
TECHNICAL BULLETIN

Wood Acclimation and Drying

It is the nature of wood products to adjust their moisture content to the equilibrium relative moisture of its surrounding environment. Wood products do this by releasing and or absorbing moisture as its surrounding environment changes in temperature and humidity. When wood takes on moisture it expands and when it loses moisture it shrinks. It is also not abnormal for wood to develop surface checks or cracks as the wood acclimates or equalizes to the project site conditions, application and exposure to UV. These checks and cracks have no effect on the strength or durability of the wood; it is simply a natural reaction to the drying process.

When a log is fresh cut it is filled with water. Then when it is processed into lumber, the drying process starts and shrinkage of the board begins. There are stresses in the lumber when acclimating and the rate of loss in moisture may cause movement and behavior of the wood fiber.

Wood dries by movement of free water and water vapor through wood cells, fiber cavities, fiber walls. Because wood is not homogeneous, it shrinks more along the growth rings (radial) than across the rings (tangential). Tangential dimensional change is often nearly twice that of radial movement for most wood species and longitudinal (length) dimensional change is almost always negligible.

Shrinkage and swelling cease as the core moisture content of wood approaches equilibrium with its environment. Species of wood vary in their rate and amount of shrinkage. An individual piece of wood will display unique shrinkage or swelling patterns in these three planes of the lumber. Timbers having the pith or center of the log will tend to have more drying responses than those without the heart center.

To minimize shrinkage, warping, checking and splitting in the finished product, lumber must be acclimated to the middle of the range of expected in-use moisture equilibrium. This can be done through the process of Air Drying (natural/slow) or Kiln Drying (artificial/accelerated).

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Air Dried lumber for exterior use is generally supplied in the range of 18% to 25% for dense hardwoods, 15% to 20% for softwoods and low density hardwoods. Kiln Dried lumber for exterior use is generally supplied with an average moisture content between of 12%-14%. Wood for interior use is typically supplied between 6% and 8% moisture content.

The extent of drying responses depends on the species and the rate at which the lumber dries. For much of the United States, the moisture content of thoroughly air dried lumber for external use is between 12% to 14%. For the seasonal EMC levels in your region consult the US Forest Labs website, www.fpl.fs.fed.us. Search for the document titled, "Equilibrium Moisture Content of Wood in Outdoor Locations".

The following describe some of the responses wood may demonstrate during the acclimation process.

- Checks are responses of the wood that develop along the grain because of drying stresses. Checks are of three types: end, surface, and honeycomb. Some woods are inclined to check more readily than others.

Checking will often remedy itself with the checks closing once the core of the timber has reached equilibrium. While this is typical, it cannot be guaranteed.

Kiln Dried (Pre-Stabilized) lumber will typically show less checking than Air Dried Lumber during the acclimation process though some checking can always be expected.

To help minimize end checking as hardwood lumber acclimates it is imperative that the end grain of timbers be sealed to slow down the release of moisture from the timber. Apply a coat of a wax based end grain sealer to board ends immediately after cutting to final length.

To help minimize surface checking as the lumber acclimates, the surfaces can be sealed with a single coat of penetrating oil to slow down the release of moisture from the timber. If surface sealers are used it is wise to seal all surfaces of the timber to avoid unequal moisture loss issues. It is important to recognize that more is not better when it comes to penetrating oil wood sealers. Overapplication will only cause the surface to become sticky collecting dust which will act as food for surface mold growth.

Larger dimensional lumber sizes and timbers will usually show some checking and cracks when acclimated.

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- Honey Comb or internal cracking which is only visible when looking at the end grain of is usually caused by improper kiln drying.
- Cupping is typically caused when moisture is pulled from one face by intense heat and sun while the back face releases moisture at a slower rate. This underscores the value of kiln drying which equalizes wood on all faces equally or slowing the air-drying process. For air dried lumber a single coat of penetrating oil on all faces will help slow the acclimation process. Proper ventilation is also critical to reduce the potential of cupping. The thickness to width ratio of wood also impacts the potential for cupping. For example a 1x12 board will be more prone to cup than a 1x8 board which is more prone to cup than a 1x6 board and so on.
- Shakes are check-like openings usually at the junction of the growth rings. Shakes may originate on end grain surfaces and look like end checks, except that they follow the growth rings rather than the wood rays. Shakes are often difficult to predict prior to installation.
- Splits are longitudinal and radial separations of the wood. Usually they occur in the radial direction. Splits are generally located at a board end, but occasionally occur along the length of a board. A split along the length of the board may or may not extend completely through the thickness of the piece. Splits are sometimes associated with longitudinal stresses that were in the log and the board when it was freshly sawn. When a split originates, the longitudinal stresses cause it to open wide and extend along the length of the piece.
- Cracks have the appearance of surface checks or splits but are formed differently. Cracks occur in pieces containing the pith or heart center of the tree. Their characteristically large width is caused by the difference between tangential and radial shrinkage. Cracks are common in poles, posts, and boxed-heart timbers.
- Warping is caused by the differences in shrinkage in the three grain directions and irregular and distorted grain. The differences in shrinkage characteristics of wood result in distortions of the cross section of a board. These distortions are termed warp and in lumber items, are classified as bow, crook, and twist.

Wood is an organic material, not manufactured, with variations from board to board in grain, density and moisture content. Many contractors order an additional percentage of material to allow for waste as pieces are selected for installation. When specifying lumber it is incumbent of the architect/engineer/specifier to recognize the potential impact of the acclimation process to the appearance of the completed project.

This information has been gathered from US Forest Lab publications including; "Wood Handbook, Wood as an Engineering Material", "Air Drying of Lumber" report #FPL-GTR-117, and others. These are available from their website www.fpl.fs.fed.us