CHAPTER 1 Introduction to Graphics Communication and Sketching

OBJECTIVES

After completing this chapter, you will be able to:

1. Describe why the use of graphics is an effective means of communicating when designing.
2. Define standards and conventions as applied to technical drawings.
3. Describe the design process.
4. Identify the important parts of a CAD system used to create technical drawings.
5. Identify the important traditional tools used to create technical drawings.
6. Use sketching and CAD to draw lines, circles, arcs, and curves.
7. Read and use scales.
8. Identify standard metric, U.S., and architectural drawing sheet sizes.
9. Identify the types and thicknesses of the various lines in the alphabet of lines.
10. Create a design sketch using pencil or computer.
11. Identify and use sketching tools.
12. Follow good hand-lettering practice.

INTRODUCTION

Chapter 1 is an introduction to the graphic language and tools of the engineer and technologist. The chapter explains why technical drawing is an effective way to communicate engineering concepts, relating past developments to modern practices, and examines current industry trends, showing why engineers and technologists today have an even greater need to master graphics communications. Concepts and terms important to understanding technical drawing are explained and defined, and an overview of the tools, underlying principles, standards, and conventions of engineering graphics is included. In addition, this chapter introduces you to sketching and the use of sketching for lettering. These techniques are expanded on in later chapters.

Technical drawings are created using a variety of instruments, ranging from traditional tools, such as pencils, compass, and triangles, to the computer. Drawing tools are used to make accurate and legible drawings and models. Traditional drawing instruments are still important, especially for sketching; today, however, the computer can be used for most drawing and modeling requirements. This chapter is an introduction to: computer-aided design/drafting (CAD) systems, including the related hardware, software, and peripheral devices; and the traditional equipment normally used by engineers and technologists to create technical drawing models.

1.1 In engineering, 92 percent of the design process is graphically based. The other 8 percent is divided between mathematics, and written and verbal communications. Why? Because graphics serves as the primary means of communication for the design process.

1.2 Drafting and documentation, along with design modeling, comprise over 50 percent of the engineer's time and are purely visual and graphical activities. Engineering analysis depends largely on reading engineering graphics, and manufacturing engineering and functional design also require the production and reading of graphics.

1.3 Engineering graphics can also communicate solutions to technical problems. Such engineering graphics are produced according to certain standards and conventions so they can be read and accurately interpreted by anyone who has learned those standards and conventions.

1.4 A designer has to think about the many features of an object that cannot be communicated with verbal descriptions. Technical drawings are a nonverbal method of communicating information.

1.5 **Engineers** are creative people who use technical means to solve problems. They design products, systems, devices, and structures to improve our living conditions. **Technologists** assist engineers and are concerned with the practical aspects of engineering in planning and production. Both engineers and technologists are finding that sharing technical information through graphical means is becoming more important as more nontechnical people become involved in the design/manufacturing process.

THE IMPORTANCE OF ENGINEERING GRAPHICS

Engineering graphics is a real and complete language used in the design process for:

1. Communicating
2. Solving problems
3. Quickly and accurately visualizing objects.
4. Conducting analyses.

1.6-7 A drawing is a graphical representation of objects and structures and is done using freehand, mechanical, or computer methods. Drawings may be abstract, such as the multiview drawings shown in, or more concrete, such as the very sophisticated computer model shown in.

1.8 Technical drawing is used to represent complex technical ideas with sufficient precision for the product to be mass-produced and the parts to be easily interchanged.

THE DESIGN PROCESS

1.11 A engineering drawing is used for documentation. These types of drawings are used in manufacture, for planning, fabrication, and assembly.

1.12 The traditional design process involves organizing the creative and analytical processes used to satisfy a need or solve a problem. It is a sequential process that can be grouped into six major activities, beginning with identification of the problem and ending with documentation of the design.

1.13 This finite element model of a crane hook is used in the analysis of a part to determine where maximum stress and strain occurs when a part is placed under various load conditions.

CHANGES IN THE ENGINEERING DESIGN PROCESS

1.14 The design process in U.S. industry is shifting from a linear, segmented activity to a team activity, involving all areas of business and using computers as the prominent tool. This new way of designing, with its integrated team approach, is called concurrent engineering. **Concurrent engineering** involves coordination of the technical and nontechnical functions of design and manufacturing within a business. Engineers must be able to work in teams. They must be able to design, analyze, and communicate using powerful CAD systems, and they must possess a well-developed ability to visualize, as well as the ability to communicate those visions to nontechnical personnel.

1.15 Geometric modeling is the process of creating computer graphics to communicate, document, analyze, and visualize the design process. There are various applications for a CAD database in the production of a product, using concurrent engineering practices.

STANDARDS AND CONVENTIONS

1.16 **Conventions** are commonly accepted practices, rules, or methods used in technical drawing.

1.17 **Standards** are sets of rules that govern how technical drawings are represented. Standards allow for the clear communication of technical ideas. In the United States, the **American National Standards Institute (ANSI)** is the governing body that sets the standards used for engineering and technical drawings. Other professional organizations, such as the American Society for Mechanical Engineering (ASM), assist ANSI in developing technical graphics standards.

ALPHABET OF LINES

1.18 The **alphabet of lines** is a set of standard linetypes established by the American National Standards Institute (ANSI) for technical drawing. The alphabet of lines, and the approximate dimensions used to create different linetypes, which are referred to as **linestyles** when used with CAD. Listed below are the standard linetypes and their applications in technical drawings:

Center lines are used to represent symmetry and paths of motion, and to mark the centers of circles and the axes of symmetrical parts, such as cylinders and bolts.

Break lines are freehand lines used to show where an object is broken to reveal interior features.

Dimension and **extension lines** are used to indicate the sizes of features on a drawing.

Section lines are used in section views to represent surfaces of an object cut by a cutting plane.

Cutting plane lines are used in section drawings to show the location of a cutting plane.

Visible lines are used to represent features that can be seen in the current view.

Hidden lines are used to represent features that cannot be seen in the current view.

Phantom lines are used to represent a moveable feature in its different positions.

1.19 CAD software provides different linestyles for creating standard technical drawings.