SEVENTH EDITION

Architectural Drafting & Design

ALAN JEFFERIS | DAVID A. MADSEN | DAVID P. MADSEN

ADDA A Legacy of Excellence APPROVED PUBLICATION

ICC INTERNATIONAL CODE COUNCIL®

Architectural Drafting and Design

Seventh Edition

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Preface

For over 28 years, students have relied on *Architectural Drafting and Design* for easy-to-read, comprehensive coverage of architectural drafting and design instruction that complies with and reinforces architectural, engineering, and construction industry standards and practices.

This seventh edition of *Architectural Drafting and Design* is a practical, comprehensive textbook that is easy to use and understand. The content can be used as presented by following a logical sequence of learning activities for residential and light commercial architectural drafting and design, or the chapters can be rearranged to accommodate alternate formats for traditional or individualized instruction.

American Design Drafting Association (ADDA) Approved Publication

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.

About the International Code Council

The International Code Council is a member-focused association. It is dedicated to developing model codes and standards used in the design, build and compliance process to construct safe, sustainable, affordable and resilient structures. Most U.S. communities and many global markets choose the International Codes. ICC Evaluation Service (ICC-ES) is the industry leader in performing technical evaluations for code compliance fostering safe and sustainable design and construction.

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Approach

Architectural Drafting and Design provides a practical and realistic approach to solving problems that are encountered in the world of architectural design.

Practical

Architectural Drafting and Design provides a practical approach to architectural drafting and design as it relates to current standard practices. The emphasis on standardization is an excellent and necessary foundation for drafting training as well as for implementing a common approach to drafting nationwide. After students become professional drafters, this text will serve as a valuable desk reference.

Realistic

Chapters contain professional examples, illustrations, step-by-step layout techniques, drafting problems, and related tests. The examples demonstrate recommended drafting presentation with actual architectural drawings used for reinforcement. The correlated text explains drafting practices and provides useful information for knowledge building and skill development. Step-by-step layout methods provide a logical approach to beginning and finishing complete sets of working drawings.

Practical Approach to Problem Solving

The responsibility of the professional architectural drafter is to convert architects', engineers', and designers' sketches and ideas into formal drawings. This textbook explains how to prepare formal drawings from design sketches by providing the learner with basic guidelines for drafting layout and minimum design and code requirements in a knowledge-building format. One concept is learned before the next is introduced. The concepts and skills learned from one chapter to the next allow students to prepare complete sets of working drawings for residential and light commercial construction projects. Problem assignments are presented in order of difficulty and in a manner that provides students with a wide variety of architectural drafting experiences.

Real-World Architectural Problems

The problems are presented as preliminary designs or design sketches in a manner that is consistent with actual architectural office practices. It is not enough for students to duplicate drawings from given assignments. Students must be able to think through the process of drawing development with a foundation based on how drawing and construction components are put into practice. The goals and objectives of each problem assignment are consistent with recommended evaluation criteria based on the progression of learning activities. The drafting problems and chapter tests recommend that work be done using drafting skills with actual drafting materials using computer-aided drafting applications. A problem solution or test answer should be accurate and demonstrate proper drafting practice.

Team Problems

Problems can be assigned as team problems. Team problems that involve designing and drawing a set of plans for a home can be used as projects that help foster leadership and cooperation between team members. Teams are established with any desired number of members based on the project and curriculum goals. Teams can select a manager by voting in a democratic process, by selecting the person with the highest course evaluation, or as determined by the instructor. A manager is the person in charge of the project. The manager coordinates the teamwork, monitors the progress, and provides answers and instructions to the team members in cooperation with the instructor. The manager divides the project into tasks and assigns portions of the project to the drafting team members. The manager works with team members to establish design alternatives. Team members are drafters, with one drafter responsible for sheet layout and reproduction. Each drafter is assigned specific drawings for the completion of the entire set of drawings. The manager provides coordination between team members to confirm all parts of the project match. Final team assignments and members are determined by your instructor.

Team project evaluation includes:

- Project coordination: organization of project assignments.
- Project completion: complete set of working drawings finished.
- Team member cooperation.
- Project quality: drawings completed accurately and in a professional manner

Architectural artistic decisions include:

- Project properly interpreted.
- Design decisions properly evaluated and completed.

Features of the Textbook

Major features of this textbook guide you through the world of architectural design and drafting, including: realistic application of the information presented throughout each chapter, professional illustrations of each concept to be explored, CADD applications of each type of working drawing, and exploration of the 2015 building codes and standards produced by the *International Code Council*, the National Association of Home Builders (NAHB), and Leadership in Energy and Environmental Design (LEED).

Chapter Tests

Chapter tests are found at the end of each chapter. Select the Chapter Tests link on the Student Companion Website to access chapter tests using Microsoft Word. The chapter tests allow you to review or test your knowledge of the related chapter content, depending on your course objectives. Open the related link and answer the questions electronically, unless otherwise directed by your instructor.

Real-World Problems

Special emphasis has been placed on providing realistic drafting problems. Problems are presented as design layouts or preliminary drawings in a manner that is consistent with architectural practices. The problems have been supplied by architects, engineers, and architectural designers. Each problem solution is based on the step-by-step layout procedures provided in chapter content.

Problems are given in order of complexity to expose students to a variety of drafting experiences. Problems require students to go through the same thought and decision-making processes that a professional drafter faces daily, including scale and sheet size selection, view layout, dimension placement, section placement, and many other activities. Problems are solved using computer-aided drafting, as determined by individual course guidelines. Chapter tests provide complete coverage of each chapter and can be used for student evaluation or as review.

Illustrations

Drawings and photos are used liberally throughout this textbook to strengthen the concepts presented. Full-color treatment enhances the clarity. Abundant step-by-step instructions and illustrations take students through the detailed stages of the drafting process for each application. The step-by-step illustrations are created using computer-aided drafting for the highest accuracy and quality.

Computer-Aided Design and Drafting (CADD)

CADD is presented as a valuable tool that has revolutionized the architectural design and drafting industry. The complete discussion of CADD introduces terminology, drafting techniques, and sample drawings. Drawings displayed throughout this textbook are created using CADD.

Construction Techniques and Building Codes

Construction techniques differ throughout the country. This text clearly acknowledges the difference in construction methods and introduces the student to the format used to make a complete set of working drawings for each method of construction. Students can learn to prepare drawings for each construction method or, more commonly, for the specific construction techniques that are used in their locality. The problem assignments are designed to provide drawings that involve a variety of construction alternatives.

To provide oversight of the wide range of construction methods and materials used throughout the country, the 2015 model codes written by the *International Code Council* (*ICC*) are referenced throughout this textbook. The major *ICC* codes addressed in this textbook include the *International Residential Code* (*IRC*) in Chapter 1 through Chapter 41, the *International Building Code* (*IBC*) in Chapter 42 through Chapter 44, and the International Energy Conservation Code (IECC) and the International Green Construction Code (IgCC) in Chapters 9 and 41. Although many municipalities have adopted their own versions of these codes, the use of these model codes provides a firm background before exploring local variations.

Codes and Standards Compliance

Each chapter is based on information provided by the following major industry leaders:

- 2015 editions of the *International Residential Code* and the *International Building Code* published by the *International Code Council*. The International Energy Conservation Code (IECC) and the International Green Construction Code (IgCC) will be explored in Chapter 9 and Chapter 41.
- National CAD Standards® V6.
- *MasterFormat* and *UniFormat* published by The Construction Specifications Institute (CSI) and Construction Specifications Canada (CSC).
- LEED rating system published by the U.S. Green Building Council (USGBC).
- Model Green Home Building Guidelines (MGHBG) developed by the National Association of Home Builders (NAHB) and the *International Code Council* (*ICC*), which publishes the *International Residential Code* (*IRC*).

Going Green

Protecting the environment is one of the most important worldwide issues today. A flagship feature called *Going Green* is found throughout this textbook, providing current, practical, and experimental energy-efficient architectural design and construction techniques that result in a significant reduction in energy consumption. As the building industry grows to meet the demands of our

increasing population, we must take care of the environment and allow for current and future development.

As a student, and when you enter the architecture profession, it is very important for you to learn what is available today and to find ways to improve energy efficiency in architectural design and construction in the future in an effort to protect the earth. National and local programs have been established to meet this need. A leading program is often referred to as *green building*. The U.S. Green Building Council (USGBC) is a key organization developed to promote building design and construction that is environmentally responsible and healthy, while allowing construction to remain profitable. Modern advances in building construction are available to designers, builders, and owners who want to "build green" and make the most of environmental protection in the architectural and construction industries. The following is an example of one of the *Going Green* features found in this edition:

GreenFormat

The Construction Specifications Institute has established *GreenFormat: The Construction Product Sustainability Information Reporting Guide. GreenFormat* is a CSI format allowing manufacturers to accurately report the sustainability measuring properties of their products, and providing designers, contractors, and building operators with basic information to help meet green requirements. When using *GreenFormat*, construction product manufacturers complete an online *GreenFormat* reporting questionnaire that collects the sustainability information about their product. Data from the questionnaires are displayed in a standardized style designed to ease sustainable design decision making. Access to the *GreenFormat* report and the resulting data is provided through http://www.greenformat.com.

Those using the website can print reports on specific products based on their questions within the database. Sustainable information reported in *GreenFormat* is grouped into categories, each containing individual topics and questions about product sustainability. The categories are organized with topics more likely to be important to design decisions first. This flexible structure can adapt to anticipated changes in the industry. As sustainability issues evolve, new topics and questions are added in the appropriate category, and existing topics and questions that become obsolete or change are dropped if necessary. The structure can be applied to all construction products and product categories. Refer to www.greenformat.com to see the categories and their contents and to view additional information about *GreenFormat*.

CADD Applications

CADD Applications is a special boxed feature that provides a variety of real-world examples, professional presentations, software applications, tips, standards, and procedures used with computer-aided design and drafting. The following is an example of one of the *CADD Applications* found in the seventh edition:

Drawing Sections

Using a computer to draw sections has some advantages: Standard sections and details can be brought into the drawing from a library, and placing notes on the section is easy with CADD. Also, some architectural CADD packages automatically draw a preliminary section from information you provide in relationship to the floor plan. This type of parametric design requires that an imaginary cutting-plane line be placed through the floor plan in the desired section location. This is followed by computer prompts requesting information such as roof pitch and structural floor thicknesses. In programs of this type, the floor plan walls are drawn with heights established, so these dimensions automatically convert to wall height information in the sectional view. All you do to complete the section is add material symbols, dimensions, and notes.

Some architectural CADD packages contain typical section elements such as details, materials, and tags. After architects have used the CADD system for a while, they begin to save all typical or standard construction details as blocks. These blocks are commonly placed in a library manual for easy reference and can be called up and displayed at any time in any drawing. The standard details should be clearly labeled with an identification code for easy reference. Each CADD user should have a copy of the library reference manual, and every time a new detail is drawn, the reference manual should be updated with a drawing of the detail and the reference code. ■

Note

The Note feature is provided throughout this textbook to provide brief information related to the specific content where the note is found. The following is an example of a seventh edition note:

Note: *Although both groups have produced "guidelines," many municipalities are starting to move beyond the recommendation stage and are incorporating portions of these guidelines into their design and building requirements. The 2015 edition of the* ICC codes, *the* NGBS-ICC 700, *has moved from guidelines to law. Verify with the municipality that will govern each specific building project to determine whether specific aspects of a green guideline are required. The* ICC *has also developed a green building code for buildings that are not covered by the* NGBS-ICC 700, *titled* International Green Construction Code (IgCC).

Supplemental Chapter Readings

Students are directed to supplemental chapter readings that are found on the Student Companion Website and are identified by a website icon in appropriate locations throughout this textbook. The supplemental reference material provides optional learning opportunities. The supplemental material ranges from commonly known topics available for students desiring a review, to advanced information that is beyond the scope of this textbook for students interested in further exploration. The supplemental chapter readings are identified within chapter content in the following manner.

The Student Companion Website

Although not new to the seventh edition, the Student Companion Website has new and improved content.

A website icon found throughout this textbook guides students to features found on the website. Refer to the Prologue for a complete description of each component and how to use the Student Companion Website.

The following features are found on the Student Companion Website:

- Supplemental Chapter Readings
- Step-by-Step Layout Drawings

- Chapter Tests
- Drawing Checklists
- Drawing Problems
- Drawing Templates
- Architectural Blocks and Symbols
- Related Web Links
- Workbook
- Video Clips of Major Concepts
- Review Questions

Organizing Your Course

Architectural drafting is the primary emphasis of many technical drafting curricula, while some schools offer only an exploratory course in this field. This textbook is appropriate for either application, as the content reflects common elements in any architectural drafting curriculum.

Prerequisites

An interest in architectural drafting and design, plus basic arithmetic, written communication, and reading skills are the only prerequisites required. Basic drafting skills, and layout techniques are presented as appropriate. Students with an interest in architectural drafting who begin using this text can end with the knowledge and skills required to prepare complete sets of working drawings for residential and light commercial architectural construction projects.

Fundamental through Advanced Coverage

This textbook can be used in an architectural drafting and design curriculum that covers the basics of residential architecture in a one-, two-, or three-semester sequence. In this application, students use the chapters directly associated with the preparation of a complete set of working drawings for a residence, where the emphasis is on the use of fundamental skills and techniques. The rest of the textbook can remain as a reference for future study or as a valuable desk reference.

This textbook can also be used in the comprehensive architectural drafting and design program where a four- to six-semester sequence of residential and light commercial architectural drafting and design is required. In this application, students can expand on the primary objective of preparing a complete set of working drawings for the design of residential and light commercial projects with the coverage of any one or all of the following areas: energy-efficient construction techniques, solar and site orientation design applications, heating and cooling thermal performance, structural load calculations, and presentation drawings.

Section Length

Chapters are presented in individual learning segments that begin with fundamental concepts and build until each chapter provides complete coverage of every topic. Instructors can choose to present content in short, 15-minute discussions or divide each chapter into 40- to 50-minute discussions.

Drafting Equipment and Materials

Identification and use of computer-aided drafting equipment is described in a supplement. Students need an inventory of equipment available for use as listed in the content. Professional drafting materials are explained, and it is recommended that students prepare problem solutions using actual drafting materials.

Supplements

Instructor Companion Website

The Instructor Companion Website, found on cengagebrain.com, includes the following components to help minimize instructor preparation time and engage students.

- **Syllabus:** Lesson plans created by chapter. You have the option of using these lesson plans with your own course information.
- **Chapter Hints:** Objectives and teaching hints that provide the basis for a lecture outline that helps you to present concepts and material. Key points and concepts can be graphically highlighted for student retention.
- **PowerPoint Presentation:** Slides for each chapter of the text provide the basis for a lecture outline that helps you to present concepts and material. Key points and concepts can be graphically highlighted for student retention.
- **Solutions Manual:** Contains answers to end-of-chapter review questions and solutions to end-of-chapter problems.

Cengage Learning Testing Powered by Cognero is a flexible online system that allows you to:

- Author, edit, and manage test bank content from multiple Cengage Learning solutions.

- Create tests from your LMS, your classroom, or wherever you want.

MindTap for Architectural Drafting & Design

MindTap is a personalized teaching experience with relevant assignments that guide students to analyze, apply, and improve thinking, allowing you to measure skills and outcomes with ease.

- **Personalized Teaching:** Becomes YOURS with a Learning Path that is built with key student objectives. Control what students see and when they see it—match your syllabus exactly by hiding, rearranging, or adding your own content.
- **Guide Students:** Goes beyond the traditional "lift and shift" model by creating a unique learning path of relevant readings, multimedia, and activities that move students up the learning taxonomy from basic knowledge and comprehension to analysis and application.
- **Measure Skills and Outcomes:** Analytics and reports provide a snapshot of class progress, time on task, engagement, and completion rates.

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Contributing Companies

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Chief Architect Software

Special thanks are given to Derek Pedersen, the Sales Manager of Chief Architect Software. Mr. Pedersen has an AKBD and a background in real estate sales, development, and construction. Derek provided CADD content, images, and a technical review.

Chief Architect® was created in 1992 for the professional Home Design Software market and was the first object-based 3D CAD system with smart object design principles; known as building information modeling (BIM). Chief Architect is the market-leading home design software product for residential design.

Chief Architect Software is professional 3D architectural design software for architects, builders, remodelers, kitchen and bath designers, and interior designers. The software is specifically designed for residential and light commercial projects. The software's powerful building, drafting, construction document, and 3D tools provide a design process that flows naturally and allows the designer to complete the design process quickly and efficiently.

Chief Architect includes design tools for photo-realistic renderings, artistic renderings and virtual tours to help clients visualize designs. Visit the Chief Architect website to download a free trial version of Chief Architect Software at www.chiefarchitect.com /freetrial.

Energy-models.com

Special thanks are given to Bob Fassbender for Building Energy-Modeling (BEM) content. Bob is the owner of Energy-models.com, with the goal of more efficiently teaching the world about energy modeling. Bob continues training and energy modeling as a LEED accredited professional. He has worked with multiple universities teaching energy-modeling, and worked as adjunct professor for the University of Philadelphia. Energy-models.com is the world's largest website devoted to building energy simulation and allows users to learn energy-modeling from anywhere in the

world, without the need for travel and unnecessary carbon footprints.

International Code Council (ICC)

Special thanks go to Hamid Naderi, vice president of product development of the *International Code Council* (*ICC*), for reviewing the content of this text related to the *ICC* codes and for allowing us to use text from the *2015 International Residential Code* and *The International Building Code*.

Portions of this publication reproduce text from the 2015 *International Residential Code*, © 2015, with the permission of the publisher, the International Conference of Building Officials, under license from the International Code Council Inc., Falls Church, Virginia. The *2015 International Residential Code* is a copyrighted work of the *International Code Council*. Reproduced with permission. All rights reserved.

Alan Mascord Design Associates, Inc.

Alan Mascord Design Associates (www.mascord.com) provides more than 600 stock home plans in a wide range of architectural styles, from single-family homes to multifamily dwellings, including detached garage plans. An active custom design business serves clients with specific and unique requirements, and Efficient Living Services provides builders with tools and resources for building green.

Mascord Efficient Living (ISBN-10 0–9788–1131–3) is a guide to the philosophies and practicalities of green building for builders and consumers. Presenting more than 50 home plans detailed to meet nationally recognized green building standards, this book explains the elements to consider before, during, and after construction.

Special thanks are given to Jon Epley and Gary Higginbotham for their professional support for this edition in providing content, photographs, and illustrations for several *Going Green* features found throughout this textbook. Mascord Design Associates also provided several sets of working drawings used for problems in Chapter 18.

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Special thanks to Ron Palma, 3D.DZYN, for providing feedback related to professional architectural CADD applications. Palma has more than 20 years of experience in the architectural industry as a drafter, designer, lead project designer, and as a CAD manager implementing Architectural Desktop for a residential design firm. He is an Autodesk Certified Instructor, trainer, and support technician for an Autodesk reseller. Palma has professional experience as an educator at two community colleges and is a U.S. Army certified instructor. In addition, he taught the Instructor Trainer's Course for the U.S. Army and has taught courses at Autodesk University. Palma is the coauthor of several architectural drafting and AutoCAD books.

Res Communis (www.rescommunis.org)

A design collective started by Garrett and Dustin Moon, Res Communis is dedicated to the creation and dissemination of "good" design for all, not just for those who can afford it. Their goal is to contribute to the solving of problems, not the concentration and collection of intellectual property. To that end, every idea and design created is released to the public to use and refine for the good of all. Garrett and Dustin Moon provided the content and illustrations for the *Going Green* content in Chapter 12. The *Going Green* feature titled *The Ultimate Urban Green Home* is the flagship of the *Going Green* features found in this textbook, demonstrating perfect, sustainable, and self-sufficient design using super energy-efficient, environmentally safe materials, and clean energy technologies.

Construction Specifications Institute (www.csinet.org)

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Autodesk, Inc. (www.autodesk.com)

Catherine Palmer, marketing manager, AEC Initiatives, provided the *Going Green* feature content in Chapter 7.

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Dean DeSantis, CLP, president of DeSantis Landscapes, provided the content and photographs used in a *Going Green* feature found in Chapter 12.

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National Fenestration Rating Council (NFRC) (www.nfrc.org)

The NFRC provided content and illustrations for a *Going Green* feature in Chapter 16.

Bryan Higgins

Architect Bryan Higgins, AIA, LEED AP, from Portland, Oregon, provided a set of working drawings and photographs of his design of one of the winning homes in the Living Smart program in Portland, Oregon. The Living Smart program design competition created a catalog of affordable home plans designed for narrow lots, called small footprint houses. His Living Smart small footprint design is used in Problem 18–1. Higgins also provided the content for the *Going Green* feature in Chapter 18 of this textbook.

Leann Collins and Laura Numbers

Leann Collins and Laura Numbers contributed a complete set of working drawings and related photographs for a small footprint residential architectural design. This small footprint is one of the winning homes in the Living Smart program, in Portland, Oregon, and the design is used in Problem 18–3.

TKP Architects, PC, Golden, Colorado (www.keating-partnership.com)

Thanks to Erin Elston with TKP Architects for the contribution of residential architectural plans and impressive photographs.

Southwest Windpower (www.windenergy.com)

Michael French, Graphics Coordinator for Southwest Windpower, provided the content, photographs, and illustrations for the *Going Green* feature in Chapter 19.

Engineering Drawing and Design

Approximately 180 illustrations are reproduced from *Engineering Drawing and Design,* by David A. Madsen and David P. Madsen, from Delmar Publishers.

Step-by-Step Model Home Plan Drawings

The authors greatly appreciate the efforts of David P. Madsen, Tereasa Jefferis, and Connie Wilmon for their work with the step-by-step drawings found in layout chapters. In addition, we would like to thank the many staff members of Cengage Learning who worked so hard to make this book possible. We're especially grateful for all of the hard work and encouragement of Sharon Chambliss and Glenn Castle. We also appreciate the efforts of the senior project manager Charu Khanna at MPS Ltd. We would also like to thank the following people for their contributions:

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Western Wood Products Association

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To the Student

Architectural Drafting and Design is designed for you, the student. The development and format of the presentation have been tested in conventional and individualized classroom instruction. The information presented is based on the U.S. National CAD Standards, drafting room practice, and trends in the architectural design industry. This textbook is the only architectural drafting reference that you need. Use the textbook as a learning

tool while in school, and take it along as a desk reference when you enter the profession. The amount of written text is complete but kept to a minimum. Examples and illustrations are used extensively. Drafting is a graphic language, and most drafting students learn best by observation of examples. Here are a few helpful hints for using this textbook:

1. *Read the text.* The text content is intentionally designed for easy reading. Content is given in as few, easy-to-understand words as possible. You should do the reading because the content can help you to understand the drawings clearly.
2. *Look carefully at the examples.* The figure examples are presented in a manner that is consistent with architectural drafting standards and the U.S. National CAD Standard. Look at the examples carefully in an attempt to understand specific applications. If you are able to understand why something is done a certain way, it will be easier for you to apply the concepts to the drawing problems in this textbook and to similar issues when working as an architectural drafter. Drafting is a precise technology based on standards and guidelines. The goal of a drafter is to prepare drawings that are easy to read and understand. There are times when rules need to be altered to handle a unique situation. Rely on judgment based on your knowledge of accepted standards in these situations. Drafting is often like a puzzle—there is often more than one way to solve a problem.
3. *Use the text as a reference.* Few drafters know everything about drafting standards, techniques, and concepts. Always be ready to use this textbook as the reference if you need to verify how a specific application is handled. Become familiar with the definitions and use of technical terms. It is difficult to memorize everything in this text, but architectural drafting applications should become second nature as you gain experience.
4. *Learn each concept and skill before you continue to the next.* The text is presented in a logical learning sequence. Each chapter is designed for learning development, and chapters are sequenced so drafting knowledge grows from one chapter to the next. Problem assignments are presented in the same learning sequence as the chapter content and also reflect progressive levels of difficulty.
5. *Practice.* Development of good computer-aided drafting skills depends to a large extent on practice. Some individuals have an inherent talent for drafting, and some people are readily compatible with computers. If you fit into either group, great! If you have difficulty, then practice may be all you need. Practice computer skills to improve your skills and efficiency with communication and drafting.
6. *Use sketches or preliminary drawings.* Even when drawing with a CADD program, the proper use of a sketch or preliminary drawing can save a lot of time in the long run. Prepare a layout sketch or preliminary layout for each problem. This preliminary step gives you a chance to organize your thoughts about drawing scale, view selection, dimension and note placement, and sheet size. After you become an experienced drafter, you may be able to design a sheet layout in your head, but until then, you should use sketches.

About the Authors

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Alan Jefferis is Faculty Emeritus of Drafting Technology at the Autodesk Premier Training Center at Clackamas Community College in Oregon City, Oregon. He was an architectural drafting and CAD instructor at Clackamas Community College for over 30 years. He also taught at Mt. Hood Community College in Gresham, Oregon, for four years. In addition to community college experience, Alan had eight years of experience drawing for architects, engineers, and residential designers prior to working for 35 years as the principal of Residential Designs, a design firm specializing in custom, energy-efficient homes. He is also a former member of the American Institute of Building Designers. In addition to his design work, he is a coauthor of several standard reference works from Cengage Delmar Learning including *Residential Design Drafting and Detailing; Print Reading for Architectural Construction Technology; Commercial Drafting and Detailing;* and *AutoCAD® for Architecture*.

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Prologue

Student Companion Website

To access the Student Companion Website:

- Open your browser and go to www.cengagebrain.com.
- Type the author's name, or the title or ISBN of this book in the search window. (The ISBN is on the back cover.)
- Click the book title in the list of search results.
- When the book's main page is displayed, click on the link at the bottom of the page for Student Companion Website.
- On the next screen, click on Student Downloads.

The following is a list and description of each component found under the Student Downloads button.

Supplemental Chapter Readings

Throughout this textbook, a Student Companion Website icon guides you to chapter-related content provided for additional reading and research. The Supplemental Chapter Reading features found on the Student Companion Website include chapter-related content, basic information, advanced content that is beyond the scope of the main textbook, and commonly used abbreviations.

Step-by-Step Layout Drawings

Several chapters throughout this textbook use the same model home to describe step-by-step techniques for laying out drawings required in a set of residential working drawings. Click the Step-by-Step Drawings link to view Acrobat Portable Document Format (PDF) files of many of the textbook figures related to the step-by-step layout process. Use the files to display the figures on your computer screen, and to look more closely at the layout steps and details.

Chapter Tests

Chapter tests are found at the end of each chapter. Pick the Chapter Tests link to access chapter tests using Microsoft Word. The chapter tests allow you to review or test your knowledge of the related chapter content, depending on your course objectives. Open the related link and answer the questions electronically, unless otherwise directed by your instructor.

Drawing Checklists

Drawing checklists are provided for the model home layout chapters on the Student Companion Website. The checklists allow you to check your work to be sure everything is included in the drawing that you are completing.

Drawing Problems

The Chapter 18 drawing problems are found on the Student Companion Website. These problems are identified in the textbook with a website icon. The Chapter 18 drawing problems can be used for creating the floor plans of the selected or assigned house that continue throughout this textbook to create a set of working drawings.

Drawing Templates

Select the Drawing Templates link to access a page containing a link to architectural and civil AutoCAD drawing template (.dwt) files. Use the Drawing Templates link and the available drawing template files to create new drawings, as a resource for drawing content, or for inspiration when developing your own templates. The architectural drafting templates are set up to allow you to prepare architectural drawings, whereas the civil drafting templates include preset civil drawing content for site plans and other civil drafting projects. Use the U.S. templates to draw using U.S. customary, or feet and inch, units. Use the metric templates to draw using metric units. Each template includes a variety of appropriate drawing settings and content, such as layers, layouts, and object styles. You can also use a utility

such as DesignCenter to add content from the drawing templates to your own drawings and templates. Consult with your instructor to determine which template drawing and drawing content to use.

Architectural Blocks and Symbols

The Architectural Symbols link provides access to an AutoCAD drawing (.dwg) file that contains several common architectural drafting symbols. These symbols are stored in folders named for the drawings in which they are most typically used. Many of the symbols are in AutoCAD block form and are drawn on the 0 layer; others are common symbols that should be made into blocks before inserting into the drawing. Use a utility such as DesignCenter, or copy and paste, to add the blocks to your own drawings. Use the blocks as desired or as directed by your instructor. Additional symbols are available through a variety of resources. Some software programs, such as AutoCAD, include and allow you to access many architectural symbols. Many other symbols are available through the Internet for free download or purchase. The U.S. National CAD Standard (NCS) includes separate .dwg files of the symbols presented in the standard.

Related Web Links

Internet research is an excellent way to gain additional knowledge about architectural drafting and the professional organizations related to architectural drafting and design. The Related Web Links section contains a variety of related website links for you to explore as preferred or as directed by your instructor. The website links are provided in alphabetical order covering the entire textbook content, and chapter by chapter. Click a link to go automatically to the designated website.

Workbook

Additional problems have been provided to reinforce the knowledge and skills introduced throughout the textbook. These problems are divided into these sections and chapters:

- Section I: Basic Residential Projects
  - Chapter 1 Basic Architectural Drafting Practices
  - Chapter 2 Site Plans
  - Chapter 3 Floor Plan Fundamentals
  - Chapter 4 Basic Floor Plan Problems
  - Chapter 5 Floor Plan Dimensions
  - Chapter 6 Electrical Plans
  - Chapter 7 Plumbing and HVAC Plans
  - Chapter 8 Roof Plans
  - Chapter 9 Elevations
  - Chapter 10 Cabinet Elevations
  - Chapter 11 Foundation Plans
  - Chapter 12 Details
  - Chapter 13 Sections
  - Chapter 14 Stair Sections
  - Chapter 15 Fireplace Sections
  - Chapter 16 Design Criteria for Structural Loading
  - Chapter 17 Construction Specifications, Permits, and Contracts
  - Chapter 18 Presentation Drawings
- Section II: Advanced Residential Projects
- Section III: Additional Advanced Residential Projects
- Section IV: Advanced Research Projects

Review Questions

This feature provides you with review questions that are in addition to the chapter-by-chapter test questions provided throughout the textbook. Use the review questions for additional opportunities to test your knowledge and review textbook content.

SECTION 1

Introduction to Architectural Design and Drafting

CHAPTER 1

Professional Architectural Careers, Office Practices, and Opportunities

INTRODUCTION

As you begin working with this text, you are opening the door to many exciting careers in the field of architecture, engineering, and construction (AEC). Each career in turn has many different opportunities within it. Whether your interest lies in theoretical problem solving, artistic creations, or working with your hands to create something practical, a course in architectural drafting and design will help you satisfy that interest. An architectural drafting class can lead to a career as a CAD drafter, CAD technician, designer, interior decorator, interior designer, architect, or engineer. Mastering the information and skills presented in this text will prepare you for a job as a drafter and serve as a solid foundation for each of the other listed professions, as well as many others.

Note: *If you've followed employment trends in the AEC fields, you know that the availability of jobs in all phases of the field is down. The good news, though, is that according to the International Code Council® (ICC) studies, permit applications for multiunit housing and commercial structures have been up since the end of 2012, with predictions for continued growth. Don't be discouraged from completing your studies in the field. The market will get better, but to be prepared to compete for a job, you'll need a well-rounded education.*

Drafter

A **drafter** is the person who creates the drawings and details for another person's creations. The U.S. Bureau of Labor Statistics defines a drafter as a person who uses software to convert the designs of architects and engineers into the technical drawings used to construct a structure. It is the drafter's responsibility to use the proper line and lettering standards and to properly lay out the required drawings necessary to complete a project. Such a task requires great attention to detail, as the drafter creates the working drawings from the supervisor's sketches. Although the terms are used interchangeably, professionals often use the term *drafter* to refer to a person who draws manually using pencils or pens. The terms *CAD drafter* and *CAD technician* are used to describe a person who creates the same type of drawings using a computer. In addition to these terms, job listings may also be described using the terms CAD designer, engineering technician, CAD operator, CAD design technician, CAD engineering design technician, technician, and design drafter. Throughout this book, the term *drafter* will be used to describe both those who create drawings using software and a computer and those who draw manually. Although most firms in the AEC industry now work with electronic drawings, some firms still require manual drafting skills in order to update older drawing projects.

The Beginning Drafter

Your job as a beginning or junior drafter will generally consist of making corrections to drawings created by others. There may not be a lot of mental stimulation to making changes, but it is a very necessary job. It is also a good introduction to the procedures and quality standards within an office. As you master the company standards, your responsibilities will be expanded. In addition to mastering basic CAD commands, you'll need to become familiar with the U.S. National CAD Standards® (NCS). These are guidelines assembled by the National Institute of Building Sciences© (NIBS) that incorporate the Uniform Drawing System (UDS) published by the Construction Specifications Institute© (CSI), CAD Layer Guidelines published by the American Institute of Architects©, and the U.S. Coast Guard. These guidelines are aimed at bringing uniformity among consulting firms to ensure quality plans. Future chapters in this text will introduce key concepts from the NCS. You'll also need to become proficient using the firm's computer standards and any special menus and list processing language (LISP) routines needed to work efficiently.

No matter what software is used to create drawings, as a new drafter your supervisor will typically give you a rough draft and expect you to complete the required drawing. **FIGURE 1.1** shows a project manager's sketch.

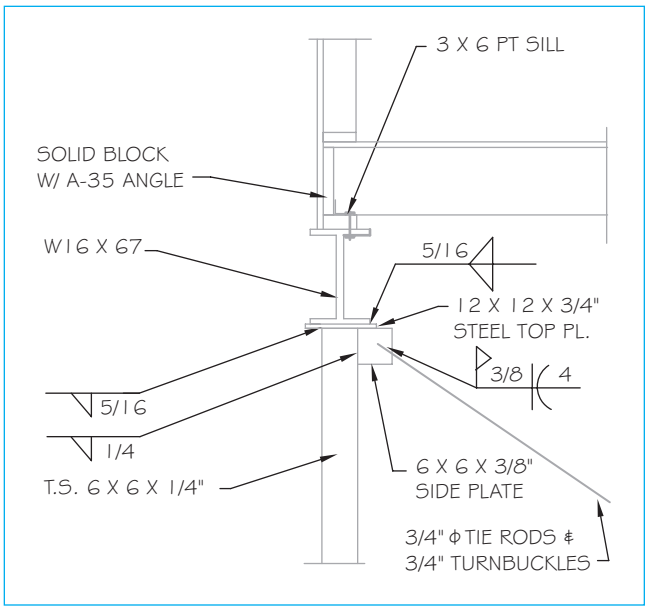

FIGURE 1.1 A rough draft created by the project manager is usually given to a junior drafter to follow for a first drawing. The drafter can find information for completing the drawing by examining similar jobs in the office.

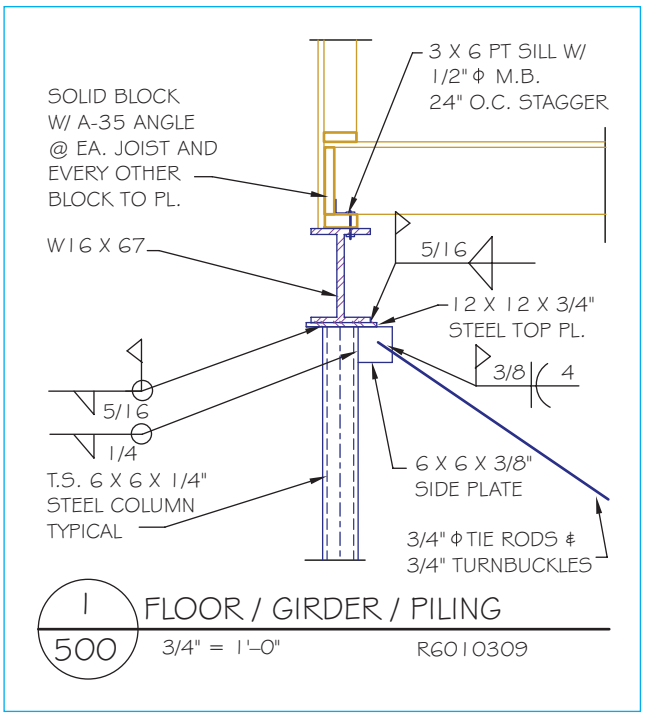

FIGURE 1.2 A detail completed by a drafter using the rough draft shown in in Figure 1.1.

FIGURE 1.2 shows the drawing created by a drafter. As you gain an understanding of the drawings that you are making and gain confidence in your ability, the sketches that you're given generally will become more simplified. Eventually your supervisor may just refer you to a similar drawing and expect you to be able to make the necessary adjustments to fit it to the new application.

The decisions involved in making drawings without sketches require the drafter to have a good understanding of what is being drawn. This understanding does not come from a textbook alone. To advance as a drafter and become a leader on the drawing team will require you to become an effective manager of your time. This will include the ability to determine what drawings need to be created, selected from a stock library, and edited; and to estimate the time needed to complete these assignments and meet deadlines established by the team captain, the client, the lending institution, or the building department. An even better way to gain an understanding of what you are drafting is to spend time at a construction site watching projects that you've worked on become a reality. Gaining an understanding of what a craftsperson must do as a result of what you have drawn will greatly aid you as you assume more responsibility on projects.

Note: *A visit to a construction site requires preparation. Because of the high risk of injury and the dangers construction firms face from theft and liability, not everyone is welcome as a guest at a construction site. If possible, call and schedule visits ahead of time, especially if visiting a large construction site, so that someone will be available to guide you on your tour. You'll rarely be welcome when overhead deliveries are in progress, so knowing when crews take rest breaks, break for lunch, or end their day will make it more likely that you'll be allowed to tour the site. When you do go to the site, report immediately to the job supervisor to verify that your visit is approved. Don't show up in flip-flops and expect to tour the construction site. Hard-soled shoes are generally required, and steel-toed work boots are preferred. An orange or yellow shirt will increase your visibility, and a hard hat is a must. The site supervisor will typically supply an orange vest and hard hat so that you comply with OSHA safety standards.*

Your role in the development of architectural drawings will vary depending on the size and structure of the firm where you work. Most small architectural and engineering firms consist of a single office. As the size of the firm increases, they may have multiple offices located throughout the country, and some very large companies are international. The size of the company will also affect the types of structures they work with. Some design firms are very specialized and work only in one field, such as educational or institutional facilities. As the size of the firm increases, they may have several different divisions within the company for designing various areas of occupancy. Chapters 9 and 41 will introduce specific areas of construction based on the occupancy of the structure.

Depending on the size of the office where you work, you may also spend a lot of your time as a beginning CAD technician editing stock details, running prints, obtaining permits, and doing other office chores. Don't get the idea

that a drafter does only the menial chores around an office. But you do need to be prepared, as you go to your first drafting job, to do things other than drafting.

The Experienced Drafter

Although your supervisor may prepare the basic design for a project, experienced CAD technicians are expected to make decisions about construction design. These decisions might include determining structural sizes and connection methods for intersecting beams, drawing renderings, visiting job sites, and supervising beginning drafters. As you gain experience, you will be assigned drawings that are more complex. Instead of revising existing details or drawing site plans, cabinet elevations, or roof plans, an experienced CAD drafter and team leader may be working on the floor and foundation plans, elevations, and sections. Your supervisor probably will still make the initial design drawings, but will pass these drawings on to you as soon as a client approves the preliminary drawings.

In addition to drawing with a computer, you may work with the many city and state building departments that govern your work. This will require you to research the codes that govern the building industry. You will also need to become familiar with vendors' materials. Information can be obtained from individual manufacturers and suppliers or their websites. Another valuable resource is Sweets.construction.com. *Sweets*™ is a collection of information on a wide variety of building products arranged by their *MasterFormat*® system numbers. Information is listed by manufacturer, trade name, and type of product.

Educational Requirements

In order to get your first CAD drafting job, you will need a solid education, good computer-aided drafting (CAD) skills, a good understanding of basic computer skills, and the ability to sell yourself to an employer. Although AutoCAD® is used in most midsize and larger architectural and engineering firms to aid in collaboration with consulting firms, many smaller design professionals use a variety of software programs such as Revit®, Google SketchUp Pro®, Graphisoft ArchiCAD®, Chief Architect®, or SoftPlan®. Especially in smaller cities, taking time to research what software is in demand with most of the area's design professionals will aid you in finding future employment. Making scheduled visits with design professionals to discuss the hiring and educational requirements for their firm is also a great way to get your foot in the door for a future job interview.

CAD skills must include a thorough understanding of drawing and editing commands, as well as the ability to quickly decide which option is best for a given situation. This ability will also come with practice. If you work full-time editing details, you'll quickly become proficient at determining the best commands to use. The education required for a drafter can range anywhere from one or more years in a high school drafting program, to a diploma from a one-year accredited technical school, to a degree from a two-year college program, all the way to a master's degree in architecture. The required education is greatly affected by the size of the city where you're seeking employment and the strength of the economy in that area.

Note: *In some areas of the country, and in a thriving economy, a high school student could obtain an entry-level drafting intern position. In a stagnant job market, that same student may find himself competing against someone with a four-year degree. Even in a strong economy, because of the complexities involved in creating architectural drawings, most offices require college training.*

Educational Recommendations

Helpful areas of study for an entry-level CAD technician include math, science, English, writing, drawing, and computer drafting. Taking a class or seminar on learning how to study will help you maximize these areas of study.

Math

The math required ranges from simple addition to calculus. Although the CAD technician may spend most of the day adding dimensions expressed in feet and inches, knowledge of advanced math is helpful for solving many building problems. You'll often be required to use basic math skills to determine quantities, areas, percentages, and volumes. Clients are always concerned with room sizes and areas devoted to specific tasks. Building departments are also concerned with the size of individual rooms, living areas, openings required for escape, and the percentages of openings/wall areas to be calculated for determining heat loss or gain. Many firms provide their clients with a list of the quantities of specific materials required to construct the project. Area calculations determine the size of each room, areas to meet basic building code requirements, the loads on a structural member, or the size of the structure.

Science

Any science class that you can squeeze into your schedule will be helpful in your design career. Classes in biology are helpful as you work on environmental

areas of a project, including managing and tracking LEED credits. Chemistry classes will prove helpful as you work to ensure that chemicals contained in the products specified on the drawings are environmentally friendly. An understanding of the potential chemicals at a jobsite will be helpful during job supervision visits and for completing safety reports related to each project site. Physics classes will prove useful as you advance in your design career. Understanding how forces act on a structural member, as well as the entire structure, will help you size and specify structural materials. Understanding how energy, momentum, temperature, and pressure affect a structure will be helpful in all areas of the design process.

English, Grammar, and Technical Writing

Writing skills are also helpful to a new employee entering the design world. Your writing ability is an important key just to get an interview to show your work. Although many smaller design firms still accept paper resumes, most mid to large sized firms only accept electronic applications. Your grammar, your ability to write clear and concise statements that can be easily understood by coworkers and customers from different cultures, and your willingness to use spell check will all aid you in getting that first interview.

Once you're hired, you'll often be required to complete the paperwork that accompanies a set of plans, such as permit applications, requests for variances, written specifications, and environmental impact reports. You'll also need to effectively communicate using the Internet, email, text messaging, and tweets. Although many have used these methods of communicating for years, messages that you send professionally must forsake the grammar shortcuts associated with texting, and use proper grammar and English. While our methods of communicating have changed, the need for proper grammar, sentence structure, and good technical writing skills has not. You will need effective writing skills that meet professional standards as you prepare written estimates, work orders, and memos throughout the design and the construction process. Most likely, your company will require you to be able to:

- Prepare simple written documents and reports using existing company procedures
- Retrieve and edit existing documents
- Format text using basic formatting functions
- Employ word processing utility tools such as spell check, grammar check, and a thesaurus

Technical writing courses will introduce you to the skills needed to master these requirements in a professional manner. Chapter 8 will further explore professional writing opportunities and requirements.

Miscellaneous Education Recommendations

In addition to standard CAD drafting classes and core educational classes, knowledge of several other fields will be helpful. Classes in public speaking will prove beneficial in a wide range of professional activities. Skills learned in speech classes will aid you in demonstrating your confidence by making eye contact with those you're speaking with, and in giving you the confidence to stand and describe a project at a community advisory committee. Speech classes will also help you organize your thoughts for collecting information to clarify the exact expectations of the client, your team leader, or building officials. The ability to ask intelligent questions is the first step in being able to deliver a quality project that meets the needs of the client.

Classes in art offer skills in the use of light, balance, and color that will be helpful to you as a designer or an illustrator. Classes in photography are invaluable in moving beyond using your cell phone to snap a photo to developing skills to capture images using good lighting techniques, as well as learning methods to mount and display photos. Classes related to construction skills, such as surveying, estimating, and construction methods, are also helpful.

In addition to learning how to use CAD drawing programs, most companies require new employees to be able to effectively use the Internet for research purposes. You will be expected to:

- Effectively search for job specific products and materials without wasting time looking at inappropriate material.
- Select and use appropriate search engines and search procedures.
- Navigate websites using software functions.
- Access and evaluate Internet resources for accuracy. (Just because you find information on the Internet doesn't make it true. Take time to verify the source and the accuracy of the information you've found.)
- Access business and technical information using the Internet.
- Use the Internet to secure needed supplies and resources.

Many large firms require employees to use software such as Microsoft® Word, Microsoft® Excel, or other programs designed to manipulate spreadsheets. Most

offices expect a CAD drafter to perform the following skills using a spreadsheet:

- Create, retrieve, edit, save, and print spreadsheets.
- Input and process data using spreadsheet functions.
- Locate and replace data using the search and replace functions.
- Process data using database functions such as structure, format, attributes, and relationships.
- Perform company-related calculations and analysis on spreadsheet data.
- Create charts and graphs from a spreadsheet.
- Perform calculations using simple formulas.

Personal Requirements

In addition to a solid education, professionals working in the design field need to function well in group settings. As a CAD drafter, you will generally be working for several architects and engineers and collaborating with a multitude of drafters within an office; therefore, you must be able to get along well with others. You also must be reliable. Reliability within an office is measured by the maintenance of good attendance patterns and the production of drawings as scheduled. Little things like showing up on time, performing your job assignments on time, and offering to help around the office are greatly rewarded in the long run. Occasionally coming in early to do research regarding company standards or staying late without pay or whining helps to show that you want to be a respected part of the design team.

To become a valued member of the drawing team will require you to become an effective manager of your time. This includes the ability to determine what drawings will need to be created, to select drawings from a stock library and edit them, and to estimate the time needed to complete these assignments and meet deadlines established by the team captain, the client, the lending institution, or the building department. It is also important that you be able to accurately estimate the time required to complete each project. You can develop this skill while working on school projects by estimating the amount of time that will be required to complete the project prior to starting the drawing. In the planning stage, break the project into components and estimate how long each component will take. When the drawing is complete, review your estimates and use the AutoCAD® TIME command to determine the actual time required to complete the drawing. Although most firms would prefer a drafter who can quickly complete a project, speed is no substitute for accuracy. Push yourself as a student to meet a self-imposed time deadline while maintaining quality and accuracy. Reliability is also important because a team completes the drawings for a large structure and most multiunit residential projects. The ability to get along with others, to complete assigned projects in a timely manner, and to coordinate different parts of a project with others will greatly affect how fast you will advance.

To advance and become a good team leader, you will also need to develop skills that promote a sense of success among your teammates. It is against the law to discriminate on the basis of race, color, religion, gender, sexual orientation, age, marital status, or disability. A good team leader moves beyond complying with the law and creates a friendly and productive work environment for coworkers of different cultures, genders, and backgrounds. Other key skills for a good team leader include:

- Speaking clearly and conveying information accurately.
- Providing clear written and verbal directions to teammates using email and written memos.
- Matching team members to appropriate projects based on skill levels.
- Accurately estimating time requirements for each aspect of a project, as well as the amount of time various team members will require based on their CAD skills, experience, and areas of expertise.
- Managing daily, weekly, and monthly schedules using the appropriate software.
- Maintaining clear communication with other project leaders in the office to coordinate the use of team members among teams.
- Evaluating the efficiency and effectiveness of team members and reviewing their progress for job advancement.
- Recognizing and encouraging the efforts of coworkers.
- Maintaining positive interpersonal skills to enhance the advancement potential of teammates and accurately measuring their growth.

Note: *Although you've been exposed to a variety of people in school and college, in the workplace you'll be expected to work, share ideas, and produce results with people from diverse cultures, varied backgrounds, and contrasting lifestyles from what you view as typical. To advance in an office setting, you'll need to treat your fellow employees with respect. Failure to treat others as you want to be treated could lead to your dismissal and place you in the middle of a lawsuit.*

Workplace Ethics

A key quality required in any of the design professions that you might enter is to be ethical. Ethics are rules and principles that define right and wrong conduct. When you are a student, your school will typically have guidelines in a student handbook or web page outlining what is and is not acceptable behavior in the classroom. As a design professional, one of your first jobs should be to determine what is expected of you. Information can be gained from a discussion as you complete the required documents for receiving a paycheck and paying taxes or from a company website link that outlines acceptable behavior. As a new employee, you must be able to access appropriate resources to identify roles, rights, and responsibilities for both you and your employer.

Although ethics guidelines can be as simple as treating others as you would like to be treated, most mid size and larger offices have a formal code of ethics that employees are required to sign in order to obtain a job. This is a formal document that states an organization's values and the rules and principles that employees are expected to follow. In general, a code of ethics contains these main elements: be dependable, obey the laws, and be good to customers. The following list is an example of an architectural firm's standards for ethical business conduct:

1. Honesty: to be truthful in all our endeavors, to be honest and forthright with one another, with our customers, and with our communities.
2. Integrity: to say what we mean, to deliver what we promise, and to stand for what is right.
3. Respect: to treat one another with dignity and fairness, appreciating the diversity of our workforce and the uniqueness of each employee.
4. Trust: to build confidence through teamwork and open, candid communication.
5. Responsibility: to speak up, without fear of retribution, and report concerns in the workplace, including violations of published or unpublished works that are copyrighted.

Copyright Protection

Occasionally clients come to an architectural firm hoping to use the plan of a competitor as the basis for the design for their project. It's important to understand that architectural drawings are protected by copyright. A copyright is secured automatically by the person who created the design. The work is created when it is fixed in a copy for the first time. Copies are material objects from which the work can be read or visually perceived either directly or with the aid of a machine or device. In the world of architecture, you'll be most affected by copyright laws as clients present you with plans from magazines and ask you to recreate the design. There is nothing illegal when a client gives you several stock plans and expects you to combine features from these plans into a new plan. However, it is very illegal to take one stock plan, make minor changes, and pass it off as your design. That's copyright infringement.

Note: *Professional designers and architects have donated the plans in this book, knowing that they will be copied and redrawn. It is perfectly legal for you to reproduce these plans for school projects. It is important to realize, however, that it is not acceptable to reproduce these drawings for resale. Laws vary for each state, but as a general rule, unless you've changed more than 50% of the plan, or significantly altered the appearance of the design, you may be found guilty of copyright infringement. Never take a plan from another professional, make minor changes, and then call it your design. That's lazy, unethical, and illegal.*

Employment Opportunities

CAD drafters can find employment in firms of all sizes. Job opportunities can be found by searching the categories of architectural drafter, architectural design, architectural CAD operator, CAD drafter, CAD technician, and engineering technician while looking on the Internet at sites such as monster.com, jobs.com, careerbuilder.com, jobdango.com, or a link to local job listings. Many smaller firms place listings for employment in the classified ads of local newspapers.

Designers, architects, and engineers all require entry-level and advanced technicians to help produce their drawings. Architectural fabricators and equipment suppliers also employ CAD technicians. This work might include drawing construction details for a steel fabricator, making layout drawings for a cabinet shop, or designing ductwork for a heating and air-conditioning installer. Many manufacturing companies hire CAD operators with an architectural background to help draw and sometimes sell a product or draw installation diagrams for instruction booklets or sales catalogs. Drafters are also employed by many government agencies. These jobs include working in planning, utility, or building departments; on survey crews; or in other related municipal jobs.

Designer

The meaning of the term *designer* varies from state to state. Many states restrict its use by requiring those calling themselves **designers** to have had formal training and have passed a competency test. A designer's

responsibilities are very similar to those of an experienced drafter and are usually based on both education and experience. A designer is usually the coordinator of a team of drafters. The designer may work under the direct supervision of an architect, an engineer, or both and supervise the work schedule of the drafting team.

In addition to working in a traditional architectural office setting, designers often have their own office practice in which they design residential, multifamily, and some types of light commercial buildings. State laws vary regarding the types and sizes of buildings a designer may work on without an architect or engineer's stamp. The *American Institute of Building Design* (AIBD) is a national association of designers and CAD technicians who are certified to be knowledgeable in the field of residential design. The *National Council of Building Designer Certification (NCBDC)* provides third-party testing, accreditation, and certification of AIBD design professionals. Started in 1951, the AIBD and NCBDC work together to ensure that building industry professionals exceed minimum design requirements so that prospective clients can be assured that they are hiring qualified professional designers for their residential projects. Members must have a minimum of six years of professional practice including working 20 hours per week minimum for a professional building designer, architect, or professional engineer. Applicants must pass a national test to ensure their understanding of the design process and basic building standards, as well as demonstrate their ability to create residential drawings that meet the NCBDC drawing standards. Designers who pass the NCBDC certification process can then place the certification stamp of CPBD (Certified Professional Building Designer) in their title blocks and letterheads. These individual drawing standards will be described throughout this text as each drawing is introduced.

As a drafter gains experience, completing the certification process and becoming a licensed designer allows a drafter the opportunity to become self-employed and complete residential, multifamily, and small retail buildings. State laws vary regarding the types and sizes of buildings a designer may work on without the stamp of an architect or engineer. Students wishing more information about a career as an architectural designer can contact one of the following groups.

American Institute of Building Design (AIBD)
7059 Blair NW Suite 201
Washington, DC 200012
1-800-366-2423
Website: www.aibd.org
Email: info@aibd.org

Students wishing more information about becoming a certified designer should contact:

The National Council of Building Designer Certification (NCBDC)
7059 Blair Road NW Suite 201
Washington, DC 20012
1-888-726-7659
Website: www.ndbdc.com
Email: information@ncbdc.com

Students can also contact the American Design and Drafting Association (ADDA), the U.S. Department of Labor, or the U.S. Office of Education.

Interior Decorator

An **interior decorator** decorates the interiors of buildings, with the aim of making rooms more attractive, comfortable, and functional. Most interior decorators are hired to decorate homes, but they may also be hired to decorate interiors of businesses such as boutiques, restaurants, and offices. They may work on the entire interior of a building or a single room. An interior decorator's work may involve a variety of elements, including space planning, determination of color schemes, furniture placement, and the coordination of interior finishes such as paint and wallpaper, window coverings, and flooring. It may also include the arrangement of lighting fixtures, art objects, furnishing accessories, and interior plants. Specific job requirements may include:

- Meeting with clients to determine the scope of a project.
- Reviewing and measuring the space to be decorated.
- Preparing proposed room layouts and obtaining cost estimates.
- Providing samples and colors of materials to be used.
- Arranging and overseeing painting, wallpapering, and flooring.
- Selecting and purchasing furnishings and other items.

There are no formal educational requirements to enter this career. You can start calling yourself an interior decorator as soon as you start doing interior decorating.

Kitchen and Bath Designer

Some drafters and designers choose to specialize in the area of residential kitchen and bath design. This might include design work for a client, working with a residential contractor, or working with manufacturers of kitchen

and bath equipment. In order to meet the demand for qualified professionals in this area of design, the National Kitchen & Bath Association (NKBA) has created its own training program that offers the foundation for professional career growth through its course offerings, technical manuals, and multilevel certification programs. The three professional levels in which the NKBA certifies its members, and the requirements of each level are:

- Associate Kitchen & Bath Designer (AKBD)—One year of experience related to the kitchen and bath industry and one year in a related field, 30 hours of NKBA professional development training, and successful completion of the AKBD exam.
- Certified Kitchen Designer (CKD) or Certified Bathroom Designer (CBD)—Three years of experience related to the kitchen and bath industry and four years in a related field, 60 hours of NKBA professional development training, and successful completion of the AKBD exam.
- Certified Master Kitchen & Bathroom Designer (CMKBD)—Ten years of experience related to the kitchen and bath industry, 100 hours of NKBA professional development training, and both CKD and CBD certification.

For further information about careers in the field of kitchen and bath design, contact:

National Kitchen & Bath Association
687 Willow Grove Street
Hackettstown, NJ 07840
800-843-6522
Website: www.nkba.org

Interior Designer

An **interior designer** works with the structural designer to optimize and harmonize the interior design of structures. In addition to health and safety concerns, interior designers help plan how the space will be accessed, how a space will be used, the amount of light that will be required, acoustics, seating, storage, and work areas. An interior designer must consider how the visual, tactile, and auditory senses of the occupants will be impacted. Visual considerations include the study and application of color, lighting, and form to improve how the occupants function in the space. Consideration must be given to the design of surfaces, the shape of individual rooms within a structure, and the texture of finished surfaces and how furnishing will affect the usage of areas within a structure. The design of a structure must also be considered in relation to how noise and echo will be created and how they can be controlled. An interior designer must have an aesthetic, practical, and technical appreciation for how people use and respond to these elements and to how the elements interact with one another.

Interior designers must also be knowledgeable about the many types and characteristics of furnishings, accessories, and ornaments used in creating interiors. Furniture, lighting, carpeting and other floor coverings, paint and wall coverings, glass, wrought metal, fixtures, art, and artifacts are some of the many items and materials designers select. In addition, they must be familiar with the various styles of design, art, and architecture and their history. Interior designers provide a variety of services, which include:

- Consulting to help determine project goals and objectives.
- Generating ideas for aesthetic possibilities of the space, and arranging space to suit its intended function.
- Creating illustrations and renderings of proposals.
- Developing documents and specifications related to interior spaces in compliance with applicable building codes.
- Specifying colors and purchasing fixtures, furnishings, products, and other interior materials.
- Designing and managing fabrication of custom furnishings and interior details.
- Monitoring and managing construction and installation of the design.

Although a college degree is currently not a requirement, the trend among employers and in states that have licensing requirements is to require a degree from an accredited institution. This can range from training in a two-year program to earn an associate's degree or certificate, to a four- or five-year program leading to a bachelor's (BA, BS, BFA) or master's (MA, MS, MFA) degree. The option chosen may depend on the licensing requirements in your state and whether you have completed a degree in another field.

In the United States, where interior designers are registered by title, designers may not use the title "interior designer" or "registered interior designer" unless they have met the requirements for education, experience, and examination as set forth in the statutes established by the National Council for Interior Design Qualification (NCIDQ). Candidates who apply to take the NCIDQ examination must demonstrate an acceptable level of professional work experience and completion of related coursework. The minimum examination requirements include two years of formal interior design experience and four years of full-time

work experience in the practice of interior design. Passing the examination is required in twenty jurisdictions in the United States and eight provinces in Canada that regulate the profession of interior design. For further information about careers in the field of interior design, contact:

American Society of Interior Designers (ASID)
202-546-3480
Website: www.asid.org
International Interior Design Association (IIDA)
Website: www.iida.org

Students can also contact the American Design and Drafting Association, the U.S. Department of Labor, or the U.S. Office of Education.

Architect

An **architect** is a licensed professional who designs commercial and residential structures. Architects perform the tasks of many professionals, including designer, artist, project manager, and construction supervisor. Few architects work full-time in residential design. Although many architects design some homes, most devote their time to commercial construction projects such as schools, offices, and hospitals. An architect is responsible for the design of a structure and for the way the building relates to the environment. The architect often serves as a coordinator on a project to ensure that all aspects of the structure blend together to form a pleasing relationship. This coordination includes working with the client, the contractors, and a multitude of engineering firms that may be involved with the project. **FIGURE 1.3** shows a home designed by an architect to blend the needs and wishes of the client with the site, materials, and financial realities.

David Papazian/Photographer's Choice RF/Getty Images

FIGURE 1.3 Architects use their training to blend the needs and wishes of the client with the site, materials, and financial realities.

Positions in Architectural Firms

Use of the term *architect* is legally restricted to individuals who have been licensed by the state where they practice. Once the required degree has been completed, obtaining a license will require practical experience working under the supervision of a licensed architect. A typical path to becoming an architect requires three years to complete a master's program, three years as an intern, and two years to complete the registration exam process. Some states allow a designer to take the licensing test through practical work experience. Although standards vary for each state, five to seven years of experience under the direct supervision of a licensed architect or engineer is usually required. Positions in an architectural firm include:

Technical staff—Consulting engineers such as mechanical, electrical, and structural engineers; landscape architects; interior designers; CAD operators; and drafters.

Intern—Unlicensed architectural graduates with less than three years of experience. An intern's responsibilities typically include developing design and technical solutions under the supervision of an architect.

Architect I—Licensed architect with three to five years of experience. An Architect I's job description typically includes responsibility for a specific portion of a project within the parameters set by a supervisor.

Architect II—Licensed architect with six to eight years of experience. An Architect II's job description typically includes responsibility for the daily design and technical development of a project.

Architect III—Licensed architect with eight to ten years of experience. An Architect III's job description typically includes responsibility for the management of major projects.

Manager—Licensed architect with more than 10 years of experience. A Manager's responsibilities typically include management of several projects, project teams, and client contacts, as well as project scheduling and budgeting.

Associate—Senior management architect, but not an owner in the firm. This person is responsible for major departments and their functions.

Principal—Owner/partner in an architectural firm.

Education

High school and two-year college students can prepare for a degree program by taking classes in fine arts, math, science, and social science. Many two-year drafting programs offer drafting classes that can be used for credit in four- or five-year architectural programs. A student planning to transfer to a four-year program should verify with the new college which classes can be transferred. Depending on the desired field of practice, students will eventually need to complete the requirements for a bachelor of architecture, master of architecture, or a doctorate of architecture degree.

Fine arts classes such as drawing, sketching, design, and art along with architectural history will help the future architect develop an understanding of the cultural significance of structures and help transform ideas into reality. Classes that will aid problem-solving abilities, as well as math and science classes, including algebra, geometry, trigonometry, and physics, will provide a stable base for the advanced structural classes that will be required. Sociology, psychology, cultural anthropology, and classes dealing with human environments will help develop an understanding of the people who will use the structure. Because architectural students will need to read, write, and think clearly about abstract concepts, preparation should also include literature and philosophy courses. In addition to formal study, students should discuss with local architects the opportunities and possible disadvantages that may await them in pursuing the study and practice of architecture.

Areas of Study

The study of architecture is not limited to the design of buildings. Although the architectural curriculum typically is highly structured for the first two years of study, students begin to specialize in an area of interest during the third year of the program.

Students in a bachelor's program may choose courses leading to a degree in several different areas of architecture such as urban planning, landscape architecture, and interior architecture. Urban design is the study of the relationship among the components within a city. Interior architects work specifically with the interior of a structure to ensure that all aspects of the building will be functional. Landscape architects specialize in relating the exterior of a structure to the environment. For further information on training or other related topics, students can contact:

American Institute of Architects (AIA)
1735 New York Avenue NW
Washington, DC 20006
800-242-3837
Website: www.aia.org

American Society of Landscape Architects (ASLA)
636 Eye Street NW
Washington, DC 20001
202-898-2444
Website: www.asla.org

Engineer

The term *engineer* covers a wide variety of professions. In general, an **engineer** is a licensed professional who applies mathematical and scientific principles to the design and construction of structures. In the construction fields, structural engineers are the most common, although many jobs exist for electrical, mechanical, and civil engineers. Structural engineers typically specialize in the design of structures built of steel or concrete (see **FIGURE 1.4**).

alina_hart/E+/Getty Images

FIGURE 1.4 The architectural team determines the shape and style of the structure. The structural engineering team is responsible for determining the size of materials to resist the loads and stresses that a building will face.

Many directly supervise drafters and designers in the design of multifamily and light commercial structures.

Electrical engineers work with architects and structural engineers and are responsible for the design of lighting and communication systems. They supervise the design and installation of specific lighting fixtures, telephone services, and requirements for computer networking.

Mechanical engineers are also an instrumental part of the design team. They are responsible for the sizing and layout of heating, ventilation, and air-conditioning systems (HVAC) and plan how treated air will be routed throughout the project. They work with the project architect to determine the number of occupants of the completed building and the heating and cooling load that will be generated.

Civil engineers are responsible for the design and supervision of a wide variety of construction projects, such as highways, bridges, sanitation facilities, and water treatment plants. They are often directly employed by construction companies to oversee the construction of large projects and to verify that the specifications of the design architects and engineers have been carried out.

Becoming an Engineer

As with the requirements for becoming an architect, a license is required to function as an engineer. Potential engineers can apply for the license after several years of practical experience, or after obtaining a bachelor's degree and three years of practical experience. Success in any of the engineering fields requires high proficiency in math and science, and involves completing courses in physics, mechanics, print reading, architecture, mathematics, and material science. An engineer must complete five years of education at an accredited college or university, followed by successful completion of a state-administered examination. Certification can also be accomplished by training under a licensed engineer and then successfully completing the examination. Additional information can be obtained about engineering by writing to:

National Council of Structural Engineers Associations (NCSEA)
645 N. Michigan Ave.
Suite 540
Chicago, Il 60611
1-312 649 4600
Website: www.ncsea.com

American Society of Civil Engineers (ASCE)
1015 15th Street NW Suite 600
Washington, DC 20005
1-800-548-2723
Website: www.asce.org

American Consulting Engineers Council (ACEC)
1015 15th Street, NW, Suite 802
Washington, DC 20005
202-347-7474
Website: acec.org

American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE)
1791 Tullie Circle NE
Atlanta, GA 30329-2305
800-527-4723
Website: www.ashrae.org

Illuminating Engineering Society of North America (IESNA)
120 Wall Street, 17th Floor
New York, NY 10005
212-248-5000
Website: www.iesna.org

Related Fields

So far, only opportunities that are similar because they involve drawing, design, and creativity have been covered. In addition to these careers, there are many related careers that require an understanding of drafting principles. These include model maker, illustrator, specification writer, plans examiner, inspector, and construction-related trades.

Model Maker

In addition to presentation drawings, many architectural offices use models of a building or project to help convey design concepts. Models such as the one shown in **FIGURE 1.5** are often used as a public display to help gain support for large projects. Model makers need basic drafting skills to help interpret the plans required to build the actual project. Model makers may be employed within a large architectural firm or may work for a company that only makes models for architects. For more information contact:

Association of Professional Model Makers (APMM)
P.O. Box 165
Collinsville, CT 06019
1-887-663-2766
Website: www.modelmakers.org

ewg3D/E+/Getty Images

FIGURE 1.5 Models are often used to convey design ideas from the design team to the owners and to review boards.

Illustrator

Many drafters, designers, and architects have the basic skills to draw architectural renderings. Very few, though, have the expertise to make this type of drawing rapidly. Most illustrators have a background in art. By combining artistic talent with a basic understanding of architectural principles, the illustrator can produce drawings that show a proposed structure realistically. **FIGURE 1.6** shows a drawing that was prepared by an architectural illustrator. Section 11 provides an introduction to presentation drawings. For more information, contact:

American Society of Architectural Illustrators (ASAI)
1022 Tait Street
Oceanside, CA 92054
1-760-453-2544
Website: www.asai.org

Specification Writer

Specifications are written instructions that describe the data needed to build a structure. They are used to clearly convey the intentions of the owner, the architectural team, and each consultant involved with the project. Written specifications provide a method of supplementing the working drawings regarding the level of quality to be used for materials and the labor and methods to be used to install each material. The construction drawings and written specifications must be compatible for bidding and building accuracy, and they must be clear to avoid misinterpretation. The drawings visually define the relationships between materials, products, and systems within the structure by showing the location and size of each element. Specifications provide information regarding the quality of materials and workmanship, methods of installation, the desired performance at completion, and how performance is to be measured.

Generally, a writer will have had classes in technical writing at the two-year-college level. A **specification writer** must have a thorough understanding of the construction process and the use of the CSI 2014 *MasterFormat* numbering system, and have a good ability to read plans. The *MasterFormat* system is published by the Construction Specification Institute (CSI) in the United States, and by Construction Specifications Canada (CSC) in Canada. The numbering system is used by all areas of the architectural world to assign reference numbers to architectural materials and products. These listings can be used for production, distribution, filing, and retrieval of construction documents. Each major division of the *MasterFormat* system is related to a major grouping of the construction process and will be introduced in Chapter 8.

Specification writers must also have good computer skills and be able to use basic word processing software such as Microsoft Word. They also must be able to communicate clearly and have the ability to translate technical information into usable information for the various trades that will use the specs while maintaining the information in a format that will hold up in a court of law. Taking classes in grammar, English composition, and technical writing at the high school and community college levels can help develop these skills. Technical writers must also be able to:

- Write specifications for products and materials that comply with all applicable local, state, and federal requirements and codes.
- Recognize and correctly use jargon and terminology specific to the AEC world.
- Correctly use words that have double meanings in the proper context.
- Use spell check, grammar check, and a thesaurus.

Photograph by Bob Greenspan, Courtesy of Alan Mascord Design Associates, Inc.

FIGURE 1.6 Drawings created by an architectural illustrator are often used for advertising and presentation purposes.

- Use editing functions of the selected software proficiently.
- Accurately convey information found on vendors' websites to professionals and nonprofessionals who will work with the specification.
- Read, explain, and ensure that various aspects of service contracts and specifications at the job site are in compliance.
- Clearly define the requirements of various construction crews in the installation of materials.
- Apply vendor specifications for individual products so that once installed, they will be compatible with other materials in an assembly and the chemicals from various building products will not interact.

Construction Estimators

Construction estimators work in most large AEC firms to accurately determine the cost and amount of materials required for future projects. **Construction estimators** develop the cost information that companies need to bid on construction contracts and to decide on the profitability of proposed new projects. Estimators collect and analyze data on all of the factors that can affect costs, such as materials, labor, location, duration of the project, and special machinery requirements, including computer hardware and software. Job duties vary widely depending on the type and size of the project. On a large construction project, the estimating process begins with the decision to submit a bid.

Construction estimators are sometimes employed by the project's architect, engineering firm, or owner to help establish a budget, manage and control project costs, and to track actual costs relative to bid specifications as the project develops. During construction, estimators may manage the cost of change orders and negotiate and settle any extra costs or mitigate potential claims. Estimators may also be called upon as expert witnesses on cost in construction dispute cases.

To prepare for a career as a construction estimator, students need:

- A background in architectural design and construction or a degree in construction management, building science, or construction science.
- Experience in construction gained through professional practice, internships, or cooperative education programs.
- A thorough understanding of construction materials, costs, and construction procedures.
- An aptitude for mathematics and the ability to analyze, compare, and interpret detailed information.
- Proficiency with computers and possession of skills in programming, cost estimating, and BIM software.
- The ability to manage personal schedules, job schedules, contract information, and to coordinate work between various occupations.
- The ability to manage daily, weekly, and monthly schedules of materials and labor to complete a project.
- The ability to maintain a database of information related to all phases of the construction project.
- Be aware of, evaluate, and incorporate OSHA and EPA regulations that are relevant to the construction project.
- Have the supervision skills to oversee inspections and compliance with government and OSHA regulations.

Plans Examiner

Building departments require that plans and the construction process be inspected to ensure that the required codes for public safety have been met. The primary responsibility of the plans examiner is to review the working drawings, written specifications, and all calculations to ensure they comply with the structural, mechanical, and fire and life safety codes. Once the plan review has been completed, the plans examiner will return the drawings to the design plan for additional corrections or determine the fees for a building permit, and then approve building permit applications. The plans examiner must also respond to questions from engineers, developers, property owners, and architects regarding adopted codes.

A plans examiner must be licensed by the state or certified by the *International Code Council* (*ICC*) to certify minimum understanding of the construction process. In most states, there are different levels of examiners. An experienced CAD technician or designer may qualify as a residential plans examiner by obtaining the required state certifications. Generally, advancing to an upper-level position requires a degree in engineering or architecture.

Inspector

The construction that results from the plans must also be inspected. Depending on the size of the building

An Introduction to Green Design

Reduce, reuse, recycle! No matter what area of the design or construction field you enter, an important aspect of your career will be a building mindset that revolves around these three words. Whether it is called *earth-friendly, green, ecological,* or *sustainable* construction, the concept is to build in a manner that will produce a structure that uses energy efficiently, that uses materials that have low impact on the environment, and that contributes to a healthier workplace.

One of the leaders in the development of sustainable construction is the Leadership in Energy and Environmental Design Green Building Rating System, referred to as LEED. LEED is a rating system used to evaluate key areas of building projects, such as:

- Innovation and the design process.
- Location and linkages.
- Sustainable sites.
- Water efficiency.
- Energy and atmosphere.
- Material and resources.
- Indoor environmental quality.
- Awareness and education.

Other key organizations that are leaders in green construction include those developed by the National Association of Home Builders (NAHB), American National Standards Institute (ANSI), and the *International Code Council* (*ICC*), which publishes the *International Residential Code® (IRC®), the International Energy Conservation Code®* (IECC®), and the *International Green Construction Code™* (IgCC™). The *IRC* will be introduced in Chapter 9. These three industry leaders have combined their resources to develop the *National Green Building Standards®* (ICC 700-2012). The NGBS are a group of guiding principles that can be used throughout the construction process to ensure an environmentally friendly project. These current guidelines have become mandatory as part of the ICC code family as the 2015 codes are released. Major principles addressed by the 2015 guidelines include:

- Site design and development.
- Site design, preparation, and development.
- Resource efficiency.
- Energy efficiency.
- Water efficiency.
- Indoor environmental quality.
- Operation, maintenance, and building owner education.

The LEED and NGBS principles will be introduced throughout the text. As a new employee in a firm, you may not be making the decisions on how to increase the sustainability of a residence, but in order to advance in an office, you must understand key green issues presented in each of these guidelines.

Section 2 of this text will examine common methods of designing a residence that is environmentally friendly. Section 8 will examine common framing methods found in residential construction. Environmentally friendly framing is not just a matter of selecting green materials; once selected, these green products must be transported and used in a manner that will reduce the environmental impact of the structure. Creating an environmentally friendly structure requires the matching of materials to a specific design and site that minimizes the effect on that site. Five questions should be considered that affect the selection of materials to make a sustainable structure:

1. Can products be selected that are made from environmentally friendly materials?
2. Can products be selected because of what they do not contain?
3. Will the products to be used reduce the environmental impact during construction?
4. Will the products to be used reduce the environmental impact of operating the building?
5. Will the products to be used contribute to a safe, healthy indoor environment?

department, the plans examiner may also serve as the building inspector. In large building departments, one group examines plans and another inspects construction. Being a construction inspector requires an exceptionally good understanding of code limitations, print reading, and construction methods. Each of these skills has its roots in a beginning drafting class. Additional information regarding becoming a building inspector can be obtained from the *International Code Council* at www.iccsafe.org.

Jobs in Construction

Many drafters are employed directly by construction companies. The benefits of this type of position have already been discussed. These drafters typically not only do drafting but also work part-time in the field. Some drafters give up their jobs for one of the high-paying positions in the construction industry. The ease of interpreting plans as a result of a background in drafting is of great benefit to any construction worker.

Design Basics

As you enter the world of design, it's important to understand what you can expect to encounter in an architectural office. Designing a custom home for a specific client can be an exciting but difficult process. Very rarely can an architect sit down and instantly create a design that meets the needs of the client perfectly. The time required to design a home can range from a few days to several months. It is important for you to understand the design process and the role that the drafter plays in it. This requires an understanding of basic design, financial considerations, and common procedures of design. In the balance of this chapter, the terms *architect* and *designer* can be thought of as synonymous.

Typically the designing and much of the drafting will already be done before a project is given to the junior drafter. As experience and confidence are gained, the drafter enters the design process at earlier stages.

Financial Considerations

Both designers and drafters need to be concerned with costs. Finances influence the drafter's decisions about framing methods and other structural considerations. Often the advanced drafter must decide between methods that require more materials with less labor and those that require fewer materials but more labor. The owner may never be aware of these decisions, but the choices made can make the difference in whether or not the house is affordable. The designer makes the major financial decisions that affect the cost and size of the project. The designer needs to determine the client's budget at the beginning of the design process and work to keep the project within these limits.

Through past experience and contact with builders, the designer should be able to make an accurate estimate of the cost of a finished house. This estimate is often made on a square footage basis in the initial stages of design. For instance, in some areas a modest residence can be built for approximately $75 per square foot. In other areas this same house may cost approximately $150 per square foot. A client wishing to build a 2,500-square-foot house could expect to pay between $187,500 and $375,000, depending on where it will be built. Keep in mind that these are estimates. A square footage price tells very little about the home. In the design stage, square footage estimates help set parameters for the design. The estimate is based on typical costs for previous clients. The price of materials such as lumber, concrete, and roofing will vary throughout the year depending on supply and demand. Basic materials will typically account for approximately 50% of the project cost. Finished materials are the part of the estimate that will cause wide variation in the cost. For example, if you have ever been in a home supply store, you know that a toilet can be purchased for between $30 and $300. Every item in the house will have a range of possible prices. The final cost of the project is determined once the house is completely drawn and a list of materials is prepared. With a list of materials, contractors are able to make accurate decisions about cost.

The source of finances can also affect the design process. Certain lending institutions may require some drawings that the local building department may not. Federal Housing Administration (FHA) and Veterans Administration (VA) loans often require extra forms, drawings, and specifications that need to be taken into account in the initial design stages.

The Client

Most houses are *not* designed for one specific family. Often referred to as a *spec* (speculation) house, these homes are intended to meet the needs of a wide variety of families and are built without a specific buyer in mind. In order to help keep costs down, these houses are often built in subdivisions and designed to appeal to a wide variety of people. One basic plan may be built with several different options, thus saving the contractor the cost of paying for several different complete plans. Sections 4, 6, and 7 will explore alternative designs to the home presented throughout this text. Some families may make minor changes to an existing plan. These modified *stock plans* allow the prospective home buyer a chance to have a personalized design at a cost far below that of custom-drawn plans (see **FIGURE 1.7**). If finances allow, or if a stock plan cannot be found to meet their needs, a family can have a plan custom designed.

The Design Process

The design of a residence can be divided into several stages. These generally include initial contact, preliminary design studies, room planning, initial working drawings, final design considerations, completion of working drawings, permit procedures, and job supervision.

Design Basics, Inc. Home Plan Design Service.

FIGURE 1.7 Stock plans are designed to appeal to a wide variety of buyers.

Initial Contact

Clients often approach designers to obtain background information. Design fees, schedules, and the compatibility of personalities are but a few of the basic questions to be answered. This initial contact may take place by viewing a website, by telephone, or a personal visit. The questions asked are important to both the designer and the client. The client needs to pick a designer who can work within budget and time limitations. Drawing fees are another important consideration in choosing a designer. Design fees vary based on the type of project and the range of services to be provided. Fees are generally based on hourly rates, price per square feet of construction, on a percentage of construction cost, or a combination of these methods. Square footage prices vary based on the size of the project and the area of the country, but must be set to cover design and drafting time, overhead, and profit margin. New drafters are often shocked to learn that their office bills clients at a rate that is often three to four times their hourly rate of pay for drafting time. It is important to remember that this billing price must include supervision time, overhead, state and federal taxes, and hopefully a profit for the office. Design fees for architectural services of a custom house range from 5% to 15% of the total construction cost. The amount varies based on the services provided, the workload of the office, and the local economy. The designer needs to screen clients to determine if the client's needs fit within the office schedule.

Once an agreement has been reached, the preliminary design work can begin. This selection process usually begins with the signing of a contract to set guidelines that identify which services are to be provided and when payment is expected. This is also the time when the initial criteria for the project will be determined. Generally, clients have a basic size and a list of specifics in mind, a sketch of proposed floor plans, and a file full of pictures of items that they would like in their house. During this initial phase of design, it is important to become familiar with the lifestyle of the client as well as the site where the house will be built.

Preliminary Design Studies

Once a thorough understanding of the client's lifestyle, design criteria, and financial limits has been developed, the preliminary studies can begin. These include research with the building and zoning departments that govern the site, investigation of the site, and discussions with any board of review that may be required. Once this initial research has been done, preliminary design studies can be started. The preliminary drawings usually take two stages: bubble drawings and scaled sketches.

Bubble drawings are freehand sketches used to help determine room locations and relationships. Several sketches similar to **FIGURE 1.8** are usually created. It

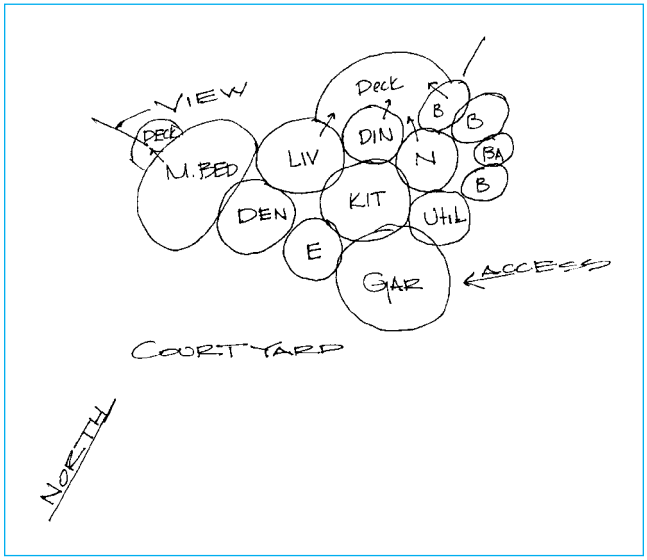

FIGURE 1.8 Bubble designs are the first drawings in the design process. These drawings are used to explore room relationships.

is during this stage of the preliminary design that consideration is given to the site and energy efficiency of the home by planning room orientation to the site, the surroundings, the movement of the sun, and available sunlight at the property at various times of the day.

Once a satisfactory layout has been sketched, these shapes are transformed into scaled drawings. **FIGURE 1.9** shows a preliminary floor plan. Usually several sets of sketches are developed to explore different design possibilities. Consideration is given to building code regulations and room relationships and sizes. After the design options are explored, the designer selects a plan to prepare for the client. This could be the point when a drafter first becomes involved in the design process. Depending on the schedule of the designer, a senior drafter might prepare the refined preliminary drawings, which can be seen in **FIGURE 1.10**. These will include floor plans and an elevation. These drawings are then presented to the client. Changes and revisions are made at this time. Once the plans are approved by the client, the preliminary drawings are ready to be converted to design drawings.

Room Planning

Room usage must be considered throughout the design process. Many professionals verify standard sizes by using vendor catalogs and books such as *Architectural*

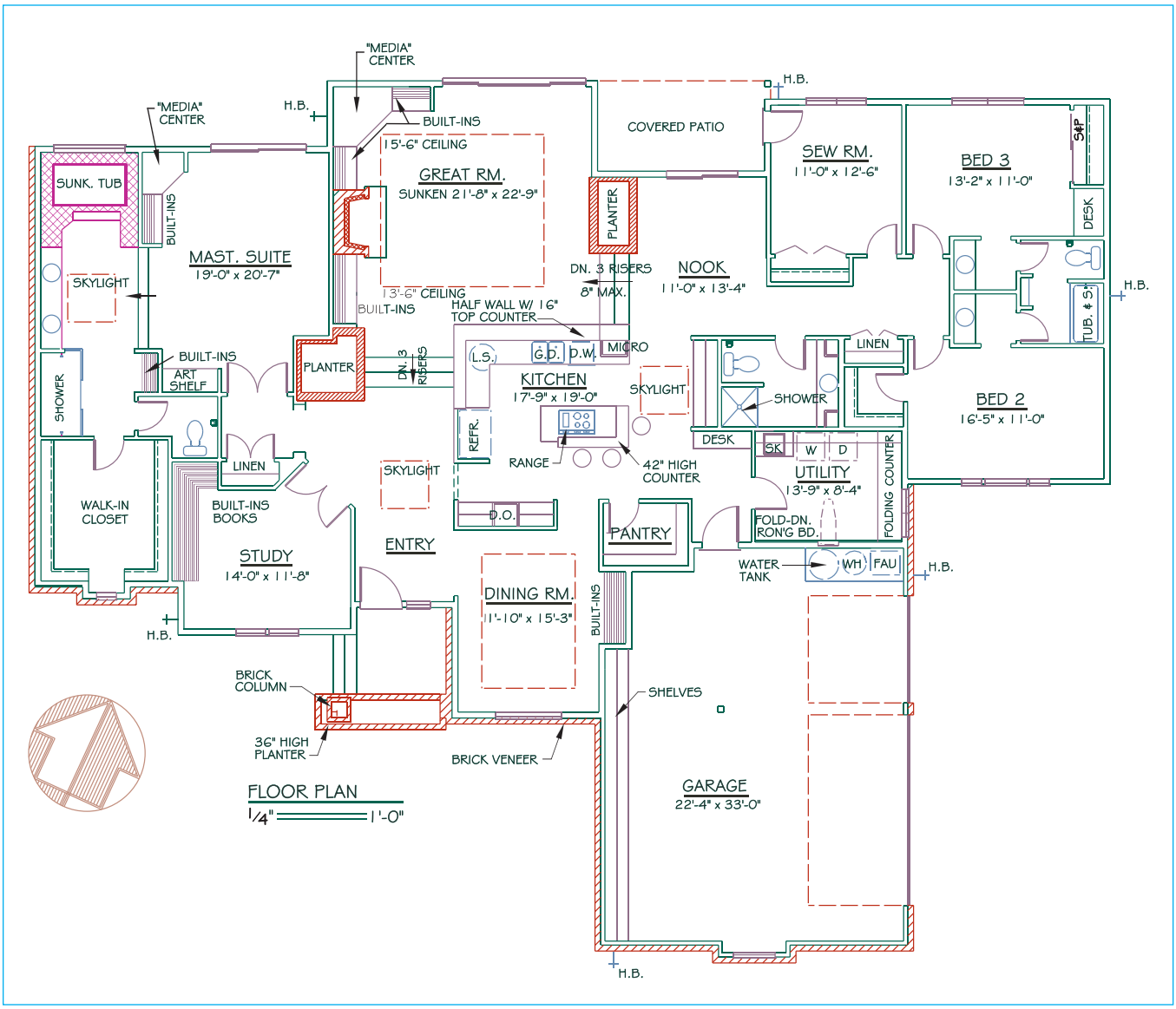

FIGURE 1.9 Bubble drawings are converted to scale drawings so that basic sizes can be determined. The preliminary floor plan contains enough text to convey ideas to the owner, but will require additional annotation to be added for the construction process.

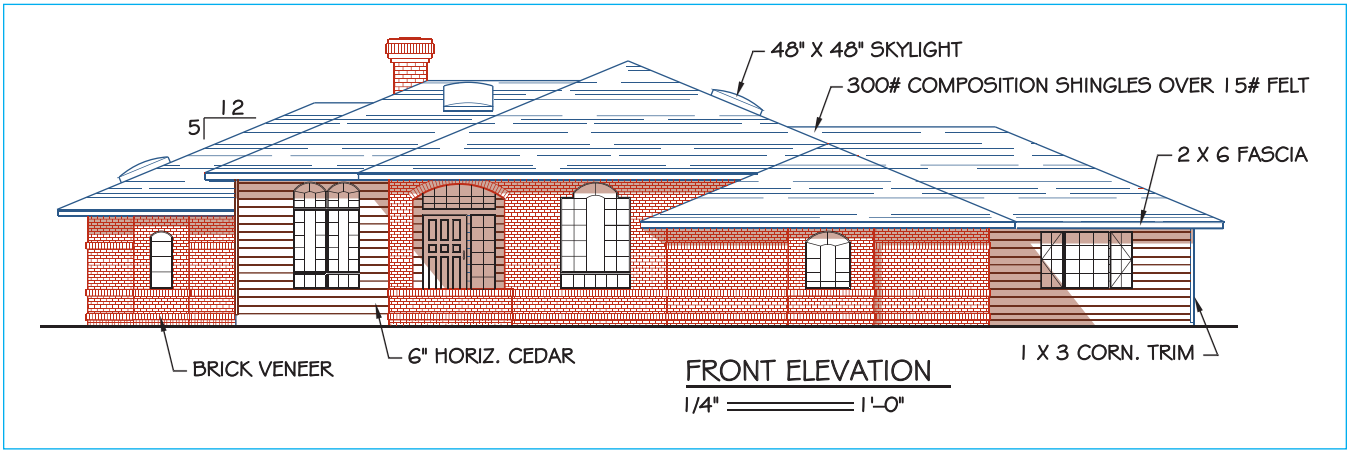

FIGURE 1.10 Based on preliminary floor plans, the front elevation is drawn to explore design options.

Graphic Standards. Chapter 10 will introduce major interior design concepts to be considered. Typically the designer will have talked with the owners about how each room will be used and what types of furniture will be included. Occasionally, placement of a family heirloom will dictate the entire layout. The designer will need to determine any specific furniture needs of the owner and verify the size requirements for that particular piece of furniture.

When placing furniture outlines to determine the amount of space in a room, the drafter can use blocks that come with the CAD program or blocks supplied by third-party vendors. **FIGURE 1.11** shows a preliminary floor plan with the furniture added by the use of blocks.

In the final stages of the preliminary process, the designer will often work with the clients, or bring in the assistance of interior designers to start planning interior finishes. With the interior space designed, attention can now be focused on interior details. This might include the use of interior elevations, interior perspectives, and presentation boards. Presentation boards are used to present samples of cloth or other materials that can be used for wall finishes and furniture. Each element will be addressed in future chapters. This is also the time the design team will start to help the clients make selections about key pieces of furniture, lighting fixtures, and equipment.

Initial Working Drawings

With the preliminary drawings approved, a drafter can begin to lay out the working drawings. The procedure will vary with each office, but generally each of the drawings required for the project will be started. These will include the foundation, site, roof, electrical, cabinet, and framing plans. At this stage the drafter must rely on past experience for drawing the size of beams and other structural members. Beams and other structural material will be located, but exact sizes are not determined until the entire project has been laid out.

Final Design Considerations

Once the drawings have been laid out, the designer will generally meet with the client several times again to get information on flooring, electrical needs, cabinets, and other finish materials. This conference will result in a set of marked drawings that the drafter will use to complete the working drawings.

Completion of Working Drawings

The complexity of the residence will determine which drawings are required. Most building departments require a site plan, a floor plan, a foundation plan, elevations, and one cross section as the minimum drawing to get a building permit. On a complicated plan, a wall framing plan, a roof framing plan, a grading plan, and construction details may be required. Some lending institutions may require interior elevations, cabinet drawings, and finish specifications.

The skills of the drafter will determine their participation in preparing the working drawings. As an entry-level drafter, you will often be given the job of making corrections on existing drawings or drawing the site plans or cabinets. As you gain skill, you will be given more drawing responsibility. With increased ability, you will start to share in the design responsibilities.

Working Drawings

The drawings that will be provided vary for each residence and within each office. **FIGURE 1.12** through

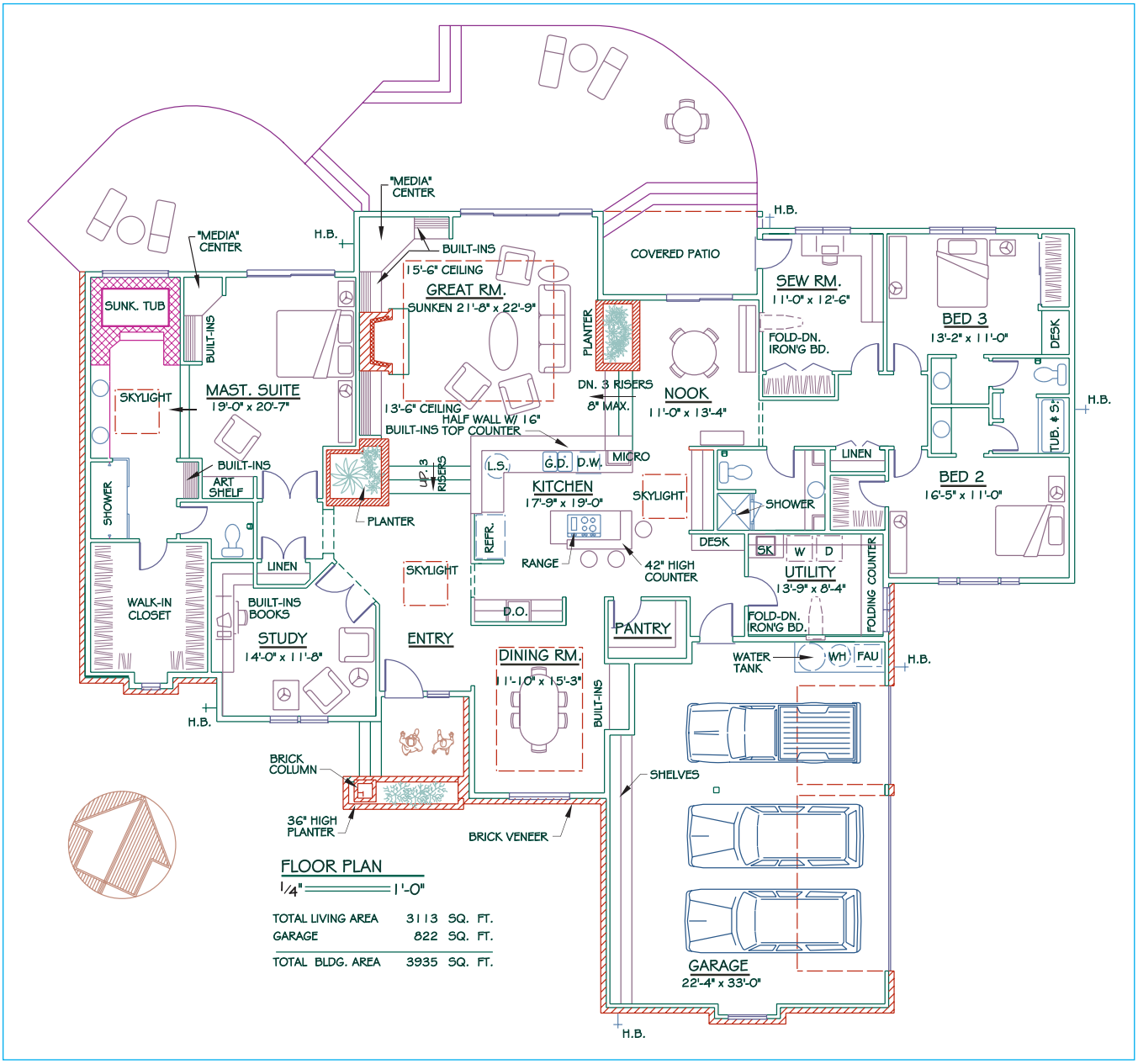

FIGURE 1.11 The preliminary floor plan shows the owner's changes, with furniture added.

FIGURE 1.17 show what are typically considered the *architectural drawings*. These are drawings that show finishing materials. **FIGURE 1.18** through **FIGURE 1.20** show the *electrical drawings*. **FIGURE 1.21** through **FIGURE 1.24** show what are typically called the *structural drawings*. Many architectural firms number each page based on the type of drawing on that page. Pages are represented by:

A—Architectural

S—Structural

M—Mechanical

E—Electrical

P—Plumbing

Figure 1.12 shows the site plan that was required for the residence in Figure 1.8. Typically the site plan is completed by a junior drafter from a sketch provided by the senior drafter or designer. A grading plan is not required for every residence. Because this home is to be built on a fairly level site, the elevations are indicated at each corner of the structure. **FIGURE 1.13** shows a site plan for a hillside home. Because of the large amount of soil to be excavated for the lower floor, the grading

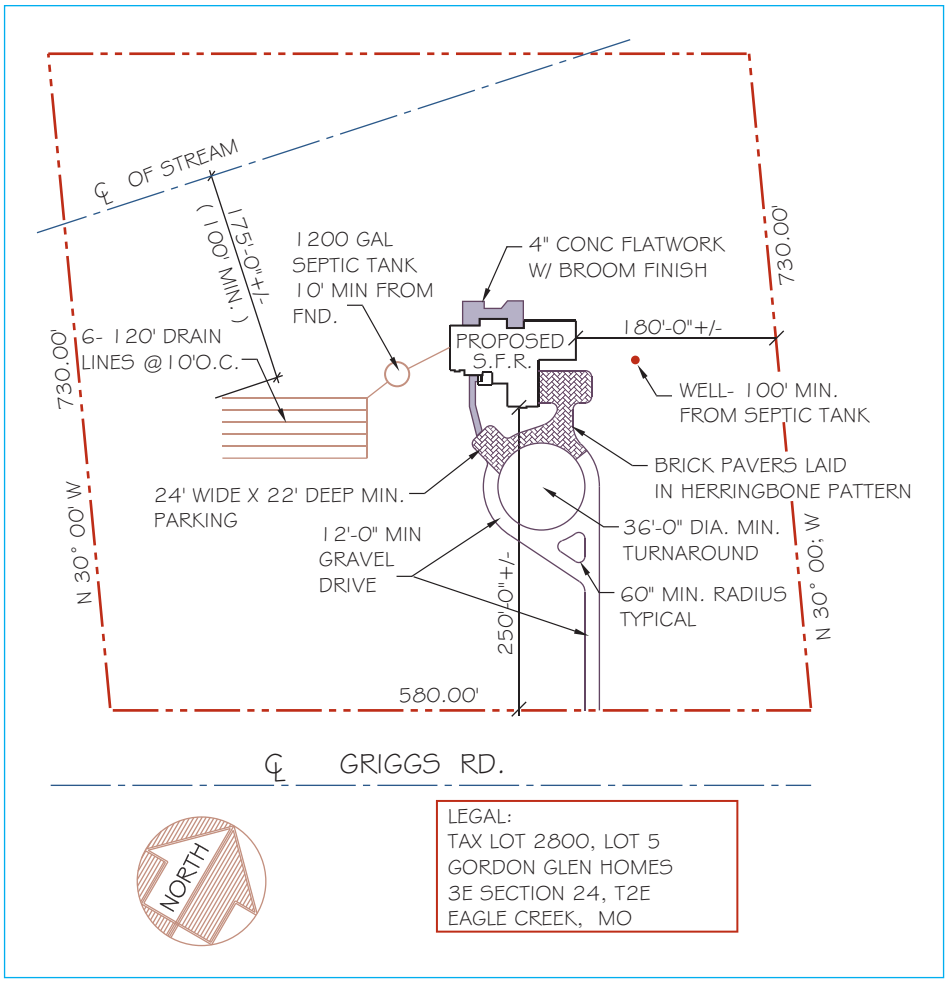

FIGURE 1.12 A site plan is used to show how the structure relates to the site. When the site is relatively flat, grading information is placed on this drawing.

plan was provided (**FIGURE 1.14**). The junior drafter may draw the base drawing showing the structure and site plan and the designer or senior drafter will usually complete the grading information. Typically the owner is responsible for hiring a surveyor, who will provide the topography and site map, although the designer will coordinate the work between the two offices. Section 3 will provide insight into how site drawings are developed.

Using the preliminary drawing that was presented in Figure 1.10, the working elevations can be completed. Depending on the complexity of the structure, they may be completed by either the junior or the senior drafter. **FIGURE 1.15** shows the working elevations for this structure. Section 7 will provide information needed to complete working elevations, and Section 11 will introduce presentation elevations.

FIGURE 1.16 and Figure 1.17 show the completed plan views of this structure. Figure 1.16 shows the view from flying over the structure. The roof plan is often completed by the junior drafter using sketches provided by the senior drafter. Section 6 will provide information on roof plans. The floor plan, represented in **FIGURE 1.17A**, is usually completed by the senior drafter. These drawings provide information related to the room arrangements and interior finishes. Junior drafters also work on the plan views by making corrections or adding notes, which are typically placed on a marked up set of plans provided by the designer or senior drafter. Section 4 will provide information for completing floor plans.

Figure 1.18 shows the electrical plan. Depending on the complexity of the residence, electrical information may be placed directly on the floor plan. A junior drafter typically completes the electrical drawings by working from marked up prints provided by the designer. Chapter 19 will provide information for completing the electrical plans.

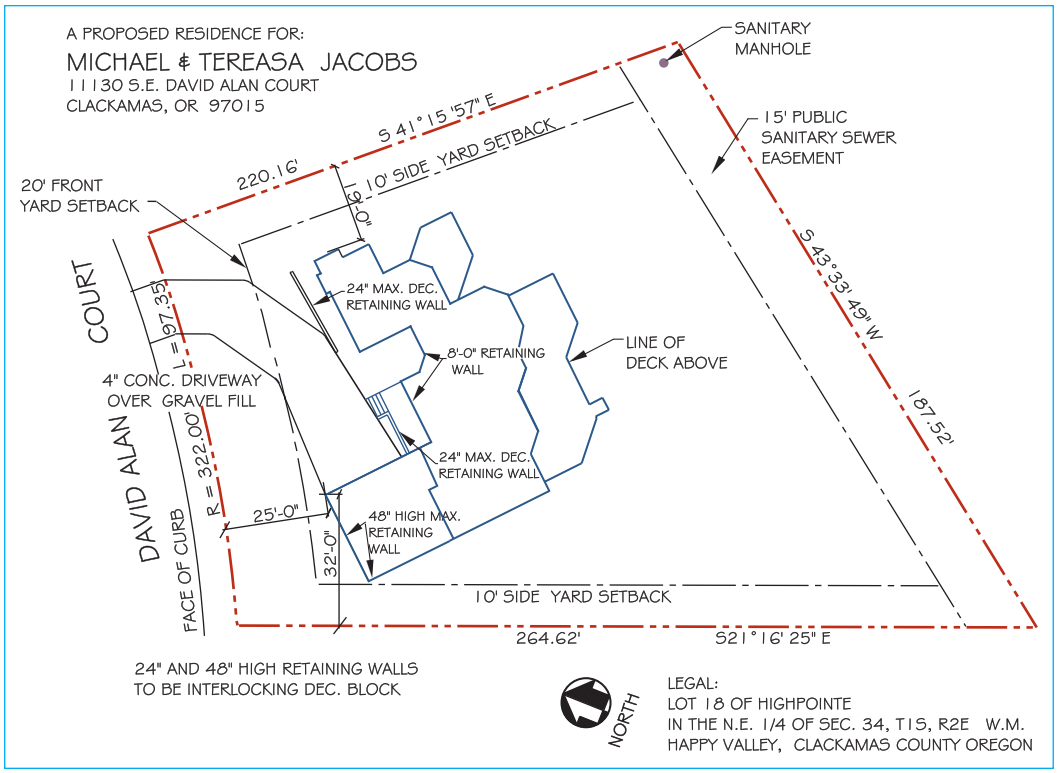

FIGURE 1.13 If grading is extensive, the site plan is separated from the grading plan. By careful use of layers, this site plan was used as a base for the grading plan in Figure 1.14.

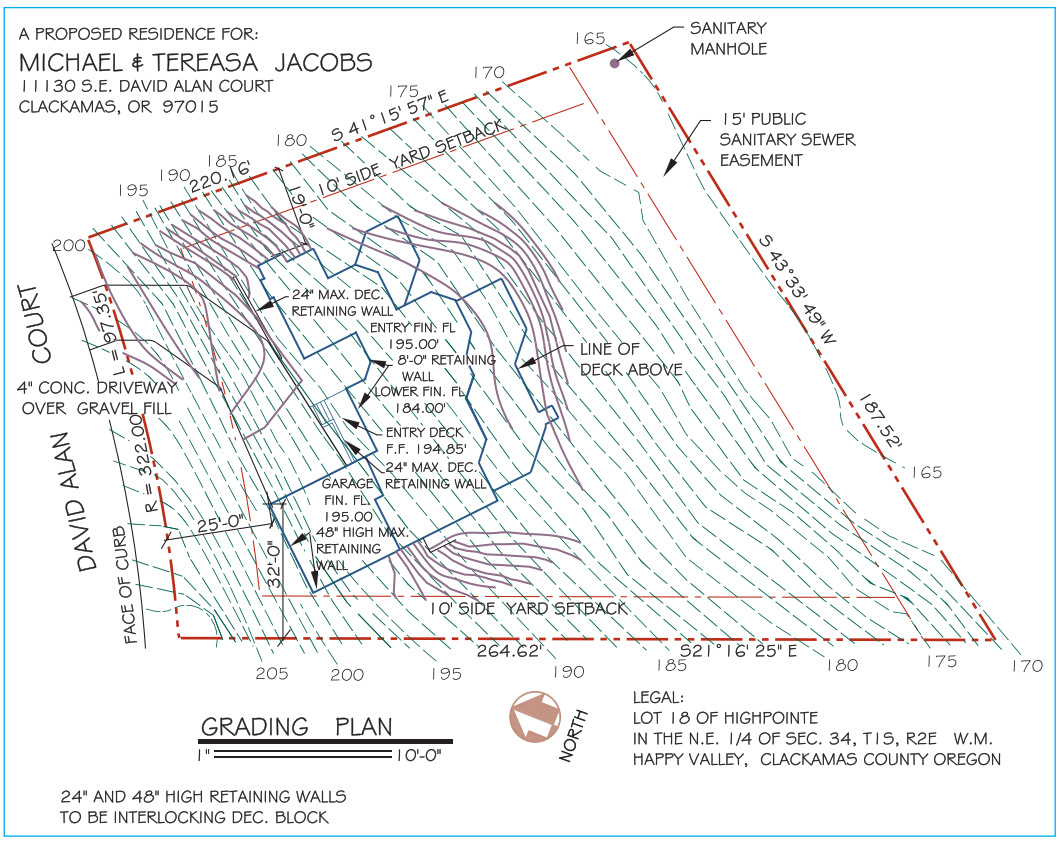

FIGURE 1.14 A grading plan is used to define new and existing grades, and the cut and fill banks that will be recreated as the soil is relocated. On this drawing, existing soil contours are shown with dashed lines, and new grade contours are represented with solid lines.

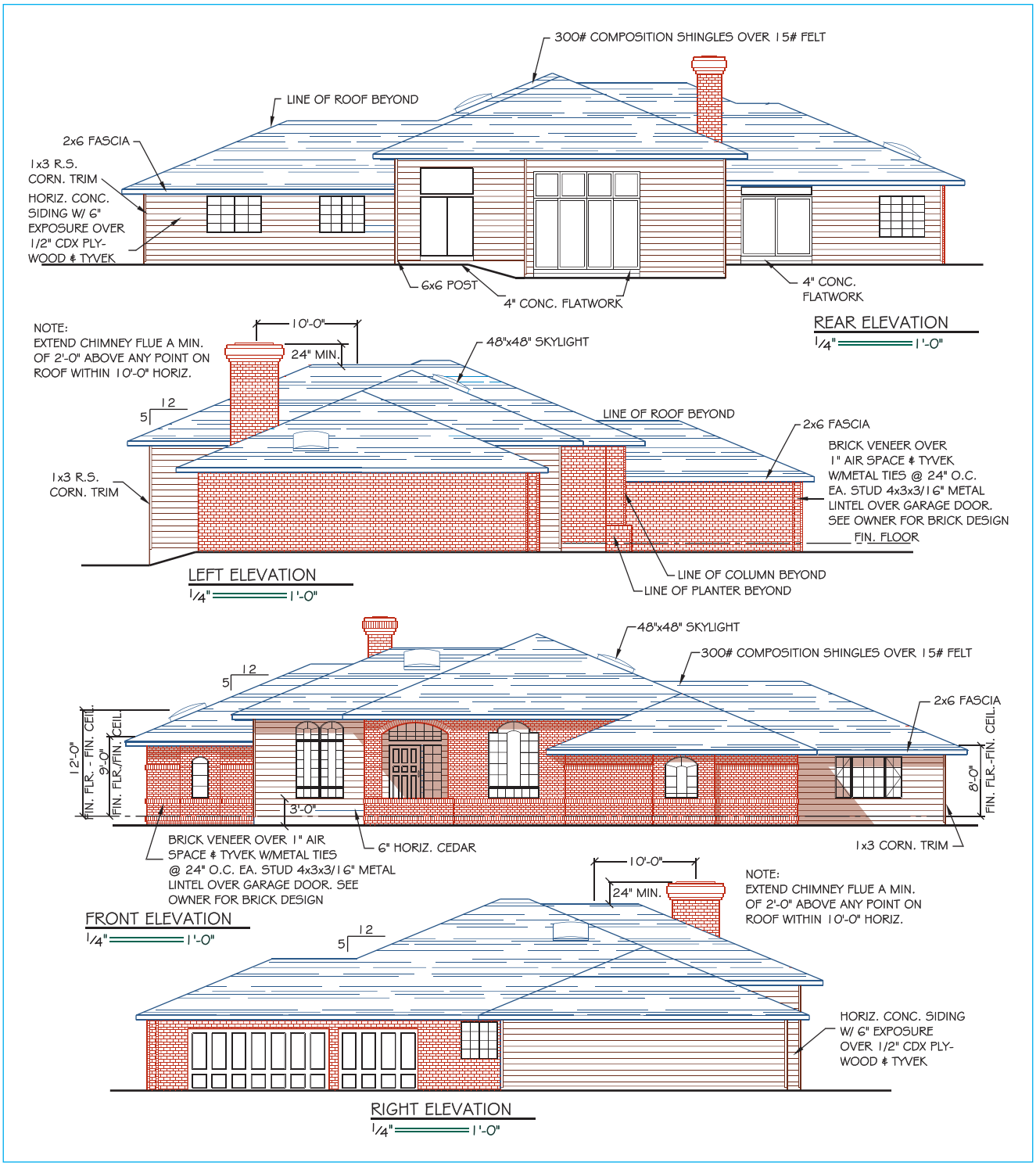

FIGURE 1.15 Once the owners have approved the preliminary designs, the exterior elevations can be completed. The elevations will provide a view of each side of the structure and show and specify all exterior materials to be used.

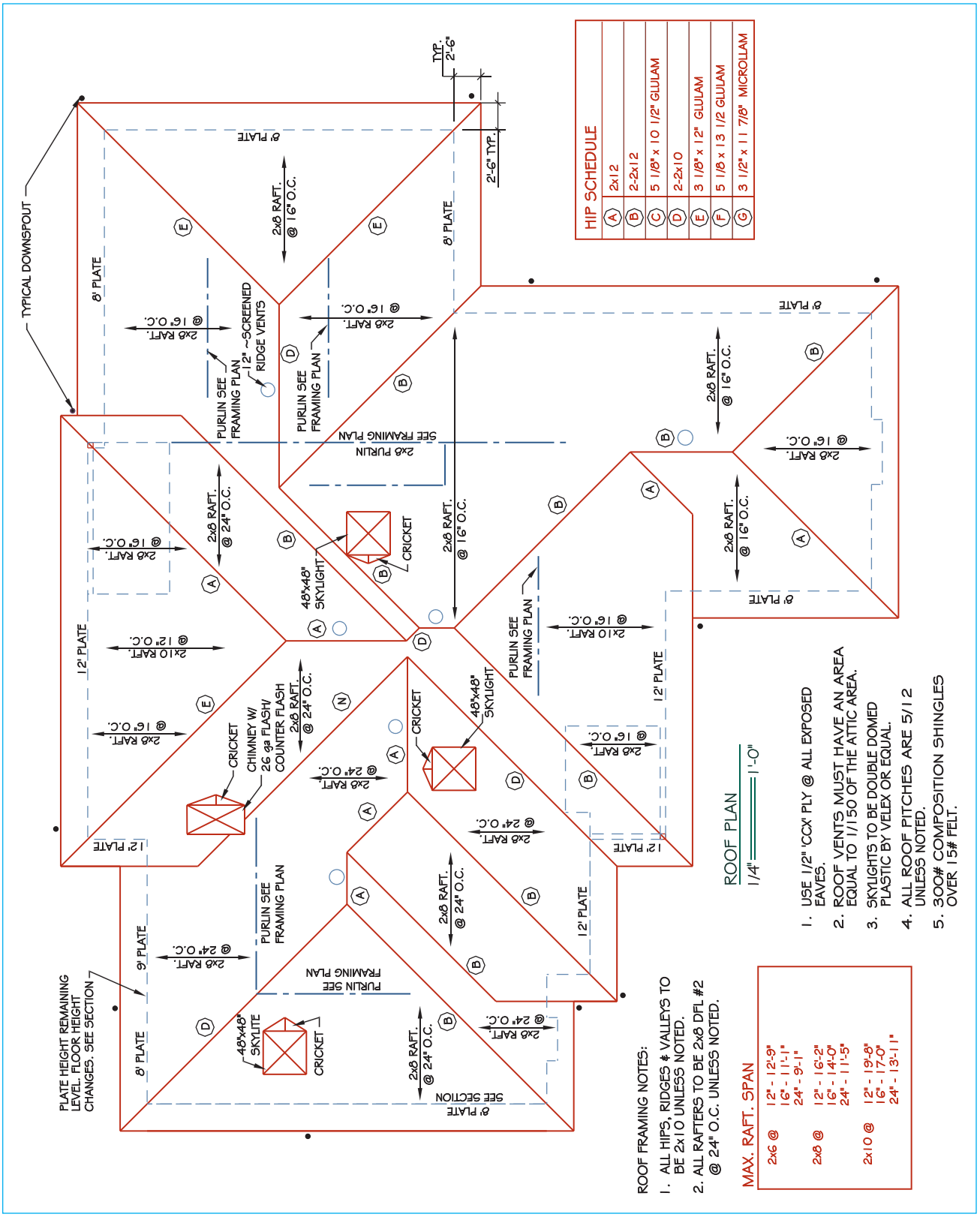

FIGURE 1.16 The roof plan shows the shape of the roof structure as well as vents and drains.

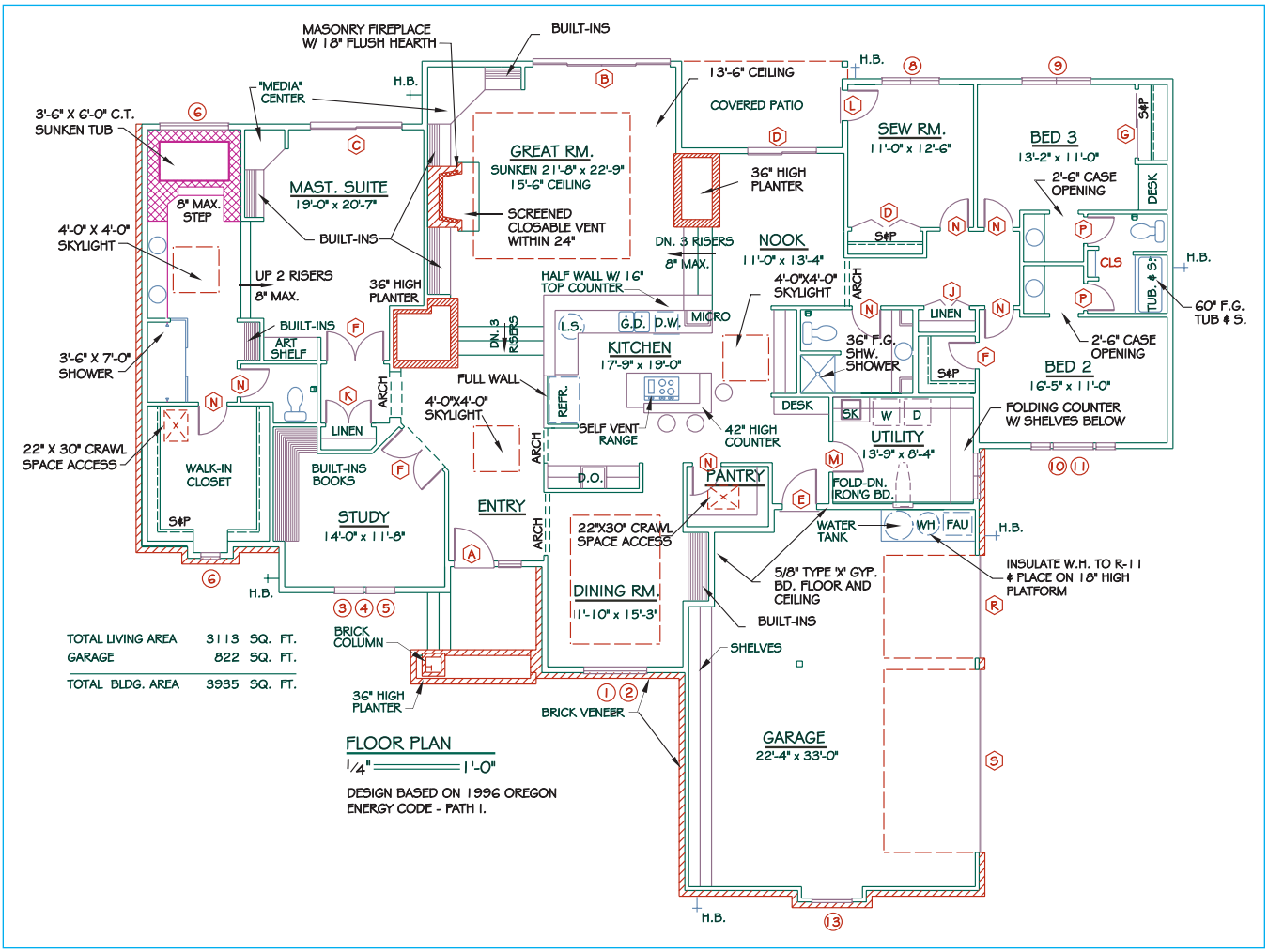

FIGURE 1.17A The preliminary floor plan is used to form the base of the finished floor plan. Text to describe all interior materials must be provided.

DOOR SCHEDULE

SYM.	SIZE	TYPE	QUAN.
A	3'-6" X 8'-0"	S.C.,R.P., W/ 24" SIDELIGHT W/ SQ. TRANSOM ABOVE	1
B	12'-0" X 8'-0"	SL. GLASS W/ 12'-0" X 3'-0" SQ. TRANSOM ABOVE	1
C	8'-0" X 6'-8"	SL. FRENCH DRS. W/ 12" SQ. TRANSOM ABOVE	1
D	6'-0" X 6'-8"	SL. GLASS DRS. W/6'-0" x 3'-0" SQ. TRANSOM ABOVE	1
E	3'-0" X 6'-8"	SELF CLOSING, M.I.	1
F	PR 2'-6" X 6'-8"	HOLLOW CORE	2
G	6'-0" X 6'-8"	SL. MIRROR	1
H	6'-0" X 6'-8"	BIFOLD	1
J	4'-0" X 6'-8"	BIFOLD	1
K	PR 2'-0" X 6'-8"	HOLLOW CORE	1
L	2'-8" X 6'-8"	S.C., M.I.	1
M	2'-8" X 6'-8"	HOLLOW CORE	1
N	2'-6" X 6'-8"	HOLLOW CORE	7
P	2'-4" X 6'-8"	HOLLOW CORE	3
Q	16'-0" X 8'-0"	OVERHEAD, GARAGE	1
R	9'-0" X 8'-0"	OVERHEAD, GARAGE	1

DOOR NOTES:

1. FRONT DOOR TO BE RATED AT 0.54 OR LESS; VERIFY DOOR STYLE WITH OWNER.
2. EXTERIOR DOORS IN HEATED WALLS TO BE U 0.20 OR LESS.
3. DOORS THAT EXCEED 50% GLASS ARE TO BE U 0.40 OR LESS.
4. ALL GLASS WITHIN 18" OF DOORS TO BE TEMPERED.

WINDOW SCHEDULE

SYM.	SIZE	TYPE	QUAN.
1	5'-6" X 7'-6"	ARCHED TOP	1
2	5'-6" X 1'-0"	AWNING	1
3	2'-6" X 5'-0"	PICTURE	2
4	2'-6" X 1'-0"	AWNING	2
5	2'-6" X 2'-6"	ARCHED TOP	2
6	1'-8" X 4'-6"	ARCHED TOP	1
7	6'-0" X 4'-6"	HOR. SLIDING	1
8	5'-0" X 4'-0"	HOR. SLIDING	1
9	6'-0" X 4'-0"	HOR. SLIDING	1
10	1'-8" X 4'-6"	CASEMENT	2
11	3'-6" X 4'-6"	PICTURE	1
12	4'-0" X 3'-0"	PICTURE	1
13	3'-6" X 4'-6"	ARCHED TOP	1

WINDOW NOTES:

1. ALL WINDOWS TO BE VINYL FRAME, MILGARD OR BETTER.
2. ALL WINDOWS TO BE U 0.40 MIN.
3. ALL BEDROOM WINDOWS TO BE WITHIN 44" OF FIN. FLOOR.
4. GLASS WITHIN 18" OF DOORS TO BE TEMPERED.
5. ALL WINDOW HDRS. FOR 8' & 9' CEIL. HEIGHTS TO BE SET AT 6'-8", ALL HDRS FOR 12' CEIL. TO BE SET AT 10'-8", UNLESS OTHERWISE NOTED.
6. VERIFY HEIGHT OF WINDOW #7 WITH TUB HEIGHT.

GENERAL NOTES:

1. STRUCTURAL DESIGNS ARE BASED ON 2015 I.R.C AND 2012 OREGON ENERGY CODE PATH 1.
2. ALL PENETRATIONS IN TOP OR BOTTOM PLATES FOR PLUMBING OR ELECTRICAL RUNS TO BE SEALED. SEE ELECTRICAL PLANS FOR ADDITIONAL SPECIFICATIONS.
3. PROVIDE 1/2" WATERPROOF GYP. BD. AROUND ALL TUBS, SHOWERS, AND SPAS.
4. VENT DRYER AND ALL FANS TO OUTSIDE AIR THRU DAMPERED VENTS.
5. INSULATE WATER HEATER TO R-11. PROVIDE 18" HIGH PLATFORM FOR GAS APPLIANCES.
6. PROVIDE 1/4" COLD WATER LINE TO REFRIGERATOR.
7. BRICK VENEER TO BE PLACED OVER 1" AIR SPACE, AND TYVEK W/ METAL TIES @ 24" O.C. EA. STUD.

FIGURE 1.17B Notes and schedules are typically displayed near the floor plan.

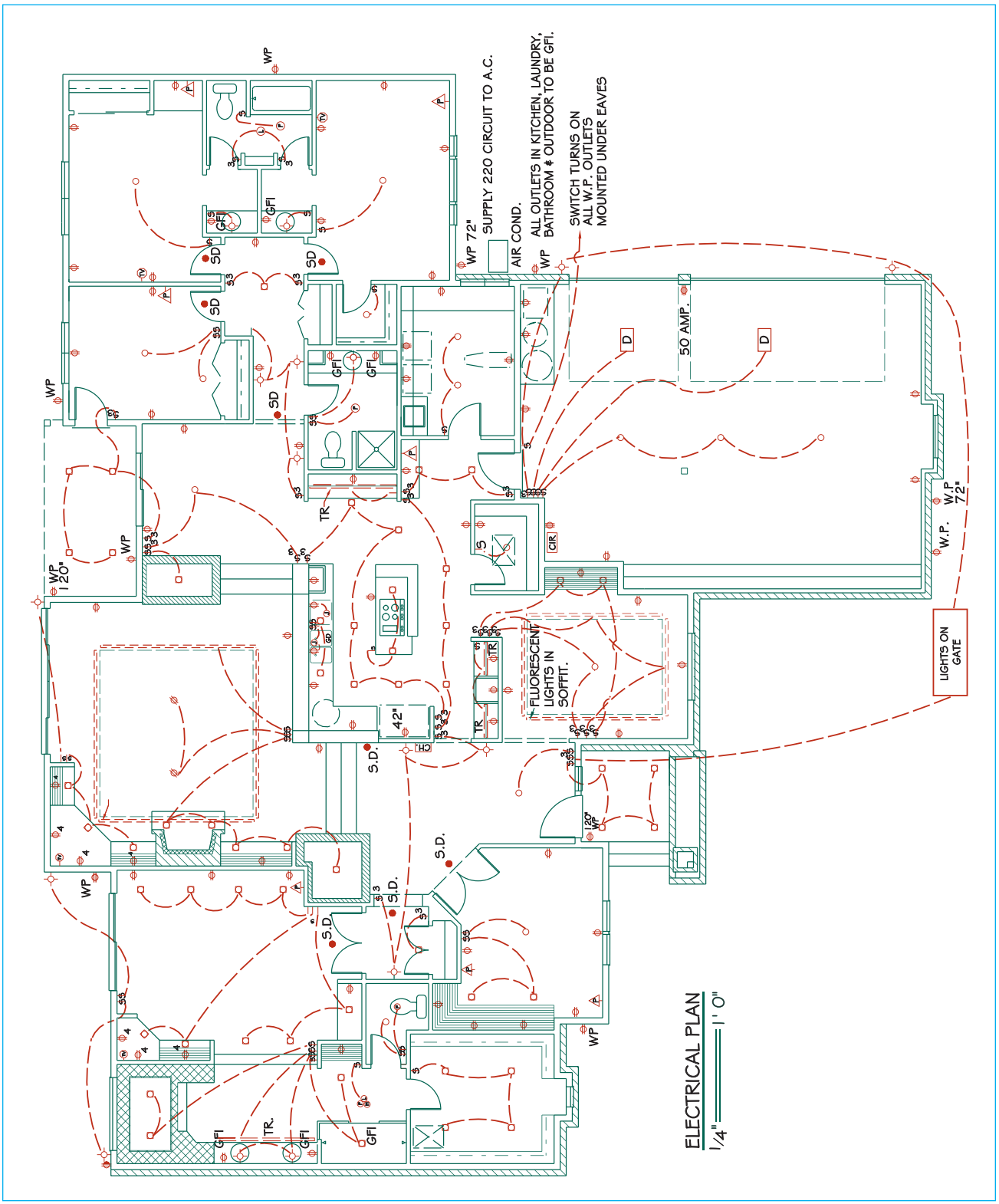

FIGURE 1.18A The electrical plan shows the locations for lights, plugs, switches, and other electrical fixtures and specifications. Using the floor plan as the base drawing, the electrical drawing can be completed by adding the electrical information on new layers.