

UNIT 1

SKETCHING AND VISUALIZATION

Total Periods: 5

Unit Outcome

At the end of this unit, students should be able to:

- ✓ Understand basic principles and techniques of free-hand sketching.
- ✓ Know how sketching integrates into the design process.
- ✓ Apply the sketching techniques in the initial phases of design and product development.
- ✓ Appreciate the importance of free-hand sketching help to put idea on paper.

Unit Overview

Sketching is a fast form of graphical communication that helps organize thoughts, generate ideas, record dimensions, and transfer information from place to place. Ideas, designs, and manufacturing/construction procedures/techniques are communicated by words, numbers, and visual images. Sketching is a free-form exercise to develop geometric size, shapes, and features for a specific design idea. It is the beginning phase of a more concerted effort to fix the final geometric parameters and constraints that will ultimately define a design.

Therefore this topic introduces students to freehand sketching, giving them the knowledge necessary to formulate, express, and record ideas and objects in the form of sketches. Students will also be exposed to works of visual arts such as perspectives.

Lesson 1.1 *Principles of sketching*

Number of Period: 1

Learning Competencies

At the end of this lesson, students should be able to:

- ✓ describe the use and application of free- hand sketching;
- ✓ Describe how sketching integrate into the design process;
- ✓ Identify free-hand sketching materials;
- ✓ use free-hand sketching materials properly.

Planning ahead

This lesson is to introduce students to the techniques of sketching through demonstration, and handouts, the students will learn the beginning principles for techniques in sketching.

Give an overview on technical drawing plus a purpose of sketching. Therefore the teacher should get himself ready by:

1. Preparing visual aids to show “examples of free-hand drawings”
2. Reviewing essential questions, “why are the uses of free-hand sketching in a design process?”
3. Practicing the three materials required for freehand sketching and developing a skill how to use them for sketching if you were not practicing free-hand sketching before.

Hints for Teaching

Sketching is a necessary part of drafting because the drafter in industry frequently sketches ideas and designs prior to making the drawing. Therefore the suggested instructional strategies are:

1. You can start the class by inviting students in text question/brain storming question about free hand sketching they did and how they did it.
2. Conduct class discussions by comparing instruments drawing with free-hand sketching; the importance of sketching and how organizing one's ideas through sketching.
3. Display and discuss examples of sketches (student and professional). Have students keep sketch ideas in a notebook.
4. Allow students to practice on check point 1.1.

Teaching Notes

The ability to sketch ideas is not only important to engineers it is absolutely essential. Even if an engineer was stranded alone on an island, the ability to sketch would help to work out details in ideas and help to identify potential problems. Sketching does NOT require any artistic ability. Once one is made aware of the basic techniques, it is no longer the "ability to draw" that will limit his/her sketches. But rather, the limitation is one's "ability to think through the details of their design." In industry sketching is used to quickly document rough ideas and identify general needs for improvement. Technical drawing would be employed only for those ideas deserving a permanent record. Sketches are composed of the same basic information, but there is a tradeoff between times required to generate it verses the level of design detail (and accuracy). The basics of sketching can be learned in a single sitting. However, it

will take considerable practice to achieve the fluency that really facilitates team discussions in the future. Don't be surprised if those who are new to sketching actually enjoy working on sketching assignments. It is an easy area for most students to achieve in.

Lesson 1.2 *Sketching Techniques*

Number of Periods: 3

(1 period theory and 2 periods for practice)

Learning Competencies

At the end of this lesson, students should be able to:

- ✓ sketch a line in free hand;
- ✓ Sketch different types of lines, areas, angles, circles, and arcs by applying sketching techniques;
- ✓ Lay out a sketch using proportion;
- ✓ sketch multi-view drawing of 3D objects;

Planning ahead

In advance you should prepare to describe and demonstrate the students on the techniques/procedures for: sketching straight lines, sketching long lines, finding the midpoint of a line, the four methods of drawing a circle and maintaining proportion.

Given instruction and sample problems, the student will implement sketching procedures and demonstrate the skills and techniques essential to creating art products such as perspective drawings, to the satisfaction of the instructor.

Teacher uses one period for theoretical concept and demonstration about Sketching techniques. In addition two periods for student practice on activities and check points.

Hints for Teaching

Insist the students to make a sketch before making any kind of instrumental drawing all the time because free-hand sketching transfer ideas in clear, concise way. Encourage students to practice as “sketching is a personal skill which everyone can improve.”

Therefore the suggested instructional strategies are:

1. You can start the class by inviting students in text question about Techniques of free hand sketching.
2. Conduct class discussions on verbal versus graphic language on the sketching technique and on organizing one's ideas through sketching.
3. Provide sketching activities 1.1 & 1.2 and check points from 1.2 up to 1.10 to students.

Teaching Notes

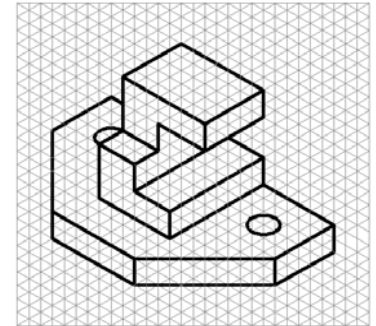
Construction lines and points will improve the appearance of freehand circles. It takes only a few seconds to block in horizontal, vertical and 45 degree points shown. These points help when sketching the arcs for the circle. Note that the edge of a piece of paper may be used as a gage for measuring points on a circle and the final shape is sketched by pressing down hard on the pencil to create a smooth block outline.

Activities

Drafting I - Construct a Multi-view Sketch

Requirements: Each student is required to create a simple multi-view sketch.

1. Using only pencil, eraser, and the paper provided by your instructor sketch a MULTI-VIEW sketch of the object whose pictorial is given below.
2. The sketch should be done at a scale of 1:1 (full size) using the measurements provided.
3. Use accepted drafting standards for lines and freehand lettering.
4. Letter your name, scale, and date in the title block.
5. Time Limit = 40 minutes.
6. Your sketch should reflect an understanding of the object's shape and features as determined from the pictorial. Other areas of evaluation will include the accuracy of your measurements, and the quality of your line work and lettering.



Assessment: The multi-view sketch should be evaluated based on the following criteria:

Concepts and principles of orthographic projection	50 points
Measurements	20 points
Lines	20 points
Lettering	5 points
Layout & balance	5 points

Lesson 1.3 *Pictorial Sketching Techniques*

Number of Periods: 3

(1 period theory and 2 periods for practice)

Learning Competencies

At the end of this lesson, students should be able to:

- ✓ create an isometric sketch of an object;
- ✓ create an oblique sketch an object;
- ✓ create a one-point perspective sketch;
- ✓ prepare a free-hand sketch of any 3D objects in three types of pictorial drawing.

Planning ahead

Teacher Preparation

Given a presentation and pictorial sketching, the student will demonstrate skill in using sketching solutions for problem assignments, with a degree of accuracy and completeness acceptable to the instructor.

Teacher uses one period for theoretical concept and demonstration about pictorial sketching and techniques. In addition two periods for student practice on activities and check points. Therefore the suggested instructional preparations are;

1. Gather some simple objects that have varying features on each side (like video cassette tapes, stapler, etc.) and produce reasonably accurate orthographic projections for at least one of the objects.
2. Prepare isometric sketches of objects composed of basic shapes (rectangles and circles) that will be used to practice orthographic projection sketching.

3. Prepare isometric and orthographic graphing paper appropriately scaled for the objects that you have chosen.

Hints for Teaching

You can start the class by inviting students in text question about Techniques for pictorial free hand sketching.

Without any introduction to technical sketching guidelines, have the students sketch one of your selected objects "with enough detail that someone else can make a similar object." Compare their sketches to a detailed technical sketch (that describes features on every side, has basic dimensions, and includes basic material descriptions). Explain the basic rules of orthographic sketching using a few examples. Then allow the students to practice in small groups. Explain the basic rules of isometric sketching using a few examples. Then allow the students to practice in small groups. Allow the students to work together to answer questions about a real part based on dimensioned sketches (or drawings) of the part. Therefore suggested instructional strategy is to have students' complete two- and three-dimensional sketches (isometric, oblique, perspective and orthographic). Provide pictorial sketching check points from 1.11 up to 1.14 to students.

Teaching Notes

Orthographic Projection is a generally accepted convention for representing 3D objects using multiple 2D views of the front, top, bottom, back, and sides of the object. In practice, the minimal number of views possible is used to describe all the details of the object. Usually, the Front View, Top View, and a single Side View are sufficient and are oriented on the paper according to accepted convention. Isometric Projection attempts to represent 3D objects

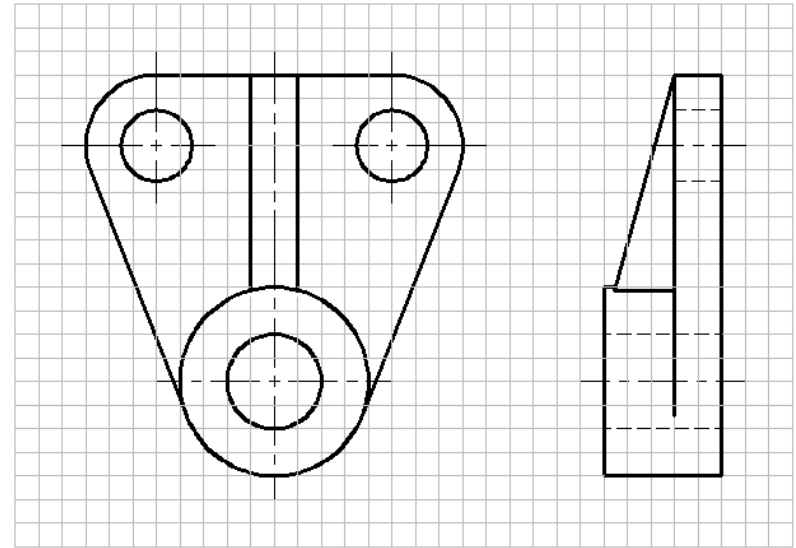
using a single view. Instead of the observer viewing the object perpendicular to the object, the object is rotated both horizontally and vertically relative to the observer.

There are rules and conventions to guide the creation of both types of projections. Additionally, either of them can be supplemented with various types of dimensions. Whether sketching or drawing, the goal is the same. The goal is to communicate the necessary detail to the intended audience.

Drafting I - Construct an Oblique Sketch

Requirements: Each student is required to create a simple oblique pictorial sketch.

1. Using only pencil, eraser, and the paper provided by your instructor, sketch a **CAVALIER OBLIQUE** pictorial (using a receding axis angle specified by your instructor) of the object whose orthographic views are given below.
2. The drawing should be done at a scale of 1:1. One square grid equals one oblique grid.
3. Use accepted drafting standards for lines and freehand lettering.
4. Letter your name, scale, and date in the title block.
5. Do **NOT** include any hidden lines on your oblique sketch.
6. Time Limit = 40 minutes.
7. An effort should be made to create a balanced appearance of the sketch on the paper provided.
8. Your sketch should reflect an understanding of the object's shape and features as determined from the orthographic views. Other areas of evaluation will include the accuracy of your measurements, and the quality of your line work and lettering.

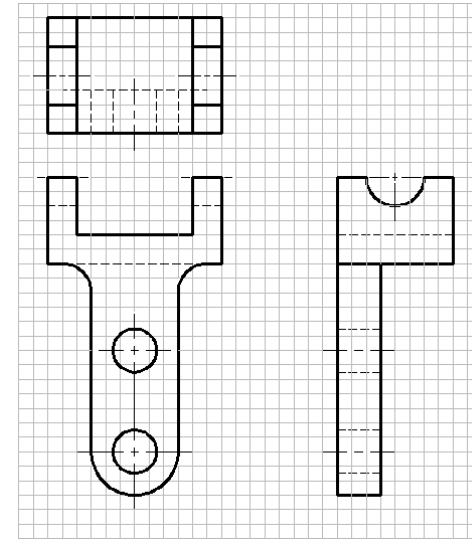


Drafting II - Construct an Isometric Sketch

Requirements: Each student is required to create a simple isometric pictorial sketch.

1. Using only pencil, eraser, and isometric grid paper sketch an **ISOMETRIC** pictorial of the object whose views are given on the next page.
2. The sketch should be done at a scale of 1:1. One square grid equals one isometric grid.
3. Use accepted drafting standards for lines and freehand lettering.
4. Letter your name, scale, and date in the title block.
5. Do **NOT** include any hidden lines on your isometric sketch.
6. Time Limit = 40 minutes.
7. An effort should be made to create a balanced appearance of the sketch on the paper provided.
8. Your sketch should reflect an understanding of the object's shape and features as determined from the orthographic views.

Other areas of evaluation will include the accuracy of your measurements, and the quality of your line work/lettering.



Assessment: The isometric sketch should be evaluated based on the following criteria:

Concepts and principles of isometric sketches	50 points
Accuracy	25 points
Line weight, technique, and neatness	20 points
Lettering	5 points

Lesson Guide

Period	Lesson title	Starter activity	Main activities	Concluding activities
1	1.1 Principle of sketching	Ask brain storming question about sketching from the textbook.	- Discuss and demonstrate the principle and material used in sketching - Let the students to practice on check point 1.1.	- Students give feedback about today's lessons. (Teacher acts as facilitator.) - Give home work to do exercises from the textbook
2	1.2 Sketching techniques	Ask brain storming question about sketching from the textbook.	- Discuss and demonstrate the techniques of sketching on line, angle, circle and Multi-view drawing - Let the students to practice activities 1.1 & 1.2 and check point 1.2 up to 1.10. - Help to do activity of the teachers guide	- Individually practice sketching techniques guided by the teacher. (Teacher acts as facilitator.) - Give home work to do exercises from the textbook
2	1.3 Pictorial sketching techniques	Ask brain storming question about sketching from the textbook.	- Discuss and demonstrate the techniques of sketching on pictorial sketching - Let the students to practice on check point 1.11 up to 1.14. - Help to do activities of the teachers guide	- Individually practice sketching techniques guided by the teacher. (Teacher acts as facilitator.) - Give home work to do exercises from the textbook

Method

- Discussion and Demonstration
- Group discussion (6-8 students per a group)
- Individual practice

Assessments

The teacher should follow and assess each student's work continuously over the whole activity of the each lesson and compare

it with the following description to determine whether the student has achieved the minimum required level.

Students working below the minimum requirement level will require extra help if they are to catch up with the rest of the class. They should be given extra attention in class and additional activities at the end of the lesson or during breaks.

Students working above the minimum requirement level should be praised and their achievements recognized. They should be encouraged to continue working hard and not become complacent.

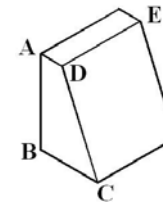
Quiz

(you can select any number of questions depending on the time you give)

Read each of the following multiple-choice items and the possible answers carefully. Mark the letter of the correct answer on your answer sheet or as instructed by your teacher.

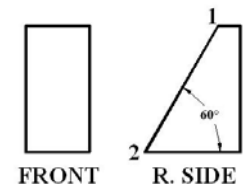
1. In the sketch below, which line is **NONISOMETRIC**?

- A. AB B. BC
C. CD D. DE

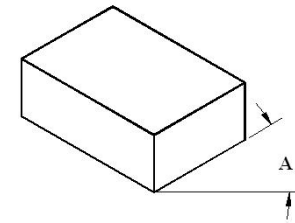


2. To construct an **ISOMETRIC** sketch using the views below, how would line 1,2 be drawn?

- A. Locate points 1 and 2, then connect them
B. Locate point 1, then draw a line at 60°
C. Locate point 2, then draw a line at 60°
D. Use a protractor to construct a 60° angle

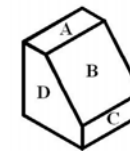


3. In the **ISOMETRIC** sketch below, what is angle “A”?



- A . 15° B . 30° C. 45° D. 60°

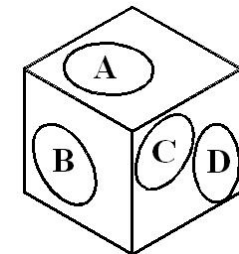
4. A normal **ISOMETRIC** ellipse should **NOT** be drawn on which surface?



5. Most drawings done with instruments start from:

- A. Blueprint drawings for manufacturing.
- B. Models of a proposed object.
- C. Parts drawings found in catalogues.
- D. Sketches provided by engineers or designers.

6. In the figure below, which **ISOMETRIC** ellipse is **NOT** correctly oriented?



7. In an **OBLIQUE** sketch, on which plane are arcs, holes, and irregular features commonly placed?

- | | |
|--------------|---------------|
| A. Any plane | C. Horizontal |
| B. Frontal | D. Profile |

8. When sketching long, narrow objects in **OBLIQUE**, distortion can be lessened by placing the long dimension along:
- A. A 30° receding axis
 - B. A 45° receding axis
 - C. The horizontal axis
 - D. The vertical axis
9. Which type of **PICTORIAL** sketch allows circles to appear on the front face as a true circle?
- A. Dimetric
 - B. Isometric
 - C. Oblique
 - D. Perspective
10. Which **PICTORIAL** sketch shows the most descriptive features parallel to the plane of projection?
- A. Dimetric
 - B. Isometric
 - C. Oblique
 - D. Perspective
11. What type of sketch is **BEST** for describing a new product?
- A. CAD detail
 - B. Design
 - C. Multi-view
 - D. Orthographic
12. What are the materials required for making a sketch?
- A. Pencil and compass
 - B. Pencil and paper
 - C. Pencil, paper and scale
 - D. Pencil, paper and triangle
13. It is commonly accepted practice that sketches are made with:
- A. 3mm leads.
 - B. Red pencils.
 - C. Softer leads.
 - D. Harder leads.

14. A good sketching technique for drawing a straight line is to focus on the:
- A. End point of the line.
 - B. Left side of the page.
 - C. Pencil point.
 - D. Right side of the page.
15. What is the advantage of using “pencil-sight” sketching technique?
- A. Aids in keeping correct proportion
 - B. Makes the sketch perspective
 - C. Makes the sketch pictorial
 - D. Provides a sketching grid
16. What is the symbol that describes a location in space?
- A. Line
 - B. Plane
 - C. Point
 - D. Surface
17. What is the path between two points (straight or curved) called?
- A. Line
 - B. Plane
 - C. Point
 - D. Surface
18. What is a flat or non-flat element created from curved lines?
- A. Line
 - B. Plane
 - C. Surface
 - D. Texture
19. What type of sketch is typically used for an object with very little thickness?
- A. Isometric
 - B. Multiview
 - C. Pictorial
 - D. Single view

20. In an **ISOMETRIC** sketch, a circle will appear as a(n):
- A. Arc.
 - B. Circle.
 - C. Ellipse.
 - D. Straight line.
21. The first step in sketching an isometric circle or ellipse is to sketch a(n):
- A. Large arc tangent at points.
 - B. Isometric square/rhombus.
 - C. Small arc tangent at points.
 - D. Square.
22. In an **ISOMETRIC** sketch, what lines are **NOT** parallel to the three isometric axes?
- A. Elliptical
 - B. Non-isometric
 - C. Trimetric
 - D. Vertical
23. In an isometric sketch, how are **NONISOMETRIC** lines drawn?
- A. 30° off horizontal
 - B. 60° off horizontal
 - C. Locate endpoints and connect
 - D. Use a protractor to measure the angle
24. Which type of **OBLIQUE** sketch has the receding axis drawn at one-half the true-depth?
- A. Cabinet
 - B. Cavalier
 - C. General
 - D. Uniform
25. Which **PICTORIAL** sketch has a 90° angle between two of its three axes?
- A. Dimetric
 - B. Isometric
 - C. Oblique
 - D. Perspective

Answer to quiz

1. C	6. D	11. B	16. C	21. B
2. A	7. B	12. B	17. A	22. B
3. B	8. C	13. C	18. C	23. C
4. B	9. C	14. A	19. D	24. A
5. D	10. C	15. A	20. C	25. C