



**PASSIV
HAUS
INSTITUT**

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**Heat bridge calculation to determine the point heat
bridge loss coefficients of the articles**

Equipment carrier VARIO article number: 1159-50

One-gang junction box for ETICS Econ 55

Article number: 1555-51

in the composite thermal insulation system

Brief expert report

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on behalf of the company

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Introduction



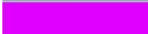







On behalf of Kaiser GmbH & Co. KG, the Passivhaus Institut (Passive House Institute) has determined the thermal characteristics for the VARIO equipment carrier item number: 1159-50 and one-gang junction box for ETICS Econ 55 item number: 1555-51 for a façade suitable for a passive house (20 cm insulation).

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 calculated 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
	Air	
	Insulation material	0.032
	High-density polyethylene (HDPE)	0.500

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)]	8.0
Indoor air temperature [°C]	20.0
Heat transfer inside [W/(m ² K)]	12.5



Modelling

3D CAD models were created, consisting of interior plaster, concrete wall, heat insulation and exterior plaster.

For the three-dimensional heat flow calculation, the models were divided into finite elements using a three-dimensional mesh. The mesh size is smaller than 0.5 mm in the area of the equipment carrier / one-gang junction box. The mesh size increases towards the edges of the model. In total, the model for the equipment carrier comprises 2,937,282 nodes and the model for the one-gang junction box comprises 5,665,680 nodes. The heat flow through the undisturbed wall for the equipment carrier is 1.36676 W and for the one-gang junction box 1.36658 W, corresponding to a wall U-value of 0.153 W/(m²K).

The equipment carrier and one-gang junction box were inserted into these models to determine the respective heat bridge loss coefficients and the calculation was repeated. The heat bridge loss coefficient results from the difference between the undisturbed model and the model with equipment carrier / one-gang junction box. A cable (NYM 3*1.5) with an equivalent heat conductivity was also modelled for the socket.

Model dimensions

Height	750 mm
Depth	600 mm
Width	400 mm

Wall construction (U= 0.153 W/(m²K))

External plaster	8 mm
Insulation	200 mm
Concrete wall	175 mm
Interior plaster	15 mm

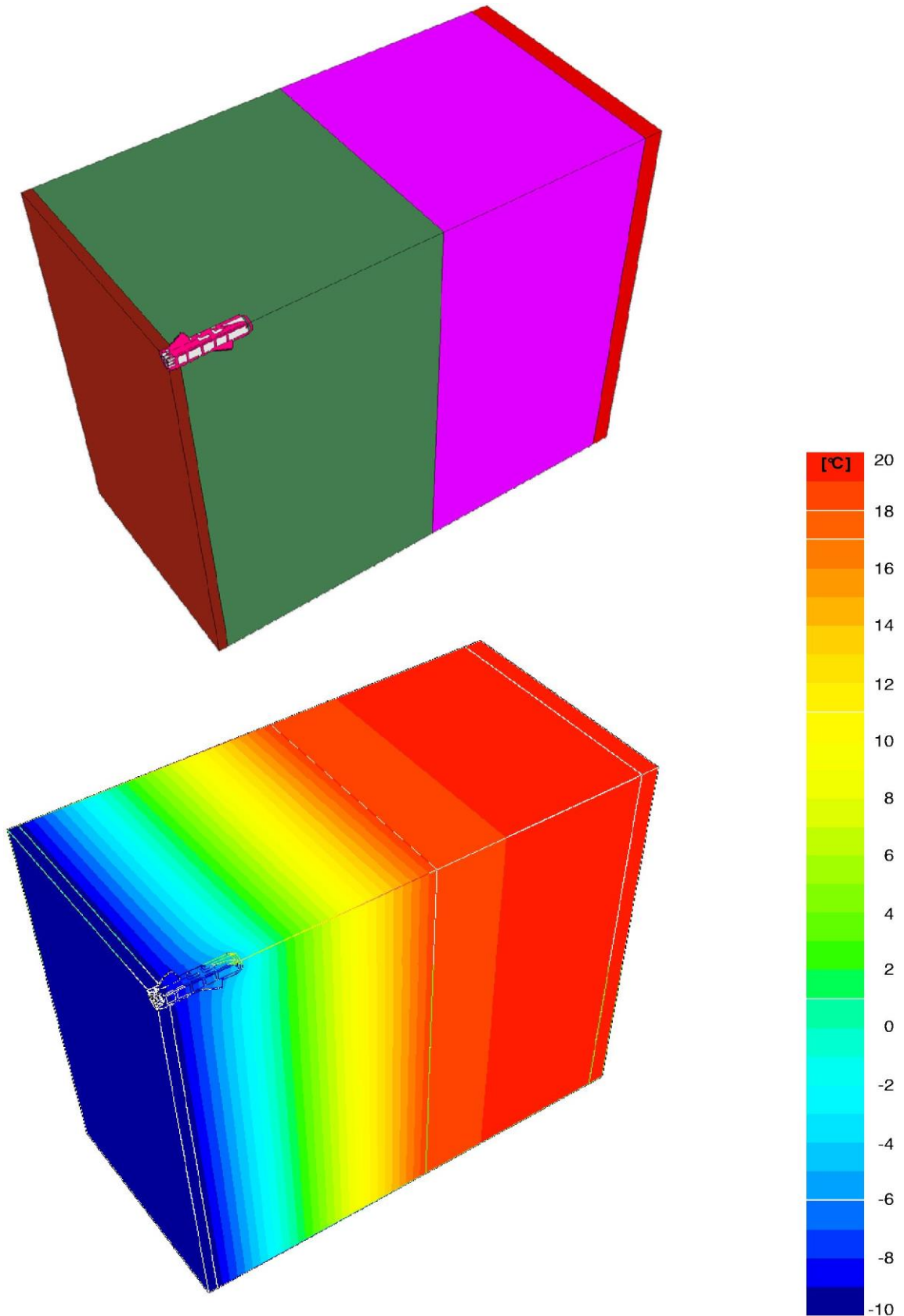
Results of the heat bridge calculations

Table 3: Heat bridge loss coefficients and surface temperatures of the analysed components with 20 cm insulation thickness (U= 0.153 W/(m²K))

Type	$\theta_{i,min, WB}$ [°C]	Q_{ref} [W]	Q_{WB} [W]	χ_{WB} [W/K]
Equipment carrier VARIO article number:1159-50	19.429	1.366760	1.368370	0.000054
One-gang junction box for ETICS Econ 55 Article no: 1555-51	19.120	1.366580	1.517890	0.005044



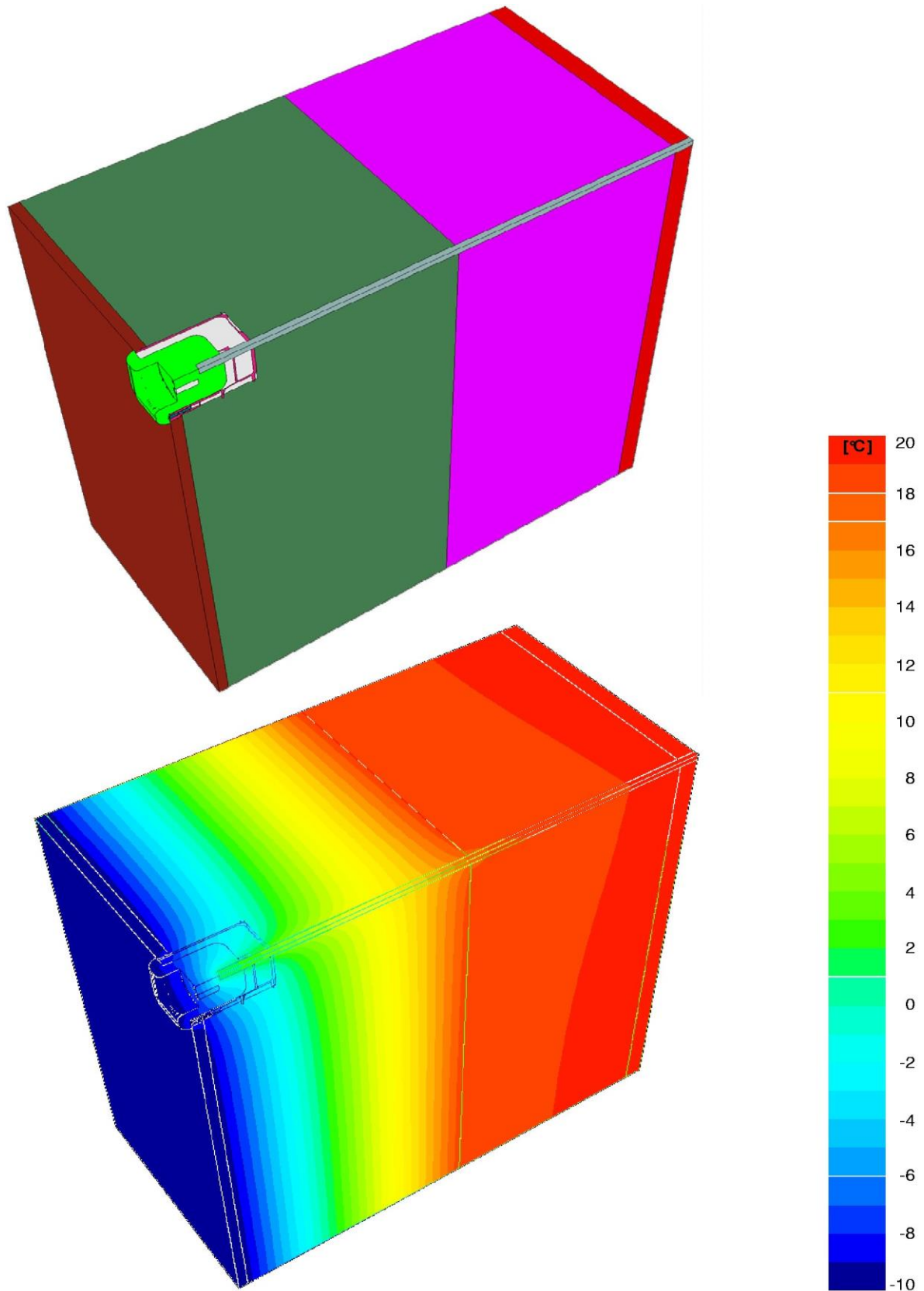
Model and isothermal image of the equipment carrier (cut-out)



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Model and isothermal image of the one-gang junction box (cut-out)



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