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TEST REPORT

DC2701

AS/NZS 2908.2 FROST RESISTANCE TESTING OF KALSI® FIBRE CEMENT BOARDS

CLIENT
Promat Australia Pty Ltd
1 Scotland Road
Mile End South SA 5031
Australia

TEST SUMMARY

Objective

AS/NZS 2908.2 Type A Bending Strength Testing was completed on nominally 7 mm thick Kalsi® Fibre Cement boards.

Clause 6.3 Frost Resistance Type Characteristics were also tested for the product.

Client

Promat Australia Pty Ltd
1 Scotland Road
Mile End South SA 5031
Australia

Description of test specimen

BRANZ has no knowledge of the sampling criteria used to select the boards submitted for testing, nor how representative they are of the quality of the board as a whole or on a consistent or sustained basis.

Date of test

April – June 2015

Test results

AS/NZS2908.2 Characteristic	Rating
6.3 Frost Resistance	Pass

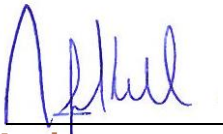
LIMITATION

The results reported here relate only to the item/s tested.

TERMS AND CONDITIONS

This report is issued in accordance with the Terms and Conditions as detailed and agreed in the BRANZ Services Agreement for this work.

SIGNATORIES



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DOCUMENT REVISION STATUS

ISSUE NO.	DATE ISSUED	DESCRIPTION
1	15 June 2016	Initial Issue
2	7 February 2017	Adding board thickness information

1. SCOPE

Samples of Kalsi® Fibre Cement board that were nominally 7 mm thick were supplied by the client, for assessment against the Type test requirements of **clause 6.3 Frost resistance** specified in **AS/NZS 2908.2** ***Cellulose-cement products. Part 2: Flat sheets***.

2. CAVEAT

The results reported here relate only to the item/s tested.

BRANZ has no knowledge of the sampling criteria used to select the boards submitted for testing, nor how representative they are of the quality of the board as a whole or on a consistent or sustained basis.

Consequently this report does not have the same weight as a formal product Appraisal, which would necessitate the consideration of statistical sampling techniques, Product Certification, quality system auditing, or other appropriate quality assurance methods.

Statements under this item 2 in no way limit any provision or requirement of the terms of engagement between BRANZ and the Client.

3. SAMPLE DESCRIPTION

The following specimens were supplied pre-cut from the client:

Control: 10 of 7 mm x 250 mm × 250 mm specimens for wet bending strength

Frost resistance: 10 of 7 mm x 250 mm × 250 mm specimens.

4. METHODS

4.1 Bending Strength (Modulus of Rupture)

Modulus of rupture (M.O.R.), or bending strength, is a routinely specified mechanical property used for grading of cellulose fibre-cement sheet products. It was determined in accordance with **clause 8.1.2.1** of **AS/NZS 2908.2** using 250 mm x 250 mm square specimens. Testing was conducted with an Instron Universal Testing Machine, equipped with a calibrated 10 kN load cell and Bluehill™ control software. A three-point bending apparatus was employed for loading, with a support span of 215 mm and a constant crosshead deflection rate of 25 mm/min.

Due to the anisotropy typically observed in cementitious composites, testing was carried out both parallel to ('machine direction') and perpendicular with ('cross direction') the dominant orientation of the fibre.

The individual modulus of rupture of a specimen in MPa, is calculated from the expression

$$R_f = \frac{3Pl}{2be^2}$$

where:

R_f	is the modulus of rupture (MPa)
P	is the breaking load (N)
l	is the distance between the support axes (215 mm)
b	is the width of the test piece (250 mm)
e	is the average thickness of the test specimen at the break

The modulus of rupture of a sheet is defined in **clause 8.1.2.1.7** as the '…*arithmetic mean of the four values (two values in each direction)*'.

4.1.1 Sample Pre-conditioning

Clause 5.2.1 of **AS/NZS 2908.2** requires that '*Type A sheet strengths shall only be specified in the wet condition and the specimens shall be tested in the wet condition*'. Consequentially, to provide as-received results for testing the Type Characteristic per **clause 6.3**, modulus of rupture specimens were also pre-conditioned by soaking in water at ambient laboratory temperature for 24 hours, before testing in a saturated surface-dry state.

4.2 Frost Resistance

Freeze-thaw testing assesses susceptibility to failure caused by dilative pressure exerted internally when water-filled pores within cellulose fibre-cement sheets freeze.

Testing was carried out in accordance with **clause 8.2.3** of **AS/NZS 2908.2**. Standard 250 mm square modulus of rupture specimens were tested in pairs with the corresponding wet bending strength specimens described in section 4.1 'Bending Strength (Modulus of Rupture)'. The latter served as controls, to allow any loss in performance on exposure to the freezing conditions to be quantified.

The test specimens were subjected to 50 freeze-thaw cycles consisting of repeated cooling to -20°C ± 2°C followed by thawing in water to reach +20°C ± 2°C, as specified by **clause 8.2.3.3** of **AS/NZS 2908.2**. A single freeze-thaw cycle was completed in four hours, with the specified temperature extremes maintained for one hour. Prior to commencement of temperature cycling, the specimens were immersed in water at 5°C until constant mass was achieved, defined as < 0.5% difference over consecutive weighings at 24 hour intervals. At this point, the specimens were sealed into heavy gauge polythene bags to maintain their water saturated condition through the duration of the test.

At the conclusion of cycling, the specimens were re-conditioned under ambient laboratory conditions for 7 days and then examined with the naked eye to detect cracking, delamination or other defects.

The susceptibility of the samples supplied to freeze-thaw damage was quantified by comparing the average modulus of rupture in the wet condition of the temperature-cycled test pieces with the strength of pairs of control specimens cut from the corresponding as-received board.

5. RESULTS

5.1 Bending Strength

Modulus of Rupture (MPa) – Wet Condition					
Sheet No	Specimen (i)		Specimen (ii)		Mean Result
	Cross	Machine	Cross	Machine	
1	8.99	13.76	6.89	13.62	10.81
2	7.74	12.99	7.49	12.97	10.30
3	7.08	12.66	6.80	13.21	9.94
4	6.93	13.53	7.46	13.89	10.45
5	6.97	12.79	7.31	13.69	10.19
Minimum M.O.R.					***9.94***
Mean M.O.R.					*10.34*

5.2 Frost Resistance

Freeze-Thaw Cycle						
	Specimen (i) MOR (MPa)		Specimen (ii) MOR (MPa)		Mean	$r_i = \frac{R_{fi}}{R_{fci}}$
	Cross	Machine	Cross	Machine	R_{fi}	
1	7.22	12.78	7.65	12.67	10.08	0.975
2	7.23	13.13	6.84	13.47	10.17	0.984
3	6.90	12.93	8.05	13.44	10.33	0.999
4	7.02	12.28	7.08	12.41	9.70	0.938
5	7.00	13.21	5.49	11.46	9.29	0.899
Mean, r						0.96
Standard deviation, s						***0.04***
Lower 95% confidence limit, L_i						***0.94***

Note: This is the ratio of the wet condition M.O.R. of the tested specimens after 50 freeze-thaw cycles compared with the corresponding wet condition M.O.R. of reference control specimens (reported under 5.1).

*According to **clause 6.3** of **AS/NZS 2908.2**, the lower (95th percentile) confidence limit, L_i, for the mean ratio of wet condition M.O.R. of the test specimens before and after 50 freeze-thaw cycles shall not be less than 0.75, when tested in accordance with **clause 8.2.3**.*