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E2 Evaluation

of Metal Design Solutions Group EuroSpan, Double Standing Seam, Angle Seam and Snap Lock Roof and Wall Architectural European-Style Metal Tray Cladding

Evaluation by The Building Business for Metal Design Solutions Group Ltd

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Introduction

The EuroSpan, Double Standing Seam, Angle Seam and Snap Lock Roof and Wall Architectural European-Style Metal Tray Cladding profiles (Standing Seam Roof and Wall profiles) are long-run sheet-metal tray trough profiles supplied by Metal Design Solutions Group for use as roofing and wall cladding.

For the purposes of this evaluation, the four profiles, EuroSpan, Double Standing Seam, Angle Seam and Snap Lock are generically named as "Standing Seam" as the difference between the four profiles is a minor variance to the crest height and the standing seam interlocking laps.

This evaluation has been prepared to provide assurance of compliance with the NZ Building Code for the Standing Seam Roof and Wall profile. Because the profile is outside the scope of Acceptable Solution E2/AS1 and the New Zealand Metal Roofing Manufacturers New Zealand Metal Roof and Wall Cladding Code of Practice (the Code of Practice), compliance with the Building Code must be demonstrated as an alternative solution.

Profile description

Profile	Use	Description	Difference to E2/AS1
Roof Cladding Profiles			
EuroSpan	Over self-supporting wrap or plywood substrate	Standing seam, interlocking edge crest of 45 mm, swag pan typically 463 mm o/a	Pan width
Double Standing Seam	Over plywood substrate	Standing seam, interlocking edge crest of 38 mm, flat pan typically 500 mm o/a	Pan width
Angle Seam	Over plywood substrate	Standing seam, interlocking edge crest of	Pan width and crest height

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		25.5 mm and 38 mm, flat pan typically 500 mm o/a	
Snap Lock	Over plywood substrate	Standing seam locking edge crest of 25 mm and 38 mm, flat pan, typically 500 mm o/a	Pan width and crest height
Wall cladding profiles			
EuroSpan Vertical	Over self-supporting wrap affixed to a horizontal cavity batten	Standing seam, interlocking edge crest of 44 mm, swag pan typically 463 mm o/a	Pan width
Angle Seam Horizontal	Over plywood substrate and affixed to a horizontal cavity batten	Standing seam, interlocking edge crest of 25.5 mm and 38 mm, flat pan, typically 526 mm o/a	Pan width and crest height
Angle Seam Vertical	Over plywood substrate and affixed to a vertical cavity batten	Standing seam, interlocking edge crest of 25 mm, flat pan, typically 526 mm o/a	Pan width and crest height

Methodology

This evaluation is based on comparing and evaluating profile and the installation details with Acceptable Solution E2/AS1 and the Code of Practice, the weathertightness principles of E2/AS1 and the relevant performance requirements of the Building Code.

This evaluation is limited to the scope of use described in the EuroSpan, Double Standing Seam, Angle Seam and Snap Lock Roof and Wall Architectural European Style Metal Tray Cladding pass™.

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Relevant Building Code clauses and cited documents

This applicable Clause E2 requirements are:

> **Clause E2.3.1** Roofs must shed precipitated moisture. In locations subject to snowfalls, roofs must also shed melted snow.
>
> **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 E2.3.5** 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.

The Standing Seam Roof and Wall profiles are long-run metal tray trough profile. Trough profiles are:

- described in Acceptable Solution E2/AS1 (paragraph 8.4.4 c) 'trough profile', with 'vertical ribs at a minimum height of 38 mm, and flat or lightly profiled pans of 210 mm maximum between crests'; and
- described in the Code of Practice as: a 'standing seam', being 'a fully supported metal roofing system that consists of an overlapping or interlocking seam that occurs at an upturned rib and is made by turning up the edges of two adjacent metal panels, and folding and interlocking them once for a single seam and twice for a double seam', and

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with the pan being 'no greater than 200 mm between ribs'. The Code of Practice does not include dimensional requirements.

Acceptable Solution E2/AS1 also sets the minimum pitches for profile metal roofing (BRANZ, December 2008).

For roofing, the Standing Seam Roof and Wall profile sections are outside the scope of E2/AS1 and the Code of Practice as they have crests of a minimum 25 mm and pan varying pans widths of typically up to 526mm.

For wall cladding, the Standing Seam Roof and Wall profile is outside the scope of E2/AS1, because E2/AS1 only provides solutions for corrugated or trapezoidal profiles.

This means key issues that need to be considered are deflection and deformation that may occur through thermal expansion and lack of support of the larger trough sections. The wall profile is more susceptible to outward pressure (suction), while the roofing profile is susceptible to permanent weight imposed, live load and point loads.

Weathertightness risk assessment

Compliance with the Building Code must, therefore, be demonstrated through an alternative solution.

As part of the risk assessment, applied loads, thermal expansion, design and installation have been considered.

A roof or wall cladding is exposed to a number of applied loads that could damage or distort the metal profile and allow moisture to enter the building either through distortion of the laps, elongation around fastenings, and penetration or permanent damage of the metal due to deformation beyond its elastic state.

Based on data about the expansion and contraction of metals, distortion will be primarily along the length of the sheet.

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Given the thermal expansion and contraction data at 0 °C to 82 °C of 1.00 mm/m, the likelihood of seam distortion across the width is negligible (Fielders, n.d.). Linear expansion has been estimated at 10 mm over a length of 40 m. In the unlikely event that a greater length is specified an expansion or step joint can be incorporated (refer to paragraph 7.3 of the Code of Practice).

Risks associated with the use of the Standing Seam Roof and Wall profiles are:

Roofing profiles may:

- deform through thermal expansion and contraction
- deform through lower rib height that may reduce the structural span length between supports
- deform because the pan widths may not provide adequate fixings (concealed clips) to withstand applied loads
- deform because of the greater pan width, restricting the roof's ability to shed melted snow through ponding or incorrect roof slope
- deform because of wind actions, inward and outward wind pressure
- deform because allowances have not been made for live and point loads (trafficable roof, plant and services)
- leaks due to poor installation.

Wall cladding profiles may

- deform because pan widths may not provide adequate fixings to accommodate applied loads because of the greater distance between concealed clips
- deform because of lack of support resulting in rotation and deflection of the wall profile
- deform because of wind actions, inward and outward wind pressure
- moisture condensation on the underside of the roofing material because of limited air flow/ventilation
- Leaks due to poor installation.

Other risks include poor design and/or installation of the profiles.

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Weathertightness mitigations

Mitigations for the identified risks are described in the following table.

Risk	Mitigations	Outcome
Roofing		
May deform through thermal expansion and contraction.	• Installed with a clip fastening and interlocking standing or double standing seam system. • Fully supported longitudinally down each of the interlocking crests	• Each roofing panel can move independently and not transfer any movement to the adjoining panel.
May deform through lower rib height, which may reduce the span length between supports.	• Must be installed over a plywood substrate that fully supports the roof cladding or where swagged in the pan can be supported on a self-supporting wrap.	• No structural impact because the profile is fully supported by a substrate. • Uniform continuity byway of interlocking seam at each crest edge to reduce rotation and deflection.
May deform because the pan widths may not provide adequate fixings (concealed clips) to withstand applied loads.	• For larger pan widths, the frequency of concealed metal edge clips can be increased from typically, 900 mm centres to 400 mm centres for Extra High Wind Zones (55 m/sec) • Profile clips to be fixed with screws based on the MultiONE® User & Installation guide [Bremick®, 07/2021], Reisser Cleat screw and the Rees Product Specification [Schneefangsysteme Res GmbH & Co. KG, 05/11/2019].	• Limits the possibility of distortion due to negative suction. • Increased support over a roofing substrate to accommodate applied loads. • Uniform continuity byway of standing seam and additional along each edge to reduce rotation and deflection due to additional fixing clips.

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May deform because of the greater pan width, restricting the roof's ability to shed melted snow and rainwater through ponding or incorrect roof slope.	• Pan width limited by the coil width but typically 526 mm maximum between crests. • Installed over plywood that fully supports the roofing. • Installed in conjunction with a roofing underlay. • For larger pan widths, the frequency of concealed metal clips can be increased subject to design wind pressure. • Increase the roof pitch from the minimum 3° as specified in clause 7.1.1 of the Code of Practice. • Manufactured from .55 BTM to withstand higher wind speed and limit deflection. • The Code of Practice provides for the selection of pan widths to ensure effective drainage based on section 7.1.4 of the Code of Practice and rainfall intensities based on NIWA's HIRDS tool or 5.3.2 of the Code of Practice.	• Decreases the likelihood of distortion because of the increase in structural support. • Limits the possibility of distortion due to negative suction. • Incorporates a second layer of moisture protection. • Plywood substrate limits the opportunity of distortion which could result in ponding. • Pan widths and standing seam ensure rain intensity volume does not exceed the trough section area.
May deform because of inward and outward wind actions.	• The profile has a standing seam, which allows for thermal expansion at each joint. • Installed over plywood that fully supports the roofing. • Manufactured from .55 BTM to withstand higher wind speed and limit deflection.	• There are adequate clearances to accommodate expansion and minimal expansion will occur across the sheet width. • Decreases the likelihood of distortion and allows the roof to shed snow and increase in structural support.

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May deform because allowances have not been made for live and point loads (trafficable roof, plant and services).	• Installed over plywood that fully supports the roofing. • Manufactured from .55 BTM to withstand higher live and point loadings. • Designer to consider live loads and take into account roof plant and services. • Limit penetrations with the use of proprietary mounts and proprietary systems that reduce point load pressure.	• The roof is fully support because of the plywood substrate which will manage most of the point and trafficable loads. • Where required, the designer will make account for specific services loads and apply structural support that provides a UDL.
Condensation on the underside of the roof cladding	• It is important to keep the roof dry on the underside. While there will be a building wrap that meets the performance requirements of Table 23 of E2/AS1, the designer must consider the need for passive ventilation within the roof space	• The risk of condensation is mitigated by a secondary breathable building wrap which allows any moisture to move to the outside of the building envelope. • Passive ventilation will limit any residual ceiling moisture vapor.
Leak due to poor installation	• Where a skillion roof is used a 50 mm minimum void shall be installed between the insulation layer and the underside of the plywood substrate and the metal roofing. • Building wrap will be installed that meets the performance requirements of Table 23 of E2/AS1 and has the required lap at joints.	• Adequate clearance to allow radiant drying in the event of condensation or minor leakage. • Two to three layers of added defense depending on whether the metal profile is over a plywood and building wrap or wrap alone. • Adequate roof pitch to ensure fall to the outside of the building envelope.
Poor design and/or installation	• The designer must use the tools provided by MDS which include indicative details:	• Provided the designer and installer follow MDS requirements, the resulting completion of

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	MDS_R_ESP_001-011 MDS_R_ESV_001-011 MDS_R_DSS_001-013 MDS_R_ASR_001-011 MDS_R_SLR_001-013 and must use E2/AS1 and the Code of Practice in accordance with the scope and limitations of the pass™. • The installer must hold a current LPB registration and be familiar with MDS Standing Seam Roof Cladding system. • The installer must complete the installation in accordance with the building consent documentation.	the work will meet the requirements of the Building Code.
Wall cladding		
Pan widths may not provide adequate fixings to accommodate applied loads because of the greater distance between concealed clips.	• For larger pan widths, the frequency of concealed metal edge clips can be increased from, typically, 900 mm centres to 400 mm centres for Extra High Wind Zones (55 m/sec). • Pan width limited by the coil width but, typically, 526 mm between crests. • Must be installed over a drained and ventilated cavity.	• Distortion is minimal. • Decreases the likelihood of distortion and allows an increase in structural support. • Increased air flow for drying and drainage in the cavity. • Greater cover provided than required for vertical weatherboard.
Profiles may distort because of the greater pan width and have the potential for driven rain to enter the wall, particularly at cladding junctions in complex building designs.	• Must be installed over a drained cavity. • Installation of an approved building wrap (Table 23 of E2/AS1) over a plywood substrate in conjunction with a drained and ventilated cavity system to E2/AS1.	• High volume air flow and radiant heat flow provided for condensation drying as well as drainage. • Two layers of defense used in the assembly. • System meets the performance

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	• Double raised seams allows for any crest distortion. • Scope of use restricted in accordance with E2/AS1 and the Code of Practice as per the pass™.	requirements of Clause E2. • Use limited in some situations.
Leak due to poor installation	• The profiles are required to be installed over a drained cavity in accordance with E2/AS1. • Building wrap will be installed over the plywood substrate that meets the performance requirements of Table 23 of E2/AS1 and has the required lap at joints. • Like the E2/AS1 flashing systems, the MDS flashing systems are primarily designed to work as a back-flashings, which allows (at times) moisture to breech the metal cladding and drop to the base of the cladding.	• Adequate clearance to allow radiant drying and drainage in the event of condensation or minor leakage. • Where the design incorporates a drained cavity and a building wrap the metal profile has two secondary forms of dealing with moisture.
Poor design and/or installation	• The designer must use the tools provided by MDS which include indicative details: MDS_W_ESP_001-012 MDS_W_ASH_001-012 MDS_W_ASV_001-012 and must use E2/AS1 and the Code of Practice in accordance with the scope and limitations of the pass™. • The installer must hold a current LPB registration and be familiar with the MDS Standing Seam Wall Cladding system.	• Provided the designer and installer follow MDS requirements the resulting completion of the work will meet the requirements of the Building Code.

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	• The installer must complete the installation in accordance with the building consent documentation.	

Details comparison – roofing

The following compares the details and installation requirements for the Standing Seam Roof and Wall profile with Acceptable Solution E2/AS1 and the Code of Practice.

The E2/AS1 and Code of Practice details are generic in nature. Therefore, the comparison of these details assesses their alignment with the weathertight principles of Clause E2 of the Building Code and E2/AS1 and the Code of Practice. The provision of flashing cover to prevent moisture penetration in accordance with the performance requirements of Clause E2 of the Building Code is also considered.

The Standing Seam Roof and Wall profile Roofing details (Issue 1.1 and 1.2) [MDS, 09/2020b, c, e, f, 11/2020a, b] and are in accordance with E2/AS1 and the Code of Practice with respect to the minimum flashing cover, stop-ends and flashing detailing of the eaves' flashing/gutter, apron flashing, barge flashing, parapet, ridge/hip flashing and valley flashing.

E2/AS1 calls for all metal roofing profiles to be installed over bitumen and fire-retardant paper-based products (refer to Table 23 of E2/AS1). The Standing Seam Roof and Wall profile roofing details incorporate an underlay over a minimum 15 mm plywood substrate. The plywood substrate provides for a fully supported roof and wall system ensuring reduced deflection; and the underlay provides a structural support substrate that is a vapour-permeable, barrier between the metal profile and plywood. This is in keeping with E2/AS1 and is consistent with the Code of Practice.

The use of a plywood substrate for the Standing Seam profile can be substituted for a self-supporting underlay because of the added straight obtained by the swages in the pan. Where live loads are expected MDS and good trade practice would recommend added support.

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Details comparison – wall cladding

The following compares the details and installation requirements for the Standing Seam Roof and Wall profile with Acceptable Solution E2/AS1.

The E2/AS1 details are generic in nature. Therefore, the comparison of these details considers the weathertight principles of Clause E2 of the Building Code and E2/AS1 and the provision of flashing cover to prevent moisture penetration in accordance with the performance requirements of Clause E2 of the Building Code.

Paragraph 9.6 of E2/AS1 provides profiled metal wall cladding acceptable solutions. The Standing Seam Roof and Wall profile is outside the scope of E2/AS1, because E2/AS1 only provides solutions for corrugated or trapezoidal profiles. However, the principles adopted in the Standing Seam Roof and Wall profile wall cladding details (Issue 1.1) [MDS, 09/2020a, d, e] largely follow the E2/AS1 details.

Where reliance is placed on stop-ends of the profile in and around wall junctions to limit moisture entry, back flashings, foam seals and tape are used to direct any moisture that may have breached the primary flashing away from the cavity.

The flashing profiles are manufactured and supplied as accessory components, which reduces the possibility of poor flashing specification and performance.

All clearances are in keeping with the principles of E2/AS1. This includes proximity to ground (paved 100 mm or unpaved 175 mm) and clearances for decks or roofs. All back flashings either meet or exceed the upstand heights, return lengths and cover required in E2/AS1.

The design of the system incorporates a nominal 20 mm drained cavity system in keeping with the principles of E2/AS1, with battens spaced at 600 mm horizontal centres for vertical claddings or up to a maximum of 1100 mm where horizontal cladding is to be used. The batten spacing is subject to specific wind considerations.

The flashings are primarily folded formable grade 0.55mm BMT for galvanized, aluminium/zinc-coated and pre-painted steel, and 0.90mm for aluminium (or 0.7mm

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for small aluminium flashings) to the same standards as the profiled sheets, notched where across the profile.

Standing Seam Roof and Wall profile wall cladding details jointing methods incorporating a single overlapping clip system with anti-capillary swages, kick-outs, or hems.

The contact area of the profiles is minimal against the horizontal or vertical cavity battens, therefore maintaining high volume air movement. The system's design incorporates a 15 mm plywood, rigid air barrier with an underlay and is installed over a cavity system, over laid with a building wrap. This allows for easy installation for additional fixings and minimises metal deflection (to pans between ribs) under wind loads.

The primary flashing is the overlapping and interlocking standing seam, which is incorporated in both the roof and wall cladding crest and the hold down clips. The standing and interlocking seams sit snugly against the roofing pan with a clearance of approximately 2 mm, which provides adequate clearance for profile movement. The profile has a cover variation of 12 mm - 30 mm at the crest with the smaller cover used on vertical walls which is more than sufficient to cater for shedding of moisture on a roof and wind-driven rain on a vertical wall.

The window flashings are a mixture of cutbacks on the profile, hems, closed cell tape and a cover that exceeds the requirements of E2/AS1.

Depending on the application (vertical or horizontal) the system must be set out, designed and executed in accordance with the MDS details [MDS, 09/2020].

Conclusion

The Standing Seam Roof and Wall profile complies with Clause E2 of the Building Code as an alternative solution because:

- for roofing, while the profiles differ from those covered by Acceptable Solution E2/AS1 and the Code of Practice, appropriate mitigations have been

applied with respect to the scope and limitations of use and the installation details to account for the differences in the profiles and the details are essentially the same in principle as the details provided by Acceptable Solution E2/AS1 and the Code of Practice, notwithstanding that the profiles are out of scope; or

- for wall cladding, appropriate mitigations have been applied with respect to the scope and limitations of use and the installation details to account for the differences in the profiles and the details are essentially the same as the details provided by Acceptable Solution E2/AS1, notwithstanding that the profiles are out of scope.

This is on the basis that:

- the structural frame and substrate is in accordance with the Building Code
- the use is within the scope and limitations of the EuroSpan, Double Standing Seam and Snap Lock Roof and Wall Roof and Wall Architectural European-Style Metal Tray Cladding pass™
- the design is in accordance with MDS Standing Seam Roof and Wall profile and/or Wall Cladding details
- the construction is in accordance with Standing Seam Roof and Wall profile and/or Wall Cladding details
- the specified system components are not substituted.

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