career CONNECTIONS

Sampler

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Career Connections: One Trade, Many Careers *Employability Skills Introductory Text*

Career Connections: Project Book 1 *for Beginning Carpentry Students*

Career Connections: Project Book 2 *for Intermediate Carpentry Students*

Career Connections: Project Book 3: Commercial Construction *for Advanced Carpentry Students*

Career Connections: Project Book 3: Residential Construction *for Advanced Carpentry Students*

Career Connections: Math for the Trades *for all students taking construction technology or other trade-related courses*

Teacher Annotated Editions *accompany each book*

Created by Today's Professional Carpenters for Tomorrow's Professional Carpenters

CARPENTERS INTERNATIONAL TRAINING FUND

Published by the Carpenters International Training Fund (CITF), the training arm of the United Brotherhood of Carpenters

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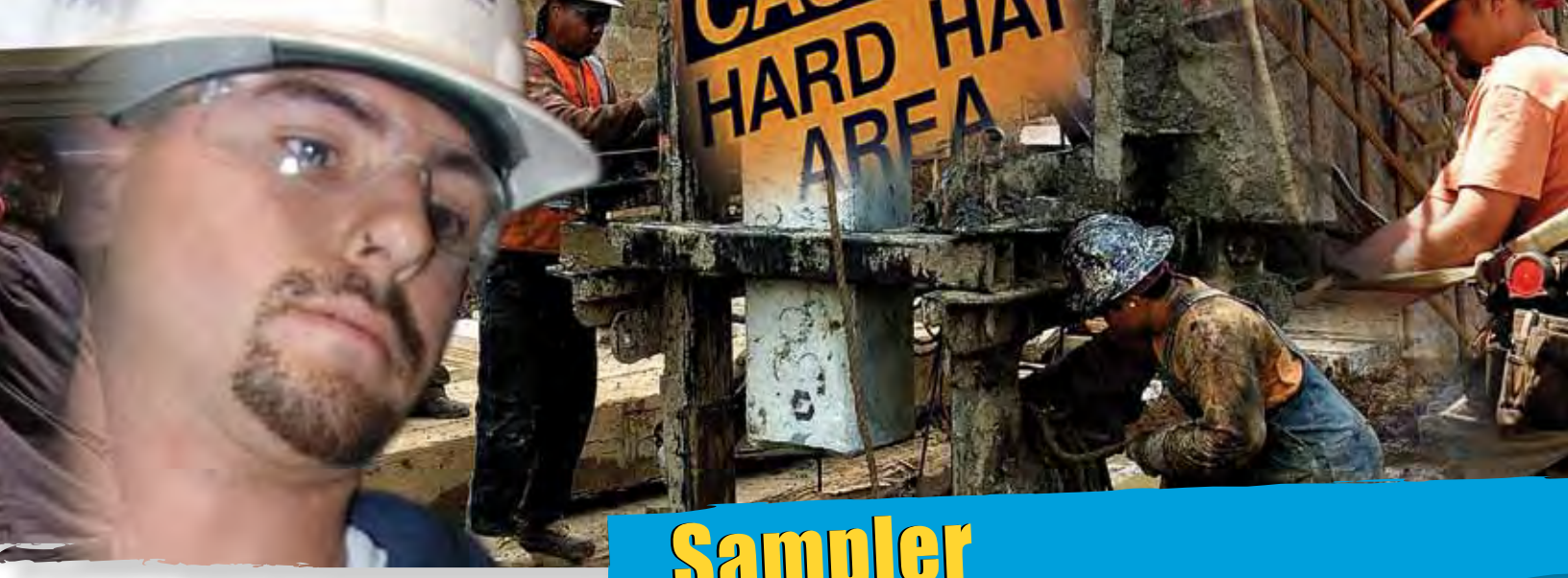
Send all inquiries to:
Carpenters International Training Fund
6801 Placid Street, Las Vegas, Nevada 89119
www.carpenters.org



Sampler

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COMPONENTS OF THE PROGRAM

Career Connections Program

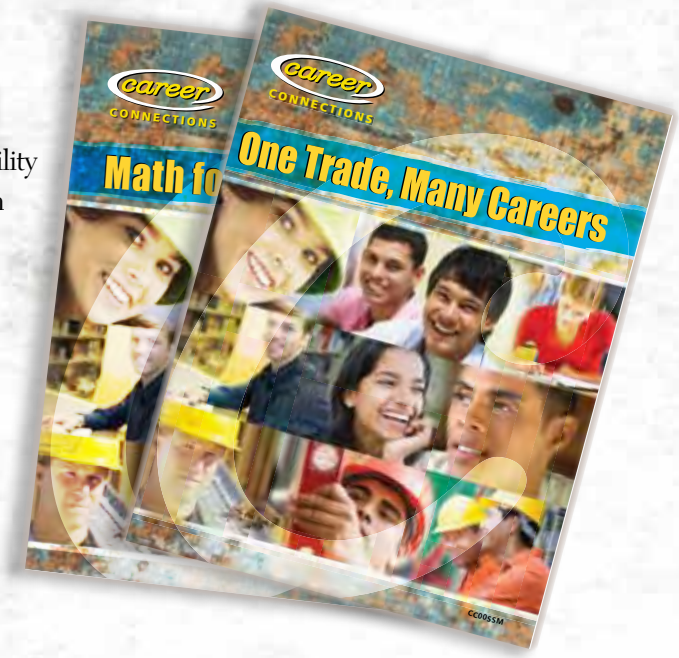
Resource CDs contain *Lesson Plans* for all books; end-of-chapter tests and answers; *Project Evaluations* and *Grading Rubrics; Safety and Operation Checklists* for tools and equipment; *Drawings* for all projects; *Instructions* for building props, jigs, and templates; relevant sections of CITF manuals: *Math for the Trades* with exercises and answers, *Ergonomics,* and *Safety Data Sheets.*

Career Connections: One Trade, Many Careers

presents self-evaluation; goal setting; career investigations; employability skills; specific career information on carpentry and other construction trades; descriptions and illustrations of workers at their jobs.

Career Connections: Math for the Trades

relates all basic math skills to real life work scenarios. Includes area and volume measures.



Teacher Annotated Edition

Career Connections: One Trade, Many Careers provides *Lesson Plans* with suggestions for time frames required for teaching each chapter; *Discussion Guide* for the video, *One Trade, Many Careers;* skills matrixes for the projects; end-of-chapter tests with answers; page-by-page teacher notes throughout with teaching tips and suggestions for using additional resources.

Instructor Guide

Career Connections: Math for the Trades provides tips for teaching throughout; Lesson Plans; additional math practice; all answers

One Trade, Many Crafts DVD

contains 10-minute video showing professionals at work in the construction industry.

The Virtual Shop DVD

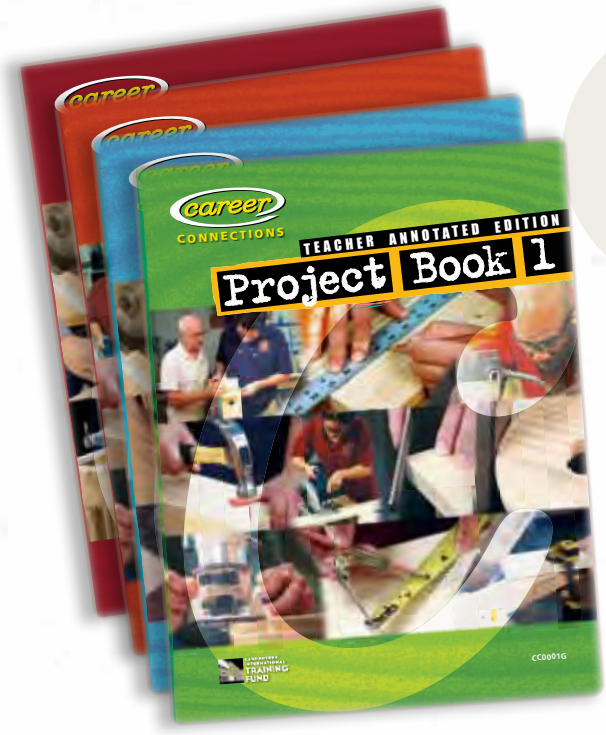
contains step-by-step animations of all projects in Project Book 1 and Project Book 2.

Career Connections ExamView® Assessment Question Bank

contains questions covering content in all books in the program.

Project Books

Career Connections: Project Book 1, Project Book 2, Project Book 3: Commercial Construction, Project Book 3: Residential Construction present information on shop safety including personal protective equipment and safe practices; detailed descriptions of tools to be used with student checkouts on the safe and proper operation of each tool; explanations of materials and fasteners to be used; lists of expectations students must meet for satisfactory performance; highly illustrated step-by-step procedures to be followed in building projects. *Project Book 1* contains projects to develop basic skills. *Project Book 2* contains projects to develop intermediate skills. *Project Books 3* develop advanced carpentry skills.



Teacher Annotated Edition Project Books

Career Connections: Project Book 1, Project Book 2, Project Book 3: Commercial Construction, Project Book 3: Residential Construction provide explanations of how to use *Grading Rubrics, Evaluation* documents, and *Safety and Operation Checklists;* suggestions for time frames for teaching; notes on each project to be built; *Skills Matrixes; Lesson Plans* for each chapter; *How to Set Up the Shop; Reusing Materials; Using the UBC as a Resource; Ordering Information;* and page-by-page teacher notes throughout with teaching tips and suggestions for using additional resources.

Career Connections

The Purpose of the Program

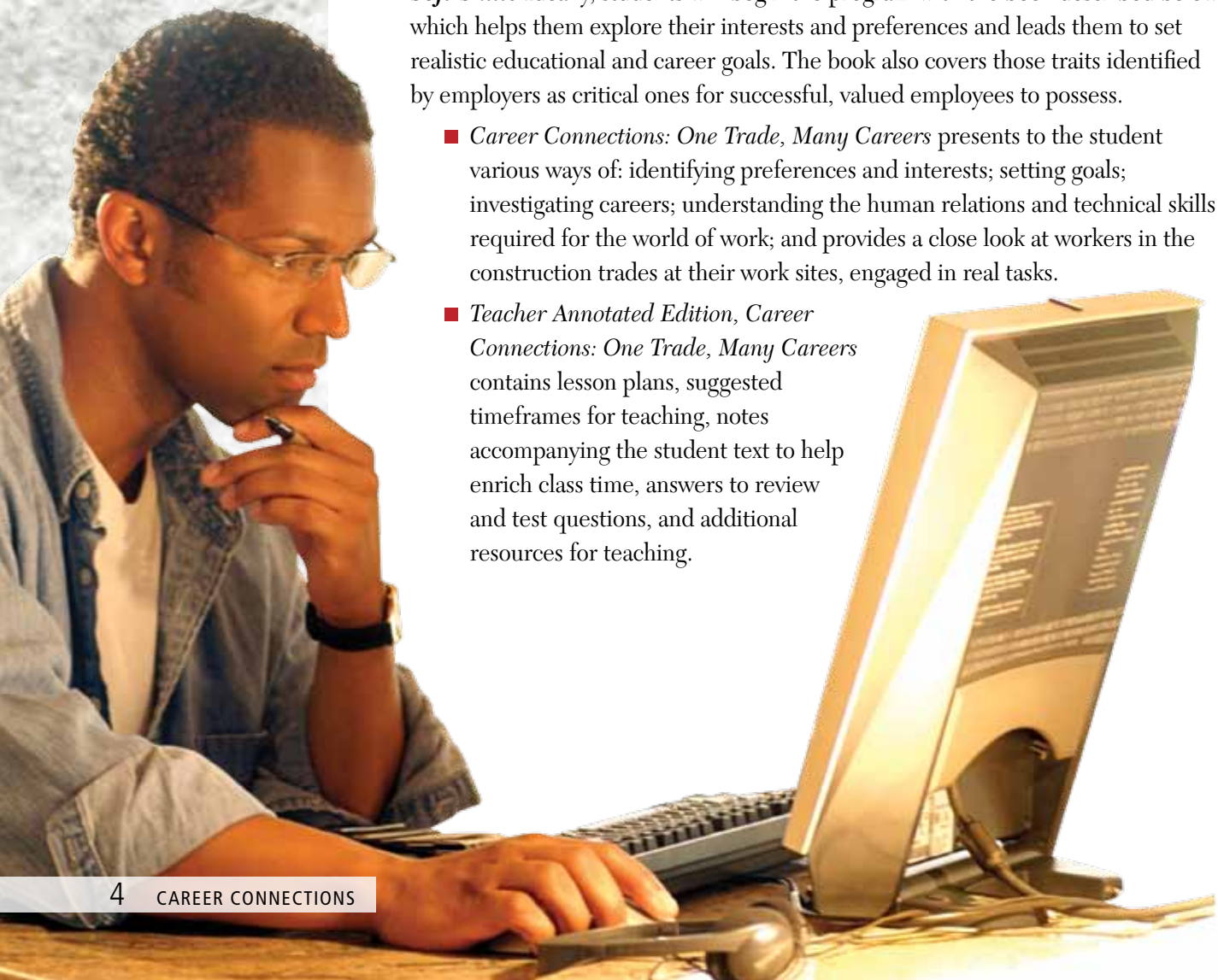
Career Connections has been published specifically for high school students to introduce them to the craft and trade of Carpentry. The program presents not only skill-based project books for students in the 9th through 12th grades but also a book that serves as a framework for deciding on a career.

The Carpenters International Training Fund (CITF), a division of the United Brotherhood of Carpenters, has developed this program to provide young people with the knowledge and skills needed to choose wisely and to prepare for advanced training in a registered apprenticeship program. The subject matter experts who created this program are all practicing carpenters with extensive field and teaching experience.

Components of the Program

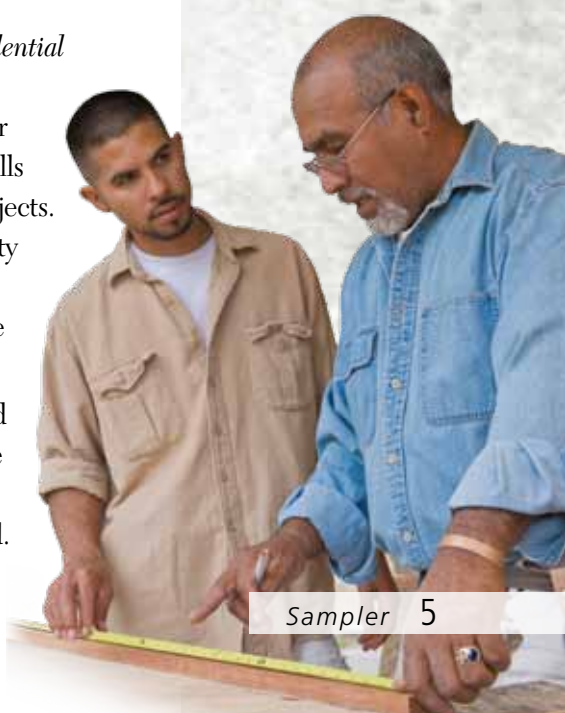
Soft Skills Ideally, students will begin the program with the book described below which helps them explore their interests and preferences and leads them to set realistic educational and career goals. The book also covers those traits identified by employers as critical ones for successful, valued employees to possess.

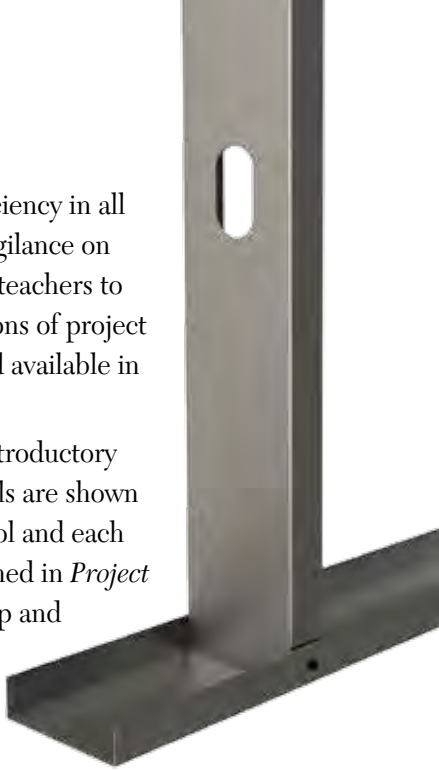
- *Career Connections: One Trade, Many Careers* presents to the student various ways of: identifying preferences and interests; setting goals; investigating careers; understanding the human relations and technical skills required for the world of work; and provides a close look at workers in the construction trades at their work sites, engaged in real tasks.
- *Teacher Annotated Edition, Career Connections: One Trade, Many Careers* contains lesson plans, suggested timeframes for teaching, notes accompanying the student text to help enrich class time, answers to review and test questions, and additional resources for teaching.



Shop Projects There are three project books, beginning with basic information and simple projects, building to project-related information and projects of intermediate difficulty, and completing with projects that challenge students to use all the knowledge and skills they have learned in the two previous books.

- *Career Connections: Project Book 1* contains chapters on safety, tools, and materials. Detailed information on safety, tools and materials required, and step-by-step procedures are presented for each project. Smaller lead-up exercises precede each shop project for the practice of specific skills.
- *Career Connections: Project Book 2* contains chapters on safety, tools, and materials for projects at an intermediate level of difficulty. Detailed information on safety, tools and materials required, and step-by-step procedures are presented for many of the projects. Smaller lead-up exercises precede each shop project, allowing students to practice specific skills related to the project, such as the proper operation of hand tools or the use of measurement devices.
- *Career Connections: Project Book 3: Commercial Construction* and *Career Connections: Project Book 3: Residential Construction* contain chapters on safety, tools, materials, and print reading to get students ready to build projects demanding an advanced level of skill. Each project book deals specifically with the skills necessary in either residential or commercial carpentry. Detailed information on the safety, tools, and materials used for the project in each book is presented, as are detailed step-by-step procedures for each portion of the project. The projects are designed to build upon the student's existing skills. Where new skills are presented, "lead-up" exercises allow students to practice specific skills related to the project.
- *Career Connections: Math for the Trades* covers the basic math skills that workers in the construction industry are most likely to use on the jobsite. The use of addition, subtraction, multiplication, and division for calculations on the jobsite are included. These math tools are then applied to working with fractions, decimals, percentages, layout, and both area and volume measure. Topics, examples, and exercises reflect real-life on the job scenarios.
- *Teacher Annotated Edition, Career Connections, Project Book 1, Project Book 2, Project Book 3: Commercial Construction, Project Book 3: Residential Construction.* Each project book is accompanied by its own Teacher's Annotated Edition (TAE). The TAE provides lesson plans, notes, answer keys to review and test questions, and evaluation and rubric forms. A skills matrix in each TAE identifies beginning, appropriate skill levels and projects. (Samples from Project Books 1 and 3 are included in this sampler.) Safety information is foremost in the presentation of the projects. Students are taught the use of each tool and must demonstrate their ability to operate the tool properly and safely before they begin a project.
- *Instructor Guide, Career Connections: Math for the Trades* is designed to connect math to real-world construction tasks. Worksheets, Practice Sheets, and Job Sheets all use real-world examples. Lesson Plans, Tips for Teaching, Answer Keys, and final Assessment test are also included.



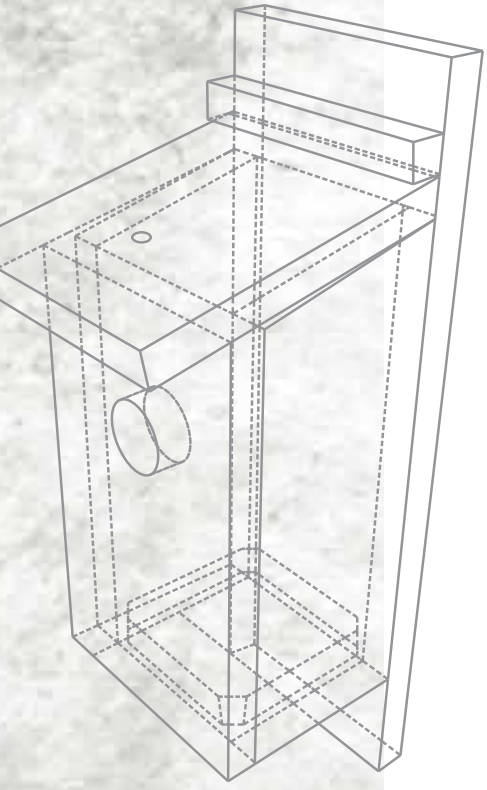


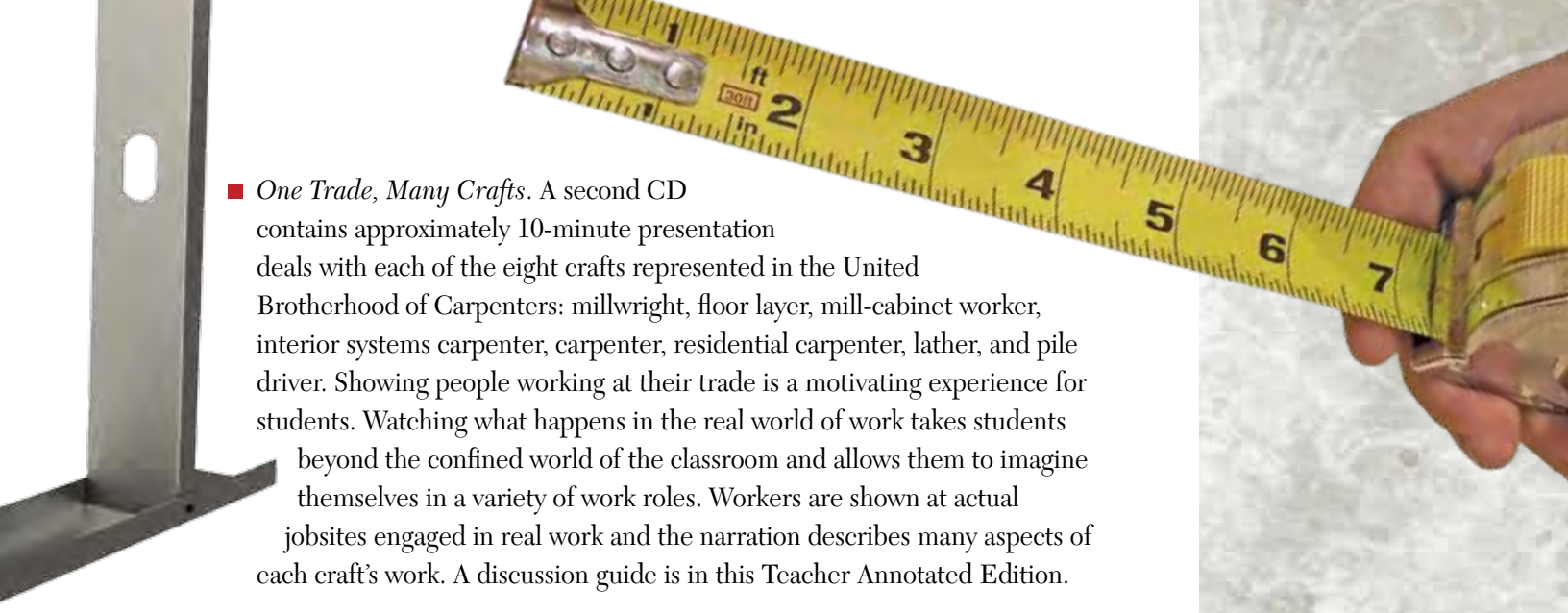
Demonstration Software Ensuring students' safety and efficiency in all aspects of learning carpentry has always involved enormous vigilance on the part of the teacher. A unique set of animation tools allows teachers to present to students information and step-by-step demonstrations of project building. The software, described below, will be published and available in late 2010.

The Virtual Shop. This demonstration software contains introductory modules on personal and shop safety and on tools. The tools are shown in three dimensions; the safety practices related to each tool and each tool's proper use is also shown. Every major project contained in *Project Book 1* and *Project Book 2* is shown being built step-by-step and in three dimensions. This program is an excellent way to prepare students for each shop experience and to give them a sense of confidence about performing their shop tasks well.

Contents of CDs

- *Lesson Plans*. All lesson plans are on the DVD and they may be modified to conform to the format required by your program. Sample lesson plans from *One Trade, Many Careers, Project Book 1,* and *Project Book 3: Commercial Construction* are included in this sampler.
- *Math*. The first five chapters of CITF's *Math for the Trades* training manual are on the DVD for your use: Chapter 1 General Math (basic functions); Chapter 2 Fractions; Chapter 3 Decimals; Chapter 4 Measurement and Measurement Tools; Chapter 5 Layout. The answers to all problems are also included.
- *SDS*. Two chapters of CITF's *Hazard Communication and Chemical Safety* training manual are included on the DVD for your use: Chapter 5 Labels and Other Forms of Warning; Chapter 6 Safety Data Sheets. A sample Safety Data Sheet is provided.
- *Ergonomics*. An excerpt from CITF's *Ergonomics* training manual is included on the DVD providing the ergonomically correct methods of lifting.
- *Project Evaluation* documents for use in grading student performance in building each project is on the DVD. Sample evaluations from *Project Books 1, 2,* and 3 are included in this sampler.
- *Drawings* for all projects in *Project Books 1, 2,* and 3.
- *Grading Rubrics* for each project accompany the *Project Evaluation* on the DVD. A sample grading rubric is included in this sampler.
- *Safety and Operation Checklists* to be used in testing students in the safe and proper use of all tools and equipment is on the DVD. A sample is included in this Teacher Annotated Edition.
- *Procedures for Building Props, Jigs, and Templates*. Some lead-up exercises require props, jigs, or templates to be built by the instructor.





- *One Trade, Many Crafts*. A second CD contains approximately 10-minute presentation deals with each of the eight crafts represented in the United Brotherhood of Carpenters: millwright, floor layer, mill-cabinet worker, interior systems carpenter, carpenter, residential carpenter, lather, and pile driver. Showing people working at their trade is a motivating experience for students. Watching what happens in the real world of work takes students beyond the confined world of the classroom and allows them to imagine themselves in a variety of work roles. Workers are shown at actual jobsites engaged in real work and the narration describes many aspects of each craft's work. A discussion guide is in this Teacher Annotated Edition.

Additional Resources

Throughout this annotated edition, notes recommend contacting and using such resources as the Red Cross, the local fire department, the Occupational Health and Safety Administration (OSHA), manufacturers, and local suppliers and contractors. The United Brotherhood of Carpenters also serves as a local resource through their outreach program for high school and pre-apprenticeship programs.

Program Benefits

The features of the program, presented above, yield a number of benefits to both students and schools:

- The principles and practices of carpentry as written by practicing carpenters ensure that students get the correct information and learn to perform tasks the correct way.
- The program provides students with a welcome opportunity to consider a career that has many jobs for which they will be well paid and will have benefits without having to go the traditional route of a four-year college education.
- Students, whether or not they are interested in carpentry as a career, will develop and become proficient in basic, useful carpentry skills.
- The carpentry program is a relatively inexpensive one for schools to implement. *Career Connections* has been developed requiring only the use of hand or portable power tools, not more expensive stationary equipment such as table saws or drill presses.
- Schools that use *Career Connections* will have the consultative help of a local union carpenter who will be available to provide advice on materials or shop procedures; act as a speaker or arrange for speakers from various sectors of the construction industry; or sponsor field trips to a UBC apprenticeship training center and accept orders for *Career Connections* materials.

What's Inside Career Connections: One Trade, Many Careers *Teacher Annotated Edition*

Teacher annotations in the margins of the text provide teaching tips, activity suggestions, questions to promote understanding and discussion, online resources, and ideas to involve and motivate students.

Career Connections: One Trade Many Careers is organized into three manageable ***parts*** so you can teach personal skills, workplace skills, and construction career options.

Conversation Starter and ***Teaching Tip*** provide ideas on how to introduce topics and stimulate discussion.

The ***Group Learning Activity*** is typically a game designed to stimulate interest and learning through peer interaction as it involves the entire class.

Enrichment Activity expands on topics taught in the chapter and increases learning.

Teacher's Resources lists the components available to you for teaching the course.

Student Resources lists what students should have access to for completing the course.

What You Now Know and ***What You Will Know*** point out what students bring to the chapter and what new material they'll learn.

Vocabulary Preview lists in alphabetical order the vocabulary terms discussed in the chapter. Vocabulary terms appear in bold where the term is first defined. These terms are also defined at the end of the chapter and in the glossary at the back of the book.

Each chapter is divided into ***Sections*** that focus on specific topics.

Features in each chapter provide real world examples, information, and ideas that students can relate to. ***Framing Your Future*** provides students with useful career tips. ***Building a Better You*** tells students how they can be more valuable in the workplace. ***How I See Myself*** gives students food for thought about their career potential. ***Shout Out*** profiles people in construction. ***Nailing It*** describes mastering certain skills.

Lesson Plan summarizes the main objectives of the lesson, as listed in the lesson plan provided for the chapter.

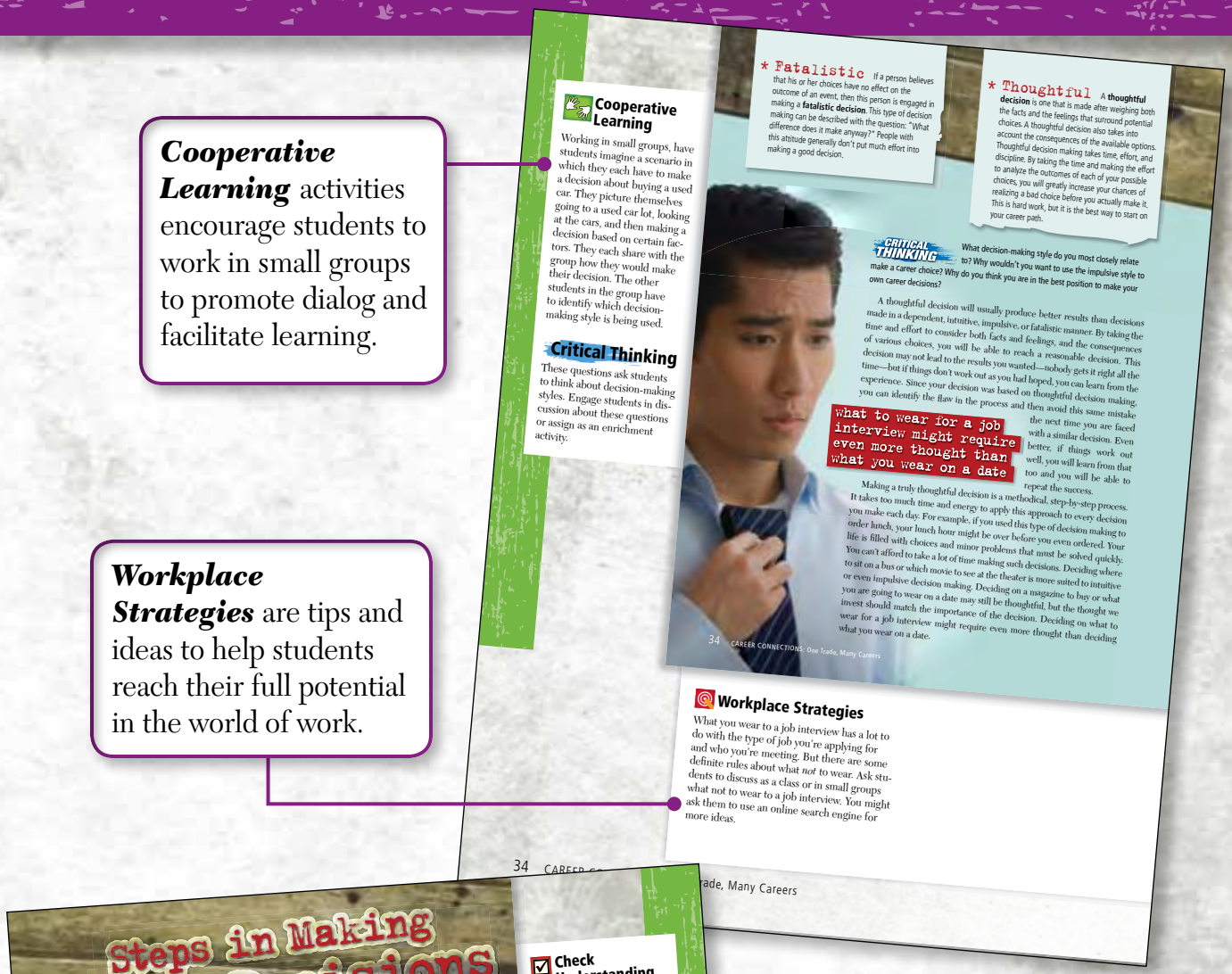
Critical Thinking questions challenge students to apply what they've read to their own lives.

Each ***Reinforcement Activity*** helps students solidify understanding of lesson topics.

Cooperative Learning activities encourage students to work in small groups to promote dialog and facilitate learning.

Workplace Strategies are tips and ideas to help students reach their full potential in the world of work.

Use the ***Check Understanding*** notes throughout the chapter to review and test student comprehension of key points.



Cooperative Learning

Working in small groups, have students imagine a scenario in which they each have to make a decision about buying a used car. They picture themselves going to a used car lot, looking at the cars, and then making a decision based on certain factors. They each share with the group how they would make their decision. The other students in the group have to identify which decision-making style is being used.

Critical Thinking

These questions ask students to think about decision-making styles. Engage students in discussion about these questions or assign as an enrichment activity.

* **Fatalistic** If a person believes that his or her choices have no effect on the outcome of an event, then this person is engaged in making a **fatalistic decision**. This type of decision making can be described with the question: "What difference does it make anyway?" People with this attitude generally don't put much effort into making a good decision.

* **Thoughtful** A **thoughtful decision** is one that is made after weighing both the facts and the feelings that surround potential choices. A thoughtful decision also takes into account the consequences of the available options. Thoughtful decision making takes time, effort, and discipline. By taking the time and making the effort to analyze the outcomes of each of your possible choices, you will greatly increase your chances of realizing a bad choice before you actually make it. This is hard work, but it is the best way to start on your career path.

CRITICAL THINKING What decision-making style do you most closely relate to? Why wouldn't you want to use the impulsive style to make a career choice? Why do you think you are in the best position to make your own career decisions?

A thoughtful decision will usually produce better results than decisions made in a dependent, intuitive, impulsive, or fatalistic manner. By taking the time and effort to consider both facts and feelings, and the consequences of various choices, you will be able to reach a reasonable decision. This decision may not lead to the results you wanted—nobody gets it right all the time—but if things don't work out as you had hoped, you can learn from the experience. Since your decision was based on thoughtful decision making, you can identify the flaw in the process and then avoid this same mistake the next time you are faced with a similar decision. Even better, if things work out well, you will learn from that too and you will be able to repeat the success.

What to wear for a job interview might require even more thought than what you wear on a date

Making a truly thoughtful decision is a methodical, step-by-step process. It takes too much time and energy to apply this approach to every decision you make each day. For example, if you used this type of decision making to order lunch, your lunch hour might be over before you even ordered. Your life is filled with choices and minor problems that must be solved quickly. You can't afford to take a lot of time making such decisions. Deciding where to sit on a bus or which movie to see at the theater is more suited to intuitive or even impulsive decision making. Deciding on a magazine to buy or what you are going to wear on a date may still be thoughtful, but the thought we invest should match the importance of the decision. Deciding on what to wear for a job interview might require even more thought than deciding what you wear on a date.

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Workplace Strategies

What you wear to a job interview has a lot to do with the type of job you're applying for and who you're meeting. But there are some definite rules about what *not* to wear. Ask students to discuss as a class or in small groups what not to wear to a job interview. You might ask them to use an online search engine for more ideas.

34 CAREER [illegible]

[illegible]rade, Many Careers

Steps in Making Good Decisions

When making really important decisions, such as what career path you will follow, you should always apply a thoughtful decision-making process and invest plenty of time in that process. After all, you could be living with the consequences of this decision for a long time. The thoughtful decision-making process consists of the following seven steps.

1. **Accept Responsibility for the Decision** Sometimes making decisions can make us uncomfortable. Decisions often close the door on one opportunity even as they open the door on another, and this can be painful. You may wish to avoid making a painful decision or to put it off as long as possible, but you shouldn't. Once you recognize that a decision should be made, take responsibility for making the decision. In this way, you are taking responsibility for your own life. Also realize that by taking this responsibility, you are also accepting responsibility for the consequences of that decision.
2. **Identify the Problem** Think of a decision as a problem to solve. You can even think of an upcoming career choice as a problem that needs a solution. The problem is picking an appropriate career that you will be happy with. A good decision will provide an acceptable solution to the problem. A poor decision may delay the solution to the problem or even make it a more difficult problem. To solve any problem well, it is important to understand as much about the problem or situation as possible. It may be helpful to write out the problem and then list as many possible solutions you can think of.

CHAPTER 2 *What's in My Toolbox?* 35

Check Understanding

Ask students to brainstorm examples of decisions that require the time needed for thoughtful decision making. In contrast, ask them for examples of decisions that can be made using intuitive decision making.

Conversation Starter

Ask students to respond to this statement: "In any moment of decision the best thing you can do is the right thing, the next best thing is the wrong thing, and the worst thing you can do is nothing."

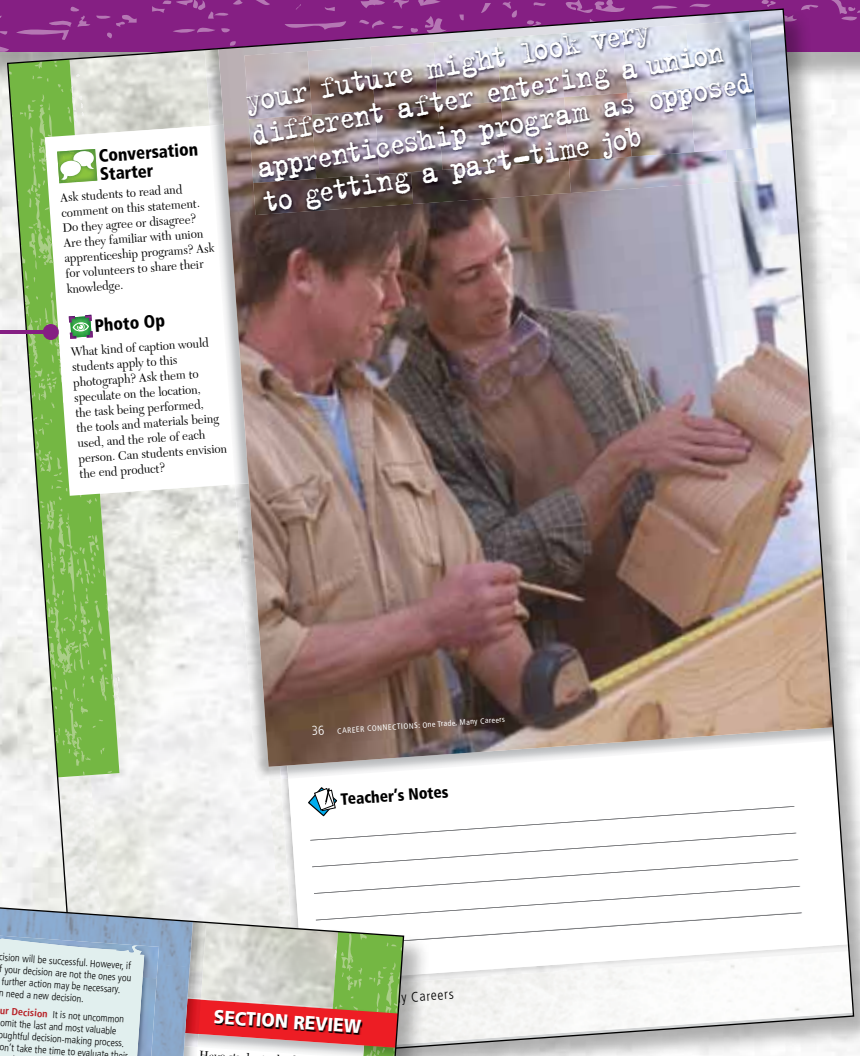
Reinforcement Activity

Point out that in everyday life, we each make a series of decisions using a step-by-step process. Getting dressed in the morning involves a specific set of steps, done in a specific order. Ask students why they think making a career decision is likely to be more successful if they follow a specific step-by-step process.

Teacher's Notes

Chapter 2 *What's in My Toolbox?* 35

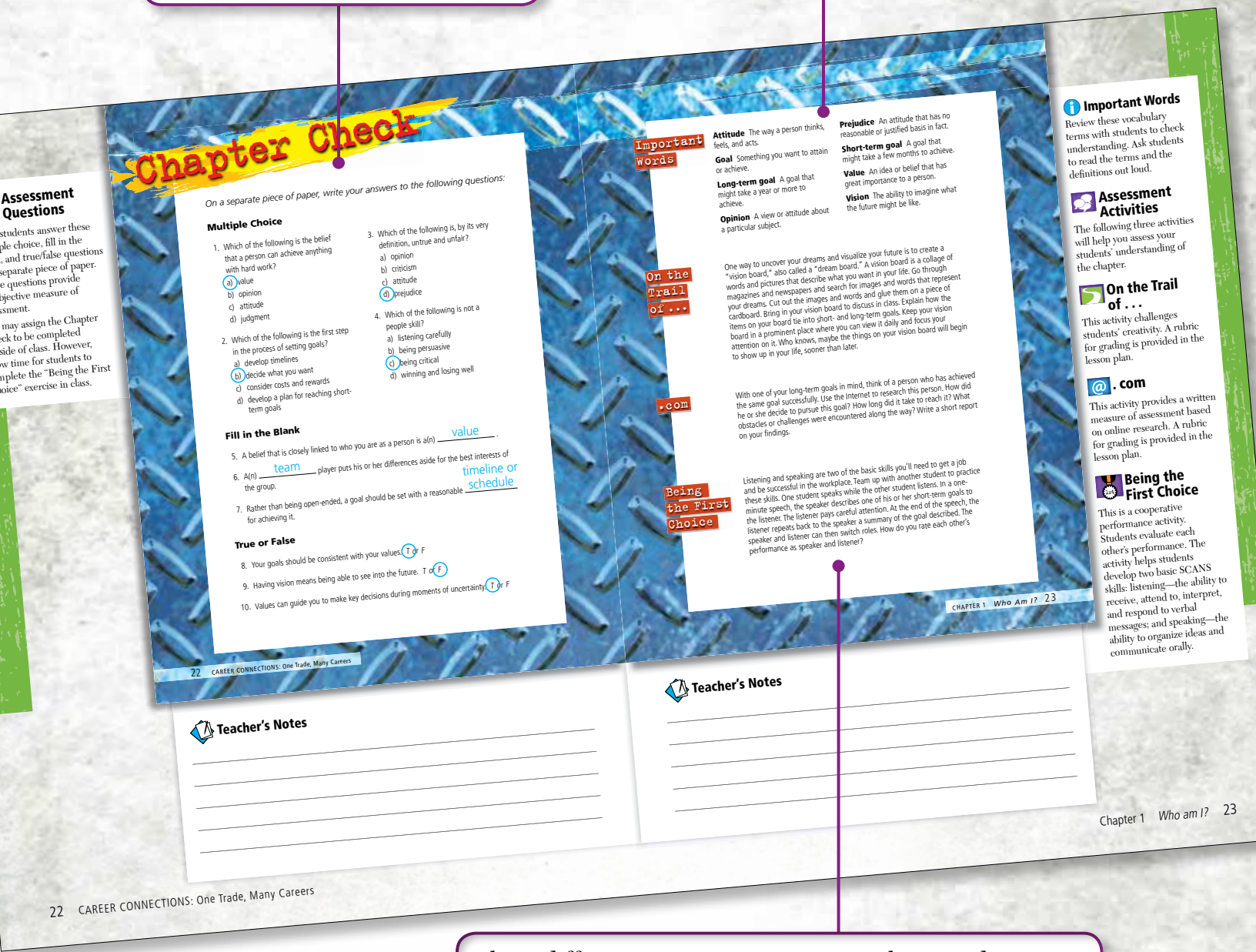
Use ***Photo Op*** notes to draw students' attention to the images in the book and stimulate conversation.



Section Review appears at the end of each section. ***Chapter Review*** appears at the end of the chapter. Use these notes to summarize content and check understanding.

Chapter Check provides assessment questions that require students to review the chapter for the correct answers.

Important Words are the vocabulary terms introduced in the chapter and redefined here.



Chapter Check

On a separate piece of paper, write your answers to the following questions:

Multiple Choice

1. Which of the following is the belief that a person can achieve anything with hard work?
   a) value
   b) opinion
   c) attitude
   d) judgment
2. Which of the following is the first step in the process of setting goals?
   a) develop timelines
   b) decide what you want
   c) consider costs and rewards
   d) develop a plan for reaching short-term goals
3. Which of the following is, by its very definition, untrue and unfair?
   a) opinion
   b) criticism
   c) attitude
   d) prejudice
4. Which of the following is not a people skill?
   a) listening carefully
   b) being persuasive
   c) being critical
   d) winning and losing well

Fill in the Blank

5. A belief that is closely linked to who you are as a person is a(n) value.
6. A(n) team player puts his or her differences aside for the best interests of the group.
7. Rather than being open-ended, a goal should be set with a reasonable timeline or schedule for achieving it.

True or False

8. Your goals should be consistent with your values. T or F
9. Having vision means being able to see into the future. T or F
10. Values can guide you to make key decisions during moments of uncertainty. T or F

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Teacher's Notes

Important Words

Attitude The way a person thinks, feels, and acts.

Goal Something you want to attain or achieve.

Long-term goal A goal that might take a year or more to achieve.

Opinion A view or attitude about a particular subject.

Prejudice An attitude that has no reasonable or justified basis in fact.

Short-term goal A goal that might take a few months to achieve.

Value An idea or belief that has great importance to a person.

Vision The ability to imagine what the future might be like.

On the Trail of . . .

One way to uncover your dreams and visualize your future is to create a "vision board," also called a "dream board." A vision board is a collage of words and pictures that describe what you want in your life. Go through magazines and newspapers and search for images and words that represent your dreams. Cut out the images and words and glue them on a piece of cardboard. Bring in your vision board to discuss in class. Explain how the items on your board tie into short- and long-term goals. Keep your vision board in a prominent place where you can view it daily and focus your attention on it. Who knows, maybe the things on your vision board will begin to show up in your life, sooner than later.

.com

With one of your long-term goals in mind, think of a person who has achieved the same goal successfully. Use the Internet to research this person. How did he or she decide to pursue this goal? How long did it take to reach it? What obstacles or challenges were encountered along the way? Write a short report on your findings.

Being the First Choice

Listening and speaking are two of the basic skills you'll need to get a job and be successful in the workplace. Team up with another student to practice these skills. One student speaks while the other student listens. In a one-minute speech, the speaker describes one of his or her short-term goals to the listener. The listener pays careful attention. At the end of the speech, the listener repeats back to the speaker a summary of the goal described. The speaker and listener can then switch roles. How do you rate each other's performance as speaker and listener?

CHAPTER 1 *Who Am I?* 23

Teacher's Notes

Important Words

Review these vocabulary terms with students to check understanding. Ask students to read the terms and the definitions out loud.

Assessment Activities

The following three activities will help you assess your students' understanding of the chapter.

On the Trail of . . .
This activity challenges students' creativity. A rubric for grading is provided in the lesson plan.

. com
This activity provides a written measure of assessment based on online research. A rubric for grading is provided in the lesson plan.

Being the First Choice
This is a cooperative performance activity. Students evaluate each other's performance. The activity helps students develop two basic SCANS skills: listening—the ability to receive, attend to, interpret, and respond to verbal messages; and speaking—the ability to organize ideas and communicate orally.

Chapter 1 *Who am I?* 23

Three different ***Assessment Activities*** have students apply what they've learned in practical ways. ***On the Trail Of*** challenges students' creativity. ***.com*** requires internet research. ***Being the First Choice*** develops SCANS (Secretary's Commission on Achieving Necessary Skills) competencies that will prepare students for employment.

what's inside student edition

Career Connections: One Trade, Many Careers

Your textbook *Career Connections: One Trade Many Careers* is organized to help you learn more about yourself, the workplace, and careers in construction.

Each **PART** focuses on one aspect of the big picture and how you fit into it.

Each **CHAPTER** gives you the tools you need to move ahead in your career.

What You Now Know points out what you've already got under your belt.

What You Will Know shows what you'll learn in the chapter.

sections

each chapter is divided into Sections that focus on specific topics

Easy-to-read text and descriptive photos communicate the chapter topics clearly.

1 What Is a Construction Site?

A construction site is any place where a structure is being built or remodeled. It may begin as an empty field, a vacant lot on a city or suburban block, a few acres of forest, or someday even in outer space. A construction site may be alive with workers and crammed with materials and equipment, or it may be a relatively quiet and peaceful place. The sights and sounds of a construction site are determined by the type and size of the project, the stage of the construction process, and how much work is being done at the time.

Can you see yourself one day working on a construction site?

CRITICAL THINKING How would you recognize a construction site? What activities on a construction site do you find interesting? Can you see yourself one day working on a construction site?

STAGES OF CONSTRUCTION

A construction site may seem like a chaotic place with workers and machines coming and going. But actually, construction is an orderly process. All structures are built in carefully planned stages. Usually, one part of the process must be complete, or almost complete, before workers move to the next part of the process. The construction process will differ from project to project, but most structures are built in the following basic stages:

* **Site Preparation** Before construction can begin, the site must be properly prepared. Any trees, shrubs, or existing structures that may interfere with the construction process must be cleared away, and then the ground is prepared. This stage of the construction process is sometimes called **clearing and grading**.
* **Establishing the Foundation** The ground may seem hard if you trip and fall on it, but natural soils and rock formations are not firm enough to support modern buildings. To keep them from sinking into the ground and eventually toppling over, buildings are placed on top of a solid **footing** made of reinforced concrete. The footing is the part of the foundation that bears on the prepared soil. The foundation above the footing is also made of reinforced concrete, or concrete block, or a combination of these materials. In many cases the foundation is further supported by steel, wood, or concrete pile driven deep into the ground.

descriptive photos

shout out!

Derek Stump of South Bend, Indiana, has made three important decisions in his life. The first one was in high school, when he got his Dodge Ram pick-up truck. The second decision was to customize the truck and race it competitively. With 360 horsepower at the wheels and 866 foot pounds of torque, Stump became the defending national champion in Street Class with the Diesel Hot Rod Association. To earn enough money to support his love of racing, Stump made a career decision when he got out of high school: to become a union carpenter. "I'm a hands-on person, and I was always building stuff when I was growing up. In carpentry, you really feel like you've accomplished something once it's all done. It makes you feel good." Today, Stump is content with his career and lifestyle decisions. "I'm single. I own my own house. I have a truck I love. What more can I ask for?"

framing your future

First Lady Eleanor Roosevelt wrote in a letter to a friend, "Somewhere along the line of development we discover what we really are, and then we make our real decision for which we are responsible. Make that decision primarily for yourself because you can never really live anyone else's life, not even your own child's."

These and other decisions can be hard to make. The most difficult thing about making decisions is that you can't be absolutely certain you are making the right ones. Making a decision requires what is sometimes referred to as a "judgment call," and our judgment can mislead us. Maybe you were the one who picked the movie that turned out to be terribly boring. That may have been disappointing and perhaps even a little embarrassing, but it's hardly a disaster. It's just a decision you made that didn't work out as well as you had hoped. Everyone makes the wrong decision sometimes, and the results can be far worse than having to sit through a bad movie. That's why people occasionally get anxious when faced with a key decision.

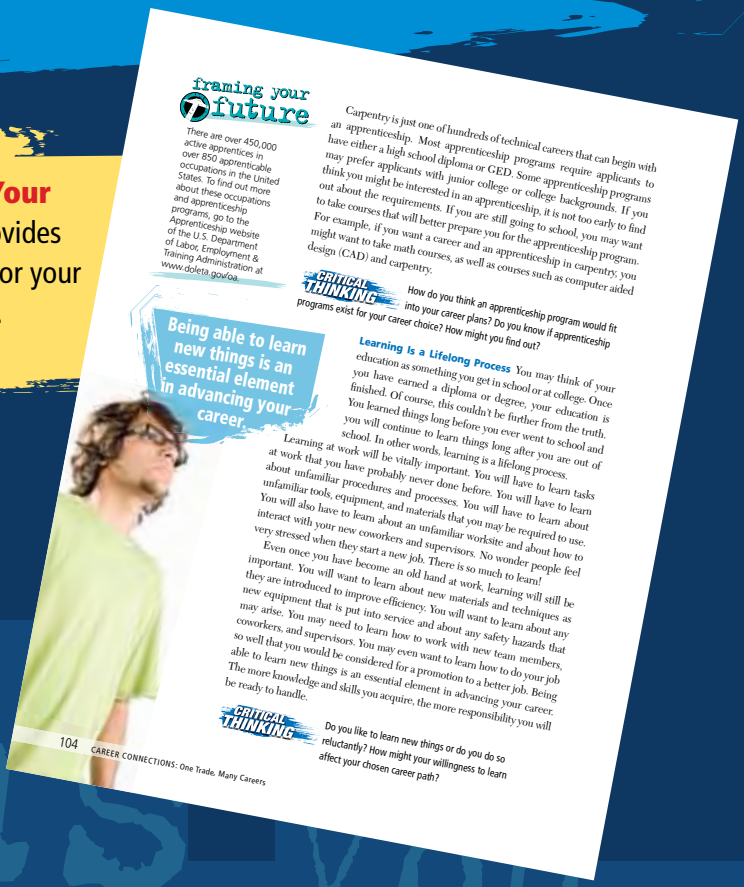
The best way to ensure that you reach your own goals is to be in charge of your own decision making.

Shout Out profiles people you can relate to in construction.

features

features in each chapter provide real-world examples, information, and ideas you can relate to

Framing Your Future provides useful tips for your career path.



framing your future

There are over 450,000 active apprentices in over 850 apprenticeable occupations in the United States. To find out more about these occupations and apprenticeship programs, go to the Apprenticeship Website of the U.S. Department of Labor, Employment & Training Administration at www.doleta.gov/oa.

Carpentry is just one of hundreds of technical careers that can begin with an apprenticeship. Most apprenticeship programs require applicants to have either a high school diploma or GED. Some apprenticeship programs may prefer applicants with junior college or college backgrounds. If you think you might be interested in an apprenticeship, it is not too early to find out about the requirements. If you are still going to school, you may want to take courses that will better prepare you for the apprenticeship program. For example, if you want a career and an apprenticeship in carpentry, you might want to take math courses, as well as courses such as computer aided design (CAD) and carpentry.

CRITICAL THINKING How do you think an apprenticeship program would fit into your career plans? Do you know if apprenticeship programs exist for your career choice? How might you find out?

Being able to learn new things is an essential element in advancing your career.

Learning Is a Lifelong Process You may think of your education as something you get in school or at college. Once you have earned a diploma or degree, your education is finished. Of course, this couldn't be further from the truth. You learned things long before you ever went to school and you will continue to learn things long after you are out of school. In other words, learning is a lifelong process.

Learning at work will be vitally important. You will have to learn tasks at work that you have probably never done before. You will have to learn about unfamiliar procedures and processes. You will have to learn about unfamiliar tools, equipment, and materials that you may be required to use. You will also have to learn about an unfamiliar worksite and about how to interact with your new coworkers and supervisors. No wonder people feel very stressed when they start a new job. There is so much to learn!

Even once you have become an old hand at work, learning will still be important. You will want to learn about new materials and techniques as they are introduced to improve efficiency. You will want to learn about any new equipment that is put into service and about any safety hazards that may arise. You may need to learn how to work with new team members, coworkers, and supervisors. You may even want to learn how to do your job so well that you would be considered for a promotion to a better job. Being able to learn new things is an essential element in advancing your career. The more knowledge and skills you acquire, the more responsibility you will be ready to handle.

CRITICAL THINKING Do you like to learn new things or do you do so reluctantly? How might your willingness to learn affect your chosen career path?

104 CAREER CONNECTIONS: One Trade, Many Careers

real-world examples

ideas you can relate to

3 Skills Needed on a Construction Site

Construction work requires a wide range of skills. The personal skills needed on a construction site are the same as those required for any other type of employment. Construction workers must be able to listen carefully and speak clearly. They must be able to respond well to supervision and work with others as part of an effective team. They must be able to manage time, make decisions, and solve problems. They must be reliable, on time, and ready to do their best work every day. They should know how to think critically, that is, to ask the right questions and to recognize meaningful answers. Every worker should also have well developed basic skills such as reading, writing, and math.

Construction workers must have the hands-on skills needed to use tools that are required for the job. Reading and interpreting prints, using a computer, and executing a complex construction process are required technical skills. When workers step onto a construction site, they must bring all of these skills with them.

Experienced construction workers know how to safely and efficiently use many different hand tools and power tools. They know how to safely and efficiently use wood, metal, drywall, concrete, and many other materials. And they know how to make proper use of technical processes such as forming a level foundation, installing a staircase, or stretching a carpet.

CRITICAL THINKING What are the three kinds of skills needed by a construction worker?

nailing it!

Using the right tools for the job is critical on a construction site. And knowing how to identify tools and materials is equally important. Skilled tradespeople know which power tool or hand tool is needed and when. They can recognize one grade of material from another. They know one drill bit from another. They know the difference between a nut, bolt, screw, spacer, rivet, and clip and the tools needed for driving them. Do you know the nuts and bolts of building materials and tools, and is it something you want to learn?

CHAPTER 8 What Happens on a Construction Site? 161

Nailing It describes mastering certain skills.

features

make yourself more valuable in the workplace

iron worker

The outer shells or exteriors of most large buildings do little to support their weight. In fact, most of the siding materials you see on the outside of these buildings are attached to a sturdy internal framework of steel. The frameworks are put in place by iron workers. An **iron worker** is a skilled worker who bolts and welds steel beams and girders and places the network of steel that reinforces concrete walls and supports. Iron workers work on roads, bridges, dams, sports complexes, high rises, and large structures of all types. They often work at great heights. Iron workers also must be able to direct the operators of heavy equipment.

painter

wallpaper hanger

drywall finisher

The interior walls of buildings and homes would look very plain and unattractive without the benefit of paint, wallpaper, and other finishes. The basic job of a painter and a wallpaper hanger is probably obvious without much further explanation. On the other hand, you may not be as familiar with the work of a **drywall finisher**. Once sheets of drywall have been attached to the interior walls and ceilings of a building or house, it is the job of drywall finishers to make all the individual sheets of drywall look like a continuous, smooth surface. Once this is done, drywall finishers often add decorative textures to make the surfaces more pleasing to the eye and also to hide surface imperfections. Most of the work of drywall finishers is done using paper tape and a plaster-like material called joint compound.

As for painters, they skillfully apply paint to the interiors of buildings and houses. They also paint the outside of certain buildings, homes, and structures such as bridges and water tanks. To do these jobs properly, painters must know the characteristics of a variety of paints and know how to apply each one. They must also be very detailed oriented and possess a strong sense of color and design. These characteristics also apply to wallpaper hangers, who must know how to select and apply a variety of adhesives and wallpapers.

building a better *u*

"Doing a great job is more than showing up and working a day's pay just to get better pay; it's when all the training and experience you've had falls into place. Pride in workmanship is also what many wish for and never achieve." Entrepreneur David A. Goldsmith points out that no matter what your occupation is, taking pride in what you do is what really counts.

Building a Better You tells you how to make yourself more valuable in the workplace.

how to

4 What Is a Pile Driver?

Have you ever gone boating, tied the boat to a dock, and wondered what the dock was connected to under the water? Maybe you have looked at a tall skyscraper and wondered why it doesn't sink into the ground. Or perhaps you wondered what could possibly hold up a large bridge that supports hundreds of cars and trucks. The answer to all these questions lies with the pile driver.

Skyscrapers, sports stadiums, bridges, dams, and other large structures don't just sit on the ground or on an unsupported concrete foundation. If they did, they would slowly settle into the earth and eventually topple over. Many types of structures and the foundations on which they rest must be supported by sturdy concrete, wood, or metal shafts, called **pile**, which are driven deep into the ground. The skilled worker who installs the pile is called a **pile driver**.

how *i* see myself

Brent McLain has been a commercial diver in San Francisco for five years. A day's work might include resisting a 5-knot current while dragging 200 feet of hose, using power tools underwater in total darkness, and fending off curious harbor seals. McLain helps maintain pier pile, salvages wrecks, and assists officers with homeland security. Are you up for the challenge and adventure of an underwater pile driver?

How I See Myself gives you food for thought about your career potential.

food for thought

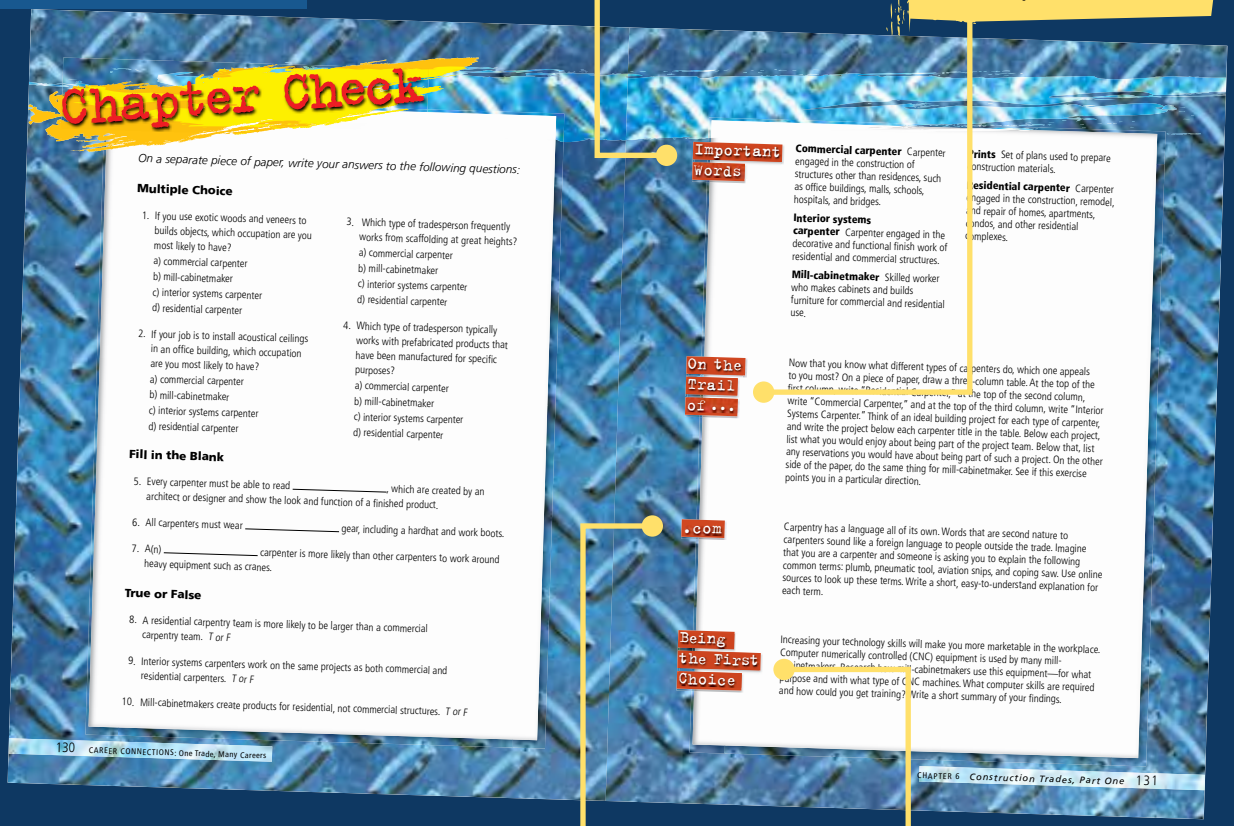
chapter check acknowledgments

chapter check allows you to review what you learned and then apply the concepts in practical ways.

expand on what you have learned

These Important Words were introduced in the chapter and are redefined here.

On the Trail Of lets you expand on what you learned in the chapter.



Chapter Check

On a separate piece of paper, write your answers to the following questions:

Multiple Choice

1. If you use exotic woods and veneers to builds objects, which occupation are you most likely to have?
   a) commercial carpenter
   b) mill-cabinetmaker
   c) interior systems carpenter
   d) residential carpenter
2. If your job is to install acoustical ceilings in an office building, which occupation are you most likely to have?
   a) commercial carpenter
   b) mill-cabinetmaker
   c) interior systems carpenter
   d) residential carpenter
3. Which type of tradesperson frequently works from scaffolding at great heights?
   a) commercial carpenter
   b) mill-cabinetmaker
   c) interior systems carpenter
   d) residential carpenter
4. Which type of tradesperson typically works with prefabricated products that have been manufactured for specific purposes?
   a) commercial carpenter
   b) mill-cabinetmaker
   c) interior systems carpenter
   d) residential carpenter

Fill in the Blank

5. Every carpenter must be able to read _____ which are created by an architect or designer and show the look and function of a finished product.
6. All carpenters must wear _____ gear, including a hardhat and work boots.
7. A(n) _____ carpenter is more likely than other carpenters to work around heavy equipment such as cranes.

True or False

8. A residential carpentry team is more likely to be larger than a commercial carpentry team. *T or F*
9. Interior systems carpenters work on the same projects as both commercial and residential carpenters. *T or F*
10. Mill-cabinetmakers create products for residential, not commercial structures. *T or F*

130 CAREER CONNECTIONS: One Trade, Many Careers

Important Words

Commercial carpenter Carpenter engaged in the construction of structures other than residences, such as office buildings, malls, schools, hospitals, and bridges.

Interior systems carpenter Carpenter engaged in the decorative and functional finish work of residential and commercial structures.

Mill-cabinetmaker Skilled worker who makes cabinets and builds furniture for commercial and residential use.

Prints Set of plans used to prepare construction materials.

Residential carpenter Carpenter engaged in the construction, remodel, and repair of homes, apartments, condos, and other residential complexes.

On the Trail of ...

Now that you know what different types of carpenters do, which one appeals to you most? On a piece of paper, draw a three-column table. At the top of the first column, write "Residential Carpenter," at the top of the second column, write "Commercial Carpenter," and at the top of the third column, write "Interior Systems Carpenter." Think of an ideal building project for each type of carpenter, and write the project below each carpenter title in the table. Below each project, list what you would enjoy about being part of the project team. Below that, list any reservations you would have about being part of such a project. On the other side of the paper, do the same thing for mill-cabinetmaker. See if this exercise points you in a particular direction.

.com

Carpentry has a language all of its own. Words that are second nature to carpenters sound like a foreign language to people outside the trade. Imagine that you are a carpenter and someone is asking you to explain the following common terms: plumb, pneumatic tool, aviation snips, and coping saw. Use online sources to look up these terms. Write a short, easy-to-understand explanation for each term.

Being the First Choice

Increasing your technology skills will make you more marketable in the workplace. Computer numerically controlled (CNC) equipment is used by many mill-cabinetmakers. Research how mill-cabinetmakers use this equipment—for what purpose and with what type of CNC machines. What computer skills are required and how could you get training? Write a short summary of your findings.

CHAPTER 6 Construction Trades, Part One 131

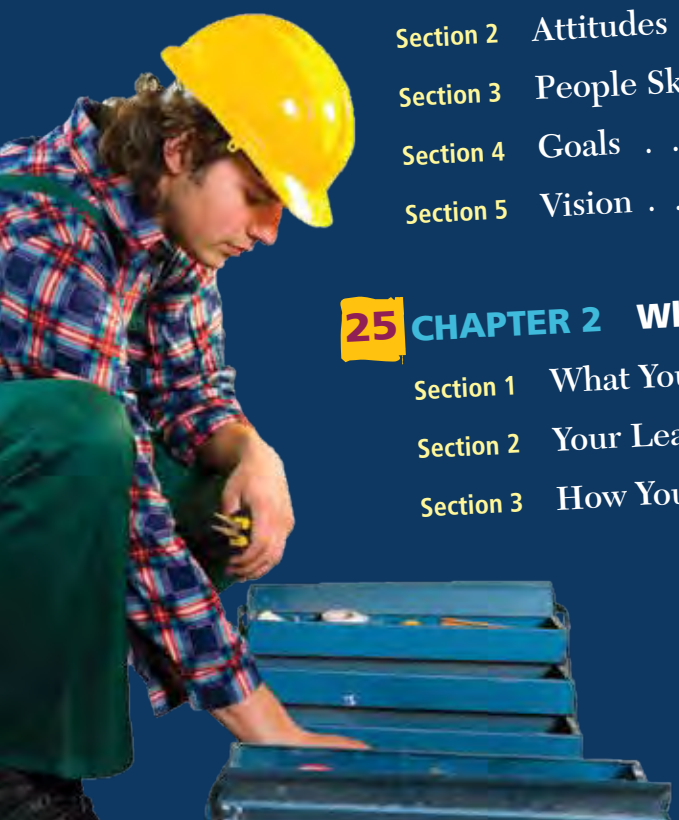
opportunity to do some Internet research

.com is an opportunity to do some Internet research on a chapter topic.

Being the First Choice allows you to develop skills that will make employers want to hire you.

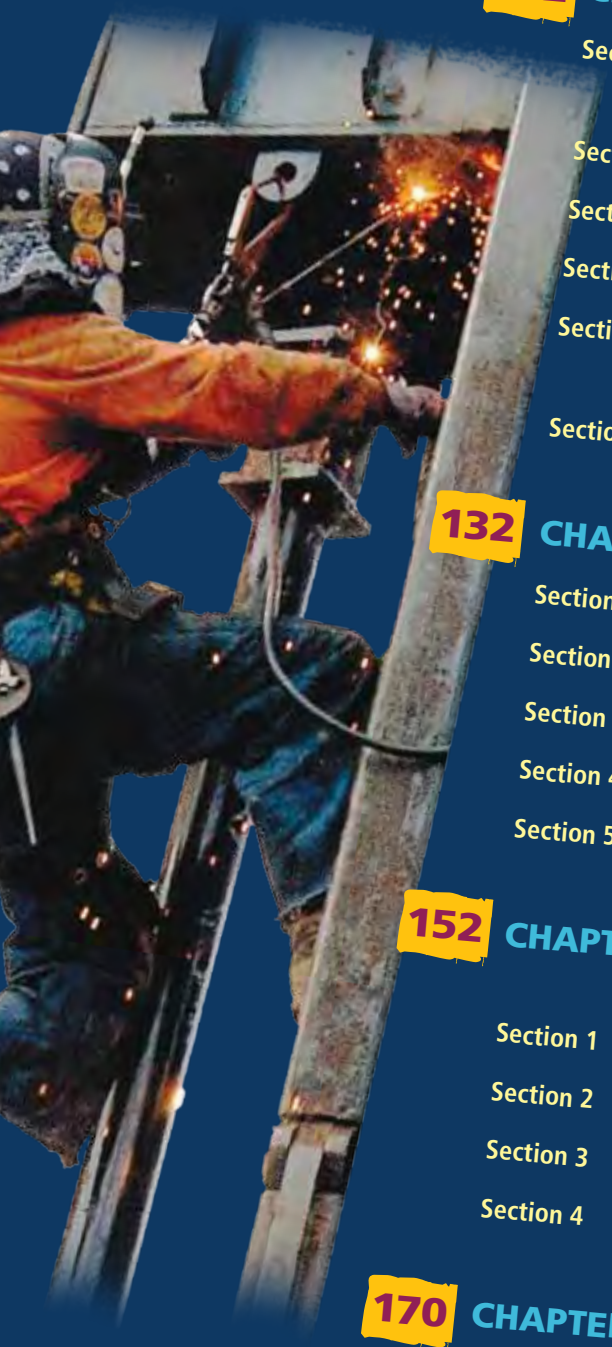
contents

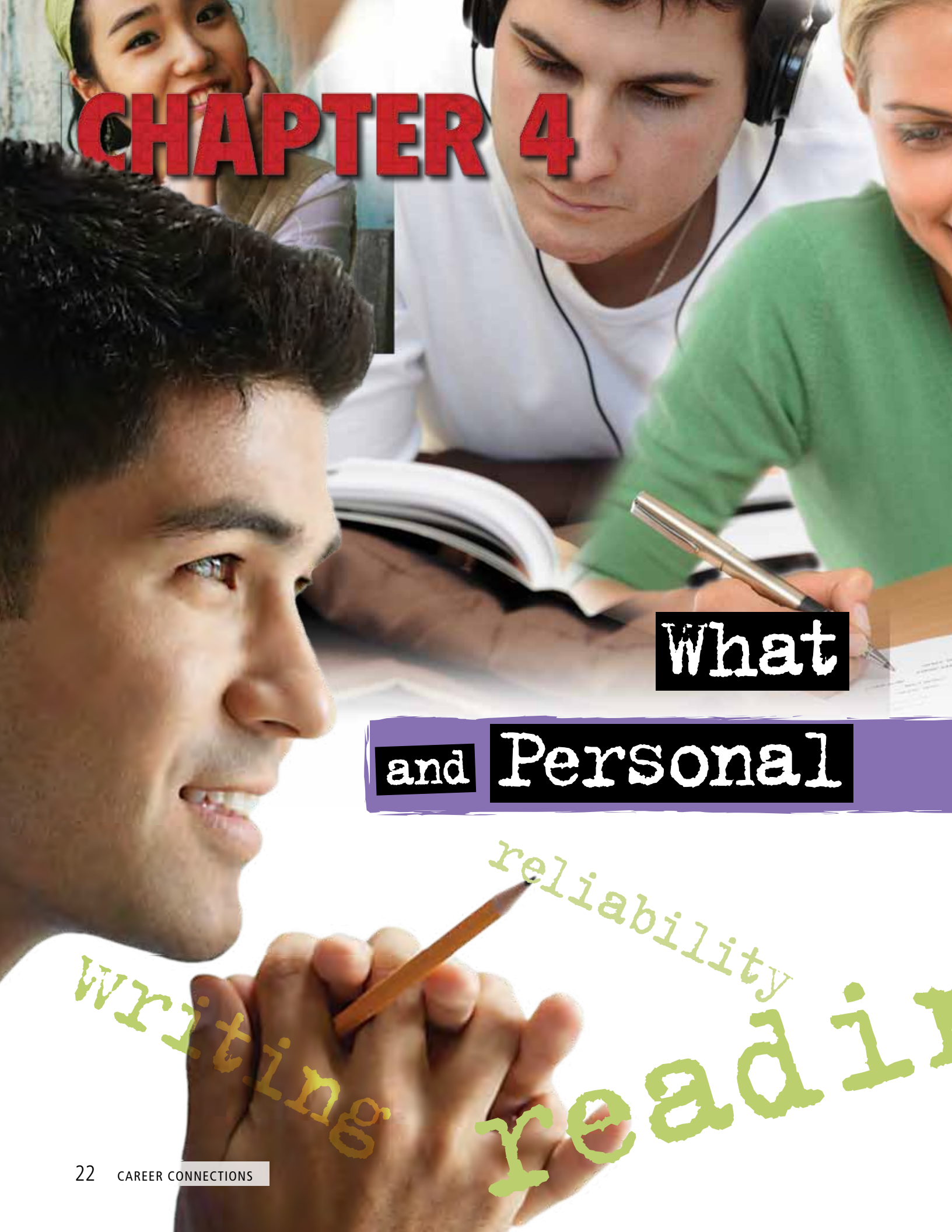
part 1 My World



Part 2 The World of Work

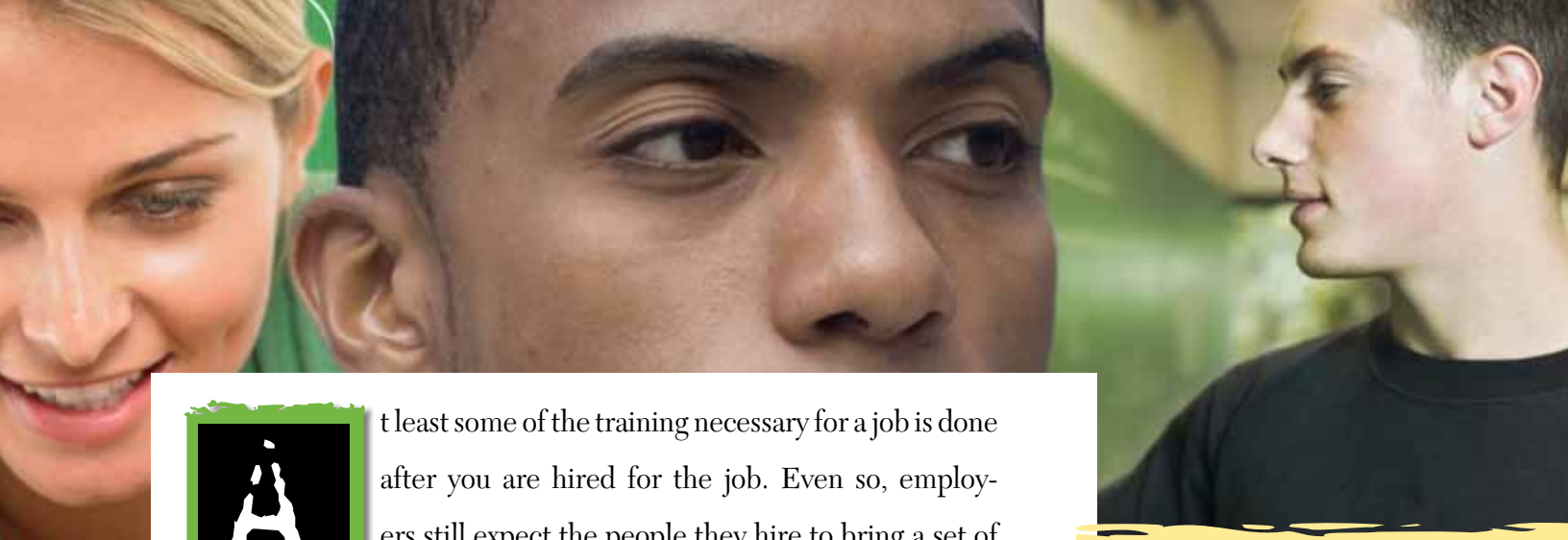
part 3 The World of Construction





CHAPTER 4

What and Personal



At least some of the training necessary for a job is done after you are hired for the job. Even so, employers still expect the people they hire to bring a set of skills and positive personal traits to the workplace. These include basic skills, such as reading, writing, and arithmetic, and personal qualities, such as honesty and reliability. Most of these skills and qualities are the same ones that helped you in school. You will continue to need these skills and qualities in the world of work. Without them it will be very difficult to get a good job and keep it.

Basic Skills Qualities Do I Need?

What You Now Know

- How to communicate effectively
- How to make decisions and solve problems
- Your basic skills and personality

What You Will Know

- The basic skills necessary to be successful in the workplace
- The important role that thinking skills play in the workplace
- How your personal qualities affect your success

ng honesty arithmetic

1 Basic Skills

Everyone has a different experience at school. Some love school, others don't like it as much, and there are others that are bored and can't wait to get out. No matter how you feel about school, it has provided you with an opportunity to prepare yourself for your life ahead. If you have worked hard and have been successful in school, then you already possess many of the skills you need to hold a job. At a minimum you will need the basic skills of reading, writing, and math. But you'll also need to know how to think clearly and logically about important matters.

reading

There are few skills that will be as important to you on the job and in life as the ability to read. Depending on the type of work you do, you may be asked to read forms, reports, written instructions, manuals, memos, and many other written materials. If you have difficulty reading and understanding these materials, it will be very hard for you to do your job effectively. This is why employers want workers who can read well.

How do you know if you are a good reader? If you enjoy reading, then you are almost certainly a good reader. If you can read this book without much difficulty, then you are probably a good reader. If you often read newspapers and magazine articles or read novels for fun, then you are very likely a good reader. On the other hand, if you feel you're getting lost or off track when reading something that is more than one or two paragraphs in length, then you may need a little help with your reading skills.

Fortunately, one of the best things about reading is that it is something everyone can learn to do well. Once people have learned to read at a basic level in school, all they need to do to be really good at it is to read and keep reading. And another good thing about reading is there is plenty of reading material available just about everywhere. Newspapers, magazines, the Internet, the library, bookstores, and even the checkout counter of the grocery store, all provide good sources for reading. Be sure you select materials that interest you. This will make reading practice much more enjoyable.

how i see myself

"My mother and my father were illiterate immigrants from Russia. When I was a child they were constantly amazed that I could go to a building and take a book on any subject. They couldn't believe this access to knowledge we have here in America. They couldn't believe that it was free." The actor Kirk Douglas's childhood memory of reading raises the question: In what ways do you value your right to read?

If, after practicing your reading every day for a period of time, you are still not satisfied with your reading skills, you should not be shy about asking for help. You can ask for extra help from teachers or advisers at school, or your parents. Also, most communities have programs to help adults or recent high school graduates improve their reading skills.

CRITICAL THINKING Are you a good reader? Do you have difficulty reading newspapers or long magazine articles? How do you think your reading skills will help you succeed in the world of work?

reading comprehension

Most of the reading you do on the job will be very different than the reading you do for pleasure. Most work-related reading involves information that will be important to you, your coworkers, and your project or company. For this reason, you must be sure that you correctly and completely understand, or comprehend, what you are reading. You can use the following steps to make sure you comprehend a set of instructions, a memo, or any other written communication:

1 scan

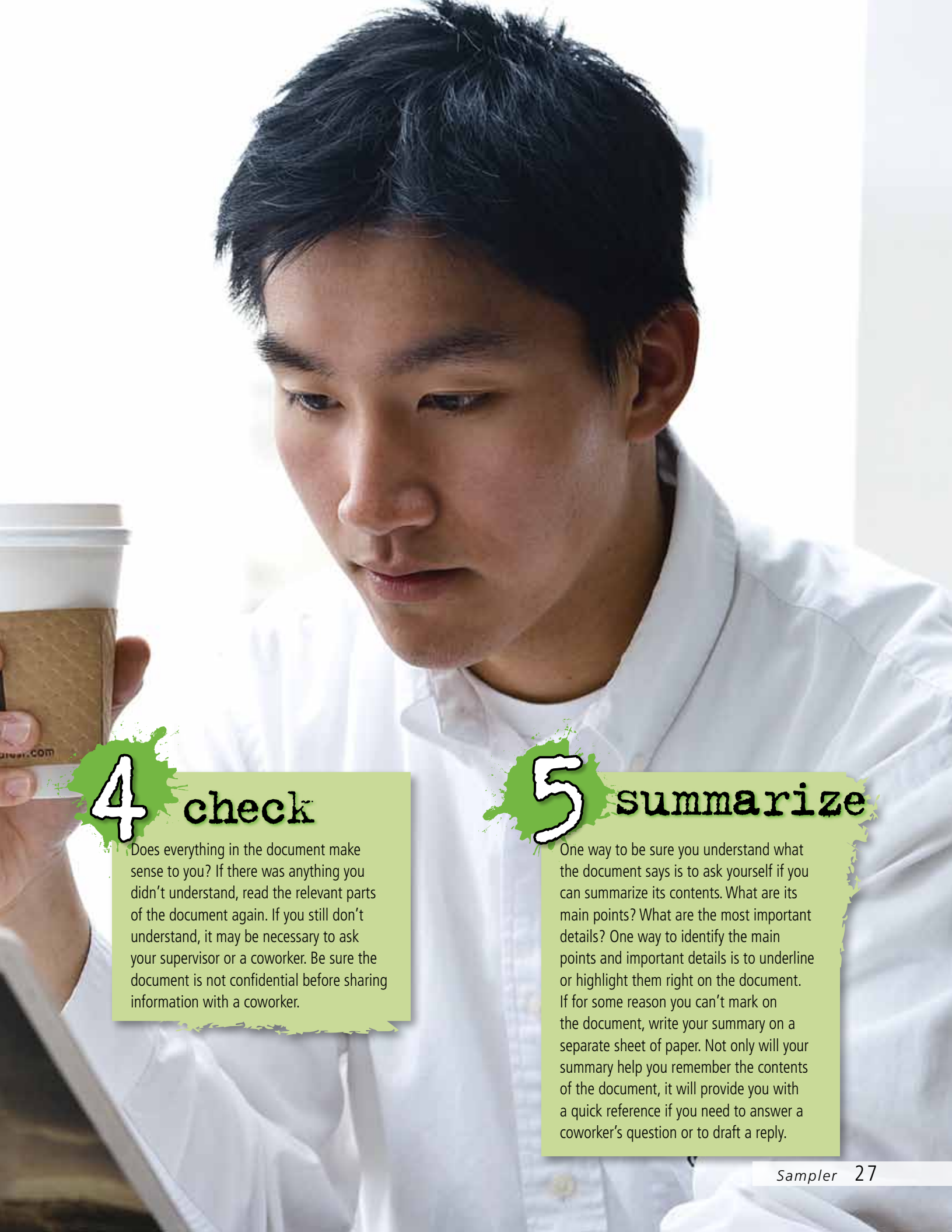
Your first step should be to scan the document to get the basic idea of what it is about. Scan the document quickly to ask questions such as: Is the document meant only for you or for a group of people? Does the document call for a reply? Does it require you to take some action or is it intended only for general information? Do any parts of the document seem more important than others?

2 read

Once you have scanned the document, it is now time to read it carefully. Be observant as you read, paying close attention to the main points as well as the details. Sometimes the most important information contained in a document is found in the details.

3 analyze

Carefully sort through the main points of the document and see how they relate to one another. If you have any questions concerning one or more of these points, check to see if they are answered somewhere else in the document. Perhaps the answers to your questions are in details that you overlooked.



4 check

Does everything in the document make sense to you? If there was anything you didn't understand, read the relevant parts of the document again. If you still don't understand, it may be necessary to ask your supervisor or a coworker. Be sure the document is not confidential before sharing information with a coworker.

5 summarize

One way to be sure you understand what the document says is to ask yourself if you can summarize its contents. What are its main points? What are the most important details? One way to identify the main points and important details is to underline or highlight them right on the document. If for some reason you can't mark on the document, write your summary on a separate sheet of paper. Not only will your summary help you remember the contents of the document, it will provide you with a quick reference if you need to answer a coworker's question or to draft a reply.

writing

Not all jobs require good writing skills. However, many jobs do. And some jobs require excellent writing skills. Depending on your job, you may have to produce emails, letters, memos, reports, and many other types of written material. If you are required to do much writing on the job, you will need to have good writing skills. The better your skills, the more successful you will be.

Just like reading, writing is an important skill not just in the world of work but also for day-to-day living. That is why writing, or composition as it is often called, is taught in every school. However, the writing you will do at work may have different goals than the writing you did at school. Writing at work may be done to bid for a job, to sell a concept or product, to promote safety, or for a variety of other reasons.

every written document should be

Clear

To avoid confusion, all documents should be written in a style that is both clear and direct. The reader should have no trouble understanding all of the information in the document.

Concise

To avoid wasting time, the document should be brief and to the point. It should be no longer than is necessary to clearly cover the required information.

Complete

The document should thoroughly address all of the relevant information. The reader should be able to easily comprehend the purpose and the contents of the document.

Convincing

The document should be persuasive. The reader should think that the person who wrote the document knows the subject thoroughly and is confident in what is written.

Free of Errors

A document should have properly constructed sentences, appropriate punctuation, and correct spelling. Documents that contain a lot of errors may not be taken seriously and may even cause the reader to question the writer's competence. Before a document is passed along to others, it should always be carefully proofread at least twice to make sure it doesn't have any errors.

Fortunately, most word-processing programs can help check spelling and grammar. However, these programs are not perfect, and they don't catch all errors. For example, they won't catch the problem of using the word "there" when you should have used "their." So don't think that just because you used a grammar and spell check on your computer that the document is error free. If the document is long, complex, or concerns critical information, you may want to have a coworker with good writing skills also proofread it before you send it.

Proofreading TIPS

Read for meaning

Read the document to check for meaning, clarity, and logic. As you read, imagine you are one of the people receiving the document. Sometimes, statements that seemed logical to the writer are not to the reader. Reading the document out loud will help in this process.

Read for grammar, spelling, sentence structure, and punctuation

Once you have proofread for sense, proofread a second time to check the mechanics of the writing. Some sentences may need to be reworded to make sure they are both clear and correct.

Compare drafts

When finding errors or making changes, mark them on a draft of the document. Then transfer the changes to the final draft. To make sure the final draft contains everything essential, place the final draft beside your first draft and compare them line by line.

Test read

If the document is particularly important or will be widely distributed, you may want to try it out on a test reader. The test reader should be someone who has not seen an earlier draft of the document. The test reader can give you honest feedback about whether the document makes sense and has the desired impact.

Rewrite

Don't be discouraged if your document doesn't read as well as you had hoped. Just try again. Some important documents may need to be rewritten one or more times before they are clear and ready for distribution.

building a better u

A dictionary can be your best friend when you need help with words. But how do you look up a word if you can't even spell it? You can sound out the word and then scan the dictionary in hopes of finding the word you want. Or, you can look up a synonym—another word that means the same thing. You'll very likely find the word you're looking for under the definition of the synonym. Another option is to use an online dictionary. You can type in just the letters you know and then choose from a list of possibilities.

mathematics

Some people are better than others at handling complex calculations, but anybody can learn to work with numbers. The ability to work with numbers is a life skill that everybody needs and that anyone can master. It is also a skill that is required for most jobs. Accountants and financial analysts are not the only professions that require "number crunching." Workers in nearly every field have to add, subtract, multiply, divide, or work with fractions and decimals—and they have to come up with the correct answers.

you will need an excellent grasp of math if you want a career in any of the construction trades

You will need an excellent grasp of math if you want a career in any of the construction trades. Principles of math and the use of math formulas are involved in all aspects of properly laying out and building structures, including commercial buildings, homes, and bridges. Having trouble solving basic math problems could prevent you from getting the job you want or succeeding in the career you have chosen.

Fortunately, it is not too late to improve your math skills if that is what you want to do. All you need to do is ask for help. You can ask for extra help from teachers or advisers at school or from your parents. Also, most communities have programs to help adults or recent high school graduates improve their math skills.

framing your future

Math skills are critical—not only for just about every job you'll ever have but for functioning in the everyday world. Math is everywhere. In the kitchen when you're cooking, at the car dealership when you're deciding to buy or lease, in the office when you're balancing a checkbook. You need to do mental math to make quick calculations in stores, restaurants, or gas stations. Every time you pull out a tape measure or pull out your wallet, you're doing math. Strong math skills will help you plan your future.

ability to work with numbers is a life skill that everybody needs


ON/C
OFF
LN
LOG
TAN
COS
GOOD MORNING
PRECAST LINTEL
TILE
15'-10"
GFIP
SINK
TILE

2 Thinking Skills

Every day we acquire more and more information in our heads. People who have acquired a lot of information are often regarded as being smart. But being smart is less about knowing a lot of information and more about applying that information. People who are truly smart know how to apply knowledge to new situations, think creatively about what they have experienced, and are able to solve problems. In other words, smart people have developed strong thinking skills. And like other skills, thinking skills can be learned and improved with practice. Thinking skills involve a variety of other skills, but the cornerstones are focused attention, logical reasoning, creative thinking, and critical analysis.

Focused Attention Strangely enough, the most common mistake people make when thinking about something is that they don't think about it long enough. When considering a problem, they may be satisfied with the very first solution that pops into their heads without considering any other possibilities. For example, let's say your supervisor at work passes you in the hallway and doesn't say hello. In considering what happened, you may quickly conclude that your supervisor doesn't like you. However, by giving this matter more thought, other possibilities might occur to you. Your supervisor simply might not have noticed you, or he or she may have been in deep thought about some important issue.

Random thoughts are the enemies of focused attention. Random thoughts such as what you are going to do tonight, the price of a video game, or the cool car you saw that morning are constantly competing for attention in your brain. It's perfectly natural to have such thoughts, but they must be controlled if you are to focus attention on solving a problem or answering a question. When random thoughts start invading your thinking, simply pause for a moment and refocus. By keeping your thoughts on track, you will be practicing mental discipline.

random thoughts are the enemies of focused attention

CRITICAL THINKING Why is it important to consider all the likely possibilities when trying to answer a question or solve a problem? What do you do when you are easily distracted by unrelated ideas or memories when trying to think clearly about something important?

Logical Reasoning is the ability to come to a rational conclusion based on facts, rather than emotions. We all use logical reasoning every day to make all kinds of decisions. For example, in choosing a cell phone to buy, you would want to base your decision on the facts about each phone.

here is a career related example

Suppose you already know that you don't want a career that would require you to work at a desk in an office. Your friend hands you a pamphlet or points you to a website that describes careers in carpentry. Part of the information has photos showing carpenters working outdoors. Since it is clear that a career in carpentry fits at least one of your major career criteria, you decide to gather more information and consider carpentry as a career. Your action was a response to logical reasoning.

innovative

original

creative thinking

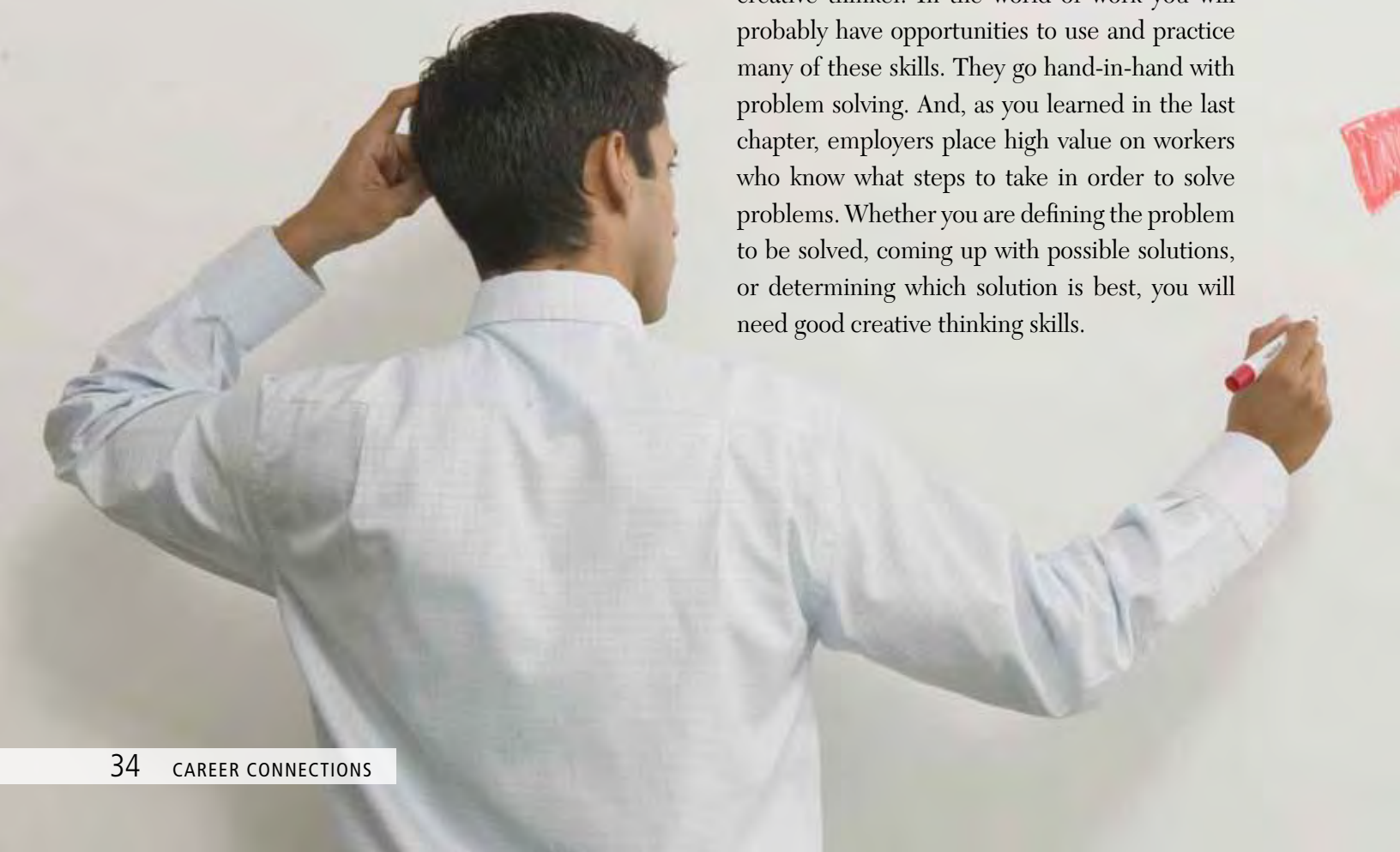
requires an open and flexible mind

Creative Thinking is the ability to think of original and innovative ideas. Although there is no one way to be a creative thinker, creative thinking usually requires an open and flexible mind. For example, when a chemist working at the 3M Company accidentally created a new adhesive that was not very strong, he did not just assume it was a failure. Instead, his thinking was open and flexible enough to find a new application for this weak adhesive. This is how he invented the very popular Post-It® Notes.

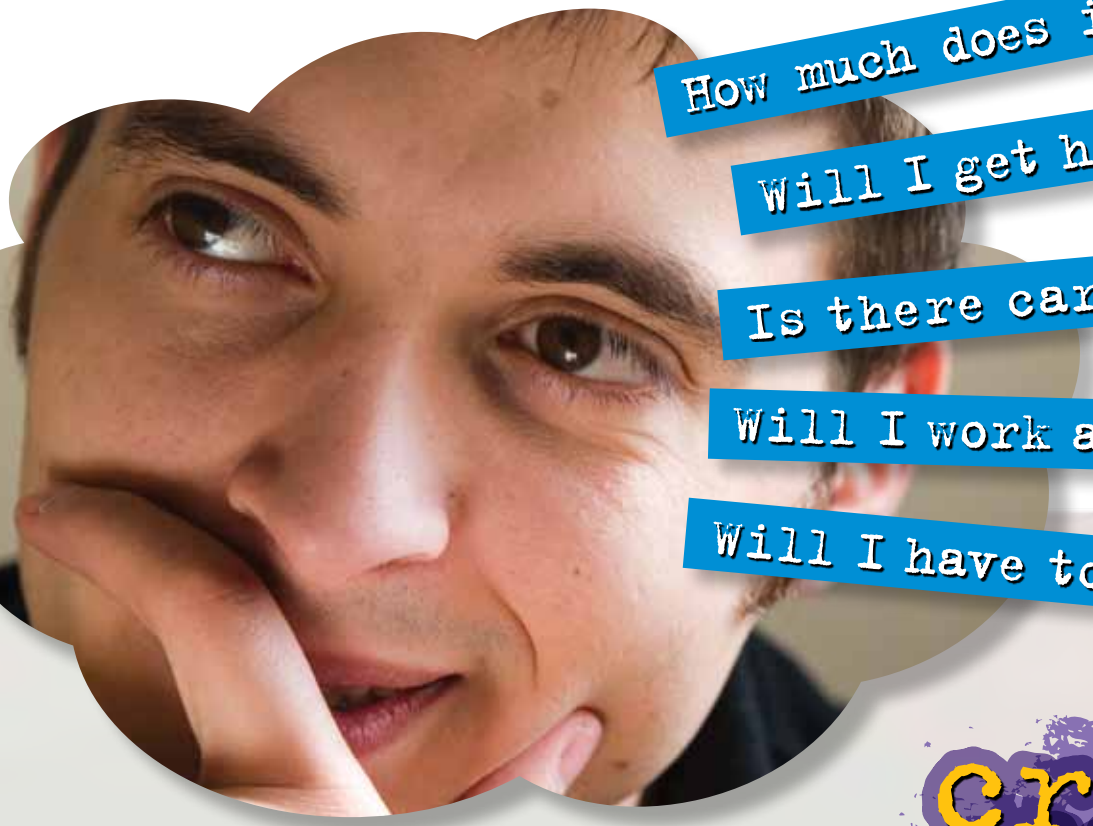
Creative thinking involves brainstorming, which is a technique of allowing yourself and others the freedom to generate ideas without any judgments about their worth. Brainstorming encourages a great many ideas that may broaden your thinking. Later, when you analyze the ideas, you may discover a great idea, or you may need to combine several ideas to form a great idea.

Another good tool when thinking creatively is to practice what is called **associative thinking**. This is the skill of associating one thing with another. For example, the inventor of Velcro® thought of this unique fastening method when he was brushing his dog and saw how tightly burrs stuck to the dog's coat.

As you can see, there are many skills that can help you become a good creative thinker. In the world of work you will probably have opportunities to use and practice many of these skills. They go hand-in-hand with problem solving. And, as you learned in the last chapter, employers place high value on workers who know what steps to take in order to solve problems. Whether you are defining the problem to be solved, coming up with possible solutions, or determining which solution is best, you will need good creative thinking skills.



Critical Thinking is basically a matter of asking and answering probing questions when you are considering something or trying to solve a problem. For example, when you consider a possible career, many questions may come to mind.



critical thinking is a matter of asking and answering

Just by asking these questions, you have engaged in the type of critical thinking that will help you in making your important decision about a career.

Critical thinking can be a big help in the workplace. For example, you may be part of a work team that uses a particular process to reach its goal. The process works, but asking the following questions about it may prove worthwhile:

- Is it the quickest process to get the job done?
- Is it the least expensive process to get the job done?
- Does the process produce the highest quality results?

Asking and answering questions like these represent critical thinking in action. You may even have situations in your personal life that could be improved as a result of asking and answering some probing questions.

CRITICAL THINKING How have you applied logical reasoning to make a recent decision? Can you think of a time when you used creative thinking to come up with a new idea? In what situation in your life might you use critical thinking to solve a problem?

3 Personal Qualities

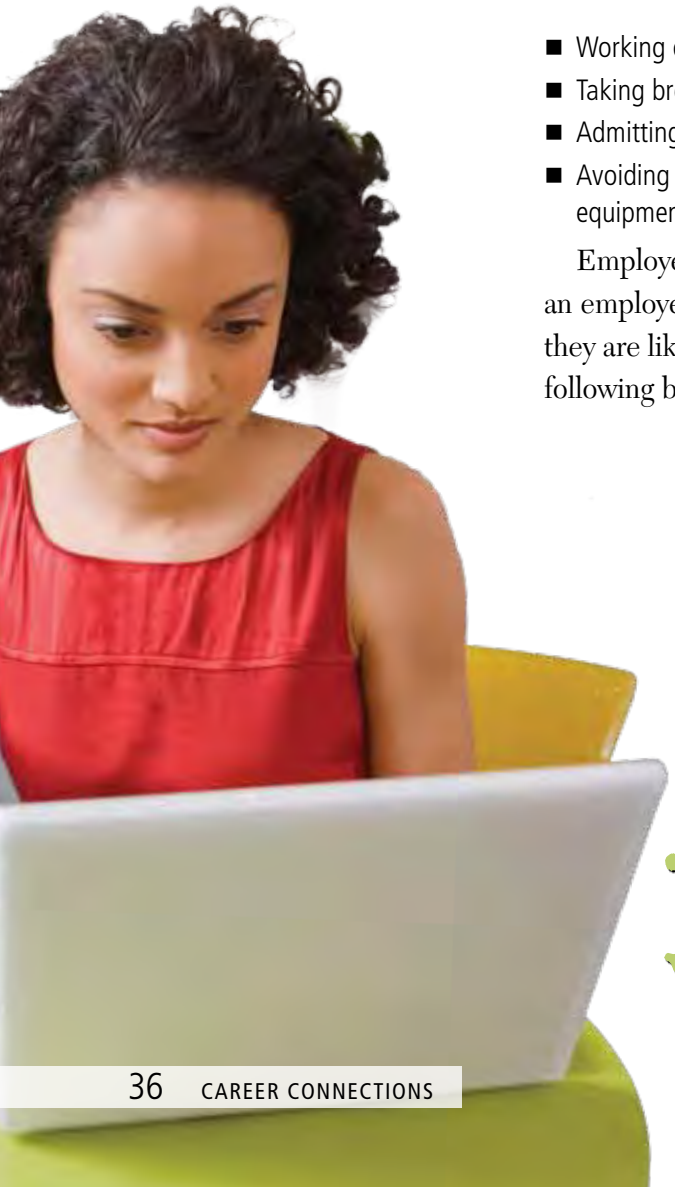
No matter how many important job skills you have mastered, they will not make up for negative qualities like being dishonest or being undependable. It is no exaggeration to say that employers have very little tolerance for workers who do not have the qualities of honesty and reliability. Employers also want workers who do quality work and who take pride in a job well done.

Honesty Honesty means being truthful in what you say and what you do. Honest people do not lie, cheat, or steal. For obvious reasons, employers expect workers to be honest in their words and their actions. Employers value honesty in workers because honesty contributes to a trusting work environment and to the company's overall success. Examples of honest behavior in the workplace include the following:

- Working diligently during the entire work day
- Taking breaks only during designated break times
- Admitting responsibility for mistakes and accidents
- Avoiding practical jokes or pranks that may endanger yourself, others, equipment, or materials

Employers do not hire workers they believe to be dishonest. And when an employer discovers that they have hired a dishonest person by mistake, they are likely to end the employment. Most employers would consider the following behaviors to be dishonest:

- Lying about qualifications on a resumé or during a job interview
- Reporting more hours on a timecard than actually worked
- Lying about reasons for taking time off from work
- Removing items from the workplace without permission
- Covering up or shifting the blame for errors or mistakes
- Lying to clients or customers
- Personally accepting a reward or praise for the work of others
- Covering up safety violations



...reliable means
word can be
and you can be

Reliability is the quality of being dependable or trustworthy. Being reliable means that your word can be trusted and you can be counted on to meet expectations. Without reliable employees, a company can't possibly operate smoothly and efficiently. Reliable employees also make more significant contributions to a company while requiring less oversight. A reliable employee can be recognized by the following behaviors:

- Shows up to work on time prepared to begin the work day
- Operates in a manner that is consistent with the mission of the company and the requirements of the job
- Completes work assignments on time and with high quality
- Performs tasks with little or no supervision
- Arrives at meetings on time and prepared

It is reasonable for companies to put such a high value on reliability. Imagine trying to run a business where the employees showed up whenever they wanted, were late to important meetings, missed deadlines, and produced poor-quality work. Such a company would certainly not be in business very long. Can you imagine any customer who would be willing to put up with this type of service?

CRITICAL THINKING Do you consider yourself to be an honest and reliable person? What makes you think so? What kind of feedback have you gotten from others about these qualities in you?

that your trusted counted on...

Having an eye for quality is something you must learn.

Quality Conscious All companies try to balance cost with quality. In other words, they try to produce the highest-quality products or services for the cost. If you were having a house built and you had a lot of money, you might be able to use the most expensive materials and include the latest in technology. On the other hand, if you were building a house on a budget, you would probably opt for less expensive materials and fewer bells and whistles. In either case, however, you would want your house built well. You would want the workmanship of your house to be of the highest quality possible.

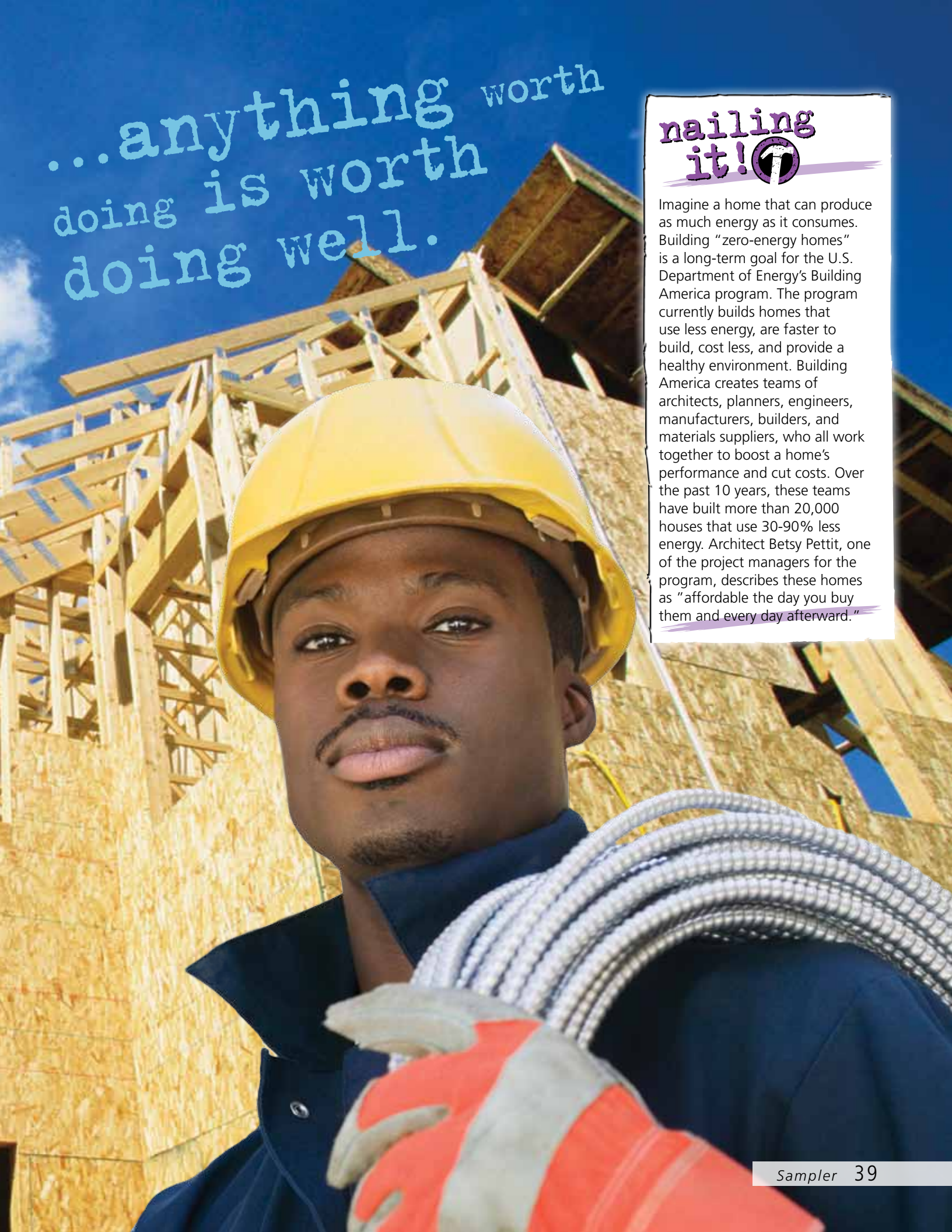
Employers also want to be sure that their products are of the highest quality within the limits of the cost. They want workers who will strive to do the best job possible whether working with expensive materials or more economical materials. Employers want to maintain a standard of quality that will satisfy their customers and make their business successful. They do not want to turn out products that may or may not be of high quality depending on who worked on it. This would be very bad for business.

Like all skills, an eye for quality is something you must learn. No one is born with the ability to do quality work. You have probably already developed a sense of relative quality when you evaluated various products before you purchased them. Quality was probably a prime consideration in your evaluation. Employers will want you to recognize quality and to consistently produce quality work.

CRITICAL THINKING What are some characteristics of a high-quality product that you may want to buy in the near future? Why would you decide to spend more money in order to get the higher-quality product? Why would you decide to get a lower-quality product?

Pride in a Job Well Done There is an old saying: anything worth doing is worth doing well. Those who succeed in the world of work generally agree with this statement. They want to do an excellent job because they see their work as a reflection of their character. Employers prefer to hire people who take pride in their work because they usually work hard, require less supervision, and produce excellent results.

Taking pride in your work is really the same as taking pride in yourself. You can probably think of times when you have been filled with pride from doing some excellent work. This excellent work probably even boosted your self esteem. It's a great feeling to be able to take pride in a job well done. Your future customers, supervisors, and coworkers will recognize and appreciate your ability to take pride in your work. They will know it as a sure sign that you are doing the best work you can offer.



nailing it!

Imagine a home that can produce as much energy as it consumes. Building "zero-energy homes" is a long-term goal for the U.S. Department of Energy's Building America program. The program currently builds homes that use less energy, are faster to build, cost less, and provide a healthy environment. Building America creates teams of architects, planners, engineers, manufacturers, builders, and materials suppliers, who all work together to boost a home's performance and cut costs. Over the past 10 years, these teams have built more than 20,000 houses that use 30-90% less energy. Architect Betsy Pettit, one of the project managers for the program, describes these homes as "affordable the day you buy them and every day afterward."

Chapter Check

On a separate piece of paper, write your answers to the following questions:

Multiple Choice

1. Which one of the following words describe a persuasive work document?
   a) complete
   b) complex
   c) convincing
   d) quality conscious

2. Reading for meaning is something you do to a document when you are doing which of the following?
   a) proofreading
   b) scanning
   c) summarizing
   d) associative thinking

3. What type of thinking are you engaging in when you ask about the pay and benefits of a job you are considering?
   a) constructive
   b) associative
   c) critical
   d) creative

Fill in the Blank

4. To make sure you understand a written document, the first step is to _____ the document by looking it over quickly to get an idea of what it's about.

5. When proofreading an important document, you can ask a(n) _____ reader, someone who has not seen the document before, to read it and provide honest feedback.

6. Showing up on time for work every day and doing your job with little or no supervision demonstrates that _____ is one of your personal qualities.

True or False

7. Emotions play an important role in logical thinking. *T or F*

8. By definition, being quality conscious means using expensive materials. *T or F*

9. Every written business document should be persuasive. *T or F*

10. Innovators use associative thinking to come up with new ideas. *T or F*

Important Words

Associative thinking The ability to relate one thing to another while thinking creatively.

Creative thinking The ability to think of original and innovative ideas.

Critical thinking The ability to ask and answer probing questions when considering something or trying to solve a problem.

Logical reasoning The ability to come to a rational conclusion based on facts.

Reliability The quality of being dependable or trustworthy.

On the Trail of ...

Inventors use creative thinking to come up with original ideas and new products. Research an invention and its inventor. Write a short report on the inventor's thought process. How did he or she get the idea for the invention? Was associative thinking involved? How did the inventor's attitude and open-mindedness influence the process? What has been the impact of this invention on individual users or on society?

.com

Team up with another student. One of you is in the market to buy a certain product or material. The other one is the seller. Decide together what that product or material is. The buyer writes an email to the seller asking some questions, perhaps about product availability, price, delivery, color, and so on. The seller writes back with detailed answers. Both buyer and seller can use the internet for product ideas and information. Buyer and seller should print each other's email and correct it for spelling and grammar.

Being the First Choice

Knowing how to write and being able to display positive personal qualities will make you a valuable asset in the workplace. Imagine that you have an opportunity to be a team member for an exciting building project. The building project could be the set for a school play, a jungle gym for a local park, a deck for a friend's house, an 8-foot sailboat – anything that you'd be thrilled to help build. All the training would be provided on the job. With this dream project in mind, write a letter to your teacher, who will be the project manager. In the letter, list all the personal qualities you would bring to the project. Describe the ways in which you would demonstrate honesty, reliability, quality consciousness, and pride in your work.

Using Career Connections
Project Books

The Goals of the Course

Your purpose in teaching this course is twofold:

- To impart the knowledge, skills, behaviors, and attitudes that will prepare students to become competent entry-level carpenters; and
- To encourage students to implement their career choice by seeking out further training

Structure of Project Book 1

The first six chapters of the book have the following elements:

1. *What You Now Know,* a reminder of the major points students learned in the previous chapter
2. *What You Will Know,* a statement of the objectives of the present chapter
3. Introductory material, an overview of the major topics to be covered in the chapter
4. Safety information and practices related to the jobsite and to topics covered in the chapter
5. Presentation of the major topics
6. *Lead-Up Exercises,* actual practice exercises designed to let students practice the skills they will need to build each project

Chapters 7 through 11 contain the projects students will be building in the shop. Each chapter is structured this way:

1. Well-illustrated, detailed information about the project including a materials list
2. Expectations, describing the criteria for a satisfactorily built project
3. Step-by-step procedures for building the project with the critical specific steps illustrated
4. *Project Evaluation* document showing all components and dimensions of the project as well as the minimum and maximum number of points to be awarded for each component; there is also a scoring column

Structure of Project Book 2

The first two chapters of *Project Book 2* are review chapters: the first chapter reviews safety on the jobsite; the second chapter reviews tools, materials, and fasteners.

Chapters 3 through 7 contain the projects students will be building in the shop. Each chapter is structured this way:

1. Well-illustrated, detailed information about the project including a materials list
2. Expectations, describing the criteria for a satisfactorily built project
3. Step-by-step procedures for building the project with the critical specific steps illustrated
4. *Project Evaluation* document showing all components and dimensions of the project as well as the maximum number of points to be awarded for each component; there is also a scoring column

Structure of Project Books 3: Commercial Construction; Residential Construction

The first unit of each *Project Book 3* deals with concepts that are common to any type of construction, including safety; a review of tools; what it is like to be a carpenter on the job; and how to work from prints.

Units 2 through 8 of *Commercial Construction* and units 2 through 12 of *Residential Construction* deal with the building of a structure, including laying out walls, using tools and materials common to construction, building the structure, as well as installing the ceiling and the floor. Each unit is structured this way:

1. *What You Now Know*, a reminder of the major points students learned in the previous unit
2. *What You Will Know*, a statement of the objectives of the present unit
3. Introductory material, an overview of the major topics to be covered in the unit
4. Safety information and practices related to the jobsite and to topics covered in the unit
5. *Lead-Up Exercises*, actual practice exercises designed to let students practice the skills they will need to build each project

Additionally, each chapter is structured this way:

1. Well-illustrated, detailed information about each portion of the project including a materials list
2. Expectation describing the criteria for a satisfactory built project or portion of the project
3. Step-by-step procedures for building the project with the critical specific steps illustrated
4. Evaluation document showing all components and dimensions of the project as well as the minimum and maximum number of points to be awarded for each component; there is also a scoring column

What's Inside Career Connections

Project Book 1

Teacher Annotated Edition

Teacher annotations in the margins of the text provide teaching tips, activity suggestions, helpful building strategies, questions to promote understanding and discussion, online resources, ideas to motivate the students, and ideas to emphasize and incorporate safety.

Teacher's Resources provides you with a list of resources available to assist with the chapter.

Make Contact suggests outside resources that you can bring into the class or are helpful references.

The **Student Resources** provides a list of the items or materials these students will need access to.

Online Resources provides additional information related to the topic that can be found on the internet.

Reinforcement Activity provides methods of strengthening student comprehension.

Safety Emphasis provides methods and activities designed to emphasize important aspects of safety.

How it Works is a reminder to explain how an item functions.

The **Lesson Plan** provides you with strategies for teaching the lesson.

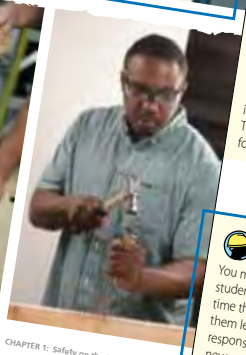
Proper Use of Tools

Lack of familiarity with tools is among the most common causes of work-related injuries. You should never use a tool until you have been trained to use it and have demonstrated your ability to operate it properly and safely. Both hand tools and power tools can cause injury when used improperly.

Saws, drills, routers, and other power tools must all be used with caution. Power tools are handy because they enable you to work quickly. Unfortunately, when used improperly, they can cause accidents and injuries just as quickly. Anyone wanting to use a power tool must be completely familiar with it before it is used.

You may think that safety is a less important concern with hand tools than with power tools. This could not be further from the truth. Hand tools require safe and proper handling to avoid injury. An improperly used hand tool has just as much potential of causing serious injury as does a power tool. Proper training and the ability to demonstrate the safe use of a tool are necessary before you operate any tool.

All tools, whether powered or not, must be kept clean and in good working condition. If you notice a tool that is broken, defective, or not working properly, you should report this immediately to your instructor or supervisor. Tools must also be properly stored when not in use. Never hesitate to admit you don't know something, and always feel free to ask your instructor or supervisor for assistance or for more information.



Teaching Tip

It is important to emphasize the need for safety with the tools. However, it is equally important to do this in a way that does not scare the students and make them afraid of the tools.

Check Understanding

Ask students which is more potentially hazardous – a utility knife or a power saw? Explain how a simple tool such as a utility knife can be just as hazardous as a power saw. A utility knife is sharp and can cause cuts and punctures. It is also a versatile tool that is used for many different tasks. Therefore it presents more chance for injury.

Safety Note

You may want to assign one student to check the tools every time they are used. This helps them learn to be accountable and responsible. However, you should never rely on the student's ability to identify all potential defects. In case a student does not report a defective tool or is not able to identify a problem, always check all the tools before distributing them to the students. Check all the tools after the stud... put the...

Safety Emphasis

Assure students that they will never get in trouble for reporting a defective tool. However, there could be consequences, including injury to a student, if they do not report it. Emphasize to the students how important it is to report any defective tool so it can be taken out of service and repaired.

The **Teaching Tip** provides you with information designed to assist in teaching the lesson.

Check Understanding provides methods of determining student comprehension.

The **Safety Note** provides methods of ensuring safety in the shop or with the projects.

- How likely is it that the situation or item will cause an accident or injury?
- What could go wrong if the situation or item is left unchanged?
- What are the likely consequences if it does go wrong?
- What is the source of the potential hazard?

Once you've answered these questions, you will be able to determine if the situation or item is a hazard. You will also have a better idea of the potential hazards you and others are likely to face. If you recognize a hazard or a potential hazard, be sure you tell others about it. Then take steps to eliminate the hazard or make it easier to avoid.

Never use a tool unless you know how to use it properly.

Safe Work Habits

The most effective way to prevent accidents is by developing safe work habits and sticking with them. If you make a habit of using safe working practices, it is less likely that you or someone else will be injured in an accident. Of course, safe work habits don't just happen. They must be developed over time and maintained through proper training, planning, and constant vigilance.

Knowledge and Skill

A safe carpenter is most likely to be a skilled carpenter. Ignorance, lack of skill, or lack of proper training could lead to an accident and injury. Never attempt a task unless you have the knowledge and skill necessary to complete it safely. Never use a tool unless you know how to use it properly. Always feel free to ask your instructor or supervisor for help if there is something you feel you cannot do safely.

Workplace Strategies

Provide the students with some real world scenarios taken from newspapers or the internet. Have students use the scenarios to answer these questions.

Critical Thinking

Give an example of a task and have a student walk through the planning process – for example taking a vacation. The student should decide on the destination and then be able to communicate their planning process; would you consult a travel agent, research the internet, ask a friend, just get in the car and go; what would you pack; how long will you stay; how will you pay for it; who will you go with; what will you pack; what will the weather be like; how will you get there, will you take a car, plane, or boat; how long it will take to get there; what will you do once you get there; how will you get around; and so on. Relate this example to a job in construction. It is easier to safely complete tasks when you have a plan, know what you are doing, how you are going to do it, and plan for any surprises.

Teacher's Notes

Workplace Strategies provides methods of reinforcing learning by placing students in real world situations.

Critical Thinking provides activities that help the student apply concepts learned to situations outside the classroom.

what's inside student edition

Career Connections Project Books

Career Connections Project Book 1 is organized to provide you with information on all aspects of safety, detailed information on measuring, marking, layout tools; basic carpentry hand tools; power tools for cutting, shaping, fastening, and finishing; and materials and fasteners.

What You Now Know is a reminder of the major points you learned in the previous chapter.

What You Will Know is a statement of the objectives of the present chapter.

Each section of **the introductory material** gives you an overview of the major topics to be covered in the chapter.

What You Now Know

- Tools make it easier to accomplish a task.
- Safety is an important part of tool use.

What You Will Know

- Why tools are so important to a carpenter
- How to use measuring, marking, and layout tools

MEASURING, MARKING, AND LAYOUT TOOLS

CONTENTS

26 CAREER CONNECTIONS: PROJECT BOOK 1

1 Showing Respect for Tools

On the job, tools are a carpenter's best friends. Very few carpentry tasks would be possible without some kind of tool. Carpenters and other craftspeople have been using tools of one kind or another for as long as tools have been invented. In fact, our ability to make and use complex tools is one of the things that distinguishes us as being human.

What Is a Tool?

A tool is any object or device that makes it easier to accomplish a task. For instance, a hammer is a tool that makes it easier to drive a nail. A ruler is a tool that makes it easier to measure a space or an object. Without tools, some jobs could hardly be done at all. For example, imagine how hard it would be to cut a thick piece of lumber without a saw.

CHAPTER 2: Measuring, Marking, and Layout Tools 27

Importance of Using Tools with Care

Since tools are so helpful and play such an important role in a carpenter's work, they should be shown proper respect. This means understanding how tools work and making a commitment to develop the skills necessary to use them properly. It means never using a tool for any purpose other than the one for which it was designed. It also means keeping tools clean and storing them properly when you are not using them. Above all, it means using tools in a safe manner at all times.

Importance of Tool Safety

No matter how familiar or unthreatening a tool may seem, when used improperly, any tool can cause an injury. That is why students and professional carpenters don't just learn how to use a tool. They learn how to use it safely.

Types of Tools

Carpenters use a broad range of tools. Many of these are hand tools, which require only the skilled hands and strength of the carpenter to make them work. Hand saws, block planes, wood rasps, utility knives, and tape measures are all examples of hand tools used in carpentry. Other tools used by carpenters get their power from a source other than human strength—electricity for example. Portable circular saws, belt sanders, electric drills, and screw guns are examples of power tools. In many cases, a hand tool and a power tool can be used effectively for the same task. A skilled carpenter knows how to work with both hand and power tools, and understands which tool to choose for each job.

Safety information and practices related to the topics are clearly and completely presented.

2 Tools Used for Measuring, Marking, and Layout

A carpenter doesn't just grab a tool and some materials and start building something. Successful projects take careful planning. Every carpentry project begins as an idea. This idea is usually written down in the form of a drawn plan, called a print. The plan may also include a set of instructions. Before carpenters start to build, they read the prints or instructions and then use the information they gained from the prints to measure and mark the materials necessary to build the project. This process of measuring and marking the materials is called a layout.

Prints or instructions contain lengths, widths, thicknesses, lines, and angles, all of which must be carefully transferred to the materials you intend to use. To transfer this information, not only must you be able to read prints, you will also need the appropriate measuring, marking, and layout tools. Using these tools correctly, as well as reading and interpreting prints, takes skill and practice. Layout also requires a basic understanding of mathematics, including geometry.

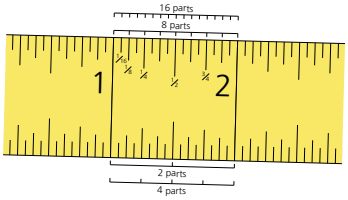
...using tools correctly takes skill and practice.

Linear Measurements

Most of the measurements made during the layout process are linear measurements. "Linear" is a term that means relating to a straight line. Therefore, a linear measurement is the length of a straight line, which is the shortest distance between two fixed points. The most commonly used tools for making linear measurements are measuring tapes, rules, and steel squares.

How Measuring Tools Are Marked

The edges of most measuring tools are marked in inches and fractions of an inch. Each inch is typically subdivided into the following fractions, or smaller parts, of an inch: ½″ (2 parts), ¼″ (4 parts), ⅛″ (8 parts), and 1⁄16″ (16 parts). Some extremely accurate measuring tools divide each inch even further into 32 or even 64 parts.



The **presentation of major topics** gives detailed descriptions and illustrations to help you visualize as you learn.

3 Retractable Tape Measure

A retractable tape measure is usually referred to as a tape measure or a measuring tape. You have probably seen or even used one. In fact, it is one of the tools most used by a carpenter. The retractable tape measure, shown in Figure 1, is a flexible piece of metal, called a tape or blade, which is housed in a plastic or metal case. The tape is usually spring loaded, which makes the tape easy to retract after it has been pulled out from the case.

The case has a locking mechanism that keeps the tape blade extended when it is pulled out to the desired length. The lock prevents the tape blade from automatically retracting into the case. Most tape measures have a floating hook at the end.

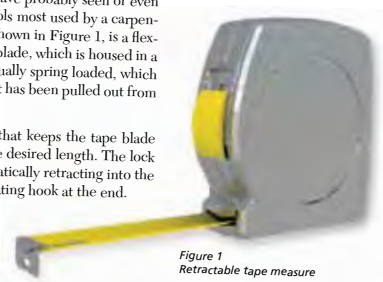


Figure 1
Retractable tape measure

Retractable Tape Measure Markings

The blades of nearly all retractable tape measures used in the United States are marked off in feet, inches, and fractions of an inch. Most tapes are clearly marked every 12″ with a black arrow and a number. The number is the length in feet at that point on the blade and the arrow makes the number easier to notice.

Between each arrow, and therefore between each foot marking, are inch marks. These inch marks are the numbers 1 through 11. Starting after the mark for the first foot, these numbers are usually smaller in size and usually red or some other color to distinguish them from the foot marks. Underneath these inch marks are larger numbers that also indicate inches. These inch marks represent the total number of inches from the beginning of the tape and are sequential. They are also the same color as the foot marks, which are usually black.

Project Book 1

Using a Hammer and a Chisel

To cut or shape wood, hold the sharpened edge of the chisel blade against the material with one hand. Then strike the chisel on the end of its handle with a hammer as shown in Figure 9. For cutting wood or other materials, hold the chisel at nearly a right angle to the material. When shaving or shaping wood, as shown in Figure 10, hold the blade at a low angle. The wood can be shaved or shaped by using the chisel without a hammer.

Figure 9
Strike chisel with hammer

Chisel Safety

As with any tool, safety comes first when handling or using a chisel. Since chisel blades are much thicker than knife or saw blades, it is easy to forget that they have very sharp cutting edges. Like other cutting or shaping tools, chisels can cause injuries. The following safety precautions will help prevent chisel-related accidents:

- When using a chisel, keep both hands behind the cutting edge and the chisel pointed away from the body.
- Be sure to secure the work piece so that it cannot move.
- Use one hand to strike the handle with a hammer while using the other hand to guide the chisel.
- Always hit the chisel squarely on the end of the handle. Glancing blows may cause the chisel to kick out and damage the wood or cause an injury to the user.
- Never place chisels in pants pockets since the sharp edge may cut through the material and cause an injury.
- When a chisel is not in use, the cutting edge of the blade should be protected.

To ensure safe use, chisels should always be kept clean, dry, and sharp. It takes more effort to use a dull chisel, and the extra force may cause the tool to slip and damage the material or injure the user.

Figure 10
Shaving with chisel

Using a Chisel to Cut a Gain

Hinges are often installed in shallow, rectangular recesses called gains. Usually gains are cut into the wood surface using a hammer and chisel. To cut a gain, use the following procedure:

You will need these tools and materials:

- Chisel
- Hammer
- Square butt hinge
- Pencil or utility knife
- Combination square
- Clamps
- 1 x 6 x 2'-0" pine board

LEAD-UP EXERCISE

1. Clamp the board to the work surface.
2. Place the hinge at the desired position and draw a line around the leaf of the hinge with a sharp pencil or mark the edges with a utility knife. See Figure 11.
3. Set the combination square to the thickness of the hinge. See Figure 12.

Figure 11
Drawing around the hinge

Figure 12
Combination square set to thickness of hinge

The **Lead-Up Exercises** are step-by-step, hands-on practice exercises designed to let you practice the skills you will need to build actual projects.

The **Contents** shows you the three projects from which you and the teacher may choose at every skill level.

BIRD HOUSE

CONTENTS

The **Expectations** describe the criteria that the teacher will use to evaluate your work.

1 Bird House

Because it is designed for use outdoors, the bird house is different from some of the other projects you will complete. It must be made of a material that will stand up well in all weather conditions. For this reason the bird house can be built with cedar, a wood known for its ability to resist moisture and decay.

However, working with cedar requires special precautions. Cedar has a tendency to split, so you will drill pilot holes to prevent fasteners from splitting the wood. Make sure your pilot holes are the correct size. They must be small enough for the threads of the screws to hold, but not so small that the screws split the wood.

Expectations

When your project is complete, it will be evaluated on its overall appearance and on the quality of your work. An example of a completed bird house is shown in Figure 1. The form the evaluator will use is found at the end of this chapter. The evaluator will consider the following criteria:

- There should be no gaps in joints, no shiners, and no splits.
- The dimensions should match those in the drawing.
- All pieces should be cut to within 1/8" of the dimensions shown in the prints.
- All fasteners should be inserted to the correct depth.
- There should be no tear outs caused by drilling holes.
- Holes should be drilled perpendicular to the face.

Figure 1
Bird house

You will need the following materials:

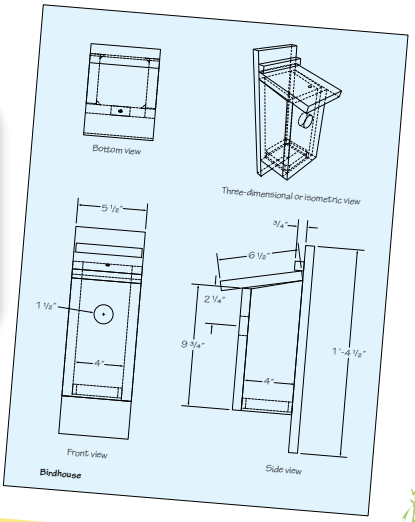
- 1 x 6 x 5'-0" pine or cedar board
- 6d galvanized nails
- (3) 1 ¼" construction screws

You will need the following tools:

- Combination square
- Tape measure
- Circular saw
- Rasp
- Drill with ⅜" chuck
- ⅛" twist drill bit
- 1 ½" spade bit
- Nail set
- Claw hammer
- Screw gun or screw driver
- Sandpaper
- Clamps
- Pencil

The **Materials List** tells you exactly what tools and materials are required to build your project.

Photographs clearly guide you through the building of your project by illustrating the critical steps.



PROCEDURE

Laying Out and Cutting the Pieces

1. Review the drawing.
2. Create a cut list. Your cut list should have seven pieces.
3. Check one end of the 1 x 6 x 5'-0" board for square. Cut to square if needed.
4. Secure the 1 x 6 x 5'-0" board to the work surface and reposition for the following cuts as needed.
5. Measure, mark, and cut one 6 ½" piece from the squared end of the board for the roof.
6. Measure, mark, and cut one 9 ¾" piece for the front wall.
7. Measure, mark, and cut one 1[illegible]

Make sure your pilot holes are the correct size.

Step-by-step **Procedures** guide you through the building of your project.

7. Nail the top in place, using four 6d nails on each long side equally spaced and one nail centered on each short side, placing the nails ⅜" inside the traced lines. See Figure 63.
8. Set the nails.
9. Wipe off any excess glue with a damp rag.
10. Smooth the rough edges and remove any pencil lines with sandpaper.
11. Finish as desired.

Figure 63
Figure 63 illustrates step 7

Student Name:_____ Date: _____

Tool Box Project Evaluation

PROCEDURE		CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Cutting the End Pieces, Side Pieces, and Handle	**Ends (2)**	Width	5	
		Height	5	
		Angles	5	
		Location of hole	5	
		Diameter of hole	5	
		Subtotal	*25*	
	Sides (2)	Length	5	
		Height	5	
		Square	5	
		Subtotal	*15*	
	Bottom	Length	5	
		Width	5	
		Square	5	
		Subtotal	*15*	
	Handle	Length	5	
Assembling the Tote Box	Square		4	
	Overall dimensions		4	
	No excess glue		2	
	Nails properly set		2	
	No splits and shiners		2	
	Edges flush		2	
	Joints tight		4	
	Subtotal		*25*	
General	Tool handling		5	
	Followed direction		5	
	Cleaned up		5	
	Safe work practices		5	
	Subtotal		*20*	
			Student score:	

Total Possible Points = 100

Suggested minimum acceptable score: 70 points or _____

Student

The **Project Evaluation** lets you know exactly how you will be graded and how many points are awarded for each component of your project. The maximum and minimum number of points to achieve a satisfactory performance are shown at the bottom.

Career Connections
Project Book 1

Career Connections Project List

Project Book 1

Chapter 7

- *Tote box*
- *Paper towel holder – alternate*
- *Foot stool – alternate*

Chapter 8

- *Bird house*
- *Saw key holder – alternate*
- *Coat rack – alternate*

Chapter 9

- *Step stool*
- *Chest – alternate*
- *Bread box – alternate*

Chapter 10

- *Bookcase*
- *CD rack– alternate*
- *Magazine rack – alternate*

Chapter 11

- *Tool box*
- *Kids' BBQ table – alternate*
- *Storage chest – alternate*

Project Book 2

Chapter 3

- *Notched-top sawhorse*
- *I-beam sawhorse – alternate*
- *Beveled-top sawhorse – alternate*

Chapter 4

- *Curved radius picnic table*
- *Folding picnic table – alternate*
- *Octagonal picnic table – alternate*

Chapter 5

- *Skateboard ramp*
- *Adirondack chair – alternate*
- *Folding work bench – alternate*

Chapter 6

- *Shed*
- *Garden tool shed – alternate*
- *Wishing well – alternate*

Chapter 7

- *Play house*

CHAPTER 8

BIRD HOUSE

CONTENTS

1 Bird House

Because it is designed for use outdoors, the bird house is different from some of the other projects you will complete. It must be made of a material that will stand up well in all weather conditions. For this reason the bird house can be built with cedar, a wood known for its ability to resist moisture and decay.

However, working with cedar requires special precautions. Cedar has a tendency to split, so you will drill pilot holes to prevent fasteners from splitting the wood. Make sure your pilot holes are the correct size. They must be small enough for the threads of the screws to hold, but not so small that the screws split the wood.

Expectations

When your project is complete, it will be evaluated on its overall appearance and on the quality of your work. An example of a completed bird house is shown in Figure 1. The form the evaluator will use is found at the end of this chapter. The evaluator will consider the following criteria:

- There should be no gaps in joints, no shiners, and no splits.
- The dimensions should match those in the drawing.
- All pieces should be cut to within 1/8″ of the dimensions shown in the prints.
- All fasteners should be inserted to the correct depth.
- There should be no tear outs caused by drilling holes.
- Holes should be drilled perpendicular to the face.

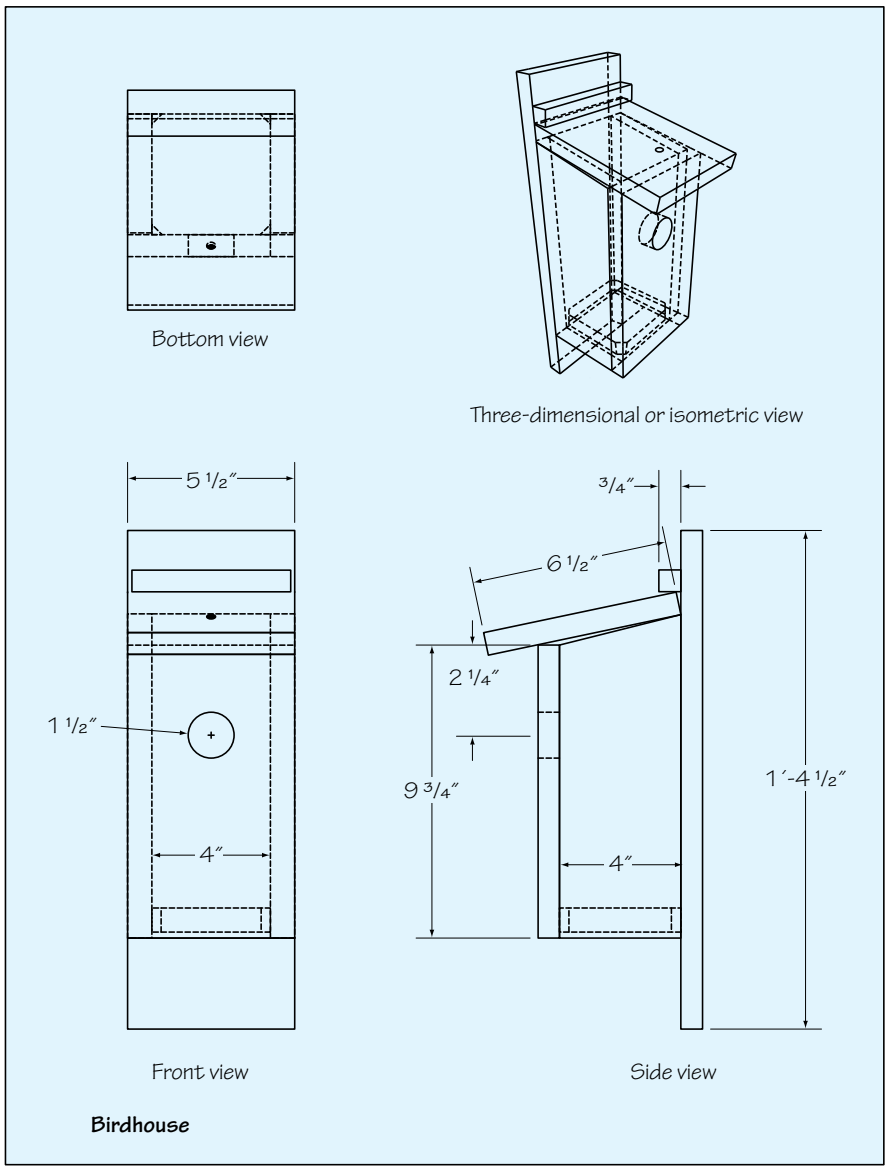
Figure 1
Bird house

You will need the following materials:

- 1 x 6 x 5´-0˝ pine or cedar board
- 6d galvanized nails
- (3) 1 ¼˝ construction screws

You will need the following tools:

- Combination square
- Tape measure
- Circular saw
- Rasp
- Drill with ⅜˝ chuck
- ⅛˝ twist drill bit
- 1 ½˝ spade bit
- Nail set
- Claw hammer
- Screw gun or screw driver
- Sandpaper
- Clamps
- Pencil



Birdhouse

PROCEDURE

Laying Out and Cutting the Pieces

1. Review the drawing.
2. Create a cut list. Your cut list should have seven pieces.
3. Check one end of the 1 x 6 x 5′-0″ board for square. Cut to square if needed.
4. Secure the 1 x 6 x 5′-0″ board to the work surface and reposition for the following cuts as needed.
5. Measure, mark, and cut one 6 ½″ piece from the squared end of the board for the roof.
6. Measure, mark, and cut one 9 ¾″ piece for the front wall.
7. Measure, mark, and cut one 16 ½″ piece for the back wall.

Make sure your pilot holes are the correct size.

Figure 2
Figure 2 illustrates step 9

8. Set the combination square to 4″.
9. Draw a line lengthwise on the remaining portion of the board using the combination square. See Figure 2.
10. Rip the board to 4″ along the line drawn in step 9 for the floor and the sides of the bird house.
11. Measure, mark, and cut a 4″ x 4″ piece for the floor of the bird house from the 4″ piece cut in step 10.
12. Measure and mark 10 ¾″ from one end of the board along one edge. See Figure 3.
13. Measure and mark 9 ¾″ from the same end of the board along the opposite edge. See Figure 4.

Figure 3
Figure 3 illustrates step 12

Figure 4
Figure 4 illustrates step 13

14. Draw a line between the two marks. See Figure 5.
15. Cut the board along the angled line; this creates one side wall of the bird house. See Figure 6.
16. Place the cut piece from step 15 on top of the board it was cut from and align the angled ends and edges.
17. Make a mark along the square end of the piece cut in step 15. See Figure 7.
18. Cut the board along the line made in step 17; this creates the other side wall of the bird house.
19. Measure, mark, and cut a 5 ¼″ long strip for the roof cleat from the ripped portion left over from step 10.

Figure 5
Figure 5 illustrates step 14

Figure 6
Figure 6 illustrates step 15

Figure 7
Figure 7 illustrates step 17

Figure 8
Figure 8 illustrates step 1

Shaping the Floor and Cutting the Entrance Opening

1. Remove approximately ¼″ x ¼″ at each corner of the 4″ x 4″ floor for drainage, using a rasp. See Figure 8.
2. Draw a vertical center line lengthwise on the 1 x 6 x 9 ¾″ front wall face.
3. Measure 2 ¼″ from one end of the front wall piece, along the center line, and make a mark to locate the center of the entrance opening. See Figure 9.
4. Secure the front wall piece to the work surface.
5. Drill a 1 ½″ hole at the center point laid out in step 3.
6. Sand any rough edges around the entrance opening.

Figure 9
Figure 9 illustrates step 3

Fasten the Front to the Sides

1. Stand one side wall piece on edge with the short edge facing up.
2. Make a temporary support for the front wall by butting the second side wall piece to the middle of the first side wall at a 90° angle to create a T. See Figure 10.
3. Place the front wall piece on top of the T, aligning the edge and bottom of the front wall piece with the edge and bottom of the first side wall piece. See Figure 11. The top of the front wall piece is closest to the hole previously drilled.
4. Drill pilot holes no less than ¾″ from the end, approximately every 1 ½″ to 2″ equally spaced for the 6d galvanized nails approximately ⅜″ in from the edge of the front wall piece.
5. Drive 6d galvanized nails through the pilot holes to secure the front wall piece to the side wall piece.
6. Pull the other side wall piece that was used to make the T support out from under the front wall piece.
7. Align the edge and bottom of the short edge of the second side wall piece with the edge and bottom of the front wall piece. See Figure 12.

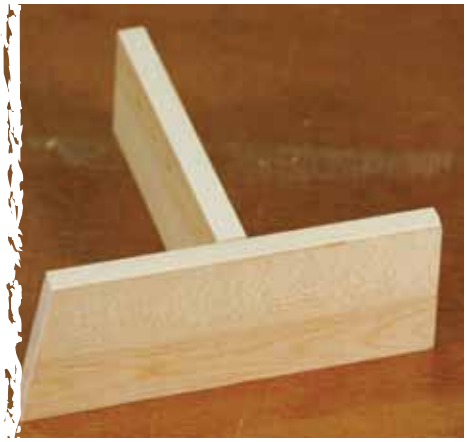


Figure 10
Figure 10 illustrates step 2

Figure 11
Figure 11 illustrates step 3

Figure 12
Figure 12 illustrates step 7

Figure 13
Figure 13 illustrates step 11

8. Drill pilot holes no less than ¾″ from the end, approximately every 1 ½″–2″ equally spaced for the 6d galvanized nails approximately ⅜″ in from the edge of the front wall piece.
9. Drive 6d galvanized nails through the pilot holes to secure the front wall piece to the second side wall piece.
10. Turn the assembled parts over so the front wall piece of the bird house is on the work surface.
11. Place the 1 x 6 x 16 ½″ back wall on top of the assembly, aligning the side edges and allowing the back to extend 3″ below the sides, creating an overhang at the bottom. See Figure 13.
12. Drill pilot holes no less than ¾″ from the end, approximately every 1 ½″–2″ equally spaced for the 6d galvanized nails approximately ⅜″ in from both edges from the back wall piece.
13. Drive 6d galvanized nails through the pilot holes to secure the back wall piece to the side wall pieces.
14. Slide the floor piece into the bird house from the bottom, so that ¼″ of the side wall pieces and front wall piece extends below the bottom piece. See Figure 14.
15. Drill two pilot holes that are equally spaced through each of the front, back and side wall pieces into the floor ⅝″ up from the bottom of the side and front wall pieces.

Figure 14
Figure 14 illustrates step 14

Figure 15
Figure 15 illustrates step 20

16. Secure the floor through the pilot holes with 6d galvanized nails.
17. Turn the assembled parts over so the back wall piece of the bird house is on the work surface.
18. Align the edges of the 1 x 6 x 6 ½″ roof piece with the edges of the side wall pieces.
19. Drill two ⅛″ pilot holes on the ¾″ side of the cleat 1″ from the ends.
20. Position the cleat at the intersection of the roof and back wall piece. See Figure 15.
21. Fasten the cleat to the back wall piece with two 1 ¼″ construction screws, leaving approximately ⅛″ clearance so that the top can be easily removed. See Figure 16.
22. Verify alignment of side wall edges with roof edges and drill a ⅛″ pilot hole though the roof into the top of the front wall piece. See Figure 17.
23. Thread the 1 ¼″ construction screw into the pilot hole attaching the roof to the front wall piece. See Figure 18.

Figure 16
Figure 16 illustrates step 21

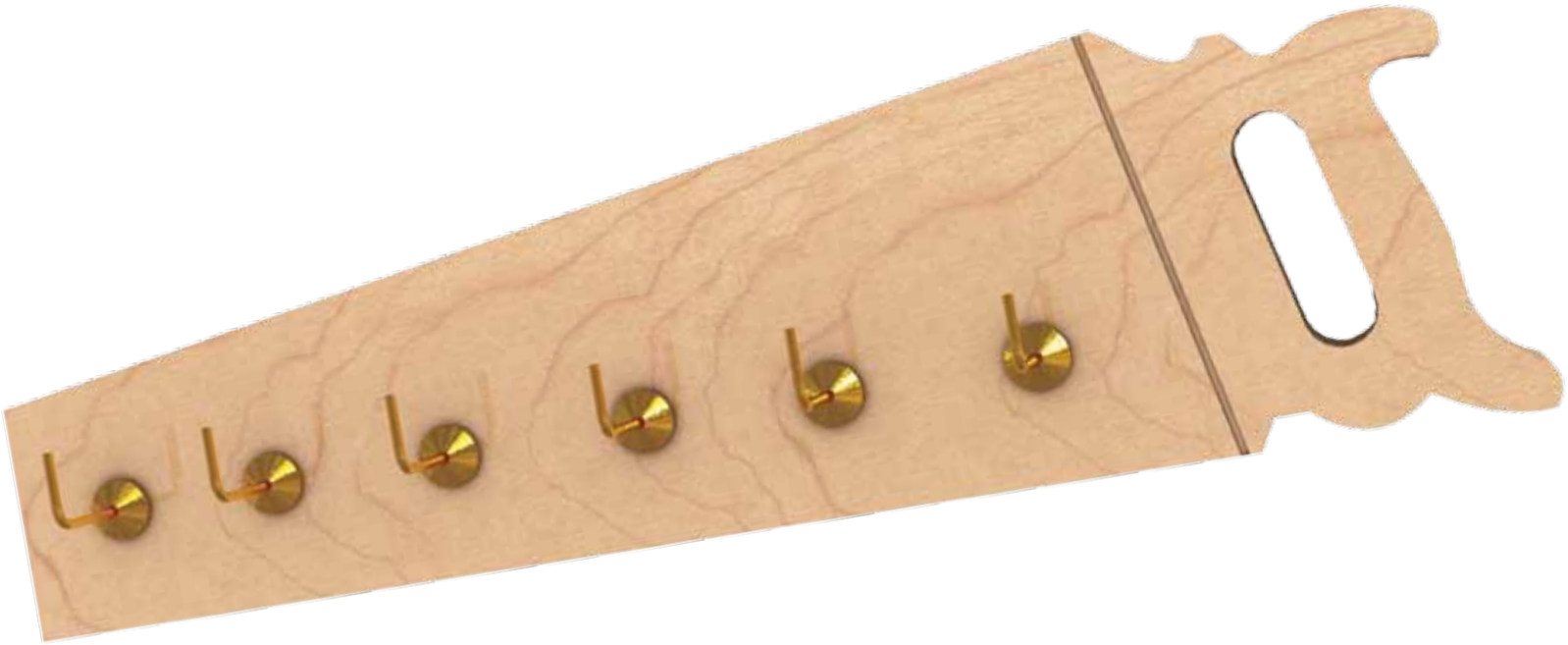
Figure 17
Figure 17 illustrates step 22

Figure 18
Figure 18 illustrates step 23

alternate project

2 Saw Key Holder

As an alternative to constructing a bird house, you may build a saw key holder. Like the other projects in this book, building the saw key holder will introduce you to basic carpentry skills and processes. In this case you will use pine wood, which you will cut with both a circular saw and saber saw.



Expectations

When your project is complete, it will be evaluated on its overall appearance and on the quality of your work. The form the evaluator will use is found at the end of this chapter. The evaluator will consider the following criteria:

- There should be no splits.
- The dimensions should match those of the template.
- All pieces should be cut to within 1/8″ of the dimensions of the template.
- All saw cuts should be smooth with no flat spots.

You will need the following materials:

- 1 x 8 x 14″ pine board
- (6) cup hooks

You will need the following tools:

- Template
- Tape measure
- Pencil
- Circular saw
- Saber saw
- Wood rasp
- Drill with ⅜″ chuck
- ½″ spade bit
- Block plane
- Sandpaper and block
- Clamps

Figure 19
Figure 19 illustrates step 2

PROCEDURE

1. Secure the template to the 1 x 8 x 14″ board aligning the bottom of the template with the bottom and the end of the board.
2. Trace the template onto the board. Be sure to include the two center marks for the handle opening and the line between the handle and the blade. See Figure 19.
3. Cut the straight line at the top of the saw key holder with the circular saw.
4. Cut the curved lines outlining the handle of the saw key holder with the saber saw. See Figure 20.

Figure 20
Figure 20 illustrates step 4

Figure 21
Figure 21 illustrates step 5

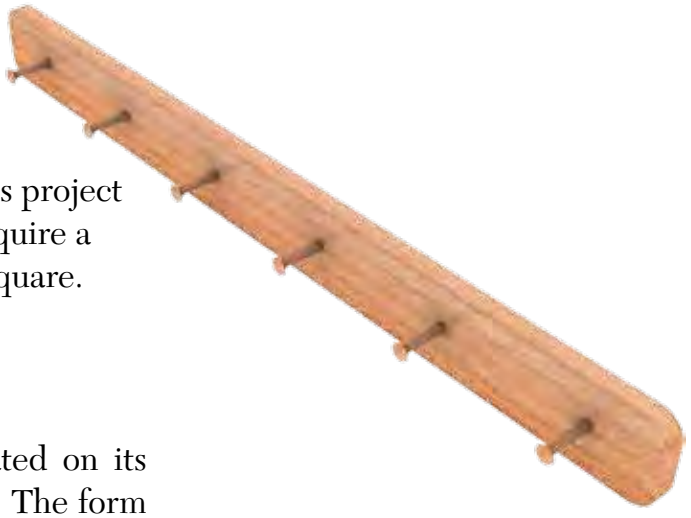
5. Drill two holes using the ½″ spade bit at the center marks defining the handle hole. See Figure 21.
6. Draw two straight lines connecting the two holes.
7. Cut out the handle hole with the saber saw.
8. Cut a kerf with the circular saw approximately ⅛″ deep along the line defining the handle. The finished cut is shown in Figure 22.
9. Smooth all surfaces and edges with the block plane, wood rasp, or sandpaper and then finish as desired.
10. Draw a barely visible line along the length of the key holder's blade 1 ¼″ from the bottom.
11. Screw in 6 cup holders, equally spaced, along the line. See Figure 23.

Figure 22
Figure 22 illustrates step 8

Figure 23
Figure 23 illustrates step 11

alternate project 3

Coat Rack



Another alternate project is making a coat rack. This project calls for the installation of wooden pegs that will require a careful layout using a compass and a combination square.

Expectations

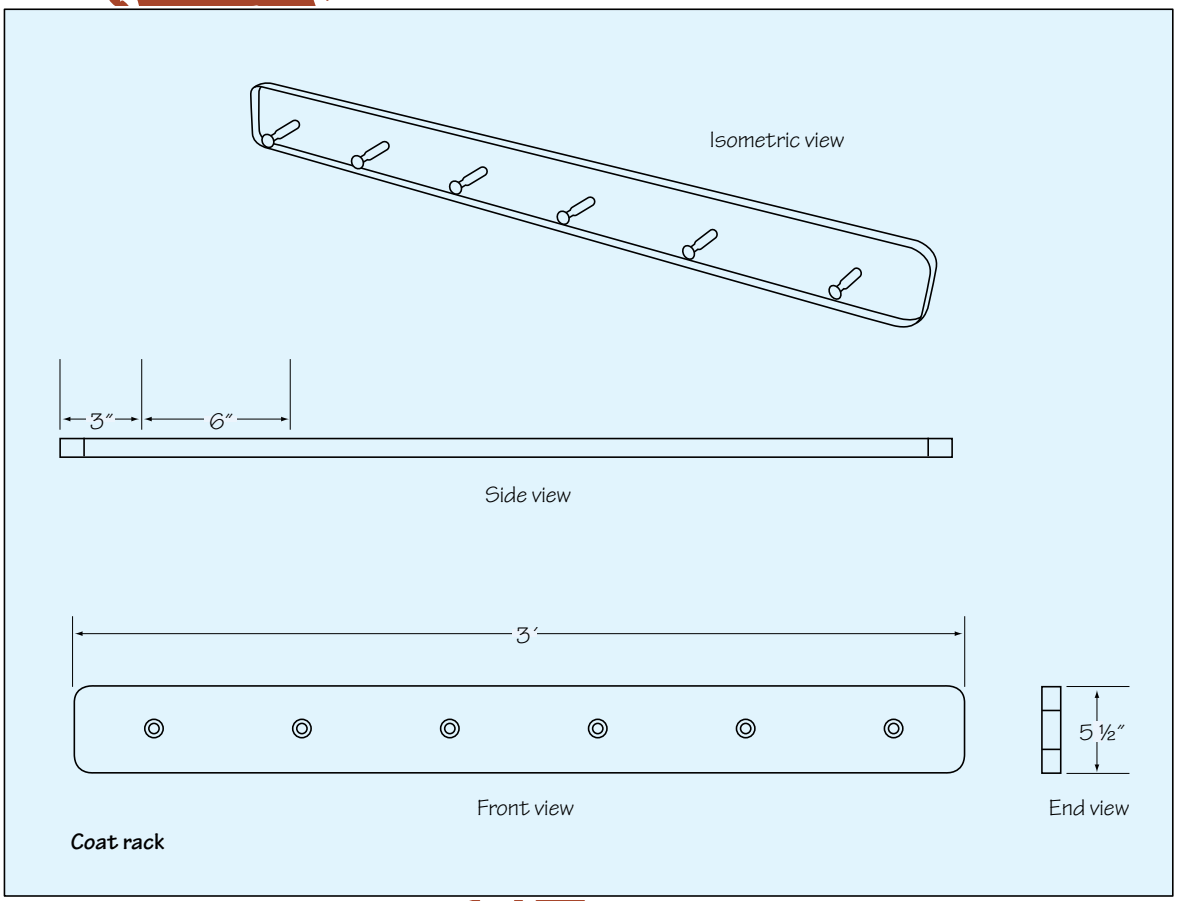
When your project is complete, it will be evaluated on its overall appearance and on the quality of your work. The form the evaluator will use is found at the end of this chapter. The evaluator will consider the following criteria:

- Dimensions should match those in the drawing.
- Holes should be drilled perpendicular to the face of the rack.
- There should be no splintering left from drilling holes.
- All dimensions should be within ⅛″ of the dimensions on the drawing.
- There should be no excess glue on the project.

When your project is complete, it will be evaluated on its overall appearance and on the quality of your work.

You will need the following materials:

- 1 x 6 x 4′-0″ pine board
- (6) 2 ½″ x 7⁄16″ shaker pegs
- Wood glue
- Tape measure
- Pencil
- Compass
- Circular saw
- Saber saw
- Wood rasp
- Drill with ⅜″ chuck
- 7⁄16″ twist bit
- Mallet
- Block plane
- Sandpaper
- Rag
- Small bucket of water



Coat rack

PROCEDURE

Cutting the Board

1. Check one end of the 1 x 6 x 4′-0″ pine board for square. Cut to square if needed.
2. Measure and cut a piece 3′-0″ long with the circular saw.
3. Set the blade of the combination square to 1″.
4. Scribe parallel lines from both edges and both ends with the combination square. See Figure 24.
5. Set the compass to a radius of 1″.
6. Place the point of the compass at the intersection of the scribed lines and swing a 1″ arc to lay out the rounded corners. See Figure 25.
7. Cut the rounded corners with a saber saw. See Figure 26 .

Figure 24
Figure 24 illustrates step 4

Figure 25
Figure 25 illustrates step 6

Figure 26
Figure 26 illustrates step 7

Figure 27
Figure 27 illustrates step 3

Laying Out and Installing the Pegs

1. Set the combination square to one half the width of the board.
2. Lightly scribe a center line along the length of the board using the combination square.
3. Measure in from each end 3″ and place marks on the center line to locate the first and last pegs. See Figure 27.
4. Equally space the four remaining pegs along the center line. See Figure 28.
5. Drill the six holes for the pegs ½″ deep using the 7⁄16″ twist bit. See Figure 29.
6. Smooth all surfaces and edges with the block plane, wood rasp, or sandpaper.

Figure 28
Figure 28 illustrates step 4

Figure 29
Figure 29 illustrates step 5

7. Place a small drop of glue in the bottom of each hole and a light coating on the shank of each peg. See Figure 30.
8. Install the pegs in each hole with a twisting motion. See Figure 31. Lightly tap with a mallet if necessary to properly seat the peg.
9. Wipe off any excess glue with a damp rag.
10. Sand and finish as desired.

Figure 30
Figure 30 illustrates step 7

Figure 31
Figure 31 illustrates step 8

Student Name:_____ Date: _____

Bird House Project Evaluation

PROCEDURE		CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Laying Out and Cutting the Pieces	**Roof**	Length	5	
	Front wall	Length	5	
	Back wall	Length	5	
	Floor	Length	5	
		Width	5	
	Sides (2)	Length	5	
		Width	5	
	Roof cleat	Length	5	
	All pieces cut square or to correct angle		5	
		Subtotal	*45*	
Shaping the Floor and Cutting the Entrance Opening	**Floor**	Shaped	5	
	Opening	Location of hole	5	
		No tear outs	5	
		Subtotal	*15*	
Fastening Front and Sides (Assembly)	Pieces square		4	
	Bird house square		4	
	Nails properly set		2	
	No splits and shiners		2	
	Edges flush		2	
	Joints tight		4	
		Subtotal	*18*	
General	Tool handling		5	
	Followed direction		5	
	Cleaned up		5	
	Safe work practices		5	
		Subtotal	*20*	
			Student score:	

Total Possible Points = 98

Suggested minimum acceptable score: 69 points or _____

Student's Signature: _____ Teacher's Signature: _____

Student Name:_____ Date: _____

Saw Key Holder Project Evaluation

PROCEDURE	CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Laying Out and Cutting the Pieces			
Dimensions	Width matches template	5	
	Length matches template	5	
	Top of saw handle cut	5	
	Bottom of saw handle cut	5	
	End of saw handle cut	5	
	Hole in saw handle	5	
	Saw handle kerf	5	
	Cup hook alignment	5	
	Cup hook spacing	5	
	Subtotal	*45*	
Overall	No splits	5	
	Subtotal	*5*	
General	Tool handling	5	
	Followed direction	5	
	Cleaned up	5	
	Safe work practices	5	
	Subtotal	*20*	
		Student score:	

Total Possible Points = 70

Suggested minimum acceptable score: 49 points or _____

Student's Signature: _____ Teacher's Signature: _____

Student Name:_____ Date: _____

Coat Rack Project Evaluation

PROCEDURE	CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Laying Out and Cutting the Pieces			
Board	Length	5	
	Square	5	
	Radius (4)	20	
	Pegs (2)	10	
	Depth of holes (6)	12	
	Subtotal	*52*	
Assembly	Peg square to board (6)	12	
	Surfaces smooth	5	
	No excess glue	5	
	No splits	5	
	Subtotal	*27*	
General	Tool handling	5	
	Followed direction	5	
	Cleaned up	5	
	Safe work practices	5	
	Subtotal	*20*	
		Student score:	

Total Possible Points = 99

Suggested minimum acceptable score: 69 points or _____

Student's Signature: _____ Teacher's Signature: _____

CHAPTER 5
SKATEBOARD RAMP

Introduction

This chapter offers you a choice of three very different and very interesting projects. You may build a skateboard ramp that may very well receive heavy use in your neighborhood, an Adirondack chair that would look good in any garden, or a portable folding workbench that would make a handy addition to any shop. By completing one or another of these projects, you will expand your knowledge of carpentry tools, materials, and techniques. Each of these projects will also give you a chance to practice the carpentry skills you have already learned.

What's New?

The projects in this chapter are intended to expand your carpentry knowledge and skills. Completing a skateboard ramp, Adirondack chair, or portable folding workbench will require you to learn about processes, procedures, tools, and techniques that, as yet, may be unfamiliar to you. Among these are the following:

Caulking Gun A caulking gun is a manual or power tool used to apply caulk or adhesive that is supplied in a tube. See Figure 1. When pressure is applied to the handle or trigger of the caulking gun, it extrudes the caulk or adhesive through a nozzle of the tube.

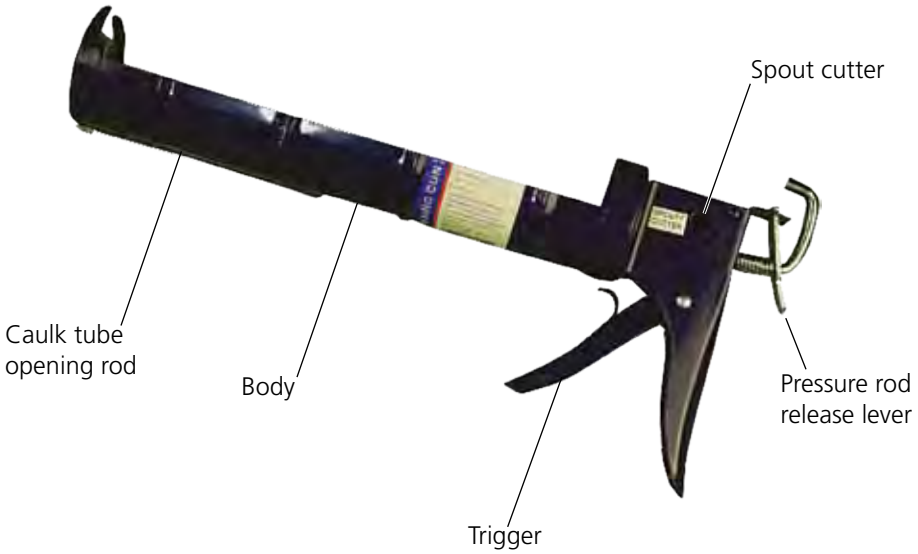


Figure 1
Caulking gun

Figure 2
Combination pilot hole and countersink bit

Combination Pilot Hole and Countersink Bit A specialized drill bit for wood that bores a pilot hole and countersinks in one operation is a combination pilot hole and countersink bit. See Figure 2. These bits are sized for specific sized screws. For example, a #8 bit is used for #8 screws.

Figure 3
Exterior wood glue

Exterior Wood Glue Designed for outdoor use, exterior wood glue contains chemicals that help it resist heat, cold, and moisture. Exterior wood glue is an excellent choice of adhesive for constructing outdoor furnishings. See Figure 3.

Panel Adhesive Panel adhesives are specially designed for bonding manufactured panels. When selecting a panel adhesive, refer to the panel manufacturer's specifications. Panel adhesives are usually applied with a caulking gun. See Figure 4.

Figure 4
Panel adhesive

Piano Hinge A piano hinge is a long, narrow hinge that is designed to run the full length of the two surfaces that are to be joined with the hinge. The two leaves of a piano hinge are held together by a pin that allows it to pivot freely. See Figure 5.

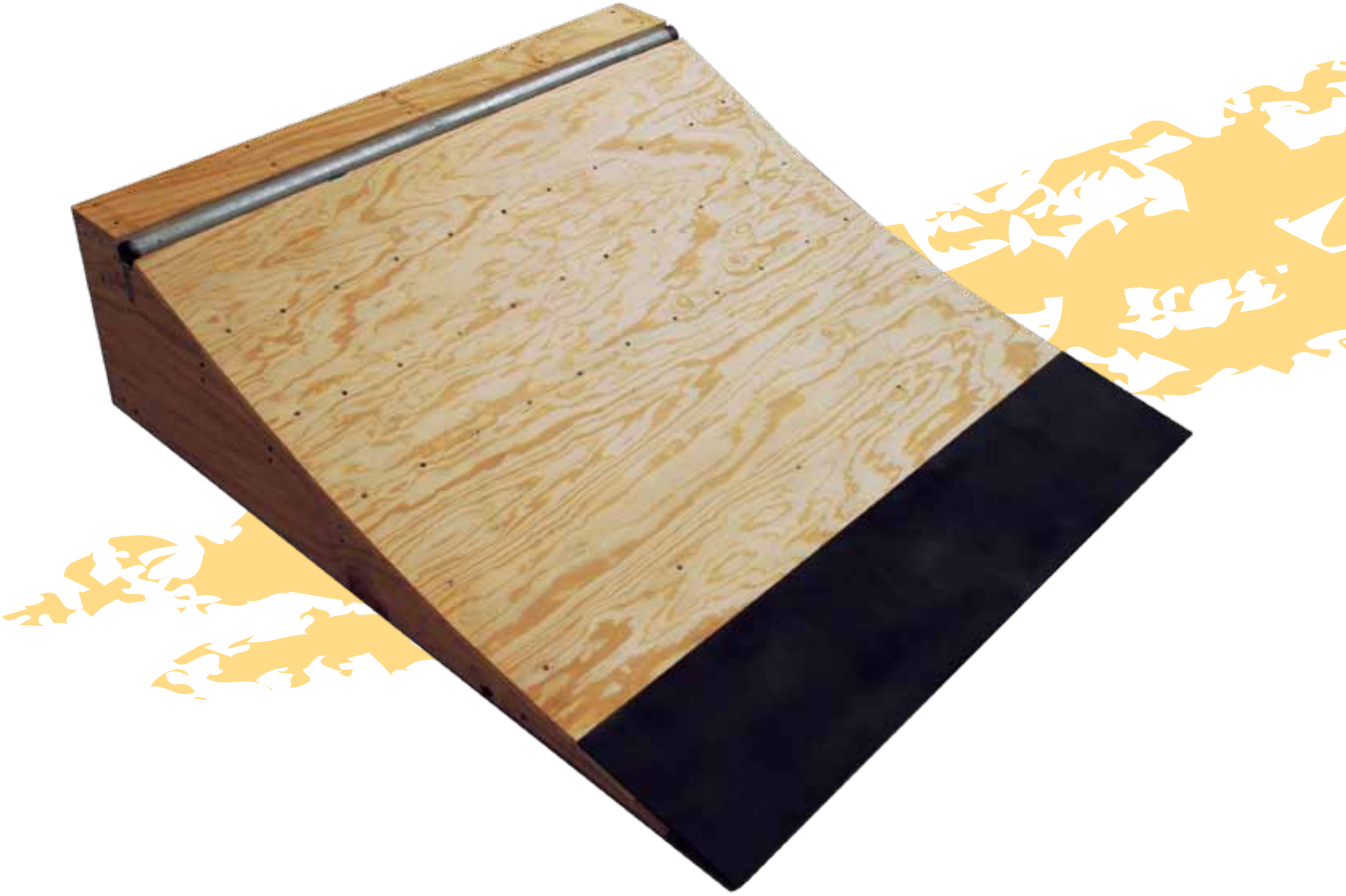
Figure 5
Piano hinge

Poplar A type of wood that is relatively soft and light. Poplar lumber is easy to cut and work, and it receives paint or stain well. See Figure 6.

Figure 6
Poplar

1 Skateboard Ramp

The curved surface of a skateboard ramp gives roller skaters or skateboarders a place to build up momentum for jumps and other acrobatics. These ramps can provide hours of fun for kids and adults. By following the detailed instructions provided in this section, you can build a highly serviceable and entertaining skateboard ramp of your own, and learn a lot about carpentry in the process. For example, you will learn how to apply panel adhesive with a caulking gun, work with steel pipe and steel plate, and use a countersink bit.



You will need the following materials:

- (1) ¼″ x 4′ x 4′ plywood
- (1) ⅜″ x 4′ x 4′ plywood
- (1) ¾″ x 4′ x 4′ plywood
- (1) ½″ x 2′ x 4′ plywood
- (6) 2 x 4 x 8′-0″ lumber
- (1) 2″ outside diameter galvanized steel pipe 4′ long
- (1) ⅛″ x 10 ⅜″ x 4′ steel plate
- (2) 11-oz tubes of panel adhesive
- (2) 3″ x 3″ x ⅛″ steel 90° brackets
- (24) 1″ deck screws
- (30) 3″ deck screws
- (64) 2″ deck screws

. . . you can build a highly serviceable and entertaining skateboard ramp of your own. . .

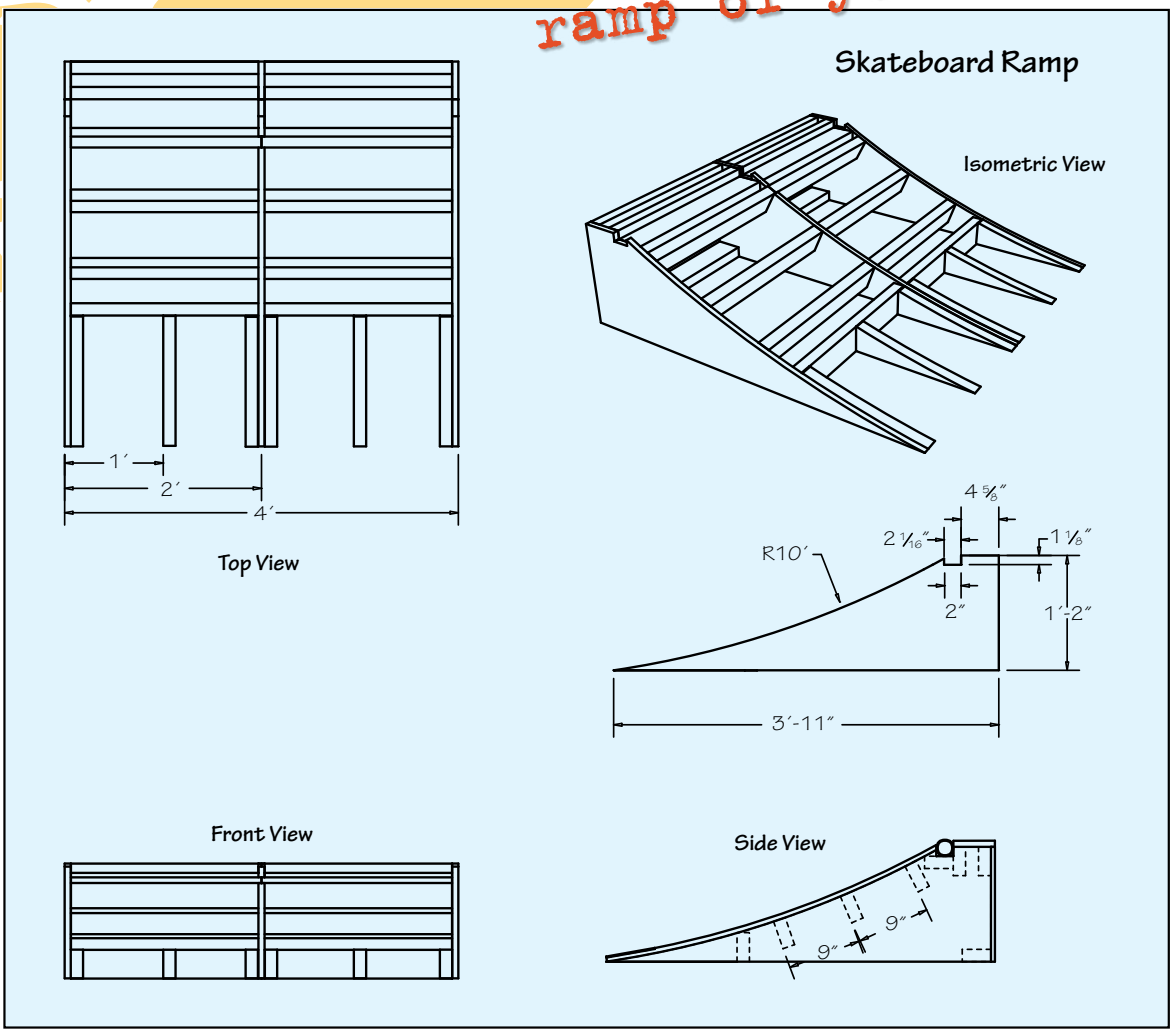


Figure 7
Figure 7 illustrates step 3

You will need the following tools:

- Caulking gun
- Center punch
- Hammer
- Chalk box
- Circular saw
- Clamps
- Combination square
- Countersink bit to cut steel
- Electric drill
- Drill index
- Pencil
- Tape measure
- Saber saw
- (2) Sawhorses
- Screw gun

Figure 8
Figure 8 illustrates step 5

Cut the Ends and Center Support

Construction of the skateboard ramp begins with cutting three pieces of ¾″ plywood for the two ends and the center support. You will use a saber saw to make a curved cut on each of the three plywood pieces. The first piece cut will provide a pattern for the remaining two pieces.

PROCEDURE

1. Prepare a work surface by laying two 2 x 4s on top of two sawhorses.
2. Lay the ¾″ plywood on top of the work surface.
3. Layout and cut three pieces 14″ x 4′-0″ from the ¾″ plywood, cutting with the grain. See Figure 7.
4. Measure 5″ along the 4′-0″ side from one of the pieces cut in step 3 and make a mark at the edge. This will be the top of the ramp.
5. Using the ⅛″ steel plate as a straightedge, scribe a line from the mark made in step 4 diagonally to the opposite corner. See Figure 8.

6. Measure the diagonal line and make a mark at the center.
7. Scribe a line perpendicular to the diagonal line at the center marked in step 6, toward the bottom of the ramp. See Figure 9.
8. Measure and mark 2″ along the perpendicular line. See Figure 10.

Figure 9
Figure 9 illustrates step 7

Figure 10
Figure 10 illustrates step 8

Figure 11
Figure 11 illustrates step 9

Figure 12
Figure 12 illustrates step 10

9. Tack a nail at the mark made in step 8. See Figure 11.
10. Stand the steel plate behind the nail and bend the ends to the 5″ mark made in step 4 and to the bottom corner. This creates the curve in the ramp. See Figure 12.
11. Trace the curve on the plywood on the nail side of the metal plate.
12. Remove the metal plate and nail.
13. Cut the curve with the saber saw. See Figure 13.

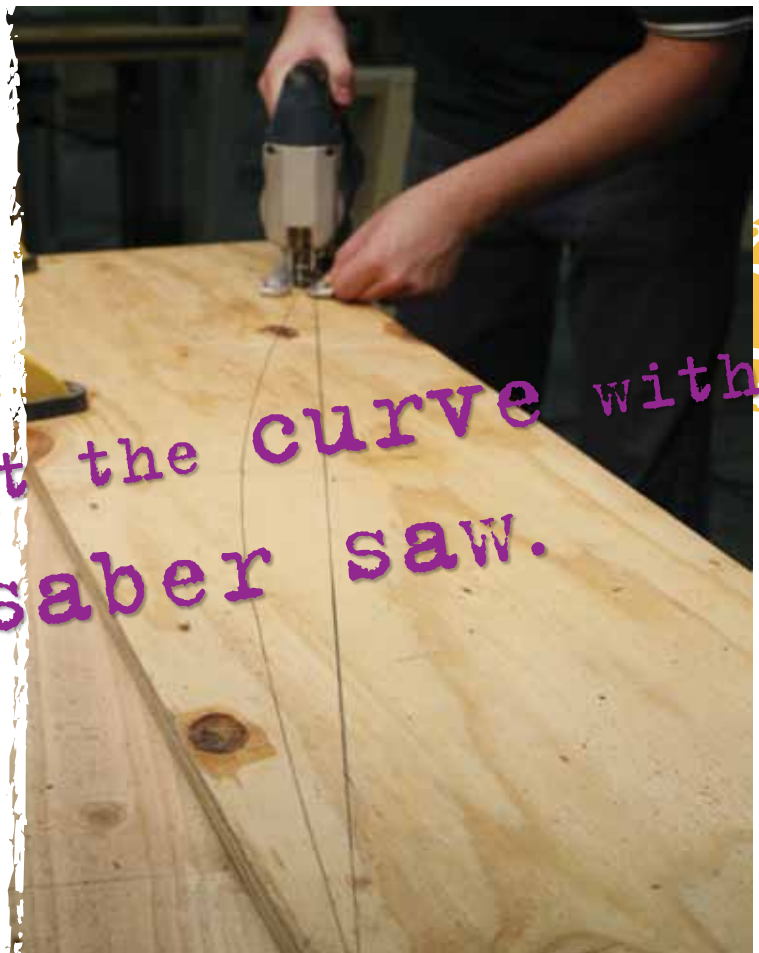


Figure 13
Figure 13 illustrates step 13

Figure 14
Figure 14 illustrates step 14

14. Locate the notch for the pipe by drawing a square line at the 5″ mark approximately 2″ long. See Figure 14.
15. Measure 1 ⅛″ on the line drawn in step 14 and place a mark. See Figure 15.
16. Draw a square line through the 1 ⅛″ mark back to the curved surface with the combination square. See Figure 16.

Figure 15
Figure 15 illustrates step 15

Figure 16
Figure 16 illustrates step 16

Figure 17
Figure 17 illustrates step 18

17. Cut out the notch for the pipe formed by the lines made in steps 14–17 with a saber saw.
18. Use this piece of plywood as a pattern to mark and cut the other two 14″ x 4′-0″ pieces to match. See Figure 17. These three pieces will serve as the two ends and the center support. Make sure to trace the notch as shown in Figure 18.

Figure 18
Figure 18 illustrates step 18

Cut the Blocking and Wedges

Next you will cut blocking and wedges to support the panels and other parts of the skateboard ramp. Usually, solid blocks of wood are screwed or glued between the panels for use as blocking. In this case, the blocking will consist of 16 separate pieces cut from 2 x 4 lumber. The wedges will support the end of the ramp.

PROCEDURE

1. Using four 2 x 4 x 8′-0″ boards, cut sixteen 2 x 4 blocks 22 ⅞″ long to be used for blocking between the plywood panels.
2. On a 2 x 4 x 8′-0″ board measure and mark a square line 16″ from a square end. See Figure 19.
3. Draw a diagonal line across the board from one corner of the square end to the marked line. See Figure 20.

Figure 19
Figure 19 illustrates step 2

Figure 20
Figure 20 illustrates step 3

Figure 21
Figure 21 illustrates step 4

4. Cut down the center of the diagonal line with the circular saw. See Figure 21.
5. Cut along the squared line made in step 2. See Figure 22.
6. Repeat steps 2–5 two more times to produce six wedges. These will be used to support the end of the ramp.

Figure 22
Figure 22 illustrates step 5

Assemble the Sides and Blocking

Now that the sides and blocking are cut, they can be assembled. This process will require two people. You will need a screw gun as well as both 2″ and 3″ deck screws.

PROCEDURE

1. Stand two of the three plywood support sections upright.
2. Fasten two plywood sections to the first block using the 2″ deck screws and the screw gun. Use two screws through the plywood into each end of the block. See Figures 23a, b.

Figure 23
Figures 23a and 23b illustrate step 2

3. Fasten the third plywood section to the second block using the 2″ deck screws and the screw gun. Use two screws through the plywood into one end of the block. Angle screw through the center plywood section into the second block. See Figure 24.

Figure 24
Figure 24 illustrates step 3

4. Measure up the curve 16″ from the bottom end of the ramp and place a mark on each end panel. See Figure 25.
5. Use a chalk line to snap a line through the marks on each end panel, marking the center panel.
6. Attach one 16″ tapered wedge to the face of a 22 7/8″ block at each end using two 3″ deck screws for each wedge.
7. Center and fasten the third wedge between the wedges fastened in step 6 with two 3″ deck screws. See Figure 26.
8. Repeat steps 6 and 7 for the second wedge assembly.

Figure 25
Figure 25 illustrates step 4

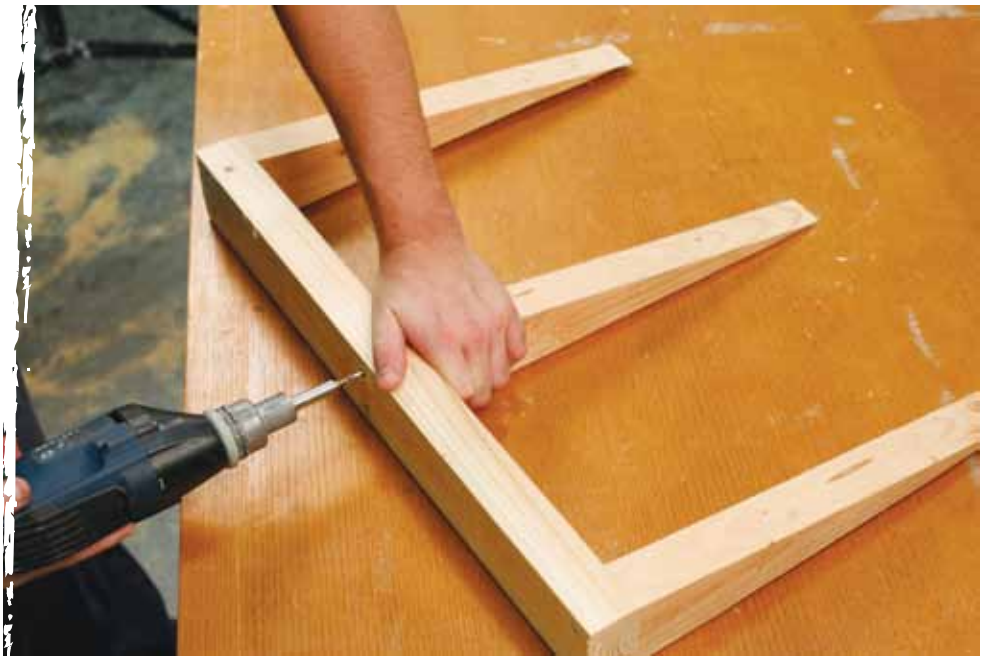


Figure 26
Figure 26 illustrates step 7

Figure 27
Figure 27 illustrates step 9

9. Position one wedge assembly between an end panel and the center panel along the line established in step 5 and fasten in place with 2″ screws on each end. See Figure 27.
10. Fasten the other wedge assembly in place through the plywood with 2″ screws on each end. See Figure 28. Attach the blocking to the center panel using 3″ deck screws placed at an angle.
11. Position a 22 7/8″ block on edge between an end panel and the center panel, aligning the top edge of the block with the top edge of the panels and the face of the block with the vertical edge of the notch for the pipe .
12. Fasten in place with 2″ deck screws through the plywood panels. See Figure 29.

Fasten in place...

Figure 28
Figure 28 illustrates step 10

Figure 29
Figure 29 illustrates step 12

13. Repeat steps 11 and 12 to install the block between the center panel and other end panel.
14. Position two 22 7/8″ blocks horizontally between the panels, against the blocks installed in steps 11–13, and align the top edges of these blocks with the bottom edges of the cutout.
15. Fasten in place with 2″ deck screws through the panels and 3″ deck screws through the vertical 2 x 4 blocks installed in steps 11–13.
16. Position two 22 7/8″ blocks horizontally between the panels, against the blocks installed in steps 11–13, and align the top edges of those blocks with the top edge of the panels. Figure 30 shows the completed step.
17. Install the six remaining blocks equidistant between the pipe notch and the 2 x 4s of the wedge assembly with 2″ deck screws. Figure 31 shows step 17 completed.

Figure 30
Figure 30 shows step 16 completed

Figure 31
Figure 31 shows step 17 completed

Cut and Install the Back Supports

The back of the skateboard ramp will consist of ½″ plywood held in place with 2″ deck screws. The plywood back will be attached to 2 x 4 supports fastened to the insides of the end pieces and to one side of the center piece.

Figure 32
Position of 2 x 4 supports

PROCEDURE

1. Cut three 2 x 4 x 11″ supports.
2. Fasten the 2 x 4 x 11″ supports with 2″ deck screws to the insides of each end piece and on one side of the center piece. As shown in Figure 32, the 2 x 4 supports should be vertical, between the blocks, with the face against the plywood.

Cut and Install the Plywood Back

PROCEDURE

1. Cut a piece of ½″ plywood 14″ x 4′-0″. Be sure to cut with the grain.
2. Place the plywood against the back of the ramp.
3. Align the edges and fasten the plywood to the 2 x 4 supports and spreader blocks with 2″ deck screws. See Figure 33.

Figure 33
Figure 33 illustrates step 3

Installing the Top and the Plywood for the Ramp

Now it is time to cut and install the top and the plywood face for the ramp. The top will consist of ¾″ plywood, and the ramp will consist of a 4′-0″ x 4′-0″ piece of ⅜″ plywood and a 4′-0″ x 4′-0″ piece of ¼″ plywood. The pieces will be held in place with both deck screws and adhesive.

Figure 34
Position of plywood

PROCEDURE

1. Turn the assembly upright.
2. Cut a piece of ¾″ plywood 5 ½″ x 4′-0″.
3. Place it on the top flush with each side and against the pipe as shown in Figure 34.
4. Fasten with 2″ deck screws into the 2 x 4 blocking. See Figure 35.

Figure 35
Figure 35 illustrates step 4

5. Apply a bead of the panel adhesive on the 2 x 4 blocks on the curve of the ramp, the wedges, and the tops of the support plywood. Do not apply adhesive to the last 8″ of the wedges at this time. See Figure 36.
6. Center the 4′-0″ x 4′-0″ x ¼″ plywood onto the assembly against the pipe and align it to the edges of the side panels with the grain running across the assembly. See Figure 37.

Figure 36
Figure 36 illustrates step 5

Figure 37
Figure 37 illustrates step 6

7. Screw the ¼″ plywood to the 2 x 4 blocking with 2″ deck screws, starting at the top of the ramp and working to the bottom. Place the screws 2″ from each end and 4″ on center thereafter. Do not screw into the wedges at this time. See Figure 38.
8. Apply construction adhesive over the ¼″ plywood. See Figure 39.

Figure 38
Figure 38 illustrates step 7

Figure 39
Figure 39 illustrates step 8

Figure 40
Figure 40 illustrates step 9

9. Center the 4′-0″ x 4′-0″ x ⅜″ plywood onto the assembly against the pipe and align it to the edges of the side panels with the grain running across the assembly. See Figure 40.
10. Screw the ⅜″ plywood through the ¼″ plywood into the 2 x 4 blocking with 2″ deck screws, starting at the top of the ramp and working to the bottom. Place the screws approximately 1″– 2″ from each end and 4″ on center thereafter. Do not screw into the wedges at this time. See Figure 41.

Figure 41
Figure 41 illustrates step 10

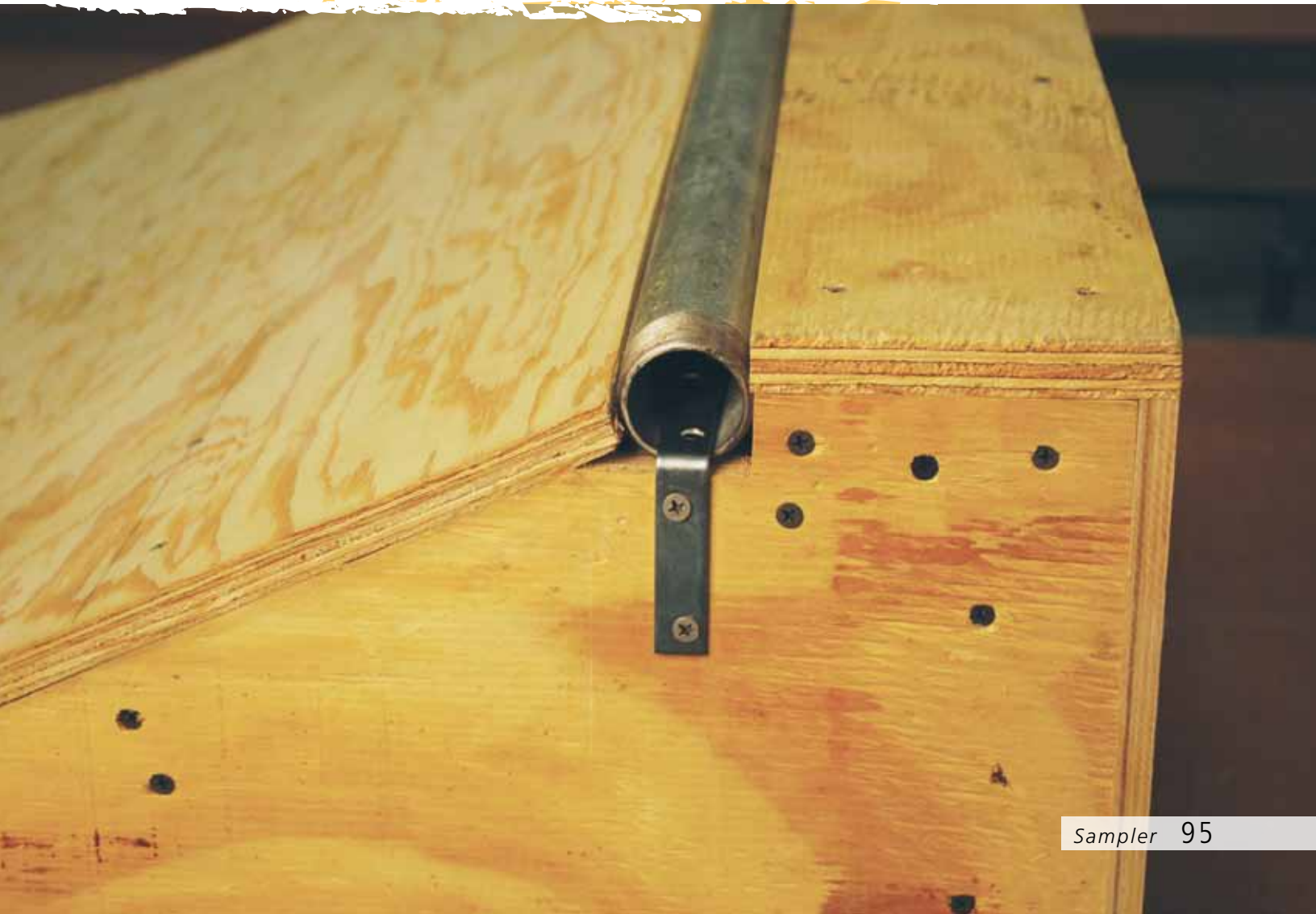
Install the Pipe

To install the pipe, you will need to attach two 90° brackets, one at each end of the pipe. Be sure to avoid drilling through the top of the pipe.

PROCEDURE

1. Lay the assembly upright.
2. Set the pipe in position in the notch.
3. Place one leg of the 90° bracket in the bottom of the pipe and the other leg tight to the plywood.
4. Install two 3" deck screws in the holes of the bracket through the plywood and into the supporting 2 x 4 behind the plywood. See Figure 42.
5. Repeat steps 3 and 4 for the other 90° bracket on the opposite side.

Figure 42
Figure 42 illustrates step 4



Install the Metal Plate

In this final stage of construction you will complete the process of attaching the ramp. You will also install the steel plate to protect the edge of the ramp using screws and adhesive. You will countersink each screw so that its head is flush with the surface.

Figure 43
Figure 43 illustrates step 1

PROCEDURE

1. Measure 3′-6 ½″ from the back edge of the ramp along the bottom and make a mark on the curved plywood ramp on each side. See Figure 43.
2. Snap a line across the curved surface of the ramp through the marks made in step 1. See Figure 44.

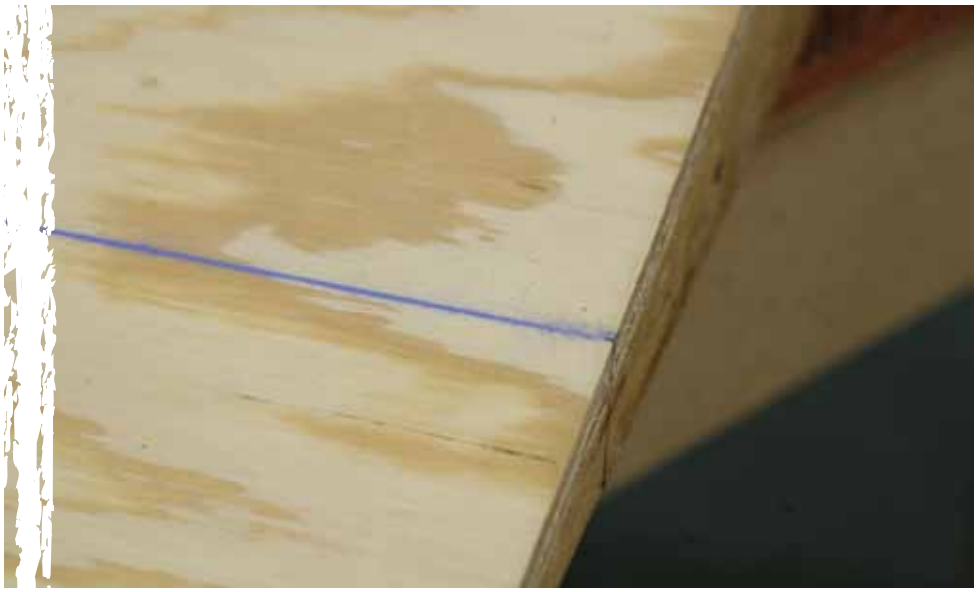


Figure 44
Figure 44 shows step 2 completed

Figure 45
Figure 45 illustrates step 4

3. Set the circular saw to cut ⅝″ deep. Be careful to set it accurately so as not to overcut into the wedges.
4. Cut along the line marked in step 2. See Figure 45.
5. Finish attaching the plywood by running 2″ deck screws through the curved plywood ramp into the wedges.
6. Mark the center of each wedge on the surface of the curved plywood ramp.
7. Cut the left over piece of ½″ plywood to 5″ wide.
8. Apply adhesive to the tops of the wedges.
9. Butt the ½″ plywood against the curved plywood ramp and align the edges. See Figure 46.

Figure 46
Figure 46 illustrates step 9

10. Attach the ½″ plywood to the wedges with 1″ deck screws. Be careful to install the deck screws so that they do not go entirely through the wedges. See Figure 47.
11. Lay the steel plate on the ½″ plywood, butting it up against the curved plywood ramp and aligning the edges. See Figure 48.
12. Transfer the wedge center line marks from the plywood across the steel plate.
13. On the centerlines place marks at ½″ and 4″ from where the steel plate meets the plywood.
14. Use a center punch and hammer to dimple the steel plate at the marks.
15. Drill a 3⁄16″ diameter hole in the steel plate at each dimple.
16. Insert a steel countersink into the electric drill and countersink each hole in the steel plate to receive the head of the deck screw.
17. Apply adhesive to the surface of the ½″ plywood.
18. Butt the steel plate against the edge of the curved plywood ramp on top of the ½″ plywood, aligning the edges.
19. Fasten in place with 1″ deck screws.

Figure 47
Figures 47 illustrates step 10

Figure 48
Figure 48 illustrates step 11

alternate project

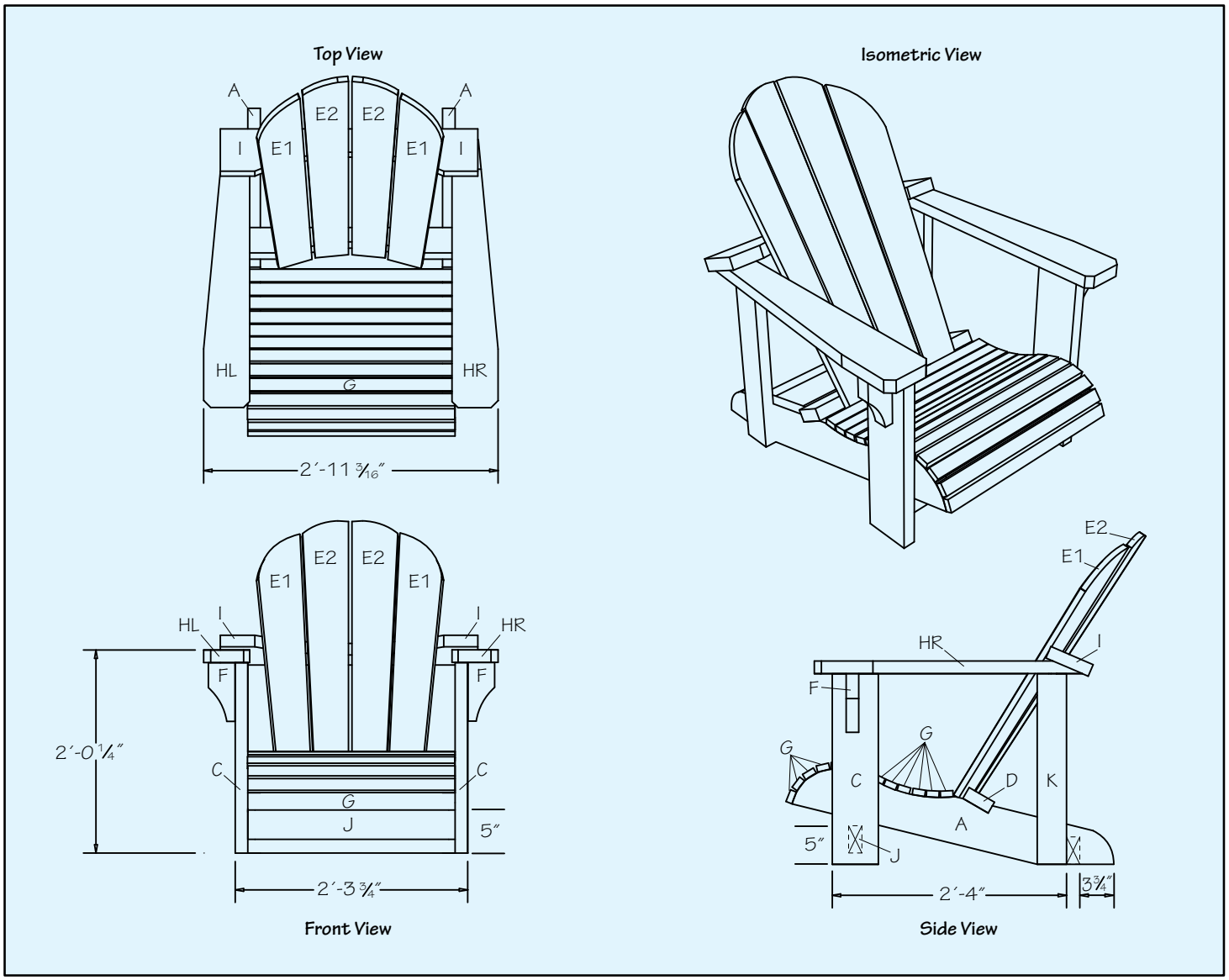
2 Adirondack Chair

The high-back wooden chairs you sometimes see in gardens or out on the lawns of old, elegant hotels are called Adirondack chairs. They got their name from New York's Adirondack Mountains, where summer resorts once made wide use of them. Building an Adirondack chair will require several advanced techniques, including making and using templates, using a router to round over edges, laying out and cutting angles, and doing complex multi-staged assembly work.

Building an Adirondack chair will require several advanced techniques...

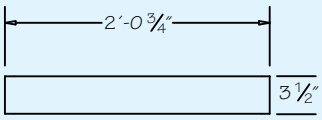
You will need the following materials:

- (1) 1 x 6 x 12′-0″ lumber for back slats
- (1) 2 x 4 x 8′-0″ lumber for front spacer, back spacer, lower back frame, two arm braces
- (5) 1 x 2 x 8′-0″ lumber for seat slats
- (1) 2 x 6 x 8′-0″ lumber for two arms, upper back frame
- (1) 2 x 6 x 12′-0″ for two chair frames, two legs
- (4) ⅜″ x 4″ galvanized carriage bolts with washers and nuts
- (2 lbs) 2″ deck screws
- (2 lbs) 3″ deck screws
- Exterior wood glue

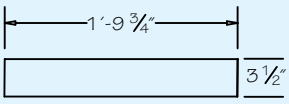


Adirondack Chair Parts

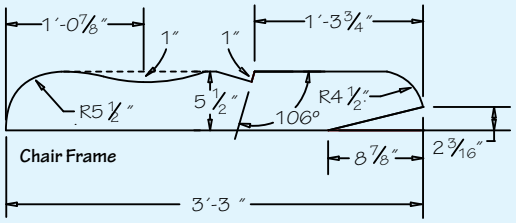
Front Spacer J Cut 1



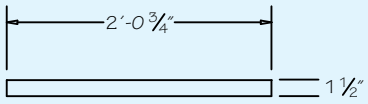
Back Spacer



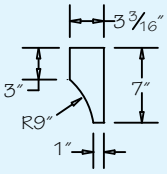
B Cut 1



A Cut 2

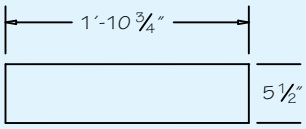


Seat Slats
G Cut 15

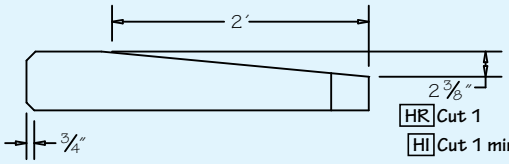


F Cut 2

Arm Support

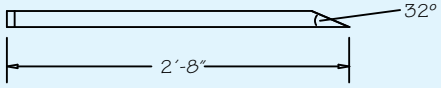


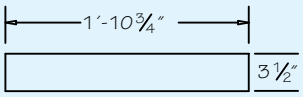
Front leg
C Cut 2



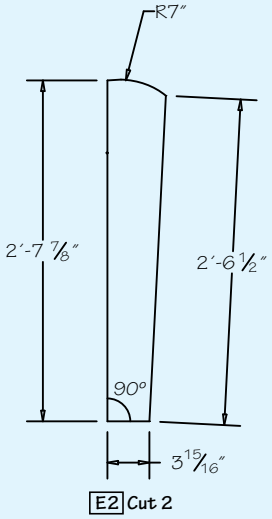
HR Cut 1
HI Cut 1 mirror image

Chair Arm



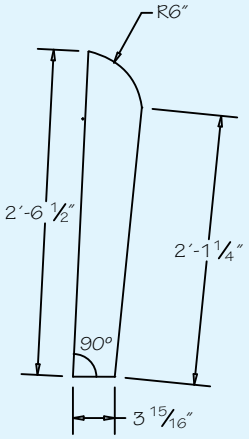


Rear Leg
K Cut 2

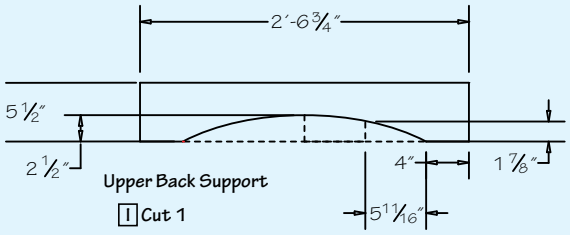


E2 Cut 2

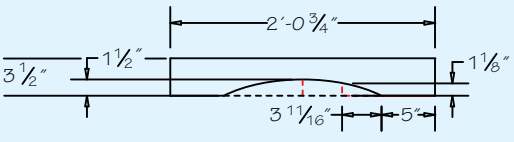
Back Slats



E1 Cut 2



I Cut 1

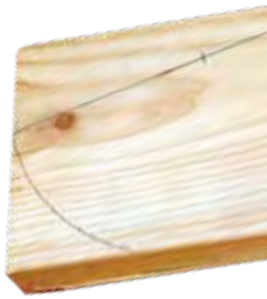


D Cut 1

Lower Chair Back

You will need the following tools:

- (2) Adjustable bar clamps
- Circular saw
- #8 x 1 ½″ combination pilot hole and countersink bit
- Compass
- Drill index
- Electric drill
- Framing square
- Hammer
- Handsaw
- Pencil
- Screw gun
- Random orbital sander (optional)
- Tape measure
- Router with ¼″ roundover bit
- Saber saw
- Power miter saw
- Speed Square
- Wrench with ⅜″ open end or socket



Lay Out and Cut Parts Nearly 30 individual wooden parts are needed to build the Adirondack chair. Use this parts list to cut the pieces to length. These pieces will be shaped later in the procedure. The parts will be cut from exterior lumber such as cedar, redwood, or artificial wood products, to withstand outdoor weather.

Nearly 30 individual parts are need to build the Adirondack chair.

Figure 49
Figure 49 illustrates step 2

PROCEDURE

1. Cut the parts to length and label.
2. Lay out and cut one chair frame, part A, to the required shape and dimensions. See Figure 49.
3. Use the chair frame cut in step 2 as a pattern to lay out and cut the second chair frame, part A.
4. Cut the lower chair back, part D, to the required shape and dimensions. See Figure 50.

Figure 50
Figure 50 illustrates step 4

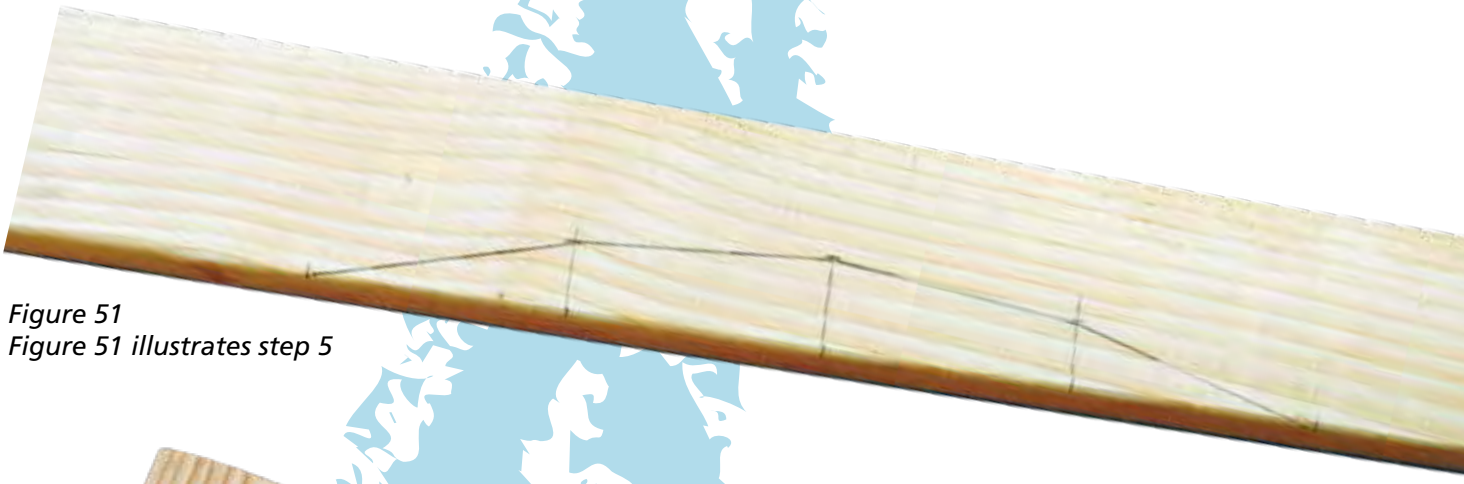


Figure 51
Figure 51 illustrates step 5

5. Cut the upper chair back, part I, to the required shape and dimensions. See Figure 51.
6. Cut two back slats, part E, to the required shapes and dimensions and use them as templates to make the other two back slats. See Figure 52.
7. Cut one arm, part HL, to the required shape and dimensions. See Figure 53.

Figure 52
Figure 52 illustrates step 6

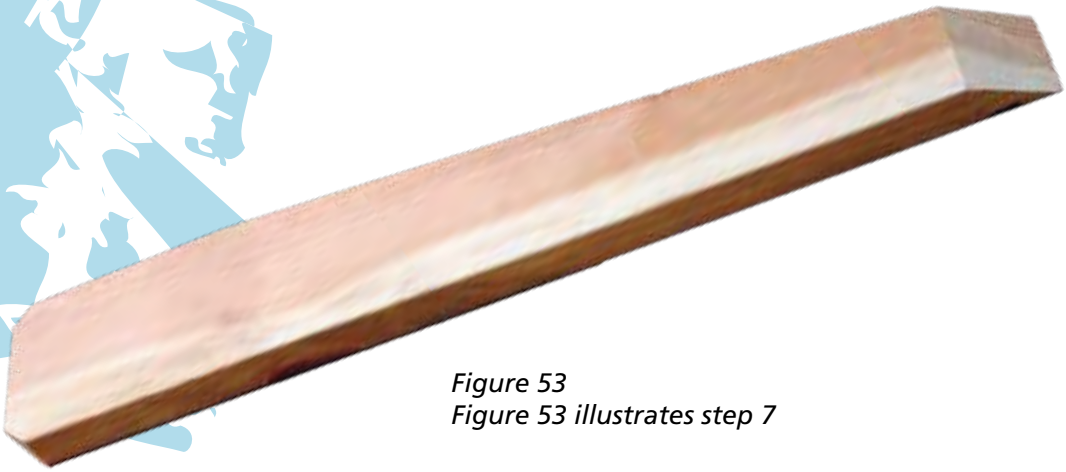


Figure 53
Figure 53 illustrates step 7

Figure 54
Figure 54 illustrates step 8

8. Use the piece cut in step 7 as a pattern to lay out and cut the second arm piece, part H. See Figure 54. Make sure the angles are opposing.
9. Cut one arm support, part F, to the required shape and dimensions. See Figure 55.
10. Use the piece cut in step 9 as a pattern to lay out and cut the second arm support, part F. See Figure 56.

Figure 55
Figure 55 illustrates step 9

Figure 56
Figure 56 illustrates step 10

11. Drill pilot and countersink holes ¾″ from the ends of each seat slat. See Figure 57.
12. Use a router and a ¼″ roundover bit to round over the top edges of the seat slats, all edges of the back slats, the exposed edges of the arm braces, and all edges of both arms. See Figure 58.

Figure 57
Figure 57 illustrates step 11

Figure 58
Figure 58 illustrates step 12

Assemble the Chair

Once cutting and layout are complete, the Adirondack chair can be assembled following the step-by-step procedure outlined below. To make assembly easier, the various parts are identified with a letter. Before assembling the parts review the prints.

PROCEDURE

1. Position the chair frames, parts A, upright on a flat surface and space them apart using the lower chair back, part D, as a spreader positioned in the notches.
2. Attach part D to part A with exterior wood glue and four 3″ deck screws, two per chair frame. See Figure 59.
3. Turn the assembly over and position the back spacer, part B, between the chair frames flush with the bottom of the legs and fasten in place with exterior wood glue and four 3″ deck screws, two per chair frame. See Figure 60.

Figure 59
Figure 59 illustrates step 2

Figure 60
Figure 60 illustrates step 3

4. Position one seat slat, part G, at the front bottom of the chair frames and attach it with exterior wood glue and two 2″ deck screws. See Figure 61.
5. Attach the two legs, part C, to the front spacer, part J, with glue and 3″ deck screws. See Figure 62.
6. Attach the front spacer and leg assembly to the chair frame, part A, with four ⅜″ x 4″ galvanized carriage bolts with washers. See Figure 63.

Figure 61
Figure 61 illustrates step 4

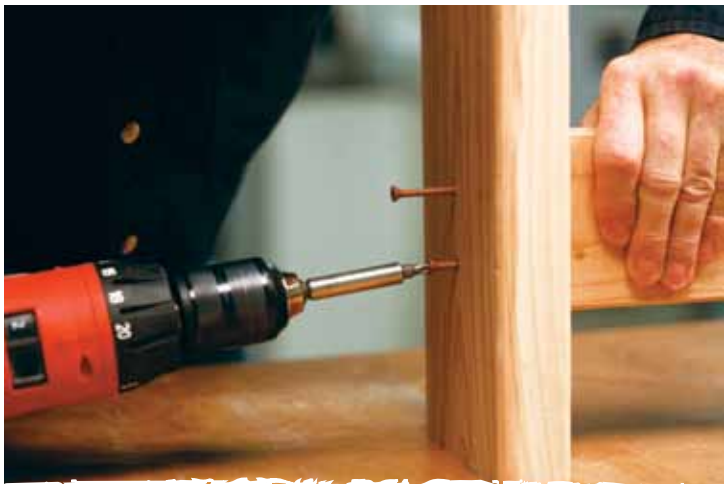


Figure 62
Figure 62 illustrates step 5

Figure 63
Figure 63 illustrates step 6

7. Attach the arm supports, parts F, flush with the top of the legs, part C, and centered left to right with exterior wood glue and three 3″ deck screws each through the leg and into the brace. See Figure 64.
8. Place the upper chair back, part I, on the work surface. Scribe a parallel line 1 ⅜″ away from the straight edge of the upper chair back along its entire length.
9. Measure and place a mark 3″ from each end of the upper chair back, part I, on the scribed line marked in step 8.
10. Draw a line perpendicular to the straightedge of the upper chair back, part I, through each mark made in step 9. See Figure 65.
11. Apply glue to the upper chair back, part I, where the arm will be attached.

Figure 64
Figure 64 illustrates step 7

Figure 65
Figure 65 illustrates step 10

Figure 66
Figure 66 illustrates step 12

12. Put the beveled end of the arm, part H, on the upper chair back, part I. Attach the arm, part H, to the upper chair back, part I, with one 2″ deck screw, and one 3″ deck screw. Align the long point of the bevel with the 1 ⅜″ line and the straightedge of the arm to the perpendicular line drawn in step 10. See Figure 66.
13. Repeat steps 11 and 12 to attach the second arm, part H.
14. Install the rear leg, part K, to the chair frame. See Figure 67.
15. Apply glue to the top of the arms and arm braces.

Figure 67
Figure 67 illustrates step 14

16. Position the arm assembly on top of the legs and arm braces, with 2″ of the arm assembly extending beyond the front leg. See Figure 68.
17. Secure the arm assembly to the legs and arm supports with 3″ deck screws. Place three screws into the front leg and arm support and two screws into the back leg on each side. See Figure 69.
18. Place a center mark on the upper chair back, part I, and the lower chair back, part D.

Figure 68
Figure 68 illustrates step 16

Figure 69
Figure 69 illustrates step 17

Figure 70
Figure 70 illustrates step 19

Figure 71
Figure 71 illustrates step 20

19. Beginning from the center and working out to the sides, attach the back slats to the upper chair back and lower chair back with exterior glue and two 2″ deck screws in both the lower chair back and upper chair back. Be sure to keep the slats flush to the bottom of the lower back frame. See Figure 70.
20. Install the remaining seat slats, part G, with exterior glue and 2″ deck screws, starting from the seat slat already in place at the front of the chair frame and continuing to the back slats. See Figure 71.
21. Lightly sand any rough surfaces, and finish as desired.

alternate project

3 Portable Folding Workbench

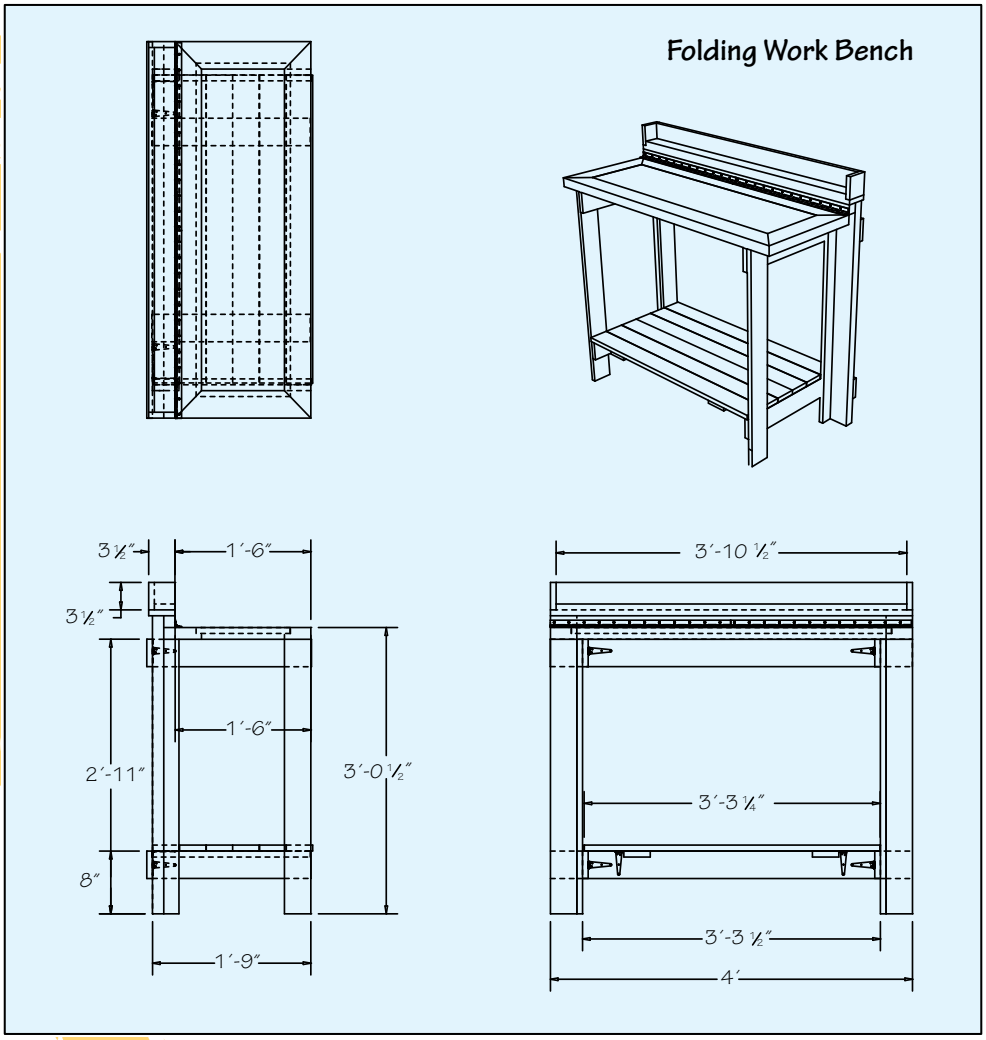
As an alternate project, you may build a portable folding workbench. A sturdy wooden workbench provides a convenient surface for working on a variety of carpentry projects. For this reason, a well constructed workbench would make an excellent addition to almost any shop or garage. Since shop space is often limited, it helps if the bench is collapsible so that it can be put away and stored easily. In making this project, you will get experience cutting dados, installing two different types of hinges, and doing complex, multi-staged assembly work. The portable folding bench will be built in the following six steps: cutting the pieces, assembling the back frame, assembling the side frames, joining the back frame and the side frames, building the tabletop, and installing the bottom shelf.

A sturdy wooden workbench provides a convenient surface for working...

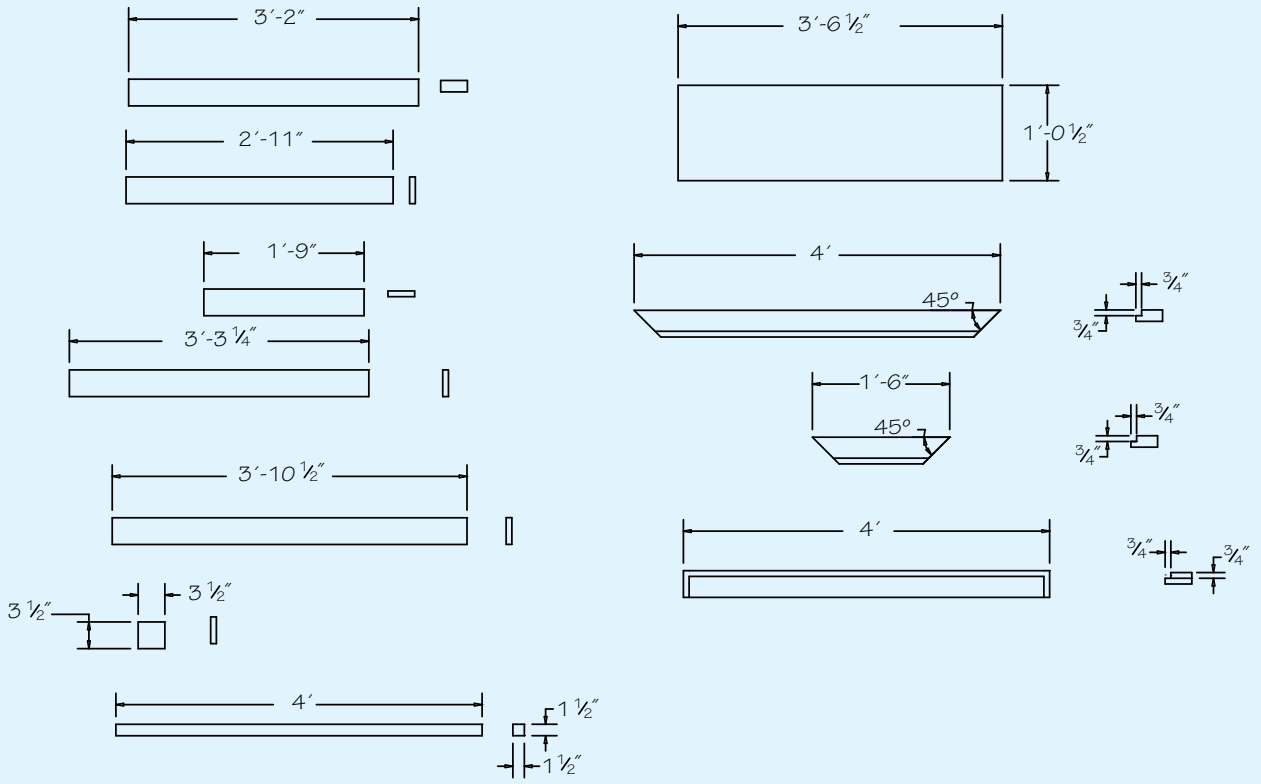
You will need the following materials:

- (8) 1 x 4 x 8′-0″ poplar or similar lumber
- (1) 1 x 4 x 6′-0″ poplar or similar lumber
- (4) 2 x 4 x 8′-0″ standard or better lumber
- (1) ¾″ x 4′ x 8′ sheet of plywood, finished on one side
- (2) ⅜″ x 1 ½″ dowel pins
- (½ lb) ¾″ construction screws
- (1 lb) 1″ construction screws
- (1 lb) 3″ construction screws
- (1 lb) 6d finish nails
- (6) 3″ strap hinges
- (1) 1″ x 4′ piano hinge with screws
- Exterior wood glue

Note: Pilot holes should be drilled for all of the screws.



Work Bench Parts



You will need the following tools:

- (2) Bar clamps
- Circular saw
- Combination square
- Drill index
- Electric drill
- Miter saw (optional)
- Pencil
- Tape measure
- Router, ½″ straight bit, ¾″ guide bushing
- Sandpaper
- (2) Sawhorses
- Screw gun
- Wood rasp
- Straightedge
- Adjustable corner clamp

Cut the Pieces

Construction of the portable folding workbench begins with cutting the parts. The workbench requires 21 separate parts cut from poplar or similar lumber and plywood. You will make the cuts using a circular saw or miter saw.

Assemble the Back Frame

The next stage in construction of the portable folding workbench is to assemble the back frame. For this you will use the back legs, back rails, back face, back top, and shelf member pieces you cut in the previous procedure. The various parts will be attached with construction screws.

PROCEDURE

1. Clamp together the two 2 x 4 x 3′-2″ back legs laid flat, side by side, edge to edge with the ends flush.
2. Lay out the top and bottom dados on each of the 2 x 4 x 3′-2″ back legs by measuring from the end of each leg and placing a mark at 4 ½″ and another mark at 8″. Using a square, scribe a line across the face of the material at each mark. See Figure 72.
3. Using a straightedge and clamps as a guide for the router, remove the material between the lines across the board to a depth of ⅜″. See Figure 73.
4. Fit the top and bottom 1 x 4 x 4′-0″ back rails into the dados, flush at the ends.

Figure 72
Figure 72 illustrates step 2

Figure 73
Figure 73 illustrates step 3

Figure 74
Figure 74 illustrates step 5

5. Fasten the back rails to the back legs with four screws at each joint. See Figure 74.
6. Fasten the 2 x 4 x 4′-0″ back face member to the back frame, flush at the ends and top of the frame, with two screws at each joint. See Figure 75.
7. Using a combination square set at ¾″, scribe a line along the face and edge of the 2 x 4 x 8′-0″ members to lay out a ¾″ x ¾″ rabbet. Cut the rabbet.
8. Glue and fasten the 1 x 4 x 3′-10 ½″ shelf members to the 2 x 4 x 4′-0″ routed top member at the routed edge. See Figure 76.

Figure 75
Figure 75 illustrates step 6

Figure 76
Figure 76 illustrates step 8

9. Glue and fasten the 1 x 4 x 3 ½″ back shelf member to the 2 x 4 x 4′-0″ routed top member at the routed edge. See Figure 77.
10. Fasten the assembled 2 x 4 x 4′-0″ routed top member to the back frame, flush with the ends and the front edge of the back frame, with screws from the top down at 12″ o.c. See Figure 78.

Figure 77
Figure 77 illustrates step 9

Figure 78
Figure 78 illustrates step 10

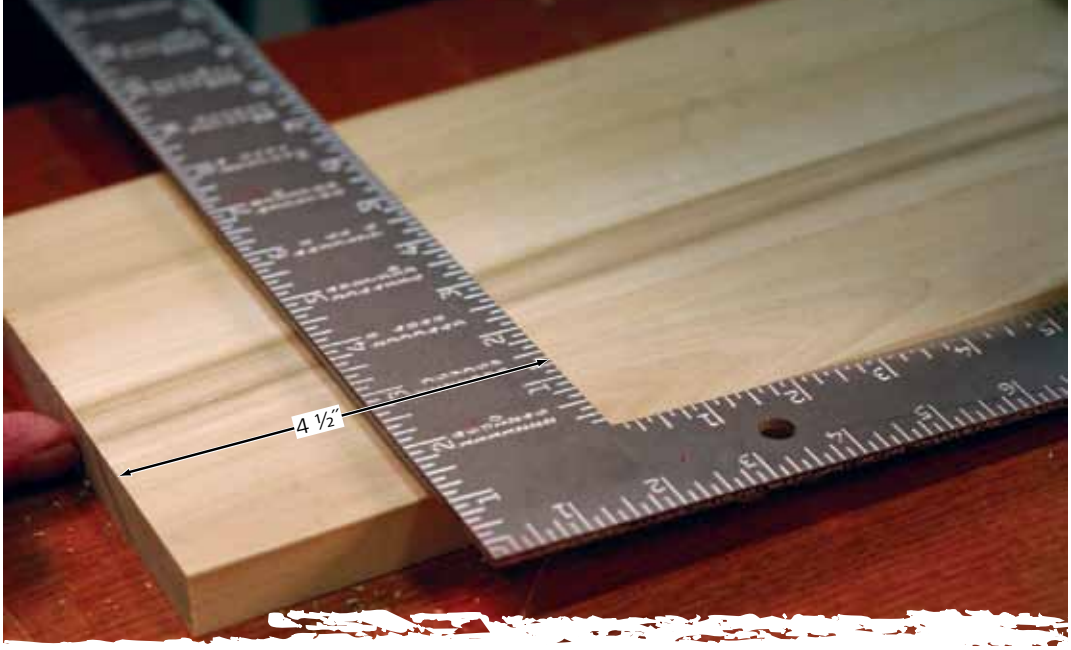


Figure 79
Figure 79 illustrates step 1

Assemble the Side Frames

In this procedure you will assemble the side frames using the front legs and side rail pieces. This assembly will be fastened with screws, glue, and a dowel. You will use an electric drill to make a ¾″ deep hole for the dowel.

PROCEDURE

1. Measure 4 ½″ from one end of each 1 x 4 x 2′-11″ front leg and make a mark across the face of the material using the square. See Figure 79.
2. Fasten one of the 1 x 4 x 1′-7 ½″ side rails to the front leg with the lower edge of the 1 x 4 aligned with the mark made in step 1 using four screws.
3. Fasten another side rail to the front leg, flush with the top of the leg, using four screws. See Figure 80.
4. Center mark and install strap hinges at the end of each top and bottom side rail with a screw in each hole in the leaf. See Figure 81.
5. Measure 1 ¼″ from the front edge of the 1 x 4 front leg and make a mark across the top of the leg.

Figure 80
Figure 80 illustrates step 3

Figure 81
Figure 81 illustrates step 4

Figure 82
Figure 82 illustrates step 6

6. Measure ⅜" from the edge of the leg and make a mark intersecting the line made in step 5. See Figure 82.
7. Drill a hole ¾" deep for the dowel at the mark made in step 6. See Figure 83.
8. Glue and install the dowel. See Figure 84.
9. Repeat steps 1–8 for the opposing side frame.

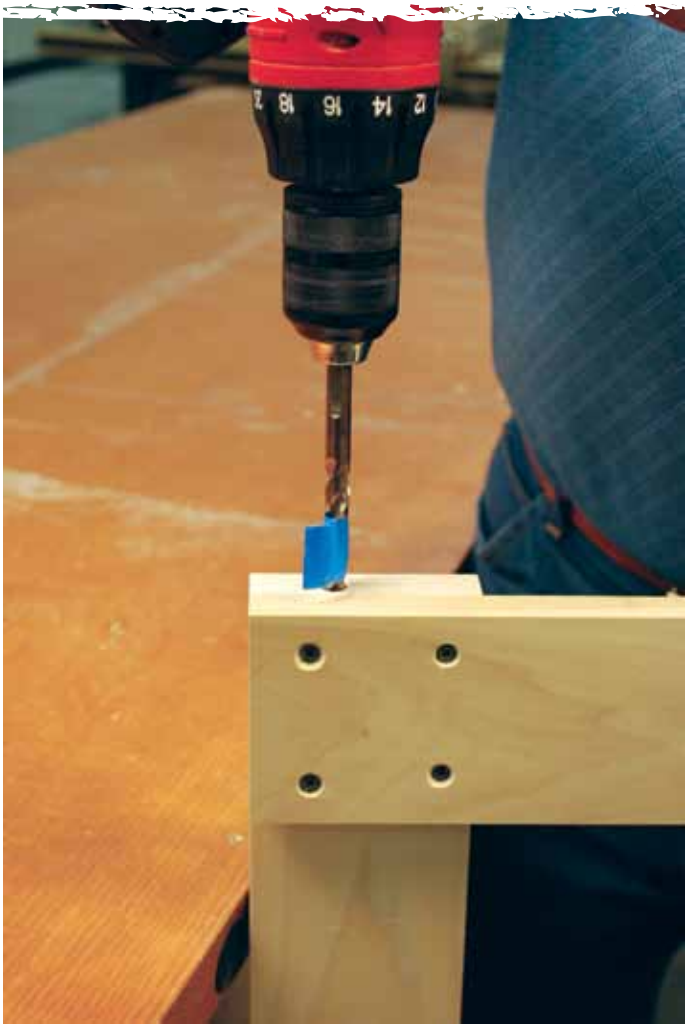


Figure 83
Figure 83 illustrates step 7

Figure 84
Figure 84 illustrates step 8

Join the Back Frame and Side Frames

Now the back frames and side frames can be linked with hinges. The hinges will be attached to the frames with screws.

PROCEDURE

1. Place the side frame on the inside of the 2 x 4 back leg.
2. Fasten the leaf of one hinge to the 1 x 4 lower horizontal back rail on the back frame with a screw through each hole. See Figure 85.
3. Fasten the leaf of one hinge to the 1 x 4 upper horizontal back rail on the back frame with a screw through each hole. See Figure 86.
4. Repeat steps 1–3 for the opposing side frame.

Figure 85
Figure 85 illustrates step 2

Figure 86
Figure 86 illustrates step 3

Build the Tabletop

The tabletop or work surface of the bench will be built by inserting the ¾″ plywood component into the rabbet of the frame members. The plywood is then fastened to the members using construction screws.

PROCEDURE

1. Position all four table top frame members with the rabbetted side, previously cut, facing up and the mitered cuts aligned and tight and fasten with glue and screws. See Figure 87.
2. Insert the 14 9⁄16″ x 3′-6 5⁄8″ x ¾″ plywood member into the rabbetted edges of the table top frame members.
3. Fasten the plywood to the frame members with 1″ construction screws, three in each end and four in each side, making sure the mitered joints remain tight. See Figure 88.
4. Mark and install the piano hinge along the back side of the assembled table top frame. See Figure 89.

Figure 87
Figure 87 illustrates step 1

Figure 88
Figure 88 illustrates step 3

Figure 89
Figure 89 illustrates step 4

Figure 90
Figure 90 illustrates step 8

5. Attach the piano hinge to the bottom side of the 2 x 4 x 4′-0″ horizontal back face member in the back frame.
6. Lower the table top and adjust the side frames until they are square with the back frame.
7. Mark each location where the dowels in the side frames meet the table top.
8. Drill holes ¾″ deep at each mark to accept the dowel pins. See Figure 90.

Install the Bottom Shelf

The final stage in construction of the portable folding workbench is to install the bottom shelf. The shelf will be attached to the back rail with strap hinges.

PROCEDURE

1. Mark and install two strap hinges along the plywood bottom shelf, 8″ from each end, with ¾″ construction screws.
2. Attach the other leaf of the strap hinges to the lower horizontal back rail with ¾″ construction screws. See Figure 91.
3. Sand and finish the workbench as desired.

Figure 91
Figure 91 illustrates step 2

Figure 92
Completed portable folding workbench

Student Name:_____ Date: _____

Skateboard Ramp Project Evaluation

PROCEDURE	CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Cutting and Assembly	End cut (2)	5	
	Center support cut	5	
	Blocking cut (16)	32	
	Wedge cut (6)	12	
	Finished wedge assembly (2)	10	
	Blocking installed	5	
	Wedge assembly installed	5	
	Back support cut (3)	7.5	
	Pipe installed	5	
	Plywood back cut and installed	5	
	Ramp and top cut and installed	5	
	Ramp surface installed	5	
	Metal plate installed	5	
	Finished height	5	
	Finished width	5	
	Subtotal	*116.5*	
Overall	Joints tight	5	
	No rough edges	5	
	Screws installed per procedures	5	
	No splits and shiners	5	
	Edges flush	5	
	No excess glue	5	
	Subtotal	*30*	
General	Tool handling	5	
	Followed direction	5	
	Cleaned up	5	
	Safe work practices	5	
	Subtotal	*20*	
		Student score:	

Total Possible Points = 166.5

Suggested minimum acceptable score: 117 points or _____

Student's Signature: _____ Teacher's Signature: _____

Student Name:_____ Date: _____

Adirondack Chair Table Project Evaluation

PROCEDURE	CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Cutting	Chair frame (2)	5	
	Back spacer	5	
	Leg (4)	10	
	Lower chair back	5	
	Back slat (4)	10	
	Arm support (2)	5	
	Seat slat (13)	26	
	Arm (2)	5	
	Upper chair	5	
	Front spacer	5	
	Subtotal	*81*	
Shape	Chair frame (2)	5	
	Lower chair back	5	
	Upper chair back	5	
	Back slat (4)	10	
	Arm shape (2)	5	
	Arm support (2)	5	
	Hole depth on seat slat (13)	26	
	Rounded edge of seat slats	5	
	Rounded edge of back slats	5	
	Rounded edge of arms supports	5	
	Rounded edge of arms	5	
	Subtotal	*81*	
Assembly	Finished height of arms	5	
	Finished seat width	5	
	Finished depth from face of the leg to back of the seat frame	5	
	Slat installation	5	
	Leg square to arm (2)	5	
	Arm support installation (2)	5	
	Location of front spacer	5	
	Carriage bolts installation	5	
	Screw installation	5	
	Joints tight	5	
	Edges flush	5	
	No rough edges	5	
	No splits or shiners	5	
	No excess glue	5	
	Subtotal	*70*	
General	Tool handling	5	
	Followed direction	5	
	Cleaned up	5	
	Safe work practices	5	
	Subtotal	*20*	
		Student score:	

Total Possible Points = 252

Suggested minimum acceptable score: 176 points or _____

Student's Signature: _____ Teacher's Signature: _____

Student Name:_____ Date: _____

Portable Folding Workbench Project Evaluation

PROCEDURE	CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Cutting	Back legs (2)	5	
	Front legs (2)	5	
	Back rails (2)	5	
	Back face	5	
	Back top	5	
	Side rails (4)	10	
	Tabletop frame members 2 x 4 x 4′0″ (2)	5	
	Tabletop frame members 2 x 4 x 20″ (2)	5	
	Back shelf member	5	
	Left and right hand shelf members	5	
	Bottom shelf	5	
	Top insert	5	
	Subtotal	*65*	
Assembly	Back rails attached to back legs	5	
	Back face member	5	
	Top shelf assembled and attached	5	
	Side frame	5	
	Side rail squared to front leg	5	
	Side frame fastened to back leg	5	
	Plywood installed in tabletop frame	5	
	Tabletop assembly fastened together	5	
	Tabletop assembly attached to back assembly	5	
	Bottom shelf attached to back frame	5	
	Subtotal	*50*	
Overall	Height	5	
	Width	5	
	Depth	5	
	Edges flush	5	
	Joints tight	5	
	Screws installed per procedures	5	
	Dowel holes in tabletop	5	
	No splits and shiners	5	
	No rough edges	5	
	No excess glue	5	
	Subtotal	*50*	
General	Tool handling	5	
	Followed direction	5	
	Cleaned up	5	
	Safe work practices	5	
	Subtotal	*20*	
		Student score:	

Total Possible Points = 185

Suggested minimum acceptable score: 130 points or _____

Student's Signature: _____ Teacher's Signature: _____

What's Inside Career Connections

Project Book 3
Commercial Construction

Teacher Annotated Edition

Teacher annotations in the margins of the text provide teaching tips, activity suggestions, helpful building strategies, questions to promote understanding and discussion, online resources, ideas to motivate the students, and ideas to emphasize and incorporate safety. In addition to the notes shown, the following notes are also included: How It Works, Reinforcement Activity, Workplace Strategies, Safety Tip, and Lesson Plan. The same features are found in the Teacher Annotated Edition for Project Book 3: Residential Construction.

Tip

Tell the students that it is a good habit to report to a class instructor or supervisor when supplies in the gang box are getting low on a job. For example, nails and screws are items that need replacing frequently on a busy job.

Safety Emphasis

Emphasize the pinch points when using a gang box like the type shown in the photo. Demonstrate for the students how the top hinges and unhinges over the sides of the box to close and secure it. Lock and unlock the box.

Check Understanding

Have the students note how the tools and materials are neatly organized in the gang box. It is everyone's responsibility to keep a gang box organized. Remind students how you want your gang box kept, if this is how you store your class tools. Also explain what goes in first and what goes in last. Usually it is power saws and tools first, cords next, then hand tool pouches on top.

Chapter Review

This chapter covered the importance of teamwork and described the work environment on a typical commercial jobsite. This chapter emphasized good habits for your students to become accustomed to whether in the classroom or on the jobsite.

Safety Emphasis provides methods and activities designed to emphasize important aspects of safety.

Check Understanding provides methods of determining student comprehension.

Secure Storage of Tools

Tools often remain at the jobsite for the duration of the project. Many of these tools are the personal property of the workers who use them, while other tools may belong to the contractor or the company employing the worker. Workers eat the employer's tools as if they were their own. costly to repair or replace if damaged, vandal- olen. It is the employer's responsibility to provide of each trade with separate areas where tools can stored. These areas may include rooms or gang an be locked.

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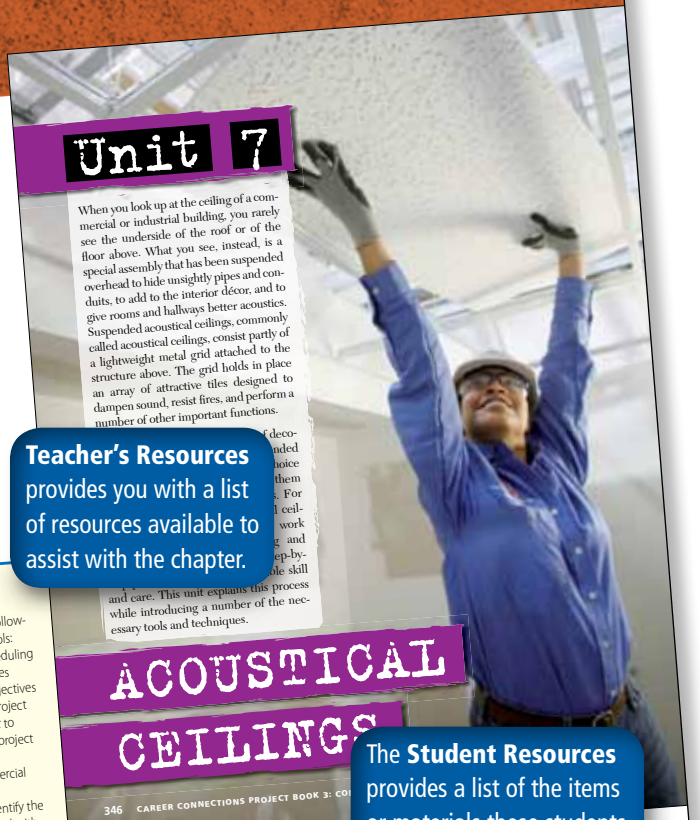
Teacher's Notes

40 CAREER CONNECTIONS PROJECT BOO

Unit 7

When you look up at the ceiling of a commercial or industrial building, you rarely see the underside of the roof or of the floor above. What you see, instead, is a special assembly that has been suspended overhead to hide unsightly pipes and conduits, to add to the interior décor, and to give rooms and hallways better acoustics. Suspended acoustical ceilings, commonly called acoustical ceilings, consist partly of a lightweight metal grid attached to the structure above. The grid holds in place an array of attractive tiles designed to dampen sound, resist fires, and perform a number of other important functions.

deco- nded hoice them . For l ceil- work g and ep-by- ble skill and care. This unit explains this process while introducing a number of the necessary tools and techniques.



ACOUSTICAL CEILINGS

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Teacher's Resources provides you with a list of resources available to assist with the chapter.

Teacher's Resources

This unit comes with the following additional teaching tools:

- *Lesson Plan* for class scheduling and assessment strategies
- *Project Evaluation* for objectives and evaluation of the project
- *Project Evaluation Rubric* to provide criteria for the project evaluation
- *Drawing* for the commercial construction project
- *Skills Matrix* to help identify the skills that will be learned with each project

Student Resources

Make sure the student has access to:

- Appropriate PPE for the procedures
- Set of prints for the project
- Tools and materials for the *Lead-Up Exercises* and the procedures

The **Student Resources** provides a list of the items or materials these students will need access to.

346 CAREER CONNECTIONS PROJECT BOOK 3: Commercial Construction

What's inside Project Book 3: Commercial Construction

Career Connections Project Book 3 is designed to build upon the basic carpentry skills you gained in Project Books 1 and 2. The same features are found in the Student Edition for Project Book 3: Residential Construction.

What You Now Know is a reminder of the major points you learned in the previous chapter.

What You Will Know is a statement of the objectives of the present chapter.

CHAPTER 2

TOOL REVIEW

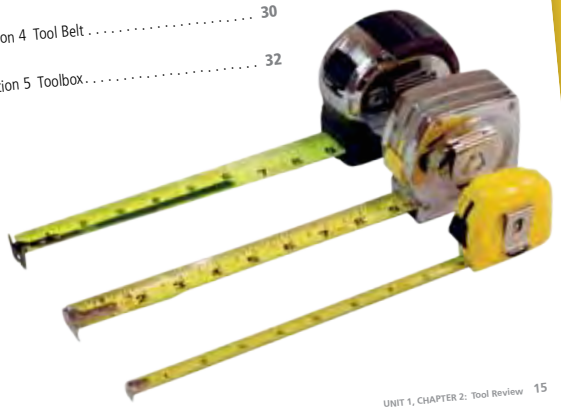
What You NOW Know

- How to handle and maintain basic construction tools such as hammers, screwdrivers, and saws
- The definition of many different construction tools and what they are used for

What You Will Know

- What tools are typically found on a commercial jobsite
- What tools belong in the carpenter's personal tool belt

CONTENTS



1 Handling Tools Properly

Carpenters understand that tools are effective only when used with skill and care. Improperly used tools can destroy expensive materials, damage components, and cause injury. Among the most important skills carpenters learn is how to use tools safely and efficiently. This requires a commitment to treat tools and materials with respect and to observe safety precautions at all times. Experienced carpenters observe the following rules for handling and maintaining tools.

Each section of **the introductory material** gives you an overview of the major topics to be covered in the chapter.

Know Your Tools

Never use any tool without proper supervision unless completely familiar with it and skilled in its use. Improperly using a tool may damage materials or the tool itself. Lack of familiarity and skill with tools is a major cause of work-related injuries.

Keep Tools Clean

Oil, dust, dirt, and grime will interfere with the effectiveness of a tool and make it harder to control. For these and other reasons, tools should be kept clean at all times. Make sure tools are clean before each use, and clean them properly after each use.

3 Ladder Safety

Ladders are indispensable tools and are used extensively on construction sites to help carpenters move up and down from one level to the next or to help them gain access to elevated work areas. Ladders should be used properly, with careful thought given to the safety issues involved in working at heights.

Ladders must be positioned, secured, climbed, and descended in the safest manner possible. When using a ladder, always maintain three points of contact, as shown in Figure 1. This means that both feet and one hand or both hands and one foot must be in contact with the ladder at all times. Tools, materials, and other objects should never be carried while climbing or descending a ladder. Instead, objects being moved up or down should be hoisted or passed along by a coworker.

Figure 1
Three points of contact

Ladder Inspection and Maintenance

Before a ladder is used, it should be carefully inspected. It must be free of oil, grease, and other slippery substances. Ladders should also be inspected periodically for visible defects by someone with experience in ladder maintenance. Defects may include broken or missing rungs, cleats, or steps, broken or split rails, corroded components, or other faulty or broken parts. If a ladder is found to be defective, it must be taken out of service immediately and marked as defective or tagged with a "Do Not Use" sign.

Using Ladders Correctly

Ladders are designed to safely hold all loads up to the maximum rated capacity assigned to them by the manufacturer. The load rating is indicated on a sticker or a placard that is attached to the ladder, as shown in Figure 2. Loads include the weight of the carpenter climbing the ladder and any equipment, tools, materials, and objects resting on any part of the ladder. The total load must not exceed the rated capacity of the ladder.

Figure 2
Ladder load rating

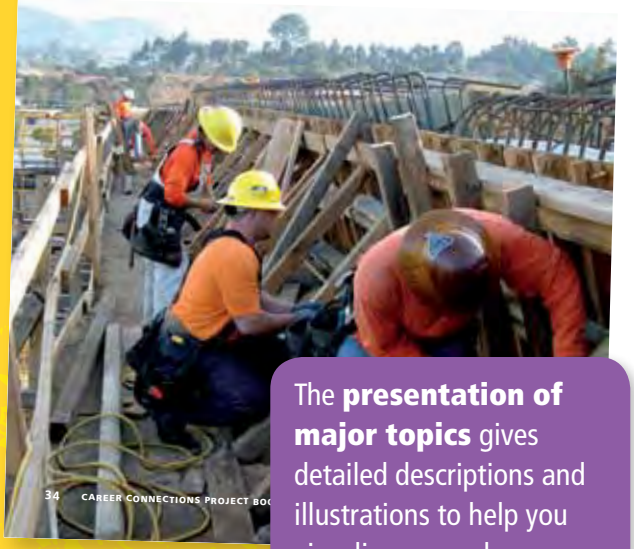
Although most ladders today come with slip-resistant feet, they should be positioned with great care on firm, stable surfaces. They should also be secured to prevent any accidental movement. Considerable caution should be taken when using ladders in passageways, doorways, driveways, or other places where they may be accidentally struck and dislocated. When ladders must be located in such areas, a barricade should be used to warn other workers and keep away unwanted traffic. No ladder should be moved, shifted, or extended while it is in use. A ladder should be inspected before use to make sure it is in good condition. When choosing a ladder, it is important to select the most appropriate ladder for the task.

Although most ladders today come with slip-resistant feet, they should be positioned with great care....

Safety information and practices related to the topics are clearly and completely presented.

1 Importance of Teamwork

Carpenters are very productive. They move materials from one place to another and make skillful use of tools to shape and fasten those materials into walls, floors, ceilings, and other types of structures. In order for this work to be done safely and efficiently, all carpenters and supervisors on an active jobsite must understand and respect their relationships with one another. They must be able to communicate effectively and to accurately give and carry out instructions.



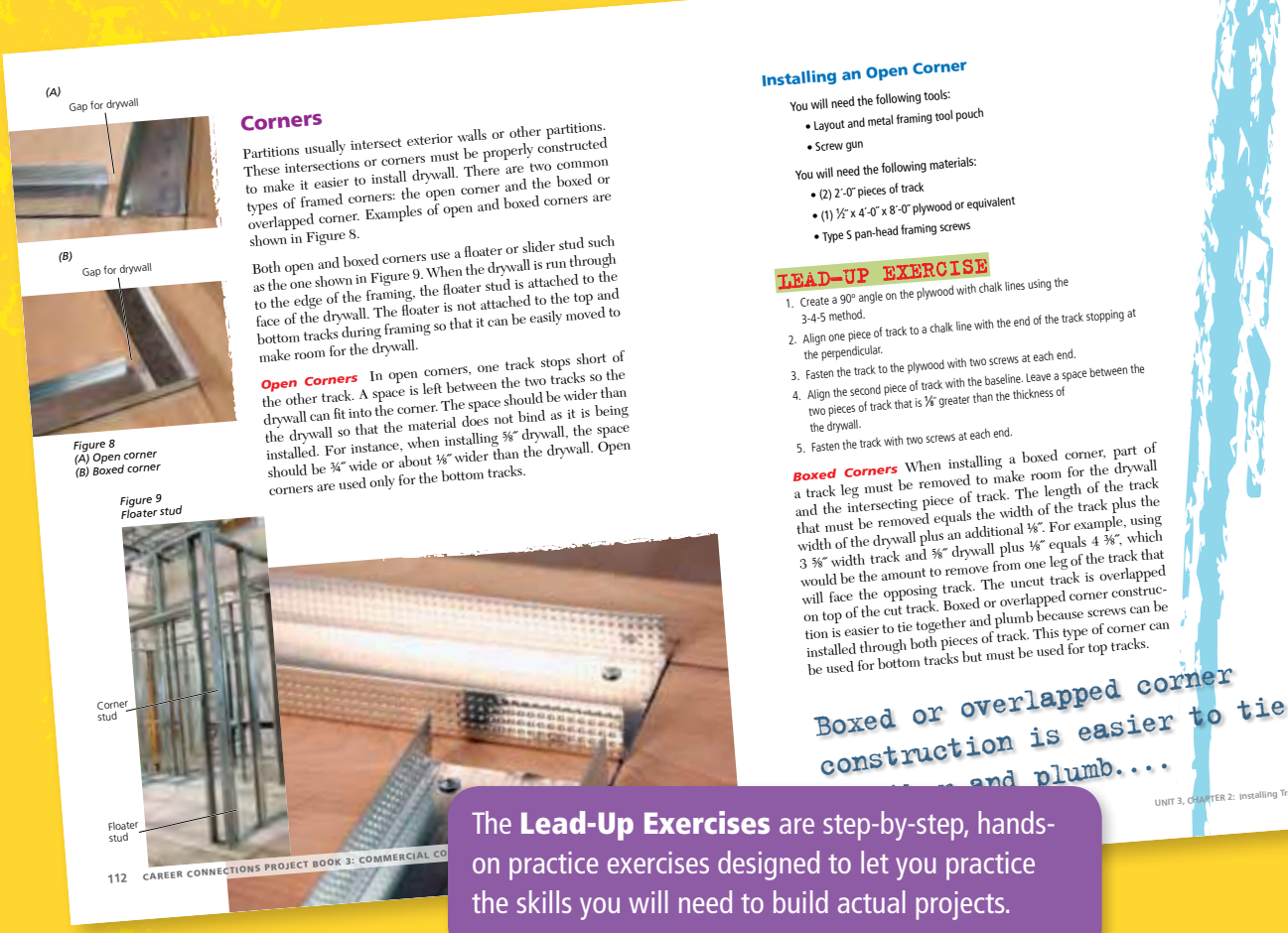
The **presentation of major topics** gives detailed descriptions and illustrations to help you visualize as you learn.

It takes workers in many different crafts or trades to build a structure. However, all of the craftsmen must work together in order for the structure to be built properly, on time, and within budget. Being part of a team means that you must pay attention not only to the tasks assigned to you, but also to the work that is going on around you. If a task is not completed on time or in the proper manner, it could cause delays throughout the entire project.

For example, if you are assigned to frame a wall with a rough opening for a door and you incorrectly frame the opening, the correction will delay the job and cause unproductive rework. This seemingly minor mistake, as shown, creates a domino effect that will delay the job and be very costly. The carpenter assigned to install the door will not be able to install the door without correcting the rough opening. Other trades may have to rework some of their installation to accommodate the corrected door opening. The electrician may have to move the light switch; the drywall installer will have to patch around the opening; the drywall finisher will have to finish the repair; the painter will have to repaint; and the floor installer will have to patch in or replace flooring before the door can be hung.

Being part of a team means that you must pay attention to the work going on around you.

Project Book 3



The **Lead-Up Exercises** are step-by-step, hands-on practice exercises designed to let you practice the skills you will need to build actual projects.

The **Contents** shows you the three projects from which you and the teacher may choose at every skill level.

One of the keys for framing is to build on something that is set plumb....

6 Project Partition Framing

Now that the framing components have been identified, this project will begin with the partition layout. After layout is complete, partition framing can begin by installing the bottom track for all partitions. It is important to establish a plumb corner stud because all of the framing is based off this beginning stud. When the corner stud is plumbed and braced, there should be no adjustments needed when transferring layout from the bottom track to the top track. After a plumb corner has been established, the top track and the remaining wall studs for the perimeter partitions are installed. Interior partitions, soffits, and columns are framed and installed after the perimeter is complete. Using the materials and the step-by-step procedure below ensures an accurate and properly framed project.

Expectations

When your project is complete, it will be evaluated on its overall appearance and the quality of your work. As the project progresses, each procedure is evaluated individually. The evaluation will consider the following criteria:

- Track is aligned to the layout.
- Corners are constructed and attached.
- Splices on the bottom track are accurately aligned and attached.
- Track is terminated at the marks defining the rough door openings.
- Track attachment is no more than 24″ on-center.
- Each stud is attached with four screws.
- Stud layout is accurate and could accommodate drywall.
- Studs are in plumb position.
- The beginning corner stud is plumb and braced in both directions.
- Walls are plumb at the intermediate braces.
- Door headers and cripples are installed at the correct height or layout.
- Floater studs are left unattached.
- Utility punchouts are in alignment, and the soft sides of the studs were all facing the direction of the layout.
- The top track mirrored the bottom track at all corners.

You will need the following tools:
- Construction drawings
- Layout and metal framing tool pouch
- Screw gun

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UNIT 3, CHAPTER 2: Installing Track and Studs 137

The **Expectations** describe the criteria that the teacher will use to evaluate your work.

You will need the following materials:

- (70) 3 ⅝˝ x 9'-0˝ wall studs
- (25) 3 ⅝˝ x 10'-0˝ track
- 1 ¼˝ Type W drywall screws
- Type S pan-head framing screws

PROCEDURE

Framing Partitions

1. Review the construction drawings and ge
2. Install bottom track for the perimeter and accurately aligned to the partition layout.

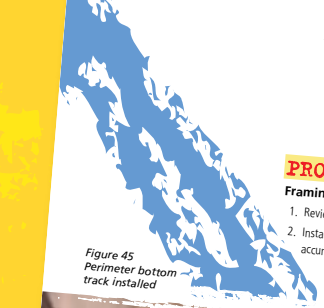


Figure 45
Perimeter bottom track installed

The **Materials List** tells you exactly what tools and materials are required to build your project.

3. Pull and mark the stud layout on the bottom track. See Figure 46.
4. Install and brace a beginning corner stud. See Figure 47.
5. Start the top track installation, mirroring the bottom track for stud layout and floater corner construction. See Figure 48.

(A)

Figure 46
(A) Pulling the stud layout
(B) Marking the stud layout

(B)

Pull and mark the stud layout....

Photographs clearly guide you through the building of your project by illustrating the critical steps.

Figure 24
Installing the horizontal studs

19. Cut studs ¼˝ shorter than the dimension determined in step 18.
20. Attach the horizontal studs to the wall track with the appropriate fasteners. See Figure 24.
21. Position the horizontal studs on the wall angle using locking C-clamps as needed. See Figure 25.
22. Check the soffit for plumb at each end and in the center and adjust as needed.
23. Fasten the horizontal studs to the wall angle and vertical studs with the appropriate fasteners. See Figure 26.

Figure 25
Clamping the horizontal studs to the wall angle

Figure 26
Fastening the horizontal studs

Student Name:_____ Date: _____

Layout and Framing Evaluation

PROCEDURE	CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Project layout	Establishing a perpendicular	5	
	Parallel sides equal	5	
	Diagonal dimensions equal	5	
	Wall thickness	5	
	Interior partition location	5	
	Soffit and column locations	5	
	Door location	5	
	Door rough opening dimension	5	
	Subtotal	*40*	
Bottom track	Track aligned to layout	5	
	Corner construction (gap for drywal)	5	
	Stud layout	5	
	Fastener spacing	5	
	Subtotal	*20*	
Framing partitions	Corner stud and perimeter partitions plumbed and braced	5	
	Interior partitions plumbed	5	
	Top track mirrors bottom track	5	
	Transferred stud layout	5	
	Stud orientation	5	
	Studs fastening	5	
	Header height	5	
	Header fastened to framing	5	
	Floater studs not fastened	5	
	Subtotal	*50*	
Framing columns	Top track mirrors bottom track	5	
	Backing for top track	5	
	Utility knockouts aligned	5	
	Floater studs not fastened	5	
	Studs plumbed and fastened	5	
	Subtotal	*25*	
Ceiling framing	Reference line is level	5	

The **Project Evaluation** lets you know exactly how you will be graded and how many points are awarded for each component of your project. The maximum and minimum number of points to achieve a satisfactory performance are shown at the bottom.

Career Connections Project Book 3

CHAPTER 4

INSTALLING DRYWALL

What You Now Know

- How to use a screw gun safely and effectively
- How drywall is cut, measured, and shaped

What You Will Know

- How to develop a screw pattern
- How to use a screw gun to apply drywall
- How to plan the drywall installation
- How to install drywall on ceilings and walls

CONTENTS

1 Screw Types and Patterns

Figure 1
Type W screws

Once drywall has been cut to the proper size, it is lifted into place and securely attached to the framing of the walls or ceiling. The drywall is usually fastened to the frame with screws. This must be done with care, since screws and other fasteners can damage the drywall.

Screw Types

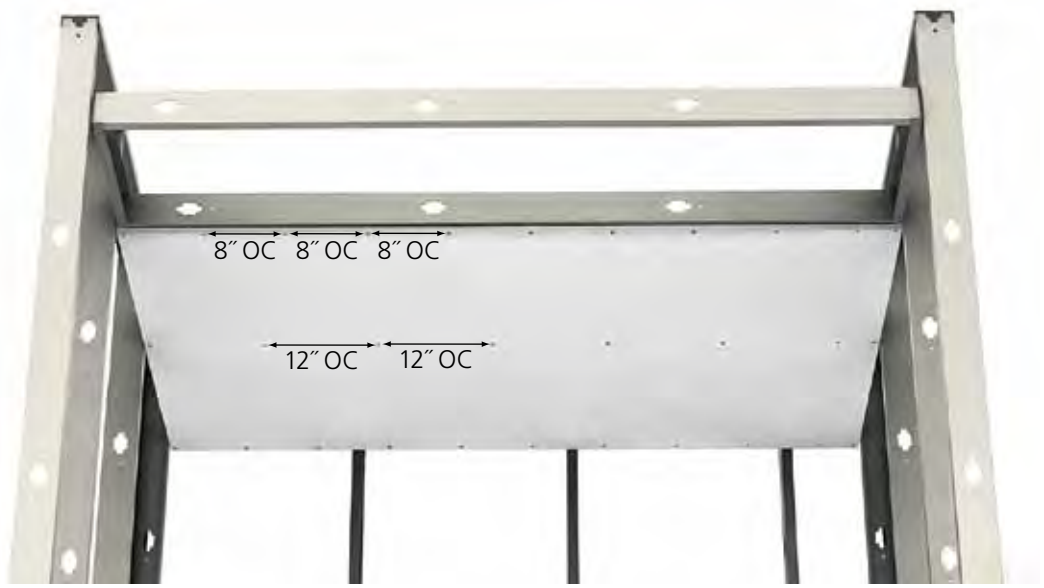
The large, widely spaced threads of Type W screws are excellent for biting into wood and attaching drywall to wood framing. The narrower threads of Type S screws make them the best choice for attaching drywall to steel framing. Type W screws are shown in Figure 1, and Type S screws are shown in Figure 2.

Screw Pattern

The screw pattern for drywall placed on ceilings and walls should be a maximum of 8″ o.c. along the perimeter and a maximum of 12″ o.c. along the joists or studs over the field of the sheet. The field of the sheet is considered to be the area of the sheet not containing the edges. Screws should be located ⅜″ in from the edges of the sheet. Figure 3 shows recommended screw spacing. Always follow local building codes or any specifications regarding the screw pattern for fire- or sound-tested drywall systems.

Figure 2
Type S screws

(A)



(B)

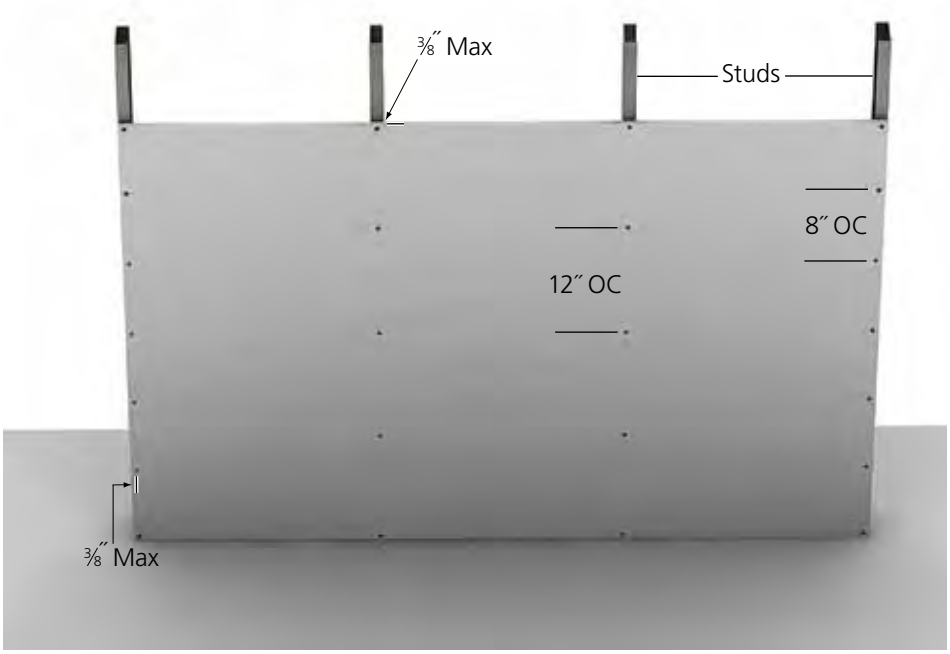


Figure 3
(A) Screw pattern on ceilings
(B) Screw pattern on walls

Adjusting for Depth

When attaching drywall with screws, the nose cone of the screw gun should always be adjusted for proper depth. Figure 4 shows a properly dimpled screw head. Drywall screws have a bugle-shaped Phillips head that is specially shaped to make a uniform dimple in the surface of the wallboard. These screws should always be set with the heads slightly below the surface of the wallboard. However, care must be taken to avoid breaking the face paper, an error sometimes called "coring" the screw. Be sure to remove or correct all improperly driven screws or screws which miss the framing member.

Figure 4
Dimpled screw head

Screw Attachment

To solidly attach drywall to wood framing, the screw must penetrate no less than ⅝″ into the wood. For metal framing, the screws should penetrate the metal stud a minimum of ⅜″ or 3 screw threads. Always check to make sure screws have been

driven to the proper depths. Keep in mind the following recommendations when attaching drywall with screws:

- Start the screw straight and perpendicular to the face of the sheet.
- Make sure the screw head reaches the proper depth.
- Keep screws at least ⅜″ from the ends and edges of the drywall sheet.
- Keep the screw gun operating continuously while in use.
- Apply constant hand pressure to the drywall while installing screws to make sure the drywall is tightly attached to the framing. See Figure 5.

Figure 5
Correct screw attachment

. . . installing drywall on ceilings is somewhat different.

2 Installing Drywall

Drywall is installed not just on walls but also on ceilings. The process of installing drywall on ceilings is somewhat different from that of installing it on walls. It is similar, however, in that considerable care must be taken to accurately measure and cut drywall panels in order to create tight seams, make installation more efficient, and avoid wasting material.

Installing Drywall on Ceilings

Installing drywall on a ceiling is typically a two-person job. Due to the weight of the material and the size and configuration of the sheets, teamwork is essential when installing a

drywall ceiling. Both workers must understand the process used to install the material, making sure to lift and postion the sheets together. Verbal communication between workers prior to beginning the process will increase the chances of completing the job without injury to workers or damage to the drywall.

Ceilings are typically the first areas to receive drywall, since this makes it easier to create tight seams between the walls and ceiling. Ceiling drywall is usually installed at right angles to framing members. This reduces the amount of joint finishing, strengthens the framing, and bridges any irregularities in the spacing and alignment of framing members. Before installing ceiling drywall, measure the dimensions of the ceiling in both directions. This will make it easier to even out the spacing of drywall panels and avoid having to make a narrow rip cut or butt cut to finish the ceiling. It is also a good idea to perform the following checks:

- Check the framing for any backing that is missing from the perimeter of the ceiling.
- Check for missing receptacle rings on electrical boxes.
- Check the joist layout for any irregularities.

Expectations

When your project is complete, it will be evaluated on its overall appearance and on the quality of your work. Your teacher will consider the following criteria:

- The drywall is installed with the long edge perpendicular to the framing.
- The white side of the drywall faces the inside of the room.
- The cut edges of drywall are against the wall or ceiling.
- The cutouts around all obstacles are accurate.
- The seams at butt edges and long edges are tight.

Figure 6
Placed walk-up benches

- The recommended screw spacing at the edges and in the field is followed.
- The screws are installed at a depth just below the surface of the drywall.

You will need the following tools:

- Drywall installation tool pouch
- Panel lifter
- 4′-0″ T-square
- Screw gun

You will need the following materials:

- (12) 4′-0″ x 8′-0″ x ⅝″ drywall (per room)
- 1 ⅛″ Type S drywall screws

PROCEDURE

Installing Drywall on a Ceiling

1. Determine the starting point of the joist layout and place the walk-up benches or scaffold in the area where the middle of the sheet will be located. The long direction of the benches or scaffold will match the long direction of the sheet. See Figure 6.
2. Measure and cut the sheet for the length and width, if needed.
3. Take any measurements, to and past any obstacles, in both directions. Make the required cutouts on the sheet.
4. Orient the sheet so that the cuts will be against the walls when installed. The white side of the sheet faces the benches.
5. Using two installers, lift the sheet overhead simultaneously, with both installers standing on their bench facing the same direction.
6. Butt the sheet tight to the framing in both directions.
7. Use your forearm to press the sheet tight against the ceiling framing.
8. Install a screw on the side of the sheet next to the wall. Install another screw in the joist at the other side of the sheet. See Figure 7.

Figure 7
Screws at the wall and the edge of sheet

9. Continue installing screws for the remaining joists. See Figure 8.
10. Complete the installation process until you reach the other wall. See Figure 9.
11. Repeat the process, coming back from the other direction. Make sure you offset the butt joints by at least one stud cavity, which is the open space between two adjacent studs or joists.

Figure 8
Placing screws in the field

Figure 9
Completing the installation process

Installing Drywall on Walls

Drywall forms the outer skin of most interior walls. The drywall covers the frame of the wall and it is the part of the wall that people see when they walk into a room. Most walls receive a single layer of drywall, which may be applied horizontally or vertically. Correct placement of the drywall with tight seams between the individual panels is essential.

Planning Drywall Installation A well-planned drywall installation will save time and materials and help avoid costly mistakes. To keep end joints to a minimum and avoid wasting material, plan to use drywall sheets of maximum length. Make sure the ends and edges of the sheets are placed over framing members and that the end joints or butts are staggered and all like edges match. As shown in Figure 10, joints located on opposite sides of the same partition should not be placed over the same stud. Carefully measure the height of the wall or partition and plan the installation to avoid any small rips or butts. The width or length of the beginning sheets of drywall on a

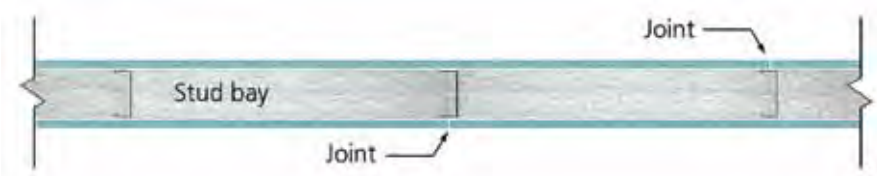


Figure 10
Correct joint placement

wall or ceiling can be cut to increase the width or length of the ending pieces. Remember that any cut edges or ends should be placed along the floor or against the exposed framing.

Placing and Fastening Drywall When placing drywall, sheet edges should touch each other but should not be forced together. When fastening drywall to framing members, start from the center of the sheet and move toward the ends. Safely hold the drywall sheet tightly against the framing while inserting the drywall screws. Safely hold metal studs firmly to prevent twisting while inserting the first screws. Always be aware of your hand placement on the framing member to avoid accidentally hitting your hand or the screw. When two sheets are attached to the same stud, always fasten the sheet to the hard side of the stud first, as shown in Figure 11.

Figure 11
Attaching two drywall panels to one stud

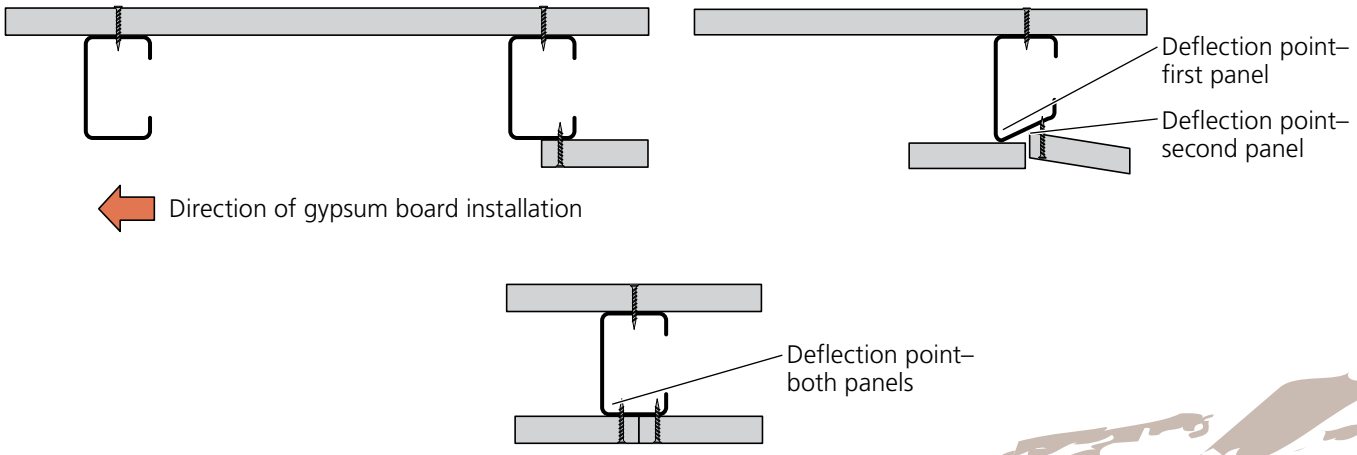


Figure 12
Top-down installation

Top-Down Installation

To create tight seams between the wall and ceiling drywall, carpenters often use the top-down installation technique. The drywall panels are attached to the wall studs in a horizontal position, as shown in Figure 12. As with most other drywall installation techniques, the top-down process begins by following the soft side of the wall studs. The process typically starts and ends on the wall where the floater stud is attached. This makes it possible to work methodically around the room, completing each wall before moving on to the next. The following project involves the top-down installation of wall drywall.

PROCEDURE

Installing Top-Down Drywall for the Top Row

1. Measure and cut the sheet to fit.
2. Measure, lay out, and cut for any obstacles.
3. Lift the sheet into place against the ceiling drywall.
4. Make sure there is a tight joint between the ceiling and sheet. See Figure 13.
5. Attach the sheet using a screw at each stud position along the bottom edge of the sheet, working from the middle to the ends of the sheet.

Figure 13
Sheet placed tight to the ceiling

6. Attach an additional screw in the approximate center of the sheet field. This will hold the sheet tight against the framing and prevent it from tipping away from the wall. See Figure 14.
7. Install the remaining screws in the sheet.
8. Continue installing all the top sheets, as necessary.

Figure 14
Placing screws in the sheet field

PROCEDURE

Installing Top-Down Drywall for the Bottom Row

1. Measure and cut the sheet to be fit.
2. Measure, lay out, and cut for any obstacles.
3. Place the sheet in position. Use a drywall panel lifter to raise the sheet, creating a tight seam with the upper sheet.
4. Install a screw at each stud position along the top edge of the sheet using the screws along the bottom edge of the upper sheet as a guide for the stud locations.
5. Fasten the perimeter and the field of the sheet. See Figure 15.
6. Continue installing all the bottom sheets. A completed installation is shown in Figure 16.

Figure 15
Fastening the perimeter

. . . continue installing all the bottom sheets

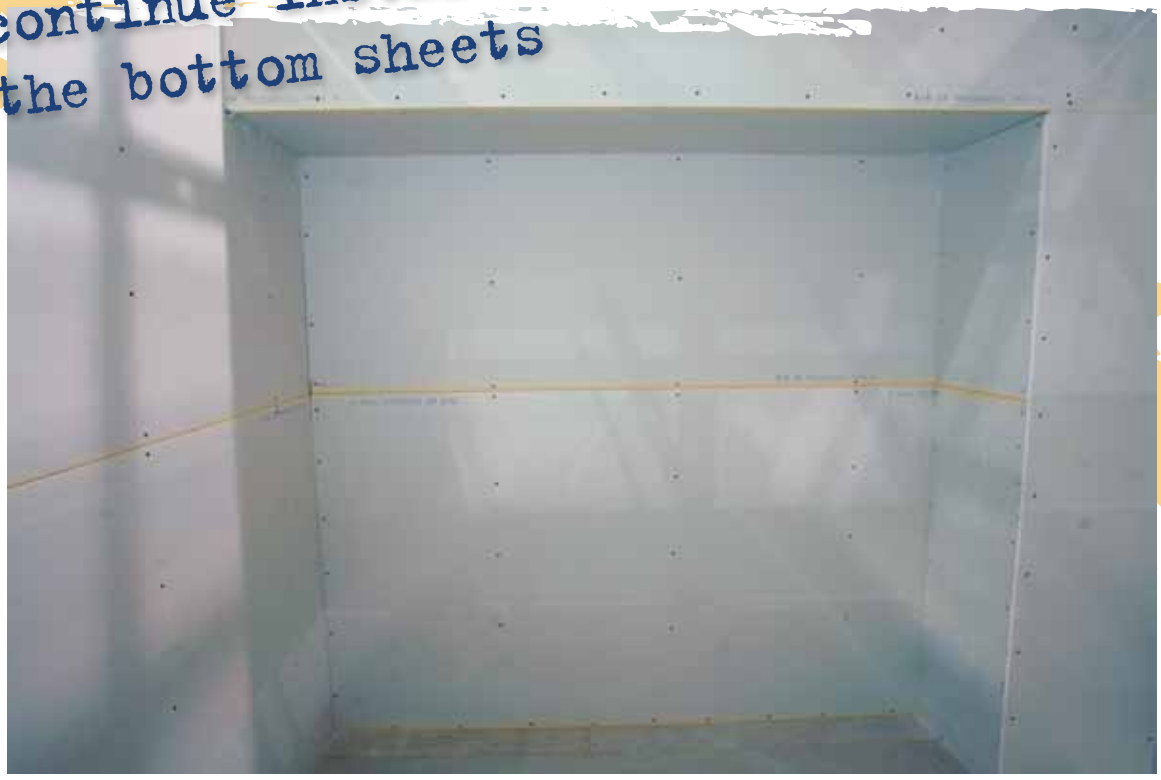


Figure 16
Completed installation

CHAPTER 1

ACOUSTICAL CEILING OVERVIEW

What You Now Know

- How to use prints to gather necessary information
- The importance of proper planning
- How to install doors and hardware

What You Will Know

- How to identify the starting point for grid layouts
- How to identify grid patterns and installation height
- How to identify different ceiling components by their function
- The procedure for determining equal borders

CONTENTS

1 Gathering Information

Before installing an acoustical ceiling, it is necessary to determine the height of the ceiling and the type of grid pattern and materials to be used. These and many other key details are found in the project prints. Of particular importance are the reflected ceiling plan, section views, elevation views, and any detail views related to the ceiling that are included in the prints.

Identifying the Starting Point

When installing an acoustical ceiling, selecting the correct starting point is crucial. The starting point may be identified in one of several ways. For instance, the reflected ceiling plan may show the distance from the edge or center of a tile to the center of a column or to one of the corners of the room. The reflected ceiling plan shown in Figure 1 provides the necessary information for identifying a starting point.

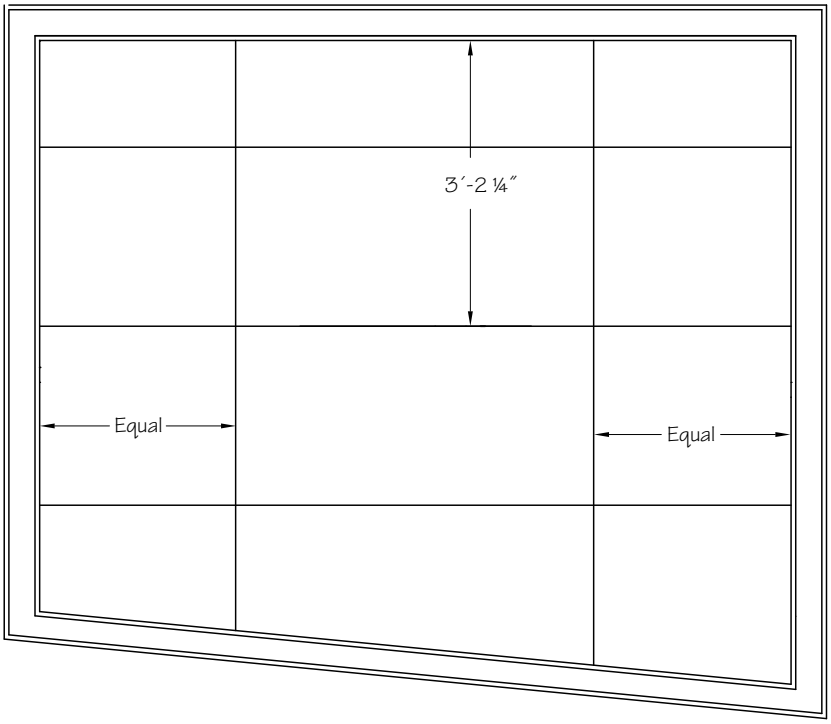
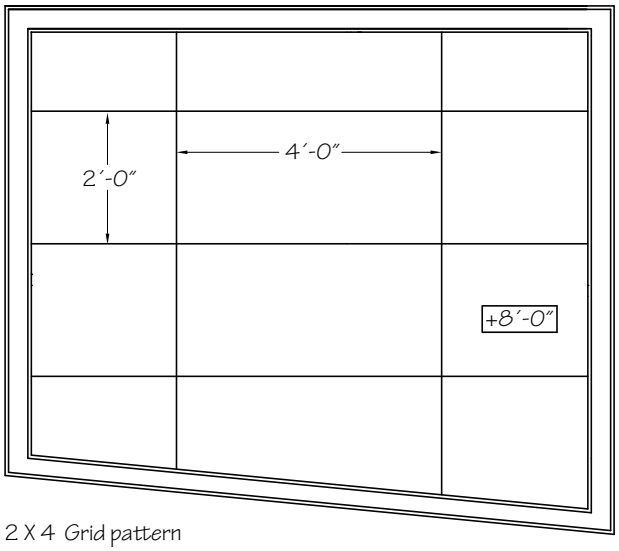


Figure 1
Laying out the starting point

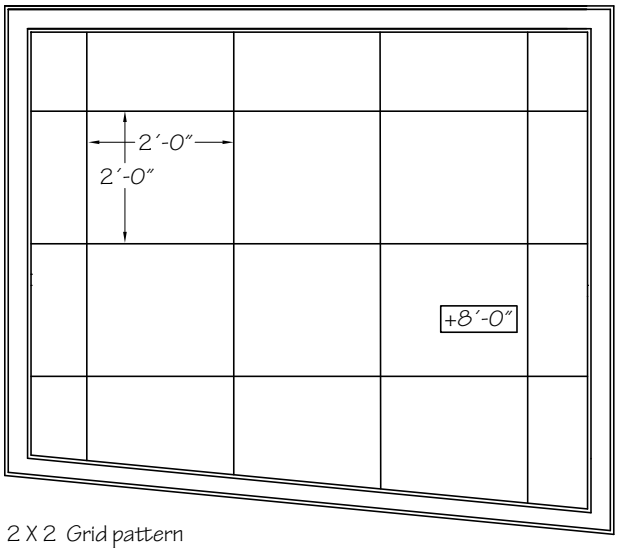
Grid Pattern

The grid pattern of a suspended ceiling can be determined by examining the reflected ceiling plan. There is an obvious difference between a 2′-0″ × 4′-0″ grid pattern and a 2′-0″ × 2′-0″ grid pattern. Figure 2 shows both types of grid pattern.

Figure 2
Grid patterns



2 X 4 Grid pattern



2 X 2 Grid pattern

Installation Height

The height of the ceiling is usually marked inside a special box or circle on the reflected ceiling plan. If not, the ceiling height can be determined by examining the appropriate section view or elevation view as shown in Figure 3. The section view and the elevation view both provide vertical dimensions that can be used to establish the distance between the floor and the installed ceiling.

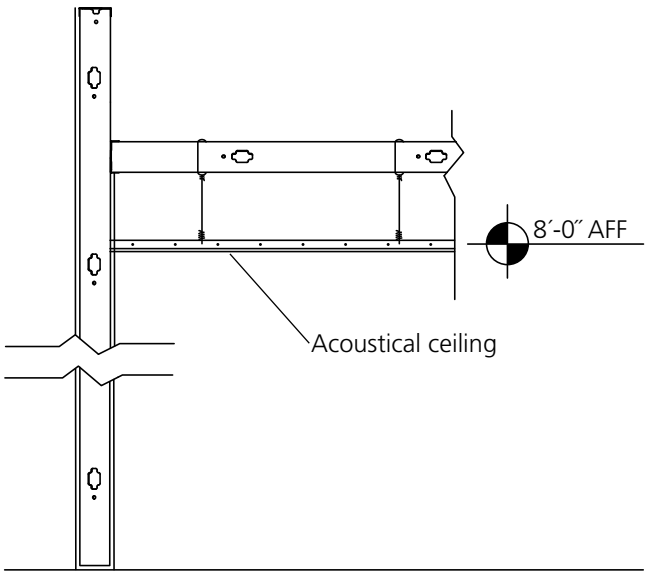


Figure 3
Ceiling height shown in the section view

Ceiling Details

Detail views may provide vital information that will determine the techniques used for installing acoustical ceilings. Most detail views can be found on the print pages containing the reflected ceiling plan or section views. A detail view with information on ceiling construction is shown in Figure 4.

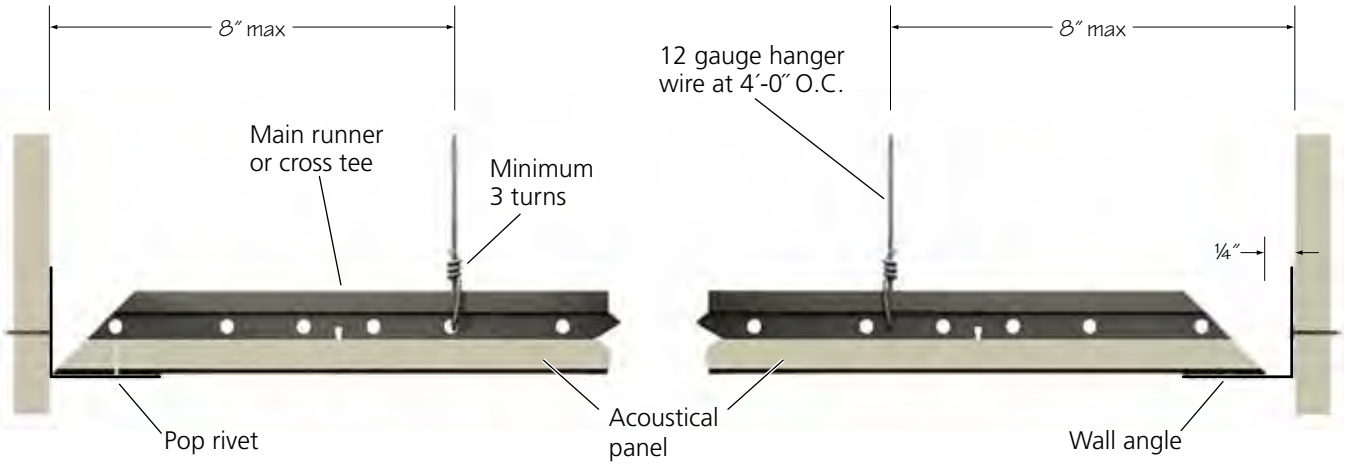


Figure 4
Ceiling detail

Detail views may provide vital information that will determine the techniques used...

2 Acoustical Ceiling Components

An acoustical ceiling is a complex system consisting of many different components. Depending on the type of acoustical ceiling, these components may include main runners, cross tees, wall angles or molding, hanger wires, and ceiling tiles. There are various types, shapes, thicknesses, colors, and textures. When installing a ceiling, these components must be handled and installed with care.

Figure 5
Exposed tee grid

Figure 6
Concealed tee grid

Types of Ceiling Systems

Most acoustical ceilings are installed using what is called an exposed tee system. This means that the grid work supporting the ceiling is exposed, as shown in Figure 5, rather than hidden from view, as in the concealed tee grid shown in Figure 6. Exposed tee ceiling grids consist of several components, as described in the following sections.

Main Runner

The primary suspension members of an acoustical ceiling system are called main runners. A typical main runner is shown in Figure 7. Main runners are also known as mains, carrying tees, carrying runners, or main beams. Main runners are manufactured in 144″ lengths with a web height of 1 ¾″ and a prefinished exposed flange that is 15⁄16″ wide.

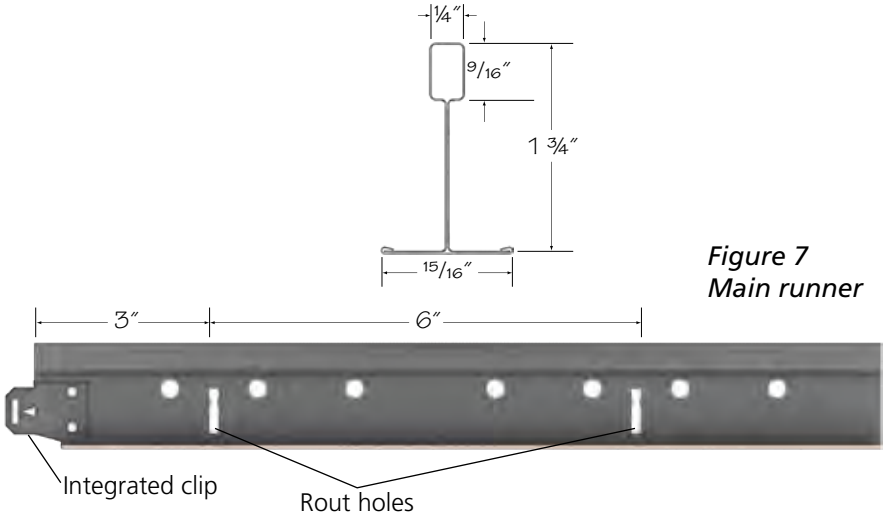


Figure 7
Main runner

Slots are punched at uniform distances along the length of a main runner.

At each end of a main runner are integrated clips which interlock with other main runners to form a secure connection. Slots are punched at uniform distances along the length of a main runner. These slots are called rout holes, and they are used for securing other support members. Usually, a rout is located 3″ from each end of the main runner with other rout holes spaced 6″apart. However, the location of routs may vary depending on the type and manufacturer of the grid components.

Cross Tee

Another important suspension component of the exposed grid system is the cross tee which interlocks into the routs of the main runner at a 90° angle. Also known as cross runners or cross T-bars, cross tees come in 12″, 24″, or 48″ lengths. Examples of cross tees are shown in Figure 8. They have a web height of 1 ½″ and a prefinished exposed flange that is 15⁄16″ wide. Some cross tees have clips or hooks at each end to make it easier to remove them without tools.

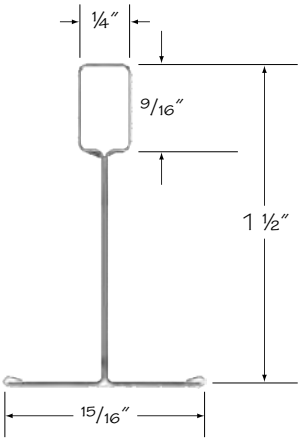


Figure 8
Cross tees

Wall Angle or Molding

The suspension member that attaches to the wall is the wall angle, also known as molding. Wall angle is a 90° angle and has an exposed flange of ⅞″, 15⁄16″, or 2″. A wall angle is shown in Figure 9. Wall angle is manufactured in either 120″ or 144″ lengths and is prefinished to match the grid system. The main runners and cross tees are attached on two walls to the wall angle by rivets.

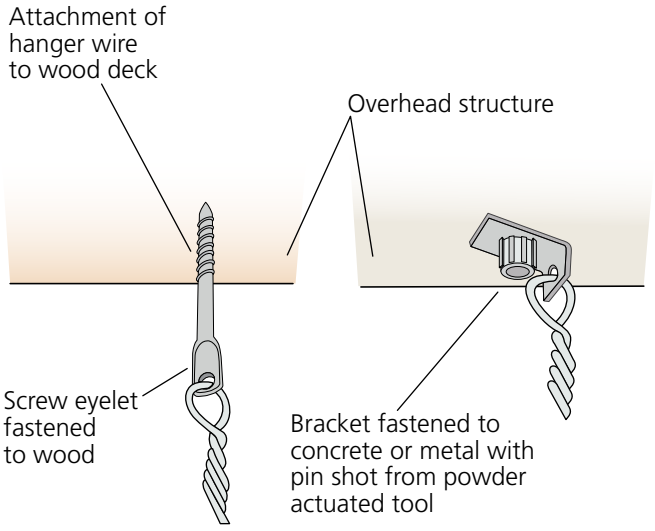
Wall angle is bent at a 90° angle...

Figure 9
Wall angle or molding

Hanger Wires

The entire exposed grid system is supported by hanger wires, also known as suspension wires. Made of galvanized steel, hanger wires must be a minimum of 12-gauge in order to safely support the grid. The hanger wires are secured to the overhead structure and then attached to the main runners at 4′-0″ intervals with the first wire located within 8″ of the wall. Cross tees are also supported with hanger wires when they exceed 8″ in length at the perimeter. As shown in Figure 10, there are several methods used to attach hanger wires to the building structure.

Figure 10
Securing hanger wire



Ceiling Tiles

"...ceiling tiles can offer an almost endless variety of looks."

When people look up at acoustical ceilings, the ceiling tiles are mostly what they see. Ceiling tiles provide the sound dampening, light reflection, and attractive qualities that architects expect to achieve with an acoustical ceiling system. Available in many different colors and textures, ceiling tiles can offer an almost endless variety of looks. The exposed surface of a ceiling tile can be smooth or textured, or it can be covered with cloth, vinyl, plastic, metal, or wood veneer.

Types of Ceiling Tile There are two main types of ceiling tile: flat lay-in, also known as flush tile, and tegular. Flat lay-in tiles have square edges and are placed flush with the bottom edge of the suspension system. Tegular tiles have stepped edges that extend past the bottom of the suspension system. Flat lay-in and tegular tiles are shown in Figure 11.

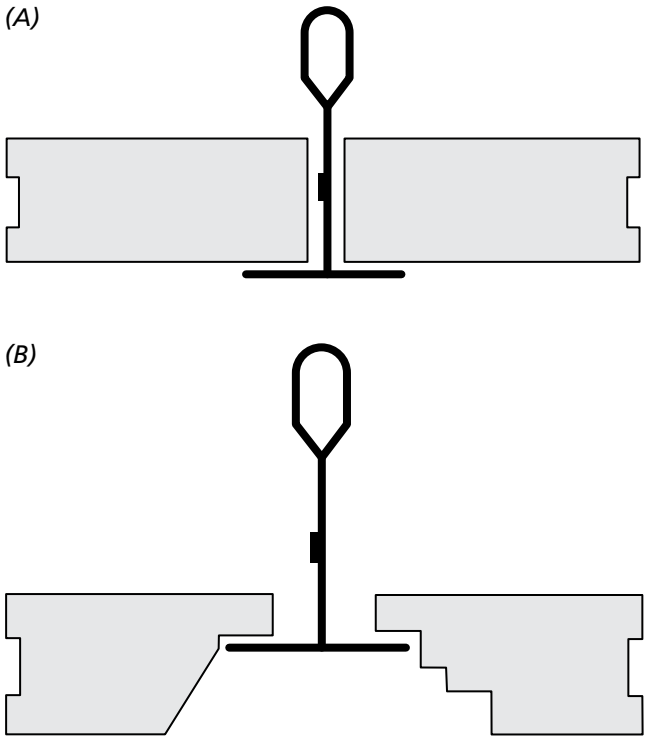


Figure 11
(A) Flat lay-in
(B) Tegular tiles

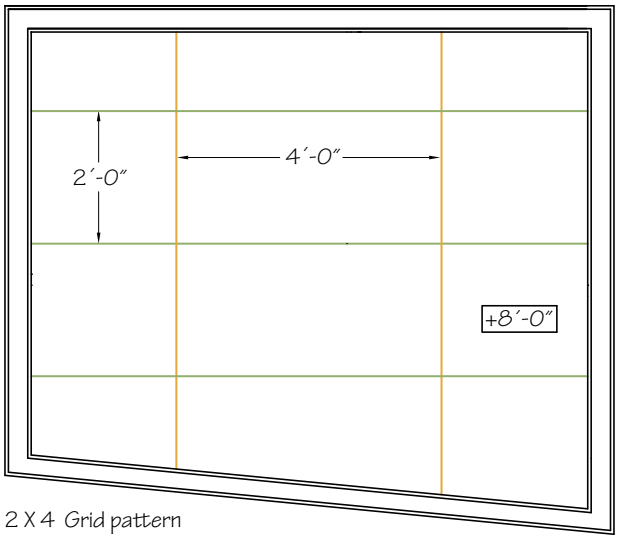
3 Grid Patterns and Layout Methods

A grid is an arrangement of lines that run perpendicular to one another at regular intervals. A suspended acoustical ceiling layout establishes a grid which determines the placement of main runners, cross tees, and ceiling tiles.

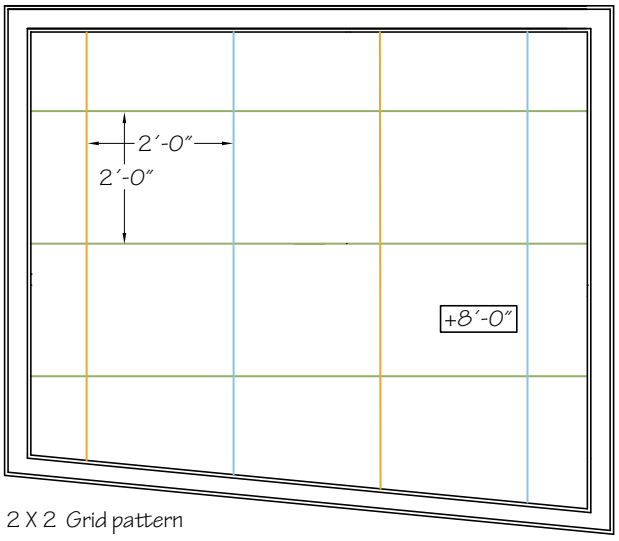
Grid Patterns

Ceiling grids are often arranged in 2′-0″ × 4′-0″ or 2′-0″ × 2′-0″ grid patterns, as shown in Figure 12. The 2′-0″ × 4′-0″ grid is the pattern most commonly used in commercial construction. Both types of ceiling grids are constructed with the main runners spaced 4′-0″ apart. To create a 2′-0″ × 4′-0″ grid pattern, 4′-0″ cross tees are installed every 2′-0″ along the length of the main runner. To create the 2′-0″ × 2′-0″ grid system, 2′-0″ cross tees are centered between the cross tees of a 2′-0″ × 4′-0″ grid pattern.

Figure 12
Grid patterns

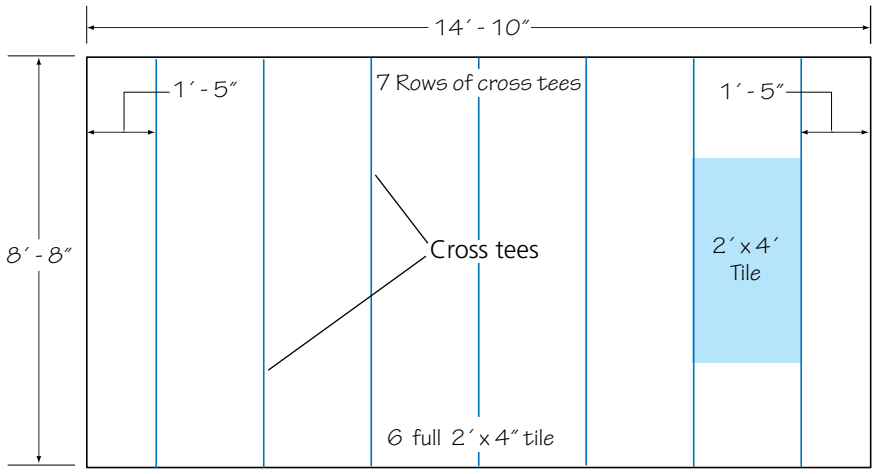


2 X 4 Grid pattern

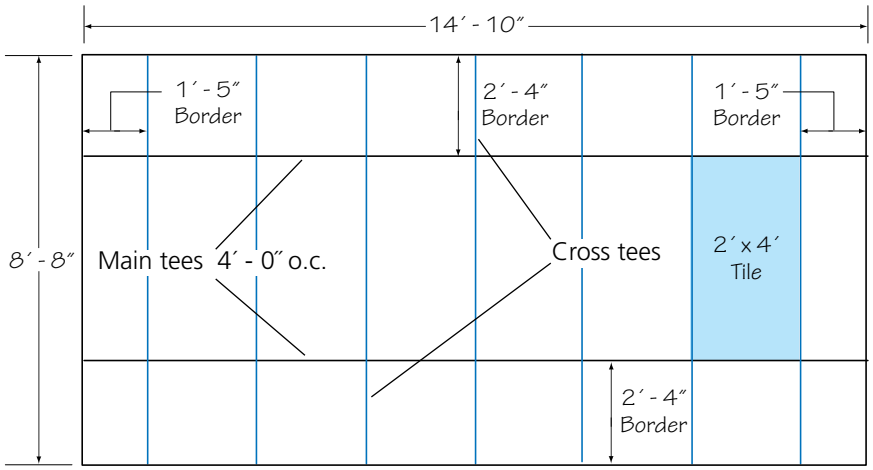


2 X 2 Grid pattern

Equal-border layout



2′ - 0″ x 4′ - 0″ Layout
Grid layout for equal cross tee borders



2′ - 0″ x 4′ - 0″ Layout
Grid layout for equal cross tee borders

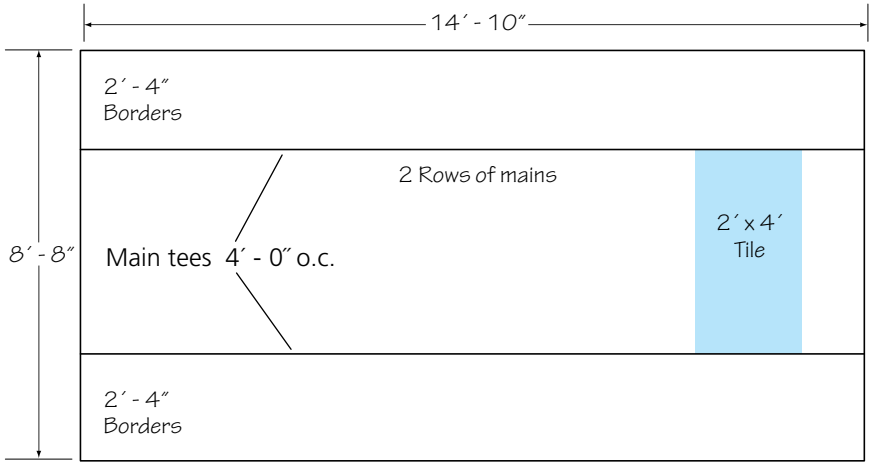


Figure 13
Equal-border layout

Equal Borders

Although manufactured ceiling tiles are usually 2′-0″ wide and either 2′-0″ or 4′-0″ long, the lengths and widths of rooms or ceilings are rarely precise multiples of 2′-0″ or 4′-0″. For instance, a ceiling may be 8′-8″ long and 14′-10″ wide. In such cases, some of the tiles will have to be cut to make them fit. Usually, architects will specify a ceiling layout with equal borders. This means that when the tiles on one side of a room are cut to fit, the tiles on the opposite side of the room must be cut to the same size. An equal-border layout requires careful planning, and the size of the tiles around the perimeter of the room must be determined mathematically. An equal-border layout is shown in Figure 13. The math is done in three steps, as follows:

...separate calculations must be done for both the length and the width...

Step 1: Divide the size of the room by the size of the tile.

Step 2: Add the feet and inches remainder of the room size to the tile size being used.

Step 3: Divide this dimension by 2 to establish the width or length of the equal-border tile.

Here is how the math would be done for the room in the sample shown in Figure 13. Keep in mind that separate calculations must be done for both the length and width of the room. According to the plan, the room measures 8′-8″ × 14′-10″. The plan indicates that the 4′-0″ lengths of the tile run across the 8′-8″ width of the room.

Following step 1, 8′-8″ is divided by 4′-0″, leaving a remainder of 8″.

8′-8″ ÷ 4′-0″ = 2 tiles with 8″ remaining

In step 2, add 8″ to the 4′-0″ length of the tile for a total of 4′-8″.

8″ + 4′-0″ = 4′-8″

In step 3, divide 4′-8″ by 2, leaving 2′-4″ as the equal-borders dimension.

4′-8″ ÷ 2 = 2′-4″

To check the calculation, add 2′-4″ to 4′-0″ to 2′-4″ for a correct total of 8′-8″.

2′-4″ + 4′-0″ + 2′-4″ = 8′-8″

According to the sample plan, the 2′-0″ width of the tiles runs across the 14′-10″ length of the room. To do the math for this direction:

Follow step 1 and divide 14′-10″ by 2′-0″, leaving a remainder of 10″.

14′-10″ ÷ 2′-0″ = 7 tiles with 10″ remaining

In step 2, add 10″ to the size of the 2′-0″ tile for a total of 2′-10″.

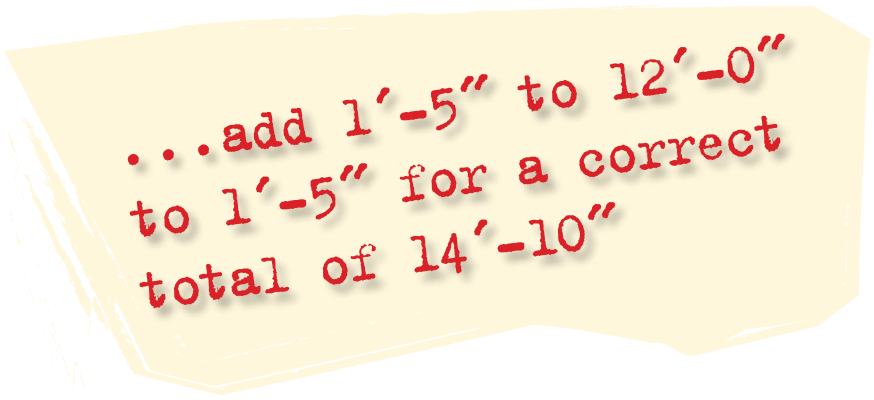
2′-0″ + 10″ = 2′-10″

In step 3, divide 2′-10″ by 2, resulting in 1′-5″ as the equal-border dimension.

2′-10″ ÷ 2 = 1′-5″

To check the calculation, add 1′-5″ to 14′-0″ to 1′-5″ for a correct total of 14′-10″.

1′-5″ +12′-0″ + 1′-5″ = 14′10″



CHAPTER 1

FLOOR TILE LAYOUT WITH EQUAL BORDERS

What You Now Know

- How to identify the starting point for grid layout
- How to determine equal borders
- How to install control lines
- How to handle ceiling tile
- How to cut ceiling tile

What You Will Know

- How to lay out a square floor tile installation with equal borders
- How to install floor tile

CONTENTS

1 Preparation

Layout is the most important step in the floor tile installation process. A professional installation should result in a floor finish with an attractive, well-balanced appearance. This is especially true when installing diagonal or checkerboard patterns with a border. See Figure 1. Achieving this result requires an accurate and carefully considered layout. This involves taking room measurements, determining border widths, and establishing perpendicular control lines. It also involves visualizing the finished appearance of the installed tile.

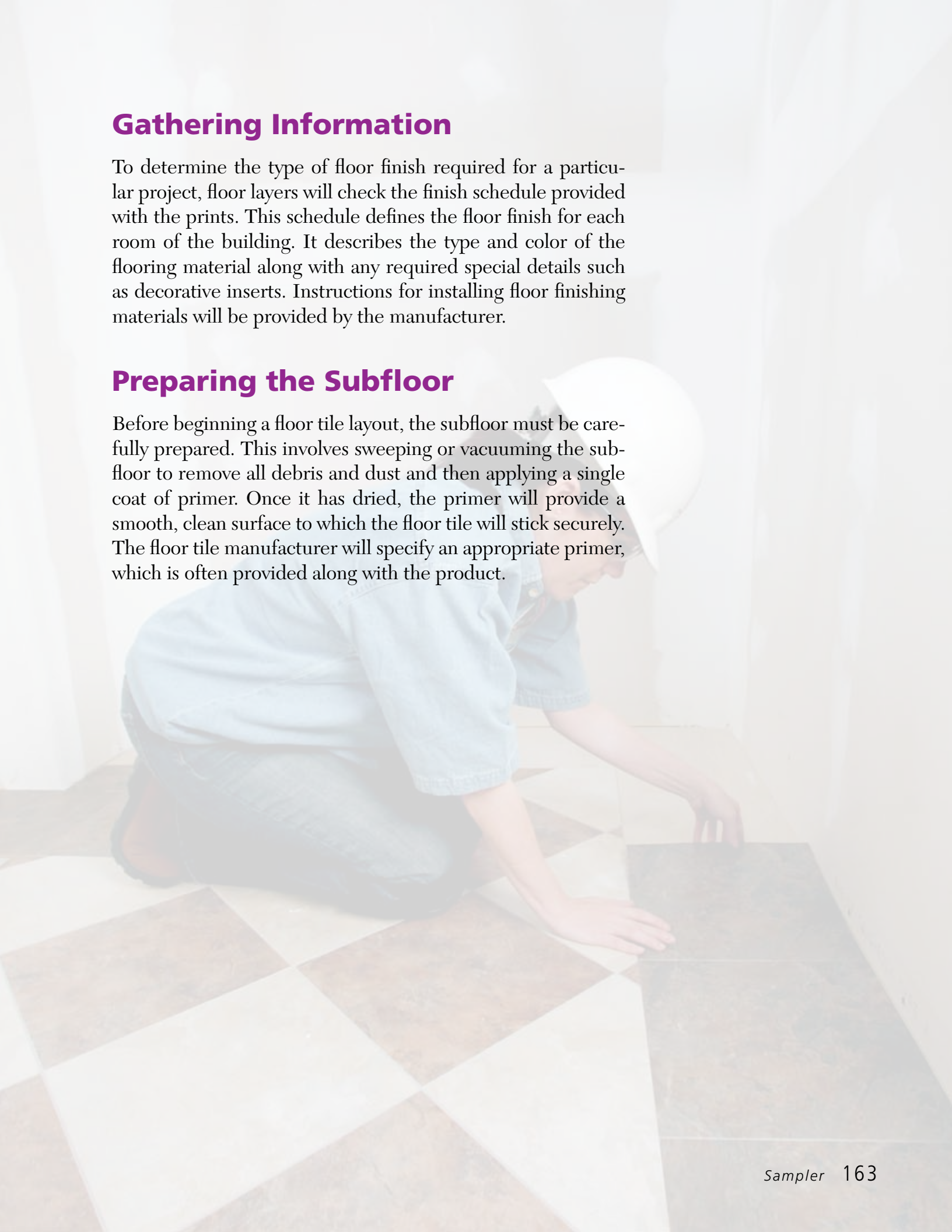
Figure 1
Patterns with border

Gathering Information

To determine the type of floor finish required for a particular project, floor layers will check the finish schedule provided with the prints. This schedule defines the floor finish for each room of the building. It describes the type and color of the flooring material along with any required special details such as decorative inserts. Instructions for installing floor finishing materials will be provided by the manufacturer.

Preparing the Subfloor

Before beginning a floor tile layout, the subfloor must be carefully prepared. This involves sweeping or vacuuming the subfloor to remove all debris and dust and then applying a single coat of primer. Once it has dried, the primer will provide a smooth, clean surface to which the floor tile will stick securely. The floor tile manufacturer will specify an appropriate primer, which is often provided along with the product.



2 Principles of Floor Tile Layout

Whether for a square office, a circular auditorium, or a rectangular retail space, each layout presents its own special set of challenges. Understanding the principles of floor tile layout will help most of these challenges. A proper layout requires accurate measurements and precisely located control lines. These ensure that the layout and the installed floor finish will be square and balanced. The control line should be parallel to the predominant wall of the room, hallway, or auditorium. The predominant wall is the longest, straightest, or most visible wall in the room.

The tile along the edges of a room or other space are called cut tile or border tile. Cut tile are full-sized tile that have been cut to a specific size to fit the remaining space between the last full tile and the border or the wall. Border tile, cut tile, and full tile are shown in Figure 2. For an attractive finished appearance, the cut tile must be balanced. In other words, they should be the same size on each side of the room. Cut tile should be a minimum of one-half the width of a full-sized tile. If the width of the cut tile is less than half the width of a full-sized tile, the layout must be adjusted to increase the size of the tile along the borders of the layout.

The tile along the edges of a room or other space are called **cut tile** or **border tile.**

For an attractive finished appearance, the cut tile must be balanced.

Figure 2
Border, cut, and full tile

3 Square Floor Tile

Floor tile are available in different shapes and sizes. Although some are rectangular, typical floor tile are square and 12″ in length and width. The following procedure explains how to lay out a square-tile floor installation project.

Expectations

When your project is complete, it will be evaluated on its overall appearance and on the quality of your work. Your teacher will consider the following criteria:

- The floor of the room was properly prepared.
- Both the length and width of the room were accurately established.
- The adjustment of the control line was mathematically calculated based on the size of the tile.

You will need the following tools:

- Floor layout and installation tool pouch
- Construction drawings

PROCEDURE

Laying Out Square Floor Tile

1. Prepare the floor for layout.
2. Measure the length and width of the room. In the example shown in Figure 3, the width of the room is 6′-6″ and the length is 9′-2″.
3. Mark the center of the room width along both walls on the floor, with the center being 39″ in the 6′-6″ direction. See Figure 4.
4. Divide one half the width of the room by the size of the tile. For example, 39″ ÷ 12″ = 3.25 or 3 full tile and ¼ of a tile.
5. If the remainder is less than half of a full tile, adjust the center mark by half the width of a full tile. See Figure 5. If the remainder is half or more, the center mark does not need to be adjusted.

Mark the center of the room width along both walls on the floor.

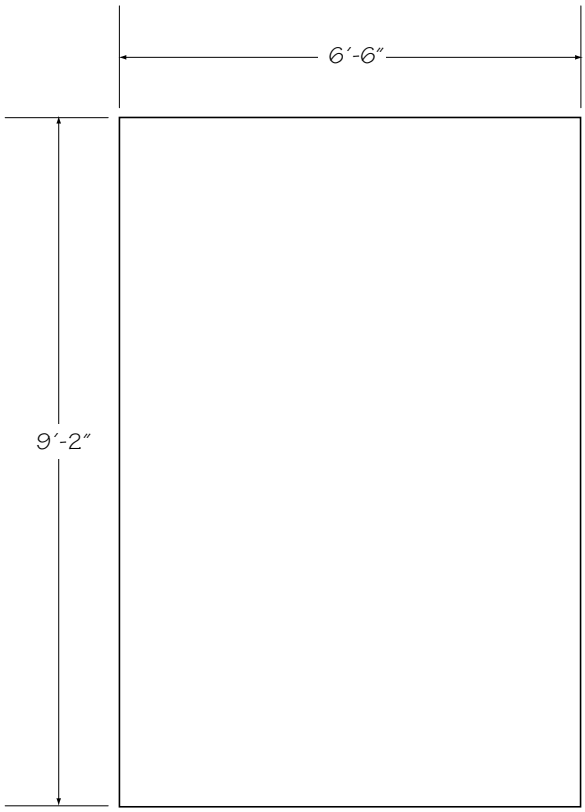


Figure 3
Sample floor tile layout

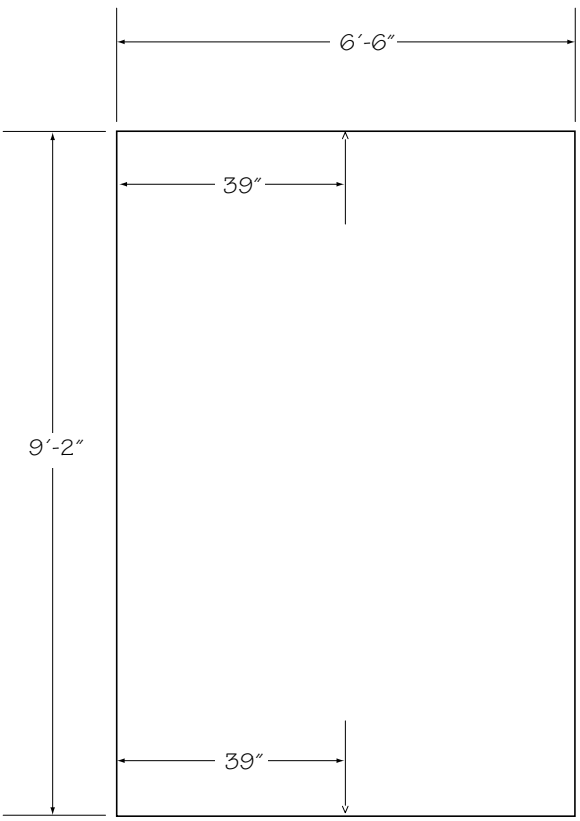


Figure 4
Marking center of room

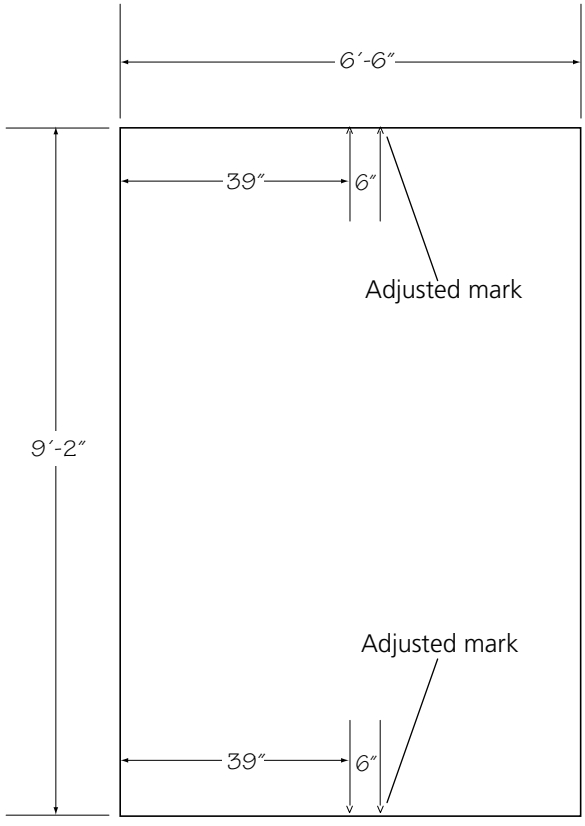


Figure 5
Adjusting center mark

6. Snap a line on the marks made in the previous step to establish a control line. See Figure 6.
7. Mark the center of the length for the room on the control line made in step 6.
8. Repeats steps 4 and 5 to determine if the center mark made in step 7 needs to be adjusted.
9. Establish a perpendicular line from the mark determined in step 8.
10. Extend the perpendicular control line to the walls. See Figure 7.

Figure 6
Established control line

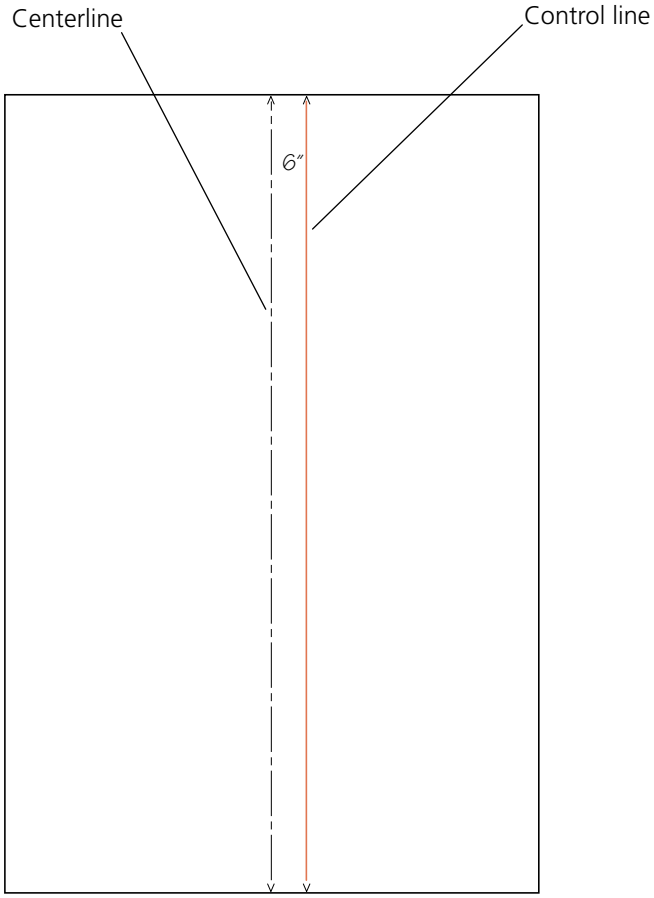
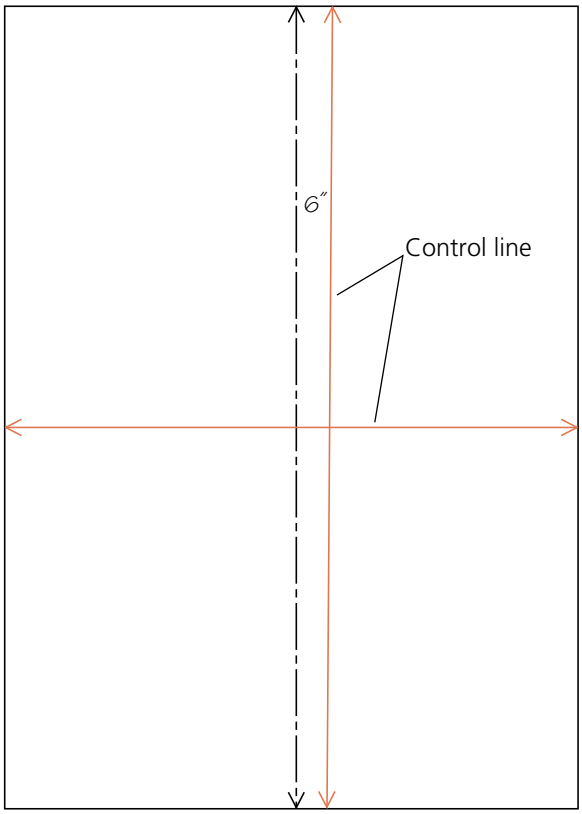


Figure 7
Extended perpendicular control line



4 Floor Tile Installation

Once the subfloor has been properly prepared and the layout is completed, the tile is installed. Installation begins at the intersection of the two control lines. The first line of tile is installed along the long control line and the second line is installed along the shorter control line. Make sure the edge of each tile is placed exactly on the control lines. As each tile is placed, the backing is removed, as shown in Figure 8, and the tile is fitted against the edge of the previous tile. Avoid pushing the tile together, since this may cause the edges of the tile to lift off the subfloor.

Figure 8
Removing backing from tile

Continue to install the tile in a stair-step or pyramid pattern starting from the intersection of the control lines. Throughout the installation process, check repeatedly to make sure the edges of the tile are properly aligned. After placing the last full tile near the wall, the border tile are cut with a sharp utility knife. Most floor tile can be cut with a utility knife and a straightedge. All cut tile should be installed with the cut edge against the wall. The following procedure explains how to install floor tile.

Expectations

When your project is complete, it will be evaluated on its overall appearance and on the quality of your work. Your teacher will consider the following criteria:

- The two control lines of a room were established.
- The first row of floor tile was properly laid.
- All remaining rows of tile were laid according to the established pattern.
- Border tile was marked, cut, and installed properly.

You will need the following tools:

- Tool pouch
- Straightedge

You will need the following materials:

- (35) Tile

PROCEDURE

Installing Floor Tile

1. Place the first tile at the intersection of the two control lines, as shown in Figure 9.
2. Lay the first full row along the long control line. See Figure 10.

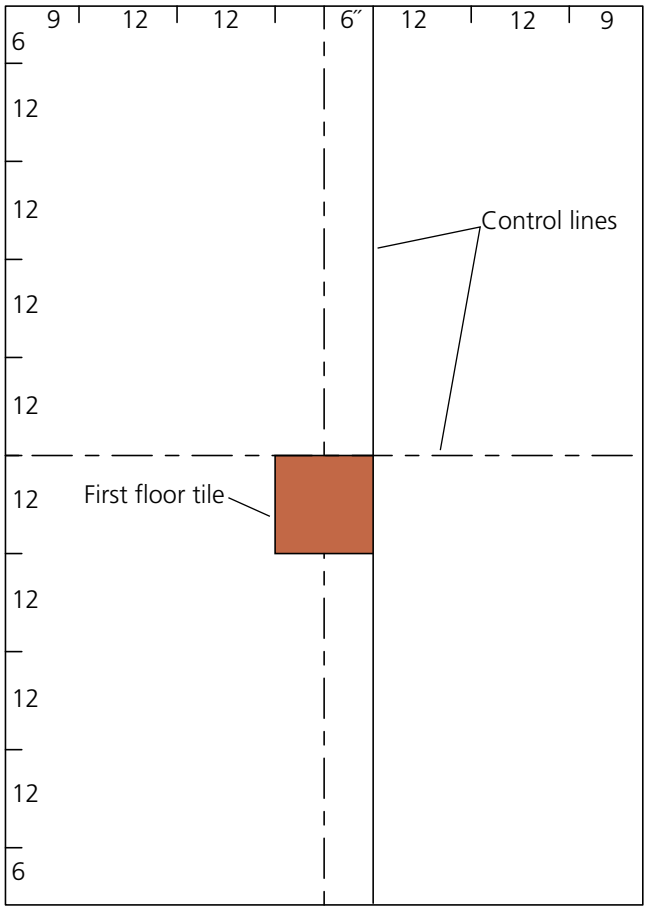
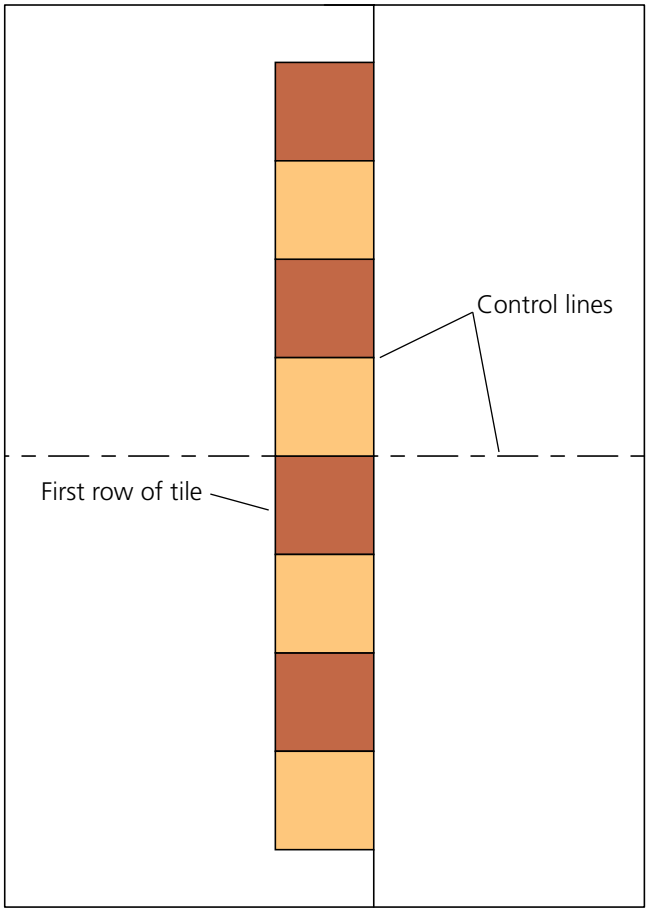


Figure 9
First tile placed

Figure 10
First row placed



3. Lay the second full row along the cross control line.
4. Place tile in a stair-step or pyramid pattern until all full tile are placed. See Figure 11.
5. Mark and cut the border tile to fit between the walls and the full tile.
6. Install the border tile. See Figure 12.

Figure 11
Stair-step pattern

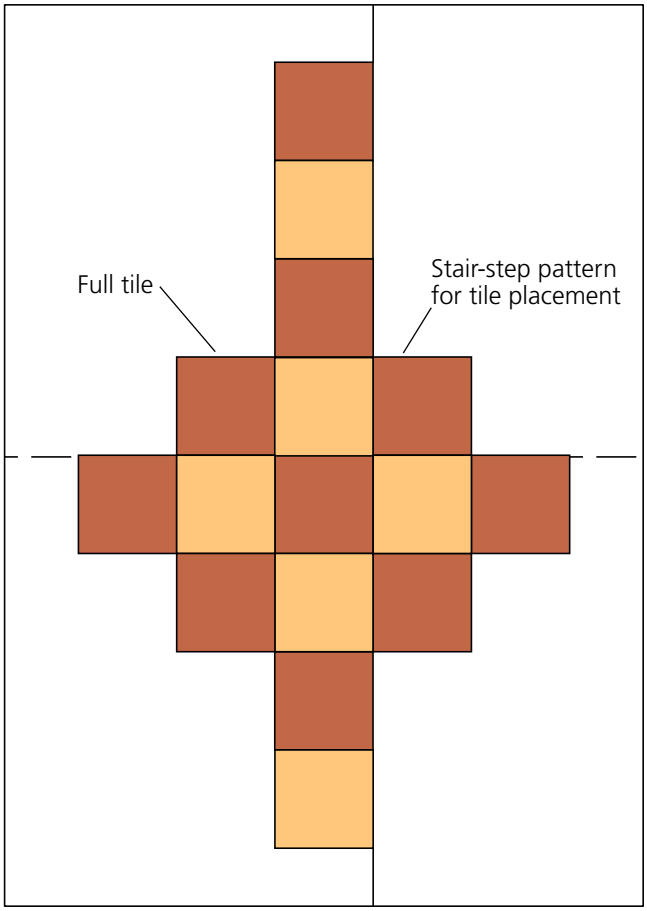
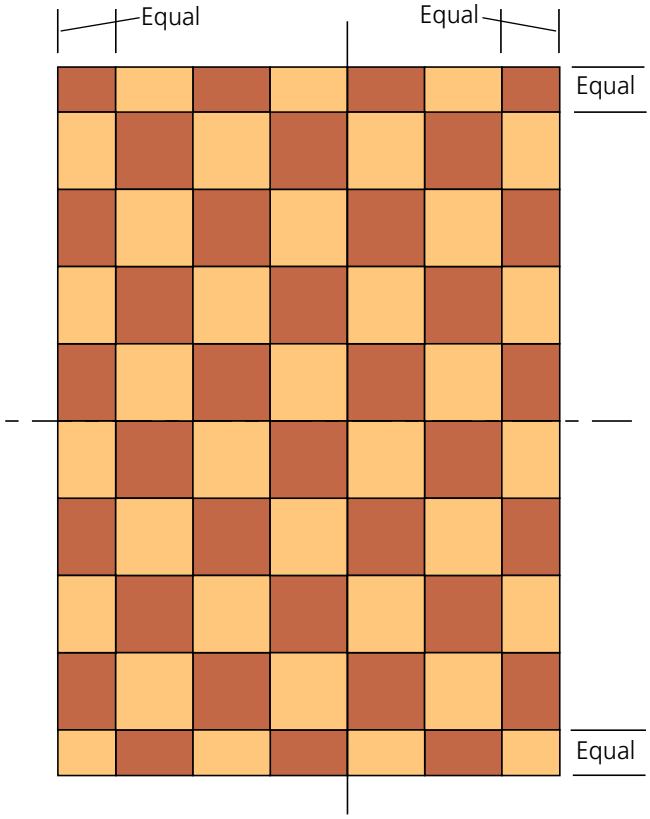


Figure 12
Installed border tile



CHAPTER 1

FOOTINGS

CONTENTS

The Teacher Annotated Edition (TAE) for Project Book 3: Residential Construction is not presented in the Sampler. It contains the same features as the TAE for Project Book 3: Commercial Construction.

The following is a sample chapter from the Student Edition of Project Book 3: Residential Construction.

What You Now Know

- The purpose and function of stakes in a site layout
- How to set up batter boards

What You Will Know

- The different types of footing forms used in residential construction
- How to lay out footing forms
- How to construct footing forms

1 Concrete Footings

A footing is the part of a concrete foundation that spreads and transmits loads placed on it by the structure above. A footing can support the base of a building, a weight bearing wall, or a column. Footings are usually made of concrete. They must be wider than the structures they support so they can distribute weight over a larger area.

Concrete

Concrete is not the same thing as cement. Concrete is a composite material consisting of a sand and pebble aggregate mixed with a binding agent, such as cement. Cement, on the other hand, is a manufactured material that hardens and binds aggregates or other materials together after it is mixed with water and allowed to cure.

Concrete is mixed using Portland cement, which forms a paste when combined with water. The paste coats the surface and binds the coarse and fine particles together in the aggregate. Through a chemical reaction called hydration, the paste then hardens and gains strength to form the rock-like mass known as concrete.

When freshly mixed, concrete is relatively soft and malleable and can be used to form construction components or a wide array of other objects in almost any shape. Once the concrete is cured, it becomes as strong and durable as solid rock. Because of these qualities, concrete is one of the most useful materials in the construction industry.

Mixing and Placing Concrete

Soon after the aggregates, water, and cement are combined, the mixture starts to harden. The concrete will become increasingly stiff and difficult to work. For this reason, once the concrete is thoroughly mixed and workable it should be placed in forms, as shown in Figure 1, to give it the intended shape.

Concrete does not reach full strength immediately after it is dry.

Curing

In its simplest terms, curing is a process that gives the concrete its strength. Concrete does not reach full strength immediately after it is dry. While concrete reaches a majority of its strength in the first month after it is in place, the curing process continues at a slower rate, often for many years.

In the initial curing process, the concrete can be treated so that a sufficient amount of moisture is present. The treatments used when curing the concrete are applied after the exposed surfaces of the concrete have hardened sufficiently to resist marring. Concrete surfaces are treated by sprinkling them with water fog or by using moisture-retaining fabrics, such as burlap or cotton mats. Other treating methods prevent evaporation of the water by sealing the surface with plastic or specially designed sprays and curing compounds.

Figure 1
Placing concrete in forms

2 Footing Form Materials

Fresh concrete will flow like mud or lava unless it is confined by some sort of barrier. The barriers used to confine concrete and give it a desired shape are called forms. Made from wood, plywood, polyvinyl chloride (PVC), or a combination of these materials, footing forms serve as a type of mold that holds the concrete in place until it is strong enough to retain its shape.

Wood Forms

Wood forms are versatile and can be used to create a wide variety of shapes. They are typically made of plywood or dimensional lumber. A wooden footing form is shown in Figure 2. The materials needed to make wood forms are widely available and relatively inexpensive.

Wood forms are built so that they can be pulled apart with a minimal amount of effort after the concrete has set. Before the concrete is placed, the forms are coated with a releasing agent that will prevent the concrete from bonding to the form.

Figure 2
Wooden footing form

PVC Forms

Another material that footing forms can be made from is polyvinyl chloride, commonly called PVC. An example of this type of form is shown in Figure 3. One of the biggest advantages of this type of form is that it can be left in place after the concrete is set. This is because the forms are equipped with both an integrated drainage system and a radon gas venting system. Radon gas is a radioactive, colorless, odorless gas that occurs naturally in the soil. The venting system allows the gas to escape, instead of being trapped and allowed to build, which can cause health hazards.

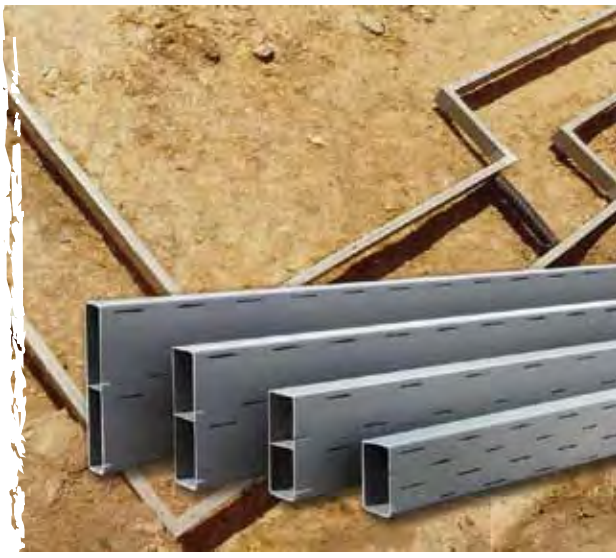


Figure 3
PVC form

Footing Stakes, Spreaders, and Braces

Footing forms are often held in place with pointed wood or metal stakes that are driven into the ground. See Figure 4. The stakes must be positioned precisely. This is important not only because the footing forms will be fastened to the stakes, but also because the stakes will be used to establish the exact height, location, and configuration of the footing forms. Additional stakes may be added at corners or to provide additional reinforcement where they are needed. Braces are installed behind the stakes to hold them in an upright position. Spreaders are fastened to the top of the footing forms to maintain the width of the footing. The stakes can be reinforced with diagonal braces, also known as kicker braces. The forms are built so they can be pulled apart with a minimal amount of effort after the concrete has set. Before the concrete is placed, the forms are coated with a releasing agent that will prevent the concrete from bonding to the form.

Figure 4
Metal footing stakes

Stepped footings are shaped like a series of elongated stair steps.

3 Footing Form Types

There are several types of footing forms; however the ones most commonly used in residential construction are pier, monolithic, continuous, and stepped footings. Regardless of the footing form used, all footings need to be below the frost line. The frost line is the deepest point at which the ground freezes in the winter. Of course, the frost line will vary from region to region, but it is important that the footings be built below this line. When the footings are not below the frost line, structural damage to the residence can occur.

Pier Footing

A pier footing is a concrete base used to support wood or steel columns. In residential construction, this type of footing is most commonly used to hold the columns that help support the first floor. Like other types of footings, pier footings distribute the loads placed on them from above the soil. The dimension of a pier footing is determined by the ability of the soil to bear the necessary load. This means that the denser the soil, the smaller in diameter the pier footing needs to be. Conversely, the looser the soil, the larger in area the pier footing must be.

Figure 5
Pier footing with sides running wild

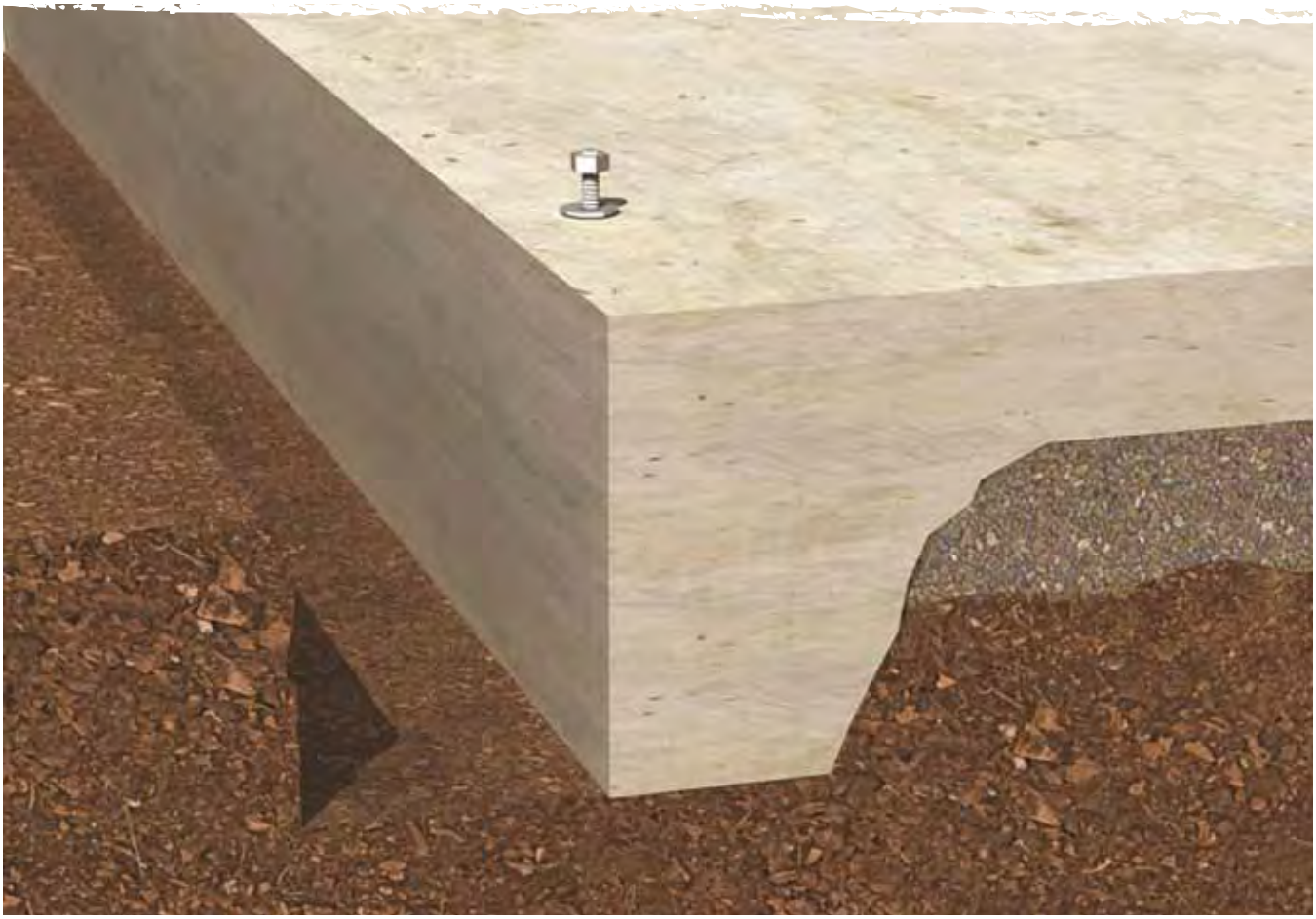
There are several methods of making a form for a pier footing, but they all have a couple of things in common. First, all pier footings are simply boxes, whether square or rectangular, designed to hold concrete while it cures. Second, the corners are typically reinforced to keep the box tight and prevent the concrete from leaking out. The

reinforcement also prevents the box from coming apart from the force of the concrete placed inside. The corners of the footing can be constructed so they meet, as in a typical box, or they can be allowed to "run wild," as shown in Figure 5. In this type of construction, the materials are more easily reused since they are not cut to specific lengths, which also wastes less lumber.

Monolithic Footing Forms

A monolithic footing form, also called a thickened edge slab, is a combined slab and foundation. A monolithic footing is shown in Figure 6. The monolithic footing and concrete floor are placed at the same time. This process takes less time and material. A monolithic footing is more suitable to warm climates where frost is not a problem.

Figure 6
Monolithic footing



Continuous Footing

Continuous footings, sometimes called spread footings, are a type of footing that is typically used on a leveled surface. An example is shown in Figure 7. Continuous footings are common in residential and light commercial work. They are often used for full basements, crawl spaces, and under retaining walls. The footing is typically twice as wide as the thickness of the foundation wall, but the thickness of the footing is equal to the thickness of the foundation wall. This type of footing is usually formed and poured independent of the foundation wall. A tapered groove, called a keyway, is formed into the top of the footing to interlock the foundation wall, which is formed and poured later in the construction process.

Figure 7
Continuous footing

Stepped Footing

Stepped footings are shaped like a series of elongated stair steps. A step footing form is shown in Figure 8. They require bulkheads and are generally built on sloped lots or when soil-bearing conditions require changes in elevation. Bulkheads are vertical partitions set into the forms. They are used to prevent fresh concrete from entering another area of the form. Bulkheads must be firmly secured in order to withstand the pressure placed on them by the concrete as it is placed in the footing.

Figure 8
Stepped footing

4 Footing Form Construction

Footing forms are laid out before they are built. This must be done carefully and accurately if the footings are to properly serve their purpose. The footing layout process involves locating the corners of the building, establishing offset lines, building batter boards, and setting dry lines. Building footing forms involves marking the ground for excavation, excavating to the required depth, building the footing forms, placing steel reinforcing bar if necessary, creating keyways, and stripping the forms.

Excavating Soil

If excavation is required, the ground must be carefully marked to indicate the areas where soil is to be removed. Excavation lines follow the dry lines and are made using chalk or other line-marking materials. The full width of the excavation must be measured and marked out. Except in the case of an earthen form, the excavation needs to be wider than the actual footing. This will allow the space necessary for building forms, placing concrete, and stripping the formwork. It is important to make sure the excavation closely follows the marked excavation lines and is to the depth required by specifications. All trenches or footing forms must be free of debris, loose dirt, and roots.

Constructing the Forms

Stakes are driven to establish the outside of the footing forms. When driving stakes, batter boards and dry lines are used as a reference. The stakes representing the outside of the form boards are driven first. Then a spreader is used as a template to position the inside stakes before driving them into place. Once the stakes are positioned, the height of the footing form is established using a leveling instrument. This height is marked on the outside of the footing form stakes. The forms themselves are secured to the stakes by nailing the stake into

the footing form. The height of the outside form is transferred to the inside stakes using a 2′ level. A line is then snapped on the inside stake. The footing forms are secured to the inside stakes in the same manner as they were secured to the outside stakes. Spreaders and braces are added to the footing forms to reinforce and straighten the structure. Figures 9–12 show footing forms in various stages of construction.

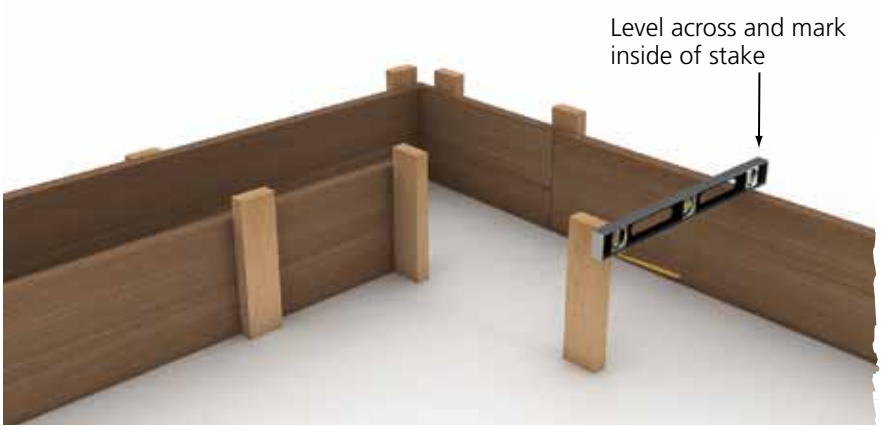


Figure 9
Leveling footing forms

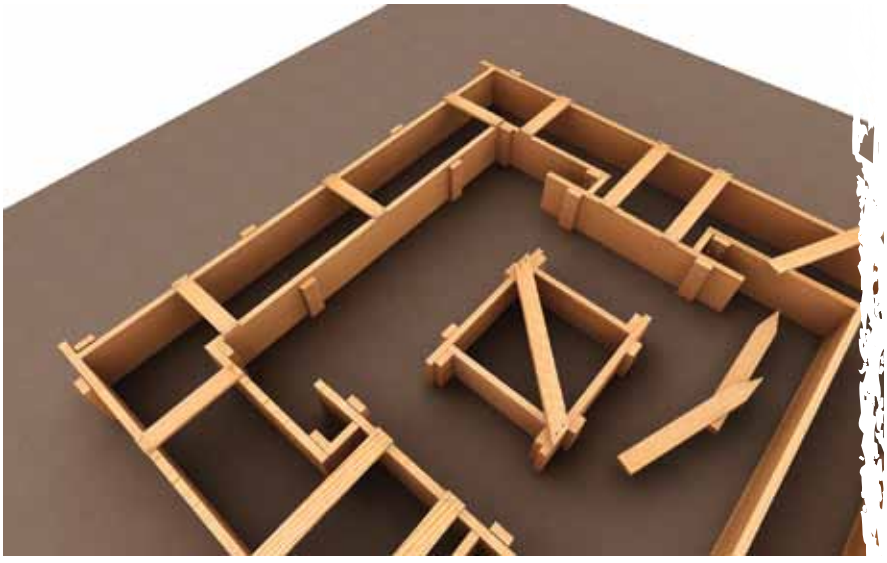


Figure 10
Spreaders installed on a footing form

Figure 11
Footing forms in place

Figure 12
Footing forms being poured

Placing Reinforcing Bar

Steel reinforcing bar is used to reinforce footings and other concrete structures. The reinforcing bar is inserted after the forms are in place. Reinforcing bar such as that shown in Figure 13 is available in various diameters and lengths, and with different surface textures. The size of the reinforcing bar and the amount to be used are determined by local building codes.

Reinforcing bar must be suspended inside the concrete to provide the required reinforcement. Several methods are used to suspend the bars. Figure 14 shows reinforcing bars suspended by wires.

Figure 13
Steel reinforcing bar

Figure 14
Reinforcing bar suspended by wires

Figure 15
Embedded vertical reinforcing bar

If a concrete foundation wall is to be placed on top of a footing, vertical reinforcing bar is embedded in the footing concrete, as shown in Figure 15. Vertical reinforcing bar may be inserted in the fresh concrete, or it may be secured by wires to the horizontal reinforcing bar. The vertical reinforcing bar helps tie together the foundation wall and footing.

Creating Keyways

When the concrete for a footing and a foundation wall are placed separately, the footing and foundation must be locked together to prevent them from moving. The joint that creates the lock is called a keyway. The keyway consists of a tapered groove at the top of the concrete footing.

If a concrete foundation wall is to be placed on top of a footing, vertical reinforcing bar is embedded in the footing concrete.

The wooden form used to create the tapered groove is also called a keyway. This wooden keyway can be made by cutting a bevel on either one or both edges of a 2 × 4 piece of lumber, as shown in Figure 16. After the wooden keyway is cut, it is treated with a releasing agent. Then the wooden keyway is installed at the top of the footing form and positioned so that it is inside the lines of the foundation wall. See Figure 17. It is a good practice to locate the keyway as close to the center of the foundation wall as possible. However, this may be difficult, depending on the thickness of the foundation wall and the placement of reinforcing bars. If the reinforcing bars interfere with the wooden keyway, it may be necessary to split it by ripping the wooden keyway end to end. After the concrete has hardened, the wooden keyway is removed, leaving a tapered depression in the top of the footer, as shown in Figure 18.

Figure 16
Wooden keyway

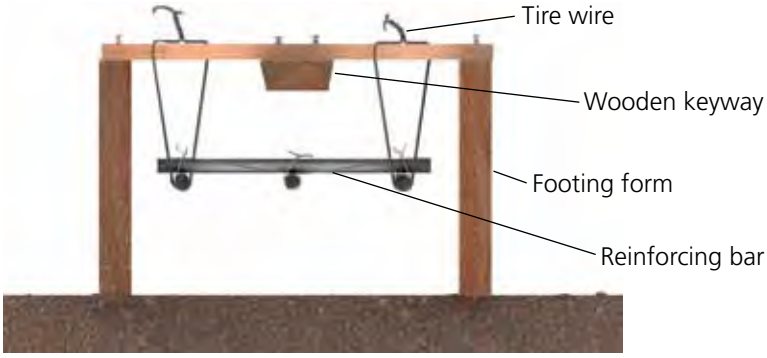


Figure 17
Wooden keyway in position

Figure 18
Keyway in the footer

Stripping Footing Forms

Once the concrete has been placed in the footing forms and has set, the formwork is stripped or removed. Nails used to fabricate the footing forms are pulled as the forms are stripped. When stripping formwork, care should be taken to prevent unnecessary damage to the materials so that they can be reused. It is also important not to damage the concrete since it is not yet fully cured.

Student Name:_____ Date: _____

Drywall Installation Evaluation

PROCEDURE	CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Installing Drywall on Ceiling	First piece cut to correct length	2	
	First piece aligns with the wall	2	
	Second piece cut to correct length	2	
	Second piece aligns with adjacent piece	2	
	Third piece cut to correct length and width	2	
	Third piece aligns with adjacent piece	2	
	Fourth piece cut to correct length and width	2	
	Fourth piece aligns with adjacent piece	2	
	Butt seams offset	4	
	Fastener depth	5	
	Fastener spacing	5	
	Subtotal	*30*	
Drywall – Top Row	First piece cut to correct length	2	
	First piece aligns with the ceiling	2	
	Second piece cut to correct length	2	
	Second piece aligns with adjacent piece	2	
	Third piece cut to correct length	2	
	Third piece aligns with adjacent piece	2	
	Fourth piece cut to correct length	2	
	Fourth piece aligns with adjacent piece	2	
	Cut out around door	4	
	Fastener depth	5	
	Fastener spacing	5	
	Subtotal	*30*	
Drywall – Bottom Row	First piece cut to correct length	2	
	First piece tight to the top piece	2	
	Second piece cut to correct length	2	
	Second piece aligns with adjacent piece	2	
	Third piece cut to correct length	2	
	Third piece aligns with adjacent piece	2	
	Fourth piece cut to correct length	2	
	Fourth piece aligns with adjacent piece	2	
	Cutouts (electrical and rip at door)	4	
	Fastener depth	5	
	Fastener spacing	5	
	Subtotal	*30*	

Continued on next page

Student Name:_____ Date: _____

Drywall Installation Evaluation *(continued)*

PROCEDURE	CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Drywall on Column	Pieces cut to correct length and width	2	
	Alignment with outside corner	2	
	Tight to wall and ceiling	2	
	Fastener depth	2	
	Fastener spacing	2	
	Subtotal	*10*	
Drywall on Soffit	Pieces cut to correct length and width	2	
	Alignment with outside corner	2	
	Tight to wall and ceiling	2	
	Fastener depth	2	
	Fastener spacing	2	
	Subtotal	*10*	
General	Cleaned up	5	
	Efficient use of time	5	
	Followed direction	5	
	Proper tool handling	5	
	Safe work practices	5	
	Subtotal	*25*	
		Student score:	

Total possible points = 135

Suggested minimum acceptable score: 95 points or _____

Total possible points without ceiling drywall = 105

Suggested minimum acceptable score: 95 points or _____

Student's Signature: _____ Teacher's Signature: _____

Student Name:_____ Date: _____

Acoustical Ceiling Evaluation

PROCEDURE	CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Installing Wall Angle	Reference lines level	5	
	High point of floor established	5	
	Ceiling height from high point established	5	
	Chalk line located at top of wall angle	5	
	Wall angle length	5	
	Corners of wall angle mitered	5	
	Wall angle aligned with chalk line	5	
	Fastener spacing	5	
	Subtotal	*40*	
Installing Hanger Wire	Wire length	5	
	Wire location started and spaced	5	
	3 wrap tie	5	
	Subtotal	*15*	
Installing Control Lines	Main runner control line parallel to main runner	5	
	Main runner control line stretched tight	5	
	Cross tee control line parallel to cross tees	5	
	Cross tee control line stretched tight	5	
	Subtotal	*20*	
Installing Main Runners and Cross Tees	Main runner cut to length using an angle cut	5	
	Main runner aligned with control line	5	
	Cross tees or rout holes aligned with control line	5	
	Grid square	5	
	Equal Borders correct length	5	
	Equal Borders correct width	5	
	Border cross tees cut to length using an angle cut	5	
	Mains and cross tees attached to wall angle	5	
	Subtotal	*40*	
Cutting and Placing Ceiling Tile	Border tiles correctly cut to length and/or width	5	
	Face of tiles undamaged	5	
	Unbroken corners on tiles	5	
	Subtotal	*15*	
General	Cleaned up	5	
	Efficient use of time	5	
	Followed direction	5	
	Proper tool handling	5	
	Safe work practices	5	
	Subtotal	*25*	
		Student score:	

Total Possible Points = 155

Suggested minimum acceptable score: 108 points or _____

Student's Signature: _____ Teacher's Signature: _____

Student Name:_____ Date: _____

Floor Tile Layout and Installation Evaluation

PROCEDURE	CRITERIA AS SPECIFIED BY THE PROJECT	POSSIBLE POINTS	SCORE
Laying Out Floor Tile Square to the Room With Equal borders (Use for Square Evaluation)	Floor is clean	5	
	Length is divided in half	5	
	Width is divided in half	5	
	Subtotal	*15*	
Square to the Room Floor Tile Installation (Use for Square Evaluation)	Tile installed tight to each other	5	
	Border tile cut correctly	5	
	Border tile equal at opposing walls	5	
	Undamaged edges or corners on tile	5	
	Subtotal	*20*	
Laying Out Floor Tile Diagonally to the Room With Equal Borders (Use for Diagonal Evaluation)	Floor is clean	5	
	Length is divided in half	5	
	Width is divided in half	5	
	Length and width divided diagonally	5	
	Border laid out	5	
	Subtotal	*25*	
Installing Diagonal Floor Tile With a Border (Use for Diagonal Evaluation)	Field tile installed tight to each other	5	
	Border tile cut to length	5	
	Undamaged edges or corners on tile	5	
	Subtotal	*15*	
General (Use for Both Evaluations)	Cleaned up	5	
	Efficient use of time	5	
	Followed direction	5	
	Proper tool handling	5	
	Safe work practices	5	
	Subtotal	*25*	
		Student score:	

Total Possible Points

Diagonal = 65

Suggested minimum acceptable score: 46 points or _____

Square = 60

Suggested minimum acceptable score: 42 points or _____

Student's Signature: _____ Teacher's Signature: _____

Addition to Career Connections This is the first book to be added to the basic Career Connections four-year program of construction skills. *Math for the Trades* encompasses those critical math skills at the heart of achieving competency as an entry-level worker in the construction industry.

Understanding the Usefulness of Math The five authors of *Math for the Trades* are from different parts of the country, representing particular viewpoints and practices in various trades. All of them have extensive teaching experience and field experience in their trades. They are unified in their belief that math is useful and in this book they have shown its usefulness by applying math to real world situations. Throughout the development of this book they all worked diligently to put project-based education into practice, to provide a link frequently missing in education between the discipline taught and the real world.

Working in partnership with the Carpenters International Training Fund (CITF), the publisher of *Math for the Trades*, one of the authors, Joe Youcha, is heading up a program called "Working With Numbers." Fourth year apprentices and UBC journeymen from various regions of the country are going into schools in their communities to lead hands-on math workshops They will use techniques from a successful program headed up by Joe Youcha called "Building to Teach," based in Alexandria, Virginia. In this program math skills and work readiness are taught through teaching boat building. The program has all the elements of a national model for hands-on math education. It is this same method of teaching the usefulness of math that informs *Math for the Trades* in which the principles of math are taught through observing job-related situations and solving problems in order to do tasks associated with a variety of trades.

Sample Chapter A chapter from *Math for the Trades* is included here for your review.

Contents

CHAPTER 3

Decimals

CONTENTS

INTRODUCTION

Decimals are fractions that express parts of a whole. Decimals do this in units of ten: tenths, hundredths, thousandths, and smaller. The whole that is being described can be almost anything: time, weight, distance, speed, money. Calculations with decimals are often easier than calculations with fractions because there is no need to find a common denominator. Decimals are used in print reading, calculating areas and volumes, and on precision measuring tools.

This chapter defines decimals and the terms and concepts related to them. Using job-related examples and situations, the chapter shows how to add, subtract, multiply, and divide decimals. It also shows how to convert decimals to fractions and fractions to decimals and how to use decimals in calculating ratios and proportions. The final section of the chapter discusses percentages. It shows how percentages relate to fractions and decimals and how they are used on the job. Throughout the chapter, practice problems, which appear in the Self Checks, offer computation drills designed to improve calculation skills. Word problems, which also appear in the Self Checks, provide on-the-job examples of the use of decimals in the work place.

KEY TERMS

decimals express parts of a whole in units of ten: tenths, hundredths, thousandths, and so on

decimal place value every digit to the right of the decimal point has a place value ten times smaller than the digit to its left

decimal places digits to the right of the decimal point

decimal point period that marks the beginning of the fractional part of the number

exponent number written or superscripted to the upper right of the original number

percent or **percentage** part of a whole that is expressed in hundredths, indicated by the symbol "%"

power number indicating how many times a number is multiplied by itself, usually indicated by an exponent

power of ten number formed by multiplying tens together

rounding method of simplifying a number by dropping digits below a desired place value

OBJECTIVES

Upon successful completion of this chapter, the student should be able to:

1. Define decimals and decimal place values.
2. Round to a specified decimal place value.
3. Add and subtract decimals.
4. Multiply and divide decimals.
5. Convert decimals to fractions and fractions to decimals.
6. Calculate ratios and proportions using decimals.
7. Convert decimals and fractions to percentages and percentages to decimals and fractions.
8. Calculate a percent of a number.
9. Calculate the percent that one number is of another.

1 Decimal Terms and Concepts

All **decimals** are fractions. They have a numerator and a denominator, but that numerator and denominator are not written in the usual fraction form as numbers separated by a horizontal line. Decimals are written as numbers to the right of a decimal point, as shown in Table 1. A **decimal point** is a period that marks the beginning of the fractional part of a number. When a number with a decimal point is spoken, the decimal point is usually referred to as "point" or "and." The number 3.1415 can be read aloud as "three point one four one five" or as "three and one thousand four hundred fifteen ten-thousandths."

Dividing the numerator of a fraction by its denominator results in a decimal version of that fraction.

$1 \div 10 = .1$, or one tenth

$1 \div 100 = .01$, or one one-hundredth

$1 \div 1{,}000 = .001$, or one one-thousandth

$1 \div 10{,}000 = .0001$, or one ten-thousandth

TABLE 1

Decimal fractions and common fraction equivalents

	Decimal	Fraction
One tenth	.1	$\frac{1}{10}$
One one-hundredth	.01	$\frac{1}{100}$
One one-thousandth	.001	$\frac{1}{1000}$
One ten-thousandth	.0001	$\frac{1}{10000}$

What the Decimal Point Does

The decimal point shows that the digits following it represent a fraction. In whole numbers, each place value is ten times greater than the place value to its right. With decimals, each **decimal place value** is ten times less than the place value to the left.

The decimal 0.1257 is equivalent to the fraction $\frac{1257}{10000}$. Decimals use the decimal point and place value to show the numerator and denominator. The numbers to the right of the decimal point, 1257, are the numerator. The denominator, 10,000, is shown by the number of **decimal places**, digits to the right of the decimal point, in the number. The first decimal place to the right of the decimal point is the tenths' place, the second is the hundredths' place, and so on by powers of 10.

Power is a number that indicates how many times a number is multiplied by itself. A **power of ten** is a number formed by multiplying tens together. $10 \times 10 \times 10 = 1{,}000$ or 10 to the third power or 10^3. The number written or superscripted to the upper right of the original number is called the **exponent.** It represents how many times to multiply the original number by itself. For each time a number is multiplied by 10, the decimal point moves to the right.

The denominator in a decimal is always a power of ten: 10, 100, 1000, 10000, and so on. When read aloud, 0.1257 is "one thousand two hundred fifty-seven ten-thousandths or "point one two five seven."

Mixed Numbers

Decimals can also express *mixed numbers*, which consist of a whole number and a fraction. For example, 350.07 is the decimal form of the the mixed number $350\ \frac{7}{100}$. In 350.07, the whole number is to the left of the decimal point. The fraction, .07, is to the right of the decimal point. The place values for the digits in 350.07 are shown in Table 2.

TABLE 2

Place values progress on left and right of decimal

100	10	1	.	$\frac{1}{10}$	$\frac{1}{100}$
3	5	0	.	0	7

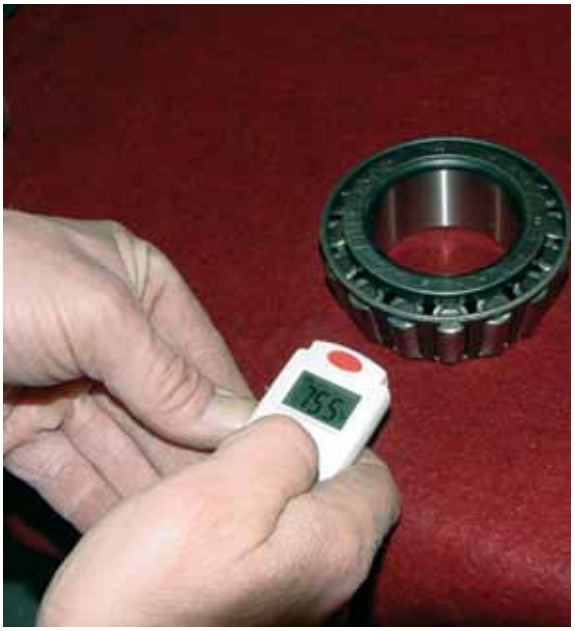
Another way to look at the number 350.07 is shown in Table 3. The table shows how place values progress to the left and right of the decimal point.

TABLE 3

Place values align to left and right of decimal

Places	Values
Three 100s	300.
Five 10s	50.
Zero 1s	0.
Zero $\frac{1}{10}$ths	.0
Seven $\frac{1}{100}$ ths	.07
Total	350.07

The total read aloud is "three hundred fifty point zero seven" or "three hundred fifty and seven-hundredths."



Subdividing a Decimal Into Smaller Parts

Notice how, in the number 350.07, zero serves as a placeholder. Zeros mark the places where ones and tenths would go if there were any in this number. The decimal version of the fraction $\frac{1}{10000}$ has three zeros between the decimal point and the 1 that represents $\frac{1}{10000}$: 0.0001, or one ten-thousandth.

There is no limit to the number of decimal places that can be to the right of the decimal point. In the same way that it is always possible to add 1 to any whole number, it is also always possible to subdivide a decimal into smaller parts of the whole, from hundredths down to thousandths, ten-thousandths, hundred-thousandths, even millionths, and beyond. However, just because it is possible to do something, does not mean that doing it is always a good idea. In fact, for most job situations, there is limit to the number of decimal places that are useful. The next section, on rounding, describes how to limit the number of decimal places in a logical way.

SELF CHECK 1

1. Write the following decimals as fractions.

a. .37 _____

b. .139 _____

c. .627 _____

d. .7591 _____

2. Write the following fractions and mixed numbers as decimals.

a. $\frac{3}{10}$ _____

b. $\frac{3}{100}$ _____

c. $57\frac{2}{10}$ _____

d. $6\frac{75}{100}$ _____

e. $452\frac{36}{1000}$ _____

f. $3{,}729\frac{9}{100}$ _____

3. Break down the mixed number 1,204.501 by place value.

a. 1,000s _____

b. 100s _____

c. 10s _____

d. 1s _____

e. $\frac{1}{10}$ths _____

f. $\frac{1}{100}$ths _____

g. $\frac{1}{1000}$ths _____

Rounding Decimals

When making measurements or performing calculations with decimals, the resulting number may have more decimal places than are really needed or can be used. **Rounding** is a method of simplifying a number by dropping digits below a certain place value. For example, in rough framing, there is no reason to measure closer than $\frac{1}{16}$ of an inch, which is equal to the decimal .125 inch. The level of precision required depends on the task and the tools. For some tasks, the level of precision may only be to one decimal place. For others, it may be to three or four decimal places.

For example, the calculation for a measurement might be 4.782″, but the tool that will be used to make that measurement might only show increments of hundredths of an inch, not thousandths. The number 4.782 would need to be rounded to two decimal places. Rounding a decimal, or a whole number, to a specified place value involves a short decision-making process. There are standard rules for rounding:

- Round up if the digit to the right of the specified place value is equal to or greater than 5.
- Round down if the digit to the right of the specified place value is less than 5.

Directions for rounding are usually given in terms of "rounding to" a certain number of decimal places or to a specific decimal denominator, such as the nearest tenth, hundredth, or thousandth. The following shows how to apply the rule for rounding.

PROCEDURE

How to Round to the Nearest Tenth

Round 1.735 to the nearest tenth.

1. Decide whether to round up or round down, looking to the decimal place past the specified one. In this case, that is the hundredths' place.
2. Is the number in the hundredths' place equal to or greater than 5, or is it less than 5?
3. The number in the hundredths' place of 1.735 is 3. It is less than 5. Round down by dropping all of the digits past the tenths' place. 1.735 becomes 1.7 rounded to the nearest tenth.

PROCEDURE

How to Round to Two Decimal Places

Round 30.397 to two decimal places.

1. Look at the decimal place past the one that the number needs to be rounded to. In this case, that is the thousandths' place.
2. Is the number in the thousandths' place equal to or greater than 5, or is it less than 5?

(continued)

PROCEDURE *(continued)*

3. The number in the thousandths' place of 30.397 is 7. It is more than 5. Round up by dropping that number and adding 1 to the number in the second decimal place: 9 + 1 = 10.
4. How can 9 in the hundredths' place become 10? There is no room for two digits in one place value. The 9 becomes 10 but only the zero goes in the hundredths' place. Carry the 1 to the tenths' place, adding it to the 3 for a total of 4 tenths.

```
   1
30.39
+   1
-----
30.40
```

Rounded to two decimal places, 30.397 becomes 30.40

Sometimes, it is necessary to round a number to a place value that it does not already have. For example, the number 8.2 has only one decimal space. It can be rounded to two decimal places by adding a zero after the first decimal place, making it 8.20 without changing its value.

SELF CHECK 2

1. Round to two decimal places.
   - **a.** .71875 _____
   - **b.** 1.40034 _____
   - **c.** .546875 _____
2. Round to three decimal places.
   - **a.** 34.33339 _____
   - **b.** 58.6873 _____
   - **c.** .93 _____
3. Round to the nearest tenth.
   - **a.** 0.7815 _____
   - **b.** 8.891 _____
   - **c.** 40.034 _____
   - **d.** 0.5009 _____
4. Round to the nearest hundredth.
   - **a.** 5.177 _____
   - **b.** 75.1 _____
   - **c.** 400.623 _____
   - **d.** 14.9345 _____
5. Round 0.7932 to the nearest thousandth. _____
6. Round 1.100439 to the nearest ten-thousandth. _____

(continued)

SELF CHECK 2 *(continued)*

7. Round to whole numbers.

a. 3.785 _____

b. 81.2999 _____

c. 23.33976 _____

d. 5.47865 _____

8. Round $275.38 to the nearest dollar. _____

2 Adding and Subtracting Decimals

Decimals are added and subtracted the same way that whole numbers are added and subtracted. Line up the digits by place value, and work from right to left. When adding and subtracting decimals, always make sure the decimal points are lined up. This automatically lines up the ones, tens, and other place values to the left of the decimal point and the tenths, hundredths, and other decimal values to the right of the decimal point.

Adding Decimals

Lining up the decimal points is the key to accuracy in adding decimals. It does not matter whether the decimals being added are tenths, hundredths, thousandths, or even millionths. If the decimal points are lined up, the decimal places in the answer will come out right. The next procedure demonstrates the process for adding decimals.

PROCEDURE

How to Add Decimals

A crew placed 25.5 pounds of concrete into one casting and 117.66 pounds into a second one. What is the combined weight of the castings?

1. First, line up the decimal points in each of the two numbers and in the place for the answer. It makes keeping track of place values easier.

$$\begin{array}{r} 25.5 \\ +\ 117.66 \\ \hline \end{array}$$

2. The two numbers have different numbers of decimal places. Adding a placeholder zero to 25.5 gives it the same number of decimal places as 117.66 without changing its value. Having the same number of decimal places in all the numbers being added makes it easier to keep them lined up correctly and contributes to accuracy. Add one column at a time, from right to left, carrying as necessary.

(continued)

PROCEDURE *(continued)*

	1	11	11	11
25.50	25.50	25.50	25.50	25.50
+ 117.66	+ 117.66	+ 117.66	+ 117.66	+ 117.66
. 6	.16	3.16	43.16	143.16

The solution is that the combined weight of the castings is 143.16 pounds.

Subtracting Decimals

In subtracting decimals, as in adding, lining up the decimal points correctly is the key to accuracy. Once that is done, start with the right-hand column. Subtract one column at a time, moving from right to left, borrowing as necessary. The next procedure demonstrates the process.

PROCEDURE

How to Subtract Decimals

A reel contained 320.7′ of cable when it was delivered to a jobsite. Making a guardrail used 217.08′ of the cable. How many feet of cable are left?

1. Subtract 217.08 from 320.7 Adding a zero after the 7 in 320.7 makes lining up the place values easier.

```
 320.70
-217.08
```

2. Starting with the column on the right, subtract one column at a time, moving from right to left. Borrow where necessary.

```
  11 61
 320.70
-217.08
 103.62
```

The solution is that there are 103.62′ of cable left.

Estimate, Calculate, and Check

As with any kind of calculation on the job, remember to estimate, calculate, and check. Accuracy matters and saves time and money in the long run! Even using a calculator, it is easy to key in the wrong numbers. Making an

estimate first—not a wild guess, but a logical estimate—and checking the calculation against that estimate can prevent cutting materials to the wrong length, loading a support structure beyond its capacity, or running out of supplies in the middle of a job. This procedure shows how estimating can be a logical part of working with decimals.

PROCEDURE

How to Estimate, Calculate, and Check

A crew is forming foundations. They need to form 90′ all together. On the first day, they completed 23.5 feet. On the second day, they did 27.75 feet. How many feet are left to form?

1. First, estimate by rounding the completed feet to whole numbers that are easy to add. On both days, the results were slightly under or slightly over 25′. They have formed approximately 50′. Ninety minus 50 is 40. A logical estimate is that they have approximately 40′ left to form.

2. Now, add the actual amounts.

$$\begin{array}{r} 23.5 \\ +\ 27.75 \\ \hline \end{array}$$

3. Add a zero to the top number, then calculate the actual amount.

$$\begin{array}{r} {\scriptstyle 11} \\ 23.50 \\ +\ 27.75 \\ \hline 51.25 \end{array}$$

   The estimated total was 50. The calculated answer of 51.25 is reasonable.

4. Next, calculate how much more needs to be done.

$$\begin{array}{r} 90.00 \\ -\ 51.25 \\ \hline \end{array} \qquad \begin{array}{r} {\scriptstyle 89\ 91} \\ \cancel{90.00} \\ -\ 51.25 \\ \hline 38.75 \end{array}$$

5. Check the answer.

   The calculated answer of 38.75′ left to form is reasonable when compared to the estimated answer of approximately 40 feet.

SELF CHECK 3

1. 5.2 + 1.4 _____

2. 3.9 + 16.0 _____

3. 4.91 + 65.005 _____

4. 6.4 + 4.7 + 7.9 _____

5. 0.017 + 4.91 + 7.045 _____

6. 5.4 − 1.2 _____

7. 16.0 − 3.9 _____

8. 210.1 − 17.3 _____

9. 71.02 − 3.921 _____

10. 426.0 − 65.005 _____

11. There is a balance of $2,313.77 in Daveco Contracting's checking account. After depositing a check for $739.95, what is their new balance? _____

12. Floor layers determine that the square footage of material needed for three rooms is 516.43 sq. ft., 712.56 sq. ft., and 3420.2 sq. ft. What is the total amount of material needed? _____

13. Jim trades in his car for a truck that weighs 2,440.59 pounds more than the car. If the truck weighs 3,650.99 pounds, what was the weight of the car? _____

14. While completing a punch list, a carpenter records hours for several tasks. 6.5, 2.25, 3.7, and .08 are the hours recorded. How many total hours were worked? _____

15. A crew dumps 972.4 pounds of gravel to grade a driveway. They remove 3 wheelbarrow loads totaling 458.4 pounds. How much gravel is left? _____

16. Geologists find a water table at a depth of 279.61 feet. A well is drilled to 159.52′ before hitting bedrock. How many feet of rock must be drilled through to reach the water? _____

17. Components for a series of interior partitions are shipped to a jobsite. Their weight in pounds is 323.25, 700.5, and 2,179. What is the total weight of the materials? _____

18. Today, $2,340.00 is Daveco Contracting's checking account balance. What is their new balance after cutting a check for $76.75? _____

19. A surveyor records four measurements of a land boundary, all in feet: 456.178, 389.234, 512.542, and 401.001 feet. What is the total of these measurements? _____

20. A crew of carpenters forms foundations. They form 19.5′ the first day, 23.07′ the second day, and 31.46′ on the last day. How many feet of foundation did they form? _____

(continued)

SELF CHECK 3 *(continued)*

21. A form is run for 43.3 feet in the morning, and another is run for 62.3 feet in the afternoon. How many more feet of form were installed in the afternoon than in the morning?

_____

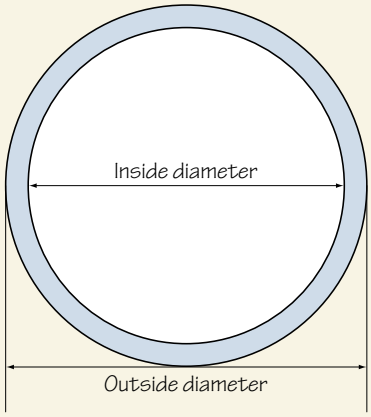
22. A new drill costs $143.40; Sue has $213.25 How much money would she have after buying the drill? _____

23. A block of steel was milled down from 1.250″ in thickness to 1.156″ in thickness. What thickness of steel was removed?

_____

24. A shaft 2″ in diameter was turned down on a lathe by a cut .028″ deep. What was the diameter of the shaft after the cut was made? _____

25. The inside diameter of a pipe is 2.844 inches. Its wall thickness is .156 inch. What is its outside diameter (see illustration below)? _____



26. From a piece of drill rod 25.75″ long, three pieces are to be cut. The first piece is to be 4.688″ long, the second is to be 2.75″, and the third is to be 9.938 inches. If .375″ is waste in cutting the drill rod, what is the length left over? _____

3 Multiplying and Dividing Decimals

UBC members use multiplication and division of decimals in many ways on the job, from calculating time and expenses to determining the amount of materials required. The mechanics of multiplying and dividing decimals are basically the same as for multiplying and dividing whole numbers. The challenging part is deciding where to put the decimal point. The paragraphs that follow describe how to multiply and divide decimals and how to determine where to place the decimal point.

Multiplying Decimals

Just as with whole numbers, multiplication with decimals involves stacking the numbers to be multiplied, then multiplying each of the digits in the top number by each of the digits in the bottom number. Unlike addition and subtraction, lining up the decimal points is not necessary in multiplication. In fact, it is simpler to align the numbers to the right.

To find where to place the decimal point in the solution, add the number of decimal places in each of the numbers being multiplied. That sum is the number of decimal places to use in the product. The next procedure shows how to multiply decimals.

PROCEDURE

How to Multiply Decimals

A bag of crushed stone weighs 53.7 pounds. Constructing a walkway required 25.25 bags of the stone. What is the total weight of the stone used for the walkway? Round the answer to one decimal place.

1. Set the problem up as shown.

$$\begin{array}{r} 25.25 \\ \times\ 53.7 \\ \hline \end{array}$$

2. Multiply each digit in the top number by the digit in the bottom number. Carry when necessary.

Start by multiplying each digit in the top number 25.25 by 7, the digit on the right in the bottom number, 53.7

$$\begin{array}{r} 25.25 \\ \times\ 53.7 \\ \hline 17675 \end{array}$$

Next, multiply each digit in the top number by 3, the next digit in 53.7

$$\begin{array}{r} 25.25 \\ \times\ 53.7 \\ \hline 17675 \\ 7575 \end{array}$$

Then, multiply each digit in the top number by 5, the last digit in 53.7

$$\begin{array}{r} 25.25 \\ \times\ 53.7 \\ \hline 17675 \\ 7575 \\ 12625 \end{array}$$

(continued)

PROCEDURE *(continued)*

3. Finally, add the products from each of the digits.

```
   25.25
 ×  53.7
  17675
  7575
+ 12625
 1355925
```

4. Position the decimal point in the answer by counting the number of decimal places in the two numbers being multiplied. There are two decimal places in 25.25, and in 53.7 there is one decimal place. The total is three. The decimal point in the product, 1355.925, goes three places from the right.

5. Now, round the answer to one decimal place, the tenths' place.

Should you round up or round down? The number after the tenths' place is 2. Since it is less than 5, round down. At the end of 1355.925, drop the 2 and the 5.

The solution is that the total weight of the crushed stone used in the walkway, rounded to one decimal place, is 1355.9 pounds.

MATH TIP

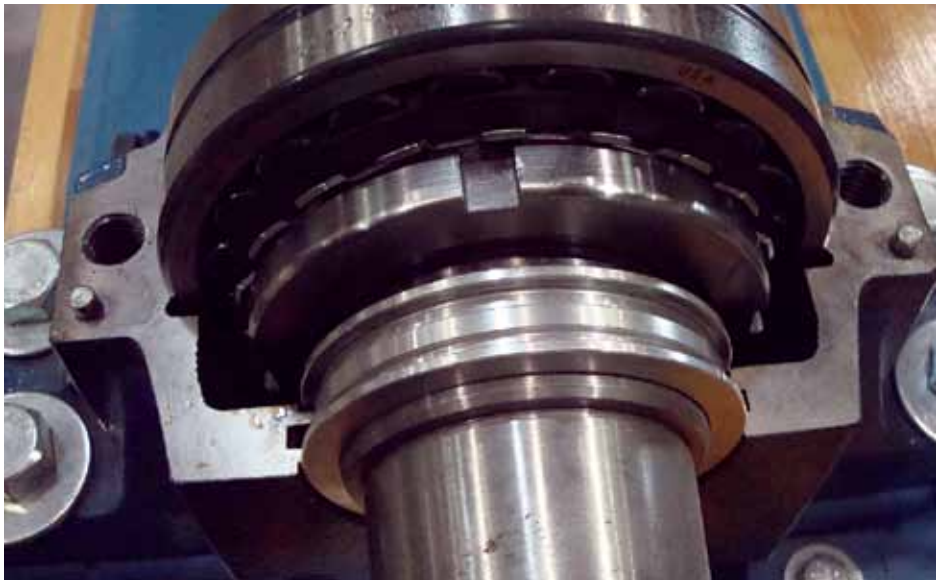
For problems like this example, using zeroes as placeholders may be helpful.

```
   25.25
 ×  53.7
  17675
  75750
+ 1262500
 1355925
```

Adding Zero to the Product Sometimes, a decimal multiplication problem has fewer digits in the answer than the number of decimal places needed. The following example shows how to handle that problem.

Multiply .03 by .15

```
  .03
× .15
  15
  3
  45
```



The numbers .03 and .15 together have four decimal places. Their product has only two digits. Add zeros to the left of the product, 45, until there are 4 decimal places: 0.0045

SELF CHECK 4

1. 5.4 × 1.2 _____

2. 16.0 × 3.9 _____

3. 32.3 × 24.7 _____

4. 61.61 × 19.19 _____

5. 210.1 × 17.3 _____

6. 71.02 × 51.22 _____

7. 426.0 × 65.005 _____

8. 7.045 × 0.017 _____

Dividing Decimals

When dividing decimals, the division continues until it reaches a target number of decimal places or until the answer comes out even. The number of decimal places in the answer, the *quotient*, of a division problem, is determined by the position of the decimal points in the *dividend*, the number being divided, and the *divisor*, the number by which the dividend is being divided. The next example shows how to divide decimals.

Example

If it costs $35.56 to mail a package that weighs 12.7 pounds, what is the cost per pound of mailing that package?

The dividend, $35.56, is the number being divided. It goes inside the division bracket. 12.7 is the divisor. It goes outside the bracket.

$12.7\overline{)35.56}$

Before doing anything else, take care of the decimal points. Move the decimal point in the divisor, 12.7, as far to the right as it can go because the divisor must be a whole number; in this example, it only moves one space. Move the decimal point in the dividend that same number of spaces to the right. Then, put a decimal above the bracket in the same position. That is where the decimal point should be in the quotient (the answer).

Now, divide the divisor into the dividend.

$$
\begin{array}{r}
2.8 \\
127.\overline{)355.6} \\
-\ 254 \\
\hline
1016 \\
-\ 1016 \\
\hline
0
\end{array}
$$

The quotient is 2.8; that is \$2.80 in dollars. \$2.80 is the cost per pound for shipping the package.

SELF CHECK 5

1. 12.6 ÷ 2 _____

2. 20.5 ÷ .5 _____

3. 17.34 ÷ 5.1 _____

4. 32.11 ÷ 24.7 _____

5. 5.4 ÷ 1.2 _____

6. 6.815 ÷ 4.7 _____

7. 211.06 ÷ 17.3 _____

8. 703.8 ÷ 15 _____

9. 425.75 ÷ 65.5 _____

10. 6.97 ÷ 0.17 _____

11. Eight (8) drywallers each hang board in a restaurant for 72.35 hours. How many total hours of work have been done?

_____

12. Twelve (12) display cases require 120.05 square feet of glass each. How many square feet of glass will be used in total?

_____

13. If it takes 4.24 hours to drive one box pile for a bridge abutment, how long will it take to drive 14 pile? _____

14. If underlayment for a finished floor takes .15 hours per square foot to install from start to finish, how long will it take to install 1750 square feet of underlayment? _____

15. If an oxyacetylene torch uses .024 tank of acetylene every ten minutes of operation, how much fuel will it use in 92 minutes?

_____

(continued)

SELF CHECK 3 *(continued)*

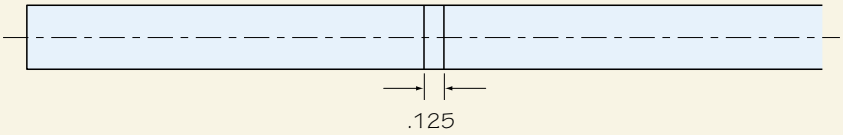
16. If an offshore rig is located 32 miles away from the nearest helipad on the mainland, and a chopper flies one mile in .87 minutes, how long does a round trip take? _____

17. A millwright installs a computer-controlled machine tool that fabricates 72 machine parts per hour. How many parts can it produce in 239.83 hours of operation? _____

18. A meter is 3.28 feet. A bookshelf is 6.888′ tall. What is its height in meters? _____

19. How many 3.75″ pins can be cut from a 36″ piece of dowel, allowing 0.125″ waste for each pin (see illustration below)?

_____



20. If a carpenter installs 28 panels in 10.5 hours, what is the average time to install one? _____

21. If the carpenter in the previous question was paid $28.67 an hour, what was the installation cost per panel? _____

22. If ceramic tiles cost $1.72 each and tiling a kitchen counter and backsplash cost $830.76 in materials, how many tiles were used? _____

23. A planer is set to remove .0625″ of thickness per pass. How many passes will it take to surface a 1.25″-thick board to a thickness of 0.8125″? _____

24. Four (4) pile drivers each order the lunch special at the diner near the jobsite. $31.80 was their total bill. What was the cost of the special? _____

25. One cubic inch of grey iron weighs .26 pounds. What is the weight of a grey iron casting having a volume of 783.5 cubic inches? _____

26. The net weight of the bolts in a keg is 250 pounds. Each bolt weighs .0625 pounds. How many bolts are there in the keg?

_____

4 Converting Decimals to Fractions and Fractions to Decimals

On the job, it is often necessary to convert decimals to fractions and fractions to decimals. For example, determining which size drill bit to use to drill a 0.349″ hole requires converting that decimal number to a fraction that corresponds to a drill bit size such as $\frac{5}{32}$, $\frac{1}{4}$, or $\frac{3}{16}$ of an inch. Being able to efficiently convert a fraction to a decimal or a decimal to a fraction is an important skill.

Converting Decimals to Fractions

In decimals, the numbers to the right of the decimal point are equivalent to the numerator of a fraction. These numbers tell how many parts of the whole that this decimal represents. If it were a fraction instead of a decimal, these would be the numbers above the line that separates the numerator from the denominator. The place value of the last digit to the right of the decimal point is equivalent to the denominator, or bottom number, of a fraction.

When converting decimals to fractions, before starting, always remember the easy decimal conversions—for example 0.25 = $\frac{1}{4}$, 0.5 = $\frac{1}{2}$, 0.75 = $\frac{3}{4}$, and so on—and how easy they are to solve. Other easy conversions from decimals to fractions are the tenths.

To convert .5 to a fraction, set up the fraction the way the decimal is said aloud: "five tenths." The numerator of the fraction will be 5 and the denominator will be 10 or $\frac{5}{10}$. After converting a decimal to a fraction, always check to see if it can be further simplified. The fraction $\frac{5}{10}$ can be reduced to $\frac{1}{2}$.

This procedure shows the conversion of the decimal 0.345 (three hundred forty-five thousandths) to a fraction.

PROCEDURE

How to Convert Decimals to Fractions

1. Set up the fraction the way the decimal is said aloud: "three hundred forty-five thousandths." The numerator of the fraction will be 345 and the denominator will be 1000.

   $$.345 = \frac{345}{1000}$$

   This fraction can be reduced to lowest terms. The number 5 is a factor of both 345 and 1000.

2. Dividing each of those numbers by 5 will simplify the fraction.

   $$\frac{345}{1000} \div \frac{5}{5} = \frac{69}{200}$$

   There is no number that will go into 69 and 200 evenly. It is not possible to reduce $\frac{69}{200}$ any further.

   $$.345 = \frac{69}{200}$$

There are not too many situations where a decimal needs to be converted to a fraction with a denominator of 10, 100, or 1000. More common is the need to convert decimals to fractions that have denominators of common ruler measurements: sixty-fourths ($\frac{1}{64}$), thirty-seconds ($\frac{1}{32}$), sixteenths ($\frac{1}{16}$), eighths ($\frac{1}{8}$), quarters ($\frac{1}{4}$), and halves ($\frac{1}{2}$). Table 4 shows several of the more common ruler fractions and their decimal equivalents.

TABLE 4

Equivalents of common ruler measurements

Fraction	Decimal
$\frac{1}{64}$	.01563
$\frac{1}{32}$	.03125
$\frac{1}{16}$	.0625
$\frac{1}{8}$	.125
$\frac{1}{4}$	.25
$\frac{3}{8}$	.375
$\frac{7}{16}$	.4375
$\frac{15}{32}$	.46875
$\frac{1}{2}$	.5
$\frac{3}{4}$	.75
$\frac{7}{8}$	.875

Converting Decimal Inches to a Fraction To change a number in decimal inches to a fraction, first identify the required denominator for the task. Some tasks, such as setting a mechanical seal, may require measurements in sixty-fourths of an inch, or $\frac{1}{64}''$. Other tasks, such as cutting with a torch, may use eighths of an inch, or $\frac{1}{8}''$. The procedure demonstrates how to convert decimals of an inch to a fraction with a specific denominator.

PROCEDURE

How to Convert Decimal Inches to a Fraction

Convert the decimal measurement 7.349 inches to a measurement expressed in inches and 16ths of an inch.

1. First, take stock of what is already known: The fraction will be a mixed number consisting of 7 and a fraction that is equal to $\frac{349}{1000}$. The denominator of the fraction will be 16 because the measurement needs to be expressed in sixteenths of an inch.
2. Before calculating an answer, estimate an answer. The estimate can be used later to check the calculation for reasonableness. The number of whole inches is known. It will be 7. The fraction will be equal to .349, the decimal. That fraction should be greater than $\frac{1}{4}$, which is .25 in decimal form. The answer should be less than $\frac{1}{2}$, which is .5 in decimal form.
3. Now, calculate the answer.

   Multiply the decimal .349 by 16, the desired denominator, and add the products for a total.

$$\begin{array}{r} 25 \\ .349 \\ \times\ \ \ 16\text{ths} \\ \hline 2094 \\ +\ 349 \\ \hline 5.584 \end{array}$$

   Because there are three decimal places in .349 and none in 16, the decimal point in the answer, 5.584, goes three places from the right.
4. Round 5.584 to a whole number. That whole number will be the numerator of the fraction in the answer. When rounding to a whole number, look at the first number to the right of the decimal point. If it is five or greater, round up. If it is less than 5, round down.

   The number to the right of the decimal point is 5. Rounded up, 5.584 becomes the whole number 6.

$$.349 = \frac{349}{1000} = \frac{6}{16} = \frac{3}{8}$$

5. Finally, check the answer for reasonableness.

   $\frac{3}{8}$ is reasonable and consistent with the estimate of greater than $\frac{1}{4}$ but less than $\frac{1}{2}$.

   The solution is $7.349'' = 7\ \frac{3}{8}''$.

Converting Decimal Feet to Feet and Inches There are times when decimal feet must be converted to feet and inches. Sometimes, it is relatively easy. This procedure shows both an easy conversion and one that must be rounded.

PROCEDURE

How to Convert Decimal Feet to Feet and Inches

Convert 34.75′ to feet and inches.

1. To convert 34.75′ to inches requires finding the number of inches that are equal to .75 feet.
2. The conversion factor for changing feet to inches is 12 because there are 12 inches in each foot.

   Multiply .75 by 12 to find the number of inches.

   .75 × 12 = 9″

   The solution is that three-fourths of a foot equals 9 inches, so 34.75′ = 34′-9″.

   Converting decimal feet to feet and inches is a little different when the decimal portion of the original number does not convert to a whole number of inches. When the conversion includes fractional inches, it is necessary to determine what denominator the fraction should have. That depends on the job at hand, the measurement tools being used, and the level of precision required. The next example demonstrates how to convert decimal feet into feet and fractional inches.

Convert 19.772′ to feet and inches.

1. Determine what denominator is needed for any fractional inches. For example, if burning with a torch, there is no need to work in 64ths of an inch. If the measurement is in sixteenths, then 16 is the denominator that is needed for the fractional inches. For this problem, find the fractional inches in 16ths.
2. Set aside the whole number of feet: 19
3. Then, convert the decimal feet to inches.
4. Multiply .772 by 12. There are 12 inches in a foot.

$$\begin{array}{r} .772 \\ \times \quad 12 \\ \hline 1544 \\ +\ 772 \\ \hline 9.264 \end{array}$$

5. Set aside the whole number 9. That is how many whole inches there are.
6. Convert the decimal inches, .264, to a fraction. Before calculating the fraction, make an estimate of the answer. The resulting fraction should at least be $\frac{1}{4}$, or $\frac{4}{16}$, because the decimal .25 is equal to $\frac{1}{4}$. The fraction should be less than $\frac{3}{8}$, or $\frac{6}{16}$, because the decimal .375 is equal to $\frac{3}{8}$.

(continued)

PROCEDURE *(continued)*

7. Multiply .264 by 16th, the desired denominator.

$$\begin{array}{r} .264 \\ \times \quad 16 \\ \hline 1584 \\ +\ 264 \\ \hline 4.224 \end{array}$$

8. Round 4.224 to the whole number 4. It will be the numerator of the fractional inches. The denominator is 16. The result, $\frac{4}{16}$, is consistent with the estimate of at least $\frac{4}{16}$ and less than $\frac{6}{16}$.

9. Now, put the whole number of feet, the whole number of inches, and the fractional inches together.

The solution is 19.772′ = 19′-9 $\frac{4}{16}$″ or, reduced to lowest terms, 19′-9 $\frac{1}{4}$″.

SELF CHECK 6

Convert the following measurements to fractions or mixed numbers.

1. 9.119″ to 16ths _____

2. 5.987″ in 32nds _____

3. 32.625″ in 8ths _____

4. 14.441″ in 64ths _____

5. 2.078′ to feet and inches _____

6. 10.28″ to 8ths _____

7. 3.59′ to feet, inches, 8ths _____

8. 4.41″ to 8ths _____

9. 29.2′ to feet, inches, 32nds _____

10. .464′ to inches and 16ths _____

Converting Fractions to Decimals

Just as decimals need to be converted to fractions on the job, fractions may need to be converted to decimals. Prints often require conversion from one unit of measurement to another. To convert a fraction to a decimal, divide the numerator by the denominator. Think of a fraction as a division problem whose solution is a decimal: Start with a known easy number: $\frac{1}{2}$ is equal to .5 The fraction $\frac{1}{2}$ is actually the division problem 1 ÷ 2 = .5 To convert a fraction to a decimal, divide the numerator by the denominator. The next procedure demonstrates how to convert $\frac{5}{8}$″ to decimal inches.

PROCEDURE

How to Convert Fractions to Decimals

1. To convert $\frac{5}{8}''$ to decimal inches, divide the numerator by the denominator.

$$
\begin{array}{r}
.625 \\
8\overline{)5.000} \\
-48 \\
\hline
20 \\
-16 \\
\hline
40 \\
-40 \\
\hline
0
\end{array}
$$

The solution is $\frac{5}{8}'' = .625$ inch.

Sometimes, mixed numbers containing inches and a fractional part of an inch have to be converted to decimals. The process is similar to that for converting fractional inches to decimal inches. The next example demonstrates the steps.

2. To convert $7\ \frac{3}{16}''$ to a decimal, place the whole number for $7''$ off to the side, and work only with the fraction.

Divide the numerator of $\frac{3}{16}$ by its denominator to find the decimal equivalent of the fraction.

$$
\begin{array}{r}
.1875 \\
16\overline{)3.0000} \\
-16 \\
\hline
140 \\
-128 \\
\hline
120 \\
-112 \\
\hline
80 \\
-80 \\
\hline
0
\end{array}
$$

$\frac{3}{16} = 0.1875$

The solution is that the decimal equivalent of $7\ \frac{3}{16}''$ is 7.1875 inches. Whether to keep all four decimal places or to round to fewer decimal places depends on the level of precision needed and on the measuring tools used.

Converting Mixed Numbers That Contain Feet and Inches Sometimes, it is necessary to convert mixed numbers containing feet and inches to decimal feet. The process for doing that is similar to converting mixed numbers to decimal inches. The procedure shows how it is done.

PROCEDURE

How to Convert Mixed Numbers That Contain Feet and Inches

Convert $12'\text{-}5\frac{3}{4}''$ to decimal feet.

1. First, make an estimate of the answer. $12'\text{-}5\frac{3}{4}''$ is almost 12 and $\frac{1}{2}'$, which equals 12.5 feet. The calculated answer should be just a little less than 12.5 feet.
2. Now calculate. Convert the mixed number of inches to decimal inches, $\frac{3}{4} = .75$, so $5\frac{3}{4}'' = 5.75$ inches.

   To convert inches to feet, divide the inches by 12. Convert 5.75 inches into decimal feet by dividing 5.75 by 12.

```
     .4791
  12)5.7500
   -48
     95
    -84
     110
    -108
      20
     -12
       8
```

3. How many decimal places should the answer contain? That depends on the level of precision needed and the tools being used.

   Rounding to three decimal places gives an answer of .479 because the number in the fourth decimal place, 1, is less than 5. It is dropped.

   Rounding to two decimal places gives an answer of .48 feet because the number in the third decimal place is 9, which is greater than 5. Therefore, .47 becomes .48 when rounding.
4. Now, put the parts of the mixed number back together:

   The solution is that the mixed number $12'\text{-}5\frac{3}{4}'' = 12.48'$ if rounded to two decimal places and $12.479'$ if rounded to three decimal places.
5. Check that both answers are consistent with the estimated answer of slightly less than 12.5 feet.

SELF CHECK 7

Convert the following fractional measurements in feet and inches to decimal feet. Round to the nearest 100th.

1. $7'\text{-}9\frac{11}{16}''$ _____

2. $9\frac{9}{16}''$ _____

3. $5\frac{15}{32}''$ _____

4. $12'\text{-}3\frac{3}{32}''$ _____

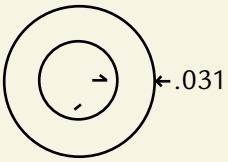
5. $17'\text{-}2\frac{15}{64}''$ _____

6. $3'\text{-}3\frac{33}{64}''$ _____

7. If 6 boxes of floor tiles weigh $36\frac{1}{4}$ pounds each and cost $18.50/pound, what is the total cost to the nearest cent?

_____

8. Using the illlustration below, if a shaft $4\frac{3}{4}''$ in diameter was turned down by a cut .031″ deep, what would be the finished diameter in decimals? _____



9. If $1\frac{3}{8}$ tons of scrap is loaded into a dumpster that weighs 1728.43 pounds, what is the total weight in pounds and tons of the loaded dumpster? _____

(continued)

SELF CHECK 7 *(continued)*

10. If structural steel is installed in 2.75 floors of a building in $2\frac{3}{8}$ days, how long will it take to install steel in 11 floors?

_____

11. If a keg of nails costs \$129.45 and $\frac{6}{7}$ of the keg is used, what is the value of the remaining nails? _____

12. Starting with a 9′ steel bar, if a welder cuts three lengths of 25″, 16″, and $19\frac{1}{2}$″ from the bar and each cut is 0.125″ wide, what is the length of the remaining steel bar? _____

13. If 125.75 feet of molding are used in trimming $\frac{1}{7}$ of an office, how much molding will be used in the whole office?

_____

14. If a person making \$560 a week earns a 12% raise, what is the new weekly pay? _____

15. Union membership typically results in a salary that is 23% higher than that paid for the same job to a nonunion worker. If a nonunion worker makes \$13.60 an hour, what does the union worker typically make? _____

5 Using Percentages

Another type of decimal is a **percent** or **percentage**, which is a part of a whole expressed in hundredths and indicated by the symbol %. Percentages are some of the most commonly used fractions: a weather report may call for a 30% chance of rain, waiters are generally tipped 18%, and a grade of 96% is usually an A.

Converting Percentages to Decimals

Percentages can be converted to decimals by removing the percent symbol and moving the decimal point two places to the left. For example, 75% equals .75 in decimal form. If the percent is a single digit, it is necessary to add a zero as a placeholder when converting to a decimal: 5% equals .05 in decimal form.

A good way to remember how to convert percentages to decimals is to think of dollars and cents. One cent is 1% of a dollar. As a decimal, it would be written as .01. Forty-nine cents is 49% of a dollar or $\frac{49}{100}$ of a dollar, which can be written as .49 in decimal form. Moving the decimal point to convert a percent into a decimal is the same as dividing the percent by 100. Dividing 49 by 100, results in .49 in decimal form.

If a percentage already contains a decimal point, it can still be converted to a decimal. For example, 99.9% equals .999 in decimal form. The decimal point has been moved two places to the left of where it was when the number was expressed as a percentage. The percentage .25% converts to .0025 in decimal form. The next example demonstrates how to convert percentages to decimals.

TRADE TIP

To convert a percentage to a decimal, divide by 100. To convert a decimal to a percentage, multiply by 100.

Example

Convert the following percentages to decimals.

35% 66.6% 7% .05%

Delete the percent sign and place a decimal point two places to the left.

35% = .35 66.6% = .666

What about 7%? It only has one place. If the percent has fewer than two places to move the decimal, add zeros as needed. So, 7% becomes .07 in decimal form.

Sometimes, it is necessary to add more than one zero. There are already two decimal places in .05% Dividing .05% by 100 = .0005 in decimal form. This is the same as moving the decimal two places.

Converting Decimals to Percentages

Decimals can be converted to percentages by moving the decimal point two places to the right and adding the percent symbol (%). For example, the decimal .45 equals 45%. If the decimal is a single digit, it is necessary to add a zero as a placeholder when converting it to a percent: .8 converts to 80%. This is the same as multiplying .8 by 100, which equals 80%.

Example

Moving the decimal point two places to the right has the following results:

1. .7 = 70%
2. .0015 = .15%
3. 3.33 = 333%
4. .658 = 65.8%
5. 2.5 = 250%
6. 5 = 500%

Converting Fractions to Percentages

Converting a fraction to a percentage is accomplished the same way as converting a fraction to a decimal: by dividing the numerator by the denominator. Converting a fraction into a percentage requires converting the fraction into a decimal, then making the decimal into a percent. The next procedure shows how both of these actions are accomplished.

PROCEDURE

How to Convert Fractions to Percentages

Convert the following fractions to percentages: $\frac{1}{2}$, $\frac{7}{8}$, $3\frac{1}{2}$. Converting a fraction to a percent is like converting a fraction to a decimal.

1. Convert $\frac{1}{2}$ and $\frac{7}{8}$ to percentages.

First, divide the numerator by the denominator. Remember a fraction is a division problem whose solution is a decimal.

$$
\begin{array}{r}
.5 \\
2\overline{)1.0} \\
-\,1\,0 \\
\hline
0
\end{array}
$$

2. Move the decimal point two places to the right, adding a zero as a placeholder if necessary. Drop the decimal point if there are no remaining numbers to the right of the decimal. Then add a percent sign: .5 = .50 = 50%.

$$
\begin{array}{r}
.8\,7\,5 \\
8\overline{)7.0\,0\,0} \\
-\,6\,4 \\
\hline
6\,0 \\
-\,5\,6 \\
\hline
4\,0 \\
-\,4\,0 \\
\hline
0
\end{array}
$$

3. Move the decimal point two places to the right. Add a percent sign: .875 = 87.5%

4. To convert a mixed number, such as $3\frac{1}{2}$, first convert it to an improper fraction.

$$3\frac{1}{2} = \frac{7}{2}$$

$$
\begin{array}{r}
3.5 \\
2\overline{)7.0} \\
-\,6 \\
\hline
1\,0 \\
-\,1\,0 \\
\hline
0
\end{array}
$$

Move the decimal point two places to the right, adding a zero as a placeholder if necessary. Drop the decimal point if there are no remaining numbers to the right of the decimal. Then add a percent sign: 3.5 = 350%.

Converting Percentages to Fractions

Converting a percentage to a fraction is very similar to converting a decimal to a fraction. In fact, the first step in the process is to turn the percentage into a decimal. The next step is to make the decimal into a fraction. The

denominator chosen for the fraction depends on the use of the fraction and the level of precision needed for the job. The next procedure demonstrates the steps in the process.

PROCEDURE

How to Convert Percentages to Fractions

Convert 55% to a fraction.

1. Begin by converting the percent to a decimal by removing the percent sign and moving the decimal point two places to the left: 55% = .55
2. Now, convert .55 to a fraction.

   Saying the decimal helps to see how to convert it. The decimal .55 said out loud is 55 hundredths. Written as a fraction, that is $\frac{55}{100}$.
3. If hundredths is the unit of measure or level of precision needed, this is as far as it is necessary to go. However, depending on the task at hand, it may be better to reduce the fraction to lowest terms. The number 5 is a factor of both 55 and 100. Dividing the numerator and denominator each by 5 will simplify the fraction.

   $\frac{55}{100} \div \frac{5}{5} = \frac{11}{20}$

   The solution is that 55% = $\frac{11}{20}$.

SELF CHECK 8

1. Convert the following percents to decimals.
   - **a.** 45% _____
   - **b.** 75% _____
   - **c.** 62.5% _____
   - **d.** 4% _____
   - **e.** 4.5% _____
2. Convert the following decimals to percents.
   - **a.** .20 _____
   - **b.** .001 _____
   - **c.** .667 _____
   - **d.** .0025 _____
   - **e.** 1.50 _____
3. Convert the following fractions to percents.
   - **a.** $\frac{3}{5}$ _____
   - **b.** $\frac{5}{16}$ _____
   - **c.** $\frac{3}{50}$ _____

(continued)

SELF CHECK 8 *(continued)*

d. $\frac{7}{20}$ _____

e. $\frac{9}{49}$ _____

4. Convert the following percents to fractions.

a. 2% _____

b. .5% _____

c. $12\frac{1}{2}\%$ _____

d. 35% _____

e. 175% _____

Calculating a Percentage of a Number

Calculating the percentage of a number is basically a decimal multiplication problem. First, it is necessary to convert the percent to a decimal. Then, perform the math calculation. The next procedure shows how to do it.

PROCEDURE

How to Calculate a Percentage of a Number

What is 30% of 300?

1. First, convert 30% to a decimal by dropping the percent sign and moving the decimal point two places to the left. Dropping the percent sign leaves the number 30. Placing a decimal point two places to the left makes the 30 into .30 in decimal form.

To find 30% of 300, multiply .30 by 300.

$$\begin{array}{r} 300 \\ \times \quad .30 \\ \hline 90.00 \end{array}$$

The decimal point in the product of 300 × .30 goes two places to the left because there is a total of two decimal places in the two numbers being multiplied, two in .30 and none in 300.

There are a variety of ways to solve percentage problems. Three of the most common types of percentage problems are: (1) finding a percent of a given number, 70% of what number is 5? (2) finding what percent one number is of another, 4 is what percent of 25? (3) finding a number when a percent of it is given, what number is 75% of 10?

Percentage is a mathematical concept that appears frequently in everyday life. Some examples include a store offering a 20 percent discount on a selected group of items. The materials that make up work pants are 75 percent polyester and 25 percent cotton. Banks pay a three and one half percent interest rate annually on regular savings accounts. Gratuity is usually 18 percent of the bill before tax is added.

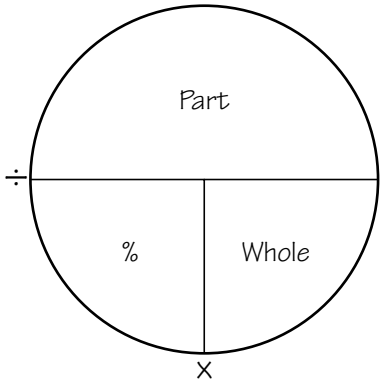


FIGURE 1
Solving percentage problems

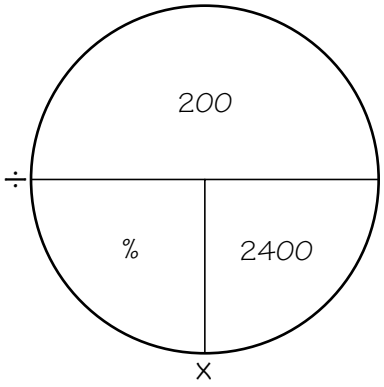


FIGURE 2
What is known about the gas expense percentage problem

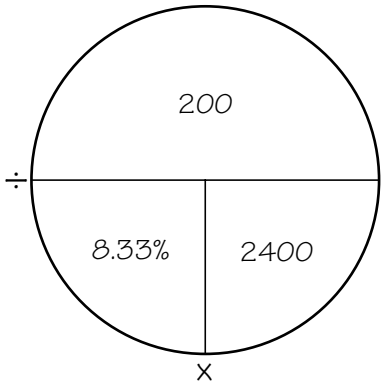


FIGURE 3
Gas expense solution

Any of these percentage problems are easily solved. The first step is to read the problem carefully to determine what is being asked. Regardless of how the problem is worded or set up, all percentage problems have three components:

- Part: a portion of the whole amount
- Whole: the total amount calculated
- Percent: a portion of 100 equal parts or 100%

An easy way to solve any percentage problem is to draw a circle and label as shown in Figure 1. The lines inside the circle will determine which math operation needs to be performed. The horizontal line means divide. The vertical line means multiply.

PROCEDURE

How to Solve Percentage Problems Using a Three-Piece Circle

Use the 3-piece circle to find what percentage of your monthly income is spent on gas. Your take home pay is $2400.00 per month. Your gas expense is $200.00 per month.

1. Look at the problem and determine what is asked for.
   a. We need to find what percentage $200.00 is of $2400.00
2. Write the known information in the appropriate places in the circle. See Figure 2.
   a. 2400 is the whole.
   b. 200 is the part.
   c. In this example the percent is missing.
3. Use your thumb to cover the percent portion of the circle.
4. Perform the appropriate operation. Remember, the horizontal line means divide. The vertical line means multiply.
   a. The horizontal line is between the two known values, 200 and 2400.
   b. Divide the 2400 into the 200.

$$
\begin{array}{r}
.0833 \\
2400\overline{)200.0000} \\
-\ \underline{19200} \\
8000 \\
-\ \underline{7200} \\
8000
\end{array}
$$

Therefore, the percentage of your monthly income spent on gas is 8.3%. See Figure 3.

Example 1

Use the 3-piece circle to find how much money you should leave in tip for a meal that costs $25.00 before tax. You want to leave an 18% tip.

1. Look at the problem and determine what is asked for.
   - **a.** 18% of $25.00 is what we need to know.
2. Write the known information in the appropriate places in circle. See Figure 4.
   - **a.** 25 is the whole.
   - **b.** 18 is the percent.
   - **c.** In this example the part is missing.
3. Use your thumb to cover the part portion of the circle.
4. Convert 18% into a decimal.
   - **a.** 18% is .18 in decimal form
5. Perform the appropriate operation.
   - **a.** The vertical line is between the two known values, .18 and 25.
   - **b.** Multiply .18 × 25.

$$\begin{array}{r} 25 \\ \times\ .18 \\ \hline 200 \\ +\ 25 \\ \hline 4.50 \end{array}$$

Therefore, $4.50 is the tip. See Figure 5.

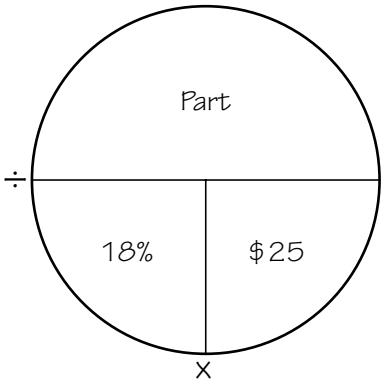


FIGURE 4
What is known about tip percentage problem

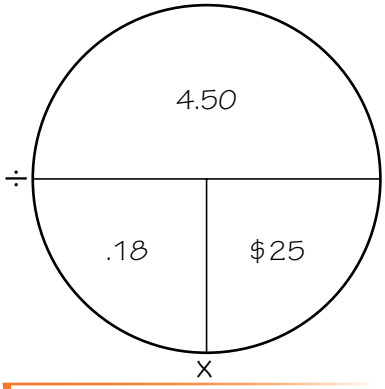


FIGURE 5
Tip solution

Example 2

A construction company built 600 houses in one year and 800 houses in the next year. The second year's production is what percentage greater than the production of the first year.

1. Look at the problem and determine what the problem is asking.
   - **a.** We need to find what percentage of increase 800 houses is over 600 houses.
2. Write the known information in the appropriate places in circle. See Figure 6.
   - **a.** 600 is the whole.
   - **b.** Find the difference of the houses built between the first year and the second year. 800 – 600 = 200.
   - **c.** In this example the percentage is missing.

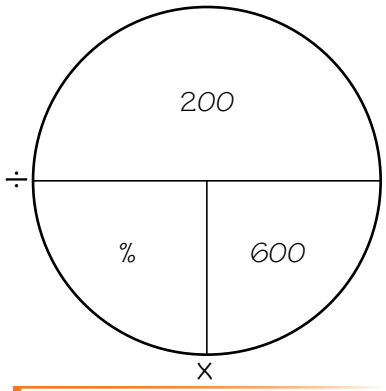


FIGURE 6
What is known about the housing increase percentage problem

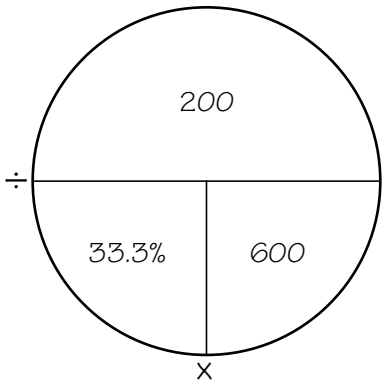


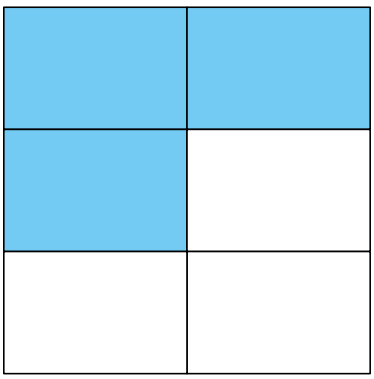
FIGURE 7
Housing increase solution

3. Use your thumb to cover the percent portion of the circle.
4. Perform the appropriate operation. The horizontal line means divide. The vertical line means multiply.
   a. The horizontal line is between the two known values, 200 and 600.
   b. Divide 600 into 200.

Therefore, 33.3% is the production increase percent from the first year to the second year. See Figure 7.

SELF CHECK 9

1. What is 75% of $45,300? _____
2. What is 60% of 480? _____
3. What percent of 50 is 34? _____
4. What percent of 270 is 90? _____
5. Last month, 5% of all the parts inspected for an assembly job were rejected because of defects. The total number of parts inspected during the month was 12,540. How many were rejected for imperfections? _____
6. Thermite steel contains .05% to .10% carbon. What is the smallest amount of carbon that might be contained in 200 pounds of this steel? _____
7. Nickel steel usually contains from 3% to 3.5% nickel. What is the largest amount of nickel that might be contained in 1000 pounds of this steel? _____
8. A brass casting weighs 40 pounds. The copper used in making it weighed 24.8 pounds. What percent of the casting is copper? _____
9. A job requiring 42 minutes was speeded up. It was completed in 38 minutes. What percent of the original time was saved? _____
10. A line is $6\frac{1}{2}''$ long. A segment $2\frac{1}{4}''$ long is what percent of the line? _____
11. In the illustration to the left, what percent of the square is shaded? _____
12. In an inspection of 600 valves, 540 were accepted. Of the valves inspected, what percent was rejected? _____



Summary

Decimals are a way of writing fractions in units of ten. Decimals can be added, subtracted, multiplied, and divided. Answers may be requested to a specific level of precision, such as to the nearest hundredth of an inch. Answers may be rounded to the required place value. Round up if the digit to the right of the specified place value is equal to or greater than 5. Round down if the digit to the right of the specified place value is less than 5.

When adding or subtracting decimals, line up the decimal points and work from right to left, from the smallest place value to the largest. When multiplying decimals, align both factors and do not worry about place value. Multiply each digit in one of the factors by each digit in the other. Add the products. Determine where to place the decimal point by adding the number of decimal places in the two factors. Place the decimal point that many places to the left of the first digit on the right in the answer. When dividing decimals, move the decimal point of the divisor all the way to the right. Then, move the decimal point of the dividend the same number of places to the right. Put the decimal point in the quotient in that same position.

Decimals, fractions, and percentages may each be converted to each other, and all three may be used on a job. Prints or other plans may require conversion from one form of measurement to another, requiring the conversion of decimals to fractions or fractions to decimals.

Decimals QUESTIONS

Show an understanding of the information in this chapter by answering the questions and filling in the blanks below.

1. Calculate the decimal value of each of the following.

a. 11.59 + 4.03 _____

b. 2008 + 6.72 _____

c. 56.9 – 7.4 _____

d. 45.338 – 18.45 _____

e. 467.003 – 224.34 _____

f. 67 × 8.3 _____

g. 3.21 × .06 _____

h. 45 ÷ 7.34 _____

i. 3.35 into 170 _____

j. $\frac{11}{64}$ _____

2. Round the following to the specified place value.

a. 0.9899 to hundredths _____

b. 123.124 to tenths _____

c. 56.04989 to thousandths _____

3. Convert the following decimals to fractions.

a. 0.658 _____

b. 8.44 _____

c. 2.971″ in thirty-seconds _____

d. 28.987′ in sixteenths _____

4. Convert the following as directed.

a. 29% to a decimal _____

b. $\frac{4}{64}$ to a percent _____

c. 67% of 1028 _____

5. Write an equation and solve for each scenario.

a. There are 17 offices to inspect in a commercial building. Each inspection takes 40 minutes. How many hours will the full inspection take?

---

b. A drywaller wants to order core board for a 15-story elevator shaft. Each floor uses 18.5 sheets. Calculate the number of boards needed. Add 10% of the total for waste.

---

c. Three and three-eighths ($3\frac{3}{8}$) buckets of glue are used on a floor. A bucket holds 4.5 gallons. How many gallons of glue are used?

---

d. A lot measures 63.41 feet. What is the measurement in feet, inches, and fractions of an inch? Answer to the nearest $\frac{1}{16}''$.

---

e. Twenty-eight percent (28%) of an employee's take-home pay goes for rent. He makes $3,028.25 per month. How much is spent on rent?

Decimal Place Value Chart

Instructions Solve the math problems clearly accurately and successfully by drawing a place value chart that will determine the value of digits and decimal fractions in a number. To complete this task successfully, the student will establish the correct positions of the following on the chart:

- decimal point
- ones' place
- tens' place
- hundreds' place
- thousands' place
- ten-thousands' place
- tenths' place
- hundredths' place
- thousandths' place

Materials

¼″ block graph paper
pencil
ruler

Procedure

1. Draw a horizontal line across the center of the graph paper.
2. Starting in the center of the line, establish the decimal point.
3. Starting from the decimal point, label the resulting spaces to the left of the decimal point and above the horizontal line with 1, 10, 100, 1,000, and 10,000.
4. Starting from the decimal point, label the resulting spaces to the right of the decimal point and above the horizontal line with 1/10, 1/100, 1,000, and 10,000.
5. Starting from the decimal point, draw vertical lines between the place values in both directions.
6. Write the following numbers in their correct place value:
   thirty-seven hundredths
   fifteen and eleven ten thousandths
   seven hundred fifty-three and five hundred sixty-seven ten-thousandths

Self Evaluation

	Yes	No	N/A
Drew the place value chart from 1s to 10,000ths.	_____	_____	_____
Wrote thirty-seven hundredths in correct value columns.	_____	_____	_____
Wrote fifteen and eleven ten-thousandths in correct value columns.	_____	_____	_____
Wrote seven hundred fifty-three and five hundred sixty-seven ten-thousandths in correct value columns.	_____	_____	_____

Adding and Subtracting Decimals Using the $\frac{1}{10}$th Scale on a Framing Square

Instructions Use the $\frac{1}{10}$th scale on a framing square to measure the wood blocks. Then, write these measurements as decimals. To complete this task successfully, the student will:

- create a table into which measurements can be entered
- measure each block to the nearest $\frac{1}{10}''$
- write these measurements into the table as decimals
- add the lengths, widths, and heights of the blocks using the table
- check calculations by physically measuring the blocks
- subtract total width from total length

Materials

notebook
random-sized blocks of wood
pencil

Tools

framing square with $\frac{1}{10}$th scale

Procedure

1. Draw a table similar to the example below into which measurements can be entered. Use your notebook for the table.

	Block 1	Block 2	Total
Length			
Width			
Height			

2. Measure the longest edge of each block (the length) using the 10ths scale on the framing square.
3. Write the number in decimal form in the appropriate place in the table. Measurements should be to the nearest $\frac{1}{10}$ of an inch.
4. Measure the next longest edge of each block (the width), and write the number in the appropriate place in the table.
5. Measure the next shortest edge of each block (the height), and write the number in the appropriate place in the table.

Adding and Subtracting Decimals Using the $\frac{1}{10}$th Scale on a Framing Square(continued)

6. Using the table, add the lengths, the widths, and the heights of the blocks.
7. Verify the calculations by physically measuring the blocks together.
8. Subtract the total width measurement from the total length measurement.

Self Evaluation

	Yes	No	N/A
Created a simple data chart.	_____	_____	_____
Accurately measured in $\frac{1}{10}$ths of an inch.	_____	_____	_____
Accurately wrote decimals.	_____	_____	_____
Accurately added decimals.	_____	_____	_____
Accurately subtracted decimals.	_____	_____	_____

Multiplying and Dividing Decimals Using a $\frac{1}{10}$th Scale on a Framing Square

Instructions Use the $\frac{1}{10}$th scale on a framing square to measure the wood blocks. Then, write these measurements as decimals.To complete this task successfully, the student will:

- create a table into which measurements can be entered
- measure wood blocks using the $\frac{1}{10}$th scale on a framing square
- write these measurements into the table as decimals
- multiply as indicated in the procedure
- divide as indicated in the procedure

Materials

notebook
pencil
random-sized blocks of wood

Tools

framing square with $\frac{1}{10}$th scale

Procedure

1. Draw a table similar to the one below into which measurements can be entered. Use your notebook for the table.

	Block 1	Block 2
Length		
Width		
Height		

2. Measure the longest edge of each block (the length) using the $\frac{1}{10}$th scale on the framing square.
3. Write the measurement in decimal form to the nearest $\frac{1}{10}$ of an inch in the appropriate place in the table.
4. Measure the next longest edge of each block (the width) and write the measurement in the appropriate place in the table.
5. Measure the next shortest edge of each block (the height) and write the measurement in the appropriate place in the table.
6. Multiply the length by the width for each block.

Multiplying and Dividing Decimals Using a $\frac{1}{10}$th Scale on a Framing Square (continued)

7. Multiply the resulting products by the height for the appropriate block.
8. Divide the length by the width for each block.

Self Evaluation

	Yes	No	N/A
Created a simple data chart.	_____	_____	_____
Accurately measured in $\frac{1}{10}$ths of an inch.	_____	_____	_____
Accurately wrote decimals.	_____	_____	_____
Accurately multiplied decimals.	_____	_____	_____
Accurately divided decimals.	_____	_____	_____

Decimals Mechanical Seal Layout

Instructions Convert the decimals shown from the starting point on the mechanical seal print to fractional parts of an inch. To complete this task successfully, the student will:

- draw a table
- find dimension X
- convert decimals of an inch to inches
- convert all decimal dimensions on the attached drawing to the nearest $\frac{1}{64}''$

Materials

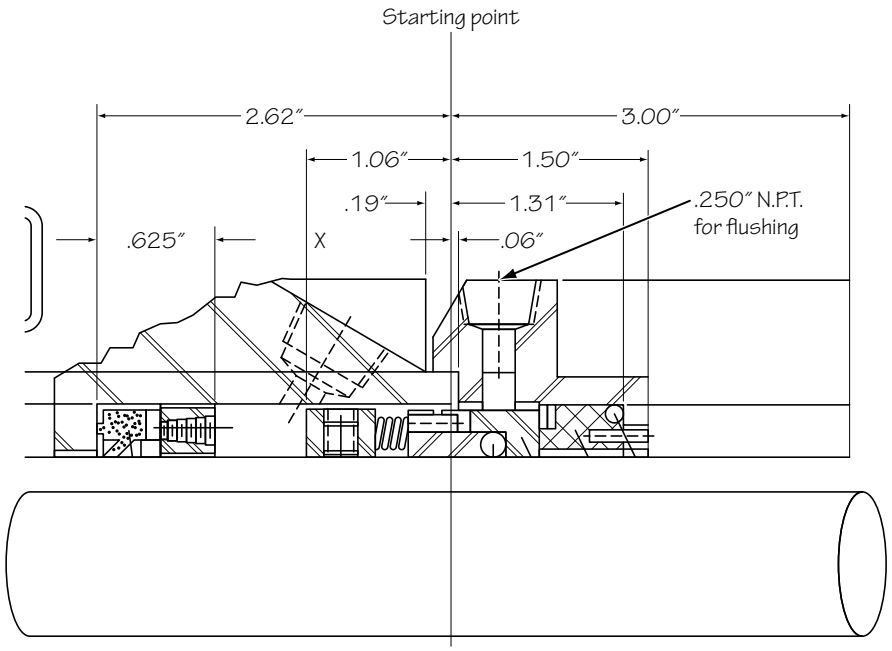
notebook
pencil

Tool

6″ scale

Procedure

1. Create a table in your notebook into which measurements can be entered.
2. Find dimension X.
3. Convert all decimals of an inch to the nearest $\frac{1}{64}''$.



Decimals Mechanical Seal Layout (continued)

Self Evaluation

	Yes	No	N/A
Created a table for measurements.	_____	_____	_____
Found dimension X.	_____	_____	_____
All decimals converted to fractions correctly.	_____	_____	_____
Converted decimals to the nearest $\frac{1}{64}''$.	_____	_____	_____
Set up the problems correctly.	_____	_____	_____
Correctly performed the math operation.	_____	_____	_____
Measured from the correct starting location.	_____	_____	_____
All dimensions accurately laid out on the drawing.	_____	_____	_____

Decimals Measuring a Dowel

Instructions Find the center of a dowel measuring 9.625″ long.
To complete this task successfully, the student will:

- convert decimals of an inch to inches
- find the center of the dowel
- lay out the center of the dowel

Materials

notebook
pencil
dowel 9.625″ long

Tools

6″ scale

Procedure

1. Convert the decimal length of the dowel to inches and fraction of an inch.
2. Use a 6″ scale and measure the center of the dowel.
3. Mark the center on the dowel.

Self Evaluation

	Yes	No	N/A
Converted the rod length to inches.	_____	_____	_____
Set up the problem correctly.	_____	_____	_____
Correctly performed the math operation.	_____	_____	_____
Labeled the center of dowel.	_____	_____	_____
Measured the correct center location.	_____	_____	_____

Percentage: Coffee Order

Instructions Take a coffee order from 5 classmates and calculate the tax and tip using the pricing information provided below. To complete this task successfully, the student will:

- make an organized, itemized list of each person and the item ordered
- calculate sales tax
- calculate the tip
- calculate the correct total including tax and tip

Materials

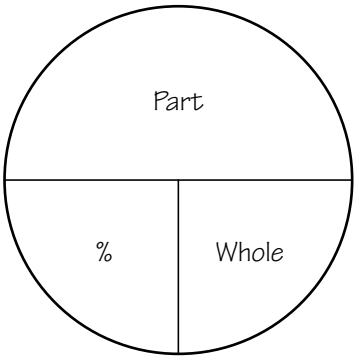
notebook
pencil

Tools

calculator

Procedure

1. Write the name of each person placing an order.
2. Make a column for the drinks: coffee and soda.
3. Make a column for the food: muffins and doughnuts.
4. Use the following prices for each item:
   - regular size coffee $1.10
   - soda $1.35
   - doughnut $0.75
   - muffin $1.25
5. Itemize by each item from the individuals' orders. Example: 7 coffees @ $1.10 each = $7.70
6. Calculate the total bill before tax and tip.
7. Place the total from step 5 in the whole section of the circle.
8. Place 7.3% sales tax in the percent area of the circle.
9. Solve for the sales tax.
10. Add the sales tax to the whole amount.
11. Place the original amount from step 5 in the whole of the circle.
12. Place 18% tip in the percent area of the circle.
13. Solve for the tip.
14. Add the tip to the whole amount.
15. Calculate the total bill with tax and tip included.



Percentage: Coffee Order (continued)

Self Evaluation

	Yes	No	N/A
Made an organized list.	_____	_____	_____
Individually calculated the amount of each item in the order.	_____	_____	_____
Properly labeled the function of the horizontal and vertical lines in the circle.	_____	_____	_____
Performed the correct math operation for sales tax.	_____	_____	_____
Performed the correct math operation for the tip.	_____	_____	_____
Calculated the correct total including tax and tip.	_____	_____	_____

Lesson Plan Chapter 6

Career Connections: One Trade, Many Careers

Time Required

Two 50-minute class periods

Goal

To introduce careers in construction and describe the jobs and skill requirements of carpenters and mill-cabinetmakers.

Objectives

At the end of this chapter, students should be able to:

1. Describe the basic educational and training requirements for the construction trades.
2. Identify the types of skilled occupations that are classified as carpenters.
3. Describe the work of residential carpenters.
4. Describe the work of commercial carpenters.
5. Describe the work of interior systems carpenters.
6. Describe the work of mill-cabinetmakers.

Procedures

The following provides a summary of instructional and assessment procedures.

Teach

MINUTES	ACTIVITY
5	**Review** Review Chapter 5 assignments.
5	**Chapter 6 Introduction** Review lesson goal and lesson objectives with students.
10	**Section 1** Discuss how to get the necessary education and training for a job in construction. Review critical thinking questions with students.
10	**Section 2** Discuss how "carpenter" includes a range of skilled crafts in construction. Engage students in critical thinking questions.
10	**Section 3** Provide a general overview of the work of residential carpenters. Engage students in the critical thinking questions.
10	**Section 4** Provide a general overview of the work of commercial carpenters. Engage students in the critical thinking questions.
CLASS PERIOD 2	
10	**Review** Review chapter content previously taught.
10	**Section 5** Provide a general overview of the work of interior systems carpenters. Engage students in the critical thinking questions.
10	**Section 6** Provide a general overview of the work of mill-cabinetmakers. Engage students in the critical thinking questions.
10	**Chapter Check** Allow students to complete answers to the questions. Make sure students understand the vocabulary listed under *Important Words*.
10	**Activities** Assign the end-of-chapter activities to be completed outside of class. Consider having students complete the *On the Trail of . . .* activity in class. Assign Chapter 7 as required reading for the next class.

Assess

ASSESSMENT ACTIVITY	ASSESSMENT METHOD AND CRITERIA			
Chapter Check questions	1 point for each correct answer			
On the Trail of . . .	Rubric for Three-Column Table			
		Excellent 3	*Satisfactory 2*	*Poor 1*
	Overall Content	All information is provided. Very well thought out.	Most of the information is provided. Fairly well thought out.	Incomplete information. Little time spent on activity.
	Quality of Information	Excellent ideas and comments about building projects.	Very good ideas and comments about building projects.	Poor ideas for building projects. Minimal comments.
	Organization and Writing	Information is well organized in easy-to-read columns. Very few grammatical, spelling, or punctuation errors.	Information is fairly well organized in columns. Several grammatical, spelling, or punctuation errors.	Information is not well organized in columns. Many grammatical, spelling, or punctuation errors.
	Total _____ of 9 points			
.com	Rubric for Vocabulary Explanation			
		Excellent 3	*Satisfactory 2*	*Poor 1*
	Overall Content	All four terms are defined.	Only three terms are defined.	Fewer than three terms are defined.
	Internet Use	Successful use of internet to find correct explanations of terms.	Somewhat successful use of internet to find correct explanations of terms.	Unsuccessful use of the internet to find correct explanations of terms.
	Organization and Writing	All explanations are short and easy to understand. Very few grammatical, spelling, or punctuation errors.	Most explanations are short and easy to understand. Several grammatical, spelling, or punctuation errors.	Few explanations are short and easy to understand. Many grammatical, spelling, or punctuation errors.
	Total _____ of 9 points			
Being the First Choice	Rubric for Research Summary			
		Excellent 3	*Satisfactory 2*	*Poor 1*
	Overall Content	Clearly relates to topic. All requested information is provided.	Somewhat relates to topic. Most of the requested information is provided.	Information has little to do with the topic. Very little information is provided.
	Quality of Information	Details show successful information gathering.	Details show somewhat successful information gathering.	Minimal details show unsuccessful information gathering. Summary is lacking in data.
	Organization and Writing	Summary information is organized and clear. Very few grammatical, spelling, or punctuation errors.	Summary information is fairly organized and fairly clear. Several grammatical, spelling, or punctuation errors.	Summary information lacks organization and clarity. Many grammatical, spelling, or punctuation errors.
	Total _____ of 9 points			

Lesson Plan Career Connections: Project Book 1

Chapter 1 Safety on the Jobsite

Time Required

Three to five 50-minute class periods (five class periods are outlined below; fewer are required if you teach general safety information and then teach particular aspects of safety as they occur in projects)

Goal

To demonstrate the importance of safety by describing the types of accidents that can occur and the methods for preventing them.

Objectives:

At the end of this chapter, students should be able to:

1. Explain the importance of safety.
2. Distinguish between hazards, accidents, and injuries.
3. Identify the kinds of mistakes that lead to accidents and injuries.
4. Summarize the methods for preventing accidents.
5. Support the training procedures required to promote safety.

Instruction and Assessment:

The following provides a summary of steps for instruction and assessment.

Teach

MINUTES	ACTIVITY
5	**Chapter 1 Introduction** Review the lesson goal and objectives with students.
45	**Section 1** Discuss the importance of safety. Explain the meaning of "Safety First." Review the list of safe work practices. Use both the classroom and shop area as needed.
CLASS PERIOD 2	
5	**Review** Review chapter content previously taught.
45	**Section 2** Discuss and explain the relationship between hazards, accidents, and injuries. Discuss and expand upon the types of jobsite hazards listed. Explain how hazards cause accidents and injuries. Use both the classroom and shop area as needed.
CLASS PERIOD 3	
5	**Review** Review chapter content previously taught.
45	**Section 3** Explain how to avoid mistakes that lead to accidents and injuries by discussing the list of specific hazards to watch for when walking into a shop. Discuss unsafe behaviors (inattention, carelessness, over-confidence) vs. the list of safe behaviors. Provide an overview of the proper use of tools and safety equipment. Demonstrate as needed. Discuss the need for safe work habits and attitudes, particularly when doing repetitive work. Review the list of personal qualities of professional carpenters. Explain what appropriate and protective clothing is for carpenters. Discuss the role of good communication to avoid and correct hazards. Use both the classroom and shop area as needed.

CLASS PERIOD 4	
5	**Review** Review chapter content previously taught.
45	**Section 4** Introduce the topic of preventing accidents by reviewing the list of requirements. Discuss the importance of recognizing hazards. Review the list of questions that help identify a hazard. Explain how developing safe work habits begins by acquiring knowledge and skill. Discuss the list of practices that keep the work area clean and safe. Describe the rules for proper handling of materials to avoid injuries. Describe the uses for personal protective equipment (PPE). Demonstrate proper use of this equipment. Use both the classroom and shop area as needed.
CLASS PERIOD 5	
5	**Review** Review chapter content previously taught.
45	**Section 5** Summarize the importance of promoting safety, at school or at work. Explain the activities and precautions listed in a typical safety plan. Familiarize students with the school or shop safety plan. Describe the steps involved in case of an accident. Discuss the importance of knowing the location of the first aid station. Show students the location and contents of the school or shop first aid station.
15	**Chapter Check** Allow students to complete answers to the questions. Ask students to review Chapter 2 for the next class.

Assess

ASSESSMENT ACTIVITY	ASSESSMENT METHOD AND CRITERIA
Chapter Check questions	1 point for each correct answer

Lesson Plan

Career Connections: Commercial Construction

Unit 1 Construction Concepts

Time Required

18–21 class periods (21 class periods are outlined below to increase the student's jobsite safety awareness and print interpretation skills). This chapter includes an overview of a commercial set of drawings and provides instruction for print interpretation. Interpreting lines, origination and termination of dimensions, symbols, abbreviations, types of drawings and views, schedules, and specifications are covered in this unit. Shop cleanup should be minimal for each class.

Goal

Learn the skills needed to work safely and effectively on the jobsite as an individual and as a team member. Successfully interpret information contained in a basic set of commercial drawings.

Objectives

At the end of this unit, students should be able to:

1. Increase jobsite safety awareness
2. Identify what tools are found on a commercial jobsite
3. Recognize the importance of teamwork
4. Interpret the information contained in the project drawings

Procedures

The following provides a summary of instructional and assessment procedures.

Teach

HOURS	ACTIVITY
CLASS PERIODS 1–4	
4	**Unit 1 – Introduction** Review the lesson goal and lesson objectives with students.
	Chapter 1 – Safety Distribute books and begin presentation of the chapter. Review jobsite safety awareness, PPE, ladder, and scaffold safety. Allow time to complete the answers to the chapter check questions.
CLASS PERIODS 5–9	
5	**Chapter 2 – Tool Review** Review chapter content previously taught. Present handling tools properly, hand tools, power tools, tool belt, and toolbox. Allow time to complete the answers to the chapter check questions.
CLASS PERIODS 10–11	
2	**Chapter 3 – Carpenters on the Job** Review chapter content previously taught. Present importance of teamwork and the work environment. Allow time to complete the answers to the chapter check questions.

CLASS PERIODS 12–21	
10	**Chapter 4 – Print Interpretation** Review chapter content previously taught. Present print overview, interpreting lines, origination and termination of dimensions, symbols and abbreviations, types of drawings, types of views, schedules, and specifications. Allow time to complete the answers to the chapter check questions.

Assess

ASSESSMENT ACTIVITY	ASSESSMENT METHOD AND CRITERIA
Chapter Check Questions	1 point for each correct answer

Skills Matrix Project Book 1

Skill	Lead-Up Exercise	Tote Box	Paper Towel Holder	Foot stool	Bird House	
Using/reading a measuring tape						
Interpreting prints						
Creating a cut list						
Transferring measurements from print to project						
Using templates						
Using a jig						
Making Cuts						
bevel cut with a circular saw						
bevel cut with a sliding compound miter saw						
chop cut with sliding compound miter saw						
crosscut with a circular saw						
crosscut with handsaw						
compound cut with a sliding compound miter saw						
compound miter cut with a circular saw						
miter cut with a circular saw						
miter cut with a sliding compound miter saw						
rip cut with a circular saw						
Slide cut with sliding compound miter saw						
taper						
Using Measuring Tools						
Chalk box						
creating a straight line with a chalk box						
Combination square						
checking a combination square for accuracy						
checking 90 degree angles with a combination square						
Laying out a 45 degree angle with a combination square						
Laying out a parallel line with a combination square						
Compass						
drawing a circle with a compass						
forming arcs with a compass						
Framing square						
checking the framing square with accuracy						
Measuring tape						

indicates when the tool, object, or task is first introduced to the student

indicates when the tool, object, or task is included in the project or lead-up exercise

	Saw Key Holder	Coat Rack	Step Stool	Chest	Bread Box	Bookcase	CD Rack	Magazine Rack	Tool Box	Kids' BBQ Table	Storage Chest

Skills Matrix, Project Book 3

Skill	Lead-Up Exercise	Project Layout	Installing bottom track	Installing top track	Installing studs, headers, and cripples
Establishing perpendicular	■	■			
Marking door openings	■	■			
Partition layout	■	■	■	■	
Cutting 2″ or less from metal stud or track	■		■	■	■
Cutting 2″ or more from metal stud or track	■		■	■	■
Installing open corner	■		■	■	
Installing a box corner	■		■	■	
Installing open intersection	■		■		
Installing tabbed intersection	■			■	
Making split lap	■		■	■	
Splicing top track with stud	■			■	
Stud layout			■	■	
Locating top track using plumb bob	■				
Bracing beginning corner stud					■
Cutting metal headers	■				■
Setting up fixed beam pocket laser	■				
Setting up water level	■				
Establishing a level reference line using a water level	■				
Laying out and fabricating a boxed beam header	■				
Laying out a truss template*	■				
Fabricating a truss template*					
Adjusting the nose cone of a screwgun	■				
Making a butt cut using a tape measure	■				
Making a butt cut using a T-Square	■				
Making a rip cut	■				
Scribing lines parallel to a tapered edge	■				
Measuring and marking cutouts	■				
Installing ceiling drywall	■				
Installing metal corner using clinch-on tool and rubber mallet					
Attaching vinyl trim with staples					
Preparing joint compound					
Filling the mud pan					

indicates the Lead-Up Exercise where the tool, object, or task is first introduced; the next dark purple box indicates the project where the tool, object, or task first occurs

indicates when the tool, object, or task is included in the project or Lead-Up Exercise

Installing ceilings and soffits	Structural steel framing	Roof framing with trusses	Installing drywall	Drywall finishing	Doors and hardware	Acoustical ceilings	Floor tile layout and installation

Skills Matrix, Project Book 3, continued

Skill	Lead-Up Exercise	Project Layout	Installing bottom track	Installing top track	Installing studs headers and cripples
Applying the first coat					
Embedding tape and removing excess compound					
Taping inside corners and angle joints					
Spotting fasteners					
Installing paper tape on trim					
Applying second and third coats of joint compound					
Sanding compound					
Cutting a door spreader					
Installing a knockdown metal door frame					
Installing a one-piece metal door frame					
Installing hinges on a door					
Hanging a door					
Installing a latch set					
Making miter cuts on wall angle for inside corners					
Making miter cuts on wall angle for outside corners					
Installing wall angle					
Installing hanger wire					
Installing main runner control line					
Installing cross tee control line					
Cutting the main runners					
Placing the main runners					
Placing the cross tees					
Securing the grid					
Squaring the grid					
Using the Whitney punch and pop rivet tool					
Installing less than full ceiling tile					
Laying out floor tile with equal borders					
Installing floor tile					
Laying out diagonal floor tile with a border					
Installing diagonal floor tile with a border					

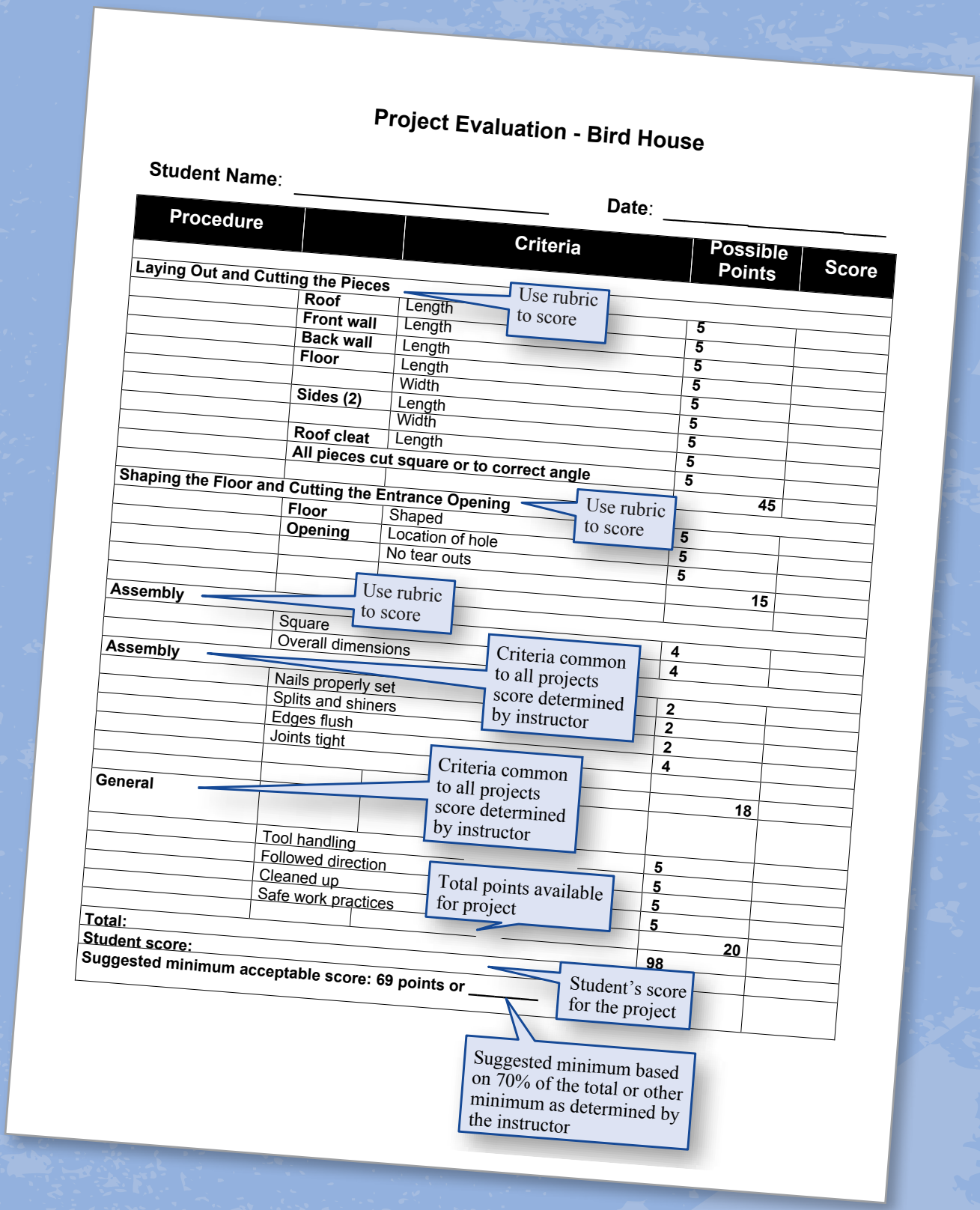
indicates the Lead-Up Exercise where the tool, object, or task is first introduced; the next dark purple box indicates the project where the tool, object, or task first occurs

indicates when the tool, object, or task is included in the project or Lead-Up Exercise

Installing ceilings and soffits	Structural steel framing	Roof framing with trusses	Installing drywall	Drywall finishing	Doors and hardware	Acoustical ceilings	Floor tile layout and installation

Project Evaluation Rubric: Bird House

Points:	5	4	3	2.5	2	1.5	1	.5	0
Criteria:									
Roof piece cut to correct length	+/- 1/16″	+/- 3/32″	+/- 1/8″		+/- 5/32″		+/- ¼″		>+/- ¼″
Front wall cut to correct length	+/- 1/16″	+/- 3/32″	+/- 1/8″		+/- 5/32″		+/- ¼″		>+/- ¼″
Back wall cut to correct length	+/- 1/16″	+/- 3/32″	+/- 1/8″		+/- 5/32″		+/- ¼″		>+/- ¼″
Floor cut to correct length	+/- 1/16″	+/- 3/32″	+/- 1/8″		+/- 5/32″		+/- ¼″		>+/- ¼″
Floor cut to correct width	+/- 1/16″	+/- 3/32″	+/- 1/8″		+/- 5/32″		+/- ¼″		>+/- ¼″
Side piece cut to correct length (2)				+/- 1/16″	+/- 3/32″	+/- 1/8″	+/- 5/32″	+/- ¼″	>+/- ¼″
Side piece cut to correct width (2)				+/- 1/16″	+/- 3/32″	+/- 1/8″	+/- 5/32″	+/- ¼″	>+/- ¼″
Roof cleat cut to correct length	+/- 1/16″	+/- 3/32″	+/- 1/8″		+/- 5/32″		+/- ¼″		>+/- ¼″
Floor shaped correctly	+/- 1/16″	+/- 1/32″	+/- 1/8″		+/- 5/32″		+/- ¼		>+/- ¼″
Hole for opening located correctly	+/- 1/16″	+/- 1/32″	+/- 1/8″		+/- 5/32″		+/- ¼		>+/- ¼″
Hole for opening drilled w/o tearout	No tearouts								Has a tear out
Pieces are cut square		All pieces square	6 pieces square		5 pieces square		4 pieces square		<4 pieces square
Bird House is square		+/- 1/16″	+/- 3/32″		+/- 1/8″		+/- 5/32″		>+/- ¼″



Project Evaluation - Bird House

Student Name: _____ **Date**: _____

Procedure		Criteria	Possible Points	Score
Laying Out and Cutting the Pieces				
	Roof	Length	5	
	Front wall	Length	5	
	Back wall	Length	5	
	Floor	Length	5	
		Width	5	
	Sides (2)	Length	5	
		Width	5	
	Roof cleat	Length	5	
	All pieces cut square or to correct angle		5	
			45	
Shaping the Floor and Cutting the Entrance Opening				
	Floor	Shaped	5	
	Opening	Location of hole	5	
		No tear outs	5	
			15	
Assembly				
		Square	4	
		Overall dimensions	4	
Assembly				
		Nails properly set	2	
		Splits and shiners	2	
		Edges flush	2	
		Joints tight	4	
			18	
General				
		Tool handling	5	
		Followed direction	5	
		Cleaned up	5	
		Safe work practices	5	
			20	
Total:			98	
Student score:				
Suggested minimum acceptable score: 69 points or _____				

Use rubric to score

Use rubric to score

Use rubric to score

Criteria common to all projects score determined by instructor

Criteria common to all projects score determined by instructor

Total points available for project

Student's score for the project

Suggested minimum based on 70% of the total or other minimum as determined by the instructor

Safety and Operation Checklist
PORTABLE CIRCULAR SAW

Student Name _____ **Instructor Name** _____

Competency	Demonstrated			Date Completed	Instructor Initial *	Student Initial **	Comments
	Yes	No	NA				
1. Wore proper safety equipment							
2. Always worked in a clean work area							
3. Used tool only as designed							
4. Ensured hands are away from cutting edge							
5. Checked that switch actuates properly							
6. Checked that blade is sharp and secure							
7. Used correct blade for the application							
8. Confirmed that blade guard is working							
9. Checked that saw cord and extension cord are out of the blade path before and during cutting							
10. Secured materials to work surface							
11. Allowed the blade to come to full speed before cutting							
12. Disconnected the power cord before replacing the blade							
13. Adjusted the blade depth so that no more than ¼″ protrudes below cut							
14. Ensured angle adjustment is locked before cutting							
15. After cut, checked that blade guard is closed							
16. Used two hands to operate saw							
17. Did not force saw into cut							
18. Did not cut materials between supports							
19. Did not leave saw plugged in while unattended							
20. Maintained body balance when cutting							
21. Did not place hands under material while cutting							
22. Changed blade properly							
23. Made a square cross cut properly							
24. Made a rip cut properly							
25. Made a bevel cut properly							
26. Made a miter cut properly							
27. Made a compound miter cut properly							
28. Other							

*- Instructor initial indicates that both students and instructor demonstrated competencies for proper and safe use of this tool.
** - Student initial indicates that both students and instructor demonstrated competencies for proper and safe use of this tool.

acknowledgments

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Let us start with the members. Without their commitment to excellence, their understanding of the importance of training, and their continued contributions and support, this program would be meaningless. It is their contributions that make this program possible, and this program serves their interests as well as the interests of future workers in the industry.

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Ordering Information

Your local UBC Outreach Specialist will handle orders and re-orders for materials as well as requests for UBC Certificate of Completion. **Information may also be found at www.carpenters.org**

Our #1 priority is helping UBC members develop the skills and productivity that make them the best in the industry.

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The UBC's 250 training centers and more than 1,500 full-time instructors throughout North America provide UBC members with access to the most comprehensive state-of-the-art training in the industry.

By participating in these training programs UBC members continue a proud history of skill and craftsmanship. They also demonstrate their own personal commitment to excellence.

The leadership of UBC applauds this commitment and joins all UBC members in meeting the challenges of a tough, competitive industry.

MILLWRIGHT

FLOOR LAYER

CARPENTER

CABINET MAKER
MILL CABINET

RESIDENTIAL
CARPENTER

LATHER

PILE DRIVER

INTERIOR SYSTEMS
CARPENTER

The Carpenters International Training Fund (CITF) is dedicated to job-training and certification programs for UBC membership.

CARPENTERS INTERNATIONAL TRAINING FUND

6801 Placid Street, Las Vegas, Nevada 89119
www.carpenters.org/training

UBC Headquarters
Washington, DC