Produce a Sketch of an Object Using Axonometric Projection

Unit: Oblique and Axonometric Projection

Problem Area: Oblique and Axonometric Projection

Lesson: Produce a Sketch of an Object Using Axonometric Projection

Student Learning Objectives.

Instruction in this lesson should result in students achieving the following objectives:

1. **Describe two methods of isometric sketching.**
2. **Identify the steps in isometric sketching.**
3. **Explain how to sketch isometric circles and arcs.**

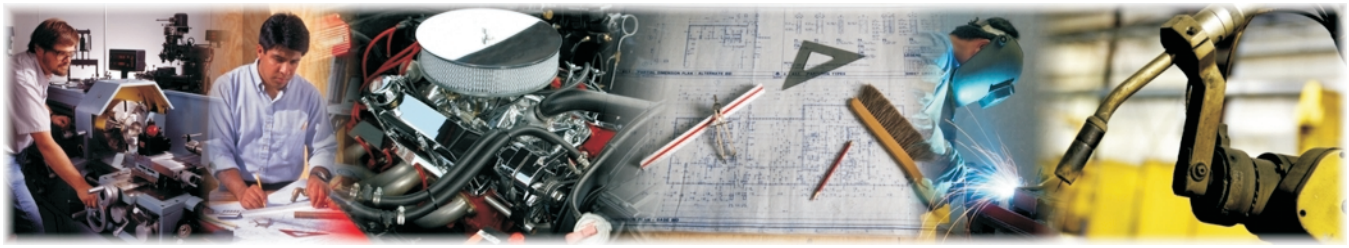
List of Resources.

The following resources may be useful in teaching this lesson:

Giesecke, Frederick E., et al. *Technical Drawing*, 12th ed. Pearson Prentice Hall, 2003.

I.D.E.A. Curriculum. Illinois Drafting Educators Association. Accessed , Dec. 27, 2007. <http://www.idea-online.org/curriculum.html>.

Madsen, David A., David P. Madsen, and J. Lee Turpin. *Engineering Drawing & Design*, 4th ed. Thomson Delmar Learning, 2007.



List of Equipment, Tools, Supplies, and Facilities

- ✓ Overhead or PowerPoint projector
- ✓ Visual(s) from accompanying master(s)
- ✓ Copies of sample test, lab sheet(s), and/or other items designed for duplication
- ✓ Materials listed on duplicated items
- ✓ Computers with printers and Internet access
- ✓ Classroom resource and reference materials

Terms.

The following terms are presented in this lesson (shown in bold italics):

- axonometric projection
- box method
- centerline layout method
- coordinate method
- cube
- four-center method
- isometric
- isometric axis
- isometric lines
- isometric sketch
- nonisometric lines

Interest Approach.

Use an interest approach that will prepare the students for the lesson. Teachers often develop approaches for their unique class and student situation. A possible approach is included here.

> *An axonometric drawing allows three adjacent views to be seen at the same time. Ask students which three views are typically shown. (Answer: the top, front, and right side views.) To illustrate this, draw a cube on the writing surface in which the top, front, and right side views can be seen.*

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Describe two methods of isometric sketching.

Anticipated Problem: What are two methods of isometric sketching?

I. ***Axonometric projection*** rotates the object with respect to the observer so that all three dimensions may be seen in one view, approximately as they appear to the observer. The most common axonometric projection is ***isometric*** ("equal measure"). Two methods of isometric sketching are the box, or coordinate, method and the centerline layout method.

A. The ***box method*** (also known as the ***coordinate method***) is the most common form of isometric drawing. It is used for objects that have angular or radial features.

1. First, draw an isometric box the size of the overall dimensions of the object.
2. Then, transfer the measurements of the features of the object to the isometric box.
3. You may need to draw construction lines on the orthographic views and transfer measurements directly from these views to the isometric view, especially when drawing irregularly shaped objects.

B. The ***centerline layout method*** starts with the skeleton of an object, the centerlines. This method is used for objects with several circles and arcs.

1. First, locate the center points of all the circles and arcs. Begin with a good reference point, such as the bottom of the object.
2. Draw vertical axis lines up from the center points.
3. Then, determine the various sizes of any ellipses and draw them at their proper locations.

Many techniques can be used to help students master this objective. Use VM–A to review the key terms introduced in this objective. Refer to Figures 15.12, 15.13, and 15.14 in Engineering Drawing & Design, 4th ed., to illustrate the box and centerline layout methods of isometric drawing.

Objective 2: Identify the steps in isometric sketching.

Anticipated Problem: What steps are involved in isometric sketching?

II. An ***isometric sketch*** provides a three-dimensional pictorial representation of an object. It makes a very realistic exhibit of the object and is fairly easy to create.

A. The steps involved in isometric sketching are as follows:

1. Choose an appropriate view of the object.
2. Determine the best position in which to show the object.
3. Sketch the ***isometric axis*** (a horizontal reference line, two 30-degree angular lines, and a vertical line). Use light construction lines.
4. Using correct proportion, draw a rectangular box surrounding the object to be drawn.
   a. Start sketching the box by marking off the width at any convenient length. This is your measurement line.
   b. Then, estimate and mark the height and length relative to the measurement line.
   c. Using lines parallel to the original axis lines, draw the three-dimensional box.
   d. Drawing the box is the most important part of an isometric sketch. If it is not drawn correctly, the sketch will be out of proportion.
5. Lightly sketch the insets, slots, and other features of the object.
6. To finish the sketch, darken all the object lines. Do not show any hidden lines.

B. ***Isometric lines*** are on or parallel to the three original isometric axis lines. They can be measured in true length.

C. All other lines in an isometric sketch are nonisometric lines. ***Nonisometric lines*** appear either shorter or longer than they actually are. To determine where nonisometric lines should be located, you have to relate to an isometric line.

Many techniques can be used to help students master this objective. Use VM–B to review the steps involved in making an isometric sketch. Refer to Figures 6.47 through 6.54 in Engineering Drawing & Design, 4th ed., to illustrate these steps. Refer to Figure 6.55 to illustrate nonisometric lines.

Objective 3: Explain how to sketch isometric circles and arcs.

Anticipated Problem: How do you sketch isometric circles and arcs?

III. Circles and arcs appear as ellipses in isometric drawings. To sketch isometric circles and arcs correctly, the relationship between circles and the faces, or planes, of an isometric cube needs to be determined.

A. To practice sketching isometric circles, isometric surfaces are needed to draw the circles on.

1. Isometric surfaces can be created by drawing a cube in isometric.
2. A ***cube*** is a box with six equal sides. Only three of the sides can be seen in an isometric drawing.

B. One method of sketching an isometric ellipse is known as the ***four-center method***. When using this method, care must be taken to form the ellipse arcs correctly so that the ellipse does not appear distorted.

1. First, draw an isometric cube.
2. On each surface of the cube, draw connecting lines from the 120-degree corners to the centers of the opposite sides.
3. Then, sketch arcs that begin and end at the centers of the opposite sides on each isometric surface.
4. Finally, complete each isometric ellipse by sketching arcs that connect with the arcs drawn in Step 3.

C. Sketching isometric arcs is much the same as sketching isometric circles.

1. First, block out the overall shape of the object.
2. Then, establish the centers of the arcs.
3. Finally, sketch the arcs so that they lie in the proper plane and have the correct shape.

Many techniques can be used to help students master this objective. Use VM–C to describe the four-center method of sketching isometric circles. Refer to Figures 6.61 through 6.66 in Engineering Drawing & Design, 4th ed., to illustrate how to sketch isometric circles and arcs.

Review/Summary. Use the student learning objectives to summarize the lesson. Have students explain the content associated with each objective. Student responses can be used in determining which objectives need to be reviewed or taught from a different angle. Questions at the ends of chapters in the textbook may also be used in the review/summary.

Application. Use the included visual masters and lab sheet to apply the information presented in the lesson.

Evaluation.

Evaluation should focus on student achievement of the objectives for the lesson. Various techniques can be used, such as student performance on the application activities. A sample written test is provided.

Answers to Sample Test:

Part One: Matching

1. b
2. a
3. d
4. f
5. h
6. g
7. e
8. c

Part Two: Completion

1. four-center
2. Isometric lines
3. coordinate
4. three
5. ellipses
6. isometric sketch

Part Three: Short Answer

The box method is the most common form of isometric drawing. It is used for objects that have angular or radial features. The centerline layout method starts with the skeleton of an object, the centerlines, and is used for objects with several circles and arcs.

Sample Test

Name _____

Produce a Sketch of an Object Using Axonometric Projection

Part One: Matching

Instructions: **Match the term with the correct definition.**

a. cube
b. isometric
c. box method
d. nonisometric lines
e. axonometric projection
f. isometric axis
g. isometric sketch
h. centerline layout method

_____1. Equal measure

_____2. A box with six equal sides

_____3. Appear either shorter or longer than they actually are

_____4. A horizontal reference line, two 30-degree angular lines, and a vertical line

_____5. Used for objects with several circles and arcs

_____6. Provides a three-dimensional pictorial representation of an object

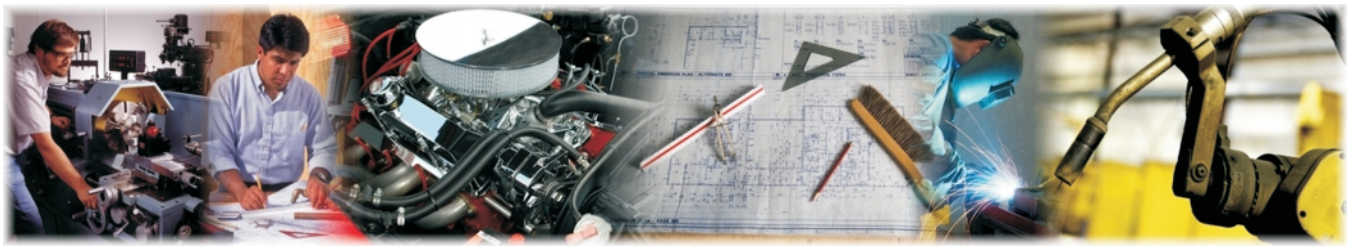
_____7. Rotates the object with respect to the observer so that all three dimensions may be seen in one view, approximately as they appear to the observer

_____8. Used for objects that have angular or radial features

Part Two: Completion

Instructions: **Provide the word or words to complete the following statements.**

1. When using the _____ method, care must be taken to form the ellipse arcs correctly so that the ellipse does not appear distorted.



2. _____ are on or parallel to the three original isometric axis lines.
3. The box, or _____, method is the most common form of isometric drawing.
4. Only _____ sides can be seen in an isometric drawing.
5. Circles and arcs appear as _____ in isometric drawings.
6. An _____ makes a very realistic exhibit of the object and is fairly easy to create.

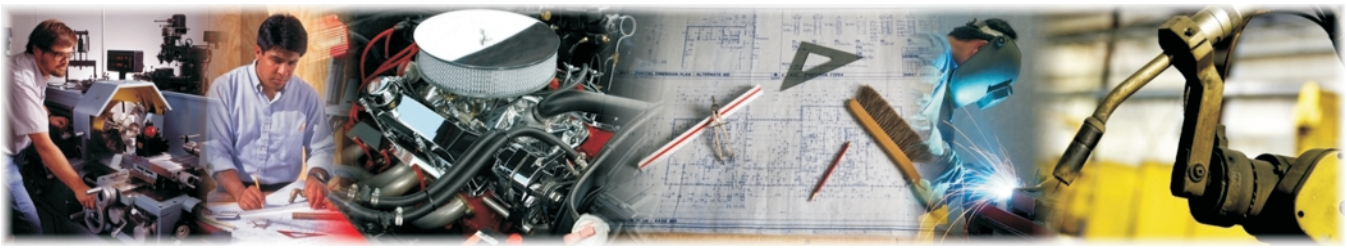
Part Three: Short Answer

Instructions: **Complete the following.**

Compare and contrast the box method and the centerline layout method.

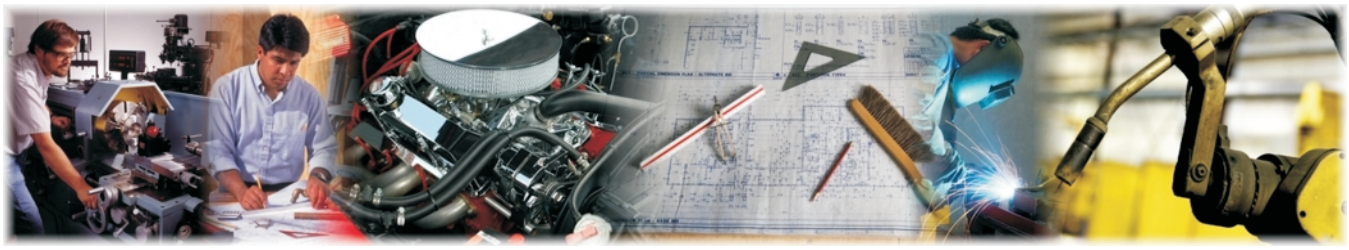
KEY TERMS

- **Axonometric projection—**rotates the object with respect to the observer so that all three dimensions may be seen in one view, approximately as they appear to the observer
- **Isometric—**equal measure
- **Box method (also known as the coordinate method)**—used for objects that have angular or radial features
- **Centerline layout method—**used for objects with several circles and arcs



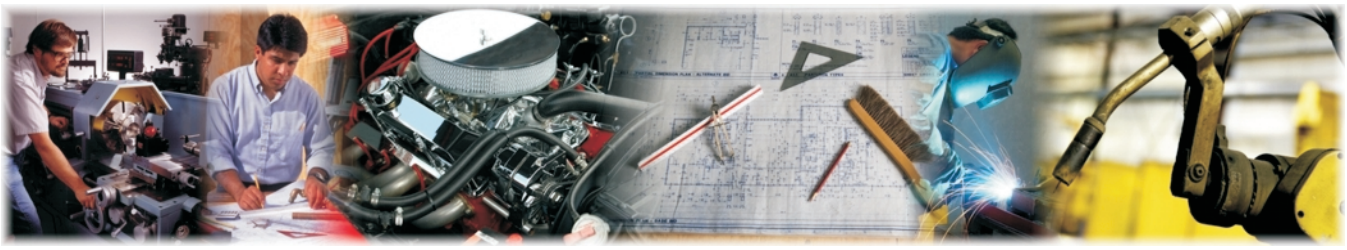
STEPS IN ISOMETRIC SKETCHING

1. Choose an appropriate view of the object.
2. Determine the best position in which to show the object.
3. Sketch the isometric axis (a horizontal reference line, two 30-degree angular lines, and a vertical line). Use light construction lines.
4. Using correct proportion, draw a rectangular box surrounding the object to be drawn.
5. Lightly sketch the insets, slots, and other features of the object.
6. To finish the sketch, darken all the object lines. Do not show any hidden lines.



FOUR-CENTER METHOD

1. First, draw an isometric cube.
2. On each surface of the cube, draw connecting lines from the 120-degree corners to the centers of the opposite sides.
3. Then, sketch arcs that begin and end at the centers of the opposite sides on each isometric surface.
4. Finally, complete each isometric ellipse by sketching arcs that connect with the arcs drawn in Step 3.



LS–A

Name _____

Isometric Sketching

Purpose

The purpose of this activity is to enhance your ability to make isometric sketches using the box method, the centerline layout method, and the four-center method.

Objectives

1. Demonstrate the ability to use the box method to create an isometric sketch.
2. Demonstrate the ability to use the centerline layout method to create an isometric sketch.
3. Demonstrate the ability to use the four-center method to create an isometric sketch.

Materials

- drafting instruments
- drawing paper
- lab sheet
- writing utensil

Procedure

1. Use the box method to sketch a circle with a 4-inch (approx.) diameter.
2. Sketch the same-size circle using the centerline layout method.
3. Use the four-center method to sketch three isometric ellipses on each surface of an isometric cube with 2-inch sides.