A NOTE ON PHYSICAL AND MECHANICAL PROPERTIES OF CHILGHOZA PINE (Pinus gerardiana Wall.) WOOD

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Abstract

This study reports physical and mechanical properties of commercially available Chilghoza pine wood. These are compared with those of deodar wood. Testing of Chilghoza pine wood was done in accordance with the standard procedures. The wood properties of Chilghoza pine and deodar are comparable in air-dry condition. Some suggestions for proper utilization of Chilghoza pine wood are given.

Introduction

Chilghoza pine (*Pinus gerardiana* Wall.) naturally grows in Afghanistan and North-western parts of Pakistan in Baluchistan and N.W.F.P., at an elevation of 2100 to 3400 meters. It is found only in the dry regions outside the influence of the monsoon, where the rainfall is scanty but there is a heavy winter snowfall. It grows gregariously, forming forests of a somewhat open type, though moderately dense pole crops are also met with (1,2). It is commonly associated with deodar (*Cedrus deodara*), *Quercus ilex* and *Fraxinus xanthoxyloides*, and in the trans-*Indus* with kail (*Pinus wallichiana*). In the past, the chief value of the tree lay in its seed, which are roasted and eaten. However, presently, large quantities of wood of this species are brought to Pakistan from Afghanistan through barter trade. Some locally grown timer of Chilghoza pine is being sold in the market. Due to extremely high prices of deodar and other good quality timbers in this country, the Chilghoza pine wood is being used extensively for low priced joinery and construction work. It has colour somewhat similar to deodar, and is therefore commonly used as substitute of the latter wood.

There are two major characteristics which determine the suitability of a wood for any use, viz, it must have an adequate strength and it should be resistant to attack by biological agencies. Chilghoza pine wood is much inferior to deodar in respect of its natural durability. No information is, however, available regarding the strength properties of this timber. As a result, it is not recognized as a useful wood in the timber industry. There has rather been a general prejudice about usefulness of Chilghoza pine wood in Pakistan. Consequently, commercially available timber of Chilghoza pine was tested for physical and mechanical properties in the Forest Products Research Division of the Pakistan Forest Institute. These properties were also compared with those of deodar wood.

Material and Methods

The material for this study was purchased in the form of five squared blocks of wood from the local market. Their sizes were variable: the length varied from 2.5 to 3 meters and

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side dimensions from 12 to 18 cms. Four quarter sawn planks 3 cms thick were cut along the four mutually perpendicular radii from each block. These planks were then converted into wood samples of 2x2 cms cross – sectional area, starting from the end nearer the pith. Test specimens of the following sizes were cut from each sample for determination of different strength characteristics:

i.	Static bending:	2 x 2 x 30 cms
ii.	Impact bending:	2 x 2 x 30 cms
iii.	Compression parallel to grain:	2 x 2 x 6 cms
iv.	Tensile strength perpendicular to grain:	2 x 2 x 7 cms
v.	Cleavage:	2 x 2 x 4.5 cms
vi.	Hardness:	Half the sample used for static bending.

Test specimens for shear and compression perpendicular to the grain were cut in the following sizes from the remaining pieces of the blocks.

i.	Shearing strength:	2" x2" x 2.5"
ii.	Compression perpendicular to the grain:	2" x 2" x 2"

All the strength tests were made in accordance with the British Standard 373 except the shear test which was performed according to A.S.T.M. Standard (3,4). As the moisture content of the specimens during their preparation had gone below the fibre saturation point, the tests were carried out only in air-dry condition. The moisture content of test specimens varied from 9.2 to 10.4 percent. All the samples were kept under the normal laboratory conditions for about a week before actual testing to allow them to come to equilibrium with the surrounding atmosphere. The strength data for deodar wood was adjusted for 2 cms sizes before making the comparison.

Results and Discussion

Table 1 gives the average value, standard deviation, co-efficient of variation and the total range for different wood properties of Chilghoza pine. The average air-dry wood specific gravity of this species has been calculated as 0.58 which is less than the reported value of 0.70 for this species in India (5). The specific gravity of the test material was however, found to be quite close to that of the reported value for deodar (0.57) by Limaya (6). On the basis of the strength properties, Chilghoza pine can be classed as a moderately hard and strong timber. Table 2 gives the comparison of the strength properties of Chilghoza and deodar woods. From the values in this table, it is clear that there are no large differences in the strength of the two species. The strength properties of Chilghoza wood are comparable to those of deodar. The modulus of rupture, however, is about 10% higher in the case of Chilghoza wood. The stiffness value or modulus of elasticity is slightly less than that of deodar wood. The values for compression parallel and perpendicular to the grain and shearing strength are almost identical in Chilghoza pine and deodar woods. The side hardness for Chilghoza wood is slightly higher than that of deodar whereas the end hardness is about 15% lower than that of the latter. This was

probably due to the splitting of most of the samples before the specified penetration of the steel ball could be achieved during testing. Though the comparable data for impact bending strength for deodar wood was not available, it is believed that Chilghoza pine wood is generally poor in resistance against sudden shocks and it fails with a brash failure. The impact bending strength of this wood is lower than that of the recently tested poplar species (7).

Table 1. Density and Strength Properties of Chilghoza pine wood in the air-dry condition

S. No.	Property	Average value	Standard deviation	Co-efficient of variation	Max. value	Mon. value
1.	Specific gravity	0.58	± 0.065	11.21	0.75	0.47
2.	Modulus of rupture: kg/cm^2	869	± 118	13.58	1096	554
3.	Modulus of elasticity: kg/cm^2	71983	± 12791	17.80	99475	46448
4.	Impact bending m-kg/4 cm^2	1.26	± 0.38	30.16	2.34	0.55
5.	Max. compressive strength parallel to grain' kg/cm^2	426	± 42.83	10.05	526	325
6.	Compressive strength parallel to grain at elastic limit: kg/cm^2	327	± 45.66	13.96	440	256
7.	Compressive strength perpedicular to grain at elastic limit :kg/cm^2	59	± 11.04	18.71	79	40
8.	Max. shearing strength:kg/cm^2	94	± 18.39	19.56	118	50
9.	Max. tensile strength perpedicular to grain:kg/cm^2	17	± 2.72	16.00	24	13
10.	Cleavage: kg/cm	19	± 3.69	19.42	33	13
11.	Hardness, Side: kg.	332	± 68.87	20.74	553	235
	End: kg.	385	± 66.36	17.24	600	290

Table 2. Comparison of strength properties of Chilghoza pine and deodar woods at 12% moisture content.

S.No.	Property	Chilghoza wood	Deodar* wood
1.	Specific gravity	0.58	0.57
2.	Modulus of rupture: kg/cm^2	869	780
3.	Modulus of elasticity: kg/cm^2	71983	95475
4.	Max. compressive strength parallel to grain: kg/cm^2	426	449
5.	Compressive strength perpendicular to grain at elastic limit: kg/cm^2	59	62
6.	Max. shearing strength: kg/cm^2	94	100
7.	Hardness:		
	Side:kg	332	322
	End: kg	385	447

* Values adjusted for 2 cms sizes.

Conclusions

On the basis of the test carried out on Chilghoza pine wood, it is observed that this species has strength properties comparable to those of deodar wood and should be suitable for all joinery and constructional work. Since Chilghoza wood is not naturally durable, a suitable preservative treatment would of course, be needed in places where resistance to attack by insects and fungi is of importance. In general, a properly treated Chilghoza wood should give the same performance as deodar wood. Therefore, Chilghoza pine wood should be given due consideration by timber using agencies in Pakistan. This would not only be highly economical but would also reduce the heavy demand of deodar wood which is already in limited supplies in this country. However, additional studies are needed to determine the extent of variation in the strength properties of Chilghoza pine wood throughout its range of natural occurrence. These studies should be done on 4-5 healthy and well formed trees selected in defferent forest areas. Further, studies should also be carried out to find out dimensional stability of Chilghoza wood for comparison with deodar wood as it was not done in the study reported in this article.

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