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True Oak® Deep Roof and Wall Claddings

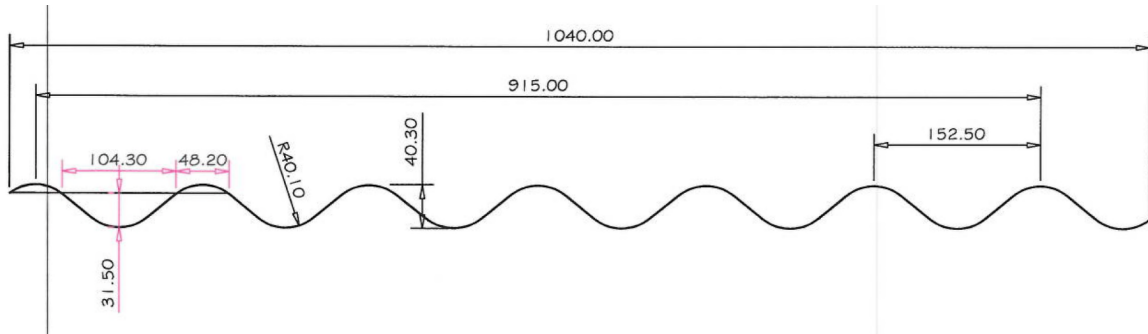
Compliance with the Building Code for E2 External Moisture

Executive Summary

This report presents arguments supporting the use of **True Oak® Deep** profile as roofing and vertically and horizontally fixed wall cladding complying with the requirements of the Building Code regarding E2 External Moisture.

Background

True Oak® Deep is a symmetrical corrugate profile with a minimum crest height of 40.3mm and a 915mm cover with a pitch of 152.5mm between crests. **True Oak® Deep** corrugate is similar to True Oak® corrugate but has a wider pitch and deeper sinusoidal wave profile.



Acceptable Solution E2/AS1 provides for corrugate profile roofing with a minimum crest height of 16.5 mm.

It also provides for metal cladding of corrugate profile to be used as wall cladding when direct fixed vertically (up to and including Risk Score 20). It allows horizontal fixing over a drained and ventilated cavity (up to and including Risk Score 20). Vertical fixing on cavity is not explicitly addressed, but the notes to E2/AS1 Table 3 comment that direct fixed vertical corrugated steel is included as cavity construction, ie vertical fixing on cavity (should that be considered) is no different than direct fixing, which is permitted up to and including Risk Score 20.

Compliance with the Building code Clause E2 External Moisture for different profiles and use in alternative applications requires analysis of the profile and its use in those applications.

True Oak® Deep profile and E2/AS1

Acceptable Solution E2/AS1 covers a range of profiles:

8.4.4 Profiles

Profiles covered in this Acceptable Solution are shown in Figure 38, and consist of:

- Corrugated** – curved with a crest height of 16.5 mm minimum,
- Trapezoidal** – symmetrical or asymmetrical with a minimum crest height of 19 mm, and for asymmetrical a flat or lightly profiled pan width of 210 mm maximum between crests, and
- Trough profile** – with vertical ribs at a minimum height of 38 mm, and flat or lightly profiled pans of 210 mm maximum between crests.

E2/AS1 para 8.4.4	True Oak® Deep	
minimum crest height of 16.5 mm	40.3 mm	Complies

It also applies to particular grades of material:

8.4.3.2 Steel

Materials for the manufacture of profiled steel roof cladding shall:

- a) have a BMT of 0.4 mm minimum
- b) be grade G550, or G300 for rolled, crimped, or trough profile roofing
- c) be selected for corrosion protection according to the intended exposure zone as shown in Table 20.

(The same requirements are repeated for profiled steel cladding, in para 9.6.3.2)

E2/AS1 paras 8.4.3.2/9.6.3.2	True Oak® Deep	
BMT 0.4 mm minimum	0.55 mm	Complies
Grade G550 or G300	G550	Complies
be selected for corrosion protection according to the intended exposure zone.....	Various coating options available.	Complies

The **True Oak® Deep** profile meets the characteristics specified in E2/AS1 in all respects for roofing and when used within the limitations of E2/AS1 it complies with E2 External Moisture.

This report also examines how compliance with performance requirements of clause E2 External Moisture of the Building Code could be argued for **True Oak® Deep** as an alternative solution for use as roofing for a minimum roof pitch of 4 degrees, which is outside the limitations of E2/AS1.

The relevant Building Code requirement is cl E2.3.2:

E2.3.2 Roofs and exterior walls must prevent the penetration of water that could cause undue dampness, damage to building elements, or both.

Analysis

Roofing

For roofing, the acceptable solution E2/AS1 provides for corrugated profile roofing limited to those with a minimum crest height of 16.5 mm.

The **True Oak®** profile meets the characteristics specified in E2/AS1 in all respects.

However, E2/AS1 limits corrugate profiles to a minimum roof pitch of 8 degrees. The Acceptable Solution requires a minimum crest height of 16.6mm but does not give “credit” for deeper corrugated profiles.

The MRM Code of Practice provides for a minimum roof pitch of 4 degrees where the corrugate crest height is between 21 mm and 35 mm.

The capacity of the **True Oak® Deep** corrugate profile has been analysed¹ to establish whether it would comply with the performance requirements of E2 External Moisture when used at a roof pitch of minimum 3 degrees.

The analysis considered the following factors:

- hydraulic flow calculations of the depth of water in profile valleys under high rainfall, for various roof pitches
- flow of water over edge laps and capillary actions
- effect of wind pressure and wind driven water through the edge lap

Hydraulic flow calculations by two methods established the depth of flow in the corrugate valley, for an assumed “worst case” scenario of 3 degree pitch, 40 m roof run and 200 mm/hr rainfall intensity, to be 14 mm or 17.5 mm, depending on the method. These are in good agreement. Taking the more conservative value, the water depth of 17.5 mm is 32.5 mm below the crest of the profile, and approximately 13.5 mm below the edge lap, creating a freeboard with a significant margin of safety, even at the maximum recorded 10-minute rainfall in New Zealand.

For roof cladding, capillary action along edge laps is only able to take place when the edge lap is either flooded by virtue of depth of water in the valley or has a film of water passing over it.

A significant freeboard is available before the edge lap would be flooded, so capillary action from a flooded edge lap can be excluded.

As is the case for all corrugate profiles, the edge lap does have water passing over it from the crest of the profile to the valley during rain, regardless of roof pitch. If capillary action of the water film passing over the lap from crest to valley was a factor that lead to roof leaks it would be a widespread effect on roofs of all pitches and under even modest rainfall intensities. This obviously does not happen and can be discounted.

Intuitively it might be thought that high wind at the time of rainfall would increase the chance of leaks. However, in general the pressure on the roof due to air passing across it is negative i.e. a suction force, so is unlikely to exacerbate the passage of water through the edge laps. From building physics **True Oak® Deep** corrugate at 3 degrees roof pitch is even less likely to leak at edge laps due to wind action than at 8 degrees roof pitch or any of the circumstances where it would be permitted in the acceptable solution E2/AS1.

¹ True Oak Deep Corrugate Profile Tekton Consulting Report T14318, 3 April 2020

That report concluded that “**True Oak® Deep** corrugate profile roofing meets the performance requirements of the New Zealand Building Code for External Moisture E2 when used on roofs with a minimum pitch of 3 degrees.”

Wall Cladding

The **True Oak® Deep** profile meets the characteristics specified in Acceptable Solution E2/AS1 in all respects for cladding and when used within the limitations of E2/AS1 it complies with E2 External Moisture.

Conclusions

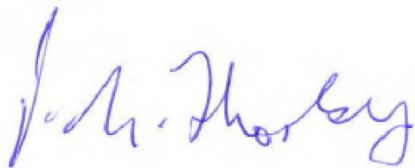
True Oak® Deep roofing meets the requirements in Acceptable Solution E2/AS1 for corrugate profile metal roofing and meets the performance requirements of E2 External Moisture.

True Oak® Deep roofing also meets the performance requirements of E2 External Moisture when used with a minimum roof pitch of 3 degrees.

True Oak® Deep direct fixed vertically as cladding complies with E2/AS1 and meets the performance requirements of E2 External Moisture (up to and including Risk Score 20).

True Oak® Deep fixed vertically as cladding over a nominal 20 mm drained cavity complies with E2/AS1 and meets the performance requirements of E2 External Moisture (up to and including Risk Score 20).

True Oak® Deep fixed horizontally as cladding over a nominal 20 mm drained cavity meets the requirements in Acceptable Solution E2/AS1 for corrugate profile metal cladding and meets the performance requirements of E2 External Moisture (up to and including Risk Score 20).



P N Thorby