Introduction

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Key Terms in this Chapter

Term	Description
Attributes	Descriptions of electronic drawing elements.
CAD	An acronym for Computer Aided Design. It synonymously used for Computer Aided Drafting.
CADD	An acronym for Computer Aided Design & Drafting.
CADD system	A computer system that enables you to perform drawing and design tasks.
CAFM	An acronym for Computer Aided Facility Management
CAE	An acronym for Computer Aided Engineering
CAM	An acronym for Computer Aided Manufacturing
Command	A single instruction issued by the user to complete a task on the computer.
Database	A stored collection of data that can be retrieved and organized in different ways.
Function	A task in a program that can be completed by issuing a set of commands through the program.
Menu	A collection of functions or commands that are displayed on the screen. You can make selections from the menu with a pointing device such as a mouse.
Parametric design	A computer capability that links graphics on the screen with automated calculations and vice versa.

What is CADD?

When we think of Computer Aided Design and Drafting (CADD), certain questions arise that we never think of while working on the drawing board. We do not use the essential drawing board tools: paper, pencil, T-square, compass, eraser or scale, yet still have to design or make a drawing. When even one of

these tools is missing we know how aggravating it can be. With CADD we don't need even one of them!

CADD is an electronic tool that enables you to make quick and accurate drawings with the use of a computer. Unlike the traditional methods of making drawings on a drawing board, with CADD you can sit back in an easy chair and create wonderful drawings just by clicking the buttons of a keyboard. Moreover, drawings created with CADD have a number of advantages over drawings created on a drawing board. CADD drawings are neat, clean and highly presentable. Electronic drawings can be modified quite easily and can be presented in a variety of formats.

A decade ago, CADD was used only for specific engineering applications that required high precision. Due to CADD's high price, only a few professionals could afford it. In recent years, however, computer prices have decreased significantly and more and more professionals are taking advantage of CADD.

There are hundreds of CADD programs available in the CADD industry today. Some are intended for general drawing work while others are focused on specific engineering applications. There are programs that enable you to do 2D drawings, 3D drawings, renderings, shadings, engineering calculations, space planning, structural design, piping layouts, plant design, project management, etc. There is a CADD program for virtually every engineering discipline you can think of.

CADD is primarily intended for single-line drafting. It has very limited capabilities to create artistic impressions. However, CADD's 3D and rendering features are fascinating. You can create a 3D model of an object and view it from any angle. With proper shading and rendering, it can be made to look picture perfect!

What to Expect from CADD

You can do amazing things with CADD that you never thought possible while creating drawings with a pen or pencil. The following are some of the important capabilities that make CADD a powerful tool:

- Presentations
- Flexibility in editing
- Units & accuracy levels
- Storage and access for drawings
- Sharing CADD drawings
- Project reporting
- Engineering analysis
- Computer Aided Manufacturing (CAM)
- Design
- Add-on programs

Presentations

You can create fine drawings with hundreds of colors, line types, hatch patterns, presentation symbols and text styles. Even if you don't like something about your presentation after you have finished it, you can quickly change it. It takes only a few simple steps to change the text style, color or line type and you can print a fresh copy of the drawing.

There are a number of ready-made presentation symbols and hatch patterns available in CADD that can be used to enhance the look of drawings. For example, a site planner can add tree symbols, shrubs, pathways, human figures, and other landscape elements to create a site plan. Similarly, an architect can use ready-made symbols of doors, windows, furniture, etc., to make a presentation.

In addition to preparing impressive presentations on paper, you can use CADD to make on-screen presentations. You can plug your computer into a projector and present your ideas on-screen. Advanced CADD programs even allow you to created animated images. You can illustrate how a building would appear while walking through it, or how a machine would function when different machine assembly parts operate.

Flexibility in Editing

CADD provides the flexibility to make quick alterations to drawings. You can erase any portion of a drawing with pinpoint accuracy. It takes only seconds to do a job that could take hours on a drawing board. In many cases, you won't even have to erase the drawing to make the change. You can rearrange the existing components of the drawing to fit new shape. This enables you to analyze design options with minimal effort.

The following are some of the editing capabilities of CADD:

- Move or copy drawing elements
- Enlarge or reduce parts of a drawing
- Add one drawing to another
- Stretch a drawing to fit new dimensions
- Make multiple copies of a drawing element
- Change the size and style of text
- Change units of measure, accuracy and style of dimensions

Units & Accuracy Levels

CADD allows you to work with great accuracy. If you need to create highly accurate geometrical shapes, CADD is the answer. It can help avoid time-consuming mathematical calculations.

You can work with different units of measure, such as architectural units, engineering units, scientific units and surveyor's units. These units are represented in standard formats commonly used by professionals.

Example: When working with engineering units, you can specify whether all the dimensions should be represented in inches, feet-inches, centimeters or meters. Similarly, you can choose angular units of measurement such as decimal degrees, minutes, seconds or radians.

You can set an extremely high accuracy for the units of measurement. You can work with as high precision as 1/1000th of an inch! However, such accuracy is seldom required. You will often need to set the CADD program to a lesser accuracy to avoid unnecessary fractions.

In general, when you need to work on a large scale drawing such as a plan of a township, you may want to set a lesser degree of accuracy, say 1'-0". The computer will round off all the measurements to the next foot and you won't see any fractions less than a foot. When you need to work on a minute detail, you can set a higher degree of accuracy such as 1/8th or 1/64th of an inch.

Storage and Access of Drawings

It is quick and convenient to organize CADD drawings in a computer. You can have thousands of drawings on a computer's hard disk and can open any one of them within seconds.

A computer's electronic filing system has the following advantages over the traditional filing system:

- It enables you to create a highly organized environment
- It contributes to savings in working space
- An electronic drawing never gets old and faded. Any time you need a drawing, you can print a new copy from the disks.

Sharing CADD Drawings

The electronic drawings can be shared by a number of users, allowing them to coordinate projects and work as a team. This is accomplished by connecting different computers via a network.

Example: In a building project, different professionals such as architects, engineers and construction managers can use the same set of electronic drawings to coordinate building services. If a change is made to the drawings, this information becomes available to all the team members automatically.

With the use of modems and the Internet, it has become far easier to share information. Most architects and engineers these days share drawings electronically.

You can also publish your drawings on the Internet and collaborate CADD projects using a web site. Many CADD programs include special functions that allow you to export drawings in a format that can be viewed on the Internet. Refer to Chapter 9 "Maximizing CADD" for more information on collaborating CADD projects on the Internet.

Project Reporting

The computer can be used to prepare project reports such as records of areas, quantities and cost estimates. Using the database capabilities of CADD, you can link non-graphic information (such as text or value) with the graphic elements of the drawing. The non-graphic information is stored in a database, which can be used to prepare reports.

Example: An architect can link text attributes associated with the symbols of doors and windows in a drawing. The attributes can describe the size of the door, material, hardware, cost, etc. Later on the computer can automatically prepare a door schedule listing all the doors and windows in the drawing.

The non-graphic information is directly linked with the drawing objects. When a change is made to the drawing, the values in the reports are updated automatically. This provides a useful means to manage large projects.

There is a special category of software called Computer Aided Facility Management (CAFM) designed for building management. These programs allow you to import drawings from CADD programs and link attributes to them to form a database. The database can be used to keep track of spaces, areas, costs, people, equipment, furniture, building maintenance schedule, etc..

See Chapter 10 "CADD Industry Resources" for a list of CAFM software.

Engineering Analysis

There is a separate category of programs called Computer Aided Engineering (CAE) that can use CADD drawings for engineering analysis. The CAE programs have a number of applications in structural design, civil engineering, mechanical engineering and electrical engineering.

Example: A structural engineer can use a CAE program to test the design of structural components in a building. The engineer can instantly analyze the impact on structural members when a different load is applied to the structure or the spacing between the members is changed. Similarly, there are programs for mechanical engineers to test machine assemblies. The mechanical engineer can create a prototype electronic model and test it without building a physical model.

The advanced engineering programs even provide the ability to link calculations with the CADD drawings. This capability is known as "parametric design" that allows the computer to automatically update the drawings when the associated calculations are changed and vice versa.

Computer Aided Manufacturing (CAM)

CADD extends its power to yet another branch of engineering called Computer Aided Manufacturing (CAM). CAM is a common method of manufacturing used by large corporations. CADD and manufacturing programs are often integrated into one system called CAD-CAM. These systems import CADD drawings into CAM programs to automate the manufacturing process.

Example: An engineer can draw a machine part using CADD. The CADD drawing is brought into a computer aided engineering (CAE) program for engineering analysis. When the design is finalized, the drawing is brought into a CAD-CAM system that uses numerical data from the CADD drawing for actual manufacturing.

Design

CADD provides a convenient means to create designs for almost every engineering discipline. It can be used for architectural design, landscape design, interior design, civil and surveying, mechanical design, electrical engineering, plant design, industrial design, duct design, electronic circuit design, plumbing design, textile design and product design.

CADD's drafting capabilities provide ample means to create a design scheme. You can create designs with great accuracy and have the flexibility to easily edit them. This allows you to quickly prepare design alternatives.

In addition to the drafting capabilities of CADD, there are special programs that can analyze designs or even create new ones. These programs use artificial intelligence to "think" and make design decisions.

The design capabilities of CADD are available only in advanced CADD programs. There are only a few such programs available. Design programs are usually not generic. They often need to be custom-written to accomplish a specific task. See Chapter 9 "Maximizing CADD" for discussion on design programs.

Add-on Programs

There are a number of separate programs available that can enhance the power of CADD. The add-on programs work as an extension of CADD to accomplish specific tasks. Today, there are hundreds of add-on programs available for popular CADD programs.

An architectural add-on program can allow you to instantly draw symbols of doors, windows, kitchens, bathrooms, staircases, etc. A shading and rendering program can be used to enhance the look of 3D images. A plumbing design program includes special functions to draw pipes, drains and plumbing joints. A civil engineering program includes special features to work with contours and land development; the list goes on and on.

Most manufacturers market CADD programs in separate modules. They sell a basic drafting module for a certain price with the options to add on other modules. There are a number of add-on programs available from independent vendors as well.

A Look at the CADD Industry

There are hundreds of CADD programs available in the CADD industry today. Most of them are simply drafting programs, while some offer certain engineering analysis, design or database capabilities. Some programs are more elaborate than others. You can purchase a CADD program with just the basic drawing capabilities for as little as $200. These are called low-end programs and are commonly used for general drawing work.

Another category of software is mid-range. This category offers advanced drafting techniques such as layers, 3D, basic database capabilities, advanced dimensioning and many automated drawing features. Architecture and engineering design firms commonly use mid-range software. About 80% of all the CADD programs fall into this category and there is immense competition in this market. Their prices vary significantly.

There are a few advanced CADD programs available, which are commonly used by large corporations for manufacturing. These programs include integrated features such as solid modeling, engineering analysis, design, database and project management. These are called high-end programs. Most of the time they are customized to meet the specific requirements of the corporation. These programs are priced quite high.

Note: It's often hard to determine whether a program is low-end, mid-range or high-end. Low-end programs claim to be mid-range, while mid-range programs claim to be high-end.

Certain CADD programs have gained popularity among groups of professionals due to their unique characteristics. For example, AutoCAD has gained popularity among architects and other engineering trades associated with building construction. Microstation and Datacad are also quite well known in this industry. Allplan, ArchiCAD and Arris are popular architectural software programs in Europe. Pro-engineer has the largest market share in the mechanical engineering CADD market. Cadkey, CADDS, VELLUM and MicroCADAM are also quite popular in the mechanical market. Archibus, Drawbase and Aperture are specifically designed for facility management. MiniCAD and PowerCAD are favorites among Macintosh brand computer users. TurboCAD and DesignCAD are affordable industrial design programs. 3D studio, Form-Z and Lightscape are well-known rendering software. For more information, see Chapter 10 "CADD Industry Resources."

Important Tip:

Additional information about the CADD industry can be obtained by logging on to a web site dedicated to this book http://www.caddprimer.com, which contains hundreds of links to web sites associated with the CADD industry.

The Focus of this Book

With so many CADD programs available, it is impossible to learn each one. Most programs have similar drawing capabilities, but the exact procedures are quite different. You may be an expert on one program and yet not know much about another. This is because different CADD programs use different terminology and procedures to accomplish the same tasks. It may take you quite some time to learn the intricacies of a particular CADD program.

CADD PRIMER is designed to give you a head start in learning CADD regardless of any program you may have to use. It describes the general principles and applications of CADD that are applicable to most of the programs. Its objective is to familiarize you with all the aspects of working with CADD. Once you understand what individual functions do and which functions to use where, you can apply this knowledge to any CADD program.

The following are the main objectives of CADD PRIMER:

- To present an overview of CADD and describe its applications in different fields.
- To describe common terms associated with CADD hardware and software.
- To outline the basic principles associated with CADD and to demonstrate common drafting techniques and shortcuts used by professionals.
- To introduce the advanced capabilities of CADD and how they can be used to increase productivity.
- To provide information about the CADD industry resources.

How to Use *CADD PRIMER*

CADD PRIMER is a reference book. The examples in this book are illustrated in a generic way, because our objective is not to focus on a specific program. The examples used in this book are intended to give you an idea of how CADD works and what it can do for you. To learn about a specific program, you will have to obtain literature specific to that program.

A look inside *CADD PRIMER...*

Chapter	Description
Chapter 1: *CADD Hardware and Software*	Gives an overview of CADD hardware and describes the terminology associated with the equipment. Presents an overview of CADD functions and describes their role in CADD and how they are organized in various menus. Teaches you how to communicate with CADD through different means of data entry.

Chapter	Description
Chapter 2: *CADD Basics*	Instructs you on the basic drawing concepts of CADD. You will start with a simple drawing exercise. Explains the essential features of CADD, such as how to enter distances using different coordinate methods. You will learn how to use Absolute, Relative and Polar coordinates. Presents guidelines on setting up a prototype CADD drawing. You will learn how to save and manage CADD drawings.
Chapter 3: *The Drawing Tools*	Gives you a closer look at all the drawing capabilities of CADD. You will learn different methods for drawing lines, arcs, polylines, text, dimensions, etc.
Chapter 4: *View Displays*	Describes how View-Display functions are used to display different views of a drawing. You will learn how to zoom in on portions of the drawing and how to save and restore selected views.
Chapter 5: *The Edit Functions*	Describes the application of CADD's edit functions. You will learn a number of shortcut methods to fix errors. You will also learn how easy it is to make changes by using the erase, copy and move functions. Includes a number of exercises to illustrate functions.
Chapter 6: *Working with Layers*	Discusses the use of layers in CADD drawings. This is a commonly used technique that enables you to organize your drawings better by grouping information on specific layers.
Chapter 7: *Introduction to 3D*	Gives an overview of 3D functions of CADD. You will learn basic 3D drawing techniques. Describes how to make isometrics and perspectives, enter 3D coordinates, and display 3D views from different angles.
Chapter 8: *Printing and Plotting*	Describes CADD's plotting and printing procedures. You will learn how to print the same drawing with a number of variations. Includes a discussion on plotting and printing machines.
Chapter 9: *Maximizing CADD*	Presents an outline of advanced features of CADD, such as the use of attributes to make project reports, the use of macros to do automated tasks, applications of design and database, and how CADD works in an integrated environment with other programs.
Chapter 10: *CADD Industry Resources*	Presents an outline of important features offered by leading CADD programs and the guidelines to choose a CADD system. Includes a helpful CADD directory listing the leading CADD programs and important resources on the Internet.