

The Wood Properties of Mesquite (*Prosopis glandulosa* var. *glandulosa*): Its Basic Properties and Variability.

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Introduction

The wood of the mesquite tree is renowned for its beauty and fine woodworking properties. In applications such as furniture, flooring, and other products, it holds its own against even the finest of woods such as

walnut, oak, maple, and the exotic imports. Its distinctive grain and fine finishing characteristics are extremely attractive to both the woodcrafts-person and to the connoisseur of fine woods.

Discussion of Basic Properties

Many of mesquite wood's physical and mechanical properties equal, if not, surpass, those of most all commonly recognized fine hardwoods. It is a relatively dense strong wood and is an extremely stable wood, i.e., it does not shrink and swell appreciably when subjected to extremes in moisture conditions. Table 1 gives a summary of four physical and mechanical properties of wood comparing mesquite to six other woods.

Mesquite wood's average density of 45 lbs/ft³ is equal to that of hickory and higher than that of most all other woods. Wood density is a wood's weight per unit volume and can be generally used as an indicator or predictor of most all other physical and mechanical pro-

erties. The greater the density the higher the property.

The average wood density of mesquite wood is greater than southern red oak, hickory, hard maple and pecan with wood densities in the range of 28.0 to 44.9 lbs/ft³. These woods are also used in products such as flooring and furniture.

A wood's surface hardness is a measure of its ability to withstand being "dented" when subjected to heavy loads. It may be or may not be an indicator of scratch resistance, depending on various factors. Surface hardness is measured by determining the pounds of force necessary to embed a 0.44 inch diameter ball one-half of its diameter into the wood surface. This figure, although having not absolute value, can be used for comparative purposes between samples of a species, between species, and for different coatings for wood surfaces.



The mesquite tree has a multi-stemmed trunk.

From Table 1, it can be seen that mesquite's average surface hardness of 2,336 pounds is significantly greater than most all other species and generally equal to that of hickory's 2,400 pounds. It can be seen that it is approximately twice that of oak and hard maple with surface hardnesses of 1,060 pounds and 1,450 pounds, respectively. Having high surface hardness is very attractive in applications such as flooring, countertops and furniture.

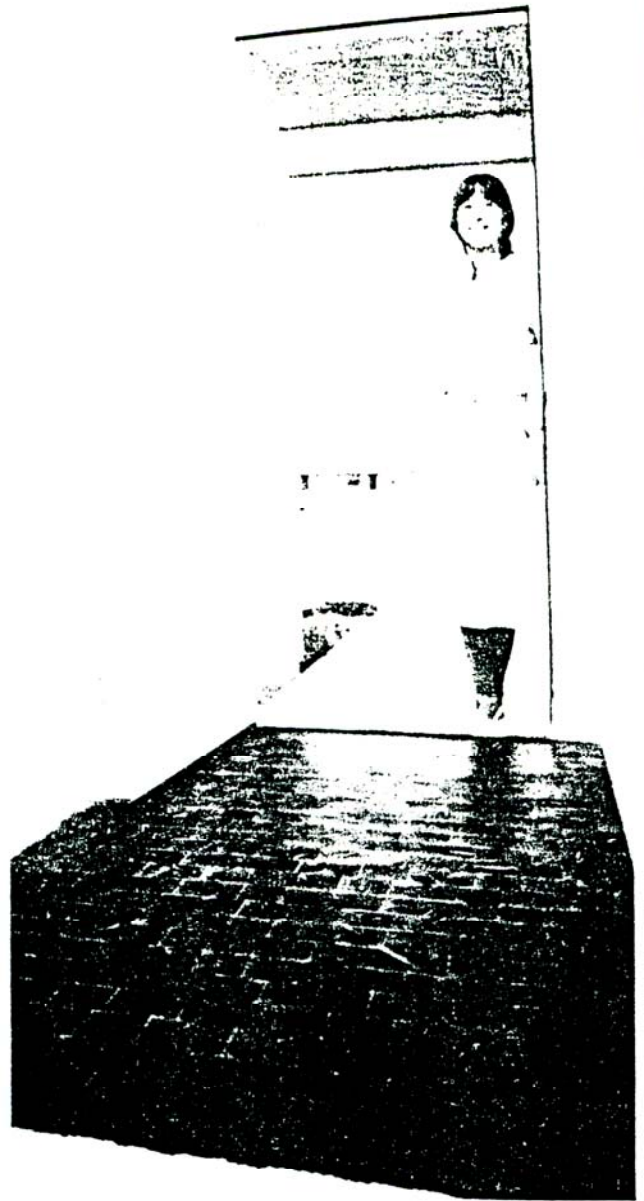
One of mesquite's finest characteristics is its extremely high dimensional stability. Wood must be "seasoned" or dried to a proper moisture content before use to minimize problems. If not properly dried, wood will shrink or swell causing both physical and aesthetical damage such as warpage, splitting, and separation of the wood at glue lines.

As can be seen in Table 1, mesquite has extremely low volumetric shrinkage percentage of 4.7% (high dimensional stability) much lower when compared to other species. Although it would not be a recommended practice, reports have been made that floors of mesquite wood have been installed using wood that was relatively green and have dried in place over time with little or no problems due to shrinkage. Mesquite's volumetric shrinkage is one-third to one-fourth that of other commonly used woods.

In addition to low volumetric shrinkage, the degree to which the shrinkage occurs in the different cellular directions in wood has a tremendous bearing on the extent of defects due to changing moisture conditions. There are three cellular directions in wood: longitudinally, in a direction up and down the tree; radially, in a direction from the center of the tree outwards towards the bark; and tangentially, in a direction along the growth rings of the tree. Wood shrinks differently to varying degrees depending on the direction relative to the tree.

All wood shrinks very little longitudinally and is usually ignored in any analysis of potential problems. Most woods have a wide difference between their radial and tangential shrinkage degrees. One of mesquite's greatest assets is that it shrinks and swells almost equally in both directions. It shrinks 2.2% and 2.6% in the radial and tangential directions, respectively, from the green (live) to a dry condition. In contrast, most all other commonly used woods not only have high volumetric shrinkage, but also have tremendous differences between radial and tangential amounts.

For example, from Table 1 it can be seen that Southern red oak has a radial and tangential shrinkage percentage of 4.7% and 11.3%, respectively. Due to this high variability, when the wood does take up moisture due to seasonal weather changes or water problems there are tremendous stresses occurring in the wood because the wood is trying to swell to different degrees in each direction. This is what usually causes warpage, splitting and other problems.



Mesquite makes an attractive parquet floor.

A wood's bending strength is that force the wood will take under weight loaded situations and still recover its original shape and form. Above that load, the wood will either fail structurally and break or remain deformed and not recover its original shape after the load is removed. Mesquite wood, as seen in Table 1, has a rather low bending strength of 1,380 psi for its density when compared to other species (range of 1,300 psi to 2,220 psi). This is probably due to the large amount of extractives present which increases the density greatly but does not contribute to the wood strength. The 1,300 psi figure is for cottonwood which is an extremely light and weak wood.

Table 1: Selected Physical and Mechanical Properties of Mesquite (*Prosopis Glandulosa* var. *Glandulosa*) and Various Other Fine Woods (Commonly Used Values)

Property	Mesquite	Southern ¹ Red Oak	Mockernut ² Hickory	Pecan ¹	Loblolly ⁴ Pine	Sugar ⁵ Maple	Eastern ⁶ Cottonwood
Density (Lbs/Ft ³)	45.0	36.8	44.9	41.2	31.8	39.3	28.0
Bending Strength MOE ($\times 10^3$ pse)	1,380	1,490	2,220	1,730	1,790	1,830	1,300
Volumetric Shrinkage (%)	4.7	16.1	17.8	13.6	12.3	14.7	13.9
(Radial/Tangential Shrinkage)	(2.2/2.6)	(4.7/11.3)	(7.7/11.0)	(4.9/8.9)	(4.8/7.4)	(4.8/9.9)	(3.9/9.2)
Side Hardness (Pounds)	2,336	1,060	2,400	1,820	690	1,450	430

¹*Quercus falcata* Michx.

²*Carya tomentosa* Nutt.

³*Carya illinoensis* [(Wangenh.) K. Kock]

⁴*Pinus taeda* L.

⁵*Acer saccharum* Marsh.

⁶*Populus deltoides* Bartr.

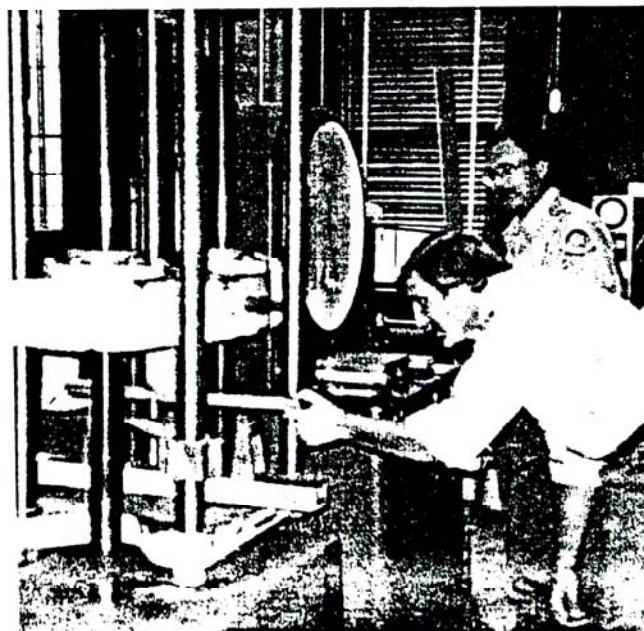
Table 2. The Variation in the Physical and Mechanical Properties of Mesquite Wood (*Prosopis Glandulosa* var. *Glandulosa*) as Tested by the Texas Forest Products Laboratory over a 15 year period

Property	Lowest	Highest	"Published Average"	percent Difference from Lowest
Density (Lbs/Ft ³)	39.9	61.6	45.0	54.4
Bending Strength MOE ($\times 10^3$ psi)	612	1,441	1,380	136
Volumetric Shrinkage (%)	1.8	7.5	4.7	316.7
Side Hardness (Pounds)	1,210	3,010	2,336	149

Variation in Wood Properties

If a drawback exists to the use of mesquite wood for particular applications it is that it exhibits extremely wide variations in its wood properties. It is just not sufficient to discuss a wood's potential performance relative to its "average" value. Consideration as to the effect potential wide variations in a particular property of the wood has on its performance must be acknowledged, understood, and taken into account. For example, in spite of its high surface hardness, there have been instances where women's high heels have marred mesquite flooring due to the extreme pounds per square foot associated with the small area of a high heel. On inspection, the particular pieces of wood in suspect were a low density and subsequent low surface hardness. The same consideration would probably come into effect in furniture, countertops and other products.

Table 2 gives the extremes in recorded values of four physical or mechanical properties of mesquite wood. These values were determined over a period of 20 years



Machine used by FPL to test properties of mesquite.

at the Texas Forest Products Laboratory from mesquite wood collected from various locations in Texas. Depending on the property considered, the percent of variation from the lowest to the highest values ranges from 54 to 317 percent.

Mesquite wood's lowest observed wood density of 33.4 lbs/ft³ is just slightly higher than that of a very soft hardwood, cottonwood having a density of 28.0 lbs/ft³. Mesquite's lowest recorded surface hardness of 1210 pounds is 1/3 that of its highest and 1/2 that of the average recorded value. Although still much higher than that of cottonwood, mesquite's low surface hardness is much lower than hickory, pecan, and hard maple.

In flooring applications, it would seem ludicrous to use cottonwood as a flooring material, but that is in essence what you are doing by using the extremely low

density, soft mesquite pieces.

Mesquite's lowest bending strength of 612,000 psi is extremely low; much lower than that of cottonwood at 1,300,000 psi. If one was to look at the variation of 612,000 psi to a high of 1,441,000 psi it may be assumed that mesquite can be variable in strength. Depending on the individual piece, mesquite is a rather stiff wood and may break easily under weight-loaded situations rather than bending.

Although mesquite's volumetric shrinkage is quite variable, a 317% variation, even the highest value is much less, over 1/2, that of all competing woods. This explains why there are few significant problems such as warping and splitting with mesquite wood when subjected to moisture variations regardless of the properties of individual pieces.

Summary

The wood of the mesquite tree has some of the most attractive wood properties desirable in fine wood. It is an extremely stable and hard wood compared with red oak, hickory, hard maple, and walnut. Its wood density of 45 lbs/ft³ and surface hardness of 2,336 pounds are both high. Its low volumetric shrinkage of 4.7% is probably its finest characteristic and is only one-fourth that of most all other woods. Its even shrinkage in the

different cellular directions eliminates most all distortion and warpage associated with the uptake and loss of moisture during drying and during use.

The one drawback to the use of mesquite wood is that its properties are extremely variable . . . as much as 317% depending on the property in question. Sample selection based on the desirable characteristic will alleviate most all effects of species variability.