Dimensional Stability of California Redwood

Redwood is much less subject to common defects associated with dimensional change. . .

Redwood has the least volumetric shrinkage of any commercial domestic wood; therefore, it can be subjected to considerably more change in moisture before it has the same change in dimensions as other commercial species. This means that projects manufactured with redwood will be much less subject to open joints, warping, cupping, splitting and other defects associated with dimensional change. Table 1 provides relative shrinkage values for a number of common domestic softwoods. These values are shown on a relative basis taking the values for old-growth redwood as 100 percent. Values over 100 indicate shrinkage greater than that for old-growth redwood.

Average relative shrinkage values. . .

Table 1. Average relative shrinkage values for common domestic softwoods

Species	Shrinkage from green to oven-dry condition based on dimensions when green		
	Radial	Tangential	Volumetric
Redwood, old growth	100	100	100
Redwood, young growth	85	111	103
Western redcedar	92	114	100
White fir	127	159	144
Baldcypress	146	141	154
Ponderosa pine	150	141	143
Douglas-fir (coastal)	185	173	182
Southern pine (loblolly)	185	168	181
Western hemlock	162	177	182

Water exists in green (unseasoned) wood in two conditions: as free water in the cell cavities and as bound water in the cell walls. When wood contains just enough water to saturate the cell walls, it is said to be at the fiber saturation point (FSP). Water in excess of this amount cannot be absorbed by the cell walls and, therefore, is free water in the

cell cavities. Removal of the free water from the cell cavities has no apparent effect on the properties of wood except to reduce its weight, but as soon as any of the bound water in the cell walls is removed, wood begins to shrink. Since the free water is the first to be removed, shrinkage does not begin until the FSP is reached.

Shrinkage is about twice as great across the flat grain face. . .

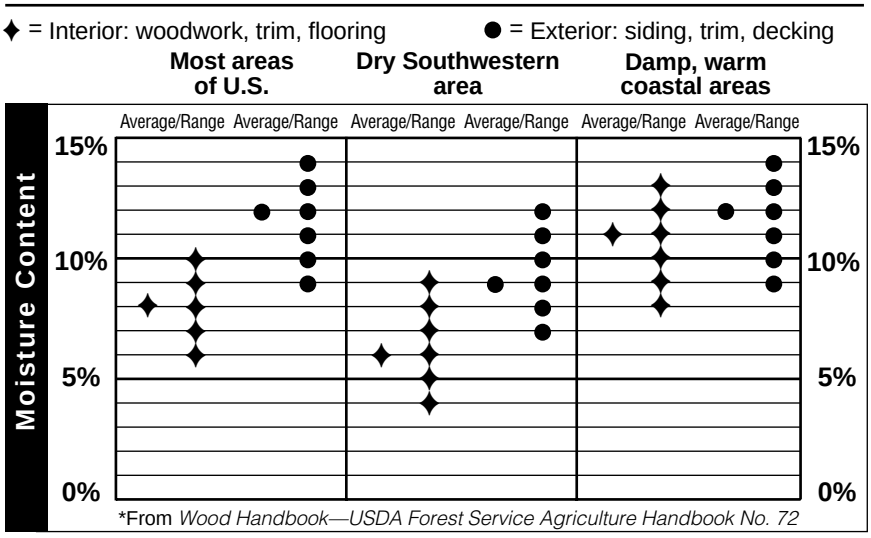
The FSP for wood varies from about 22 percent to 30 percent moisture content. For redwood, FSP can be taken as approximately 22 percent. Dimensional change does not occur until moisture content reductions from the green, or unseasoned, condition go below this value and the cell walls begin to give up bound water. Then redwood begins to shrink in all directions, although not uniformly. Generally speaking, the shrinkage is about twice as great across the flat grain face (tangential shrinkage) as it is across the vertical grain face (radial shrinkage). Longitudinal shrinkage is normally so small that it is generally not considered significant.

All woods contain certain quantities of chemical extractives in addition to the cellulose and lignin components. Redwood is rich in extractives which, combined with redwood's cellular structure, are responsible for its low shrinkage. In properly dried wood there is little appreciable difference between sapwood and heartwood with respect to dimensional change. Sapwood, however, may be more susceptible than heartwood to changes in atmospheric humidity; therefore, its dimensions may change more quickly than those of heartwood.

Moisture content critical at time of manufacture and installation. . .

Ideally, wood products should be manufactured and installed at the moisture content to which they will equilibrate in use. This moisture content is referred to as the equilibrium moisture content or EMC. Table 2 provides recommended moisture content values for various wood items at the time of installation.

Table 2. Recommended moisture content values for various wood items at time of installation*



*From *Wood Handbook—USDA Forest Service Agriculture Handbook No. 72*

Redwood general purpose grades are available green (unseasoned) or S-DRY (19 percent or less moisture content). Redwood architectural grades are available green, S-Dry or Certified Kiln Dried (CKD) in accordance with RIS *Standard Specifications for Grades of California Redwood Lumber*, paragraph 725.

The change in dimension within the moisture content limits of 6 to 14 percent, as defined in the *Wood Handbook*, Chapter 14-2, can be estimated by using dimensional change coefficients as follows:

To estimate change in dimension within a 6 to 14 percent moisture content limit. . .

$$\Delta D = Di [Ct (Mf - Mi)]$$

where: ΔD = change in dimension,
$D i$ = initial dimension (inches),
$C t$ = dimensional change coefficient, tangential direction (for radial direction, use Cr),
$M f$ = final moisture content (percent),
$M i$ = initial moisture content (percent).

Dimensional change coefficients for redwood:

	Cr (radial)	Ct (tangential)
old growth	.00120	.00205
young growth	.00101	.00229

Because lumber products rarely are perfectly flat grain (tangential) or vertical grain (radial), this calculation will usually overestimate tangential shrinkage and underestimate radial shrinkage.

Refer to <u>USDA Forest Service Wood Handbook</u> when moisture content is greater. . .

For approximate dimensional changes associated with moisture content changes greater than 6 to 14 percent, or when one moisture content value is outside of those limits, refer to USDA Forest Service *Wood Handbook*, Chapter 14-3.

A general rule of thumb is that redwood will shrink or swell approximately 0.7 percent in width for each 4 percent reduction or increase in moisture content below FSP.

The Technical Services Division of the California Redwood Association will be glad to assist you with any designs or problems where shrinkage is an important factor in wood utilization.

California Redwood Association

405 Enfrente Drive, Suite 200
Novato, California 94949
Telephone 415 382-0662
Fax 415 382-8531
Toll Free 1-888-CAL REDWOOD
www.calredwood.org

Redwood—our renewable resource