

Seventh Edition

# Civil Drafting Technology

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EARSON





# Civil Drafting Technology

## SEVENTH EDITION

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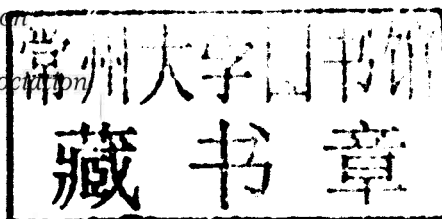
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# Preface

## Civil Drafting Technology

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*Civil Drafting Technology* is a workbook approach that provides comprehensive instruction in civil drafting. The content has been tested in the classroom and was created with input from civil engineering industry professionals and educators. The primary objective is to provide students with a foundation of work done by civil engineering companies and a broad education in the civil drafting field, which includes associated drawings, skills, and terminology. Most civil drafting and mapping is generated by specialized computer-aided design and drafting (CADD) software using a variety of data collected using electronic surveying techniques. Regardless of the software used, a drafter must still have knowledge of how maps and drawings are created.

*Civil Drafting Technology* is arranged in 14 chapters, each dealing with a specific subject area. The content can be used in a one-term or one-semester course, or the content, tests, and problems can fit a variety of course formats. When used in the prescribed manner, *Civil Drafting Technology* provides a broad understanding of civil drafting and a working knowledge of the basic components of mapping. With this knowledge and skill, a variety of job opportunities are open to you, and these opportunities can offer a challenging career. Opportunities found in civil drafting can be filled with variety and excitement and can include CADD, surveying, construction, courthouse research, artistic interpretation, mapping, cartography, and architectural drafting options. Civil drafting and mapping requires accuracy, neatness, and an eye for creative and uncluttered layout.

## Major Features

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*Civil Drafting Technology* has these important features:

- Numerous real-world illustrative examples that support text content
- Actual civil drafting examples used to illustrate chapter content
- Civil drafting industry standards
- Step-by-step layout methods
- Civil drafting layout techniques
- Current CADD applications
- Practical and useful appendixes
- Real-world industry problems

- Chapter tests for examination or review
- Web site references
- Introduction to types of maps
- Civil drafting and mapping requirements
- The U.S. National CADD Standard
- CADD applications
- Civil drafting and mapping scales
- Civil drafting and mapping symbols
- Measurement of distance and elevation
- Surveying fundamentals
- Identification and use of location and direction
- Use and creation of legal descriptions
- Plot plans and plats
- Contour lines
- Horizontal alignment layouts and profiles
- Sections and details
- Highway and site plan cut and fill layouts
- Earthwork calculations
- Civil engineering detail drawings
- Introduction to geographic information systems (GIS)

*Civil Drafting Technology* provides a practical approach to drafting as related to standards typically found in the civil engineering industry. When you become a professional, this text can stay with you as a valuable desk reference.

## Computer-Aided Design and Drafting

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Computer-aided design and drafting is presented throughout this text. CADD topics include:

- CADD software used in drafting and design
- The U.S. National CADD Standard
- CADD templates
- Recommended CADD layers
- CADD material requirements
- Specific CADD applications
- File management
- Plotting guidelines
- CADD menus and symbol libraries for specific civil engineering drafting applications
- Increased productivity with CADD
- Reuse of drawing content with CADD
- The CADD environment in industry
- Ergonomics

## Industry Approach to Problem Solving

---

Your responsibility as a drafter is to convert engineering sketches or instructions to formal drawings. This text explains how to prepare drawings from engineering sketches and information by providing

basic guides for layout and arrangement in a knowledge-building format. One concept is learned before the next is introduced. Problem assignments are presented in order of difficulty at the end of each chapter and throughout the text. The concepts and skills learned in one chapter can be used in the next chapters, so that by the end of the text, you have the ability to solve problems using a multitude of skills learned previously through discussions, examples, and activities. The problems are presented in a manner that is consistent with the civil engineering environment. Some problems are presented as layout sketches. It is not enough for you to duplicate drawings from given assignments; you must be able to think through the process of drafting development. The goals and objectives of each problem assignment are consistent with recommended evaluation criteria based on the progression of learning activities.

## Chapter Format

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Each chapter provides realistic examples, illustrations, problems, and related tests. The examples illustrate recommended drafting and design presentation based on civil drafting standards, with actual industry drawings used for reinforcement. The correlated text explains drafting techniques and provides professional applications for skill development. Layout methods provide a logical approach to setting up and completing drafting problems. Each chapter has these special features:

**CADD applications:** CADD applications are provided to illustrate how the use of CADD is streamlining the civil engineering design and drafting process.

**Related tests:** There is a content-related test at the end of each chapter for examination or review. Tests provide a variety of options, such as short-answer, multiple-choice, true-and-false, and sketching questions to help you understand chapter content. Answers to chapter test questions can be provided manually by removing the perforated pages for convenient use, or you can access the *Civil Drafting Technology* Student Web site and follow the instructions to answer the questions electronically.

**Problems:** Each chapter ends with real-world drafting and design problems for you to practice what you have learned. Problems vary from basic to complex. Problems are presented as engineering sketches, engineering layouts, written instructions, and actual industry projects. You can use manual or computer-aided drafting, depending on your course objectives. Advanced problems are given for challenging applications or for use as team projects.

## Civil Drafting Technology Companion Web Site

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The *Civil Drafting Technology* Web site contains:

- AutoCAD border and title block template drawings
- AutoCAD symbol blocks for civil drafting
- Base drawings for many of the drafting problems in the textbook
- A chapter-by-chapter list of Internet Web site links
- Microsoft Word files for all chapter tests and map reading exercises
- An optional final exam and final project

## Suggested Course of Study

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By studying *Civil Drafting Technology* and enrolling in a course in which you can apply the concepts presented, you are providing yourself with an excellent civil drafting foundation. If you are interested in expanding your knowledge and skills in civil drafting and design, you should enroll in advanced civil courses, surveying courses, or courses that provide training in specialized civil design and drafting software and geographic information systems (GIS). A wide variety of civil engineering design, modeling, drafting, and GIS software is in use today.

To access supplementary materials online, instructors need to request an instructor access code. Go to **www.pearsonhighered.com/irc**, where you can register for an instructor access code. Within 48 hours after registering, you will receive a confirmation e-mail that provides an instructor access code. After you receive your code, go to the site and log on for full instructions on downloading the materials you want to use.

## Professional Organizations

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The following are some professional organizations related to civil engineering and civil drafting:

- American Design Drafting Association (ADDA), at **www.adda.org**
- American Society of Civil Engineers (ASCE), at **www.asce.org**
- American Institute of Architects (AIA), at **www.aia.org**

## American Design Drafting Association (ADDA)–Approved Publication

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The content of this text is considered a fundamental component to the design drafting profession by the American Design Drafting Association. This publication covers topics and related material, as stated in the ADDA Curriculum Certification Standards and the

ADDA Certified Drafter Examination Review Guide. Although this publication is not conclusive with respect to ADDA standards, it should be considered a key reference tool in pursuit of a professional design-drafting career.

## **Special Note on the Seventh Edition**

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Advancements in technology have dramatically altered the manner in which drawings and maps are created. Topographic data collection has undergone a radical transformation in the past 25 years. Whereas surveyors once measured and recorded terrain data mechanically and manually, now the process is entirely digital, aided by satellites, global positioning systems (GPS), infrared distance measurement, and robotic surveying instruments. What once took three or four surveyors hours or days to accomplish can now be completed by one or two people in a fraction of the time.

Data collected by electronic methods can be transmitted to an office and immediately downloaded into civil engineering computer-aided design and drafting (CADD) software that displays the data in the form of a digital terrain model (DTM). Once the model is in the computer, designers and engineers can insert components of a new design, such as roads or sewer lines, and immediately display the new alignments in plan, elevation (profile) views, and even 3D shaded images. In addition, the new terrain model can be linked to a wide variety of information, such as database files of equipment lists, digital images and videos, client and manufacturer Web sites, and file transfer and storage Web sites for use by all parties involved in a project.

Throughout this text, the authors discuss CADD applications and current procedures and techniques. But it is important to note that the focus of this textbook is not instruction in one specific brand of software or one specific software product. Although specific software products are mentioned, it is not imperative that the student use those products to learn the materials presented in this book. Because a large number of schools use AutoCAD, this product is mentioned most often.

This edition has updated content to reflect current practices, while retaining some of the traditional information as background. Much manual drafting material has been eliminated, and new material has been added on computer-aided drafting and civil engineering. In addition, some traditional surveying and drafting information has been moved to the appendixes. Where necessary, the chapters have been updated with discussions of current practices.

Students, instructors, and reviewers all provide valuable input to the content and revisions of a book such as this. The authors welcome your comments and suggestions. Please direct your comments to one of the editors at Pearson/Prentice Hall listed in the front of the book.



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*David A. Madsen*  
*Terence M. Shumaker*  
*David P. Madsen*

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## CHAPTER

# 1

# Introduction to Civil Drafting Technology

## Learning Objectives

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After completing this chapter, you will be able to:

- Define civil drafting and civil engineering.
- Identify the purpose of civil engineering companies.
- Describe the schooling required to be a civil drafter.
- Define terms related to maps and civil drafting.
- Identify a variety of map types.
- Draw lines typically used in civil drafting.
- Generate words using typical civil drafting text styles.
- Create general and specific notes.
- Discuss workplace ethics.
- Identify professional organizations.
- Explain the purpose of intellectual property.

## Key Terms

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Civil drafting  
Civil engineering  
Ethics  
Intellectual property  
Maps  
Title block  
Cartography  
Aeronautical chart  
Contour lines  
Cadastral map  
Quadrangle map  
Engineering map  
Geographical map  
Hydrologic map  
Military map  
Nautical chart  
Photogrammetric map  
Topographic map  
Planning map  
Digital elevation model (DEM)  
Geologic map  
Line work  
Text  
General notes  
Field  
Specific notes

# Introduction to Civil Drafting

---

This chapter describes general civil drafting and map concepts. Information about civil drafting and map drafting requirements and employment opportunities is also covered.

Topics include:

- Civil engineering companies
- Schooling
- Maps
- Computer-aided design and drafting (CADD)
- Basic civil drafting techniques
- Text
- General and specific notes

**Civil drafting** is drafting performed for civil engineering projects. **Civil engineering** is the branch of engineering relating to the design and building of projects such as highways, bridges, waterworks, harbors, railroads, canals, and building sites. The land site or subdivision upon which your house, condominium, or apartment is located was probably designed and drafted by a civil engineering company. Generally, anything that has to do with the design of the land for construction projects involves civil drafting. While civil drafting also involves designing and drafting structures such as bridges, this textbook focuses on land-related projects such as roads and building construction sites. For this reason, much of the content covers the theory and drafting of maps and related applications.

## Civil Engineering Companies

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Civil engineering is the oldest form of engineering known, after military engineering. It spans the surveying and alteration of the land, to the planning, design, construction, and maintenance of structures. A student wanting to become a civil engineer must complete four or five years of college and graduate with a bachelor of engineering or a bachelor of science degree. Students can specialize in one of the wide variety of subdisciplines in the final years of study. Students who desire to work as CADD drafters/designers for a civil engineering firm should complete a one-year certificate or a two-year associate of science degree, with studies in civil drafting and geographic information systems (GIS).

Civil engineering companies are located nationwide in most cities. Some of these companies specialize in certain aspects of the industry, while others are quite diversified. The following is a list of some of the tasks that civil engineering companies may take part in:

- Land planning and subdivision
- Transportation
- Flood control
- Irrigation and drainage

- Sewage and water treatment
- Municipal improvements
- Environmental studies
- Land and construction surveys
- Construction inspection
- Refuse disposal
- Map-making
- Power plants
- Hydrologic studies
- Foundation work and soil analysis
- Agribusiness

A complete directory of consulting engineers is available from the American Council of Engineering Companies ([www.acec.org](http://www.acec.org)).

Drafting salaries of workers at civil engineering firms are usually competitive with those in other technologies. Working conditions vary but are usually excellent. Companies have a wide range of employee benefits. Check your local area regarding salary ranges and schooling requirements for entry-level drafters. Areas of the country differ in these concerns.

## Schooling

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Technical schools and community colleges throughout the United States and Canada have drafting programs. Schools may provide a specific drafting education in mechanical, architectural, civil, piping, structural, technical illustration, sheet metal, or electrical drafting. Other schools provide students with a more general CADD curriculum that may have courses in a variety of drafting areas. Often, a school focuses on the industry needs of the immediate area. The best thing to do is to identify the school program that will best serve your specific goals. Civil drafting is offered in many technical schools and community colleges.

Your specific goals in civil drafting may include learning one of several available CADD software programs. Most, if not all, technical schools and community colleges offer CADD classes in conjunction with drafting classes, and some places of employment provide additional industry- or company-specific CADD instruction to their employees who do drafting. While drafting with the aid of a computer is a skill in itself, your sound background and competence in essential drafting knowledge, technique, and standards are necessary to your success as a CADD operator. It is preferable that you combine drafting theory with your studies of CADD so that basic drafting skills are not overlooked. Therefore, if you are interested in civil drafting as a career, in addition to learning CADD, your schooling should include the development of some of these fundamental skills:

- Drafting theory and national standards
- Sketching techniques and skills
- Use of bearings and azimuths
- Use of the engineer's scale



- Scale conversion
- Conversion of surveying field notes
- Drawing of contour lines
- Use of mapping symbols
- Interpretation of legal descriptions
- Preparation of a plat and site plan
- Development of plans and profiles
- Layout of highways, centerlines, curves, and delta angles
- Drawing of cuts and fills
- Basic use and knowledge of surveying equipment
- Math through basic trigonometry

## Professional Organizations

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The American Design Drafting Association (ADDA), [www.adda.org](http://www.adda.org), is a nonprofit professional organization dedicated to the advancement of design and drafting. The ADDA sponsors the following programs and activities for the design drafting profession:

- Leadership
- Curriculum certification
- Student chapters
- National design drafting conference and contest
- Drafting examination review
- The *U.S. Department of Labor's Occupational Outlook Handbook* as a free download
- Employment center
- Drafter certification program

According to the ADDA Web site, Drafter Certification (CD) is an international program that allows drafters to indicate their knowledge of drafting concepts and internationally recognized standards and practices. ADDA developed the examination to elevate an individual's comprehension of the professional standards related to design drafting. Certification allows drafters to demonstrate professional capabilities and helps employers in identifying quality employees. The test does not cover software specific to CADD.

The ADDA Drafter Certification Examination is open to all individuals, regardless of experience and formal education. Membership in the ADDA is not required to take the test or become certified.

Becoming a Certified Drafter reflects your proven knowledge of drafting. Certification enhances your credibility as a professional, improves your opportunities for promotion and pay increases, and gives you a competitive edge in a highly technical job market.

When employers hire an ADDA Certified Drafter, they know that the new employee meets certification criteria and has demonstrated initiative and pride in the profession by becoming certified. Thus, certification can serve as one