A NOTE ON PROPERTIES AND UTILIZATION OF *TECTONA GRANDIS* (LINN. f.) GROWN AT CHANGA MANGA

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Abstract

Physical and mechanical properties of Teak wood (*Tectona grandis*) grown at Changa Manga were determined by standard laboratory methods. .The results of the properties have been compared with the same species found in Burma. On the basis of result of properties the locally grown Teak wood is not only superior in strength but also suitable for various purposes where high stress is required. The local Teak wood has favourable relationship between tangential and radial shrinkage and aptness for framework and similar articles where the dimensional stability is of high importance. It is also recommended for a number of uses due to its better strength figures.

Intorduction

Teak wood is very variable in size according to climatic conditions and soil. In favourable localities it is large deciduous tree with a tall clear cylindrical bole. It is very sensitive to frost when young, but comparatively hard when established. The weight per cubic foot varies from 38 to 43 lb. (609–689 Kg per cubic meter) in the air – dry state (Trotter, 1944).

Teak is indigenous in India, Burma, Thailand, and Vietnam and is virtually naturalized in Java, Siam, Cambodia, Cochin China and some of the smaller islands of Indonesian Archipelago. It is also grown successfully in certain other countries where climatic conditions are suitable, notably Ceylon, Nigeria and Trinidad. Now-a-days Burma and Thailand are the main sources of supply for the world market (World Timbers).

Teak is one of the most valuable of all the hardwoods on account of its outstanding properties. It is world famous for its durability and stability combined with good strength and working properties. Its main use in ship and boat building is for decking. Teak is the standard timber for all kinds of constructional work.

It is occasionally grown in the plains of as far west as Lahore (Parker, 1918). In 1980s, Teak was planted on trial basis at Changa Manga. The trees were harvested after 13 years for determination of technological properties. In this study an attempt has been made to find out the utilization potential of Teak wood grown under different prevailing climatic conditions. The small clear wood specimens were prepared and tested for different physical and mechanical properties in green as well as in air dry conditions as per testing methods described in ISO standards.

Material and Methods

The logs of Teak wood were received from the Divisional Forest Officer, Changa

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Manga. Transverse section of about seven cm from each log was cut for age, growth rate, shrinkage, density and moisture content. Mechanical properties were determined from butt ends logs after their conversion. The half of the planks was stacked for drying the material in seasoning shed to attain equilibrium moisture content (EMC). However, the freshly sawn material was further converted into strips of 2" x 2" cross section for preparation of small clear wood specimens for testing of different physical and mechanical properties. The samples of following sizes were prepared:

S.No.	Property	Size of test sample
1.	Shrinkage	3cm x 2 cm x 2 cm
2.	Density	6 cm x 2 cm x 2cm
3.	Static bending	30 cm x 2 cm x 2 cm
4.	Impact bending	30 cm x 2 cm x 2 cm
5.	Compression parallel to grain	6 cm x 2cm x 2 cm
6.	Tensile strength perpendicular to grain	7 cm x 2 cm x 2 cm
7.	Cleavage	4.5 cm x 2 cm x 2 cm
8.	Hardness	10 cm x 2 cm x 2 cm

The values of the properties tested for air dry condition were adjusted at EMC using the formula given in ISO standards.

The samples were tested on Amsler Universal Wood Testing Machine with a total loading capacity of 4,000 Kg with an accuracy of one per cent of the total loading capacity. An Effort was made to use only defect free specimens for determination of various properties of indigenous Teak wood.

Results and Discussion

In this study Teak wood specimens have been tested for physical and mechanical properties in green state as well as air dry condition. The results of the properties are discussed as below:

Physical Properties

The average moisture content of the logs was determined as 60 percent. Teak wood is classified as strong, moderately elastic and hard. (Pearson and Brown, 1982). Air dry density of Teak was determined as 638 kg/cm^3. Basic density (ratio of oven dry weight to green volume) was calculated as 448.

The shrinkage along radial, tangential and longitudinal directions has been calculated for different levels of moisture content. It is found that the wood has negligible longitudinal shrinkage that ranges from 0.180 - 0.206 per cent. The maximum shrinkage along radial and tangential sides from green to oven-dry condition has been calculated as 1.891per cent and 3.855 per cent respectively. Moreover, the values from green to air-dry and air dry to oven dry conditions have also been given (Table 1).

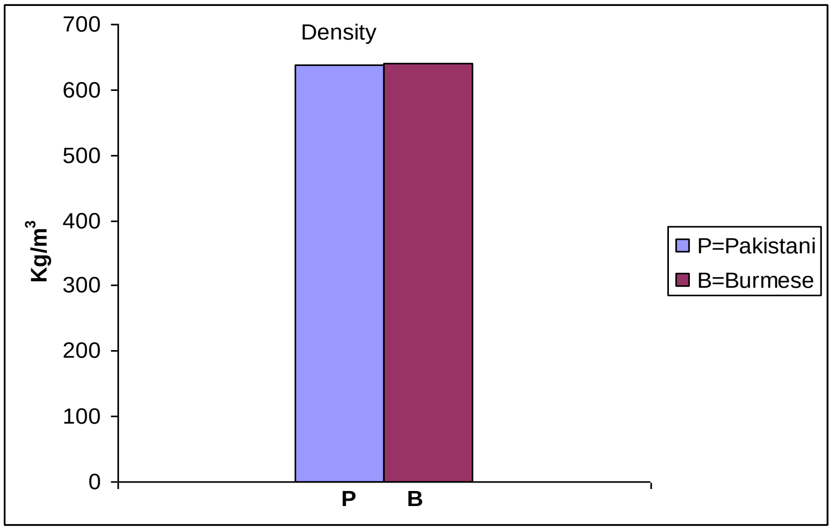

Fig. 1. Comparison of density of Teak wood

Table 1. Physical properties of Teak (*Tectona grandis*) wood

S.No.	Property	Average value
1.	Specific Gravity	638
2.	Basic Density	448
3.	Moisture Content % (Air dry)	12
4.	Moisture Content % (green) Maximum	60
5.	Longitudinal Shrinkage: (%)	
	From green to air dry	0.180
	From green to oven dry	0.206
6.	Radial Shrinkage (%)	
	From green to air dry	1.357
	From to air dry to oven dry	0.541
	From green to over dry	1.891
7.	Tangential Shrinkage (%)	
	From green to air dry	2.578
	From air dry to oven dry	1.312
	From green to oven dry	3.855

Mechanical Properties The average values of the properties of the wood tested for both conditions are compared with the reported values of the same species found in Burma (Table 2). However, for comparison of properties of the wood species only the results in air dry conditions are compared.

Table 2. Comparison of indigenous and Burmese Teak wood properties

S.No.	Properties	Green		Air Dry	
		Actual value	Reported value	Actual value	Reported value
1.	Specific gravity	0.544	0.550	630	641
2.	Modulus of rupture (kg/cm^2)	895	857	1587	1082
3.	Modulus of elasticity (Kg/cm^2)	88813	89796	114388	102041
4.	Maximum comparison parallel to grain (kg/cm^2)	256	437	718	616
5.	Impact bending (m-kg)	2.32	--	3.00	--
6.	Cleavage (kg/cm)	26	17	34	18
7.	Tension perpendicular to the grain (kg / cm^2)	30	--	33	--
8.	Hardness: (kg)				
	Side grain:	468	414	570	454
	End grain:	520	--	840	--

Burmese Teak is of same density class as the locally grown at Changa Manga. A number of factors influence the density of a particular wood species which have not been discussed here. Specific gravity has direct relation with the strength of the wood tested for various mechanical properties (Desch and Dinwoodic, 1983). For comparison purposes, actual values of Teak are superior when the strength data is compared with reported values of Burmese Teak.

The figures of strength properties show that the local Teak wood is of relatively, better ultimate bending strength (modulus of rupture). The fibers stress at maximum load is of high value. The property is about 47% greater than the reported value. The fibre stress at elastic limit (MOE) is also 12% more than the value given in the literature. This shows that locally found Teak wood is more suitable for many uses particularly when it is used as furniture, door and window frames, beams, shipbuilding for decking and boat etc.

The average maximum compression parallel to grain of the wood is 718 kg/cm^2 which is superior to the reported value of the property by 16%. Due to the greater value of compressive stress the locally grown timber bears more vertical load when applied on its members. Therefore, the local wood is more suitable for poles and posts, stunts, bridges, piles, carriage building, pit props, railway sleepers, cross arms etc.

The wood from Changa Manga has high values of cleavage (34 kg/cm) and tensile strength perpendicular to grain (33 kg/cm^2) which show that the wood has comparatively better nail/screw holding power and favours its utilization in construction, joinery work, joints in wood working etc.

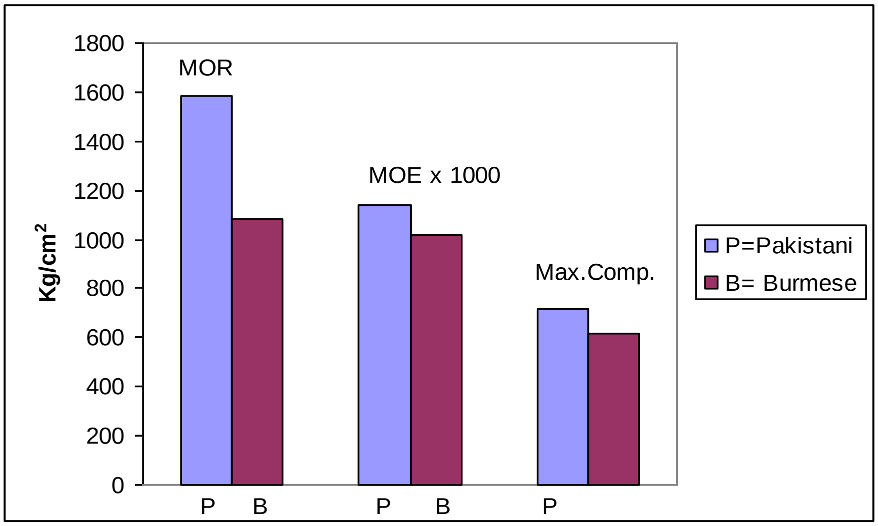

Fig. 2. Comparison of stress values of different properties of Teak wood

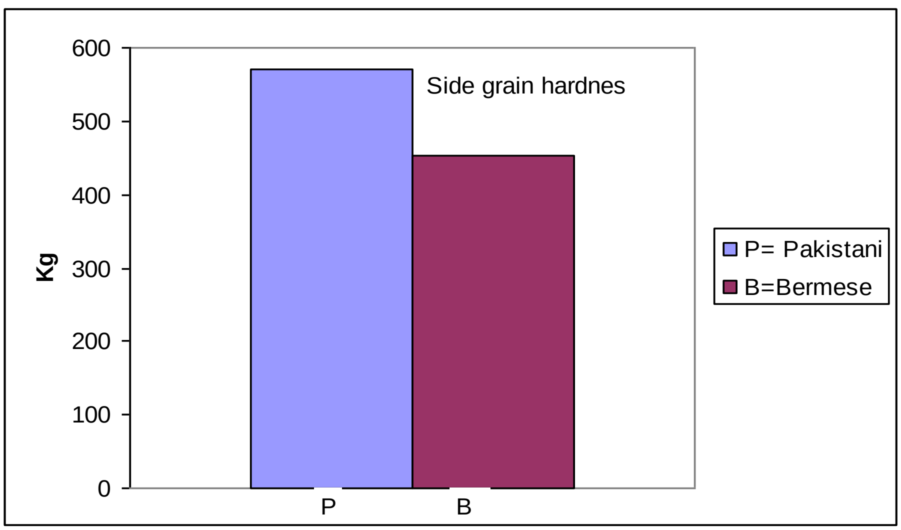

Fig. 3. Comparison of side hardness of Teak wood

Similarly, it has reasonably high values of resistance to indentation, side hardness 570 kg and end - hardness 840 kg. The property shows that the timber is suitable for wood working operations where cutting, boring, jointing, carving etc. are required during its processing.

However, it has low average value of toughness; 3.0 m-kg and the wood is not recommended for the uses where resistance to sudden shocks is of prime importance.

Conclusion

The Teak grown at Changa Manga is classified as moderately hard and strong wood. However, it offers low resistance to sudden shocks. It has better strength to weight ratio when compared with wood species of same density class and can be processed without difficulty. Local Teak wood is superior to the same species grown in different parts of the world regarding its various technological properties. The results reveal that indigenous Teak wood has better values of modulus of rupture, maximum comparison parallel to grain, tension perpendicular to grain, cleavage, side grain hardness and end grain hardness. It has considerable potential which is used for construction, flooring, furniture, carving, molding, for decking, poles, posts and exposed woodwork of every kind. It is hard but not very difficult to work. Due to less volumetric shrinkage the wood is suitable for framework.

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