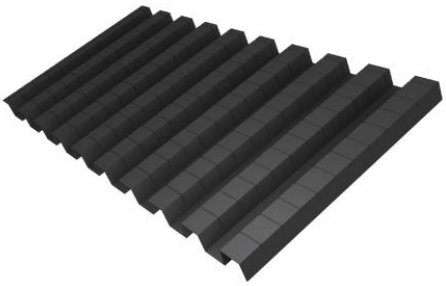
Roll Panel Vent Detailed Thermal Calculations

VENT
PASSIVE VENTILATION

G502 Roll Panel Vent



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Summary

We have conducted a detailed thermal model of a standard and Roll Panel Vent roof to wall junction. The analysis is performed per the ISO10211 standard "Thermal bridges in building construction — Heat flows and surface temperatures — Detailed calculations" using typical Australian and New Zealand current practice construction.

The primary defect explored was the common approach of leaving the ceiling insulation fiberglass batts short of fully covering the wall top plate in order to allow ventilation over the insulation versus using a Roll Panel Vent to allow fully insulating over the top plate (including the impact of the insulation compression).

The Roll Panel Vent would decrease the overall heat loss from the roof by 35% compared to holding back the insulation at the top plate.

This approach of holding back the insulation is often recommended in order to prevent condensation under the roofing due to warm moist air leaking from inside the home into the roof space and condensing under the roofing. One function of roof underlay is to adsorb this moisture on cold clear nights where the roof becomes cold and then release it into outside air ventilation during the following day. Compressing insulation into the roof corner would reduce or remove the ventilation rate and could result in roof condensation not being able to dry out and mould.

Table 1: Results of detailed thermal analysis.

	Ψ [W/(mK)]	f_{RSI}	*EXAMPLE CEILING HEAT LOSS*
CURRENT PRACTICE HOLD BACK	0.356	0.34	100% Reference
USE THINNER 400MM WIDE STRIP OF INSULATION	0.016	0.72	70%
ROLL PANEL VENT	-0.043	0.81	65%

There are two 'types' of results the thermal bridging amount, Ψ, and the surface temperature criteria, f_{RSI}.

These are explained below and in both cases the Roll Panel Vent is a significant improvement over the current practice with the insulation held back.

The thermal bridging amount, Ψ is best understood when combined with the overall roof heat loss. For the assumed R3.6 Ceiling Batts and timber trusses the overall heat loss for an example 183m² roof would have a heat loss of 49 W/K accounting for the timber fraction.

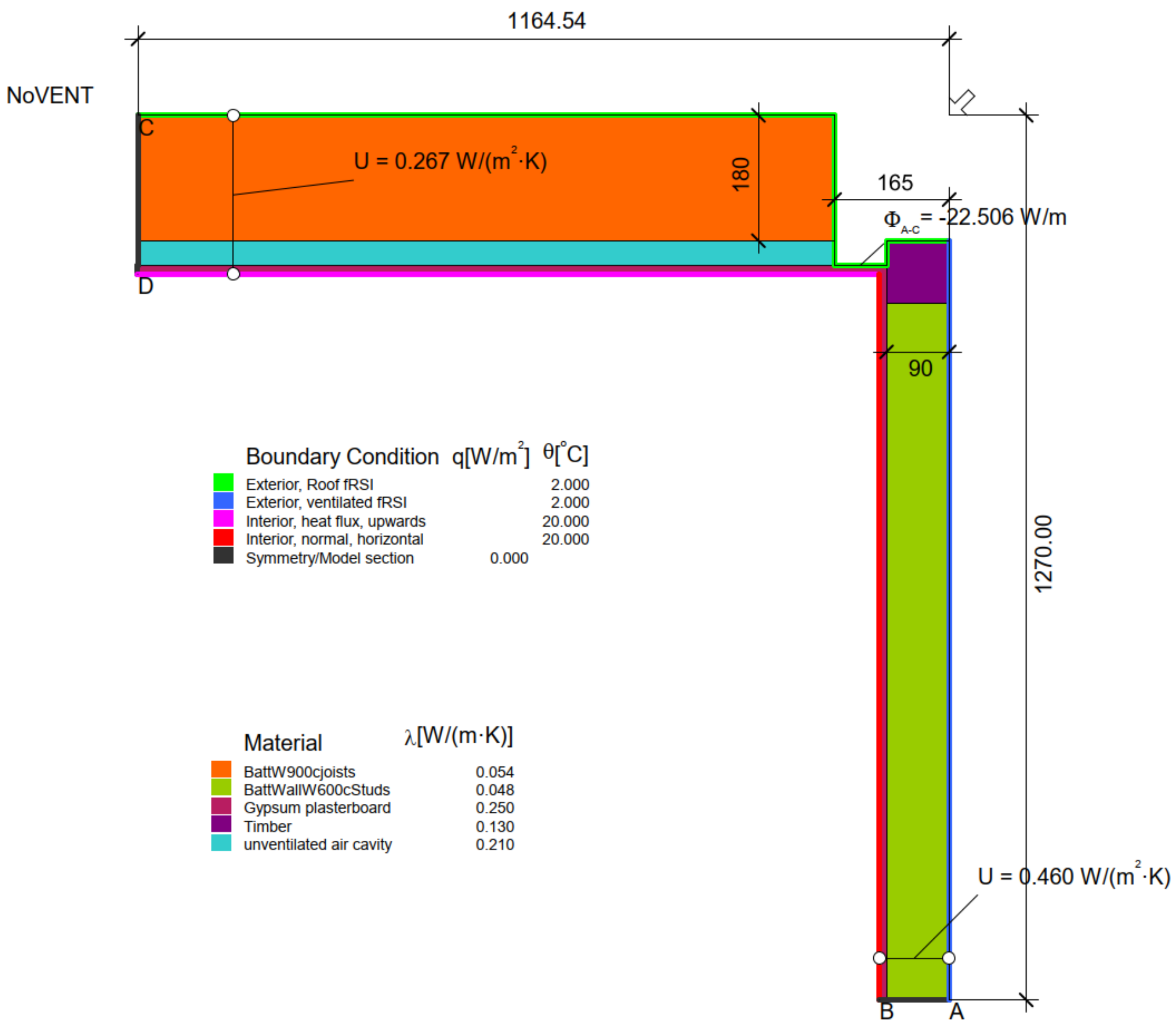
- The current practice with the insulation held back would increase this by 22 W/K up to 71 W/K. As this is often current practice, we've set this to 100% in the table above.
- Optionally an improved practice is installing a 400mm wide strip of 90mm R1.8 insulation batt to fully cover the top plate and still leave a 25mm ventilation gap. This also increases the heat loss over that calculated. However, as the top plate is fully covered the loss is only an additional 1 W/K for a total of 50 W/K for the ceiling. This is 70% of the ceiling heat loss with the insulation simply held back.
- The Roll Panel Vent would *decrease* the 49 W/K by 3 W/K to 46 W/K. The Roll Panel Vent would decrease the overall heat loss from the roof by 35% or results in 65% of the heat loss of the current practice with the insulation held back.

In addition to the thermal bridging reduction the current practice with the insulation held back has a f_{RSI} = 0.34 which is below the internationally recommended 0.55 for Warm Climates. This increases the risk for mould on the cool surface at the roof perimeter (see Figure 3).

As the Roll Panel Vent significantly improves the performance of the ceiling insulation and allows meeting the surface temperature criteria, we recommend it's use rather than holding back the insulation.

Detailed Thermal Calculations

Roof insulation assumed to be R3.6 Ceiling Batts which are 180mm thick. Assuming a 20° roof pitch requires the batt to be held back 165mm from the outside edge of the top plates for the current practice roof to maintain a ventilation gap. The results for this are shown in Figures 1&2 below. Using a roll panel vent allows the insulation batt to be compressed into the corner. This results in the heat loss show in Figures 3 & 4 below.



$$\Psi_{A\text{-}E\text{-}C} = \frac{22.506}{18.000} - 0.460 \cdot 1.270 - 0.267 \cdot 1.165 = 0.356 \text{ W/(m·K)}$$

Figure 1: Current practice - Thermal bridge due to insulation held back to maintain ventilation under roofing.

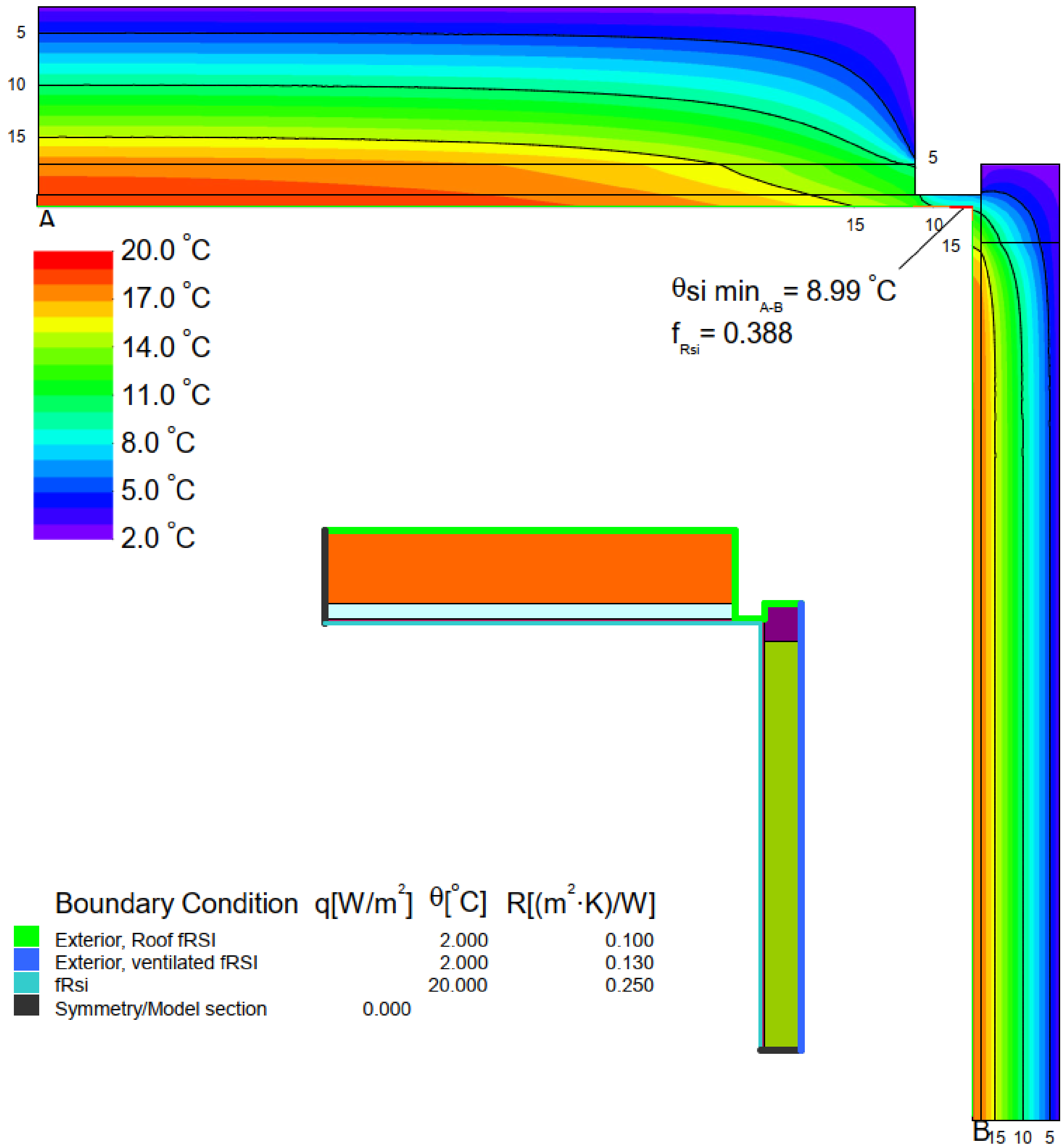
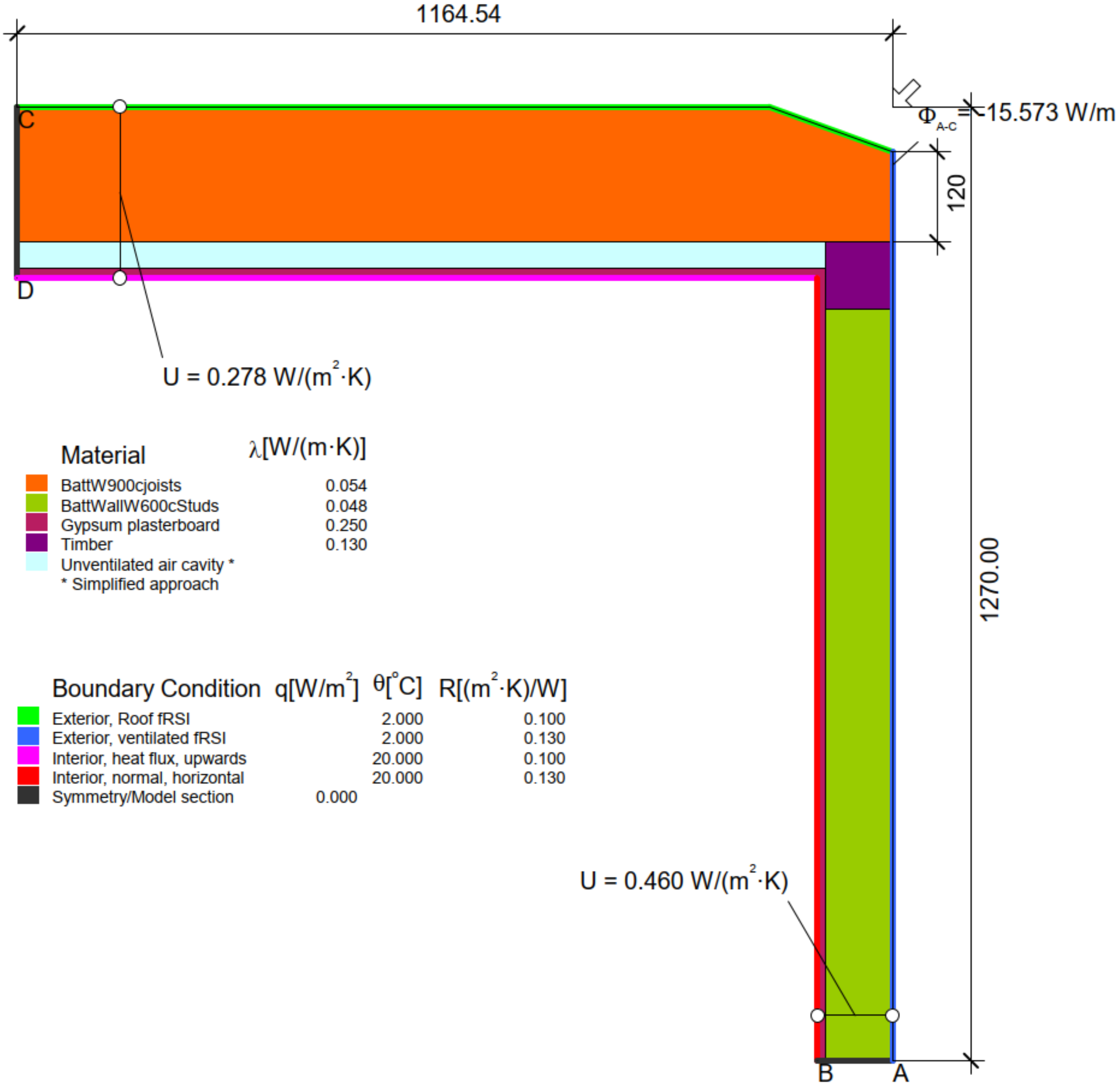


Figure 2: Low surface temperature criteria due to insulation held back to maintain ventilation under roofing. Note a surface temperature less than 0.55 Is not recommended due to potential for mould. This computer simulation Is slightly optimistic as the volume of ceiling battens below the Insulation would ventilate and further lower the ceiling Insulation effectiveness.



$$\Psi_{A\text{-}E\text{-}C} = \frac{15.573}{18.000} - 0.460 \cdot 1.270 - 0.278 \cdot 1.165 = -0.043\ \text{W/(m·K)}$$

Figure 3: Thermal bridge reduced significantly due to insulation coverage of top plate.

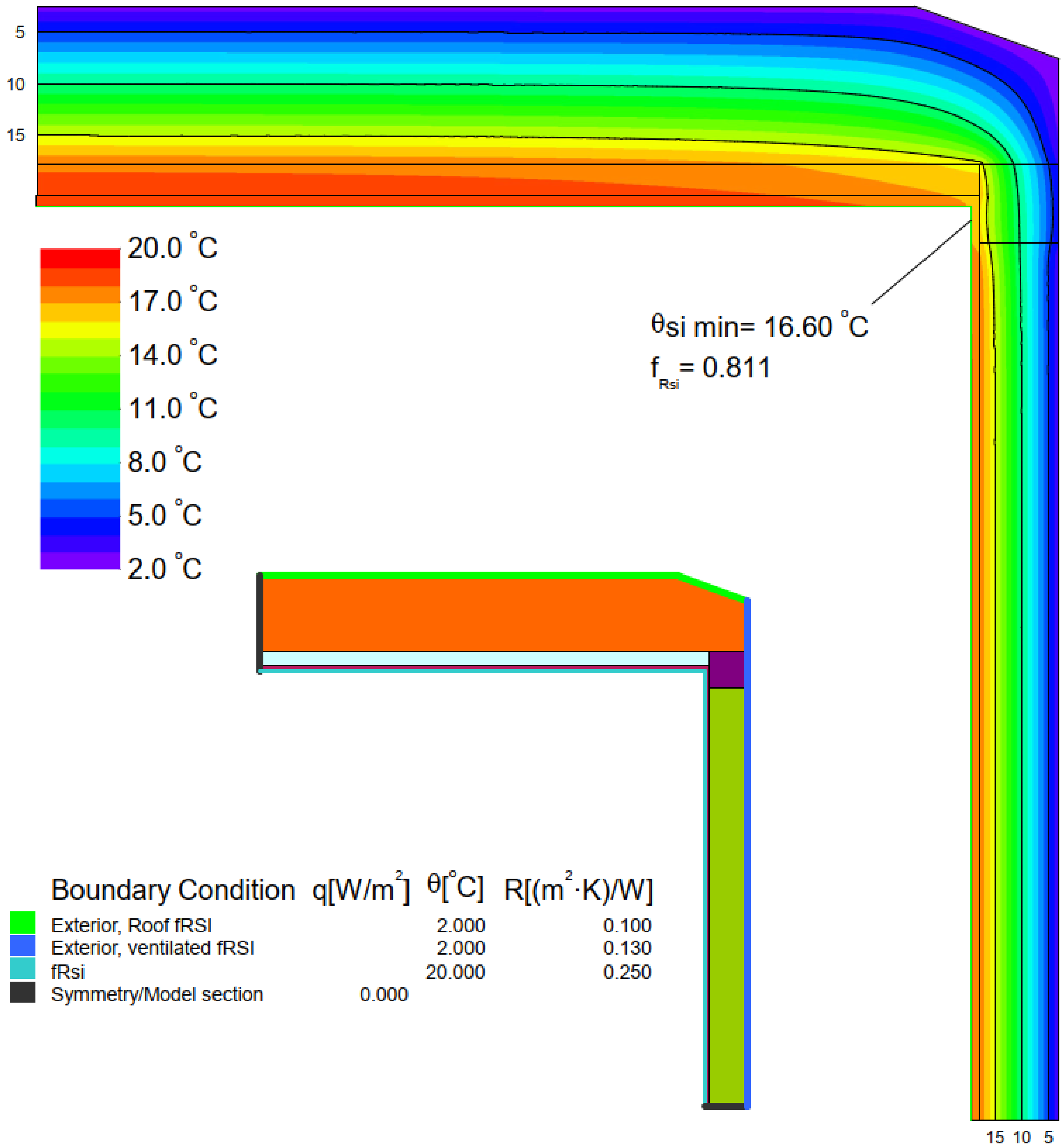
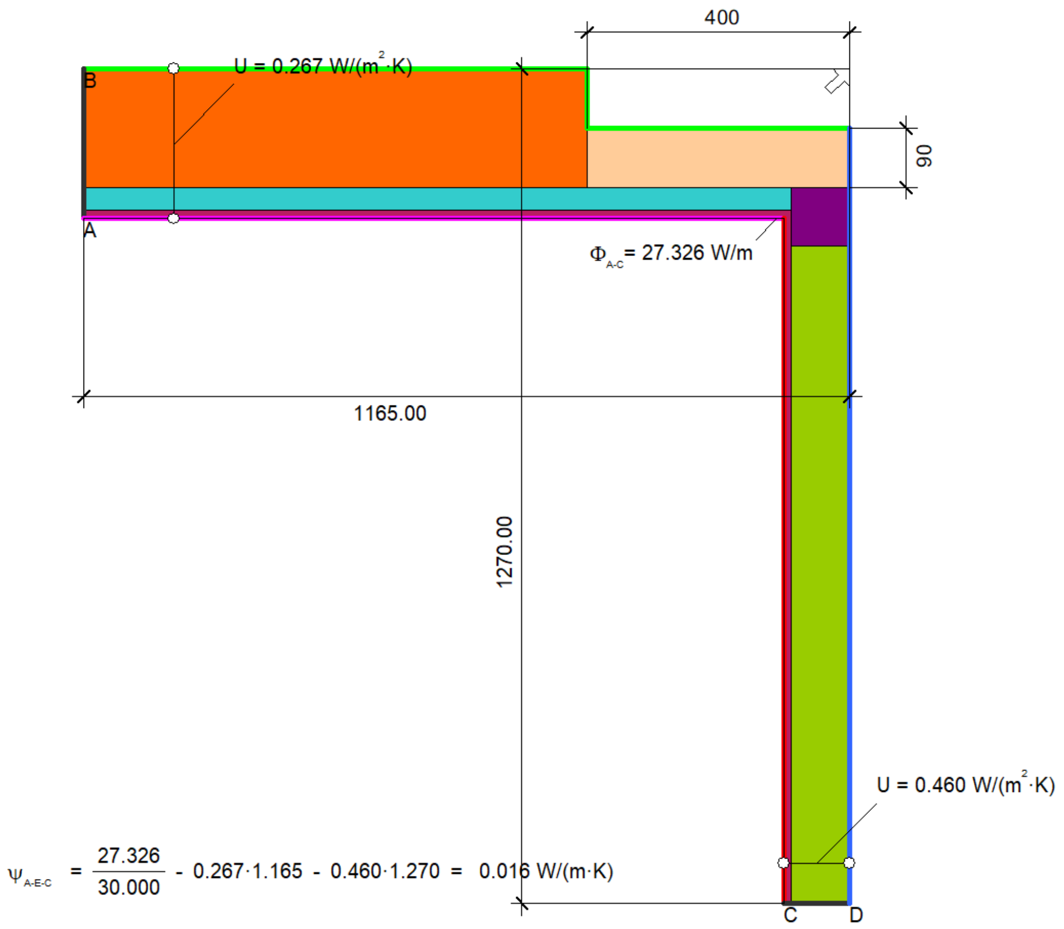


Figure 4: Surface temperature criteria significantly improved due to insulation coverage of top plate.



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε	φ[%]
Exterior, Roof		-10.000	0.100		
Exterior, ventilated		-10.000	0.130		
Interior, heat flux, upwards		20.000	0.100		
Interior, normal, horizontal		20.000	0.130		
Symmetry/Model section	0.000				

Material	λ[W/(m·K)]	ε	μ[-]
BattW900cjoists	0.054	0.900	1.000
BattWallW600cStuds	0.048	0.900	1.000
FibreInsulation 0.05	0.050	0.900	
Gypsum plasterboard	0.250	0.900	7.000
Timber	0.130	0.900	1.000
unventilated air cavity	0.210	0.900	1.000

Figure 5: Thermal bridge reduced significantly due to insulation coverage of top plate but higher heat loss than with the Roll Vent.

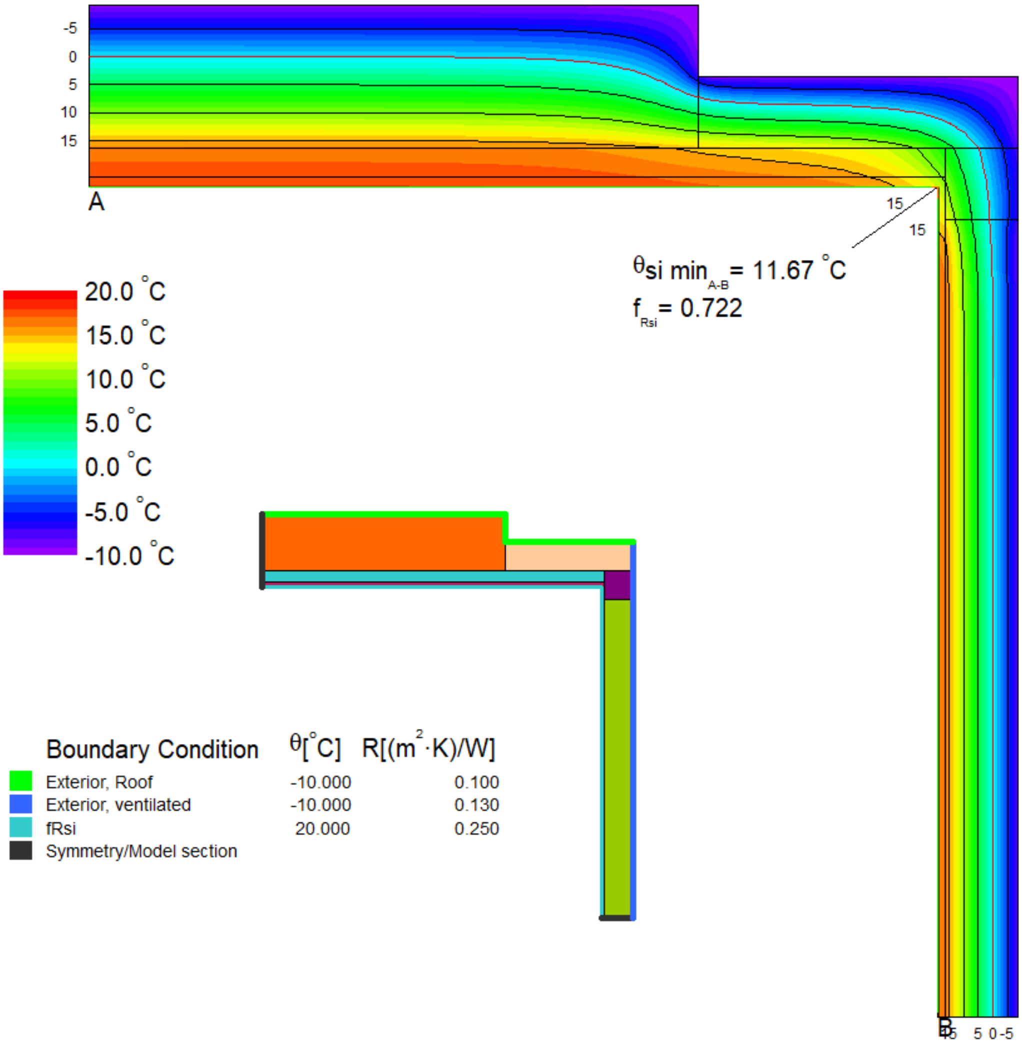


Figure 6:: Surface temperature criteria significantly improved due to insulation coverage of top plate. This meets the minimum temperature index criteria for all climates in NZ and AU.