

## MECHANICAL TESTS OF SOME MYSORE TIMBERS

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The tests of which the results are here given were carried out on specimens of timber kindly provided for the purpose by the Chief Conservator of Forests in Mysore.

The timber was received in the form of logs about four feet long ; these were quartered and stored in a dry situation with free access of air for at least a year before use.

When the test-specimens had been cut to shape and size, they were kept for several days—sometimes weeks—in a dry room and then measured accurately by micrometer before test. The actual details of measurements have not been given, but each measurement shown in the paper is the mean of at least three readings of the micrometer. On account of the length of exposure to the atmosphere, all specimens when measured and tested must have been air-dry ; so, although no moisture determinations were made, it is probable that the moisture content of the specimens varied between  $5\frac{1}{2}$  and 11 per cent. according to the humidity of the atmosphere.

The tests were performed on a 10,000-lb. Denison's Single Lever Testing Machine (hand-operated) in which the load is applied by traversing a sliding weight along the horizontal lever or steelyard, and the strain is taken up by means of a screw. Loads are read direct in pounds on a scale engraved on the steelyard ; the scale reads up to 10,000 lbs., but the sliding weight can be moved to a position corresponding to a total load of 10,170 lbs. When specimens failed to break down under a load of 10,170 lbs., additional load was in a few cases applied by means of cast iron bars suspended in a stirrup at a point near the end of the lever ; this procedure was adopted in a few cases only, as its continued application was considered likely to damage the knife-edges.

A dead-weight calibration of the machine showed a constant error of about 0.3 per cent. up to 1,000 lbs. ; an error of 0.3 per cent. in readings having such large variations as are met with in all mechanical tests on timber is so small as to be absolutely negligible.

The following tests were carried out:—(I) Transverse, (II) Tension, (III) Single Shear, and (IV) Compression; in addition to these, density determinations were also made.

I. *Transverse Tests*.—These were performed on specimens approximately 1" wide, 2" deep and 36" span between knife-edges. In order to prevent cutting, small plates of sheet iron were interposed between the knife-edges and the specimens.

Assuming the ordinary elastic theory to hold good, the application of a load  $W$  lbs. at the centre of a span of  $l$  inches will cause a maximum stress  $f = \frac{Wlh}{8I}$ , where  $h$  is the depth of the section in inches and  $I$  the second moment in inch units. On the same assumption, the deflection of the beam at the centre will be  $\Delta = \frac{Wl^3}{48/E}$ ,  $E$  being Young's Modulus.

Let  $b$  be the breadth of the section.

$$\text{Then } I = \frac{bh^3}{12}$$

Substituting for  $l$  its value, 36, and for  $I$  its value,  $\frac{bh^3}{12}$ , we get

$$f = \frac{54W}{bh^2} \quad \text{and} \quad E = \frac{11664W}{bh^3 \Delta}$$

If we now substitute 1 for  $b$  and 2 for  $h$ , we get

$$f_0 = 13.5 W \quad \text{and} \quad E_0 = \frac{1458 W}{\Delta}$$

Let the actual values of  $b$  and  $h$  be  $1 + \delta b$  and  $2 + \delta h$ .

Then the actual values of  $f$  and  $E$  will be

$$f = f_0 + \delta f = f_0 + \frac{df}{db} \delta b + \frac{df}{dh} \delta h$$

$$\text{and} \quad E = E_0 + \delta E = E_0 + \frac{dE}{db} \delta b + \frac{dE}{dh} \delta h.$$

$$\text{Now} \quad f = \frac{54W}{bh^2} \therefore \frac{df}{db} = -\frac{54W}{b^2 h^2} = -\frac{f}{b}$$

$$\text{and} \quad \frac{df}{dh} = -\frac{2 \times 54W}{bh^3} = -\frac{2f}{h}$$

$$\therefore f = f_0 - f \frac{\delta b}{b} - \frac{2f \delta h}{h}$$

As the actual values of  $b$  and  $h$  did not vary much from one and two inches respectively, we can put

$$f = f_0 \left(1 - \frac{\delta b}{1} - \frac{2 \delta h}{2}\right) \\ = f_0 (1 - \delta b - \delta h) \quad \therefore f = 13.5 W (1 - \delta b - \delta h).$$

$$\text{Similarly, } E = \frac{11664 W}{bh^3 \Delta}$$

$$\frac{dE}{db} = -\frac{11664 W}{b^2 h^3 \Delta} = -\frac{E}{b}$$

$$\text{and } \frac{dE}{dh} = -\frac{3 \times 11664 W}{bh^4 \Delta} = -\frac{3E}{h}$$

$$\therefore E = E_0 - E \left( \frac{\delta b}{b} - \frac{3E\delta h}{h} \right) \\ = E_0 \left( 1 - \frac{\delta b}{1} - \frac{3\delta h}{2} \right) \\ E = \frac{1458 W}{\Delta} \left( 1 - \delta b - \frac{3}{2} \delta h \right)$$

In working out the results of the Transverse Tests, the two formulae derived above for  $f$  and  $E$  were applied in all calculations of Fibre-Stress, Modulus of Rupture and Young's Modulus; in the two former cases the values of  $\delta b$  and  $\delta h$  were taken from the dimensions of the central cross-section, and in the latter case they were taken from the dimensions of the average cross-section.

II. *Tensile Tests.*—The specimens used for the Tensile Tests, shown in Fig. 1, were of rectangular cross-section,  $\frac{1}{2}$ " thick through-

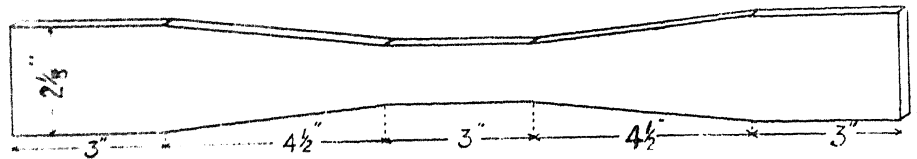


FIG. 1. TENSILE TEST SPECIMEN.

out, and 18" long; the maximum width of section, for 3" at each end, was  $2\frac{1}{8}$ "; the width was then tapered gradually towards the centre for a distance of  $4\frac{1}{2}$ " at each end, thus leaving a parallel portion for a distance of 3" at the centre of the specimen; to this central portion of minimum cross-section I shall refer as the contracted portion.

The specimens were initially made  $1\frac{1}{2}$ " wide in the contracted portion, so as to have a cross-sectional area of  $\frac{5}{8}$  square inch; but in some cases this had to be reduced as the limiting load of 10,170 lbs. was insufficient to cause fracture, and in other cases further specimens had to be prepared with reduced width in the contracted portion owing to the original specimens fracturing at the enlarged ends due to the crushing-effect of the wedges by which they were held in the shackles.

In spite of all precautions, which ensured that the fractures all took place in the contracted portion, the variations in breaking-stress for any one species were very wide, the maximum being in some cases as much as three times the minimum. On the whole, however, the average breaking-stress works out—as would be expected—at rather less than the Modulus of Rupture. The results are shown in Schedule II.

III. *Shear Tests.*—The results of the Shear Tests are also given in Schedule II.

The specimens were prepared as follows:—

Rectangular blocks were cut, 7" long,  $2\frac{1}{2}$ " wide and 1" thick; a rectangular block 3" long,  $2\frac{1}{2}$ " wide and  $\frac{1}{2}$ " thick was cut away from the centre of one side, leaving a specimen  $\frac{1}{2}$ " thick in the centre with ends 1" thick for a length of 2". The specimen is shown in Fig. 2. These

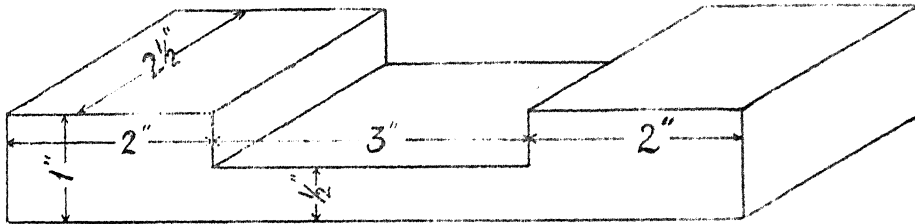


FIG. 2. SINGLE SHEAR TEST SPECIMEN.

specimens were placed in specially prepared shackles by means of which the ends were pulled apart from one another, thus tending to shear them through a central plane—a continuation of the boundary surface of the hollow cut in the middle portion of the specimen; the area in shear, if the specimens could have been prepared accurately to size, would, therefore, be  $2\frac{1}{2}$ " (width)  $\times$  2" (length), i.e. 5 square inches at each end. The shackles were so constructed that the axis of pull lay in the plane of the shear. On account of unavoidable inaccuracy in the preparation of the specimens, it was necessary to take measurements of the area in shear at each end of the specimen; in many instances the shear occurred in the larger of the two sections in shear—due to local variations in strength; but only the dimensions at the end where the specimen sheared are shown in the Schedule.

IV. *Compression Tests and Density Determinations.*—The specimens initially used were  $1\frac{1}{4}$ " cubes and rectangular blocks  $1\frac{1}{4}$ " square in cross-section and  $2\frac{1}{2}$ " long. In some cases the strength of these specimens was too great for the capacity of the machine and the machine was overloaded, as mentioned on page 1: in other similar cases, the specimens were cut down to 1" cubes and blocks  $2" \times 1" \times 1"$ .

Prior to testing the specimens were accurately measured and weighed on a chemical balance; the figures thus obtained formed the basis of the density determinations, which are shown together with the Compression Tests in Schedule II.

The average results for the various logs dealt with in Schedules I and II have been collected together and shown in Schedule III; in this Schedule, in order to reduce the number of figures, stresses have been shown only in tons per square inch.

It will be observed that two logs of *Albizzia odoratissima* were tested; the first mentioned was sent from Lakkavalli Range, the second from Kankankote Range, both logs being taken from the middle of the trunk. Three logs of *Terminalia paniculata* were supplied; the first was from the middle of the trunk, the other two from the upper trunk.

It should, perhaps, be mentioned that for the Transverse Tests the specimens were cut with their depth radial to the annual rings of the timber and the same was the case for the Shear Tests, that is, the shear was in a radial plane. The specimens for tensile and compressive tests were so cut that the direction of pull or thrust coincided with the axis of the tree and not necessarily with the direction of the grain, which was in some cases very far from being straight.

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## SCHEDULE

## Transverse

WOOD	Ref. No. of Specimen	Section at centre	Average section	ELASTIC		
				Load lbs.	Deflection inches	FIBRE
						Lbs. per sq. in.
<i>Pocilonuron indicum</i> , Bedd. (Kanarese, Balgi)	124	1.01" × 2.005"	1.009" × 1.994"	800	0.54	10,600
	125	0.995" × 2.01"	0.991" × 1.987"	800	0.56	10,700
	126	1.02" × 1.995"	1.009" × 1.991"	700	0.55	9,300
	Averages ...	...	1.01" × 2.00"	1.00" × 1.99"	767	0.55
<i>Holigarna arnottiana</i> , Hook. (Kanarese, Howliga)	127	0.995" × 1.99"	0.997" × 1.99"	600	0.48	8,200
	128	1.005" × 2.015"	1.008" × 2.009"	600	0.49	7,900
	129	1.005" × 1.985"	1.004" × 1.986"	700	0.65	9,500
	Averages ...	...	1.00" × 2.00"	1.00" × 1.995"	633	0.54
<i>Dalbergia latifolia</i> , Roxb. (Kanarese, Beeté)	136	1.01" × 1.99"	1.01" × 1.997"	700	0.77	9,400
	137	0.995" × 1.98"	1.003" × 1.992"	700	0.75	9,700
	138	1.015" × 1.99"	1.017" × 1.996"	600	0.62	8,000
	Averages ...	...	1.01" × 1.99"	1.01" × 1.995"	667	0.71
<i>Terminalia paniculata</i> , Roth. (Kanarese, Hulvé, Hunal)	133	1.005" × 2.01"	1.00" × 1.997"	700	0.62	9,300
	134	1.005" × 1.985"	1.003" × 1.989"	700	0.61	9,500
	135	1.005" × 1.975"	1.004" × 1.996"	800	0.66	11,000
	Averages ...	...	1.005" × 1.99"	1.00" × 1.995"	733	0.63
<i>Terminalia paniculata</i> , Roth. (Kanarese, Hulvé, Hunal)	160	0.995" × 1.97"	0.993" × 1.971"	600	0.59	8,380
	161	0.99" × 2.00"	0.99" × 2.00"	700	0.58	9,500
	162	0.995" × 1.995"	0.994" × 1.994"	600	0.53	8,150
	Averages ...	...	0.993" × 1.988"	0.992" × 1.988"	633	0.57
<i>Terminalia paniculata</i> , Roth. (Kanarese, Hulvé, Hunal)	166	1.005" × 1.995"	1.004" × 1.998"	700	0.73	9,440
	167	1.005" × 2.01"	1.007" × 2.008"	600	0.73	7,980
	168	0.99" × 1.985"	0.989" × 1.985"	300	0.42	4,140
	Averages ...	...	1.00" × 1.997"	1.00" × 1.997"	533	0.63

## I.

*Tests.*

STRESS		BREAKING STRESS				Ratio of elastic to maximum deflection	Ratio of fibre stress at elastic limit to Modulus of Rupture
STRESS	Young's Modulus lbs. per square inch	Load lbs.	Deflection inches	Modulus of Rupture			
Tons per sq. in.				Lbs. per sq. in.	Tons per sq. in.		
4.74	2,170,000	1,010	0.75	13,400	5.99	0.72	0.79
4.78	2,120,000	1,305	1.21	17,400	7.77	0.46	0.61
4.15	1,870,000	1,067	0.95	14,200	6.35	0.58	0.66
1.56	2,050,000	1,127	0.97	15,000	6.70	0.59	0.69
3.66	1,860,000	930	1.18	12,700	5.67	0.41	0.65
3.53	1,740,000	807	0.88	10,700	4.78	0.56	0.74
4.24	1,650,000	706	0.66	9,600	4.29	0.98	0.99
3.81	1,750,000	812	0.91	11,000	4.91	0.65	0.89
1.20	1,340,000	978	1.21	13,200	5.90	0.64	0.71
4.33	1,380,000	979	1.16	13,500	6.03	0.65	0.72
3.57	1,390,000	863	0.98	11,600	5.18	0.63	0.69
4.03	1,370,000	940	1.12	12,800	5.70	0.64	0.71
4.15	1,660,000	1,131	1.66	15,000	6.70	0.37	0.62
4.24	1,690,000	1,130	1.37	15,300	6.83	0.45	0.62
4.92	1,750,000	1,100	1.33	15,200	6.79	0.50	0.72
1.44	1,700,000	1,120	1.45	15,200	6.77	0.44	0.65
3.74	1,560,000	796	0.91	11,200	5.00	0.648	0.748
4.24	1,770,000	1,178	1.37	16,000	7.14	0.424	0.593
3.64	1,670,000	1,156	1.60	15,700	7.01	0.332	0.518
3.87	1,670,000	1,043	1.29	14,300	6.38	0.468	0.620
4.21	1,390,000	1,120	1.63	15,100	6.74	0.448	0.625
3.57	1,170,000	782	1.06	10,400	4.65	0.689	0.767
1.85	1,070,000	380	0.63	5,240	2.34	0.667	0.790
3.21	1,210,000	761	1.11	10,250	4.58	0.601	0.727

## SCHEDULE

## Transverse

WOOD	Ref. No. of Specimen	Section at centre	Average section	ELASTIC		
				Load lbs.	Deflection inches	FIBRE
						Lbs. per sq. in.
<i>Cornus macrophylla</i> , Wall. (Kanarese, Hadaga)	139	1.01 " × 2.005 "	1.003 " × 1.997 "	900	0.68	12,000
	140	0.995 " × 1.985 "	0.992 " × 1.985 "	900	0.74	12,400
	141	1.00 " × 1.99 "	1.00 " × 1.991 "	900	0.74	12,200
	Averages ...	...	1.00 " × 1.99 "	1.00 " × 1.99 "	900	0.72
<i>Albizzia odoratissima</i> , Benth. (Kanarese, Bilwara)	142	0.995 " × 2.00 "	1.00 " × 2.00 "	900	0.84	12,200
	143	0.995 " × 1.99 "	0.995 " × 1.986 "	800	0.62	11,000
	144	1.00 " × 1.995 "	1.011 " × 1.996 "	900	0.70	12,200
	Averages ...	...	0.995 " × 1.99 "	1.00 " × 1.995 "	867	0.72
<i>Albizzia odoratissima</i> , Benth. (Kanarese, Bilwara)	169	1.01 " × 2.015 "	0.997 " × 1.984 "	1,000	0.69	13,200
	170	1.00 " × 2.015 "	1.002 " × 1.996 "	1,100	0.76	14,600
	171	0.995 " × 2.01 "	0.989 " × 1.998 "	1,200	0.81	16,100
	Averages ...	...	1.002 " × 2.013 "	0.996 " × 1.993 "	1,100	0.75
<i>Shorea talura</i> , Roxb. (Kanarese, Jalari)	145	0.995 " × 1.98 "	0.994 " × 1.986 "	500	0.45	6,900
	146	0.985 " × 1.97 "	0.99 " × 1.971 "	800	0.79	11,300
	147	0.985 " × 1.97 "	0.993 " × 1.964 "	600	0.62	8,500
	Averages ...	...	0.99 " × 1.97 "	0.99 " × 1.97 "	633	0.62
<i>Bassia longifolia</i> , Linn. (Kanarese, Hippé)	121	2.00 " × 1.02 "	2.00 " × 1.007 "	...	...	...
	122	2.01 " × 1.015 "	2.003 " × 1.012 "	...	...	...
	123	1.99 " × 0.96 "	1.992 " × 0.972 "	...	...	...
	Averages ...	...	2.00 " × 1.00 "	2.00 " × 1.00 "	...	...
<i>Odina wodier</i> , Roxb. (Kanarese, Padri)	151	0.985 " × 1.995 "	0.992 " × 1.997 "	600	0.70	8,270
	152	0.99 " × 1.975 "	0.996 " × 1.990 "	800	0.83	11,210
	153	0.985 " × 1.99 "	0.994 " × 1.995 "	600	0.70	8,270
	Averages ...	...	0.987 " × 1.987 "	0.994 " × 1.994 "	667	0.74



I—(continued)

## Tests

STRESS		BREAKING STRESS				Ratio of elastic to maximum deflection	Ratio of fibre stress at elastic limit to Modulus of Rupture
STRESS	Young's Modulus lbs. per square inch	Load lbs.	Deflection inches	Modulus of Rupture			
Tons per sq. in.				Lbs. per sq. in.	Tons per sq. in.		
5.36	1,890,000	1,168	1.33	15,500	6.92	0.51	0.77
5.51	1,830,000	1,100	1.04	15,200	6.79	0.71	0.81
5.45	1,790,000	1,125	1.10	15,300	6.83	0.67	0.80
5.45	1,840,000	1,131	1.16	15,300	6.85	0.63	0.79
5.45	1,550,000	1,137	1.38	15,400	6.88	0.61	0.79
4.92	1,950,000	1,087	0.92	14,900	6.65	0.67	0.74
5.45	1,890,000	1,203	0.96	16,300	7.28	0.73	0.75
5.27	1,800,000	1,142	1.09	15,500	6.94	0.67	0.76
5.90	2,170,000	1,180	1.28	15,600	6.97	0.540	0.845
6.52	2,110,000	1,440	1.45	19,100	8.53	0.525	0.763
7.18	2,190,000	1,477	1.75	19,800	8.84	0.464	0.812
6.53	2,160,000	1,366	1.49	18,200	8.11	0.510	0.807
3.08	1,670,000	566	0.53	7,800	3.48	0.85	0.88
5.05	1,550,000	980	1.00	13,800	6.16	0.79	0.82
3.80	1,540,000	893	1.02	12,600	5.63	0.61	0.67
3.98	1,590,000	813	0.85	11,400	5.09	0.65	0.79
...	...	450	0.70	5,930	2.65	...	...
...	...	566	1.30	7,450	3.33	...	...
...	...	750	...	10,700	4.78	...	...
...	...	589	1.00	8,030	3.59	...	...
3.69	1,270,000	978	1.39	13,500	6.03	0.505	0.611
5.00	1,430,000	1,002	1.25	14,000	6.25	0.665	0.800
3.69	1,270,000	702	0.95	9,670	4.32	0.737	0.853
4.13	1,320,000	894	1.19	12,390	5.53	0.636	0.755

## Transverse

WOOD	Ref. No. of Specimen	Section at centre	Average section	ELASTIC		
				Load lbs.	Deflection inches	FIBRE
						Lbs. per sq. in.
<i>Stereospermum xylocarpum</i> , Benth. and Hook f. (Kanarese, Udi)	130	0.98 " × 1.99 "	0.984" × 1.984"	700	0.68	9,720
	131	1.00 " × 2.02 "	1.007" × 2.011"	600	0.58	7,910
	132	0.985" × 1.965"	0.987" × 1.977"	300	0.52	4,250
	Averages ...	...	0.988" × 1.992"	0.993" × 1.991"	533	0.59
<i>Anogeissus latifolia</i> , Wall. (Kanarese, Dindiga)	148	0.975" × 1.97 "	0.979" × 1.975"	900	0.58	12,800
	149	0.975" × 1.995"	0.977" × 1.985"	600	0.43	8,330
	150	0.985" × 1.97 "	0.982" × 1.970"	900	0.65	12,710
	Averages ...	...	0.978" × 1.978"	0.979" × 1.977"	800	0.55
<i>Stephegyne parvifolia</i> , Korth. (Kanarese, Kadaba)	154	0.98 " × 1.975"	0.994" × 1.986"	700	0.52	9,850
	155	0.99 " × 1.98 "	1.001" × 1.984"	900	0.64	12,530
	156	0.965" × 1.965"	0.979" × 1.971"	800	0.59	11,540
	Averages ...	...	0.978" × 1.973"	0.991" × 1.980"	800	0.58
<i>Garuga Pinnata</i> , Roxb. (Kanarese, Godda)	157	1.00 " × 1.985"	0.990" × 1.968"	400	0.59	5,470
	158	0.995" × 1.975"	0.999" × 1.976"	200	0.42	2,780
	158A	1.005" × 2.000"	1.002" × 1.993"	400	0.56	5,350
	159	0.99 " × 1.985"	0.984" × 1.979"	450	0.78	6,200
Averages ...	...	0.997" × 1.986"	0.994" × 1.979"	362	0.59	4,950
<i>Bridelia retusa</i> , Spreng (Kanarese, Goje)	163	0.99 " × 2.05 "	0.99 " × 2.005"	500	0.53	6,500
	164	1.015" × 2.00 "	1.012" × 2.003"	500	0.45	6,650
	165	1.00 " × 2.005"	0.998" × 1.997"	300	0.29	4,020
	Averages ...	...	1.002" × 2.018"	1.000" × 2.002"	433	0.42
<i>Tectona grandis</i> , Linn. fl. (Teak)	172	1.00 " × 2.01 "	1.00 " × 2.01 "	700	0.63	9,380
	173	1.01 " × 2.00 "	1.008" × 2.003"	700	0.64	9,380
	174	1.005" × 2.005"	0.993" × 2.002"	800	0.65	10,700
	Averages ...	...	1.005" × 2.005"	1.000" × 2.005"	733	0.64
<i>Pterocarpus marsupium</i> Roxb. (Kanarese, Honne)	175	1.015" × 2.015"	1.016" × 1.997"	400	0.53	5,240
	176	1.01 " × 2.00 "	1.007" × 1.991"	700	0.72	9,380
	177	1.005" × 2.01 "	1.004" × 1.995"	250	0.38	3,320
	Averages ...	...	1.010" × 2.008"	1.009" × 1.994"	450	0.54

## Tests

STRESS		BREAKING STRESS				Ratio of elastic to maximum deflection	Ratio of fibre stress at elastic limit to Modulus of Rupture
Tons per sq. in.	Young's Modulus lbs. per square inch	Load lbs.	Deflection inches	Modulus of Rupture			
				Lbs. per sq. in.	Tons per sq. in.		
4.34	1,560,000	1,094	1.75	15,200	6.78	0.389	0.639
3.53	1,660,000	1,051	1.28	13,900	6.20	0.454	0.569
1.90	1,090,000	431	1.50	6,110	2.73	0.347	0.696
3.26	1,440,000	859	1.51	11,740	5.24	0.397	0.635
5.72	2,370,000	1,457	1.23	20,600	9.20	0.472	0.620
3.72	2,130,000	991	1.18	13,800	6.16	0.365	0.603
5.67	2,140,000	1,550	2.02	21,800	9.73	0.322	0.582
5.04	2,210,000	1,333	1.48	18,730	8.36	0.386	0.602
4.40	2,000,000	1,200	1.37	16,900	7.54	0.380	0.583
5.60	2,090,000	1,319	1.62	18,300	8.17	0.398	0.685
5.15	2,080,000	1,348	1.54	19,400	8.66	0.384	0.594
5.05	2,060,000	1,289	1.51	18,200	8.12	0.387	0.621
2.44	1,050,000	660	1.17	9,040	4.04	0.505	0.603
1.24	720,000	238	0.61	3,300	1.47	0.688	0.843
2.39	1,050,000	665	1.32	8,900	3.97	0.425	0.602
2.77	910,000	617	1.67	8,500	3.79	0.468	0.730
2.21	930,000	545	1.19	7,430	3.32	0.521	0.694
2.91	1,500,000	748	1.50	9,710	4.33	0.354	0.672
2.97	1,590,000	1,000	1.06	13,300	5.94	0.425	0.499
1.80	1,550,000	788	1.52	10,600	4.74	0.191	0.379
2.56	1,550,000	845	1.36	11,200	5.00	0.323	0.517
4.18	1,600,000	1,039	1.25	13,900	6.21	0.505	0.672
4.18	1,590,000	800	0.76	10,700	4.78	0.841	0.873
4.78	1,800,000	1,044	1.34	14,000	6.25	0.486	0.763
4.38	1,660,000	961	1.12	12,900	5.75	0.611	0.769
2.34	1,090,000	530	0.72	6,930	3.10	0.736	0.754
4.18	1,430,000	880	0.99	11,800	5.27	0.727	0.793
1.48	950,000	399	0.69	5,300	2.37	0.55	0.624
2.67	1,160,000	603	0.80	8,010	3.58	0.671	0.724

## SCHEDULE

WOOD	TENSION TESTS					SINGLE SHEAR		
	Ref. No. of Specimen	Area in tension sq. in.	Breaking load lbs.	BREAKING STRESS		Specimen No.	Area in shear sq. in.	Breaking load lbs.
				Lbs. per sq. in.	Tons per sq. in.			
<i>Pocillozoeuron indicum</i> , Bedd.	44	0.549	5,691	10,370	4.63	84	4.82	9,134
	45	0.558	6,036	10,830	4.84	85	4.88	7,661
	46	0.540	2,408	4,450	1.99	86	5.04	9,840
	46A	0.506	5,913	11,690	5.21	..	..	..
	Averages ...	...	...	...	9,335	4.17	...	...
<i>Holigarna arnottiana</i> , Hook.	47	0.743	5,737	7,720	3.45	87	5.00	4,766
	48	0.623	5,958	9,560	4.27	88	4.99	4,747
	49	0.620	6,152	9,110	4.07	89	4.97	5,603
	Averages ...	...	...	...	8,800	3.93	...	...
<i>Dalbergia latifolia</i> , Roxb.	56	0.554	4,164	7,520	3.36	96	5.00	6,050
	56A	0.526	6,451	12,270	5.47	97	4.95	7,418
	57	0.555	3,679	6,620	2.96	98	5.03	6,308
	57A	0.508	4,080	8,030	3.59	...	...	...
	57B	0.503	4,790	9,520	4.25	...	...	...
	58	0.536	5,334	9,960	4.44	...	...	...
	Averages ...	...	...	...	8,987	4.01	...	...
<i>Terminalia paniculata</i> , Roth.	53	0.558	6,314	11,330	5.06	93	5.03	4,790
	53A	0.502	6,705	13,370	5.97	94	4.97	5,799
	54	0.573	6,806	11,900	5.31	95	4.99	3,949
	54A	0.491	6,786	13,840	6.18	...	...	...
	55	0.560	7,143	12,750	5.69	...	...	...
	55A	0.500	8,949	17,900	7.99	...	...	...
	Averages ...	...	...	...	13,510	6.03	...	...
<i>Terminalia paniculata</i> , Roth.	80	0.627	8,214	13,110	5.85	120	5.00	4,340
	80A	0.639	9,244	14,490	6.47	121	4.98	3,844
	81	0.769	8,923	11,610	5.18	122	4.97	4,437
	81A	0.515	7,859	15,280	6.82	...	...	...
	82	0.625	8,235	13,200	5.90	...	...	...
	Averages ...	...	...	...	13,540	6.04	...	...

## II.

TESTS		DENSITY AND COMPRESSION TESTS							
BREAKING STRESS		Specimen No.	DENSITY	Specific gravity	Approximate size of specimen	Area in compression sq. in.	Crushing load lbs.	CRUSHING STRESS	
Lbs. per sq. in.	Tons per sq. in.		Lbs. per c. ft.					Lbs. per sq. in.	Tons per sq. in.
1,897	0.847	9	64.2	1.03	1½" × 1¼" × 1¼"	1.55	14,375	9,250	4.14
1,570	0.700	10	68.1	1.09	2" × 1" × 1"	1.00	9,975	9,975	4.45
1,951	0.871	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
1,806	0.806	...	66.1	1.06	...	...	...	9,610	4.29
953	0.425	17	41.7	0.668	2½" × 1¼" × 1¼"	1.577	14,001	8,875	3.97
950	0.424	18	41.7	0.668	1½" × 1¼" × 1¼"	1.575	14,401	9,140	4.08
1,128	0.503	...	...	...	...	...	...	...	...
1,010	0.451	...	41.7	0.668	...	...	...	9,000	4.02
1,210	0.540	33	49.3	0.790	2½" × 1¼" × 1¼"	1.545	14,401	9,320	4.16
1,500	0.669	34	49.1	0.786	1½" × 1¼" × 1¼"	1.515	14,401	9,490	4.24
1,255	0.560	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
1,322	0.590	...	49.2	0.788	...	...	...	9,400	4.20
951	0.425	29	50.6	0.811	2" × 1" × 1"	1.00	8,516	8,516	3.80
1,167	0.521	30	53.2	0.852	1" × 1" × 1"	1.00	8,184	8,184	3.68
790	0.353	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
969	0.433	...	51.9	0.831	...	...	...	8,350	3.74
868	0.388	61	54.9	0.880	2" × 1" × 1"	1.00	7,764	7,764	3.47
771	0.344	62	49.4	0.792	1" × 1" × 1"	1.00	7,072	7,072	3.16
891	0.398	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
843	0.377	...	52.1	0.836	...	...	...	7,418	3.31

## SCHEDULE

WOOD	TENSION TESTS					SINGLE SHEAR		
	Ref. No. of Specimen	Area in tension sq. in.	Breaking load lbs.	BREAKING STRESS		Specimen No.	Area in shear sq. in.	Breaking load lbs.
				Lbs. per sq. in.	Tons per sq. in.			
<i>Terminalia paniculata</i> , Roth.	86	0.574	6,223	10,850	4.85	126	4.93	4,737
	87	0.605	9,162	15,160	6.77	127	5.01	5,940
	88	0.547	6,467	11,840	5.29	128A	4.73	3,421
	Averages ...	...	...	12,620	5.64	...	...	...
<i>Cornus macrophylla</i> , Wall.	59	0.552	8,709	15,790	7.05	99	5.02	4,785
	59A	0.503	9,124	18,180	8.11	100	4.98	6,346
	60	0.556	8,320	14,970	6.68	101	4.95	4,977
	60A	0.506	7,005	13,860	6.18	...	...	...
	61	0.557	9,280	16,670	7.44	...	...	...
	61A	0.525	6,968	13,290	5.93	...	...	...
Averages ...	...	...	15,460	6.90	...	...	...	
<i>Albizia odoratissima</i> , Benth.	62	0.552	5,446	9,850	4.39	102	4.96	5,953
	62A	0.506	6,922	13,700	6.12	102A	4.87	5,008
	63	0.535	6,570	12,300	5.49	103	4.97	5,280
	63A	0.499	8,896	17,850	7.97	104	4.97	4,391
	64	0.529	3,191	6,030	2.69	...	...	...
	64A	0.469	2,770	5,900	2.63	...	...	...
Averages ...	...	...	10,940	4.88	...	...	...	
<i>Albizia odoratissima</i> , Benth.	89	0.554	8,635	15,610	6.97	129	4.93	4,461
	90	0.425	9,037	21,300	9.51	130	4.96	5,343
	91	0.552	8,782	15,950	7.12	131	4.95	6,990
Averages ...	...	...	17,620	7.87	...	...	...	
<i>Shorea talura</i> , Roxb.	65	0.607	5,792	9,530	4.25	105	4.98	5,200
	65A	0.482	4,068	8,430	3.77	106	4.96	3,876
	66	0.605	5,439	8,980	4.01	107	4.96	6,482
	66A	0.489	3,717	7,590	3.39	...	...	...
	67	0.611	3,280	5,365	2.40	...	...	...
	67A	0.504	3,721	7,380	3.30	...	...	...
Averages ...	...	...	7,880	3.52	...	...	...	

## II—(continued)

TESTS		DENSITY AND COMPRESSION TESTS							
BREAKING STRESS		Specimen No.	DENSITY	Specific gravity	Approximate size of specimen	Area in compression sq. in.	Crushing load lbs.	CRUSHING STRESS	
Lbs. per sq. in.	Tons per sq. in.		Lbs. per c. ft.					Lbs. per sq. in.	Tons per sq. in.
960	0.428	65	47.3	0.758	1½" × 1½" × 1½"	1.53	9,520	6,240	2.79
1,187	0.530	66	40.1	0.643	2" × 1" × 1"	1.00	6,244	6,244	2.79
723	0.323	...	...	...	...	...	...	...	...
957	0.427	...	43.7	0.700	...	...	...	6,242	2.79
952	0.425	37	44.5	0.713	2" × 1" × 1"	1.00	8,517	8,517	3.80
1,273	0.568	38	46.9	0.752	1" × 1" × 1"	1.00	8,820	8,820	3.94
1,006	0.450	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
1,077	0.481	...	45.7	0.732	...	...	...	8,668	3.87
1,203	0.537	41	55.5	0.889	2" × 1" × 1"	1.000	>10,170	>10,170	>4.55
1,030	0.460	42	55.6	0.890	1" × 1" × 1"	1.000	>10,170	>10,170	>4.55
1,064	0.475	...	...	...	...	...	...	...	...
882	0.394	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
1,045	0.466	...	55.5	0.889	...	...	...	>10,170	>4.55
903	0.403	67	56.0	0.897	1" × 1" × 1"	1.00	10,125	10,125	4.53
1,067	0.476	68	56.8	0.910	2" × 1" × 1"	1.00	>10,170	>10,170	>4.55
1,414	0.632	...	...	...	...	...	...	...	...
1,128	0.504	...	56.4	0.903	...	...	...	>10,150	>4.54
1,045	0.467	45	49.0	0.785	2½" × 1½" × 1½"	1.554	12,380	7,950	3.55
780	0.348	46	50.1	0.803	1½" × 1½" × 1½"	1.541	12,567	8,150	3.65
1,310	0.585	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
...	...	...	...	...	...	...	...	...	...
1,045	0.467	...	49.5	0.794	...	...	...	8,050	3.60

## SCHEDULE

WOOD	TENSION TESTS					SINGLE SHEAR		
	Ref. No. of Specimen	Area in tension sq. in.	Breaking load lbs.	BREAKING STRESS		Specimen No.	Area in shear sq. in.	Breaking load lbs.
				Lbs. per sq. in.	Tons per sq. in.			
<i>Bassia longifolia</i> , Linn.	41	0.782	4,700	5,880	2.63	81	4.90	8,791
	41A	0.511	2,130	4,160	1.86	82	4.84	5,660
	42	0.768	6,620	8,625	3.85	82A	4.68	3,630
	42A	0.509	2,247	4,410	1.97	83	...	...
	43	0.770	11,009	14,300	6.38	83A	4.70	3,563
	Averages ...	...	...	...	7,475	3.34	...	...
<i>Odina wodier</i> , Roxb.	71	0.593	5,803	9,780	4.36	111	4.98	4,062
	72	0.607	5,664	9,325	4.16	112	5.01	3,356
	73	0.605	5,050	8,330	3.72	113	4.96	3,898
	Averages ...	...	...	9,145	4.08	...	...	...
<i>Stereospermum xylocarpum</i> , Benth. and Hook. f.	50	0.571	5,388	9,420	4.20	90	4.92	4,827
	50A	0.529	5,600	10,600	4.74	91	4.93	5,034
	51	0.564	7,067	12,550	5.60	92	4.89	5,431
	52	0.582	6,245	10,740	4.80	...	...	...
	52A	0.511	6,545	12,820	5.72	...	...	...
	Averages ...	...	...	11,230	5.01	...	...	...
<i>Anogeissus latifolia</i> , Wall.	68	0.556	9,621	17,330	7.73	108	4.98	8,709
	69	0.501	>10,170	>20,300	>9.06	109	5.03	3,958
	70	0.567	7,749	13,680	6.10	110	5.00	8,348
	Averages ...	...	...	>17,100	>7.63	...	...	...
<i>Stephagyne parvifolia</i> , Korth.	74	0.550	7,440	13,550	6.05	114	4.88	6,686
	76	0.565	9,674	17,170	7.66	115	4.89	6,488
	...	...	...	...	...	116	4.88	6,768
	Averages ...	...	...	15,360	6.85	...	...	...



## II—(continued)

TESTS		DENSITY AND COMPRESSION TESTS								
BREAKING STRESS		Specimen No.	DENSITY	Specific gravity	Approximate size of specimen	Area in compression sq. in.	Crushing load lbs.	CRUSHING STRESS		
Lbs. per sq. in.	Tons per sq. in.		Lbs. per c. ft.					Lbs. per sq. in.	Tons per sq. in.	
1,796	0.802	3	63.7	1.021	1½" × 1½" × 1½"	1.517	12,550	8,270	3.69	
1,172	0.523	4	62.0	0.993	2½" × 1½" × 1½"	1.560	11,820	7,570	3.38	
775	0.346	...	...	...	...	...	...	...	...	
757	0.338	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	
1,125	0.502	...	62.8	1.007	...	...	...	7,920	3.53	
815	0.364	53	38.1	0.610	2½" × 1½" × 1½"	1.545	13,360	8,630	3.86	
669	0.299	54	38.9	0.623	1½" × 1½" × 1½"	1.524	11,730	7,695	3.44	
785	0.350	...	...	...	...	...	...	...	...	
756	0.338	...	38.5	0.616	...	...	...	8,162	3.65	
980	0.437	25	49.5	0.794	2½" × 1½" × 1½"	1.510	14,401	9,530	4.26	
1,022	0.457	26	46.9	0.752	1½" × 1½" × 1½"	1.520	14,221	9,350	4.17	
1,112	0.496	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	
...	...	...	...	...	...	...	...	...	...	
1,038	0.463	...	48.2	0.773	...	...	...	9,440	4.21	
1,752	0.782	49	67.7	1.087	2" × 1" × 1"	1.00	>10,170	>10,170	>4.55	
787	0.351	50	60.2	0.965	1" × 1" × 1"	1.00	8,650	8,650	3.86	
1,640	0.732	...	...	...	...	...	...	...	...	
1,393	0.622	...	63.9	1.026	...	...	...	>9,410	>4.20	
1,373	0.613	57	59.6	0.955	2" × 1" × 1"	1.00	8,873	8,873	3.96	
1,327	0.592	58	59.2	0.949	1" × 1" × 1"	1.00	8,140	8,140	3.63	
1,390	0.621	...	...	...	...	...	...	...	...	
1,363	0.609	...	59.4	0.952	...	...	...	8,506	3.79	

**SCHEDULE**

WOOD	TENSION TESTS					SINGLE SHEAR		
	Ref. No. of Specimen	Area in tension sq. in.	Breaking load lbs.	BREAKING STRESS		Specimen No.	Area in shear sq. in.	Breaking load lbs.
				Lbs. per sq. in.	Tons per sq. in.			
<i>Garuga pinnata</i> , Roxb.	77	0.625	2,252	3,600	1.61	117A	3.49	946
	78	0.743	4,231	5,690	2.54	118A	3.47	1,015
	79	0.633	5,862	9,250	4.13	119A	3.54	1,084
	Averages ...	...	...	6,180	2.76	...	...	...
<i>Bridelia retusa</i> , Spreng.	83	0.626	7,631	12,210	5.45	123	4.65	4,082
	84	0.632	7,030	11,140	4.98	124	4.75	4,585
	85	0.574	6,558	11,440	5.11	125	4.71	3,781
	Averages ...	...	...	11,600	5.18	...	...	...
<i>Tectona grandis</i> , Linn. fl.	92	0.547	6,264	11,460	5.11	132	4.99	3,975
	93	0.560	6,491	11,600	5.18	133	4.94	4,985
	94	0.555	6,086	10,980	4.90	134	4.96	5,859
	Averages ...	...	...	11,350	5.06	...	...	...
<i>Pterocarpus marsu-</i> <i>pium</i> , Roxb.	95	0.534	1,667	3,120	1.39	135	4.96	5,551
	96	0.562	4,216	7,500	3.35	136	5.00	3,272
	97	0.563	1,626	2,890	1.29	137	5.00	5,260
	Averages ...	...	...	4,500	2.01	...	...	...

## II—(continued)

TESTS		DENSITY AND COMPRESSION							
BREAKING STRESS		Specimen No.	DENSITY	Specific gravity	Approximate size of Specimen	Area in compression sq. in.	Crushing load lbs.	CRUSHING STRESS	
Lbs. per sq. in.	Tons per sq. in.		Lbs. per c. ft.					Lbs. per sq. in.	Tons per sq. in.
272	0.121	59	35.2	0.564	2½" × 1½" × 1½"	1.56	10,194	6,500	2.91
292	0.130	60	34.9	0.560	1½" × 1½" × 1½"	1.56	9,801	6,300	2.82
306	0.137	...	...	...	...	...	...	...	...
290	0.129	...	35.0	0.562	...	...	...	6,400	2.86
876	0.391	63	49.0	0.786	1" × 1" × 1"	1.00	7,717	7,717	3.44
964	0.430	64	49.6	0.796	2" × 1" × 1"	1.00	7,994	7,994	3.57
802	0.358	...	...	...	...	...	...	...	...
881	0.393	...	49.3	0.791	...	...	...	7,855	3.50
796	0.355	69	47.8	0.766	1" × 1" × 1"	1.00	8,534	8,534	3.81
1,011	0.452	70	46.3	0.742	2" × 1" × 1"	1.00	7,433	7,433	3.32
1,183	0.528	...	...	...	...	...	...	...	...
997	0.445	...	47.0	0.754	...	...	...	7,983	3.56
1,120	0.500	71	49.2	0.788	1" × 1" × 1"	1.00	8,483	8,483	3.79
653	0.292	72	48.8	0.782	2" × 1" × 1"	1.00	8,254	8,254	3.69
1,052	0.470	...	...	...	...	...	...	...	...
942	0.421	...	49.0	0.785	...	...	...	8,368	3.74

### SCHEDULE III.

WOOD	Density lbs. per c. ft.	Specific gravity	TRANSVERSE TESTS			BREAKING STRESSES		
			Young's Modulus	Elastic limit	Modulus of rupture	Tension	Compression	Shear
			Tons per sq. in.	Tons per sq. in.	Tons per sq. in.	Tons per sq. in.	Tons per sq. in.	Tons per sq. in.
			1	2	3	4	5	6
<i>Poeciloneuron indicum</i> , Bedd. ...	66.1	1.06	915	4.56	6.70	4.17	4.29	0.806
<i>Holigarna arnottiana</i> , Hook. ...	41.7	0.668	781	3.81	4.91	3.93	4.02	0.451
<i>Dalbergia latifolia</i> , Roxb. ...	49.2	0.788	612	4.03	5.70	4.01	4.20	0.590
<i>Terminalia paniculata</i> , Roth. ...	51.9	0.831	749	4.44	6.77	6.03	3.74	0.433
<i>Terminalia paniculata</i> , Roth. ...	52.1	0.836	745	3.87	6.38	6.04	3.31	0.377
<i>Terminalia paniculata</i> , Roth. ...	43.7	0.700	540	3.21	4.58	5.64	2.79	0.427
<i>Cornus macrophylla</i> , Wall. ...	45.7	0.732	821	5.45	6.85	6.90	3.87	0.481
<i>Albizzia odoratissima</i> , Benth. ...	55.5	0.889	804	5.27	6.94	4.88	∇ 4.55	0.466
<i>Albizzia odoratissima</i> , Benth. ...	56.4	0.903	964	6.53	8.11	7.87	∇ 4.54	0.504
<i>Shorea tatora</i> , Roxb. ...	49.5	0.794	710	3.98	5.09	3.52	3.60	0.467
<i>Bassia longifolia</i> , Linn. ...	62.8	1.007	...	...	3.59	3.34	3.53	0.502
<i>Odina wodier</i> , Roxb. ...	38.5	0.616	589	4.13	5.53	4.08	3.65	0.338
<i>Stereospermum xylocarpum</i> , Benth and Hook. f. ...	48.2	0.773	643	3.26	5.24	5.01	4.21	0.463
<i>Anogeissus latifolia</i> , Wall. ...	63.9	1.026	987	5.04	8.36	∇ 7.63	∇ 4.20	0.622
<i>Stephegyne parvifolia</i> , Korth. ...	59.4	0.952	920	5.05	8.12	6.85	3.79	0.609
<i>Garuga pinnata</i> , Roxb. ...	35.0	0.562	415	2.21	3.32	2.76	2.86	0.129
<i>Bridelia retusa</i> , Spreng ...	49.3	0.791	692	2.56	5.00	5.18	3.50	0.393
<i>Tectona grandis</i> , Linn. fil ...	47.0	0.754	741	4.38	5.75	5.06	3.56	0.445
<i>Pterocarpus marsupium</i> , Roxb. ...	49.0	0.785	518	2.67	3.58	2.01	3.74	0.421