VARIATION IN WOOD SPECIFIC GRAVITY, RADIAL AND TANGENTIAL SHEAR STRENGTH OF THREE PROMINENT WOOD SPECIES OF KERALA

Project Report

Submitted to Department of Physics

KURIAKOSE ELIAS COLLEGE, MANNANAM

(Affiliated to Mahatma Gandhi University, Kottayam)

तमसो मा ज्योतिर्गमया

In partial fulfilment for the award of the degree of

MASTER OF SCIENCE

IN

PHYSICS

Submitted by

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Under the supervision of

Dr. FEBY JOSE

DEPARTMENT OF PHYSICS

KURIAKOSE ELIAS COLLEGE, MANNANAM

SEPTEMBER 2023

CERTIFICATE

This is to certify that the project report entitled **“VARIATION IN WOOD SPECIFIC GRAVITY, RADIAL AND TANGENTIAL SHEAR STRENGTH OF THREE PROMINENT WOOD SPECIES IN KERALA ”** is the bonafide record of project done by **DELIN SHAJI JOHN(**Reg No. **210011012405)** of Kuriakose Elias College, Mannanam, under my guidance and supervision in partial fulfilment of the requirement for the award of the degree of **MASTER OF SCIENCE IN PHYSICS**.

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(Project Guide)

Mannanam

September 2023

DECLARATION

I, **DELIN SHAJI JOHN(**Reg No. **210011012405)**, hereby declare that the project work entitled "**VARIATION IN WOOD SPECIFIC GRAVITY, RADIAL AND TANGENTIAL SHEAR STRENGTH OF THREE PROMINENT WOOD SPECIES OF KERALA"** is a bonafide record of independent and bonafide project work carried out by me under the supervision and guidance of Dr. FEBY JOSE, Asst. Professor, Dept. of Physics, Kuriakose Elias College, Mannanam.

The information and data given in the report is authentic to the best of my knowledge.

Mannanam DELIN SHAJI JOHN

September 2023

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I take the privilege to extend my sincere thanks and gratitude to my friends and family, for their unwavering support in successfully completing this work.

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CONTENTS

CHAPTER 1. INTRODUCTION

All wood is composed of cellulose, lignin, hemicellulose and minor amount of extraneous materials contained in a cellular structure. Variations in the characteristics and volume of these components and differences in cellular structure make wood heavy or light, stiff or flexible, and hard or soft. The properties of a single species are relatively constant within limits; therefore, selection of wood by species alone may sometimes be adequate. However, to use wood to its best advantage and most effectively in engineering applications, specific characteristics or physical properties must be considered.

Basically wood is a lingo cellulosic material, non-homogeneous in nature and orthotropic in structure. That is, its density is not uniform throughout the material, its physical and mechanical properties differ in the three principal directions of material, i.e. Along the grain, in the direction tangential to the circumference of the log and in the direction radial of the log i.e. From pith to periphery. These three directions are designated respectively as longitudinal, tangential and radial directions of the material. The surface plane consisting of longitudinal and radial directions is known as radial plane or in simple abbreviations as L-R plane and the surface plane consisting of longitudinal and tangential directions is known as tangential plane or merely as L-T plane. The surface bounded by radial and tangential directions is known as "cross section" or "transverse plane" or simply as R-T plane. The properties, particularly many linear and planer physical and mechanical properties, not only differ in the three directions and planes, but also vary from position to position in the same tree, between the trees, between locations and conditions of growth and so naturally between clones also. All such variations are attributed to the alignment and distribution of wood cells and extraneous material content inside the wood such as resins, latex and various other minerals which make the wood non-homogeneous in nature. In view of such wide variation exhibited in properties, the methods of determination of the properties and sampling of testing material would naturally require a high degree of standardization so that the data would become statistically comparable and repeatable under specified conditions and also reliable under given circumstances.

Indian Standards Institution (now known as Bureau of Indian Standards) has now brought out some specifications on methods of sampling the logs and specimens for the purpose of evaluation of physical and mechanical properties (IS: 2455; IS: 8745; IS: 8720) and also for actual testing procedures (IS: 1708). The main foundation of evaluating the properties lies in testing what are known as “small clear specimens” on cross sections of 5x5 cms or 6x2x2 cms from about ten separate merchantable size logs from mature trees or logs as needed for the tests. Besides prescribing the sizes of those “small clear specimen which are naturally free from any defects, the Standards also prescribe schemes of selection of samples for various tests from a chosen tree and also prescribe the required standard testing conditions such as moisture content, temperature, rate of loading in the machines and distribution of samples for testing in “green” and “dry” conditions i.e. under conditions of moisture content above and below the “fibre-saturation-point”. In green condition, the properties and dimensions of timber remain constant and do not depend on moisture content as in dry condition.

. **Weight and specific gravity:** These properties give a basic indication of general utility, ease of transporting and handling. Standard specific gravity is determined on the basis of "oven-dry' weight and "green" volume of the test specimen as these do not involve any variability due to the presence of moisture, as in the green condition wood does not shrink or swell and in oven-dry condition there is no moisture. Standard specific gravity is also an indication of strength as most strength properties of wood are related to this specific gravity.

Shear strength: The properties are primarily indicative of the behavior of timber under forces which slide one portion of the material over the adjoining portion of the same. The surfaces of shear failures would normally be either radial or tangential and very rarely the cross section or transverse section. This property with an appropriate factor of safety is useful in the design of various industrial articles and also in design of beams in constructions.

Mechanical properties: The word "strength" of wood is a general term which indicates the ultimate capacity of wood to bear several types of forces but the individual mechanical properties under forces separately of bending, tension, compression, shear etc. in the three directions or planes of wood determine the quality of wood from load-bearing point of view .It should however be remembered that properties in dry condition are not strictly comparable unless the reported moisture content is always the same or the strength figures are adjusted to the same moisture content . In India, the strength figures in dry condition are usually reported at 12% moisture content for comparative purposes.

CHAPTER 2 .OVERVIEW

CENTRAL WOOD TESTING LABORATORY, THE RUBBER BOARD

Central Wood Testing Laboratory is an ISO/IEC 17025-2017 certified wood testing laboratory, accredited to the National Accreditation Board for and Calibration Laboratories (NABL), New Delhi. Functioning under The Rubber Board, Ministry of Commerce and Industry, Government of India, the laboratory is located at Kottayam, Kerala.

Since 2000, the laboratory is providing testing, quality control, training, consultancy and R&D services to the rubber wood processing industry. The laboratory's scopes of services were later expanded to meet the quality control needs of the plywood, adhesive and block board industry as well. The laboratory has state of the art facility and equipment to test wood, plywood, doors, preservatives (in treated wood & solution), adhesives, and finger jointed panel boards etc as per relevant quality standard specifications.

Facilities and services

► Facilities are available for testing all major physical, mechanical, chemical and biological properties of wood according to the latest Indian Standard specifications. ‣It is equipped with highly advanced testing equipment and systems like:

- Universal Testing Machine (100kN Shimadzu, Japan).
- Tensile Testing Machine (15kN Kalpak Instruments &Controls, Pune
- Microscope and Image Analyser System (Olympus, Japan &Image Proplus,
- Abrasion/Scratch/Shear Tester (Taber Industries, USA)
- Door Testing facility .

Training – The laboratory provides need based training in all major aspects of wood processing (sawing, preservative treatment, seasoning, wood working, finger: jointing and panel board making) and quality control (moisture measurement, qualitative and quantitative estimation of preservative in treated timber and solution, purity of preservatives etc).

METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER .

- This Indian Standard (Second Revision) was adopted by the Indian Standards Institution on 30 April 1986, after the draft finalized by the Timber Sectional Committee had been approved by the Civil Engineering Division Council.
- The evaluation of basic properties of timber, such as strength, density effect of various treatments on strength, etc, and the establishment of design functions for structural timbers has been done on the basis of tests carried out on small clear specimens of timber. A clear specimen is one which is free from defects, such as knots and shakes. The comparison of strength properties of different timber species is also done on the basis of the tests carried out on clear specimens. In the actual design of timber structures as also in structural grading, the effect of different kinds of defects on clear specimens is assessed and after making necessary allowances for the defects, the resultant values are used. This standard is being published in parts dealing with the methods of testing small clear specimens of timber for their strength properties.
- In order to obtain a good average figure, which is truly representative of the species, it is necessary to take samples from green timber as well as from seasoned timber and also from sapwood, heartwood and from different parts of the same tree. For standard evaluation of physical and mechanical properties of a species from a locality, at least ten trees are chosen at random from the locality and sampling of material for different test is one in accordance with IS : 2455-1974(Method of sampling of model trees and logs for timber testing and their conversion). When material from a depot is required to be tested, the sampling of material for different tests is done in accordance with IS : 8720-l978(Method of sampling of timber scantlings from depots and their conversion for testing).
- This standard was first published as Part 1 in 1960 and Part 2 in 1963. It was revised in 1969 in which these two parts were combined besides other modifications. With the introduction of fast grown and various exotic species, sufficient number of samples for

tests in 5 X 5 ern cross-sectional dimensions are not generally available. Hence a need has arisen to test timber specimens in 2 X 2 ern cross-sectional dimensions. In various international standards also, the dimensions of standard test specimens have now been recommended. as 2 X 2 ern cross-sectional dimensions. Thus this standard has been revised to lay down test methods for both the dimensions, that is, 2 X 2 cm and 5 X 5 cm and the sizes have been rationalized.

- Almost all the mechanical properties of seasoned timber vary with moisture content and it is therefore necessary that the moisture content of timber and its specific gravity be determined at the time of tests, preferably immediately after the tests. Provisions for these tests have therefore, been included. Before testing, the material of seasoned timber shall be brought practically to constant weight by storage under conditions at 27 ± 2°C temperature and 65 ± 5 percent relative humidity. Change in moisture content during preparation of test specimens shall be avoided. As the mechanical properties of timber vary with the rate of application of load, it is desirable that specific rates mentioned in the standard should be adhered to in order to obtain comparable results. Where the testing machine is of a type which does not permit the specified rate of loading, actual rate of loading employed should be recorded along with the results so that those results may be suitably corrected where required for comparison of the mechanical properties. It is generally recommended that rate of loading shall not vary by more than ± 20 percent from the specified.
- The approximate percentage of sapwood, if any, by volume shall be estimated and recorded. Defects like knots, splits, etc., shall also be recorded. The number of growth rings shall be counted in the radial direction on each of the cross-section of test specimen and recorded as number of rings per centimeter.
- For the purpose of comparison of the data collected on 2 X 2 cm dimensions with that of 5 X 5 cm dimensions the adjusting factors have also been given in respective part of the specification where available. The adjusting factors have been obtained from the publication 'Mechanical tests for wood-comparison of test results on large and small size specimens', by S. S. Rajput, N. K. Shukla & R. R. Sharma, Holzforschung and Holzverwertung 32(5), 117-120, 1980.
- For reporting the results of tests done according to this standard, IS : 8745-1978* shall be referred to.

- In the preparation of this standard considerable assistance has been rendered by Forest Research Institute and Colleges, Dehra Dun which has supplied the valuable data. 0.10 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS: 2-l960. The number of significant places retained in the rounded off values should be the same as that of the specified value in this standard

CHAPTER 3. APPARATUS

ANJILI WOOD

Anjili wood is a very popular hardwood used in a variety of projects like furnishing, flooring etc. It has high durability, hardness and great look it is used worldwide by woodmakers

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RUBBER WOOD

Rubber is a light coloured medium hard tropical wood. Although it is a medium hard wood the furniture manufactured using rubber wood lasts for more than 20 years provided with proper handle and care.

TEAK WOOD


Teak is one of the prominent wood used worldwide for furniture making and flooring. Teak is famous and special for its hardness, long lasting and beautiful outlook. It’s most important physical property is hardness.

AUTOMATED VERNIER CALIPERS

Vernier calipers are used to measure the distance between the objects . They are used to measure he dimensions of an objects. They can measure both internal and external dimensions accurately.

The Vernier caliper works on the principle of the alignment of certain numeral lines, giving an accurate reading of the measurement. The Vernier calipers have two scales that coincide according to the size of object ,which is placed between two holders of the instrument.

SHIMADZU AUTOGRAPH100KNG

Designed for reliability and ease of use, these precession universal testers provide high control and measurement performance. For the three most important functions of the testing machine-setting, measurement, and inspection.

System functions

Static test is to measure the mechanical properties of materials or products the mechanical properties of the specimen are examined from the relationship between the displacement and force applied to the test specimen - acquired data is used for material selection ,material acceptance, obtaining, mechanical property values for simulation and evaluating the fracture strength and stiffness of products.

ELECTRONIC BALANCE

Fig: The electronic balance (model Sartorius).

Accuracy: 0.0001gm

Capacity: 220gm

Electronic balance is an instrument used for the accurate measurement of weight of materials. It is used in laboratories for exact measurement of experiments. Laboratory electronic balance provides digit measurement results.

LABORATORY OVEN

A laboratory oven is used for high volume thermal conduction applications. This laboratory equipment provides uniform temperature throughout the chamber necessary for annealing, drying ,sterilizing and other industrial lab functions. These are equipped thermostat to control the temperature and also have air ventilators to remove the hot gases and fumes.

UNIVERSAL WOOD WORKING MACHINE

The universal combined wood eorking achine mainly comprises of five functional groups

- Saw
- Moulder
- Surface Planer
- Thickness Planer
- Mortiser

Operated by three independent motors that generate movement. The planar group consists of a rotating cutter head with mounted cutting knives.

CHAPTER 4. EXPERIMENTAL PROCEDURE AND OBSERVATIONS

Our aim of this project is to find the specific gravity and shear strength of three prominent wood specimens of Kerala. we have selected three different wood species. The selected wood are the following,

1) Anjili Wood
2) Teak Wood
3) Rubber Wood

4.1 CUTTING ,SAWING AND PLANING

First of all we have to cut the wood species in the size specified by Indian standard test method. used universal woodworking machine for the same. The universal woodcutting machine can be used for cutting, sawing and planing.

4.2 OVEN DRY METHOD

The oven dry method is the most accurate and reliable method of determining the moisture content of wood at any moisture content. Because of this accuracy and reliability, the oven-dry method of determining Moisture content of wood is the method against which all other method are judged.

Timber wood species is dried in an oven before the density is determined. The sample is dried at 103±2ºC to a relatively constant weight.

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4.3 DETERMINATION OF SPECIFIC GRAVITY

1. SCOPE

1.1 This standard covers method of test for determining specific gravity of timber.

2. TEST SPECIMEN

2.1 The specific gravity of all the specimens for mechanical tests shall be calculated as described in 4. 2.2 When only specific gravity is to be determined the test specimens shall be 5 X 5 cm in cross-section and 15 cm in length or 2 X 2 ern in cross-section and 6 cm in length. When rectangular specimens are not obtained, a specimen of about 10 cc volume shall be taken.

3. PROCEDURE

3.1 The specimen shall be weighed correct to 0'001 g. The dimensions of rectangular specimen shall be measured correct to 0'0 I cm and volume shall be calculated by multiplying all the three dimensions. The volume of irregular specimen shall be determined by mercury volumeter. The level of mercury in the volumeter shall be raised to the given mark on the capillary tube and reading shall be noted. The level shall then be brought down and specimen shall be inserted in the volumeter. After raising the level to the given mark, the reading shall be taken again. Care shall be taken that no air bubble is entraped in the volumeter. The difference of the two readings shall be the volume of the specimen.

4. CALCULATION

4.1 Specific gravity shall be calculated as given below:

a) Specific gravity at test $=\frac{W_1}{V_1}$

b) Adjusted specific gravity $= \frac{W_1}{V_1} \times \frac{100}{100+m}$

W_1= weight in g of test specimen,

V_1 = volume in ems of test specimen, and

m = percentage moisture content of the test specimen determined as prescribed in 4 of Part 1 of this standard.

NOTE – If initial condition of the specimen is 'green' (that is well above the fiber saturation point) adjusted specific gravity, calculated by formula 4.1 (b) is known as standard specific gravity; and if the specimen is dry, the specific gravity is called 'dry specific gravity'.

4.2 If weight at a given moisture content is required to be calculated, the same shall be calculated as below:

Weight in kg/m^3 at a given moisture content m = Specific gravity at moisture content, m X 1000.

OBSERVATIONS

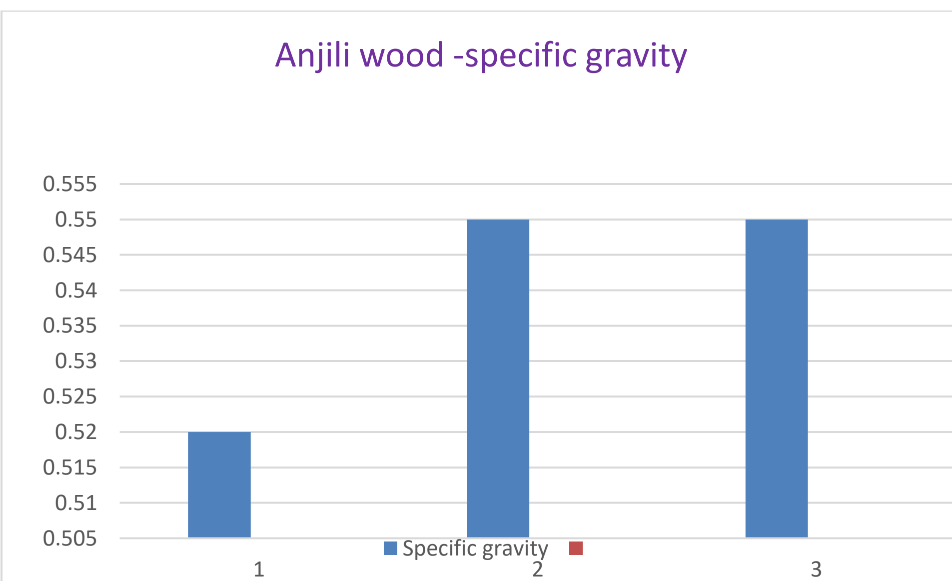
Anjili Wood

o	L1	L2	L3	Mean	B1	B2	B3	Mean	T1	T2	T3	Mean	V
209/m/2/1a	6.025	6.02	6.02	6.020333	2.075	2.066	2.051	2.064	2.089	2.096	2.084	2.09	**25.966**
209/m/2/1b	6.032	6.04	6.04	6.034667	2.055	2.057	2.061	2.05766667	2.065	2.064	2.075	2.068	**25.679**
209/m/2/1c	6.028	6.04	6.04	6.036333	2.065	2.064	2.075	2.068	2.065	2.067	2.06	2.064	**25.765**

Density kg/m3

at **OD** **Adjusted specific gravity**

int wt	**OD wt**		MC%*	**Test**		**Density**		
15.0484	**13.41**		12.2	579.5396		**516.538**		**0.52**
15.8256	**14.1**		12.2	616.2846		**549.133**		**0.55**
15.9792	**14.3**		11.8	620.1855		**554.9**		**0.55**
			12.1	**605.3**	Avg	**540.2**	**Avg**	**0.54**



Rubber Wood

No	L1	L2	L3	Mean	B1	B2	B3	Mean	T1	T2	T3	Mean	V
209/m/2/2a	5.989	5.99	5.99	5.989667	2.074	2.05	2.029	2.051	2.10	2.09	2.09	2.092	**25.696**
209/m/2/2b	6.005	6.006+	6	6	2.051	2.046	2.048	2.048	2.09	2.09	2.09	2.088	**25.657**
209/m/2/2c	5.988	5.98	5.99	5.987	2.085	2.09	2.09	2.088	2.10	2.09	2.09	2.093	**26.164**

Density kg/m3

at **OD**

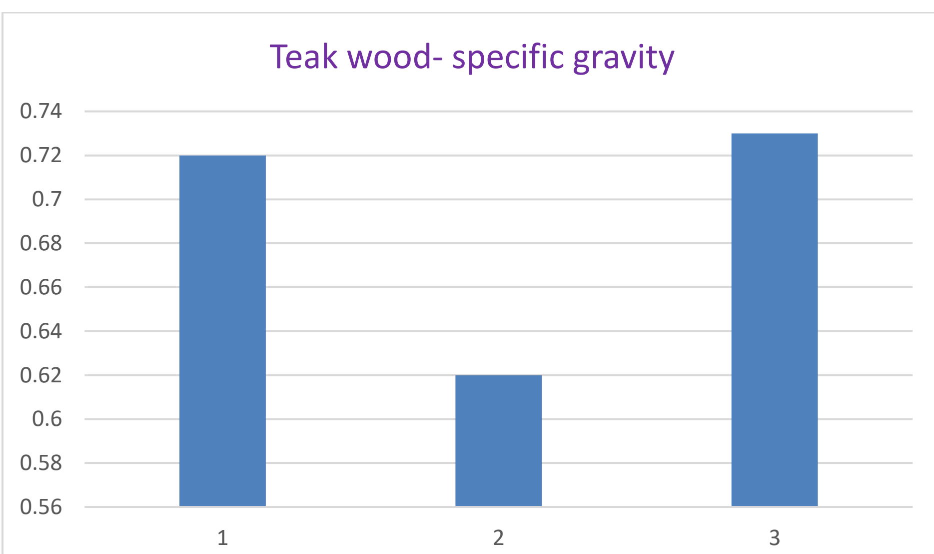
int wt	**OD wt**		MC%*	**Test**		**Density**		**Adjusted specific gravity**
17.3054	**15**		15.3	673.474		**583.899**		**0.58**
17.9745	**15.53**		15.8	700.5575		**605.217**		**0.61**
17.6617	**15.31**		15.3	675.0305		**585.305**		**0.59**
			15.5	**683.0**	Avg	**591.5**	**Avg**	**0.59**

Teak Wood

No	L1	L3	Mean	B2	B3	Mean	T1	T2	T3	Mean	V
209/m/2/3a	6.069	6.05	6.056667	2.089	2.083	2.082	2.09	2.086	2.086	2.087	**26.317**
209/m/2/3b	6.055	6.05	6.053667	2.093	2.94	2.373	2.09	2.089	2.091	2.091	**30.037**
209/m/2/3c	6.054	6.02	6.032	2.071	2.069	2.067	2.06	2.069	2.065	2.066	**25.759**

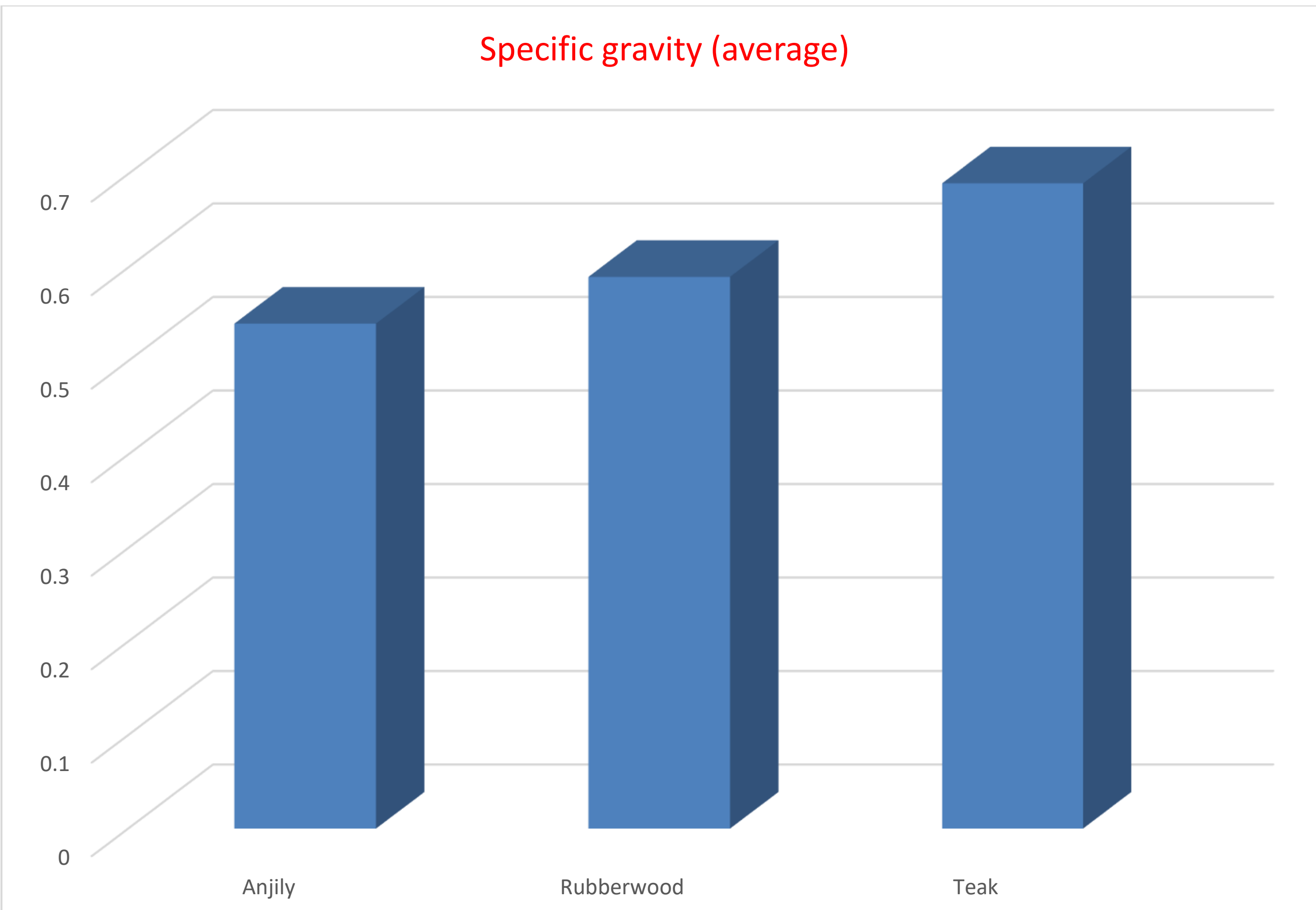
Density kg/m3

int wt	**OD wt**	MC%*	at **Test**	**OD Density**		**Adjusted specific gravity**
20.5753	**18.93**	8.69	781.8243	**719.321**		**0.72**
20.3992	**18.71**	9.04	679.1272	**622.804**		**0.62**
20.4008	**18.71**	9.04	791.9816	**726.327**		**0.73**
		8.92	**751.0**	**689.5**	**Avg**	**0.69**



Average Specific Gravity

Anjily	0.54
Rubberwood	0.59
Teak	0.69



4.4 METHODS OF TESTING OF SMALL CLEAR SPECIMENS OF TIMBER DETERMINATION OF SHEAR STRENGTH PARALLEL TO GRAIN

1. SCOPE

1.1 This standard (Part 11) covers the method of determining shear strength parallel to grain of timber.

2. TEST SPECIMEN

2.1 The test specimen shall be 5 X 5 cm in cross-section and 6 cm in length or 2 X 2 cm in cross-section and 3 cm in length. The specimens shall be notched on one end as shown in Fig. 1 to produce shear failure on 5 X 5 cm or 2 X 2 cm surface in the radial or tangential plane.

3. PROCEDURE

3.1 Placing of the Specimen - The test shall be carried out on a suitable testing machine with the help of a shearing tool in a rig. The specimen shall be supported in the rig by means of a cross bar such that the edges of the specimen are vertical and part of end surface not to be shared off rests on the support through out the test. The shearing tool shall rest on the notch. The direction of shearing shall be parallel to the longitudinal direction.

3.2 Rate of Loading - The load shall be applied continuously during the test such that the movable head travels at a constant rate of 0.4 mm per minute.

4. RECORDING OF DATA AND CALCULATION

4.1 The maximum load required for shearing the area shall be recorded. The load divided by the area gives the maximum shearing stress (MSS) in the concerned plane (radial or tangential) for both sizes.

5. RATIO

5.1 For the purpose of comparison of maximum shearing stress parallel to grain (average of radial and tangential), the ratio of the results of 5 X 5 cm and 2 X 2 cm cross-section shall be taken as 0.87

OBSERVATION

Anjili **Radial**

Max load kg	Max shearing stress MSS kg/cm^2
3348.2	133.9
2237.4	89.5
3739.6	149.6
average 3108.4	124.3333

Anjili **Tangential**

Max load kg	Max shearing stress MSS kg/cm^2
3658.7	146.35
2983.5	119.34
3181.4	127.26
average 3274.533	130.9833

Rubwood **Radial**

Max load kg	Max shearing stress MSS kg/cm^2
3108.2	124.3
3127	125.08
3100	124
average 3111.733	124.46

Rubwood **Tangential**

Max load kg	Max shearing stress MSS kg/cm^2
2892.4	115.7
2921.8	116.87
2822.9	112.92
average 2879.033	115.1633

Teak **Radial**

Max load kg	Max shearing stress MSS kg/cm^2
3718.7	148.75
3811.9	152.48
3768.5	150.74
average 3766.367	150.6567

Teak **Tangential**

Max load kg	Max shearing stress MSS kg/cm^2
3417.9	136.72
2639.8	105.59
2987.8	119.51
average 3015.167	120.6067

TABLE 7

Radial Average	Max load kg
Anjili	**3108.4**
Rubber wood	**3111.7**
Teak	**3766.4**

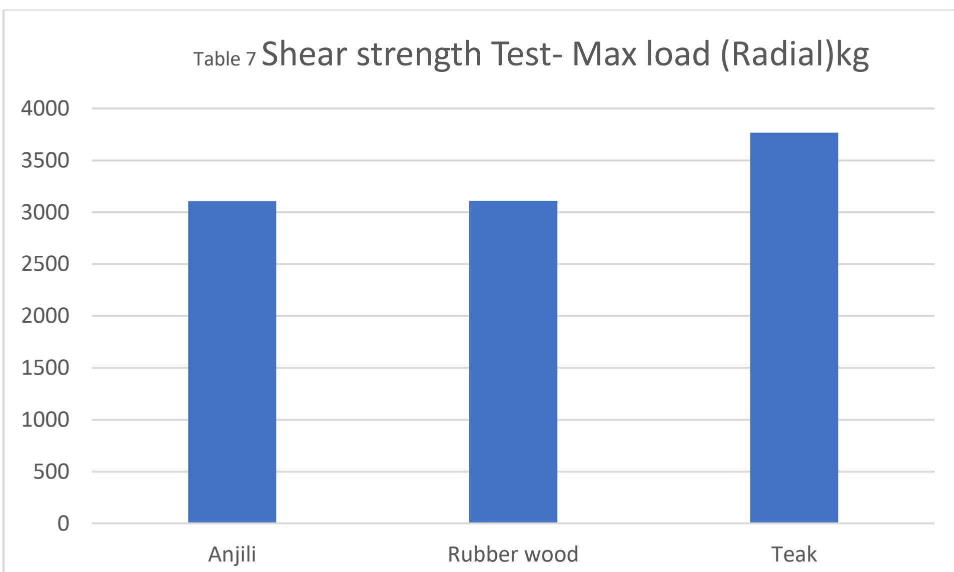


TABLE 8

Radial Average	Max shearing stress MSS kg/cm^2
Anjili	**124.3**
Rubber wood	**124.5**
Teak	**150.7**

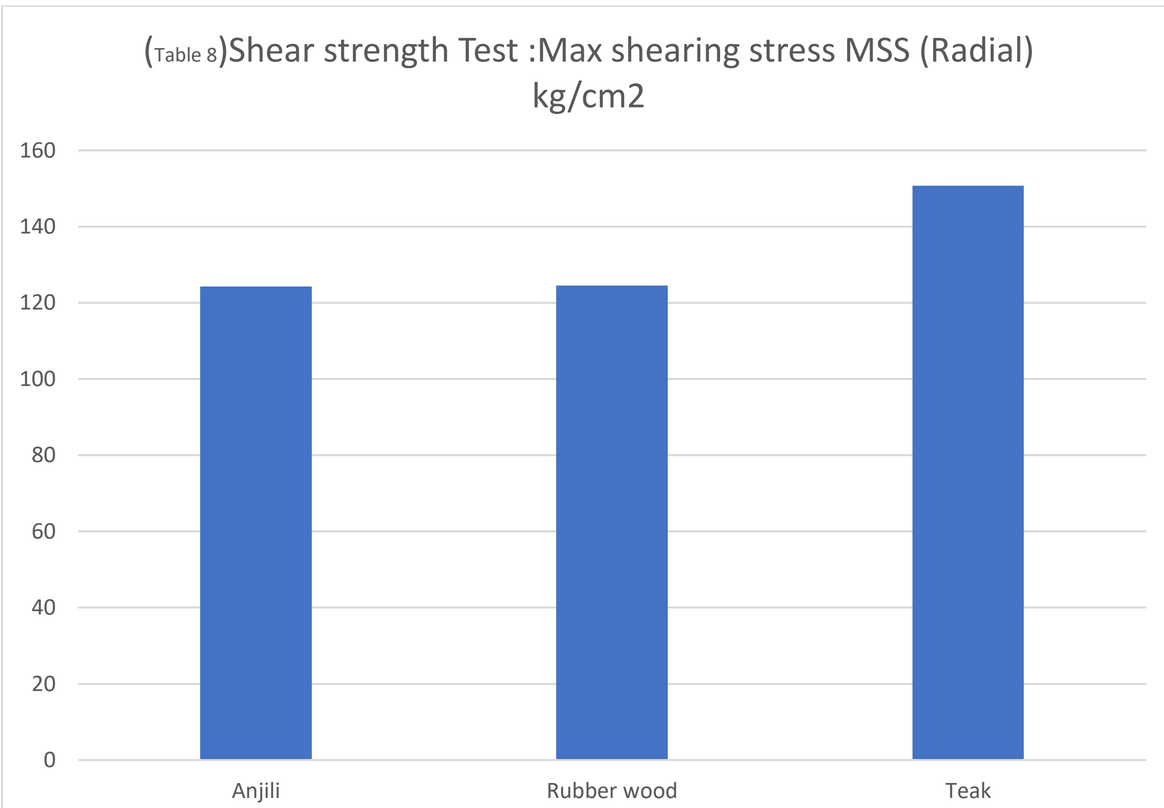


TABLE 9

Tangential Average	Max load kg
Anjili	3274.5
Rubber wood	2879
Teak	3015.2

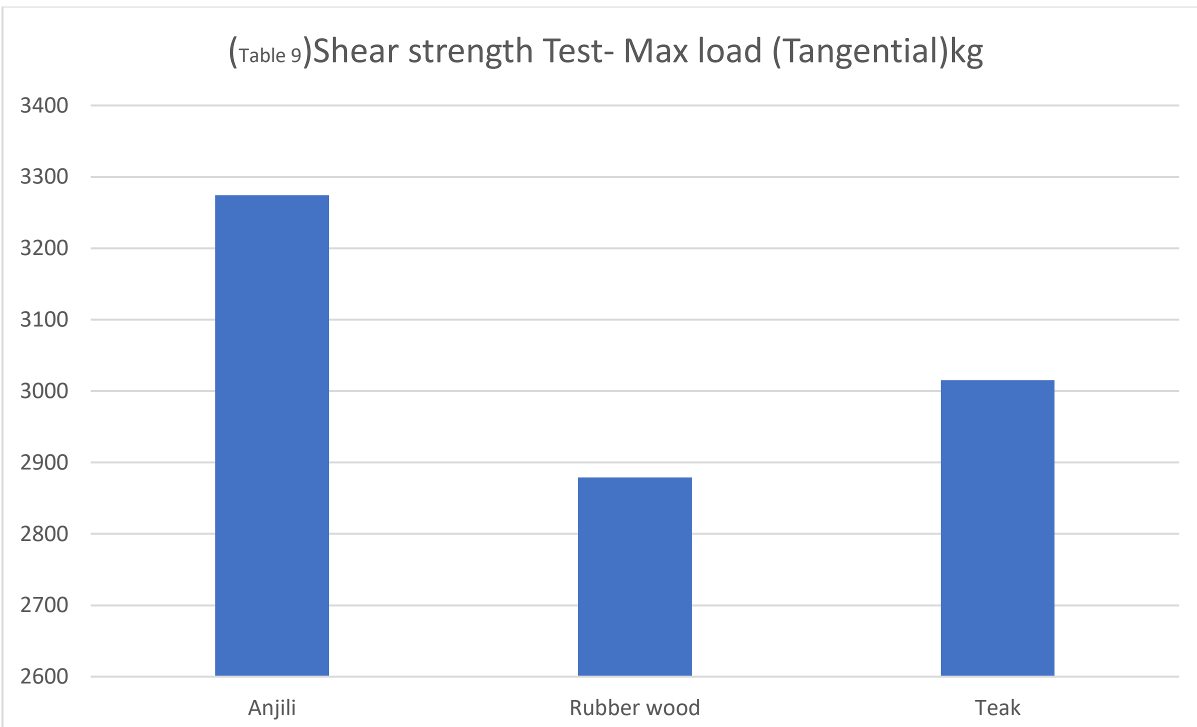
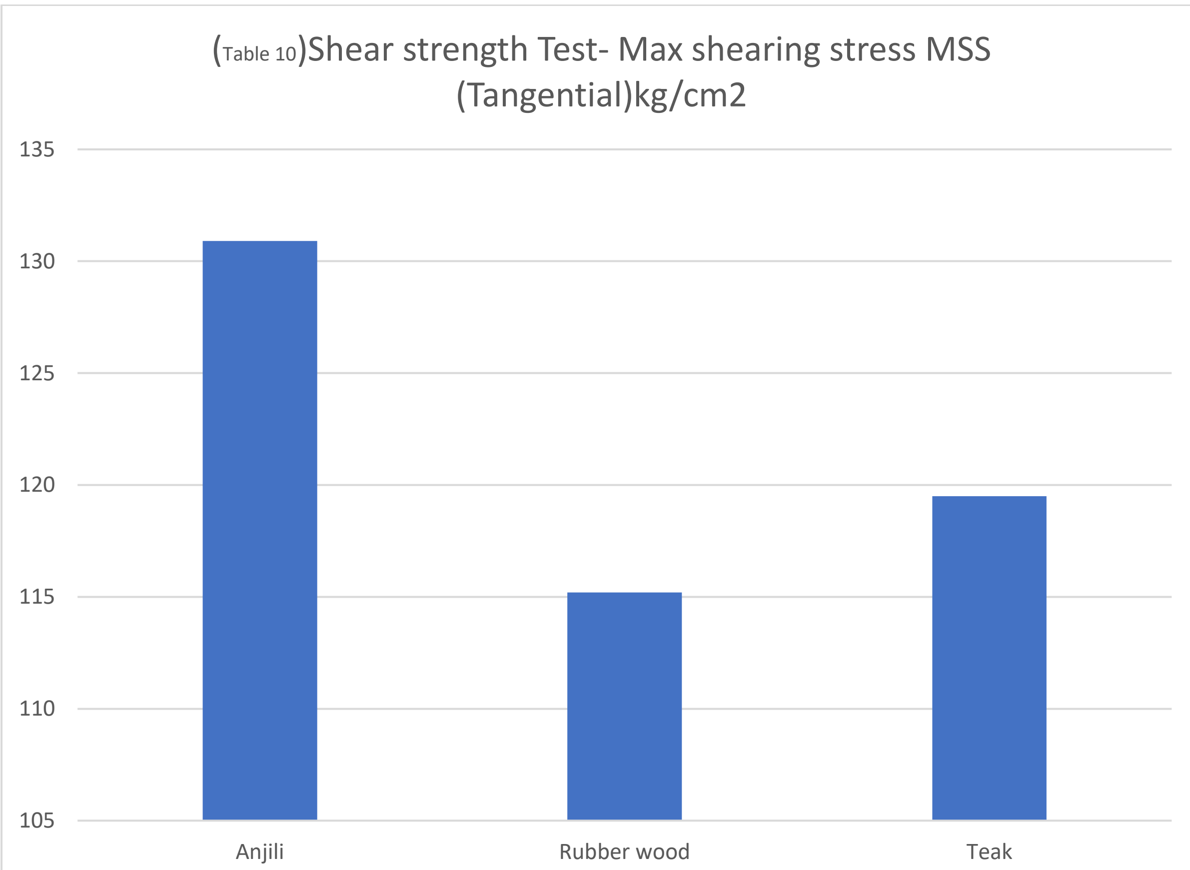


TABLE 10

Tangential Average	Max shearing stress MSS kg/cm^2
Anjili	**130.9**
Rubber wood	**115.2**
Teak	**119.5**



CHAPTER 5. RESULT AND DISCUSSION

Among the three timber species tested viz, Anjili wood ,Rubber wood and Teak wood, specific gravity (avg) of Teak wood is observed as highest 0.69 followed by Rubber wood 0.59 and lowest by Anjili 0.54. Considering the individual values, Teak has shown range of specific gravity from 0.62 to 0.73, Rubber wood 0.58 to 0.61 and Anjili 0.52 to 0.55.

In the case of Tangential Shear strength Test, Maximum shearing stress (MSS) on Radial specimen of Teak wood has shown range of values from 149 to 153 kg/cm^2. Maximum shearing stress (MSS) on Radial specimen of Rubberwood has shown range of values from 124 to 125 kg/cm^2 Maximum shearing stress (MSS) on Radial specimen of Anjili wood has shown range of values from 90 to 150 kg/cm^2

In the case of Radial Shear strength Test, Maximum shearing stress (MSS) on Tangential specimen of Teak wood has shown range of values from 106 to 137 kg/cm^2. Maximum shearing stress (MSS) on Tangential specimen of Rubberwood has shown range of values from 113 to 117 kg/cm^2 .Maximum shearing stress (MSS) on Tangential specimen of Anjili wood has shown range of values from 119 to 146 kg/cm^2

In the case of Tangential Shear strength Test, Maximum Load on Radial specimen of Teak wood has shown range of values from 3719 to 3769 kg . Maximum Load on Radial specimen of Rubberwood has shown range of values from 3100 to 3127 kg Maximum Load on Radial specimen of Anjili wood has shown range of values from 2237to 3740 kg.

In the case of Radial Shear strength Test, Maximum Load on Tangential specimen of Teak wood has shown range of values from 2640 to 3418 kg . Maximum Load on Tangential specimen of Rubberwood has shown range of values from 2823 to 2923 kg Maximum Load on Tangential specimen of Anjili wood has shown range of values from 2984to 3659 kg.

All the three species shown Maximum shearing stress (MSS) average on Radial specimen (Tangential shear strength) greater than that of the same on Tangential specimen(Radial shear strength). Maximum shearing stress (MSS) average on Radial specimen of Teak is obtained as 151 kg/cm2 while the same on Tangential specimen is 120 kg/cm^2 .Maximum shearing stress (MSS) average on Radial specimen of Rubber wood is obtained as 125 kg/cm^2 while the same on Tangential specimen is 115 kg/cm2. Maximum shearing stress (MSS) average on Radial specimen of Anjili wood is obtained as 124 kg/cm^2 while the same on Tangential specimen is 131 kg/cm^2

Maximum Load average on Radial specimen of Teak is obtained as 3766 kg while the same on Tangential specimen is 3015 . Maximum Load average on Radial specimen of Rubber wood is obtained as 3112 kg while the same on Tangential specimen is 2879 kg. Maximum Load average on Radial specimen of Anjili wood is obtained as 3108 while the same on Tangential specimen is 3275 kg

CHAPTER 6 .CONCLUSION

Since the Maximum load and Maximum shearing stress of Radial specimen (Tangential shear strength) is grater than that of Maximum load and Maximum shearing stress for tangential specimen(Radial shear strength), Radial specimen can be used for selection and design of various industrial articles and also in design of beams in construction. Since Rubberwood has shown specific gravity greater than that of Anjili wood and almost comparable to that of Teak wood, this can be an alternative to Anjili wood and Teak wood in furniture industry.

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