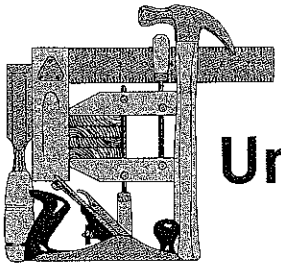


Unit 1

WOODS

This unit discusses the development of the forest industry. After studying this unit, you will be able to identify the basic parts of a tree, and how these parts function together to form usable wood. You will understand the basic classifications of wood and be able to identify common defects. In addition, you will be able to list and recognize different kinds of sheet stock manufactured from wood and wood products.

As a result of continuing lumber industry research, conservation, and a rapidly changing woods technology, the lumber industry is able to provide a larger quantity and a greater variety of wood species. Today, our lumber industry grows more wood every year than is used in both the construction and the furniture-making industries. This is only possible through planned forestry techniques. Even though a large amount of wood is lost through fire, disease, and insects, more wood is being produced than used. This overproduction allows for affordable lumber in the United States. In addition, a large quantity of logs and lumber are exported to other countries.

Good lumber production techniques have not always been used. The process of replanting small seedling trees as the mature trees are harvested, or REFORESTATION, is a slow process. Most trees require 20 or more years of growth before harvesting. Hardwoods require even more time to grow, often 50 to 75 years. In the past, many lumber companies only harvested the trees and did not consider the damage to the environment and ecology. This technique resulted in erosion, the rapid depletion of forests, and the loss of an acceptable setting for many species of animals and plants. Today, studies are made to determine the ecological effects before any major harvesting occurs. Methods that result in minimal damage to soils, plants, and animals have been developed and are now commonly used.

STRUCTURE AND GROWTH OF WOOD

Wood is composed of many very small cellulose fiber units called CELLS. These cells are held together with a natural adhesive made by the tree itself called LIGNIN. A typical wood sample is composed of 70% cellulose, 12 to 28% lignin, and up to 1% ash-producing materials. This make-up, while causing wood to be HYGROSCOPIC (expanding as it absorbs moisture and shrinking as it dries), is also responsible for its decay and its strength. In addition, the grain pattern and all other properties of the wood are determined by the way these cells are formed and grouped together.

Tree growth is unique because all new wood is formed from the perimeter of the tree outward and from last year's growth upward. New wood cells are formed in the CAMBIUM LAYER which is near the bark. The inside of this layer forms new wood cells and the outside forms new bark cells. In the spring when the year's growth begins, the wood fibers are larger with thin walls, large open centers, and light colored. This early growth is called SPRINGWOOD. Fibers that grow later in the season are smaller and stronger. They have thicker cell walls, smaller openings, and are darker colored. This later growth is called SUMMERWOOD. The summerwood forms on the outer side of the springwood. Each band of springwood and summerwood results in one year's growth called an ANNUAL RING. The age of a tree may be determined by counting the

annual rings, Fig. 1-1. An exception to this concept is in the tropics, where growth is almost continuous. Annual rings are much less apparent or do not appear.

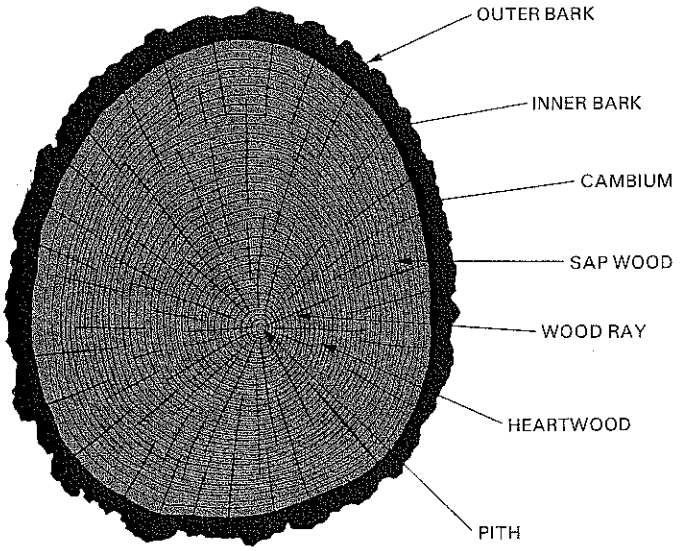


Fig. 1-1. Cross section of a tree trunk.
(Frank Paxton Lumber Co.)

The wood nearest the bark of a tree, or SAPWOOD, contains living cells. As the sapwood becomes inactive it gradually changes into heartwood. HEARTWOOD is usually darker in color because of the presence of gums and resins. MEDULLARY RAYS are rows of cells that run perpendicular (at right angles) to the annual rings toward the PITH (center of the tree). The medullary rays carry sap to the center of the tree. These rays are large in oak, beech, and sycamore and small in most other woods.

While a tree is growing upward and outward it is also growing downward. The downward growth of a tree is its root system. The ROOT SYSTEM provides the necessary support that prevents a tree from falling over. The root system also provides a means of transporting water and other nutrients from the ground to the leaves.

CLASSIFICATION AND IDENTIFICATION OF WOOD

There are several hundred species of trees in the United States. Most of the lumber used in construction and furniture making comes from about 35 species. The other species do not have the qualities necessary for commercial purposes.

Trees and lumber can be divided into two main classes, softwood and hardwood. SOFTWOODS come from cone-bearing trees. Softwood trees also have needles, and are frequently referred to as evergreens. Another name for evergreen trees is CONIFERS meaning "cone bearing." Examples of conifers are pine, fir,

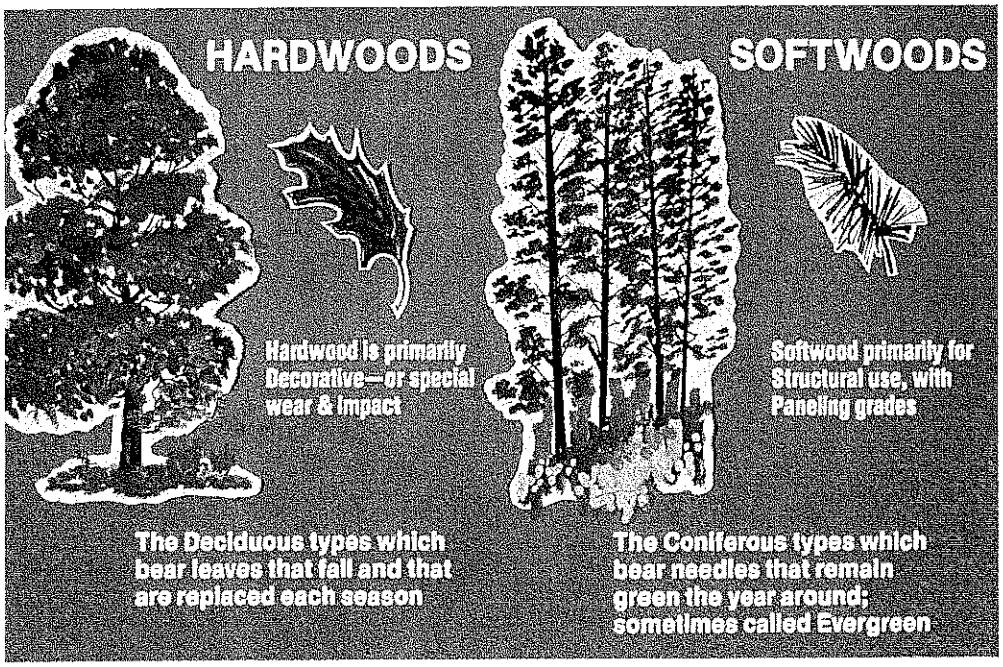


Fig. 1-2. Trees and woods can be classified as hardwoods or softwoods.
(National Forest Products Association)

spruce, cedar, redwood, and cypress. HARDWOODS come from broad-leaf trees that shed or lose their leaves every year. See Fig. 1-2. DECIDUOUS is a term given to hardwood trees. Oak, walnut, birch, maple, hickory, ash, and poplar are examples of deciduous trees. The terms "softwood" and "hardwood" do not refer to the actual hardness or softness of the wood.

Softwoods and hardwoods can also be divided into the general classifications of OPEN-GRAINED (porous) or CLOSE-GRAINED (nonporous) woods. When lumber is cut at the mill, the cells that come into contact with the saw or planer are cut or sliced, leaving small openings at the surface called PORES. Lumber with large cells form open-grained woods. Lumber with small cells form close-grained woods. Most broad-leaf trees produce open-grained lumber, but not all. Examples of open-grained lumber are oak, walnut, and mahogany. Close-grained woods include pine, birch, gum, maple, basswood, and fir. Determining whether the wood is open grained or close-grained is easy. Open-grained wood is porous; the pores are easy to see using a magnifying glass. In close-grained wood, the pores are not as readily seen.

LUMBERING AND REFORESTATION

The lumber industry is an important contributor to our nation's economy. There are currently about 7000 active saw mills, 5000 wholesalers, and over 28,000 retail lumber yards in the United States. Nearly 750,000 people are employed in all aspects of the lumber industry.

The lumber industry uses two distinct methods of harvesting trees for lumber production–clear cutting and selective cutting. In the CLEAR CUTTING process, all the trees in a given area are harvested at one time. When this area has been harvested, seedling trees are then planted. These seedlings are then cared for until they are mature and ready for harvesting. This method is primarily used for softwoods due to their rapid growth and the method of milling being used.

SELECTIVE CUTTING is commonly used for furniture-grade lumber. It generally includes hardwoods and certain softwoods, such as redwood and Ponderosa pine. The reforestation procedure for selective harvesting is quite different from clear cutting. Fewer seedlings are planted when selective cutting, and the planting is not in "rows" as with the clear cutting process. Selective cutting increases the risk to surrounding trees that may not be ready for harvesting. In addition, it is more expensive to FELL (cut standing trees) trees when selective cutting. A benefit of selective cutting, however, is that it is less disruptive to the ecology.

Scientific forest management includes proper cutting, planting, and forest fire prevention, as well as disease and pest control. Millions of hardy seedlings are grown in tree farm nurseries where they reach a good start before they are transplanted into forest areas, Fig. 1-3. Currently, forestry practice replants small nursery trees shortly after the last log is removed from an area. The sound forest management now being practiced will ensure a continuous supply of wood for generations to come.

Fig. 1-3. Tree farm nursery. (Weyerhauser)

LUMBER MANUFACTURING PROCESS

When logs arrive at the sawmill they are stored in large piles or in ponds until they are ready to be cut into lumber. Storing the logs in

water prevents end checking, washes off dirt, and allows easy sorting into sizes and qualities. Logs are usually pulled lengthwise into the mill by a chain device called a JACK-LADDER (bull-chain). Jets of water are used to remove any remaining mud and grit as the log is moved into position.

Fig. 1-4. The bark must be removed before the tree is sawed into lumber. (Southern Forest Products Association)

The bark is removed after the log is pulled inside the sawmill, Fig. 1-4. The logs are then placed onto a carriage that moves past a stationary saw blade. See Fig. 1-5. The operator of this carriage/saw machine is called a SAWYER. The sawyer quickly looks at the log to determine the cuts needed to receive the most usable lumber with the least amount of waste in the shortest period of time. Today, automation has been integrated into even the smallest sawmills. This allows the sawyer to "saw" more logs into lumber more efficiently than ever. When the most efficient cuts have been determined, the HEADSAW cuts a slab from a log. The slab is rapidly transported to the TRIMMER SAWS where several saws cut the slice into desired lengths. Each of these trimmer saws may be raised or lowered independently so that boards can be trimmed to the exact lengths required, Fig. 1-6. Other saws are then used to cut the boards to desired widths.

The manner in which the headsaw cuts through the log determines much of the appearance and strength of the resulting lumber. There are various methods of cutting logs into lumber. The most common method is PLAIN, or FLAT SAWING, where the saw blade cuts tangent (at an angle) to the annual rings. This method is the

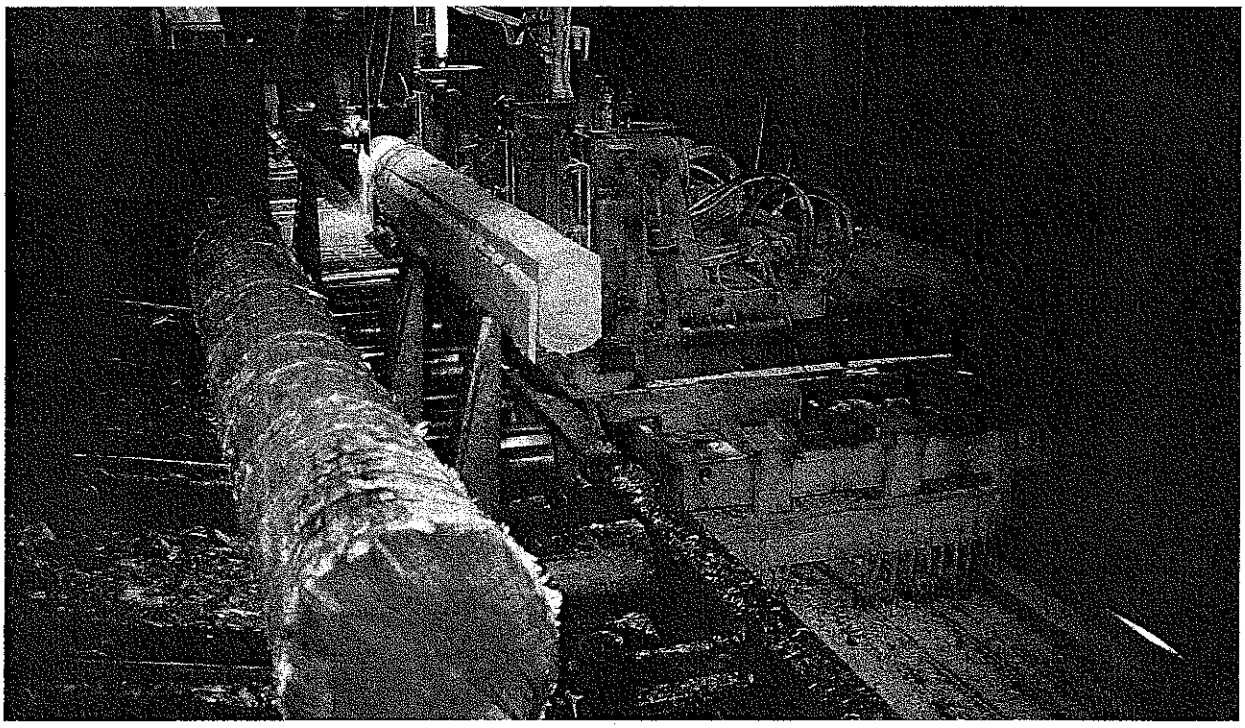


Fig. 1-5. The head sawyer cutting a log into huge slabs. (Western Wood Plywood Association)

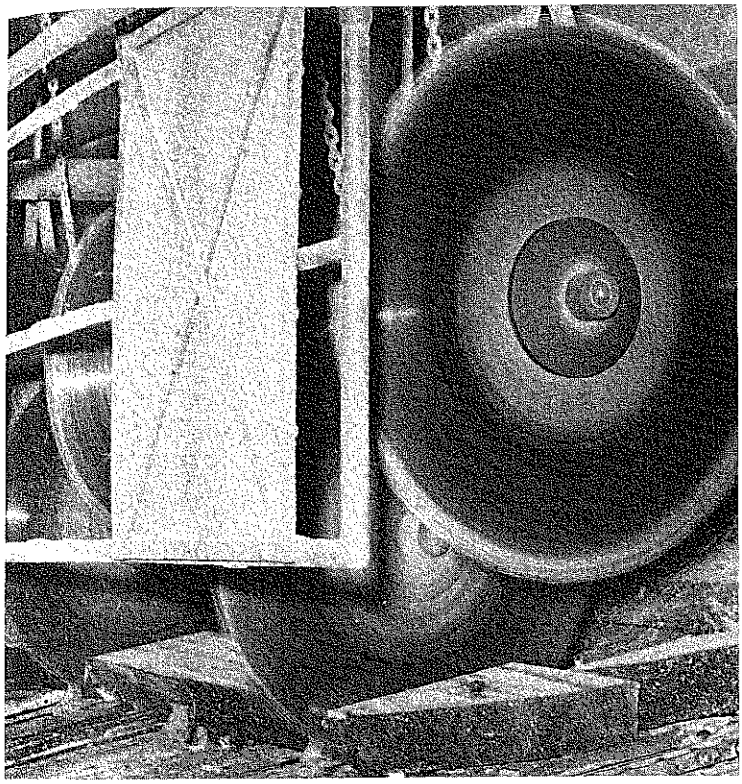


Fig. 1-6. Trimmer saws cut the slab into desired lengths. Each trimmer saw can be raised and lowered as needed.

most economical because of its low waste and speed. See Fig. 1-7. Another method of cutting logs into lumber is QUARTER SAWING. This sawing process cuts parallel to the wood rays. It is more wasteful and time-consuming, but the resulting lumber warps and checks less. Quarter-sawn lumber is desirable for furniture making because of the exposed FIGURE (grain pattern). See Fig. 1-8.

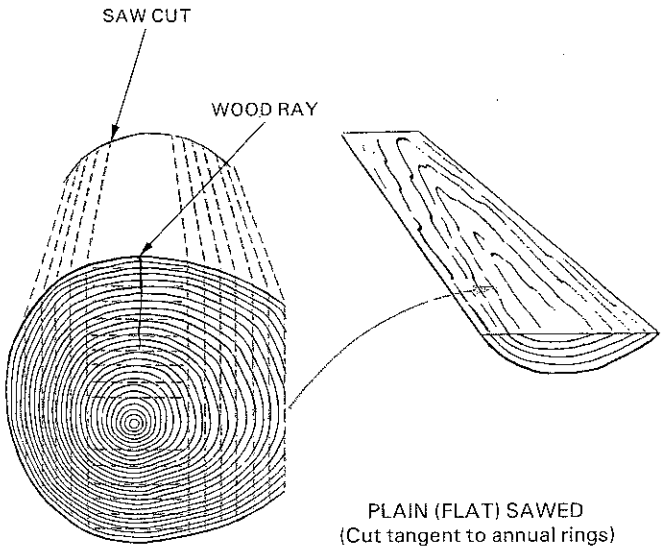


Fig. 1-7. Plain or flat sawed lumber produces less waste.

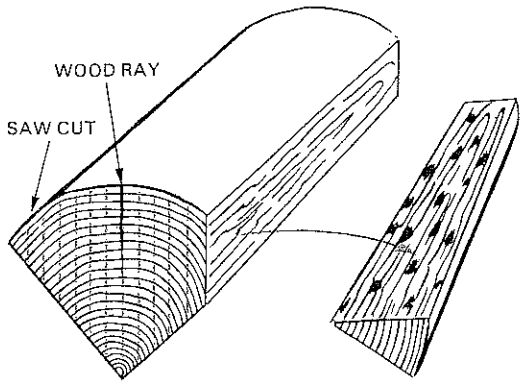


Fig. 1-8. Quartersawed lumber has a better grain pattern than flat sawed lumber.

Freshly sawed lumber is referred to as ROUGH because it has not been planed or surfaced to the final thickness. Rough hardwood lumber is carried from the mill to a sorting shed where it is graded and sorted. Rough softwood lumber is sorted, but it is not graded until after it has been planed and dried, Fig. 1-9. In order for lumber to be usable for construction or furniture making, it must first be SEASONED. This means the excess moisture in the wood cells must be removed.

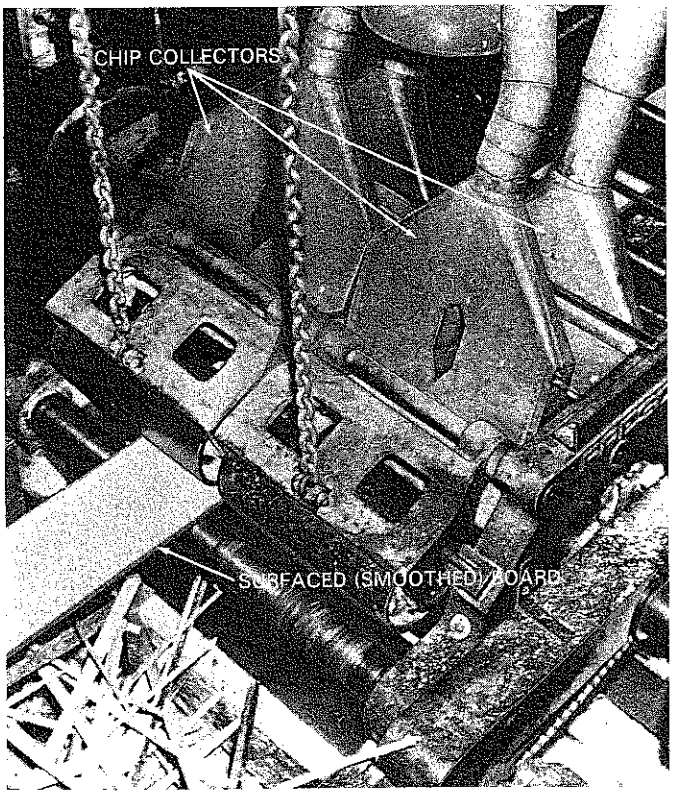


Fig. 1-9. Rough softwood lumber is planed and dried before it is sorted.

MOISTURE CONTENT, SHRINKING, SWELLING

Wood, like most fibrous materials, shrinks as it loses moisture and swells as it absorbs moisture. This characteristic is called hygroscopic. Excess moisture must be removed from GREENWOOD (freshly cut unseasoned wood) by drying or seasoning it.

The moisture content (M.C.) of lumber is expressed as a percentage. It represents a comparison of the amount of moisture in a wood sample to that of a totally dry sample. Before lumber is seasoned, it may contain a M.C. ranging from 30% to as high as 200% or more. Moisture is found in two forms within a board. First, moisture is contained *in* the cell cavities or pores. This moisture is called FREE WATER. The other form, ABSORBED WATER, is the moisture found in the cell walls or fibers. See Fig. 1-10. The FIBER SATURATION POINT is when the cell walls have absorbed their maximum amount of water. Any additional moisture would be stored *in* the cell cavities as free water.

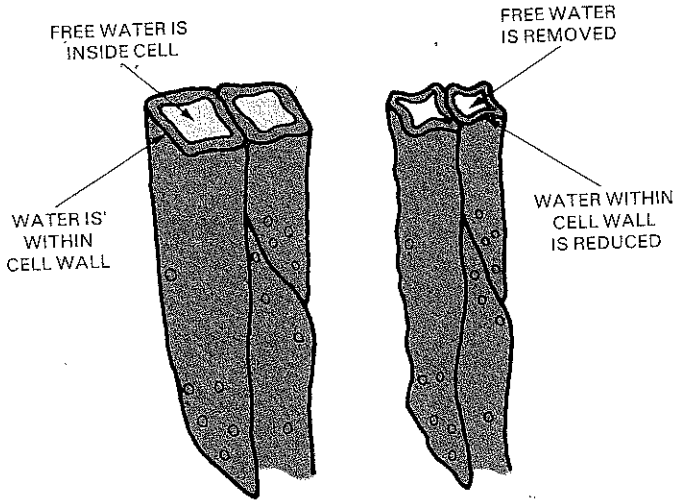


Fig. 1-10. Change in cell size as water is removed.

The fiber saturation point is critical to wood's hygroscopic characteristic. No substantial size change occurs until the water in the cell walls (fiber) is reduced. It is easy to begin understanding the basic expansion and contraction properties of wood by considering the structure of a typical wood cell with the hygroscopic effect. This expansion and contraction directly influences design, joinery, adhesives, and the application of finishes.

Expansion and contraction of a board is from 0% M.C. to the fiber saturation point, typically 30% M.C. Wood changes size about 3.3% (1/30) of the maximum possible expansion for each percentage point of moisture change. A slight change in M.C. can cause sticking drawers or doors, and splits in wood with an inadequate finish or that have been improperly glued or fastened.

Hardwoods are typically used in furniture making. They are dried to a M.C. ranging from 6 to 12 percent. Softwoods used in home construction are dried to only about 19% M.C. It has been found that decay resistance can be achieved at 20% M.C. or less and that best conditions for decay occur at 25% or higher M.C.

Seasoning may be done naturally, allowing moisture to evaporate. The lumber is stacked with small strips of wood between each new piece of lumber, allowing the air to pass around it. This is called AIR-DRYING. Air-drying is done outdoors where the sun and wind slowly reduce the moisture content to about 18 to 20 percent. Often air-dried lumber is stored in a well-ventilated shed.

Air-drying is inexpensive, but time consuming. Lumber resulting from air-drying is less desirable because the moisture removal was uncontrolled. Warping and twisting occur more often. The amount of moisture from one piece of lumber to another varies. In addition, the M.C. from one end of a board to the other also varies. Gluing and finishing air-dried lumber also present problems.

KILN-DRYING is another method used for seasoning lumber. This process uses controlled heat to remove excess moisture. The rate of moisture removal is monitored. The lumber resulting from kiln-drying meets predetermined requirements. Kiln-drying is done by placing the lumber in a large oven called a KILN at temperatures usually ranging from 110 to 180 degrees Fahrenheit (F), Fig. 1-11. Humidity, air circulation, and air temperature are carefully controlled. Kiln-dried lumber has less moisture content than air-dried lumber. Lumber is often dried to 6% or less M.C. using the kiln. During the drying process, shrinking begins to occur when the free water is removed. Since there is little or no change in the size of a board until it reaches an M.C.

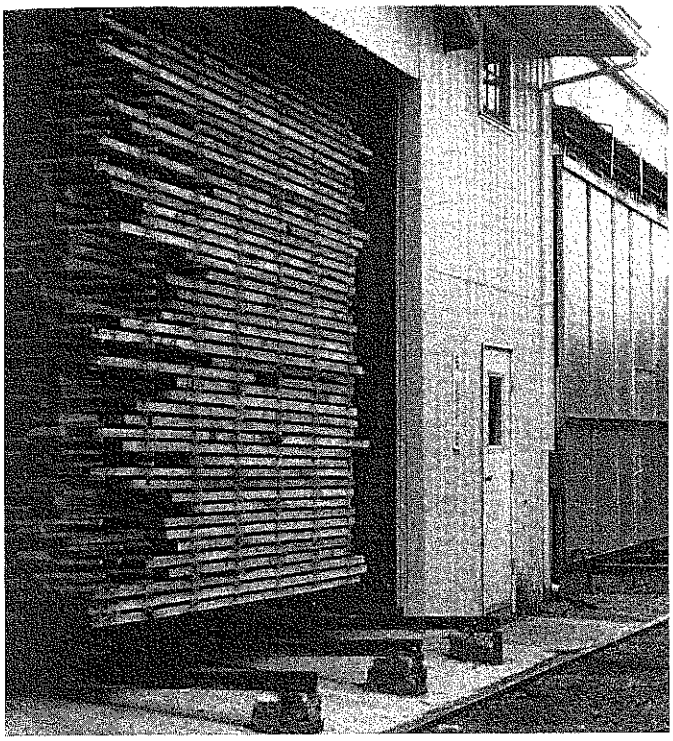


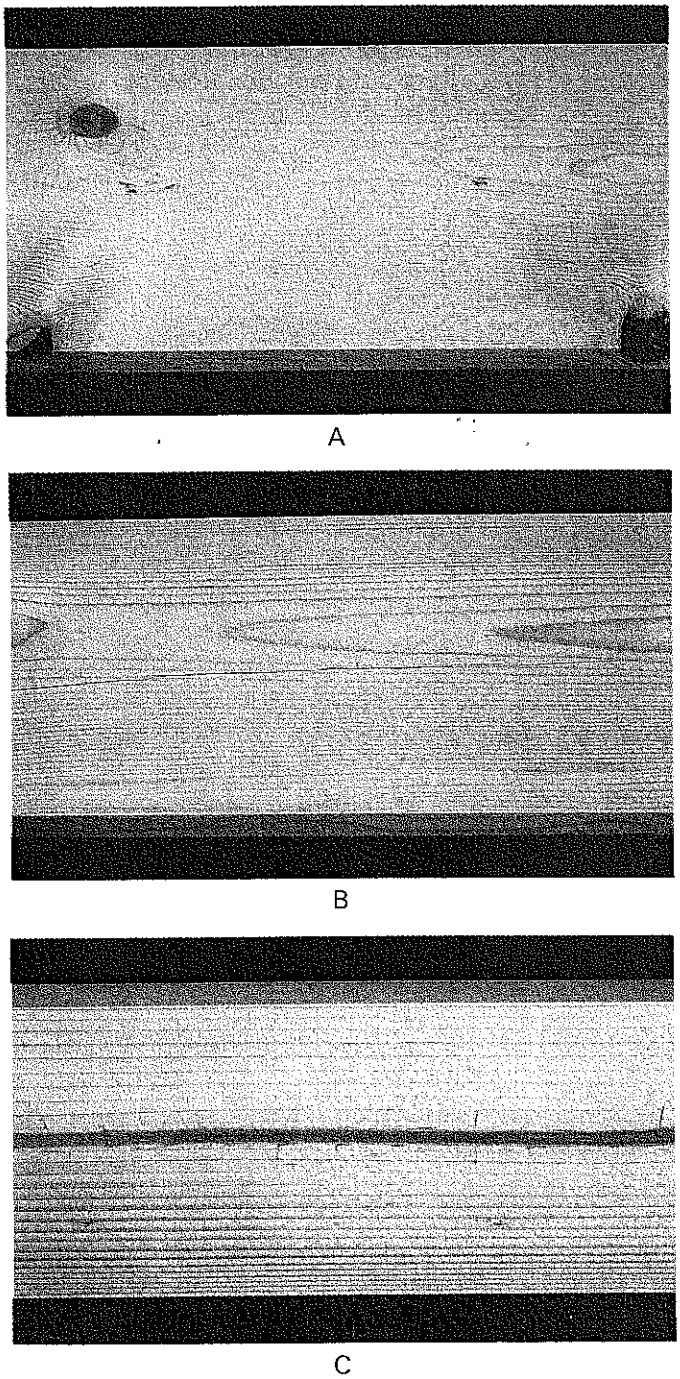
Fig. 1-11. Kiln-drying provides better humidity, air circulation, and temperature control. (Hoge Lumber Company)

of about 30%, lumber is often air dried to this point. After reaching 30% M.C., the lumber is then moved into the kiln when heat and air flow are carefully monitored. When the desired M.C. is achieved, the wood is removed.

All woods have a tendency to reach a balance in moisture content with the surrounding air after drying. This is called the EQUILIBRIUM MOISTURE CONTENT. The equilibrium moisture content varies from 6 to 12 percent M.C. Wood actually gets larger as it absorbs moisture and smaller as it loses moisture. Most size change takes place across the grain of the wood. A board may vary 4 percent or more in dimension across the grain. There is less change in thickness than in width, and almost no change in length. Kiln-dried lumber usually has less change in its dimensions resulting from differences in the moisture content. This is one reason for using kiln-dried lumber for furniture and cabinetmaking.

DEFECTS

Defects in wood may be roughly classified into two large groups–those occurring naturally during the growth of the tree, and those occurring after felling. Natural defects include physical damage such as abrasions, fire damage, insect and animal damage, and growth defects. Growth defects includes common defects, such as knots, shakes, and pitch pockets, Fig. 1-12. Embedded branches and limbs result in KNOTS that weaken the strength of a board. Knots are usually considered to be undesirable. A SHAKE is a grain separation that runs parallel to the annual rings of a board or log. Shakes seldom develop after the tree is cut. The PITCH POCKET is also a grain separation that occurs along the



A

B

C

Fig. 1-12. Natural defects in lumber. A–Knots. B–Shakes. C–Pitch pockets.

annual rings. It may contain solid or liquid resin. Pitch pockets are commonly found in softwoods, such as Douglas fir and pines.

Some of the defects that occur after a tree is felled are the result of the log losing its high moisture content. Others are a direct result of the failure to properly control the wood. Wood that is dried too fast or improperly stored often warps or develops other defects. WARPING is considered to be the change in a board from a true surface. See Fig. 1-13. Warping includes CUP (curved across the grain), BOW (surface curved lengthwise), CROOK (edge curved lengthwise), and TWIST or WIND (both surfaces and edges curved lengthwise). Small cracks or separations in the end grain of a board that are at right angles to the annual rings are called CHECKS, as shown in Fig. 1-14. Those that are along or parallel to the annual rings are called SHAKES. CRACKS or SPLITS are separations at the end of a board.

GRADING

LUMBER GRADING is the term applied to evaluating the quality and usability of a board. The following features are taken into account when judging the quality of a board: size and number of defects; number and size of clear pieces remaining after the defects have been removed; and overall width and length of the board.

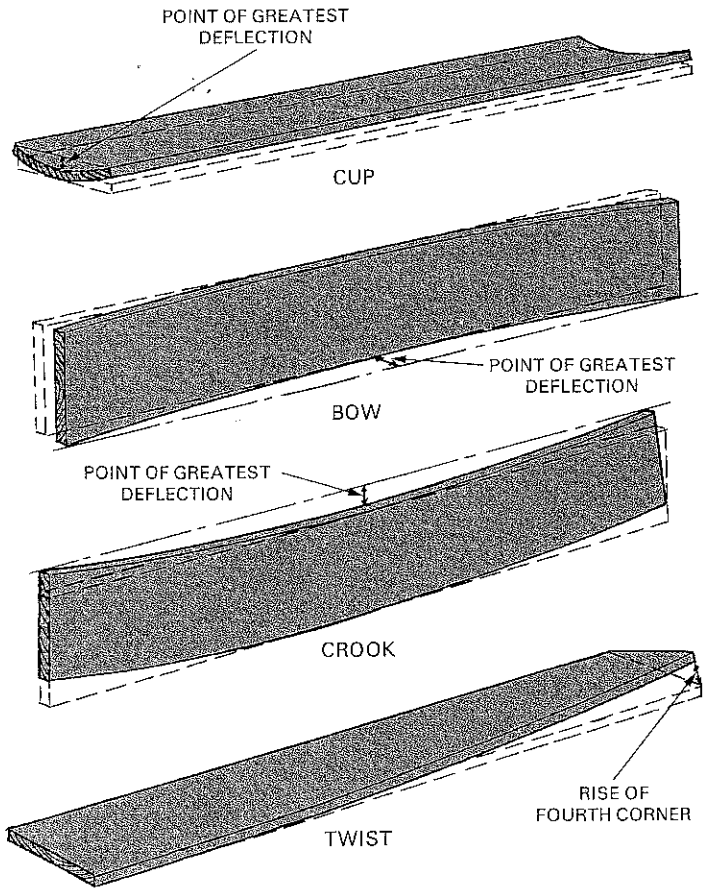


Fig. 1-13. Types of warp.

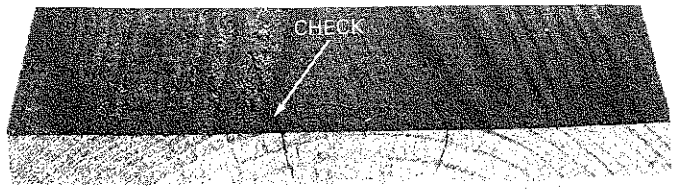


Fig. 1-14. Checks in a flat-grain board.

Grading rules, called STANDARDS, vary for hardwoods and softwoods. Softwoods are graded by looking at the best face of a board after surfacing. The grade is then stamped on the face. Hardwoods are graded by looking at the poorer face of a rough board prior to surfacing. The grade is then marked on the edge.

SOFTWOOD GRADING

Softwoods can be divided into three forms: method of manufacture, species, and grade. Softwood lumber is broadly classified as rough, surfaced, or worked. ROUGH LUMBER is sawn, trimmed to length, and edged. The faces show the saw marks. SURFACED LUMBER has been smoothed. Surfaced lumber is further broken down by the number of surfaces that have been smoothed. Surfaced lumber that has been matched according to grain pattern is WORKED LUMBER.

Softwoods can also be classified as shop and factory lumber or yard lumber. SHOP AND FACTORY LUMBER is milled for special applications such as molding. YARD LUMBER is classified as boards, dimensional, and timbers. BOARDS are pieces less than 2 inches in nominal thickness and are usually 4 to 12 inches in width. DIMENSIONAL LUMBER is from 2 to 5 inches thick and commonly 4 to 12 inches in width. TIMBERS have a width and thickness exceeding 5 inches.

Yard lumber is commonly available in retail lumber yards. It is divided into select (finish) grades, common (utility) grades, and dimensional grades. SELECT GRADES range from A through D, with the best grades being B and better. Select grades are used for siding, partitions, and finish flooring. COMMON GRADES range from #1 through #5. They are used for general building such as sheathing and subflooring. DIMENSIONAL GRADES are used for framing and applications where additional strength is required.

Softwoods are usually surfaced on four sides to finished dimensions (S4S). They are available in a variety of standard finished dimensions, Fig. 1-15. Standard lengths for softwoods range from 6 to 20 feet in 2-foot intervals.

STANDARD THICKNESS AND WIDTH OF SOFTWOOD LUMBER (Dimensions in Inches)

Rough (Nominal)	S4S (Dry)	Rough (Nominal)	S4S (Dry)
1 x 2	3/4 x 1 1/2	2 x 2	1 1/2 x 1 1/2
1 x 4	3/4 x 3 1/2	2 x 4	1 1/2 x 3 1/2
1 x 6	3/4 x 5 1/2	2 x 6	1 1/2 x 5 1/2
1 x 8	3/4 x 7 1/4	2 x 8	1 1/2 x 7 1/4
1 x 10	3/4 x 9 1/4	2 x 10	1 1/2 x 9 1/4
1 x 12	3/4 x 11 1/4	4 x 4	3 1/2 x 3 1/2

Fig. 1-15. Standard thickness and widths of softwood lumber.

HARDWOOD GRADING

Hardwoods are graded according to minimum sizes and the percentage of clear surface cuttings that can be made. FIRSTS AND SECONDS (FAS) is the best grade of hardwoods. They must yield about 85 percent clear cuttings. Minimum board size for FAS lumber is 6 inches and wider by 8 feet and longer. NUMBER 1 COMMON is the lowest grade of hardwoods. This grade permits smaller board size with about 65 percent clear cuttings.

Standard dimensions for hardwood are given in thickness only. See Fig. 1-16. Hardwoods are sold in random widths and lengths (RW&L). Hardwoods are used for furniture and cabinetmaking, where maximum yield of material can be obtained using a variety of widths and lengths. In addition, hardwoods may be purchased ROUGH (RGH) or SURFACED ON BOTH SIDES (S2S). Although hardwoods are normally sold as rough, some retailers may surface and edge trim hardwood stock.

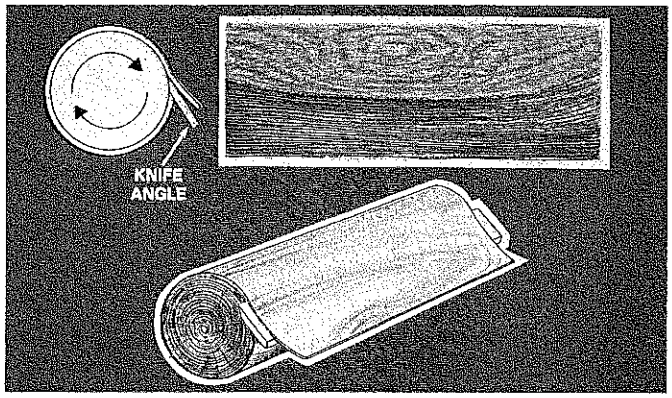
STANDARD THICKNESS OF SURFACED HARDWOOD LUMBER (Dimensions in Inches)

Rough	S2S	Rough	S2S
3/8	3/16	1 1/2	1 5/16
1/2	5/16	2	1 3/4
5/8	7/16	2 1/2	2 1/4
3/4	9/16	3	2 3/4
1	25/32	3 1/2	3 1/4
1 1/4	1 1/16	4	3 3/4

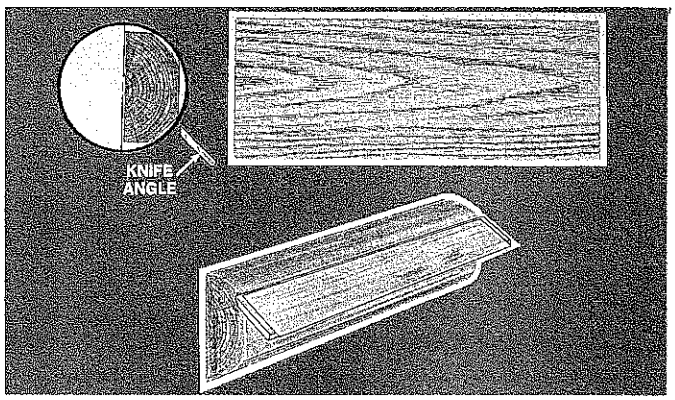
Fig. 1-16. Standard thickness of surfaced hardwood lumber.

VENEER AND PLYWOOD

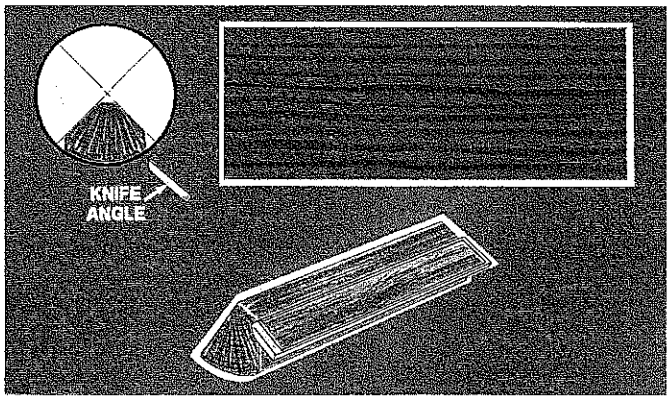
More and more products are being produced using veneers. Many products have a core that is composed of wood byproducts. These products are then covered with veneer to give them an appearance of "solid wood."



ROTARY



FLAT SLICED



QUARTER SLICED

Fig. 1-17. Methods of producing veneer. (National Forest Products Association)

VENEER

VENEER is a thin sheet of wood that is peeled or sliced from a log with a knife-like device rather than with a saw. The thickness of veneer ranges from 1/100 to 1/4 inch. Veneer is made by ROTARY CUTTING, FLAT SLICING, or QUARTER SLICING, Fig. 1-17.

Veneer produced using rotary cutting has a rippled or marble-like grain pattern. The grain pattern tends to be spread out. A more even and tighter grain pattern is preferred for furniture making. Fig. 1-18 shows a continuous sheet of veneer being produced using rotary slicing. Flat slicing is commonly used for hardwoods. The grain pattern is more even than that produced by rotary cutting. Quarter slicing produces a striped grain pattern. The grain lines may be straight or slightly wavy.

Veneers with grain designs for a variety of uses may be obtained by using the right kind of wood and the correct method of cutting. Decorative and exotic grain designs are found in some woods by cutting veneer from the tree crotch, burl, and stump, Fig. 1-19.

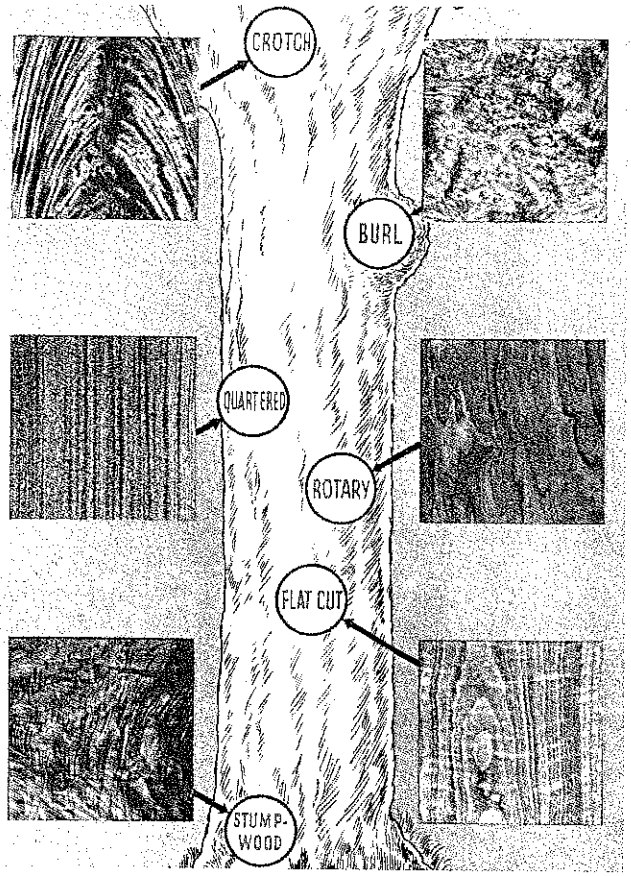


Fig. 1-19. Where veneer figures are found.

PLYWOOD

PLYWOOD is a wood product made of veneers bonded to a core of crossbanded veneers, solid lumber, or composite materials, Fig. 1-20. The grain of the outside veneers (face and back) run the same direction. When the core consists of crossbanded veneers, it is called PLYCORE.

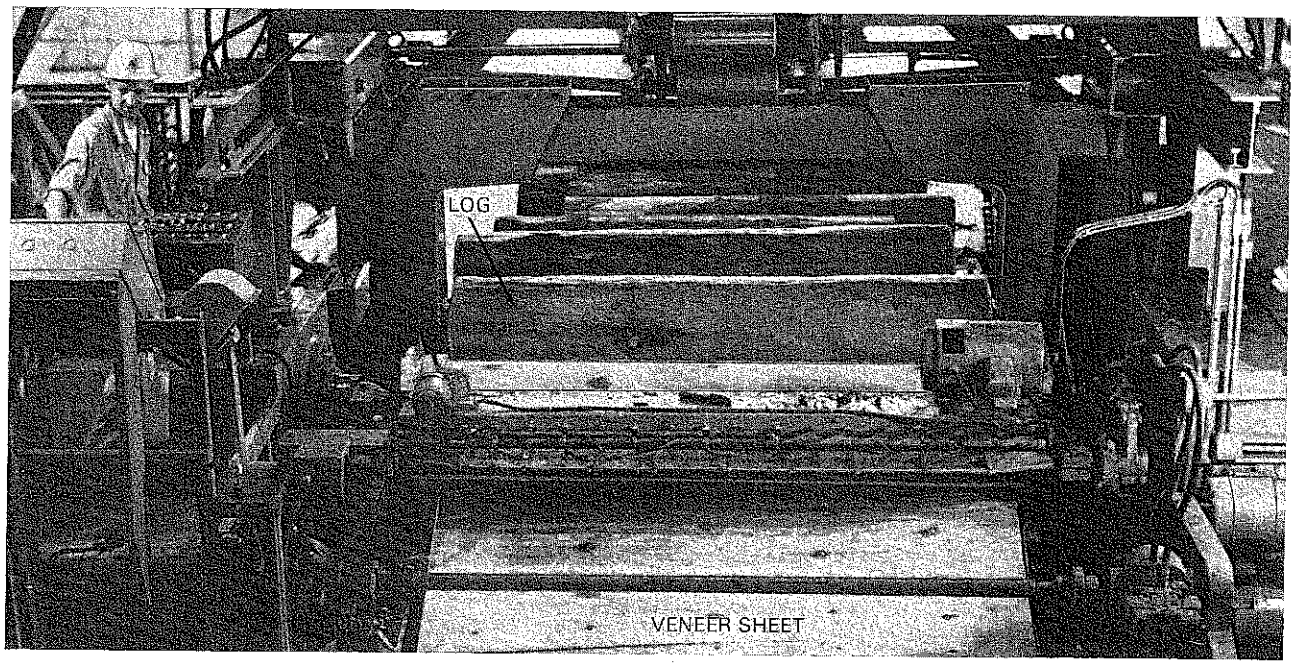
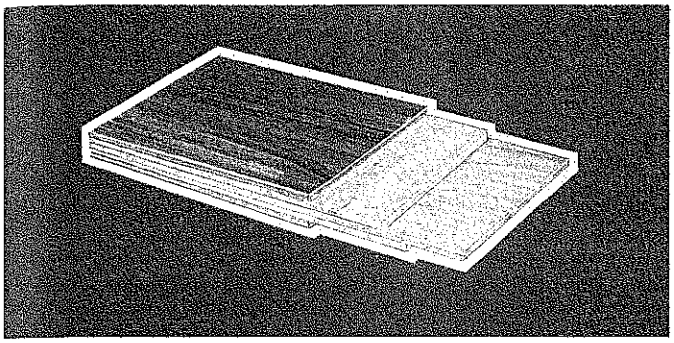
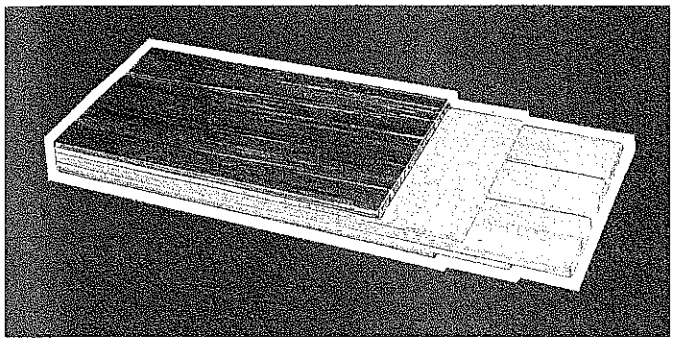


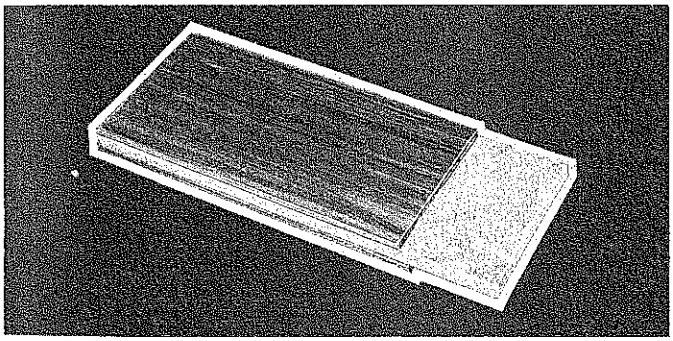
Fig. 1-18. Rotary cutting a continuous sheet of veneer.



A



B



C

Fig. 1-20. Plywood cores are made of various materials. A–Plycore. B–Lumber core. C–Composition core. (National Forest Products Association)

In plycore plywood, an odd number (3, 5, 7, etc.) of layers, or PLIES, of veneer are used. The plies of the crossbanded veneers are at right angles to each other. When solid boards are laid side-by-side to make up the core, it is called LUMBER CORE. A crossbanded veneer is placed on each side of the lumber core and a face and back veneer are attached. When the core is made up of composite materials, such as scrap wood chips or pressed paper, it is called COMPOSITION CORE or MINERAL CORE.

Plywood is generally available in standard-size sheets measuring 4 feet wide and 8 feet long. Plywood may be classified several ways depending upon its use. SOFTWOOD PLYWOOD is primarily used in construction for sheathing or subflooring. It complies with established standards, U.S. Product Standard PS1-83, for appearance, strength, dimensions, type of adhesive used, and classification of wood species. The two factors a consumer is normally concerned with are glue type and grade designation. Adhesives (glues) used to bond the plies together are either exterior (waterproof) or interior (moisture resistant). See Fig. 1-21.

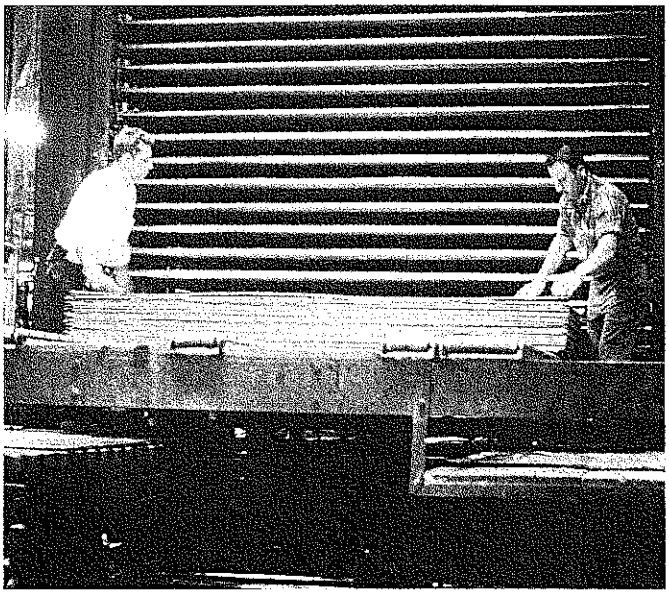


Fig. 1-21. Unloading plywood panels from the gluing press. (American Plywood Association)

There are five grades of veneers used in construction plywood–A, B, C, D, and N. The A grade has the best appearance and D grade has the poorest appearance. The N grade is applied only to special-order plywood. Typically, the grade will be stamped on the poorer of the two faces using two letters. The first letter represents the best face and the second letter represents the poorer face.

Fir plywood is the most common type of construction plywood. It is available in standard thicknesses of 1/4, 3/8, 1/2, 5/8, and 3/4 inch. These sizes are nominal–actual thickness is 1/32 inch less. The plywood may be sanded on both sides. Plywood used for sheathing or subflooring is not normally sanded.

HARDWOOD PLYWOOD, frequently referred to as decorative plywood, does not comply with the U.S. Product Standard. It is mill stamped on the edge, not the face. Grade and

glue requirements are not universally applicable as each mill sets its own standards. Generally, 1/28-inch veneer is adhered to both faces of a variety of cores. Currently, a composition core that looks much like compressed paper is very popular among cabinet shops.

MANUFACTURED PANELS

Manufactured panels, such as hardboard and particleboard, have gained wide acceptance in the furniture and cabinetmaking industries. This allows the industry to use large panels without edge gluing several smaller pieces of stock. Manufactured panels are DIMENSIONALLY STABLE, meaning that changes in humidity have little effect on their size. Typically, the initial cost of a manufactured panel is less than the cost of individual pieces glued together. One of the best reasons for using manufactured panels is that scrap and waste stock is used to manufacture the panels. This helps to conserve the raw materials and energy used to produce solid stock.

HARDBOARD

HARDBOARD is made by breaking wood chips into individual fibers, arranging them into a mat, and compressing this mat with heavy rollers. Lengths of mat (wetlap) are fed into multiple presses where heat and pressure form the fibers into a hard, thin, dry sheet. The fibers are held together with wood's natural adhesive called lignin. When hardboard is saturated with oils and resins, it is called TEMPERED HARDBOARD. Tempered hardboard is more dense and water repellent than standard hardboard. This is because the fibers are packed more closely together. Hardboard is widely used for underlayment. It is also used for paneling after a thin layer of wood-like material has been added to the surface.

PARTICLEBOARD

Particleboard production begins with planer shavings, wood chips, and logs. Milling equipment produces wood chips that are separated into desired sizes. Dryers then remove the excess moisture from the chips, and resins and binders are combined with them. Forming machines deposit the wood chips on belts forming them into mats. These mats are cured with heat and pressure, trimmed, and sanded into desired panel sizes. Particleboard is used extensively as core stock for wood veneers and plastic laminates. It is also used for siding, underlayment, sheathing, and other construction and industrial purposes. See Fig. 1-22.

Common woodworking tools may be used to cut and form hardboard and particleboard. However, it is necessary to slightly vary traditional methods due to the material characteristics. An example would be when using screws or applying a finish. Carbide-tipped tools should be utilized in order to give smoother, more accurate cuts, and to extend cutter life.

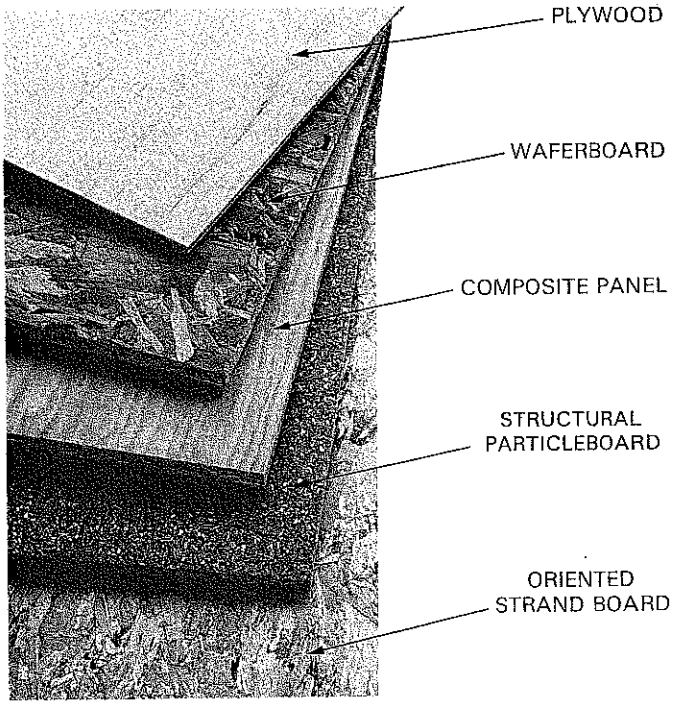


Fig. 1-22. Manufactured panels have gained wide acceptance in the furniture and cabinetmaking industries. (Georgia-Pacific)

WOOD IDENTIFICATION

A key element in the woodworking field is the proper identification of the wood. Fig. 1-23 shows a variety of wood species. Notice how the color and grain characteristics distinguish each of the species from the other.

Fig. 1-23. The wood species on the following pages are commonly used in the woodworking field. Study the color and grain characteristics of each species.

TEST YOUR KNOWLEDGE, Unit 1

Please do not write in this text. Place your answers on a separate sheet of paper.

1. Wood is composed of fiber units held together with a natural adhesive called _____.
2. New wood cells are formed in the _____ layer near the bark.
3. The age of a tree can be determined by counting the _____ rings.
4. Wood nearest the bark of a tree is called _____.
5. Medullary rays running perpendicular to the annual rings toward the pith carry _____ to the center of the tree.
6. Lumber can be divided into two main classifications-_____ and _____.
7. Softwoods are generally products of _____ bearing trees.
8. Hardwoods are mostly products of _____ leaf trees.
9. Three examples of open-grained wood are _____, _____, and _____.
10. Most lumber is plain or flat sawed (cut) tangent to the annual rings. True or False?
11. Some freshly cut lumber is placed in large ovens for _____ drying.
12. Wood _____ as it loses moisture, and _____ as it absorbs moisture.
13. Wood has a tendency to reach a balance in moisture content with surrounding air. This is called the _____ moisture content.
14. Warping is a change in a board from a true surface. In a cup, the board is curved _____ the grain. In a bow, the board surface is curved _____.
15. An even number of layers, or plies, are used when making plywood. True or False?
16. Define the term "hygroscopic."
17. What are two functions of a root system of a tree?
18. The terms "hardwood" and "softwood" refer to the hardness or softness of the wood. True or False?
19. How does clear cutting differ from selective cutting of trees?
20. The grain pattern that is exposed when logs are cut into lumber is called _____.
21. Lumber before it is seasoned may have a moisture content ranging from _____ to _____ percent.
22. Lumber that is stacked outside or in well-ventilated sheds to dry is called _____.
23. Construction-grade plywood is identified by the face veneer and back veneer grading letters. What are these letters?
24. Manufactured panels are said to be _____ _____ because changes in humidity have very little effect on their size.
25. Hardboard that is saturated with oils and resins is called _____ _____.
26. Carbide-tipped tools should be used when working with particleboard in order to provide smoother and more accurate cuts. True or False?
27. Veneers are very thin pieces of wood cut with a saw. True or False?
28. The thickness of veneer may range from _____ to _____ inch.
29. Grading rules used for evaluating the quality and usability of a board are called _____.
30. Veneers may be cut using one of three methods. What are these methods?

ACTIVITIES

1. Trace the growth cycle of trees using in-class resources and the library. Why do redwood trees usually live longer than other trees?
2. Select at least four small samples of different kinds of wood. On the back of each sample, write the name of the wood and list some of its characteristics.
3. Visit a local lumber yard to see how they store and care for wood.
4. Reforestation plays a major role in having plenty of trees available for future use. List things that you can do to support conservation of our natural resources.
5. Prepare an outline for a short report about the history and development of hardboard or particleboard.