Selected Characteristics of Colorado Woods

Wood species	Paint-holding characteristic: Oil based paint	Paint-holding characteristic: Latex paint	Weathering: Resistance to cupping	Heartwood: Decay resistance	Heartwood: Ease of treating	Heartwood: Color of heartwood	Ease of machining	Resistance to splitting in nailing and screwing	Nail and screw holding ability	Ease of bonding
Aspen	2	3	3	1	3	Pale brown	3	4	2	4
Douglas-fir	1	3	3	2	1	Pale red	3	3	4	3
Engelmann Spruce	2	3	3	1	2	White	3	4	2	4
Limber Pine				1						
Lodgepole Pine				1	2	Pale yellow	3	3	2	3
Pinon Pine				1	4					
Ponderosa Pine	2	3	3	1	4	Cream	4	4	2	4
Plains Cottonwood	2	3	1	1	3	White	1	4	2	2
Subalpine Fir	2	4	3	1	1	Pale tan	2	4	2	4
White Fir	2	4	3	1	2	White	2	4	3	4

Excellent 4 Very Good 3 Good 2 Fair 1

COLORADO WOOD UTILIZATION AND MARKETING ASSISTANCE CENTER

The Colorado Wood Utilization and Marketing Assistance Center is a collaborative between Colorado State University, the Colorado State Forest Service, and the US Forest Service. Its mission is to contribute to the improvement and maintenance of healthy forests conditions in Colorado through extension and outreach in the areas of wood science, forest products and business assistance. It was designed to help communities and businesses utilize the wood products made available from fuel reduction and forest restoration thinning activities in Colorado.

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Physical and Mechanical Properties (continued)

maximum crushing strength; compression perpendicular to grain is fiber stress at proportional limit; shear is maximum shearing strength; tension is maximum tensile strength; and side hardness is hardness measured when load is perpendicular to grain.

Most code requirements for wood interior finish materials are expressed in terms of flame spread index numbers. These values are determined in a standard fire test which evaluates the surface burning characteristics of a material. Different maximum flame spread indices are permitted depending upon building occupancy, location of the material in the building, and the presence of sprinklers.

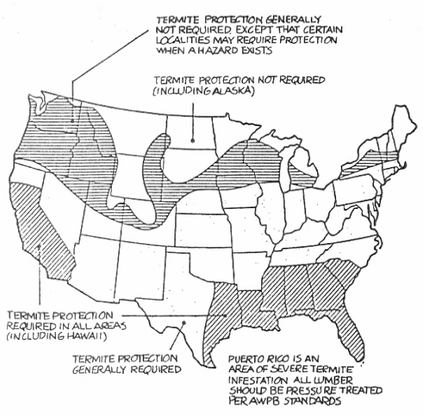
Class	Flame Spread Range	Example Location
I or A	0-25	Enclosed vertical exits
II or B	26-75	Exit access corridors
III or C	76-200	Other rooms and areas

Working Properties: Cottonwood glues well, has low nail-holding ability, does not split easily, and holds paint well.

Preservation: No information available at this time.

Toxicity: In general, working with cottonwood may cause dermatitis in some individuals.

Durability: Heartwood is slightly resistant to nonresistant to decay. The wood can be susceptible to attack by dry wood termites, ambrosia (pinhole borer) beetles, longhorn beetles, and Buprestid beetles.



Additional Information

The Wood Handbook: Wood as an Engineering Material, FPL-GTR-113. USDA Forest Products Laboratory, Madison, WI.

National Design Specification for Wood Construction. American Forest and Paper Association, Washington, DC.

Western Lumber Grading Rules. Western Wood Products Association, Portland, OR.

Colorado Wood Utilization and Marketing Assistance Center

Product Use Guide

Plains Cottonwood — By David G. Bueche

"We may use wood with intelligence only if we understand wood."

—Frank Lloyd Wright
In the Cause of Architecture: Wood
The Architectural Record
May 1928

Wood is used in many forms throughout the world. However, few people fully understand the properties and peculiarities that must be considered for optimum application. This publication was developed as an aid for furthering the understanding of wood. It is a compilation of scientific and trade names, tree and wood characteristics, including: weight; physical and mechanical properties; drying, shrinkage, and working properties; durability, preservation, toxicity, and uses for wood species native to Colorado.

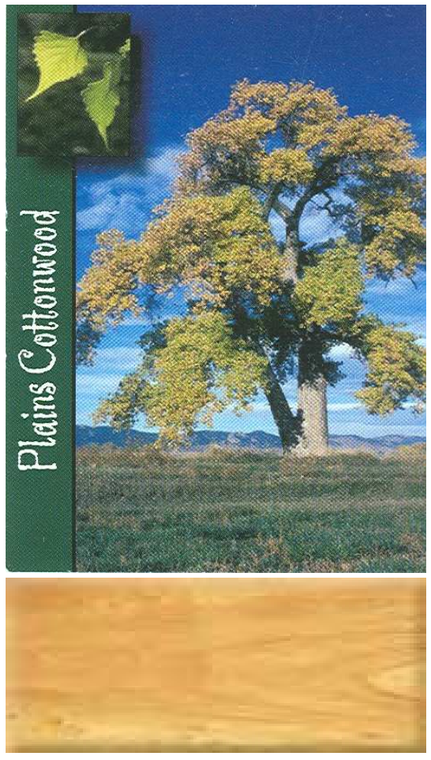
Inside Plains Cottonwood:

Colorado State University — Knowledge to Go Places

Colorado Woods

Plains Cottonwood

Populus deltoides



Description

Populus is the classical Latin name for the poplar tree. The genus *Populus* is composed of 35 species which contain the aspens and poplars. All species look alike microscopically.

The Tree: Plains cottonwood attains heights of 36 to 190 ft with diameters of 6 ft.

Bark: Green-yellow and smooth while young; dark gray, thick, rough and deeply furrowed at maturity.

Leaves: Broad-leaf foliage is glossy and yellow-green; 3 to 6 inches long, 4 to 6 inches wide; toothed margins.

Fruit: U 1/4 inch long with capsules containing 3 to 4 valves; many tiny, cotton-like seeds inside valves.

Elevation: 3,500 to 6,500 feet.

Habitat: Found in floodplains, bordering streams, near springs and moist woodlands; pure stands or with willows.

Relation to Fire: Generally killed by fire; very poor sprouting response.

General Wood Characteristics

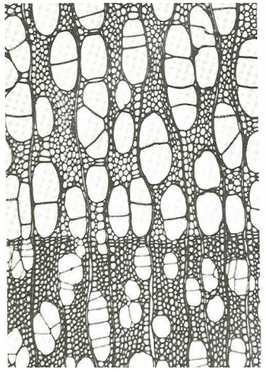
Sapwood whitish, frequently merging into the heartwood and hence not clearly defined, thin or thick; *heartwood* light brown to brown; *wood* odorless when dry or with a characteristic disagreeable odor when moist, without characteristic taste when dry, usually straight-grained, medium-light to light, moderately soft to soft. Tension wood is frequently present, causing a fuzzy surface when cut. *Growth rings* distinct but inconspicuous, narrow to very wide. *Pores* numerous, small, the largest barely visible to the naked eye and more crowded in the first-formed early wood, decreasing gradually in size through the late wood (wood semi-ring to diffuse-porous), solitary and in multiples of 2 to several. *Parenchyma* marginal, the narrow, light-colored line more or less distinct. *Rays* very fine, scarcely visible with a hand lens.

Uses

Pulp (manufactured by an alkaline process) for high-grade book and magazine paper; *excelsior* (the aspens and cottonwood are the principal excelsior woods, for which purpose they are especially well-suited because of freedom from staining materials, light color, light weight, and uniformity of texture and straightness of grain which permit easy shredding into soft but strong and resilient strands; however, this use is rapidly declining); veneer for the manufacture of plywood for furniture (mostly as core and cross-banding stock), *musical instruments*, *containers* (such as berry boxes). *Lumber* (it is estimated that 85 percent of the lumber classified as "cottonwood" is cottonwood and balsam poplar, and the remainder aspen) used for *pallets*, boxes, and crates (about 2/3 to 3/4 of all "cottonwood" lumber) for which it is especially well suited because of light weight, ease of nailing without splitting, and good color for stenciling; *furniture* (concealed parts); *poultry* and *apiary supplies* (especially poultry coops and brooders); *laundry appliances* (such as ironing boards).

Minute Anatomy

Vessels moderately few to very numerous, the largest small to medium, perforation plates simple; intervessel pits orbicular to oval or angular through crowding, large (9-13 μm in diameter). *Parenchyma* marginal, forming a narrow, continuous, or interrupted line. *Libriform fibers* coarse to very coarse, thin- to medium-thick-walled, occasionally gelatinous, medium to very coarse. *Rays* unstoried, uniseriate, essentially homocellular; pits leading to vessels confined to the marginal cells or occurring in occasional rows in the body of the ray as well, simple to bordered. The aspens are similar in structure to the cottonwoods but finer textured.



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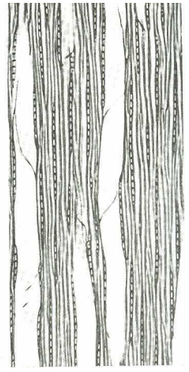

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Drying and Shrinkage

Wood shrinks as it dries, and swells as it absorbs moisture. Dimensional changes generally take place from 0% to 28% moisture content, based on its oven-dry weight. In a dry atmosphere, wet or "green" wood loses moisture in the form of water vapor. Dry wood, on the other hand, absorbs moisture from a humid atmosphere. The moisture content of wood also may be increased by wetting with liquid water. If wet wood is put into place, it eventually dries to a moisture content in equilibrium with the water vapor pressure of the surrounding air. This is the equilibrium moisture content (EMC). This drying is accompanied by shrinkage. If wood has been dried too far below the moisture content reached in use, it absorbs water until the equilibrium moisture content is achieved, and swelling results.

When changes in moisture content are great and occur quickly, shrinkage and swelling may cause, not only dimensional changes, but also splitting, cracking, glue-line failures, or other defects in woodwork, furniture and other wood products. Small changes that take place slowly usually cause very small, hardly noticeable dimensional changes. However, slight drying taking place over a fairly long period of time may generate cracks and distortions when wooden parts are severely restrained-for example, by mechanical fastenings such as staples, screws, nails, and bolts-so that shrinkage is inhibited. When drying stresses exceed the strength of either the wood itself or an adhesive bonding agent, failures will also occur, either in the wood itself or in the glue-lines.

	Percentage of shrinkage (green to final moisture content)		
Type of shrinkage	0% MC	6% MC	20% MC
Tangential	9.2	7.4	3.1
Radial	3.9	3.1	1.3
Volumetric	13.9	9.9	4.1

Physical and Mechanical Properties

	Moisture Content		
Property	Green	(12%)	Ovendry
SG	0.37	0.40	0.43
Weight (lb/ft^3)	49	28	NA
MOE (lb/in^2)	1,010,000	1,370,000	—
MOR (lb/in^2)	5,300	8,500	—
C (lb/in^2)	2,280	4,910	—
C $\perp$ (lb/in^2)	200	380	—
WML (in-lb/in^3)	4.4	2.9	—
Shear (lb/in^2)	730	740	—
Tension $\perp$ (lb/in^2)	410	580	—
Toughness (in-lb)	—	—	—
Hardness (lb)	340	430	—
Conductivity (Btu•in/h•ft^2•°F)	—	0.85	0.71
Resistivity (h•ft^2•°F/Btu•in)	—	1.2	1.4
Heat of combustion (Btu/lb)	6500	8125	—
Flame Spread ASTM E-84	—	115	—

The values reported in this table are the results of tests on small clear specimens with moisture contents (MC) in the green, airdry and ovendry conditions. MC is the total amount of water in a given piece of wood and is expressed as a percentage of the ovendry weight of the wood. The ovendry weight is used as a basis because it is an indication of the amount of solid substance present. Solid wood substance is heavier than water, its specific gravity being about 1.5 regardless of species. Variation among species in the size of cells and in the thickness of cell walls affects the amount of solid wood substance present and, therefore, the specific gravity. Thus, specific gravity of wood is a measure of its solid wood substance and an index of its strength properties. Specific gravity is based on weight when ovendry and volume when green or at 12% moisture content.

Definition of properties: Modulus of elasticity measured from a simply supported, center-loaded beam, on a span depth ratio of 14/1. To correct for shear deflection, the modulus can be increased by 10%. Impact bending is height of drop that causes complete failure, using 0.71-kg (50-lb) hammer; compression parallel to grain is also called

Continued on next page

Design Values for Visually Graded Structural Lumber

Cottonwood		Extreme fiber in bending, "F_b"		Tension parallel to grain, "F_t"	Horizontal shear, "F_v"	Compression perpendicular to grain, "$F_{c\perp}$"	Compression parallel to grain, "F_c"	Modulus Of elasticity, "E"
Commercial grade	Size classification	Single member uses	Repetitive member uses					
Stud	2" to 3" thick 2" to 4" wide	525	600	300	65	320	350	1,000,000
Construction	2" to 4" thick 4" wide	675	775	400	65	320	650	1,000,000
Standard		375	425	225	65	320	525	1,000,000
Utility		175	200	100	65	320	350	1,000,000

Values for F_b, F_t, and F_c for the grades of Construction, Standard, and Utility apply only to 4" widths. Design values for 2" and 3" widths of these grade are available from the Western Wood Products Association (WWPA).

The values in the table for dimension lumber 2 to 4" in thickness are based on edgewise use. When such lumber is used flatwise, the design values for extreme fiber in bending may be multiplied by the factors in the table to the right.

Dimension Lumber Used Flatwise			
	Thickness (in.)		
Width	2	3	4
2 in. to 4 in.	1.10	1.04	1.00
5 in. and wider	1.22	1.16	1.11

The design values for F_b for decking may be increased by 10% for 2" thick and 4% for 3" thick decking.

The design values listed were reproduced from *Design Values for Wood Construction*, a supplement to the 1986 edition of the *National Design Specification for Wood Construction* by the American Forest and Paper Association (AFPA). This supplement is revise periodically, so the designer should check with AFPA for the latest information.

Design values listed are for normal loading conditions.

Surfaced dry or surfaced green; used at 19% maximum MC.

The design values shown are applicable to lumber that will be used under dry conditions such as in most covered structures. For 2" to 4" thick lumber, the dry surfaced size shall be used. In calculating design values, the natural gain in strength and stiffness that occurs as lumber dries has been taken into consideration as well as the reduction in size that that occurs when unseasoned lumber shrinks. The gain in load-carrying capacity due to increased strength and stiffness resulting from drying more than offset the design effect of size reduction due to shrinkage. For 5" and thicker lumber, the surfaced sizes also may be used because design values have been adjusted to compensate for any loss in size by shrinkage which may occur.

*Tabulated tension parallel to grain values for 5" and wider, 2 to 4" thick size classification apply to 5" and 6" widths only. For lumber wider than 6" the tabulated "F_t" values shall be multiplied by the following:

	Multiply Tabulated F_t Values by	
Grade	8"	10" and wider
Select Structural	0.90	0.80
No.1, No.2, No.3, & Appearance	0.80	0.60
Stud	—	—

Design values for Stud grade in 5" and wider size classifications apply to 5" and 6" widths only.

When 2" to 4" thick lumber is manufactured at a maximum MC of 15% and used in a condition where the MC does not exceed 15%, the design values may be multiplied by the following factors: F_b, 1.08; F_t, 1.08; F_v, 1.05 $F_{c\perp}$, 1.00; F_c, 1.17; and E, 1.05.

When 2" to 4" thick lumber is designed for use where the MC will exceed 19% for an extended period of time, design values shall be multiplied by the following: F_b, 0.86; F_t, 0.84; F_v, 0.97; $F_{c\perp}$, 0.67; F_c, 0.70; and E, 0.97.

When lumber 5" and thicker is designed for use where the MC will exceed 19% for an extended period of time, the design values shall be multiplied by the following factors: F_b, 1.00; F_t, 1.00; F_v, 1.00; $F_{c\perp}$, 0.67; F_c, 0.91; and E, 1.00.

When split, check or shake is absent from wide face of lumber, F_v may be multiplied by a factor of 2.00. When length of split, check or shake on wide face of lumber is known and no increase in them is anticipated, see NDS supplement for additional adjustments.

Stress rated boards of nominal 1", 1¼" and 1½" thickness, 2" and wider are permitted design values shown for Select Structural, No. 1, No. 2, No. 3, Construction, Standard, Utility, and Appearance grades as shown in the 2" to 4" thick category when graded in accordance with stress rated board provions in the grading rules (see WWPA).

When Decking graded to WWPA rules is surfaced at 15% maximum MC and used where the MC will exceed 15% for an extended period of time, the tabulated design values for Decking shall be multiplied by the following factors: F_b, 0.79; E, 0.92.

When the depth of a rectangular sawn lumber member 5" or thicker exceeds 12", the design value for F_b, shall be multiplied by the size factor, C_F, as determined by the following formula: $C_F = (12/d)^{1/9}$.