

# SHRINKAGE AND DENSITY STUDIES OF TEAK OF VARIOUS AGE GROUPS<sup>1</sup>

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Shrinkage and density were studied for Teak (*Tectona grandis*) of five age groups ranging from 20 to 60 years at three height positions. Linear shrinkages were evaluated from green condition to 15 and 0 percent moisture contents. Density was determined on the basis of green and oven-dry volumes. Shrinkage and density were found to be independent of the height of the stem. The overall shrinkage and density were affected by the age factor. The variations in the average values of different age groups were, however, not observed to be significantly different in all cases.

কুড়ি হইতে ষাট বৎসরের পাঁচটি বিভিন্ন বয়সের সেগুন গাছের কাঠের সংকোচন ও ঘনত্ব তিনটি উচ্চতায় নিরীক্ষণ করা হইয়াছে। কাঁচা অবস্থা হইতে শুকনো পনের ও শূন্য জলীয় অংশে সংকোচন মাত্রা নিরূপণ করা হইয়াছে। কাঠের আর্দ্র ও শুষ্ক আয়তন অবলম্বন করিয়া ঘনত্ব নির্ধারণ করা হইয়াছে। দেখা গিয়াছে যে, উচ্চতা কাঠের সংকোচন ও ঘনত্বকে প্রভাবান্বিত করে না। অপরপক্ষে, বয়সের প্রভাবে সামগ্রিক সংকোচন ও ঘনত্ব পরিবর্তন লক্ষ্য করা গিয়াছে, কিন্তু বিভিন্ন বয়সের গাছের গড় মানের পার্থক্য পরিসংখ্যান মতে সর্বক্ষেত্রে অর্থমূলক পাওয়া যায় নাই।

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## INTRODUCTION

Teak (*Tectona grandis* Linn, f.) is one of the most important timber species. It is an excellent timber for furniture, construction and other multitude of uses. For this reason its various properties have been studied at different places. But the information available on such important properties as shrinkage and density is limited (Anon. 1956, Rehman and Gupta 1961, Sekhar and Ravat 1966). Besides, no work has been done on such properties of Chittagong Teak representing different age groups and height positions. A study was, therefore, undertaken in this respect.

## MATERIALS AND METHOD

One tree each of five age groups, 20, 30, 40, 50 and 60 years, was procured from Kaptai Reserve Forests. Three sections, 15 cm thick, were cut from the bole of each tree at three height positions above the ground—butt, middle and top. These discs were kept wet prior to preparing the test pieces. From each disc three pieces each in the tangential, radial and longitudinal direction, having nominal sizes of 2.5 cm × 2.5 cm × 10 cm, were cut. The 10 cm dimension was cut accurately in the direction of the shrinkage measurement.

Shrinkage measurements were taken from green condition to 15 and 0 percent moisture contents. For this purpose specimens were first equilibrated to 15 percent equilibrium moisture content (EMC) in a conditioning chamber, and weight and dimension measurements were taken. The specimens were then placed in an oven maintained initially at 60°C, progressively raising the oven temperature to a

final 103°±2°C. The specimens were kept in the oven till these attained constant weights. Care was taken during the drying process to avoid defects which could result from fast drying. The dimension measurements at both 15 and 0 percent moisture contents were made to an accuracy of 0.003 cm with a slide caliper and the weight measurements were taken in an electric balance to an accuracy of 0.01 gm.

Density was determined from longitudinal specimens based on green and oven-dry volumes. For green volume, the specimens were soaked in water till these were fully saturated. For oven-dry volume, the sample were coated with paraffin. The volume measurements were taken by the conventional water displacement method.

## RESULTS

Shrinkages in three linear directions were evaluated as percentages of dimensional changes from green condition to 15 and 0 percent moisture contents. The average shrinkage of Teak in the five age groups are shown in Table 1. Analysis of variance was employed to test the effect of age, height and grain direction on shrinkage. Bulk density was determined based on both green and oven-dry volumes for different age groups. The average values are given in Table 2. Analysis of variance was also employed to note the effects of age height and volume condition on density values. The results of the analyses of variance are summarised in Table 3. Further, the average tangential shrinkage and bulk density based on green volume were analysed by employing Duncan's new multiple range test to compare the mean values of different age groups. The summary of the result is presented in Table 4.

Table 1. Average shrinkage values of Teak of various age groups

Age (years)	Height position	Shrinkage Values					
		Green to 15 Percent m. c.			Green to 0 percent m. c.		
		Tangential	Radial	Longitu- dinal	Tangential	Radial	Longitu- dinal
20	butt	1,83	0,78	0,09	4,08	2,16	0,17
	mid	1,77	0,86	0,00	4,04	2,17	0,09
	top	1,70	0,78	0,00	4,18	2,08	0,09
	average	1,77	0,81	0,03	4,10	2,14	0,12
30	butt	1,84	0,87	0,00	4,29	2,18	0,09
	mid	1,78	0,95	0,00	4,03	2,09	0,09
	top	1,85	0,78	0,00	4,03	2,09	0,09
	average	1,82	0,90	0,00	4,12	2,12	0,09
40	butt	2,18	1,03	0,09	4,68	2,24	0,17
	mid	2,00	0,95	0,00	4,29	2,17	0,09
	top	1,91	0,95	0,00	4,18	2,24	0,17
	average	2,03	0,98	0,03	4,39	2,22	0,14
50	butt	1,99	0,95	0,00	4,11	2,24	0,17
	mid	2,00	0,95	0,00	4,29	2,09	0,09
	top	1,91	0,95	0,00	4,03	2,68	0,09
	average	1,97	0,95	0,00	4,14	2,14	0,12
60	butt	2,04	1,04	0,06	4,38	2,26	0,17
	mid	2,00	0,95	0,09	4,45	2,26	0,09
	top	1,90	0,96	0,00	4,20	2,17	0,09
	average	1,98	0,95	0,05	4,34	2,20	0,12
Combined average		1,91	0,92	0,02	4,20	2,18	0,12

**Table 2. Average bulk density values of Teak**

Age (years)	D e n s i t y						Average of age groups	
	Height position							
	Butt		Middle		Top			
	Volume green	ovendry	Volume green	ovendry	Volume geern	ovendry	Volume green	ovendry
2o	o,54	o 57	o,54	o,59	o.53	o,58	o,54	o,58
3o	o,55	o,6o	o,53	o,59	o,53	o,58	o,54	o,59
4o	o,57	o,62	o,56	o,61	o,55	o,6o	o,56	o,61
5o	o,55	o,6o	o,54	o,6o	o,54	o,6o	o,54	o,6o
6o	o,56	o,61	o,56	o,6o	o,55	o,6o	o,56	o,6o
Combined average							o,55	o,6o

**Table 3. Summary of the results of analyses of variance**

Source of variation	Significance	
	Shrinkage	Density
Age	*	*
Height	NS	NS
Grain direction	**	
Moisture content	**	
Volume condition		**

\* Significant at the 5% probability level

\*\* Significant at the 0,1% probability level

NS Not significant

**Table 4. Summary of the results of Duncan's Multiple Range Test<sup>1</sup>**

4. 1 Tangential shrinkage from green to zero percent moisture content for different age groups

( T-40 )	( T-60 )	( T-50 )	( T-30 )	( T-20 )
4.39	4.34	4.14	4.12	4.10

4. 2 Density based on green volume for different age groups

( D-40 )	( D-60 )	( D-50 )	( D-30 )	( D-20 )
0.560	0.557	0.543	0.537	0.537

<sup>1</sup> Any two means underscored by the same line are not significantly different.

## DISCUSSION

### Shrinkage

Shrinkage values contained in Table 1 show that there was no appreciable variation in shrinkage with increasing distance above the ground. The effect of height from the butt to the top of trees was thus not a significant factor on shrinkage values (Table 3). The tree of 40 years of age showed the maximum shrinkage among the five groups. Next to it, in descending order of shrinkage, are trees of 60, 30 and 20 years of age (Table 1). The effect of age was statistically significant on the overall shrinkage values (Table 3). The difference of shrinkage values was, however, not appreciable and thus the variations in the average values were not statistically different in the trees of all groups (Table 4.1).

### Density

The average density values ranged from 0.53 to 0.57 in the case of volume

based on green dimension while they varied from 0.57 to 0.61 for oven-dry wood (Table 2). The fluctuation in density with increasing distance above the ground was not found in this study (Table 2). The analysis of variance also shows that the effect of height was not significant on density. Like shrinkage, density was found to be highest in the 40 years old tree and lowest in the tree of 20 years of age (Tables 1 and 2). The effect of age was observed to be significant on the overall density (Table 3) although the variations in density among the trees of different age groups were not much. The difference between mean density values was thus not significantly different among the trees of five age groups (Table 4.2).

It was, of necessity, a preliminary study with limited number of specimens and only one tree at each age group was taken. A detailed investigation with more number of representative trees and specimens is, therefore, suggested.

## CONCLUSIONS

Shrinkage and density were not affected by the height factor. Thus there were no significant variations in either shrinkage or density with increasing distance above the ground.

The effect of age was significant on the overall shrinkage and density. The variations in the average values of both shrinkage and density were not significantly high among the trees of all age groups.

The maximum shrinkage and density were observed in the 40 years old tree while the minimum values were found in the youngest tree of 20 years of age.

## REFERENCES

- Anon, 1956, Country reports on Teak. FAO publication, PP 10, 46, 90.
- Rehman, M, A, and Gupta, H. K, 1961, Shrinkage on Indian Timbers, Part I, *Tectona grandis* (Teak). Indian For, Records, Wood Seasoning, 1 (3).
- Sekhar, A, C, and Rawat, B, S. 1966, Physical and mechanical properties of Teak from different localities in India and neighbouring areas. Indian For Records, Timber Mechanics Series, 1 (13).