Chapter One
INTRODUCTION TO FRAMING

Contents

Chapter One

INTRODUCTION TO FRAMING

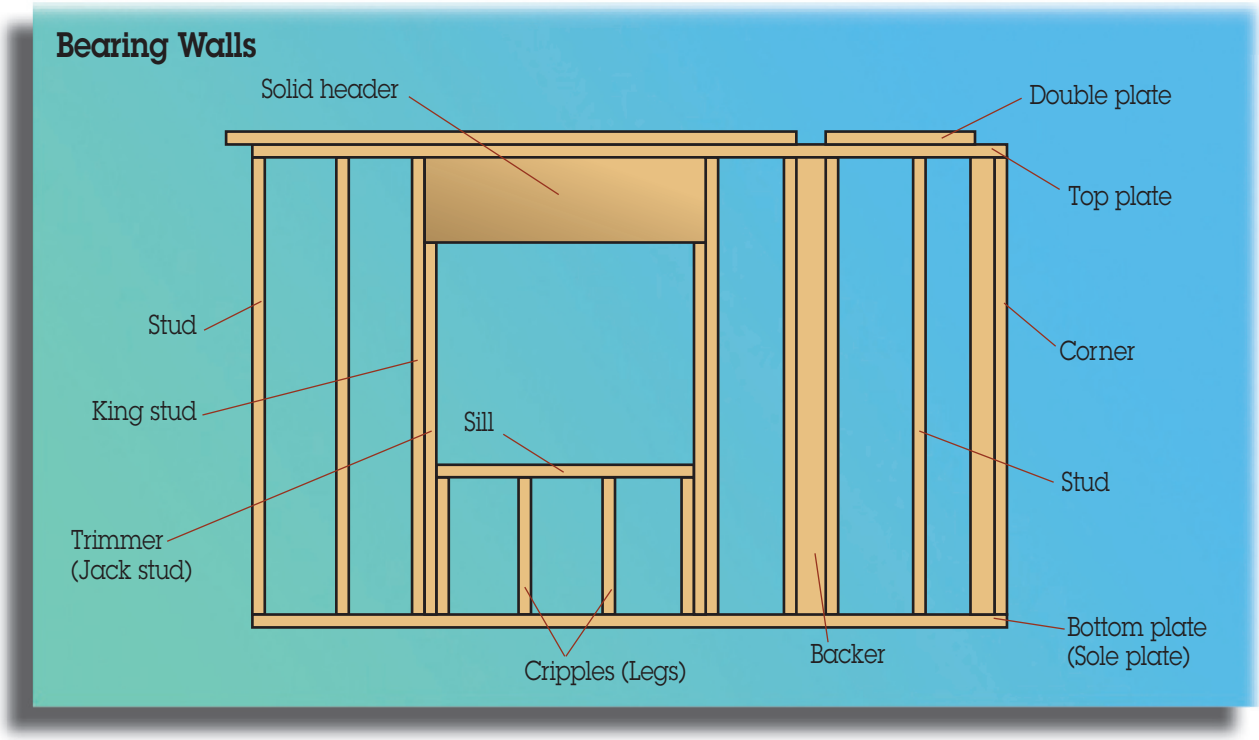
The trade of wood framing comprises the rough carpentry skills needed to produce the "skeleton" of a building and its first layer of "skin." The skeleton consists of the structural lumber forming the floors, walls, and roof. The skin consists of the lumber that encloses the skeleton and provides a surface for subsequent layers of protective and decorative finish materials.

This chapter is an illustrated review of a framer's most basic tools, materials, and terminology. This basic information is often not even taught on the job site, so if you don't know it when you arrive for work, you will have to play a guessing game or ask a lot of questions.

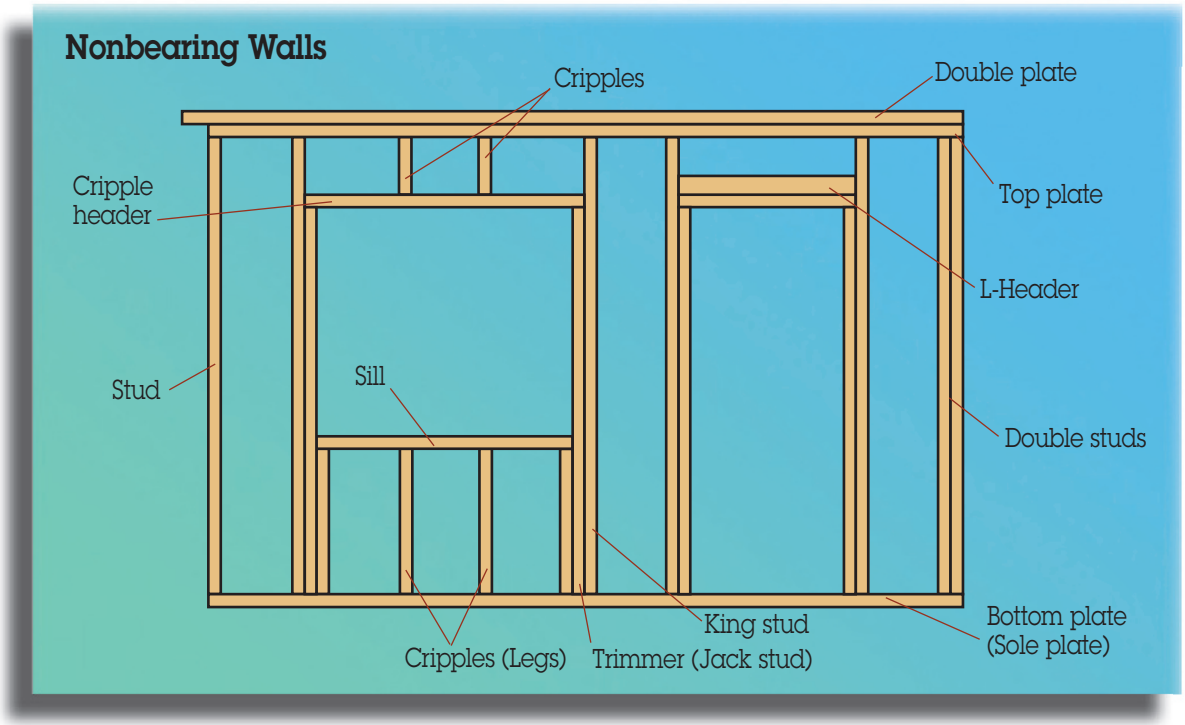
The detailed illustrations serve as a handy reference and help to reduce confusion when different words are used for the same item. Confusion can arise when framers move from job site to job site and work with different people. For example, bottom plates are often known as *sole plates*, backers as *partitions*, and trimmers as *jack studs*. But it doesn't matter what they are called as long as you know what they are. There is also a more detailed list of framing terms with definitions at the back of the book.

The suggested organization for a framing tool truck presented in this chapter is just an example of how a truck might be set up for tool storage. Its purpose is, once again, to reduce confusion and make the job easier. It is amazing how much time can be spent looking for tools and nails if they aren't put where you expect them to be.

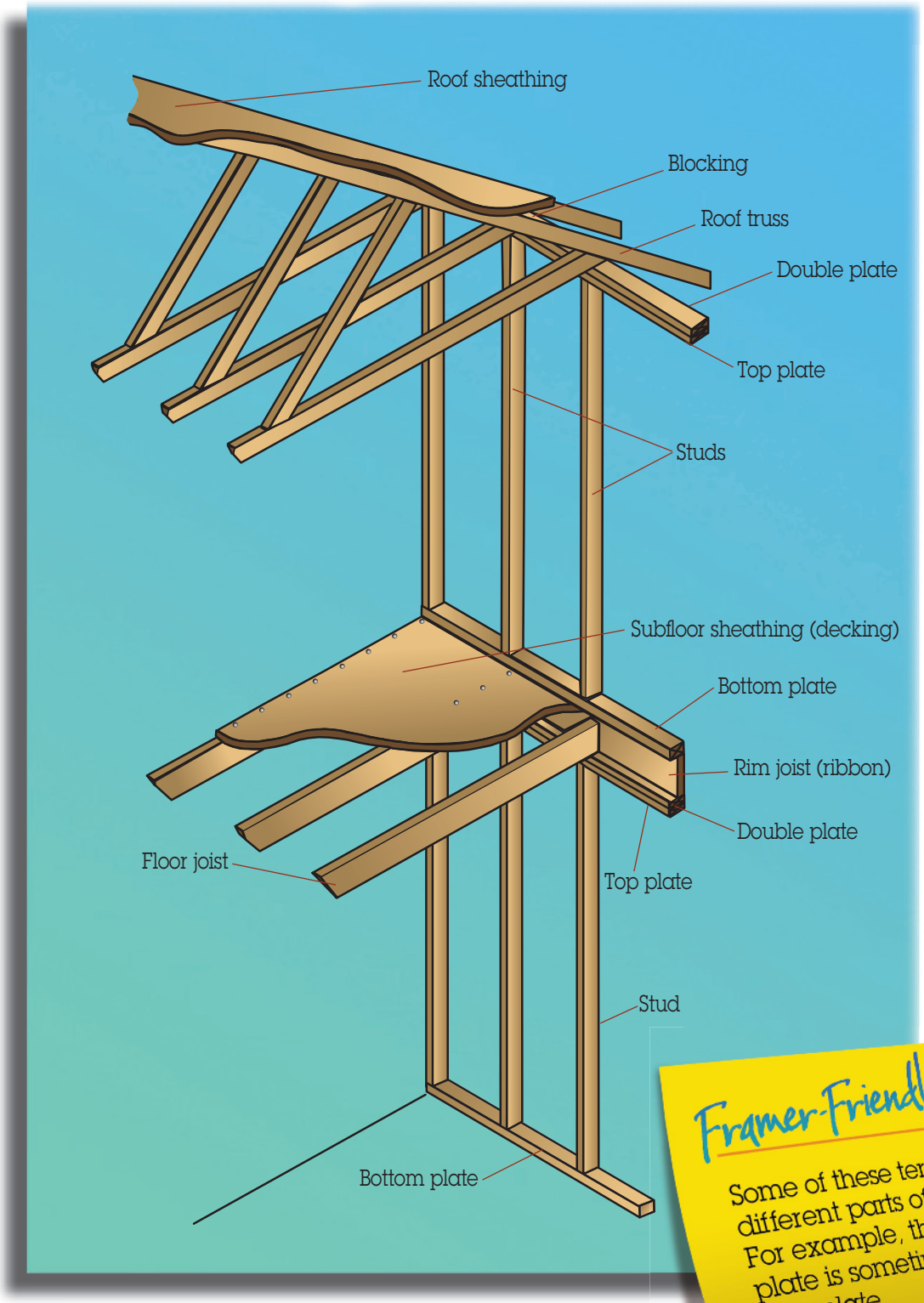
Framing Terms



Bearing walls support the main weight of an upper portion of a building, such as a ceiling, floor, or roof. Nonbearing walls provide little or no support to those upper portions. Remove nonbearing walls, and the upper portions will stand; remove bearing walls, and the upper portions will fall.



Framing Terms *(continued)*

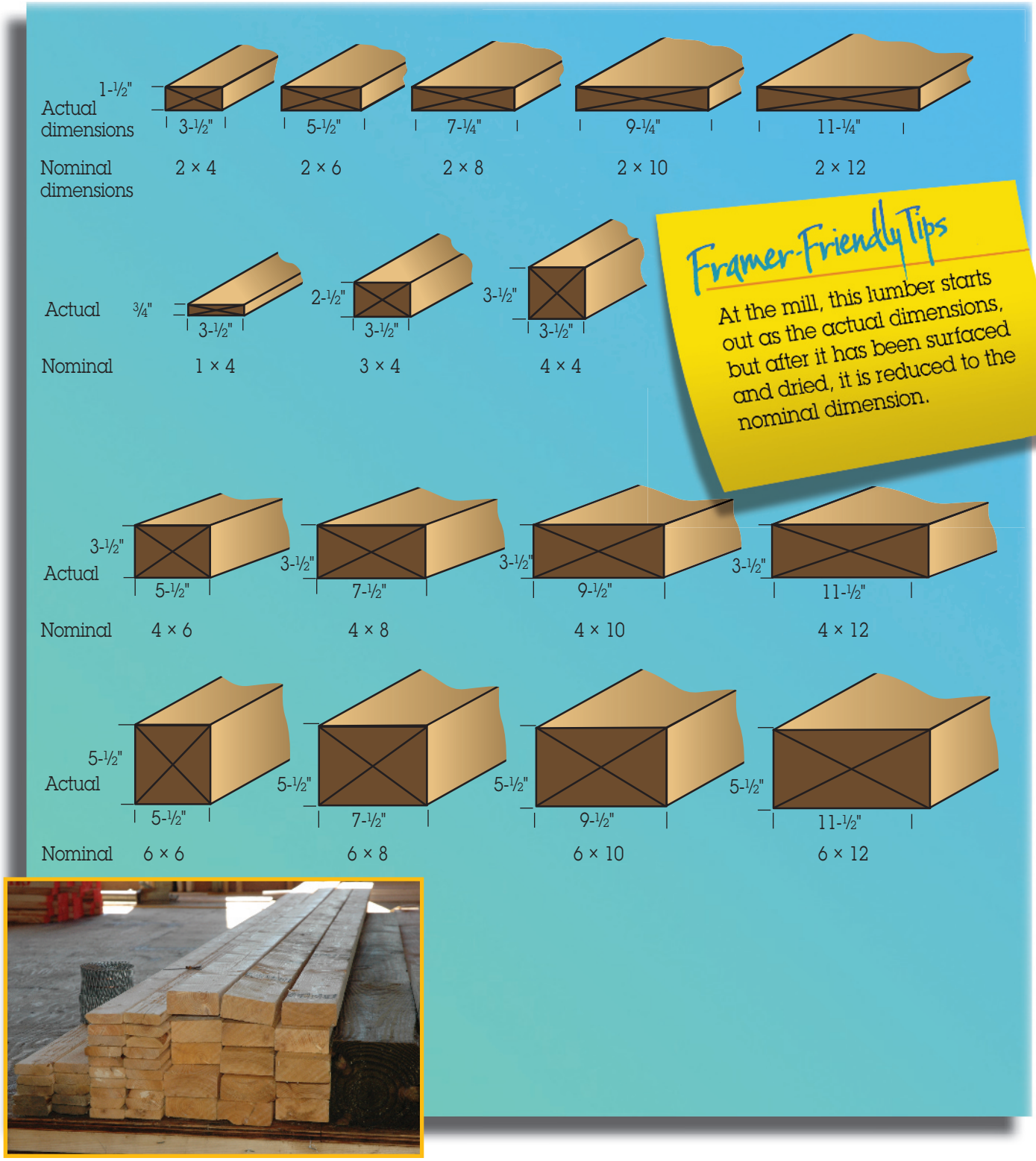


Framer-Friendly Tips

Some of these terms vary in different parts of the country. For example, the bottom plate is sometimes called the sole plate.

Framing Lumber

Lumber is sized in "nominal," as opposed to "actual," dimensions. A nominal dimension rounds off the actual dimension to the next highest whole number. For example, a piece of lumber that actually measures 1-½" × 3-½" is rounded off to the nominal 2" × 4".



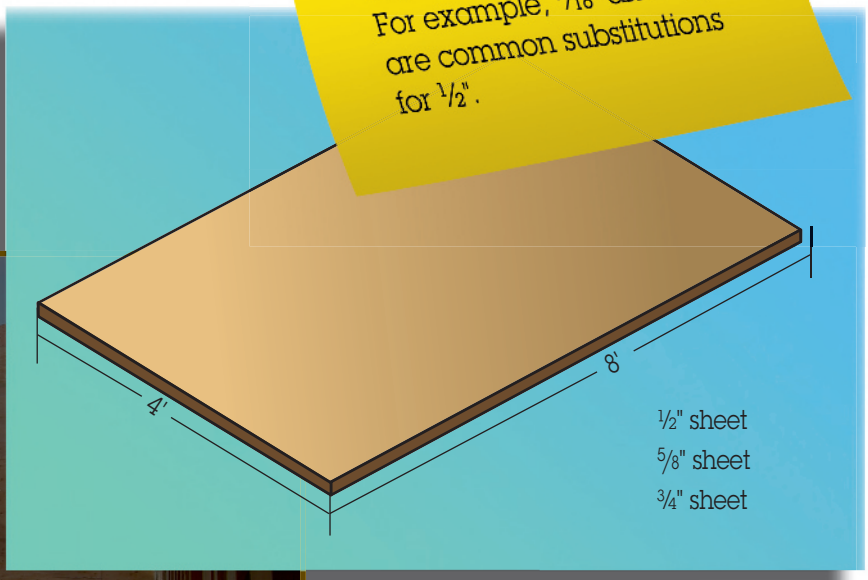
Framing Sheathing

Engineered Panel Products

Sheathing comes in 4' × 8' sheets. The thicknesses most commonly used in framing are ½", ⅝", and ¾".

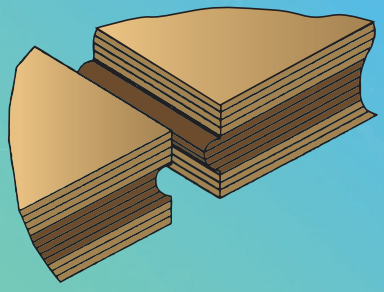
Framer-Friendly Tips

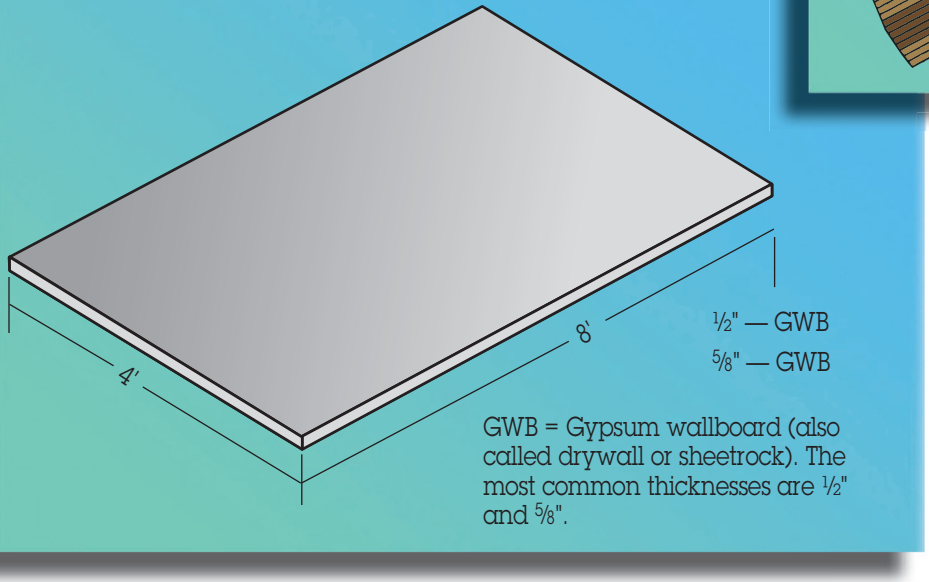
There are substitutions for these standard sizes. For example, 7/16" and 15/32" are common substitutions for ½".



The engineered panel products on this wall provide the strength needed for the high ceiling of this elementary school.

T&G Wood Structural Panels
(tongue and groove)





GWB = Gypsum wallboard (also called drywall or sheetrock). The most common thicknesses are ½" and ⅝".

Although not as common in house framing, gypsum wallboard can be used on exterior walls, such as for apartments and condos, and commercial buildings for fire protection.

Dens Glass® gypsum sheathing is a brand that has fiberglass mat, which provides mold and moisture resistance and is gold in color.

Engineered Wood Products

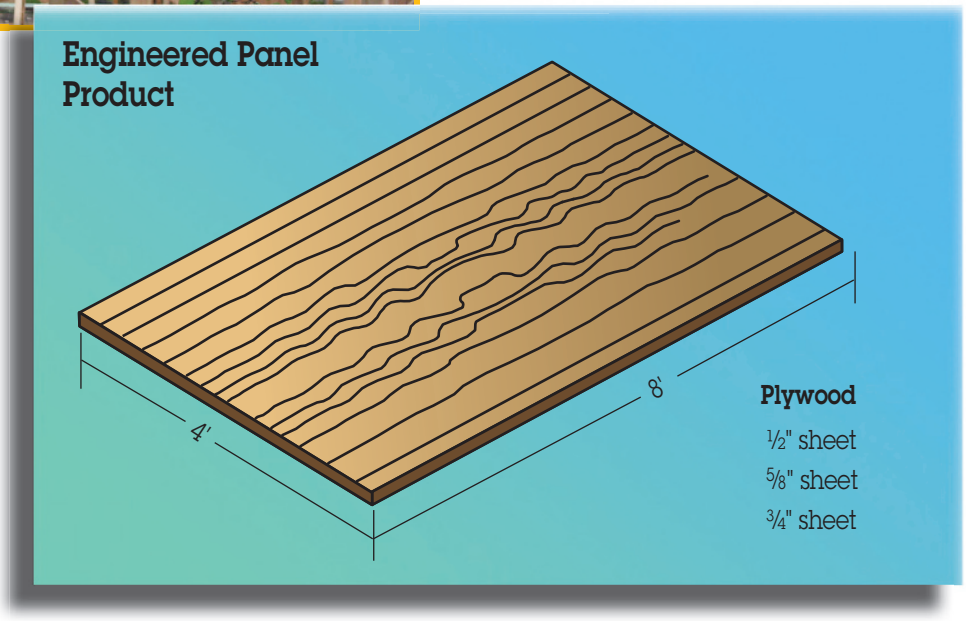
Engineered wood products are becoming more and more a part of our everyday framing. The strengths of these different products vary. Whenever you use engineered wood, it is important that you understand the qualities of the specific product you are planning to use, as well as structural considerations and any restrictions on cutting and installation.

Engineered wood products can be divided into two categories: **engineered panel products** and **engineered lumber products**. Engineered panel products include plywood, oriented strand board (OSB), waferboard, composite, and structural particleboard. Engineered lumber products include I-joists, glu-lam beams, LVLs (laminated veneer lumber), PSLs (parallel strand lumber), LSLs (laminated strand lumber), OSL (oriented strand lumber), and CLT (cross-laminated timber.)

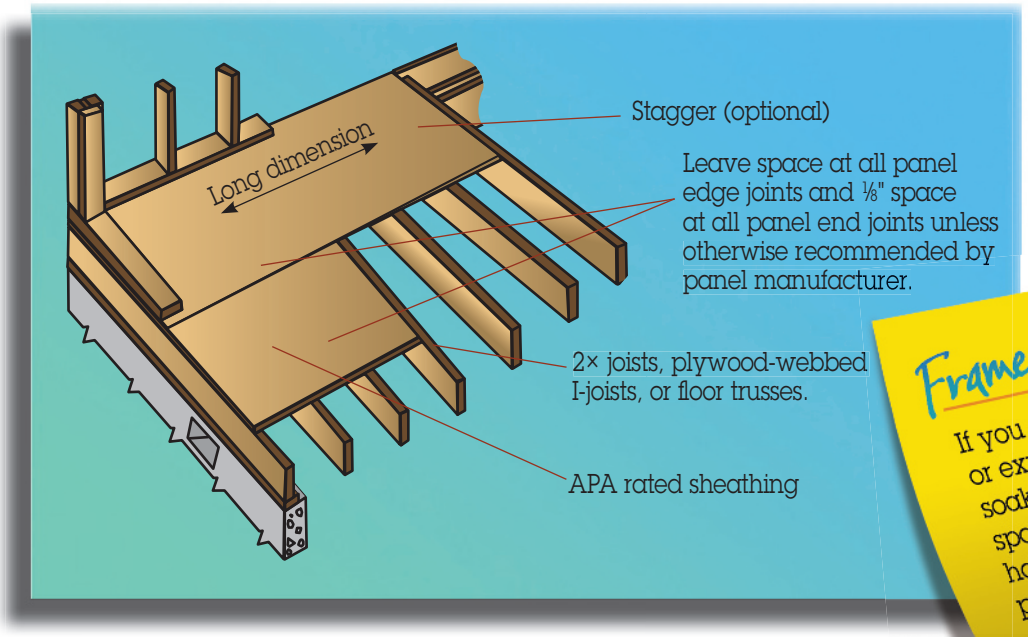
I-joists are engineered lumber products that provide consistency and fewer floor squeaks.

Engineered wood products have structural qualities different than those of traditional wood, so they must be used within the specification set by the manufacturer. When these products are specified on the plans, the architect or engineer who specified them will have checked with the structural engineer to ensure proper use.

Engineered panel products have been around for years and are treated in a



Engineered Wood Products *(continued)*



Framer-Friendly Tips

If you are installing in the rain or expect the sheathing to get soaked, allow 3/16" or more space at panel ends. Sheathing has been known to swell and push braced walls out of plumb.

manner similar to engineered wood products. The 4' × 8' typical sheets are strongest in the direction of the grain. For floors and roofs, these sheets should be laid perpendicular to the direction of the supporting members. The strength of the panels comes from the panel cantilevering over the supports—so each piece should be at least as long as two support members.

Glu-lam beams, LVLs, PSLs, and LSLs can be cut to length, but should not be drilled or notched without checking with manufacturers' specifications.

I-joists are becoming more widely used. Although the Engineered Wood Association has a standard for I-joists, not all I-joists manufacturers subscribe to that standard. Consequently, it is important to follow the manufacturer's instructions whenever using I-joists. Installation instructions are usually delivered with the load for each job. The illustration shows some of the typical instructions.

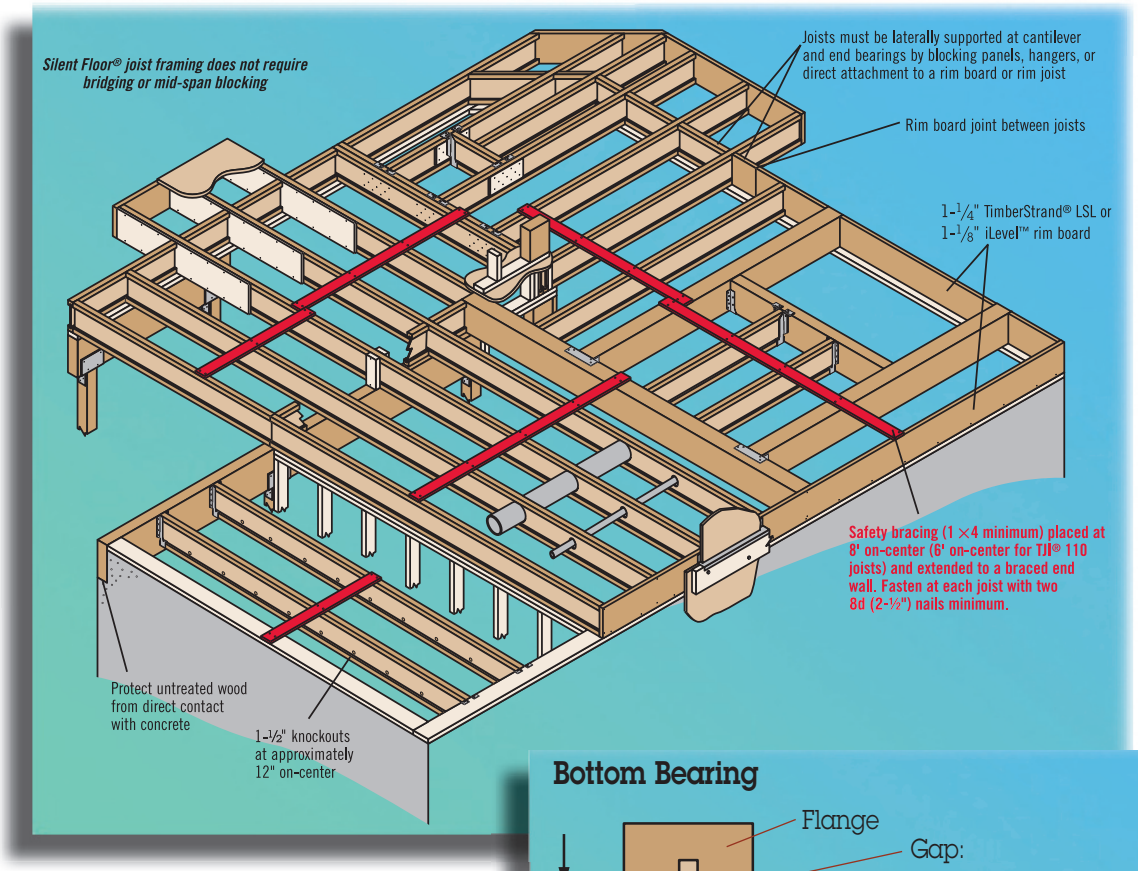
Certain features are common among all I-joists. Rim and blocking may be of I-joist or solid rim board. Typical widths are 9-½", 11-⅞", 14", 16", and 20".

Web stiffeners are used to add to the strength at bearing points. If the bearing point is at the bottom flange, then the web stiffener, which is the thickness of the flange on one side of the web, is held tight to the bottom. There should be at least a ⅛" space between the top flange and the web stiffener. If the bearing point is at the top flange, then the web stiffener is held tight to the top with at least ⅛" between the bottom flange and the web stiffener.

Framer-Friendly Tips

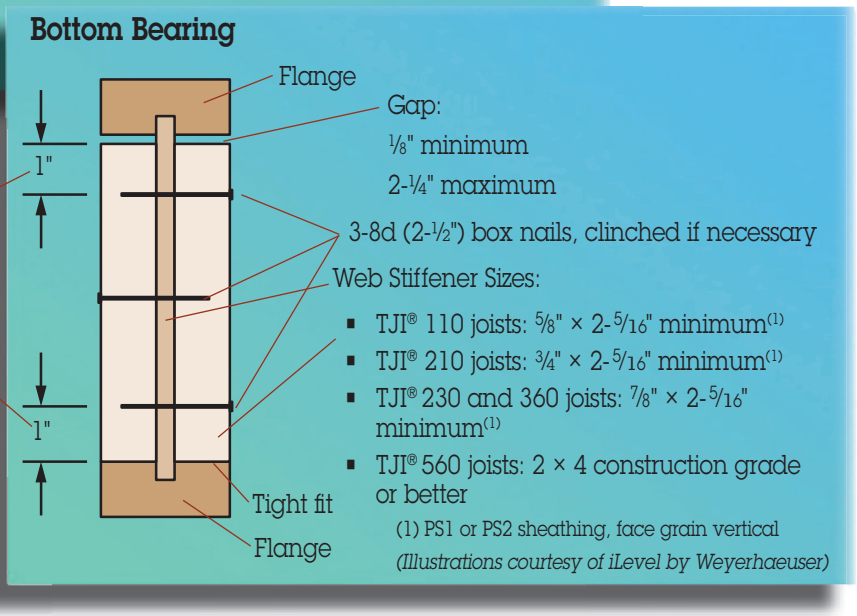
Special details are needed when attaching heavy weight—such as blocking for hanging cast iron pipes, to the bottom of I-joists—to prevent the bottom flange from breaking the glue that attaches it to the web.

Engineered Wood Products *(continued)*



Common construction details for engineered lumber joists.

1-½" for TJI® 560 Joists



Section view of I-joist. Please note the components of the joist (darker colors) and the web stiffener (lighter color). Fasteners are shown in black.

Framer-Friendly Tips

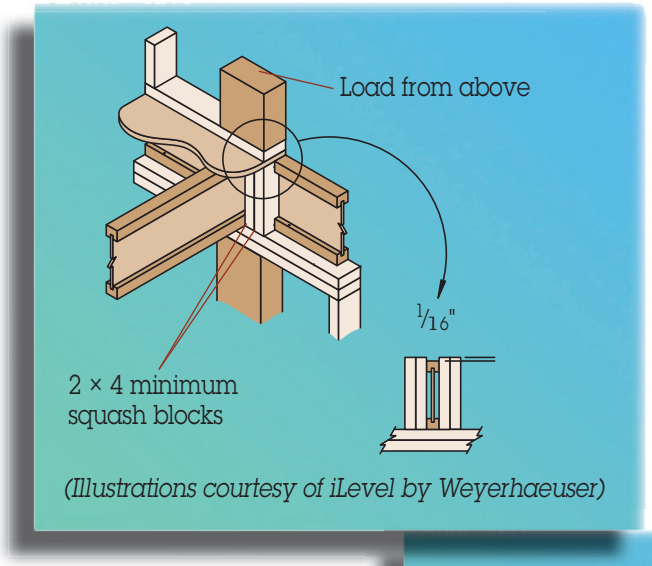
Nails that stick through both web stiffeners need to be clinched (bent over).

Engineered Wood Products *(continued)*

Squash blocks are pieces of lumber installed alongside TJIs at points of heavy loading. They prevent the weight from crushing the TJI. They are typically dimensional lumber like 2 × 4s or 2 × 6s. They should be cut 1/16" longer than the I-joist to take the load off the I-joists.

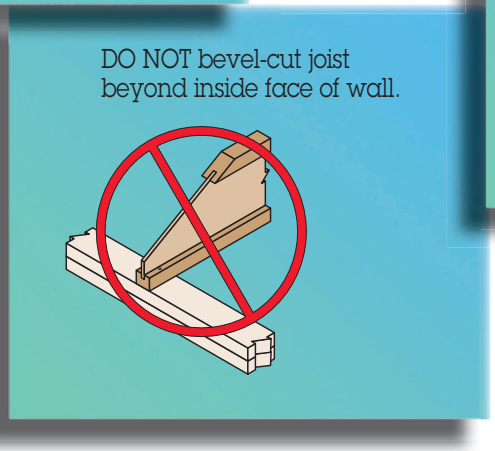
I-joist hardware, such as hangers, is usually delivered with the I-joist package. However, standard I-joist hardware can be purchased separately.

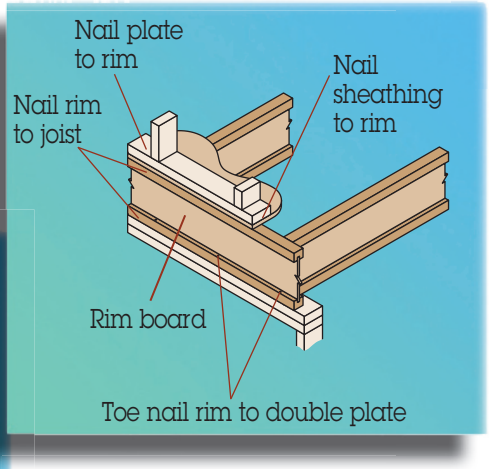
I-joists typically require a 1-¾" bearing. You can cut the end of an I-joist as long as it is not cut beyond a line straight up from the end of the bearing. However, no cuts should extend beyond a vertical line drawn from the end of the bearing point.



(Illustrations courtesy of iLevel by Weyerhaeuser)

Squash blocks should be 1/16" greater than the I-joist height.





Framer-Friendly Tips

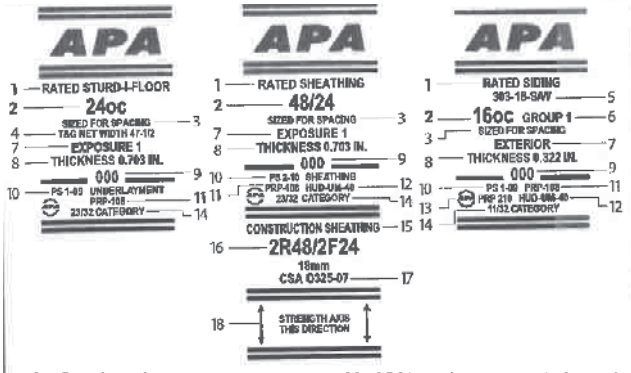
Check the floor above for posts, columns, or concentrated loads so you can install squash blocks while you are joisting.

Lumber and Wood Structural Panel Grade Stamps

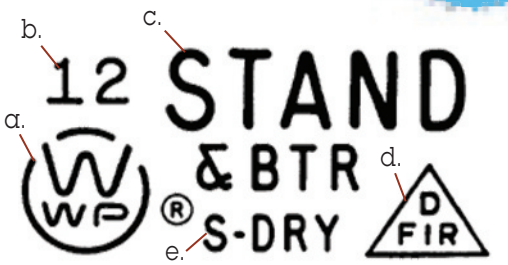
Lumber and wood structural panels are graded for strength and different uses. Each piece of lumber is stamped for identification before it is shipped.

Architects specify grades of lumber and wood structural panels for various purposes, and framers need to make sure the right wood is used.

Wood Structural Panels



1. Panel grade
2. Span rating
3. Sized less than full length/width
4. Tongue-and-groove
5. Siding face grade
6. Species group number
7. Bond classification
8. Decimal thickness designation (this value is generally at or near the lower tolerance specified in PS 1 or PS 2)
9. Mill number
10. Product standard
11. APA's performance rated panel standard
12. HUD recognition
13. Referenced product standard
14. Performance category
15. Panel grade, Canadian standard
16. Panel mark—Rating and end-use designation per the Canadian standard
17. Canadian performance rated panel standard
18. Panel face grain orientation indicator



a. **WWPA certification mark** certifies Association Quality standards and is a registered trademark.

b. **Mill identification** Firm name, brand, or assigned mill number. WWPA can be contacted to identify an individual mill whenever necessary.

c. **Grade designation** Grade name, number, or abbreviation.

d. **Species identification** Indicates species by individual species or species combination.

e. **Condition of seasoning** Indicates condition of seasoning at time of surfacing:

MC-15 – KD-15: 15% maximum moisture content

S-DRY – KD: 19% maximum moisture content

S-GRN: over 19% moisture content (unseasoned)

Lumber

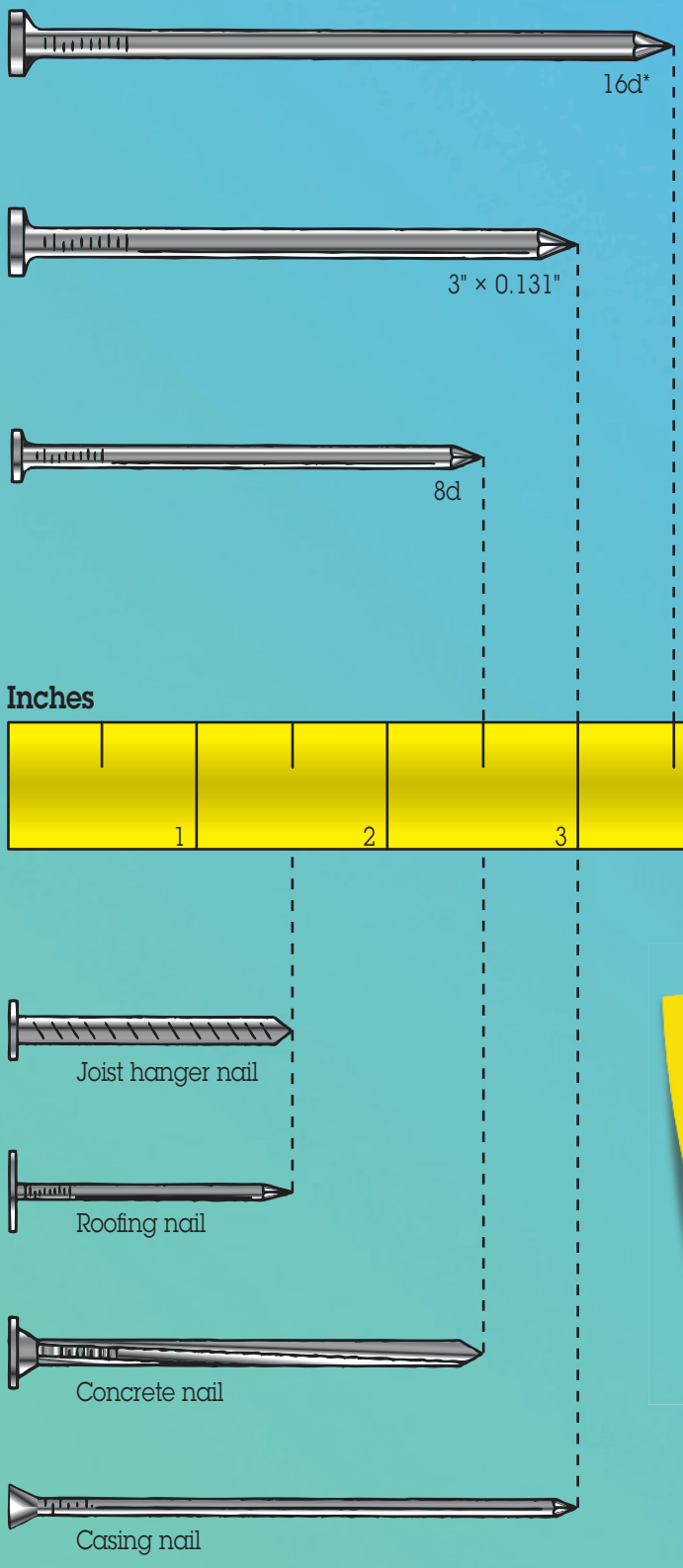
Framing	Grade	Use
Light framing 2 × 2 thru 4 × 4	Construction Standard and better Utility	Plates Sills Studs
Stud 2 × 2 thru 4 × 18	Stud	Studs Cripples
Structural framing	Select structural No. 1 and BTR No. 1 No. 2 No. 3	Studs Plates Joists Rafters Headers Posts Beams

Framer-Friendly Tips

The specification on your plans should tell you the grade you need to use.

Images of grade stamps courtesy of APA, The Engineered Wood Association and WWPA, the Western Wood Products Assocoiation

Framing Nails



16d Common – 3-½" long & 0.162" thick
16d Box – 3-½" long & 0.135" thick
16d Sinkers – 3-¼" long & 0.148" thick

P-Nail – used in a pneumatic nail gun

8d Common – 2-½" long & 0.131" thick
8d Box – 2-½" long & 0.113" thick
8d Sinkers – 2-⅜" long & 0.113" thick

Sinkers have a countersunk checked head and a cement or vinyl coating for easy nailing

Framer-Friendly Tips

If you're concerned about the wood splitting from the nail, tap the nail point with your hammer to dull it.

Framer-Friendly Tips

To help a nail penetrate more easily, some framers run it through their hair first. The oil acts as a lubricant.

***d = Penny**. The abbreviation comes from the Roman word "denarius," meaning coin, which the English adapted to penny. It originally referred to the cost of a specific nail per 100. Today it refers only to nail size.

Framing Tools

Framing Tools *(continued)*



The Switch to Cordless Tools

It's inevitable at some point that future framers will cut the cord and hose completely. The awkwardness of the cord, and the safety issues with having cords laying around, cause difficulties. With electric cords there is also the problem of rain and keeping the connections dry so that they don't trip the circuit breaker. There is also the time and difficulty of rolling up, out, and storing the cords. All in all, cords are a real pain; however, they do provide a lot of power.

The cord has already been cut for some electric tools, and manufacturers are coming out with more powerful battery tools all the time. Battery tools do have their own set of problems. There must be a plan for recharging and enough batteries to make sure that you don't lose power. There is also the reality that batteries from different manufacturers are not interchangeable.

Cutting the cord requires purchase of battery tools. The decision on the best tool is complicated. Different manufacturer's batteries are not interchangeable; however, similar-voltage batteries of different tools by the same manufacturer typically are interchangeable. It is efficient to have tools of the same voltage by the same manufacturer so that the chargers and batteries can interchange. A problem arises when you decide that one tool (e.g., circular saw) is made better by one manufacturer and another tool (e.g., drill) is made better by another manufacturer. One solution is to make a list of all the tools you need and then summarize the benefits and disadvantages of each of the tools from each manufacturer.

To do a brief analysis, it is important to have an understanding of variables that make a battery tool good. To start with, it is important to understand the basics of electricity measurements. Watts (power) is equal to amps (current) times volts (pressure). Watts = amps × volts. Torque is the force produced to turn an object. Torque differs from power or watts in that it depends on the makeup of the tool, while watts indicates the electric power delivered to the tool.

Measurements for Analyzing Tools

1. **Watts:** power = amps × volts
2. **Amps:** the amount of current (electrons flowing)
3. **Volts:** the potential difference = pressure to move the electrons
4. **Torque:** force produced to move an object
5. **HP: H**orse **P**ower—a unit of measurement of power
6. **RPM: R**otation **P**er **M**inute—how fast a tool turns
7. **IPM: I**mpacts **P**er **M**inute—impact wrenches
8. **BPM: B**lows **P**er **M**inute
9. **SPM: S**trokes **P**er **M**inute—reciprocating saws
10. **UWO: U**nits **W**atts **O**ut—power—max speed and torque
11. **VSR: V**ariable **S**peed **R**eversible
12. **AH: A**mp **H**our—battery capacity—one amp of current for one hour
13. **Ft-lbs:** the torque created by one pound of force acting at a perpendicular distance of one foot from a pivot point
14. **In-lbs:** the torque created by one pound of force acting at a perpendicular distance of one inch from a pivot point

The amount of time a battery will last before needing a recharge is the amp hours and should be listed in the specifications for the tool; however, that is not always the case.

Brushless technology is used on many new tools and will probably take over for brushed tools in the future. Brushless eliminates the brushes touching the commutator in the motors and therefore reduces heat and friction, which reduce the power output. Brushless tools are also lighter.

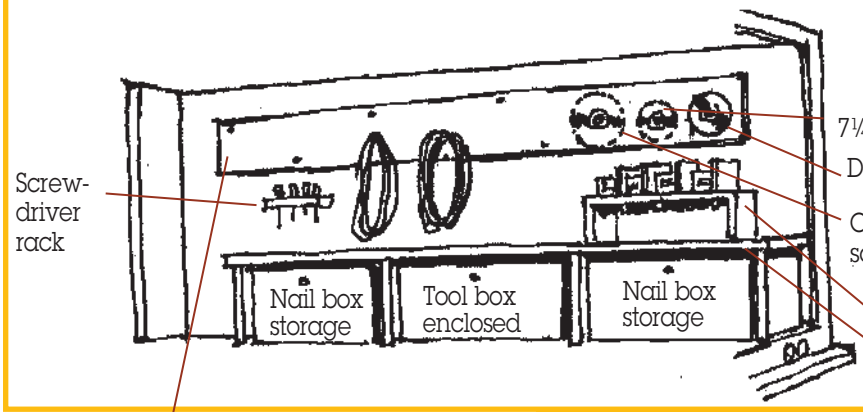
There are other factors that you will want to consider in evaluating battery tools, like the weight of the tool, if it has ergonomic padded hand grips, rafter hooks, electric brakes for circular saws, and variable speed for drills and reciprocating saws. Compare foot- or inch-pounds of torque for hammer drills and impact wrenches, maximum capacity for drill hole sizes, and many other advantages that manufacturers are always coming up with.

Framing Tool Truck

Typical Layout for a 14' Step Van

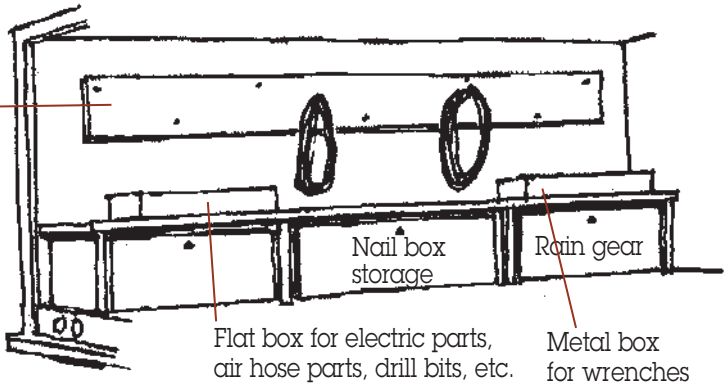
If you're a professional framer, organizing your tools helps keep them in good condition and helps you find them when you need them—saving valuable time on the job.

Right Side

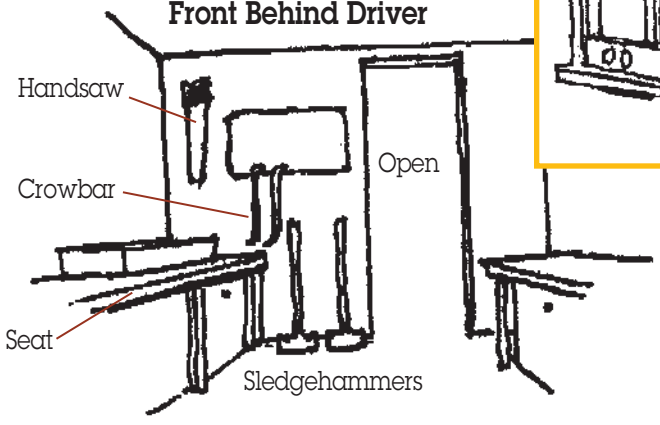


Anchor bolts attached to 2 × 10 and used for hanging air hoses, electric cords, and tool pouches

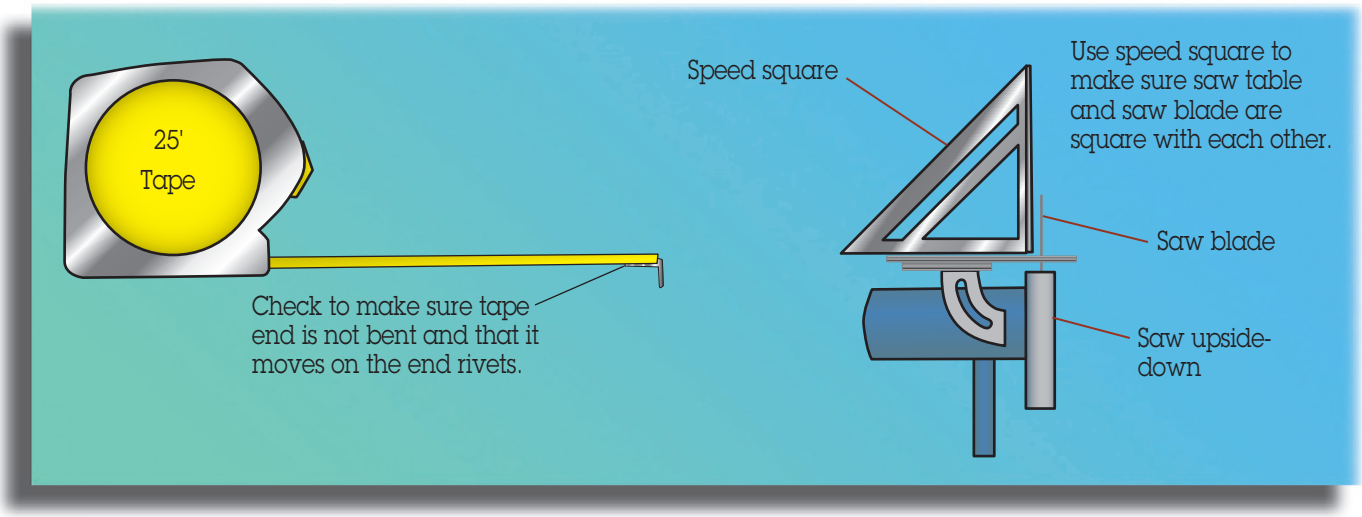
Left Side



Front Behind Driver



Cutting Lumber



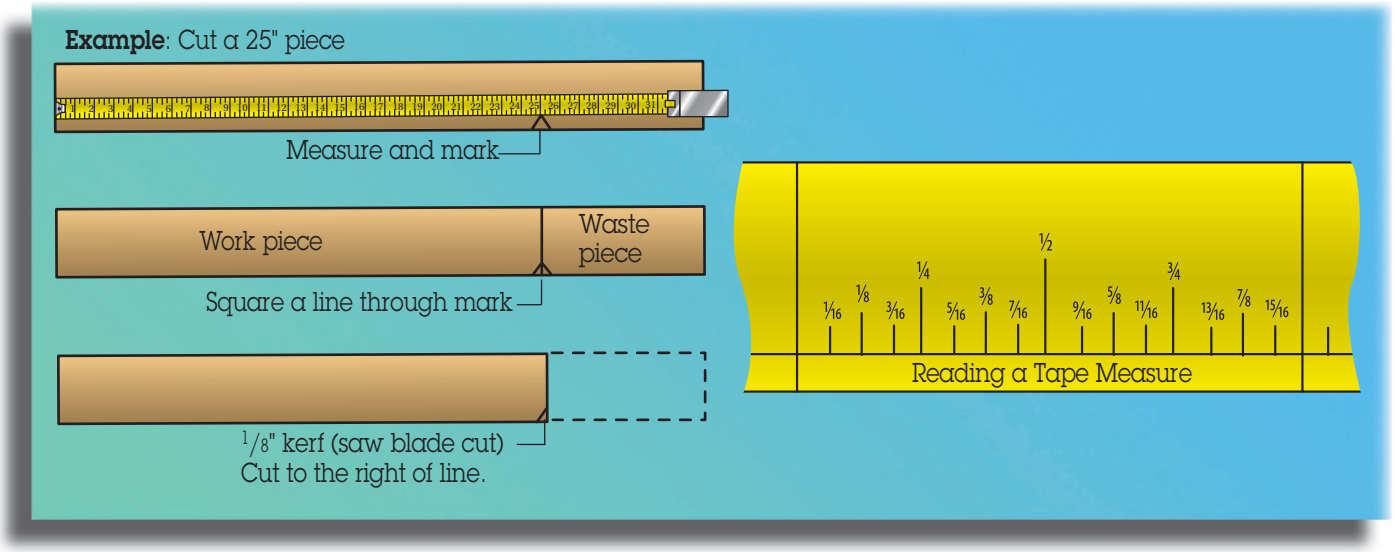
Accuracy in measuring, marking, and cutting lumber is a very important framing skill to master. Periodic checks should be made of the condition of tape measures and the squareness of saw tables and blades.

A typical saw blade removes a channel of wood approximately ⅛" wide, called a *kerf*. This must be taken into consideration when you make a cut.

Suppose you want to cut a board 25" long. Measure and make a mark at 25", then square a line through the mark with a square. The *work piece*— the 25" piece you want to use—will be to the left of the line; the *waste piece* will be to the right. Guide your saw along the right edge of the line so the kerf is made in the waste piece. If your cut is perfectly made, the work piece will be left showing exactly half the width of your pencil line, and will measure exactly 25". Thus, the old carpenter's saying: "Leave the line."

Framer-Friendly Tips

The tip of the tape is made to move in and out the thickness of the metal tip. This allows for the same measurement whether you butt the tip or hook the tape.



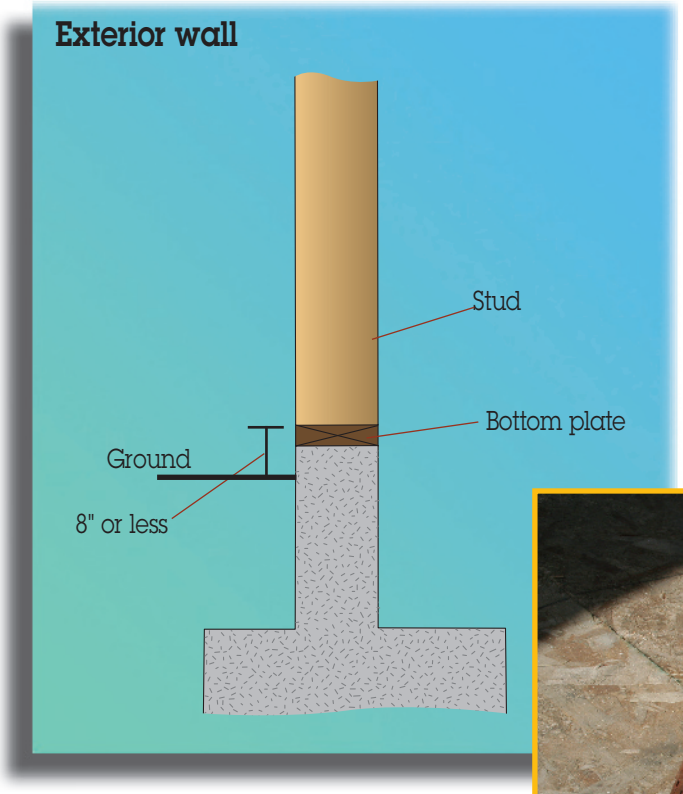
Protecting Lumber from Decay

Moisture and warmth will promote decay of most woods. To prevent decay, naturally durable woods or preservative-treated wood must be used when the wood is exposed to moisture.

Decay-resistant woods include redwood, cedar, black locust, and black walnut. Preservative-treated wood is treated according to certain industrial specifications. Preservative-treated wood is most commonly used because of its availability.

Preservative-treated or naturally durable woods should be used in the following locations:

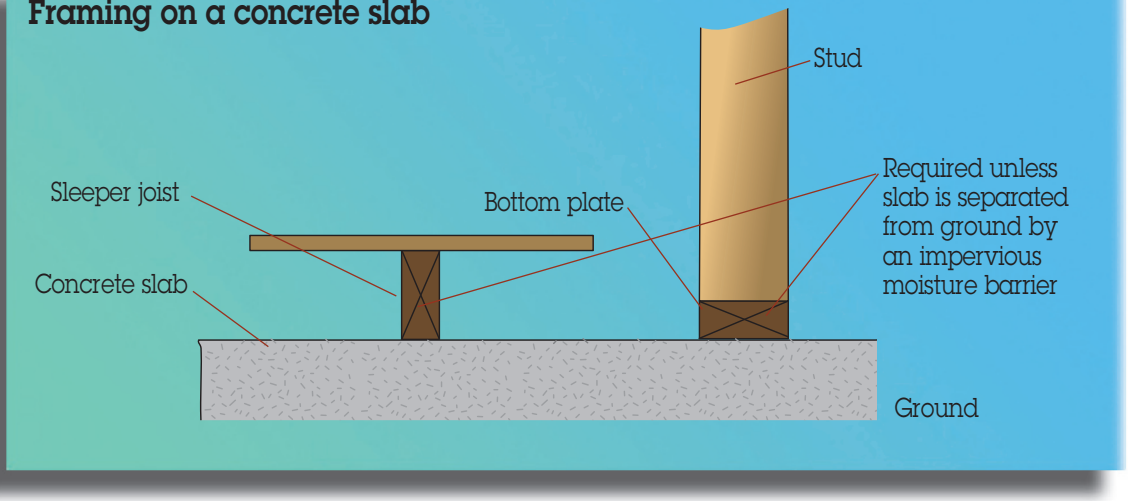
1. On concrete foundation walls that are less than 8" from exposed earth.
2. On concrete or masonry slabs that are in direct contact with earth.
3. Where wood is attached directly to the interior of exterior masonry or concrete walls below grade.
4. For floor joists if they are closer than 18" to the exposed ground.
5. For floor girders if they are closer than 12" to the exposed ground.



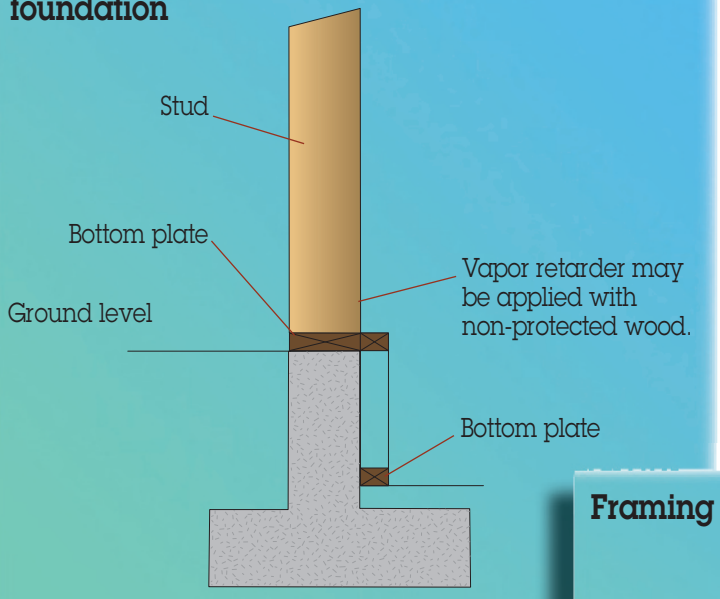
When pressure treated lumber is cut on the job site, apply treatment to the end by soaking or brushing

Protecting Lumber from Decay *(continued)*

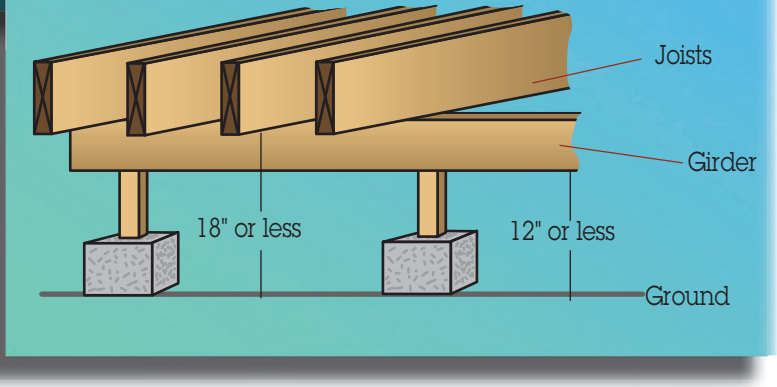
Framing on a concrete slab



Framing furring wall on a concrete foundation



Framing crawl space from ground



Preservative Treated Wood

The treating of wood in recent years has gone through some major changes. The most important thing to know is that there are different types of preservative treatment and that some of the treatments require specially coated fasteners to prevent corrosion.

A little history will help in understanding. For years the predominant chemical for preserving dimension lumber had been chromated copper arsenate (CCA). However, health concerns arose because of the arsenic content in CCA, and in 2004 the Environmental Protection Agency (EPA) required labels on CCA, which had the effect of disallowing the use of CCA-treated wood for most residential uses.

The first commonly used substitutes were copper azole (CA) and alkaline copper quaternary (ACQ). These eliminated the arsenic but created a different problem because they were corrosive to steel fasteners. To solve this problem, hardware manufacturers began making their common fasteners with a galvanized coating. For example, if you see a Simpson Strong-Tie hardware labeled Z-max you know it has been coated so that it can be used with CA and ACQ. Steel nails also had to be coated when used with lumber treated with CA or ACQ. Typically they are galvanized. Stainless steel is a better substitute for hardware and nails because it is less corrosive, but it is expensive.

Sodium Borate (SBX) preservative treatment is another substitute for CCA that does not have the problem of causing corrosion of steel fasteners, however it will wash out of the lumber with liquid exposure. It is specified for use above ground and continuously protected from liquid water.

New products are continually being developed. Carbon-based compounds are among these and could prove to be less corrosive and natural in color.

The 2018 IBC and IRC code states that preservative treated wood should be in accordance with AWPA U1 and M4 (American Wood Protection Association Use Category System) for the species, product, preservative, and end use. The lumber tag attached to the treated wood will give the use category to assist you in making sure you are using the correctly treated wood.

All the different labels and chemicals can be confusing. Most importantly, make sure that you are using the right treatment for the task at hand and that you are using corrosive resistant fasteners where necessary. To check the correct use of treated lumber, read the tag attached to the lumber or ask the lumber supplier. For CA or ACQ treatment, you will need corrosion-resistant fasteners; for SBX or other borate treatments, you will not need corrosion-resistant fasteners. Beyond that, check on the fastener boxes for specifications or ask the lumber or fastener supplier.