THE BUILDING BUSINESS LTD

Evaluation of Timberline Thermory Ash and Thermory Nordic Pine cladding systems with Clause E2 of the Building Code

Kevin Brunton, Technical Director

V4.0, May 2023

The Building Business Limited (TBB), formed in 2011, specialises in the creation and review of technical documentation for building products and systems used in the NZ construction sector. TBB assists product suppliers to meet their regulatory obligations under section 14G of the Building Act. TBB is accredited to ISO 9001: 2016 by Global-Mark PTY, and subject to annual process audits. Global-Mark PTY is certified by JAS-ANZ. The scope of TBB's ISO accreditation is consultancy, technical and legislative advice, publishing assurance statements and preparation of technical documentation for the building industry in Australia and New Zealand.

info@thebuildingbusiness.co.nz
www.thebuildingbusiness.co.nz
PO Box 54 245
The Marina
Auckland 2144

Introduction

Timberline supplies the Thermory Ash and Nordic Pine cladding systems for use as external cladding systems.

The Thermory claddings are thermally modified timber weatherboard claddings manufactured from North American and European White Ash (Thermory Ash) and European Scots Pine (Thermory Nordic Pine). Thermally modified means that the timber is heat-treated at ≥ 215 °C with no chemicals added. This changes the physical properties of the timber making it more stable and more resistant to rot.

Thermory Ash meets durability class 1 and Thermory Nordic Pine meets durability class 2 in accordance with EN 350:2016. The classes are equivalent to the durability period required for timber claddings in Clause B2.3.1(b) of the Building Code when used in applications up to and including hazard class 3.1 as defined in NZS 3640:2003. The classification and use of the Thermory claddings are comparable with other products supplied in New Zealand.

The Thermory cladding systems are outside the scope of Acceptable Solution E2/AS1, because the timber species are outside the NZS 3602:2003 listed species and NZS 3602:2003 does not consider thermal modification of timber. The Thermory cladding, without chemical treatment, will therefore comply with Clause B2.3.1(b) of the Building Code, provided the installation is in accordance with all Timberline requirements, including that the weatherboards are finished with a stain or paint finish.

This evaluation therefore considers whether the Thermory Cladding systems installed direct fixed and over a drained and ventilated cavity complies with Building Code Clause E2 as an alternative solution.

Methodology

This evaluation is based on a comparison of the Thermory Cladding systems with Acceptable Solution E2/AS1. The following documents are referred to:

- Acceptable Solution E2/AS1.
- BRANZ Bulletin Number 411 Recommended Timber Cladding Profiles (BRANZ, 04/2001).
- BRANZ Bulletin Number 673 Cavity Battens (BRANZ, 06/2020).
- Weatherboards (BRANZ, 09/09/2014).

Evaluation

Building Code Clauses

The applicable Building Code clauses are E2.3.2, E2.3.3, E3.2.5 and E2.3.7.

Clause E2 requires:

Clause E2.3.2 Roofs and exterior walls must prevent the penetration of water that could cause undue dampness, damage to building elements, or both.
Clause E2.3.3 Walls, floors and structural elements in contact with, or in close proximity to the ground, must not absorb moisture in quantities that could cause undue dampness, damage to building elements, or both.
Clause E2.3.4 Building elements susceptible to damage must be protected from the adverse effects of moisture entering the space below suspended floors.
Clause E2.3.5 Concealed spaces and cavities in buildings must be constructed in a way that prevents external moisture from being accumulated or transferred and causing condensation, fungal growth, or the degradation of building elements.
Clause E2.3.7 Building elements must be constructed in a way that makes due allowance for the following:

(a) the consequences of failure
(b) the effects of uncertainties resulting from construction or from the sequence in which different aspects of construction occur
(c) variation in the properties of materials and in the characteristics of the site.

Comparison with Acceptable Solution E2/AS1

The Thermory cladding systems are available in weatherboard profiles of bevelback and rebated bevelback, rusticated, vertical shiplap, and vertical board and batten and therefore can be compared with Acceptable Solution E2/AS1, which references NZS 3617:1979 and BRANZ Bulletin 411 Recommended timber cladding profiles.

For horizontal weatherboards, Acceptable Solution E2/AS1 provides for:

- rusticated weatherboards direct fixed where the risk score is 6 or less
- bevelback weatherboard direct fixed where the risk score is 12 or less
- rusticated and bevelback weatherboards installed over a drained and ventilated cavity where the risk score is 20 or less.

For vertical weatherboards, Acceptable Solution E2/AS1 provides for:

- shiplap weatherboards direct fixed where the risk score is 6 or less
- board and batten weatherboards direct fixed where the risk score is 12 or less.

Acceptable Solution E2/AS1 provides for horizontal weatherboards (rusticated and bevelback) to be installed either direct fixed or over a drained and ventilated cavity depending on the risk matrix score. Horizontal weatherboards are within the scope of E2/AS1 where the risk matrix score is 20 or less.

However, vertical shiplap weatherboards are only permitted by Acceptable Solution E2/AS1 where the risk matrix score is six or less and vertical board and batten where the risk matrix score is 12 or less. There is no provision in E2/AS1 for vertical weatherboards installed with horizontal cavity battens.

Comparison with reference profiles

BRANZ Bulletin BU411 provides recommendations for profiles for weatherboards. The following table compares the reference weatherboard profiles with the Thermory weatherboard profiles.

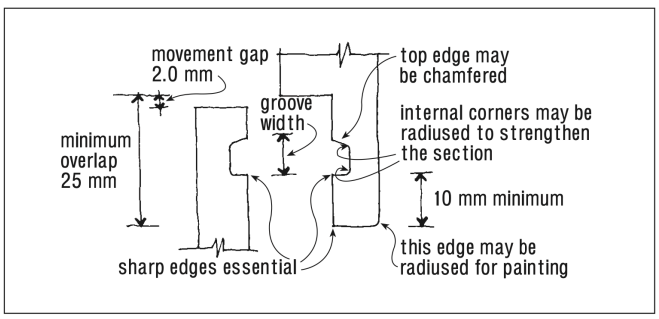
Profile	Thermory profile	BRANZ reference profile	Comparison
Rusticated	180 mm - 135 mm rusticated weatherboard Thickness – 18 mm Lap – 25 mm Expansion gap – 2 mm W/groove – 6 mm x 4 mm (head & toe) Total of W/groove when lapped & installed - 8 mm	BRANZ BU411 (Fig 7) 135 mm rusticated weatherboard Thickness – 19 mm Lap – 26 mm Expansion gap – 2 mm W/groove – 6 mm x 3 mm (head & toe). Total of W/groove when lapped & installed - 6 mm	Lap maximum 1 mm less. Depth of weather groove maximum 1 mm deeper. Board maximum 2 mm thinner.
Bevel back	135 mm bevel back weatherboard Thickness – 18 mm Cover – 103 mm Lap – 32 mm W/groove – 8 mm x 6 mm (toe) Total of W/groove when lapped & installed - 10 mm	BRANZ BU411 (Fig 3) 150 mm bevel back weatherboard Thickness – 19 mm Cover – 118 mm Lap – 32 mm W/groove – 8 mm x 6 mm (toe)	Board maximum 1 mm thinner. Lap equal W/groove - equal Total W/groove when lapped - equal

Profile	Thermory profile	BRANZ reference profile	Comparison
Bevel back	180 mm bevel back weatherboard Thickness - 18 mm Cover – 148 mm Lap – 32 mm W/groove – 8 mm x 6 mm (toe) Total of W/groove when lapped and installed – 10mm	Total of W/groove when lapped & installed - 10 mm	
Rebated bevel back	135 mm Rebated Bevel Back Weatherboard Thickness – 18 mm Cover – 110 mm Lap – 25 mm Expansion – 2 mm W/groove – 6 mm x 4 mm (head & toe) Total of W/groove when lapped & installed – 8 mm	BRANZ BU411 (Fig 4) 110 mm – 115 mm Rebated Bevel Back Weatherboard Thickness – 19 mm Cover – 84 mm - 89 Lap – 26 mm Expansion – 2 mm W/groove – 6 mm x 4 mm (head & toe) Total of W/groove when lapped & installed – 8 mm	Depth of weather groove maximum 2 mm deeper when installed. Board maximum 1 mm thinner. Depth of weather groove equal. Board maximum 1 mm thinner.
Rebated bevel back	135 mm Rebated Bevel Back Weatherboard Thickness – 18 mm Cover – 110 mm Lap – 25 mm Expansion – 2 mm W/groove – 6 mm x 4 mm (head & toe) Total of W/groove when lapped & installed – 8 mm	BRANZ BU411 (Fig 4) 154 mm Rebated Bevel Back Weatherboard Thickness – 19 mm Cover – 84 mm - 89 Lap – 26 mm Expansion – 2 mm W/groove – 6 mm x 4 mm (head & toe) Total of W/groove when lapped & installed – 8 mm	
Shiplap	135 mm square shiplap weatherboard Thickness – 18 mm Cover – 108 mm Lap – 27 mm Expansion – 2 mm Expansion gap – 3 mm W/groove – 6 mm x 4 mm (head & toe) Total of W/groove when lapped & installed - 8 mm	BRANZ BU411 (Fig 8) 135 mm - 180 mm bevelled vertical shiplap weatherboard Thickness - 19 mm Lap - 26mm Expansion gap - 2 mm W/groove - 6 mm x 3 mm (head & toe) Total of W/groove when lapped & installed - 6 mm	Lap maximum 1 mm greater. Depth of weather groove maximum 1 mm deeper. Board maximum 1 mm thinner.

Profile	Thermory profile	BRANZ reference profile	Comparison
Shiplap	180 mm square shiplap weatherboard Thickness – 18 mm Cover – 153 mm Lap – 27 mm Expansion gap – 5 mm W/groove – 6 mm x 4 mm (head & toe) Total of W/groove when lapped & Installed - 8 mm	BRANZ BU411 (Fig 8) 135 mm – 180 mm bevelled vertical shiplap weatherboard Thickness - 19 mm Lap – 25 mm Expansion gap - 2 mm W/groove - 6 mm x 4 mm (head & toe) Total of W/groove when lapped & installed - 8 mm	Lap maximum 1 mm greater. Depth of weather groove maximum 2 mm equal when installed. Board maximum 1 mm thinner.
Shiplap	90 mm bevelled vertical shiplap weatherboard Thickness – 18.5 mm Cover – 65 mm Lap – 27 mm Expansion gap – 5 mm W/groove – 6 mm x 4 mm (head & toe) Total of W/groove when lapped & installed – 8 mm	BRANZ BU411 (Fig 8) 124 mm bevelled vertical shiplap weatherboard Thickness - 19 mm Lap - 26mm Expansion gap - 2 mm W/groove - 6 mm x 3 mm (head & toe) Total of W/groove when lapped & installed - 6 mm	Lap maximum 1 mm greater. Depth of weather groove maximum 2 mm deeper when installed. Board 0.5 mm thinner.
Board and batten	180 mm – 135mm Vertical board & batten 65 mm battens Thickness – 19 mm Cover – 140 mm and 95 mm Lap – 32 mm Expansion gap – 1 mm – 2 mm W/groove – 8 mm x 8 mm Total of W/groove when lapped & installed - 16 mm	BRANZ BU411 (Fig 9) 180 mm – 135 mm Vertical board & batten. Thickness - 19 mm Lap – 30 mm Expansion gap - 5 mm – 8 mm W/groove - 9 mm x 9 m Total of W/groove when lapped & installed - 18 mm	Lap maximum 2 mm greater. Depth of weather groove is less by 2mm once installed. Thermory allows for less expansion.

BRANZ BU411 (Fig 2B) recommendations for rusticated and shiplap weatherboard.

Timberline profiles are consistent with this recommendation.



The following table assesses the differences identified between the reference weatherboard profiles and the Thermory cladding profiles.

Identified difference	Possible impact	Mitigation	Reference documents
Thermory profiles are thinner by 1 mm than the reference profile.	Greater deflection under wind loads. Reduction in strength.	Nordic Pine has the highest shear and compressive strength of the pine family, with a tensile strength of +/- 3.2 mPa. Other approved vertical shiplap weatherboards (e.g. with CodeMark certificates) are manufactured from Western Red Cedar, which has a tensile strength of +/- 1.5 mPa. The thermal modification of the cell structure changes the physical properties of the Nordic Pine, making it more stable.	Nordic Scots Pine vs Selected Competing Species and Non-Wood Substitute Materials in Mechanical Wood Products (Finnish Forest Research Institute, 2006).
Thermory profiles have a lap of maximum 2 mm greater than the reference profile.	Increase in surface tension.	The added lap will enhance the weatherboard systems ability to manage wind-driven rain.	Bulletin BU411 Recommended Timber Cladding Profiles (BRANZ, 2001).
Thermory profiles have weather grooves of maximum 1 mm deeper than the reference profile.	Improved weathertightness performance	6 mm is in keeping with the reference profile.	Weathergrooves- do they work? (BRANZ, 2015).

The Thermory weatherboard profiles meet all requirements of section 4.0 of BRANZ Bulletin 411, which includes requirements for shape, size and location of weathergrooves, allowances for movement and overlap.

There are minor differences between the Thermory and the reference profiles, which are the recommended profiles described in the BRANZ advice. It is noted that a number of weatherboard systems that have product certificates have minor differences to the reference profiles.

It is therefore concluded that the Thermory weatherboard profiles are comparable with the E2/AS1 Acceptable Solution profiles.

Use of vertical weatherboards with cavity systems

Table 3 of E2/AS1 provides for vertical shiplap weatherboards to be used, only up to a risk score of six or less and board and batten to be used, only up to a risk score of 12 or less.

Horizontal battens for use with vertical weatherboards are not included in Acceptable Solution E2/AS1. However, the availability of castellated timber and proprietary plastic horizontal battens provides a solution for vertical weatherboards to incorporate a cavity that is comparable with an E2/AS1 cavity system.

BRANZ previously described the risks with vertical shiplap weatherboards that have resulted in the E2/AS1 limitation of use (BRANZ, 2014).

The following table considers possible issues with vertical weatherboard cladding systems and whether there are mitigating features that address the risks.

Risk	Mitigations	Outcome
Distortion down the lap, with potential for driven rain to enter.	Use of a more stable timber to prevent distortion. Install nogs at maximum 480 centres to the primary structure.	Reduces the likelihood of driven rain. Provides increased structural support to minimise deflection.
Reduction in drainage and drying capacity since fitted hard against the wall framing, with high contact area against the wall underlay.	Installed over a drained and ventilated cavity using castellated timber battens with bevelled slope.	No contact is made with the wall framing. Separation from the wall lining is provided.
Poor drainage and drying capacity.	Installed over a drained and ventilated cavity using castellated timber battens with bevelled slope.	Increased airflow for drainage and drying.
Difficult to install over a cavity.	Introduction of castellated timber battens with an 18° bevel slope. Acceptance and in-service performance of vertical timber cladding systems which can be specified for use up to an Acceptable Solution E2/AS1 risk score of 20.	Castellated timber battens and proprietary plastic battens can be effectively installed over a cavity.

BRANZ advice about the use of horizontal battens recommends (BRANZ, 06/2022):

- Battens must be specifically designed for this purpose – standard radiata pine battens with a solid rectangular profile are not appropriate.
- Plain rectangular timber castellated battens with a flat top surface should not be used because the flat horizontal timber surface does not encourage drainage.
- Battens that are suitable for horizontal use – those with a sloping top edge –need to be installed with the top edge sloping down away from the wall underlay towards the back of the cladding. If castellations are on one side only, that side must be against the cladding.
- Battens must allow adequate vertical ventilation. BRANZ recommends that they provide at least as much ventilation as cavity closers (i.e., an opening area of 1,000 mm^2 per lineal metre of wall). Some castellated battens have openings at the back to achieve this ventilation in addition to the openings at the front.
- Wall claddings must be sufficiently fixed into the framing because horizontal battens are not typically used as structurally fixed battens.

The Thermory cladding systems requirements included with respect to the drained and ventilated cavity and the cavity battens is in accordance with this BRANZ advice.

Therefore it is concluded that the cavity system for the vertical Thermory cladding profiles, incorporating horizontal cavity battens, will have comparable performance to E2/AS1 weatherboards installed over a drained and ventilated cavity. Therefore, installation where a risk matrix score of 20 or less is appropriate.

Comparison of Thermory cladding installation details with E2/AS1 installation details

The installation details for the Thermory rusticated weatherboards and bevel back weatherboards both direct fixed and over a drained and ventilated cavity are identical to E2/AS1.

With respect to the Thermory shiplap and board and batten weatherboards, the use of castellated timber battens with an 18 bevelled slope provides a drained and ventilated cavity that has a comparable level of performance to an E2/AS1 drained and ventilated cavity and the building wrap or rigid air barrier and flashing system are in accordance with E2/AS1. Therefore, the installation details are comparable with E2/AS1 details.

Conclusion

The Thermory weatherboard profiles are comparable with the BRANZ reference profiles. Risks identified by BRANZ with the installation of vertical weatherboards, particularly vertical shiplap are mitigated through the installation methodology and the characteristics of thermally modified timber.

There are minor differences between the Thermory weatherboards and the reference profiles. These differences have not been considered a compliance issue in the case of other profiles that have product certificates issued and so it follows that the minor differences are not significant in the case of the Thermory weatherboard profiles.

Based on the mitigations of potential risks, the comparison with the reference profile, the advice on the use of horizontal cavity battens, and comparison with Acceptable Solution E2/AS1 installation details, it is concluded that the Thermory Cladding systems may be used on buildings with a risk matrix score of up to 20, subject to the conditions and limitations contained in the pass™. For the range of Thermory weatherboards profiles, this means the:

- rusticated weatherboards and shiplap weatherboards may be direct fixed where the risk score is 6 or less, and installed over a drained and ventilated cavity where the risk score is 20 or less
- bevelback and board and batten weatherboards may be direct fixed where the risk score is 12 or less and installed over a drained and ventilated cavity where the risk score is 20 or less.

References

BRANZ. [04/2001] *Bulletin BU411 Recommended Timber Cladding Profiles*. Retrieved from https://d39d3mj7qio96p.cloudfront.net/media/documents/BU411-Recommended-timber-cladding-profiles.pdf. [Accessed 23/05/2023].

BRANZ. [06/2020] *Bulletin Number 673 Cavity Battens*. Retrieved from

https://d39d3mj7qio96p.cloudfront.net/media/documents/Bulletin673_Cavity_Battens.pdf. [Accessed 23/05/2023].

BRANZ. [9/09/2014] *Weatherboards*. Retrieved from https://www.weathertight.org.nz/new-buildings/detail-solutions/wall-cladding-selection/weatherboards/. [Accessed 23/02/2021].

Ministry of Business, Innovation and Employment. [27/06/2019] Verification Methods E2/VM1 and Acceptable Solution E2/AS1, E2/AS2 and E2/AS3.

Finnish Forest Research Institute. [11/2006] *Nordic Scots Pine vs. Selected Competing Species and Non-Wood Substitute Materials in Mechanical Wood Properties*. Retrieved from https://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.467.1578&rep=rep1&type=pdf. [Accessed 23/02/2021].