TWP Timber and Wood Products Research Centre

M.D.F. Initial Property Determination

TWP Report No. 162
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20 September 1990

Mr D Thurlow
Laboratory Manager
Laminex Industries
PMB No 2
TELLARA via GYMPIE 4570

Laminex MDF Initial Property Determination

J/No. F72.238
TWP Report No. 162

Dear David,

Attached is TWP Report No. 162 detailing tests carried out on two sheets of Laminex Industries MDF – a couple of TWP flyers are included for your interest.

The duplicate set of coupons for your testing has been in conditioning since prepared and are to be despatched to you shortly – if possible, and at your leisure, we'd be interested in a copy of your results.

We look forward to being of further assistance to your firm.

Regards.

Roger Thomas

Introduction

A series of tests on one sheet each of MDF and Moisture Resistant MDF has been carried out by TWP to provide data for comparison with data held by the manufacturer.

To reduce the effect of within–sheet variation of properties, three times the number of test coupons required by applicable Standards were prepared and tested. A duplicate set of coupons was prepared from the same two sheets for testing by the manufacturer.

For the sake of completeness (and from curiosity), some additional tests – Minnesota shear. water absorption, transverse flexure and extra screw withdrawal tests – were carried out.

Sampling & Identification

One sheet of each of the two materials was supplied by the manufacturer's local representative from commercial stock.

The cutting plan is shown in Fig.1. An attempt was made to ensure the coupons for each type of test were taken from areas spanning the sheet in both directions and that coupons for testing by TWP were adjacent to the matching coupons returned to the manufacturer.

Coupons were identified by alphanumeric code indicating the manufacturer, board type and grid position of the coupon within the original sheet of material. The first letter indicates the manufacturer; the second the board type, where 'U' indicates conventional MDF and 'M' is used for Moisture Resistant MDF.

Conditioning

All coupons were conditioned for at least seven days at 20 degrees Celcius and 65% relative humidity before testing.

Tests

Tests were carried out in accordance with AS1859 or BS5669 with modifications as requested by the manufacturer.

Results

Detailed results from individual tests are given in Figs.2 – 11 with average results summarised in Fig.12.
Average results from additional tests are given in Fig.13.

1	25×100	MC
2	40×40	IB
3	350×100	MOE/MOR/P
4	140×140	SURF. WATER
5	75×75	SURF. SOUND.
6	100×100	24HR SWELL
7	350×100	2 HR BOIL
8	75×75	SCREW HOLD
a	TWP	
b	LAMINEX IND	

M/C DIRN.

* COUPON ID (WRITTEN IN M/C DIRECTION) eg L M J 16 / L U U23 — GRID COORDINATES

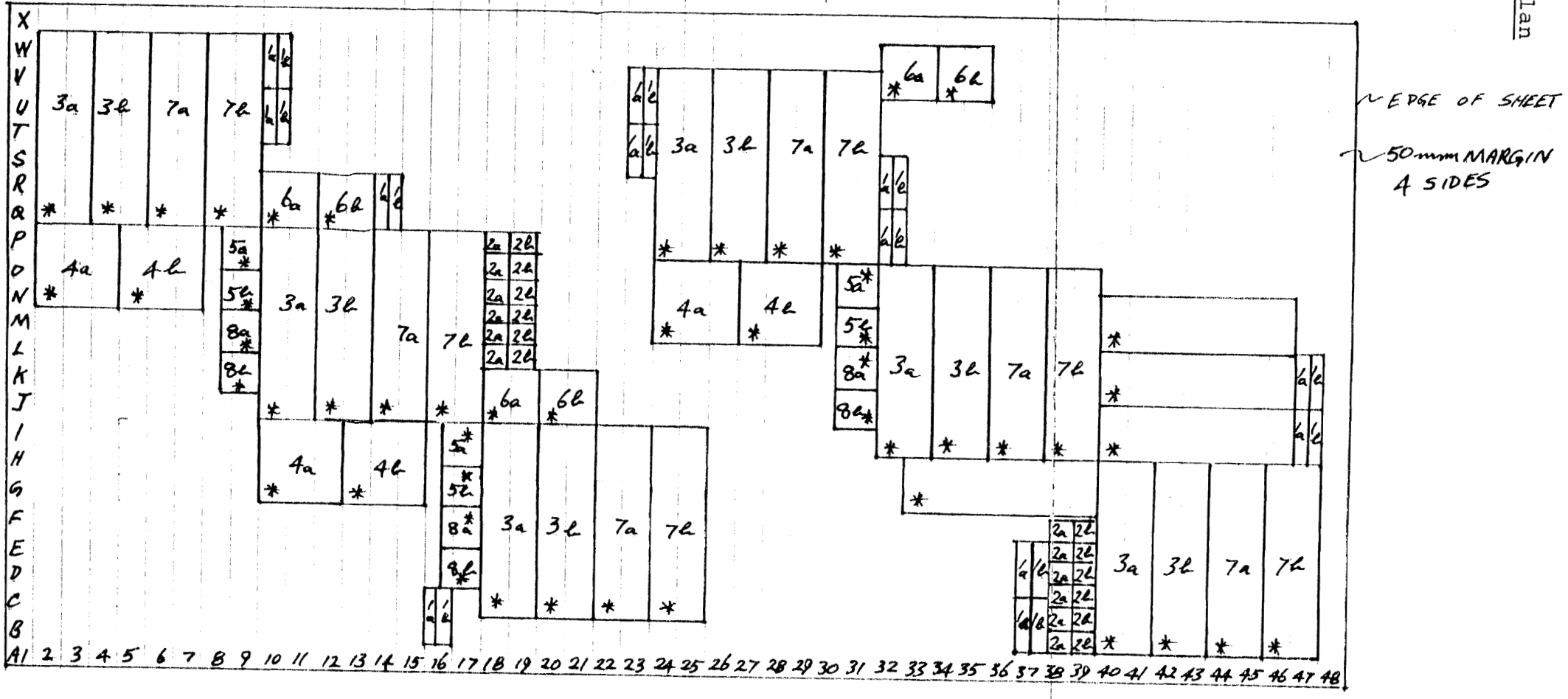

Fig. 1 - Cutting Plan

Fig. 2 – Moisture content (AS1859 App.B)

Sample ID	% m.c.	Sample ID	% m.c.
LUB16	8.3	LMB16	8.7
LUB37	8.1	LMB37	8.7
LUD37	8.0	LMD37	8.7
LUI47	8.2	LMI47	8.9
LUK47	8.1	LMK47	9.0
LUP32	8.0	LMP32	8.6
LUQ14	8.1	LMQ14	8.7
LUR32	8.0	LMR32	8.7
LUS23	8.1	LMS23	8.8
LUT10	8.0	LMT10	8.8
LUV10	8.2	LMV10	9.1
Average	8.1	Average	8.8

Fig.3 – Density (AS1859 App.C)

Sample ID	Density (kg/m^3)	Sample ID	Density (kg/m^3)
LUB40	734	LMB40	761
LUC18	735	LMC18	747
LUI32	735	LMI32	762
LUJ10	741	LMJ10	762
LUP24	752	LMP24	757
LUQ2	758	LMQ2	752
LUG33	732	LMH33	769
LUI40	740	LMI40	760
LUK40	734	LMK40	762
LUM40	737	LMM40	755
Average	740	Average	759

Fig.4 – Internal Bond Strength (AS1859 App.E)

Sample ID	I.B. (kPa)	Sample ID	I.B. (kPa)
LUB38	1030	LMB38	558
LUC38	916	LMC38	293
LUD38	883	LMC38	573
LUD38	804	LMD18	592
LUE38	798	LMD38	635
LUF38	717	LME38	693
LUL18	711	LMF38	550
LUM18	889	LML18	643
LUN18	909	LMM18	525
LUO18	650	LMM18	651
LUO18	753	LMN18	482
LUP18	703	LMP18	703
Average	814	Average	575

Fig.5 – Modulus of Rupture (AS1859 App.D)

Sample ID	MOR (MPa)	Sample ID	MOR (MPa)
LUB40	40.6	LMB40	53.2
LUC18	44.8	* LMC18	28.5
LUI32	44.2	LMI32	51.0
LUJ10	43.9	LMJ10	51.7
LUP24	45.0	LMP24	50.1
LUQ2	43.7	LMQ2	47.6
Average	43.7	Average	50.7

* – Sample damaged before test – value excluded from average.

Fig.6 – Modulus of Elasticity (BS5669 App.A.6)

Sample ID	MOE (MPa)	Sample ID	MOE (MPa)
LUB40	3380	LMB40	4030
LUC18	3520	* LMC18	4620
LUI32	3400	LMI32	4070
LUJ10	3450	LMJ10	4100
LUP24	3560	LMP24	4120
LUQ2	3440	LMQ2	3940
Average	3460	Average	4050

* – Sample damaged before test – value excluded from average.

Fig.7 – Surface Water Absorption (AS1859 App.F)

Sample ID	Absorpt.(g/m^2)	Sample ID	Absorpt.(g/m^2)
LUG10	64.4	LMG10	53.4
LUM24	63.1	LMM24	42.5
LUN2	77.7	LMU2	29.1
Average	68.4	Average	41.7

Fig.8 – Surface Soundness (BS5669 App.A.10)

Sample ID	Failure (kN)	Sample ID	Failure (kN)
LUI17	2.11	LMH17	1.98
LUN31	2.35	LMN30	1.94
LUP9	2.24	LMO9	2.00
Average	2.23	Average	1.97

All failures were of internal bond – no surface failure was observed.

Fig.9 – 24 hour Thickness Swell (BS5669 App.A17.1)

Sample ID	Avg.Thick. Swell (%)	Length Increase (%)
LMJ18	6.5	< 0.2
LMQ10	5.5	< 0.2
LMV32	5.3	< 0.2

Fig.10 – Bond Durability (2 hr. boil) (AS1859 App.H, modified)

Sample ID	MOR (MPa)	% of board MOR
LMB44	6.58	13
LMC22	7.14	14
LMI36	7.35	15
LMJ14	7.04	14
LMP28	7.34	15
LMQ6	6.81	13
Averages	7.04	14

Fig.11 – Screw Withdrawal (BS5669 App.A.11)

	Force to withdraw screw (N)		
Sample ID	Face	Edge 1	Edge 2
LUF17	1240	794	736
LUK31	1110	772	800
LUL9	1140	756	880
Averages	1160		790
LME17	1060	748	722
LMK30	1080	674	758
LML9	1070	696	762
Averages	1070		730

Fig.12 – Average values

Test (units)	LU series	LM series
Moisture content (%)	8.08	8.79
Density (kg/m^3)	743	759
Internal Bond (kPa)	814	575
Modulus of Rupture (Mpa)	43.7	50.7
Modulus of Elasticity (MPa)	3460	4050
Surface water absorption (g/m^2)	68.4	41.7
Surface soundness (kN)	2.23	1.97
24 hr Thickness swell (%)	n/a	5.8
Bond durability – MOR (MPa)	n/a	7.04
– retention (%)	n/a	13.9
Screw withdrawal – face (N)	1160	1070
– edge (N)	790	730

Fig.13 – Additional Tests

Test (units)	LU series	LM series
Transverse flexure – MOR (MPa)	44.0	50.5
– MOE (MPa)	3430	4120
Minnesota shear (MPa) (ASTM)	4.40	3.90
Water absorption – 24 hrs (%) (BS5669 App.A.16)	n/a	4.2
Screw withdrawal – edge (N) (Parallel shank self–tapping)	966	906

Discussion

The conventional board returned better internal bond and screw withdrawal test values than the moisture resistant board. As tests were restricted to one sheet of each, it cannot be assumed these results would apply generally.

As usual, the coefficients of variation for the Minnesota shear tests (5% or less) are markedly lower than those for the transverse tension (IB) tests (14% or more).

Since there are two spare edges of a screw withdrawal coupon, those edges were used to measure the screw withdrawal values of parallel– shanked self–tapping screws of the same nominal diameter as the wood screws specified in the Standard – #6 gauge.
Preparation for the tests were identical, with the pilot hole diameter and depth and embedment depth as for the wood screws.
As expected, self–tapping screws hold in the edges of the material better (20% better!) than conventional wood screws with their tapered threadform. The reason for specifying a conventional wood screw for withdrawal tests (BS5669) is unknown and seems illogical since the parallel threadform screws have been available for years and is the type that should be used in composite materials with discontinuous fibres or chips. One test was performed with a particleboard screw. The screw has a parallel threadform with steep thread pitch and deep thread. The test was performed from curiosity only, as the screw was #8 gauge and could not validly be compared with the #6 wood screws.

Surface soundness tests were passed with flying colours by both materials. In every case the internal bond failed at approximately 30 to 70% through the thickness of the coupon while the surface was unaffected. As results were dependent on bond strength, the conventional board performed better than the moisture resistant board.

Results after the boil test are woeful – all failures were mid–plane shear.
Boil tests are easy to perform but very difficult to duplicate. TWP has carried out two series of boil tests on samples matched with those sent to other timber product testing labs. The results were inconclusive and have led to the construction of a "standard" boil test tank for further trials. The author does not have a high opinion of the test as there are too many variables to try to control/duplicate, small changes in actual conditions in the tank appear to have drastic effects on test results and correlation with in–service durability is questionable.
Notwithstanding the above, failure by shear was not expected and is not desirable as it indicates internal bond failure. It is noted that, throughout the test series, the internal bond values for the moisture resistant board consistently are lower than for the conventional board.

Transverse flexure tests carried out were identical to the usual flexure tests, but specimens were cut with their long axis across the machine (lay–up) direction rather than along it. The difference in MOR/MOE in the two directions is not significant for the sheets tested – as distinct from the usual 10 – 20% difference for some other reconstituted wood products.