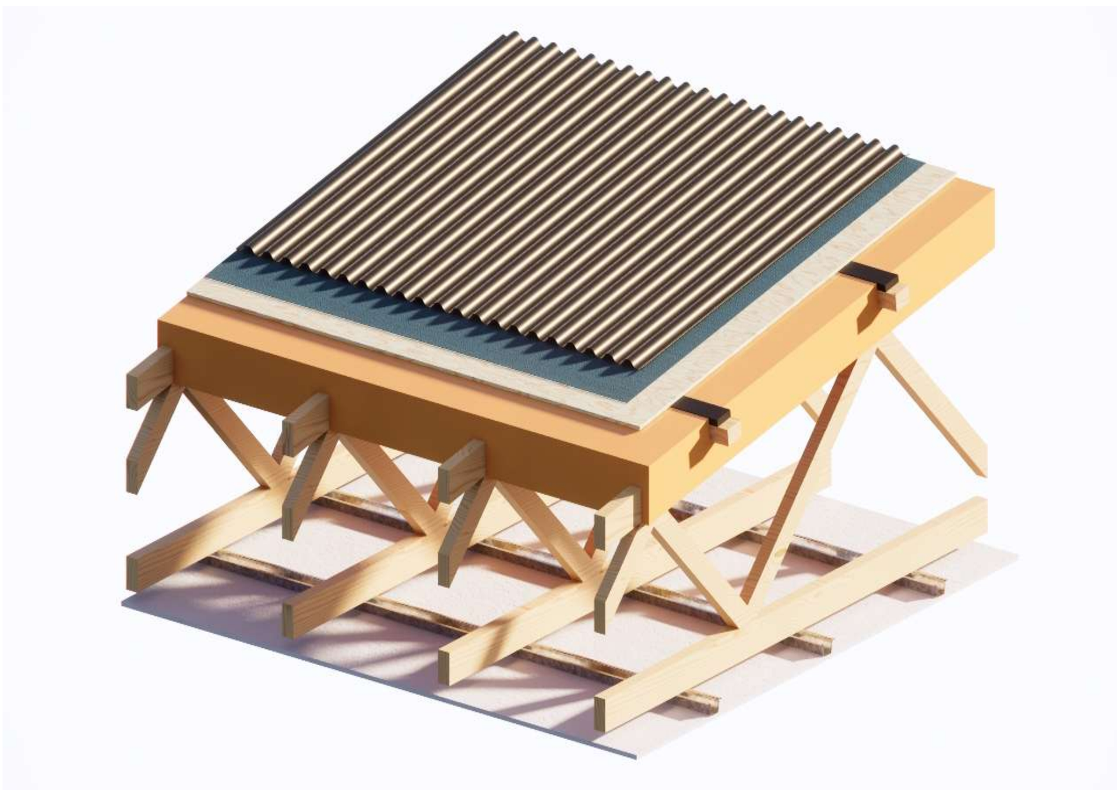
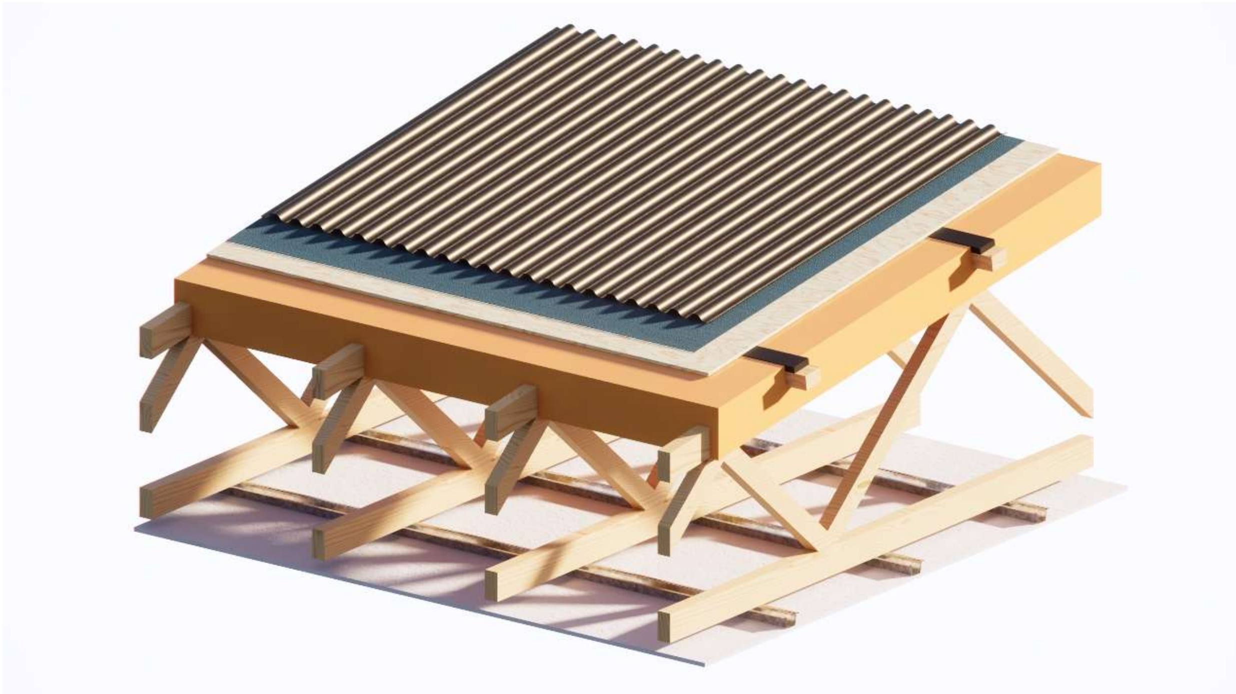
# NZ Foam Warmcore roofing Systems.



Business as Usual

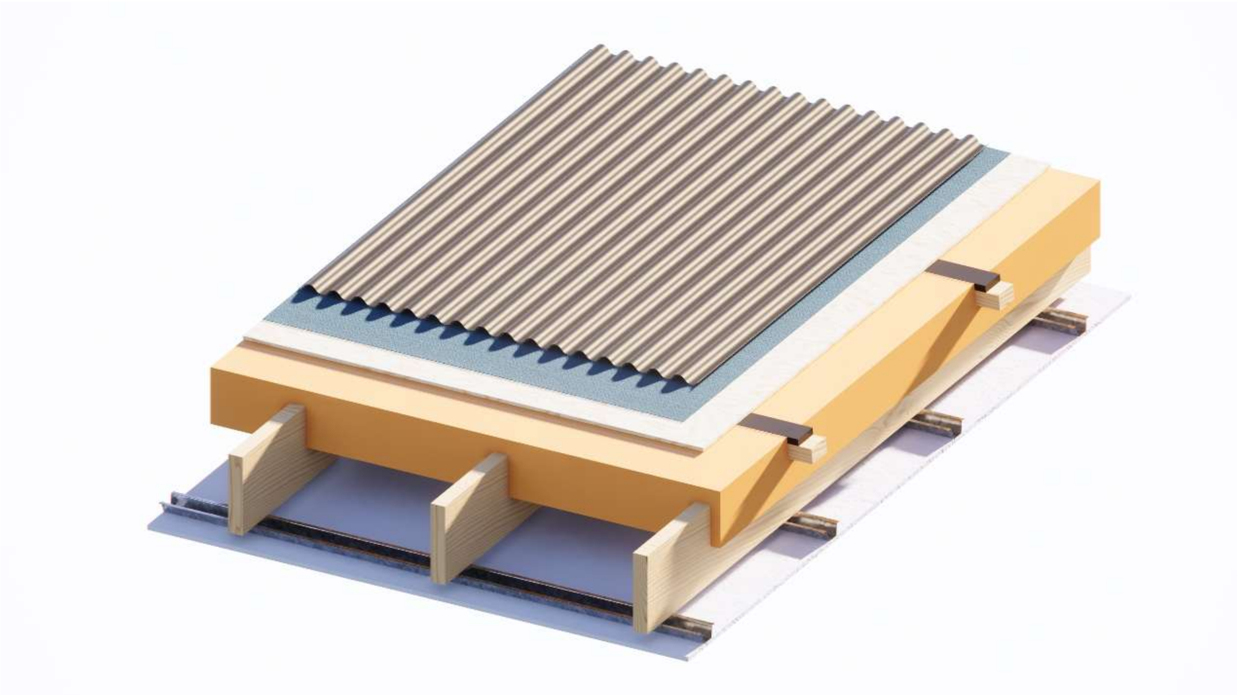
**Trusses Roofing System**



- Roof pitch: 25 degrees or less.
- Standard trusses to be supplied by the manufacturer.
- Timber purlins to be installed in accordance with the roofing cladding manufacturer's installation guidelines.
- Thermax B battens to be installed as per the manufacturer's instructions.
- Plywood is optional to be installed manufacturer's installation guidelines.
    - Depending on the type of roofing system to be installed.

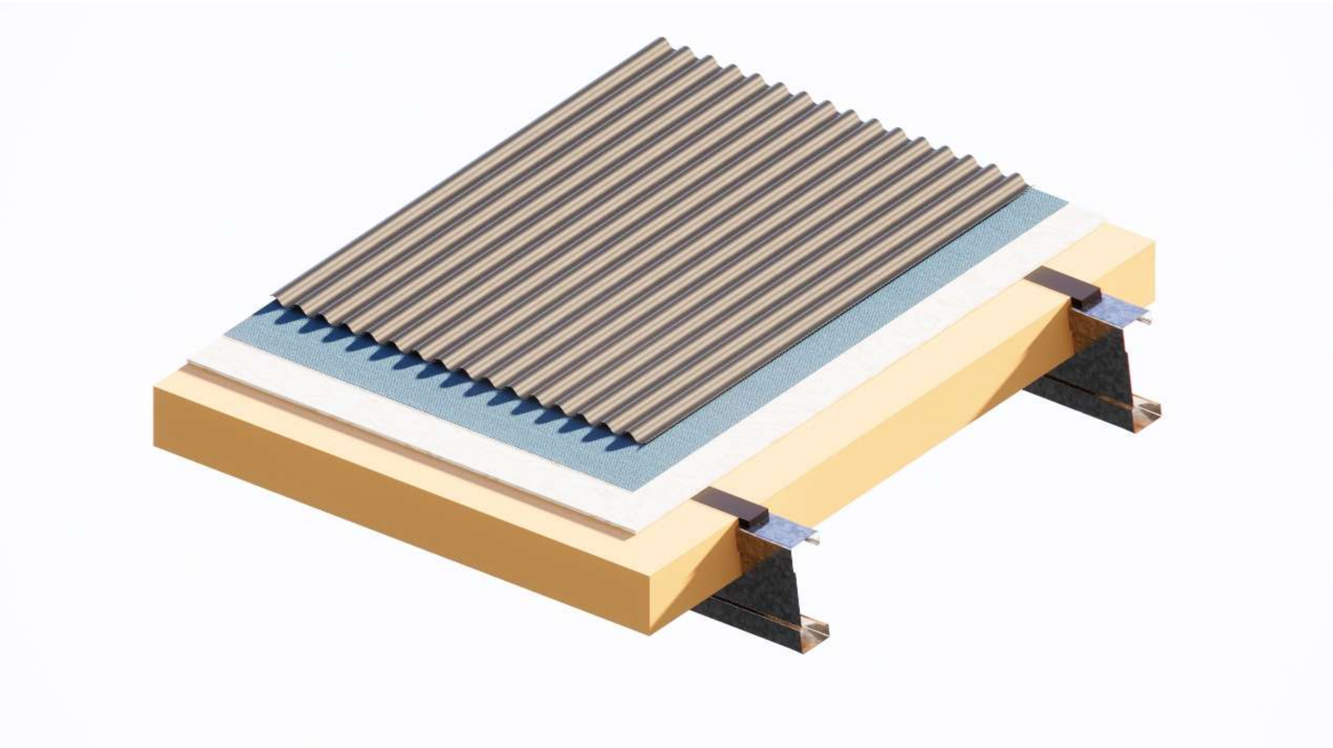
- The building underlay to be installed following the manufacturer's installation guidelines.
    - Longer screws will be required—refer to the manufacturer's manual.
- Roofing cladding to be installed according to the manufacturer's instructions.
- Warmcore insulation is installed as per manufacturer's instructions.
- STD construction beneath the Trusses.
- Ustilising Codemark Certifications for all products to create a compliant system.

**Skillion Roofing System.**



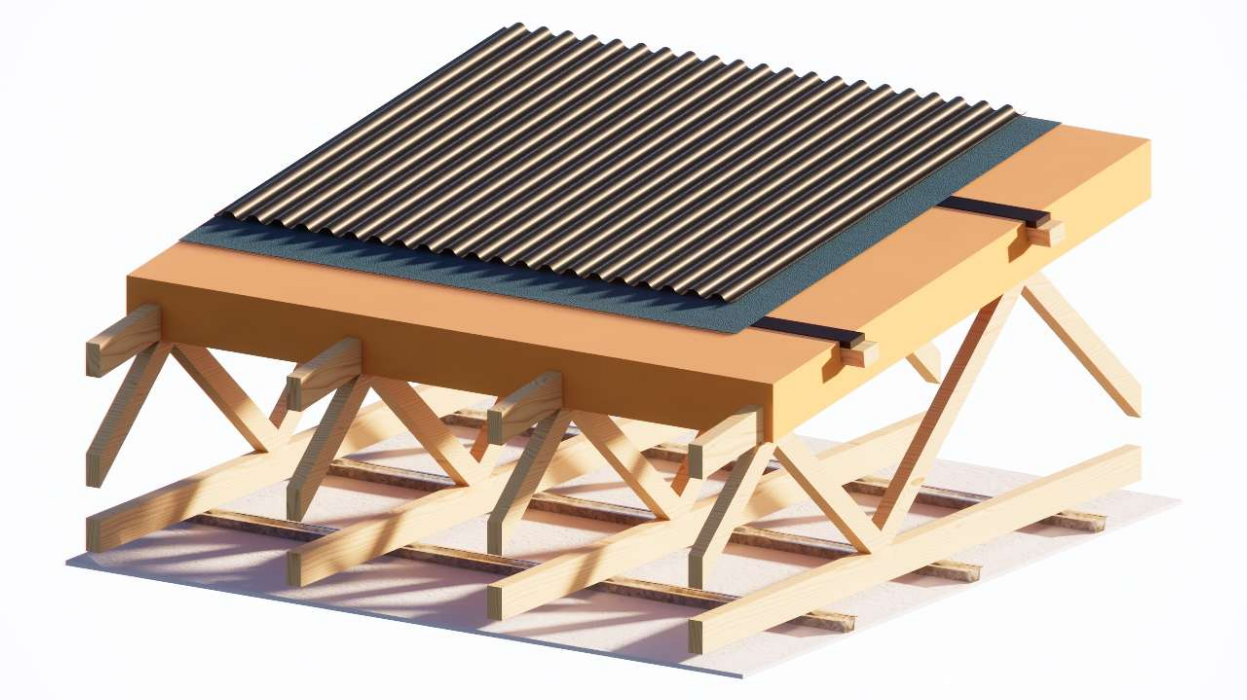
- Any Roof pitch:
- Rafters as Specified by Engineer, to be supplied by the manufacturer guidelines.
- Timber purlins to be installed in accordance with the roofing cladding manufacturer’s installation guidelines.
- Thermax B battens to be installed as per the manufacturer’s instructions.
    - No roof ventilation required.
- Plywood is optional to be installed manufacturer’s installation guidelines.
    - Depending on the type of roofing system to be installed.
- The building underlay to be installed following the manufacturer's installation guidelines.
    - Longer screws will be required—refer to the manufacturer’s manual.
- Roofing cladding to be installed according to the manufacturer's instructions.
- Warmcore insulation is installed as per manufacturer's instructions.
- STD construction beneath the rafters.
- Ustilising Codemark Certifications for all products to create a compliant system.

**Commercial Skillion Roofing System.**



- Mainly for commercial building build up.
- DHS installed as per manufacturer installation instructions.
- Thermax B battens to be installed as per the manufacturer’s instructions.
  - No roof ventilation required.
- Plywood is optional to be installed manufacturer’s installation guidelines.
- The building underlay to be installed following the manufacturer's installation guidelines.
  - Longer screws will be required—refer to the manufacturer’s manual.
- Roofing cladding to be installed according to the manufacturer's instructions.
- Warmcore insulation is installed as per manufacturer's instructions.
- STD construction beneath the DHS.
- Ustilising Codemark Certifications for all products to create a compliant system.

**Standard trusses build up.**

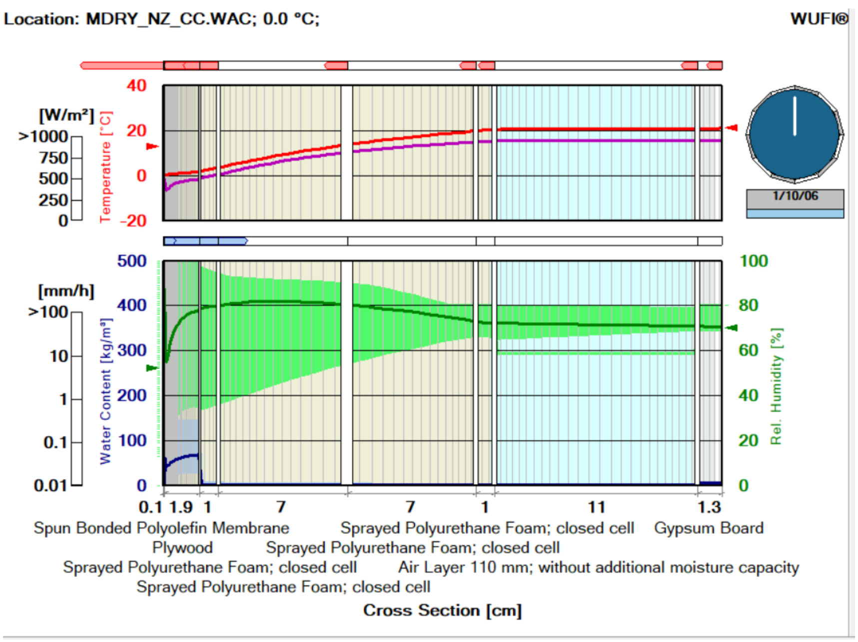


- Roof pitch: 25 degrees or less.
- Standard trusses to be supplied by the manufacturer.
- Timber purlins to be installed in accordance with the roofing cladding manufacturer’s installation guidelines.
- Thermax B battens to be installed as per the manufacturer’s instructions.
    - No roof ventilation required.
- The building underlay to be installed following the manufacturer's installation guidelines.
    - Standard screws will be required—refer to the manufacturer’s manual.
- Roofing cladding to be installed according to the manufacturer's instructions.
- Warmcore insulation is installed as per manufacturer's instructions.
- STD construction beneath the Trusses.
- Ustilising Codemark Certifications for all products to create a compliant system.

# NZ Foam Roof Plywood 24Feb2026

## NZFoam Skillion timber roof:

**3 bedroom townhouse at 45 Champion Street, Christchurch.**




**Compiled by Jessica Winter**

**Reviewed by Jason Quinn, Director**

**24Feb2026**

**Sustainable Engineering Ltd**

# Purpose:

Sustainability Engineering Ltd. has conducted a hygrothermal analysis of the NZ Foam skillion roof assembly with approximately 160mm of CCSF applied to the underside of 19mm treated plywood sarking under roofing underlay. The Christchurch Moisture Design Reference Year (MDRY) climate (released November 2024 by MBIE ) and an ASHRAE 160 residential indoor environment were used for this analysis.

ANSI/ASHRAE Standard 160-2021, Criteria for Moisture-Control Design Analysis in Buildings specifies criteria for predicting/mitigating/reducing moisture damage to the building envelope depending on climate, construction type, and HVAC system operation. This provides a framework for the hygrothermal analysis and mould failure criteria based on the current state of knowledge about mould growth. The failure criteria are intended to assess the risk level of a particular design approach while not being overly conservative.

This report describes and summarises the results of analysis and provides conclusions and recommendations about the moisture-related durability of overall assemblies for this building. E2 (external moisture) is outside of the scope of work and no bulk moisture (rainwater leaks) were considered in the analysis other than that specified in the ANSI/ASHRAE Standard 160-2021. Proper design of the E2 (external moisture) features of the design (such as flashings etc) remain the responsibility of the architectural design team.

# Summary:

This analysis concludes that the proposed assembly, evaluated under ASHRAE 160 conditions, carries a low risk for the plywood case and environments modelled. Ventilation above the underlay is required and this analysis assumed the metal roofing is vented to provide an Sd of 50m or less (this is typical and conservative for corrugated metal roofing with overlap joints).

## Hygrothermal Performance

- Plywood Case: Moisture levels in this scenario successfully meet the ASHRAE 160 compliance criteria. The plywood layer (sarking) acts as a hygrothermal buffer reducing the Relative Humidity (RH) in the foam.

Summary of points below:

- Direct fixed corrugated prepainted steel roofing was modelled. Other profiles, such as standing seam or rib profiles, could reduce ventilation rate. For these roofing materials, and in general to reduce risk, we'd recommend a ventilation layer above the plywood sarking.
- The foam was assumed to have a starting moisture content of EMC80. This is the moisture content at 80% relative humidity. All other materials excluding air layers were assumed to have EMC80x2 at the start of the simulation. This is as per ASHRAE 160 and allows for construction moisture. The foam is assumed to be installed dry as it is installed beneath the roof underlay and plywood.

Note: 1. The WUFI model assumes the foam is installed without cracks. However, timber movement can cause the foam to pull away, creating "As-Built In-Service" (ABIS) defects that could increase risk; 2. Moderate absorptivity was selected for this analysis, and more reflective claddings or roof materials would reduce solar gain which may reduce drying and increase humidity levels in the assembly.

# Advice:

The proposed assembly does not have dedicated ventilation above the roof underlay and relies on the corrugations of the roofing profile for ventilation. There is direct contact between the roofing material and the underlay which is in direct contact with the plywood. The proposed assembly has corrugated steel roofing, but other profiles such as tray or rib profiles could result in reduced ventilation rates.

The NZ Metal Roof and Wall Cladding Code of Practice (v25.12)[1] specifically requires a gap between insulation and roofing. It describes the phenomenon of Poultice Corrosion (page 126) which occurs when materials (like insulation or debris) hold moisture against the metal. We would expect the plywood sarking to distribute any trapped moisture laterally out and allow it to dry with corrugated steel roofing but the speed and effectiveness of this is not known.

**Dedicated ventilation above the roof underlay is recommended. This can be counter battens, ventilated battens, or 3D separation layer. Roofs should be designed with appropriate ventilation to allow ventilation in this layer (eaves vents, vented ridge cap).**

The foam is inherently airtight but cracks can occur around timber framing elements. If no air and vapour control layer (AVCL) is present and there is no continuous ventilation in the dwelling then there is a small risk of mould at the plywood layer in these cracks. It is essential that the foam is installed in a gap free manner; the proposed installation detail with foam between both rafters and purlins minimizes the risk of gaps but does not assure it.

Recommend specifying a drying procedure for timber prior to any insulation or lining of the interior. Timber moisture to be measured with a pin meter in multiple locations and no spray foam to be installed if the readings are over 12% on average. Note NZBC maximum is 18% and this analysis starts the plywood above this level.

Continuous ventilation exceeding 0.5ACH for the entire building should be maintained including during construction prior to the MVHR or continuous exhaust being commissioned. This can be done with fans or significant open window area at all times. The building must not be closed up during construction or the resulting condensation overnight can damage the structure and lead to mould.

[1] *COP v25.12: Other Products; Warm Roofs* Via the NZ Metal Roofing Manufacturers site. [COP v25.12:Other-Products; Warm-Roofs | NZ Metal Roofing Manufacturers]

# Limitations:

The one-dimensional hygrothermal analysis was performed using WUFI Pro 6 and WUFI Finmould (previously called WUFI VTT) per ASHRAE 160-2021. This analysis models the coupled heat and moisture diffusion and capillary effect through the assemblies and assumes that the construction is airtight (no bulk air leaks) and there is no bulk water intrusion. If the final building includes defects permitting air or water leaks through the weather/vapour/air/thermal control layers than these leaks could significantly increase the moisture risk.

Built-in construction moisture from materials not being stored adequately (timber left in the rain, insulation installed prior to weathertight construction) can significantly impact initial mould growth rates. It is recommended to store materials properly, not install fibre insulation until the building is weathertight, and allow sufficient ventilation and time for interior plaster/concrete work such as slab floors to dry before sealing the building for occupancy.

ASHRAE 160 is intended to "provide guidance on how to best design buildings with adequate moisture control features." This is intended to reduce risk but does not eliminate it as unlike structural analysis where worst-case conservative loads are used for moisture analysis the "international consensus [is] the analysis should be predicated on loads that will not be exceeded 90% of the time."

This report covers *only the specific building modelled* as changing the building form, location, occupancy, etc. will change the results.

ASHRAE160-2021 deals with rain penetration in walls only. Roof systems are to be designed and built such that there is no rainwater penetration. This analysis and the ASHRAE 160 standard assume that appropriate measures have been taken to limit bulk water entry into the building and building envelope and to resist damaging liquid water penetration from sources such as rainwater, ground water, flooding, ice dams, etc.

Note that internal conditions can cause surface mould and this is not preventable without control of internal conditions (ie conditioning including dehumidification). We recommend that internal surface mould risk should be assessed using an fRSI calculation and a building moisture balance per PHPP10 for the detailed construction assemblies planned.

As this is a one-dimensional hygrothermal simulation in general the metallic components are not modelled (fasteners etc.) and the risk of corrosion is not addressed in this report unless specifically required in the scope of work.

# Proposed Assembly

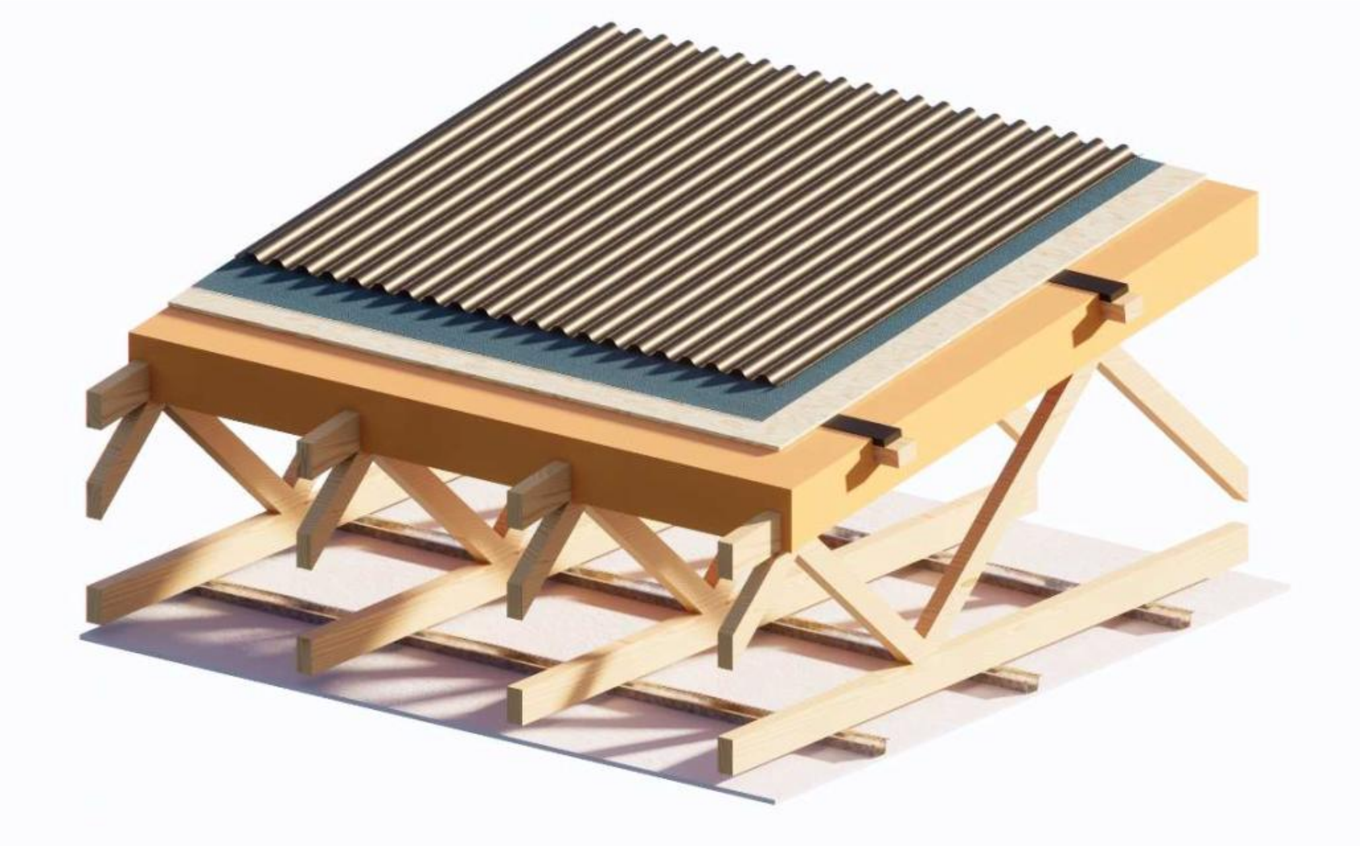
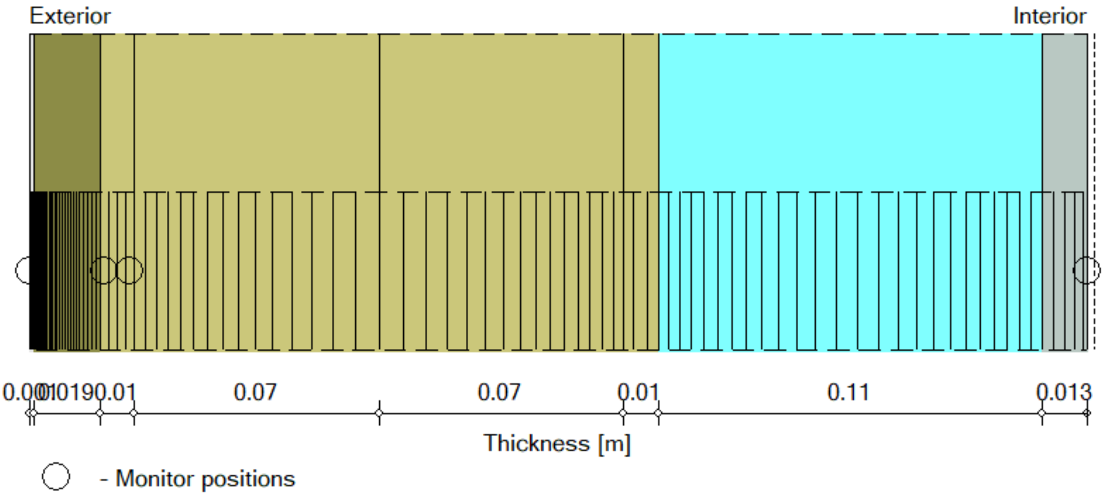


Figure 1: NZFoam warmcore roof. Note plywood layer above the Thermax B battens.

WUFI Pro 6.8

## Component Assembly

### Case: Vented.Underlay.19mmPly.CCSF.




**Materials:**

| | |
|---|---|
| - Spun Bonded Polyolefin Membrane (SBP) | 0.001 m |
| - Plywood, Exterior-Grade | 0.019 m |
| - Sprayed Polyurethane Foam; closed cell | 0.01 m |
| - Sprayed Polyurethane Foam; closed cell | 0.07 m |
| - Sprayed Polyurethane Foam; closed cell | 0.07 m |
| - Sprayed Polyurethane Foam; closed cell | 0.01 m |
| - Air Layer 110 mm; without additional moisture capacity | 0.11 m |
| - Gypsum Board (USA) | 0.013 m |

sd-Value Int. [m]: 0.2

Total Thickness: 0.303 m
R-Value: 6.81 (m² K)/W
U-Value: 0.141 W/(m² K)

Figure 2: WUFI inputs for the roof assembly WITH plywood.

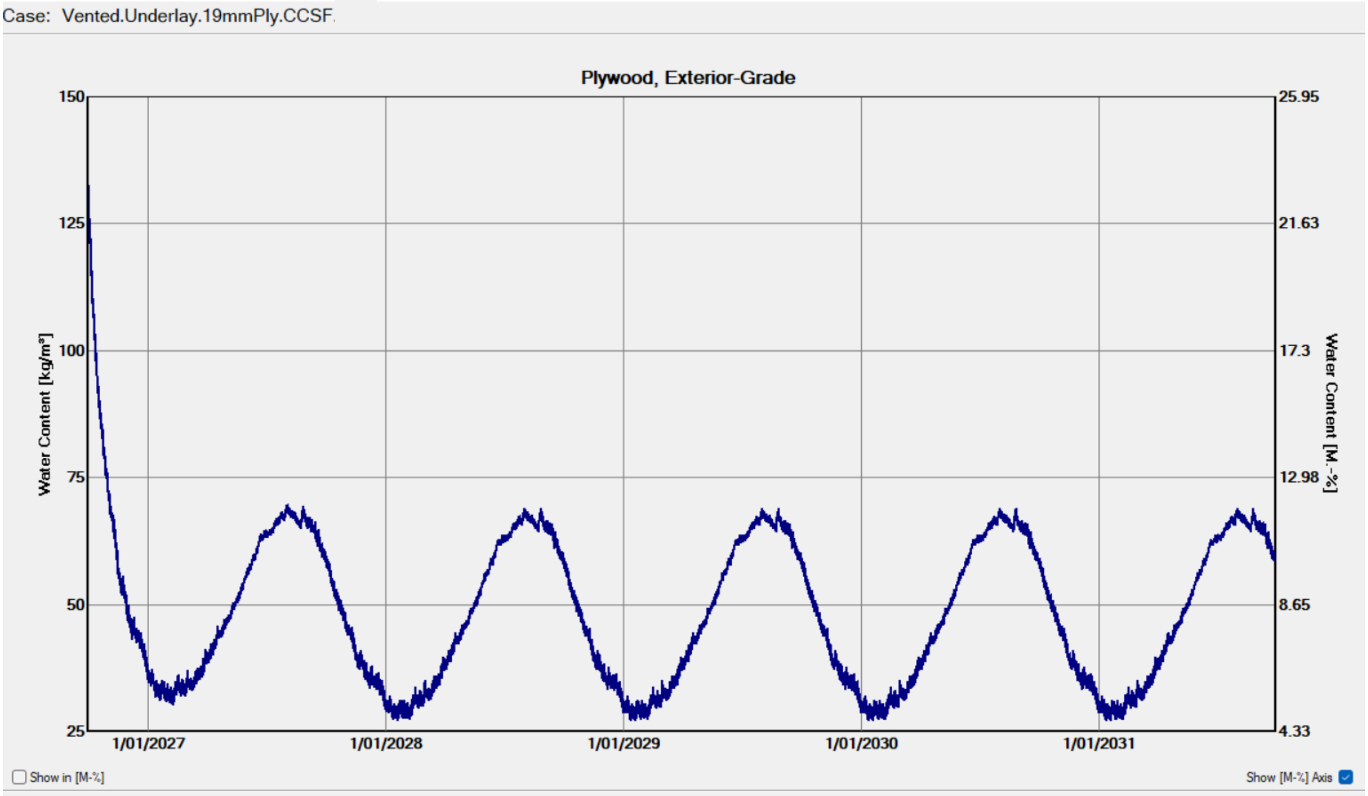



Figure 3: Moisture content in the outer section of the plywood peaking around 12% (acceptable)

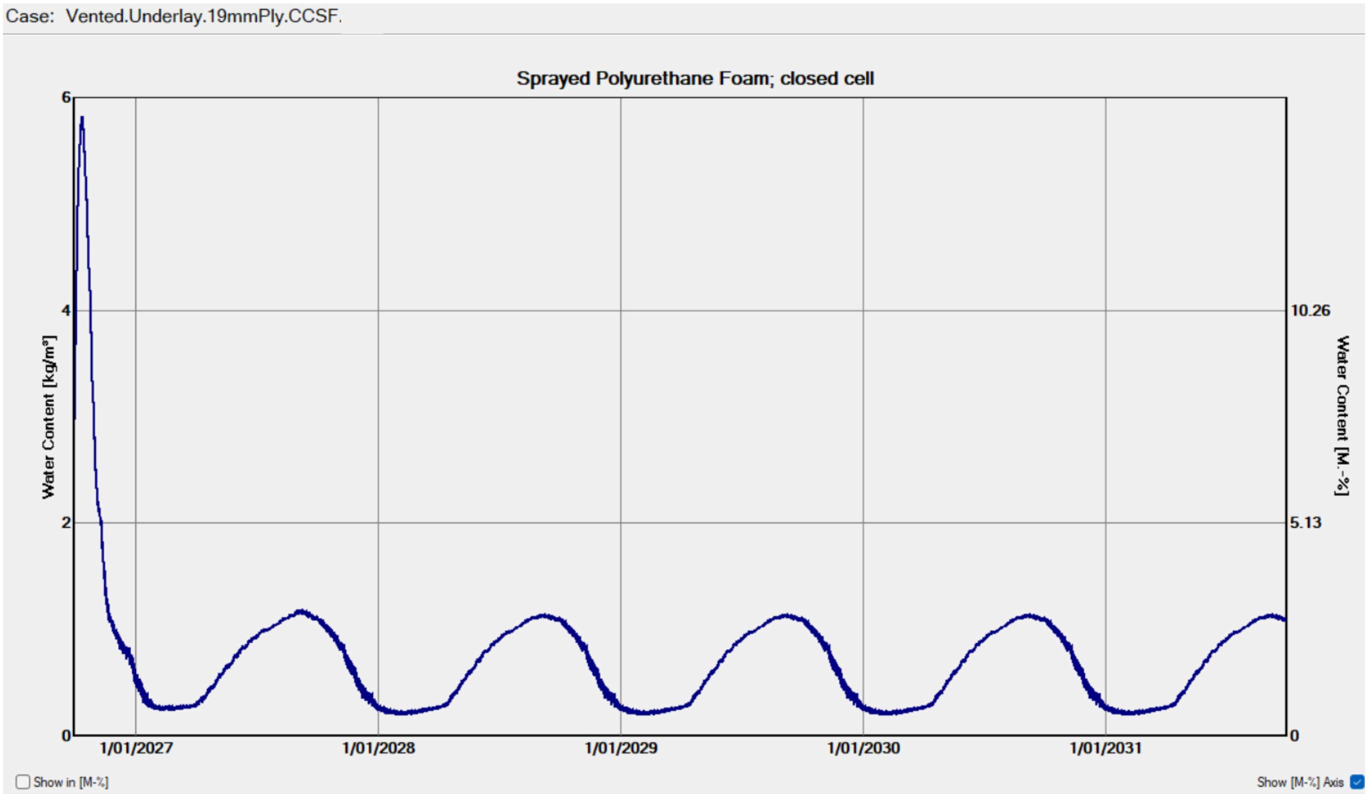



Figure 4: Water content in the outer 10mm of the spray foam.

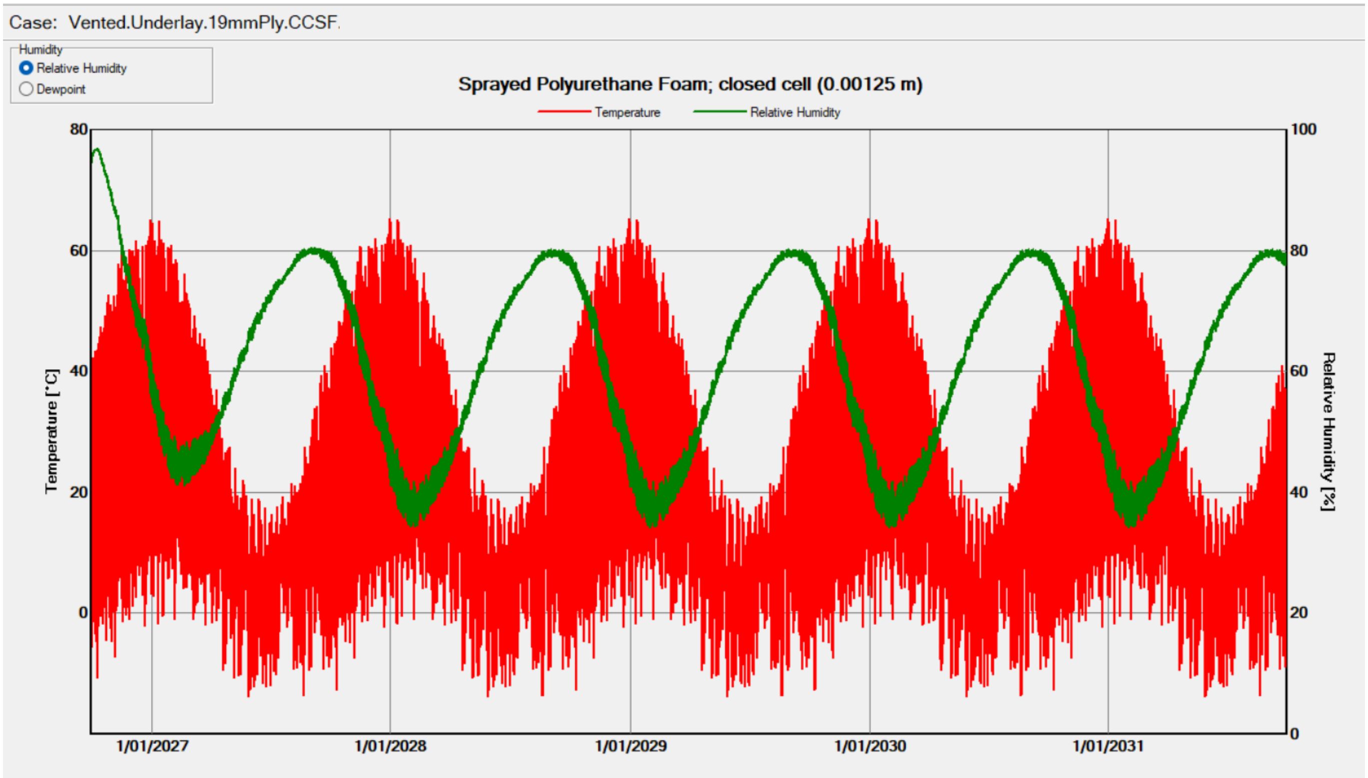



Figure 5: Relative humidity (green) in the outer 10mm of the spray foam, peaking at 80% and drying each year to below 40%

# Climate data

### Exterior Climate

The Christchurch Moisture Design Reference Year (MDRY) has been used for this analysis:

A south facing orientation was chosen as per ASHRAE 160.

## ASHRAE 160-2021 notes:

Per section 6 the analysis shall be performed for a minimum of two orientations: the highest wind-driven rain and the wall with the lowest solar radiation (i.e.  a south-facing wall for the southern hemisphere).

6.1 Moisture accumulation criteria. Simulation must be for minimum of 5 years and maximum of 10 years. The maximum total moisture content of the assembly shall be equal to or less than that of the prior year.

6.2 Conditions necessary to minimize mold growth. The mold index shall not exceed 3.0 on any surface in the assembly (excluding the exterior surface). As an additional criterion we do not recommend assemblies that fail this: The mold index calculated according to section 6.2 in ASHRAE 160-2021 shall not exceed a value of three (3) for the first year of simulation and must be equal to or below one (1) by the end of the second year of simulation and remain below one (1) after that. in the initial period until the end of the first full year of simulation one (1) starting from the second full year of simulation. Note: These requirements are contrary to the ASHRAE 160 requirement in section 6.2 and are more restrictive. Mold spores are present with a mold index above three even if no mold is visible. This might be accepted for ASHRAE 160 compliance but we do not recommend these assemblies.

Unless measurements of in-situ moisture content are available the initial moisture content of construction materials in new construction to be used in calculations for this standard shall be two times equilibrium moisture content at 90% relative humidity (EMC90) for concrete and two times EMC80 for all other materials. In retrofit applications, the initial moisture content of existing materials shall assume EMC90 for concrete and EMC80 for all other materials. If procedures to dry construction materials and/or procedures to protect construction materials and assemblies from wetting during construction are specified and ensured, the initial moisture content of new materials (in new or retrofit construction) shall assume EMC90 for concrete and EMC80 for all other materials.

Used Sd=0.2m for most permeable interior latex paint on gypsum wall board (GWB).

Note that the Australian AIRAH DA07 Criteria for Moisture Control Design Analysis document is based on ASHRAE 160-2019.

# Appendix

Table 1: Building details

| | |
|---|---|
| **TFA [m2]** | 76 |
| **Volume [m3]** | 190 |
| **# bedrooms** | 3 |
| **Air change rate without MVHR [1/hr]** | 0.2 |
| **Absorptivity** | 0.45 per Hygrothermal Simulation of ventilated pitched roofs with effective transfer parameters, Philipp Kölsch, Fraunhofer-Institute for Building Physics IBP |