In all tests of large beams it was decided to apply the loads at two points equidistant from the centre of the length of the beam, in preference to the more usual way adopted in tests of timber where the load is applied at the centre. The method adopted in this series has many advantages over the more usual method, as a constant bending moment and extreme fibre stress is produced between the points of application of the load over the central portion of the beam along which the deformation produced by the load were determined; also, the method approaches more nearly to the conditions existing in the practical use of timber. It was originally intended to test all these beams with the loads applied so as to divide the span into three equal parts, each 40 inches long, as shown in Figs. 10 and 11, and the tests made on this plan are denoted in Tables 2 and 3 thus.* Figs. 12 and 13 show the spacing of the loads afterwards decided upon where the points of application of the loads are 10 inches from the centre of the beam, giving 20 inches between the points of application of the loads. The change was made in consequence of some of the beams failing by horizontal shearing stress producing splitting at the ends before the direct tensile and compressive stresses were fully developed. In all such cases of failure the actual strength of the timber, recorded in Tables 2 and 3, in the columns headed "Modulus of Rupture," is understated.

These tables show that the failure by horizontal shear is due to defects in the timber beams tested. With the exception of the values of the modulus of rupture obtained from these defective beams, the results obtained are valuable; but it is clearly necessary to provide against the possibility of shear failure by adopting suitable proportions of depth to span in practice.

From the sound portions of the large beams after testing smaller beams were cut of similar geometrical form. From each large beam 16 small beams were obtained, each 2 in. by 2 in. cross-section, and some of these beams were tested on a span of 24 inches, the remainder were reserved for future tests by a suddenly applied load. Fig. 14 shows the method of cutting these specimens from the beam, and from the large

FIG. 10.

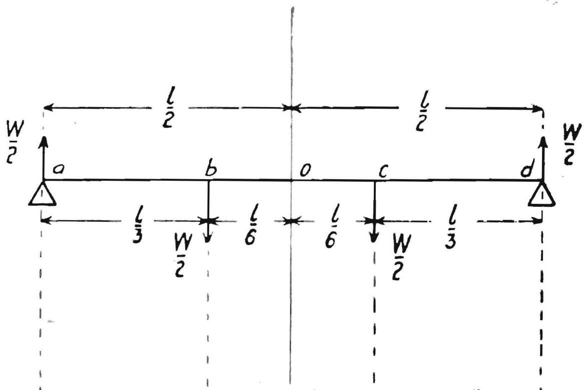
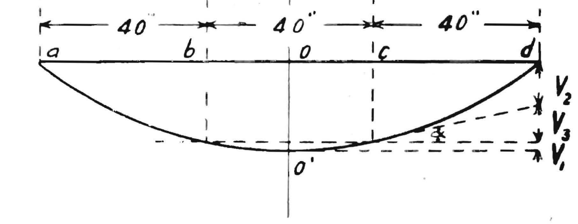


FIG 11.



Total Deflection = $\Delta = V_1 + V_2 + V_3$

FIG. 12.

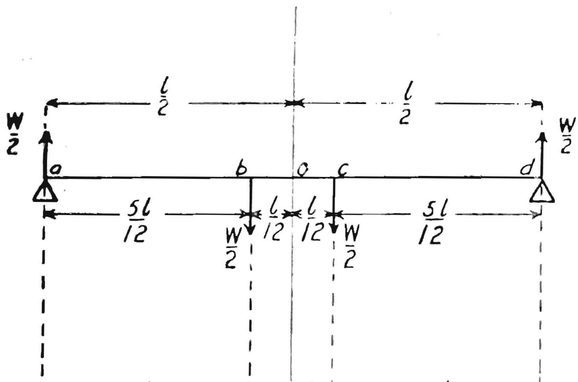
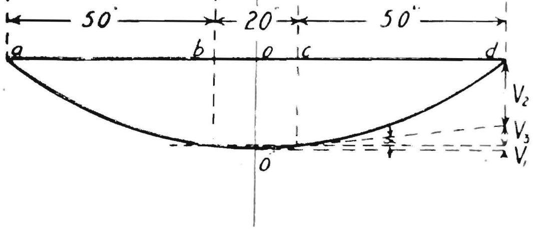


FIG. 13.



Total Deflection = $\Delta = V_1 + V_2 + V_3$

beam 4 beams were also cut, 4 in. by 4 in. cross-section, for testing on a span of 48 in. (Fig. 15). It will be noted that the large and the small beams are of square cross-section, and that in every case the span is twelve times the size of the square, or strictly in accordance with the law of similarity as to the form and dimensions of the test-pieces, but all these small beams have been loaded at the centre, as the object was to find the relationship of the strength and elasticity to the percentage of moisture. Fig. 16 shows the manner of splitting the sections of the large beam for convenience in drying in order to determine the percentage of moisture.

The method of obtaining some of the figures recorded in Tables 2 and 3 requires explanation, thus:—

Weight per Cubic Foot.—Each large beam was carefully measured and weighed before testing, and the moisture was determined immediately afterwards by cutting discs near the point of fracture, weighing and drying in a special oven. In the case of Blackbutt, Table 2, the weight per cubic foot is given at 60.7 lb., and the moisture at 31.7 per cent. after seasoning for 558 days stacked under cover. If the timber had been seasoned long enough to reduce the moisture to 15 per cent. the weight per cubic foot would have been reduced to 53 lb. The loss of weight during seasoning depends upon the size of the piece, but the weight per cubic foot of any timber depends entirely upon the percentage of moisture. All the timber tested and recorded in the tables had been seasoned for a considerable time, but the moisture present was much in excess of 15 per cent., as these large beams take a long time to dry.

Breaking Load and Modulus of Rupture.—The total load necessary to produce rupture of the beam is a measure of its strength, but the strength of the timber to resist the effect of loads causing deflection and rupture is much better expressed by the term "Modulus of Rupture."

The modulus of rupture is determined in the following manner, Figs. 10 and 11.

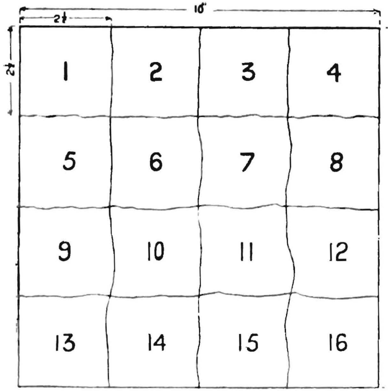


FIG. 16.

Showing method of cutting disc for determination of moisture.

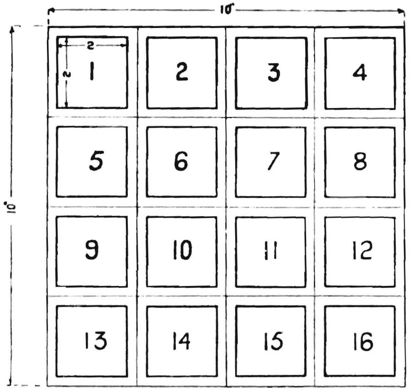


FIG. 14.

Showing method of cutting out 2in. x 2in. beams.

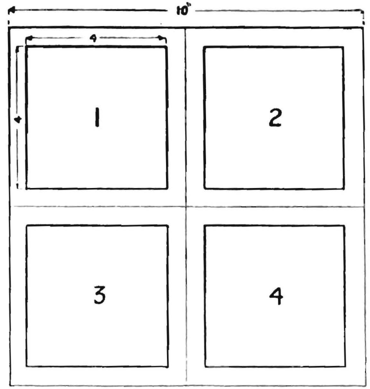


FIG. 15.

Showing method of cutting out 4in. x 4in. beams.

The bending moment is constant over the central length of 40 inches, where its value is:—

$$\frac{W}{2} \times \frac{l}{3} = \frac{W\,l}{6}$$

Where W denotes the total load applied and l the span, since l is always 120 inches, the bending moment is 20 W inch pounds or inch tons according to the method of expressing W. The moment of resistance of the cross-section of the beam is:—

$$\frac{bd^2f}{6}$$

Where b = the breadth, d = the depth of the beam, and f the modulus of rupture. Therefore:—

$$\frac{W\,l}{6} = 20\text{ W} = \frac{bd^2f}{6}$$

$$\therefore f = \frac{120\text{ W}}{bd^2}$$

In the case of the beams tested as indicated in Figs. 12 and 13, the bending moment is:—

$$\frac{5\,W\,l}{24} = 25\text{ W}$$

$$\text{and } f = \frac{150\text{ W}}{bd^2}$$

In the case of Blackbutt, Table 2, b = 9.8″, d = 9.9″, and W = 18 tons or 40,320 pounds, so that:—

$$f = \frac{120 \times 40{,}320}{9.8 \times 9.9 \times 9.9} = 5{,}060 \text{ pounds per square inch.}$$

In a similar manner all the figures in the column headed, "Modulus of Rupture," have been found.

Horizontal Shearing Stress.—It can easily be shown that the value of the horizontal shearing stress denoted by S_h is equal to:—

$$S_h = \frac{\cdot 75\text{ W}}{bd}$$

In the case of Blackbutt 1 F, Table 2:—

$$S_h = \frac{75 \times 40.320}{9.8 \times 9.9} = 318 \text{ pounds per square inch.}$$

In a similar manner all the figures in the column headed "Horizontal Shearing Stress" have been found.

Limit of Proportionality.—The limit of proportionality is the greatest load up to which the deflections are proportional to the loads producing them, and was found in the tests of the large beams by measuring the deflections for equal increments of loads and plotting the results, or by means of the autographic stress-strain diagram recorder. In the diagram obtained by plotting, or autographically, it is easily seen where the straight line passes into a curve, which is generally at about one-half of the load producing fracture. If we denote the load at the limit of proportionality by P, the stress per square inch at the extreme fibres of the beam in the central portion is:—

$$\frac{fP}{W}$$

In Grey Ironbark, 4 F (2), Table 2, the value of P is 20 tons, and of W, 34 tons, also the value of f is 12,000 pounds per square inch, so that, at the limit of proportionality, the stress at the extreme fibre is:—

$$\frac{12{,}000 \times 20}{34} = 7{,}059 \text{ pounds per square inch.}$$

Modulus of Elasticity.—The modulus of elasticity is determined from the loads and deflections produced by them within the limit of proportionality. If we denote this by E we can find its value in the beam loaded as in Figs. 10 to 13 in the following manner:—The deflection produced by the load applied may be divided into three parts V^1, V_2, and V_3, as indicated in Figs. 11 and 13, where the total deflection denoted by $\triangle$ is:—

$$\triangle = V_1 + V_2 + V_3,$$

and the value of the modulus in the beam loaded, as in Figs. 10 and 11, may be shown to be:—

$$E = \frac{W\,l^3}{4.7\ \triangle\ bd^3}$$

The value of the modulus, when loaded as in Figs. 12 and 13, may also be shown to be:—

$$E = \frac{W\,l^3}{4.16\ \triangle\ bd^3}$$

In Grey Ironbark, 4 F_2, Table 2, the deflection obtained with a total load of 10 tons was 0.345 in., and at the limit of proportionality, 20 tons, it was 0.71 in. Taking the load as 10 tons, or 22,400 lb., l = 120, b = 9.9, and d = 9.8, we have—

$$E = \frac{22{,}400 \times \overline{120}^3}{4.16 \times 0.345 \times 9.9 \times \overline{9.8}^3} = 2{,}880{,}000 \text{ pounds per sq. inch}$$

In the columns next on the right in Table 2, the modulus of elasticity has been determined from the measured extension at the extreme fibres in tension between the points of application of the loads. The recorded extension with a load of 10 tons is 0.42 in. over 20 in., or 0.0021 in. per ton per inch. The extreme fibre stress producing this extension is found as follows:—

$$\text{Bending moment} = 5 \times 50 \times 2240 = 560{,}000 \text{ inch pounds.}$$

$$\text{Moment of Resistance} = \frac{9\,9 \times \overline{9.8}^2}{6} f = 158 f.$$

$$\therefore f = \frac{560{,}000}{158} = 3{,}544 \text{ pounds per square inch.}$$

$$E = \frac{f}{\lambda} = \frac{3{,}544}{0.0021} = 1{,}700{,}000 \text{ pounds per square inch.}$$

It will be observed in Tables 2 and 3, that the values of the modulus of elasticity, obtained in this way, are always less than those obtained from the deflections. This is due to the deflection being produced by the direct and shearing stresses combined, whereas the extreme fibre stresses and extensions are not affected by the shearing stresses, as the shearing stress is zero over the central portion of the beam. In the equation for the deflection, the shearing stress was neglected, as it would only account for about $\frac{1}{35}$ of the total deflection measured. Again, the extreme fibre stresses and extensions are a maximum, and they diminish uniformly towards the neutral axis, where they are zero. The deflection, on the other hand, is due to the yielding of the beam throughout the whole of the depth in the cross-sections, due to the direct and shearing stresses developed in bending under the action of the external loads, and these deformations, in the aggregate, are necessarily smaller than those developed at the extreme fibres, so that the coefficient of elasticity, or modulus, must always be greater when determined from the deflections than from the extreme fibre extensions. The values of the extreme fibre extensions, and also of the deflections, have been carefully determined for the various loads applied, and these have been recorded in Tables 2 and 3. The diagrammatic representation of the cross-section of the beam indicate the direction of the annual rings, and the manner in which the beam has been cut relatively to the cross-section of the tree trunk.

Moment of Resilience.—The term resilience is used to express the work done in producing a given state of strain in a body. In a beam loaded and deflected, the work done in producing the deflection is termed the resilience. If the loads and deflections produced by them are within the limit of proportionality, the work done is termed the elastic resilience, and is capable of being determined by calculation. It can be shown that the resilience due to bending in a beam is:—

$$Ri = \int \frac{M^2}{2\,E\,1}\,dl,$$

where M denotes the bending moment, I, the moment of inertia of the cross-section of the beam, and E the coefficient of elasticity.

The resilience due to the action of the shearing stresses need not be considered in this case, as the moment of resilience would only be increased by a small amount in the second place of decimals.

The figures in the column headed "Moment of Resilience" are found as follows:—

In the case of Ironbark, 4 F_3, Table 2, the total elastic resilience up to the limit of proportionality corresponding with a load of 20 tons, and a deflection of 0.71 inch, is:—

$$Ri = 0.482\ W \triangle = 0.482 \times 20 \times 2{,}240 \times 0.71 = 15{,}332 \text{ in. lbs}$$

And the moment of resilience is:—

$$M.\,Ri = \frac{0.482\ W \triangle}{lbd} = \frac{15{,}332}{120 \times 9.9 \times 9.8} = 1.3 \text{ in. lbs. per cubic in}$$

In a similar manner the other figures in the column may be found. The results are very varied and depend upon the value of the load at the limit of proportionality and the corresponding deflection. In the case of Turpentine, 8 F_2, Table 2, the limit of proportionality is 20, but the deflection is 1.175 inch, giving the value of M.R*i* as 2.18.

Tests of Beams 4 x 4 *inches, Cross-section.*—These beams were cut from the sound portions of the 10 x 10 inch beams after they had been tested in the manner shown in Fig. 15. The 4 x 4 inch beams were tested on a span of 48 inches, and the results obtained have been summarised as much as possible in Table 4. The column headed "Modulus of Rupture" was calculated from the equation:—

$$f = \frac{72\ W}{bd^2}$$

Where W is the load producing rupture, b the breadth, and d the depth of the beam. The beams varied to some extent in the dimensions of the cross-section, but the average value of f is tabulated—

$$\text{If } b = d = 4, \text{ then } f = \frac{9\ W}{8}$$

The column headed "Modulus of Elasticity" was calculated from the equation—

$$E = \frac{Wl^3}{48\ E\ I} = \frac{27{,}648\ W}{bd^3 V}$$

$$\text{If } b = d = 4'', \text{ then } E = \frac{108\ W}{V}$$

In this case W is the load producing the deflection V, within the elastic limit. As before, the average value of the results is tabulated.

The column headed, "Moment of Resilience," was calculated from the equation:—

$$Ri = \frac{Wv}{96\ bd}$$

Where W is the load producing the deflection v at the limit of proportionality.

$$\text{If } b = d = 4 \text{ in., } Ri = \frac{Wv}{1{,}536}$$

The columns headed "Range of Moisture" and "Average Moisture" need no explanation.

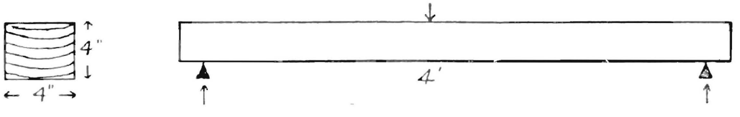
Table 4.—Transverse Tests of 4-inch Beams.
NORTH COAST TIMBERS.

Local Name.	Number and Letter of corresponding 10-inch beam.	Number of Specimens Tested.	Moisture. per cent.	Average Values.				
				Moisture, per cent.	Modulus of Elasticity. lbs. per Square Inch.	Modulus of Rupture lbs. per Square Inch.	Moment of Resilience, inch lbs. per Cubic Inch.	Breaking Load. lbs.
Blackbutt	1 F (2)	2	16.8 to 18.1	17.4	2.24×10^6	17,000	3.58	14,150
	1 F (3)	4	20.2 to 25.4	22.1	2.01×10^6	14,900	3.18	13,200
Tallow-wood ...	2 F (1)	2	17.0 to 17.5	17.2	2.14×10^6	17,100	3.78	14,300
	2 F (2)	2	17.7 to 17.9	17.8	2.61×10^6	18,100	3.40	15,100
	2 F (3)	3	25.8 to 34.6	29.5	2.36×10^6	16,600	3.58	14,400
	2 F (3)	1	23.0	23.0	2.36×10^6	12,300	1.96	11,000
Grey Gum	3 F (1)	4	17.7 to 18.9	18.7	2.28×10^6	18,600	3.60	15,300
	3 F (3)	3	22.5 to 23.9	23.3	2.27×10^6	15,600	3.10	14,100
Grey Ironbark ..	4 F (2)	4	14.0 to 18.0	15.9	2.49×10^6	17,900	3.61	15,100
	4 F (3)	3	21.3 to 26.2	23.4	2.50×10^6	17,600	3.79	15,400
Blue Gum	6 F (1)	3	17.8 to 18.0	17.9	1.92×10^6	16,200	3.37	13,500
	6 F (4)	4	23.6 to 25.4	24.3	1.86×10^6	14,300	3.08	13,000
Brush Box	7 F (1)	4	18.3 to 24.0	21.2	1.79×10^6	15,000	2.82	12,000
Turpentine	8 F (1)	2	16.6 to 16.9	16.8	2.28×10^6	17,200	2.21	13,600
	8 F (2)	2	17.2 to 17.4	17.3	1.67×10^6	14,200	3.15	12,400
	8 F (4)	4	20.3 to 25.3	23.4	1.96×10^6	14,700	2.69	12,470
Red Mahogany ..	9 F (1)	3	16.6 to 17.6	17.0	2.25×10^6	18,100	4.25	14,800
	9 F (4)	2	23.1 to 23.7	23.4	2.12×10^6	15,600	3.00	13,100
White Mahogany	10 F (2)	4	16.5 to 18.2	17.5	1.93×10^6	15,400	3.66	12,700
	10 F (3)	4	30.2 to 34.4	31.6	1.54×10^6	10,500	2.28	9,600
Colonial Teak ..	11 F (1)	3	14.1 to 14.5	14.3	1.54×10^6	10,900	2.22	9,500
	11 F (4)	3	16.8 to 22.2	19.3	1.31×10^6	10,000	2.53	9,200
	11 F (2)	1	14.0	14.0	1.68×10^6	9,500	0.98	8,200

Table 4 *(continued)*. Transverse Tests of 4-inch Beams.
SOUTH COAST TIMBERS.

Local Name.	Number and Letter of corresponding 10-inch beam.	Number of Specimens Tested.	Moisture, per cent.	Average Values.				
				Moisture, per cent.	Modulus of Elasticity. lbs. per Square Inch.	Modulus of Rupture lbs. per Square Inch.	Moment of Resilience, inch lbs. per Cubic Inch.	Breaking Load. lbs.
Grey Box	12 F (2)	3	17.4 to 18.5	18.0	2.82×10^6	19,300	3.39	16,100
	12 F (1)	1	17.3	17.3	2.51×10^6	19,700	5.33	16,500
	12 F (3)	1	22.7	22.7	2.47×10^6	18,150	4.09	16,200
	12 F (4)	2	23.0 to 23.2	23.1	2.74×10^6	16,400	3.00	14,900
Woollybutt	13 F (1)	4	17.6 to 19.9	18.6	2.73×10^6	19,400	3.80	15,900
	13 F (4)	1	23.9	23.9	2.14×10^6	15,600	2.74	13,600
	13 F (4)	3	29.5 to 34.3	31.4	1.66×10^6	12,100	3.02	11,200
Spotted Gum ...	14 F (2)	2	22.0 to 24.0	23.0	1.94×10^6	12,200	1.33	10,700
	14 F (4)	2	28.5 to 35.6	32.0	1.58×10^6	10,980	2.10	9,050
Turpentine	15 F (2)	3	16.1 to 18.9	17.3	1.95×10^6	13,600	2.73	10,200
Blackbutt	16 F (1)	2	18.3 to 19.1	18.7	2.35×10^6	15,100	3.90	12,100
	16 F (2)	2	17.6 to 18.2	17.9	2.33×10^6	17,700	3.64	14,400
Mountain Ash ..	17 F (1)	3	17.1 to 18.5	17.7	2.29×10^6	17,800	4.03	14,900
	17 F (2)	1	17.1	17.1	2.20×10^6	15,000	2.18	13,500
	17 F (3)	4	19.7 to 22.0	21.0	2.12×10^6	13,500	2.75	11,700
W. Stringy-bark	18 F (1)	1	18.3	18.3	2.25×10^6	17,200	2.98	13,800
	18 F (2)	4	18.2 to 19.2	18.6	2.04×10^6	16,300	3.32	14,100
	18 F (3)	1	34.7	34.7	2.25×10^6	17,200	4.15	14,600
	18 F (4)	1	29.6 to 31.9	30.3	2.09×10^6	13,600	1.66	12,300

All beams approximately 4in. by 4in., tested on a span of 48in., the annual rings parallel with length of beams.



It will be observed that the results are greater in the column headed "Modulus of Rupture," showing that the timber is relatively stronger when tested in smaller sizes, owing to the fact that the proportion of defective timber is less. This result has been observed in all tests of timber. It will also be noted that the column headed "Modulus of Elasticity" gives results approximately the same as those obtained from the 10 in. x 10 in. beams, showing that the stiffness of the beam within the limit of proportionality, or elastic limit, is not affected in a similar manner. This is probably due to the fact that the loads producing the small strains observed were not sufficient to develop the defects in the larger beams to the same extent as the loads producing fracture. Fig 17 shows one of these beams in the testing machine, and illustrates the method of testing.

Fig. 18 shows four of these beams photographed after testing, from which it will be seen that 4 F_2 and 16 F_1 failed by horizontal shear at the ends.

Tests of Beams 2 in. x 2 in. x 24 in. span.—These beams were cut from the sound portions of the 10 in. x 10 in. beams after testing, and they were loaded in the centre in a similar manner to the 4 in. x 4 in. beams, but were tested in a horizontal testing machine.

The object of these tests was to determine the relationship between the moisture percentage and the strength of the beams, also the relationship between the moisture and the stiffness of the beams.

A large number of specimens having various percentages of moisture were necessary in these tests; the beams nearer the centre had the greatest percentage of moisture.

The results obtained have been summarised as much as possible in Plate V. It will be observed that both the strength and elasticity increase with the dryness of the timber, but that the rate varies in different timbers. Fig. 19 shows some of the beams as they appeared after testing, also the mode of fracture.

TENSILE TESTS.

The tensile strength of timber has been determined in all comprehensive investigations in regard to the strength of timber made in Europe and in United States, America,

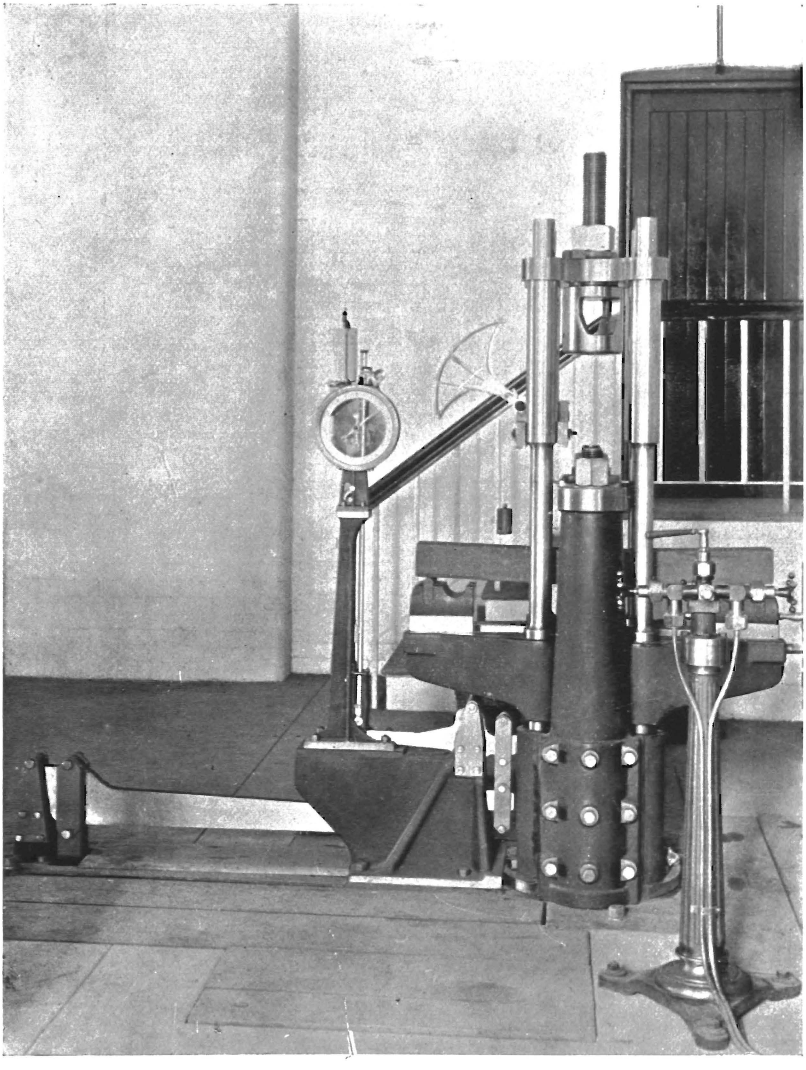


FIG. 17.

FIG. 18.

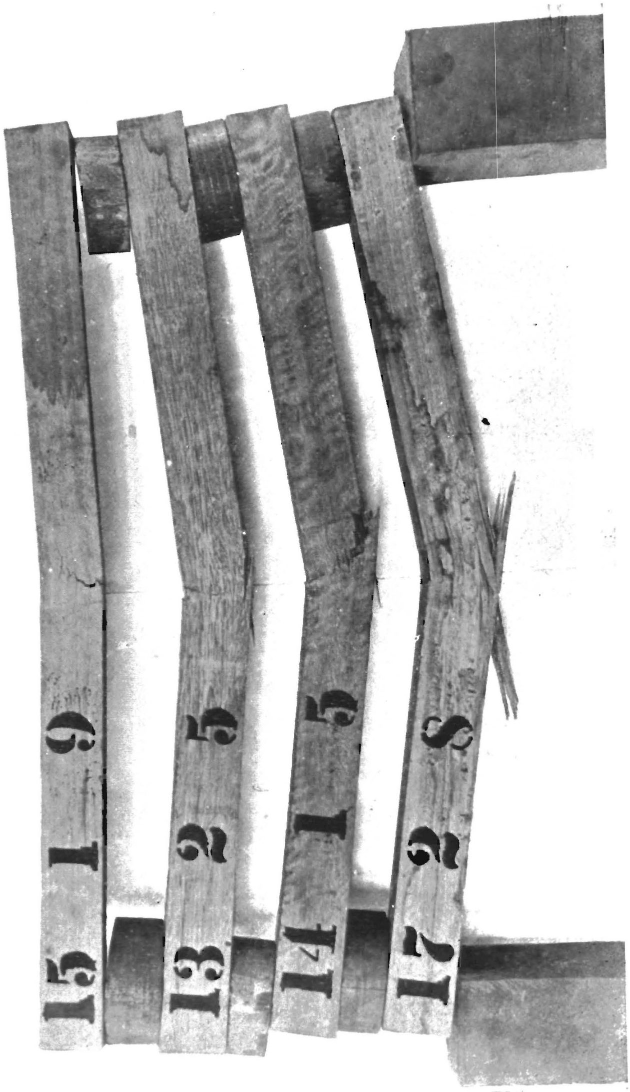


FIG. 19.

as it is of scientific importance. From a practical point of view it is of secondary importance, as in timber structures the members in tension are jointed at their ends to the other members of the structure, and the weakest point is the joint and its connections, subjected to shearing stress. Timber is stronger in tension than in compression, and enormously stronger in tension than in shear, as will be at once appreciated by comparing the results obtained in Tables 5, 6 and 7. For these reasons it is difficult to make tension tests, as the head and shoulders of the test piece must be stronger than the portion subjected to a pure tensile stress, and moreover the stress must be applied accurately along the axis of the test piece to avoid the effect of transverse stresses. The method of making accurate tensile tests was investigated in the 1892 series, and the proportions and dimensions used in this series are shown upon the test sheet, Table 5. Fig. 20 shows the test piece in the machine with the extensometer attached to it, arranged to record the extensions between the gauge points 8 inches apart. The area of the cross-section of the parallel portion, over which the elongations were measured, is 1.23 sq. in., and the tensile strength is the total breaking load applied divided by this area, thus for Tallow-wood 2D, the breaking load is 11.75 tons, and the tensile strength is:—

$$\sigma_t = \frac{11.75 \times 2{,}240}{1.23} = 21{,}400 \text{ pounds per square inch.}$$

In regard to the results recorded in Table 5, it will be observed that the tensile strength is much greater than the compressive strength, and that the Grey Ironbark is not exceptionally strong in this series, although in the 1892 test it reached 25,000 lb. per sq. in., due probably to the more favourable conditions affecting its growth, and to the fact that the specimens tested were of sounder timber more free from defects.

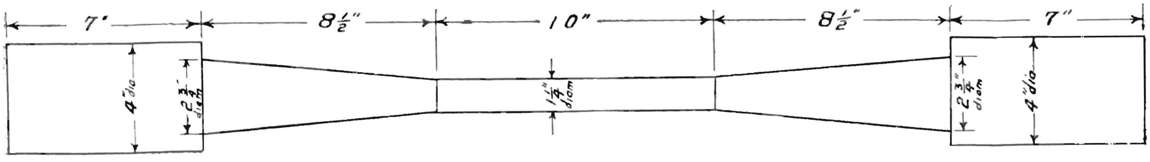
The extensions per ton, obtained from the differences between the extensions produced by loads within the limit of proportionality, were for Grey Ironbark 0.005 inch on a length of 8 inches, giving a coefficient, or modulus of elasticity, of:—

$$\frac{\sigma}{\lambda} = \frac{2{,}240 \times 8}{1.23 \times 0{\cdot}005} = 2{,}912{,}000 \text{ pounds per square inch,}$$

Table 5.—New South Wales Timbers. Tension Tests.

Local Name.	Number and Letter.	Number of Days Seasoning.	Moisture percentage.	Breaking Load. Tons.	Breaking Load. Lbs. per sq. inch.	Apparent limit of Proportionality. Tons.	Modulus of Elasticity.	Extension in inches x 2. On 8 inches.										
								1 ton.	2 tons.	3 tons.	4 tons.	5 tons.	6 tons.	7 tons.	8 tons.	9 tons.	10 tons.	11 tons.
Blackbutt	1 D	692	11.8	10.9	19,850	3	4,282,000	.0008	.0039	.0075	.0122	.0179	.0234	.0287	.0343	.0400	.0480	..
	1 H	692	12.7	8.85	16,120	3	4,282,000	.0020	.0053	.0087	.0132	.0173	.0215	.0262	.0309	..	..	..
Tallow-wood	2 D	800	13.3	11.75	21,400	5	5,600,000	.0010	.0037	.0057	.0085	.0107	.0160	.0205	.0254	.0297	.0384	.0441
	2 H	800	16.4	11.6	21,120	6	3,165,000	.0110	.0165	.0215	.0255	.0295	.0335	.0385	.0445	..	..	..
Grey Gum	3 D	650	17.0	8.03	14,620	3	3,832,000	.0077	.0116	.0152	.0211	.0272	.0328	.0386	.0459	..	..	..
	3 H	651	13.2	8.25	15,020	2.5	4,282,000	.0042	.0077	.0118	.0167	.0218	.0275	0325	..	..	..	..
Grey Ironbark.. ..	4 D	646	13.2	7.55	13,750	4.5	2,912,000	.0060	.0110	.0160	.0210	0265	.0340	.0390	..	..	..	..
	4 H	665	13.3	6.3	11,470	3.5	3,309,000	.0022	.0063	.0108	.0159	.0230	.0311	..	..	..	..	..
Blue Gum	6 D	725	13.1	9.0	16,390	4.5	4,550,000	.0025	.0040	.0069	.0112	.0162	.0223	.0297	.0372	..	..	..
	6 H	700	11.9	13.25	24,130	Indeterminate.	2,510,000	.0075	.0140	.0205	.0275	.0340	.0400	.0460	.0510	.0565	.0620	.0695
Brush Box	7 D	686	12.3	8.5	15,480	Indeterminate.	2,427,000	.0057	.0116	'0173	.0230	.0291	.0358	.0427	.0498	..	..	..
	7 H	686	12.4	6.3	11,470	2	3,309,000	.0030	.0073	.0134	.0205	.0287	.0380	..	..	..	..	..
Turpentine	8 D	636	13.3	8.17	14,880	3	3,640,000	.0044	.0080	.0123	.0182	.0255	.0328	.0399	.0468	..	..	..
	8 H	668	12.3	7.5	13,660	3	2,800,000	.0053	.0098	.0150	.0209	.0272	.0335	.0407	..	..	..	..
Red Mahogany ..	9 D	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	9 H	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
White Mahogany	10 D	671	12.3	6.75	12,290	2	3,832,000	.0037	.0069	.0113	.0152	.0219	.0276	..	..	..	..	..
	10 H	671	11.8	4.8	8,740	2.5	2,696,000	.0075	.0130	.0199	.0278	..	..	..	..	..	..	..
Colonial Teak ..	11 D	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	11 H	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Grey Box	12 D	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	12 H	458	12.9	11.55	21,030	4	4,282,000	.0047	.0077	.0112	.0152	.0199	.0252	0311	.0370	.0427	.0482	.0541
Woolly Butt	13 D	484	15.3	10.5	19,120	3.5	5,200,000	.0037	.0063	.0091	.0124	.0159	.0207	0262	.0317	.0376	.0541	..
	13 H	484	11.1	12.8	23,310	Indeterminate.	3,832,000	.0049	.0081	.0104	.0140	.0183	.0222	0268	.0317	.0372	.0429	.0482
Spotted Gum	14 D	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	14 H	514	13.5	8.0	14,570	2.5	4,282,000	.0012	.0030	.0069	.0118	.0177	.0236	0301	..	..	..	..
Turpentine	15 D	419	21.4	8.3	15,120	4	1,867,000	.0040	.0110	.0195	.0275	.0385	.0485	0565	.0675	..	..	..
	15 H	416	15.3	5.3	9,650	3	2,696,000	.0065	.0120	.0180	.0250	.0330	..	..	..	..	..	..
Black Butt..	16 D	458	..	7.5	13,660	Indeterminate	2,510,000	.0070	.0125	.0185	.0245	.0300	.0365	.0430	..	..	..	..
	16 H	456	13.2	8.25	15,020	3	3,470,000	.0067	.0105	.0150	.0195	.0250	.0300	.0350	.0400	..	..	..
Mountain Ash ..	17 D	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	17 H	460	15.8	7.65	13,930	5	4,853,000	.0031	.0059	.0090	.0123	.0156	.0206	.0266	..	..	..	..
Stringy Bark	18 D	448	13.3	6.3	11,470	3.5	2,427,000	.0065	.0124	.0183	.0248	.0331	.0408	..	..	..	..	..
	18 H	423	16.5	7.15	13,020	Indeterminate.	2,022,000	.0110	.0180	.0255	.0325	.0410	.0490	.0580	..	..	..	..

Length of pieces under test = 8 inches. Area of pieces under test = 1·23 square inches.



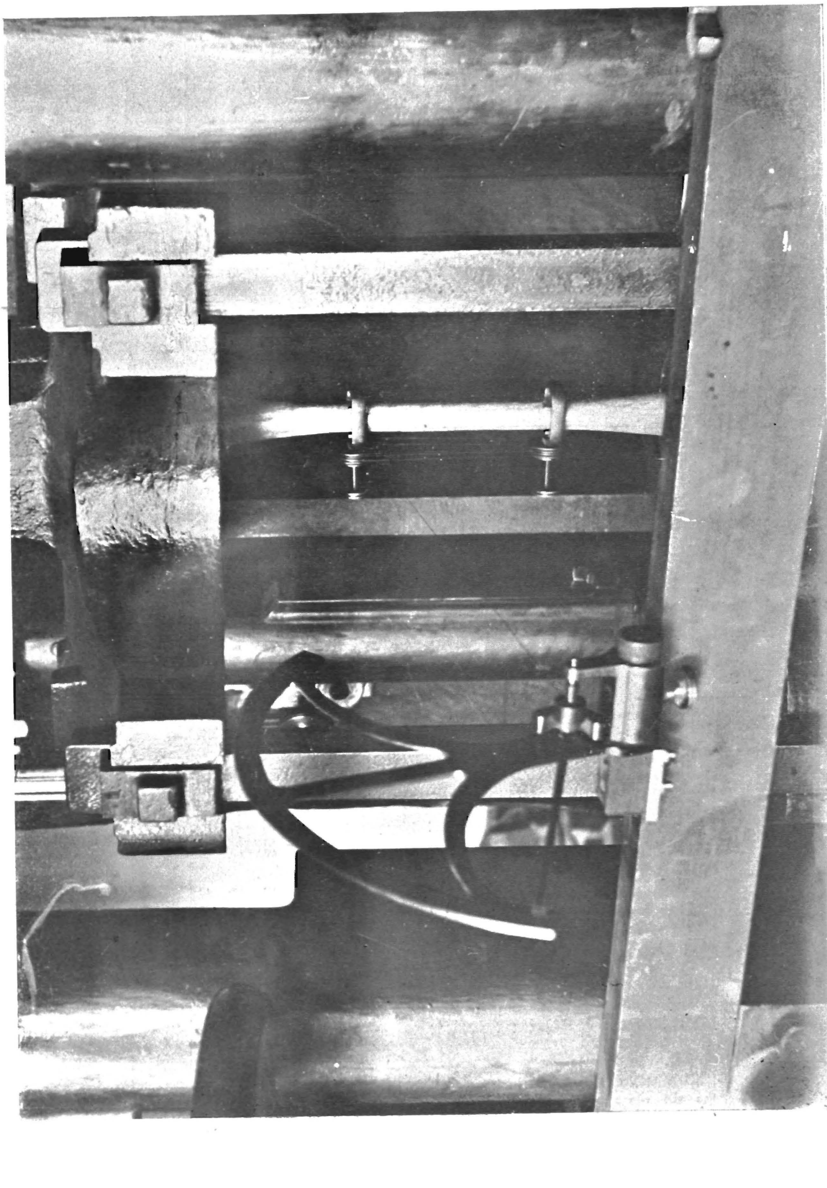


FIG. 20.

Much larger values were obtained for some of the other timbers.

The nature of the fractures obtained from several of the timbers tested are shown in the photograph, Fig. 21.

THE INFLUENCE OF THE CONDITIONS UNDER WHICH THE TESTS WERE MADE ON THE RESULTS.

The conditions which influence the results obtained in testing timber are as follows:—

a. The percentage of moisture contained.

b. The temperature of the laboratory.

c. The speed of testing.

Moisture.—In every test recorded in this series, the percentage of moisture was determined by cutting discs from the test piece by means of sharp saws, as near as possible to the section where failure occurred. In the case of the beams 10 in. x 10 in. the pieces were cut in the manner shown in Fig. 16, in the other tests one disc was cut near the point of fracture. The disc is weighed, dried in a special oven, kept at a constant temperature of 212° F., until it ceases to lose weight by further drying, and re-weighed. The moisture contained is expressed in per cent. of the dry weight of the timber.

Temperature.—The variations in the temperature of the laboratory and the rooms where the timber was stored varied from 45° F. to 90° F., and certainly the range was never greater than expressed by these extreme limits of temperature. So that the effect of temperature on the results was not considered, although in countries where the limits are much greater, a slight increase in strength has been found from the lowest to the highest temperature.

Speed of Testing.—The strength of timber is influenced by the rate of speed at which the stress is applied. The stresses produce strains, or deformations of various kinds, such as deflections, elongations, or shortenings of the fibre of the timber, the amount of which depends upon the time rate allowed for these deformations to be developed. If a beam is loaded a deflection is produced which gradually

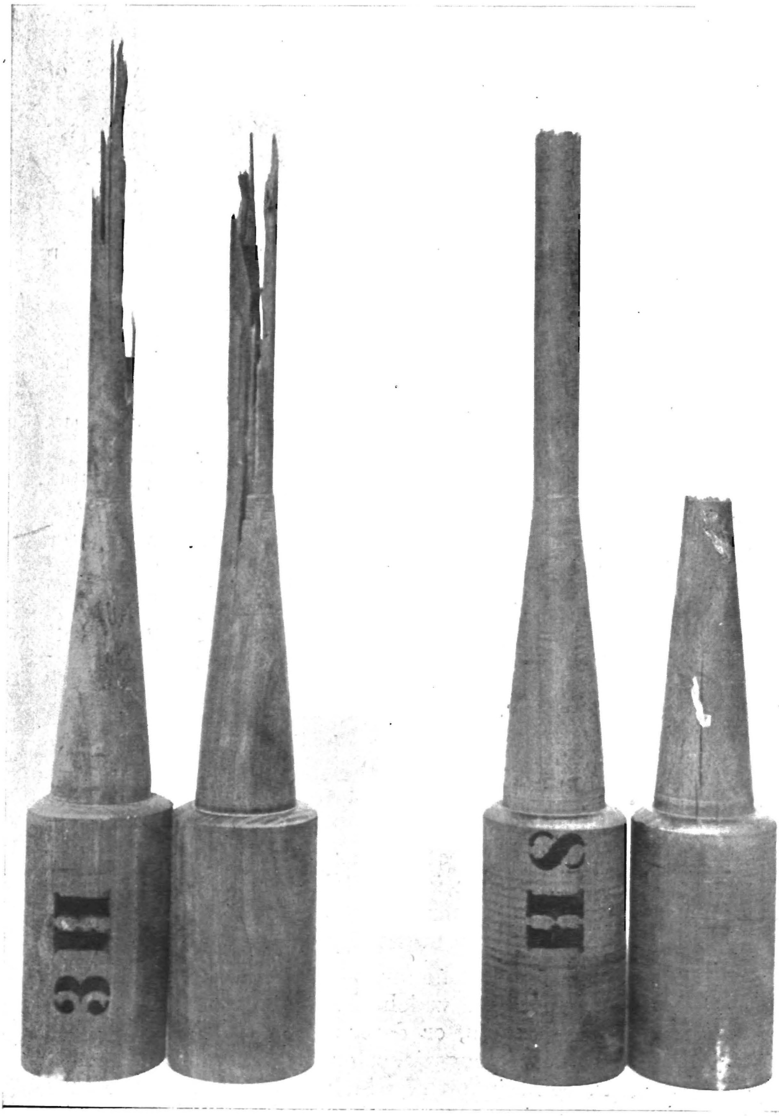


FIG. 21.