

Finish Flooring

Section 34.1

Wood Flooring Basics

Section 34.2

Installing Hardwood Flooring

Section 34.3

Vinyl, Tile, & Carpet Flooring

Chapter Objectives

After completing this chapter, you will be able to:

- **List** the three most common forms of wood flooring.
- **Describe** the major kinds of wood used in flooring and how they are graded.
- **Explain** how to install wood strip and parquet flooring.
- **Estimate** the quantity of resilient flooring needed for a room.
- **Perform** the basic methods of installing ceramic tile and carpeting.



Discuss the Photo

Finish Flooring Installation of finish flooring is the last large construction operation in a house. *What properties do you think finish flooring should have?*



Writing Activity: Research and Summarize

Research jobs in the flooring industry in your community. Make a chart of the jobs, their average pay and working conditions, and the training required for each. Then summarize which job interests you most, and why.



Before You Read Preview

Finish flooring is the topmost surface of a floor system and the last large construction operation in a house. Choose a content vocabulary or academic vocabulary word that is new to you. When you find it in the text, write down the definition.

Content Vocabulary

- plank
- parquet
- acclimation
- wear layer
- mastic
- sleeper
- volatile organic compounds (VOCs)
- underlayment
- bisque
- backerboard
- grout

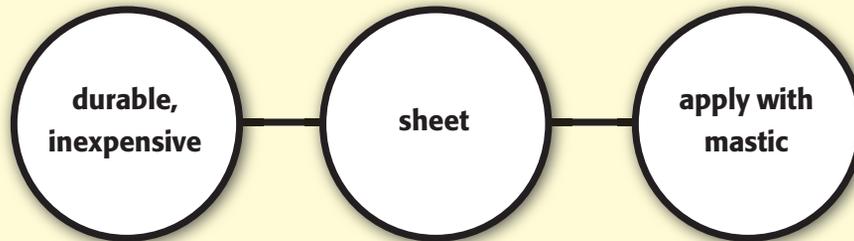
Academic Vocabulary

You will find these words in your reading and on your tests. Use the academic vocabulary glossary to look up their definitions if necessary.

- uniform
- eliminate
- inclines

Graphic Organizer

As you read, use a cluster diagram like the one shown to organize information, adding circles as needed.



Go to glencoe.com for this book's OLC for a downloadable version of this graphic organizer.

Academic Standards



Mathematics

Number and Operations: Compute fluently and make reasonable estimates (NCTM)

Problem Solving: Solve problems that arise in mathematics and other contexts (NCTM)

Geometry: Use visualization, spatial reasoning, and geometric modeling to solve problems (NCTM)



English Language Arts

Use written language to communicate effectively (NCTE 4)

Conduct research and gather, evaluate, and synthesize data to communicate discoveries (NCTE 7)



Science

History and Nature of Science: Nature of scientific knowledge (NSES)

Science in Personal and Social Perspectives: Environmental quality (NSES)

Physical Science: Chemical reactions (NSES)

Industry Standards

Floor Systems

NCTE National Council of Teachers of English

NCTM National Council of Teachers of Mathematics

NSES National Science Education Standards

Wood Flooring Basics

Solid-Wood Flooring

What is finish flooring?

Finish flooring is the topmost surface of a floor system. It should be durable and easy to clean. It should resist wear and be comfortable and attractive as well. Finish flooring is installed after the plumbing, electrical wiring, and plastering are completed, but before the final interior trim work. It is the last large construction operation in a house.

Solid wood is the most common wood flooring material. Hardwoods are particularly popular because they resist wear. Strips or planks of solid wood are fastened to the subfloor with nails, staples, or adhesives to create different effects. The wood is most often applied in rows parallel to the long dimension of a room. You can also install wood flooring in other patterns. For example, you can lay it diagonally, with a mitered or stacked border. You can make an especially decorative border by using contrasting woods. **Figure 34-1** shows three common wood flooring patterns.

Solid-wood lengths of flooring generally have tongue-and-groove edges and ends that interlock with adjoining lengths. This flooring is most often installed by blind nailing it to the subfloor. Blind nailing is the process of driving fasteners at an angle through the edge of each board, so that each fastener is concealed by the next board.

Forms of Solid-Wood Flooring

Solid-wood flooring is available in three basic forms, or types.

Strips Strip flooring consists of narrow strips of wood, generally $3\frac{1}{4}$ " wide or less. Strips are the most widely used type of solid-wood flooring. Many wood species are available in this form. You will learn how to install strips later in the chapter.

Planks A **plank** is any solid-wood board that is at least 3" wide. Plank flooring has been popular for centuries. Modern plank flooring comes in various widths. The edges of the planks may be beveled slightly to look like hand-hewn planks. You can simulate the wood pegs that fastened old plank floors by

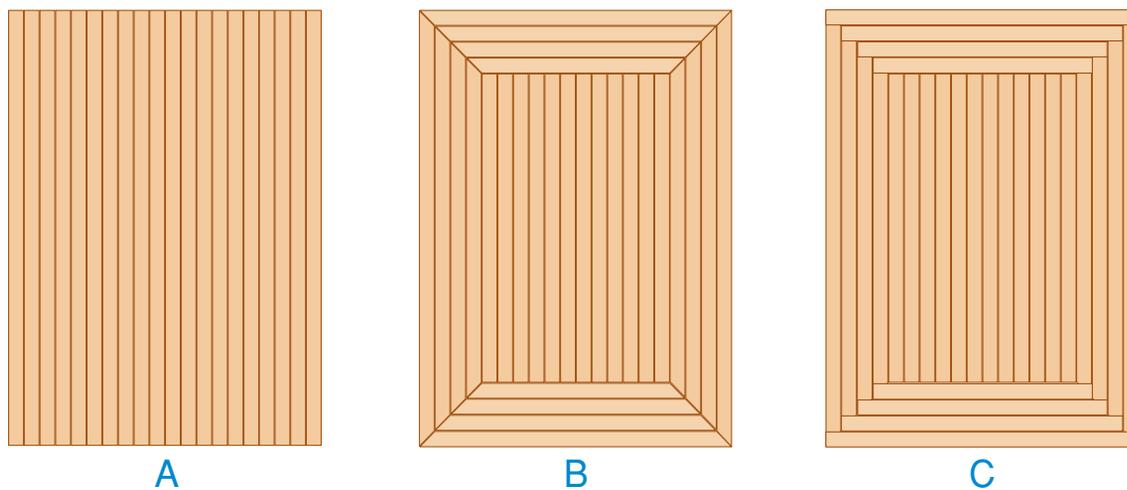


Figure 34-1 Wood Flooring Patterns

Creative Patterns Three wood flooring patterns: **A.** Standard installation **B.** Mitered border **C.** Stacked border



Figure 34-2 Plank Floor
Traditional Flooring Wood planks are fastened with screws, which are then covered with plugs.



Figure 34-3 Parquet Flooring
Decorative Options Parquet flooring comes in a variety of geometric patterns.

gluing wood plugs into shallow holes in the ends of the planks, as shown in **Figure 34-2**.

Parquet **Parquet** (par-KAY) is to any flooring assembled with small, precisely cut pieces of wood in a geometric pattern, such as squares, rectangles, and herringbone patterns. **Figure 34-3** shows a typical parquet pattern. Parquet floors have been used since the fourteenth century.

Parquet flooring can be made from individual pieces, but prefabricated parquet tiles are more common and much easier to install. Parquet tiles are made by gluing individual pieces of solid wood to a plywood backing, then machining the edges of the tiles to form tongues or grooves. You can use parquet for a whole floor or as a decorative border around other forms of wood flooring.

Unfinished and Prefinished Flooring

A protective finish makes wood flooring durable and easy to clean. Unfinished flooring must be finished after installation, which is a time-consuming process. Many manufacturers now produce wood flooring that is prefinished at the factory. Prefinished floors do not come in as many colors and finishes as floors finished on site. However, prefinished flooring has a **uniform** finish and is ready for use immediately after installation. It also benefits from *curing* methods and finish types that are possible only in a factory.

Prefinished wood flooring is easier to install than unfinished wood flooring. However, estimating how much you will need requires greater care. Special trim such as thresholds, border strips around fireplace

hearths, and transition pieces must all be prefinished to match. Make sure to order these pieces with the rest of the flooring so that all pieces match in color and finish exactly.

Grades of Wood Flooring

Through trade associations, the major North American producers of solid-wood flooring have adopted grading rules for various species of wood. Every bundle of flooring identified by this grading system is guaranteed to meet certain standards of quality and uniformity.

Oak Oak is graded according to its appearance and how sawing methods reveal the grain during manufacturing. The three main sawing methods used on oak are:

Plain sawn The end grain of the board runs from 0° (parallel) to 45° to the board's face, or surface.

Quarter sawn The end grain runs between 60° and 90° (perpendicular) to the board's face.

Rift sawn The end grain runs between 30° and 60° to the board's face.

Grading for appearance of oak is based on the top, or best, face of a board. It does not consider the board's strength. Red oak and white oak have five appearance grades:

Clear This wood has the best appearance and the most uniform color. It is mostly *heartwood*. Limited small character marks are permitted.

Select The face may contain color variations typical of heartwood and sapwood. It can include slight milling imperfections, small tight knots, and a modest number of slightly open checks.

No. 1 Common Prominent variations of color are allowed, as well as broken knots less than ½" wide and other imperfections.

No. 2 Common A greater number and degree of natural and manufacturing imperfections are allowed. This grade is used for a utility floor or where character marks and contrasting appearance are acceptable.

Shorts Pieces 9" to 18" long are bundled together in either of two subgrades: No. 1 Common & Better and No. 2 Common. These pieces can be used to fill in rows to avoid cutting longer pieces.

Maple, Beech, and Birch Maple, beech, and birch are governed by almost identical grading rules. In order of quality, these grades are First, Second, Third, Second & Better, and Third & Better. Neither sapwood nor varying natural color is considered a defect.

Each of these woods is also available in a special grade selected for uniformity of color. For maple flooring, this is First Grade White. It is the finest grade of maple flooring. For beech and birch flooring, the special grade is First Grade Red.

Sizes of Strip Flooring

Oak strip flooring is commonly ½" or ¾" thick. Maple, beech, and birch flooring comes in thicknesses of ¾", 25/32", and 33/32". Widths for all species range from 1½" to 3¼". Flooring 3/8" thick is sometimes available by special order, but only in widths up to 2".

Strip flooring is packaged in bundles. A bundle contains strips of various lengths, positioned end to end. Lengths in a bundle vary, but average lengths are specified for each grade. For example, clear oak averages 60" long. Select oak averages 48" long, and No. 1 common oak averages 33" long.



Analyze What imperfections cause oak flooring to be assigned a lower grade?

Moisture Content and Acclimation

Moisture content greatly affects the performance of wood flooring. Hardwood flooring is kiln-dried at the factory to reduce its moisture content. After flooring is installed, **acclimation** occurs: its moisture content goes up or down to match the moisture level of the building. When wood absorbs moisture, it expands. When wood dries out, it contracts. To permit acclimation, flooring should always be stored in the building in which it will be installed for at least four or five days before being laid. This will prevent problems caused by wood movement that occurs after the flooring is installed. One common problem is the appearance of open cracks between floor boards. **Table 34-1** shows how much a 2¼"-wide board will expand when installed in a building that has higher humidity than it does.

Humidity in the subfloor can also cause the underside of the flooring to expand. This causes boards to cup slightly. If the boards are then sanded flat, they will become crowned when the flooring later dries out, as shown in **Figure 34-4**. For more on moisture and wood behavior, see Chapter 16, "Wood as a Building Material."

Moisture Differential	Width Increase (approximate)
1%	1/128"
3%	1/64"
5%	1/32"
7%	3/64"
9%	1/16"
18%	1/8"

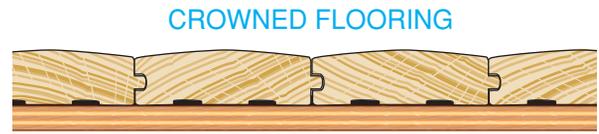


Figure 34-4 Cupped and Crowned Flooring
Moisture Damage Solid-wood flooring boards can become cupped or crowned, creating an uneven surface.

Storage and Handling of Wood Flooring Always protect wood flooring from the elements during storage and delivery. This helps to prevent excessive shrinkage or expansion, which could cause the floor to crack or buckle after it has been laid. Storage in a garage at the job site is not sufficient. While a garage protects the flooring from rain, it does not protect it from extremely dry or humid air. Take the following precautions as well:

- Never unload wood flooring when it is raining or snowing. Cover wood flooring with a tarp in foggy or damp conditions.
- Store wood flooring only in well-ventilated and weather-tight buildings.
- Store and install wood flooring in dry buildings only. Wait until the plaster and concrete work have given off most of their moisture.
- Heat the building to 70°F (21°C) before installing flooring.
- Never store wood flooring directly in contact with a concrete floor.



Summarize How does moisture affect wood?

Engineered-Wood Flooring

How are wood layers arranged?

Engineered-wood flooring is made of three, five, seven, or more layers of wood veneer or thin wood strips bonded together much like plywood. Unlike plywood, however, the top layer of engineered flooring is $\frac{1}{8}$ " to nearly $\frac{1}{4}$ " thick, as shown in **Figure 34-5**. This top layer is called the **wear layer**.

Engineered-wood strips and planks look like solid wood flooring after the flooring has been installed. However, the individual pieces of flooring are thinner, usually less than $\frac{1}{2}$ " thick. The wood layers are arranged with their grains at right angles to each other, which makes the planks extremely stable. Engineered-wood flooring is less likely than solid-wood flooring to be affected by excess moisture. Engineered-wood flooring can also be sanded and refinished like solid-wood flooring. However, the flooring cannot be sanded as many times as solid wood flooring because the wear layer is relatively thin.

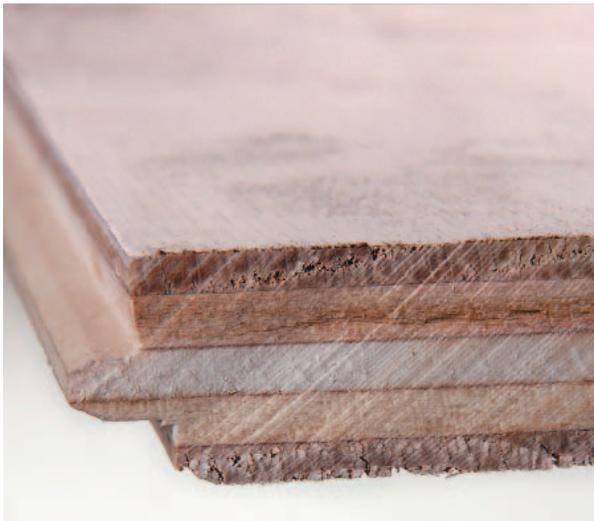


Figure 34-5 An Engineered-Wood Plank
Strength Through Layers Cross section of an engineered-wood flooring plank.

Installing Engineered-Wood Flooring

There are three basic installation methods for engineered-wood flooring. Always carefully follow the manufacturer's recommended installation methods to ensure coverage by any warranty on the product. It is especially important to use the exact type of adhesive called for in the installation instructions. Problems caused by incorrect adhesive usually do not show up until well after the flooring has been installed.

Nail-Down Method Blind nail or blind staple the planks or strips to the wood subfloor, just as you would do with solid wood flooring.

Floating Method Secure the lengths of flooring together with aliphatic resin (yellow) glue. Then float or lay the floor on a thin sheet of closed-cell foam padding.

Glue-Down Method Glue each length of flooring directly to the subfloor with mastic. **Mastic** is a thick, premixed adhesive that you spread with a notched trowel. You can sometimes use this technique to apply engineered-wood flooring directly to a concrete subfloor.



REGIONAL CONCERNS

Radiant Floor Heating This technique is popular in some parts of the United States. Engineered wood flooring and parquet flooring can be installed successfully over radiant systems. However, to improve results with solid wood flooring consider these guidelines. Use dimensionally stable woods such as American cherry, American walnut, mesquite, and teak, among others. Keep boards to 3" width or less. Use quartersawn stock if possible. Before installation, make sure the wood is at a moisture content suitable for the climate.



Go to glencoe.com for this book's OLC for more information about regional concerns.

 **After You Read: Self-Check**

1. What are the two main factors that determine the grade of an oak flooring strip?
2. Which woods are graded using the same system?
3. What happens if wood flooring absorbs moisture from the subfloor?
4. Compare and contrast solid wood flooring and engineered-wood flooring.

 **Academic Integration: Mathematics**

5. **Estimate a Mitered Border** You are installing a red oak floor with a mitered border. The room is $9' \times 12'$, and the mitered border is 1.5' wide. How many square feet is the total border area?

Math Concept A mitered border is the area of the space between two concentric squares. First, calculate the area of the entire room. Then subtract 3' from both the width and the length to account for the border, and multiply these smaller numbers to discover the square footage inside the border. The difference between the larger and the smaller square footage represents the border area.

 Go to glencoe.com for this book's OLC to check your answers.

Section

34.2

Installing Hardwood Flooring

Installing Hardwood Strip Flooring

How many people usually install wood flooring?

In the past, hardwood flooring was usually installed by carpenters. Today, it is frequently installed by flooring subcontractors. Each type of wood flooring requires a different method of installation.

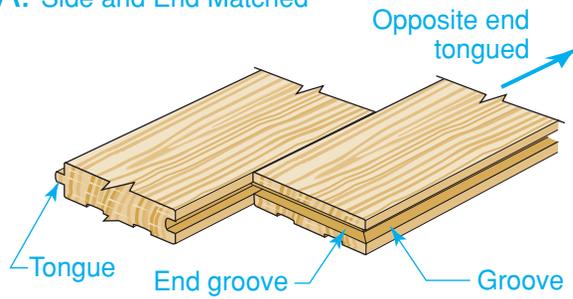
Hardwood strip flooring is the most common type of wood flooring. Most hardwood floors are created with strips of equal width. However, you can also create an attractive design by using strips of different widths,

colors, or patterns. Most hardwood strip flooring today has tongue-and-groove edges. Each piece slides in snugly against the next one, as shown in **Figure 34-6** on page 978.

Fastening Techniques

Proper nailing of floorboards is essential for safety and to prevent squeaks. Tongue-and-groove flooring is blind nailed, except for the first one or two courses (rows). These courses are difficult to blind nail because they are close to the wall, so they are face-nailed instead. To blind nail, drive the nails through the edge of the board at an angle of 45° to 50° at the point where the tongue leaves the shoulder.

A. Side and End Matched



B. Side Matched

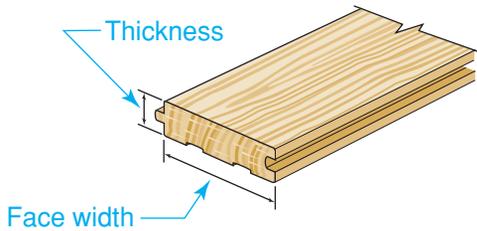


Figure 34-6 Strip Flooring

Tongue and Groove Edges Two methods of installing strip flooring: **A.** Side and end matched. **B.** Side matched.



Figure 34-7 Using a Pneumatic Nailer

Precision Fastening A lip on the nailer's base plate enables it to be quickly positioned at a precise location. Note that the installer's hammer has two different faces.

Wood flooring was once blind nailed by hand. Today, most installers use a pneumatic power nailer to make sure that nails are placed consistently. The installer slides the nailer along the tongue of a board and strikes the tool's plunger with a mallet, as shown in **Figure 34-7**. This pushes the board tightly into place and drives a nail at an angle through the tongue of the board.

Types of Fasteners

The three most common types of flooring nails are shown in **Figure 34-8** on the next page. Always follow the nailing recommendations of the flooring manufacturer. As a general rule, use 7d or 8d threaded (screw) nails or cut steel nails for flooring $\frac{25}{32}$ " thick and $1\frac{1}{2}$ " or more wide. If you use steel wire flooring nails, they should be 8d and preferably cement coated.

Preparing the Wood Subfloor

Strip flooring is usually laid over a plywood subfloor. Before you install, examine the subfloor carefully and correct any defects. Drive down raised nails and scrape any bits of plaster, joint compound, or dried adhesives off the subfloor. Then sweep the area thoroughly.

Next, staple 15 lb. asphalt building paper to the subfloor to protect the flooring from moisture that might come from below and to help prevent squeaks. Overlap the seams by 2" to 4". Nail the flooring boards into joists rather than into the floor sheathing.

Planning the Installation

Make sure to lay strip flooring at right angles to the floor joists. Plan the work so that the flooring flows from one room to another, and be sure to consider closets and hallways.

If floor coverings in adjoining rooms are different, end the flooring of each room at the center of a doorway. What if different floorings meet where there is no door? Lay the wood floor through the opening to a point even with the wall line of the adjacent room.



Figure 34-8 Flooring Nails
The Right Nail for the Job Common types of flooring nails: **A.** Barbed **B.** Screw **C.** Cut steel

Laying Strip Flooring

Many walls are not perfectly true (aligned), even in new construction. To ensure a straight course, stretch a string the length of the room between two nails placed 8" from a side wall. Line up the first courses at a uniform distance from the string rather than from the wall itself, as shown in **Figure 34-9**. Some installers snap a chalk line on the floor instead of measuring to a string.

After lining up the first courses, place a long piece of flooring with the grooved edge $\frac{1}{2}$ " to $\frac{5}{8}$ " from a side wall and the grooved end nearest an end wall. The space allows the flooring to expand without binding against the wall. You will hide the space later with baseboards or shoe molding.

Face-nail the board into place, as shown in **Figure 34-10**. Maintain the same distance from the guide string as you install each board in the first course. Drive one nail at each joist crossing, or every 10" to 12" if the joists run parallel to the flooring. Fit the groove end of each board over the tongue end of the previous board.

Depending on the width of the flooring, you may have to face-nail the second course as well. However, you can install subsequent courses with a power nailer or pneumatic nailer. Hold a board in place against the previous course and use the nailer to blind nail through the board's tongue. Slide the device along the board's tongue, nailing at

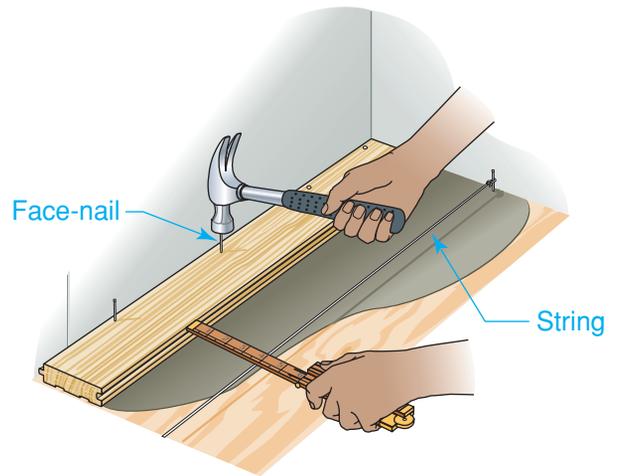


Figure 34-9 Aligning the First Course
Align and Fasten To line up the first course of flooring, stretch a string or snap a chalk line about 8" from the wall. Then face-nail the first course.

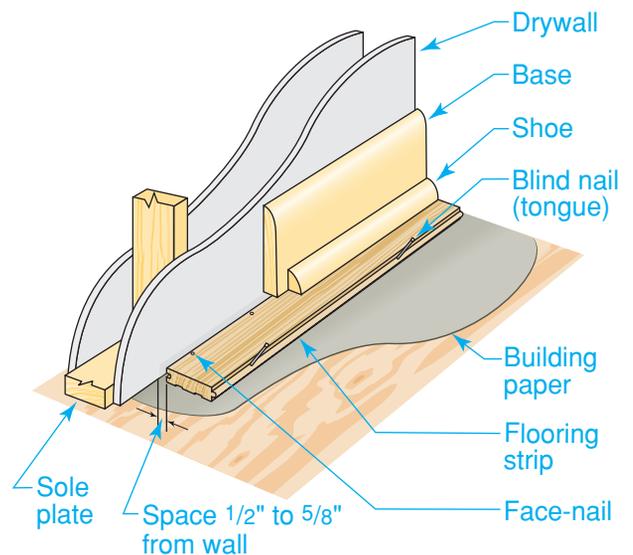


Figure 34-10 Cross Section of Wall and Floor

Where Floor Meets Wall This cross section shows the first piece of strip flooring nailed in place. Note: With lath and plaster walls, sometimes the plaster ground (guide used when installing plaster) is kept about $\frac{7}{8}$ " above the subfloor. The edge of the first piece of strip flooring is set about even with the wall line. The flooring is then allowed to expand under the plaster ground. *Why is it important to leave a space of $\frac{1}{2}$ " to $\frac{5}{8}$ " between the grooved edge and the wall?*

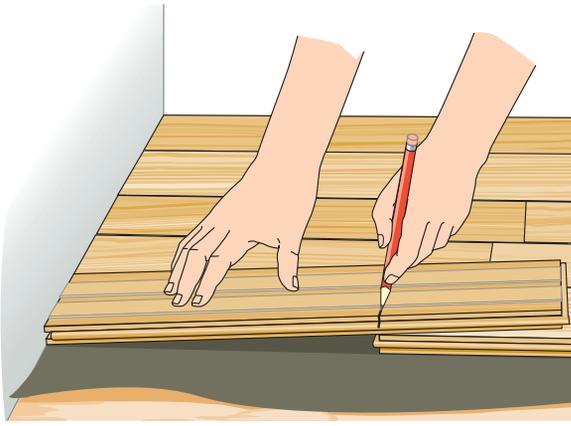


Figure 34-11 Marking Flooring to Fit
Measuring Precisely Fitting a piece of flooring to the remaining space in a course.

each joist location. For best results, stand on the flooring strip with your toes in line with the outer edge, and strike the nailer from a stooped position.

If you cannot easily find a length of flooring to fit the remaining space in a course, cut one to approximate length. Position the piece in place with the groove end touching the wall, as shown in **Figure 34-11**, and draw a line where it should be cut. Make sure to cut off the tongue end of the piece. You will need the groove end to join with the tongue end of the previous piece.

Racking the Floor Take care to stagger the end joints of the flooring pieces so that joints are not grouped closely together. A joint should be 6" or more from a joint in an adjacent course, as shown in **Figure 34-12**. Arranging the strips in this way is called racking.

Two people usually work together to install a wood floor. One racks the pieces and cuts end boards to length. The other fits the racked boards together and nails them.



Analyze Why should you align flooring courses to a string and not a wall?

Installing Closing Boards

When you reach the opposite side of the room, you will find that there is no space between the wall and the flooring

Builder's Tip



ALIGN LIKE A PRO Indicate the location of floor joists by marking the base of the walls before laying the building paper. Then snap chalk lines on the paper to indicate where the joists are. Use these chalk lines to guide you as you nail in the strip flooring.

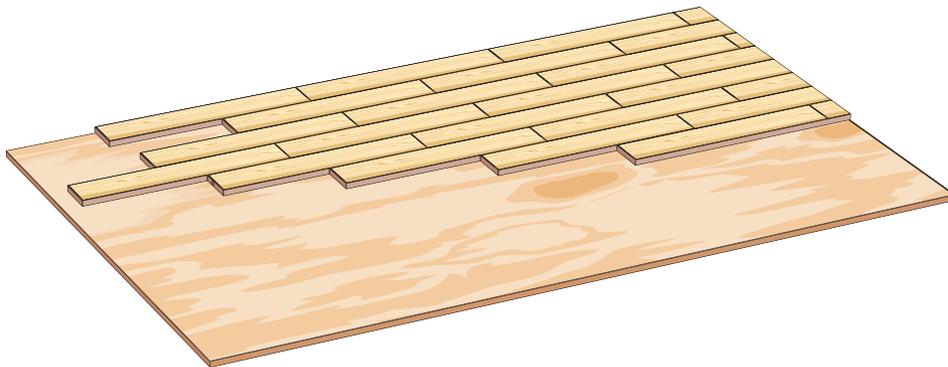


Figure 34-12 Racking the Floor
Planning for Top Appearance It is important to lay out strip flooring so that the joints are staggered. An assistant usually works ahead of the installer to rack the floor, which allows the installer to concentrate on nailing.

to allow you to blind nail the last two or three courses. Place the last few courses in position. You may need to rip the last course to width on a table saw. Then face-nail the courses while pulling the flooring up tightly by exerting pressure against it with a prybar or a piece of scrap.

When prying the pieces with the crowbar or scrap length of flooring, put pieces of scrap stock against the wall to protect the wall surface. The scrap should span several wall studs to prevent damage to the wall. Remember to leave a space for expansion. If the last course is narrow, drill holes for the nails to prevent splitting.

If flooring continues into the adjacent room, fit floorboards around openings as needed. You can continue the same orientation of tongues and grooves unless you need to make a change for convenience. Just slip a spline, also called a slip tongue, into place to connect the grooves of two boards.



Explain Why should you face-nail the last courses in a room instead of blind nailing them?

Installing Wood Flooring over Concrete

Concrete gives off moisture as it cures, which can be harmful to wood flooring. To prevent problems, allow the slab to cure for at least two months. Then test it for excessive moisture. Tape a square foot of clear polyethylene to the slab. Seal the edges with duct tape and leave the plastic in place for twenty-four hours. Then check the underside of the plastic for signs of moisture. If there are no water droplets or moisture fog beneath the plastic, the slab is dry enough for the installation of a wood floor. Hardwood flooring can be installed over concrete slabs on grade or above grade. However, it should not be installed over concrete that is below grade, as on a basement floor.

You can use two methods to install strip flooring over concrete: flooring over sleepers and flooring over plywood. However, before you begin either method, must install a vapor barrier.

Vapor Barriers Even small amounts of moisture can harm wood flooring. Use asphalt felt building paper or polyethylene plastic as a vapor barrier between the concrete and the wood.

Asphalt Felt To use asphalt felt, sweep the slab clean. Then apply cut-back asphalt mastic to the slab with a notched trowel. Cut-back mastic has been thinned slightly with a solvent. About two hours after spreading the mastic, roll out strips of 15-lb. asphalt felt over the entire slab. Lap the edges 4". Spread a second layer of mastic over the felt. Then add a second layer of felt on top of that. Both layers of felt should run in the same direction, but the rows should be offset.

Polyethylene Plastic To use a *polyethylene* plastic vapor barrier, sweep the slab clean. Then spread cut-back mastic over the slab with a notched trowel. After the mastic has dried, spread 4-mil or 6-mil polyethylene over the slab. Use a weighted floor roller to press it into the mastic.

A yellow banner with a red hard hat and a hammer icon, and the text "JOB SAFETY" in bold black letters.

CREATE SAFE LEVERAGE Never use chisels or screwdrivers to lever floorboards into place. These tools are not designed to take lateral loads and could snap suddenly under stress. Instead, use a prybar or similar device to pry with. Some flooring installers temporarily screw a wood block to the floor and use that to pry against.

Go to glencoe.com for this book's OLC for more on job safety.

Builder's Tip

ALIGN LIKE A PRO Plan carefully to get a good fit around a door frame. First, lay the board flush against the door frame. Then, measure the gap between the flooring strip that is installed nearest to the door and the groove edge of the flooring strip you will install flush with the door. Draw straight lines on the flooring to indicate where the door frame begins and ends. Draw a straight line connecting the ends of these lines. Use a jigsaw to cut the flooring along the lines.



Installing Wood Flooring Over Sleepers and Plywood

Wood flooring should not be installed directly on concrete. Instead, use either a plywood or a sleeper base. A **sleeper** is a length of lumber that supports wood flooring over concrete. Choose sleepers that are preservative-treated. See the Step-by-Step Application on the next page for instructions on installing wood flooring over sleepers.

Installing Wood Flooring Over Plywood First prepare the surface with a vapor (moisture) barrier as described on page 981. Lay $\frac{3}{4}$ " exterior grade plywood over the vapor barrier, staggering the end joints by 4". When all the plywood is in place, fasten it to the slab with concrete nails or powder-actuated fasteners, as shown in **Figure 34-13**. Use at least nine nails per panel. To ensure that the panels stay flat, nail them at the center first. Then work toward the edges. To allow for expansion, leave a gap of about $\frac{3}{8}$ " between each panel and a gap of $\frac{3}{4}$ " at the walls.

Install the strip flooring as you would over a standard plywood subfloor. Nails should be slightly less than $1\frac{1}{2}$ " long.

Installing Parquet Flooring

What is the first step in installing parquet flooring?

Like hardwood strip flooring, parquet flooring can be installed unfinished or prefinished. Unlike hardwood strip flooring, parquet flooring does not require blind nailing. Instead, it is attached to the subfloor using an adhesive paste called mastic. In this respect, planning and installing a parquet floor is like planning and installing a vinyl or ceramic tile floor.

Read and follow the manufacturer's installation instructions, which are usually boxed with the flooring. Not following these instructions may void any warranty that applies to the product or its finish. Always

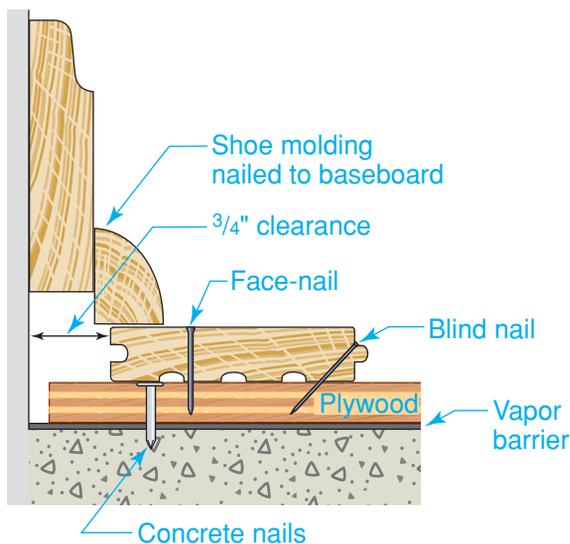


Figure 34-13 Fitting Flooring over Plywood Using Plywood Plywood can also serve as a base for installing wood flooring over concrete. Note the use of concrete nails.

check with the manufacturer if the conditions on the job site are not covered in the instructions. In general, however, you can apply parquet flooring to the same types of wood subfloors as hardwood strip flooring. Some parquet installers install $\frac{1}{4}$ " luan underlayment plywood over the existing wood subfloor. This provides an unusually smooth surface and increases adhesion. Some types of parquet flooring can be adhered directly to a concrete slab floor. The slab must be tested in several locations first to ensure that it is dry. Slabs less than 60 days old are typically too wet to install flooring.

Installing Parquet Tiles

The process for installing parquet tiles is similar to the process for installing a vinyl tile floor, which is discussed in **Section 34.3**.

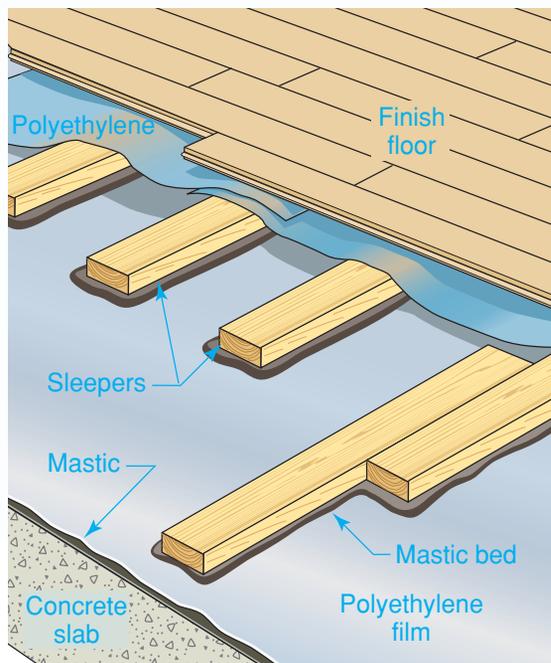
First, measure the room and establish layout lines on the subfloor to guide the installation, as shown for vinyl tile in Figure 34-18 on page 989.

Attach individual tiles or sections of parquet flooring to the subfloor with mastic. Apply the adhesive to the subfloor and spread it with a notched trowel. Choose the size and shape of the notch based on the type of flooring and the brand of mastic. The configuration of the notch is designed to maximize coverage and ensure a uniform thickness of mastic.

Apply mastic to one small area of the floor at a time. This prevents the adhesive from “skinning over,” or partially drying, which reduces its effectiveness. The temperature and humidity in the room affect how long the adhesive takes to skin over. The adhesive

Step-by-Step Application

Installing Strip Flooring over Sleepers Both sleepers and plywood can serve as a nailing base for installing wood flooring over concrete. Make sure to install a vapor barrier before you begin the installation.



Step 1 Snap chalk lines 12" apart at right angles to the direction the flooring will run. Cover the lines with rivers of asphalt mastic about 4" wide.

Step 2 Embed 2" × 4" sleepers in the mastic. Lap the ends of the sleepers at least 4". Leave $\frac{3}{4}$ " between the ends of sleepers and the walls. You do not need to nail the sleepers in place.

Step 3 After the mastic has cured, spread a 6-mil polyethylene vapor barrier over the sleepers. Lap all edges. This adds a layer of moisture protection to the system.

Step 4 Install the strip flooring at right angles to the sleepers. Adjoining courses of flooring should not have joints on the same sleeper. Where a flooring board runs over a lapped sleeper joint, nail the board into both sleepers. Provide at least $\frac{1}{2}$ " of clearance between flooring and the walls to allow for expansion.



Go to glencoe.com for this book's OLC for additional step-by-step procedures, applications, and certification practice.

manufacturer will indicate open time on the product packaging. “Open” time is the amount of time the adhesive can be used before it starts to skin over. Mastic that has skinned over should be scraped off the subfloor and discarded.

Lay tiles in the mastic immediately after spreading it. Push the tile into firm contact with the mastic and seat it further by tapping it with a rubber-faced mallet, as shown in **Figure 34-14**. As you work, clean off any mastic that squeezes up between the tiles using a soft cloth moistened in the recommended solvent.

After you cover an area of mastic with tiles, spread mastic over an adjacent area and lay another group of tiles. Cut tiles as needed to fit at the end of each row. Leave ½" of clearance between tiles and any wall or obstruction. To avoid disturbing recently set flooring, do not walk on it for at least twelve hours. Some installers recommend waiting for at least 36 hours.



Connect What should you do if the special conditions at the job site are not covered in the manufacturer's instructions?



Figure 34-14 Installing Parquet Tiles
Working with Mastic Tap each tile with a mallet to ensure a good connection with the mastic. These unfinished parquet tiles have shaped notches that help to maintain proper alignment.

Applying a Floor Finish

What are the various types of finishes?

After unfinished strip flooring or parquet flooring is in place, a finish must be applied. Finishing is a time-consuming process that stretches over several days.

Sanding

Unfinished hardwood flooring is smoothly surfaced by the manufacturer, but scratches and other marks caused by handling usually become visible after the floor has been laid. You may also see slight differences in the height of adjacent boards. This difference is called overwood. You must **eliminate** all of these imperfections. You can remove imperfections with a drum-type floor sander, shown in **Figure 34-15**, or a newer type of floor sander with random-orbit sanding pads. You may also need a smaller, handheld electric sander called an edger, which is designed to reach in corners and other small spaces. Finishing a new floor calls for several sandings, which are called cuts. Use coarse sandpaper for the first cut and progressively finer sandpaper for subsequent cuts.

When using a drum sander, make overlapping passes along the wood grain, not across the grain. Use the edger to sand close to the walls, where the drum sander cannot reach. You may also need to sand or scrape by hand if there are obstructions that interfere with the edger. After sanding, remove all dust with a vacuum.

Filling

Paste wood filler is recommended to fill the tiny surface crevices in oak and other hardwoods that have large pores. It gives the floor the perfectly smooth surface required for a lustrous appearance. Wood filler may be colorless or it may contain pigment to bring out the grain of the wood. Apply filler either before the last sanding cut or after staining. Let it dry for 24 hours before moving on to the next step.



Figure 34-15 Sanding a Hardwood Floor
Perfecting the Surface Although flooring is sanded at the mill, additional sanding with a drum sander or commercial random-orbit sander is required after the floor is laid. *Why should you sand along the wood grain, rather than across the wood grain?*

Staining

Stains are used to give the floor a color different from the color of the natural wood. Apply the first coat of stain or other finish on the same day as the last sanding. This prevents the grain from becoming raised, which roughens the surface slightly. Apply stain evenly, preferably with a high-quality brush that is 3" or 4" wide, and before applying other finishes.



Summarize In what order should you perform the following finishing tasks: stain, sand, fill?

Types of Finishes

In recent years, modern synthetic finishes have replaced many traditional finishes. For example, polyurethane has replaced varnish. Lacquer is another finish that is not used as much as it once was. An ideal finish is attractive and durable, is easy to apply and maintain, safe to apply, and can be retouched in worn spots without looking patchy.

However, no finish has all these characteristics. Some finishes are more durable than others. Some cannot be retouched easily. Others are so toxic prior to curing that they should be applied only by specialists. Choose a finish based on the characteristics that are most important for the situation.

In some areas, particularly large cities, environmental restrictions limit the use of floor finishes containing liquid solvents made from **volatile organic compounds (VOCs)**, a type of chemical that evaporates into the air. The purpose of a solvent is to dissolve various ingredients in the floor finish. When the floor finish is stirred, the ingredients are evenly distributed in the solvent. This ensures that the finish can be applied evenly. After the finish has been installed, the solvent evaporates. When this happens, the VOCs are released into the air. They react with sunlight and with other materials in the air to form ozone. Ozone is a major air pollutant. Many floor finishes have therefore been reformulated to reduce or eliminate VOCs.

Penetrating Finishes Penetrating finishes differ from other finishes in one important respect. Rather than forming a surface coating, the finish penetrates the wood fibers, becoming a part of the wood itself. It wears only as the wood wears and does not chip or scratch. It does not provide as shiny a surface as other finishes, but it can be easily retouched. Refinishing worn spots does not create a patched appearance. Penetrating finishes are available either clear or slightly tinted with color.



Figure 34-16 Applying a Penetrating Finish
Working Safely with Chemicals Penetrating finishes are tough and wear resistant and can be applied easily with long- or short-handled tools. Safe working practices are important. *What safety equipment is this worker wearing, and why?*

You can use a squeegee, a wool applicator, or a wide brush to apply penetrating finishes. The installer in **Figure 34-16** is using a handheld brush. Wipe off excess material with clean cloths or a rubber squeegee. For best results, buff the floor with No. 2 steel wool. You can also use penetrating finishes as a base for a surface finish such as varnish.

Urethane Finishes Several floor finishes are included in the general category of urethanes. These are durable finishes that cure to a hard film. They are fairly resistant to moisture.

Moisture-cured urethanes are the hardest and most moisture resistant. They offer a glossy look that resists abrasion. They cure by reacting with humidity in the air. The proper amount of humidity is critical, however. This makes these finishes difficult to apply, except by professional floor finishers.

Oil-modified urethanes, sometimes called polyurethanes, are easier to apply than moisture-cured urethanes. They provide a durable coating with a gloss, semigloss, or

JOB SAFETY

WORK SAFELY WITH CHEMICALS The chemicals and solvents that make some synthetic finishes very durable are also hazardous to your health. Always follow the manufacturer's instructions carefully. In general, these instructions call for plenty of ventilation and the use of a respirator. Fit your respirator with filter cartridges suitable for the specific finish you are using.

Go to glencoe.com for this book's OLC for more on job safety.

matte finish. They are widely available and frequently used.

Water-based urethanes are relatively new. The solid portions of the product are suspended primarily in water, rather than in a volatile *solvent*. Water-based urethanes are durable but require more coats to build up a thickness that compares to other urethanes.

Natural Finishes Varnishes were once widely used to finish floors, but they are seldom used now. They have been replaced by synthetic finishes that are easier to install and more durable.

Natural oil finishes can be used on a floor, though they require much time to fully cure. Oils are less durable than other finishes but are easy to repair. Linseed oil and tung oil are common types.

Shellac finishes result in floors of great beauty, but a shellac finish is difficult to maintain. Shellac water-spots easily and does not hold up against common household solvents.

Wax is usually applied over some other type of finish. It not only gives a lustrous sheen to a floor but also forms a film that protects the finish beneath. When wax becomes dirty, it is easily removed and replaced. However, wax can make a floor slippery and should be used with care.



This estimating and planning exercise will prepare you for national competitive events with organizations such as SkillsUSA and the Home Builder's Institute.

Strip Flooring Materials and Labor

Materials

To estimate materials, first determine the number of square feet to be covered.

1. Multiply the length of the room by the width of the room. Figure any offsets or closets separately and add them to the total. For example, a room that is 10' × 12' has 120 sq. ft. of floor area (10 × 12 = 120). A closet that is 2' × 8' has 16 sq. ft. of floor area (2 × 8 = 16). The total area of room and closet is 136 sq. ft.
2. Use the table below to calculate the amount of strip flooring you will need. Select the size you will use in the first column, then read across for the amount. For example, if you select $2\frac{5}{32}$ ' × $2\frac{1}{4}$ ' strip flooring, you will need 138.3 bd. ft. to cover 100 sq. ft. of floor area. The room in our example has 136 sq. ft. of floor space. Divide that number by 100:

$$136 \div 100 = 1.36$$

3. Multiply the result by 138.3:

$$1.36 \times 138.3 = 188.09 \text{ bd. ft.}$$

You now know that you will need 188.09 bd. ft. of strip flooring.

4. To figure the cost of the material, multiply the cost per board foot times the total number of board feet required.
5. The table shows that it will take 3 lbs. of nails to lay 100 sq. ft. of $2\frac{1}{4}$ ' strip flooring. Multiply 3 lbs. by 1.36:

$$1.36 \times 3 \text{ lbs.} = 4.08 \text{ lbs.}$$

6. Multiply the cost per lb. times the number of lbs. to find the cost of the nails.

Labor

1. The labor columns in the table show that a worker can lay 100 sq. ft. of $2\frac{5}{32}$ ' × $2\frac{1}{4}$ ' strip flooring in 3 hours.
2. Multiply 3 hours by 1.36:

$$1.36 \times 3 \text{ hrs.} = 4.08 \text{ hrs.}$$

3. Multiply this number by the hourly rate to determine total labor cost.

Estimating on the Job

Estimate the quantity of $2\frac{5}{32}$ ' × 2" strip flooring needed for a 9' × 13' bedroom and a 5' × 6' closet. Then estimate the hours of labor required to lay, sand, and finish the floor. Round your answers to the nearest tenth.

Estimating Strip Flooring Materials and Labor

Strip Flooring Size (inches)	Material		Nails per 100 Sq. Ft. (Lbs.)	Labor Hours per 100 Sq. Ft.		
	Bd. Ft. per 100 Sq. Ft.	1,000 Bd. Ft. Will Lay (Sq. Ft.)		Laying	Sanding*	Finishing*
$2\frac{5}{32} \times 1\frac{1}{2}$	155.0	645.0	3.7	3.7	1.3	2.6
$2\frac{5}{32} \times 2$	142.5	701.8	3.0	3.4	1.3	2.6
$2\frac{5}{32} \times 2\frac{1}{4}$	138.3	723.0	3.0	3.0	1.3	2.6
$2\frac{5}{32} \times 3\frac{1}{4}$	129.0	775.2	2.3	2.6	1.3	2.6
$\frac{3}{8} \times 1\frac{1}{2}$	138.3	723.0	3.7	3.7	1.3	2.6
$\frac{3}{8} \times 2$	130.0	769.0	3.0	3.4	1.3	2.6
$\frac{1}{2} \times 1\frac{1}{2}$	138.3	723.0	3.7	3.7	1.3	2.6
$\frac{1}{2} \times 2$	130.0	769.2	3.0	3.4	1.3	2.6

* Sanding and finishing times are averages.

 **After You Read: Self-Check**

1. Which floor-nailing tool must be struck by a mallet?
2. Why is wood flooring laid on building paper?
3. What standard tools should be used to lever floorboards into place? Which should not be used?
4. What impact do VOCs have on the choice of a floor finish?

 **Academic Integration: Science**

5. **Chemical Fumes and Vapors** Research the possible hazards involved in applying various floor finishes, including penetrating finishes and urethanes. What health-related problems might result from exposure to these materials? What personal protective equipment should you wear to work with each? Make a chart of your findings.

 Go to glencoe.com for this book's OLC to check your answers.

Section

34.3**Vinyl, Tile, & Carpet Flooring****Vinyl and Other Resilient Flooring**

What are three types of resilient flooring?

Many other types of flooring are available besides wood, including vinyl, ceramic tile, and carpet. Vinyl is flexible and practical, ceramic is durable, colorful, and beautiful, and carpeting is comfortable and insulating.

Vinyl is the most common type of resilient flooring. Resilient flooring is flexible and less than $\frac{3}{16}$ " thick. It is available in many forms, colors, patterns, and textures. Some types of resilient flooring, such as vinyl flooring, are made of synthetic materials. Others, such as linoleum, are made primarily of natural materials.

Vinyl flooring is often used in kitchens, bathrooms, and recreation rooms because

it is durable, stain resistant, and fairly inexpensive. Vinyl flooring comes in sheet and tile form. Sheet vinyl comes in large rolls 12' wide. It is often laid without seams, as shown in **Figure 34-17**, and is usually installed by specialists.



 **Figure 34-17 Installing Sheet Vinyl Resilient Flooring** Sheet vinyl comes in 12"-wide rolls and is usually laid without seams.

Vinyl tiles are usually 9" or 12" square. This makes them easier for homeowners to install themselves. Sheet vinyl and vinyl tiles are usually applied to a wood subfloor using mastic. However, vinyl can be laid over almost any solid, dry surface, including concrete.

Installing a Sheet Vinyl Floor

Follow the manufacturer's specific recommendations when installing a vinyl floor. The following are general instructions.

First, cover the wood subfloor with plywood underlayment. **Underlayment** is a thin panel product whose surface is smoother than standard plywood or OSB subflooring. Underlayment prevents small flaws in the subfloor from showing through to the vinyl. It also provides firm, clean, and void-free support. Underlayment should be at least $\frac{1}{4}$ " thick and have a sanded face.

Preparing the Surface Apply nails or staples 6" apart in the field, or center area of the underlayment panel, and 4" apart at the edges. The joints between underlayment panels should be staggered and butted together, as shown in **Figure 34-18**. Fill any gaps larger than $\frac{1}{32}$ " with latex patching compound and sand them flush.

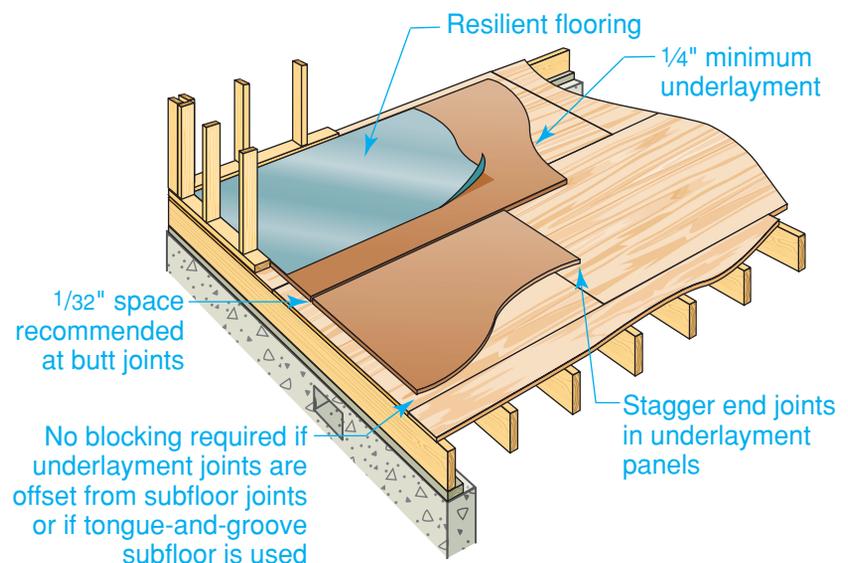
To estimate the amount of sheet vinyl you will need, calculate the square footage of floor you need to cover. Add an extra amount to account for waste, seams, and pattern matching. The extra amount you will need depends on the type of flooring and the pattern. Consult the manufacturer or distributor for information.

Sweep the floor thoroughly to remove any dust and debris. Make sure that fasteners are flush with the surface of the underlayment. One way to check this quickly is to run a wide-blade putty knife over the floor. You will hear a metallic ring when the blade hits protruding fasteners.

Measuring and Cutting Measure the room and determine if the sheet vinyl will require seams. Because of the width of vinyl sheets, it is often possible to avoid a seam. If you will need a seam, snap a chalk line where the seam will fall. Then snap two parallel lines about 8" away on either side of the first line. These chalk lines identify the width of the seam area.

Unroll the flooring and use a utility knife to cut as many pieces as you will need to cover the floor. Each piece should be about 3" longer than the length of the room. Flooring that is cold is more difficult to work with than flooring that is at room temperature.

Figure 34-18 Vinyl and Underlayment
Preparing the Surface
Underlayment panels create a smooth surface for vinyl flooring.



Spreading Adhesive Spread mastic with a notched trowel over half of the area to be covered by a single strip. This ensures that the adhesive will be a uniform thickness. Remove excess mastic with the trowel. Keep mastic out of the seam area. Place the flooring in the wet mastic and roll it smooth with a weighted floor roller. One edge should overlap the center seam line by about 1". Lift the second half of the vinyl. Apply mastic to the underlayment beneath it, then lower the vinyl into the mastic and roll it smooth. Trim the ends of the vinyl to final length.

Repeat the procedure with the next strip of vinyl. Make sure that one edge overlaps the previous piece by several inches.

After the adjoining strips of vinyl flooring are in place, there will be a 16" wide "dry zone" beneath the overlapping edges. Cut through the overlapping edges with a utility knife as shown in **Figure 34-19**. Guide the cut with a steel straightedge. Lift each edge of the flooring, apply mastic to the underlayment, and roll the seam smooth.



Reading Check

Explain Why should you use a notched trowel to spread mastic?

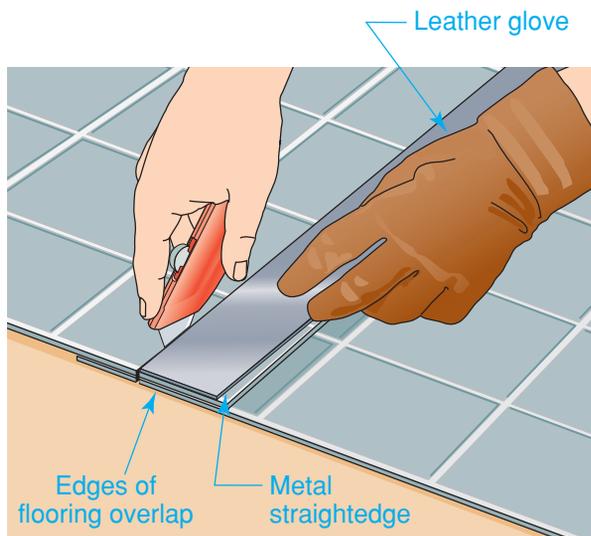


Figure 34-19 Cutting Sheet Vinyl
Removing Overlap Double-cutting an overlapped area using a steel straightedge as guide.

Installing a Vinyl Tile Floor

Vinyl tile can be laid directly over wood flooring or over a plywood floor. It is important to lay out the tile correctly. After measuring the room, determine how many tiles will fit across its length and width. Then snap chalk lines to indicate one of the two basic layouts shown in **Figure 34-20**. The layout you choose will govern the rest of the installation. Lay tiles in adhesive as the work progresses, cutting tiles to fit around obstructions such as pipes.

Ceramic Tile

How long has ceramic tile been used in construction?

Ceramic tile is often used where a highly durable, scratch-resistant flooring is desired, such as a kitchen. However, it can be used in any room of the house. It comes in a large variety of shapes, sizes, and colors. Tile has been used for over 6,000 years for roofs, paving, walls, and decoration. In new construction, tile is usually installed by tile contractors or tile setters.

Manufacturing Ceramic Tile

Custom lots of ceramic tile are still made by hand, but most tile is made in highly automated factories. It is usually made from a combination of pure clay or pure gypsum and other ingredients that extend the clay and control shrinkage. After the clay has been refined and mixed with water and these additives, it is shaped into a bisque. A **bisque** is a tile without the glaze. To form a bisque, the clay mixture is either extruded, dust-pressed, cut from a sheet, or formed by hand. Most commercial tile is made by the dust-press method. In this method, the ingredients are mixed with so little water that only high pressure can bond them together.

The bisque is then dried before being fired in a kiln at temperatures up to 2,200°F (1,204°C). A glaze (glassy finish) may be applied at this time. The glazed surface of a tile is waterproof after firing.

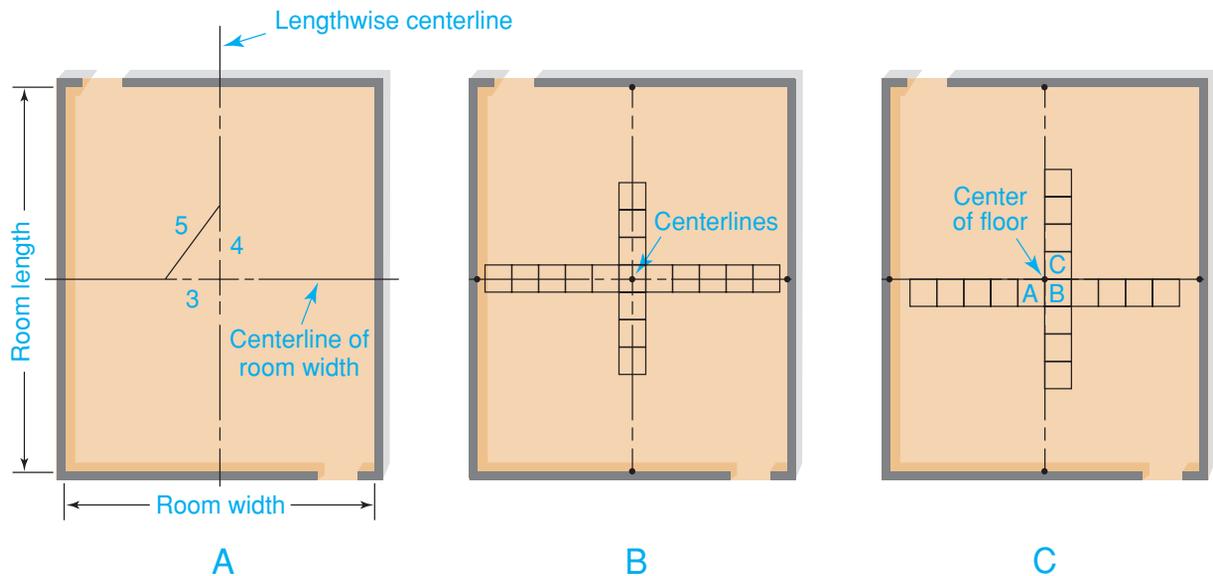


Figure 34-20 Room Layout for Vinyl Tile
Planning from Center Locate the center of the floor and establish centerlines as shown in **A**. Check the centerlines for square by using the 3-4-5 rule and adjust them as needed. Determine how many tiles will be required across the length and width of the room. If an odd number is required, establish a layout in **B**. If an even number is required, use **C** as your model. *Why should you plan the layout of tiles from the center of the room, rather than the edge?*

Characteristics of Ceramic Tile

Tile can be classified according to several characteristics. The three most important are permeability, placement, and use.

Permeability *Permeability* is the ability of a substance to allow water to pass through. Temperature and firing time determine the permeability of a tile. Highly permeable tiles are the least waterproof, because they absorb the most water. From most permeable to least permeable, the four types of tile are nonvitreous, semi-vitreous, vitreous, and impervious. (*Vitreous* means glasslike.)

Permeability is important because it determines the best use of the tile. Tiles that will be exposed to water in a bathroom, for example, should be less permeable. To test for permeability, turn a tile over and put a drop of water on the unglazed (back) portion. If the drop is absorbed immediately, the tile is highly permeable. If the drop remains on top of the tile, the tile is less permeable.

Placement Tile is often categorized by where it is used, either on walls or floors. Wall tile is generally nonvitreous, with a relatively

soft glaze that makes it unsuitable for foot traffic. It is usually about $\frac{1}{4}$ " thick and 4" or 6" square.

Floor tile can be any kind of tile (from nonvitreous to impermeable and glazed or unglazed) that is strong enough to hold up in use on the floor. Floor tile can be used on walls, but wall tile should not be used for flooring.



REGIONAL CONCERNS

Tile Use Varies by Region If you live in an area with a cold climate, you will see tile used mainly in bathrooms and kitchens. If you live in an area with a hot climate, you will see tile used throughout entire houses. Houses in hot climates are often built on a concrete slab foundation, which provides an excellent base for the installation of ceramic tile.

Go to glencoe.com for this book's OLC for more information about regional concerns.

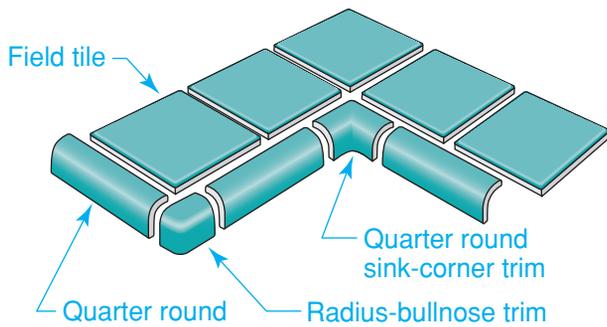


Figure 34-21 Field and Trim Tiles
Shaped for the Job Various shapes and sizes of trim tiles can be used around field tiles.

Use Another way to categorize tile is by use either in the field or as trim. Trim tile is specially shaped to form a border and is often bullnosed in shape. It may also be *radiused* to form a curve or ridged to form a pattern, as shown in **Figure 34-21**.

Field tile is the tile contained within the borders formed by trim tile. Field tile is flat rather than shaped. It is glazed on the top surface only.



Reading Check

Connect What determines the permeability of a tile?



Figure 34-22 Lugged Tile
Perfect Alignment The lugs on the edges of these tiles ensure the proper spacing between tiles. The lugs will later be covered with grout.

Types of Ceramic Tiles

Many different types of ceramic tiles are used in residential construction. Paver tiles are intended for use on floors. They are at least $\frac{1}{2}$ " thick and may be glazed or unglazed. Machine-made pavers range in size from 4" by 6" to 12" square and are up to $\frac{5}{8}$ " thick. They are usually semi-vitreous or vitreous. Handmade pavers are usually nonvitreous and have a slightly uneven surface. They range in size from 4" square to 24" square and in thickness from $\frac{1}{2}$ " to 2". Handmade, unglazed pavers are commonly known as Mexican tiles or Mediterranean tiles.

Quarry tile is generally unglazed, semi-vitreous or vitreous clay tile that ranges in thickness from $\frac{1}{2}$ " to $\frac{3}{4}$ ". It is excellent for use on floors because it is so dense. Mosaic tile is any tile 2" square or smaller. It is usually vitreous, and it ranges in thickness from $\frac{3}{32}$ " to $\frac{1}{4}$ ". Lugged tile is tile that has spacing lugs built into its sides. When the tiles are placed edge-to-edge, the lugs automatically determine the proper spacing, as shown in **Figure 34-22**.

Substrates for Installing Ceramic Tile

The substrate for ceramic tile must be stiff enough to prevent flexing, which could crack tiles or joints. Tile can be adhered



Science: Chemical Reactions

Mixing Cement and Water Most grout is made from Portland cement, an unstable chemical compound that becomes stable when you mix it with water. You are making grout that calls for 14 ounces of water for every 5 pounds of dry grout. How many ounces of water would you need to mix with a 10-pound package of dry grout?

Starting Hint Solve for ? in the following equation:

$$\frac{14 \text{ oz.}}{5 \text{ lbs.}} \times 10 \text{ lbs.} = ? \text{ oz.}$$

directly to plywood, but this is generally not recommended, particularly on floors. Tile can also be adhered directly to a drywall surface.

Cement-based sheets called **backerboard**, or cement board, provide an excellent base for tile, particularly on floors and in wet installations such as shower stalls. You can nail or screw backerboard to a subfloor or to a plywood countertop. It comes in sheets ½" or ⅝" thick, 32", 36", or 48" wide, and 4', 5', 6', or 8' long. Apply the sheets to a wood subfloor with 1½" hot-dipped roofing nails or 1¼" corrosion-resistant screws. These screws, sometimes called cementboard screws, have small fins on the underside of the head that help to countersink it.

Installation Materials

You will need adhesives, grout, and waterproofing membranes to install ceramic tile properly.

Adhesives Ceramic tile is adhered to the substrate with dry-set mortar or mastic, as shown in **Figure 34-23**. Apply the adhesive with a trowel, then “combed out”, or spread out, with a notched trowel so that it is distributed evenly. The even thickness helps to support the tile, preventing breakage caused by point loads.

Dry-set mortar, also called thin-set mortar, is a very effective adhesive. It is a mixture of Portland cement, sand, and additives that strengthen the bond. Dry-set mortar can be mixed with water, with a latex- or acrylic-modified liquid, or with epoxy resins, as shown in **Table 34-2** on the next page.

Mastic is an organic adhesive. It comes premixed in cans and is often preferred by nonprofessionals because it is easy to use.

Grout After attaching tiles to a substrate with adhesive, you will need to fill the spaces between the tiles with grout, as shown in **Figure 34-24**. **Grout** is a thin mortar used for filling spaces. It can be mixed with water,



Figure 34-23 Laying Ceramic Tile
Uniform Coverage To create an even surface for laying tile, spread adhesive on the surface with a notched trowel and then comb it out to produce uniform coverage.



Figure 34-24 Spreading Grout
Filling In Spread grout over the entire tiled surface with a grouting trowel. Pack it into the joints, then remove the excess grout with the trowel and a sponge.

Table 34-2: Adhesives for Ceramic Tile

Adhesive	Characteristics
Mastic	<ul style="list-style-type: none"> • Good grip strength (useful for setting wall tiles) • Lacks the strength or flexibility of mortar • Not heat resistant • Least expensive and easiest to use adhesive • Suitable for use on drywall • No mixing required
Dry-set mortar mixed with water	<ul style="list-style-type: none"> • Good bond strength • Good compressive strength • Not flexible • Heat resistant • Inexpensive • Easy to use
Dry-set mortar mixed with latex-modified or acrylic-modified liquid	<ul style="list-style-type: none"> • Excellent bond strength • Excellent compressive strength • Somewhat flexible • Heat resistant • Can be applied to most surfaces except steel • Resistant to frost damage
Dry-set mortar mixed with epoxy resin	<ul style="list-style-type: none"> • Very high bond strength • Somewhat flexible • Heat resistant • Expensive • Can be applied to almost any surface, including plastic laminate and steel • Can be hard to work with • Very high resistance to impact

latex- or acrylic-modified liquids, or epoxy resin. It prevents moisture and dirt from getting between the tiles. Grout comes in a wide array of colors.

Tile grout comes in two forms: plain and sanded. Plain grout is mixed with additives to make it smooth and creamy. It is generally used when the spaces between tiles are less than $\frac{1}{16}$ " wide. Sanded grout is simply plain grout to which sand has been added for strength. Sanded grout is used for joints wider than $\frac{1}{16}$ ".

Waterproofing Membranes Properly installed, ceramic tile creates a durable and water-resistant surface. Water may still penetrate below the tile around bathtubs and in other areas exposed to large amounts of water. Prevent this by placing a water-proofing membrane beneath the substrate. This membrane can be any flexible, waterproof sheet material, such as tarpaper. Nail or staple it in place, sealing the edges with asphalt adhesive.

Other products, such as chlorinated polyethylene (CPE), provide even greater

durability. CPE is a flexible material 30 mils thick that comes in large rolls. Attach it directly to the substrate with dry-set mortar and use a roller to ensure a proper bond.



Explain What are the two functions of grout?

Tools for Ceramic Tile

Two basic types of tools are used to cut ceramic tile: snap cutters and tile saws. Tilesetters often rely on tile saws for most tile cutting.

Portable Snap Cutter This tool is used to cut tiles in a straight line. Place the tile on the bed of the tool (beneath the two rails) and against the guide. Then lift the long handle of the tool and pull it toward you. This draws a small scoring wheel across the tile's surface. You can then snap the tile apart at the scored line by putting modest pressure on each side of the line. One advantage of the snap cutter is that it can be operated without the need for water or electricity.

Tile Saw A type of tile saw called a wet saw is often used to cut tile, particularly when large quantities must be cut accurately. The tool includes a circular diamond-grit blade, a water pump, and a moisture-proof motor. The pump sprays a continuous stream of

water on the blade during the cut. This lubricates and cools the blade. It also prevents the diamond abrasive from becoming clogged with clay particles. A wet saw creates a very smooth cut edge. It should be set up in an area where splashes of water will not harm nearby surfaces.

Nippers and Nibblers These simple hand tools look like pliers or small nail pullers, but they have straight, hardened cutting edges. They are used to cut curves in tile by nibbling, or eating, away at the tile edges. The resulting edge is rough, so it must be ground smooth or hidden behind some type of fitting or cap. Nibblers are often used to cut notches in tile to fit around shower pipes.

Knee Pads These pads help to protect the tile setter's knees from injury during long hours of setting floor tiles.

Trowels A tile setter uses a variety of flat and notched trowels with steel blades. Trowels with notched edges are used to spread adhesive. The size, shape, and depth of the notch determines the thickness of the adhesive layer.

Scoring Tool This hand tool has a carbide tooth mounted on a steel blank. It is used to score through the fiberglass reinforcement of cement board.

Methods of Installing Ceramic Tile

There are many methods for installing tile. Each job requires a different combination of tile, adhesive, grout, and setting methods. The proper methods and materials depend on several factors, including the stiffness of the floor system and whether or not the tile will be exposed to water. The two basic methods of installing tile are known as thick-bed and thin-bed. Thick-bed installation is a traditional method but it is time-consuming to install. Thin-bed installation goes more quickly, particularly on large areas of flooring.

Thick-Bed Installation In a thick-bed installation, you apply tiles over a mortar setting bed that is $\frac{3}{4}$ " to $1\frac{3}{4}$ " thick. Make sure to



GUARD AGAINST DUST AND VAPORS Dry-set mortars and grout are very fine powders that must be mixed with a liquid. Wear a suitable dust mask when mixing them. Some mastics give off fumes that may be harmful as well, so always check the instructions on the can for any health warnings. Work in a well-ventilated area and remember that a standard dust mask offers no protection against vapors.

 Go to glencoe.com for this book's OLC for more on job safety.

JOB SAFETY

WORK SAFELY WITH A WET SAW Water and electricity are a dangerous combination. A wet saw's motor is protected from water, but extension cords and nearby power tools may not be. Keep other electrical tools away from the area where you are using a wet saw and make sure all power tools, including the wet saw, are plugged into GFCI-protected circuits.

Go to glencoe.com for this book's OLC for more on job safety.

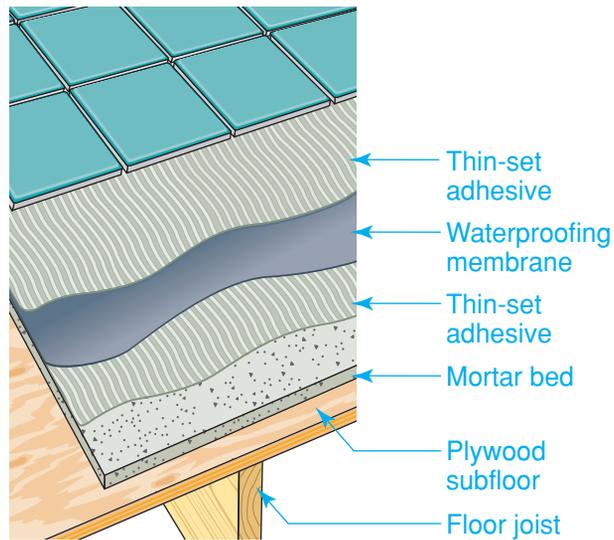


Figure 34-25 Thick-Bed Installation
Five Layers A thick-bed installation of ceramic tile over a floor.

place a waterproofing membrane beneath the setting bed. You should also add metal lath or wire mesh reinforcement. These products help to prevent the setting bed from cracking. In this way, they are much like reinforcing bar that is used in concrete slab construction. Apply the mortar in three layers: a scratch coat, a bed, and a bond coat.

After the setting bed has cured, you apply the tiles to it with dry-set adhesive. This method helps create accurate **inclines** and planes that can improve water drainage. It can also be used to level uneven substrates. The result is structurally strong and is not affected by prolonged contact with water. A typical thick-bed installation is shown in **Figure 34-25**.

Thin-Bed Installation In a thin-bed installation (also called thin-set installation), you adhere tiles directly to backerboard with adhesive. The adhesive may be mastic or dry-set mortar. Thin beds are less costly than thick beds, are relatively light, and are easier and quicker to install. However, the substrate must be very flat and very well prepared, and the surface cannot be easily sloped.

Reading Check

Connect What installation method would you use for a tile floor that slopes to a drain?

Carpeting

What is one benefit of carpeting?

Carpeting is available in a wide variety of styles, colors, and construction types. Unlike hard surface flooring such as hardwood, vinyl, and ceramic tile, carpeting offers a soft feel underfoot. This makes it particularly suited for use in living areas and bedrooms. Carpeting is slip-resistant and helps muffle sound.

Carpet Construction

The performance and appearance of carpeting depends on the fiber and on how the fiber is assembled on the carpet backing.

Types of Carpet Fibers The type of fiber is critical in determining how durable the carpet is and how easy it is to clean. Carpeting made of natural fibers such as wool is durable and naturally stain resistant. It is generally more expensive than other types of carpeting. *Synthetic* fiber carpeting is made from nylon, polyester, olefin, or acrylic. Nylon is the most durable and stain resistant carpet fiber.

Structure of Carpet Fibers Carpet fibers are twisted to help withstand crushing and matting. Carpets with dense, tightly packed fibers are more wear-resistant. Fibers can

be sheared to create a soft, plush walking surface, or looped to increase the carpet's durability and its ability to conceal dirt.

Carpet Installation Basics

Wall-to-wall carpeting is installed by carpeting subcontractors, who often work exclusively for a particular carpet outlet or store. They have the specialized skills and tools to install carpeting efficiently.

The first step is to nail tackless strip (also called "tack strip") around the perimeter of the room. This is a narrow strip of thin plywood that contains many angled tacks, as shown in **Figure 34-26**. Always wear leather gloves when handling tackless strips. The installer nails the strip to the subfloor so that the points of the tacks are exposed and angled towards the wall. The tacks will grip the underside of the carpeting.

When the tackless strip is in place, the installer cuts carpet padding to fit just inside the tackless strip, then cuts and positions carpeting over the pad. The carpeting should be 4" to 6" larger than the room's dimensions. The excess material will be trimmed off later.

The installer places the carpet in position, hooks it on the tackless strip at one end or corner of the room, and stretches it toward the opposite end of the room using a power

stretcher. This hand tool uses lever action to stretch the carpet and hook it onto the tackless strip. Once the carpet has been stretched in all directions, the installer trims the excess material and pushes the cut edges under the baseboard.

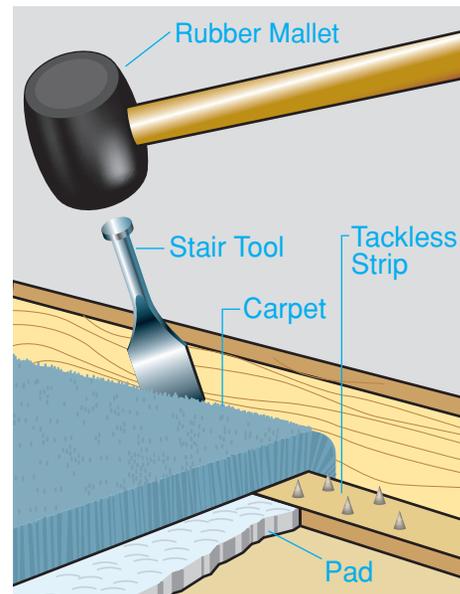


Figure 34-26 Tackless Strip for Installing Carpet
Wall to Wall Tackless stripping holds the stretched carpet in place. Trimmed carpet edges should be tucked under the baseboard.

Section 34.3 Assessment

After You Read: Self-Check

1. What are the advantages of vinyl flooring?
2. Name two types of synthetic flooring and two types of natural flooring discussed in this section.
3. Which type of adhesive is used to install resilient flooring?
4. When choosing tile, why is it important to know the tile's permeability?

Academic Integration: English Language Arts

5. **Ceramic Tile** Research the manufacture and use of ceramic tile in past centuries. What were the principal uses of tile in the past? Do those uses differ from the uses for ceramic tile today? Present your research in a one-page report.

Go to glencoe.com for this book's OLC to check your answers.

Section

34.1

Chapter Summary

Solid-wood flooring is available in several forms, including strips, planks, and parquet. The grade of the wood depends on the wood species, the manufacturing process, and the surface appearance. Allowing wood flooring to acclimate before installation prevents warping.

Section

34.2

Hardwood strip flooring is installed by blind nailing it into the floor joists. It is most often installed over a wood subfloor. It may also be installed over concrete as long as no moisture problems exist. Sanding a floor removes imperfections. After all sanding dust has been removed, the floor can be finished for color, shine, and durability.

Section

34.3

Resilient flooring is flexible and thin. It is attached to a smooth, solid underlayment using mastic. The most common types are sheet vinyl and vinyl tile. Ceramic tile can be classified by its water permeability, placement, and use. It can be applied to various substrates using different types of adhesives. Wall-to-wall carpet is installed by hooking it onto a tackless (plywood) strip.

Review Content Vocabulary and Academic Vocabulary

- Use each of these content vocabulary and academic vocabulary words in a sentence or diagram.

Content Vocabulary

- plank (p. 972)
- parquet (p. 973)
- acclimation (p. 975)
- wear layer (p. 976)
- mastic (p. 976)
- sleeper (p. 982)

Academic Vocabulary

- volatile organic compounds (VOCs) (p. 985)
- underlayment (p. 989)
- bisque (p. 990)
- backerboard (p. 993)
- grout (p. 993)
- uniform (p. 973)
- eliminate (p. 984)
- inclines (p. 996)

Speak Like a Pro

Technical Terms

- Work with a classmate to define the following terms used in the chapter: *curing* (p. 973), *heartwood* (p. 974), *polyethylene* (p. 981), *moisture-cured urethanes* (p. 986), *oil-modified urethanes* (p. 986), *water-based urethanes* (p. 986), *solvent* (p. 986), *permeability* (p. 991), *vitreous* (p. 991), *radiused* (p. 992), *epoxy* (p. 993), *synthetic* (p. 996).

Review Key Concepts

- List the common forms of wood flooring.
- Describe the major kinds of wood used in flooring and how they are graded.
- Explain how to install wood strip flooring.
- Explain how to estimate the quantity of resilient flooring needed for a room.
- Describe the basic methods for installing ceramic tile and carpeting.

Critical Thinking

- 8. Explain** A typical house contains several types of finish flooring, each with a different thickness. However, the top of the surfaces should all be at the same level. How might you achieve this?

Academic and Workplace Applications

STEM Mathematics

- 9. Front-End Estimation** Your clients are trying to decide between bamboo and reclaimed wide-plank fir flooring for 950 square feet of their remodel. Bamboo costs \$3.09 per square foot uninstalled, and reclaimed wide-plank fir costs \$6.05 per square foot uninstalled. Calculate the cost of materials, then use front-end estimation to make a quick estimate of the difference.

Math Concept To make a quick estimate of the sum or difference between two numbers, you can use front-end estimation. Just add or subtract the digits of the two highest place values, and replace the other place values with zero. This will give you an estimate of the solution to a problem.

Step 1: Calculate the cost of both flooring options. Bamboo costs \$2,934.50 and reclaimed fir costs \$5,747.50.

Step 2: Front-estimate both numbers in the problem (\$2,934.50 to \$2,900 and \$5,747.50 to \$5,700).

Step 3: Now subtract using the new numbers.

21st Century Skills

- 10. Communication Skills** Manufacturer's instructions are bundled with most flooring materials. Contact a flooring manufacturer to obtain an instruction booklet. Read all text and diagrams in the booklet. What installation method, tools, and materials are recommended? What is the proper process for preparing the subfloor? When should you lay a vapor barrier, and what kind?

Summarize in your own words in a one-page document.

STEM Science

- 11. Climate and Acclimation** The proper moisture content of wood flooring changes by location. Determine the proper percentage for where you live. Consult an acclimation table, available from flooring manufacturers and flooring trade associations, then measure the moisture content of the flooring with a moisture content meter.

Standardized TEST Practice



Multiple Choice

Directions Choose the phrase that best completes the following statement.

- 12.** It is important to install underlayment beneath sheet vinyl flooring because ____.
- a. it keeps the vinyl from peeling away from the subfloor
 - b. it reduces the square footage of vinyl needed to cover the subfloor
 - c. it blocks moisture from the subfloor
 - d. it provides firm support and a smooth surface
- 13.** Applying tiles over a mortar setting is called ____.
- a. thin-bed installation
 - b. thick-bed installation
 - c. baseboard installation
 - d. mortar installation
- 14.** The thickness of oak strip flooring is commonly ____.
- a. $\frac{1}{2}$ " or $\frac{3}{4}$ "
 - b. $\frac{3}{8}$ " or $\frac{5}{8}$ "
 - c. $\frac{1}{4}$ " or $\frac{1}{2}$ "
 - d. $1\frac{1}{2}$ " or $3\frac{1}{4}$ "

TEST-TAKING TIP

Read all of the questions and all of the answers and eliminate all statements that you know are incorrect before choosing.

*These questions will help you practice for national certification assessment.