PASSIV
HAUS
INSTITUT
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Heat bridge calculation to determine the point heat bridge loss coefficients of a telescope switch box and a telescope equipment carrier in the composite thermal insulation system

Brief expert report

Note: This document is a third party translation.
Only the original German version of this document is legally valid.

on behalf of the company

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Introduction

On behalf of Kaiser GmbH & Co. KG, the Passivhaus Institut determined the thermal characteristic values for the telescope equipment carrier (Art. no. 1159-60 and Art. no. 1159-80) and the telescope switch box (Art. no. 1159-63 and Art. no. 1159-64 and Art. no. 1159-83 and Art. no. 1159-84), installed in a façade suitable for passive houses (20 cm thermal insulation). The calculations were carried out using the three-dimensional heat flow programme SOLIDO (version 2.0w) from Physibel, Belgium. This brief expert report documents the results.

Specifications for heat bridge calculation

Table 1 lists the materials used in the calculation and their heat conductivities in conjunction with the colours selected for the representation. Sources for the heat conductivities are laboratory measured values corrected to design values or relevant standards.

Table 1 Assignment of colours and heat conductivities to the materials used

Colour	Material	Heat conductivity λ [W/mK]
	Steel	50.000
	Cable replacement material	34.290
	Reinforced concrete	2.300
	Exterior plaster	0.700
	Interior plaster	0.350
	Polypropylene (PP)	0.220
	Polyvinyl chloride (PVC)	0.210
	Heat-insulation	0.032

Boundary conditions

The selected boundary conditions are shown in Table 2.

Table 2 Heat transfer coefficients on the outer and inner surfaces

Boundary conditions	
Outside air temperature [°C]	-10.0
External heat transfer (back-ventilated façade) [W/(m^{2}K)]	7.69
Indoor air temperature [°C]	20.0
Heat transfer inside [W/(m^{2}K)]	7.69

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Modelling

True-to-original 3D CAD models were created, consisting of interior plaster, concrete wall, thermal insulation and exterior plaster.
For the three-dimensional heat flow calculation, the models were divided into finite elements using a three-dimensional mesh. In the area of the components to be tested, the mesh size is 0.5 mm and increases towards the edges of the model. In total, the telescope equipment carrier model comprises 2.4 million nodes and the telescope switch box model 3.1 million nodes.

Firstly, the hot current through the undisturbed wall was determined and then the products to be tested and a cable (NYM 3*1.5) with an equivalent heat conductivity were used and the calculation repeated. The heat bridge loss coefficient is calculated from the heat flow difference between the undisturbed model and the model with the product to be tested. Two variants were calculated in each case: With construction foam between the products and the insulation, as well as without construction foam. Table 1 shows the model dimensions and the wall construction.

Table 1: Model dimensions and wall construction

Model dimensions		**Wall construction (U= 0.128 W/(m²K))**	
Height	750 mm	Facade	
Depth	600 mm	Insulation	300 mm
Width	400 mm	Concrete wall	175 mm
		Interior plaster	15 mm

Results of the heat bridge calculations

Table 2 and Figures 1 and 2 show the results of the simulations. It is clear to see that the heat bridge loss coefficient is significantly higher without foaming the area between the product and the thermal insulation. Foaming is therefore recommended.

Table 2: Heat bridge loss coefficients and surface temperatures of the analysed products

Type		$\theta_{i.min.WB}$ [°C]	Q_{ref} [W]	Q_{WB} [W]	χ_{WB} [W/K]
Telescope equipment carrier	With foam	19.15	1.3666	1.6224	**0.0085**
	Without foam	18.31		2.7164	**0.0450**
Telescope switch box	With foam	19.08		1.5986	**0.0077**
	Without foam	18.94		1.7906	**0.0141**

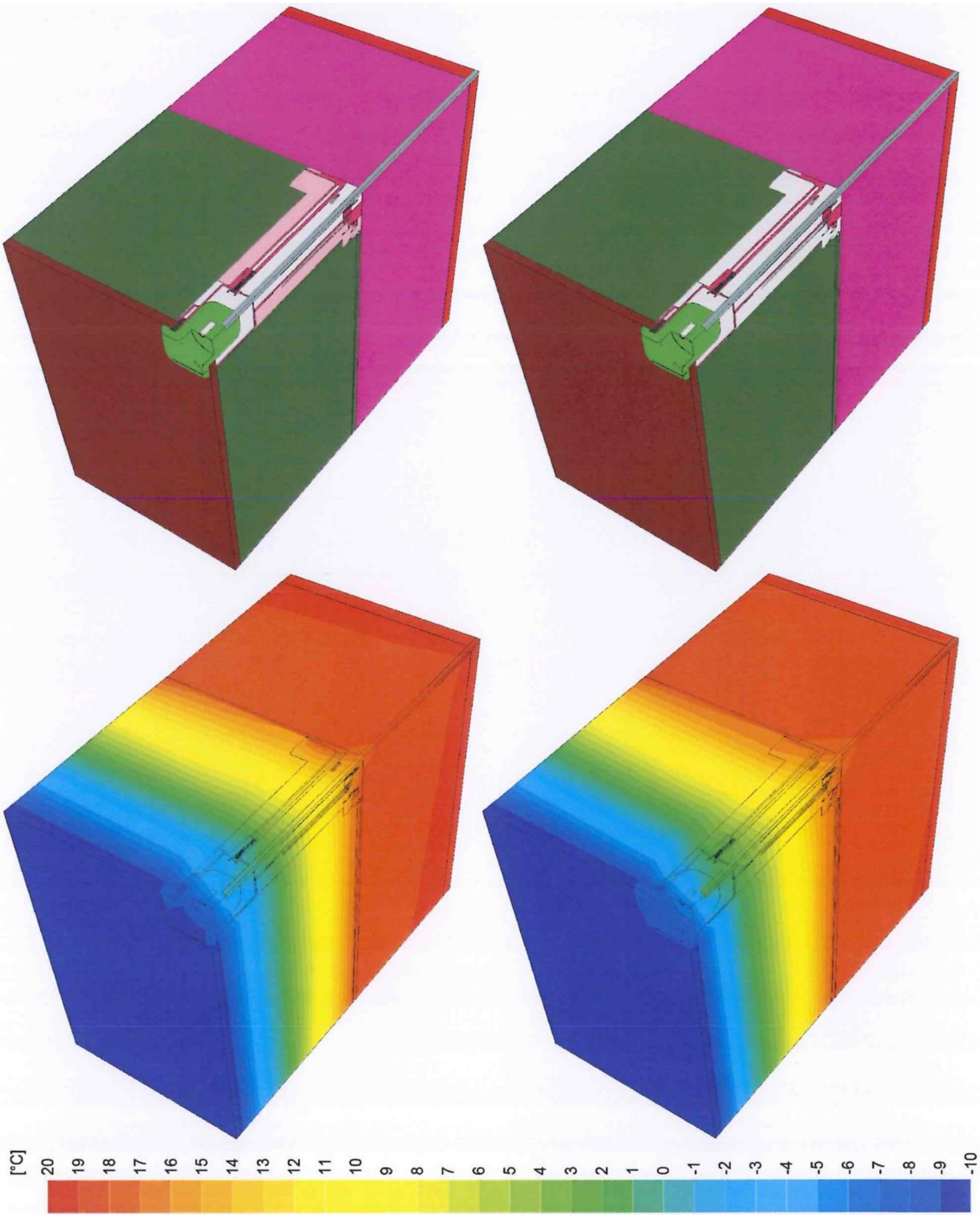

Figure 1: Telescope switch box: Top: Model with materials, bottom: Isothermal representation. Left: with foam, right: without foam

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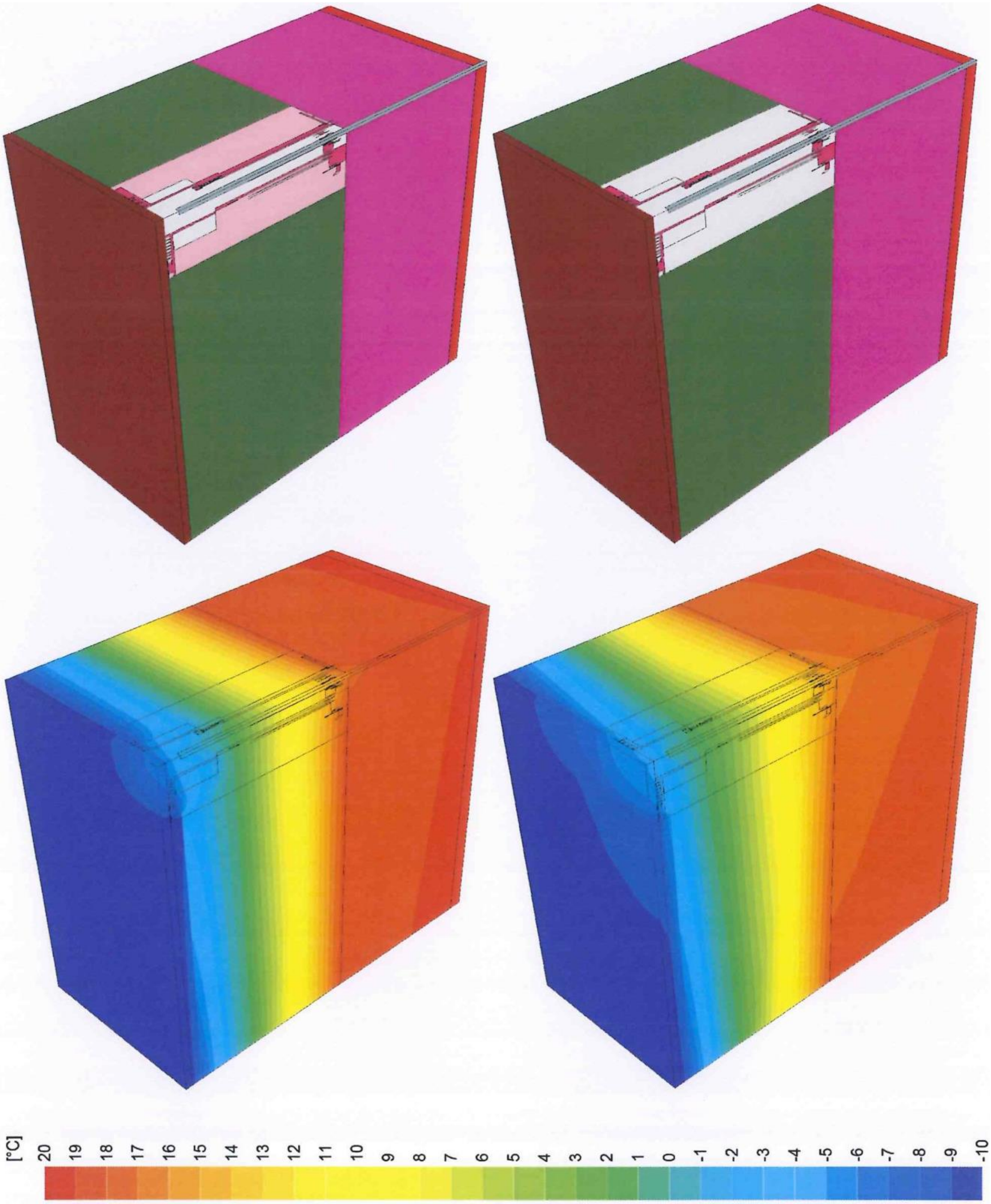

Figure 2: Telescope equipment carrier: Top: Model with materials, bottom: Isothermal representation. Left: with foam, right: without foam