TECHNICAL BULLETIN

Wood Acclimation and Drying

It is the nature of wood products to adjust their moisture content to the equilibrium relative moisture of the surrounding environment. Wood products do this by releasing and/or absorbing moisture as their surrounding area changes in temperature and humidity. When wood takes on moisture, it expands; 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. These checks and cracks do not affect the strength or durability of the wood; it is simply a natural reaction to the drying process.

When a log is freshly cut, it is filled with water. Then, when it is processed into lumber, the drying process starts, and shrinkage of the board begins. Acclimating causes stresses in the lumber, and moisture loss leads to shrinkage, which can cause deformation. The amount of shrinkage varies with the species of wood and the grain patterns of the lumber; because of this, a change in shape usually results. If the drying stresses exceed the strength of the wood, failures can develop, such as splits or complete separation of the fiber from one face to another.

Wood dries by the movement of free water through fiber cavities, fiber walls, and the movement of water vapor through the wood. 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. These shrinkage variations may cause drying responses like warping and checking. Shrinkage and swelling cease as the moisture content of wood approaches equilibrium with its environment. Species of wood vary in the 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.

6200 Tomken Rd Mississauga, ON - L5T 1X7 - Canada
1-855-344-4500 | www.TropicalForestProducts.com | info@tropicalforestproducts.com

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 processes of air-drying (natural/slow) or kiln-drying (artificial/accelerated). Air-dried lumber for exterior use is generally supplied in the range of 18% to 25% for dense hardwoods and 15% to 20% for softwoods and low-density hardwoods. Kiln-dried lumber for exterior use is generally supplied in the range of 12%-18%. As the wood acclimates, water is removed, and the lumber has the potential to warp, twist, cup, and bow. 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 is 12% to 15%. 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 describes 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 more prone to checking than others.
- Honeycomb or internal cracking, which is only visible when looking at the end grain, is usually caused by improper kiln-drying.
- 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.
- Splits are longitudinal and radial separations of the wood. Usually, they occur in the radial direction. Splits are generally located at a board's end but occasionally occur along the length of a board. A split along the length of the board may or may not extend entirely 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 cup, bow, crook, and twist.

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.

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To help minimize end-checking as hardwood lumber acclimates, the end grain of the timber must be sealed to slow down the release of moisture. Apply a heavy coat of a wax-based end grain sealer to all end grain cuts immediately after cutting to length.

To help minimize surface checking as the lumber acclimates, the surfaces can be sealed 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. In Iron Woods™ Ipe, the checking will often remedy itself with the checks closing or becoming less prominent once the timber's core has reached equilibrium. When acclimated, larger dimensional lumber sizes and timbers will often have some checking and cracks.

Wood is an organic material, not manufactured, with variations from board to board. Many contractors order an additional percentage of material to allow for waste as pieces are selected for installation. When specifying lumber, it is incumbent on the architect/engineer/specifier to recognize the potential impact of the acclimation process on 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 at www.fpl.fs.fed.us

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