C.S.I.R.O.

Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 310, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 271 JANUARY-FEBRUARY 1961

1961##271

Adjustable Leather Packings for Saws

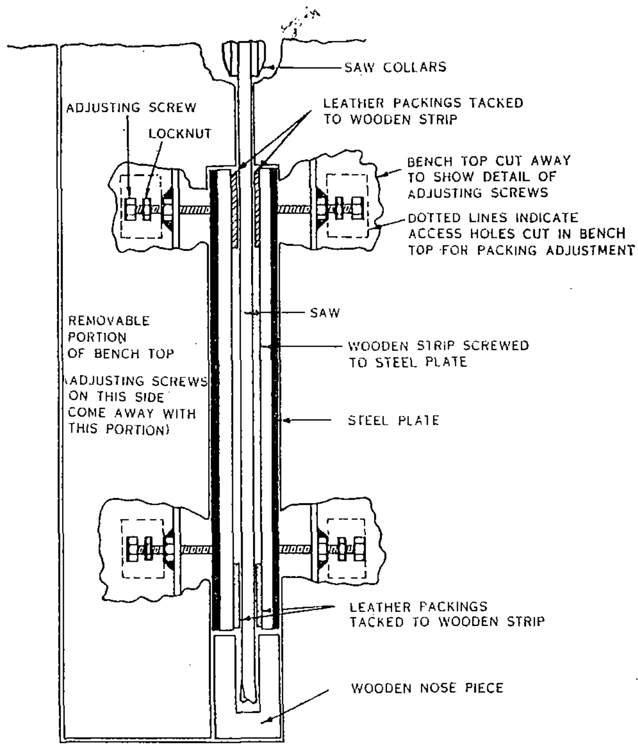
By D. S. JONES, Utilization Section

PACKINGS FOR CIRCULAR SAWS were discussed in the article entitled "Saw Packings" in Forest Products Newsletter No. 261, March 1960, and, in answer to numerous requests, more information on adjustable leather packings is given below.

Adjustable saw packings, more accurately described as saw guides, undoubtedly contribute towards better sawing for the following reasons:

- They provide a means of aligning the blade accurately with the feed direction.
- As adjustment can be made without necessarily heating the blade, saws run cooler with adjustable packings than with hemp.
- If heating is necessary it can be attained with much greater control than with hemp.
- There is less tendency for sawdust and splinters to lodge between the blade and the packings and generate excessive heat.

The constructional details of adjustable saw packings vary from bench to bench, but the accompanying diagram illustrates the main features. The pieces of leather or composition which form the packing material are about 4 in. long, 1 in. deep, and about $\frac{1}{8}$–$\frac{1}{4}$ in. thick. They are fixed to a strip of wood with brass



or copper tacks. This strip of wood, which is about 1 in. deep by $\frac{1}{2}$–$\frac{3}{4}$ in. thick, can be screwed to a strip of $\frac{3}{16}$-in. steel plate to provide greater rigidity against bending. The resulting guide strips are inserted in the channel provided for packings on most saw benches. These channels may need enlargement if a bench is being converted from hemp packings. The top of the guide strips should be flush with the top of the bench.

The length of the guide strips is such that the front packings are as near to the front of the saw as possible, while the centre packings are about $\frac{1}{4}$–$\frac{1}{3}$ of the saw radius out from the spindle. As the saw diameter decreases due to wear, the front packings obviously need

(*Continued on page 8*)

Design Tables for Timber Beams and Columns

An important aim in publishing the *Timber Engineering Design Handbook** was to provide students of universities and technical colleges, engineers, architects, and builders with up-to-date design data on Australian timbers. Recommendations on working stresses, design and construction details, and also aids to design of beams and columns were included.

To encourage the widest use of the new Handbook, the cost was kept to a minimum. This involved a decision not to reproduce the 205 pages of sizes and capacities of beams and columns which were included in the now out-of-date *Handbook of Structural Timber Design*. Instead, a few compact charts were provided to give the same information. Although many people find these charts most convenient, some prefer a tabular arrangement of the data. To meet the convenience of the latter group, the following tables have been prepared. As with the original tables in the old Handbook, these new ones cover the several Australian strength groups and indicate the stiffness and load-carrying capacities of beams and columns of various sizes and lengths.

BEAMS

Basic Allowable Loads

Table 5 gives the basic allowable, uniformly distributed, dead loads on $1\frac{1}{2}$ and 2 in. thick, green beams of standard-grade quality not subject to decay hazard. Calculations for these beams are based on their being cut the full nominal size green, with the exception of Douglas fir (D group), where allowance has been made for cutting $\frac{1}{8}$ in. scant of nominal size.

For widths of beams other than $1\frac{1}{2}$ and 2 in., the allowable loads are in direct proportion, e.g. a 10 by 6 in. beam will carry three times the load of a 10 by 2 in. beam. The weights of the beams have been taken into account in the tabulated values and no further allowance need be made for these.

In Table 5, two values are given for each beam size depending on whether strength or stiffness is the design criterion:

- The upper "strength" value is the maximum safe load which may be applied without exceeding the working stress in bending or shear.
- The lower "stiffness" value is the dead load which will eventually produce a deflection of 1/360th of the span. When this exceeds the safe load, the value of the latter only has been tabulated.

Modifications to Basic Allowable Loads

(a) *Strength Values*

Multiply the strength values by the appropriate factors in Tables 1 and 2 for the particular conditions of service.

(b) *Stiffness Values*

(i) *Deflection Equal to 1/360th of the Span*

Table 3 shows how to modify the load values for the stiffness criterion in Table 5 to obtain allowable loads for dry timber and for

* *Timber Engineering Design Handbook*.—Pearson, Kloot, and Boyd (1958). C.S.I.R.O. and Melb. Univ. Press, Melbourne.

TABLE 1
MULTIPLYING FACTORS FOR VARIOUS LOAD CONDITIONS

Load	Green Timber		Dry Timber*	
	Standard Grade	Select Grade	Standard Grade	Select Grade
Dead loads only	1·00	1·25	1·25	1·56
Live loads only, or dead and live loads	1·25	1·56	1·56	1·95

* Refers to timber with a moisture content of 15% or less when installed, and kept dry in service.

TABLE 2
MULTIPLYING FACTORS FOR EXPOSURE TO DECAY HAZARD

Exposure Conditions	Durability Class of Timber			
	1	2	3	4
Completely protected from weather with no decay hazard	1·00	1·00	1·00	1·00
Exposed to weather	1·00	0·95	0·85	0·80
Severe decay hazard*	1·00	0·90	0·70	0

* Timber embedded in the ground or in locations where it may be damp for extended periods. Horizontal and inclined members exposed to weather are also in this category because water will penetrate and remain in the seasoning checks.

live loads. Separate allowance for conditions of exposure is not normally made. The actual load applied to a beam must not exceed the corresponding maximum safe load.

(ii) *Deflection Other than 1/360th of the Span*

If a different stiffness criterion is adopted, the tabulated stiffness values are altered in proportion. Thus, if the deflection is limited to 1/240th of the span, the allowable load

TABLE 3
STIFFNESS VALUES FOR OTHER CONDITIONS

Load	Green Timber Standard and Select Grade	Dry Timber Standard and Select Grade
Dead load (DL) only	1·00 × tabulated value	1·25 × tabulated value
Live loads (LL) or dead and live loads	$\frac{1}{3}$LL+DL must not exceed tabulated value	$\frac{1}{2}$ LL+DL must not exceed $1\frac{1}{4}$ times tabulated value

TABLE 4
LATERAL SUPPORT FOR DEEP BEAMS

Ratio of Depth to Breadth	Recommended Lateral Support
Up to 2	No lateral support needed
2 to 3	Ends should be held in position
3 to 4	Ends should be held in line, as in a well-bolted chord member in a truss
4 to 5	One edge should be held in line, as by flooring nailed to the edge of a joist
5 to 6	Herringbone or equivalent bracing should be provided every 6–8 ft
6 to 7	Both edges should be held in line

= 360/240 × tabulated stiffness value (and modified according to Table 3 if necessary).

Irrespective of deflection, the maximum safe load must not be exceeded.

Lateral Stability

Deep, narrow beams may buckle laterally or twist under loads lower than those given in Table 5 unless they are adequately supported. Table 4 indicates the lateral support desirable for deep beams.

TABLE 5

BASIC ALLOWABLE UNIFORMLY DISTRIBUTED DEAD LOADS ON BEAMS

(1000 lb)

Span (ft)	Loading Criterion	Size of Beam (in.)																
		3×1½	3×2	4×1½	4×2	5×1½	5×2	6×1½	6×2	7×1½	7×2	8×2	9×2	10×2	11×2	12×2	14×2	16×2
		STRENGTH GROUP A																
4	Strength	0·89	1·19	1·59	2·12	2·49	3·31	3·18	4·24	3·93	5·24	6·37						
	Stiffness	0·24	0·32	0·58	0·77	1·14	1·52	1·98	2·64	3·16	4·20	6·30						
6	Strength	0·59	0·78	1·05	1·40	1·64	2·19	2·37	3·16	3·24	4·31	5·44	6·35	7·33	8·38	9·53		
	Stiffness	0·10	0·13	0·25	0·33	0·49	0·66	0·86	1·15	1·38	1·84	2·76	3·93	5·43	7·23	9·40		
8	Strength	0·44	0·58	0·78	1·03	1·22	1·63	1·76	2·35	2·41	3·21	4·20	5·33	6·59	7·52	8·44	10·43	12·67
	Stiffness	0·05	0·06	0·12	0·17	0·26	0·35	0·46	0·62	0·75	1·00	1·52	2·18	3·01	4·03	5·23	8·36	12·56
10	Strength	0·34	0·45	0·61	0·81	0·96	1·28	1·40	1·86	1·91	2·54	3·33	4·23	5·23	6·34	7·56	9·60	11·47
	Stiffness	0·02	0·02	0·06	0·09	0·15	0·20	0·28	0·37	0·46	0·61	0·93	1·35	1·88	2·52	3·29	5·28	7·93
12	Strength	0·27	0·36	0·50	0·66	0·79	1·05	1·15	1·53	1·57	2·09	2·75	3·49	4·33	5·25	6·26	8·53	10·77
	Stiffness			0·03	0·04	0·08	0·11	0·17	0·22	0·29	0·39	0·61	0·89	1·25	1·69	2·23	3·60	5·42
14	Strength	0·23	0·30	0·42	0·55	0·66	0·88	0·97	1·29	1·33	1·77	2·33	2·96	3·67	4·46	5·32	7·27	9·53
	Stiffness			0·01	0·01	0·04	0·06	0·10	0·13	0·19	0·25	0·40	0·61	0·87	1·19	1·57	2·57	3·90
16	Strength	0·19	0·25	0·35	0·47	0·57	0·75	0·83	1·10	1·14	1·52	2·01	2·56	3·17	3·86	4·61	6·30	8·27
	Stiffness					0·01	0·02	0·05	0·07	0·11	0·15	0·27	0·42	0·61	0·85	1·14	1·89	2·90
18	Strength	0·16	0·21	0·30	0·40	0·49	0·65	0·72	0·96	1·00	1·33	1·75	2·24	2·78	3·39	4·05	5·57	7·30
	Stiffness							0·02	0·02	0·06	0·08	0·17	0·28	0·43	0·61	0·84	1·42	2·21
20	Strength	0·14	0·18	0·26	0·35	0·43	0·57	0·63	0·84	0·88	1·17	1·55	1·98	2·47	3·01	3·60	4·93	6·50
	Stiffness									0·02	0·03	0·09	0·18	0·29	0·44	0·61	1·08	1·70
		STRENGTH GROUP B																
4	Strength	0·74	0·99	1·32	1·76	2·01	2·67	2·54	3·39	3·14	4·19	5·09						
	Stiffness	0·21	0·28	0·51	0·68	1·00	1·33	1·73	2·31	2·76	3·67	5·09						
6	Strength	0·49	0·65	0·87	1·16	1·37	1·82	1·97	2·63	2·69	3·59	4·34	5·07	5·85	6·69	7·61		
	Stiffness	0·08	0·11	0·21	0·28	0·43	0·57	0·75	1·00	1·20	1·60	2·41	3·43	4·73	6·33	7·61		
8	Strength	0·36	0·48	0·64	0·86	1·01	1·35	1·46	1·95	2·00	2·67	3·49	4·43	5·31	6·00	6·73	8·33	10·1
	Stiffness	0·04	0·05	0·11	0·14	0·22	0·30	0·40	0·54	0·65	0·87	1·32	1·90	2·62	3·50	4·57	7·30	10·1
10	Strength	0·28	0·37	0·50	0·67	0·80	1·06	1·16	1·54	1·58	2·11	2·77	3·51	4·35	5·27	6·28	7·67	9·13
	Stiffness	0·01	0·02	0·05	0·07	0·12	0·17	0·24	0·31	0·39	0·52	0·81	1·17	1·63	2·19	2·87	4·60	6·92
12	Strength	0·23	0·30	0·41	0·55	0·65	0·87	0·95	1·26	1·30	1·73	2·27	2·89	3·58	4·35	5·19	7·10	8·60
	Stiffness			0·02	0·03	0·07	0·09	0·14	0·19	0·25	0·33	0·52	0·77	1·08	1·47	1·93	3·12	4·72
14	Strength	0·18	0·24	0·34	0·45	0·54	0·72	0·79	1·06	1·09	1·46	1·92	2·45	3·03	3·69	4·40	6·03	7·90
	Stiffness					0·03	0·04	0·08	0·11	0·15	0·20	0·34	0·52	0·74	1·02	1·36	2·22	3·39
16	Strength	0·15	0·20	0·29	0·38	0·46	0·61	0·68	0·90	0·94	1·25	1·65	2·11	2·62	3·19	3·81	5·23	6·87
	Stiffness							0·04	0·05	0·09	0·12	0·22	0·35	0·52	0·72	0·97	1·63	2·51
18	Strength	0·13	0·17	0·24	0·32	0·40	0·53	0·59	0·78	0·81	1·08	1·44	1·84	2·29	2·79	3·34	4·60	6·03
	Stiffness							0·01	0·01	0·04	0·06	0·13	0·23	0·35	0·51	0·71	1·21	1·90
20	Strength	0·11	0·14	0·21	0·28	0·34	0·46	0·51	0·68	0·71	0·95	1·26	1·62	2·02	2·47	2·96	4·07	5·37
	Stiffness									0·01	0·01	0·06	0·14	0·23	0·36	0·51	0·91	1·44

TABLE 5 (continued)

BASIC ALLOWABLE UNIFORMLY DISTRIBUTED DEAD LOADS ON BEAMS

(1000 lb)

Span (ft)	Loading Criterion	3×1½	3×2	4×1½	4×2	5×1½	5×2	6×1½	6×2	7×1½	7×2	8×2	9×2	10×2	11×2	12×2	14×2	16×2
		Size of Beam (in.)																
	STRENGTH GROUP C																	
4	Strength	0·59	0·79	1·05	1·41	1·50	2·00	1·90	2·54	2·35	3·13	3·81						
	Stiffness	0·16	0·22	0·41	0·54	0·81	1·07	1·40	1·87	2·23	2·97	3·81						
6	Strength	0·39	0·52	0·69	0·92	1·09	1·45	1·57	2·10	2·05	2·74	3·24	3·79	4·37	5·00	5·69		
	Stiffness	0·07	0·09	0·17	0·22	0·34	0·46	0·60	0·80	0·97	1·29	1·94	2·78	3·83	5·00	5·69		
8	Strength	0·29	0·38	0·51	0·68	0·80	1·07	1·16	1·55	1·59	2·12	2·78	3·47	3·96	4·48	5·02	6·20	7·57
	Stiffness	0·03	0·04	0·08	0·11	0·18	0·23	0·32	0·42	0·52	0·69	1·06	1·52	2·11	2·82	3·67	5·89	7·57
10	Strength	0·22	0·29	0·40	0·53	0·63	0·84	0·92	1·22	1·26	1·67	2·20	2·79	3·46	4·19	4·68	5·70	6·83
	Stiffness	0·01	0·01	0·04	0·05	0·09	0·13	0·18	0·24	0·31	0·41	0·64	0·93	1·30	1·75	2·30	3·70	5·57
12	Strength	0·18	0·23	0·32	0·43	0·51	0·68	0·75	1·00	1·03	1·37	1·80	2·29	2·84	3·45	4·12	5·40	6·40
	Stiffness			0·01	0·01	0·05	0·06	0·10	0·14	0·19	0·25	0·40	0·60	0·85	1·16	1·54	2·50	3·79
14	Strength	0·14	0·19	0·26	0·35	0·42	0·57	0·62	0·83	0·86	1·15	1·51	1·93	2·40	2·92	3·49	4·77	6·10
	Stiffness					0·01	0·02	0·05	0·07	0·11	0·15	0·25	0·39	0·57	0·80	1·07	1·77	2·70
16	Strength	0·11	0·15	0·22	0·29	0·36	0·48	0·53	0·70	0·73	0·98	1·29	1·66	2·06	2·51	3·01	4·13	5·43
	Stiffness							0·02	0·02	0·06	0·08	0·15	0·25	0·39	0·55	0·75	1·28	1·98
18	Strength	0·09	0·12	0·18	0·24	0·30	0·40	0·45	0·60	0·63	0·84	1·12	1·44	1·80	2·19	2·63	3·63	4·77
	Stiffness									0·02	0·02	0·08	0·15	0·25	0·38	0·53	0·93	1·48
20	Strength	0·08	0·10	0·15	0·21	0·26	0·35	0·39	0·52	0·55	0·73	0·98	1·26	1·58	1·93	2·32	3·20	4·23
	Stiffness											0·02	0·08	0·15	0·25	0·36	0·68	1·11
	STRENGTH GROUP D																	
4	Strength	0·38	0·51	0·68	0·93	0·80	1·09	1·02	1·39	1·27	1·73	2·10						
	Stiffness	0·12	0·16	0·30	0·41	0·60	0·82	1·02	1·39	1·27	1·73	2·10						
6	Strength	0·25	0·33	0·45	0·61	0·71	0·97	0·91	1·24	1·10	1·51	1·79	2·09	2·41	2·77	3·15		
	Stiffness	0·05	0·06	0·12	0·17	0·26	0·35	0·46	0·62	0·74	1·01	1·53	2·09	2·41	2·77	3·15		
8	Strength	0·18	0·24	0·33	0·45	0·52	0·71	0·77	1·04	1·03	1·41	1·65	1·91	2·18	2·47	2·78	3·60	4·37
	Stiffness	0·02	0·02	0·06	0·08	0·13	0·18	0·24	0·33	0·40	0·54	0·83	1·21	1·68	2·26	2·78	3·60	4·37
10	Strength	0·14	0·19	0·25	0·35	0·41	0·56	0·60	0·82	0·83	1·13	1·49	1·81	2·06	2·31	2·58	3·29	3·93
	Stiffness			0·03	0·04	0·07	0·10	0·14	0·19	0·24	0·32	0·50	0·74	1·04	1·40	1·85	3·11	3·93
12	Strength	0·11	0·15	0·20	0·28	0·33	0·45	0·49	0·67	0·68	0·92	1·22	1·56	1·94	2·21	2·45	3·10	3·67
	Stiffness			0·01	0·01	0·03	0·05	0·08	0·11	0·14	0·20	0·32	0·48	0·68	0·93	1·23	2·11	3·20
14	Strength	0·09	0·12	0·17	0·23	0·27	0·37	0·41	0·55	0·57	0·77	1·02	1·31	1·64	2·00	2·36	2·97	3·50
	Stiffness					0·01	0·02	0·04	0·06	0·09	0·12	0·21	0·33	0·48	0·66	0·88	1·52	2·32
16	Strength	0·07	0·09	0·14	0·19	0·23	0·31	0·34	0·47	0·48	0·65	0·87	1·12	1·40	1·71	2·06	2·87	3·37
	Stiffness							0·01	0·02	0·04	0·06	0·12	0·21	0·31	0·45	0·61	1·08	1·68
18	Strength	0·06	0·08	0·11	0·16	0·19	0·26	0·29	0·40	0·41	0·56	0·75	0·97	1·22	1·49	1·79	2·59	3·27
	Stiffness									0·01	0·02	0·06	0·13	0·21	0·31	0·43	0·79	1·26
20	Strength	0·05	0·06	0·09	0·13	0·16	0·22	0·25	0·34	0·36	0·49	0·66	0·85	1·07	1·31	1·58	2·29	3·03
	Stiffness											0·02	0·06	0·12	0·20	0·30	0·58	0·95

COLUMNS

Allowable Loads

The allowable dead loads for centrally loaded columns of square section and of standard-grade unseasoned timber are given in Table 7. To find the allowable loads for timber columns loaded under other conditions proceed as follows:

(a) Centrally Loaded

(i) *Rectangular Section*

Find the allowable load for a square whose side corresponds to the least dimension of the given column, and increase the allowable load in proportion to the cross-sectional areas, e.g., for a 5 by 3 in. section, find allowable load for a 3 by 3 in. section and multiply this by 15/9.

(ii) *Combinations of Dead and Live Loads and Timber Grade*

Increase the allowable dead load as read from Table 7 (modified if necessary by (i) above) by the appropriate factor given in Table 6 for the particular ratio of dead to total load, and grade of timber. When the ratio $\frac{DL}{DL+LL}$ is between 0·8 and 1·0, it is essential to check that the column is safe for dead load alone.

(iii) *Seasoning*

Timber in large dimensions is seldom dried before use. However the smaller sections may sometimes be available in the dry condition and for such columns the allowable loads may be increased by 25%.

(b) Eccentrically Loaded

For rectangular columns loaded eccentrically, the following formula may be used:

$$P = \frac{P_a}{1+(6eP_a/dAf_b)},$$

where P = allowable eccentric load on column (lb),
P_a = allowable centric load obtained from Tables 7 and 6 (lb),
e = eccentricity of P (in.),
d = dimension of column in direction of e (in.),
A = area of column (sq. in.),
f_b = allowable extreme fibre stress in bending (lb/sq. in.).

For dead loads, f_b = 2360, 2000, 1600, and 1180 lb/sq. in. for strength groups A, B, C, and D respectively. These values may be increased by 25% for combinations of dead and live loads.

Effective Length

The effective length l depends on the end-support conditions of the column, but the following ratios may be used as a guide where L = actual column length:

Ends restrained in position only	$l = L$
Each end held by 2 bolts	$l = \frac{3}{4}L$
Flat ends	$l = \frac{2}{3}L$
One end fixed in position and direction, the other restrained in position only	$l = 0·7L$
One end fixed in position and direction, the other end free	$l = 2L$.

TABLE 6
MULTIPLYING FACTORS FOR LOAD COMBINATIONS AND TIMBER GRADE
(Applicable to all Strength Groups)

Slenderness Ratio* l/d	Ratio of Dead Load to Total Load $\left(\frac{DL}{DL+LL}\right)$											
	Standard Grade Timber						Select Grade Timber					
	1·0	0·8	0·6	0·4	0·2	0	1·0	0·8	0·6	0·4	0·2	0
0	1·00	1·25	1·25	1·25	1·25	1·25	1·25	1·56	1·56	1·56	1·56	1·56
10	1·00	1·22	1·28	1·34	1·39	1·43	1·42	1·72	1·83	1·93	2·00	2·10
20	1·00	1·18	1·34	1·50	1·73	2·01	1·14	1·33	1·55	1·85	2·23	2·84
30	1·00	1·17	1·35	1·57	1·87	2·33	1·11	1·30	1·52	1·84	2·30	3·06
40	1·00	1·17	1·37	1·64	1·98	2·54	1·08	1·24	1·48	1·81	2·24	3·04
50	1·00	1·16	1·37	1·64	1·99	2·64	1·06	1·22	1·45	1·78	2·21	3·04

* Slenderness ratio is the effective length of the column divided by the column dimension in the direction of buckling.

TABLE 7
ALLOWABLE AXIAL DEAD LOADS ON STANDARD-GRADE TIMBER COLUMNS
(1000 lb)

Strength Group	Nominal Size (in.)	Effective Length (ft)										
		4	6	8	10	12	14	16	18	20	22	24
	3×3	5·4	2·7	1·5	0·9							
	4×4	13·0	8·0	4·8	2·9	2·0						
	5×5	27·0	17·0	11·0	7·7	5·5	4·0	2·8				
	6×6	45·0	31·0	21·0	15·0	11·0	7·9	6·1	4·6	3·6		
	7×7	66·0	49·0	36·0	26·0	19·0	14·0	11·0	8·9	6·9	5·8	
A	8×8	91·0	74·0	55·0	42·0	32·0	24·0	19·0	15·0	12·0	10·0	8·3
	9×9		100·0	79·0	61·0	48·0	38·0	30·0	24·0	20·0	16·0	13·0
	10×10		130·0	110·0	87·0	69·0	56·0	44·0	37·0	30·0	25·0	21·0
	11×11		160·0	140·0	110·0	95·0	76·0	62·0	52·0	44·0	36·0	31·0
	12×12		200·0	180·0	140·0	120·0	100·0	86·0	72·0	59·0	51·0	43·0
	14×14			260·0	230·0	200·0	170·0	140·0	120·0	100·0	88·0	78·0
	16×16			360·0	330·0	290·0	250·0	220·0	180·0	160·0	140·0	120·0
	3×3	4·5	2·3	1·3	0·8							
	4×4	11·0	6·8	4·2	2·6	1·7						
	5×5	23·0	15·0	9·7	6·5	4·6	3·3	2·5				
	6×6	37·0	26·0	18·0	13·0	9·3	6·8	5·1	3·9	3·2		
	7×7	54·0	42·0	30·0	23·0	16·0	12·0	9·8	7·6	6·1	4·9	
B	8×8	74·0	62·0	47·0	35·0	27·0	21·0	16·0	13·0	10·0	8·6	7·0
	9×9		83·0	67·0	52·0	41·0	33·0	26·0	21·0	17·0	13·0	11·0
	10×10		100·0	92·0	74·0	59·0	48·0	38·0	31·0	26·0	21·0	18·0
	11×11		130·0	120·0	99·0	81·0	64·0	54·0	45·0	37·0	31·0	26·0
	12×12		160·0	140·0	120·0	100·0	89·0	73·0	60·0	52·0	43·0	37·0
	14×14			220·0	190·0	160·0	140·0	120·0	100·0	88·0	77·0	66·0
	16×16			300·0	270·0	240·0	210·0	180·0	160·0	140·0	120·0	110·0
	3×3	3·6	1·9	1·1	0·1							
	4×4	9·6	5·4	3·3	2·1	1·4						
	5×5	18·0	12·0	7·8	5·2	3·7	2·7	2·0				
	6×6	29·0	21·0	15·0	10·0	7·5	5·6	4·3	3·2	2·7		
	7×7	43·0	34·0	25·0	18·0	13·0	10·0	8·0	6·1	4·9	3·9	
C	8×8	59·0	49·0	38·0	29·0	22·0	17·0	13·0	10·0	8·3	7·0	5·7
	9×9		66·0	55·0	42·0	34·0	26·0	21·0	17·0	13·0	11·0	9·2
	10×10		87·0	74·0	60·0	49·0	39·0	31·0	26·0	21·0	17·0	14·0
	11×11		110·0	96·0	81·0	65·0	53·0	45·0	36·0	31·0	25·0	21·0
	12×12		130·0	110·0	100·0	86·0	72·0	60·0	50·0	43·0	36·0	30·0
	14×14			170·0	150·0	130·0	110·0	100·0	84·0	74·0	63·0	54·0
	16×16			230·0	210·0	190·0	170·0	150·0	130·0	110·0	100·0	89·0
	3×3	2·7	1·3	0·7	0·4							
	4×4	7·0	4·2	2·4	1·5	1·0						
	5×5	13·0	9·2	5·9	4·0	2·6	1·9	1·4				
	6×6	21·0	16·0	11·0	7·9	5·8	4·1	3·1	2·4	1·9		
	7×7	32·0	25·0	19·0	14·0	10·0	8·0	5·9	4·4	3·7	2·8	
D	8×8	43·0	37·0	29·0	23·0	17·0	13·0	10·0	8·0	6·5	5·2	4·3
	9×9		49·0	40·0	33·0	26·0	21·0	16·0	13·0	10·0	8·6	7·0
	10×10		65·0	55·0	45·0	38·0	31·0	24·0	20·0	16·0	13·0	11·0
	11×11		81·0	70·0	61·0	52·0	43·0	35·0	29·0	23·0	20·0	16·0
	12×12		98·0	88·0	77·0	67·0	57·0	47·0	39·0	32·0	28·0	25·0
	14×14			130·0	110·0	100·0	92·0	80·0	69·0	59·0	52·0	42·0
	16×16			170·0	160·0	140·0	130·0	120·0	100·0	95·0	83·0	71·0

Adjustable Leather Packings for Saws

(*Continued from page 1*)

to be moved closer to the spindle, and it is usual to have two or three sets of guide strips of different lengths to accommodate saw diameters from the largest to the smallest used.

The placement of the front adjusting screws must be arranged to suit the shortest guide strips. There is usually a stiffening flange or panel under the bench top to which the adjusting screws can be fitted. If not, small lugs can be welded or screwed in suitable positions.

The material used for the packing blocks does not appear to be critical, and, while materials such as canvas-"Bakelite" compositions should be excellent, leather is widely used with success. It has the advantage of being cheap and easy to obtain. However, if a water spray is used on the machine, composition materials which do not soften when soaked in water are preferable.

Adjustment of the packings is effected through small access holes in the bench top, as illustrated in the diagram. This is the simplest and commonest method. However, adjustment at the edges of the bench can easily be provided by means of extension rods with socket ends to fit over the heads of the adjusting screws. The rods on the fixed side of the bench can remain permanently in position, but those engaging with the screws on the removable portion of the bench top should be so fitted that their socket ends can be retracted clear of the adjusting screws whenever the bench top is removed to change a saw. This system is a good one, having the advantage that adjustment while the saw is running is safer.

While locknuts are theoretically desirable and are shown in the diagram, the screw threads usually become very stiff due to dust and gum deposits, and locknuts then become not only unnecessary, but can be a nuisance.

The packings should firstly be adjusted by lining up the offside pair with the saw removed, using a straight edge placed along the fixed saw collar. The front and centre packings are adjusted to be just clear of the straight edge. After the saw is installed, the nearside packings are adjusted to be just clear of the blade. Theoretically, this gives the ideal setting. However, due to small misalignments of the bench rollers or spindle, or to peculiarities of the saw, the front packings sometimes require further adjustment to the right or left to obtain straight cuts or to prevent the timber leading away from the fence. In addition, the centre packings may need to be tightened to heat the blade and compensate for lack of tension in a particular saw.

When the bench and saws are maintained in good condition the packings need very little adjustment. However, if the benchman is forced to spend a lot of time adjusting the packings in an endeavour to get good cutting, something is almost certainly wrong with the bench or saws.

Developing Timber Engineering — A Plan for Australia

DURING OCTOBER a talk was given by Mr. J. D. Boyd, Officer-in-Charge, Timber Mechanics Section, to the State Directors of T.D.A., and to members of the South Australian Branch, on the extensive development of timber engineering which should be possible in Australia. An organization within the timber industry which could effectively achieve this was outlined. The proposals were discussed at length by a very interested group. A full report of the talk was published in the January issue of the *Australian Timber Journal*.

DONATIONS

THE following donations were received recently by the Division:

En-Bee Timber Supplies Pty. Ltd. Revesby, N.S.W. £1 0 0

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DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 310, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 272 MARCH 1961

1961##272

A New Tree-Sampling Device

By J. W. P. NICHOLLS and L. SANTER

WIDESPREAD DEVELOPMENT in plantation forestry, together with a stimulated interest in the breeding of trees with desirable wood properties, has focused attention on the sampling techniques available. Increment borings have been used by foresters and research workers to provide information for limited wood-quality evaluation of living trees, but the largest borer at present in use supplies a specimen ½ in. in diameter, which is not large enough for comprehensive testing. It is also difficult to obtain material from pith and adjacent growth rings in these small-diameter samplings. In an endeavour to overcome these difficulties Echols and Mergen (1955) have shown how larger samples can be removed without prejudice to the tree. This method has received further attention from Brown (1958), and samples extending from bark to bark, including the pith, and having a minimum cross section of 3 by 2 in., have been sent to these laboratories. Such samples provide more than sufficient material for all but the most ambitious projects, but the extraction time of 1 hour by either method is a disadvantage.

There are occasions, however, such as when a tree has to be repeatedly sampled, or a research programme calls for the testing of many trees, when an improved method could be introduced, if only to minimize labour. The need for such a method led to the development of the sampling device described below.

The machine methods seen so far have all had to contend with increasing frictional forces, due to the inability of the tool to dispose of the cutting products (see, for example, Bowers (1960)). This can result in degrade of the specimen due to heating and compression. The chip-disposal action of the chain saw type of tool suggested the use of this principle in the proposed sampling device. However, the smallest chain saw available would have been too large for this application, and consideration was given to the use of a mortising chain.

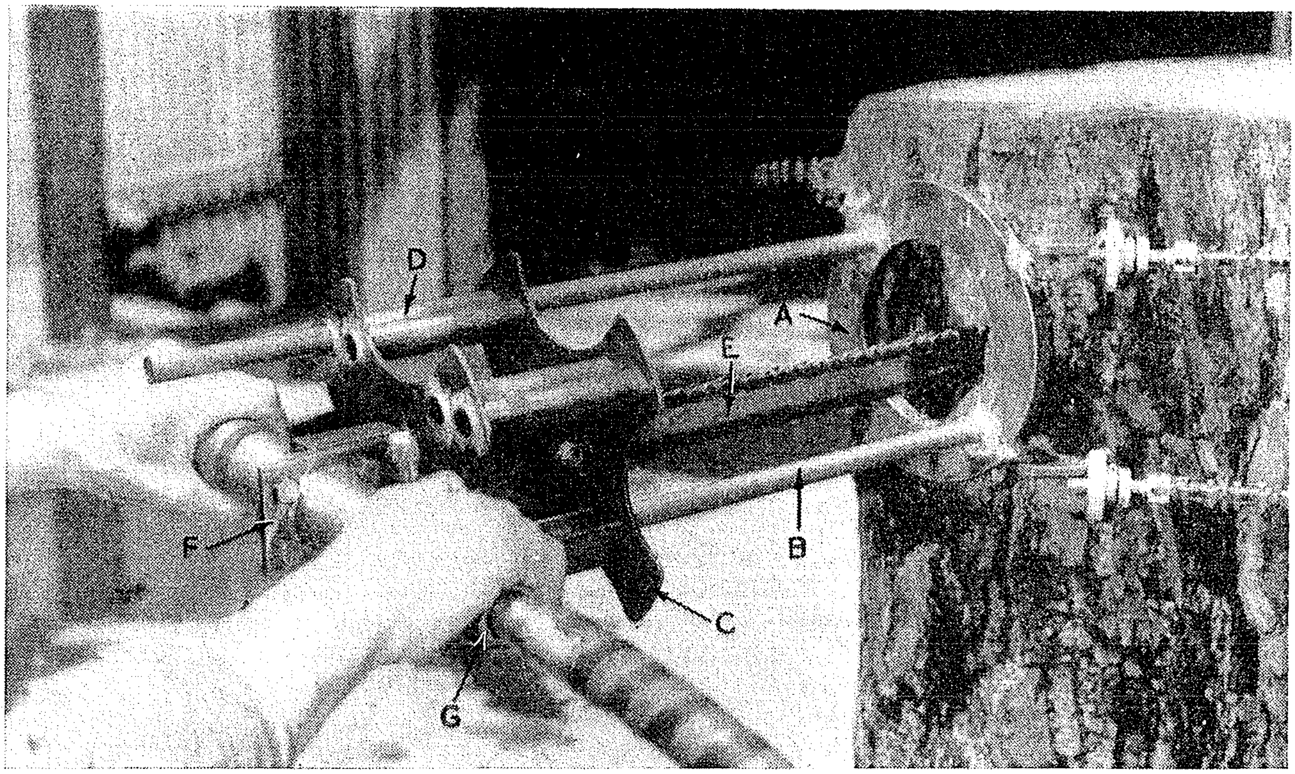
A prototype machine was built to test the feasibility of this idea and was designed to remove a sample measuring ⅞ by ⅞ in. and extending from bark to pith of a 24 in. diameter tree. As standard mortising bars and chains are only available in lengths of 6 in. or less, a special bar was made and extra links were fitted to a standard chain. A Renold mortising chain of 0·89 in. pitch and 5/16 in. wide was used on a 1½ in. diameter sprocket.

The pilot machine consists of three main components:

- Guide-pin unit
- Mortising unit
- Prime mover.

The guide-pin unit (*A*, accompanying photograph) is clamped to the tree by two pipe-wrench chains, which are adjustable to suit various tree girths.

The two guide pins (*B*) carry the mortising unit (*C*), which is fitted with eight guide bushes (*D*). A selected pair of these are used during any one cut as a slide for the mortising unit on the guide pins, to register the position of the slots to be cut. Four slots 5/16 by 1½ in. are cut in succession, which then enclose the ⅞ in. square sample. The specimen is then separated at the pith end (and the hole plugged) by a method such as that used by Echols and Mergen (1955). It is necessary to



Tree-sampling device, showing component parts. The unit is in position to cut one of the vertical slots.

align the guide-pin unit with the expected position of the pith to obtain a sample which includes every growth ring.

The mortising bar and chain (*E*) are attached to the mortising unit (*C*), which is fitted with a screw to tension the mortising chain. A flange (*F*) joins the guide unit to a tube. The right-hand side of this tube (*G*) contains the driving sprocket and the end of the flexible drive. The left-hand side of the tube is merely an extension to form a handle.

The mortising unit weighs $13\frac{1}{4}$ lb and once it rests on the guide pins little effort is required during the cutting operation.

The prototype unit was driven by a 2-h.p. electric motor through a flexible drive at 2800 r.p.m. Power measurements taken on test showed peak loads of 1·8 h.p. and an average load of 1·2 h.p., a specification which can be easily met by a number of commercially available light, portable, petrol engines. Alternatively the practice of using an existing chain saw to drive auxiliary equipment through a flexible drive may be applied to this unit.

The design used in this model was one which would quickly and conveniently test the idea of the mortising chain. Therefore, no effort was made to include the refinements usually found on commercial chain saws, such as a means of chain lubrication and a clutch operated from the handle to disconnect the power unit. A final design could well include these and incorporate a more refined method of registering the successive cuts, such as would be obtained by mounting the mortising unit on a turret.

The prototype has ably demonstrated the advantages of this method of sampling. In 10 minutes a specimen measuring $\frac{7}{8}$ by $\frac{7}{8}$ in. and extending from pith to bark was removed from a 24 in. diameter tree. It could have provided material for all the tests proposed by Dadswell and Nicholls (1959).

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What is the Termite Hazard?

By J. BEESLEY, Wood Preservation Section

TERMITES, or white ants, are found in most parts of Australia, but are more abundant in some regions than in others. In nature they serve a useful purpose by hastening the destruction of much dead timber and other vegetable matter that might otherwise take years to decompose and return to the soil.

Termites become a pest of economic importance only when they attack dwellings, fences, communications, or crops. In some regions the damage they cause each year may be valued at many thousands of pounds, with additional sums required for eradication and preventive measures. Elsewhere, builders of long experience can truthfully claim that they have never seen a termite.

Most Australian books on building give detailed instructions for the termite-proofing of new homes. Yet very few, if any, homes in the Melbourne metropolitan area have been built in such a way that they can be called "termite-proof". Some architects take precautions against termite attack as a matter of course, others, seldom if ever, worry about them. With so much conflicting evidence, how is the owner to decide when to take precautions against termite attack and when to take the risk? What help can he expect from his builder?

Precautions against termite attack should be regarded as a form of insurance. If the hazard is high, it is reasonable to spend a substantial sum on methods of construction which will keep the risk of damage by termites to a minimum. When the hazard is low, or non-existent, the cost of taking special precautions is seldom justified. When the hazard is high, or low, the right decision is not hard to make, but sound judgement is needed when the hazard is indeterminate or unknown.

The need for keeping termites out depends upon their prevalence, or the hazard in the area. The cost of keeping them out varies with the nature of the building.

One of the simplest ways of determining the local termite hazard is to ask the local building authorities and near-by residents. If there is reasonable agreement in the opinions expressed, appropriate action can be taken. If opinions are conflicting, it is better to anticipate some attack and to take commonsense precautions.

Tasmania is the only Australian State in which termites rarely cause serious damage to timber in service. In Victoria, the hazard in the Melbourne area is generally very low, although attack occasionally occurs in the bayside suburbs and in the fringe areas. As a rule, the risk of attack in these areas diminishes as the density of population increases and the native vegetation is eliminated. The only other part of the State which is virtually free from termites is the Werribee Plains area to the west of Melbourne, including Geelong. Elsewhere in Victoria, and in all other States, the hazard from termites is usually too high to be ignored and special precautions must be considered necessary. Nevertheless, within each State and especially in areas of natural grasslands, limited regions of negligible hazard may be found where termites are virtually unknown and no special precautions are necessary.

Practically all buildings can be made termite-proof. There is no great problem in protecting a new building from termites, if the possibility of attack is considered when the building is being planned. Protection of an existing building is always more difficult than the protection of a similar building during its construction. Sometimes, old buildings can be given effective protection against termite attack only at very great cost.

The cost of protecting a new building from termite attack can be affected by the site and other local factors, the type of building and its size, and even the standard of maintenance the building is likely to receive. Houses on sloping sites are seldom as easy to protect as houses on level sites. Houses with continuous foundations, patios, or terraces, or with some floors on solid-fill and some suspended, are more difficult to protect than simple timber-framed cottages on stumps. Warehouses and factories which are not likely to receive regular maintenance, and where sub-floor access is often difficult, require more efficient termite barriers than dwellings in which the occupier has a continuing and personal interest.

Timber-framed houses on stumps or piers and with good sub-floor access are comparatively easy to protect against termite attack. Properly fitted ant caps beneath the bearers, or a barrier of treated soil around the base of each stump, will give satisfactory protection. The cost of this protection is low and adds little to the total cost of the house. It may be regarded as good insurance, even in areas of low hazard.

Brick and brick-veneer houses, with continuous-foundation walls, are more difficult to proof against termites than are timber-framed houses set on stumps. The cost of proofing them is also higher because all the foundations need to be protected by barriers of treated soil or by metal shields. If sub-floor access is reasonable, shields and treated soil barriers can be relied upon to give adequate protection provided they are subjected to regular inspection and maintenance. If sub-floor access is poor, however, and inspections are difficult or impossible, as is frequently the case in brick homes, only timbers which are naturally resistant to termite attack should be used for flooring and floor supports, door frames and architraves, and for skirting boards. If naturally resistant timbers are not available, then timbers which have been impregnated with a reliable preservative may be substituted.

Because of the comparatively high cost of protecting brick and brick-veneer houses from termite attack, special precautions will be taken only when the cost of repairing damage due to termite attack is likely to exceed the cost of the special precautions necessary to prevent attack. Any tendency to avoid or omit proper termite barriers in areas of low hazard, or to compromise when the hazard is only moderate, must be avoided. Termite barriers which cannot be relied upon to give complete protection against attack are useless. They are also a waste of money because they do not prevent termites from gaining entry to the building and damaging it.

Details of methods of termite-proof construction may be obtained from State Forest Services, from the Commonwealth Department of Works (Building Research Liaison Service), and from the C.S.I.R.O. Division of Forest Products. Basically, they consist of the use of shields, or ant caps, on stumps and piers; treated soil barriers around foundations which cannot easily be protected by shielding; or the use of naturally resistant timbers or preservative-treated wood where shields and treated soil barriers cannot be relied upon for protection. In each instance the purpose of the method is to prevent termites from reaching timber which they might damage.

Both shields and treated soil barriers must be inspected regularly and kept in perfect order if they are to remain effective for the full life of the building. In areas of high hazard the barriers should be inspected every 2–3 months.

Good building practice calls for good ventilation beneath all parts of all suspended timber floors and easy access to the sub-floor area. Even if no other precautions are taken against termite attack, the provision of good ventilation will discourage attack, and easy access will simplify and reduce the cost of eradicating any attack which might occur after the building has been completed.

CORRECTION

NEWSLETTER No. 271

Page 3, Table 3, column 3, lines 5 and 6: *For* $1\frac{1}{4}$ times tabulated value *read* $1\frac{7}{8}$ times tabulated value.

DONATIONS

THE following donations were received by the Division during December and January:

Bonalbo Timber Co., N.S.W.	£100	0	0
Victorian Sawmillers' Association	£ 98	1	0
Ray and J. Page, Ivanhoe, Vic.	£ 5	5	0
K. G. Murray Publishing Co. Pty. Ltd., Sydney	£ 21	0	0

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Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 310, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 273 APRIL 1961

Soft Rot In Timbers

PART I. WHAT IS SOFT ROT?

By N. E. M. WALTERS, Preservation Section

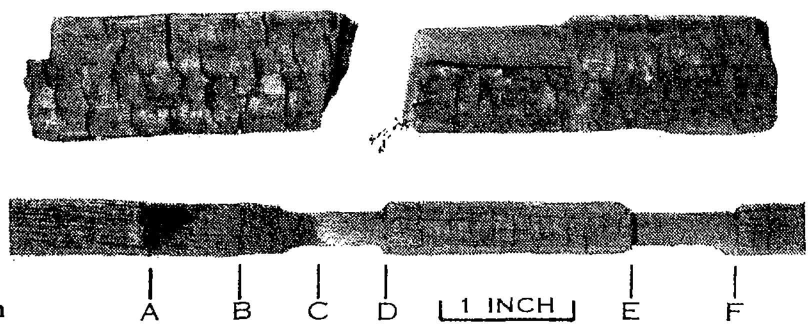


Fig. 1.—**Upper left:** *Fragment of redwood cooling-tower slat, showing soft rot.* **Upper right:** *A similar slat with part of soft rot removed to show its depth.* **Lower:** *Edge view of a similar slat. The left side to point B is wet; the rest is dry. AC was a slot holding a cross piece and was protected from attack, the extent of which is shown by the scraped section, BD. EF shows deep soft rot.*

VERY WET WOOD is not attacked by ordinary wood-decaying fungi because the oxygen supply is insufficient for their growth, but certain moulds may flourish in this wet wood and eventually bring about its breakdown. These moulds attack the cellulose of the wood fibres only near the water-washed surface, so that the decay or "soft rot" they cause creeps inwards quite slowly and evenly. It is serious only in thin wooden parts, such as cooling-tower slats (Figs. 1 and 3), but occasionally may cause trouble in railway sleepers, mine timbers, or house stumps.

For many years, the breakdown of timber by decay had been considered to be the exclusive preserve of a limited group of the higher fungi, but research work in the 1930's indicated that a more primitive type of fungus could also attack timber under conditions not favourable to the higher types. It was noticed that this new type always left its "trade mark" in the form of small boreholes down the length of the fibre wall (Fig. 2).

Some ten years ago this type of rot was found to be affecting cooling-tower timbers overseas. Since then it has been noticed that it is becoming commoner and faster in its action, especially in cooling towers using alkaline water and where, as in most modern towers, a fan is provided to increase air flow and hence efficiency. This very recent discovery of soft rot is understandable because it previously had been extremely slow in action and was mistakenly thought to be a chemical or physical softening.

Taking soft rot in cooling towers as the typical form of this decay, it appears at first as a surface softening darker in colour than normal wood but inconspicuous because the original sawcuts and growth rings are still evident. As it advances inwards the soft rot or "mud" can be scraped off in quantity from a slat (Fig. 1) and may be eroded away by the falling water. After this the growth rings stand out more clearly because the earlywood is attacked more severely than the denser latewood. The transition from "mud" to sound wood is very sudden and is usually seen under the microscope in little more than the width of five fibres (Fig. 2). In late stages a slat can bend double under its own weight, but of course at this point it has lost all its useful strength and may fall down in the tower. The weight so added to the layer below may be sufficient to cause it, and then others below, to collapse in a "pack of cards"

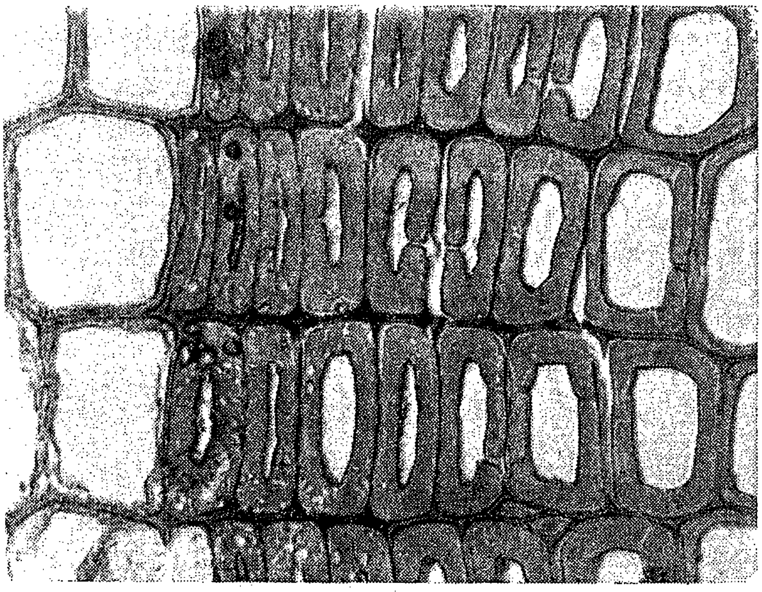


Fig. 2.—Photomicrograph across the grain of redwood, showing boreholes in and near the middle layer of the cell walls.

effect. Figure 3 shows slats reaching this stage. Wherever a slat is in close contact with other wood, soft rot fails to develop to any depth; on the other hand, nails, which corrode and release metallic ions, accelerate it. Corners of slats and tray supports become rounded, so that the slats and supports originally resting on their edges, unless otherwise secured, often turn over on their sides and in this position sag deeply.

When the slats are dried, the "mud" still retains the surface features of the original wood, but develops numerous cracks or fissures across and along the grain, so that the decay looks like a brown cubical rot with quite small cubes (Fig. 1). This is, in fact, what it is, since the cellulose is the main constituent attacked.

The rule that all fungi need some oxygen for at least a part of their life cycle holds for the soft-rot moulds, but it is to their advantage if the supply of oxygen is sufficient for their needs only, so preventing competition from the higher wood-destroying fungi. In towers operated intermittently, the outer slats and cladding may develop ordinary decay inside and soft rot outside.

Although all fungi require moisture, most cannot exist in conditions of excess water. The soft-rot moulds, however, can never have an excess of water, provided it is aerated. Most of the marine soft-rot fungi live out their whole life cycle in the water and produce spores that are wet or sticky and so adapted to dispersion in water. Other soft-rot fungi may be freshwater species and others partially aquatic with sticky spores that are dispersed by rain or flowing water. In contrast, wood-destroying fungi have dry spores that are dispersed by air currents.

Warmth is as essential to the growth of these moulds as to that of the wood-destroying fungi. Many of them flourish at high temperatures—up to 38°C or more—on the other hand it is unlikely that freezing temperatures will kill them, any more than they do other fungi. The high temperatures in cooling towers and mines often encourage soft rot.

The chemical composition of the water, particularly its alkalinity, is apparently a controlling factor, since soft rot has rarely been found in wood in contact with acid water, but is common where contact is with aerated alkaline water of pH* from 7 to 10. The nature of the alkalinity is also important, as is the presence of free chlorine (a strong oxidizing agent) in the water. Most of the substances which cause alkalinity in water, as well as oxidizing agents, have the ability

* The pH value is a measure of acidity or alkalinity. pH 7 is neutral, less than 7 acid, and greater than 7 alkaline.

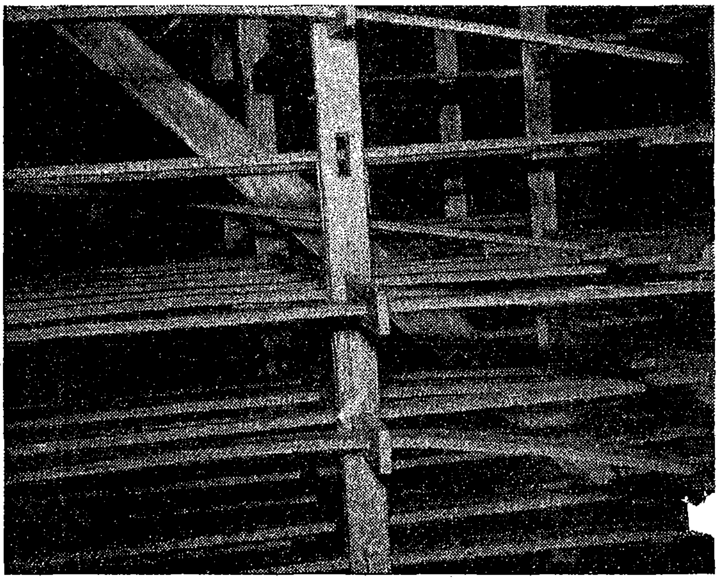


Fig. 3.—Redwood cooling-tower slats in place showing their arrangement and their dimensions. Note the sagging slats weakened by soft rot.

in their own right to cause chemical deterioration of the wood—sufficient to give the soft-rot moulds a swift start. In addition, there are some chemicals which assist the soft-rot moulds even more directly by supplying nutrients that would otherwise be in short supply. Thus chemical works such as oil refineries might allow nitrogen, sulphur, phosphorus, or other elements which serve as nutrient salts to enter the water system and so rapidly boost the growth of the moulds. Laboratory tests on soft rot can be accelerated readily by adding a suitable mixture of such nutrients.

The range of timbers attacked by soft-rot moulds is still the subject of experiment, but from field observations it is clear that they attack a wide variety of timbers, in general preferring hardwoods to softwoods. The ordinary durability rating of timbers against wood-destroying fungi does not apply so far as soft rot is concerned and will also vary according to the chemical content of the water that is expected to flow over them. It is also difficult to forecast the probable behaviour of the denser timbers in cooling towers; even some normally highly durable dense species may in special cases have little resistance because the chemical content of some waters may cause premature breakdown.

In order to assess the resistance of various species to soft rot, trays containing 24 different timbers have been prepared and are now installed in various cooling towers throughout the Commonwealth. (*The second and concluding part, "Methods of Control", will appear in the next issue.*)

More about Tooth-Indexing Pawls

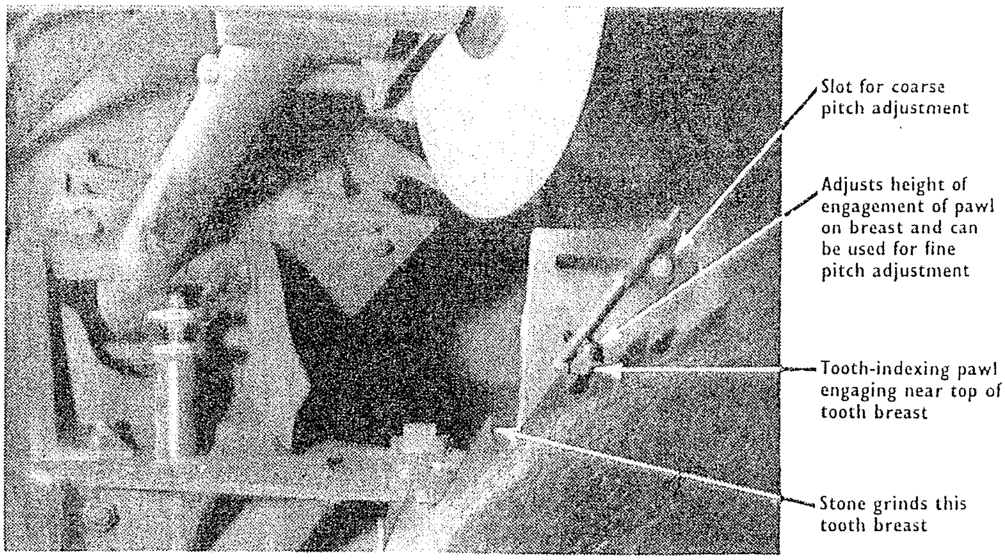
By D. S. JONES, Utilization Section

THE EFFECTIVENESS of using a tooth-indexing pawl on hand-operated saw-gulleting machines was recently demonstrated by a Melbourne saw doctor. This man is particularly careful with his work and considered that the tooth spacings on his 44-in. dia., 10-gauge, No. 1 bench saws were good and that the saws were giving the best possible performance. On the average, three saws were used during an 8-hour day, which represents an average run of 2 hr 40 min. The species sawn in this sawmill are alpine ash (*Eucalyptus gigantea*), messmate stringybark (*E. obliqua*), peppermint (*E. australiana*), and river red gum (*E. camaldulensis*), all with the bark on.

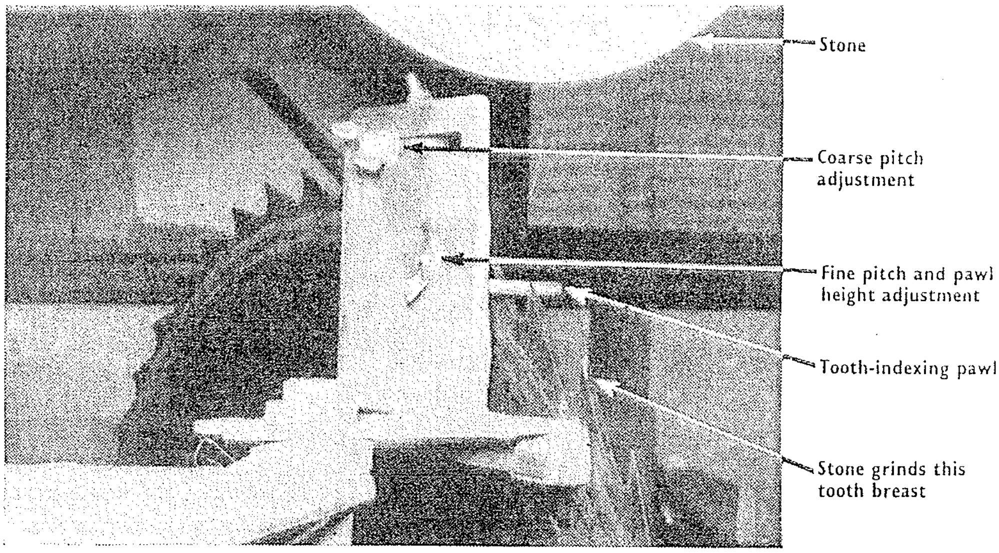
After reading "Maintaining a Uniform Tooth Pitch with Hand-operated Gulleting Machines" in Newsletter No. 268 (October 1960) he had an indexing pawl constructed by the mill engineer on the lines suggested in the article, and fitted to the gulleting machine as illustrated in the accompanying photographs. The attachment was used during the sharpening of a trial saw, and, although the bench crew knew nothing of this, they all immediately remarked that some improvement had taken place. Subsequently, other saws showed similar improvements, and the life between sharpenings, averaged over a reasonably long period, increased from 2 hr 40 min to 4 hr 20 min. No other alteration was made to the saws, and the improvement was undoubtedly due only to the use of the indexing pawl.

This remarkable improvement in sawing behaviour may be traced to several sources, one of which is the fact that tooth pitches are usually alternately long and then short around a saw which has been ground by hand. Hence, during sawing, one side of the saw will be more heavily loaded than the other, and there will be a tendency for the saw to run out of line whenever conditions become sufficiently severe. When these inequalities are removed, a saw will obviously withstand heavier sawing loads and will run for longer periods. It is probable that many saw doctors can anticipate significant sawing improvements by correction of this deficiency alone.

Another factor is that, when grinding the breast of a tooth by hand, care must be exercised not to grind the tip too heavily, otherwise it will be overheated. Furthermore, the breast may be rounded back towards the tip. Hence, the very top of the breast usually receives little more than a light touch with the stone, and may often be inadequately sharpened. When the indexing pawl is used, the stone can be brought firmly down the breast



Operator's view of tooth-indexing pawl.



Back view of pawl.

of each tooth from the tip to the gullet, the severity of grinding being pre-set by the initial adjustment of the pawl. Thus the tip of each tooth receives a more adequate sharpening and the front is perfectly flat right up to the tip. As these corrections are made to the portion of the tooth which accomplishes most of the work of cutting, more efficient sawing must result.

Furthermore, the use of the indexing pawl provides a remarkably uniform tooth shape. This is because the use of the pawl results in all the critical tooth profile dimensions being fixed. The correct radial position of the cutting tip is fixed by the stripping mark, the indexing pawl determines the peripheral distance from one tip to the next, the indexing pawl and the fixed downward path of the stone accurately define the position and angle of the tooth breast, and the depth stop fixes the depth of the gullet. The only portion of the tooth outline not accurately delineated is the back of the tooth, but as this part is well away from the cutting area its lack of definition is immaterial.

There seems no reason why the improvements demonstrated by the saw doctor mentioned above should not be reproduced, at least in some measure, in any sawmill. This could well result in the tooth-indexing pawl becoming standard equipment on all hand-operated saw-gulleting machines.

Printed by C.S.I.R.O., Melbourne

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Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 310, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 274 MAY 1961

1961##274

Soft Rot in Timbers

PART II. METHODS OF CONTROL

By N. E. M. WALTERS, Preservation Section

THE FIRST CONSIDERATION in the control of soft rot, as in all preservation work, is to remove the causes of the trouble. Assuming that for the present the main trouble will be in cooling towers, the first method that suggests itself is an alteration in pH. Unfortunately, especially in large towers, this is usually impracticable or uneconomic. Moreover, a lower pH, while suitable for the tower, may introduce serious corrosion problems elsewhere in the water circuit.

Chemical treatment for the wood of new towers should present relatively little difficulty because there are preservative treatments on the market that can render cheap pine timbers immune to soft rot for very many years. These preservatives are "fixed" in the timber and are not removed by prolonged immersion in water.

Preservative-treated slats may also be used in towers which need new filling only, since the thick framework timbers are not usually seriously threatened and either may remain untreated or may be treated by the double-diffusion process referred to below.

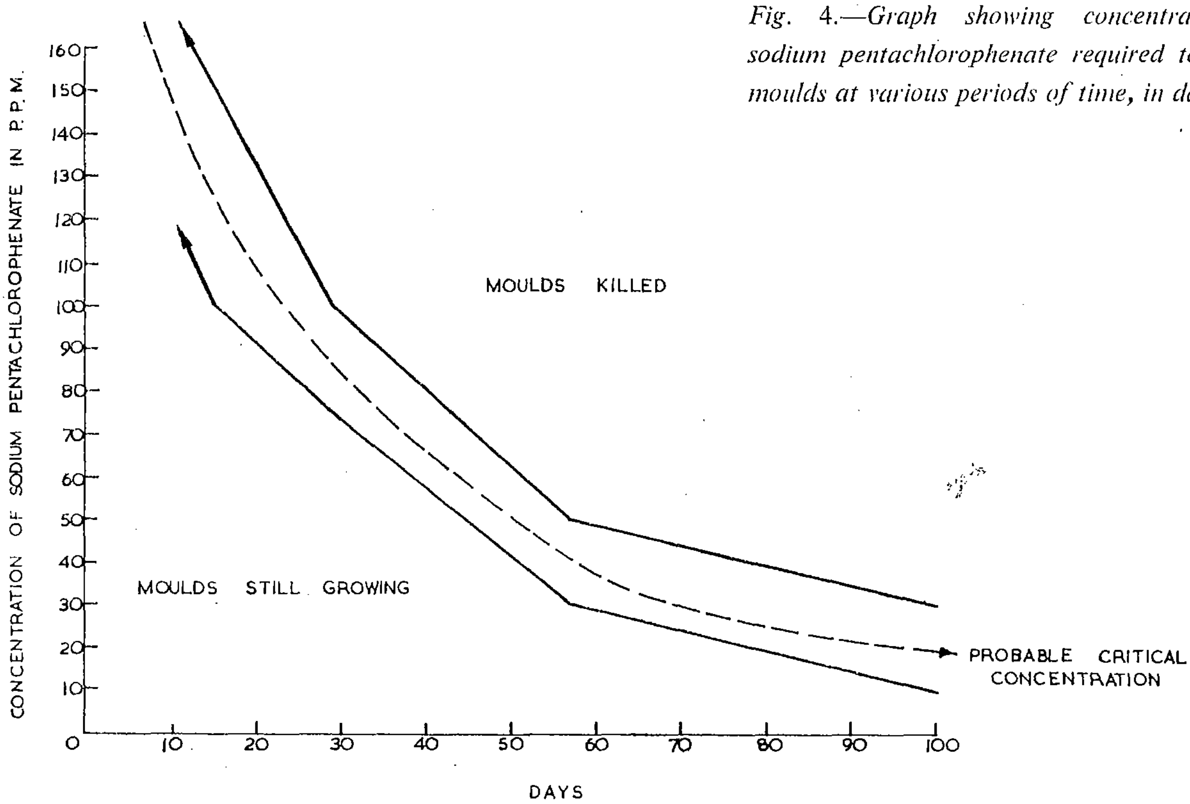
Towers in which the slats still have a useful life can be treated by one of the following procedures, none of which, however, has been on trial long enough to guarantee its efficacy for any great length of time. Methods consist of either adding fungicides to the water or rendering the wood immune to attack by treating it in some manner.

The addition to the water of a fungicidal preservative such as sodium pentachlorophenate or sodium *ortho*-phenylphenate is satisfactory in theory, as may be seen from the graph (Fig. 4), but in practice each tower must be carefully considered on its own merits. Thus, if the tower is immediately to windward of dwellings or grazing stock, the spray may be regarded as too dangerous. The disposal of effluents containing this substance may be too difficult to arrange or the water losses may, especially in very large towers, be too high and the salt lost too rapidly. As to the quantities required, one single heavy dosage of the salt at, say, half-yearly intervals may control the moulds without any great health risks, although it may be safer to dose the water continuously with small quantities at the risk of allowing the fungi to build up an immunity. Other preservatives have been tried, but none is as satisfactory as those mentioned above.

Treatment of the wood in a tower with a wood preservative is perhaps the most obvious method, but difficulties arise in the case of towers already in service which cannot remain out of action for long enough for the slats to be removed and treated in a pressure cylinder.

Another method can be used, however, whereby preservative salts are allowed to diffuse into the wet wood. This process has been used successfully in the treatment of large-section green building timbers, in which a very strong solution of the preservative is applied to the green (or wet) wood, and a suitable period allowed for diffusion.

Fig. 4.—Graph showing concentrations of sodium pentachlorophenate required to kill all moulds at various periods of time, in days.



This principle can be carried a stage further by means of the double-diffusion process whereby two strong solutions of chemicals that will react together to produce an insoluble preservative are applied separately to the timber with an interval of 2 or 3 days between. When the second solution penetrates and the reaction takes place, the resulting preservative is "fixed" inside the timber. The wet slats of cooling towers are well suited to this method and a proprietary process of this nature is available. Details may be obtained from the Division.

Another method of approach is to render the wood impervious to oxygen. Waxes cannot be considered because they not only flow slowly in warm water and so enter the cooling pipes elsewhere in the circuit, but, in addition, they destroy the desirable surface properties of wood which, when untreated, allow the water to spread evenly over its surface rather than collect in droplets. Sodium silicate, i.e. waterglass, the well-known egg preservative, has been suggested since it may, under certain pH conditions, form an impervious stony coating, but this too must somehow be prevented from depositing elsewhere in the water system. A proprietary process is available in the United States using this principle with a modified epoxy resin, and although reports are promising, the process has not yet reached Australia.

Work on the soft rot problem is continuing, and, with the valued cooperation of a number of large cooling tower users, it is hoped that further information concerning the behaviour of various species and preservative treatments in cooling towers will soon be available.

Sawmilling Film

CONSOLIDATED ZINC PTY. LTD. recently donated to the Division of Forest Products a copy of a colour sound film depicting the logging and sawmilling operations of their subsidiary, Heron's Creek Timber Mills Pty. Ltd. This new sawmill, which implements some of the suggestions put forward by Divisional officers in the early stages of planning, has taken over the production formerly spread between a number of small sawmills supplying N.S.W. hardwood timbers for use in mines at Broken Hill. Machinery in the sawmill is among the most modern used for converting hardwoods in Australia.

<< Content

Print this page

A Plywood Swimming Pool

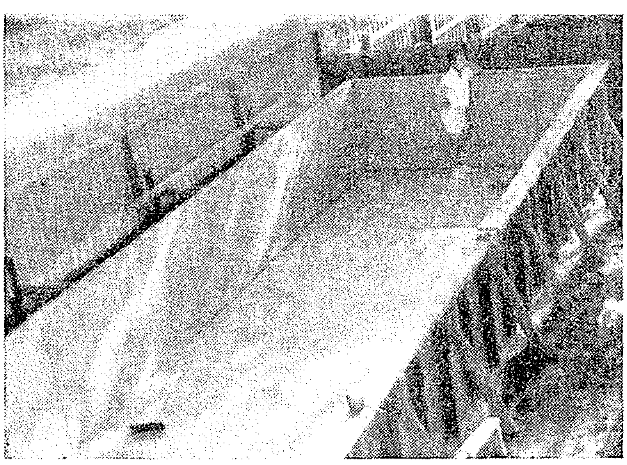
By F. A. DALE, Preservation Section

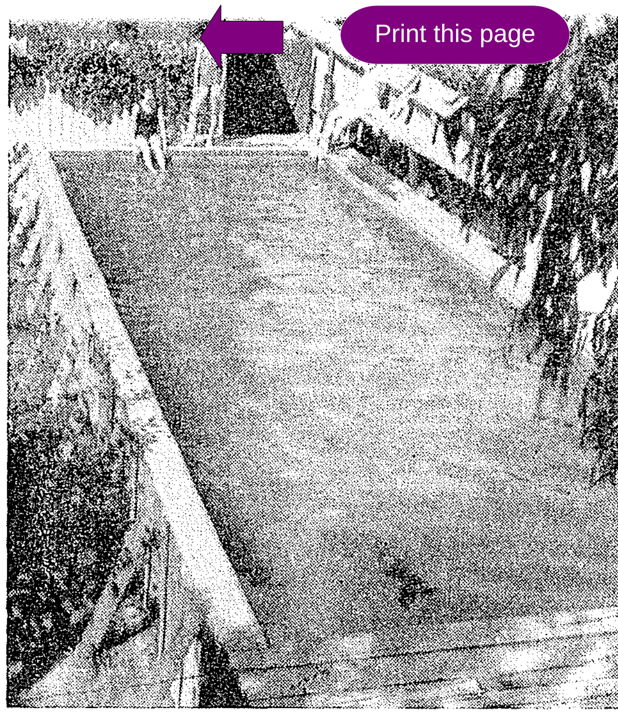
A SWIMMING POOL in the backyard has been the dream of many, but until recently the high cost has been an effective deterrent. The position has changed somewhat with the advent of fibreglass resin pools, but one obvious material, wood, has been largely neglected for the pool proper, although wooden pools with plastic liners have been made. This is surprising, because wooden tanks and pipes have been used for many years and wooden boats are still holding their popularity, particularly since waterproof plywood became available, and a swimming pool is after all only a boat with the water inside!

The main objection to the use of waterproof plywood in a pool has been its susceptibility to decay, but plywood and certain timbers can be impregnated with clean paintable preservatives to make them last for many years under the worst conditions.

A swimming pool designed by the author has recently been completed, and has aroused considerable interest, besides giving great pleasure and satisfaction at a reasonable cost. The pool, shown in the accompanying photographs, is 36 ft long, 12 ft wide, and 4 ft deep. It is of composite construction, comprising a wood and plywood wall bolted to a reinforced concrete slab. The use of a concrete floor simplified construction and reduced the cost, as did erection at ground level and the adoption of a uniform depth.

Pool under construction.





A backyard swimming pool constructed of preservative-treated wood and plywood walls bolted to a reinforced concrete slab.

The walls are framed with preservative-treated 4 in. by 2 in. *Pinus radiata* at 2 ft centres, strutted every 4 ft, and covered with $\frac{3}{8}$ in. marine-grade plywood, also preservative-treated. The frame is fastened with 4 in. galvanized flat-head nails and the plywood attached with $1\frac{1}{4}$ in. and $1\frac{1}{2}$ in. Monel boat-building nails. Dressed 8 in. by 2 in. and 4 in. by 2 in. *P. radiata* forms an edge and walkway around the top. Joints are caulked with special rubber/cement compound and the inside of the pool painted with aluminium/alkyd paint.

A recirculating filter with a plywood filter box and plastic piping keeps the water clean.

The pool took about 400 man hours to build, and total material cost was about £350. The only outside labour used was that of a concrete finisher for the slab.

A logical improvement to the construction would be the prefabrication of the walls in panel form to enable pools of any size to be erected from standard components on a concrete slab.

Grey Satinash

GREY SATINASH is the standard trade common name given to species described botanically as *Eugenia gustavioides* F. M. Bail. Its other common names are water gum and yellow satinash.

Habit and Distribution

Grey satinash is a large-boled moderately tall tree usually attaining a height of 100 ft and a diameter of from 3 to 5 ft. The trunk is straight and symmetrical and well buttressed at its base, and the crown is large and densely foliaged. The bark is rough and flaky.

Grey satinash occurs generally throughout the North-Eastern Highlands of Queensland with its main distribution between the Atherton and Eungella districts.

Timber

The timber is yellowish to yellowish-grey in colour with a uniform medium texture. It is usually straight grained and unfigured, although some material is interlocked and produces a faint figure.

Grey satinash is only a moderately strong timber and has been placed in strength group D, being comparable in strength with hoop pine. The timber is relatively light in weight and has an average density at 12% moisture content of 42·6 lb/cu. ft.

This is one of the more durable species of North Queensland and has a durability rating of 2. The non-durable sapwood is moderately susceptible to Lyctus borer attack.

The timber is easily worked, dresses well, and finishes very smoothly. It nails and glues well and takes an excellent stain and polish.

Seasoning

Grey satinash is fairly readily air or kiln dried from the green condition with little degrade. However, there is considerable variation in the drying rate, and care is needed to prevent serious stress conditions developing at the conclusion of drying. Interlocked grain, which is present in some material, causes warping, but this can usually be prevented by proper stacking practice. Collapse is slight and not sufficient to warrant a reconditioning treatment. One-inch quarter-sawn boards can usually be kiln dried in 6 days, and backsawn material in 8 to 9 days, Shrinkage is low and averages 2·5% radially and 5·7% tangentially.

Uses

This timber is used extensively in Queensland for building construction in the form of bearers, plates, studs, linings, floorings, and mouldings. It is also used for furniture, joinery, cases, plywood, and bridge decking.

Availability

Grey satinash is available in a wide range of sizes as scantling, boards, and dressed products, the annual cut being approximately 10 million super ft.

DONATIONS

THE following donations were received by the Division during February and March:

Emerald Trading Pty. Ltd., Brunswick, Vic.	£10	10	0
Corey and Smith Pty. Ltd., Ravenshoe, Qld.	£10	10	0
Bailey Bros., Glenrowan, Vic.	£15	0	0
North Queensland Sawmillers' Association	£100	0	0
Mirriwinni Sawmilling Co. Pty. Ltd., Mirriwinni, Qld. . .	£10	0	0

Printed by C.S.I.R.O., Melbourne

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Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 310, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 275 JUNE 1961

1961##275

Pole Buildings

By R. G. PEARSON, Timber Mechanics Section

ROUND TIMBERS were once frequently used for posts in many types of rural buildings. Since the last war, this type of structure has become increasingly popular in some countries, particularly the United States of America. In Australia, however, not only has round timber been much less used for such buildings, but structural timber generally has lost to steel much of a market that traditionally was exclusively its own. There are a number of reasons for this, not the least being the readiness of steel merchants to supply quickly the great demand for farm buildings which followed the increase in farm incomes during the fifties. It must be admitted, too, that in Australia poles hitherto have had their drawbacks. The untreated sapwood of most hardwoods is susceptible to *Lyctus* attack, so unless it is removed, poles which are attacked look unsightly. Also, the more durable species were becoming more difficult to obtain, and suitable poles were no longer available in quantity.

The advent in recent years of commercial plants for impregnating round timbers with preservatives, and the consequent ready availability in many localities of treated poles, has changed the picture considerably. Round timbers of almost any species can be treated so that their service life, even when exposed to severe decay hazard, will be at least as long as that of species of high natural durability. The treatment also protects against *Lyctus* and termite attack.

A further advantage of treatment is that the full diameter of a treated pole is available to carry the load, whereas with an untreated pole only the durable heart-wood is structurally effective. Consequently, treated poles may come from trees smaller in diameter than those required to supply untreated poles. The necessity to neglect the sapwood of untreated poles represents a waste of good timber which the country can ill afford, for sapwood is as strong as heartwood but its strength cannot be utilized without treatment owing to its low natural durability.

Although it is normally most convenient to purchase treated poles, in some areas this may not be practicable, or then again the farmer may prefer to use trees growing on his own property. In such cases, treatment may be carried out on the site with simple equipment by one of the procedures developed for the purpose.* If desired, the farmer may impregnate the entire length, but this is not essential for poles in a covered structure where they will be protected from the weather. Full-length treatment will, of course, ensure protection against insect attack. If the butt end only is impregnated, untreated sapwood of *Lyctus*-susceptible species should be removed from the vicinity of joints, otherwise borer attack may cause the joints to slacken.

Round timber posts embedded in the ground have considerable advantages over sawn or other posts set on foundations. The following points should be kept in mind when a new building is being planned:

- Embedded poles impart high rigidity to a

* C.S.I.R.O. Leaflet No. 12, *Round Fence Posts: Their Preservative Treatment.*

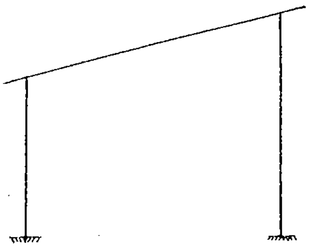

FIG. 1

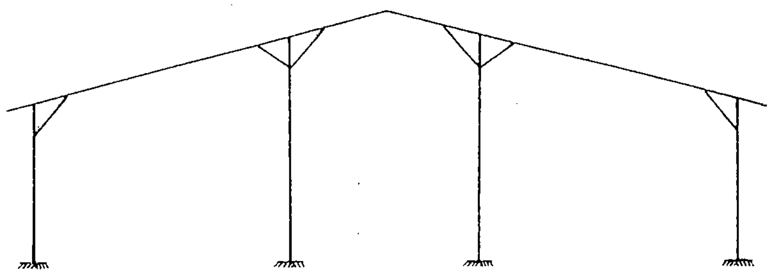

FIG. 3

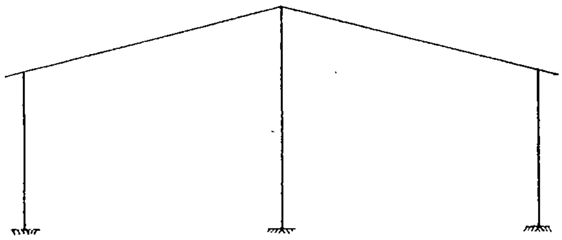

FIG. 2

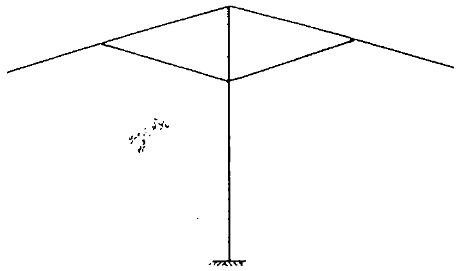

FIG. 4

building and additional bracing is often unnecessary.

●Poles are simple to erect and secure.

● Expensive foundations are eliminated. Should the ground have low bearing strength, satisfactory support may be readily and cheaply provided by pouring concrete around the pole, particularly near ground level, before backfilling the hole.

●Poles are able to withstand considerable knocking about in service. Their ability to resist high impact loads is particularly useful in sheds where vehicles are housed or used, or where material is handled and is likely to hit the posts.

● Round timber posts are stronger than sawn posts of the same species and volume. Defects such as knots have much less effect on the strength of round poles, and sloping grain, a common source of weakness in sawn timber, is absent.

● Poles are relatively inexpensive.

● Poles are suitable for a wide variety of structures.

Providing the poles are selected to be reasonably straight, there is no reason why buildings made with them should not have a perfectly satisfactory appearance. This is mainly a matter of good design and workmanship. Where the sides are to be enclosed, there is some gain in appearance if the outer edge of each pole is set vertically. The additional eccentricity of loading involved by this procedure may have to be considered in the design of long, or heavily loaded, poles.

During erection, the poles should be held with temporary braces and the holes not filled until all poles are in position. They may then be carefully lined up and other structural members attached before securing them finally by ramming the earth around them.

There are many buildings for which poles are suitable. The following list is by no means exhaustive but indicates the sort of buildings for which round timber posts should be considered. It should be noted that not all are farm buildings.

Hay barns	Tank stands
Machine sheds	Boat sheds
Milking sheds	Car ports
Fowl houses	Greenhouses
Storage sheds	Warehouses
Factory buildings	

By suitable choice of roof and wall members, the poles may be spaced as widely as desired, although of course, larger diameter poles are needed for the larger spacings. For wide buildings which must be free from central columns, roof trusses may be used.

Spans for most pole buildings, however, are not large, and the roof may be carried on simple beams across the top of the poles. Knee braces may be required for wide spans and high buildings.

Figure 1 shows the simplest construction, with Figure 2 as an extension where a central row of posts is permissible. A central passage, which may be a driveway for trucks if required, is obtained with the construction in Figure 3. Where open sides are satisfactory, as for machinery shelter-sheds, an "umbrella" structure, such as is shown in Figure 4, is possibly the most economical. To ensure stability, posts are placed under the tips of the cantilevers at the ends of the building.

The spacing of the poles in the direction of the side walls is dependent on the availability of the sizes of timbers needed for purlins. Lengths up to 18 ft are readily available, but longer lengths often have to be ordered specially. The table gives sizes of hardwood purlins and girts for sheet roofing and walling for several pole spacings. More extensive tables are available in C.S.I.R.O. Pamphlet No. 112, *Building Frames: Timbers and Sizes.*

Sizes of Girts and Purlins for Sheet Materials

Spacing of Poles in Side Walls (ft)	Purlin Size (in.) Spaced Apart:		Girt Size (in.) Spaced Apart:	
	36 in.	48 in.	36 in.	48 in.
12	5×1½	5×2	3×3	3×3
14	6×2	6×2	4×2	4×3
16	6×3	7×3	4×3	4×3
18	8×3	8×3	4×3	6×2
20	9×3	9×3	6×2	6×3

A large potential market exists for pole buildings, but considerable developmental design and testing must be done to determine the most suitable and economical types of pole buildings for various purposes.

Some firms engaged in treating or selling round timbers are able to offer designs for pole buildings. The Division of Forest Products, although willing to give advice on request, is not able to supply designs.

Improving the Wood Quality of Our Plantation-Grown Conifers

By J. W. P. NICHOLLS, Wood and Fibre Structure Section

SELECTION for tree breeding has generally been based on external characters of the parent tree, such as form, branching habit, and vigour of growth. Foresters have worked out a definite scoring for these various features and can make their selections on a systematic basis. However, there has always been the doubt whether material selected in this way will have the best wood properties for various purposes.

In the last few years a method has been evolved which enables a selection for wood quality to be carried out in addition to that for external characteristics. This has been based on research work carried out in this Division and elsewhere, in which it has been shown that there is a close relationship between the fine structure of the woody cells and the properties of the wood. Because of this relationship it is now possible to predict many wood properties from an examination of the structure of the material.

Whereas generally the tree must be felled and large samples cut from it to determine the properties of the wood, small samples for the examination of structure can be taken from the living tree. These small samples may be in the form of cores of diameter varying from ¼ in. up to a little over ½ in., or wedge-shaped pieces 2 in. by 2 in. extending through the tree from bark to bark. A method of obtaining a fairly large sized specimen was described recently in Newsletter No. 272. The removal of these larger sized specimens does not have any serious effect on the trees, which remain suitable for breeding purposes.

It has long been known that anatomical changes occur through the early years of the tree's life, and the so-called juvenile wood has, as a result, properties that differ somewhat from those of the more mature wood. To obtain a complete picture of the structural pattern it is therefore necessary to examine the structure of the wood through successive growth rings from the pith. Also, it has been found from examination of many trees of the one species, that there is a large variation among the individuals within any one population. This is so for both the anatomical features and the external tree characteristics. This variation provides a basis on which progress in selection can be made. Therefore, before carrying out any selection procedure based on wood characteristics, a number of trees of the species under investigation should be examined to ascertain the range of variation for the anatomical features selected for consideration. From the results, means can be established for particular features in the population under review. These means will constitute a level below which one should not select if an improvement in the property is to be effected.

It is also essential to determine which characteristics and/or properties are the most desirable for future tree requirements. This involves the difficulty of predicting years in advance how the wood will be used. We have, therefore, in the Division, carried out numerous experiments to determine the relationship between fibre morphology and pulp strength properties, and the importance of anatomical characteristics on the strength properties of timber.

From consideration of the relationships between structure and properties mentioned earlier it would seem that cell length and basic density are the most desirable features on which to base a selection for wood quality. The criteria for assessment to be applied to these two characteristics will, however, depend on the end use of the material. If we expect the trees of the future to be used mainly as timber, longer-than-average cell length should be chosen because it is correlated with better dimensional stability of the wood, and higher-than-average density because it is correlated with improved strength properties. On the other hand, if the wood is to be used for pulp and paper, longer-than-average cell length is again highly desirable, but lower-than-average basic density may be advantageous since it has been found, in general, that paper produced from the denser wood does not have the best strength properties. A further characteristic which should be taken into account is spiral grain. This defect is known to be inherited and therefore it is most important to exclude, as a future parent, any tree which shows excessive angles of grain deviation.

A large number of trees of *Pinus radiata* selected as "superior" trees on the basis of external characteristics have now been examined in relation to their anatomical features. Using specimens cut as indicated earlier, such features as average cell length, amount of late wood in each growth ring, wood density (which is related to cell wall thickness), longitudinal shrinkage, incidence of spiral grain, and chemical composition have been determined. From the analysis of all the results obtained, it is possible to select those trees which are also the best from the point of view of cell length, basic density, and freedom from spiral grain.

Other experiments have indicated that cell length and density are genetically controlled, and therefore one can expect to transmit improvements in them from the parent to the progeny in any tree-breeding experiments.

It is now possible in tree-breeding programmes to select the parent trees on the basis not only of external characteristics, but of intrinsic wood quality, and to expect the desirable characteristics, on which the selections have been made, to be passed on from the parents to the progeny. This must assist in the development of better wood in the trees being grown for the future.

Similar work has been carried out for other species of *Pinus* which are being grown in plantations in Australia at the present time, as well as on some native-grown conifers.

DONATIONS

The following donation was received by the Division during April:

Perfectus Airscrew Company,
Newport, Vic. £20 0 0

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Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 310, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 276 JULY 1961

1961##276

The Drying of Radiata Pine *(Pinus radiata)*

BOARD AND JOINERY TIMBERS

By G. S. CAMPBELL, Seasoning Section

RADIATA PINE, known as Monterey pine in New South Wales, enjoys the reputation of being a species which lends itself to rapid and economic kiln drying green off the saw in board and joinery sizes. Very little degrade occurs provided good stacking and drying methods are employed. Millions of super feet of radiata pine are now being seasoned annually in Australia under methods which depend partly on material thickness, by complete air drying, combined air and kiln drying, or complete kiln drying.

There are wide variations in the kiln drying schedules used, but these appear to have a bearing more on drying rate than drying degrade.

Drying Methods

Kiln drying from the green generally involves the greatest immediate capital expenditure on kilns, boiler plant, and other fixed assets for a given output, but it has the following advantages over the other two methods:

- It largely avoids risk of blue stain* (other than that already in the log at the time of conversion).
- There is minimum expenditure required on yard facilities and stock.
- It gives the fastest possible turnover.
- There is less risk of over- or under-drying once optimum drying conditions, and time, have been established because all material enters the kiln in much the same moisture content condition.

* See Newsletters 258 and 259—Control of Blue Stain.

The significance of this last statement lies in the fact that kiln operators tend to work to a time-based drying schedule when seasoning radiata pine rather than using the sample board method for determining the progress of drying.

Combined air and kiln drying, on the other hand, does give a far greater plant throughput from a given kiln installation than kiln drying from the green, but this is generally at the cost of greater overall capital outlay and working capital charges when the cost of air drying facilities, roadways, and the value of stock air drying are taken into account. Furthermore, it usually requires more care on the part of the kiln operator, because careless yard operations could lead to kiln charges being made up of partly air dried stacks of widely varying moisture contents which, in turn, could result in unevenly dried kiln charges. Also, it does involve somewhat more risk of blue stain than kiln drying from the green, despite the undoubted effectiveness of anti-stain dips. In general, complete air drying would not be recommended for radiata pine required for flooring, board, and joinery purposes except, perhaps, for comparatively short periods during summer and early autumn.

Stacking Practice

Whichever method of drying is selected, good results can be obtained only if good stacking practice is followed, and certain stacking precautions are taken. The first is that stack bearers are cut from sound timber (avoid softwood containing pith or heart) and evenly spaced at not more than 18-in. centres on the foundations. The next precaution is that stacking strips, which should be cut from sound seasoned timber and machine dressed to a uniform thickness, are placed directly over the bearers, and a perfect vertical alignment maintained throughout: the strip size recommended is $1\frac{1}{2}$ in. wide by not less than $\frac{3}{4}$ in. thick. Some plants prefer to use strips 1 in. thick, and, while this reduces kiln capacity somewhat, it should provide for faster drying.

Overhanging ends should not be permitted in a stack, as these are a source of serious warping and uneven moisture distribution in seasoned radiata pine. They can be avoided by box-ending the stacks, i.e. keeping both ends of the stack flush. Where timber is to be kiln dried, it is also most important to keep the sides of stacks vertical and flush.

Weighting the stacks is generally beneficial, particularly where material containing pith is being dried. For 1 in. thick stock, the weights used (either reinforced concrete slabs or steel rails are suitable) should be equivalent to 60–80 lb per square foot of top surface area of the stack, and they should be distributed as evenly as possible over the lines of stickers. For thicker material a heavier loading could be an advantage. The weights should be placed on the stacks before drying commences and not removed until the stack is about to be broken down for machining or despatch.

Kiln Loading and Drying Procedure

In placing stacks in the kiln, it is important to ensure that there are no gaps between, over, or under stacks where air can short circuit them. Baffles are required for this purpose and, in some cases, it has been found helpful to baffle off the gaps between individual fork-lift packs of the kiln stacks by placing a board against the ends of the separating bearers, i.e. gluts, which should be cut to uniform length to facilitate this procedure.

Kiln drying should be continued until the average moisture content of the charge is 1–2% below the desired final equilibrium moisture content, and the charge then allowed to cool for a few hours before any final treatment is given. This latter can be carried out in the kiln by giving the usual high-humidity treatment for the relief of drying stresses, or, more commonly, by removing the charge to a reconditioner where it is given a short steaming treatment at 212°F, under saturated conditions for a few hours, the actual time depending on the thickness and the quality of the material. This steaming treatment is particularly useful for reducing warp, but care is necessary to avoid over-steaming which may cause reversed stresses to develop in the timber.

After steaming, the charge should be removed to a dry storage shed and allowed to "condition" for 3–4 days before it is unstripped. This "moisture equalizing" period allows moisture gradients in individual boards to even out, and is especially useful in providing time for excess surface moisture, resulting from steaming, to dry off. It thus ensures greater uniformity in moisture content throughout the whole stack before final processing. Troubles on machining have been reported where insufficient time has been allowed for this phase of the seasoning process. On the other hand, prolonged storage during humid weather may result in an undesirable increase in surface moisture content of the timber. This effect, however, can easily be avoided by storing the timber in a shed heated to maintain the required E.M.C. condition.

Sampling for Moisture Content

The techniques used to obtain moisture quality control vary between plants, but all have a common basis in requiring the use of either of two methods of moisture content determination. The first involves the use of an electrical moisture meter. Resistance-type meters cannot be relied upon to give very

Table 1: Modified Moisture Meter Correction Data for Radiata Pine

Moisture Meter Readings (%)		8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	26	28	30	32	34	36	38	40
Corrected Moisture Content (%)	S. Aust.:	11	11	12	13	14	15	16	17	18	19	20	21	23	24	25	26	27	28	29	30	31	32	33	33	34
	Vic.:	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	28	29	30	31	33	34	35	36

Table 2: Standard Kiln Drying Schedules for Radiata Pine

D.B.T. = dry-bulb temperature; W.B.D. = wet-bulb depression

Moisture Content Change Point (%)	1-in. Mixed Sawn		1½-in. Mixed Sawn		2-in. Mixed Sawn		3-in. Mixed Sawn	
	D.B.T. (°F)	W.B.D. (°F)	D.B.T. (°F)	W.B.D. (°F)	D.B.T. (°F)	W.B.D. (°F)	D.B.T. (°F)	W.B.D. (°F)
Green	150	15	150	10	130	10	130	7
40	150	20	150	15	140	15	140	10
35	—	—	—	—	—	—	140	15
30	160	30	160	20	150	20	150	20
25	—	—	160	25	150	25	150	25
20 to final	180	30	180	30	160	30	160	30
Approximate Drying Time (24 hr/day)	2½–3½ days		6 days		9 days		14 days	
Final Treatment*	Steam for 3 hr at 212°F		Steam for 4 hr at 212°F		Steam for 5 hr at 212°F		Steam for 7 hr at 212°F	

* The alternative final treatment to steaming as above is to give a high-humidity treatment in the kiln at conditions of 180°F dry-bulb temperature with a 10°F wet-bulb depression for 8–12 hr per inch of thickness.

accurate readings below 10% or above 24% for radiata pine, and temperature has a very marked effect on moisture meter readings, particularly at the higher moisture contents. For this reason it is recommended that the timber be allowed to cool before testing.

The modified moisture meter correction data given in Table 1 are the result of recent work on *Pinus radiata* grown in South Australia and Victoria.†

The second method of measuring moisture content for moisture quality control purposes is by means of sample boards.‡ In commencing operations at a new seasoning plant, a liberal number of sample boards should be used until sufficient experience has been obtained in the drying of radiata pine and a routine procedure established. The number of sample boards then used may be reduced accordingly, but the moisture meter is still required for checking uniformity of moisture content throughout the dried material.

Kiln Drying Schedules

From studies carried out by this Division on the drying rate and behaviour of radiata pine, the kiln drying schedules given in Table 2 were developed, and have proved suitable for drying this species in conventional compartment-type internal fan kilns. These schedules are somewhat conservative, but can usually be readily held even in most of the older kilns which lack some of the heating surface and fan capacity which enable more modern kilns to provide more severe drying conditions. Even so, drying times are not unreasonable.

In the modern kilns now designed by the Division for the rapid drying of pine from the green condition, drying times of 45–50 hr are commonly attained for 1 in. thick stock. These kilns have air circulation speeds through the drying stack of 400–500 ft/min or better, and are capable of reaching initial temperatures of 180°F even when loaded

† Further information on the testing of timber for moisture content is contained in Division of Forest Products Trade Circular No. 50. Moisture meter correction data for radiata pine treated with waterborne preservatives can be obtained on application.

‡ Information on the preparation of sample boards is contained in the Division's Trade Circular No. 7.

Table 3: Some Typical Fast Drying Schedules for 1 Inch Thick Radiata Pine
D.B.T. = dry-bulb temperature; W.B.D. = wet-bulb depression

Source:	N.Z. Forest Service		Commercial Plant in N.S.W.		Suggested by C.S.I.R.O.	
Moisture Content Change Point (%)	Drying Conditions		Drying Conditions		Drying Conditions	
	D.B.T. (°F)	W.B.D. (°F)	D.B.T. (°F)	W.B.D. (°F)	D.B.T. (°F)	W.B.D. (°F)
Green	170	20	180	30	160	20
40	170	20	180	30	180	25
20 to final	170	20	200	40	200	30

with green pine with moisture contents as high as 150%. Some typical fast drying schedules are shown in Table 3. The shorter drying times obtained with these fast drying schedules have not been found to be detrimental to the timber under normal operating conditions. The kiln drying of radiata pine at temperatures above 212°F, i.e. under superheated steam conditions, is not very widely practised in Australia, but information regarding this method can be obtained on application to the Division.

Drying schedules should not be followed blindly, but should be adjusted to suit the particular class of material being dried. If knot cracking becomes a serious form of degrade, the initial wet-bulb depression should be reduced and care taken to avoid any tendency to overdry. Overdrying may produce other undesirable defects such as increased warping or difficulties on machining.

Redrying Preservative-Treated Material

In some cases, pressure treatment with waterborne preservative salts may increase drying times. Research carried out by the New Zealand Forest Service has shown that, when pressure treatments are taken "to refusal", redrying time may be considerably longer than the normal drying time for green material. On the other hand, it has been found that timber treated by diffusion methods dries just as readily as green timber. The Division hopes to carry out further research work in this field under Australian conditions as opportunity permits.

Kiln Operation

With regard to the actual operation of a pine-drying kiln, it is advantageous to bring the kiln up to operating temperature as rapidly as possible: this is best done by means of the humidifying spray, as low-humidity conditions in the early stage are thus avoided. Saturated conditions at the required temperature should then be held for an hour or so before reverting to the drying schedule.

Differences of opinion exist in the timber trade in Australia and New Zealand as to the frequency at which direction of air circulation in the kiln should be reversed when kiln drying green radiata pine. At some plants, reversals are made every half hour whereas, at others, only one reversal of circulation is made throughout the complete drying period: advocates of this latter method contend that the drying lag normally occurring at the centre of a stack is thereby practically eliminated, thus producing a more even final moisture content across the width of the stack. Until this point of issue can be clarified, however, from two to four reversals per day, at regular intervals, is recommended.

Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 310, SOUTH MELBOURNE, S.C.5, VICTORIA
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 277 AUGUST 1961

1961##277

Reaction Beam for Structural Testing

By R. G. PEARSON, Timber Mechanics Section

A VERY LARGE test reaction beam has recently been constructed to facilitate the Division's research on timber structures. It is of reinforced concrete, 120 ft long, 4 ft square in cross section, weighs 130 tons, and has been set in the ground with its upper surface at floor level. It will support timber structures under test and will provide the reaction for the hydraulic jacks used for applying the test loads.

The hydraulic jacks will be attached to the exposed upper flange of a heavy steel girder embedded in the concrete for the full length of the beam. The method of attachment will enable the jacks to be located at any position along the beam. Normally the jacks will be used in tension, but, if required, they will be capable of applying compressive loads. They will have a capacity of 5 tons and a stroke of 16 in. to cope with the large deformations which some structures show at failure. The beam has been designed to permit a total distributed load of 100 tons to be applied to structures of spans up to 100 ft. Head room available in the laboratory will permit the structures to be 20 ft high. Few, if any, other laboratories in Australia have the facilities for the indoors testing of structures of these dimensions.

It is planned to test a 95-ft span timber portal frame as soon as the auxiliary testing gear has been fabricated. This frame will be a prototype for those intended for a series of buildings which may eventually cover several acres.

The reaction beam will remove the limitations imposed by the present facilities of the Division on the length of structures which may be studied and on the loads which may be applied. Not only will it be useful for long structures but also for short ones designed for heavy loads such as bridge girders. Furthermore, it will enable several relatively short-span structures to be in the test rig at the same time and tested independently. This will allow some structures to be readily subjected to loads of moderate duration in the laboratory without interfering with other testing. It will also save the waste of time and labour involved if a structure being subjected to a prolonged investigation has to be removed from the test rig, and subsequently re-erected to allow more urgent tests on other structures to be done.

Structural engineers, architects, and builders must be sure that their structures will behave in service as they expect them to do. Consequently, if they are to have confidence in the safety and adequacy of timber structures, it is necessary that there should be available considerable information on the behaviour of the structures under load. This can only be gained by testing full-size structures; tests on components and models provide useful information but cannot give a complete picture. Theories of structural behaviour have to be checked against experimental results. Even structural steel, a material made to a definite specification and obeying a simple stress-strain relation, is still being extensively investigated in many laboratories to improve the way it is used and to determine how it behaves under various circumstances. Timber, with its inherent variability and the complex effect on its properties of time, temperature, and humidity, will not be universally regarded as a structural material of proved reliability until it, too, has been thoroughly investigated in structural forms. Much has been done in this regard in recent years, particularly in the U.S.A. and Europe, and timber has been used for structures which previously were considered outside its scope. To take only one example, a sports arena in the U.S.A. has a roof supported by timber arches 340 ft long.

In Australia also there has been an increasing interest in modern types of timber structures, and a growing demand for information on the structural use of timber and its related products, plywood and hardboard. The new reaction beam will play its part as a major piece of research equipment in the Division's programme to satisfy this demand and to assist in the development of this field of utilization of one of Australia's most important primary products.

Forest Products Research Conference

THE 10TH Forest Products Research Conference was held at the Division of Forest Products during the first week of July.

This Conference, first established in 1946, has been held at approximately 18-month intervals ever since, and provides an opportunity for discussions between officers of the Division and the various Federal and State forestry authorities.

New Zealand has been represented at the past two conferences, and this year Dr. Dennis Richardson, recently appointed Director of the Forest Research Institute at Rotorua was one of the New Zealand delegates.

Problems connected with timber preservation were actively discussed. This industry is assuming increasing importance in Australia and recommendations are constantly being sought as to suitable preservatives and retentions for specific purposes.

Another item of considerable importance was the discussion on radiata pine, Australia's most important exotic timber.

Overseas Visits

Mr. C. S. Elliot, Assistant Chief of the Division, will be leaving early this month to lead the Utilization Section of the Second World Eucalyptus Conference, in São Paulo, Brazil. Organized by F.A.O., the conference will discuss developments in the growth and utilization of eucalypts in the many countries where the genus has been introduced, and will draw up recommendations for future developments in those countries.

Mr. H. G. Higgins, Officer-in-Charge of the Wood Chemistry Section, left Australia early in July to visit laboratories in Europe concerned with pulp and paper, wood chemistry, and physical chemistry of cellulose. In September, he will present two papers at a conference at Oxford organized by the Fundamental Research Committee of the British Paper and Board Makers Association.

Mr. A. Rosel, of the Timber Preservation Section, is spending 2–3 months in Fiji assisting with the implementation of work being done in the Colony under a cooperative arrangement with the Division.

Mr. E. W. B. da Costa, of the Timber Preservation Section, left last April on an overseas study tour in which he will visit New Zealand, Canada, America, England, several European countries, and Japan. The main purpose of these visits is to discuss current trends in wood preservation, with particular reference to timber mycology, with leaders in the field in both Government and private institutions. He expects to return to Australia in October.

DONATIONS

THE following donations were received by the Division during May and June:

Particle Board Co. of Australia Pty. Ltd.	£250 0 0
George Wills & Co., Melbourne	£10 10 0
A. A. Swallow Pty. Ltd., Melbourne	£100 0 0

Allowable Loads for Planking

By H. KLOOT, Timber Mechanics Section

DESIGN TABLES* for timber beams and columns were published in Newsletter 271 at the beginning of this year. In these tables, the safe loads tabulated for beams were based on the usual practice of supporting beams, joists, rafters, etc., on edge. For certain purposes, such as scaffold planking, decking for tank stands, shelving for heavy storage, and so on, it is of course more usual to use timber sections supported on the face, that is, as planks. It is a relatively simple matter to determine the allowable loads for timber sections to be used as planks from the tables for beams supported on edge.

It should be noted that the allowable loads given in the beam tables have already had the beam weights taken into account. However, the loads calculated from them according to the following rules still include a high proportion of the beam weight. *It is essential therefore that the weight of the beam be subtracted from the calculated allowable load for the plank.*

The weight of a beam may be taken with sufficient accuracy as 0·5 *bdL*, 0·45 *bdL*, 0·4 *bdL*, and 0·33 *bdL* lb for green Strength Group A, B, C, and D timbers respectively, where *b* and *d* are the breadth and depth in inches, and *L* is the span in feet.

The procedure to be used for finding the allowable load for a plank is as follows:

- **When strength is the criterion,** find from the table the safe load for the particular timber section. *Multiply this safe load by the thickness of the plank, divide by its width, and subtract the weight of the plank. For example,* the safe distributed load for a green hardwood beam, 10×2 in., of Strength Group C supported on a span of 12 ft is given as 3460 lb. The maximum safe dead load for this section as a plank would therefore be 3460×2/10 = 692 lb. From this must be subtracted 0·4×10×2×12 = 96 lb. Therefore the maximum safe load that can be placed safely on the plank is 596 lb.

- **When stiffness is the criterion,** find from the table the allowable load for the particular section. *Multiply this load by the square of the plank thickness, divide by the square of its width, and subtract the weight of the plank. Using the same example as above,* where stiffness is the criterion, the allowable load from the table is 1300 lb. The corresponding allowable distributed dead load for this section as a plank would be 1300×2/10×2/10 = 52 lb. The beam weight of 96 lb is nearly double this load, which means that, under its own weight alone, the beam will sag to nearly twice that allowed in the beam tables.

The above rules apply directly to distributed loading. If it is desired to find the allowable concentrated load on a plank, then, when strength is the criterion, the safe load from the tables should be halved, and for stiffness the allowable load should be multiplied by five-eighths.

When live loads are involved, or the timber is dry or of a grade other than standard, the tabulated beam loads should first be modified as recommended in the design tables referred to above.

* Copies of these tables are available free on request from the Chief, Division of Forest Products, P.O. Box 310, South Melbourne, S.C.5.

Two New Publications

INFORMATION ON IMPORTED TIMBERS

THE DIVISION receives many inquiries relating to the properties of timbers imported into Australia. Generally the inquirer wants to know either the local timber which can be used in place of a previously imported one, or whether an imported timber can be used for a specific purpose. To make information on the many imported timbers readily available for reference purposes, the Division has recently published Technological Paper No. 12, **Properties of Timbers Imported into Australia,** which lists the important characteristics of 250 foreign timbers.

Apart from listing the mechanical properties in a form which allows comparisons to be made with local timbers in a very simple manner, indications of shrinkage characteristics and borer susceptibility are given for each timber, together with a description of the wood and a list of common uses.

It is hoped that this publication, which involved the reviewing of a large number of references, the translation of many, and the conversion into the British system of units of much of the data published by overseas laboratories, will prove of value to the timber trade generally and in particular to those interested in imported timbers.

SHRINKAGE AND DENSITY DATA

For the satisfactory utilization of timber it is frequently necessary to know its density and also the shrinkage which occurs on drying; and in species where collapse is important, it is desirable to have information on these properties before and after the reconditioning treatment. Other related information, such as the saturated density, the saturated moisture content, and the shrinkage intersection point, is required on occasion.

The Division has carried out measurements of these properties for a wide range of Australian timbers over many years, and the results have been published at intervals. However, it is now over twenty years since the last publication was issued summarizing the shrinkage and density values obtained, and in the meantime a large number of additional measurements have been made.

Further tests have been carried out on important species, and many other commercial species, particularly from New Guinea and elsewhere in the South-west Pacific area, have now been examined. All the results previously published, results made available by the N.S.W. Forestry Commission, and the results of recent tests in the Division have been reanalysed and published in Technological Paper No. 13, **Shrinkage and Density of Australian and other South-west Pacific Woods.** In this publication, shrinkage and density values are tabulated for nearly 400 species, and formulae are given for the calculation of other information from the tabulated data.

Copies of either of these papers may be obtained free on request to the Chief, Division of Forest Products, P.O. Box 310, South Melbourne, S.C.5.

PROPERTIES OF AUSTRALIAN TIMBERS

Red Bloodwood

Red bloodwood is the standard trade common name for the species described botanically as *Eucalyptus gummifera* (Gaertn.) Hochr. syn. *E. corymbosa* Sm.

Habit and Distribution

Red bloodwood is a medium-sized tree usually 100–120 ft in height and 3–4 ft in diameter, although in relatively dry areas it may be smaller. The trunk is about half to two-thirds the total height of the tree and often somewhat malformed. The crown is well developed and compact. The bark is rough, flaky, and persistent throughout the tree. This species occurs in coastal areas extending from eastern Gippsland in Victoria into the Atherton district of Queensland.

Timber

The timber varies from pink to dark red in colour and is characterized by the presence of numerous concentric gum veins and pockets. The wood is coarse textured and usually interlocked. The timber is hard, strong, and tough and has been placed in strength group B. It has a density of 70 lb/cu.ft in the green condition and 55·0 lb/cu.ft at 12% moisture content.

The timber is extremely resistant to decay and termites, and therefore has been rated for durability in class 1. Bloodwood is usually used in the round form and is rarely sawn because of its tendency to separate along the gum veins.

Seasoning

As red bloodwood is used in the round form it is not usually seasoned, and as a result no information is available on this aspect.

Uses

This timber is used mainly in the round or hewn form for house stumps, sleepers, fence posts, piles, sills, mining timbers, and heavy construction.

Availability

Red bloodwood is fairly readily available in New South Wales and Queensland, the annual total log volume being approximately 10 million super ft.

Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.
Forest Products Newsletter
DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 310, SOUTH MELBOURNE, S.C.5, VICTORIA
REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 278 SEPTEMBER 1961

1961##278

The Timber Preservation Industry in Australia

PART I. TREATMENT FACILITIES

By F. A. DALE, Preservation Section

SINCE the introduction of boron immunization in New South Wales and Queensland, timber preservation has made considerable progress and commercial preservation is now an important part of the timber industry of Australia. This article gives a brief review of its growth and outlines the facilities now available and their potentialities for the timber trade.

Why is Preservation Needed?

Timber preservation is necessary in Australia for these reasons:

- To enable the use of susceptible sapwood.
- To enable the continuing use of timber where the supply of naturally durable species is diminishing or non-existent.
- To maintain the use of timber in competition with other "durable" materials where its other properties make it desirable.

What Timber can be Treated?

It is vital to realize that only certain types of timber can be effectively treated with preservative by the methods now commonly employed. Generally speaking, all round timber, whether hardwood or softwood, can be impregnated with preservative in the sapwood and so be effectively protected.

For the same reason, certain timbers such as *Pinus radiata* and some rainforest timbers which have a very wide sapwood can be effectively treated when sawn. Only a very few timbers have permeable heartwood. Eucalypts, which comprise the bulk of building timbers used in Australia, cannot be treated in the heartwood except at very high pressures, but treatment of these timbers is not necessary for ordinary building purposes.

Softwoods such as Douglas fir, hemlock, and Baltic spruce imported into Australia in large quantities either have narrow or impervious sapwood and are not treated except in special circumstances.

Plywood can be treated in two ways. If made of permeable veneers such as coachwood or hoop pine sapwood, then the finished sheets can be pressure treated with various types of preservative and penetration to the centre of the sheet can be obtained. If impervious veneers are used the penetration in from the edge will depend on the veneer species and extent of peeling checks in the veneers. Such plywood can often be satisfactorily treated if no cutting is to be done after treatment.

Alternatively, green veneers can be treated by either pressure or diffusion methods with waterborne preservatives before drying and gluing, but these techniques and associated problems are still being studied.

As waterproof plywood is commonly used in places of high decay hazard, it is most desirable that it be treated. This and other aspects are covered in the Division's Technological Paper No. 6 *Preservative Treatments for Plywood.*

What Processes can be Used?

All the preservation processes used in Australia have as their aim the impregnation of timber in depth with a preservative which will prevent insect and/or fungal attack. Surface treatments have very limited value and will not be discussed in this article.

The processes in use are broadly classified as follows:

(1) Pressure treatment in which preservative oils or waterborne solutions of preservative

Typical small multi-purpose pressure plant.

salts are forced into the timber under hydraulic pressure with or without the use of heat and vacuum. The common variations of this process are:

- *Full-cell* (Bethell) process in which an initial vacuum is drawn in the impregnation vessel or cylinder in order to remove all air possible from the wood before impregnation. This ensures a maximum retention of preservative.
- *Empty-cell* (Rueping) process in which air pressure is applied to the wood before filling the cylinder under the same pressure. A final vacuum is drawn after impregnation. This variation controls the retention while still ensuring adequate penetration.

The *Lowry* process is a variation of the empty-cell process in which the cylinder is filled under atmospheric pressure. This results in final retentions less than those obtained with full-cell but greater than those with Rueping treatment.

(2) **Diffusion treatment** in which chemicals penetrate into the green (or wet) timber by slow molecular movement from aqueous solution. The process can be accelerated by heating but does not require the application of vacuum or pressure.

(3) **Hot and cold bath treatment** is in fact a form of pressure treatment in which wood is heated to expel air and then allowed to cool in preservative which replaces the expelled air. Oils and certain waterborne solutions may be used.

Other processes such as cold soaking of dry timber in preservative oils and sap replacement with waterborne preservatives of round timber can be used, but they are not commercially important in this country.

Preservatives

Two types of preservative are in common use. The preservative oils include creosote, a coal-tar distillation product, usually prepared to Australian Standard Specification K.55, and solutions of pentachlorophenol or "penta" in petroleum oils.

The waterborne preservatives are inorganic compounds or mixtures of such compounds which are dissolved in water, the timber then being impregnated with the solution. The two main types of waterborne preservative are:

(1) **"Fixed" preservatives**—multi-salt preservatives which are usually applied under pressure and which "fix", *i.e.* become insoluble in the wood after treatment. "Boliden", "Celcure", and "Tanalith" are proprietary preservatives in this class.

(2) **Diffusing preservatives** including the boron and fluorine compounds largely used for immunizing Lyctus-susceptible sapwood and the multi-salt preservative initially developed by this Division for the treatment of building timber in New Guinea. These compounds do not "fix" in the wood.

(3) **Miscellaneous** waterborne preservatives include ammonium phosphate compounds used for fire-proofing and sodium pentachlorophenate and other compounds, used in dipping green timber to prevent blue mould or "sapstain".

Preservative Treatment Facilities

Pressure Plants

Pressure plants are now established in every State in Australia and the location and particulars of each plant operating as at July 1961 are set out in the table in Part II of this article. The first large-scale commercial pressure plant was established at Grafton, New South Wales, in January 1957 to treat poles with creosote for the Postmaster-General's Department.

The need for such treatment had been apparent since the end of the war, when supplies of durable poles became scarce. Tests set up by this Division had shown that non-durable eucalypt poles with adequate sapwood treatment could give service at least as good as that of the durable species, and the establishment of treatment plants became a necessity. Other plants to meet the needs of pole users have since been set up in all the southern States. All have cylinders 6 ft in diameter by 70 ft long so that they can treat the largest poles and piles. Creosote is used in all mainland plants but the Tasmanian plant uses a waterborne preservative ("Tanalith C") mainly due to the high cost of transporting creosote. The efficacy and permanence of this type of preservative had already been established in pole tests in Victoria and in large-scale use overseas.

While primarily treating poles for Government Departments, all these plants can supply poles, fence posts, and other treated timber to any inquirer and this demand is steadily increasing.

Since 1957 a number of other pressure plants have been established in all States. Most of them were set up for the treatment of sawn *Pinus radiata* with waterborne preservatives, but they can treat any round timber and other sawn softwoods. One plant at Mount Gambier, South Australia, was set up as a creosoting plant to treat pine rail sleepers, posts, and poles, primarily as a result of tests started in that State in 1936 by this Division and State authorities, which showed that oil treatment of *Pinus radiata* sleepers could give service lives at least as good as jarrah or red gum in most conditions.

A third class of pressure plants comprises the low-pressure treatment plants, mostly designed by this Division and used for the treatment of round fence posts, hop poles, and in one case mining timbers. One of these, near Adelaide, was the first plant to treat fence posts for sale in Australia. However, they are special-purpose plants and only a few are treating timber for sale. Because they treat at a pressure of only 50 lb/sq.in. they are light, easy to build, and cheap, and there is still a place for them as private plants on large holdings or to fill local needs where the establishment of 200 lb/sq.in. plant could not be justified economically. A portable plant similar to the prototype built by this Division costs about £500–£600 and can treat 80–150 fence posts, according to size, per day. Such a plant can use oils or waterborne preservatives, but the latter are generally preferred for cleanness and the ease of handling of both preservative and treated product.

The high-pressure plant is a recent development by which the heartwood of some species can be impregnated sufficiently to gain appreciable protection. Following several years of development with the Division's pilot plant, the first commercial high-pressure plant was established in Western Australia in 1960. Here, sawn karri (*E. diversicolor*) cross-arms are treated at pressures of 600–1000 lb/sq.in. using pentachlorophenol in heavy oil.

A similar plant, also for treating hardwood cross-arms, is being installed in Victoria. It will treat various eucalypt species at similar pressures.

The number and location of pressure plants are such that Australian timber users are now able to buy treated timber or have timber treated in most parts of the continent.

Immunizing Plants

The first commercial preservation treatment in this country was the immunization of Lyctus-susceptible sapwood in Queensland and New South Wales using boron compounds. Immunization is required by law in these States, and the treatment is applied to veneer used in plywood manufacture and to sawn timber. Green timber or veneer can be treated very cheaply by dipping in concentrated solutions of boron (and fluorine) compounds and then block stacking for a specified period to allow diffusion to take place. Alternatively green timber can be treated by the "hot immersion" method, in which the rate of diffusion is greatly increased by heating. Dry or partly dry timber can be treated by the hot and cold bath or the steam and quench treatment.

Recently such timber has been treated by pressure methods. The concentration of solution used depends on the degree of drying and the consequent liquid absorption of the timber, and timber that is only partly dried must be held after treatment and before kiln drying to allow diffusion of the preservative into the wetter "core" material to take place.

Inquiries concerning treatment of timber under a State Act should always be addressed to the Forest Department of the State concerned. (*The second and concluding part, "The Uses of Treated Timber", will appear in the next issue.*)

Round Timber Bridge Stringers

By R. G. PEARSON, Timber Mechanics Section

ONE of the earliest methods of crossing a stream was to fell a tree over the gap. Even today, round timbers still provide one of the simplest, cheapest, and strongest structural systems for small-span bridges and culverts. They are obviously suitable for crossings on access roads on farms and in forest areas, but it is not always realized that they may often be used with economic advantage on shire roads and secondary highways.

Steel and concrete are usually favoured because they are regarded, not always justifiably, as permanent materials requiring little or no maintenance. Permanence, however, is by no means an essential requirement for bridges. Long before they become structurally unsound, the normal growth in traffic density and change in type of traffic usually render most bridges obsolescent, and frequently unwanted in their existing locations owing to realignment of the road. This does not imply that timber bridges have a short life. When properly designed, their life will be more than adequate provided the timber is either from a naturally durable species or is impregnated with preservative.

The need for maintenance of timber bridges usually relates to the foundations or the decking and not to the stringers. Preservative impregnation of timbers for piles and abutments reduces maintenance to minor proportions as far as most foundations are concerned, and there are possibilities for improved types of decking such as nailed, laminated panels of impregnated scantlings side by side on edge, or even concrete where the cost is warranted.

In considering materials for structural bridge members, the engineer or builder should keep in mind timber's characteristic ability to absorb impact loads. Not only does no special provision have to be made for impact loads unless abnormally high (in excess of 100% of the static load), but a considerable overload can be sustained provided it is of short duration.

Both sawn and glued laminated timbers are successfully used in bridge construction. However, round timbers for stringers have advantages which should be carefully considered. Round timbers may be safely stressed more highly than sawn solid timbers because defects such as knots or spiral grain have less effect on strength and cross-grain is absent. Preservative-treated poles are readily available and are relatively inexpensive. Impregnation with preservative renders the sapwood highly durable and so the full cross section, including the sapwood of a treated pole, may be counted on to carry stress. Consequently, smaller treated poles are the equivalent in strength of larger untreated poles for which the sapwood must be disregarded. These smaller poles are easier and cheaper to handle and transport, and may be from non-durable species.

To assist engineers, forest officers, and others concerned in the design of timber bridges, a number of tables have been prepared in which are given the sizes of round stringers needed for various spans, spacings, and loadings. The spans considered range from 10 to 40 ft and the loads correspond approximately to 10, 15, and 20 ton vehicles.

These tables will be included in a handbook for forestry officers to be issued by the Forestry and Timber Bureau, but roneod copies may be obtained on application to the Chief, Division of Forest Products.

DONATIONS

THE following donations were received by the Division during July:

Murray Valley Sawmills, Nathalia, Vic.	£ 15	0	0
Woodpecker Sawmillers and Traders, Welshpool, W.A. ..	£ 5	5	0
Bright Pine Mills Pty. Ltd., Vic.	£100	0	0

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Printed by C.S.I.R.O., Melbourne

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Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 310, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 279 OCTOBER 1961

1961##279

The Timber Preservation Industry in Australia

PART II. THE USES OF TREATED TIMBER

By F. A. DALE, Preservation Section

ONCE builders, architects, and engineers as well as the timber trade realize that timber can be given "built-in" protection, then the range of applications for which it is used in this country will be very much wider than at present, and this range will include a great many traditional uses from which it has disappeared because the durable species once used are no longer available.

Timber has a number of properties which make it an ideal material for building and construction, such as lightness, high strength/weight ratio, and ease of fabrication. When an assured life under exposed conditions is added to these properties it becomes much more attractive and can usually compete more than favourably with so-called durable materials which often require regular maintenance to attain similar lives.

The list below covers a range of applications where treated timber can be used to advantage because it is cheaper, more resistant to destructive elements, more attractive to look at, or easier to erect. Many uses for treated timber are overlooked simply because the potential user cannot visualize timber in that situation. All the uses are supported by actual examples in Australia and overseas, and photographs and descriptions can be seen at the Division. The list is itemized under types of construction for convenient reference, although this involves a certain amount of repetition.

Whether round or sawn timber is used will depend on the particular application, but it must be remembered that:

- Round timber is usually much cheaper than the equivalent sawn section.
- Only a few timbers are suitable for treatment in the sawn condition.

Applications of Treated Timber

Agriculture

Fence posts and rails
Barn, shed, and transmission poles
Irrigation weirs; erosion control
Bridges, culverts, pipe protection
Silage clamps and silos
Feed troughs and feeders
Kerbs and plinths
Cattle pits; duckboards
Pig sties, fowl houses, kennels
Tank stands
Gates, stock races, pens, crushes
Sheep dips
Trailer and truck bodies
Hop poles, vine trellis, tomato stakes
Greenhouses, seedling frames
Fruit picking boxes, drying racks.

Roadworks

Bridge piles, abutments, stringers, beams, decking, kerbs, handrails
Lighting poles, traffic signs
Crash barriers; fences
Retaining walls
Culverts, drains, erosion control

Railways

Sleepers
Bridges and culverts
Station platforms, ramps
Signal ducting
Fencing, signposts
Footbridges
Telegraph and signal poles
Truck floors, van linings
Retaining walls, erosion control

Commercial Pressure Treatment Plants in Australia—1961

Location	Plant Owner or Operator	Cylinder Size (feet)	Cylinder Pressure (p.s.i.)	Preservative
Queensland				
Eidsvold	Eidsvold Sawmills	3½ × 40	200	Tanalith C
Brisbane*	Hickson's Timber Impregnation Co.	3½ × 42	200	Tanalith C
Brisbane*	Brandon Timbers Ltd.	6 × 80	200	Celcure A
New South Wales				
Grafton	Hickson's Timber Impregnation Co.	6 × 72	200	Creosote
Wauchope	Hickson's Timber Impregnation Co.	6 × 72	200	Creosote
Queanbeyan	Hickson's Timber Impregnation Co.	6 × 72	200	Creosote
Queanbeyan	Hickson's Timber Impregnation Co.	3 × 24	200	Tanalith C
Thornton	Hickson's Timber Impregnation Co.	4½ × 42	200	Tanalith C
Botany	Hickson's Timber Impregnation Co.	3½ × 37	200	Tanalith C
Wollongong	South Coast Timbers Pty. Ltd.	4 × 40	200	Tanalith C
Silverwater	Sydney Timber Treatment Pty. Ltd.	6 × 40	200	Celcure A
Rhodes	H. McKenzie Ltd.	3½ dia.	50	Borax
Victoria				
Brooklyn	Saxton Timber & Trading Ltd.	6½ × 75	200	Creosote
Trentham	Hickson's Timber Impregnation Co.	6 × 72	200	Creosote
Brooklyn	Hickson's Timber Impregnation Co.	3½ × 37	200	Tanalith C
Officer*	Hickson's Timber Impregnation Co.	4 × 37	1000	Penta. in oil
Myrtleford	Local Timbers Pty. Ltd.	3½ × 42	200	Tanalith C
Eurobin	Panlook Bros.	3½ × 42	200	Tanalith C
Glenrowan	Bailey Bros.	4 × 8†	50	Tanalith C
Catani	J. Dwyer (contractor)	3½ × 8	50	Tanalith C
Birregurra	J. Gubbins (grazier)	4 × 8	50	Tanalith C
Great Western	B. Seppelt & Sons	4½ × 12	100	Tanalith C
Spotswood	H. Beecham & Co.	8 × 45	200	Celcure A
Dartmoor	Alstergren Pty. Ltd.	6 × 70	200	Boliden K.33
Epping	J. W. Porta & Sons	10 × 30	100	Borax
Tasmania				
Longford	Hickson's Timber Impregnation Co.	6 × 72	200	Tanalith C
King Island	Tas. Forests Commission	4 × 8†	50	Tanalith C
South Australia				
Wingfield	Hickson's Timber Impregnation Co.	3½ × 42	200	Tanalith C
Jamestown	Wadlow Ltd.	3½ × 20	200	Tanalith C
Meadows	B. Wilson & Sons	4 × 8	50	Tanalith C and creosote
Adelaide	Adelaide Vac. & Press. Timb. Impreg. Co.	4 × 46†	200	Celcure A
Mt. Gambier	Kauri Timber Co.	8 × 45	200	Celcure A
Mt. Gambier	S.A. Woods & Forests Dept.	6 × 60	200	Creosote
Western Australia				
Perth	Bunning Bros. Ltd.	3½ × 20	200	Tanalith C
Bunbury	Hickson's Timber Impregnation Co.	6 × 72	200	Creosote
Pemberton	State Building Supplies (Hawker-Siddeley)	4¼ × 37	1000	Penta. in oil
Papua				
Port Moresby	Pacific Island Timbers	3½ × 37	200	Tanalith C

* Under construction, September 1961. † Two cylinders.

Mining
- Pit props, beams, lagging, cribbing
- Rail sleepers
- Hoppers and bins
- Fire doors

Marine
- Piling—structural and fender
- Beams, decking, braces
- Groynes; sea walls
- Navigation lights, beacons
- Boat framing
- Boat planking (plywood)
- Pontoons

General and Domestic Construction
- Domestic fencing—paling and ornamental
- Security fencing
- Pole-type buildings, stores, garages
- Carports, pergolas, sundecks
- Playground equipment; shelters; seats
- Drive-in theatre screens
- Advertising signs
- Foundation piles
- Radio masts; T.V. aerials
- Seed boxes, flower boxes
- Sub-floor timbers; nailing strips in concrete
- Factory floors (wood block)
- Tannery, dye house, and textile mill roofs
- Swimming pools; tanks and vats
- Stairways, ladders
- Cooling towers
- Fire doors
- Reservoir roofing, trash screens
- Sewerage plants; manhole covers
- Stadium seats

Availability

Two approaches are now available to the timber user. He can buy treated timber and he can buy timber treatment. The accompanying table shows the facilities for pressure treatment available in Australia and the companies responsible for their operation. It will be seen that a number of timber millers and merchants are now licencees or owners of pressure treatment plants. Some of these firms have also made arrangements to supply treated timber on demand through associated merchants. The ideal situation when a customer will be able to buy treated timber ex stock from his timber merchant cannot be too far distant.

Inquiries concerning treated timber can be answered in general by the companies shown in the list, but information concerning special applications can be obtained from this Division or the State Forest Departments.

Sawmill Studies in North Queensland

IN SEPTEMBER, the Division of Forest Products commenced a series of studies in sawmills in North Queensland at the request of the Queensland Department of Forestry and the North Queensland Sawmillers' Association. The aims are to determine the recoveries obtained from the principal species and the rates of production of sawn timber under conditions now prevailing in the region's sawmills.

A study party from the Division's Utilization Section will spend about a week at each of 34 sawmills to record the logs being sawn by species, dimensions, and quality; to time the sawing activities; and to tally the widths, thicknesses, lengths, and grades in the output. The details for each log will be analysed. Computers will then determine for each species the output by sizes and grades and the rate of production, and show how log girth and defects in logs may influence the results.

Information provided by the studies will enable timbermen and foresters to determine the values of outputs from different species and the mill door values of logs. The close attention that will be given to the sawing procedures on a wide range of logs with differing equipment should allow the influence of many factors on sawmill performance to be examined.

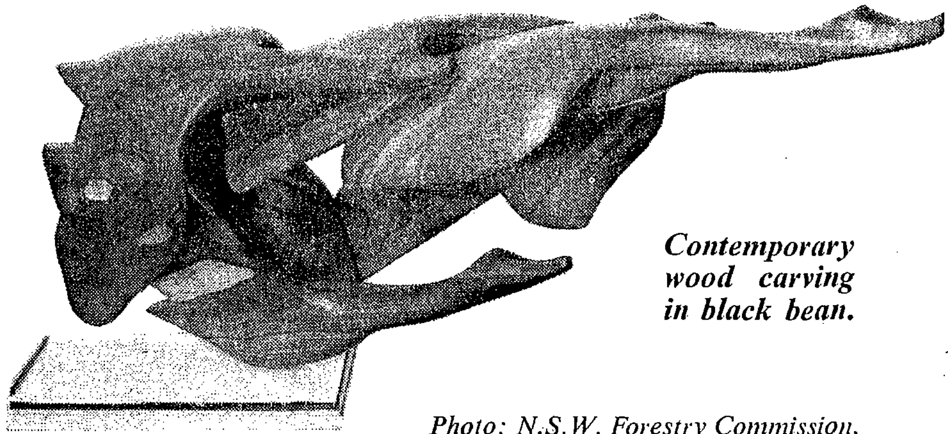
DONATIONS

THE following donations were received by the Division during August:

Perfectus Airscrew Co., Melbourne	£10 0 0
Neville Smith & Co., Melbourne	£25 0 0

PROPERTIES OF AUSTRALIAN TIMBERS

Black Bean



Contemporary wood carving in black bean.

Photo: N.S.W. Forestry Commission.

BLACK BEAN is the standard trade common name for the timber known botanically as *Castanospermum australe* A. Cunn. Black bean is also known as Moreton Bay chestnut or bean tree because of its large bean pod like fruit.

Habit and Distribution

The tree is large, attaining a height of 130 ft and a stem diameter of 4 ft under favourable conditions. The stem is slightly buttressed and the bark is slightly rough, with very small pustules varying in colour from grey to brown. The crown, which forms one third of the tree's height, is large and densely foliaged. The species occurs in north-eastern Australia from the Belinger River in New South Wales, northwards through the coastal areas, to the Cairns-Atherton district of Queensland.

Timber

The heartwood of the timber is dark brown in colour deepening to almost black, while the sapwood varies from white to yellowish. The grain is generally straight though sometimes interlocked. Texture is coarse and figure is prominent owing to longitudinal streaks of pale tissue surrounding the pores. Density at 12% moisture content is 44·4 lb/cu. ft before reconditioning and 43·0 lb/cu. ft afterwards. The heartwood of this species is considered highly durable although the sapwood is non-durable and highly susceptible to *Lyctus* attack.

The timber is easy to work with hand and machine tools and cuts cleanly, making it suitable for carving. It finishes to a smooth and oily surface which makes it somewhat difficult to glue. It screws and nails readily and takes an excellent polish. It is a moderately strong timber, although in its most common usages strength is not a criterion.

Seasoning

Black bean is a slow-drying timber and care in seasoning is necessary to prevent considerable degrade in the form of collapse and internal checking. When air drying, stock should be closely stickered with thin strips and the ends of the stack baffled to control drying. During kiln drying a mild schedule is necessary, together with a reconditioning treatment in order that recovery from collapse may be effected. Shrinkage from the green to 12% moisture content averages 1·8% radially and 5·8% tangentially. This can be reduced to 1·3% radially and 3·3% tangentially by a reconditioning treatment.

Uses

Black bean is possibly one of the most attractive cabinet timbers in Australia and is highly regarded for carved woodwork, furniture, panelling, and joinery. It slices well and forms attractive veneers which are used extensively for both plywood and furniture. The timber is also used for inlay work. It turns well and makes attractive walking sticks and serviette rings. It has been recommended for gun stocks, and, because of its high electrical resistance, has found use in switchboards and other electrical equipment.

Availability

The timber is available in limited quantities in boards, veneers, and plywood.

Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.

Forest Products Newsletter

DIVISION OF FOREST PRODUCTS, C.S.I.R.O., P.O. BOX 310, SOUTH MELBOURNE, S.C.5, VICTORIA

REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 280 NOVEMBER 1961

1961##280

Taking Another Look at Air Drying

By R. M. LIVERSIDGE and R. FINIGHAN, Seasoning Section

DURING RECENT YEARS there have been many indications from the timber industry that rising production and distribution costs are tending to price wood out of its traditional markets. An examination of the cost structure shows that a considerable part of the production costs is contributed by stacking and drying charges—perhaps as much as 20%.

In most cases both air and kiln drying are practised, so that any reduction in the cost of either of these operations must make an improvement in the ability of the seasoned products to compete with alternatives.

Generally speaking, Australian kilns and kiln drying techniques are efficient despite present limitations of kiln design data, but time and money are usually wasted and output lost because kiln drying times are unnecessarily prolonged. Where this occurs, it is usually due to wide variations in moisture content within and between air dried packs going to the kiln, or to a high moisture content condition from poor air circulation in the drying yard. For example, it is not unusual to find that the top pack in an air drying stack is down to a moisture content of 20% while the bottom pack is still at 50%. As the kiln drying schedule is usually geared to the wetter sample boards, it follows that the drier packs of a composite charge of this nature will be in the kiln much longer than necessary—in some cases for a week or more. The alternative to this is to hold the stacks in the drying yard until the slowest pack is also sufficiently dried. In most layouts this means that the upper packs which are ready for kiln drying must be held in the yard for much longer periods than necessary.

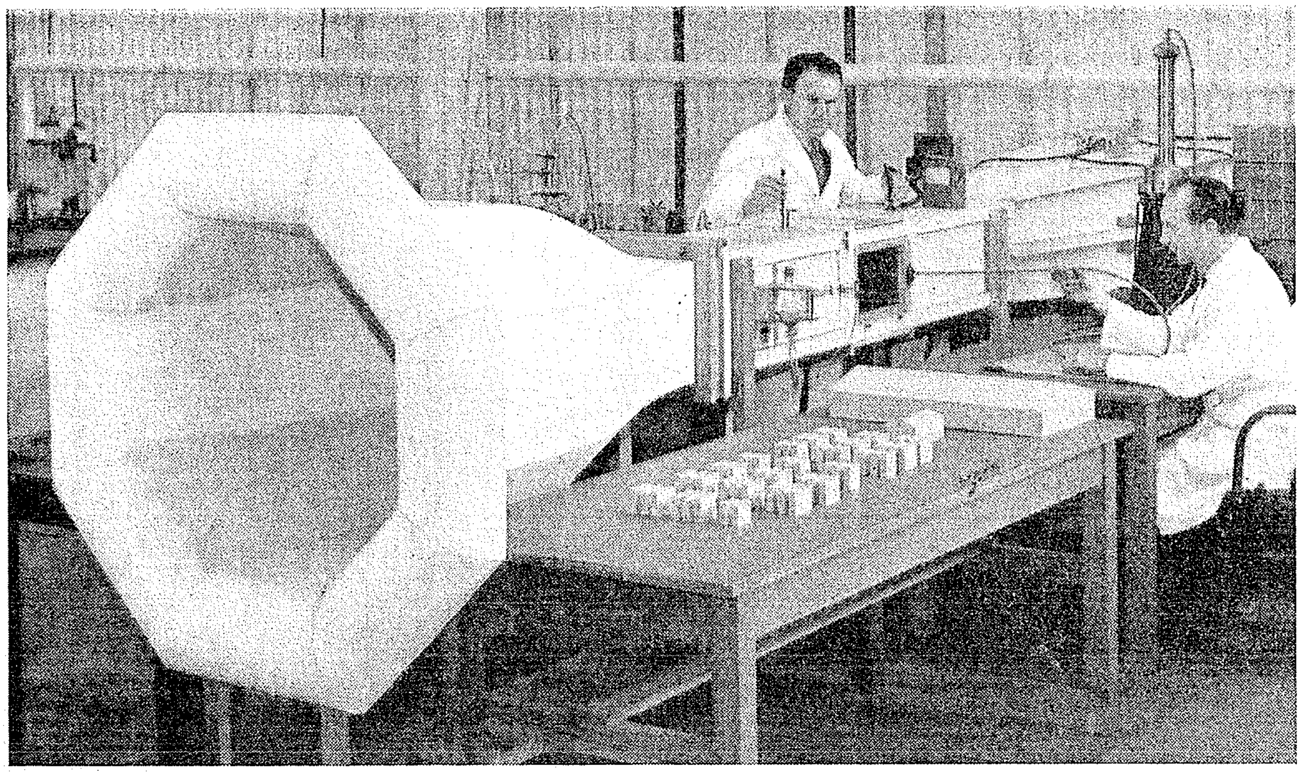
Where this problem exists the obvious solution is to raise the efficiency of the air drying yards by improving the uniformity and speed of drying. In addition to reducing kiln drying costs significantly, such an improvement must result in a faster turnover from a given area, a consequent reduction in capital outlay for stocks held in the yard, and lower air drying costs.

With this picture in mind the Division is conducting a number of experiments designed to test the various factors which may influence air drying standards, and contribute to faster and more uniform air drying. These include:

- Roofing of stacks
- Stack foundations
- Spacing between stack rows
- Stack orientation with respect to the direction of prevailing winds
- Stack width
- Sticker thickness
- The influence of rain wetting on drying rate

Results of these experiments will be published in the Newsletter as they become available.

In addition to the above field studies, the Division is experimenting with the use of scale models of air drying yards for the observation of air circulation patterns. It is apparent that many aspects of air seasoning can be readily examined using stacks containing sample boards, but the investigation of air circulation presents special problems because many factors are outside the control of the investigator. For example, the continual fluctuation of both wind speed and direction makes the task of tracing the air circulation pattern for any given commercial yard extremely difficult. Another limiting factor in field testing is the time required to



The wind tunnel in use during an instrument calibration.

study the effect on the drying rate of each of the layout variations to be tested: each experiment may require measurements for up to two years before sufficient data are obtained, and not many commercial yards can make space, or timber stocks, available for experiments of this duration. It is expected that the model approach will overcome many of these problems, and provide some basic information on circulation within stacks and through air drying yards.

Using the model technique it is intended to use a wind tunnel to examine, by means of smoke probes and anemometers, the air flow patterns for a flat unobstructed layout using a number of wind speeds and directions. This will be done for various layout designs until the best pattern is obtained. In this way a rapid examination can be made of the effect of such variables as stack spacing, stack height, foundation height, length of rows, width and arrangement of roadways, and stack orientation. Not all air drying yards are flat and unobstructed, of course, so special allowance will need to be made for the influence of site features such as buildings, embankments and terracing, trees, hills, etc.

As can be imagined, some model layouts could cover quite a large area, requiring a wind tunnel of considerable dimensions. Fortunately, a tunnel of suitable size is available in Australia at the Commonwealth Experimental Building Station at Ryde, N.S.W., and through the cooperation of the Station, arrangements have been made for the use of this tunnel. Work will also be done in the tunnel to determine basic flow data on air movement in and around a section of a full-size stack.

To enable a rapid preliminary assessment of various stack patterns without building complete models, use will be made of a smaller wind tunnel at the Royal Melbourne Institute of Technology. Certain other tests will be made using dye tracer techniques in a water channel, which is also available at the Institute.

A necessary prelude to this work has been the design and calibration of measuring instruments, and the investigation of suitable tracing techniques. Work on these aspects is at present in hand using a calibration wind tunnel designed and constructed at the Division for this purpose.

The Fire Resistance of Timber

Part I. The Fallacy of Relying on Incombustibility for High Fire Resistance

EVERYONE is well aware that steel softens and loses much of its original strength even if raised to only a moderately high temperature. Nevertheless, this does not prevent steel being used for all sorts of structures. Yet timber, although superior to unprotected steel in its ability to carry load in a fire, is regarded as unsuitable, if not dangerous, for permanent or major structures because it burns. In recent years, however, it has been forcibly demonstrated that combustibility or otherwise of the materials forming the structure of a building bear little relation to fire safety in regard to human life, the contents, or the building itself.

In 1935, in Oregon, U.S.A., a fire burned 40,000 sq. ft of bituminous felt roofing from what was originally a blimp hangar, but no damage was suffered by the structural timber framing. This hangar, which was used as a factory at the time of the fire, was 1000 ft long, 170 ft high at the apex, and 296 ft wide. The framework comprised trussed arches 20 ft apart with purlin trusses supporting the rafters and 2 in. thick plank roof sheathing. All this timber was pressure impregnated with fire-retardant chemicals. The fire started in an exhaust duct high up on the roof and swept upward and downward over the roofing material on the outside of the building. Firemen could reach at first only about the lower one-third of the height of the building with their hose streams. After the fire had burned for an hour, firemen working on the roof managed to reach the flames and control the blaze, but it was a further 6 hours before it was completely extinguished everywhere.

Although about one-tenth of the roof area was burned over, only 3000 sq. ft of the 2 in. planking burned through; only 15,000 sq. ft (or less than 4% of the total) was replaced and 1500 sq. ft of ½ in. plywood was used to restore the thickness in less charred areas.

> THIS ARTICLE is the first of several dealing with this subject. They were prepared by Mr. R. G. Pearson, of the Timber Mechanics Section of the Division, and presented as part of a series of post-graduate lectures on timber engineering. Although not representing actual research carried out by the Division, it is felt that they will be of interest to timber users generally.

No structural damage occurred to any rafters, purlins, bracing, or other parts, despite the fact that the flames had swept through the hole burnt in the planking.

By contrast, a fire in 1953 swept through the General Motors Transmission Plant at Livonia, Michigan, U.S.A., and collapsed the 34 acre steel building in a matter of minutes. The building and contents were destroyed despite the fact that all materials used, both for the building and manufacturing process, were non-combustible and that the building had been confidently proclaimed "fire-proof". Before production could be resumed, the building had to be razed, the site cleared, and a new building erected. In the case of the wooden hangar, there was little interruption to production during repairs.

In considering buildings in relation to safety of human life, tests and experience have made it clear that irrespective of the material used, by the time the structural members are seriously weakened by fire, the hazard to life is great. High temperature of the air and the presence of smoke and poisonous gases make survival impossible.

For many years it has been recognized that time is a vital element in the destruction of a building by fire and in saving human life. Following a disastrous fire in the U.S.A. in

December 1958, in which 92 children and 3 nuns died, safety authorities made a searching inquiry into fire hazards. One of their conclusions was that so-called "fire-proof construction"—actually the use of fire-resistant materials in buildings—has been greatly over-rated as a first line of defence against school fires. The National Fire Protection Association subsequently proposed virtual elimination of requirements for fire-resistant construction. This was on the basis that it adds enormously to building costs, may do little good, and may do positive harm by inducing a false sense of security. *Primary emphasis should be placed on exits, wall finishes, and sprinklers.*

Many people do not realize the very important and sometimes overwhelming influence of the combustible contents of a building. The structure represents generally a very small proportion of the available fuel. A roof structure, for example, comprising timber trusses, purlins, and bracing will weigh between 2 and 5 lb/sq. ft depending on span and loading. It could contribute therefore no more than 17,000–42,000 B.t.u. per sq. ft to a fire; for comparison, the British Joint Committee on Fire Grading of Buildings designates 100,000 B.t.u. per sq. ft as a low fire load.

For adequate protection of human life and contents, the critical consideration is that the design of a building as a whole should restrict the spread of the fire and facilitate fire fighting. As a consequence, it is now becoming widely recognized that incombustibility is not the sole, or even the most important factor to be considered in modern buildings, whether for industrial, storage, school, or office use. It must be remembered that no fire in any building of appreciable size can be extinguished from the outside. Whether it is safe for firemen to enter depends on their estimation of the probable time the fire has been burning, the violence of the fire, the kind of occupancy, and the ability of the structural members to withstand heat without collapsing. This last factor is most important to designers, and it will be considered in some detail in Part II of this series.

A Correction to "Design Tables for Timber Beams"

In table 3 of the design tables published in Newsletter No. 271 and also distributed as reprints, column 3 should read as set out here.

Dry Timber Standard and Select Grade
2 × tabulated value
$\frac{1}{2}$ LL + DL must not exceed 2 times tabulated value

It should be noted that, because the tabulated values allow for the self-weight of *green* beams, the allowable loads calculated for *dry* timber will be significantly under-estimated when the self-weight forms a substantial part of the total load.

Retirement of Miss M. I. Hulme

Last month Miss M. I. Hulme, Librarian at the Division of Forest Products, retired after a long association with the Division.

Miss Hulme established the Division's library when it was formed in 1929, assisted in building up a unique collection in this very specialized field, and has done much to publicize and exploit it.

In post-war years particularly, Miss Hulme has established a valuable liaison between librarians working in similar fields overseas. The translation exchange scheme on forest products subjects promoted by Miss Hulme was one of the first examples of international cooperation between special librarians.

Miss A. Forbes, who has been Assistant Librarian for some years, has been appointed to the position of Librarian.

DONATIONS

The following donations were received by the Division during September:

W. J. Wilson & Son, Meadows, S.A.	£10 10 0
Cairns Timber Ltd., Cairns, Qld.	£15 0 0
Timber Development Association of Victoria	£500 0 0
Oxley Plywood Co., Brisbane	£50 0 0

Printed by C.S.I.R.O., Melbourne

C.S.I.R.O.

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REGISTERED IN AUSTRALIA FOR TRANSMISSION BY POST AS A PERIODICAL

NUMBER 281 DECEMBER 1961

1961##281

The Fire Resistance of Timber

PART II. EFFECT OF HIGH TEMPERATURE ON BUILDING MATERIALS

THE BURNING CONTENTS of buildings may create temperatures of 1700°F and upwards. All structural materials are affected in some manner at such temperatures.

Steel begins to lose strength as the temperature approaches 500°F. At 1000°F, steel has one-half, and at 1400°F only 10% of its original strength. Size of member makes little difference in a large fire because heat is quickly conducted throughout the entire cross section.

Aluminium is much more severely affected and melts at 1220°F.

With increasing temperature, many aggregates, including natural stone, expand and may cause spalling. The cement shrinks due to dehydration and, above 600°F, crazing of the surfaces commences with weakening and eventual cracking of the concrete. Heated concrete does not regain its original strength on cooling. Significant reduction in bond between concrete and steel occurs when temperatures reach about 600°F. However, heat penetrates slowly, and reinforced or prestressed concrete with a thick covering of concrete over the steel can retain much of its strength for an extended period in a fire. Considerable crazing and spalling will occur when water is hosed on to heated concrete.

Wood is not easy to ignite unless its surface area is large relative to its volume, as in kindling. However, if its temperature is raised to about 500°F, chemical decomposition occurs, and, if air and an ignition source are present, burning begins with the production of glowing charcoal and flaming vapours. The flaming is mainly responsible for the rapid spread of fire, but the glowing assists in maintaining the production of flames and is the main element resisting extinction of the fire. It is the mechanism of the transfer of heat from the burning material to preheat the unburnt material which determines at what rate, if at all, the fire will spread. The significant factor in this connection is wood's low thermal conductivity. Despite the fact that the surface of the timber may be flaming, the interior will only be heated at a slow rate, the temperature about $\frac{1}{4}$ in. ahead of the charring being only about 360°F and much less further in. Consequently, the strength and cross section of the member will be reduced slowly. Even in intense fires, large timber sections burn at a rate of only about $1\frac{1}{2}$ in. of depth of charcoal per hour.

This behaviour of wood in a fire is illustrated by a test on a glued laminated beam of Douglas fir. The beam, $27\frac{5}{8}$ by 9 in. cross section was exposed to fire for 1 hr at temperatures ranging from 500 to 1600°F, the average being 1270°F. By the end of that time, the section modulus was still about 70% of its original value. It is of interest to note that to produce a source of fire of such intensity and duration would require the burning of about 6000 lb of dry wood or approximately 51 million B.t.u. The beam itself was charred to an average depth of $\frac{7}{8}$ in. over a length of 63 in.; thus the added fuel from the beam was approximately 150 lb only, corresponding to little more than 1 million B.t.u. or $2\frac{1}{4}\%$ of the total fuel. It is of some interest too that the temperature at the centre of the section of this beam rose only 4°F after an exposure of 20 min in the fire test.

Only portion of the heat from flames is transmitted back to the timber, and if this is insufficient to heat the timber enough to produce inflammable vapours, then flaming will die down. Flame will not persist on smooth wood surfaces if the air temperature falls below 1000°F. As flames rise vertically, they transmit more heat to timber above them than laterally or downward. Consequently vertically disposed timbers such as panelling, doors, etc. constitute a more serious fire hazard than horizontally disposed timbers such as beams and floors. There is also a minimum thickness of timber at which heat is not transferred sufficiently fast to maintain flaming. For a vertical piece of timber ignited at the lower end, this thickness is $\frac{3}{4}$ in., so such a piece would not continue to burn without supplementary heat. Mutual radiation from burning adjoining pieces will, of course, enable combustion to proceed with pieces much thicker than $\frac{3}{4}$ in. With vertical members spaced close together, this mutual assistance is at a maximum, and this explains the rapidity of the spread of fire in narrow passages, lift wells, and similar enclosed spaces.

Thus, from the above remarks, it is apparent that timber in building construction presents its maximum hazard when disposed vertically, with closely spaced vertical surfaces and when members are relatively thin. Contrariwise, horizontal surfaces and thick members present minimum hazard.

Wood exposed to high temperatures for a short period will recover its original strength upon cooling. Even if the period is long, in large members it will only be the outer surfaces which might suffer through prolonged exposure, the temperatures in the interior being much lower.

Another advantage of timber is that it, and particularly wood char, absorbs water, so increasing its resistance to burning.

In many fires, the timber structure will stop active burning once the contents have been consumed because the temperature drops below the necessary level to oxidize charcoal. So the fact that wood will burn does not mean that it necessarily will spread fire. Unfortunately the good performance in fires of well-designed timber structures when proper provisions against fire are adopted is not sufficiently recognized.

In Part III, the fire endurance of building materials will be discussed.

Pulp and Paper Research Conference

THE EIGHTEENTH Pulp and Paper Research Conference was held at the Division of Forest Products on October 24 and 25, 1961. It was attended by senior members of the research staff from Australian and New Zealand pulp and paper companies and by officers of the Wood and Fibre Structure Section and the Wood Chemistry Section of the Division of Forest Products.

In opening the Conference Dr. I. W. Wark, a Member of the Executive of C.S.I.R.O., stressed the value of close contact and exchange of opinion between research workers in C.S.I.R.O. and their counterparts in industry.

Items discussed covered the fibre structure of wood, factors influencing the pulping of wood, and the beating and processing of pulps, biochemical studies, and the physical properties of pulp and paper.

DONATIONS

THE following donations were received by the Division during October:

Tasmanian Plywood Mills Ltd.	£105	0	0
British Phosphate Commissioners	£100	0	0
Hickson's Timber Impregnation Co. (Aust.) Pty. Ltd. . .	£21	0	0

Reducing Degrade In Log Dumps

By R. FINIGHAN and R. M. LIVERSIDGE,
Seasoning Section

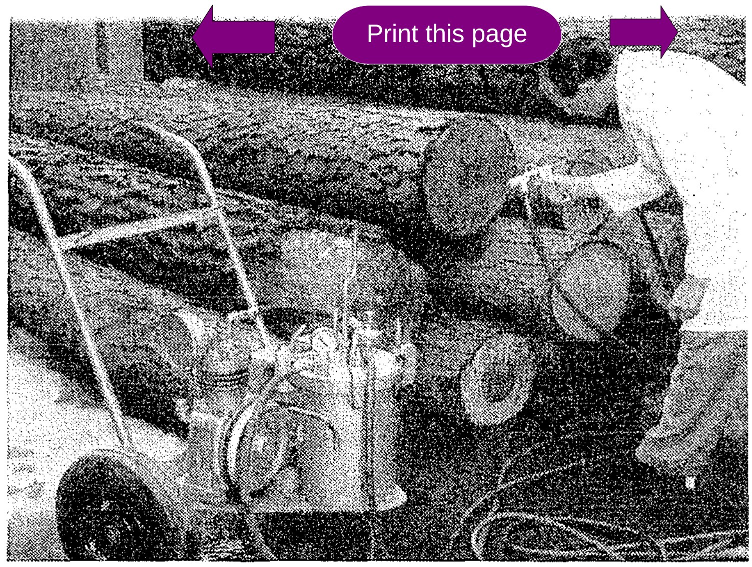
With the summer now upon us the problem of log degrade during storage in hot, dry weather becomes a headache for most sawmillers.

At this time of the year it is not unusual for the sawmiller to be faced with a log loss of up to 10% of his input because of severe end and barrel splitting. With a log dump of some 2 million super feet—a not exceptional quantity for a sawmiller—the corresponding financial loss from weathering damage can amount to some £3000–£5000 per annum if actual log damage, loss of profits, and the increased processing difficulties are taken into account.

End coating is widely used as a means of log protection, and the results of a number of experiments using end coatings have been previously reported (See Newsletter No. 245). Recent progress in this direction is the development by a Melbourne firm,* in cooperation with this Division, of a portable powered spraying unit which is capable of spraying any of the usual liquid end coatings. This unit also has a lance attachment which enables a wide area to be covered from any one position, and this immensely simplifies two time-consuming and tedious tasks which have so far been inherent in end coating, i.e. the hand application of coatings on individual logs by paddle or brush, and the climbing of log stacks to reach the ends of logs.

However, experience has shown that, valuable as it is, end coating is not the complete answer to the problem of log degrade, and that additional log protection measures require investigation.

In cooperation with a Gippsland sawmiller, Mr. Brian Howell, of Newlands Lumber Company Pty. Ltd., Heyfield, Vic., a number of test stacks of sawmill logs are to be set up this month (December), to examine the effectiveness and economy of different



Spraying unit developed for end coating.

protective methods. These will include:

- Sprayed end coatings—with and without sun and wind shields
- Complete stack spraying (ends and barrels) with a moisture-resistant barrier (a crude "mothballing")
- Complete covering with a plastic sheeting, e.g. polythene
- Water sprays

Comparisons will be made with results from an unprotected stack of similar logs. If possible, the effectiveness of log pond storage will also be examined.

In the case of the plastic cover, the logs will first be sprayed with a suitable mixture of an insecticide and a fungistat because of the high humidity conditions which may develop under the cover. A similar arrangement may be needed where the water sprays are used, and incorporation of an insecticide and fungistat in the recirculating water system could prove satisfactory.

This study will extend through the summer of 1961–62 to the following winter, when it is expected conversion of the logs into sawn timber will commence. Records of log quality and drying degrade will be made through the log-holding period, and the influence of the various protective methods on sawn recovery in the sawmill will be measured during final sawing.

It is understood the new spray unit referred to above will be demonstrated, in conjunction with end coating materials, at Heyfield during the erection of the log stacks. Sawmillers interested in inspecting this equipment, or the various protective methods after installation, may obtain more information from Mr. Brian Howell.

* Industrial Service Engineers, Pty. Ltd., Franklin Street, Melbourne.

PROPERTIES OF AUSTRALIAN TIMBERS

Broad-Leaved Peppermint

BROAD-LEAVED PEPPERMINT is the standard trade common name given to the species described botanically as *Eucalyptus dives* Schau. It is also known as peppermint or blue peppermint in Victoria.

Habit and Distribution

Broad-leaved peppermint is a small tree usually 40–80 ft in height and 18–30 in. in diameter, with a large closely knit crown comprising two-thirds to three-quarters of the tree's height. The bark is sub-fibrous and persistent on the trunk and main branches, becoming smooth and ribbony on the smaller branches. The species is widely distributed through eastern and southern Victoria and southern New South Wales within the altitude range 500–4000 ft. It is usually found in association with other peppermint species and occasionally apple box and red stringybark.

Timber

The timber is pale to light brown in colour, straight to slightly interlocked in the grain, and often has numerous gum veins. It is fairly hard and tough and comparable in strength with messmate stringybark, having a strength group rating of C. Broad-leaved peppermint is classed as a light hardword, having a green density of 70 lb/cu. ft and an average density at 12% moisture content of 50·6 lb/cu. ft before reconditioning and 46·1 lb/cu. ft after reconditioning.

The timber is only moderately durable and is placed in durability class 3. The sapwood is moderately susceptible to Lyctus borer attack. Easily worked, broad-leaved peppermint machines cleanly and finishes fairly well.

Seasoning

No information is available on the seasoning properties of this species; however, reports indicate that it is fairly readily seasoned although very susceptible to collapse. Shrinkage is high, averaging 5·9% radially and 11·2% tangentially before reconditioning and 2·9% radially and 5·0% tangentially afterwards.

Uses

The leaves of broad-leaved peppermint are a source of eucalyptus oil and are used commercially for this purpose. The clearer material from this species is used for joinery, mouldings, linings, and floorings. Other material is used for building construction and fence palings.

Availability

Due to the increasing demand for sawn timber, the output of this species is increasing. The annual cut for this and other peppermint species is approximately 20 million super ft in the form of scantlings and boards.

F. A. O. Appointment

DR. W. G. KAUMAN, of the Seasoning Section of the Division of Forest Products, has accepted a 2½-year assignment with the Food and Agriculture Organization of the United Nations.

He has been appointed as a Forestry Officer (Wood Technology Branch) on a United Nations Special Fund Project of the F.A.O. to the Government of Chile.

Dr. Kauman will leave about January 1 for Rome, where he will receive briefing at F.A.O. Headquarters. He then hopes to visit a number of Forest Products Laboratories in Europe before proceeding to Chile.

For the last few years, Dr. Kauman has been responsible for the Division's work on collapse during drying and its removal, and has published several papers on this subject. He also initiated experiments on diffusion of moisture in wood.

In Chile, he will join the Chilean Forestry Institute. His probable duties will be to assist the four main Universities in that country in setting up and operating forest products research laboratories, and to coordinate their research activities, particularly in timber mechanics, seasoning, and preservation.

Dr. Kauman has been granted leave of absence from C.S.I.R.O. and will return to the Division of Forest Products on the conclusion of his assignment.

Printed by C.S.I.R.O., Melbourne