

# *WOOD CONSTRUCTION METHODS*

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Wood has long been considered to be an excellent material for construction purposes. It has qualities of durability, and it is easily shaped using modern tools and equipment. Wood used as construction material should be carefully chosen. The different kinds of

wood have different qualities and construction capabilities. They should be used for the purposes for which they are best adapted. Wood is a durable and beautiful construction material when it is properly chosen and used.

## OBJECTIVES

After completing this chapter, you should be able to

- distinguish between processed woods of the hardwood and softwood varieties
- list some distinguishing characteristics useful in identifying woods of different species
- identify some characteristics of wood that contribute to its value for construction purposes
- identify some characteristics of wood that detract from its value for construction purposes
- describe the general process by which logs are processed into lumber
- classify the different cuts of processed wood according to their dimensions
- distinguish between lumber and timbers
- identify some characteristics of hardwoods that contribute to their usefulness
- explain the source and methods of processing wood veneers
- distinguish the differences among the different types of reconstituted boards

## TERMS FOR UNDERSTANDING

beam	gang saw	planer	square
block	green chain	plank	tensile strength
board	hardboard	plywood	timber
cant	headrig	pneumatic power	veneer
cross-banding	headsaw	pores	warp
debarking	loading jack	resin duct	
fiberboard	lumber	sawyer	
flitch	particle-board	slab	

## IDENTIFICATION OF WOODS

Different kinds of wood are divided into two broad classifications: hardwoods and softwoods. Hardwoods are obtained from broad-leaved trees and softwoods are obtained from conifers which bear needles or scale leaves. The different kinds of trees were discussed throughout these units and information useful in identifying live trees was provided. Processed woods also have unique characteristics. For example, one distinguishing feature between hardwoods and softwoods is the presence of pores in hardwoods and the absence of pores in softwoods. **Pores** are the specialized vessels through which dissolved nutrients moved when the tree was alive.

**Resin** is a viscous, sticky substance clear or translucent in appearance. It is not soluble in water, and it is exuded by a tree as a defense mechanism to protect the tree in places where injuries have occurred. **Resin ducts** are openings in the wood through which resin moves within a live tree. They are present in softwoods, but not in hardwoods.

Some woods can be identified by their color or odor. For example, the odor of wood obtained from cedar trees is distinctive. Another aromatic wood comes from the sassafras tree. Among the woods distinctive in color are mahogany, rosewood and cherry; however, woods are found in nearly every

color. Color differences between sapwood and heartwood are also evident in many kinds of trees. Sapwood tends to be light in color while heartwood is dark. Differences exist between species in the proportions of sapwood and heartwood.

The density of wood is a quality indicator, but it is also a method of wood identification. The weight or density of wood depends on the ratio of cell wall material to the volume of the wood. Wood density is usually expressed as pounds per cubic foot or per thousand board feet. Density is also a measure of hardness. The pignut hickory is the most dense of all North American hardwoods.

The texture and grain of woods are also useful in identification. Some woods are fine grained, while others are coarse grained. Many woods have distinctive grain patterns that aid in their identification. Some woods even appear to have no visible growth rings and the grain is nearly invisible. The texture of these woods appears to be fine, while the texture of conifers where growth rings are prominent is described as coarse. When distinct differences appear in the growth rings between the spring-wood and the summer-wood, the texture is considered to be uneven.

## PROPERTIES OF WOOD

Wood has many qualities that make it desirable for constructing useful things. Hardwoods have great durability and toughness making them desirable in uses where the structural material is expected to endure high stress loads or abrasive wear. Softwoods are easily shaped, and they are used for purposes that require more decorative beauty than durability and strength.

Strength along the long axis of the tree is much greater than it is across the thickness of a tree. This measurement of strength is called **tensile strength**. It is attributed to the type of wood cells found in the trunk of a tree. Most are tracheid cells much longer than they are wide. They are aligned lengthwise in the trunk of the tree making the wood up to ten times stronger along the length of tree than across it. This is the source of strength of the wood used for timbers and structural **beams**.

Wood has aesthetic properties that make it desirable in the construction of paneling, doors, cabinets and furniture. Highly polished wood crafted into useful things is highly regarded for its beauty. Some woods are also highly durable, and furniture constructed of these materials is often valued by the owners for several generations.

One reason wood is desirable for construction of homes and buildings is because it has insulating qualities against the transfer of heat. In comparison with metal or concrete, wood conducts very little heat because heat moves very slowly between wood cells. Wooden wall studs and wall coverings actually resist the movement of heat. This becomes evident when fire consumes a

structure. Quite often, the wooden beams remain in place long after the metal structural beams have been warped and bent by heat.

One quality that makes wood useful as construction material is its flexibility. Buildings constructed using wood structural materials are capable of some movement at times of stress. Flexibility is also useful in the manufacturing industry. Wooden devices, such as sporting goods, require flexibility. The ability of wood to flex without breaking is an important characteristic that favors its use as a construction material.

Some properties of wood restrict its uses for some purposes. One of these properties is the tendency of wood to shrink when dry conditions prevail and to swell when conditions are damp. Among the problems caused by this property are loose joints and warped members. This can be a serious problem with hardwood floors and wooden furniture.

Another property of wood that interferes with its usefulness is that it cannot be molded to new shapes, and it cannot be fused or melted together. Wood has elastic qualities that allow it to bend, but wood also springs back to its original shape once pressure is released. Wood can be glued together, but its fibers cannot be welded.

Other qualities that detract from wood as a material for construction include its lack of uniformity. Variability even exists in lumber from the same tree. Wood also breaks down over time, especially when damp conditions prevail.

## LUMBER MANUFACTURING

Modern lumber mills are equipped with high tech equipment and machinery capable of high speed operation. Logs are sawed into marketable dimensions using a **headsaw** or **headrig**. This is the main cutting platform in the mill where logs are sawed into boards. Many modern lumber mills cut timber with a bandsaw having teeth on both edges. This allows the saw to cut a board as the moving carriage carries the log in either direction. The double cutting band saw blade has greatly contributed to the efficiency of modern sawmills. Nearly twice as much timber can be cut using this blade in comparison to a bandsaw blade that cuts in a single direction. Band saws are also capable of cutting very large logs. The only size restriction for a bandsaw is the distance between the upper guide for the blade and the floor of the carriage.

Some sawmills have continued to use circular blades to saw logs, but most mills use these blades to trim boards. Circular blades may also be used in a multiple-blade combination called a **gangsaw**. A gangsaw is capable of making several cuts at the same time in processing small logs, or in cutting boards to standard lumber sizes. Circular blades are effective, but they can cut in only one direction. They also have fewer cutting teeth than band saw blades which makes it necessary to sharpen them at more frequent intervals. They are also limited in the size of log they can cut by the size of the blade. The diameter of the largest log that can be cut on a circular saw cannot exceed the cutting radius of the blade.

Each log that enters a modern lumber mill is subjected to debarking. The bark is removed by large machines that apply pressure and function to the log surfaces to remove the bark. Large lumber mills often operate more than one processing line. When this occurs, logs are often sorted by size after they enter the mill. The largest logs are moved to the main headsaw where they are cut into boards and timbers.

Many modern lumber mills now use X-ray machines to scan logs. The X-ray profile of the log is evaluated by the computer to determine how the log should be positioned and which cuts should be made to obtain the highest value from the log. A computer link to the carriage and the headsaw allows the log

to be cut automatically to maximize its value. The person who operates the headrig is called a **sawyer**. The sawyer is responsible to carefully watch the automated operations and to override the system by operating the machinery manually when problems arise.

The first cut on each of the four sides of a log removes an exterior piece of wood called a **slab**. This wood is usually chipped for use as paper pulp or biomass. A log from which all four slabs has been removed is called a **cant**. Logs are often exported in this form. Each board or timber falls from the saw-blade to a set of rollers that carry it to the next processing area. A wood piece less than 5" X 5" in its dimensions is generally called **lumber**. A cut of wood less than 2" thick and more than 4" wide is called a **board**. A piece of wood that measures 1 7/8"-4"- in thickness and more than 11" in width is a **plank**. A wood piece more than 5"x5" in its dimensions is called a **timber**. A **beam** is a timber more than 8"x8" in its dimensions. Any timber square-cut with equal dimensions on all four sides is called a **square**. Standard wood sizes are recognized by the timber industry .

Boards and timbers are sorted by thickness using mechanical sorting gates located throughout the mill. Lumber of one-inch thickness passes under the mechanical gates, while lumber of thicker dimensions strikes the gate causing a mechanical arm known as a **loading jack** to be raised from between the rollers, lifting the timber to another set of rollers located on a higher plane. The same process is repeated as 2" lumber is separated from 4" lumber and larger timbers. Most mills use compressed air to provide **pneumatic power** for the operation of loading jacks and sorting gates.

No two lumber mills are designed exactly the same way but, in general, boards move along rollers until they come to a gangsaw. Here they are positioned, trimmed and cut to standard widths. All lumber products smaller than timbers and beams are run through a machine called a **planer**. This machine reduces the rough lumber to standard lumber dimensions less than their nominal sizes, and it makes the surfaces smooth. It does this by shaving or planing off the outer surfaces.

Lumber now moves into the sorting sheds on the green chain consisting of parallel chains

that carry the boards. In some mills, the ends of the lumber pieces are trimmed to standard lengths at this stage of processing. Once the lumber products arrive in the sorting sheds, they are inspected, sorted by grade, and

stacked in layers. Modern equipment is available that inspects, sorts and stacks the lumber according to its size and grade. Some machines even test lumber and certify it as a stress graded product.

### CAREER OPTION: LUMBER GRADER

A lumber grader is responsible for grading lumber products according to the standards of quality. Lumber products are inspected as they move across the conveyor system or in the lumber stacks after processing is complete. The lumber grader looks for defects such as decay, splits, milling defects, knots and stains, and assigns a grade to the product. The lumber is measured to assure that standard dimensions are met, and marked according to grade. The grader may also be responsible for removing wood that detracts from the grade of a package of lumber. It may also be the responsibility of the grader to keep a tally according to the grade and board footage of the lumber. Training and work

experience in a lumber mill prepare a worker for this forest industry career.

Green lumber still contains much of the moisture that was in the live tree. Lumber allowed to dry without first stacking it is likely to **warp** or become distorted in shape. This is because loss of moisture causes the wood to shrink. When moisture is lost at different rates from different sides of a board or timber it becomes crooked or warped. Green lumber is stacked in layers separated by narrow strips of wood called stickers to allow air to circulate over the board surfaces. This allows the damp lumber to dry in the stacks, or it can be dried in kilns to speed up the process.

### TIMBERS AND STRUCTURAL PRODUCTS

Timbers and beams consist of large dimension lumber used to construct the frames of buildings, bridges and other structures. They are also used extensively by the mining industry to shore up mines, preventing cave-ins. They are used in large numbers as the crossbeams used as railroad ties to which rails are fastened in the construction of railroad tracks. Large numbers of beams continue to be used in the electrical industry as cross-members on utility poles, and construction timbers are driven into the ground as pilings upon which bridges, docks and buildings are constructed. Structural

timbers are being replaced for many of these uses, however, by laminated wood products, metal and reinforced concrete.

The value of some woods as structural materials can be enhanced by treating them with chemicals to resist decay. This is usually done by injecting chemical compounds directly into the wood. This process extends the useful life of wood construction materials for many years. Some woods, such as redwood, are naturally resistant to decay. This quality makes this wood particularly valuable for construction purposes.

### HARDWOODS

Hardwoods are generally considered to be superior quality wood for many purposes in comparison with softwoods. High quality hardwoods are used to construct hardwood floors in homes and gymnasiums where durability is a high priority. Most of the world's finest furniture is constructed of high quality hardwoods that combine beauty with durability. The market for antique hardwood furniture bears out the durability claims made for hardwoods. In addition to the use of hardwood materials to construct doors and wood

furniture, hardwoods are also used in the frames of chairs and couches stuffed and covered with leather and other materials. They are also used for many purposes where durable construction material is required. A growing demand for hardwoods is for the construction of durable pallets for industrial use.

Hardwoods such as black walnut and a few other species are so valuable that great care is taken to avoid waste. Some high value

hardwoods are peeled or sliced to make high quality veneers for furniture. Some of the best hardwood logs are sawed into thick pieces of high quality wood. Each of these is called a **fitch**. Fitches are usually sliced into

high quality veneers for use in the construction of expensive furniture. Hardwood veneers are made from large diameter trees (>16" dbh) free of knots, decay and other defects.

## LAMINATED AND RECONSTITUTED PRODUCTS

Wood is a versatile building material that can be shaped and formed to create structural materials. A group of products of this kind that has found acceptance by the construction industry includes laminated structural beams. Laminated materials consist of layers of individual pieces that overlap, all of which are smaller than the finished product. Laminated structural beams are constructed of multiple layers of wood glued together to form long, uniform structural supports for the roof of a large building. Laminated beams are often used when long, rounded roof spans are desired, such as in gymnasiums where there are no internal supporting walls. Individual pieces of lumber are bent to the desired curvature of the beam, and held in place with clamps while the glue sets up between the layers. Once the glue has cured, these massive beams will hold their shape.

### Veneers and Plywoods

**Veneer** consists of thin sheets of wood, 1/4" or less in thickness, peeled off the surface of a log using a specialized lathe. The process begins by cutting the logs to proper lengths. A log cut to a standard length to fit the lathe is called a **block**. Blocks are prepared for the lathe by heating them with hot water or steam. Next, the blocks are peeled forming a long, thin ribbon clipped to the proper size. Veneer is then cured in dryers to remove moisture.

Some veneers are sold to the furniture industry where they are bonded to inexpensive wood in the manufacture of furniture. Veneer is also used to make crates and packing containers. Most veneers are used to make plywood. **Plywood** is a laminated wood product made of several sheets of veneer joined together by adhesives. The orientation of the wood grain in each layer is alternated to align the long wood fibers across one another. This practice is called **cross-banding**. It gives added strength to the plywood sheet and minimizes contraction and expansion of the material. Each succeeding layer is joined to the others with special adhesives. Each different layer

in plywood is called a ply, hence the name, plywood. With the glue in place, the sets of plies are introduced in the hot presses. When the boards emerge, they are trimmed and sanded.

One advantage that plywood construction materials offer is that small trees can be converted to building materials with large, standard dimensions. Plywood can also make use of lower grade materials such as particle-board in the center of the board than is evident on the outer layers of the board. The more expensive grades of plywood use high quality material throughout the board. Much of this material is used to manufacture furniture or cabinets. The main uses of construction grade plywoods include house siding, paneling and sheathing materials.

### Reconstituted Boards

It has been estimated that only 40-70% of the clean wood that enters a sawmill actually ends up as salable lumber. The rest of the wood was burned or wasted until recent years. Today, most of the material trimmed from lumber products is used for reconstituted wood products, or it is reduced to wood chips by a machine called a hog for use as pulpwood or biomass. The hog and the chip-n-saw are wood chipping machines used to reduce large slabs or other wasted wood materials to wood chips. A reconstituted board contains wood material bonded together by an adhesive. The size of the wood particles ranges from fairly large in particle-board to medium or small chips in fiberboard and hardboard.

**Particle board** contains a high percentage of wood shavings in the central core of the board with layers of wood flakes on either side of the core and fine sawdust near the surfaces. These materials along with an adhesive are pressed together between two steel sheets until the glue has bonded. Some cross-banding occurs, but not to the extent found in plywood. Particle board has replaced much of the plywood that was

formerly used as sheathing in the construction of buildings.

**Fiberboard** is made of wood fibers that become cross-banded in the panel due to the random arrangement of the fibers in the mat from which the board is formed. Fiberboard is a rather loose arrangement of wood fibers in comparison with other reconstituted boards. The density range of this product is .16 to .5 grams/cubic centimeter. Fiberboard is used as acoustical tiles to deaden sound between rooms and in large rooms like auditoriums and gymnasiums. Fiberboard used as sheathing on buildings is treated with asphalt to make it more durable and water repellent.

**Hardboard** is made of similar materials to fiberboard, but the boards are press-bonded

between heated steel plates resulting in a density range for this product of .5 to 1.3 grams/cubic centimeter. Hardboard is probably better known as Masonite, which is a brand name under which it is marketed. Among the uses for which hardboard is suited are siding, panels, tiles and pegboard. Approximately 60% of lumber and reconstituted wood products is used in the building construction industry, and the other 40% is used to make furniture or other wood products. Wood panels account for approximately 30-35% of all lumber products used. Lumber products of all kinds are processed in high tech mills fitted with modern machines. These mills are designed to produce each of the different kinds of wood construction materials available in the modern construction industry.

## LOOKING BACK

Wood is an excellent material for construction purposes. Hardwood features that help distinguish them from softwoods include the presence of pores in hardwoods, but not in softwoods. Softwoods contain resin ducts and hardwoods do not. Wood characteristics that favor its use in construction include good tensile strength, aesthetic beauty, insulating qualities, flexibility and ease of shaping. Wood characteristics that detract from its

usefulness include the tendency of wood to decay, the inability to fuse wood, and the tendency of wood to resist forming to shapes. Wood is processed in high tech lumber mills into standard dimensions of lumber, timbers and reconstituted wood products. High quality hardwoods and softwoods are processed into veneer used in plywood panels and in the furniture industry.

## QUESTIONS FOR DISCUSSION AND REVIEW

### Essay Questions

1. What differences exist between processed woods of the hardwood and softwood varieties?
2. What properties of wood make it suitable as a material for construction purposes? What properties detract from its usefulness?
3. Describe the general process by which logs are processed into lumber.
4. List the different cuts of processed wood according to standard lumber and timber dimensions.
5. List the duties performed by a person who has chosen a career as a lumber grader.
6. What force causes green lumber to warp when it is not properly stacked as it cures?
7. What are some ways that structural wood products are used?
8. What are some major uses for which hardwoods are best adapted?
9. Explain what veneer is and how it is obtained from logs.
10. What is the process by which plywood is manufactured?
11. How are reconstituted boards such as particle-board, fiberboard and hardboard made?
12. How are plywood, particle-board, fiberboard and hardboard different from one another?

### Multiple Choice Questions

1. Which of the following is a distinguishing visual feature of hardwoods?  
a. pores  
b. resin ducts  
c. density  
d. odor
2. Which of the following, is a distinguishing feature of a softwood?  
a. pores  
b. color  
c. resin ducts  
d. heartwood
3. The strength of wood along the long axis of a tree is called:  
a. ductile strength  
b. density  
c. toughness  
d. tensile strength
4. A saw that makes two or more cuts at the same time is called a:  
a. gangsaw  
b. handsaw  
c. headrig  
d. circular saw
5. A log from which only the slabs have been removed is called  
a. A. timber  
b. cant  
c. beam  
d. block
6. A timber with a cross-section measurement of 8" x 8" or greater is called a:  
a. cant  
b. block  
c. beam  
d. flitch
7. A source of power used in lumber mills that is provided by compressed air is called:  
a. hydraulic power  
b. pneumatic power  
c. wind power  
d. steam power



8. A condition that occurs as green lumber dries unevenly resulting in distorted shapes in the wood is known as:
- a. lamination
  - b. asymmetry
  - c. symmetry
  - d. warp
9. A thin sheet of wood that is peeled from a block is called:
- a. veneer
  - b. plywood
  - c. particle-board
  - d. reconstituted wood
10. The practice of aligning long wood particles and fibers across one another in the manufacture of reconstituted wood is called:
- a. articulation
  - b. cross-banding
  - c. integration
  - d. cross-bonding
11. Another name by which hardboard is well known is:
- a. particle-board
  - b. waferboard
  - c. Masonite
  - d. fiberboard
12. A reconstituted wood product in which wood shavings are a major component is called:
- a. waferboard
  - b. fiberboard
  - c. hardboard
  - d. particle-board

### LEARNING ACTIVITIES

1. Visit a home building supply warehouse, either individually or as a class, and report on the dimensions, grades and prices of wood products available for home construction. Assign students to small work groups, and assign them some log dimensions (debarked). Have each group calculate the highest possible retail value that could be obtained from the log based on the lumber dimensions and prices observed at the warehouse.
2. Obtain some samples of reconstituted wood products, and allow the students to examine them. Assign students to small work groups, and have each group do an in-depth written and oral report on the types of materials used to make the product. Have each group explain the probable process by which the product was manufactured.