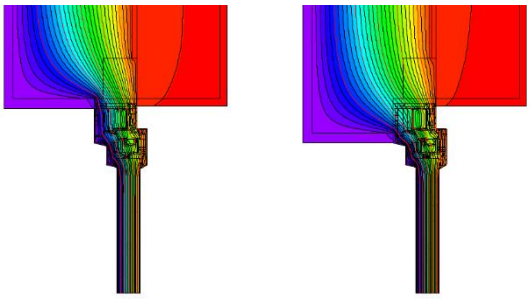
Extending Wall Insulation Over Window Frames – But What About Aluminium?

A proven Passive House strategy

In Passive House design, it's standard to extend external wall insulation over the top and side profiles of inward-opening windows (leaving the bottom exposed for drainage). This minimises the thermal bridge at the junction - often reducing the installation Psi-value (W/(mK)) to near or below zero. Even with windows installed in the structural layer, covering the frame with insulation still offers a thermal benefit. This effect can be seen in the thermal simulations in figure 1:

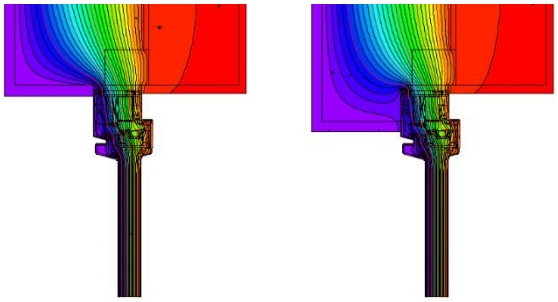


Ψ = 0,023 W/(mK) Ψ = 0,002 W/(mK)

Figure 1: Difference in thermal bridge effect between un-insulated and over-insulated frame – PVC window © Passivhaus Institut (window frame: WINCHE)

Where it stops working: aluminium cladding

However, the benefit is greatly reduced when the frame uses aluminium cladding. In thermally broken aluminium, wood-aluminium, or PVC-aluminium frames, using full external aluminium covers will mean that heat is conducted from the warm inner wall to the cold exterior, greatly reducing the effect of the extended insulation, as shown in figure 2:



Ψ = 0,018 W/(mK) Ψ = 0,016 W/(mK)

Figure 2: Difference in thermal bridge effect between un-insulated and over-insulated frame – PVC-aluminium window © Passivhaus Institut (window frame: Kochs GmbH)

Optimising wood-aluminium frames

Some Passive House-standard wood-aluminium windows now use reduced cladding to the top and sides: aluminium only where it's visible. The remaining area is finished in exposed rigid insulation (e.g. wood fibre), greatly reducing the thermal bridging effect. You can see an example of this in figure 3:

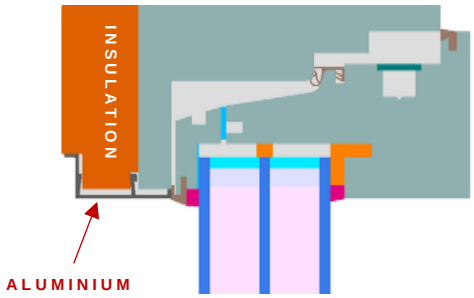
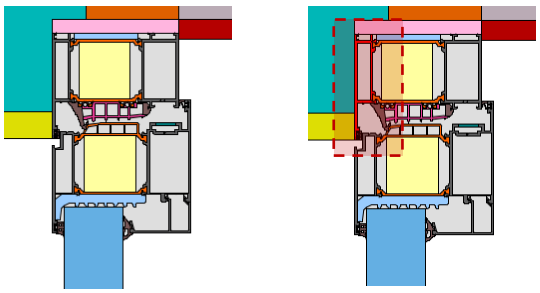


Figure 3: Wood-aluminium window with aluminium cover reduced in size to visible surface only. © Passivhaus Institut (window frame: Pro Passivhausfenster GmbH)

PVC-aluminium and full-aluminium solutions

PVC-aluminium frames can also benefit from 'shorter' aluminium covers. Though harder to re-design than wood frames, reducing the visible aluminium leaves exposed PVC, which performs better thermally. The biggest potential, however, lies with thermally broken aluminium frames. In their most common form, these use slim aluminium profiles connected via glass fibre-reinforced plastic (GFRP). By replacing the external aluminium profile at the top and sides with GFRP, the thermal bridge could be significantly reduced, as shown in figure 4:



Ψ = 0,017 W/(mK) Ψ = 0,002 W/(mK)

Figure 4: Difference in thermal bridge effect between full aluminium frame and one where the top and side outermost profiles are replaced with GFRP. © Passivhaus Institut (window frame: Aluxil GmbH)

Call to action

The Passive House Institute therefore encourages aluminium window frame manufacturers to prioritise thermal optimisation of installation details—particularly at the top and sides—for future research and development.

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