

**ASSESSMENT OF TIMBERCRETE®  
FOR FREEZE/THAW DURABILITY  
BY TESTING TO ASTM C1262-05a**

**Ross Anderson**

**September 2005**

**ensis**



Test-7

**ASSESSMENT OF TIMBERCRETE® FOR FREEZE/THAW  
DURABILITY BY TESTING TO ASTM C1262-05a**

**Ross Anderson**  
**ensis – Wood Processing and Products**  
Rotorua, New Zealand

Report prepared for:

Timbercrete Rotorua Ltd

Correspondence to:

Unit Leader  
**ensis** Wood Processing and Products  
Private Bag 3020  
ROTORUA

Approved for Release

Unit Leader

*ed. e. J. J. J.*

Date:

*8 Sep 05*

Phone: (07) 343-5777  
Fax: (07) 343-5507

The opinions provided in the Report have been prepared for the Client and its specified purposes. Accordingly, any person other than the Client, uses the information in this report entirely at its own risk. The Report has been provided in good faith and on the basis that every endeavour has been made to be accurate and not misleading and to exercise reasonable care, skill and judgment in providing such opinions.

Neither ensis nor its parent organisations, CSIRO and Scion, or any of its employees, contractors, agents or other persons acting on its behalf or under its control accept any responsibility or liability in respect of any opinion provided in this Report by ensis.

©Ensis – A Joint Venture of CSIRO and Scion

All rights reserved. Unless permitted by contract or law, no part of this work may be reproduced, stored or copied in any form or by any means without the express permission of **ensis** Wood Processing

*Test - 7*

# ASSESSMENT OF TIMBERCRETE® FOR FREEZE / THAW DURABILITY BY TESTING TO ASTM C1262-05.

## SUMMARY

Five Timbercrete® blocks were tested by Ensis to 25 freeze thaw cycles as specified in ASTM C1262-05a<sup>(1)</sup>. All samples lost less than 0.2% of their mass after exposure to these cycles with the average loss being less than 0.1%. Two of the samples were coated with an acrylic and the other three were coated with a silicate. No difference in durability was apparent after exposure to 25 cycles of freeze/thaw.

## OBJECTIVE

To determine if TIMBERCRETE® will pass the durability (freeze / thaw) requirements of ASTM C1262-05a.

## INTRODUCTION

Timbercrete® block is made from recycled waste timber and cement. This product was developed in Australia approximately 10 years ago. Timbercrete® is now manufactured in New Zealand and is currently being assessed as a building material. Timbercrete Rotorua Limited approached Ensis to independently assess the extent of degradation after Timbercrete blocks have been subjected to repeated cycles of freeze and thaw to gain information on their durability.

## MATERIALS AND METHOD

### Test Samples

Five 32 mm thick "slices" of Timbercrete® block (140mm x 132mm) were used for the freeze thaw test. Two samples (1 and 2) had an acrylic coating brushed onto the blocks and the other three samples had a silicate coating.

### Freeze/Thaw Cabinet

A modified freezer was used as to cycle the five samples through twenty five freeze / thaw cycles specified in ASTM C1262-05a. The Fisher & Paykel H701X freezer had extra heating and refrigeration added along with a CAL 9500P<sup>(2)</sup> programmable process controller that allowed the ramp rate and set-points to be specified.

### Freeze-Thaw Test Procedure

Five Timbercrete® samples were soaked to a depth of 13 mm for 24 hours before the freeze / thaw test was started. Freeze / thaw testing was performed in accordance with ASTM C1262 procedures. The freeze / thaw cycle operates at -18°C for 4.5 hours and then the temperature was ramped over a 90 minute period to reach 24°C. This temperature was maintained for 4.5 hours and then the

temperature was ramped to  $-18^{\circ}\text{C}$  over a 90 minute period. This meant two cycles per day were done.

The sawn surfaces of the Timbercrete<sup>®</sup> test samples were labelled 1 to 5. Samples were placed on 3 mm spacers in a plastic bag that contained sufficient water to maintain a depth of 13 mm (10 mm sample submerged). The enclosed samples were placed in aluminium trays before water was added into the plastic bag. The plastic bag was then sealed after sufficient water allowed a 35 mm "space" containing water between the sample edge and the outside of the plastic bag (see Photo 1).



Photo 1: Timbercrete<sup>®</sup> block no.5 after 25 cycles of freeze/thaw test.

After the Timbercrete<sup>®</sup> samples had finished the 25 cycle freeze / thaw exposure, each sample had the saturated surface rinsed with distilled water into a filter funnel containing Whatmann 40 filter paper. The contents of the plastic bag were also rinsed through the filter paper. The filter paper with residue was oven dried at  $103^{\circ}\text{C}$  for 24 hours before determining the amount of dry residue that was dislodged from the Timbercrete<sup>®</sup> surface. The Timbercrete<sup>®</sup> samples were then oven-dried and the percent residue based on the oven-dry residue divided by these oven-dry sample weights.

## RESULTS

The results for the freeze / thaw durability test of Timbercrete<sup>®</sup> are listed below in Table 1.

**Table 1: Sample weights and residue from 25 cycle freeze / thaw tests.**

Timbercrete freeze / thaw test to ASTM C1262-05a.

Coating Colour	Arylic Pink	Arylic Pink	Silicate Yellow	Silicate Yellow	Silicate Yellow
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5
Wet Weight	858.78	772.74	859.87	832.51	850.08
Dry weight	717.63	612.4	716.71	654.2	714.71
OD weight	654	626.88	630.1	570	614.6
Filter Paper + residue	1.79	1.5	1.63	2.19	1.54
Filter Paper	1.19	1.19	1.15	1.18	1.18
Residue	0.6	0.31	0.48	1.01	0.36
Percentage loss	0.09	0.05	0.08	0.18	0.06
Average Percentage Loss	0.09				

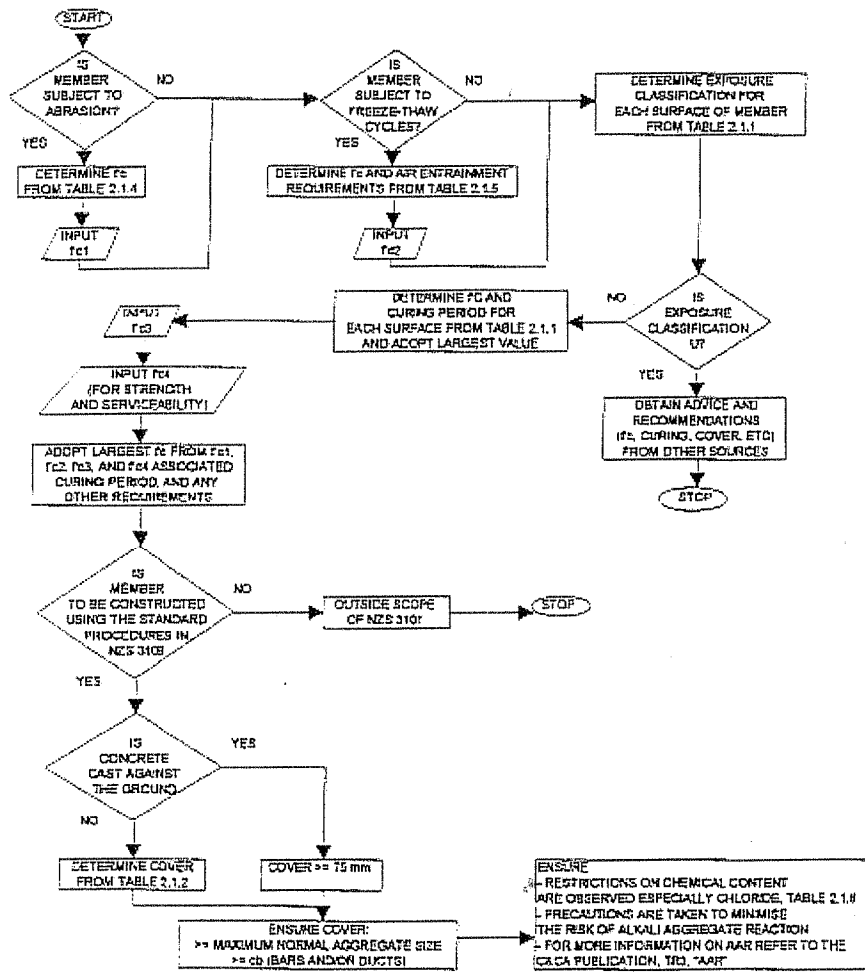
Dry Weight = Mass of sample before soaking  
 Wet Weight = Mass of sample after soaking  
 OD Weight = Mass of sample after oven drying

## DISCUSSION

The ASTM C1262 test method for "Freeze / Thaw Durability of Segmental Retaining Wall Units" describes a 25 cycle test which soaks part of the test sample and freezes the wetted cement product at -18°Celsius before heating the sample to 24°Celsius. A Minnesota authority's publication<sup>(3)</sup> on testing truncated concrete domes for freeze / thaw durability quotes "the maximum average loss of five samples shall be less than 1.0 percent with the maximum loss of any individual sample being less than 1.5 percent". The number of cycles is dependent on the local authorities and the severity of the exposure that the masonry is expected to encounter. Although requirements are different for various environments, the Timbercrete samples would pass the Minnesota requirement for freeze / thaw durability.

The New Zealand Building Code<sup>(4)</sup> states that for a structure, the life of the building must not be less than 50 years unless the specified intended life has been stated and the structural requirements for the durability of concrete masonry are for not less than 50 years<sup>(5)</sup>. Recognising this fact, the latest version of NZS 3101<sup>(6)</sup> contains an entire chapter on durability, which is primarily related to the 50 year life situation. There is currently no "pass mark" requirement for the percentage of material lost after freeze-thaw testing.

A suggested approach to cover the durability requirements for cement / concrete products is provided in the Cement & Concrete Association of New Zealand's flow chart (see Flowchart 1). Durability for freeze / thaw resistance in New Zealand is done by specifying the minimum compressive strength and the percentage entrapped air in the concrete. The AS/NZS 4455<sup>(7)</sup> standard mentions freeze-thaw tests in Appendix D 4.10 and states: "there is no one test applicable to all conditions. Consumers should rely on manufacturer's recommendation or local experience."



Flowchart 1. Designing for durability.

Table 2. Freeze / thaw resistance for Ordinary Portland Cement concrete.

Exposure Condition	Minimum Characteristics Strength, $f_c$ (MPa)	Entrained air for nominal aggregate size (mm)	
		10 - 20	40
25 - 49 cycles per annum	20	4 - 8%	3 - 6%
Greater than or equal to 50 cycles per annum	30	4 - 8%	3 - 6

### REFERENCES

1. ASTM C1262-05a. American Society for Testing and Materials Standard Test Method for Evaluating the Freeze / Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units.
2. CAL 9500P Programmable Process Controller. CAL Controls Ltd. Bury Mead Road, Hitchin, Herts, SG5 1RT. UK Email: [support@cal-controls.co.uk](mailto:support@cal-controls.co.uk).  
Webpage: <http://www.cal-controls.com>
3. <http://mrr.dot.state.mn.us/materials/TruncatedDomes040715.pdf>
4. The New Zealand Building Code 1991.
5. Department of Building and Housing: Building Controls – Concrete Masonry and Weathertightness.  
Webpage: <http://www.building.dbh.govt.nz/e/publish/cw5-concrete.shtml>
6. NZS 3101: 1995. New Zealand Standard - "Concrete Structures Standard".
7. AS/NZS 4255:1997. Australian / New Zealand Standard – Masonry units and segmental pavers.

THE JOINT FORCES OF CSIRO & SCION

**ensis**

### Contacting ensis

ensis Australia  
Telephone: +61 3 9545 8100  
Freephone (within Australia only): 1800 231 051  
Facsimile: +61 3 9545 2223

Bayview Avenue  
Clayton, Vic 3168  
Private Bag 10  
Clayton South, Vic 3169  
Australia

[www.ensisjv.com](http://www.ensisjv.com)  
[enquiries@ensisjv.com](mailto:enquiries@ensisjv.com)

ensis New Zealand  
Telephone: +64 7 343 5777  
Freephone (within NZ only): 0800 231 051  
Facsimile: +64 7 348 0952

Te Papa Tipu Innovation Park  
49 Sala Street  
Private Bag 3020  
Rotorua  
New Zealand

ensis is a joint venture of CSIRO FFP Pty Ltd and Scion Australasia Ltd.

Test-17