

Carpentry

FLOYD VOGT • FOURTH EDITION



RESIDENTIAL CONSTRUCTION ACADEMY

Carpentry

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**Residential Construction Academy:
Carpentry, Fourth Edition**
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Preface

About the Residential Construction Academy Series

One of the most pressing problems confronting the building industry today is the shortage of skilled labor. The construction industry must recruit an estimated 185,000 new craft workers each year to meet future needs. This shortage is expected to continue well into the next decade because of projected job growth and a decline in the number of available workers. At the same time, the training of available labor is becoming an increasing concern throughout the country. This lack of training opportunities has resulted in 94,000 unfilled construction sector jobs in 2014. This challenge is affecting all construction trades and is threatening the ability of builders to construct quality homes.

These challenges led to the creation of the innovative *Residential Construction Academy Series*. The *Residential Construction Academy Series* is the perfect way to introduce people of all ages to the building trades while guiding them in the development of essential workplace skills, including carpentry, electrical wiring, HVAC, plumbing, masonry, and facilities maintenance. The products and services offered through the *Residential Construction Academy* are the result of cooperative planning and rigorous joint efforts between industry and education. The program was originally conceived by the National Association of Home Builders (NAHB)—the premier association of more than 140,000 members - and its affiliate, the Home Builders Institute (HBI), a leading career training provider in the residential construction industry.

For the first time, construction professionals and educators created national skills standards for the construction trades. In the summer of 2001, NAHB, through the HBI, began the process of developing residential craft standards in six trades: carpentry, electrical wiring, HVAC, plumbing, masonry, and facilities maintenance. Groups of employers from across the country met with an independent research and measurement organization to begin the development of new craft training standards. Care was taken to assure

representation of builders and remodelers, residential and light commercial, custom single family and high production or volume builders. The guidelines from the National Skills Standards Board were followed in developing the new standards. In addition, the process met or exceeded American Psychological Association standards for occupational credentialing.

Next, through a partnership between HBI and Cengage Learning, learning materials—textbooks, DVDs, and instructor’s curriculum and teaching tools—were created to teach these standards effectively. A foundational tenet of this series is that students *learn by doing*. Integrated into this colorful, highly illustrated text are Procedure sections designed to help students apply information through hands-on, active application. A constant focus of the *Residential Construction Academy* is teaching the skills needed to be successful in the construction industry and constantly applying the learning to real-world applications.

In 2009, the Home Builders Institute enhanced the Residential Construction Academy Series by adding industry Program Credentialing and Certification for both students and instructors. National Instructor Certification ensures consistency in instructor teaching/training methodologies and knowledge competency when teaching to the industry’s national skills standards. Student Certification is offered for each trade area of the Residential Construction Academy Series in the form of rigorous testing. Student Certification is tied to a national database that will provide an opportunity for easy access for potential employers to verify skills and competencies. Instructor and Student Certification serve the basis for Program Credentialing offered by HBI. For more information on HBI Program Credentialing and Instructor and Student Certification, please go to <http://www.hbi.org>.

About this Book

A home is an essential part of human life. It provides protection, security, and privacy to its occupants. It is viewed as the single-most important possession a family can own. This book is written for students who want to learn how to build a home.

This book is organized in four sections: Tools and Materials, Rough Carpentry, Exterior Finish, and Interior Finish. These sections and the chapters within them are presented in the order in which a home is constructed.

We begin with an understanding of the tools and building materials used in residential construction. Hand and power tools provide the means to shape the material into the desired form. The choices of material are vast and change as technology provides better products to meet the needs of the industry. Fasteners hold it all together.

Rough framing creates the outline of the building. The learner will understand how a building grows and seems to come alive where empty space once existed. Carpenters begin where the masons leave off by installing the floor and walls. Workers are required to work above the ground using scaffolds and ladders; safety is a constant focus for the learner throughout the book. Once skill at working aboveground is achieved, the roof is erected. After the outline of the building is completed, it is ready for the finishes that make the building weathertight and comfortable.

The learner then moves on to the exterior finish that covers the frame, protecting it from the effects of weather and seasonal changes. Each locale has its particular climatic influence. Some regions are cold and homes there must be well insulated; others are warm but subject to high winds and hurricanes. Other areas are somewhere in between. The exterior finish defends the home and makes an architectural statement of style.

Interior finish provides flat surfaces ready for decor. It completes the boundary between the outside and the warmth or coolness of the inside. The learner is introduced to many different types of materials that may be used for finishing the interior and exterior building surfaces.

This book is designed to present information in a step-by-step fashion. Learners are expected to understand the skills and techniques of earlier chapters before going on to new material. The learners' knowledge of construction grows with the home. Yet, just as it is OK to cut lumber using your right hand or your left, variations in

construction techniques do exist. It should be understood at the outset that there is more than one way to do most tasks. The techniques adopted for this book are time tested and chosen for their simplicity and straightforward approach, making the presentation of this information as easy as possible.

Life as a construction worker is a noble profession. Workers have the opportunity to work with their hands in a creative manner. Taking materials delivered to the site and generating a structure brings someone's dream to fruition. Anyone with the desire to do so can learn the skills to accomplish the tasks of home construction. It is to those students who choose to follow our forefathers into the field of construction that this book is dedicated.

NEW TO THIS EDITION

The fourth edition of *Residential Construction Academy: Carpentry* features current information related to the industry and new information to facilitate learning:

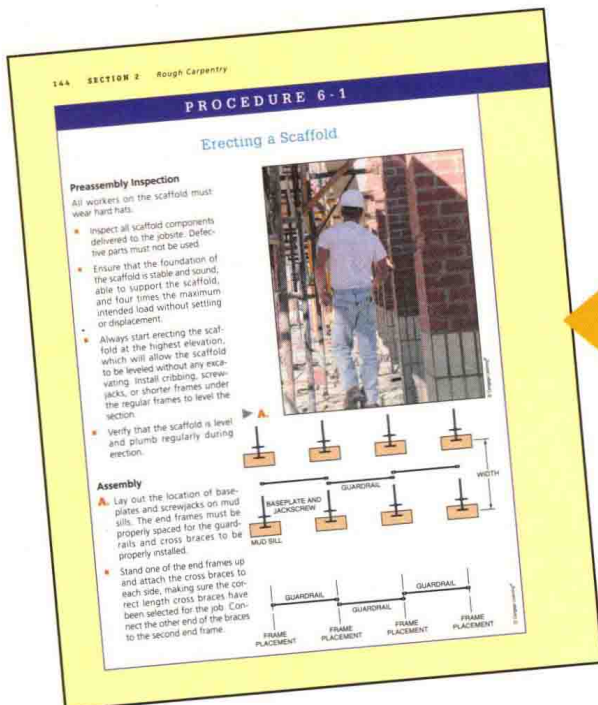
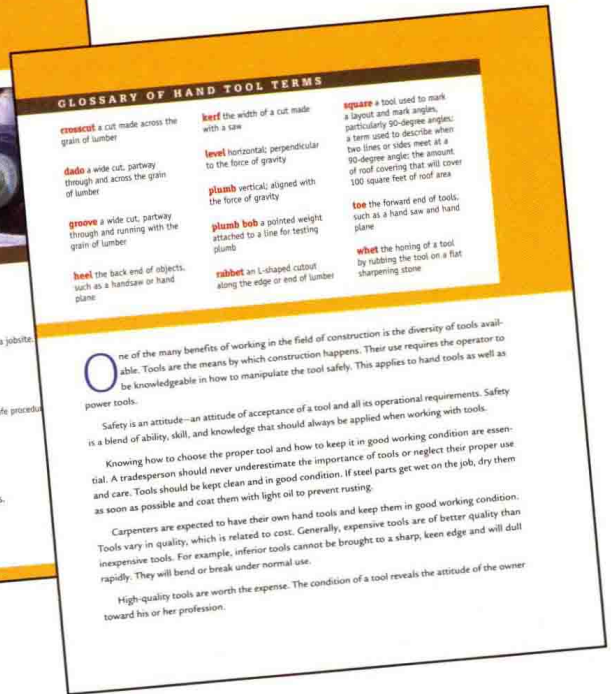
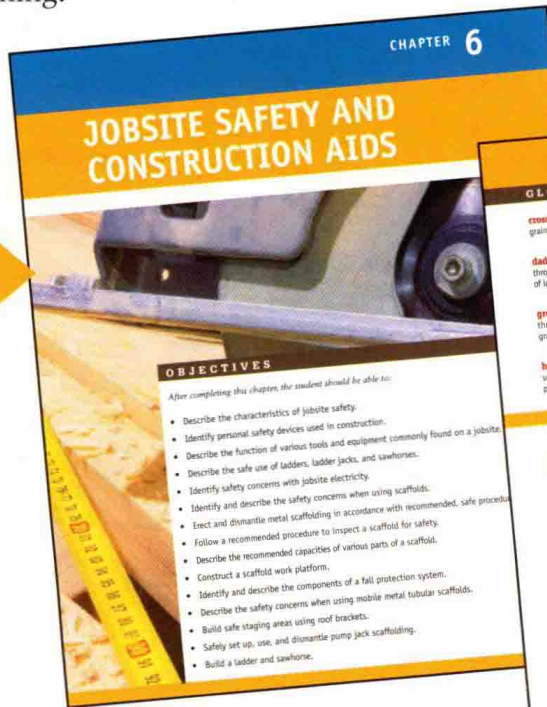
- Statistics in the *Introduction* reflecting the current state of the construction industry.
- New information in the *Introduction* related to *properly* communicating via electronic and digital devices on the jobsite, as well as new photos that depict current professionals working in various occupations within the industry.
- Expanded information in the *Introduction* related to energy efficiency and renewable energy sources.
- A new *Career Profile*, featuring Lawrence D. Dykhous, Jr., a man who started his education early and at the young age of 21 started his own construction business, *Dykhous Construction Company, Inc.*
- Reorganized chapters within the *Rough Carpentry* and *Exterior Finish* sections to present safety issues earlier in the book while still offering a logical flow of information.
- Revised information explaining how to safely operate a portable electric saw, including new photos and a new accompanying step-by-step *Procedure* demonstration.
- Expanded information on drill bits, including new photos and descriptions of twist bits, speed bores, forstner bits, expansive bits, countersinks, combination drills, hole saws, and masonry drill bits.
- Current information on safety is offered in *Chapter 6: Jobsite Safety and Construction Aids*.
- A new section on crawl space foundations to represent warm-weather climates.
- A new section specifically focused on working safely on a roof, including a discussion of current OSHA regulations.
- Revised information explaining how to properly flash a chimney, including new photos and a new accompanying step-by-step *Procedure* demonstration.
- New information on house-wrap and water-resistant sheathing, including a new step-by-step *Procedure* on installing house-wrap.
- Expanded information on installing windows, including a thoroughly revised accompanying step-by-step *Procedure* demonstration.
- New on-the-job photos along with photo-realistic full-color illustrations enhance how-to explanations concerning the operations of tools and equipment, tasks, and step-by-step procedures.
- Thoroughly revised end-of-chapter photos depicting various jobsite activities and thought-provoking questions and comments surrounding the activity promote on-the-job critical thinking skills.

FEATURES

This innovative series was designed with input from educators and industry professionals and informed by the curriculum and training objectives established by the standards committee. The following features aid learning:

LEARNING FEATURES

such as the **Objectives**, **Glossary** and **Introduction** set the stage and help learners identify key concepts and information. These learning features serve as a road map for the chapter. Learners also may use them as an on-the-job reference.



ACTIVE LEARNING is a core concept of the Residential Construction Academy Series. Information is heavily illustrated to provide a visual of new tools and tasks encountered by learners. Chapters also contain a **Procedures** section that applies the information so that learning is accomplished through doing. In the **Procedures**, various tasks in home construction are grouped in a step-by-step approach. The overall effect is a clear view of the task, making learning easier.

SAFETY is emphasized throughout the text to instill safety as an attitude among learners. Safe job site practices by all workers are essential; if one person acts in an unsafe manner, all workers on the job are at risk for injury. Learners will come to appreciate that safety is a blend of ability, skill, and knowledge that should be continuously applied to all they do in the construction industry.

CAUTION features highlight safety issues and urgent safety reminders for the trade.

- CAUTION**
- General Safety Rules
- Be trained and competent in the use of stationary power tools before attempting to operate them without supervision.
 - Make sure power is disconnected when touching the cutters.
 - Make sure saw blades are sharp and suitable for the operation. Ensure that safety guards are in place and that all guides are in proper alignment and secured.
 - Wear eye protection and appropriate, properly fitted clothing at all times.
 - Keep the work area clear of scrap that might present a tripping hazard.
 - Keep stock clear of saw blades before starting a machine.
 - Do not allow your attention to be distracted while operating power tools. Watch the cutting operation closely.
 - Turn off the power and make sure a machine has stopped before leaving the area.
- Additional safety precautions that apply to specific operations are given when those operations are described.

TABLE SAWS

The size of the table saw (Fig. 3-1) is determined by the diameter of the saw blade. It may measure up to 16 inches. A commonly used table saw on



FIGURE 3-1 The 10-inch contractor's saw is frequently used on the job site.

the construction site is the 10-inch model. The blade is adjusted for depth of cut and tilted up to 45 degrees by means of hand wheels. Blades are secured to the machine with an arbor nut. To remove the blade, first unplug the saw. Then while holding the arbor with a wrench, rotate the nut in the same direction the blade rotates when cutting.

A rip fence is used to guide material while ripping it to size. A miter gauge is not used in the same operation. This is unsafe because the smaller cut off piece could bind in saw and fly out toward the operator with great force.

A guard should always be placed on the blade to protect the operator. Exceptions to this include some table saw operations, such as dados, rabbets, and cuts, in which the blade does not penetrate the entire stock thickness. A general rule is that if the guard stock thickness. A general rule is that if the guard should be used. Therefore, good habits are important to make and keep. Never reach over the blade.

- CAUTION**
- Stand to either side of the blade. Never stand directly in back of the saw blade. Make sure no one else is in line with the saw blade in case of kickback. Be prepared to turn the saw blade off at any back. A splitter and anti-kickback device should be used when the cutting operation allows it.

Ripping Operations

To rip stock to width, follow a safe and established procedure:

- Wear eye and ear protection.
- Measure from the rip fence to the point of a saw tooth set closest to the fence. Lock the fence in place. Check and adjust the rip fence measuring scale, if necessary.
- Adjust the height of the blade to about 1/4 inch above the stock to be cut. Some manufacturers recommend setting the blade at full height inside the blade guard to allow the blade to run cooler and cut more easily.
- With the stock clear of the blade, turn on the power.
- Hold the stock against the fence with the left hand. Push the stock forward with the right hand, holding the end of the stock (Fig. 3-2).

REVIEW QUESTIONS

Select the most appropriate answer.

1. To use a power tool properly, the operator should always:
a. wear eye protection.
b. wear ear protection.
c. understand the manufacturer's recommended instructions.
d. all of the above.
2. Tools with dull cutters:
a. put less stress on the operator than sharp tools.
b. cut faster than sharp tools.
c. are more dangerous to use than sharper tools.
d. all of the above.
3. The table saw arbor nut that holds a circular saw blade in position is loosened by rotating the nut:
a. clockwise.
b. with the rotation of the blade.
c. counterclockwise.
d. against the rotation of the blade.
4. The features of a table saw that should not be used at the same time are:
a. rip fence and push stick.
b. miter gauge and rip fence.
c. push stick and miter gauge.
d. miter gauge and a dado head.
5. The table saw feature used to make large grooves in material is:
a. dado head.
b. miter gauge.
c. rip fence.
d. rabbit head.
6. The table saw guide used for cutting with the grain is called a:
a. rip fence.
b. miter gauge.
c. biting arbor.
d. ripping jig.
7. The table saw tool that should not be used at the same time as a rip fence is a:
a. blade guard.
b. push stick.
c. dado head.
d. miter gauge.
8. The tool suited to rip a board into thinner pieces with a small kerf is the:
a. miter saw.
b. table saw.
c. jointer.
d. band saw.

REVIEW QUESTIONS complete each chapter. These are designed to reinforce the information learned in the chapter and to review what was accomplished.

FROM EXPERIENCE offers tricks of the trade and practical advice that make a particular task a little easier for the novice to accomplish.

from experience...

Blunting or cutting off the point of the nail also helps prevent splitting the wood (Fig. 1-40). When nailing along the length of a piece, stagger the nails from edge to edge, rather than in a straight line. This helps prevent splitting the board and provides greater strength (Fig. 1-41). Drive nails at an angle for greater holding power. Additionally, this will help prevent the points of long nails from protruding the backside of thinner material (Fig. 1-42).

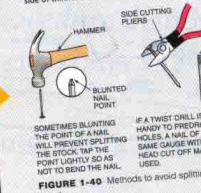


FIGURE 1-40 Methods to avoid splitting wood.



FIGURE 1-41 Stagger nails for greater strength and to avoid splitting the stock.

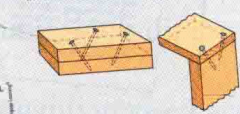


FIGURE 1-42 Driving nails at an angle increases holding power.

hail the nail length at an angle less than 45 degrees. Then bend the nail to more than 45 degrees, closer to 60 degrees, and drive the nail (Fig. 1-43). If appearance is important, drive nails almost home and then use a nail set to finish the nail. This will prevent hammer marks on the surface.

Screwdrivers

Screwdrivers are manufactured to fit all types of screw heads. The slotted screwdriver has a straight tip to drive common screws, and the Phillips screwdriver has a cross-shaped tip (Fig. 1-44). Other screwdrivers include the Robertson screwdriver, which has a squared tip. Slotted screwdrivers are

sized by the length of the blade and by the head type. Lengths generally run from 3 to 12 inches. Screwdrivers should fit snugly, without play, into the slot of the screw being driven (Fig. 1-45). The correct size screwdriver helps ensure that the screw will be driven without slipping out of the slot.

Screwdriver bits (Fig. 1-46) are available in many shapes and sizes to accommodate a variety of screws. They are designed to drive a screw using a drill or screw gun.

SCREWDRIVING TECHNIQUES

If possible, select screws so that two-thirds of their length penetrates the piece in which they are gripping. In hardwoods, a pilot hole is needed to

BUILDING PLANS

An architect designs buildings and creates drawings to reflect those designs. These drawings use various kinds of lines, dimensions, notes, symbols, and abbreviations to describe a structure to be built. The method of drawing, lettering, and dimensioning may vary slightly with the drafter's style. Different kinds of drawings are required for the construction of a building. These are called plans, elevations, sections, and details. When put together, they constitute a set of prints.

Today most architectural plans, also called architectural drawings or construction drawings, are done using a CADD (computer-aided drafting and design) program. CADD drawings are produced faster and more easily than drawings done by hand. Changes to the plan can be made faster, allowing them to be easily customized to the desires of the customer. Once the plans are finished, they are sent to a plotter or copier, which prints as many copies as needed.

Prints are drawn using symbols and a standardized language. To adequately read and interpret these prints, the builder must be able to understand the language of architectural plans. Although this is not necessarily difficult, it can be confusing.

TYPES OF VIEWS

The architect can choose from any of several types of views to describe a building with clarity, and often multiple views are prepared. Because many people and many different trades are needed to build a house, different views are required that contain different information.

Pictorial View

Pictorial drawings are usually three-dimensional (3D) perspective or isometric views (Fig. 7-1). The lines in a perspective view diminish in size as they converge toward vanishing points located on a line called the horizon. In an isometric drawing, the horizontal lines are drawn at 30-degree angles. All lines are drawn to actual scale. They do not diminish or converge as in perspective drawings.

A presentation drawing is usually a perspective view. It shows the building from a desirable vantage point to display its most interesting features (Fig. 7-2). Walks, streets, shrubs, trees, vehicles, and even people may be drawn. Presentation drawings are often colored for greater eye appeal.



FIGURE 7-1 A perspective drawing.



FIGURE 7-2 A presentation drawing.

Presentation drawing for construction project as a marketing tool for completed building.

Multiview Drawings

Different kinds of orthographic drawings, are of a building. Multiview drawings (Fig. 7-3). They show the building from different angles.

GREEN CHECKLIST

- ☐ Some areas of the United States recycle concrete. Concrete is broken into sizes of large aggregate and used in new concrete, replacing crushed stone.
- ☐ Vapor retarders under concrete footings and slabs reduce moisture in a building. This saves energy because moisture increases heating and cooling costs.
- ☐ Plan ahead to reduce waste of leftover concrete. Leftover concrete can be placed in pre-made forms for small paths, patio blocks, and splash blocks, or used as backfill for various posts.
- ☐ Masonry can store solar energy when installed in areas of direct sunlight. This helps balance the daily high and low room temperatures.

GREEN TIPS and **GREEN CHECKLISTS** highlight tips and topics on new environmentally friendly and sustainable construction methods.

KNOW YOUR CODES is an application-based feature that prompts students to research their local and regional codes, providing excellent practice for a critical on-the-job skill.

19. The beveled edge of a swinging door
- allows the door to swing without touching the jamb
 - is the edge where the lockset is installed
 - is $\frac{1}{4}$ to $\frac{1}{2}$ inch back beveled along width
 - all of the above

20. The decorative plate used to cover the edges of a bored hole in a door is called a
- astragal
 - dead bolt
 - escutcheon
 - all of the above

KNOW YOUR CODES

Some regions of the country require window installation to be inspected. This is because heavy wind forces from hurricanes can blow poorly installed windows out of the opening. Be sure to check with the local officials for the inspection schedule.

CONSIDER & COMPARE

Carefully study Figures 17-39 and 17-40 and think about what is wrong and what is right. Consider all possibilities.



FIGURE 17-39 Workers are installing drywall that is 16 feet long. Sheet is at a steep angle and looks improper, but it was done to make it fit into a cut provided for the post.



FIGURE 17-40 This photo is of the same drywall piece being installed as in figure 17-39. It is now obvious why such a steep angle was necessary. This size and cut of drywall is a challenge to install that is solved by using teamwork.

CONSIDER & COMPARE feature illustrates and describes various practices being demonstrated on actual jobsites, leaving it up to the learner to evaluate the situation and determine if the practices are smart and safe—or not. This feature is an excellent tool to reinforce the lessons learned in the chapter and promote critical thinking skills.

TURNKEY CURRICULUM AND TEACHING MATERIAL PACKAGE

We understand that a text is only one part of a complete, turnkey educational system. We also understand that instructors want to spend their time on teaching, not preparing to teach. The *Residential Construction Academy Series* is committed to providing thorough curriculum and preparatory materials to aid instructors and alleviate some of their heavy preparation commitments. An integrated teaching solution is ensured with the text, instructor resources, print Instructor's Resource Guide, Workbook, CourseMate, and student DVDs.

Instructor Resources

Cengage Learning's Instructor Resources is a complete guide to classroom management. The **Instructor Resources CD-ROM** contains the Instructor's Resource Guide, PowerPoint® presentations, ExamView Computerized Test Bank, an Image Gallery, and a Correlation to the Carpentry National Skill Standards. Designed as a complete and integrated package, the Instructor Resources also provides suggestions for when and how to use the package components. A printed **Instructor's Resource Guide** is also available.

Companion Site

The companion site to accompany *Residential Construction Academy: Carpentry* is new for this edition. It offers a FREE and secure online option for accessing the resources found on the Instructor Resources CD-ROM, including the Instructor Resource Guide, PowerPoint® Presentations, Computerized Testbanks, Image Gallery, and Carpentry National Skill Standards Correlation.

For these instructor-specific resources, please visit CengageBrain.com at <http://login.cengage.com> and follow the prompts for obtaining access to this secure site.

DVDs

The *RCA: Carpentry DVD* series steps viewers through the process of constructing a home and contains a set of eight 20-minute videos that cover everything from the basics of obtaining the building permit to the detail work of interior trim. Special geographic considerations are addressed to more accurately reflect building practices throughout the United States. In addition, the videos offer such features as Carpenter's Tips and Safety Tips full of practical advice from the experts.

The complete set includes: Video #1–Building Layout; Video #2–Form & Concrete Placement; Video #3–Sub-Flooring & Wood-Bearing Walls; Video #4–Truss Installation; Video #5–Window & Door Installation; Video #6–Interior Trim; Video #7–Interior Partition Framing; Video #8–Stair Construction.

Workbook

Thoroughly revised and expanded for the new edition, this workbook provides additional review questions, problems, and activities designed to challenge and reinforce the student's comprehension of the content presented in the core text.

CourseMate

An online tool, this course is designed for students and combines the *Residential Construction Academy: Carpentry, Fourth Edition* ebook with additional features to enhance learning for the student. It includes the PowerPoint® presentations, additional quizzing, glossary, interactive games and activities, video clips, and other helpful resources related to the lessons in the book. Also featured is an Engagement Tracker that allows instructors to monitor time on task for each individual student.

About the Author

The author of this text, Floyd Vogt, is a sixth-generation carpenter/contractor. He was raised in a family with a small business devoted to all phases of home construction and began working in the family business at age 15.

After completing a B.A. in chemistry from the State University of New York College at Oneonta, Mr. Vogt returned to the field as a self-employed remodeler. In 1985, he began teaching at State University of New York at Delhi, New York, www.delhi.edu. He has taught many courses, including Light Framing, Advanced Framing, Math, Energy Efficient Construction, Finish Carpentry, Finish Masonry, and Estimating. He is currently a professor in the Construction Management, Design and Build Bachelors degree program at Delhi. Course responsibilities include Residential Construction, Auto CAD, Construction Seminar, Physical Science Applications and Building Science. He has served as a carpentry regional coordinator for Skills-USA and postsecondary Skills-USA student advisor.

Compliance with Apprenticeship, Training, Employer, and Labor Services (ATELS)

These materials are in full compliance with the Apprenticeship, Training, Employer, and Labor Services (ATELS) requirements for classroom training.

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Carpentry National Skill Standards

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INTRODUCTION

Organization of the Industry

The residential construction industry is one of the biggest sectors of the American economy. According to the U.S. Department of Labor, construction is one of the nation's largest industries, employing 6 million workers nationwide. About 62 percent of wage and salary jobs in construction were in the specialty trade contractors sector, primarily plumbing, heating and air-conditioning, electrical, and masonry. The National Association of Home Builders (NAHB) reports that home building traditionally accounts for 50–55 percent of the construction industry. Opportunities are available for people to work at all levels in the construction industry, from those who handle the tools and materials on the job site to the senior engineers and architects who spend most of their time in offices. Few people spend their entire lives in a single occupation, and even fewer spend their lives working for one employer. You should be aware of all the opportunities in the construction industry so that you can make career decisions in the future, even if you are sure of what you want to do at this time.

Construction Personnel

The occupations in the construction industry can be divided into four categories:

- Unskilled or semiskilled labor
- Skilled trades or crafts
- Technicians
- Design and management

Unskilled or Semiskilled Labor

Construction is labor intensive. That means it requires a lot of labor to produce the same dollar value of end products by comparison with other industries, where labor may be a smaller part of the picture. Some construction laborers are construction workers who have not reached a high level of skill in a particular trade and are not registered in an apprenticeship program. Other laborers may also be skilled construction workers opting to work in a role with reduced responsibility and increased simplicity. Laborers are sometimes assigned the tasks of moving materials, running errands, and working under the close supervision of a skilled worker. Their work keeps them in excellent physical condition.

Some laborers specialize in working with a particular trade, such as mason's tenders or carpenter's helpers (Fig. I-1). The mason's tender knows how to mix mortar for particular conditions, can erect scaffolding, and is familiar with the bricklayer's tools. Many laborers go on to acquire skills and become skilled workers. Laborers who specialize in a particular trade are often paid slightly more than completely unskilled laborers.