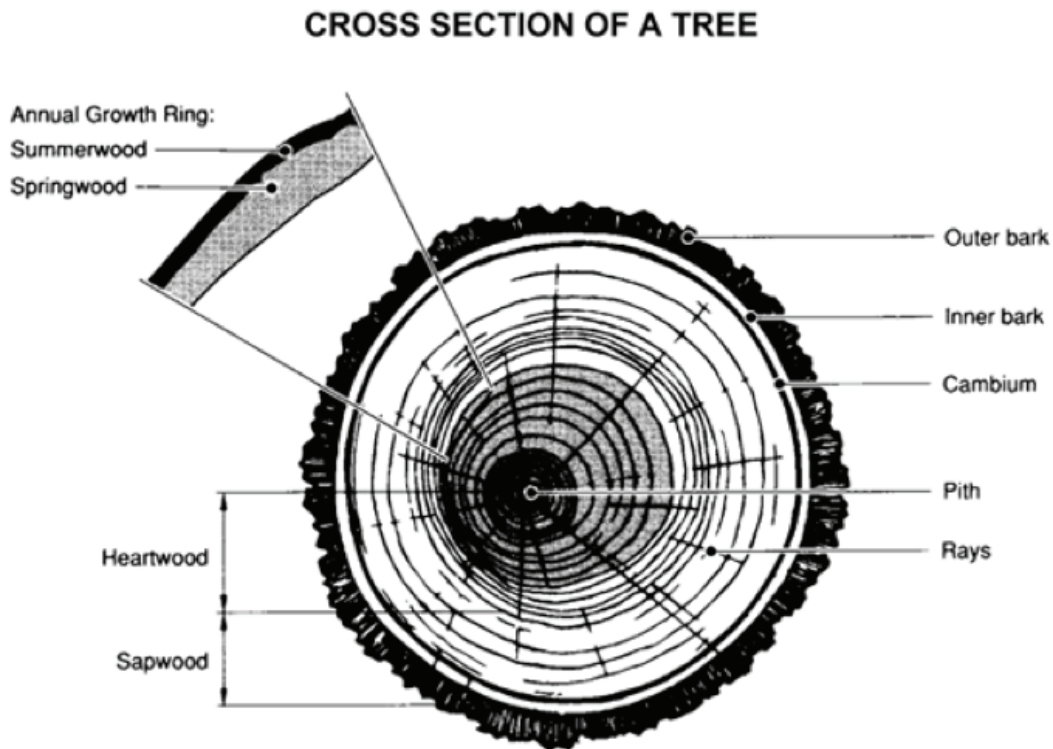




Chapter 1: Types of Lumber



- A light colored section is called springwood and a darker section is called summerwood. Springwood is wider than summerwood because it is formed in the spring and grows faster and therefore is less dense than the summerwood.
- As the number of annual rings increases, those nearest the center receive less nourishment and become inactive usually changing to a darker color. Heartwood and sapwood may be about equal in strength, but heartwood may be more resistant to rot and decay.
- Vertical grain is when the grain of the wood runs parallel to the width of the piece.
- Flat grain is when the grain runs perpendicular.

GREEN SIZES OF LUMBER

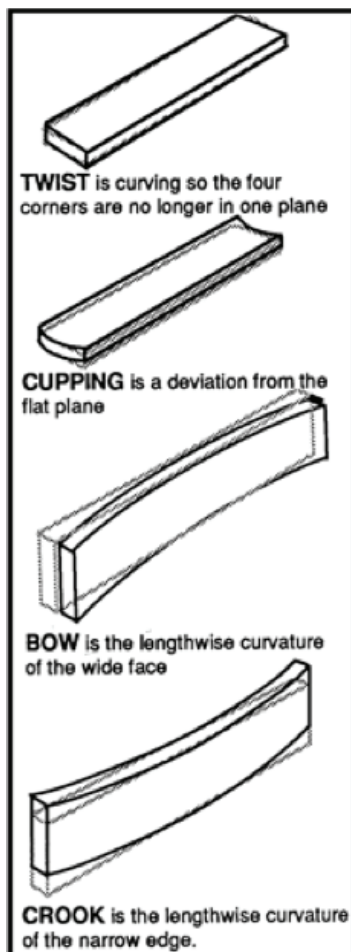
- The stated size of lumber is either stated in its nominal size, dry size or green size. Called its nominal size; this is not the actual size of lumber. For example: a nominal (stated) size might be 2"x4", but the actual size is 1-1/2"x3-1/2".
- The piece started out approximately 2"x4", but after drying and planing it is smaller. How much it shrinks depends on whether the lumber has been left green (un-dried) or if it's been dried to a moisture content of 19% or less (which is considered dry).

In the chart below, you'll notice the green lumber is slightly larger than the dry lumber. When the green lumber eventually dries out, it will be about the same dimensions as the dry lumber.

Nominal Size	Actual Size	Green Size
1"	3/4"	25/32"
2"	1-1/2"	1-9/16"
4"	3-1/2"	3-9/16"
6"	5-1/2"	5-5/8"
8"	7-1/4"	7-1/2"
10"	9-1/4"	9-1/2"
12"	11-1/4"	11-1/2"

COMMON DEFECTS OF SOFTWOOD

- The stated size of lumber is either stated in its nominal size, dry size or green size. Called its nominal size; this is not the actual size of lumber. For example: a nominal (stated) size might be 2"x4", but the actual size is 1-1/2"x3-1/2".
- The piece started out approximately 2"x4," but after drying and planing it is smaller. How much it shrinks depends on whether the lumber has been left green (un-dried) or if it's been dried to a moisture content of 19% or less (which is considered dry).
- In the chart below, you'll notice the green lumber is slightly larger than the dry lumber. When the green lumber eventually dries out, it will be about the same dimensions as the dry lumber.



Some common names of defects for softwoods are:

- Check—Wood separation along the length of the grain.
- Decay—Rotting of the wood usually caused by fungi and/or moisture.
- Knots—Many kinds of knots classified by size from pin knots to large knots, those over 1-1/2" in diameter.
- Pitch—Resin accumulated in the wood cells making a patchy appearance.
- Split—Wood separated length-wise completely through from one face to the other.
- Wane—Bark, or no wood at the corner or edge of lumber.
- There are more natural and manufactured defects than listed here. The more severe and frequent, the more they affect strength.
- Lumber used for finishing, appearance and non-structural purposes can be whatever the customer is satisfied with. But lumber used for structural purposes must meet structural requirements. So building codes require grade stamped lumber for these purposes. This lumber is graded to a national standard reflecting the defect severity and frequency. (For more information, see next pop-up window.)

GRADING AGENCIES FOR SOFTWOODS

- There are several grading agencies for softwoods, but they have all voluntarily adopted the same grading standards. A piece stamped "CONSTRUCTION" by any agency will meet the same standards.
- One of the largest lumber producers associations is the Western Wood Products Association (WWPA), which defines grades of lumber produced in the western states. There are other reputable associations grading western lumber, but most information on western lumber in this training course comes from the WWPA.
- The Southern Pine Inspection Bureau (SPIB) defines the grades of softwood lumber produced in the Southeastern United States.
- The Northeastern Lumber Manufacturers Association (NELMA) is the major rules writing association in the Northeastern United States.
- Canadian softwoods are graded under the National Lumber Grades Authority (NLGA).
- Remember, all these agencies use the set of standards (PS 20-99) for grading lumber set by the American Lumber Standards Committee, which is part of the U.S. Department of Commerce.
- In addition, some single species have their own associations of lumber producers. The biggest of these is probably the California Redwood Association (CRA), which uses its Redwood Inspection Service (RIS) to grade redwood boards and dimension lumber. Western red cedar also has its own grade names.
- Depending on your location, you may use Western lumber, Southern pine, Eastern, Canadian lumber, or any combination, depending on market conditions.

SIZING BOARDS

A board is generally a piece of lumber 1" nominal in thickness (3/4" actual) and any width.

Thickness

- Most boards are 3/4" in actual thickness (1" nominal).
- Some boards are 5/8" or 1/2" thick, but they are usually sold for drawer sides, hobby work, etc.
- Boards thicker than 1" nominal are called 5/4 (five-quarter) or 6/4. These are graded under board grading rules and might be used in making trim, cabinets or stair treads.
- Boards that are 5/4 are often softwoods in finish grades.
- Technically, boards can be as thick as 16/4 according to the grading rules for boards. Most lumberyards, though, don't carry anything thicker than 6/4.

Width

- Boards are typically 2" and wider.
- Typical stock for a store is 1"x2", 1"x3", 1"x4", 1"x6", 1"x8", 1"x10" and 1"x12".
- With thicker boards, it is common to buy S2S lumber (surfaced on two sides, not on the edges). They are often random widths.

Length

- Lengths for boards are uniform.
- Sizes start at 6' and go to 24', and beyond.
- Typical stock for a store is boards in even foot lengths from 8' to 16'. Some markets will demand 18', 20' and 24'.

Patterns

- Some boards are precut into standard shapes for uses such as paneling, siding, flooring or shiplap, which is a board with notched edges so adjoining pieces overlap.
- Standard patterns are assigned a number and are compiled in a "Standard Product Pattern" booklet published by the WWPA.
- Stores can order a specific pattern from a mill and be assured they will get the same shape.

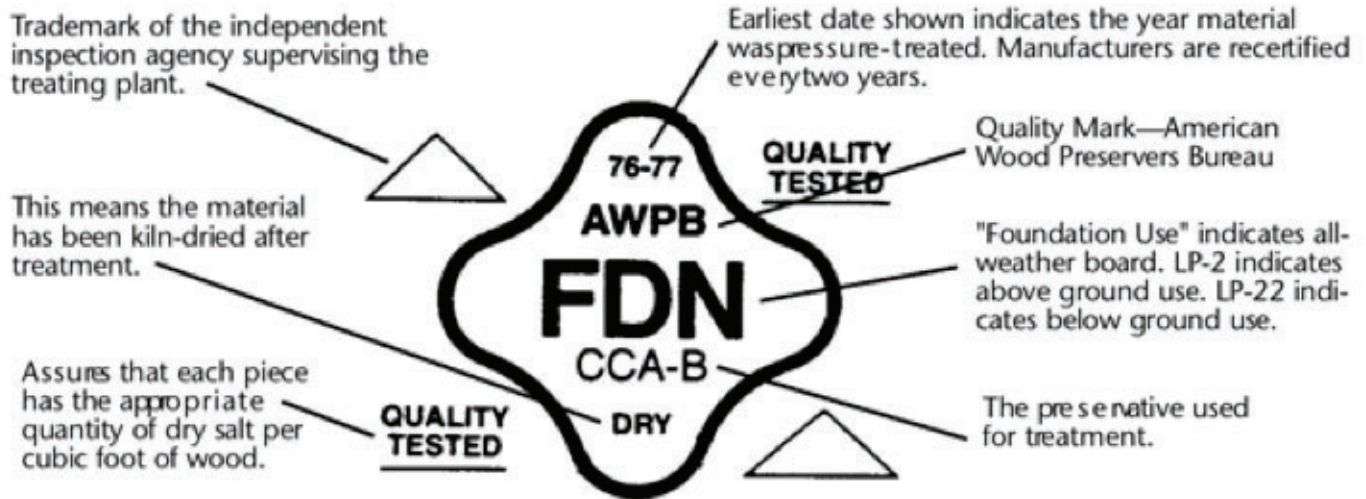
Module 2: Dimensional Lumber

DIMENSIONAL LUMBER GRADING

These are the grading guidelines established for Southern Pine. These grades are similar to other species grades but they have more grade separations available. However, most mills do not manufacture all products and make all grade separations. Those products and grades manufactured by relatively few mills are noted with an asterisk.

- Select Structural: high quality, relatively free of characteristics that may impair strength or stiffness.
- *Dense Select Structural: Recommended for uses where high strength, stiffness and good appearance are required.
- No. 1: Provides high strength, recommended for general utility and construction purposes.
- No. 1 Dense: good appearance, especially suitable where exposed because of knot limitations.
- No. 2: Although less restricted than No. 1, suitable for all types of construction.
- No. 2 Dense: Allows well-spaced knots of any quality.
- No. 3: Assigned design values meet wide range of design requirements. Recommended for general construction purposes where appearance is not a controlling factor. Many pieces included in this grade would qualify as No. 2 except for a single limiting characteristic. Provides high quality and low cost construction.
- Stud: Composite of No. 3 strength and No. 1 nailing edge characteristics.
- *No. 3 Dense: Recommended for general construction purposes where appearance is not a controlling factor. Many pieces included in this grade would qualify as No. 2 except for a single limiting characteristic.
- *Construction: Recommended for general framing purposes. Good appearance, strong and serviceable.
- * Standard: Recommended for same uses as Construction grade but allows larger defects.
- * Utility: Recommended where economy is desired. Excellent for blocking, plates and bracing.
- Economy: Usable lengths suitable for bracing, blocking, bulk heading and other utility purposes where strength and appearance are not controlling factors.

TYPICAL QUALITY STAMP FOR PRESSURE TREATED LUMBER



QUALITY CONTROL MARK

All pressure-treated material should include a quality control mark from an approved agency (approved under the major model building codes), which assures compliance with American Wood Products Association (AWPA) standards. The following information should be included in the quality mark:



Glossary

S2S: surfaced 2 sides

RGH: rough sawn, as it came off the lumber mill

S4S: surfaced on all four sides

4/4: one inch rough sawn

5/4: one and one quarter inch rough sawn

6/4: one and one half inches rough sawn

8/4: two inches rough sawn

13/16: one inch surfaced

BF: board foot

J1E: jointed (straightened) one edge

SD1-80: sanded one side with 80 grit sandpaper

FAS: first and seconds

FT: foot or feet

IN: inch, inches

JTD: jointed

KD: kiln dried

LBR: lumber

LGR: longer

LGTH: length

LF: linear foot

T&G: tongue and grooved

Module 3: Boards

SIZING BOARDS

A board is generally a piece of lumber 1" nominal in thickness (3/4" actual) and any width.

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Module 4: Decks and Fencing

GRADING OF DECKS AND FENCING

REDWOOD

HEARTWOOD GRADES

- Clear All Heart: Normally kiln-dried, well-manufactured and free from defects on one surface. Surfaced or saw-textured. Finest architectural heartwood grade. Used for siding, paneling, trim, cabinetry, moulding, fascia, soffits, millwork and decks.

- **Construction Heart:** Contains knots of varying sizes and other slight imperfections. Usually unseasoned. Surfaced or rough. Used for decks, retaining walls, fences, stairs, garden structures or other outdoor uses.
- **Merchantable Heart:** Economical grade. Slightly larger knots than Construction grades. Holes limited to size of knots. Allows checks, some splits and some manufacturing flaws. Unseasoned, surfaced and rough. Used for fences, retaining walls and garden structures.

SAPWOOD GRADES

- **Clear:** Contains sapwood and heartwood in varying amounts. Normally kiln-dried with some imperfections that are not permitted in Clear All Heart. Surfaced or textured. Used for siding, paneling, trim, fascia, moulding, decking and garden shelters.
- **B Grade:** Quality grade containing sapwood, limited knots and other. Kiln-dried or unseasoned. Surfaced or saw-textured. Used for siding, paneling, trim, fascia, moulding, decking and garden shelters.
- **Construction Common:** Same general characteristics as Construction Heart but permits sapwood in varying amounts. Unseasoned or seasoned. Surfaced, rough or saw-textured. Used unseasoned for decking, fence boards and other above garden uses. Used seasoned for rustic sidings.
- **Merchantable:** Some characteristics as Merchantable Heart but contains sapwood in varying amounts. Unseasoned but can be ordered surfaced or rough. Use for fence boards, railings and other above-ground garden uses.

OTHER GRADES

- **Select Heart:** Tight-knotted heartwood resistant to insects and decay. Face free of splits or shake. Usually unseasoned, surfaced or rough. Used for decking, fence boards, garden structures and other above ground uses not requiring durability.
- **Select:** Contains sapwood in varying amounts with some imperfections on the back side. Usually unseasoned. Surfaced or rough. Used for decking, fence boards, garden structures and other above-ground uses not requiring durability.
- **Finger-Jointed:** Clear boards up to 24'. Made of kiln-dried pieces finger-jointed and end-glued. Normally surfaced mixed grain. Used for fascia, exterior trim, exterior siding, interior paneling, trim and moulding.

CEDAR

Following are grading guidelines published by the Western Red Cedar Lumber Association used to grade cedar wood.

- **Architect Clear®**—The finest appearance. Manufactured with a strict standard that restricts natural characteristics.
- **Architect Knotty®**—Permits knots, but they must be tight and sound. Knotty posts of the best quality.
- **Custom Knotty®**—A good appearance for the price sensitive customer. Defects such as unsound knots are restricted.
- **Standard and Better**—Commonly used for fence construction where structure is more important than appearance. Allows for a range of natural characteristics.

Staining

Clear Stain: Maintains the natural color of the wood. In addition to protecting against normal wear and tear, a clear stain should protect against water and UV rays. A clear stain requires frequent recoating.

Tinted Stain: One step removed from a clear stain. They add a slight pigment to the wood and last longer than a clear stain.

Semi-Transparent Stain: Adds a hint of color while allowing the grain and texture of the wood to show through. Not for use on wood previously painted a solid color. Use only on wood untreated or stained with a lighter shade of stain.

Solid Color Stain: Changes the color of the wood while still allowing the grain to show through. Offer the best protection and are ideal for wood that has begun to show its age. They last longer than other types of stains. Can use to cover previously stained or painted surfaces.

Here are some additional tips for finishing redwood.

- Water repellent with mildewcide is a recommended natural, stand-alone finish and an excellent basecoat for paint or stain. It reduces checking and the effects of dirt and weather, resists mildew and avoids natural darkening. With two coats, wood gradually lightens to buckskin tan.
- Bleaching Oils containing mildewcide produce permanent driftwood gray, eliminating darkening. They may contain or can be mixed with water repellent and gray stain.
- Semi-transparent stains in light colors tone wood without hiding grain patterns. Water repellent is contained in, or can be mixed with, these low-maintenance finishes.
- Heavy-bodies latex-based stains apply solid colors that obscure wood grains but highlight textures. They should be applied over compatible oil-based primer.
- Paint should be applied over compatible oil-based primer. Particularly with saw-textured wood, two topcoats will last 8-10 years.
- Factory finish available on some redwood. The finish may be a water repellent, paint primer or stain. Can be more economical and uniform than field applications.

Maintaining

Here are some tips you can give your customers who need to clean, waterproof, strip or stain their wood deck or fence

Cleaning

- Keep the surface swept of leaves and dirt.
- Always clean dirt, mildew and algae before staining
- Repair loose or rotten boards before staining
- Clean with a power washer, but limit the power to 1,500 psi
- Let the cleaner sit on the fence for about 2 minutes before rinsing

Waterproofing

- Every wood surface, even if it's pressure treated, needs waterproofing
- Apply water-based products just hours after cleaning the surface
- Apply oil-based products to a completely dry surface
- Apply only one coat. Multiple coats will not result in extra protection. Rather, it will leave a tacky finish
- Use products that offer mildew-resistance

Stripping

- Use a power washer and be sure to wear protective clothing
- Cover plants, sidewalks and anything else that might be damaged by the stripping solution
- Use a synthetic, stiff bristle brush (not a wire or natural bristle brush) to scrub out stubborn stains
- After applying the stripper, thoroughly rinse to completely remove the chemical residue
- Let the fence dry thoroughly before staining, usually a couple of days.

Staining

- Test a small area to be sure you are satisfied with the color
- Mix gallons for uniformity of color
- Use an airless sprayer on the lowest setting and with a fine mist and use a large orifice tip
- Have a brush handy to eliminate pools of stain

Staining Tips

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Factory finish available on some redwood. The finish may be a water repellent, paint primer or stain. Can be more economical and uniform than field applications.

Module 5: Hardwood Lumber

COMMON CHARACTERISTICS OF HARDWOOD

The following are common characteristics of hardwood not considered defects when grading the quality of a board.

Quarter Sawn

To quarter saw a piece of wood means cutting the log at a 90° angle to the growth ring. This will produce a uniform or vertical grain pattern. This method of cutting produces fewer boards per log and thus quarter-sawn boards are more expensive. They are usually used for decorative applications and will expand and contract less than boards cut from the log by other methods.



Plain Sawn

To plain saw a piece of wood means to cut it tangentially to a tree's growth ring. This creates a flame-shaped or cathedral pattern. Cutting a log this way produces more boards and thus plain sawn boards are more cost effective. It also expands and contracts more than a board cut by other methods.



Heartwood and Sapwood

Heartwood is the more mature part of the log, closer to the center of the tree and darker in color. Sapwood is the lighter, younger part of the log closer to the bark.



Burl

A burl is a grain pattern. It is a twist or a swirl that does not contain a knot.



Mineral Streaks

These are streaks of color that usually follow the grain pattern.



COMMON DEFECTS OF HARDWOOD

The following are characteristics of hardwood that are considered defects when grading the quality of a piece of lumber.

Worm Holes

These are holes in the wood that range in size from 1/16" to more than 1/4".



Split

This is a lengthwise separation of the wood. It usually occurs as the piece dries. If there is a separation along the growth rings, it is called a Shake. A Check is a lengthwise opening in the face of the board. It does not go through the entire board like a split, but it is also caused by faulty drying.



Knot

This is a circular area where there was once the base of a branch. In some cases, the wood is missing. Other times, it may be solid with no signs of decay.



GRADING AGENCIES FOR HARDWOOD

The National Hardwood Lumber Association establishes these grades of hardwood lumber. Since hardwoods are rarely used for structural purposes, the main factor in hardwood grading is appearance and the number of clear cuttings possible from a piece.

- FAS (First and Seconds). The most pieces clear of defects and also the most expensive. Boards are generally 6" and wider and 8' and longer. Used for fine furniture and cabinetry.
- Selects. A cost-effective substitute for FAS when only one good facing is required. Boards are 4" and wider, 6' and longer.
- #1 Common. A shop or thrift grade where boards are 2/3 clear face cuttings. A good value for where smaller pieces, 4" x 2' or 3" x 3', can be used.
- #2 Common. Boards have 50 percent clear faces. Generally 3" and wider and 4' and longer. Used for some paneling and flooring.



Chapter 2: Selling Lumber

Module 1: Board Feet

ORDERING LUMBER

Truckloads

- You can also order lumber by the truckload. Common truckload quantities vary by specie and by what geographical area they come from.
- They are usually about 27,000 board feet (BF), ranging from 23,000 BF to 30,000 BF.
- Most lumber will be delivered by truck directly to your home center or lumberyard. However, you may have it delivered by railcar.

Railcar Loads

- If you order lumber by the railcar, you might order by the boxcar, which is usually 80,000 BF, but might be from 40,000 to 90,000 BF.
- A flat car is usually 112,000 BF, but might be from 70,000 to 120,000 BF.
- Much of the lumber cost can be the freight charges from the mill to your store. Therefore, freight charges can be a determining factor in the kind of lumber you stock. Certain minimum weight amounts give you the best freight rate.
- If you unload lumber directly from a train, you have a certain amount of time, such as 48 hours, to unload a car after it is in a position to be unloaded. You are charged demurrage if you take too long to unload.
- It is easier to unload if lumber is banded together.

Lumber Producing Regions

- Lumber can be categorized by the region of the country where it is grown.
- Coast lumber is considered to be West Coast species grown between the Pacific Ocean and the mountain ranges. Examples are Douglas Fir-coastal, Larch, Redwood and Cedar.
- Inland lumber is considered to be from the West, but harvested east of the coastal plains all the way to the Great Plains. Examples are Douglas Fir-inland, Larch, Cedar, Idaho White Pine and Hem-Fir.
- Southern Pine is the major specie from the South-Southeast part of the U.S.
- Eastern woods from the Appalachian area include Spruce, Fir, Norway Pine, Virginia Ponderosa Pine, Eastern White Pine and more.
- Canadian lumber is much the same as the Western and Eastern species, but is usually noted in the code books with "North" following the species. Examples include Spruce-Pine-Fir, Douglas Fir, Hem-Fir and also East Coast species such as Eastern White Pine.

Lumber quantity chart

- In this chart you can see some standard lumber unit quantities and sizes.
- In the pieces/unit column, the first number listed for each size category is the most commonly sold unit. The next quantities are those used by some lumber mills and/or wholesalers. These may not be available in your area.

Size	Pieces/Unit
2x4	294
2x4	192
2x4	180
2x4 Studs	294
2x4 Studs	312
2x4 Studs	192
2x6 Studs	189
2x6 Studs	128
2x6	189
2x6	128
2x8	147
2x8	96
2x10	105
2x10	80
2x12	84
2x12	64

Board Feet Practice Problems

How many board feet are in the following quantities?

1. 7 pieces of 1x4 – 4' _____
2. 560 LFT of 2x4 _____
3. 25 pieces of 2x4 – 15' _____

How many lineal feet are in the following quantities?

4. 1,500 BF of 1x8 _____
5. 210 BF of 2x4 _____
6. 800 BF of 2x10 _____

How many pieces of lumber are in the following quantities?

7. 1,100 BF of 2x4 – 16' _____
8. 200 BF of 1x2 – 14' _____

What is the cost of the following quantities of lumber, priced at \$550/M?

9. 20 pieces 2x4 – 8' \$ _____
10. 9 pieces 1x4 – 16' \$ _____
11. 300 pieces 2x4 – 16' \$ _____
12. 1,000 BF 2x8 \$ _____

Answers:

1. $9\frac{1}{3}$

2. $373\frac{1}{3}$

3. 250

4. 2,250

5. 315

6. 480

7. 103+

8. 85+

9. 107 BF/\$58.85

10. 48 BF/\$26.40

11. 3,200 BF/\$1,760.00

12. 1,331 BF/\$733.70

Module 4: Board Feet

Who publishes building codes?

- There are three major building codes that have evolved as model building codes: the National Building Code (published by the Building Officials and Code Administrators International Inc.), the Uniform Building Code (published by the International Conference of Building Officials) and the Standard Building Code (published by the Southern Building Code Congress International Inc.).
- The International Code Council is a cooperation of three major building codes. This council publishes the International Residential.
- In an effort to standardize building codes, these three building codes cooperate as the International Code Council and publish the International Residential Code (IRC) for One- and Two-Family Dwellings.

COMMON STRESS TYPES

Following is a more detailed explanation of the various stress types placed on lumber.

Calculating Modulus of Elasticity

- In the course, we learned that the modulus of elasticity is abbreviated E and is how much a piece of lumber will sag or deflect in relation to the load placed on it.
- The building code will set a limit on how much a piece of lumber is allowed to deflect. These are reflected in the span tables.
- A general rule is $\frac{1}{360}$ th of the span. That is a maximum sag of 1" for every 360" (30') of joist length.
- You can figure the deflection by changing the span length into inches then dividing by 360.

- The span tables we used previously were acceptable for span limits. As a double check, note the symbol $L/360$ in the upper right. That indicates the deflection limit is $1/360$, acceptable for code.
- Typically, these deflection limits do not mean that the joists will actually sag to the full acceptable amount any time you use them. More than likely, the piece of lumber you are using will sag less because it is not being loaded or spanned to capacity.
- Codes allow ceiling joists slightly more deflection, commonly $1/240$ th of the span.
- Modulus of Elasticity is a ratio between the amount a material will deflect in proportion to a load. It is represented by "E" and expressed in psi (pounds per square inch). That value is often shortened by dividing by 1 million. Example: An E value of 1,500,000 is often called 1.5E.

Compression Parallel to Grain

- Abbreviated FC.
- A normal stress on a post, column, stud, etc.
- Typical stress where the load is supported on the end of the piece.
- The fibers in the wood are uniformly stressed. Stress is parallel to and along the full length of the wood.
- Rarely a problem in home construction as most lumber is very strong.
- The opposite kind of stress is Fiber Stress in Tension (Ft), then the stresses on the lumber is trying to pull it apart. This is rare in house building and rarely a factor in choosing lumber.

Compression Perpendicular to Grain

- Abbreviated FC
- The stress when a floor joist, ceiling joist, beam, etc., rests on a support. The load tends to crush, or compress, the fibers at the bearing point.
- The bearing area has to be large enough so that the load doesn't crush the fibers at the side grain.
- Building codes set minimum bearings for lumber.
- Minimum bearing for wood floor and ceiling joists, rafters, beams and girders is $1\text{-}1/2$ " on wood and 3" on masonry. Joists that are lapped must be lapped at least 3". If you follow these minimums, you won't have to worry about compression perpendicular to the grain.

Horizontal Shear

- Stress when wood fibers slide over themselves horizontally right at the top to bottom mid-point of the member.
- The only time when this stress is a problem is in short, heavily loaded beams that are deep. The solution is to increase beam cross section.