Differentiate Between First-Angle Projection and Third-Angle Projection

Unit: Orthographic and Multi-View Projection

Problem Area: Representations of Orthographic and Multi-View Projections

Lesson: Differentiate Between First-Angle Projection and Third-Angle Projection

Student Learning Objectives.

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

1. **Explain how to use the glass box principle to visualize multiviews.**
2. **Compare and contrast first-angle projection and third-angle projection.**

List of Resources.

The following resources may be useful in teaching this lesson:

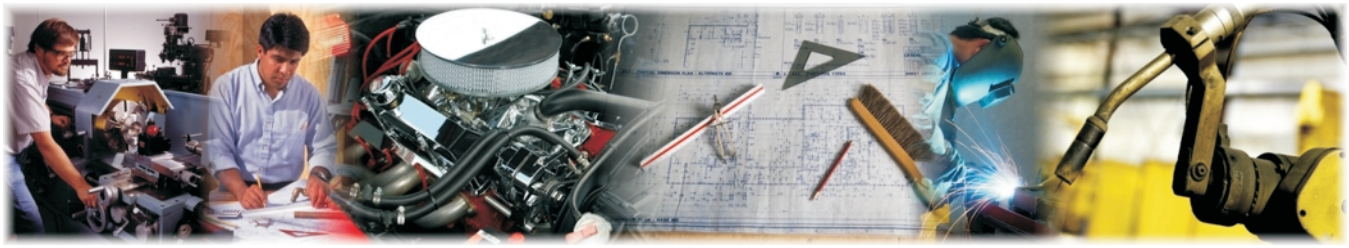
American Design Drafting Association. Home page. Accessed Jan. 18, 2008. <http://www.adda.org>.

American Society of Mechanical Engineers. Home page. Accessed Jan. 18, 2008. <http://www.asme.org>.

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

I.D.E.A. Curriculum. Illinois Drafting Educators Association. Accessed Jan. 18, 2008. <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):

- dihedral angle
- first-angle projection
- fold lines
- glass box principle
- mitre line
- multiviews
- third-angle projection

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.

> *Up to the late 19th century, drawings everywhere were typically made in first-angle projection. Then, around 1890, the United States decided to adopt third-angle projection as its standard method of projection on technical drawings. Canada and England (to some extent) followed suit. Ask students to define first-angle projection and third-angle projection and to compare and contrast the two.*

SUMMARY OF CONTENT AND TEACHING STRATEGIES

Objective 1: Explain how to use the glass box principle to visualize multiviews.

Anticipated Problem: How is the glass box principle used to visualize multiviews?

I. The common practice on technical drawings is to use two-dimensional views called ***multiviews***. These views represent the shape description of an object.

A. ***Glass box principle***

1. If an object is placed in a glass box so the sides of the glass box are parallel to the major surfaces of the object, then the surfaces can be projected onto the sides of the glass box to create multiviews.
2. Now, imagine the sides of the glass box are the planes of projection. If you look at all sides of the glass box, you have six total views:
   a. Front
   b. Top
   c. Bottom
   d. Right-side
   e. Left-side
   f. Rear
3. The front view is generally the most important view. The other views are established from the front view.

B. Fold lines

1. Now, unfold the glass box as if the corners were hinged about the front view.
2. These hinge lines are referred to as ***fold lines***.

C. Alignment of views

1. When the glass box is completely unfolded onto a flat surface, the six views are aligned in the following manner:
   a. The top view is directly above the front view.
   b. The bottom view is directly below the front view.
   c. The left-side view is directly to the left of the front view.
   d. The right-side view is directly to the right of the front view.
2. This alignment of views allows points to be projected from one view to the next to help establish related features on each view.
3. One dimension is always common between adjacent views. For example, the width is common between the front and top views and height is common between the front and side views.

D. Mitre line

1. A ***mitre line*** is a 45-degree line projected from the corner of the fold, or hinge, between the front, top, and side views. It is used as an aid in projecting views.
2. All features established on the top view can be projected to the mitre line and then down onto the side view. Conversely, features from the side views may be projected to the mitre line and then over to the top view.
3. These projections work because the depth dimension is the same between the top and side views.

Many techniques can be used to help students master this objective. Refer to Figures 9.7 through 9.11 in Engineering Drawing & Design, 4th ed., to illustrate the glass box principle, fold lines, view alignment, and the mitre line. Use VM–A as a visual aid during a class discussion on the six views.

Objective 2: Compare and contrast first-angle projection and third-angle projection.

Anticipated Problem: What are the similarities and differences between first-angle and third-angle projection?

II. If the vertical and horizontal planes of projection intersect at 90 degrees with each other, the four dihedral angles produced are the first, second, third, and fourth angles. A ***dihedral angle*** is the angle between two planes.

A. ***First-angle projection***

1. If an object is placed above the horizontal plane and in front of the vertical plane, the object is in the first angle.
2. In this case, the object is between the observer's line of sight and the projection plane.
3. When the glass box in first-angle projection is unfolded, the right-side view falls to the left of the front view, and the top view falls below the front view.
4. First-angle projection is the standard type of projection arrangement used in Europe and many other countries.

B. ***Third-angle projection***

1. If an object is placed below the horizontal plane and behind the vertical plane, the object is in the third angle.
2. In this case, the projection plane is between the observer's line of sight and the object.
3. When the glass box in third-angle projection is unfolded, the right-side view falls to the right of the front view, and the top view is above the front view.
4. Third-angle projection is the standard type of projection arrangement used in the United States, Canada, and (to some extent) England.

C. Basically, the only difference between first-angle and third-angle projection is the arrangement of the views.
   1. Confusion and possible errors may result, however, when a first-angle drawing is thought to be a third-angle drawing, or vice versa.
   2. To avoid confusion, standard projection symbols have been developed to distinguish between first-angle and third-angle projections. These symbols are typically located on or adjacent to the drawing title block.

D. Second-angle and fourth-angle projections are not used.

Many techniques can be used to help students master this objective. Refer to Figures 9.20, 9.21, and 9.22 in Engineering Drawing & Design, 4th ed., to illustrate first-angle projection. Refer to Figures 9.17, 9.18, and 9.19 to illustrate third-angle projection. Use Figure 9.23 and VM–B as visual aids during a class discussion on the similarities and differences between first-angle and third-angle projection.

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

Part Two: Multiple Choice

1. d
2. a

3. b
4. b
5. c

Part Three: Short Answer

1. A mitre line is used as an aid in projecting views. All features established on the top view can be projected to the mitre line and then down onto the side view. Conversely, features from the side views may be projected to the mitre line and then over to the top view.
2. The basic difference between first-angle projection and third-angle projection is the arrangement of the views.
3. front; top; bottom; right-side; left-side; rear

Sample Test

Name _____

Differentiate Between First-Angle Projection and Third-Angle Projection

Part One: Matching

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

a. dihedral angle
b. mitre line
c. multiviews
d. fold lines
e. glass box principle
f. first-angle projection
g. third-angle projection

_____1. The object is placed below the horizontal plane and behind the vertical plane

_____2. A 45-degree line projected from the corner of the fold, or hinge, between the front, top, and side views

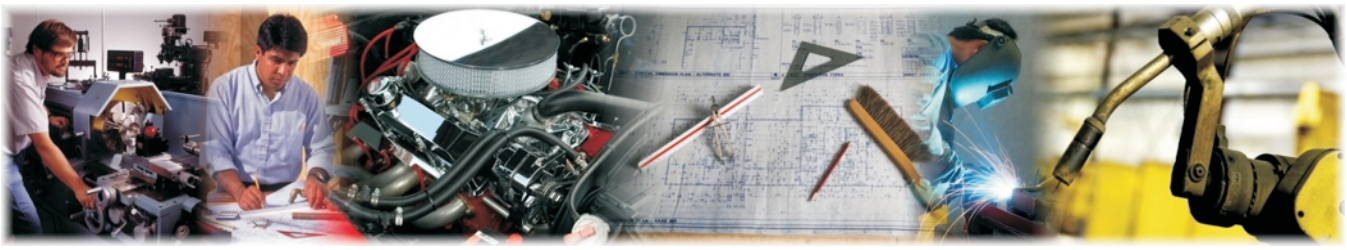
_____3. Two-dimensional views representing the shape description of an object

_____4. The object is between the observer's line of sight and the projection plane

_____5. Hinge lines located at the corners of the front view

_____6. The angle between two planes

_____7. An object is placed in a glass box so the sides of the glass box are parallel to the major surfaces of the object and the surfaces are projected onto the sides of the glass box, creating multiviews



Part Two: Multiple Choice

Instructions: **Write the letter of the correct answer.**

_____1. How many total views do you have when looking at all sides of the glass box?

a. Four
b. Eight
c. Two
d. Six

_____2. What projection is commonly used in Europe?

a. First-angle
b. Second-angle
c. Third-angle
d. Fourth-angle

_____3. Which of the following statements is correct concerning the alignment of views when the glass box is unfolded?

a. The front view is directly above the top view.
b. The bottom view is directly below the front view.
c. The left-side view is directly to the left of the right-side view.
d. The right-side view is directly to the right of the left-side view.

_____4. The _____ view is generally the most important view.

a. Top
b. Front
c. Bottom
d. None of the above

_____5. In third-angle projection, the right-side view falls to the _____ of the front view, and the top view is _____ the front view.

a. Right; below
b. Left; above
c. Right; above
d. Left; below

Part Three: Short Answer

Instructions: **Complete the following.**

1. What is the purpose of using a mitre line?

2. What is the basic difference between first-angle projection and third-angle projection?

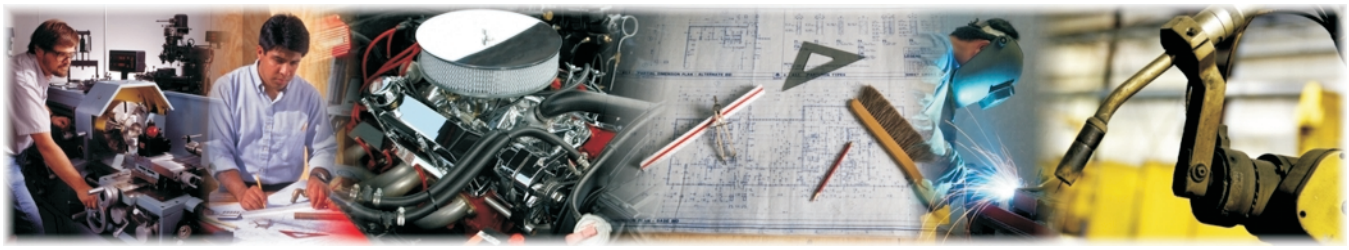
3. List the six views.

THE SIX VIEWS

- Front
- Top
- Bottom
- Right-side
- Left-side
- Rear

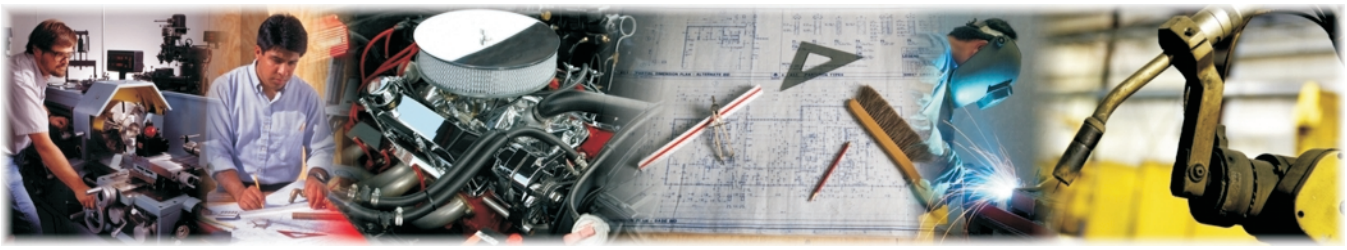
ALIGNMENT OF THE SIX VIEWS:

- The top view is directly above the front view.
- The bottom view is directly below the front view.
- The left-side view is directly to the left of the front view.
- The right-side view is directly to the right of the front view.



FIRST-ANGLE PROJECTION VS. THIRD-ANGLE PROJECTION

First-Angle Projection	Third-Angle Projection
The object is placed above the horizontal plane and in front of the vertical plane.	The object is placed below the horizontal plane and behind the vertical plane.
The object is between the observer's line of sight and the projection plane.	The projection plane is between the observer's line of sight and the object.
The right-side view is to the left of the front view, and the top view is below the front view.	The right-side view is to the right of the front view, and the top view is above the front view.
The standard type of projection arrangement used in Europe and many other countries.	The standard type of projection arrangement used in the United States, Canada, and (to some extent) England.



LS–A

Name _____

Sketching Projection Methods and Symbols

Purpose

The purpose of this activity is to sketch representations of first-angle projection and third-angle projection.

Objectives

1. Demonstrate the ability to sketch a representation of first-angle projection.
2. Demonstrate the ability to sketch a representation of third-angle projection.

Materials

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

Procedure

1. On a sheet of drawing paper, sketch a representation of first-angle projection. Include the standard first-angle projection symbol on your sketch.
2. On a separate sheet, sketch a representation of third-angle projection. Include the standard third-angle projection symbol on your sketch.