Drawing Management

Learning Objectives

After studying this chapter, you will be able to:

- List and describe the traditional ways used to reproduce drawings.
- Explain how drawings are prepared for microfilm storage.
- Describe the tools used in the reproduction and storage of CAD drawings.
- Explain the common distribution methods used for transferring CAD drawing files.

Technical Terms

Aperture card
Archive
Blueprint
Diazo process
Electrostatic process
Inkjet plotter
Intermediate
Microfilm
Pen plotter
Photodrafting
Photodrawing
Print
Scissors drafting
Security copies
Toner
Transmittal package
Whiteprints
Xerography

In traditional (manual-based) drafting, making prints of original drawings consumes a major portion of the time spent on reproductions. However, this is not the only type of reproduction work performed. Other reproduction methods traditionally used in manual drafting include microfilming, photodrafting, and scissors drafting. These processes have done much to improve the manual drafting process.

By comparison, CAD has revolutionized the way drawings are created, reproduced, and retrieved. Since CAD drawings are created as electronic files, drawings can be accessed quickly and reproduced with little difficulty. The transfer of drawing data from one location to another is also greatly simplified. This chapter discusses traditional-based and CAD-based methods used for reproducing, storing, and distributing drawings.

Traditional Methods of Reproducing Drawings

Traditional reproduction processes for drawings include microfilming, photodrawing, and scissors drafting. These are discussed in the following sections to give the student an understanding and appreciation of the traditional importance to drafting of these processes.

Microfilming

Microfilm is a fine-grain, high-resolution film containing an image greatly reduced in size from the original. The technique of microfilming has been known since the early 1800s. However, it was not until World War II that microfilming was applied to drafting. Microfilming was used to store security copies of original drawings at a separate location in the event of a disaster. ***Security copies*** are exact duplications of the original drawings. More recently, microfilming has been developed as an active working technique in creating new drawings, updating old drawings, reducing storage space requirements, and in finding drawings once they have been filed. See **Figure 20-1**.

The microfilm system revolutionized traditional drafting operations. The principal advantages are:

- Less storage space is required.
- The retrieval time is nearly instantaneous. This allows for quick viewing, or for quick hard copies.
- The data in drawings is used more because of the ready availability.
- There is reduced handling. This helps to preserve the original drawings.

However, in order to offer these advantages, microfilming places rigid quality control demands on the original drawing. The microfilm process reduces a 34″ × 44″ (E-size) drawing 30 times. This means there is not much room for error in line weight, lettering, and drawing quality.

Microfilmed drawings may be stored on rolls of microfilm or on aperture cards. An ***aperture card*** is a punched card with a single-frame microfilm insert that contains the image of the original drawing. A card storing a particular drawing may be located quickly in an electronic card sort and inserted in a microfilm reader for viewing and/or printing.

Drafting techniques for microfilm quality

The quality of any drawing reproduction depends on the quality of line work used, as well as the legibility of notes and dimensions.

Figure 20-1. A microfilm scanner equipped with a module for viewing microfilm in roll form. The system also has an aperture card module used for viewing drawings on aperture cards. Drawings can be viewed on a computer monitor and printed as hard copy using a printer. (SunRise Imaging, Inc.)

The drawing dimensions must have clear, well-formed letters and numbers. For drawings to be microfilmed, these qualities are especially important.

Refer to Chapter 5 for a discussion on lettering drawings to be microfilmed. In addition to precise lettering, drawings should have good line quality. Lines should be a minimum of .01″ thick. However, avoid excessively thick lines. Also, the space between lines (or lines of lettering) should be a minimum of .06″, **Figure 20-2**. Cleanliness is also very important for drawings that will be microfilmed.

Photodrawings

A ***photodrawing*** is a photograph of either an object or a model of an object that callouts and notes are added to. A photodrawing is made on reproducible drafting film or paper.

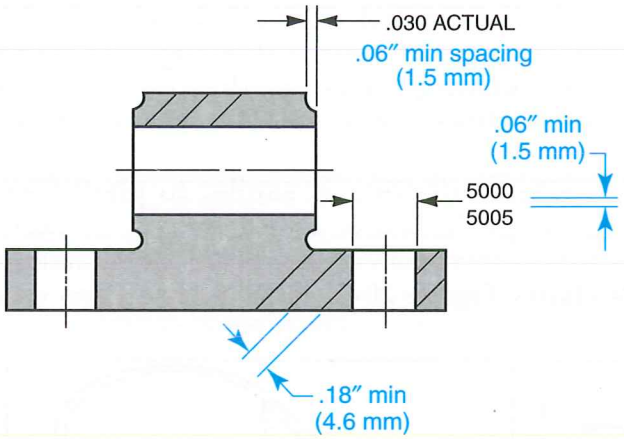

Figure 20-2. Line and letter quality, spacing, and cleanliness are critical for drawings that will be microfilmed.

The necessary lines, dimensions, and notes are added to the paper to create the photodrawing, **Figure 20-3.** Photodrawings have been used for some time in aerial mapping of land areas for highway projects and other construction projects. They have also been widely used in the electronic industry for wire assembly work.

Where a drawing would require a considerable number of hours in layout work, and where a pictorial presentation would aid in interpreting the drawing, a photodrawing might be more descriptive than a conventional drawing. This might mean considerable time savings as well.

Photodrawings begin with a photograph of a machine part, model, or building. The photo is prepared as a continuous tone or halftone print. Halftone photographs produce the best reproduction quality for diazo prints.

Photodrafting is also used to reproduce drawings. This term is also used to refer to photodrawing, but it includes the process of making a drawing where no photographs are used. In this case, sections of one or more drawings are

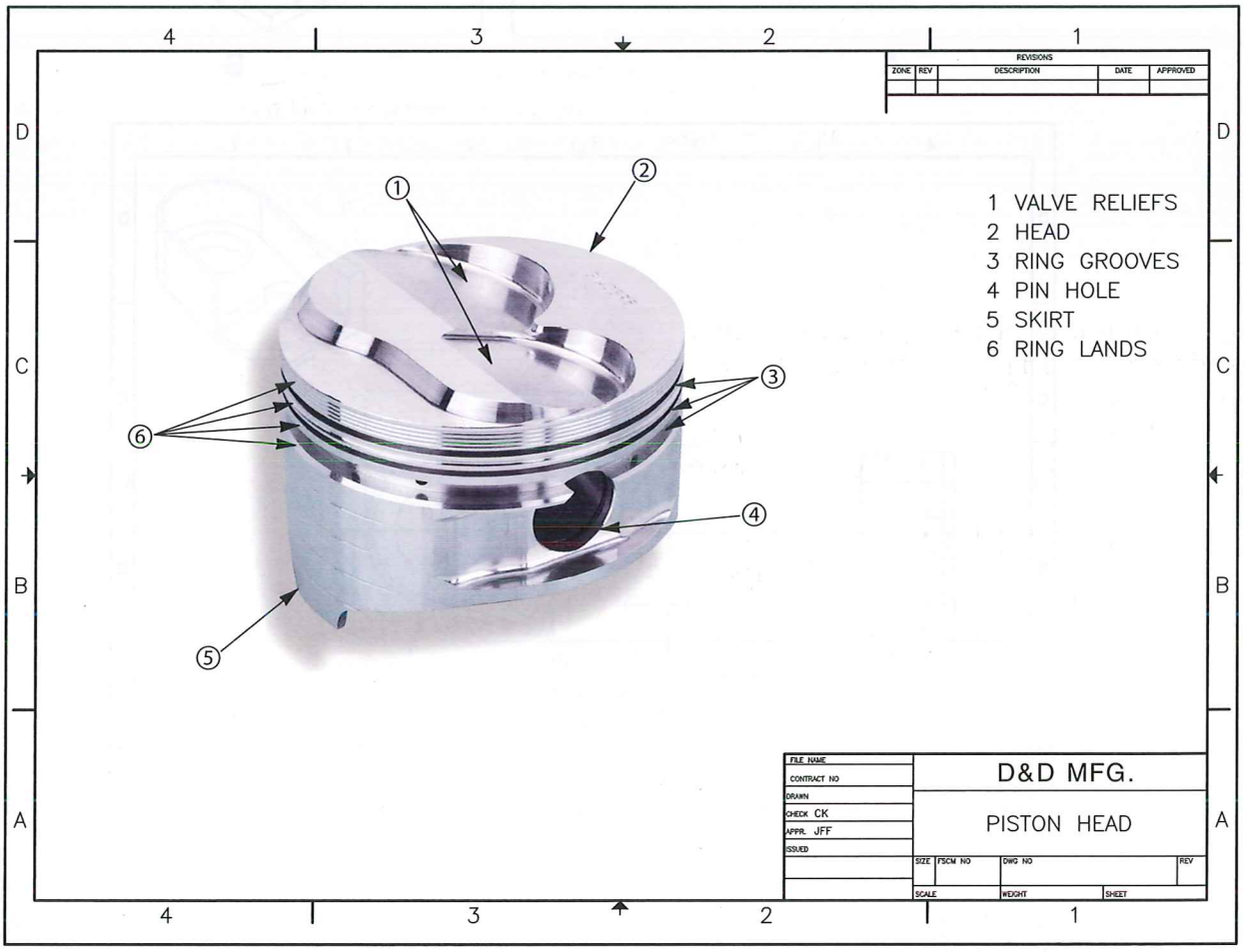

Figure 20-3. A photodrawing is a photograph of an object that is reproduced on drafting film, or paper, with notes and callouts added to complete the drawing. (Photograph courtesy of Holley Performance Products)

combined in a new or revised drawing using photographic techniques. The process of "cutting and pasting" is referred to as "scissors drafting" and is discussed in the next section.

Scissors Drafting

Scissors drafting is a method in which part (or all) of one drawing is used to create part (or all) of a "second original" drawing. In this method, parts of several drawings are reproduced and merged onto one drawing sheet. The necessary lines, notes, and dimensions can then be added.

Scissors drafting is similar to photodrawing, except the source of the "add-on" material is from other drawings, prints, parts catalogs, or charts, **Figure 20-4**. Unwanted sections on a

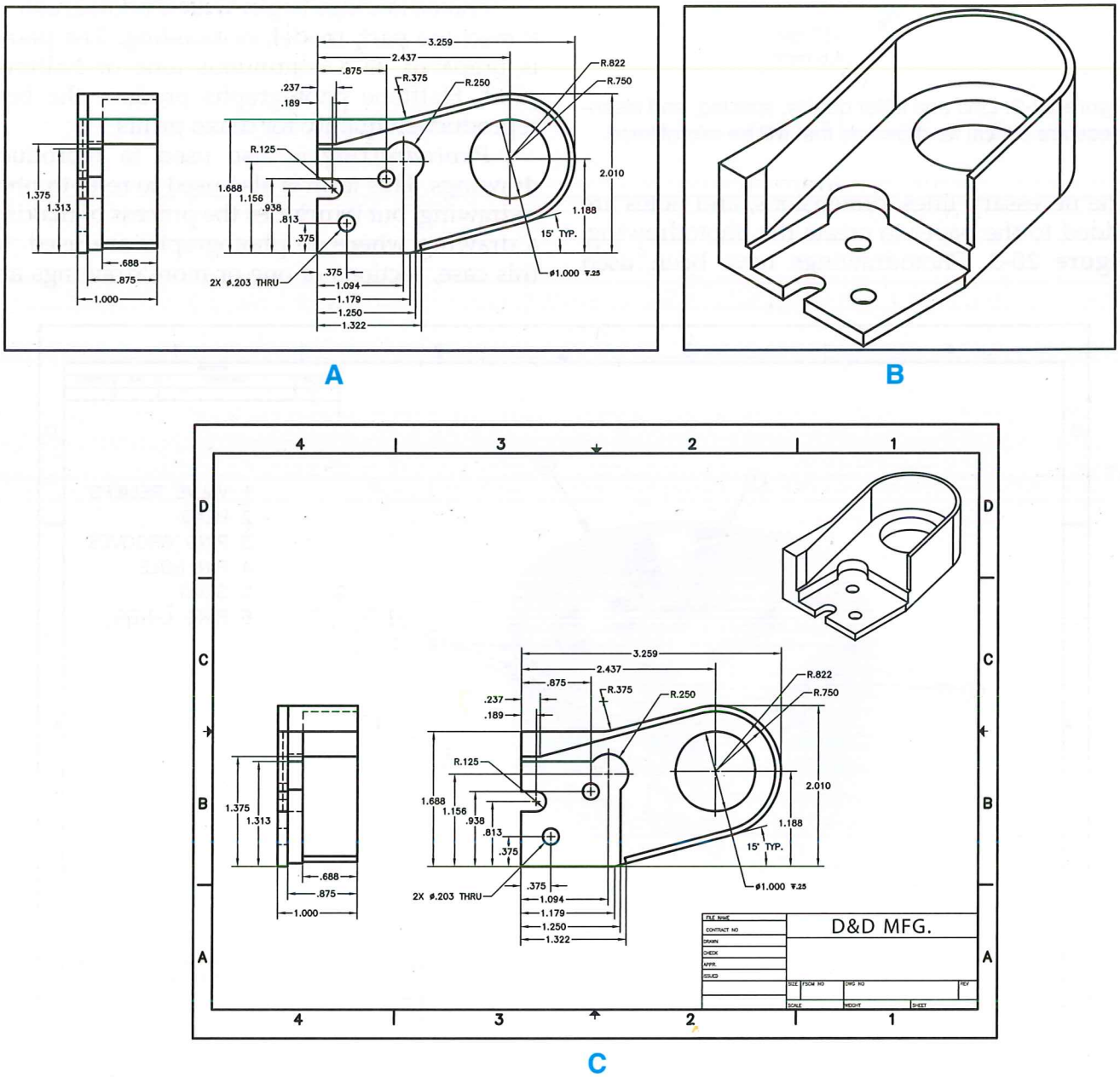

Figure 20-4. Scissors drafting takes parts of original drawings and splices other parts in for a "second original" drawing. A—An existing orthographic drawing of a part made up of front and side views. B—An isometric view of the part created as a separate drawing. C—The drawings are reproduced and "merged" onto a drawing sheet to create a "second original" drawing.

drawing can be "cut" or "blanked out" during the reproduction process. Changes can be drawn in without erasing.

When the parts have been combined onto one reproducible drawing, a positive print is made and serves as the "second original" drawing. Callouts, notes, and dimensions are then added to complete the drawing. Considerable drafting time can be saved when the parts added represent complicated and detailed objects.

Traditional Methods of Reproducing Prints

The term ***print*** refers to any hard copy reproduction of an original drawing. In addition to the reproduction methods previously discussed, there are numerous processes used in drafting to make prints from original drawings. The most common printmaking processes require a translucent drawing (or microfilm copy) and a sheet of paper, film, or other medium coated with a light-sensitive chemical. After passing the drawing and light-sensitive paper past a light source, the materials can be developed chemically to produce legible reproductions.

The lines and lettering on the original drawing, or other master copy, prevent the light from acting on the sensitized coating of the reproduction base material, **Figure 20-5**. This unexposed material will react during the chemical treatment process to develop the image of the original drawing. The type of reproduction print made depends upon the type of sensitized material used and its subsequent processing.

Several types of reproductions are made to serve different purposes. One type of reproduction, called an ***intermediate,*** is developed on a suitable medium such as vellum, film, or photographic paper. This will serve as a drawing medium in preparing "second original" drawings. Another type of intermediate is developed on a translucent material and serves as the "tracing" for use in making additional

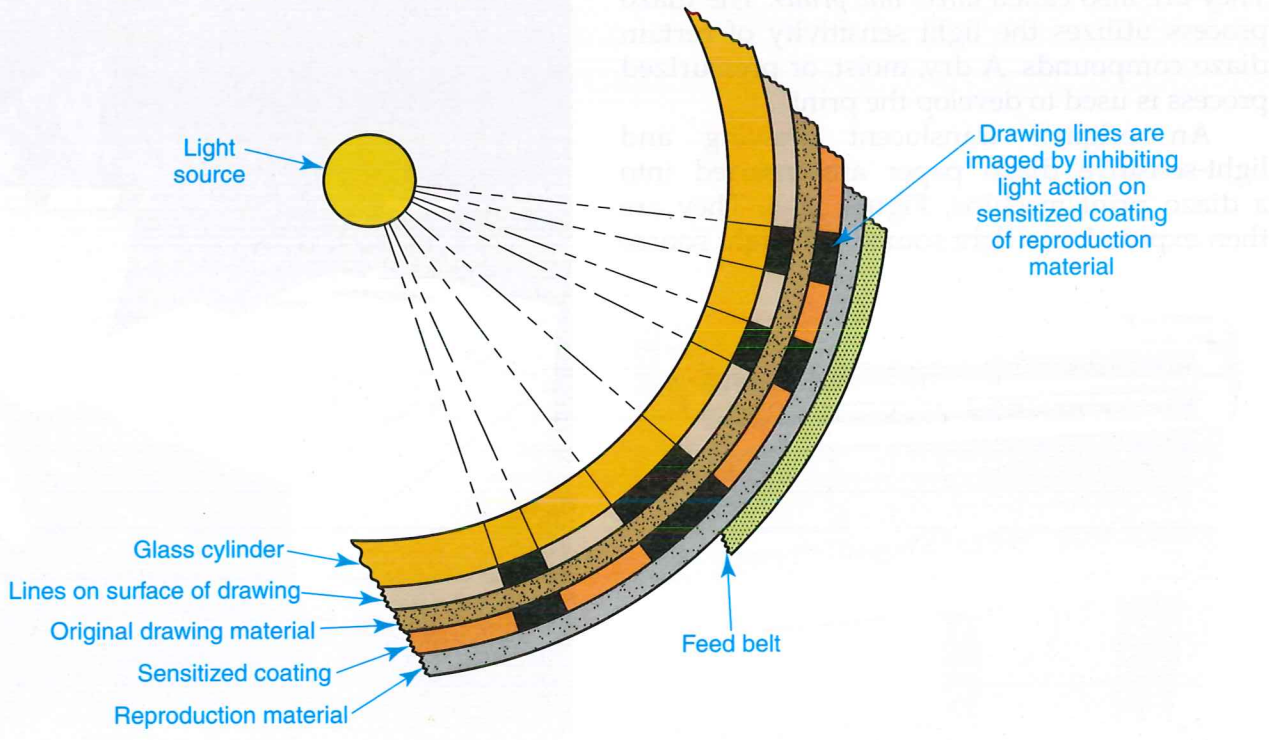

Figure 20-5. In traditional printmaking, a reproduction machine uses a light source to reproduce the lines on a drawing. The lines on the drawing being reproduced block light to certain areas of the light-sensitive paper. These "blocked" areas will become the lines on the reproduction. After exposure to the light source, the original returns to the machine operator and the sensitized material continues through a chemical treatment to develop the print.

prints, saving the wear and tear on the original drawing. The largest number of reproductions used are opaque reproductions. These are used by the workers who will actually produce the object described on the drawing.

Blueprints

For many years, the ***blueprint*** was the only type of reproduction made. A blueprint has white lines on a blue background. It is called a *negative print* because the reproduction is opposite in tone to the original drawing. Dark lines on a light background produce light lines on a dark background.

Diazo Printing

The ***diazo process*** is a more commonly used process than traditional blueprint reproduction. The diazo process produces positive prints with dark lines on a light background. Diazo prints may have blue, black, brown, red, or other colored lines and are often referred to as ***whiteprints***. They are also called *direct line prints*. The diazo process utilizes the light sensitivity of certain diazo compounds. A dry, moist, or pressurized process is used to develop the print.

An original translucent drawing and light-sensitive diazo paper are inserted into a diazo print machine, **Figure 20-6**. They are then exposed to a light source. The light source destroys the unprotected diazo compound. The original drawing is returned to the operator and the exposed sensitized paper is carried through the developing section of the machine. Here it is exposed to a chemical that develops the print.

The moist process transfers an ammonia solution to the print to make the development. The print is delivered in a somewhat moist or damp state. The dry process utilizes an ammonia vapor to develop the exposed copy. The copy produced is relatively dry. The pressurized process uses a thin film of a special activator delivered under pressure to the exposed copy to complete the development.

Figure 20-6. Diazo print machines are commonly used to reproduce drawings. (Diazit Company, Inc.)

Electrostatic Printing

The ***electrostatic process*** is a means of producing paper prints from original drawings or microfilm, **Figure 20-7**. This process, commonly referred to as ***xerography***, develops a print on unsensitized paper. It produces same size, enlarged, or reduced copies of the original drawing. The

Figure 20-7. Electrostatic printing machines are convenient to use because they produce copies of drawings quickly. Some machines can handle sheets as large as E-size, and some can automatically cut and roll the reproduced prints. (Xerox)

electrostatic process is commonly used because it is very convenient and fast. It works by forming an image electrostatically on a selenium-coated drum or plate. The image can then be transferred onto almost any type of material. The exposed surface is dusted with a dark powder called ***toner***. The toner is affixed permanently by heat or solvent action.

Storing Drawings

The production of engineering drawings represents a sizable investment to a company. Therefore, proper control and storage of original drawings is important. A typical system provides for three things. First, the location and status of drawings is known at all times. Second, damage to original drawings through improper handling is minimized. Finally, distribution of prints to appropriate individuals is provided for.

Companies using traditional drafting procedures store drawings in flat-drawer cabinets, tubes, or vertical hanging cabinets, **Figure 20-8**. Storing drawings in a safe place is important, but rapid location is also necessary. Prints are often folded and stored in standard office file cases. If properly organized, this method does provide rapid retrieval and security.

Reproducing, Distributing, and Storing CAD Drawings

One of the chief advantages of CAD over traditional drafting methods is increased efficiency in the management of drawings. In CAD, drawings are created as electronic files. This provides many advantages in production, storage, and control. When proper procedures are followed, the use of CAD saves time and simplifies many of the management tasks associated with traditional drafting.

There are a number of common methods used for reproducing CAD drawings as hard copy. In addition, there are a variety of ways to transfer CAD drawings electronically to different locations. As is the case in traditional drafting, proper storage methods must also be used to protect against the loss of drawings. Common reproduction, distribution, and storage methods for CAD drawings are discussed in the following sections.

Figure 20-8. Vertical storage cabinets provide easy access to large drawings. (Diazit Company, Inc.)

Plotting and Printing CAD Drawings

There are two basic types of devices used to output CAD drawings as hard copy: plotters and printers. Plotters are typically used for printing large-size drawing sheets, while printers are typically used for smaller work. Pen plotters, electrostatic plotters, and inkjet plotters are all used for plotting CAD drawings. A ***pen plotter*** uses technical ink pens to produce high-quality inked line drawings, **Figure 20-9**. Pen plotters plot *vectors* (line objects) by "drawing" complete lines, in much the same way a drafter does it. An ***inkjet plotter*** produces prints by "spraying" ink onto paper. Inkjet plotters are very useful for full-color drawings.

Printers vary in print quality and output size. Most printers are designed for small sheet sizes, but more expensive models are available for large-format sheets. Both laser and inkjet printers are used for making prints.

Each type of output device has advantages and disadvantages. Pen plotters produce high-quality line drawings in a variety of colors. However, they are slow and cannot produce renderings. Inkjet plotters can produce high-quality color renderings, but they are slow and expensive to operate. Laser printers are fast, but most cannot produce color or large-size prints.

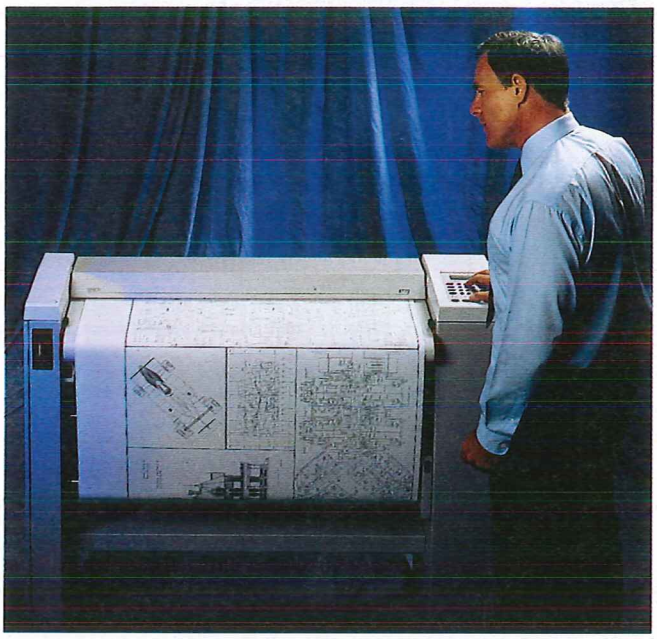

Figure 20-9. Plotters are used to generate large-size prints of CAD drawings. (Xerox)

Plotting can hinder productivity in an office or classroom if a system is not in place to ensure efficiency. Establish a procedure for plotting that is familiar to all users. Post the procedures in strategic locations and insist that everyone follow them.

Distributing CAD Drawings

CAD drawing production lends itself to other types of reproduction methods besides printing and plotting. Since CAD drawing data is electronic, the transfer of drawings is greatly simplified. In any given project, it may be necessary to transfer drawings to other drafting firms or to clients. There are many ways to transfer CAD drawings from one location to another. Drawing files can be saved to portable media, such as recordable compact discs (CDs) or digital video discs (DVDs), or to portable storage devices, such as miniature data drives (sometimes called "flash" drives). Portable media and data drives allow drawings to be quickly saved to storage and opened on different computers.

Another way to transfer drawings is to send them via electronic mail on the Internet. When multiple drawing files must be transferred, a file data compression program can be used to package the files together and save them as one compressed file. Some CAD systems provide special tools for packaging files together for electronic transmittals. A package of files prepared from CAD drawings for distribution purposes is called a ***transmittal package***. When using this feature, a package of files can be prepared from all of the drawings in a project. It may consist of a large number of drawings and file types, including the actual plan drawings, reference drawings, renderings, font files, and customization files. A transmittal package can be created as a single folder (set of files) or as a single compressed file.

Sometimes, drawings must be submitted to a location where the recipient does not have the software used to create the drawings. For example, it may be necessary for a client to view a drawing electronically without having access to the software. In such cases, a drawing (or set of drawings) can be exported to a different file format that permits viewing access by a "freeware" viewer. The viewer software typically provides navigation tools for zooming or panning the display. This allows the client to view one or more drawing files on a computer without having to run the CAD software.

Drawings are sometimes exchanged between drafters using similar methods. For example, a drawing can be exported to an alternate file format for different purposes, such as viewing on a web page on the Internet. The same type of file can also be sent to another drafter or firm via electronic mail. Instead of sending the original drawing file, a version similar to a "read-only" file is sent, and the recipient uses viewer software to open the file. This type of workflow is common because it permits collaboration between drafters in different locations. When drawings are shared in this manner, some drafters use special software with "markup" tools to add comments or notes in graphic form. This type of software allows different drafters to review a version of the drawing, but does not allow for editing changes to be made. This provides a way to exchange comments on a drawing without making changes to an original drawing file.

The need to share files with others is one of many reasons it is important to be able to keep original drawing data protected. The proper storage of CAD files ensures that drawings remain free of errors and data loss. Storage methods for CAD drawings are discussed next.

Storing and Retrieving CAD Drawings

Proper maintenance and storage play a very important role in ensuring that original CAD drawing data is not lost. To maintain drawing files properly, a system of organization and standardized procedures must be developed. The system should also include a file backup procedure to protect the drawing content. When managed in the right manner, a CAD storage system makes it easy to keep track of files and increases productivity. The effective management of a CAD storage system should consider the following factors:

- The development of a computer network that permits multiple user access and incorporates security procedures to prevent file corruption.
- The logical organization of folders for storing all drawing files and other project-related files on the hard disk.
- The use and proper storage of symbol libraries.
- The standard creation of template (or "prototype") drawings.
- The use of standard file naming conventions.
- The regular performance of file backup.

The number of files stored on a computer is typically kept at a minimum to increase efficiency, improve security, and prevent files from being misplaced or overwritten. Files should be stored in a logical hierarchy of folders to make it easy to locate drawings quickly. For example, each drawing project can be assigned its own set of folders within the overall hierarchy to establish an organized file system.

A CAD storage system must have a set of procedures in place to back up files regularly. One way to back up drawing files is to save them to backup discs or storage tapes. Depending on the CAD program you are using, you may also be able to create electronic archives of drawing files. An ***archive*** is a master file or folder containing all of the files belonging to a project, such as all of the related drawing files, template files, reference files, image files, and spreadsheets. Constructing an archive establishes a logical, orderly record of a project for future reference or retrieval. It may be useful, for instance, to create an archive during the project to keep a record of the project status at a certain point in time. When the project is completed, a second archive can be compiled as a final record of the project. This is a good way to manage a large number of drawing files and keep them stored together in an organized manner.

Actual storage and backup methods for CAD files will vary, so it is important to become familiar with your school or company standards. Learn the file management procedures that are in practice and follow them.

Chapter Summary

There are a number of ways used by drafters to reproduce drawings. In traditional (manual-based) drafting, the most common methods include making a print (hard copy) from an original drawing, microfilming, and making a photodrawing. In CAD, drawing reproductions are most commonly made by plotting or printing drawing files.

A common method of making prints from manual drawings is the diazo process. The product is often referred to as a whiteprint. Another method used is the electrostatic process, commonly referred to as xerography. This process uses unsensitized paper for the hard copy.

Most CAD systems support two types of hard copy output devices—pen plotters and printers. Pen plotters use technical ink pens to produce high-quality inked line drawings. Inkjet plotters produce prints by "spraying" ink to form the image. Laser printers and inkjet printers are also used to generate prints of CAD drawings.

One of the chief advantages of CAD over traditional drafting methods is increased efficiency. This efficiency extends to making hard copies, distributing drawings, and storing drawing files. Portable media storage and electronic distribution methods simplify the task of transferring drawings to different locations. Because CAD drawings are electronic, it is important to have standard procedures in place for organizing files and backing up saved data. A properly managed CAD storage system makes it easy to keep track of files and increases productivity.

Review Questions

1. Name three traditional reproduction processes used for duplicating original drawings.
2. What is *microfilm*?
3. The microfilm system revolutionized traditional drafting operations. Name three principal advantages of this system.
4. The microfilm process reduces an E-size drawing _____ times.
5. Microfilmed drawings may be stored on rolls of _____ or on _____.
6. A _____ is a photograph of either an object or a model of an object that callouts and notes are added to.
7. What is *scissors drafting*?
8. The term _____ refers to any hard copy reproduction of an original drawing.
9. A _____ has white lines on a blue background.
10. What traditional reproduction process reproduces positive prints with dark lines on a light background?
11. In CAD, drawings are created as _____ files.
12. What are the two basic types of devices used to output CAD drawings as hard copy?
13. What is a *transmittal package*?
14. One way to back up CAD drawing files is to save them to backup _____ or storage _____.
15. What is an *archive*?
16. One of the chief advantages of CAD over traditional drafting methods is increased _____.

Problems and Activities

The following problems and activities provide you an opportunity to gain further knowledge of the common reproduction processes used in drafting. Complete the activities as assigned by your instructor.

1. Select drawing problems from this text, or as assigned by your instructor. Prepare working drawings to microfilm quality standards.
2. Prepare a photodrawing utilizing a suitable photograph. Dimension the drawing and add necessary notes.
3. Prepare a "second original" drawing using the scissors drafting technique. Select an earlier drawing to be modified or combined with another. Estimate the time saved by this technique over preparing an entirely new drawing.
4. Make a print of one of your drawings on a translucent medium. Use either the diazo process or the blueprint process. Study the reproduction qualities of the drawing as revealed in the print.
5. Make an electrostatic copy of one of your drawings prepared earlier. Compare the quality of this reproduction with the print made in Problem 4.
6. Visit a local print service company and find out the types of reproduction processes they perform. Which type of reproduction is in greatest demand? What are the costs for the various types of reproduction prints? Write a short paper summarizing your findings.
7. Visit a drafting equipment supply company and inquire about the type of reproduction equipment the company sells. Find out about new processes or trends developing in this field. Write a short paper on the new processes and trends.