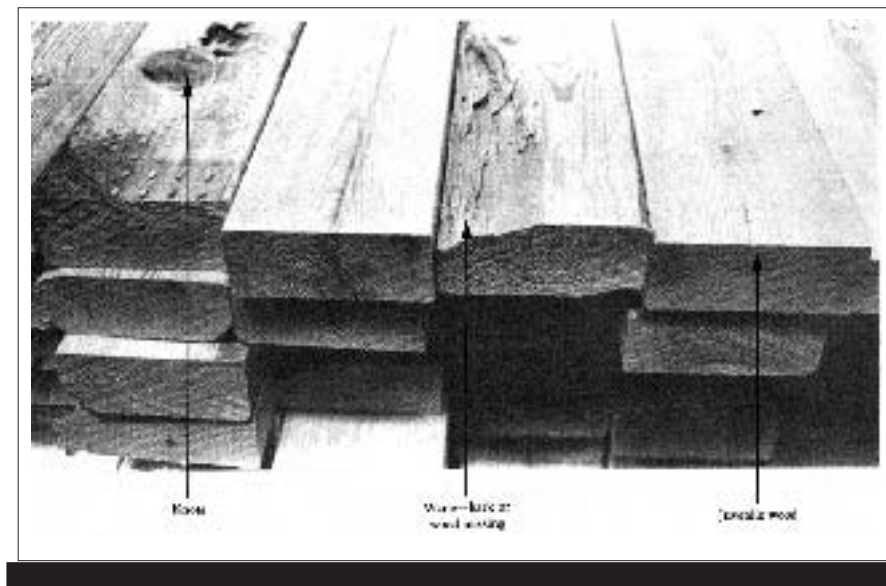




IS LUMBER QUALITY SLIPPING?

by Robert Stroh

The harvesting of younger trees means more knots, crossgrain, and other defects in your lumber

Lumber serves as the primary framing material for residential and light-commercial construction. Has lumber changed over the years? What is the future outlook for the lumber supply?

Answers to these questions require a discussion of tree growth, lumber production, lumber grading and purchasing, and forest management. The discussion will be on the softwoods, from which framing lumber is commonly produced.

Tree Growth

The center of the stem of a tree is called the pith. Surrounding the pith and running out to the bark is the woody portion of the tree, which is the source of our lumber. Unfortunately, lumber is not a uniform material: It contains knots, varies in density and strength, and varies in color. Understanding these variations will help you use lumber effectively.

Knots. The most obvious discontinuity in the wood is caused by limbs. Some limbs originate at the pith of the tree while others originate from buds formed on the outside of the stem. As the tree and limbs grow larger in diameter, the limbs become surrounded by the wood. These embedded limbs appear in lumber as knots.

Lumber reaching the building site in recent years appears to have more knots. The wood has more knots, particularly small tight knots, because the nation's old-growth forests are being replaced by second- and third-growth forests and by plantation-grown trees. The trees being harvested are younger and smaller in diameter. Because of the smaller diameter, there is less space between limbs growing at the same height on the tree. Producing clear wood from these trees is more difficult (see Figure 1, page 64).

Every builder knows that knots can

reduce the strength of a piece of lumber — large ones more so than small ones. Builders are also aware of the premium price of a piece of knot-free lumber (see Figure 2).

The effect of a knot on strength depends on the size of the knot relative to the size of the lumber, the location

of the knot, and the distribution of loads on the lumber.

Sapwood and Heartwood

There are two kinds of wood in a tree — sapwood and heartwood. Sapwood is the outermost portion located just inside the bark. It varies in thickness

Common Lumber Defects

You may have heard these terms before, but do you really know what they mean? These common lumber defects should be part of every builder's vocabulary.

Bark pockets. Bark pockets are small patches of bark embedded in dressed lumber. They usually affect only the appearance of the piece, but they can reduce the withdrawal strength of a nail or screw. Grading rules limit the amount of bark, but because of its location near the outside of the tree, it may pass graders' tests for strength and stiffness.

Checks and splits. These are tiny splits that develop along the fibers of the wood during drying. To prevent checking, lumber should be dried properly and protected on the job site. This is especially important for wood trusses.

Compression wood. Internal fibers of wood can be damaged by high winds, snow loads, or rough handling during logging. This defect shows up as streaks. Compression wood can suddenly break when used for structural applications such as ladder rails, planks, or decking.

Crossgrain. When wood fibers are not oriented parallel to the length of the piece of lumber, the wood has crossgrain. The slope of grain predicts how great the reduction in strength will be. This characteristic is tested by lumber graders.

Knots. Although a knot itself is as strong as the rest of a piece of wood, the area near the knot is weak because of crossgrain. If a piece of lumber is milled when the log is still green, the knot is said to be "tight." If the growth layer of the tree is dead, however, the knot will be loose or fall out when sawn. The number, size, and location of knots influence the strength of structural lumber.

Shakes. These are cracks or fiber separations that occur along the grain and between annual rings. They may be caused by genetic factors, frost, wind, or growth stress.

Wane. Bark or lack of wood on edges or corners of lumber.

Warp. Bending, twisting or distortion that take place during seasoning.

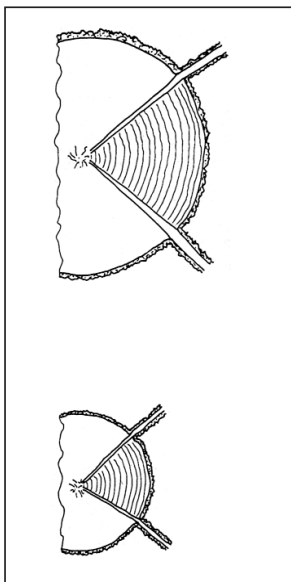


Figure 1. Larger-diameter trees (a) produce more knot-free wood than smaller-diameter trees (b).

from tree to tree and from species to species. Builders using redwood siding are familiar with the lighter-colored sapwood. This color variation is not as obvious in other species. In general, sapwood in a given species is similar in strength to the heartwood but is less resistant to decay.

Heartwood extends from the pith to the sapwood. It, too, has variations. Aside from the embedded limbs, the most visible variation in heartwood is related to the annual growth rings that appear on the ends of a piece of lumber.

The growth rings on the end of a piece of lumber may appear sharply curved or as gentle arcs. Sharply curved growth rings indicate that the lumber was cut near the center of the tree; gently curved rings indicate that the lumber was cut farther from the center of the tree.

Some lumber has completely circular growth rings indicating that the piece was cut from the center of the tree and includes the pith. Such lumber contains juvenile wood, which has lower strength and great shrinkage as discussed below (see figure 3).

The orientation of the growth rings within a piece of lumber also affects its performance. When the tree is harvested, cut into lumber, and allowed to dry, it begins to shrink. Wood shrinks mostly in the direction of the annual rings (tangentially), about half as much

across the annual rings (radially), and only slightly along the grain (longitudinally).

When framing lumber with a moisture content of 15 to 20 percent is installed in a new building, the wood will continue to dry to a lower moisture content – on the order of 10 to 12 percent or lower. As it dries, it shrinks further, which may result in warping, checking, splitting, or other performance problems.

Lumber shrinkage is not new. However, the reduced diameter of the trees being harvested today results in a larger proportion of flat-grained lumber than edge-grained lumber. Flat-grained lumber is more subject to shrinkage and causes such problems as cupping and bowing (see Figure 4).

Juvenile Wood

Heartwood can be either juvenile or mature wood. Unfortunately, it can be difficult to differentiate between the two types of wood by visual inspection unless the pith is present. Pith in a piece of lumber indicates it contains juvenile wood.

University and government researchers define juvenile wood as that portion of the heartwood formed close to the pith, usually within the first 5 to 20 growth rings. It is generally characterized as having lower density than mature wood, wider annual rings, and much lower strength properties.

Juvenile wood is nothing new; it has been around ever since trees were first sawn into lumber. The problem today is that the proportion of lumber containing juvenile wood is growing. The reasons for this include: harvesting smaller trees, using the stem of the tree up to smaller diameters, the use of genetically "improved" trees that grow faster, and growing trees in plantations that are irrigated and fertilized to increase growth.

Juvenile wood can have poor dimensional stability as evidenced by crook, twist, bow, and warp. And unlike mature wood, juvenile wood can shrink lengthwise. In fact, longitudinal shrinkage can even occur when lumber containing juvenile wood is kiln-dried to 15 percent and put in place in a building where it continues to dry. Research indicates that juvenile wood shrinks longitudinally up to ten times as much as mature wood of the same species.

The most widely publicized symptom of juvenile wood longitudinal shrinkage has been the "rising truss" problem. Research has traced the problem to unusually high lengthwise shrinkage of the bottom truss chord due to the presence of juvenile wood. The problem

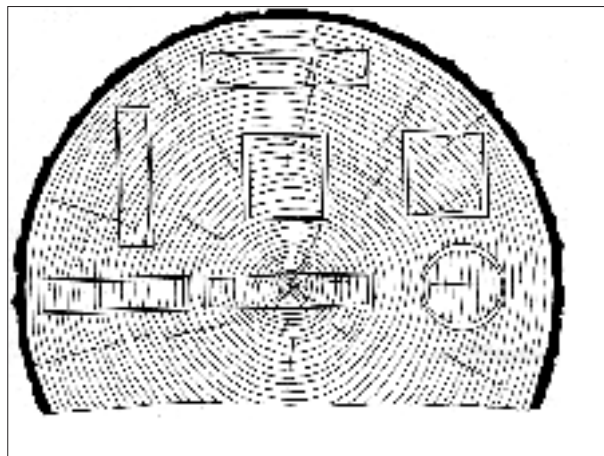


Figure 3. Characteristic shrinkage and distortion of flats, squares, and rounds as affected by the direction of growth rings.

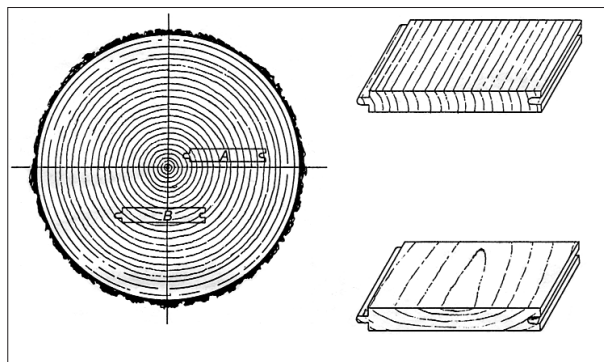


Figure 4. Edge-grained wood shrinks less across the grain and warps less than flat-grained wood.

has often puzzled builders because of its sporadic occurrence among trusses produced by the same truss fabricator from what was apparently the same lumber.

Lumber Grading

Lumber producers have graders who grade every piece of lumber as it is produced. The key factors considered in the grading process are knots and slope of grain. Grading also considers a low number of growth rings per inch in some species (for example, southern pine) as a visual indication of the presence of low-density material and, to some extent, juvenile wood.

The regional inspection groups, which monitor the process, visit each mill at least ten times a year to check the grading. These regional groups contend that today's mill-based inspectors are better trained and more sophisticated now than at any time in the past.

As a result of this improved inspection process, structural lumber reaching the lumber yards today is more "on grade" than in years past. So even if some of today's lumber looks worse than in days gone by, builders have great assurance that a piece of lumber graded "No. 1" will perform at its grade level.

Lumber Milling

Some saw mills have equipment for efficiently handling small-diameter logs. Some of these mills are referred to as "chip-and-saw" operations. The outer slabs cut from the log go directly to a chipper; the center of the log is sawn into a few pieces of lumber. In their quest to be more efficient and to use more trees of smaller diameter, the chip-and-saw operations unwittingly produce more lumber from that portion of the tree most likely to contain juvenile

nile wood almost entirely.

Lumber Purchasing

Careful wood production, milling, and grading can be wasted if you buy the wrong lumber for the job. The only guarantee a builder has is the grade stamp that should appear on every piece of lumber purchased. It may be false economy to either specify or accept an 88-cent economy grade stud in place of a construction-grade stud. The waste, rework, and potential call-backs may outweigh the cost difference.

Future Forest Management

Historically, forest managers regarded maximization of timber volume per acre of forest land as the key to profitable operations. A shift in this thinking has begun as recently as this decade, as a result of the dwindling portion of lumber that is cut from old-growth forests.

Younger-growth forests and plantations tend to be more carefully and intensively managed – including genetically improved stock, thinning, pruning, fertilization, and shorter rotation. These practices alter the forest products produced and, therefore, the potential return on investment. If improper choices are made during the trees' growth years, the final product may be destined for the chipper rather than the saw mill.

The future supply of lumber for construction will depend on forest scientists making the right decisions about forest management and silviculture. ■

Robert C. Stroh, Ph.D. is Director of Information Technology for the NAHB National Research Center.

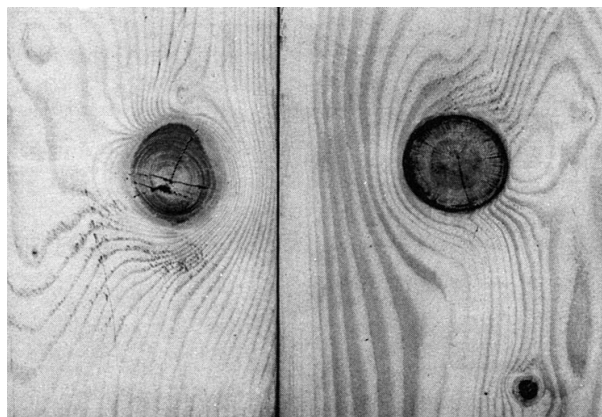


Figure 2. Intergrown knots (left) have increased crossgrain which weakens the lumber. Encased knots (right) may fall out, but the lumber is actually stronger.