UNIT 3

The Nature of Wood

Wood used in carpentry (and other trades) is obtained mostly from the trunk of the tree. An understanding of the different parts of a treetrunk and of how a tree grows is useful to anyone who works with wood.

STRUCTURE OF WOOD

Wood is composed of tiny cells (fibers). These cells are tubular in shape and are about as thick as a human hair. Cells in softwood trees are about 1/8″ long. Cells in hardwood trees are about 1/24″ long. See Figure 3–1.

The walls of each cell are composed of *cellulose* matter. The cells are held together with a natural cement called *lignin*. A tree grows by forming new wood cells. It reaches full maturity and stops growing when new cells stop forming.

Annual rings begin at the center of the trunk and continue outward to the bark. See Figure 3–2. Each ring represents a year of cellular growth. Therefore, the age of a tree is very close to the number of its annual rings. In drier seasons there is less growth, so some rings are narrower than others. A close look at each annual ring shows that it is made up of an inner, light-colored section and an outer, darker section. The light-colored section is the earlier growth of that year and is known as *springwood*. The darker part develops later in the growing season and is known as *summerwood*. Spring-

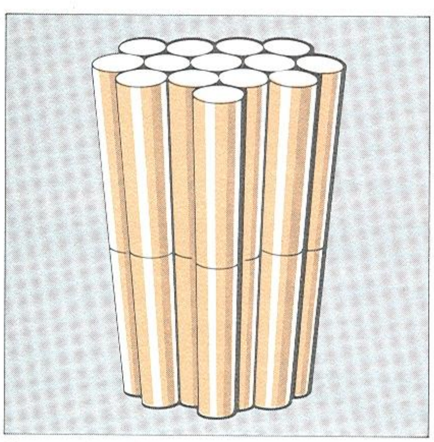
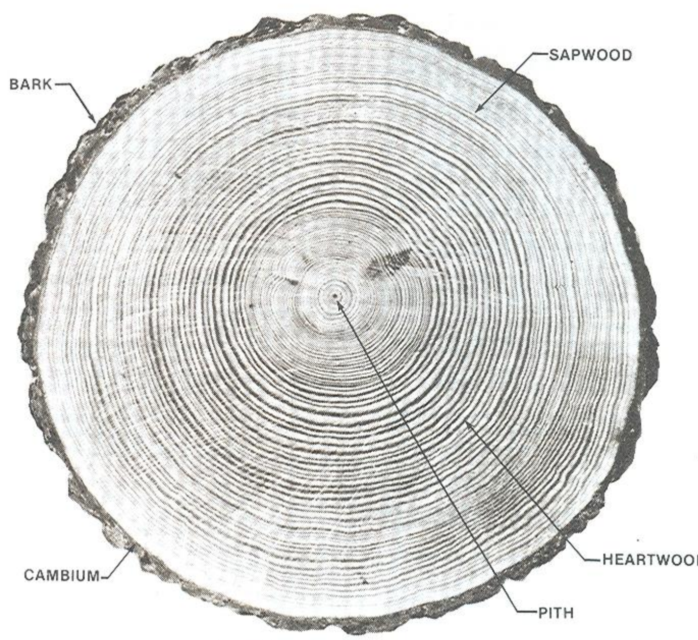


Figure 3–1. Wood is composed of tiny cells. The cells are drawn here many times larger than their actual size.



Forest Products Laboratory—Forest Service USDA

Figure 3–2. Cross section of treetrunk shows annual rings. Each ring represents a year of cellular growth.

wood is usually weaker and less dense than summerwood.

The outside covering of the tree consists of *bark*. A tree has two layers of bark. The outer layer is dry, dead tissue. Its purpose is to protect the tree from exterior damage. The inner bark is moist and soft. Its function is to help transport food from the leaves to all the growing areas of the tree.

Directly underneath the bark is a very thin layer called the *cambium*. The light-colored section under the cambium is *sapwood*. The darker layer that goes from the sapwood to the *pith* (center) of the trunk is *heartwood*. The *medullary rays*, also called *wood rays*, extend radially from the pith to the outer bark.

Cambium

New cells are formed in the cambium. The inner part of the cambium develops the wood cells that become sapwood. The outer part of the cambium produces the new cells that form the bark.

Sapwood

Sapwood is the growing portion of a tree. Food is stored and absorbed here. Sap, the watery fluid that circulates through a tree, travels from the roots, up through the sapwood, and to the leaves. A young tree consists entirely of sapwood.

Heartwood

As a tree grows, the number of annual rings increases. Also, the layers of wood nearest the center of the trunk undergo certain changes. The wood cells become inactive and no longer conduct sap and food. When this happens, the sapwood in this central part of the tree changes into heartwood and usually begins to darken in color.

Lumber cut from sapwood and lumber cut from heartwood are about equal in strength. However, heartwood is more resistant to decay. As a result, it is more durable than sapwood when exposed to weather and is therefore a better outside finish material.

Pith and Medullary Rays

The pith is the small central core of the tree. It is a soft, spongy material and does not produce a good structural grade of lumber.

The medullary rays start from the pith area and move toward the outside of the trunk. Their purpose is to store and transport food.

MOISTURE CONTENT OF WOOD

Water accounts for a large percentage of the weight of a living tree. It is present in the cell cavities of the wood as well as in the walls of each cell. Recently cut lumber (*green lumber*) consequently has a very high amount of moisture.

Lumber begins to dry out as the water contained in the wood cells evaporates. The water evaporates first from the cell cavities, then from the cell walls. When the cell cavities are empty of water but the cell walls still contain water, the *fiber saturation point* has been reached. Wood does not begin to shrink until after it reaches the fiber saturation point. Only when the water begins to leave the cell walls do the cells begin to decrease in size, which causes the wood to shrink.

Lumber gives off moisture until the amount of moisture in the wood is the same as the amount of moisture in the surrounding air. When this occurs, the lumber has reached a state of *equilibrium moisture content*. At this point the lumber stops shrinking.

Moisture content can be tested in a laboratory by the oven-drying method shown in Figure 3–3. It can also be tested in the

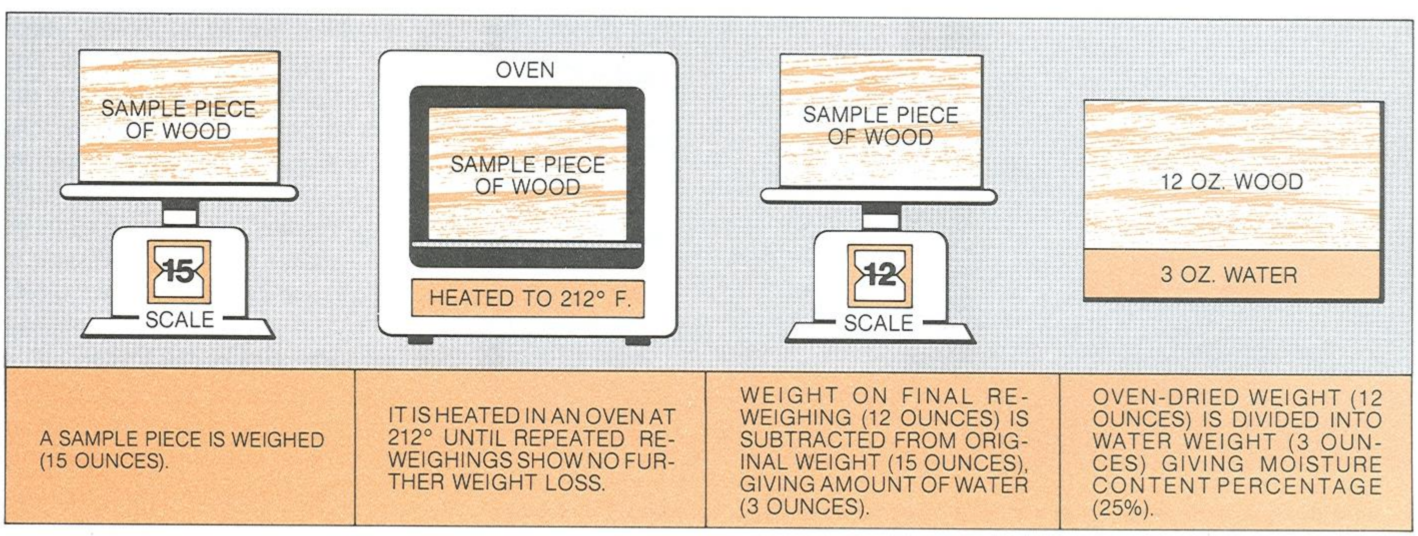
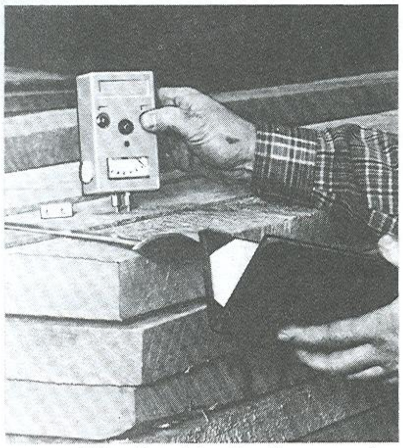


Figure 3–3. The moisture content of wood is the percentage of its weight that is water. The oven-drying method gives an accurate measure of moisture content.



Educational Lumber Company, Inc
Figure 3–4. A moisture meter is a less accurate but more convenient way to check the moisture content of wood than the oven-drying method.

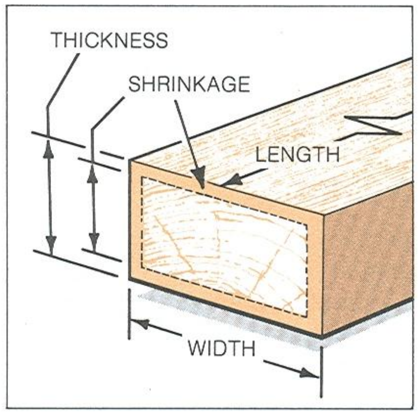


Figure 3–5. Most lumber shrinkage occurs across the grain. For example, a 2″ x 4″ x 8′ piece of lumber will shrink more across its 2″ thickness and its 4″ width than along its 8′ length.

field with a moisture meter. See Figure 3–4. A moisture meter gives an instant reading of moisture content by measuring the resistance to current flow between two points driven into the wood. It is not as accurate as the oven-drying method, but it is accurate enough for most construction purposes.

Lumber should have moisture content compatible with the air that will surround it after it is installed. In drier parts of the country the moisture content of lumber should be no more than 15%. In damper areas as much as 19% is acceptable. Interior finish materials in most areas should have a moisture content between 6% and 12%.

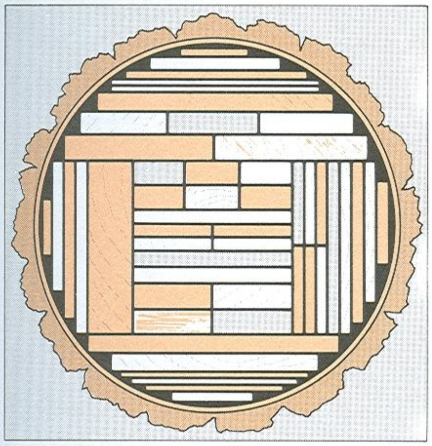
Effects of Moisture Content

If lumber has too high a moisture content when used on a job, problems may develop from additional shrinkage. Framing members inside the walls may shrink as the wood dries out, causing plaster to crack, or nails to pop out if drywall is used. Most wood shrinkage occurs across the grain. A piece of material 2″ thick, 4″ wide, and 8′ long will shrink very little along its 8′ length. It will, however, noticeably shrink across its 2″ thickness and 4″ width. See Figure 3–5.

The strength of wood increases as moisture content decreases, because the cell fibers of the wood stiffen and become more compact as they dry out. Wood will not decay (rot) if the moisture content is below 20%. Wood installed under conditions where the moisture content will remain higher than 20% should be treated with chemicals that prevent decay.

Many wood products today (such as plywood) consist of layers glued together. The glue bond of these wood products improves as the moisture content of the wood decreases.

UNIT 4



Manufacture of Lumber

Trees are one of our greatest natural resources. As the population of our country continues to grow, however, more and more trees are needed to supply the lumber required for housing and other kinds of construction. Part of the answer to this problem is being provided by improved forest management, and another part by the elimination of waste in sawmill operations.

About half of the bulk of a round-shaped log fed into a modern sawmill comes out as usable construction lumber. The other half is *residue*, consisting of chips, bark, trimmings, shavings, and sawdust. At one time the residue was considered of no value and was burned as waste. Today almost all of the residue is converted to useful products. The wood chips are a major source of wood fiber used by paper mills. Planer shavings and chips are important ingredients in the manufacturing of panels used for sheathing and insulation. (These panel products are discussed in a later unit.)

The manufacture of lumber begins in the forest where the trees are cut. Limbs and branches are removed, and the tree is cut into sections (logs) small enough to be transported by truck to the sawmill. See Figures 4–1 and 4–2. The logs are manufactured into the different sizes of lumber used in construction work. See Figure 4–3.

Initial sawmill operations include *debarking,* a process of stripping the bark from the log. See Figure 4–4. The debarked logs are cut into smaller sections, which are cut into boards by a bandsaw. See Figure 4–5. The boards are fed by conveyor belts into a *trimmer,* which cuts the boards to standard lengths and also cuts off pieces with defects. See Figure 4–6.

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Figure 4–1. Log loader placing freshly cut logs on the bed of a lumber truck for transport to the sawmill. This loading equipment features a hydraulic power boom and grapple.

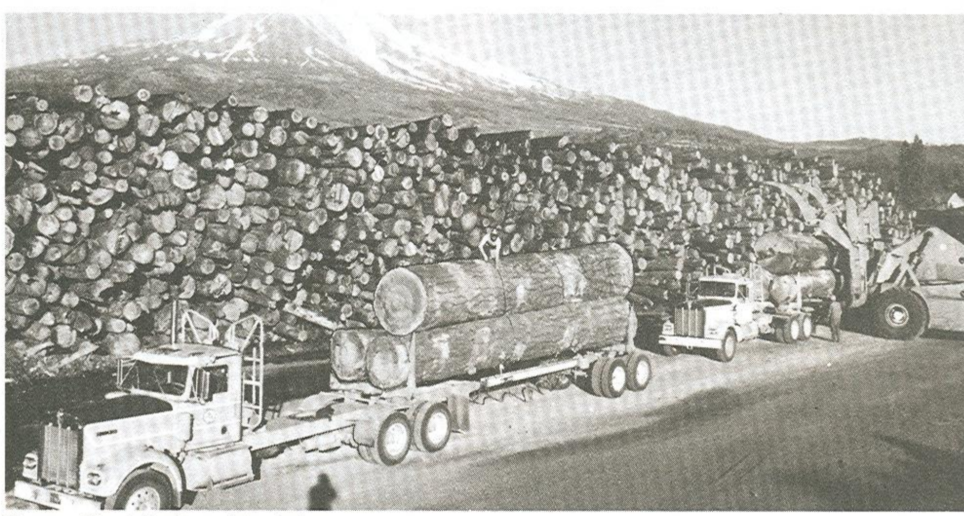

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Figure 4–2. Mechanical log stacker at rear unloads trucks that have brought logs to the storage yard.

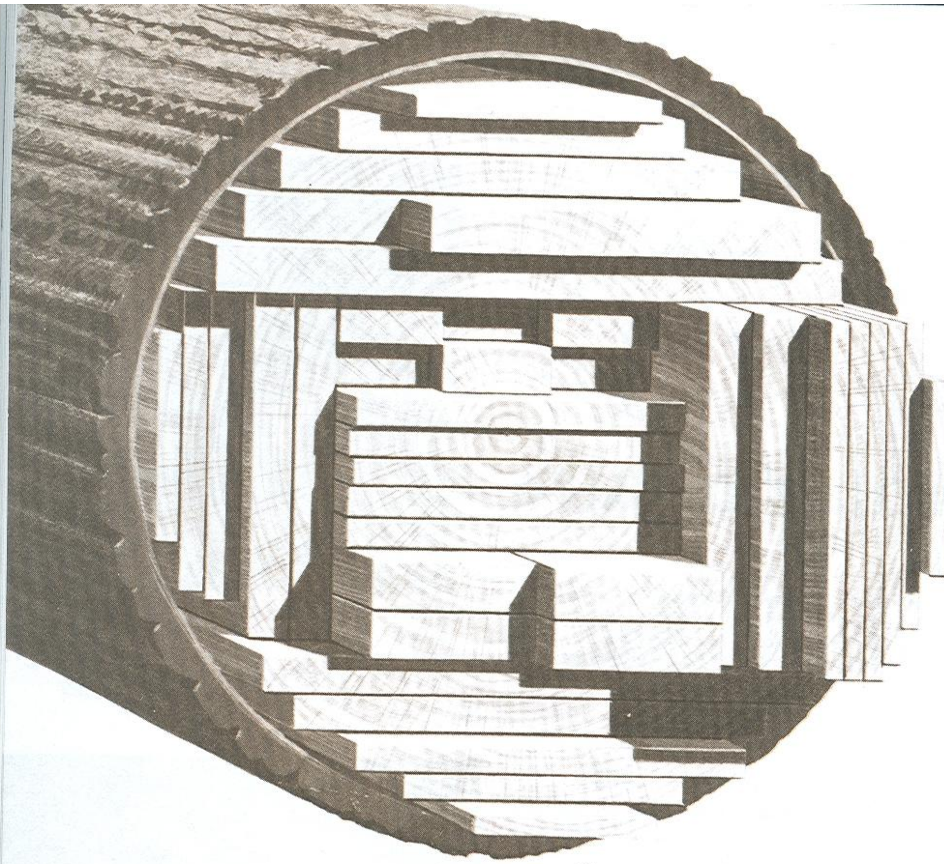

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Figure 4–3. A log can be cut into many shapes and sizes of lumber.

SAWING METHODS

There are two methods of cutting logs into pieces of lumber. One method produces *plainsawn* hardwood lumber and *flat-grained* softwood lumber. The other produces *quartersawn* hardwood lumber and *edge-grained* softwood lumber. See Figure 4–7.

Plainsawn and Flat-grained lumber

In plainsawing, the annual growth rings of the log are at an angle of 45° or less to the wide surface of the boards being cut. This is sometimes called a *tangential* cut. Most lumber is produced in this manner. It provides the widest boards and results in the least amount of waste. The term *plainsawn* refers to hardwood lumber. *Flat-grained* refers to results of the same method on softwood.

Quartersawn and Edge-grained Lumber

For quartersawn lumber, the log is first quartered lengthwise. Then boards are cut out of each quartered section. This method is much more expensive than plain-

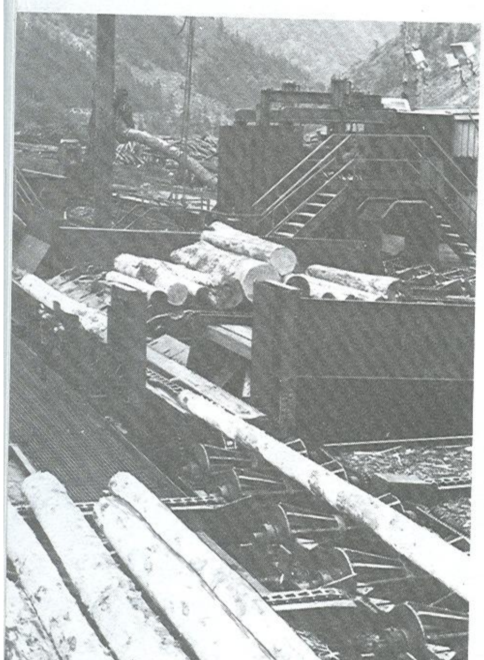

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Figure 4–4. Logs being conveyed to the sawmill from a log merchandising deck. The logs first pass through a debarker (upper right). They are then cut into smaller sections and moved to the conveyor belt shown in front of the merchandising deck. The conveyor belt carries the logs to their proper station in the sawmill.

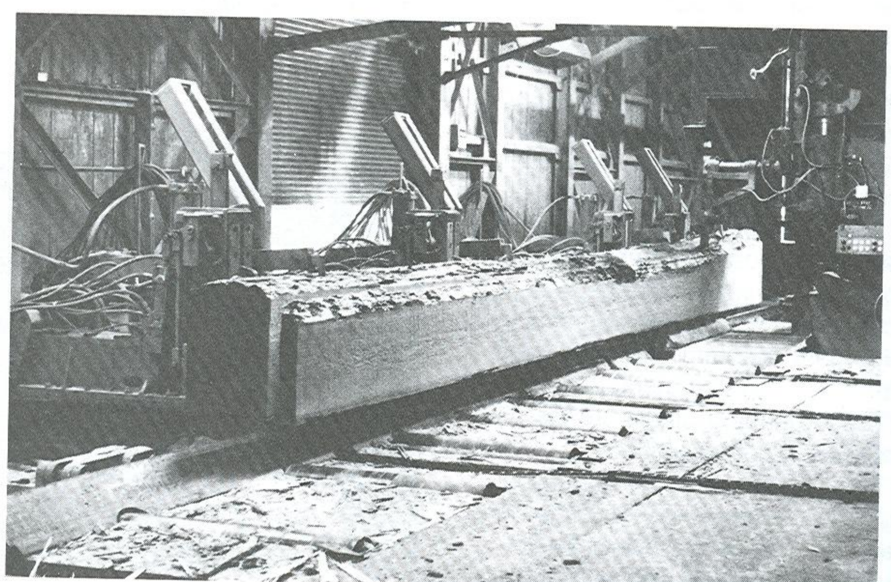

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Figure 4–5. Cutting a board out of a log. A carriage system moves the log through a bandsaw, which is shown completing the cut at the right end of the log.

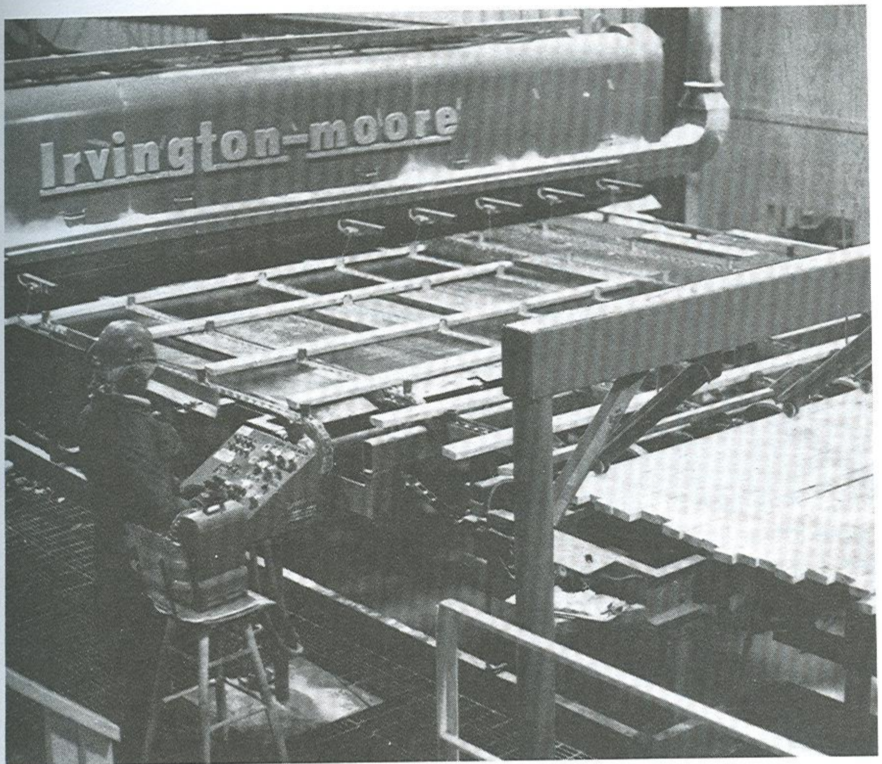

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Figure 4–6. The operator controls a trimmer (upper left), which consists of a series of saw blades that remove defects and cut the boards to standard lengths. The boards are fed into the trimmer by conveyor belts.

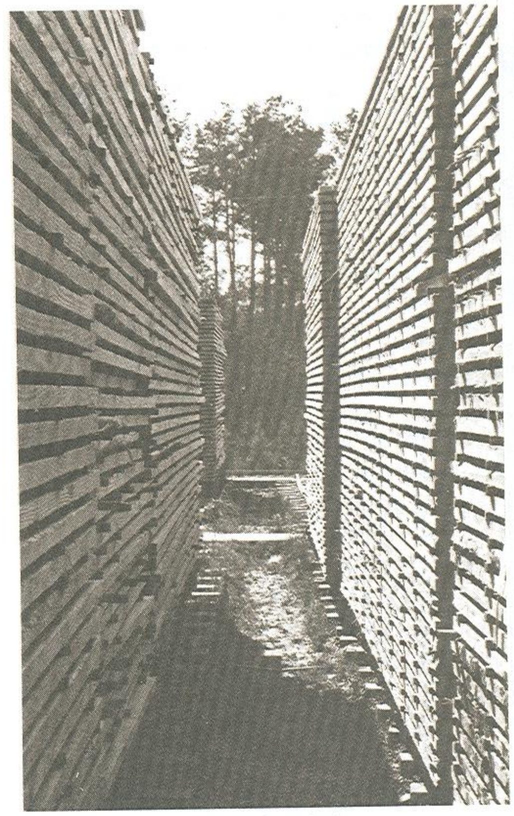

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Figure 4–8. One method of seasoning lumber is air drying. Note the stickers placed between rows of lumber to allow for complete circulation of air.

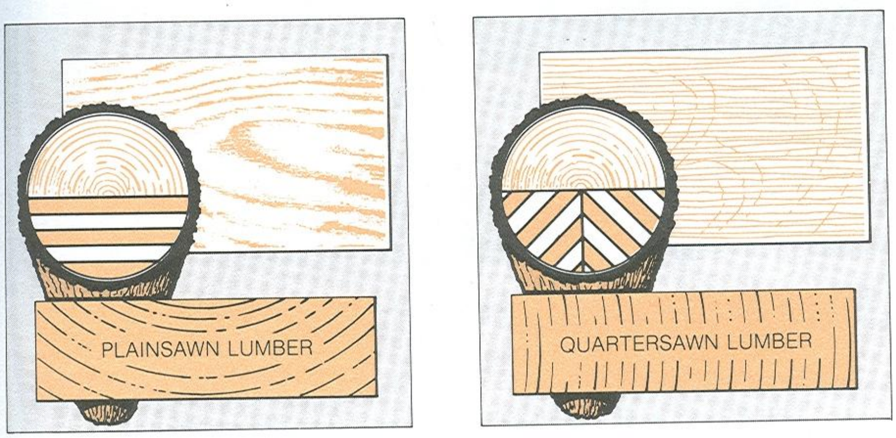

Figure 4–7. One sawing method produces plainsawn lumber on hardwood and flat-grained lumber on softwood. The other sawing method produces quartersawn lumber on hardwood and edge-grained lumber on softwood.

sawing, as it produces narrower boards and creates more waste. However, it produces a more attractive grain pattern in some hardwoods. Also, there is less warpage in quartersawn wood. The term *quartersawn* refers to hardwood lumber. *Edge-grained* refers to results of the same method on softwood.

SEASONING METHODS

Lumber must be *seasoned* (dried) before it is placed on the market. The two methods of seasoning are *air drying* and *kiln drying*.

Air Drying

For air drying, the newly produced lumber is stacked out in the open air. Wood strips are placed between the layers of wood so that air can circulate around each piece. See Figure 4–8. It takes several months for the lumber to season adequately. Most softwood used for rough construction is seasoned by this system.

Kiln Drying

For kiln drying, the lumber is placed in a temperature-controlled building called a *kiln*, which acts like a large oven. First, steam is used to keep the humidity (amount of moisture in the air) high in the kiln. As the temperature in the kiln is gradually increased, the humidity level is brought down. Lumber seasoned in this manner is stamped *kiln-dried* and is more expensive than air-dried material. This method of seasoning is usually used for the higher grades of hardwood lumber that are used for finish work.

PLANING AND GRADING

When it is cut from the log, lumber has a rough surface. After seasoning, it must be finished off in a planing mill.

At the mill, it passes through *planers*, which are machines with rotating knives that smooth off (*surface*) the sides and edges of the lumber. As it moves along a conveyor belt, highly skilled workers called *graders* examine the boards for defects and mark each piece according to grade. See Figure 4–9. The graded pieces are later sorted according to thickness, width, and length. See Figure 4–10.

LUMBER DEFECTS

Defects sometimes, but not always, affect the strength, stiffness, or appearance of lumber. Most individual pieces of lumber have some defects. The number and type of defects determine the grade of the lumber. Lumber with serious defects cannot be used for structural purposes.

Natural Defects

Most defects occur from natural causes during the growth of the tree. *Knots* are one of the better known examples. As the tree grows, its upper limbs, as well as the limbs of surrounding trees, cast shadows upon its lower limbs. The lack of light causes some lower limbs to die, decay, and fall away. However, a small piece of the dead limb may remain attached to the tree. As the tree continues to grow and expand, new sapwood is added to the trunk. The pieces of dead limb are covered over and become knots.

Knots are found in most lumber. See Figure 4–11. If they are *sound* knots (those that remain firmly in place), a small number of them will not significantly affect the strength of the lumber. Knots are identified by their diameter as follows:

1. Pin knot: ½″ or less.
2. Small knot: More than ½″ but less than ¾″.
3. Medium knot: More than ¾″ but less than 1½″.
4. Large knot: More than 1½″.

Other defects brought about by natural causes are (see Figure 4–12):

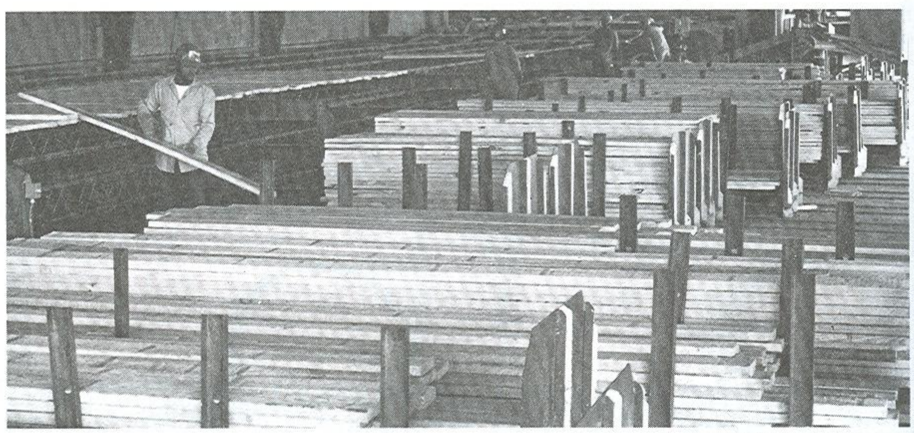

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Figure 4–10. The graded pieces of lumber are being removed from the conveyor belt and sorted according to thickness, width, and length.

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Figure 4–9. Grader stamping lumber grades on the pieces emerging from the trimmer.

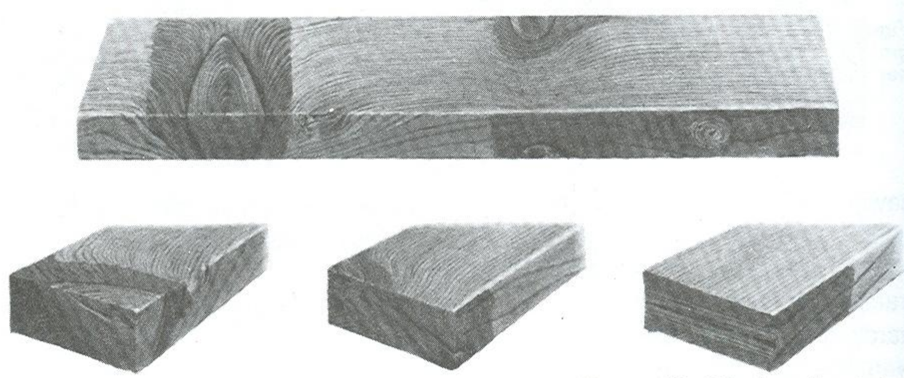

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Figure 4–11. Knots are found in most grades of lumber. A small number of sound knots will not significantly affect the strength of the lumber.

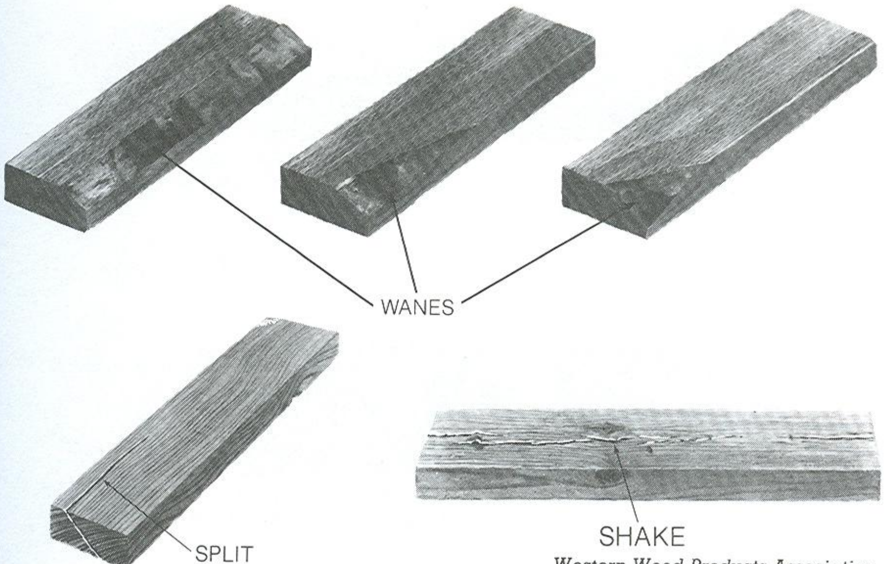

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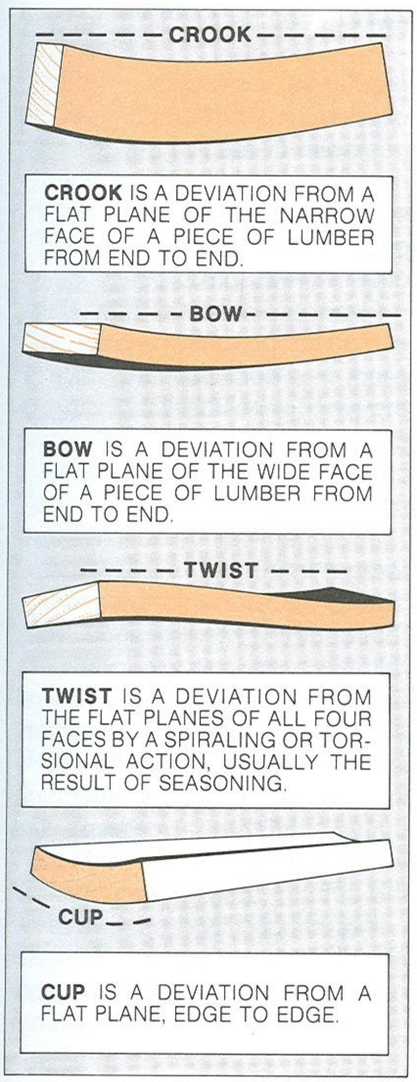
Figure 4–12. Wanes, splits, and shakes are among the lumber defects that occur from natural causes.



Information from Western Wood Products Association

Figure 4–13. Different kinds of warpage can occur during the evaporation of water from the cells of the wood.

Wane: An absence of wood or the presence of bark on the edge or corner of a piece of lumber.

Shake: A lengthwise separation of wood fibers between or through the annual growth rings.

Check: A separation of wood fibers across the annual growth rings.

Split: Same as a check but extending all the way through a piece of lumber.

Pitch pocket: An opening in the wood that contains solid or liquid pitch.

Pitch streak: A section of wood fibers saturated with enough pitch to be visible.

Defects caused by fungi are discussed later in this unit.

Warping

Warping is a distortion that occurs during the evaporation (drying out) of water from the cells of the wood. Uneven shrinkage in the wood produces warping. This results in twisted and uneven shapes of lumber. Common warpage shapes are the bow, crook, twist, and cup. See Figure 4–13.

Damage from Manufacturing Processes

Defects that mar the appearance of lumber may be caused during sawmill operations. A list of such defects follows:

1. Chipped, torn, raised, or loosened grain.
2. Skip marks that occur during surfacing.
3. Machine-caused burns.
4. Bite or knife marks.

WOOD PROTECTIVE TREATMENT

Wood can be treated to make it resistant to fire, decay, and attacks from insects. Most wood treatments are designed to protect against fungi and termites, as these are the main causes of serious damage to lumber. The damage usually begins in the wood members near ground level. (Protection against termites is discussed in Section 8.)

Damage Caused by Fungi

Dry rot causes wood tissue to break down, reducing the strength of a wood member. See Figure 4–14. It is the most common type of damage caused by a fungus. The fungus that causes dry rot lives in the wood and can be seen only with a microscope. Since this fungus must have water to live, it can survive only in wood with a moisture content of at least 20%. The term *dry rot* is misleading, since the decay begins under damp conditions. However, it is often not detected until after the wood has dried out.

Other types of fungi than the one that causes dry rot cause specks, molds, and stains. These fungi are fairly harmless, since they damage only the surface of the wood, affecting its appearance but not its structural quality. *White speck* and *honeycomb* are examples of this type of damage. Wood with white speck has small white spots or pits. See Figure 4–15. Honeycomb is similar, but the spots are larger or the pits are deeper. Another type of fungus causes *blue stain,* which is a blue-gray discoloration.

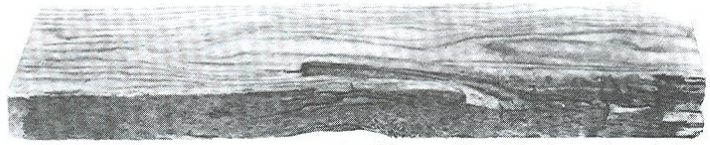


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Figure 4–14. Decay (dry rot) is the breakdown of wood caused by a wood-destroying fungus.

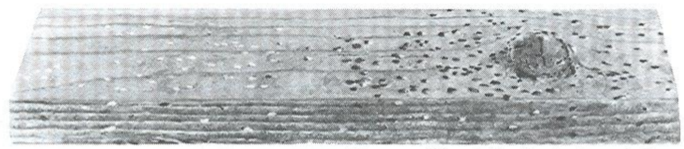

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Figure 4–15. White speck affects only the surface of the lumber.

Wood Preservatives

Wood preservatives come in liquid form. They contain chemicals that protect the wood against fungi decay and insect attack. Preservatives can be divided into three major types: water-borne, oil-borne, and creosote.

Water-borne Preservatives. Water-borne salt preservatives are used to treat lumber and plywood for residential construction. Two highly recommended mixtures are ammoniacal copper arsenate and chromated copper arsenate. After application of a water-borne preservative, the surface of the wood will be clear, odorless, and easy to paint.

Oil-borne Preservative. Best known as pentachlorophenol, an oil-borne preservative is highly toxic to fungi and insects. However, this type of preservative may affect the surface color of the treated material.

Creosote. Creosote is one of the oldest preservatives and is still one of the most widely used. It comes in a number of mixtures and leaves a slight odor after it has been applied. Surfaces coated with creosote cannot be painted.

Methods of Application. Preservatives may be applied by a *pressure* or a *non-pressure* process. The pressure process is considered to be the most effective. Lumber is loaded onto tram cars and rolled into long steel cylinders, which are then sealed off. The cylinders are filled with the preservative liquid. Intense pressure builds up inside the tank and causes the preservative to penetrate deep into the wood.

The non-pressure process gives less protection, but it is simpler and less expensive to apply. The wood is submerged in an open tank filled with preservative for a period of at least three minutes.

Fire-retardant Treatment

Attention is being focused today on the fire hazards connected with building materials. Wood is highly combustible (it ignites and burns easily). Methods are continually being developed to give greater fire protection to lumber used in construction. Lumber that has been treated to make it fire-retardant is available for roof systems, beams, posts, studs, doors, hardwood paneling, and other interior trim products.

Fire retardants are applied the same way preservatives are applied. In a non-pressure process the wood receives a fire-retardant coating. In a pressure process it is impregnated with the fire-retardant chemicals.

The chemicals used in fire-retardant treatment react to heat slightly below the temperature required to ignite the wood. They release a vapor that surrounds the wood fibers and sets off a reaction in the wood. This reaction is the formation of a protective insulating *char* on the surface of the wood. The char prevents the wood from igniting and reduces the amount of smoke and toxic fumes caused by the fire. Fire-retardant wood products are also resistant to termites and decay.

UNIT 5

Softwood and Hardwood

All trees are divided into the two main classes of *softwood* and *hardwood*. Therefore, all lumber is referred to as either softwood or hardwood lumber. In addition, lumber is called by the same name as the tree it comes from. For example, Douglas fir lumber comes from a Douglas fir tree. Walnut lumber comes from a walnut tree.

The terms *softwood* and *hardwood* can be confusing, since some softwood lumber is harder than some hardwood lumber. Generally, however, hardwoods are more dense and harder than softwoods.

Softwood trees are called *conifers*. They have thin, needle-shaped leaves and they bear cones in which seeds germinate and grow. See Figure 5–1. These trees are called *evergreens* because they usually bear leaves all year long. Over 75% of the wood used for construction is softwood.

Hardwood trees are broad-leaved, *deciduous* trees, meaning they lose their leaves in the autumn. See Figure 5–2.

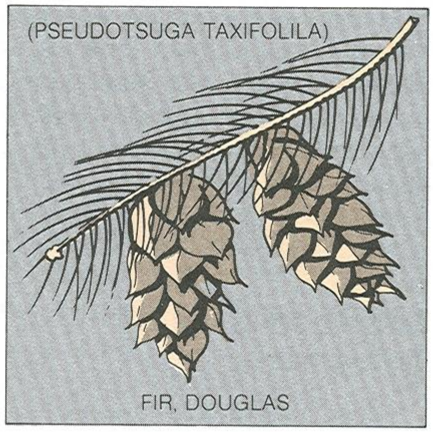

Figure 5–1. Softwood lumber comes from evergreen trees, which bear cones and have needle-shaped leaves.

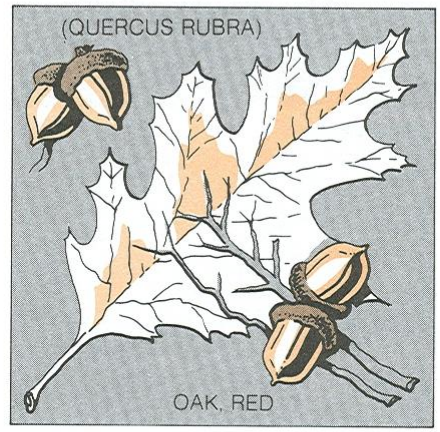

Figure 5–2. Hardwood lumber comes from broad-leaved, deciduous trees. These trees lose their leaves in the fall.

SOFTWOOD LUMBER

All lumber used for rough construction is softwood. Examples of rough construction are the framing and sheathing of wood-framed houses (Figure 5–3) and the building of forms for concrete structures.

Softwood species are also used for finish products such as moldings, doors, and cabinets. As a rule, softwood finish material is painted rather than stained. Some of the more frequently used softwoods are:

- Douglas fir
- White fir
- White pine
- Ponderosa pine
- Sugar pine
- Southern pine
- Hemlock
- Spruce
- Cypress
- Redwood
- Western red cedar

Many species of softwood are about equal in quality. However, redwood and western red cedar are particularly recommended for exterior trim, siding, outside decks, and fences as they have a much stronger resistance to decay than most other kinds of wood.

In the western United States Douglas fir is used for most rough construction, since Douglas fir trees are abundant along the Pacific Coast. In the southeastern states various species of southern pine (longleaf, slash, shortleaf, loblolly) are widely used for rough construction.

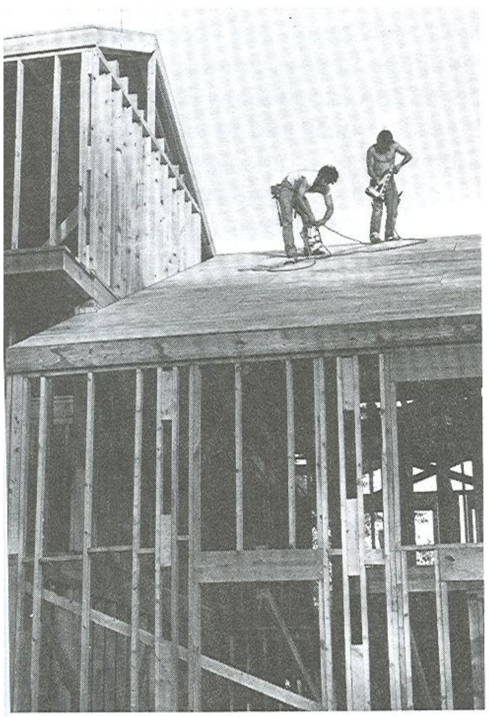

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Figure 5-3. The framework of this building is constructed of softwood lumber.

These species grow in forests from Virginia to Texas.

Softwood Grading Systems

The grade of a piece of lumber is based on its strength, stiffness, and appearance. A high grade of lumber has very few knots or other kinds of defects. A low grade of lumber may have knotholes along with many loose knots. The lowest grades are apt to have splits, checks, honeycombs, and some kind of warpage. The grade of lumber to be used on any construction job is usually stated in the specifications for a set of blueprints.

Grade systems are established by lumber-producing associations in different parts of the country. These associations must comply with all the provisions of the American Softwood Lumber Standard (PS 20-70) established by the U.S. Department of Commerce. One regional group is the Western Wood Products Association, which defines the grades of lumber used in the western states. See Appendix A. Another association is the Southern Forest Products Association, which serves the same function for the southeastern states. See Appendix B.

Grade Marks

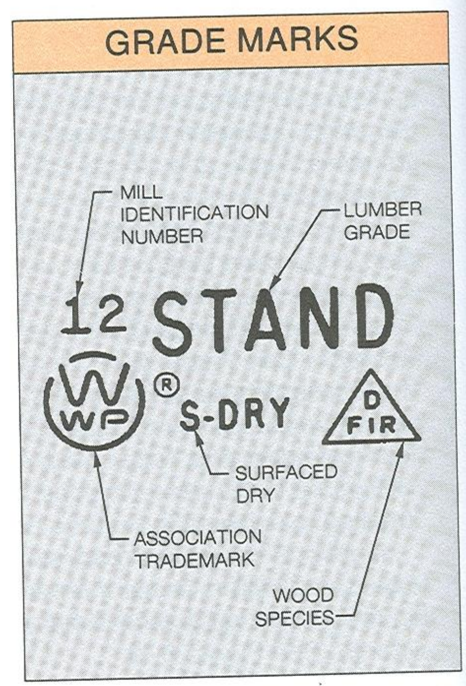
Grade marks are stamped on lumber to provide grading information. A typical grade mark includes the official trademark of the association, such as the Western Wood Products Association and the Southern Pine Inspection Bureau. Also included is the lumber grade, mill identification number, wood species, and surfacing and moisture designations. See Figure 5–4.

Softwood Grading Categories

Three general grading categories, as defined in the Western Lumber Grading Rules, are Appearance, Framing, and Industrial Lumber.

Appearance Lumber. This "board lumber" consists of several nonstructural grades intended where strength is not the main consideration, such as High Quality Appearance, General Purpose, and Radius Edged Decking grades. High Quality Appearance grades (Selects, Finish, and Special Western Red Cedar) are used for finish applications. See Figures 5–5, 5–6, and 5–7. General Purpose Boards include several common board grades. The #1, #2, and #3 common grades are frequently used for shelving and paneling. The #4 common grade is used for sheathing, concrete forms, and low-cost fencing. A *board* is a piece of lumber less than 2″ thick and between 4″ and 12″ wide. Radius Edged Decking grades are used for patio decking. As this type of decking is considered load bearing and placed flat-wise, the joists below are spaced a maximum of 16″ on center.

Framing Lumber. This category includes Timbers, Dimension Lumber, and Special Dimension grades. *Timbers* are used for posts, beams, and girders. Timbers are lumber that is 5″ × 5″ or larger in nominal size with the width not more than 2″ greater than the thickness. See Figure 5–8. Dimension Lumber is used primarily for structural purposes. These include studs, joists, planks, roof rafters, trusses, and components that make up the framework of a



Western Wood Products Association
Southern Pine Inspection Bureau
Figure 5-4. Grade marks stamped on lumber provide grading and other relevant information.

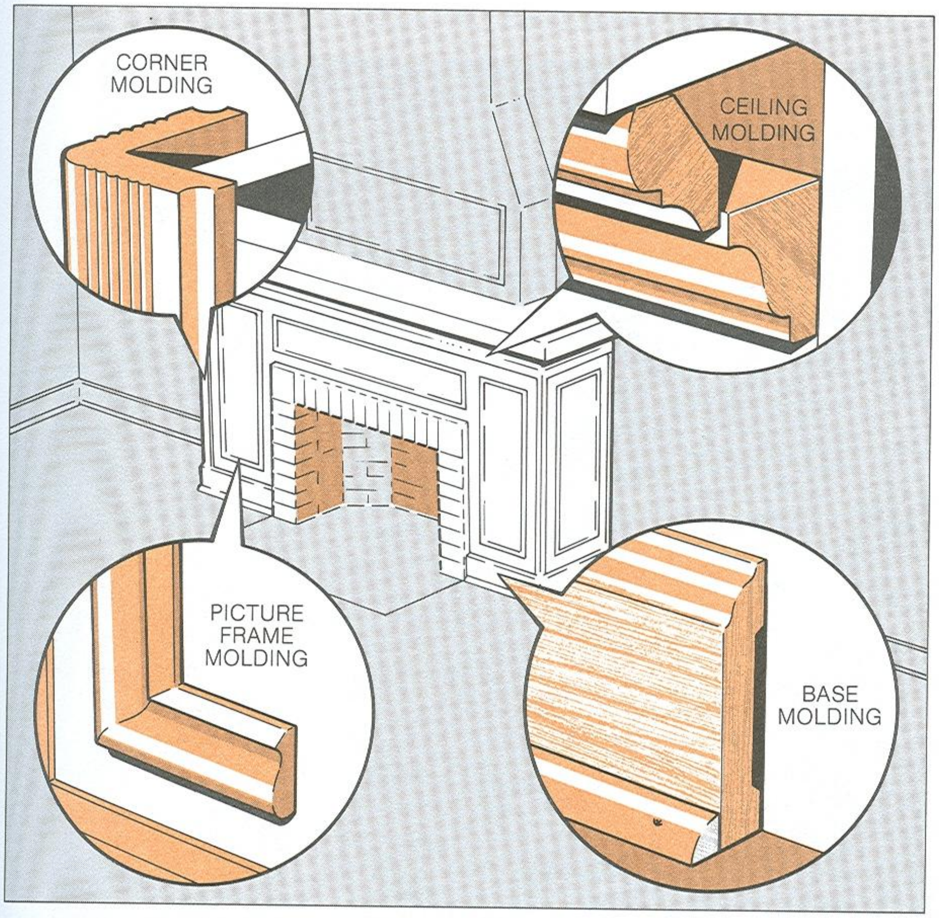
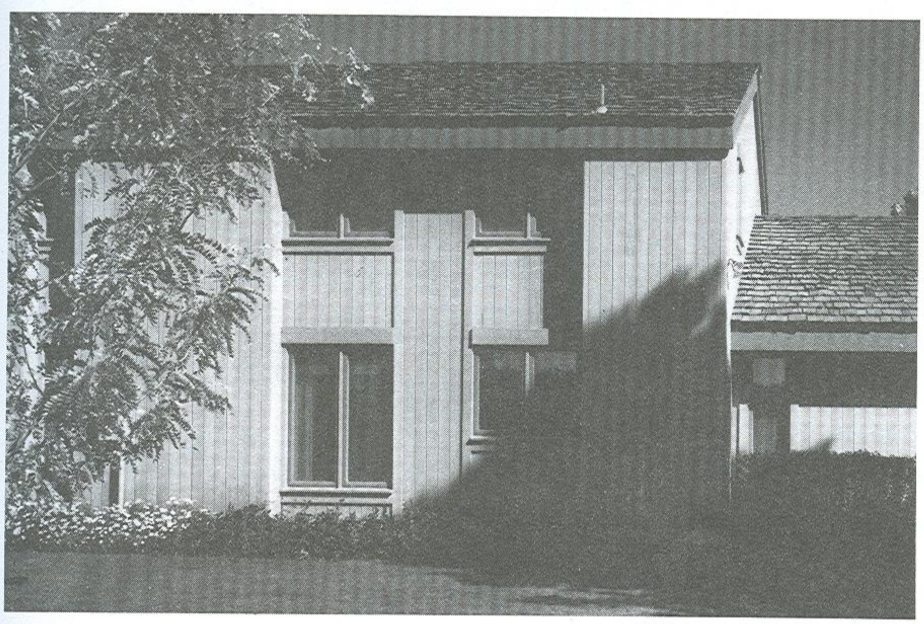


Figure 5-5. Appearance grade boards are used to make interior molding.

building. See Figures 5–9 and 5–10. Special Dimension Lumber includes structural decking. It is also designed for machine stress-rated lumber that must have a designed value such as light trusses, belt rails, box beams, and factory built homes.



California Redwood Association

Figure 5-6. Appearance grade boards are used for siding.

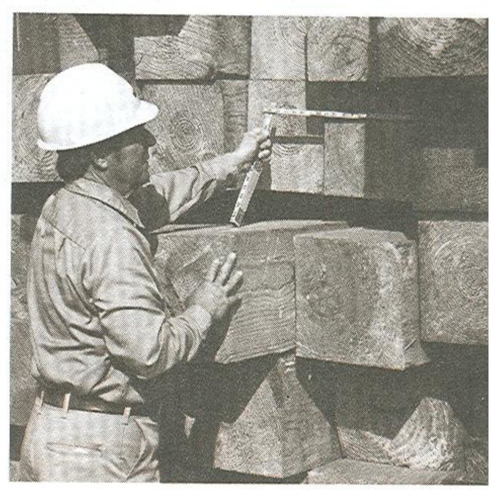
Industrial Lumber. This category includes Structural, Factory, and Nonstructural grades. The Structural grades are used for mining timbers, scaffold planks, and foundation lumber. Factory and Shop grades are intended for cut-up and manufacture. Nonstructural grades are used for fence pickets, lath, batten, and gutters.

HARDWOOD LUMBER

Hardwood accounts for approximately 25% of total lumber production. Most of the hardwood

California Redwood Association

Figure 5-7. Finish appearance grades of lumber are used for interior paneling.



Southern Forest Products Association

Figure 5-8. These timber pieces will be used for heavy structural members such as posts, girders, and stringers.

tree species that are suitable for lumber manufacture grow in the eastern sections of the United States. Hardwood is much more expensive than softwood. It is used to make such products as molding, stair treads, the outside veneers of doors and wall paneling, and flooring. Better quality furniture and cabinets are often constructed from hardwood.

Since many of the hardwoods have a much more attractive grain pattern than softwoods, hardwood trim is normally used when a natural or stained finish is desired.

The hardwood species used most often are the oaks and walnuts. They account for over 50% of total hardwood production. Other hardwoods used frequently are:

- Birch
- White ash
- Beech
- Elm
- Maple
- Mahogany
- Basswood
- Butternut
- Chestnut
- Yellow poplar
- Gum

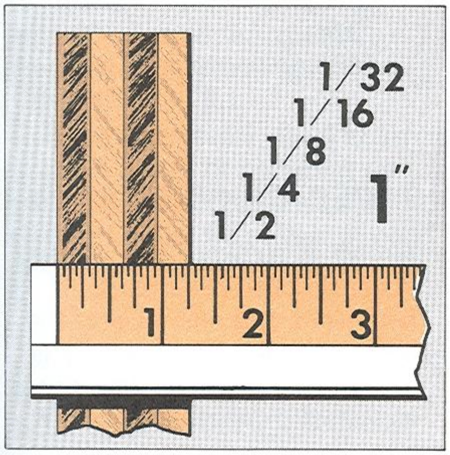
Hardwood Grading System

The standard grades of hardwood lumber established by the National Hardwood Lumber Association are:

- First and Second (FAS)
- Selects
  - No. 1 Common
  - No. 2 Common
  - No. 3 Common

Appearance is of prime importance to the grade of hardwood. Another factor in the grade is the number of *cuttings* that can be obtained from the board. Cuttings are the smaller sections that are cut from the board. An FAS grade is usually required for hardwood trim materials that will have a natural or stained finish.

UNIT 6



Measurement of Lumber

The metric system is used in most countries of the world today. In the United States, however, we still use the *customary,* or *English,* system of measurement. In the customary system the basic units of measurements are the yard, foot, inch, and inch-fraction.

ORDERING LUMBER

The specifications for a set of blueprints usually give the *species* and *grade* of lumber to be used on a construction job. The specifications may also include the stress rating and moisture content of the lumber. Unless otherwise mentioned, it is assumed that the lumber will be S4S (surfaced on all four sides). When ordering materials from the lumber yard, it is necessary to give all the preceding information, plus the quantity of lumber required and the length of the pieces. The quantity (except for hardwood molding) is stated in *board feet*. (The board foot is discussed later in this unit.) A typical lumber order is:

Douglas fir
Standard grade
S4S, 2 x 4 x 16
4,500 board feet

Lumber Size

A piece of lumber is usually referred to by its *nominal* size, which differs from its *actual* size. See Figure 6–1. A 2 × 4, for example, is 2" thick and 4" wide when it is cut out of the log at the sawmill. However, it shrinks after being air-dried or kiln-dried. Then its measurements are further reduced by surfacing at the planing mill. When it is placed on the market, its *actual* size is 1½" × 3½". Nevertheless, it is called a 2 × 4 (its *nominal* size) because its original dimensions were 2" × 4".

Lumber measurements are stated in the following order: thickness, width, and length. For example, a piece of lumber 2" (nominal size) thick, 4" (nominal size) wide, and 16' long is referred to as a 2 × 4 × 16. See Figure 6–2.

Softwood lumber is usually sold in even lengths ranging from 6' to 24'. An extra (premium) charge is made for lumber over 20' in length.

The Board Foot

Lumber is usually ordered by the *board foot*, which is the *unit of*

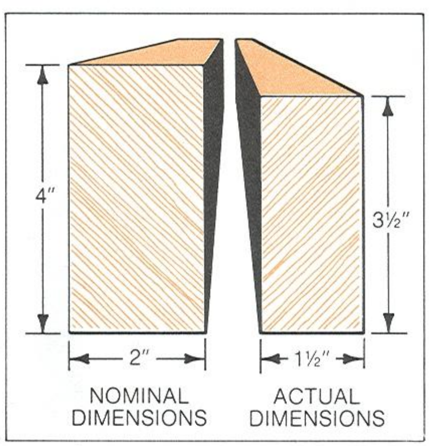


Figure 6–1. Nominal thickness and width compared to actual thickness and width.

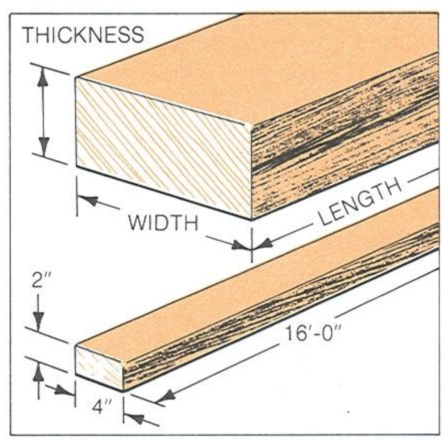


Figure 6–2. The abbreviated way of referring to a piece of lumber 2" thick by 4" wide by 16' long is: 2 x 4 x 16.

cost of the material. The number of board feet in a piece of lumber is not the same as the number of lineal feet. For example, a 2 × 4 × 16 piece of lumber is 16 lineal feet long. However, its price is based on the number of board feet that it is equal to.

A board foot is 1″ (nominal size) thick, 12″ wide (nominal size) and 12″ long (1″ × 12″ × 12″) *or the equivalent*. For example, a piece of lumber 1″ thick, 6″ wide, and 24″ long equals one board foot. The amount of wood in a board foot is always 144 cubic inches. See Figure 6–3.

To find out how many board feet there are in a piece of lumber, use the following formula (in the formula, T = thickness, W = width, and L = length):

$$\frac{T \times W \times L}{12} = \text{board feet}$$

The example that follows shows how to find the number of board feet in a board that is 2″ thick, 4″ wide, and 16′ long.

$$\frac{2\,(T) \times 4\,(W) \times 16\,(L)}{12} =$$

$$\frac{2 \times \overset{1}{\cancel{4}} \times 16}{\underset{3}{\cancel{12}}} = \frac{32}{3} =$$

10⅔ board feet

There are 10⅔ board feet in a 2 × 4 × 16.

On any construction job many pieces of the same size lumber are ordered. The following example shows how to find the total number of board feet in 35 pieces of 2 × 4 × 16 lumber.

$$\frac{\text{number of pieces} \times T \times W \times L}{12} =$$

$$\frac{35 \times 2 \times 4 \times 16}{12} =$$

$$\frac{35 \times 2 \times \overset{1}{\cancel{4}} \times 16}{\underset{3}{\cancel{12}}} = \frac{1120}{3} =$$

373⅓ board feet

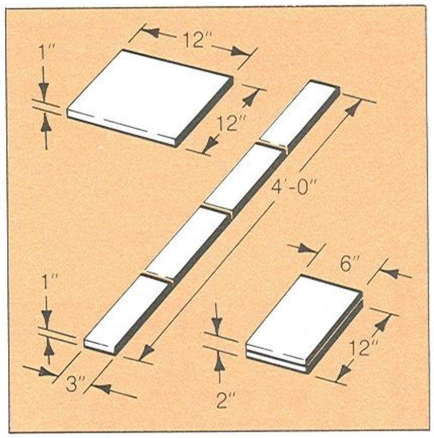


Figure 6–3. A board foot is equal to a piece of lumber 1″ x 12″ x 12″, or any other measurement that contains 144 cubic inches.

There are 373⅓ board feet in 35 pieces of 2 × 4 × 16 lumber.

To determine the cost of lumber, multiply the cost per board foot times the number of board feet. For the cost of the lumber in the preceding example, round off the total board feet to the next whole number (374) and multiply by the board foot price ($1.79).

374	board feet
× 1.79	board foot price
33 66	
261 8	
374	
$669.46	total cost for 374 board feet

TYPES OF SURFACING

Almost all softwood lumber used in construction is surfaced on both sides and both edges. The *edge* of a piece of lumber is its narrowest dimension. The *side* is its widest dimension. (A 2 × 4 has a 2″ edge and a 4″ side.) Lumber can also be ordered with all rough surfaces, or with a combination of smooth and rough surfaces. Mill-cabinet shops often order materials that have rough edges and smooth sides. A board with unsurfaced edges is wider, so more pieces can be cut from it.

A special type of rough surfacing is applied to resawn lumber. See Figure 6–4. The pieces are

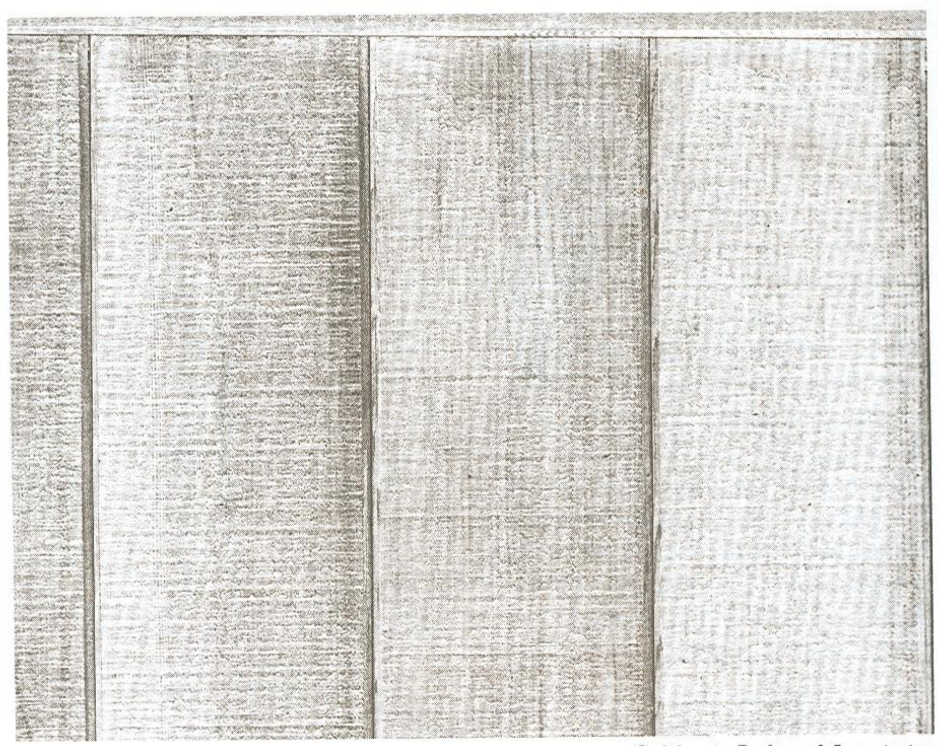


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Figure 6–4. Resawn lumber has an attractive textured surface.

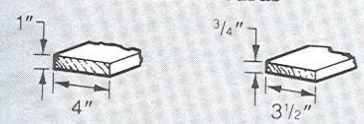
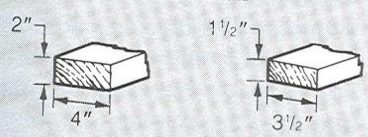
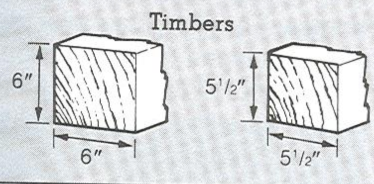
run through a special bandsaw that produces a coarse, textured pattern on the surface of the wood. Resawn lumber is most often used for exterior trim, siding, or paneling.

Abbreviations are used to indicate the type of surfacing required. For example, lumber surfaced on all four sides is ordered as S4S lumber. Some common abbreviations for lumber surfacing are:

	surfaced on:
S1S	one side
S2S	two sides
S4S	four sides
S1E	one edge
S2E	two edges
S1S1E	one side and one edge
S1S2E	one side and two edges
S2S1E	two sides and one edge
S/S	saw sized (resawn)

STANDARD SIZES

Boards, dimension lumber, and timbers are available in standard sizes. The actual size is always smaller than the nominal size. For example, the actual size of a 2 × 4 is 1½″ thick and 3½″ wide. See Figure 6–5.

STANDARD SIZES OF LUMBER				
TYPE	NOMINAL SIZE		ACTUAL SIZE	
	THICKNESS*	WIDTH*	THICKNESS*	WIDTH*
Common Boards 	1	2	¾	1½
	1	4	¾	3½
	1	6	¾	5½
	1	8	¾	7¼
	1	10	¾	9¼
	1	12	¾	11¼
Dimension 	2	2	1½	1½
	2	4	1½	3½
	2	6	1½	5½
	2	8	1½	7¼
	2	10	1½	9¼
	2	12	1½	11¼
Timbers 	5	5	4½	4½
	6	6	5½	5½
	6	8	5½	7½
	6	10	5½	9½
	8	8	7½	7½
	8	10	7½	9½

* in inches

Figure 6–5. The actual size of lumber is always smaller than the nominal size.