lines are not shown.

In some cases, dimension and extension lines may be used to clarify the drawing. Dimension lines always need to be parallel to the line (or edge) they are measuring, and extension lines will extend perpendicular from the dimension lines.

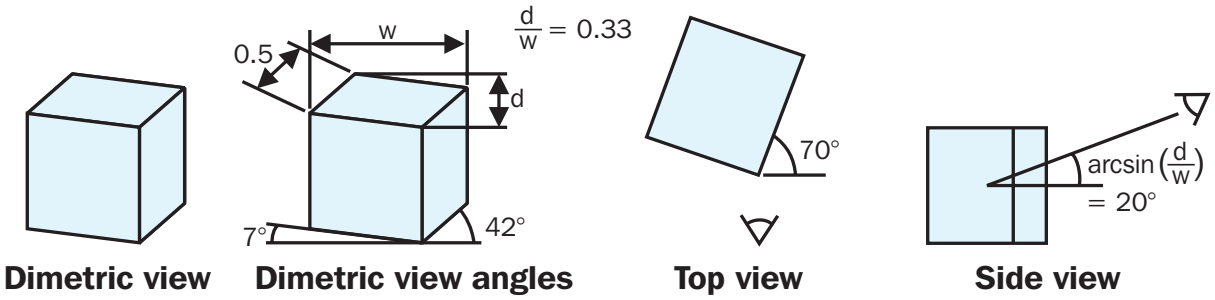


**FIGURE 5. This is a basic and simple example of a dimetric drawing, including the orientation of the original top and side views.**

# Trimetric Projections from Multiview Orthographic Drawings

Steps to create trimetric projections are similar to those used to create isometric and dimetric projections. In trimetric projections, the angles for the left, right, and vertical axis must be chosen. Shallow angles can place an emphasis on receding lines. The object should be rotated to show as much of the important information as possible in one drawing.

A horizontal line can be drawn as a reference to locate your new axis. Then (with construction lines), draw in your three new axis lines to locate your right, left, and top views. Next, locate your orthographic drawings at their appropriate angles. By placing them along their axis, the dimensions and features can be projected into their proper planes for the trimetric draw-

ing. If you are going to foreshorten a side, calculate the new dimensions. Parallel lines to each axis may be created as guides to help locate the object's features.

If you are using CAD, rotate your orthographic drawings to their appropriate angles. Be sure to place the orthographic drawings on a separate layer—one that can be locked or turned off when you are done. Some of the drawing features in CAD can make it easy to create your projections. Lines can easily be rotated to exact angles and offset or copied to new locations.

## Summary:

Axonometric projection rotates the object so all three dimensions may be seen in one view, approximately as they appear to the observer. An isometric drawing is a three-dimensional pictorial representation of an object. Isometric relates to the orientation of the object. A dimetric drawing is drawn off the axis from two different dimensions or angles, and a trimetric is drawn off the axis from three different angles.

All the views drawn create the visible surfaces. It is important that you choose the surfaces with the most information to display. Orthographic drawings define different features and dimensions of an object from the top, front, and one side.

Dimetric projection uses three projection planes. The vertical axis is at 90 degrees off the horizontal; the right and left receding axes are at different angles to each other. A trimetric projection also has three planes. However, all three axes' angles must be determined. By placing orthographic drawings along their appropriate axis, features and dimensions can be transferred onto the planes of your axonometric drawing.

## Checking Your Knowledge:

1. What are three types of axonometric drawings?
2. What surfaces are receding in an isometric drawing?
3. What are visible surfaces in an axonometric drawing?
4. What dimension is typically foreshortened in a diametric projection?
5. What are the two common angles of the receding axes in a diametric projection?

## Expanding Your Knowledge:

A great way to practice and learn how to create axonometric drawings is by using graph paper. With graph paper, you can quickly and accurately sketch in the receding axis. You can also use the grid to help line up features and to create ellipses. Get

a pad of graph paper and practice sketching objects. You may also want to use some free online tutorials to improve your skills.

## Web Links:

**Parallel Projections**

http://frank.mtsu.edu/~csjudy/planeview3D/tutorial-parallel.html

**Axonometric Projections**

http://www.compuphase.com/axometr.htm

**What Are Axonometric Drawings?**

http://www.reading-detailing-house-plans.com/axonometric_drawings.html

**Examples of Isometric Drawings**

http://library.thinkquest.org/TQ0310106/iso.html