THE BUILDING BUSINESS LTD

Evaluation of saveBOARD betterBRACE Rigid Air Barrier

Evaluation by The Building Business

for Upcycled Building Materials

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Purpose

This evaluation considers the use of saveBOARD betterBRACE Rigid Air Barrier as a rigid air barrier.

Product description

saveBOARD betterBRACE Rigid Air Barrier is supplied for use as a rigid air barrier and bracing element to be used in buildings where air vapour control design limits are applied.

saveBOARD is a structural composite panel manufactured from shredded and compressed composite packaging. saveBOARD betterBRACE Rigid Air Barrier boards have a fibreglass outer face and paper inner face.

The boards are 1200 mm in width and supplied in the following sizes (thickness x length, mm):

- 10 x 2450, 2750, and 3000
- 12 x 2400, 2700, and 3000.

saveBOARD is manufactured from 100 % recycled materials diverted from landfill. All offcuts and waste may be reused as feedstock for new building products.

Methodology

This evaluation is a comparison and evaluation of saveBOARD betterBRACE Rigid Air Barrier boards as a rigid air barrier with the requirements of Acceptable Solution E2/AS1, the weathertightness principles of E2/AS1 and Clause E2 of the Building Code, and principles and performance requirements for internal moisture management of Clause E3 of the Building Code.

This evaluation is based on test data provided by Upcycled Building Materials.

The applicable Building Code Clauses are Clauses B1 (with respect to the material), B2, E2 and E3. This evaluation, therefore, considers the properties of saveBOARD betterBRACE Rigid Air Barrier that relate to Clause B1, Clause B2, Clause E2 and Clause E3 of the Building Code.

The performance of saveBOARD betterBRACE Rigid Air Barrier boards as a bracing element has been established through the P21 wall bracing test and evaluation procedure carried out by Scion and BRANZ in accordance with Verification Method B1/VM1.

Moisture and air vapour control

Acceptable Solution E2/AS1

saveBOARD betterBRACE Rigid Air Barrier is supplied for use as a rigid air barrier and bracing element to be used in buildings where air vapour control design limits are applied.

E2/AS1 requires external walls to have barriers to airflow. BRANZ, with reference to Acceptable Solution E2/AS1, explains that the purpose of a rigid wall underlay (or rigid air barrier) is to minimise the pressure difference across wall construction and reduce the potential for water entry through air movement (BRANZ, 2013).

A rigid wall underlay (or rigid air barrier) installed behind a drained cavity lowers the risk of weathertightness failure by taking the pressure on the outer face of the framing rather than on the sheet lining. It also prevents insulation from bulging and bridging across the cavity movement (BRANZ, 2013).

E2/AS1 species the barrier to be a flexible wall underlay in wind zones up to and including Very High or a rigid wall underlay (or rigid air barrier) in an Extra High wind zone. A flexible underlay must be installed in conjunction with an E2/AS1 rigid wall underlay (which are limited to plywood and fibre cement). A rigid wall underlay is not required for E2/AS1 direct fixed cladding as the weathertightness risk is regarded as low as defined in E2/AS1 Risk Matrix, but rigid air barriers may be used (BRANZ, 2013). A

rigid wall underlay is also not required for E2/AS1 cladding systems installed in wind zones up to and including Very High.

Proprietary rigid air barriers are outside the scope of E2/AS1 and generally do not require a flexible wall underlay as the sheet is sealed and flashed (BRANZ, 2013).

Some common materials used as proprietary rigid air barriers, as an alternative to E2/AS1 rigid wall underlays or rigid air barriers that must be installed with a flexible wall underlay are:

- fibre cement board with sealed face surface
- oriented strand board (OSB) with sealed face surface
- plywood with sealed face surface.

Proprietary rigid air barriers are not covered by E2/AS1 and therefore must be considered as alternative solutions (BRANZ, 2013).

One way of establishing compliance with the Building Code as an alternative solution is comparison with an Acceptable Solution or Verification Method by showing how changes to materials, detailing, or steps of the solution are compensated for or justified (Ministry of Business, Innovation and Employment, 2016).

Therefore, the performance properties of saveBOARD betterBRACE Rigid Air Barrier are compared to E2/AS1 properties of Table 23 for barriers to airflow.

Comparison with Acceptable Solution E2/AS1 rigid air barrier

Table 23 of Acceptable Solution E2/AS1 requires rigid air barriers to have vapour and water resistance where a cavity system is incorporated. Vapour resistance must be ≤ 7 MN.s/g, tested to ASTM E96B (procedure B/water method). Water resistance must be ≥ 20 mm water head pressure, tested to AS/NZS 4201.4.

The use of saveBOARD betterBRACE Rigid Air Barrier as a rigid air barrier is subject to building design that incorporates a drained and ventilated cavity.

saveBOARD betterBRACE Rigid Air Barrier boards achieved the following performance (Scion, 2022):

- 12.5 MN.s/g water vapour resistance, tested to ASTM E96B
- resistance to water penetration greater than 20 mm, tested to AS/NZS 4201.4.

saveBOARD betterBRACE Rigid Air Barrier boards achieves the prescribed performance requirements of Table 23 of E2/AS1, except for the level of water vapour resistance prescribed by Table 23 of E2/AS1.

The required Table 23 vapour resistance property of ≤ 7 MN.s/g is low resistance (BRANZ, 2016). The vapour resistance of a material is a measure of the material's reluctance to let water vapour pass through (BRANZ, 2016). The classification for vapour resistance in AS/NZS 4200:1994 is ≤ 450 MN.s/g for medium and greater than 450 MN.s/g for high vapour resistance. Given the scale of the categories, the difference in vapour resistance between an E2/AS1 rigid air barrier and saveBOARD betterBRACE Rigid Air Barrier boards is minimal.

It is noted that E2/AS1 is a one-size-fits-all solution with respect to the climate zone and is likely to be conservative in some climate conditions, as it doesn't consider the effect of regional differences in humidity. However, saveBOARD betterBRACE Rigid Air Barrier boards may allow marginally less vapour to diffuse through the barrier to the wall framing and lining than an E2/AS1 rigid air barrier. This means there is potential for slightly increased moisture levels compared to an E2/AS1 construction. The impact of this may allow moisture to accumulate at the framing; however, this is mitigated by drying by way of radiant heating, moisture diffusion (Science Direct, 2022) and the treatment level of the timber to boric H1.2.

WUFI® hygrothermal wall modelling analysis

To determine the significance of the higher vapour resistance of saveBOARD betterBRACE Rigid Air Barrier, Upcycled Building Materials Limited obtained hygrothermal modelling analysis for saveBOARD betterBRACE Rigid Air Barrier, as well as water vapour transmission and permeance testing, and testing for resistance to the growth of mould.

WUFI® (Wärme und Feuchte Instationär) hygrothermal wall modelling analysis was carried out by a building envelope specialist to establish the conditions for use and required

temperature controls to limit vapour flows (Kaizon, 2022). WUFI® analysis calculates the coupled heat and moisture transfer in building components exposed to natural climate conditions. Heat and moisture are coupled because moisture levels and heat loss are related, and the temperature conditions affect the transport of moisture in the building. The analysis also considers the risk of mould growth based on time, surface temperature, surface relative humidity and material sensitivity, because internal moisture accumulation can lead to mould growth on surfaces.

WUFI® hygrothermal wall modelling analysis carried out by a building envelope specialist establishes the conditions for use and required temperature controls to limit vapour flows –vapour resistance– [Kaizon, 12/07/2022]. Using the different wall construction methods based on the BRANZ vapour control study (BRANZ, 2016) and NIWA data for Auckland, Hamilton, Tauranga and Auckland, WUFI® analysis the mould Index (MI) presented a low risk and was less than 3.0 on the MI. Auckland was considered the worst case location primarily because of the high levels of RH at a maximum of 85 %. However, when applying a different control point from those provided in the BRANZ study to the internal temperature: heating: 20 °C ± and cooling 24 °C ± the high-risk MI was reduced to low. This analysis considers the worst-case scenario.

The design and specification of saveBOARD betterBRACE Rigid Air Barrier and the design and specification of the building must consider the exterior thermal envelope and internal controls that relate to ventilation, space temperature, relative humidity, and geographical climate zones. The design method must be as specified in the saveBOARD NZBC E3 Design Guide Internal Moisture Control (June 2022, Version 1), Table 1 'Approved saveBOARD Design Methods (SDM)' that applies to the relevant climate region.

The use of full-building mechanical ventilation and temperature control (MVTC) for controls for relative humidity and interior temperature in residential buildings is recommended.

Internal moisture accumulation

Testing to ASTM D2373-12 for resistance to growth of mould shows saveBOARD resists the growth of mould contaminants (Intertek, 2013). Internal moisture accumulation is the main cause of mould growth. The WUFI® analysis shows that based on the BRANZ study about vapour control (BRANZ, 2016) which provided an average indoor uncontrolled temperature, baseline of 16.4°C and a medium RH of 64 % in July and January in NZ over a one-year period. Interior climate modelling set the following control points at 60 % RH and internal controlled air conditioning dehumidification to a temperature control of between 16.4 °C ± 4 °C. The WUFI® models consisted of a cross section through the wall assembly containing insulation, framing, battens, fibre cement cladding and saveBOARD betterBRACE Rigid Air Barrier board. A mould Index based on ASHRAE Standard 160 defines the criteria for determining the level of biological growth on material surface. The standard states that the mould index (MI) should not exceed 3.0. Where the MI is above 1 but below 3, this presents an elevated risk; however, this is considered acceptable. The WUFI® referenced Intertek (2012) and concluded that saveBOARD had no volatile organic compounds that would promote mould growth. The Sustainable Engineering Building Science Report (Sustainable Engineering, 2020) concluded an MI less than 3.0 which assumes the use of saveBOARD betterBRACE Rigid Air Barrier board (fibreglass coated) is suitable as a construction material in Auckland.

Conclusion (moisture and vapour control)

Based on the WUFI® hygrothermal wall modelling analysis and the comparison with an Acceptable Solution E2/AS1 rigid wall underlay (or rigid air barrier), saveBOARD betterBRACE Rigid Air Barrier meets the requirements of Clauses E2 and E3 of the Building Code.

This is subject to the design and specification of saveBOARD betterBRACE Rigid Air Barrier and the design and specification of the building, taking into account the exterior thermal envelope and internal controls that relate to ventilation, space temperature, relative humidity, and geographical climate zones. The design method must be as specified in saveBOARD NZBC E3 Design Guide Internal Moisture Control (June 2022,

Version 1), Table 1 'Approved saveBOARD Design Methods (SDM)' that applies to the relevant climate region.

The use of full-building mechanical ventilation and temperature control (MVTC) for controls for relative humidity and interior temperature in residential buildings is recommended.

Stability

As E2/AS1 provides a solution for the construction of an external wall that complies with the Building Code, it can be concluded that a rigid air barrier that is comparable with the level of performance of an E2/AS1 rigid air barrier also meets the requirements of Clause B1 that applies to the material/building element.

E2/AS1 limits rigid air barrier materials to fibre cement and plywood. While Table 23 doesn't prescribe mechanical strength properties for rigid air barriers, the saveBOARD betterBRACE Rigid Air Barrier boards can be compared with the generic mechanical strength properties prescribed by the New Zealand standards for plywood and fibre cement board.

The bending strength/modulus of rupture of saveBOARD has been tested in accordance with AS/NZS 2269.1 (which is the test method specified for plywood). saveBOARD achieves 14.01 MPa perpendicular and 16.14 MPa parallel bending strength (Scion, 2021). The bending strength achieved is lower than specified by AS/NZS 2269.0 for plywood (Stress grade F7), but greater than specified by AS/NZS 2908.2 for fibre cement sheets (Class A). While the two test methods have differences in the prescription for the sample size, the methods are generally comparable.

Therefore, it can be concluded that the saveBOARD betterBRACE Rigid Air Barrier boards have the necessary mechanical strength properties to comply with Clause B1 of the Building Code that applies to the material/building element.

Durability

saveBOARD betterBRACE Rigid Air Barrier boards are manufactured from compressed composite packaging, which by its nature does not degrade.

The boards have been tested in accordance with Acceptable Solution E2/AS1 and NZS 2295 and achieve comparable results with an E2/AS1 and/or NZS 2295 barrier to airflow for all properties (Scion, March 2022).

The boards have a fibreglass and resin external face coating finish which has proven historic weather protection performance. Once the external cavity and cladding system are installed, any UV degradation is eliminated.

There are no volatile organic compounds that would promote mould growth.

Additional mitigations are: the use of saveBOARD betterBRACE Rigid Air Barrier as a rigid air barrier is subject to building design that incorporates a drained and ventilated cavity; and also the design and specification of saveBOARD betterBRACE Rigid Air Barrier and the design and specification of the building must take into account the exterior thermal envelope and internal controls that relate to ventilation, space temperature, relative humidity, and geographical climate zones.

Conclusion

The tested data for saveBOARD betterBRACE Rigid Air Barrier shows that the material properties and characteristics of the saveBOARD meet the provisions of the Building Code in respect of Clauses B1, B2, E2 and E3, as:

- Although saveBOARD betterBRACE Rigid Air Barrier is outside the scope of E2/AS1 (as it is a proprietary rigid air barrier so is an alternative solution), it meets the E2/AS1 moisture management properties of E2/AS1.
- WUFI® analysis demonstrates that saveBOARD betterBRACE Rigid Air Barrier can be used in different geographical location throughout NZ.
- WUFI® analysis demonstrates that saveBOARD betterBRACE Rigid Air Barrier does not promote mould growth; however, the use of full building mechanical ventilation

and temperature control (MVTC) for control of relative humidity and interior temperature in residential buildings are recommended.

The scope and limitations to the use of saveBOARD will need to apply with respect to:

- Use in geographical climate zones as defined in H1/VM1, 5th edition; H1/VM2, 1st edition; and H1/AS1, 5th edition, as the building must be designed in accordance with an applicable building design method as specified in saveBOARD NZBC E3 Design Guide Internal Moisture Control (June 2022, Version 1), Table 1 'Approved saveBOARD Design Methods (SDM)' that applies to the relevant climate region
- use as a rigid air barrier, as the building must be designed in accordance with the building design methods as specified in saveBOARD NZBC E3 Design Guide Internal Moisture Control (June 2022, Version 1), Table 1 'Approved saveBOARD Design Methods (SDM)'. SDM 1 specifies climate regions where temperature control is not required. SDM 2 specifies design criteria input options. SDM 3 allows for project-specific hygrothermal analysis. In addition, the use of full-building mechanical ventilation and temperature control (MVTC) for control of relative humidity and interior temperature in residential buildings is recommended.

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