Certification report | Zertifizierungsbericht

Passive House Institute

Building system
Bausystem

for cool, temperate climate

für kühl-gemäßigtes Klima

Product I Produkt:	**ECOCOCON Straw Panels**
Client I Auftraggeber:	**ECOCOCON Ltd.**
Construction I Konstruktion	**Lightweigt timber Construction I Holzleichtbau**
Contact person Ansprechpartner Website	Bjorn Kierulf +421905313078 info@ecococon.lt www.ecococon.eu
Date I Datum: Author I Autor:	**25.01.2016** **Dr.-Ing. Benjamin Krick**

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Content I Inhalt

1 Introduction I *Einleitung*

Because a separate heating system is not necessarily required in Passive Houses, high demands are placed on the quality of the building components used. The colder the climate, the higher the requirements for the components. To cover this, PHI has identified regions of similar requirements, and defined certification criteria. These criteria are available for free download at the website of the Passive House Institute.

If the below summarized requirements are met and a well-designed airtightness layer is proved, the label "Certified Passive House Component" can be awarded by the Passive House Institute (PHI)

Passivhäuser stellen aufgrund der Möglichkeit, auf ein separates Heizsystem zu verzichten, hohe Anforderungen an die Qualität der verwendeten Bauteile. Dabei steigen die Anforderungen, je kälter das Klima ist. Darum hat das Passivhaus Institut Regionen gleicher Anforderung identifiziert und für diese Zertifizierungskriterien festgelegt. Die Kriterien sind auf der Homepage des Passivhaus Instituts als kostenfreier Download verfügbar.

Werden die unten zusammengefassten Anforderungen erreicht und ist eine gut geplante luftdichte Ebene nachgewiesen, kann ein Produkt als "Zertifizierte Passivhaus Komponente“ ausgezeichnet werden.

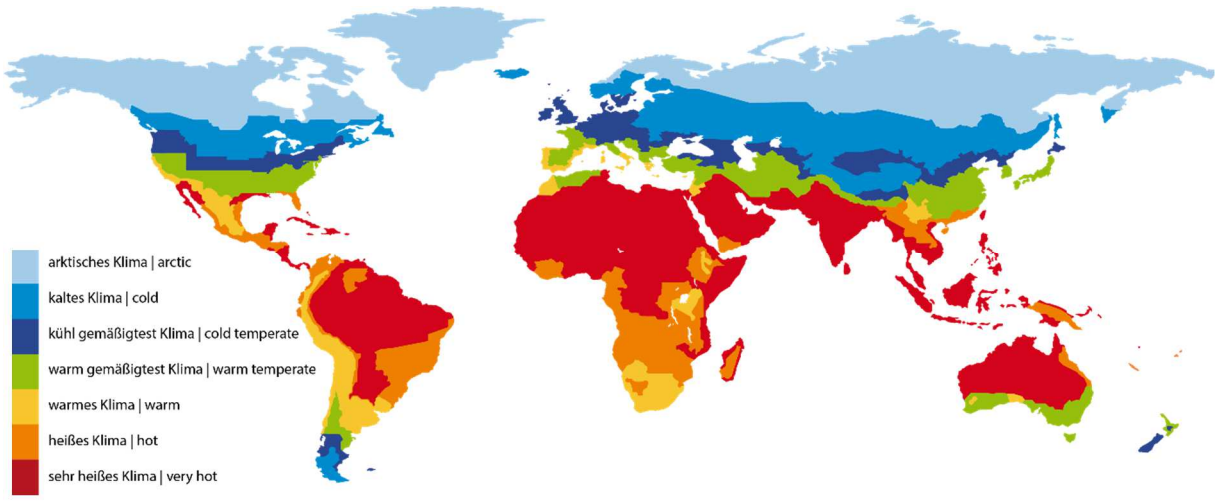
Table 1: Adequate certification criteria

Climate zone	**Hygiene criterion**	**Comfort criterion**	**Efficiency criteria**		
	$f_{Rsi=0.25\ m^2K/W}$ ≥[3]	U-value of the installed window[1] ≤	U-value opaque to ambient $U_{opaque} * f_{PHI}$[2] ≤	Purely opaque details $f_{Rsi=0.25\ m^2K/W}$ ≥	Absence of thermal bridges Ψ_a ≤[4]
	[-]	[W/(m²K)]	[W/(m²K)]	[-]	[W/(mK)]
1 Arctic	0.80	0.45 (0.35)	0.09	0.90	0.01
2 Cold	0.75	0.65 (0.52)	0.12	0.88	
3 Cool, temperate	0.70	0.85 (0.70)	0.15	0.86	
4 Warm,temperate	0.65	1.05 (0.90)	0.25	0.82	

1 applies for vertical windows with a test size of 1.23*1.48 m. The criteria for other transparent building com-ponents can be taken from the relevant certification criteria. Value in brackets: respective reference glazing.

2 $f_{R,\ PHI}$: Reduction factor: always 1, exception: areas in contact with the ground and towards the unheated basement: 0.6

4 as a thermal bridge loss coefficient based on external dimensions and length. Specific constructions such as inner edges are exempted from this criterion.



2 Description of the certified system | *Systembeschreibung*

2.1 Opaque building envelop | *Opake Gebäudehülle*

Modular Straw-Timber frame Construction. Thickness of straw panels is always 40cm. The straw is pressed homogenously at 110kg/m3 in a double wooden loadbearing timber frame 45x95mm. Top and bottom of the panels are covered with plywood. The flat, cut straw surface is visible inside and outside and when connecting the panels to each other. Clay plaster can be applied directly to the straw on the inside. The outside is covered with an airtight membrane (see below) and a wood fiber board. The wood fiber board can be plastered or a ventilated facade can be installed.

The system is based on an external insulated floor slab.

Modulares Holzrahmensystem mit 40 cm starker Strohdämmung. Das Stroh wird homogen zu einer Dichte von 110 kg/m³ in eine doppelte, lasttragende Holzkonstruktion aus 45/90 mm Kanthölzern eingebracht. Der obere und untere Abschluss der Module besteht aus 12 mm Sperrholzplatten. Das geschnittene Stroh ist innen und außen sichtbar. Die Innenseite wird auf der Baustelle mit Lehm verputzt. Die Außenseite wird mit einer diffusionsoffenen Folie und mit einer Holzweichfaserplatte verkleidet. Die Weichfaserplatte kann verputzt, oder mit einer hinterlüfteten Fassade verblendet werden. Das Dach besteht aus Stegträgern mit Zellulosedämmung.

2.2 Windows | *Fenster*

The certification was done with the window smartwin solar I, which is a very slim phA-class window with triple 18 mm argon glazing, Swisspacer Ultimate spacer bar with PU secondary seal.

In No. 01, the window is installed in the center of the wall.

In No. 02, it is installed in flush with the exterior plaster.

In No. 03, the windows are installed right at the inner edge, see certification report.

Die Zertifizierung wurde mit dem Fenster smartwin solar I, einem sehr schlanken Fenster der Klasse phA durchgeführt. Das Fenster ist mit 3-fach 18 mm Argonverglasung mit Swisspacer Ultimate und PU Sekundärdichtung ausgerüstet.

Nr. 01 bezeichnet den Einbau des Fensters in der Wandmitte.

Nr. 02 bezeichnet den Einbau bündig zum Außenputz.

In Nr. 03 wird das Fenster nahezu innenbändig eingebaut.

2.3 Airtightness concept | *Luftdichtheitskonzept*

A diffusion open, but airtight membrane with sd<0,2m is wrapped on the outside of the straw during construction. The membrane doubles as quick weather protection during construction. The membrane is taped to the airtight layer of the floor and roof. The membrane is later covered with wood fiber boards. The membrane is pulled to the inside at the window openings. Windows are then taped to the membrane.

Eine diffusionsoffene, luftdichte Membran (sd <0,2 m) wird auf die Rahmenkonstruktion aufgebracht und mit der Holzweichfaserplatte verkleidet. Die Membran wird mit Klebebändern mit der luftdichten Ebene des Daches (Ebenfalls eine Membran) und des Fußbodens verbunden. Zum Anschluss an die Fenster wird die Membran nach innen geführt und mit den Fensterrahmen verklebt.

3 Evaluation | *Bewertung*

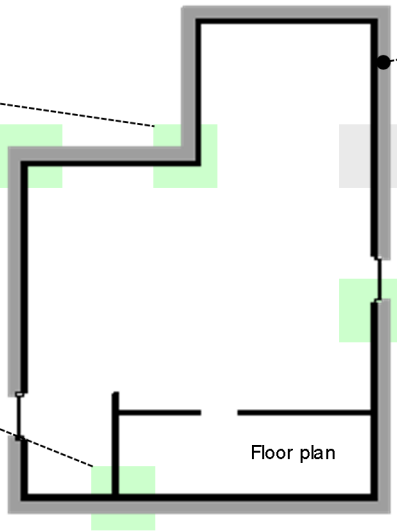
The examined building system with the indicated details meets the PHI criteria for Certified Passive House Components.

Das untersuchte Bausystem entspricht den Anforderungen an eine Zertifizierte Passivhaus Komponente.

4 Summary of the results I *Zusammenfassung der Ergebnisse*

Thermal bridge not calculated
Criteria achieved

Efficieny driteria not achieved
Hygiene- or comfortcriterion not achieved



EW01	External wall
U [W/(m²K)]	0.13
Thickness [m]	0.492

EWIC01	
Ext.w.-inner corner	
ψ [W//mK]	0.034
$f_{Rsi=0,25\ m^2K/W}$	0.98

EWEC01	
Ext.w.-outer corner	
ψ [W//mK]	-0.089
$f_{Rsi=0,25\ m^2K/W}$	0.92

EWIW01	
Ext.w.-internal wall	
ψ [W//mK]	-0.001
$f_{Rsi=0,25\ m^2K/W}$	0.96

EWEJ01	
Ext.w.-elem. junction	
ψ [W/(mK)]	
$f_{Rsi=0,25\ m^2K/W}$	

WISI	Eindow side		
Typ	01	02	03
b_f [m]	0.062	0.062	0.062
U_f [W/m²K]	0.83	0.83	0.83
ψ_g [W/mK]	0.020	0.020	0.02
ψ_i [W/mK]	0.006	0.023	0.009
$f_{Rsi=0,25\ m^2K/W}$	0.84	0.83	0.85

ROVE01	
Verge	
ψ [W//mK]	-0.071
$f_{Rsi=0,25\ m^2K/W}$	0.92

ROIW01	
Roof - internal wall	
ψ [W//mK]	
$f_{Rsi=0,25\ m^2K/W}$	

RWSI01	
Roof window top	
ψ [W//mK]	
$f_{Rsi=0,25\ m^2K/W}$	

EWCE01	
Ext.w.-ceiling	
ψ [W//mK]	0.007
$f_{Rsi=0,25\ m^2K/W}$	0.94

WITH01	
Window threshold	
b_f [m]	0.067
U_f [W/m²K]	1.03
ψ_e [W/mK]	0.020
ψ_i [W/mK]	0.020
$f_{Rsi=0,25\ m^2K/W}$	0.75
$U_{w,i}$ [W//m²K]	**0.79**

RO01	Roof
U [W/(m²K)]	0.10
Thickness [m]	0.478

FS01	Floor slab
U [W/(m²K)]	0.18
Thickness [m]	0.360

WITO	Window top		
Typ	01	02	03
b_f [m]	0.062	0.062	0.062
U_f [W/m²K]	0.83	0.83	0.83
ψ_g [W/mK]	0.020	0.020	0.020
ψ_i [W/mK]	0.009	0.025	0.011
$f_{Rsi=0,25\ m^2K/W}$	0.84	0.83	0.85

WIBO	Window bottom		
b_f [m]	0.062	0.062	0.062
U_f [W/m²K]	0.93	0.93	0.93
ψ_g [W/mK]	0.020	0.020	0.020
ψ_i [W/mK]	0.026	0.034	0.034
$f_{Rsi=0,25\ m^2K/W}$	0.84	0.81	0.81
$U_{w,i}$ [W//m²K]	**0.81**	**0.86**	**0.86**

BWBC01	Basem.w.-basem.c.
ψ [W//mK]	
$f_{Rsi=0,25\ m^2K/W}$	

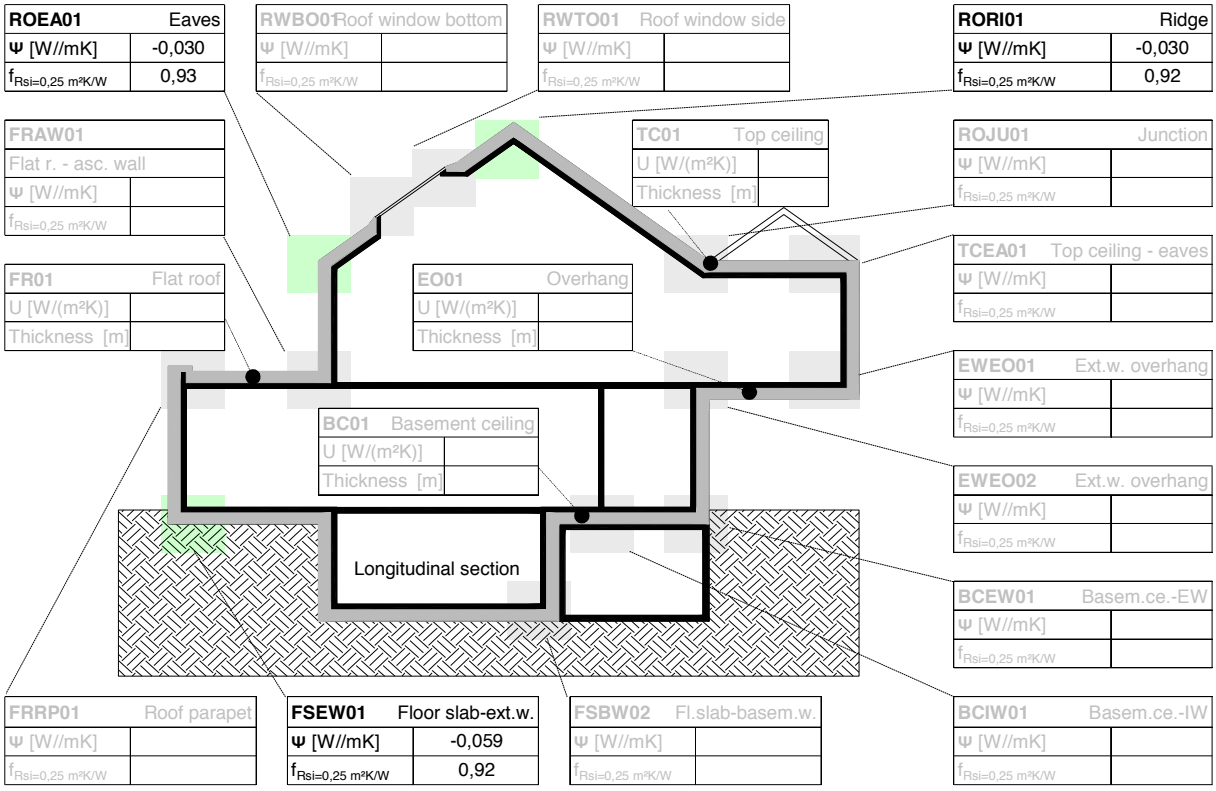
BWFS01	Basem.w.-floor slab
ψ [W//mK]	
$f_{Rsi=0,25\ m^2K/W}$	

FSBW01	Fl.slab-basem.w.
ψ [W//mK]	
$f_{Rsi=0,25\ m^2K/W}$	

FSIW01	
Fl.slab-intern.w	
ψ [W//mK]	-0.004
$f_{Rsi=0,25\ m^2K/W}$	0.92

BW01	Basement wall
U [W/(m²K)]	
Thickness [m]	

FS02	Floor slab	U [W/(m²K)]		Thickness [m]	



5 Using the results in the PHPP | *Verwendung der Ergebnisse im PHPP*

The following points are relevant for working with the here presented results in the Passive House Planning Package (PHPP):

- For the system being certified here, the thermal bridges in the regular construction of the buildings shell resulting from regularly occurring interruptions are already included in the U-values by using equivalent thermal conductivities for the materials of the interrupted layers. They do not have to be considered further.
- The results of the calculation of the linear thermal transmittance are always determined based on the external dimensions.
- Additional point thermal bridges may have to be taken into account.

Die folgenden Punkte sind für die Arbeit mit den hier zusammengefassten Ergebnissen im Passivhaus Projektierungs-Paket (PHPP:

- *Die im regulären Aufbau der Bauteile vorkommenden Wärmebrücken ist über äquivalente Wärmeleitfähigkeiten der betreffenden Bauteilschichten bereits in den U-Werten der Konstruktionen erfasst und müssen nicht weiter berücksichtigt werden.*
- *Alle linearen Wärmebrücken gelten für den Außenmaßbezug.*
- *Zusätzliche punktförmige Wärmebrücken sind zu berücksichtigen.*

6 Legal information | Rechtliche Hinweise

The following information should be kept in mind when planning and executing the detail solutions documented in this report:

The detail drawings in this documentation are schematic and might be to adapted for the specific constructions. Sealing of the construction against moisture and the absence of condensation as well as the check of hydrothermal matters was not the subject of this examination. Where necessary, this should be carried out in accordance with the accepted technical standards. The responsibility for checking the above mentioned points lies with the applicant for the certification procedure and/or the user.

The present documentation does not allow conclusions to be drawn regarding other characteristics of the examined construction that may determine its performance and quality. In particular, this documentation is not a substitute for building authority approval.

The scope of the examination and accountability of the certification is limited to the testing routines with regard to compliance with the stated criteria of the Passive House Institute. A legal basis for making any claims against the Passive House Institute Darmstadt Dr. Wolfgang Feist based on the information provided in this report is excluded

Die folgenden Informationen sind bei der Planung und Ausführung der in diesem Bericht gezeigten Details zu beachten:

Die Detailzeichnungen in diesem Bericht sind schematisch und beispielhaft. Sie müssen evtl. auf die Spezifika auszuführender Gebäude angepasst werden. Hygrothermische Aspekte wurden im Rahmen dieser Zertifizierung nicht betrachtet. Wo nötig sollten diese Betrachtungen entsprechend den gültigen Regeln der Technik vorgenommen werden. Die Verantwortung der Umsetzung oben genannter Punkte obliegt dem Hersteller oder Anwender des Bausystems.

Die vorliegende Dokumentation erlaubt keine Rückschlüsse auf andere, als die überprüften Punkte. Sie stellt insbesondere keinen Ersatz für einen Bauaufsichtliche Zulassung dar.

Aus der Zertifizierung oder diesem Bericht und den darin veröffentlichten Informationen können keine Ansprüche gegen das Passivhaus Institut Darmstadt Dr. Wolfgang Feist abgeleitet werden.

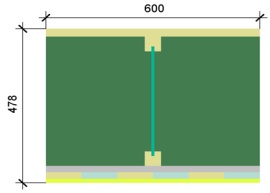
Appendix 1: U-value of building assemblies

pro Passivhausfenster GmbH: smartshell reno ID: 0842ws03 for cool, temperate climate

Acronym	Building assembly description	Interior insulation?
RO01	Roof	

Heat transmission resistance [m²K/W]

Orientation of building element: 1-Roof | Adjacent to: 3-Ventilated | interior R_{si}: 0,10 | exterior R_{se}: 0,10



U-value determined by thermal simulation (see appendix 2)

length of model [m]	Δϑ [K]	thermal flux [W/m]	**U-value** [W/(m²K)]
0,600	30	1,8393	**0,1022**

Equivlent conductivity of inhomogeneous layers

Material	λ [W/(mK)]	Description	length [m]
Airgap, slightly vent.	0,250	According to EN ISO 6946	0,100
Timber	0,130	According to EN ISO 10456 (500 kg/m³)	0,100
		Equivalent conductivity Airgap, slightly vent. / Timber [W/(mK)]	**0,1900**

U-value determined according to PHPP

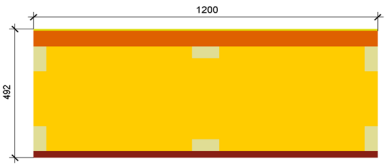
Material of Layer	λ [W/(mK)]	Description	Thickness [mm]
OSB-board	0,130	According to EN ISO 10456	25,0
Cellulose/Joist	0,0438	Ittertive determined to match thermal sim.	400,0
Airgap/Timber	0,190	Equivlent conductivity of inhomogeneous layers	20,0
Airgap/Timber	0,190	Equivlent conductivity of inhomogeneous layers	20,0
Gypsum plaster board	0,250	According to EN ISO 10456	12,5
		Total	**47,8** cm

U-value: 0,1022 W/(m²K)

Acronym	Building assembly description	Interior insulation?
EW01	**External wall**	

Heat transmission resistance [m²K/W]

Orientation of building element: 2-Wall | Adjacent to: 1-Outdoor air | interior R_{si}: 0,13 | exterior R_{se}: 0,04



U-value determined by thermal simulation (see appendix 2)

length of model [m]	Δϑ [K]	thermal flux [W/m]
1,200	30	4,7343

U-value [W/(m²K)]: **0,1315**

U-value determined according to PHPP

Material of Layer	λ [W/(mK)]	Description	Thickness [mm]
Clay plaster	0,910	According to DIN 4108-4 density 1800 kg/m³	25,0
Straw / Timber	0,0645	Ittertive determined to match thermal sim.	400
STEICO protect Typ H	0,050	According to approval Z-9.1-826	60
Lime cement plaster	1,000	According to EN ISO 10456	7
		Total	49,2 cm

U-value: 0,1315 W/(m²K)

Acronym	Building assembly description	Interior insulation?
FS01	**Floor slab**	

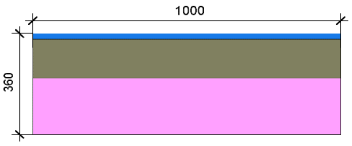
Heat transmission resistance [m²K/W]

Orientation of building element	3-Ground	Adjacent to	2-Ground	interior R_{si}	0,17	exterior R_{se}	0,00

U-value determined by thermal simulation (see appendix 2)

length of model [m]	Δϑ [K]	thermal flux [W/m]
1,000	30	**5,3082**

U-value [W/(m²K)]: **0,1769**



U-value determined according to PHPP

Material of Layer	λ [W/(mK)]	Description	Thickness [mm]
Austrotherm XPS	**0,037**	**According to Z-23.34-1552**	**200**
Concrete 1% steel	**2,300**	**According to ISO 10456:2007/2009**	**140**
Artificial stone	**1,300**	**According to ISO 10456**	**20**
		Total	**36,0** cm

U-value: **0,1769** W/(m²K)

Appendix 2: Thermal simulations | Wärmestromsimulationen

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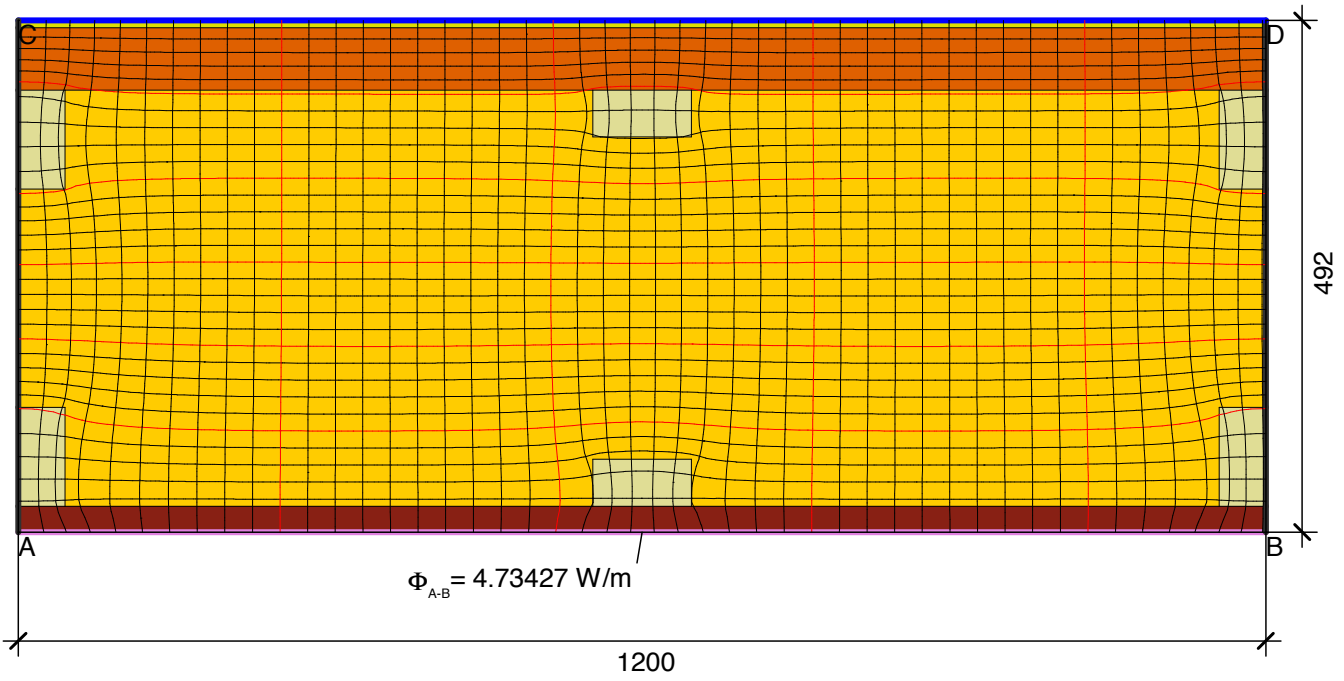
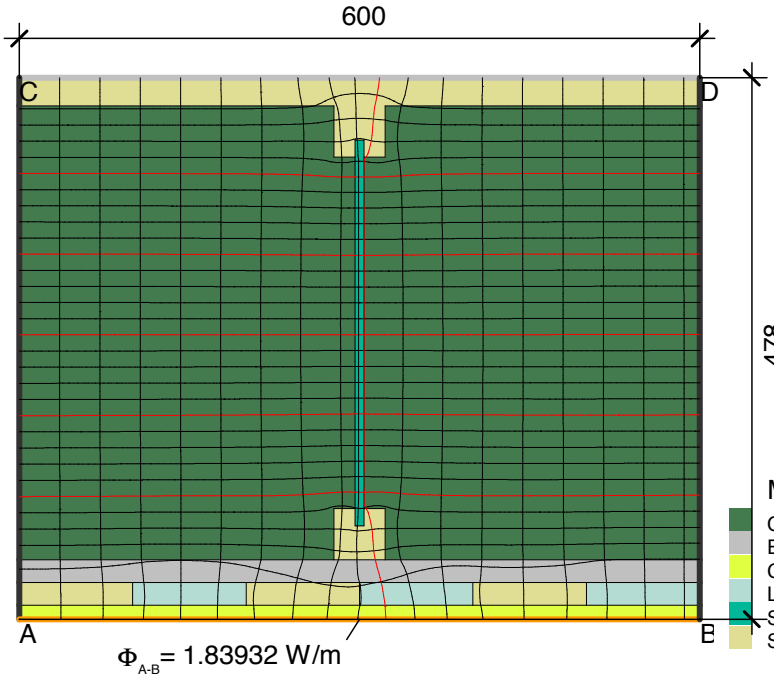
Wall and roof | Wand und Dach
Constructions to ground | Erdberührte Bauteile
Windows | Fenster



$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.734}{30.000 \cdot 1.200} = 0.132\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]
Clay plaster I Lehmputz 4108-4	0.910
Lime cement plaster I Kalkzement Putz	1.000
STEICO protect Typ H	0.050
Softwood, OSB I Weichholz, OSB 10456	0.130
Straw compressed	0.062

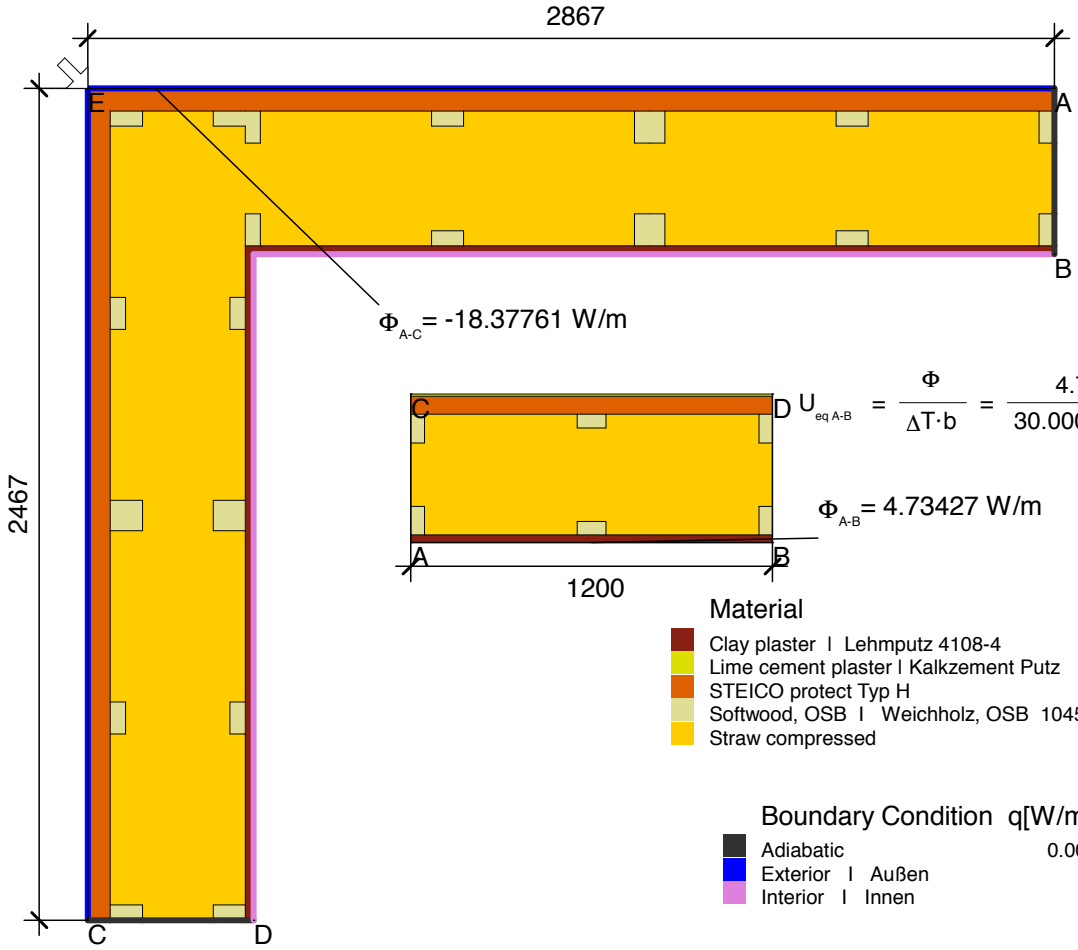
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
Interior I Innen		20.000	0.130



$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{1.839}{30.000 \cdot 0.600} = 0.102\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]
Celulose 040	0.040
EQ-airgap-roof	0.190
Gypsum board I Gipskartonplatten 900 kg/m3 10456	0.250
Luftschicht, schwach belüftet, aufwärts, Dicke: 20 mm	0.250
Softwood flow parallel I Weichholz Q parallel	0.290
Softwood, OSB I Weichholz, OSB 10456	0.130

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior roof I Außen Dach		-10.000	0.100
Interior up. I Innen auf.		20.000	0.100

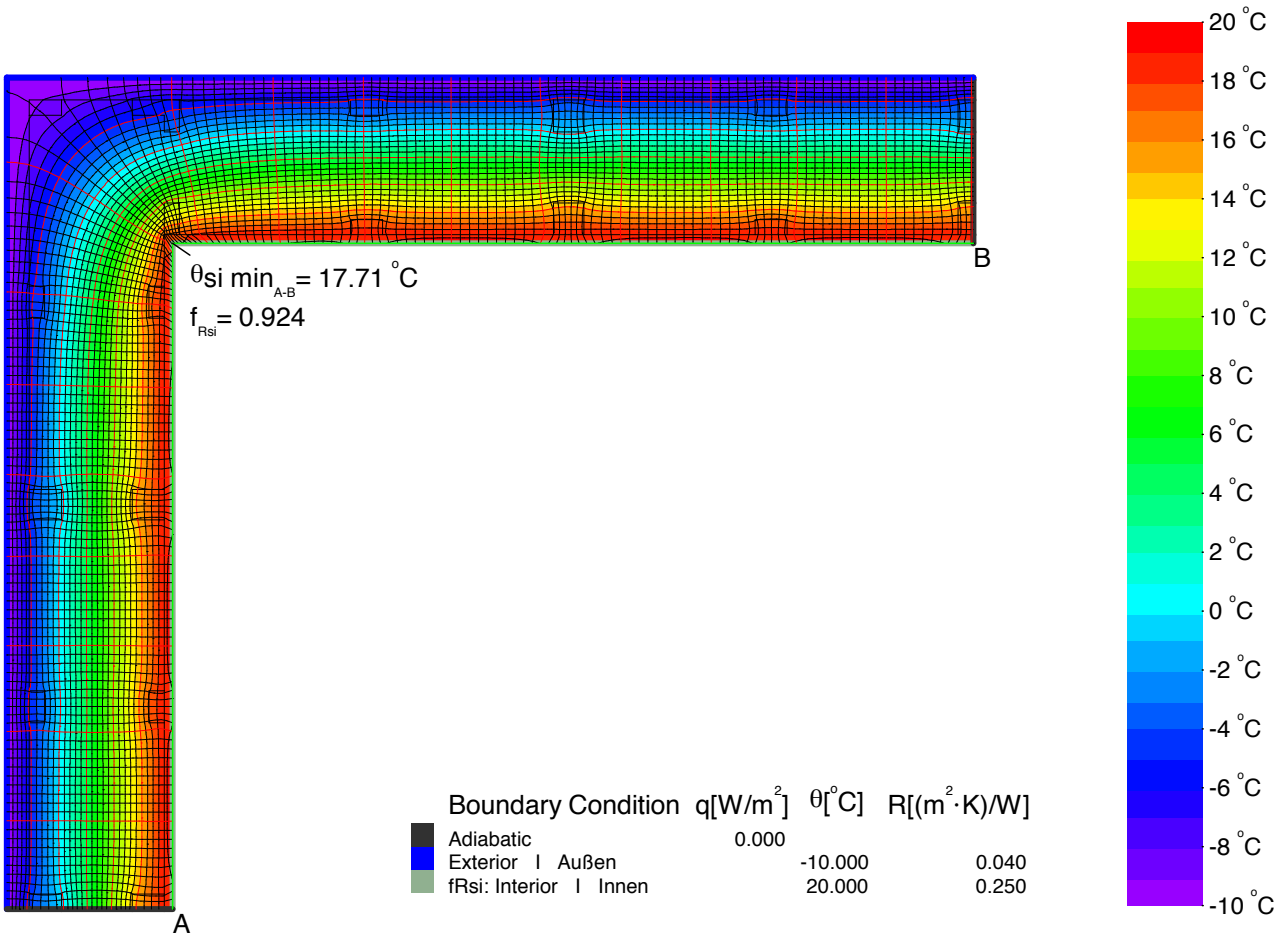


$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.734}{30.000 \cdot 1.200} = 0.132\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]
Clay plaster I Lehmputz 4108-4	0.910
Lime cement plaster I Kalkzement Putz	1.000
STEICO protect Typ H	0.050
Softwood, OSB I Weichholz, OSB 10456	0.130
Straw compressed	0.062

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
Interior I Innen		20.000	0.130

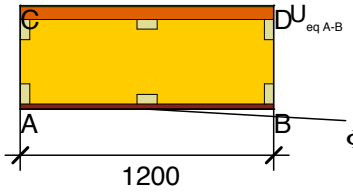
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{18.378}{30.000} - 0.132 \cdot 2.867 - 0.132 \cdot 2.467 = -0.089\ W/(m \cdot K)$$



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
fRsi: Interior I Innen		20.000	0.250

Material	λ[W/(m·K)]
Clay plaster I Lehmputz 4108-4	0.910
Lime cement plaster I Kalkzement Putz	1.000
STEICO protect Typ H	0.050
Softwood, OSB I Weichholz, OSB 10456	0.130
Straw compressed	0.062

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
Interior I Innen		20.000	0.130

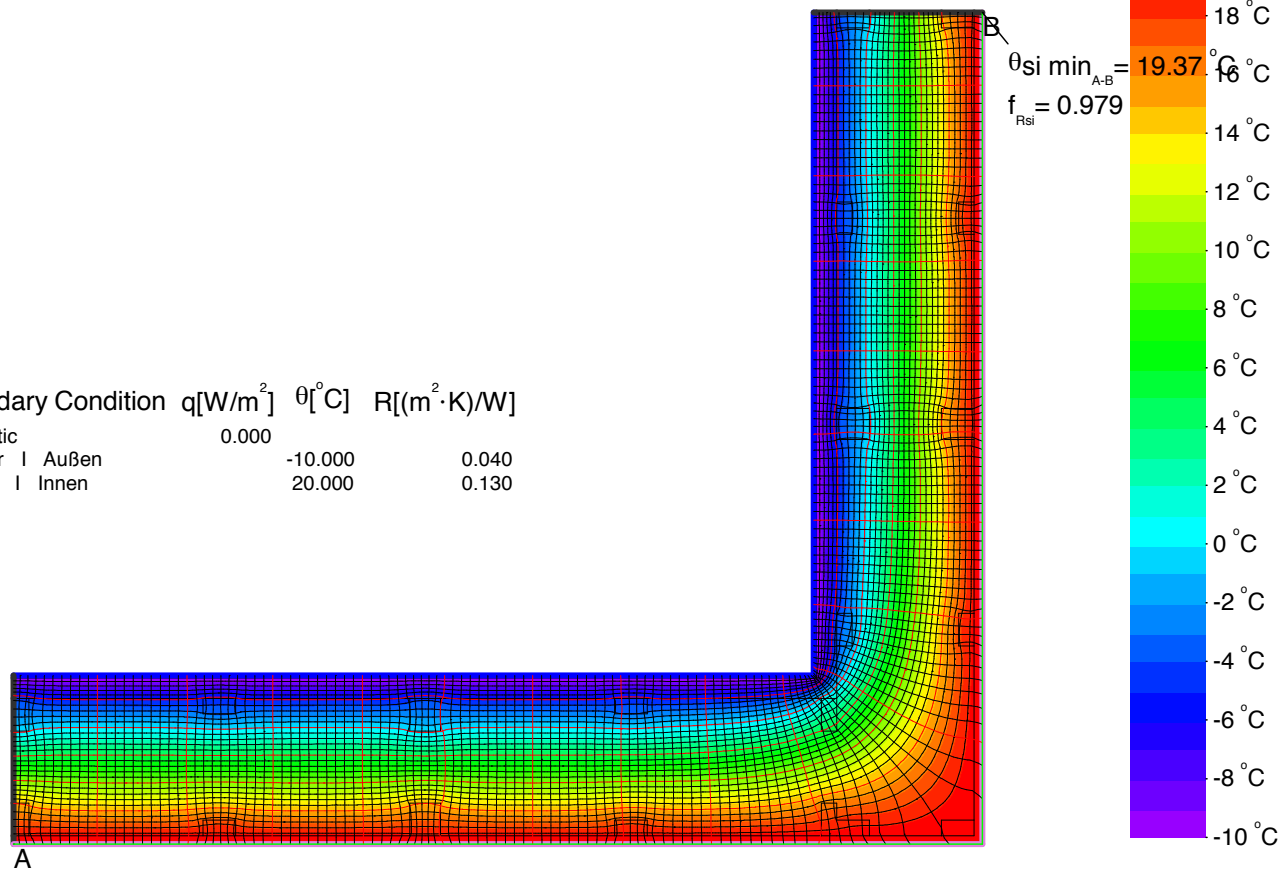


$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.734}{30.000 \cdot 1.200} = 0.132\ W/(m^2 \cdot K)$$

$\Phi_{A\text{-}B}$ = 4.73427 W/m

$\Phi_{A\text{-}C}$ = 17.85592 W/m

$$\psi_{A\text{-}E\text{-}C,\ *} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{17.856}{30.000} - 0.132 \cdot 2.333 - 0.132 \cdot 1.933 = 0.034\ W/(m \cdot K)$$



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
Interior I Innen		20.000	0.130

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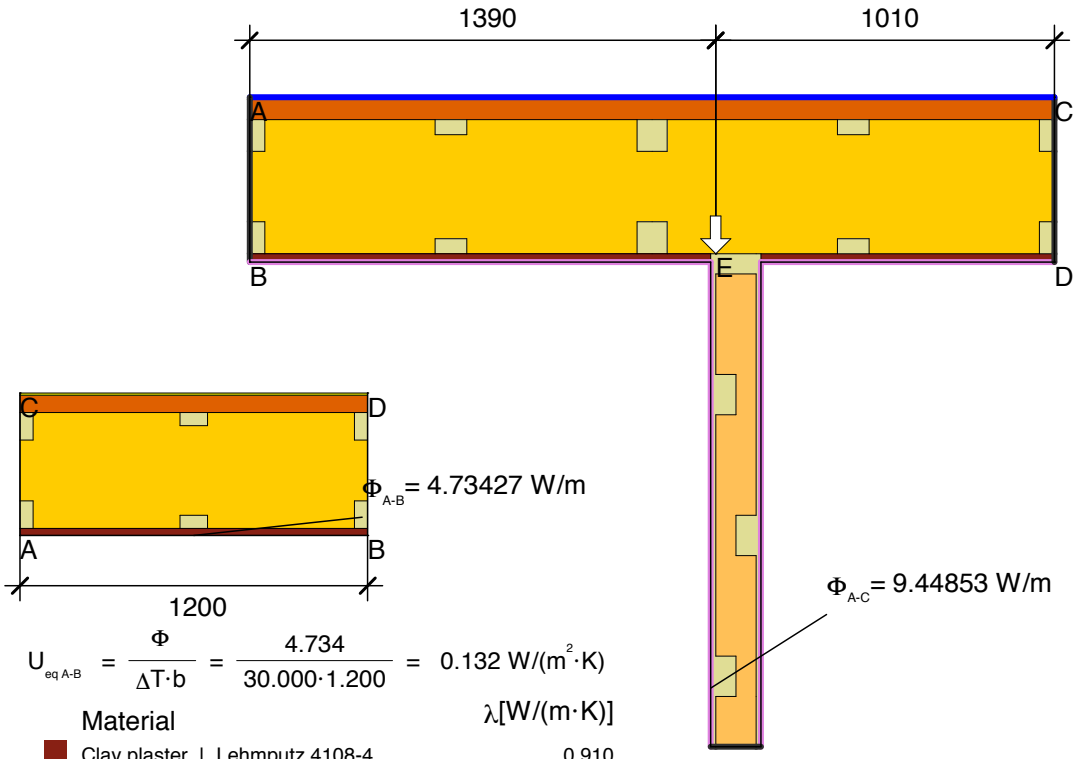


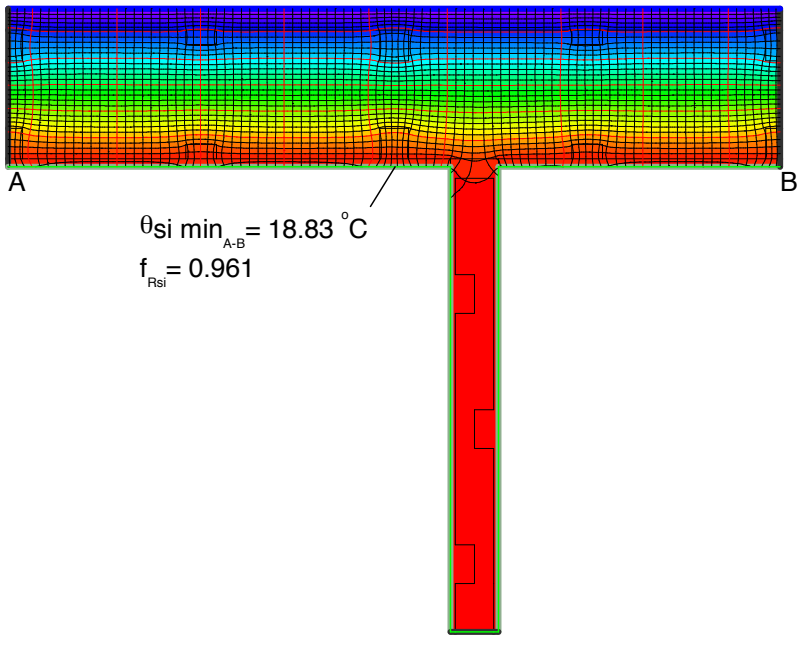
$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.734}{30.000 \cdot 1.200} = 0.132\ W/(m^2 \cdot K)$$

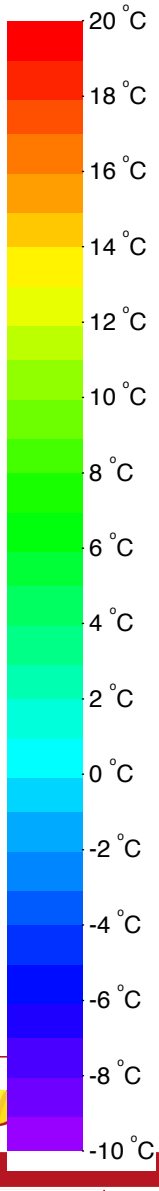
Material	λ[W/(m·K)]
Clay plaster I Lehmputz 4108-4	0.910
Lime cement plaster I Kalkzement Putz	1.000
STEICO flex 039	0.039
STEICO protect Typ H	0.050
Softwood, OSB I Weichholz, OSB 10456	0.130
Straw compressed	0.062

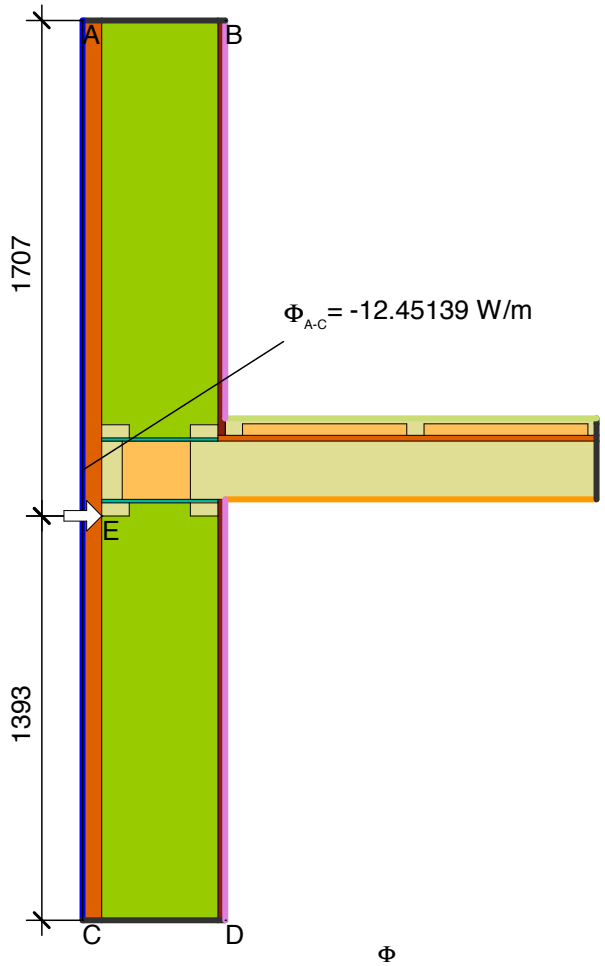
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
Interior I Innen		20.000	0.130

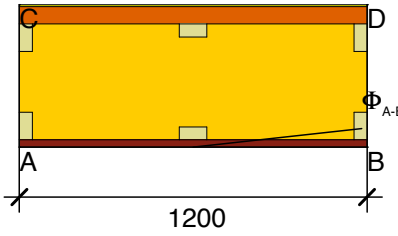
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{9.449}{30.000} - 0.132 \cdot 1.390 - 0.132 \cdot 1.010 = -0.001\ W/(m \cdot K)$$

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
fRsi: Interior I Innen		20.000	0.250







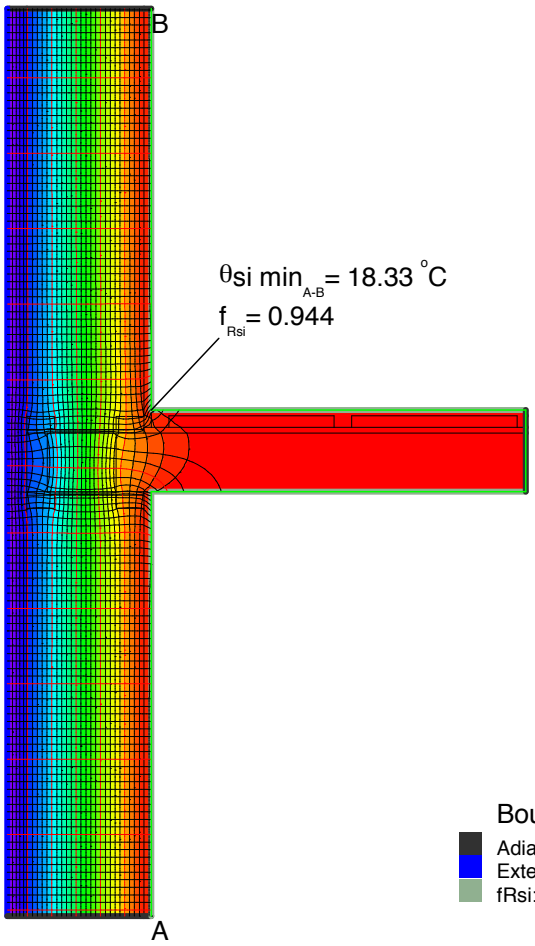


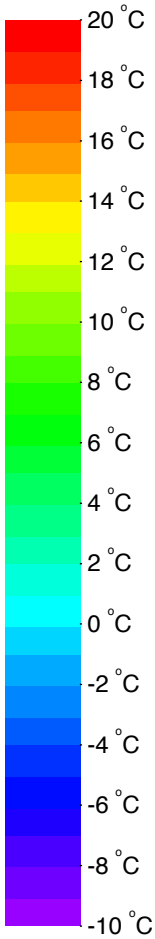
$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.734}{30.000 \cdot 1.200} = 0.132\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]
Clay plaster I Lehmputz 4108-4	0.910
EQ-insulation_wall	0.065
Lime cement plaster I Kalkzement Putz	1.000
STEICO flex 039	0.039
STEICO protect Typ H	0.050
Softwood flow parallel I Weichholz Q parallel	0.290
Softwood, OSB I Weichholz, OSB 10456	0.130

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
Int. flux down I Innen abwärts		20.000	0.170
Interior I Innen		20.000	0.130
Interior up. I Innen auf.		20.000	0.100

$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{12.451}{30.000} - 0.132 \cdot 1.707 - 0.132 \cdot 1.393 = 0.007\ W/(m \cdot K)$$





Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
fRsi: Interior I Innen		20.000	0.250

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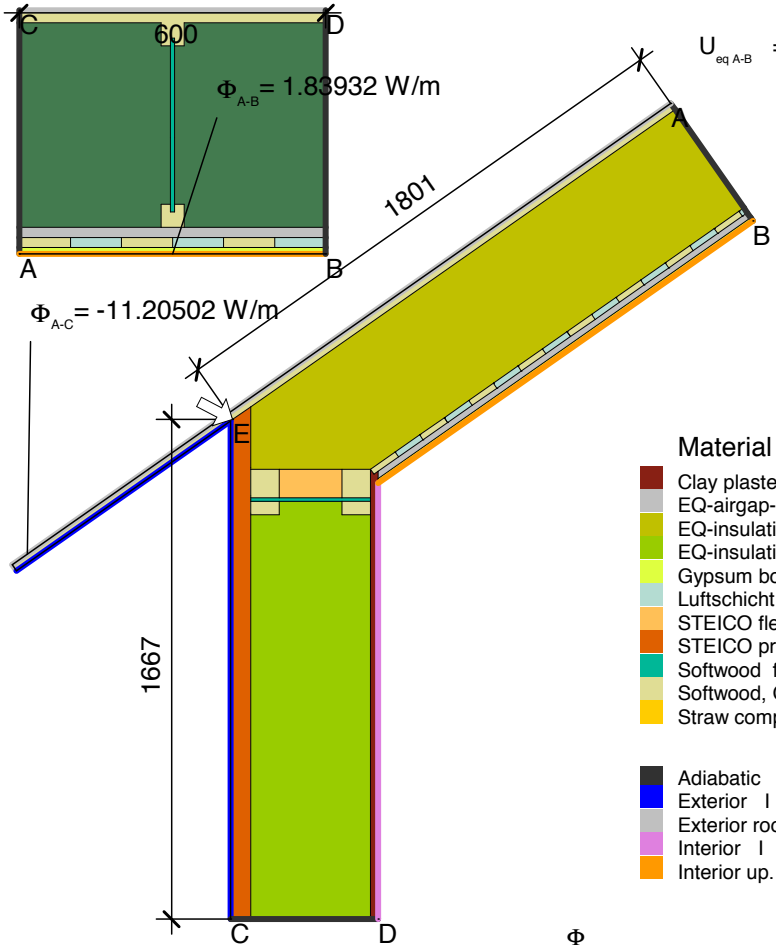


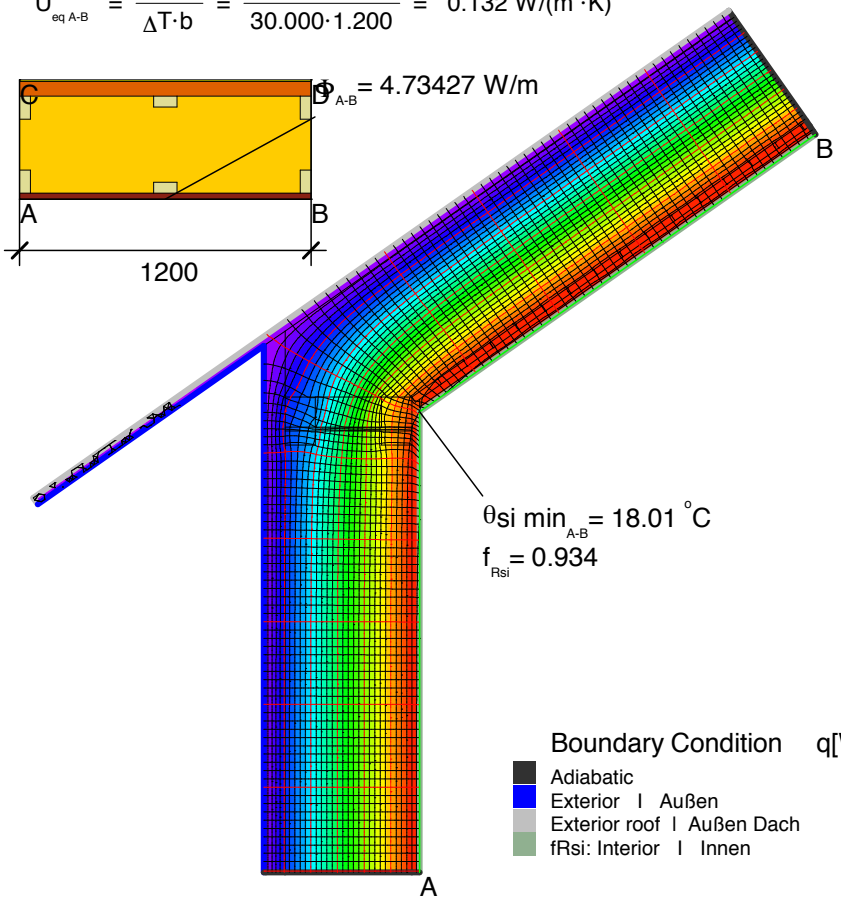
$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{1.839}{30.000 \cdot 0.600} = 0.102\ W/(m^2 \cdot K)$$

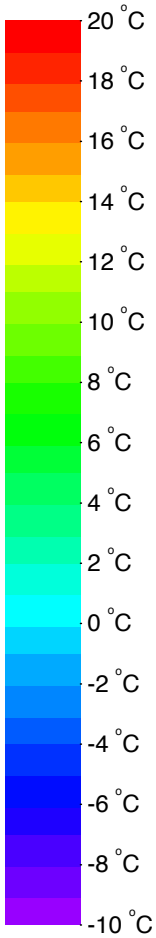
Material	λ[W/(m·K)]
Clay plaster I Lehmputz 4108-4	0.910
EQ-airgap-roof	0.190
EQ-insulation_roof	0.044
EQ-insulation_wall	0.065
Gypsum board I Gipskartonplatten 900 kg/m3 10456	0.250
Luftschicht, schwach belüftet, aufwärts, Dicke: 20 mm	0.250
STEICO flex 039	0.039
STEICO protect Typ H	0.050
Softwood flow parallel I Weichholz Q parallel	0.290
Softwood, OSB I Weichholz, OSB 10456	0.130
Straw compressed	0.062

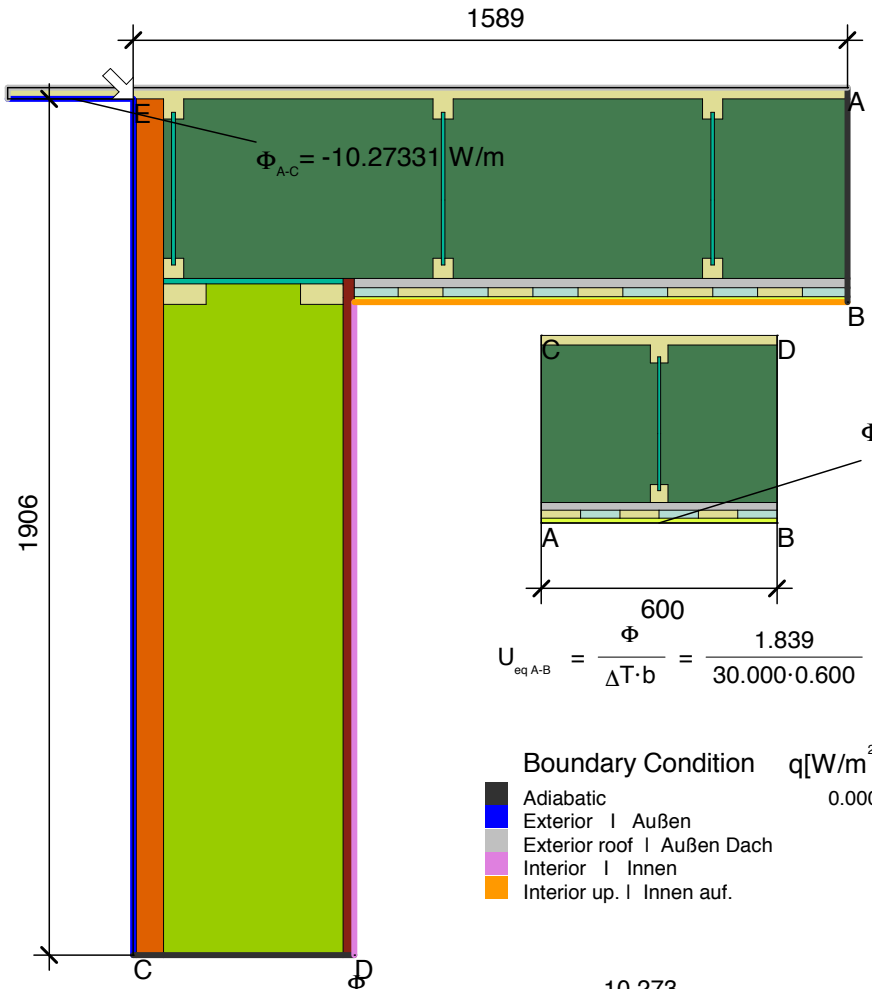
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
Exterior roof I Außen Dach		-10.000	0.100
Interior I Innen		20.000	0.130
Interior up. I Innen auf.		20.000	0.100

$$\psi_{A-E-C,\ *} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{11.205}{30.000} - 0.102 \cdot 1.801 - 0.132 \cdot 1.667 = -0.030\ W/(m \cdot K)$$

$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.734}{30.000 \cdot 1.200} = 0.132\ W/(m^2 \cdot K)$$



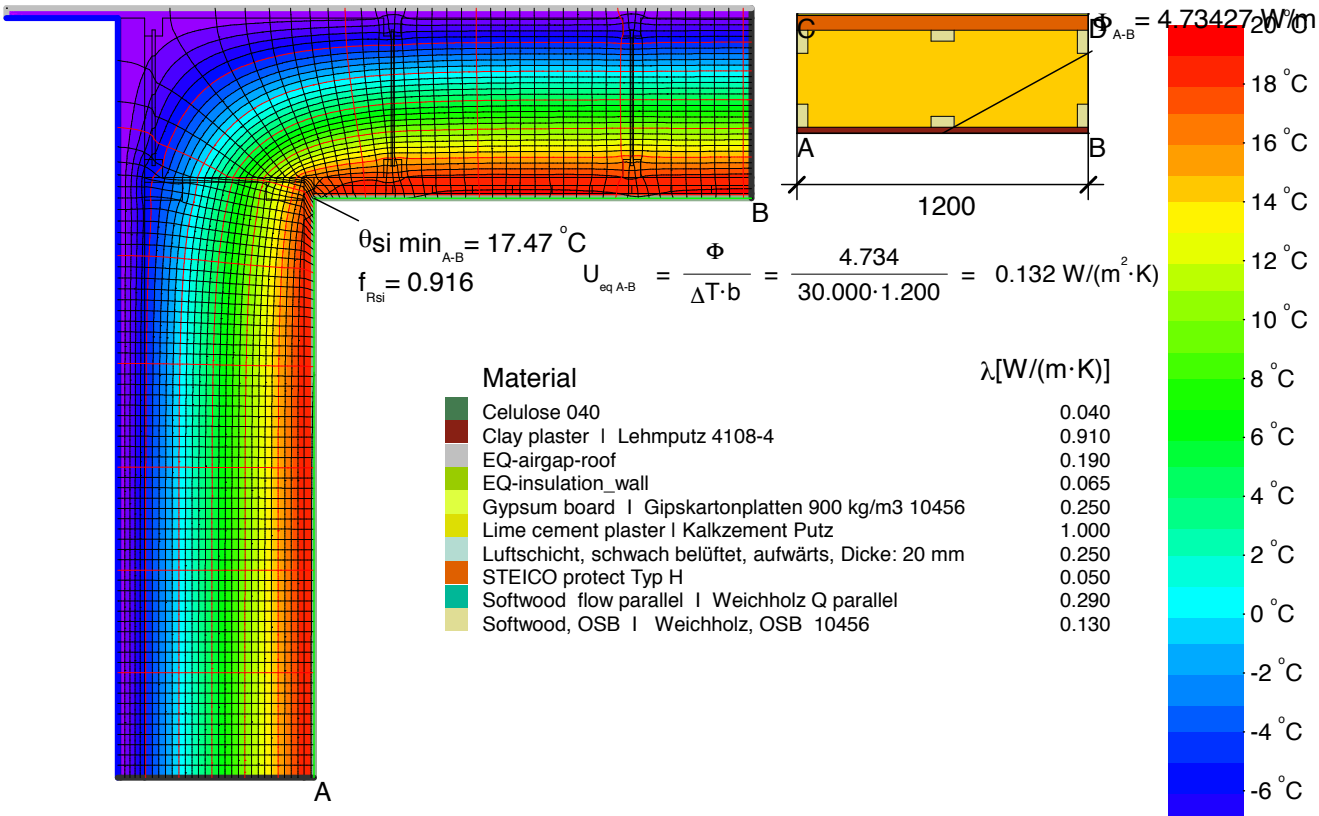




$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{1.839}{30.000 \cdot 0.600} = 0.102\ W/(m^2 \cdot K)$$

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
Exterior roof I Außen Dach		-10.000	0.100
Interior I Innen		20.000	0.130
Interior up. I Innen auf.		20.000	0.100

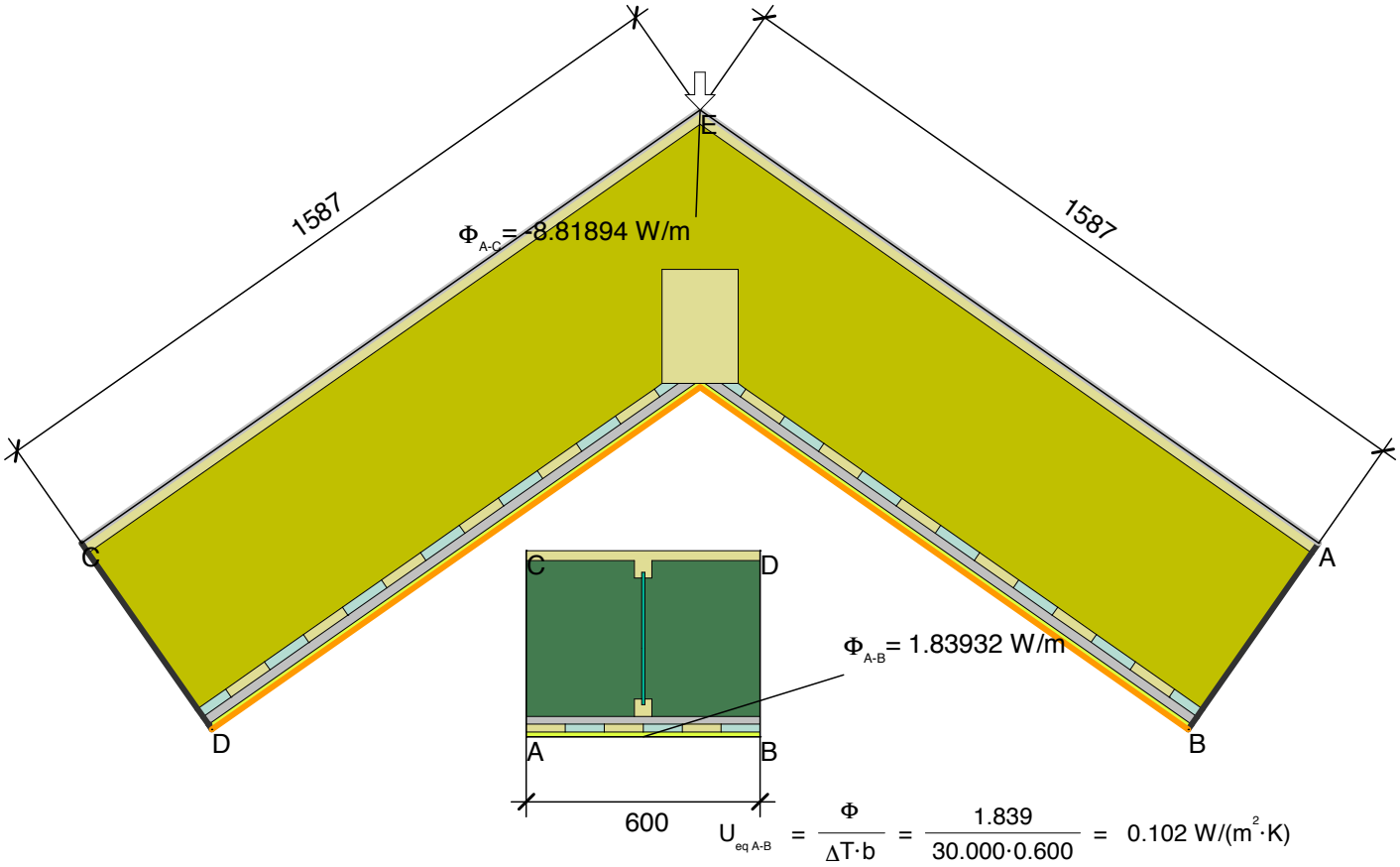
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{10.273}{30.000} - 0.102 \cdot 1.590 - 0.132 \cdot 1.906 = -0.071\ W/(m \cdot K)$$



$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.734}{30.000 \cdot 1.200} = 0.132\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]
Celulose 040	0.040
Clay plaster I Lehmputz 4108-4	0.910
EQ-airgap-roof	0.190
EQ-insulation_wall	0.065
Gypsum board I Gipskartonplatten 900 kg/m3 10456	0.250
Lime cement plaster I Kalkzement Putz	1.000
Luftschicht, schwach belüftet, aufwärts, Dicke: 20 mm	0.250
STEICO protect Typ H	0.050
Softwood flow parallel I Weichholz Q parallel	0.290
Softwood, OSB I Weichholz, OSB 10456	0.130

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior I Außen		-10.000	0.040
Exterior roof I Außen Dach		-10.000	0.100
fRsi: Interior I Innen		20.000	0.250

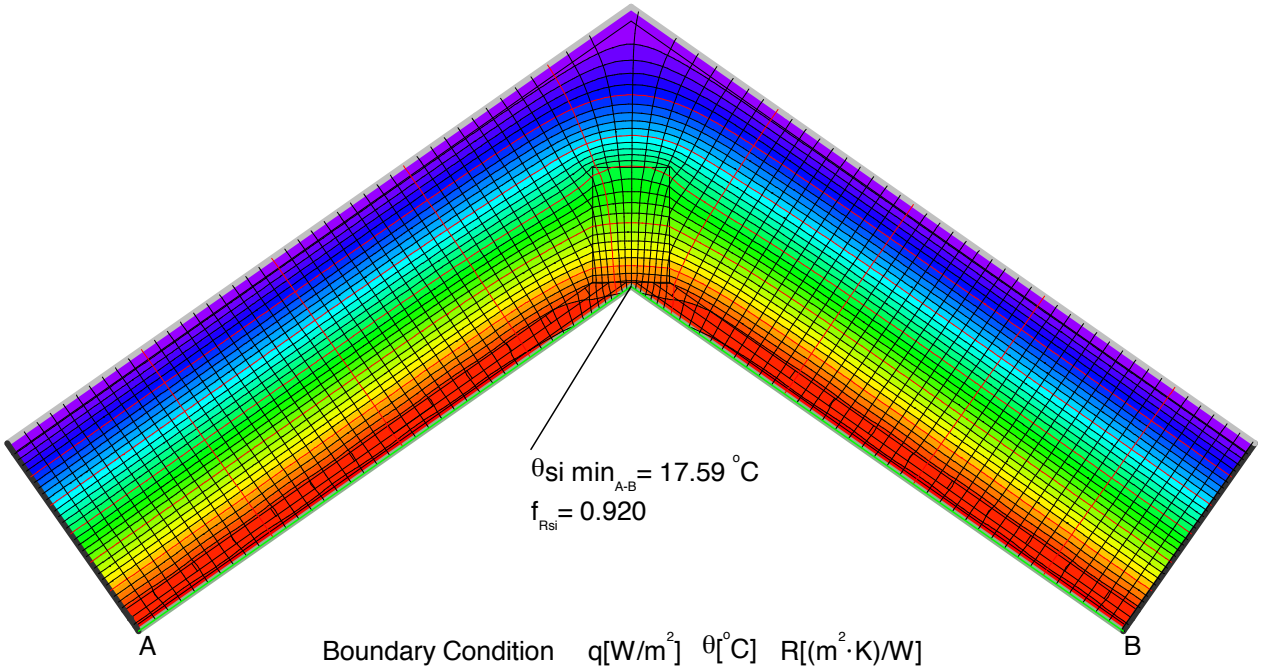


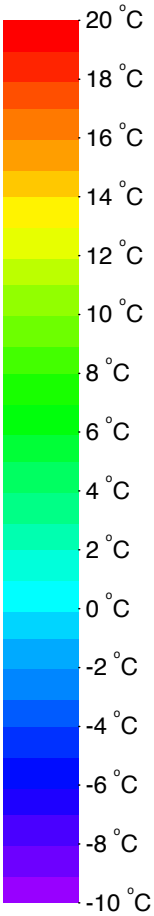
$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{1.839}{30.000 \cdot 0.600} = 0.102\ W/(m^2 \cdot K)$$

$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{8.819}{30.000} - 0.102 \cdot 1.587 - 0.102 \cdot 1.587 = -0.030\ W/(m \cdot K)$$

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior roof I Außen Dach		-10.000	0.100
Interior up. I Innen auf.		20.000	0.100

Material	λ[W/(m·K)]
EQ-airgap-roof	0.190
EQ-insulation_roof	0.044
Gypsum board I Gipskartonplatten 900 kg/m3 10456	0.250
Luftschicht, schwach belüftet, aufwärts, Dicke: 20 mm	0.250
Softwood, OSB I Weichholz, OSB 10456	0.130



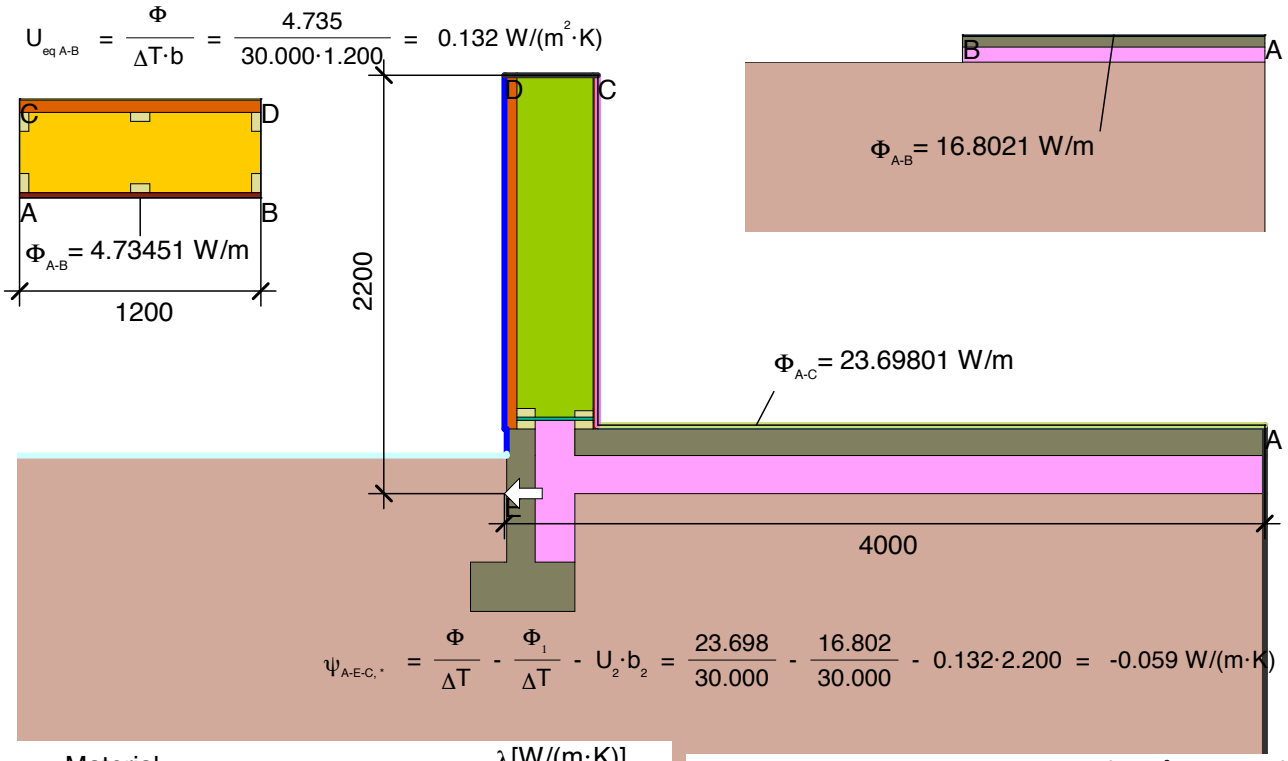


Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Exterior roof I Außen Dach		-10.000	0.100
fRsi: Interior I Innen		20.000	0.250

Passive House Institute

Constructions to ground | Erdberührte Bauteile

$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.735}{30.000 \cdot 1.200} = 0.132\ W/(m^2 \cdot K)$$

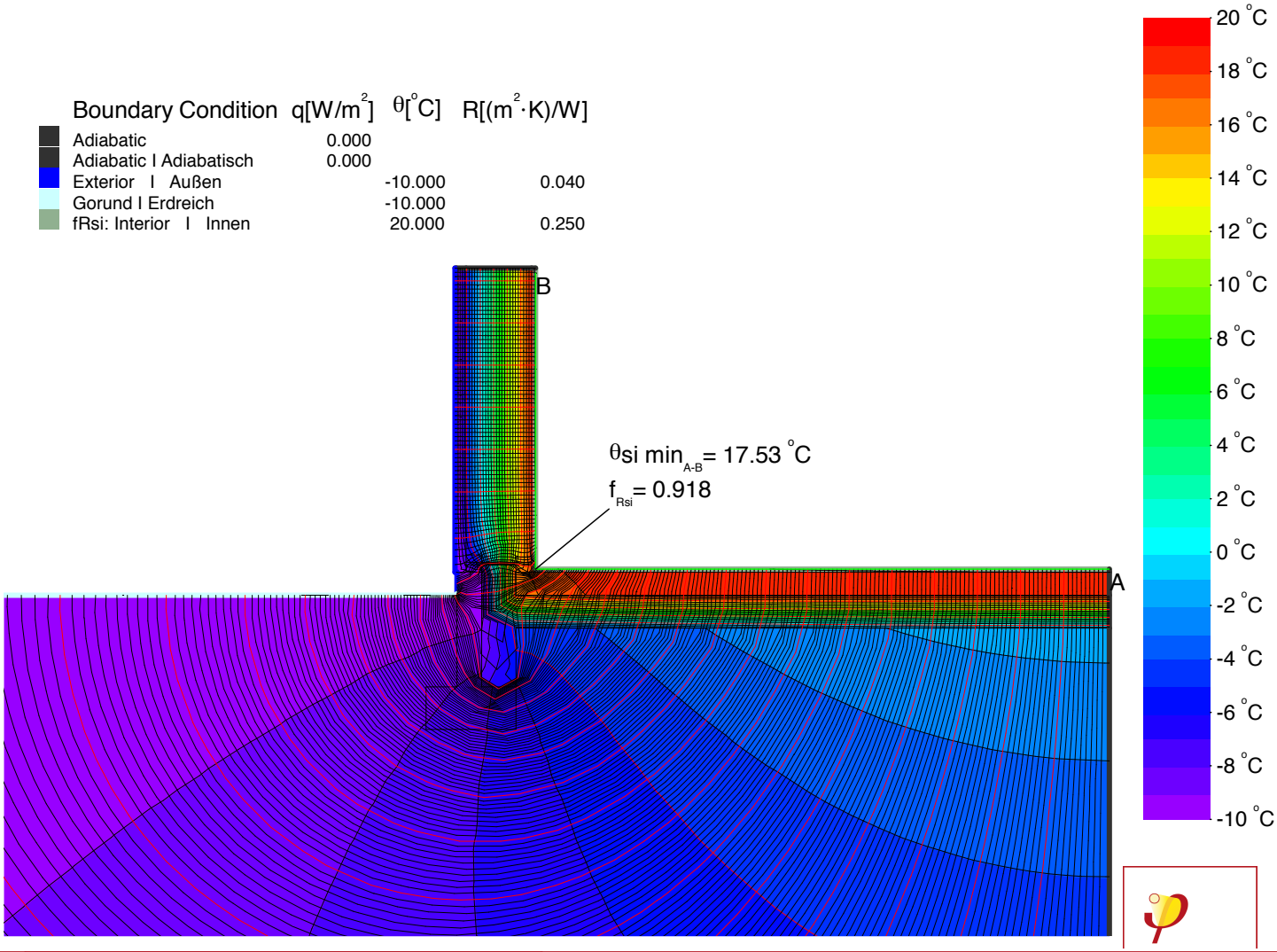


$$\psi_{A\text{-}E\text{-}C,\ *} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{23.698}{30.000} - \frac{16.802}{30.000} - 0.132 \cdot 2.200 = -0.059\ W/(m \cdot K)$$

Material	λ[W/(m·K)]
Artificial stone I Kunststein 10456	1.300
Austrotherm XPS TOP	0.037
Clay plaster I Lehmputz 4108-4	0.910
Concrete, 1% Steel I Beton, 1% Stahl 10456	2.300
EQ-insulation_wall	0.065
Ground I Erdreich	2.000
Lime cement plaster I Kalkzement Putz	1.000
STEICO protect Typ H	0.050
Softwood flow parallel I Weichholz Q parallel	0.290
Softwood, OSB I Weichholz, OSB 10456	0.130

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Adiabatic I Adiabatisch	0.000		
Exterior I Außen		-10.000	0.040
Gorund I Erdreich		-10.000	
Int. flux down I Innen abwärts		20.000	0.170
Interior I Innen		20.000	0.130

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Adiabatic I Adiabatisch	0.000		
Exterior I Außen		-10.000	0.040
Gorund I Erdreich		-10.000	
fRsi: Interior I Innen		20.000	0.250



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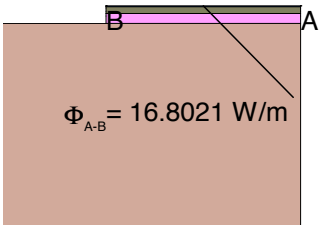
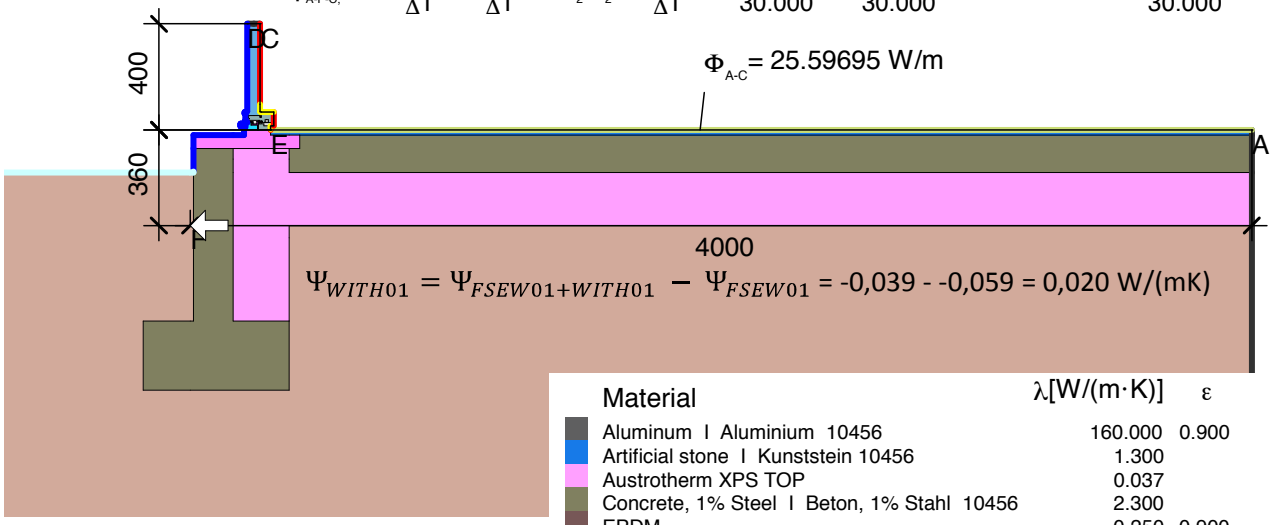


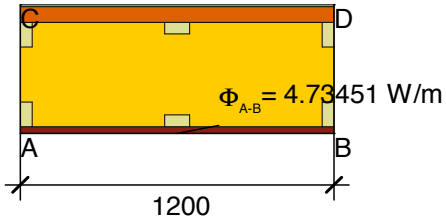
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Adiabatic I Adiabatisch	0.000			
Exterior I Außen		-10.000	0.040	
Gorund I Erdreich		-10.000		
Int. flux down I Innen abwärts		20.000	0.170	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

$$\psi_{A\text{-}F\text{-}C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 - \frac{\Phi_3}{\Delta T} = \frac{25.597}{30.000} - \frac{16.802}{30.000} - 0.132 \cdot 0.360 - \frac{8.547}{30.000} = -0.039 \text{ W/(m·K)}$$

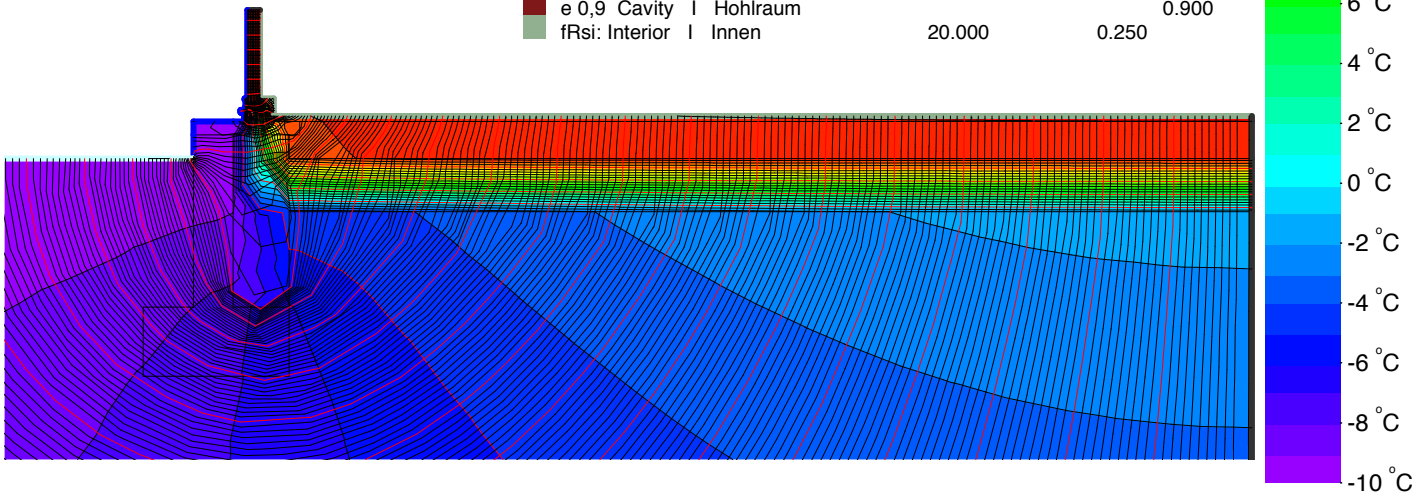


Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160.000	0.900
Artificial stone I Kunststein 10456	1.300	
Austrotherm XPS TOP	0.037	
Concrete, 1% Steel I Beton, 1% Stahl 10456	2.300	
EPDM	0.250	0.900
GRP, >50% I GFK >50%	0.630	0.900
Ground I Erdreich	2.000	
Insulation I Wärmedämmung 040	0.040	0.900
PU foam I PU-Schaum 027	0.027	0.900
Panel I Maske	0.035	
Purenit 500 M	0.086	
Silicone I Silikon	0.350	
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Unvent. cavity I unbel. Hohlr. slightly vent. cav. I leicht bel. Hohlr.		

$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.735}{30.000 \cdot 1.200} = 0.132 \text{ W/(m}^2\text{·K)}$$



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Adiabatic I Adiabatisch	0.000			
Exterior I Außen		-10.000	0.040	
Gorund I Erdreich		-10.000		
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	



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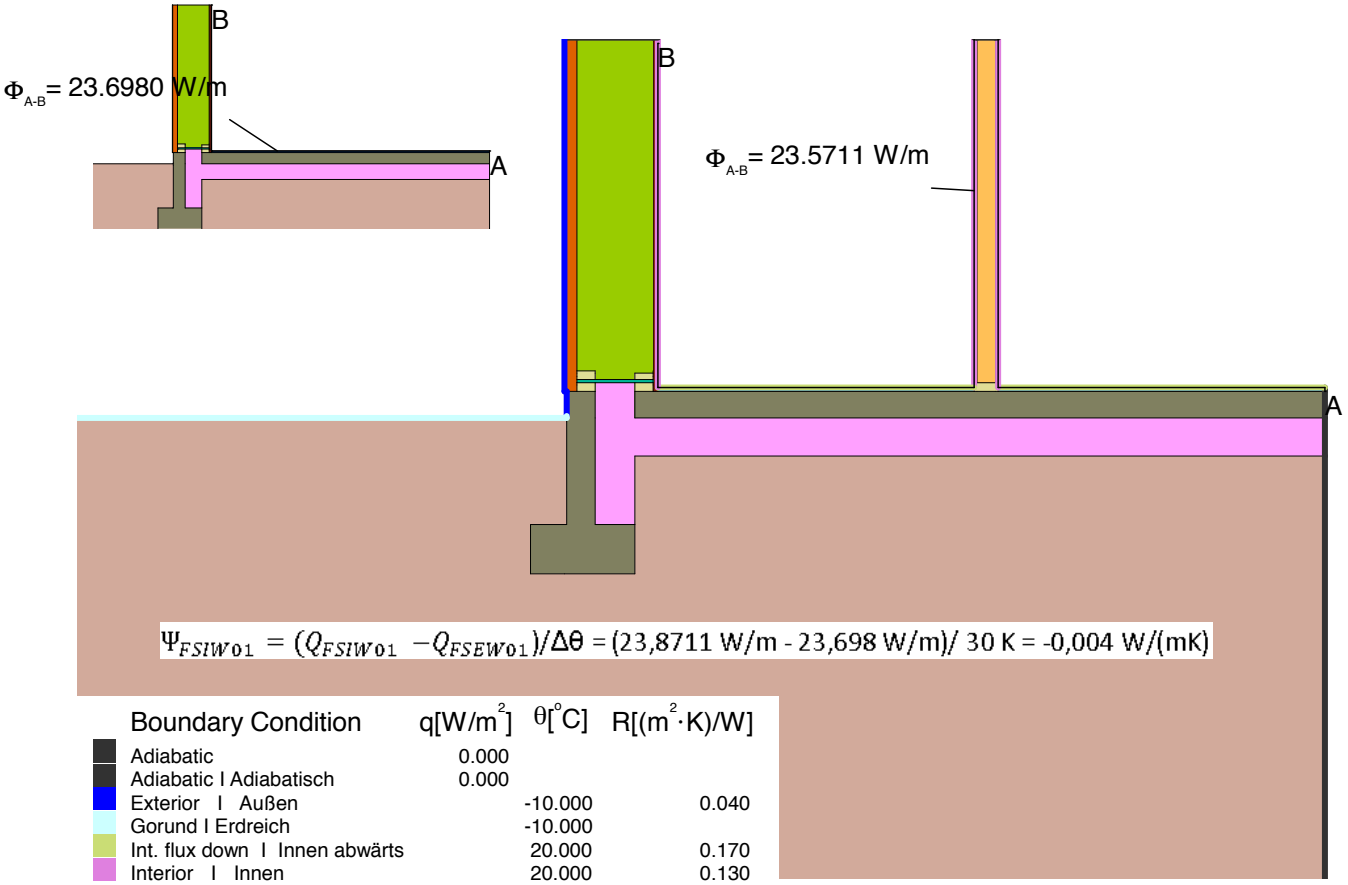
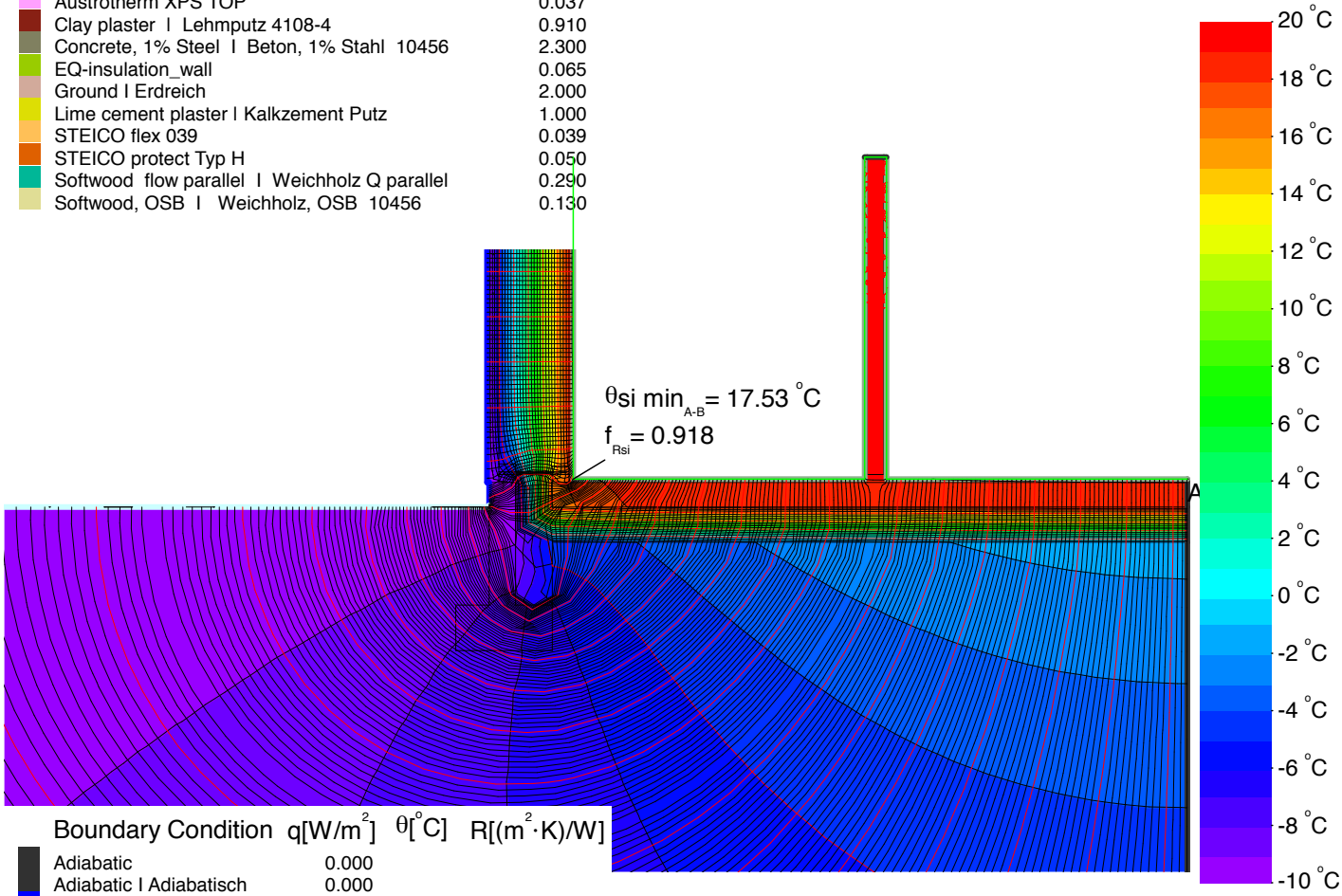


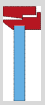
$\Psi_{FSIW01} = (Q_{FSIW01} - Q_{FSEW01})/\Delta\theta = (23{,}8711\ W/m - 23{,}698\ W/m)/\ 30\ K = -0{,}004\ W/(mK)$

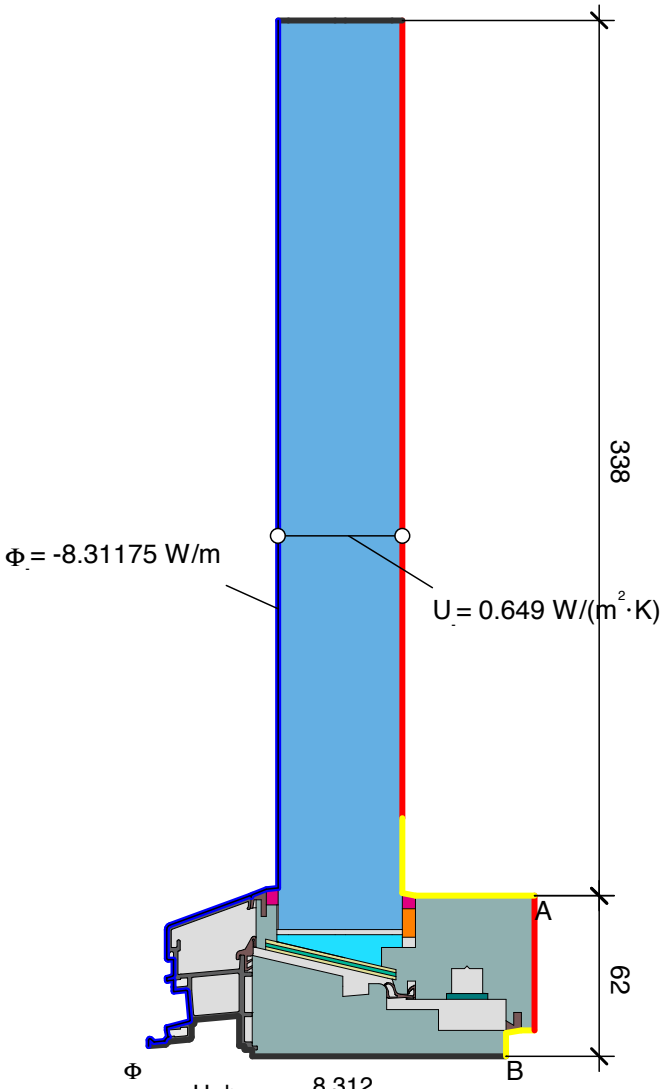
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Adiabatic I Adiabatisch	0.000		
Exterior I Außen		-10.000	0.040
Gorund I Erdreich		-10.000	
Int. flux down I Innen abwärts		20.000	0.170
Interior I Innen		20.000	0.130

Material	λ[W/(m·K)]
Artificial stone I Kunststein 10456	1.300
Austrotherm XPS TOP	0.037
Clay plaster I Lehmputz 4108-4	0.910
Concrete, 1% Steel I Beton, 1% Stahl 10456	2.300
EQ-insulation_wall	0.065
Ground I Erdreich	2.000
Lime cement plaster I Kalkzement Putz	1.000
STEICO flex 039	0.039
STEICO protect Typ H	0.050
Softwood flow parallel I Weichholz Q parallel	0.290
Softwood, OSB I Weichholz, OSB 10456	0.130



Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic	0.000		
Adiabatic I Adiabatisch	0.000		
Exterior I Außen		-10.000	0.040
Gorund I Erdreich		-10.000	
fRsi: Interior I Innen		20.000	0.250

	smartwin solar		01			02			03			01
frame values | Rahmenwerte			Bottom	Top	Side	Bottom	Top	Side	Bottom	Top	Side	Bottom barrier-free
			Unten	Oben	Seitl.	Unten	Oben	Seitl.	Unten	Oben	Seitl.	Unten barri-erefrei
	Spacer I Abstandhalter: Swisspacer Ultimate PU											
	Frame width Rahmenbreite	b_f [mm]	62	62	62	62	62	62	62	62	62	67
	U-value frame Rahmen-U-Wert	**Uf** [W/(m²K)]	0,93	0,83	0,83	0,93	0,83	0,83	0,93	0,83	0,83	1,03
	Ψ-glass edge Glasrand-Ψ-Wert	**Ψg** [W/(mK)]	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020	0,020
	U-value window Fenster-U-Wert	**Uw** [W/(m²K)] @U_g = 0,70 W/(m²K)	**0,781**			**0,781**			**0,781**			
	Passive House effiziency class Passivhaus Effizienzklasse		**phA**			**phA**			**phA**			
Installation | Einbau												
		$f_{Rsi=0,25m²k/W}$	0,838	0,838	0,838	0,806	0,827	0,827	0,814	0,845	0,845	0,745
		$\Psi_{install}$ [W/(mK)]	0,026	0,009	0,006	0,034	0,025	0,023	0,034	0,011	0,009	0,020
		$U_{W,\ installed}$ [W/(m²K)]	0,81			0,86			0,86			

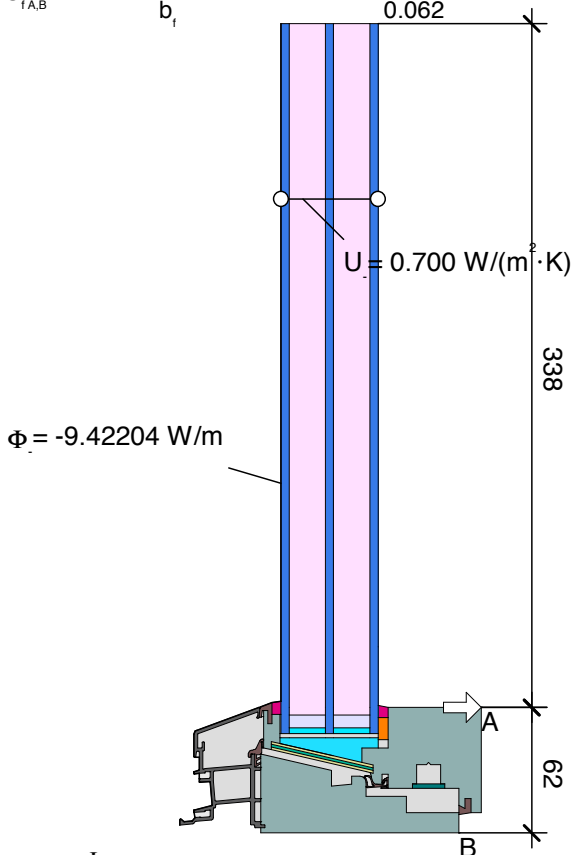


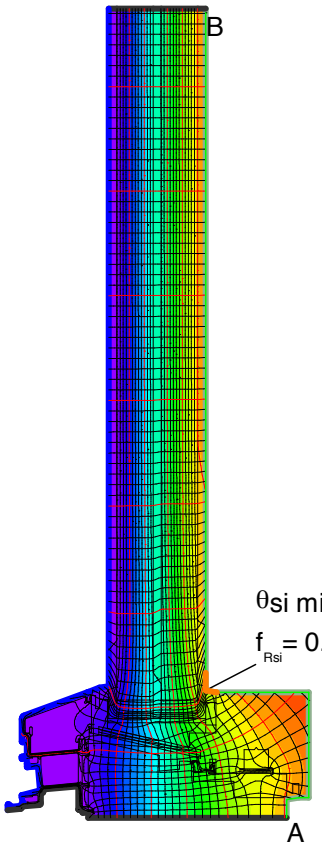
Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160.000	0.900
Ar18 in 48 mm U 0,7	0.029	
Argon 18 mm in 48 mm U 0,7	0.029	
EPDM	0.250	0.900
Glass I Glas	1.000	0.900
Insulation I Wärmedämmung 040	0.040	0.900
PU foam I PU-Schaum 027	0.027	0.900
PU-Seal I PU Dichtung	0.250	0.900
SWISSP. Ultimate Box 2	0.140	
Silicone I Silikon	0.350	0.900
Softwood flow parallel I Weichholz Q parallel	0.290	
Softwood, OSB I Weichholz, OSB 10456	0.130	0.900
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Unvent. cavity I unbel. Hohlr.		
slightly vent. cav. I leicht bel. Hohlr.		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	

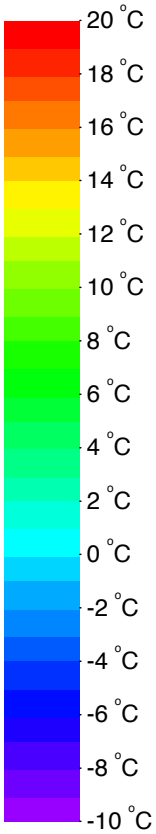
$$U_{f\,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{8.312}{30.000} - 0.649 \cdot 0.338}{0.062} = 0.932\ W/(m^2 \cdot K)$$



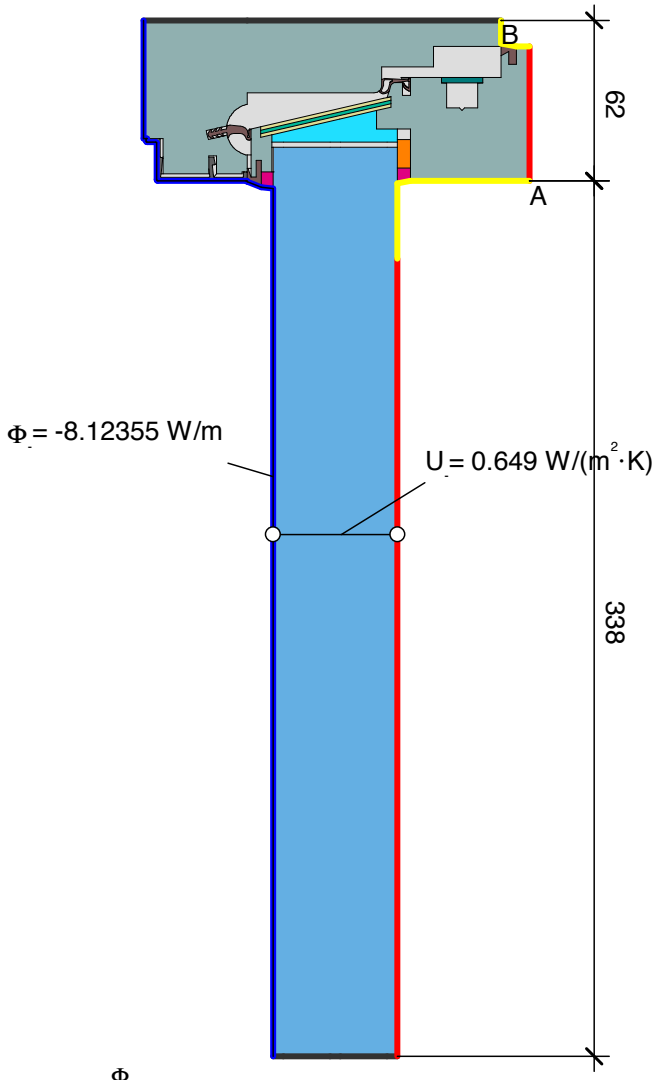


θsi min A-B = 11.78 °C

f Rsi = 0.726



$$\psi_A = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{9.422}{30.000} - 0.700 \cdot 0.338 - 0.932 \cdot 0.062 = 0.020\ W/(m \cdot K)$$

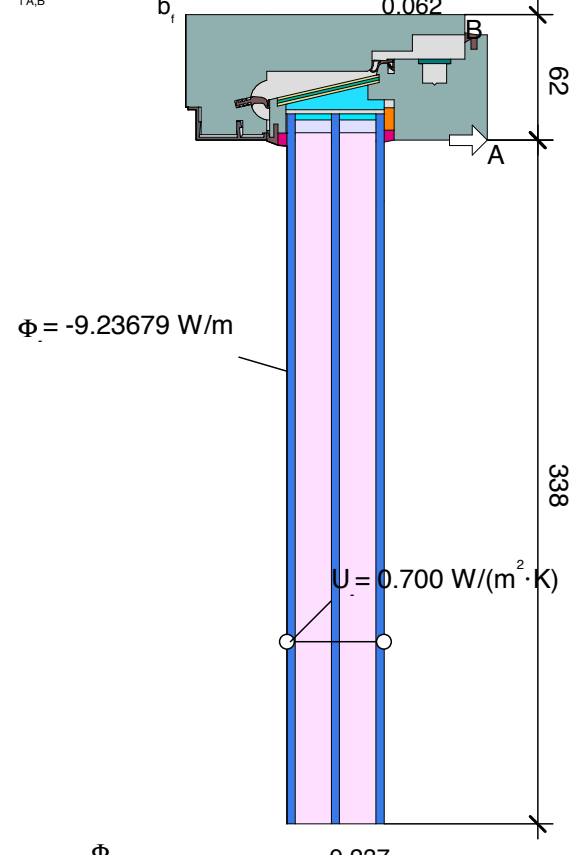


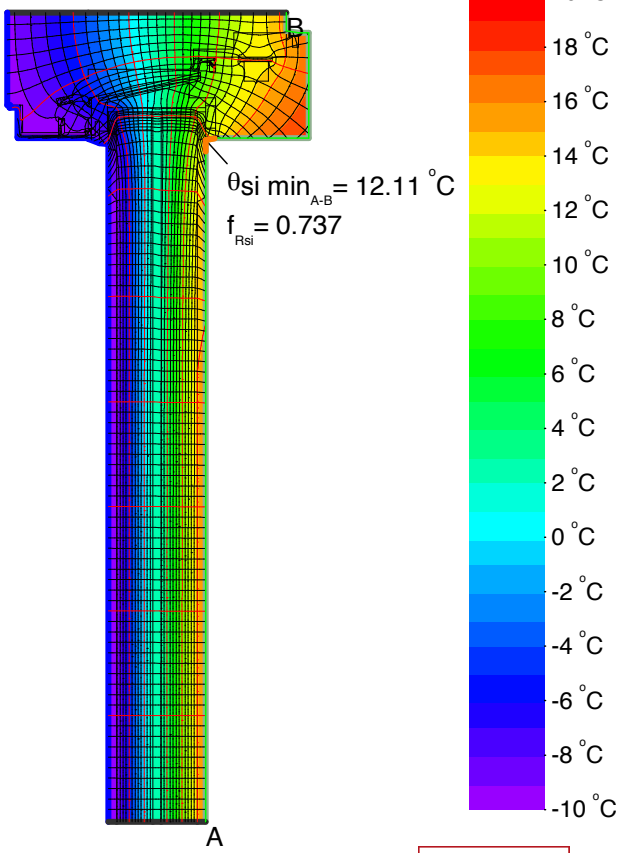
Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160.000	0.900
Argon 18 mm in 48 mm U 0,7	0.029	
EPDM	0.250	0.900
Glass I Glas	1.000	0.900
Insulation I Wärmedämmung 040	0.040	0.900
PU foam I PU-Schaum 027	0.027	0.900
PU-Seal I PU Dichtung	0.250	0.900
SWISSP. Ultimate Box 2	0.140	
Silicone I Silikon	0.350	0.900
Softwood flow parallel I Weichholz Q parallel	0.290	
Softwood, OSB I Weichholz, OSB 10456	0.130	0.900
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Unvent. cavity I unbel. Hohlr.		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	

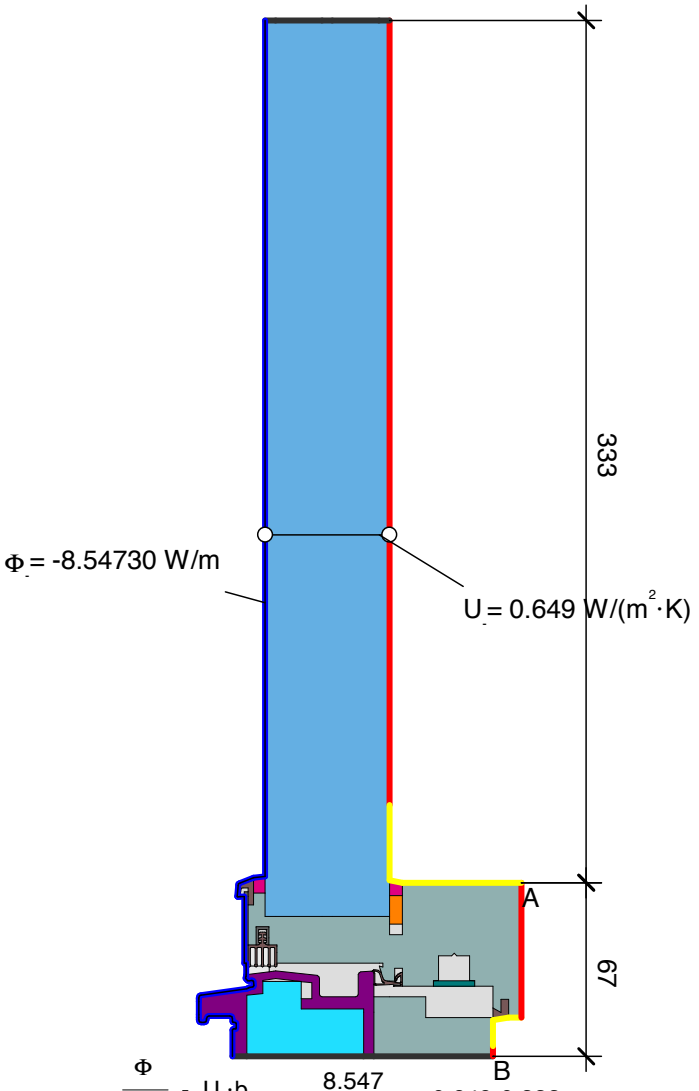
$$U_{f\,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{8.124}{30.000} - 0.649 \cdot 0.338}{0.062} = 0.831 \text{ W/(m}^2\text{·K)}$$





$$\psi_A = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{9.237}{30.000} - 0.700 \cdot 0.338 - 0.831 \cdot 0.062 = 0.020 \text{ W/(m·K)}$$

Passive House Institute

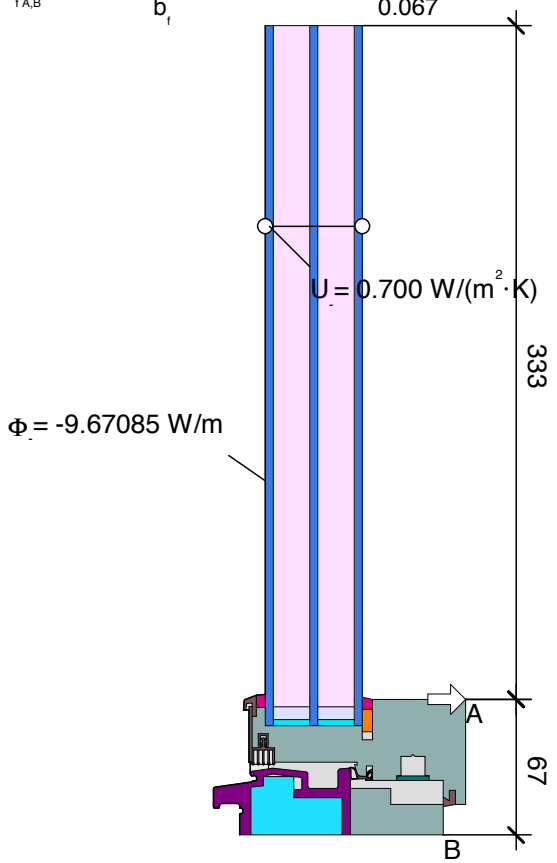


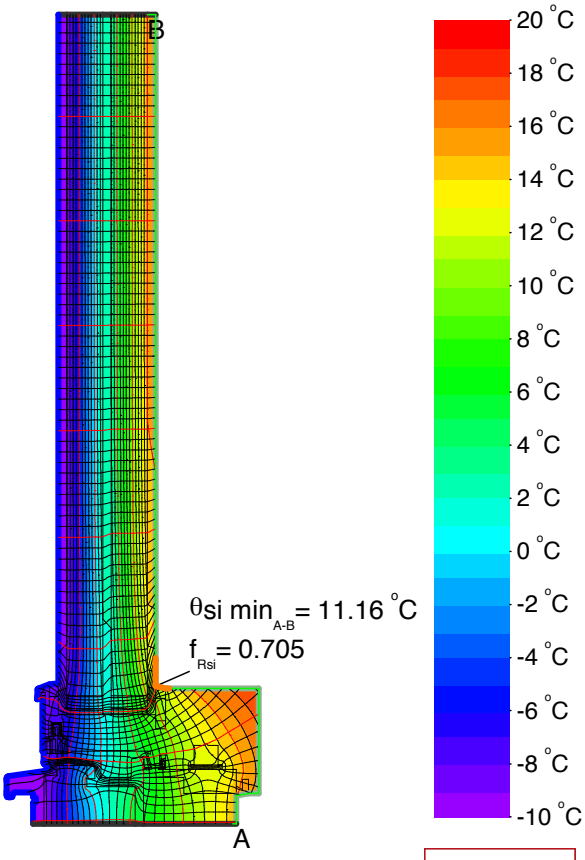
Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160.000	0.900
Argon 18 mm in 48 mm U 0,7	0.029	
EPDM	0.250	0.900
GRP, >50% I GFK >50%	0.630	0.900
Glass I Glas	1.000	
Insulation I Wärmedämmung 040	0.040	0.900
PU foam I PU-Schaum 027	0.027	0.900
PU-Seal I PU Dichtung	0.250	
SWISSP. Ultimate Box 2	0.140	
Silicone I Silikon	0.350	
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Unvent. cavity I unbel. Hohlr.		
slightly vent. cav. I leicht bel. Hohlr.		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	

$$U_{f\,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{8.547}{30.000} - 0.649 \cdot 0.333}{0.067} = 1.028\ W/(m^2 \cdot K)$$

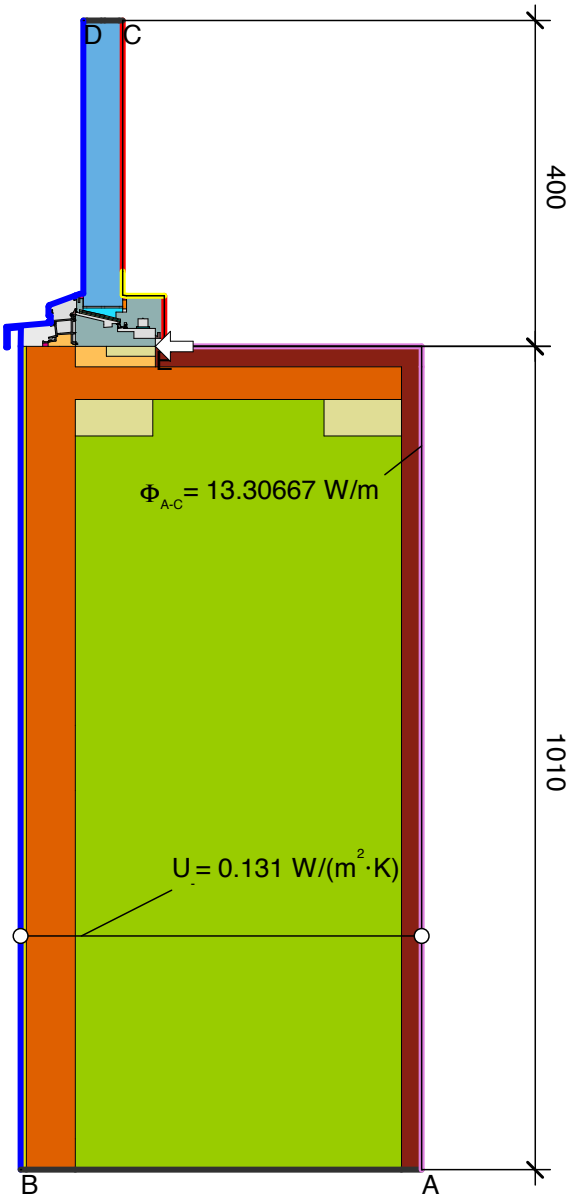


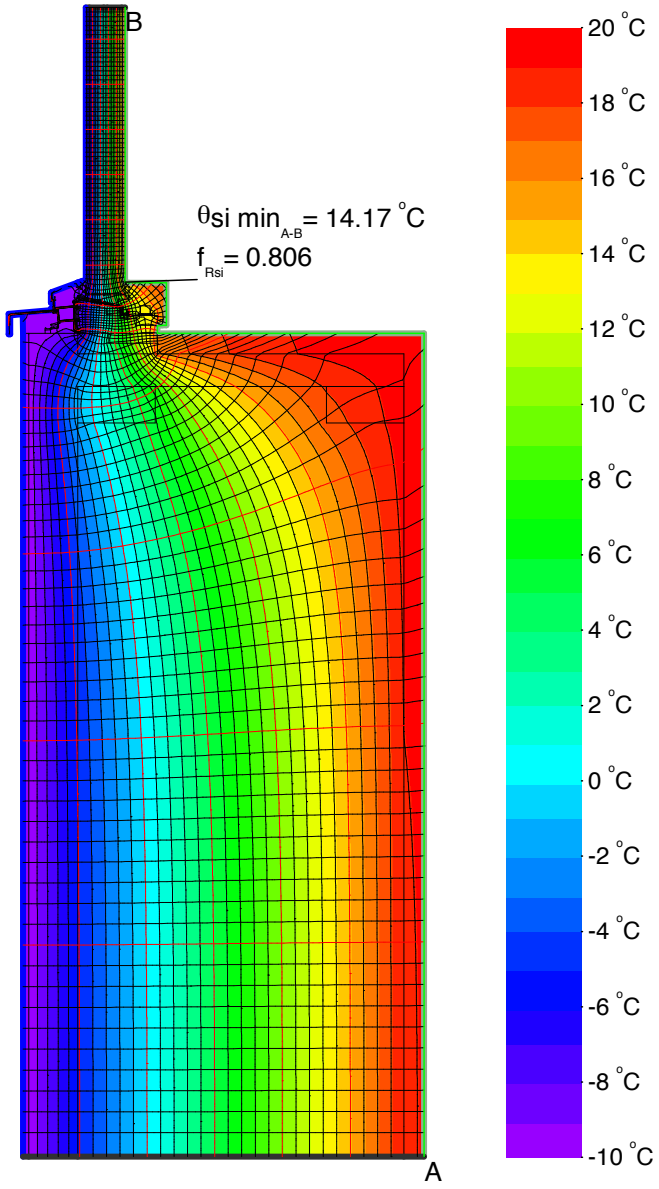


$$\psi_A = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{9.671}{30.000} - 0.700 \cdot 0.333 - 1.028 \cdot 0.067 = 0.020\ W/(m \cdot K)$$

Passiv: THRESHOLD I SCHWELLE

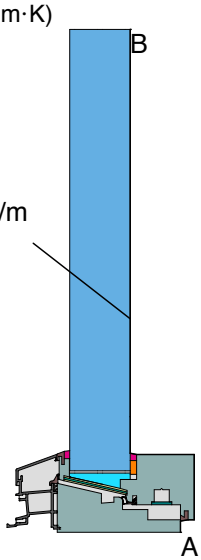
Passive House Institute





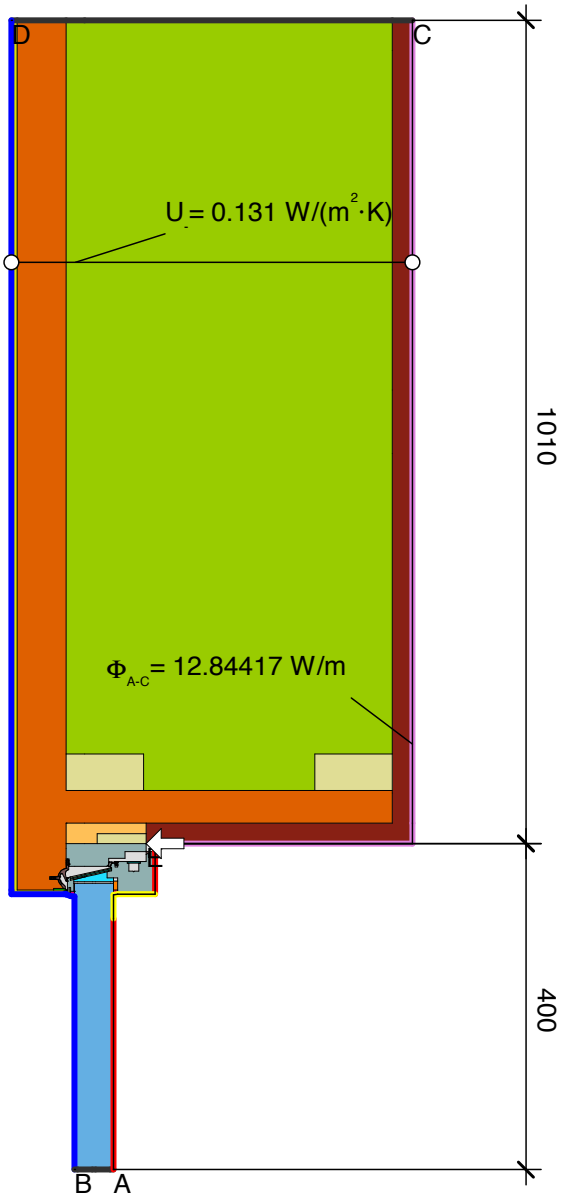
$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{13.307}{30.000} - 0.131 \cdot 1.010 - \frac{8.312}{30.000} = 0.034\ \text{W/(m·K)}$$

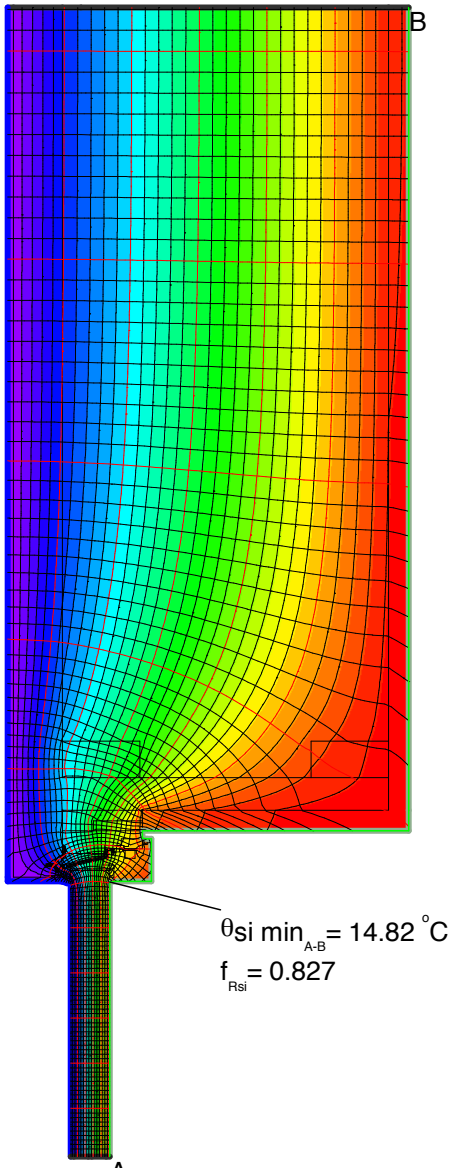
Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160.000	0.900
Clay plaster I Lehmputz 4108-4	0.910	0.900
EPDM	0.250	0.900
EQ-insulation_wall	0.065	
Insulation I Wärmedämmung 040	0.040	0.900
Lime cement plaster I Kalkzement Putz	1.000	0.900
PU foam I PU-Schaum 027	0.027	0.900
Panel I Maske	0.035	0.900
STEICO flex 039	0.039	
STEICO protect Typ H	0.050	0.900
Silicone I Silikon	0.350	0.900
Softwood flow parallel I Weichholz Q parallel	0.290	
Softwood, OSB I Weichholz, OSB 10456	0.130	0.900
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Unvent. cavity I unbel. Hohlr.		
slightly vent. cav. I leicht bel. Hohlr.		

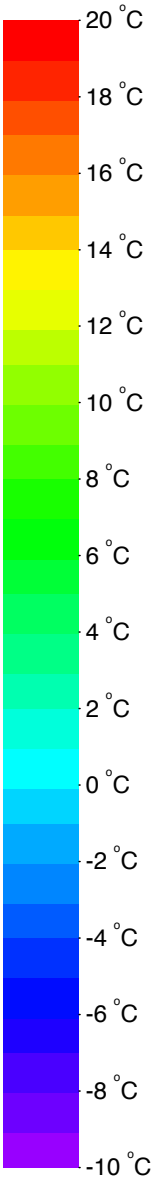


Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior I Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

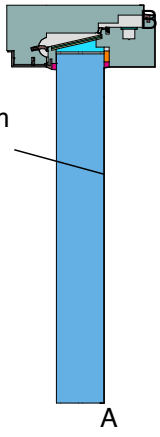
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	







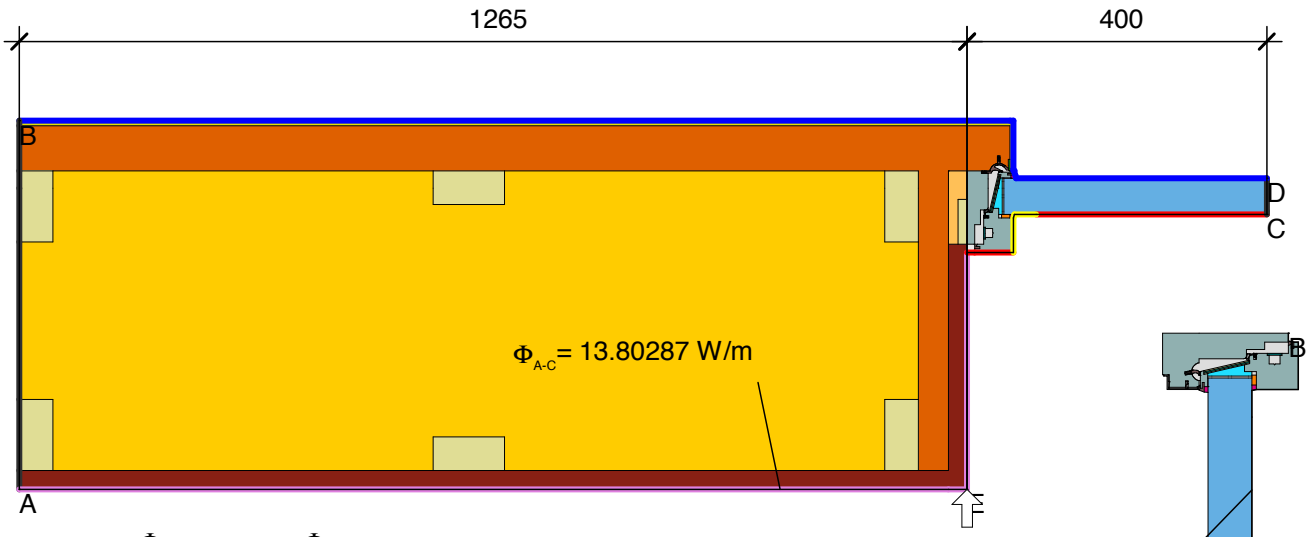
$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{12.844}{30.000} - \frac{8.124}{30.000} - 0.131 \cdot 1.010 = 0.025 \text{ W/(m·K)}$$



Material	λ[W/(m·K)]	ε
Clay plaster I Lehmputz 4108-4	0.910	0.900
EPDM	0.250	0.900
EQ-insulation_wall	0.065	
Insulation I Wärmedämmung 040	0.040	0.900
Lime cement plaster I Kalkzement Putz	1.000	
PU foam I PU-Schaum 027	0.027	0.900
Panel I Maske	0.035	0.900
Polyvinylchloride (PVC)	0.170	0.900
STEICO flex 039	0.039	
STEICO protect Typ H	0.050	0.900
Silicone I Silikon	0.350	0.900
Softwood flow parallel I Weichholz Q parallel	0.290	
Softwood, OSB I Weichholz, OSB 10456	0.130	0.900
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Unvent. cavity I unbel. Hohlr.		
slightly vent. cav. I leicht bel. Hohlr.		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior I Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	

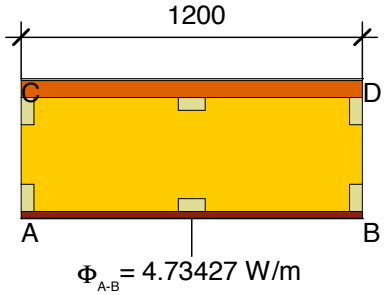


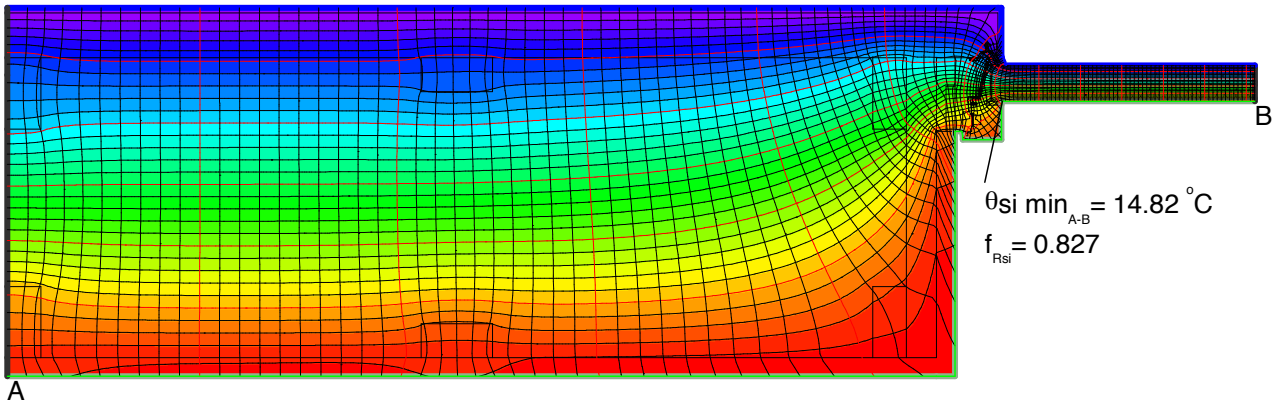
$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{13.803}{30.000} - 0.132 \cdot 1.265 - \frac{8.124}{30.000} = 0.023 \text{ W/(m·K)}$$

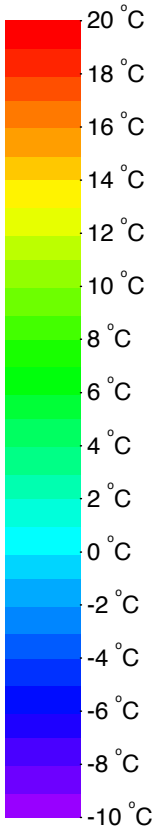
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior I Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

Material	λ[W/(m·K)]	ε
Clay plaster I Lehmputz 4108-4	0.910	0.900
EPDM	0.250	0.900
Insulation I Wärmedämmung 040	0.040	0.900
Lime cement plaster I Kalkzement Putz	1.000	
PU foam I PU-Schaum 027	0.027	0.900
Panel I Maske	0.035	0.900
Polyvinylchloride (PVC)	0.170	0.900
STEICO flex 039	0.039	
STEICO protect Typ H	0.050	0.900
Silicone I Silikon	0.350	0.900
Softwood flow parallel I Weichholz Q parallel	0.290	
Softwood, OSB I Weichholz, OSB 10456	0.130	0.900
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Straw compressed	0.062	
Unvent. cavity I unbel. Hohlr.		
slightly vent. cav. I leicht bel. Hohlr.		

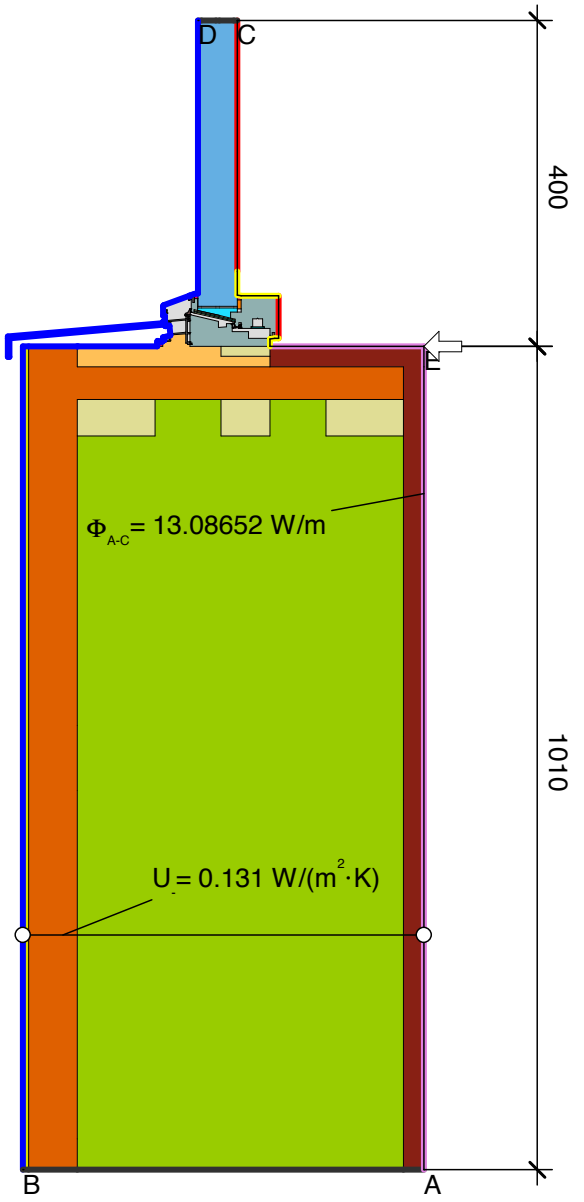
$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.734}{30.000 \cdot 1.200} = 0.132 \text{ W/(m²·K)}$$

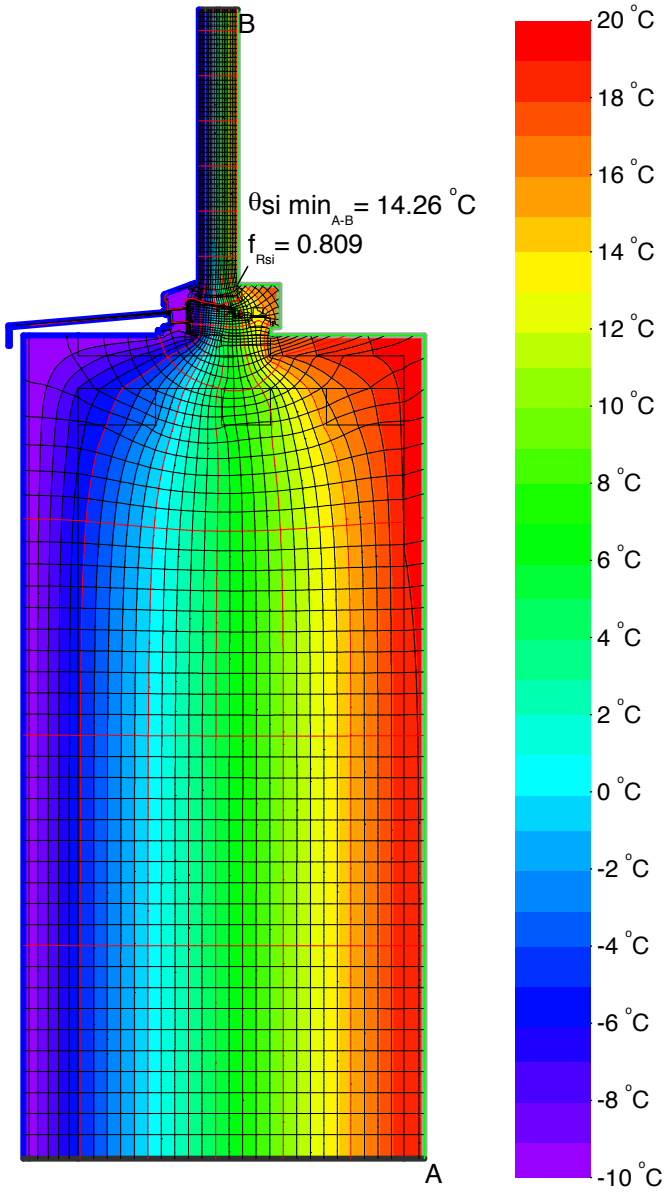






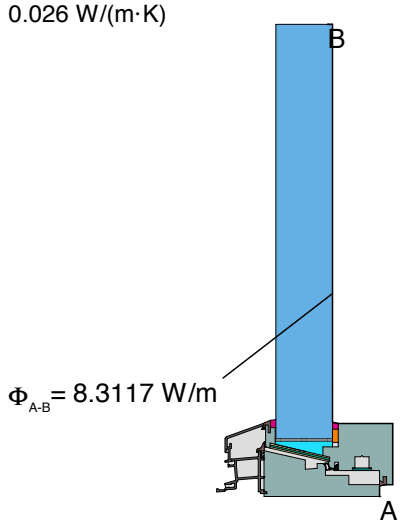
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	





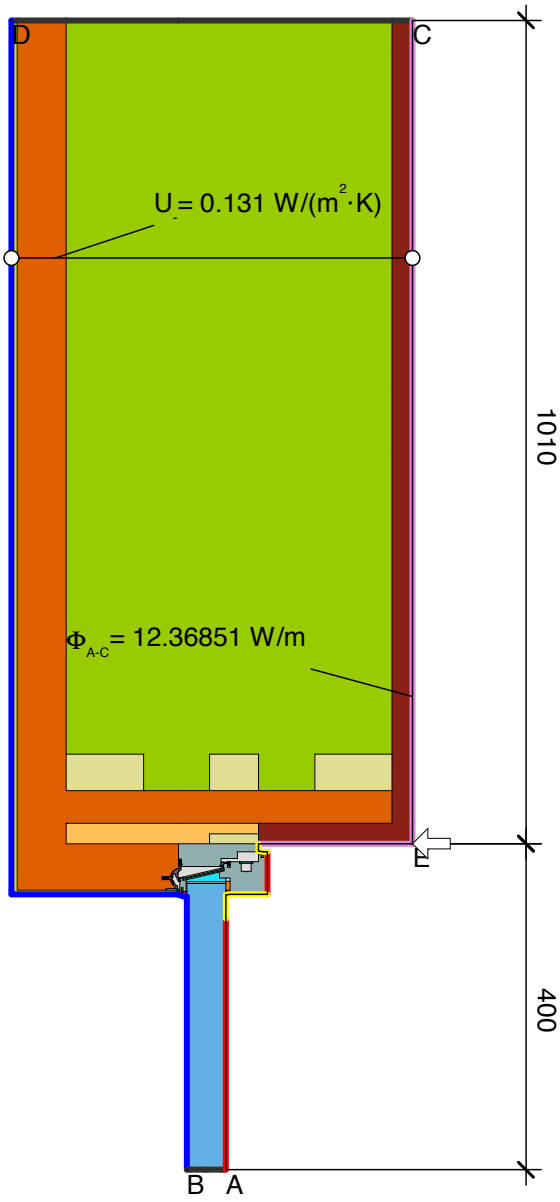
$$\psi_{A\text{-}E\text{-}C,\,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{13.087}{30.000} - 0.131 \cdot 1.010 - \frac{8.312}{30.000} = 0.026\ \text{W/(m·K)}$$

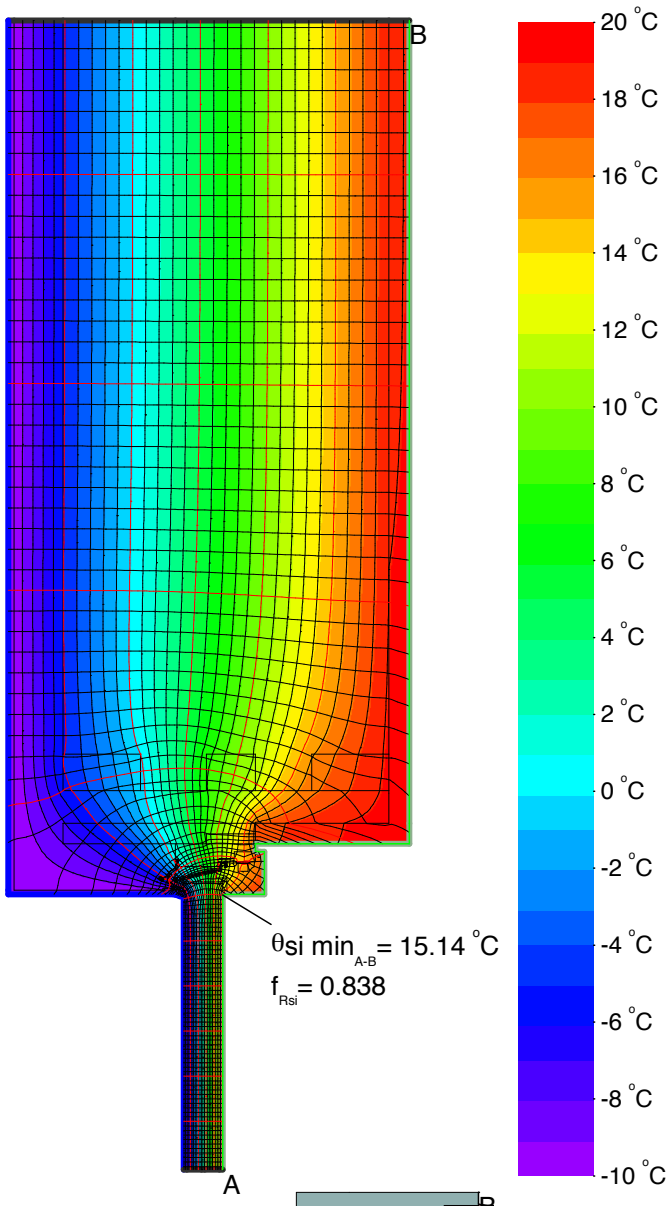
Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160.000	0.900
Clay plaster I Lehmputz 4108-4	0.910	
EPDM	0.250	0.900
EQ-insulation_wall	0.065	
Insulation I Wärmedämmung 040	0.040	0.900
Lime cement plaster I Kalkzement Putz	1.000	
PU foam I PU-Schaum 027	0.027	0.900
Panel I Maske	0.035	0.900
STEICO flex 039	0.039	
STEICO protect Typ H	0.050	
Silicone I Silikon	0.350	0.900
Softwood flow parallel I Weichholz Q parallel	0.290	
Softwood, OSB I Weichholz, OSB 10456	0.130	0.900
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Unvent. cavity I unbel. Hohlr.		
slightly vent. cav. I leicht bel. Hohlr.		



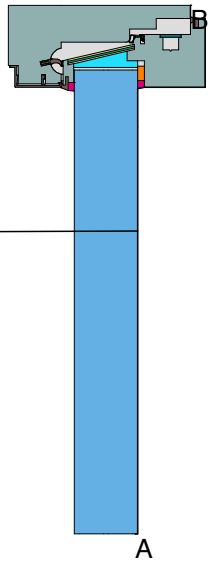
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior I Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	





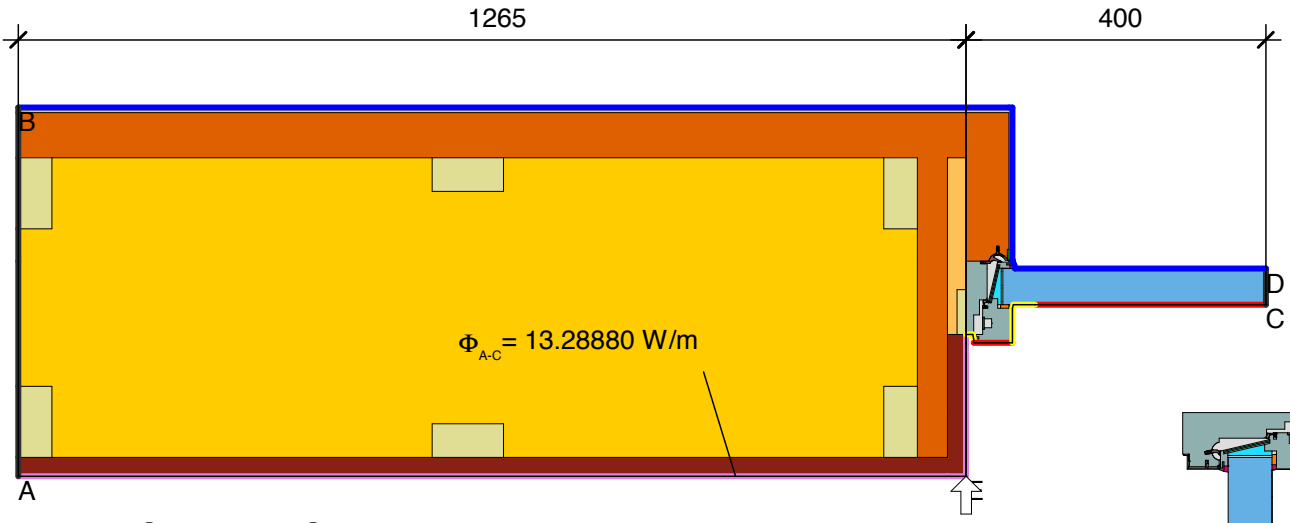
$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{12.369}{30.000} - \frac{8.124}{30.000} - 0.131 \cdot 1.010 = 0.009 \text{ W/(m·K)}$$



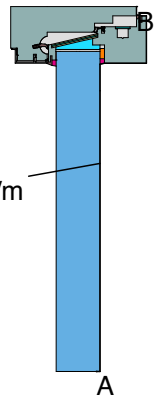
Material	λ[W/(m·K)]	ε
Clay plaster I Lehmputz 4108-4	0.910	
EPDM	0.250	0.900
EQ-insulation_wall	0.065	
Insulation I Wärmedämmung 040	0.040	0.900
Lime cement plaster I Kalkzement Putz	1.000	
PU foam I PU-Schaum 027	0.027	0.900
Panel I Maske	0.035	0.900
Polyvinylchloride (PVC)	0.170	0.900
STEICO flex 039	0.039	
STEICO protect Typ H	0.050	0.900
Silicone I Silikon	0.350	0.900
Softwood flow parallel I Weichholz Q parallel	0.290	
Softwood, OSB I Weichholz, OSB 10456	0.130	0.900
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Unvent. cavity I unbel. Hohlr.		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior I Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	



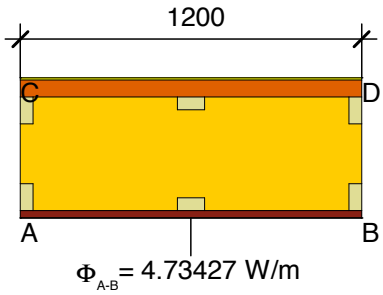
$$\psi_{A\text{-}E\text{-}C,\,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{13.289}{30.000} - 0.132 \cdot 1.265 - \frac{8.124}{30.000} = 0.006\ \text{W/(m·K)}$$

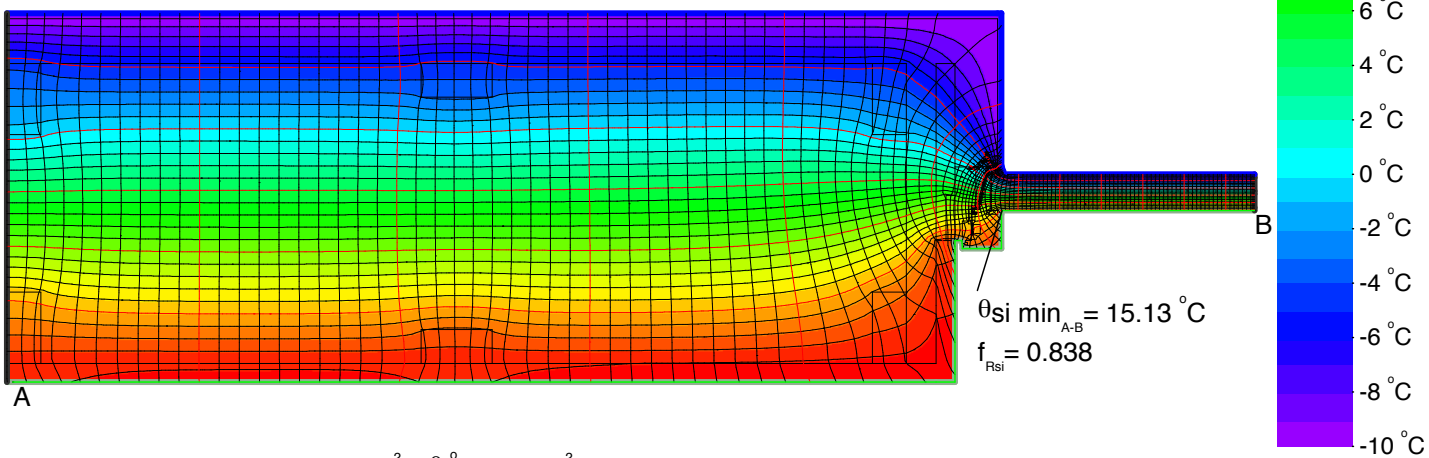


Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior I Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

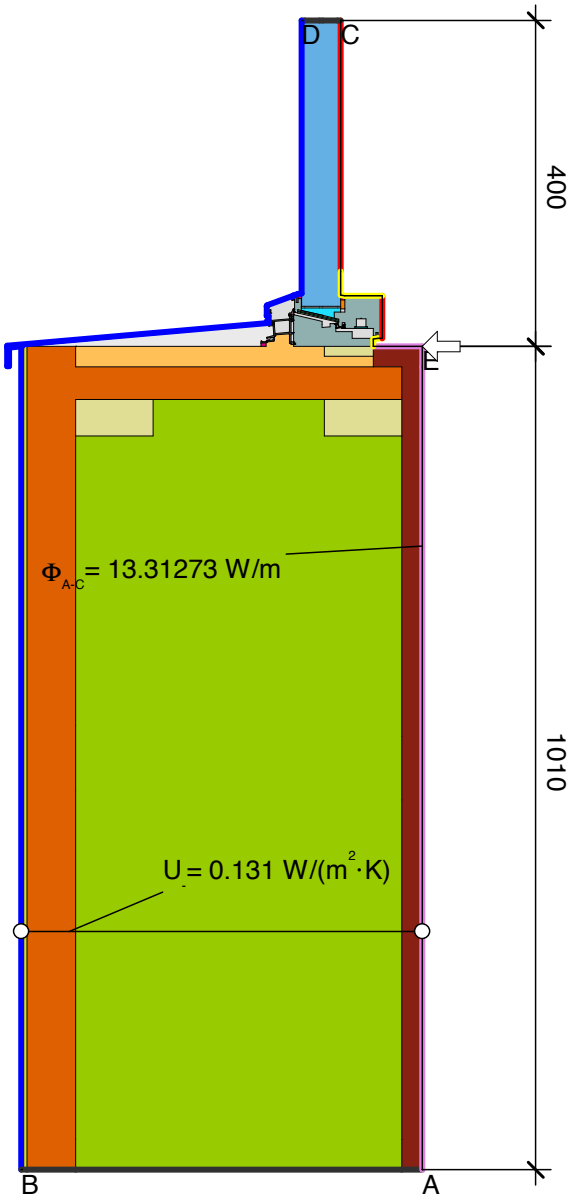
Material	λ[W/(m·K)]	ε
Clay plaster I Lehmputz 4108-4	0.910	
EPDM	0.250	0.900
Insulation I Wärmedämmung 040	0.040	0.900
Lime cement plaster I Kalkzement Putz	1.000	
PU foam I PU-Schaum 027	0.027	0.900
Panel I Maske	0.035	0.900
Polyvinylchloride (PVC)	0.170	0.900
STEICO flex 039	0.039	
STEICO protect Typ H	0.050	0.900
Silicone I Silikon	0.350	0.900
Softwood flow parallel I Weichholz Q parallel	0.290	
Softwood, OSB I Weichholz, OSB 10456	0.130	0.900
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Straw compressed	0.062	
Unvent. cavity I unbel. Hohlr.		

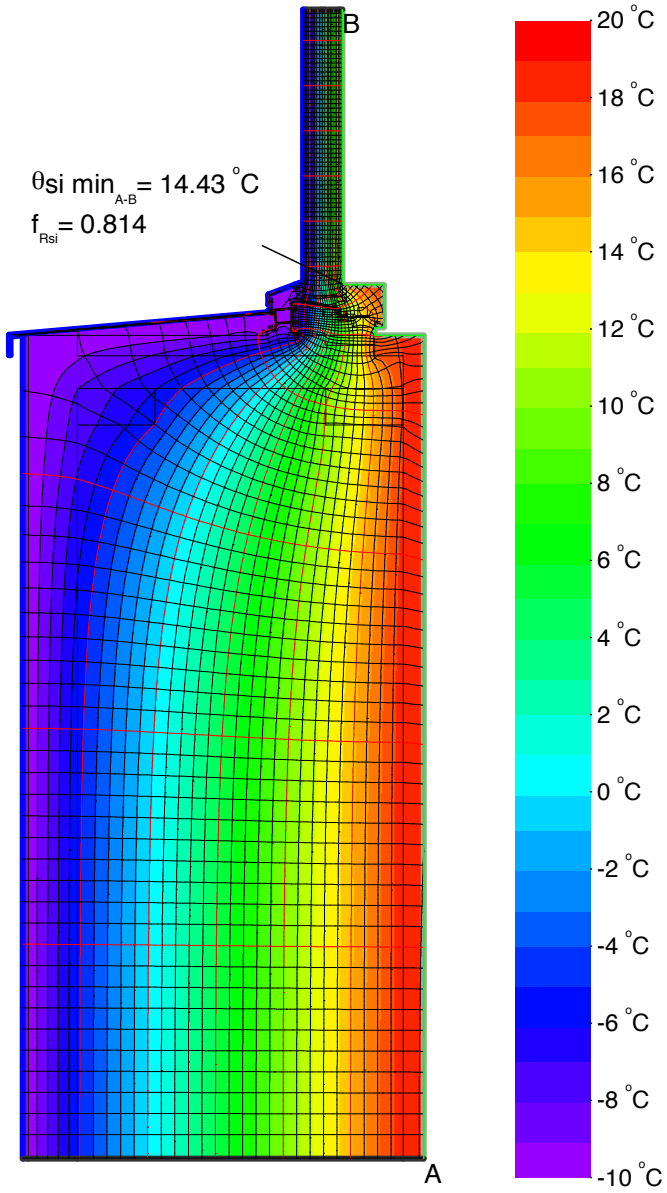
$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.734}{30.000 \cdot 1.200} = 0.132\ \text{W/(m²·K)}$$





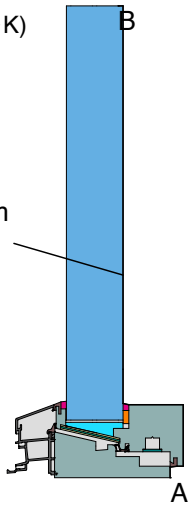
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	





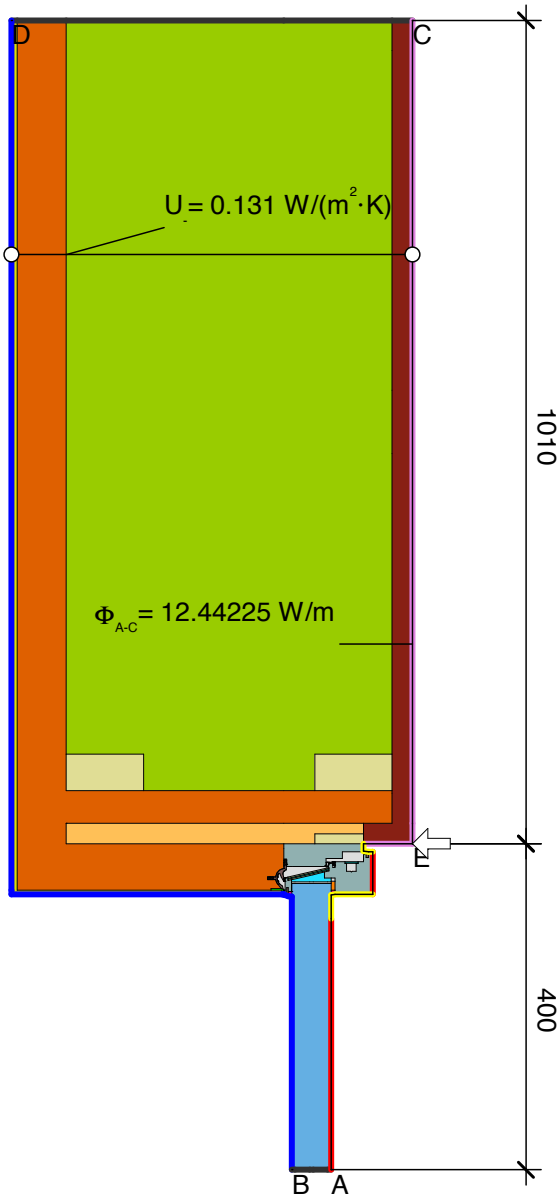
$$\psi_{A\text{-}E\text{-}C,\,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{13.313}{30.000} - 0.131 \cdot 1.010 - \frac{8.312}{30.000} = 0.034\ \text{W/(m·K)}$$

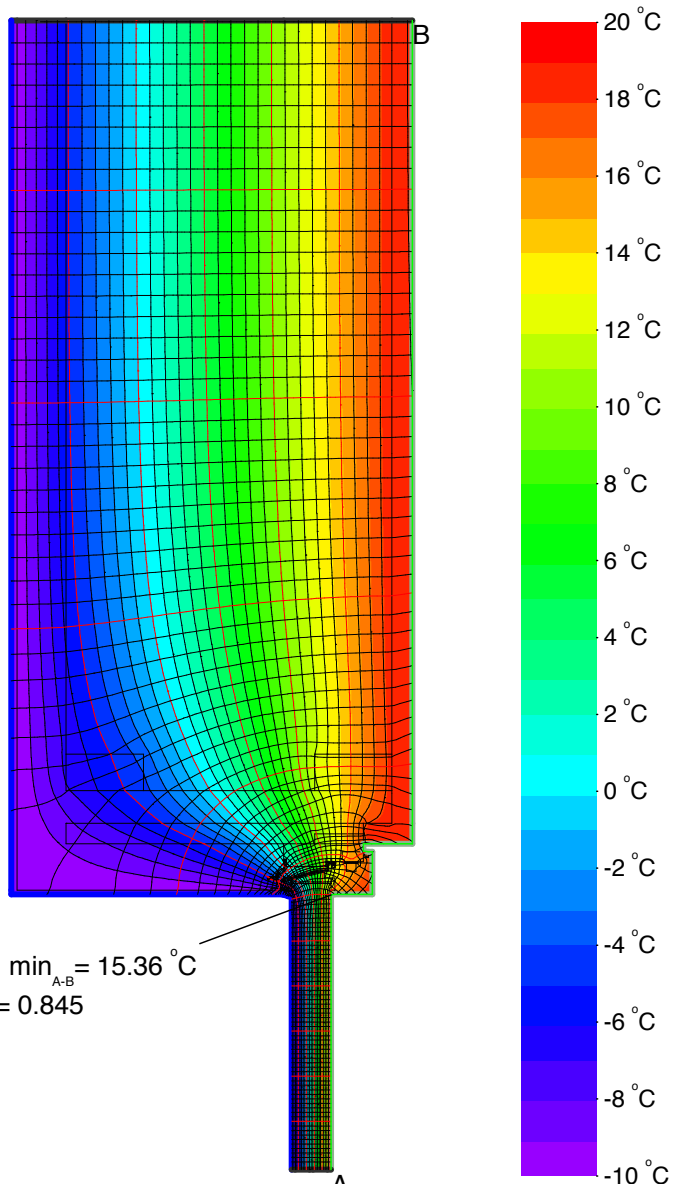
Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160.000	0.900
Clay plaster I Lehmputz 4108-4	0.910	
EPDM	0.250	0.900
EQ-insulation_wall	0.065	
Insulation I Wärmedämmung 040	0.040	0.900
Lime cement plaster I Kalkzement Putz	1.000	0.900
PU foam I PU-Schaum 027	0.027	0.900
Panel I Maske	0.035	0.900
STEICO flex 039	0.039	0.900
STEICO protect Typ H	0.050	0.900
Silicone I Silikon	0.350	0.900
Softwood flow parallel I Weichholz Q parallel	0.290	
Softwood, OSB I Weichholz, OSB 10456	0.130	0.900
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Unvent. cavity I unbel. Hohlr.		
slightly vent. cav. I leicht bel. Hohlr.		



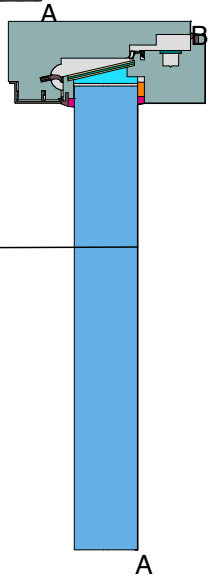
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior I Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	





$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{12.442}{30.000} - \frac{8.124}{30.000} - 0.131 \cdot 1.010 = 0.011 \text{ W/(m·K)}$$



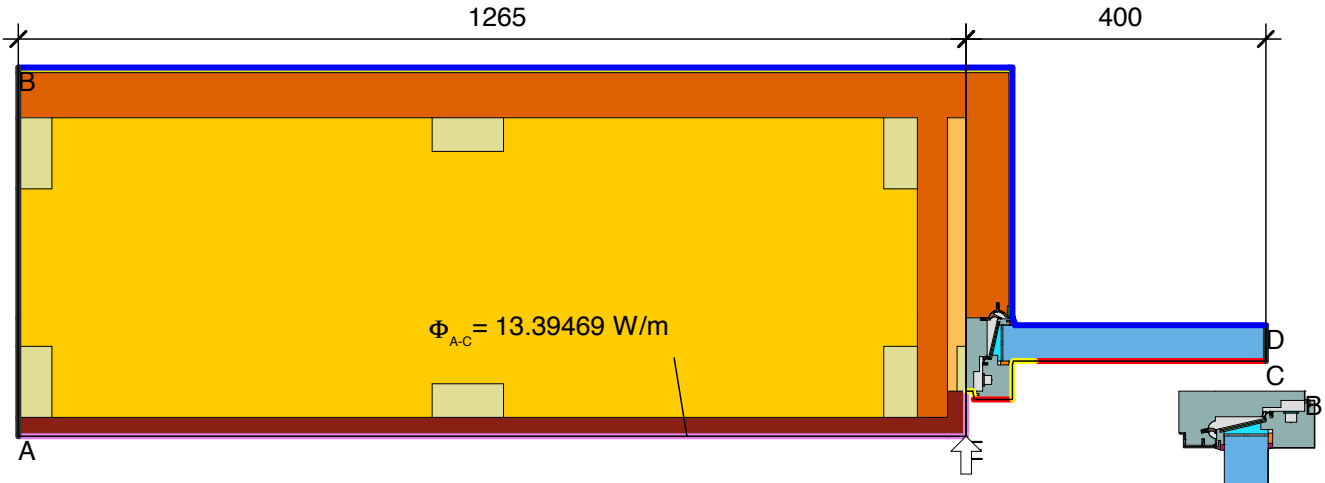
Φ A-B = 8.1236 W/m

Material	λ[W/(m·K)]	ε
Clay plaster I Lehmputz 4108-4	0.910	
EPDM	0.250	0.900
EQ-insulation_wall	0.065	
Insulation I Wärmedämmung 040	0.040	0.900
Lime cement plaster I Kalkzement Putz	1.000	
PU foam I PU-Schaum 027	0.027	0.900
Panel I Maske	0.035	0.900
Polyvinylchloride (PVC)	0.170	0.900
STEICO flex 039	0.039	
STEICO protect Typ H	0.050	0.900
Silicone I Silikon	0.350	0.900
Softwood flow parallel I Weichholz Q parallel	0.290	
Softwood, OSB I Weichholz, OSB 10456	0.130	0.900
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Unvent. cavity I unbel. Hohlr.		

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior I Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

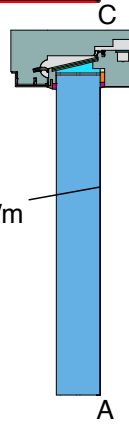
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	

Passive House Institute



$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{13.395}{30.000} - 0.132 \cdot 1.265 - \frac{8.124}{30.000} = 0.009 \text{ W/(m·K)}$$

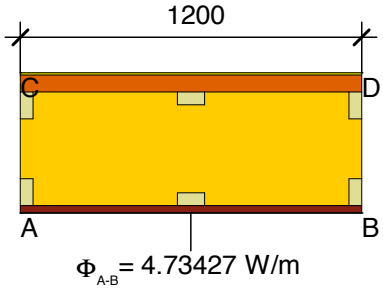
Φ_{A-B}= 8.1236 W/m

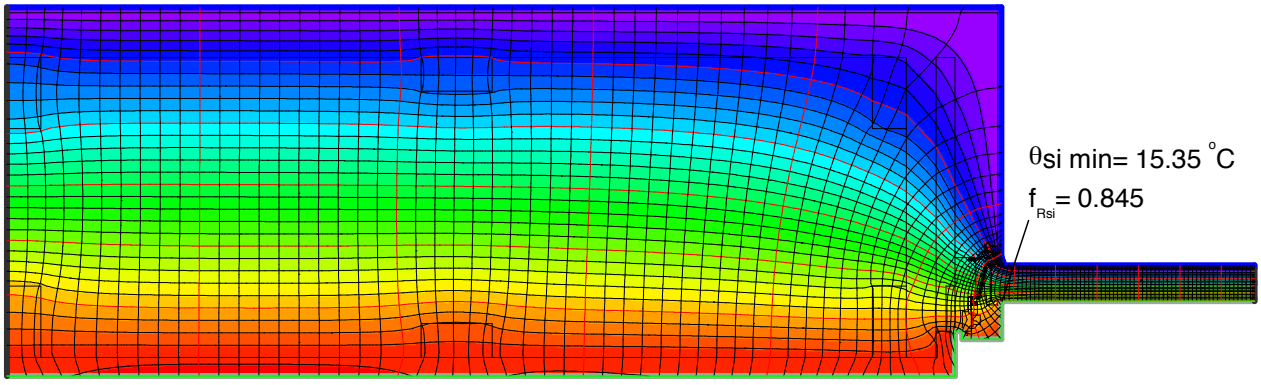


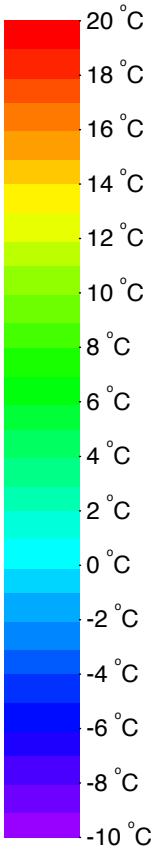
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
Interior I Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity I Hohlraum				0.900

Material	λ[W/(m·K)]	ε
Clay plaster I Lehmputz 4108-4	0.910	
EPDM	0.250	0.900
Insulation I Wärmedämmung 040	0.040	0.900
Lime cement plaster I Kalkzement Putz	1.000	
PU foam I PU-Schaum 027	0.027	0.900
Panel I Maske	0.035	0.900
Polyvinylchloride (PVC)	0.170	0.900
STEICO flex 039	0.039	
STEICO protect Typ H	0.050	0.900
Silicone I Silikon	0.350	0.900
Softwood flow parallel I Weichholz Q parallel	0.290	
Softwood, OSB I Weichholz, OSB 10456	0.130	0.900
Spruce, Fir I Fichte, Tanne	0.110	0.900
Steel I Stahl	50.000	0.900
Straw compressed	0.062	
Unvent. cavity I unbel. Hohlr.		

$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.734}{30.000 \cdot 1.200} = 0.132 \text{ W/(m²·K)}$$







Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Exterior I Außen		-10.000	0.040	
e 0,9 Cavity I Hohlraum				0.900
fRsi: Interior I Innen		20.000	0.250	

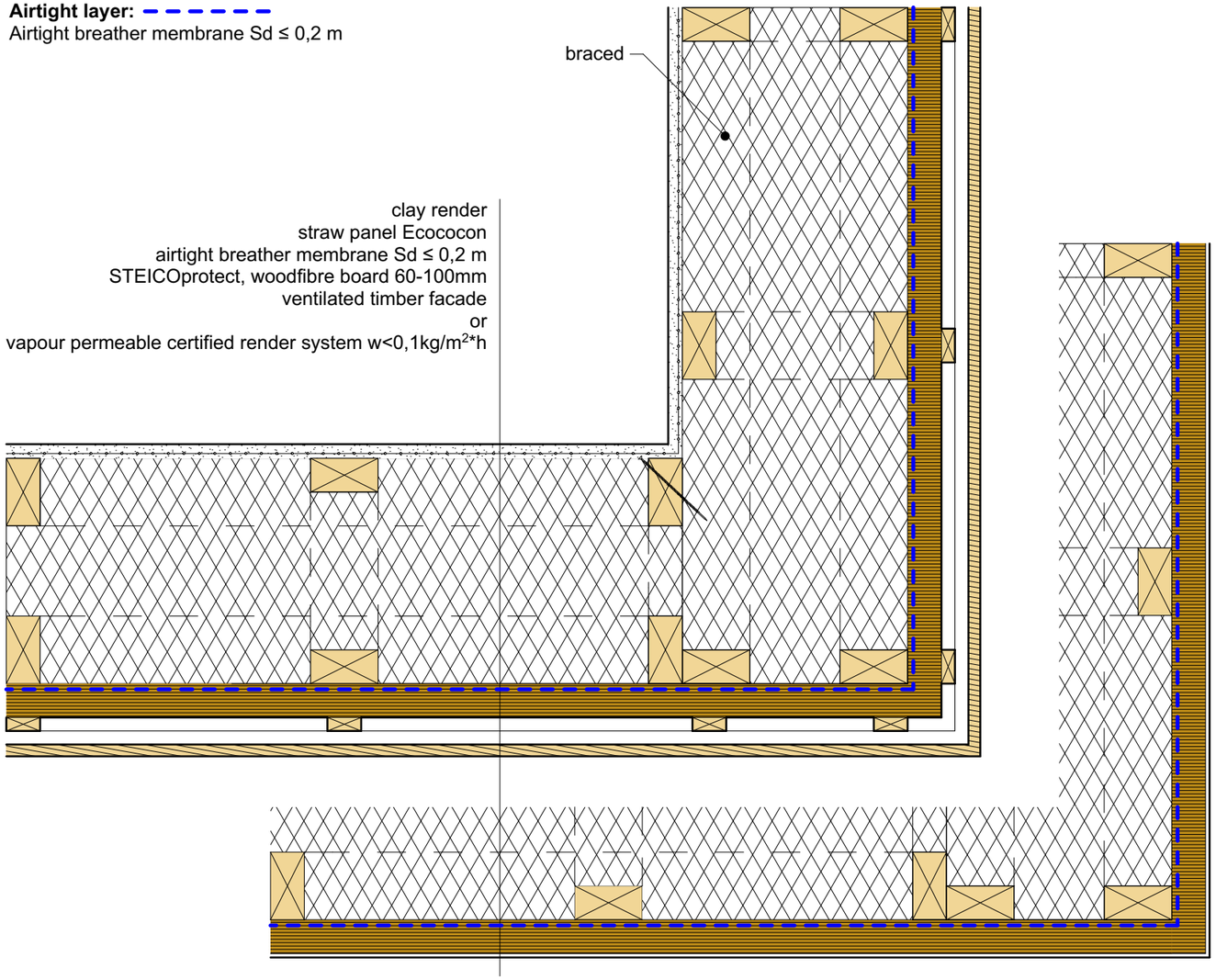
Appendix 3

Certified Passivhaus DETAILS

CERTIFIED COMPONENT
Passive House Institute

ECO COCON
Nurtured by nature

Airtight layer:
Airtight breather membrane Sd ≤ 0,2 m



0,050 W/(mK) - Steico Protect Typ H 60mm

0,0645 W/(mK) - Straw/Wood Ecococon Panel

0,039 W/(mK) - Steico Flex

PH CERTIFICATION

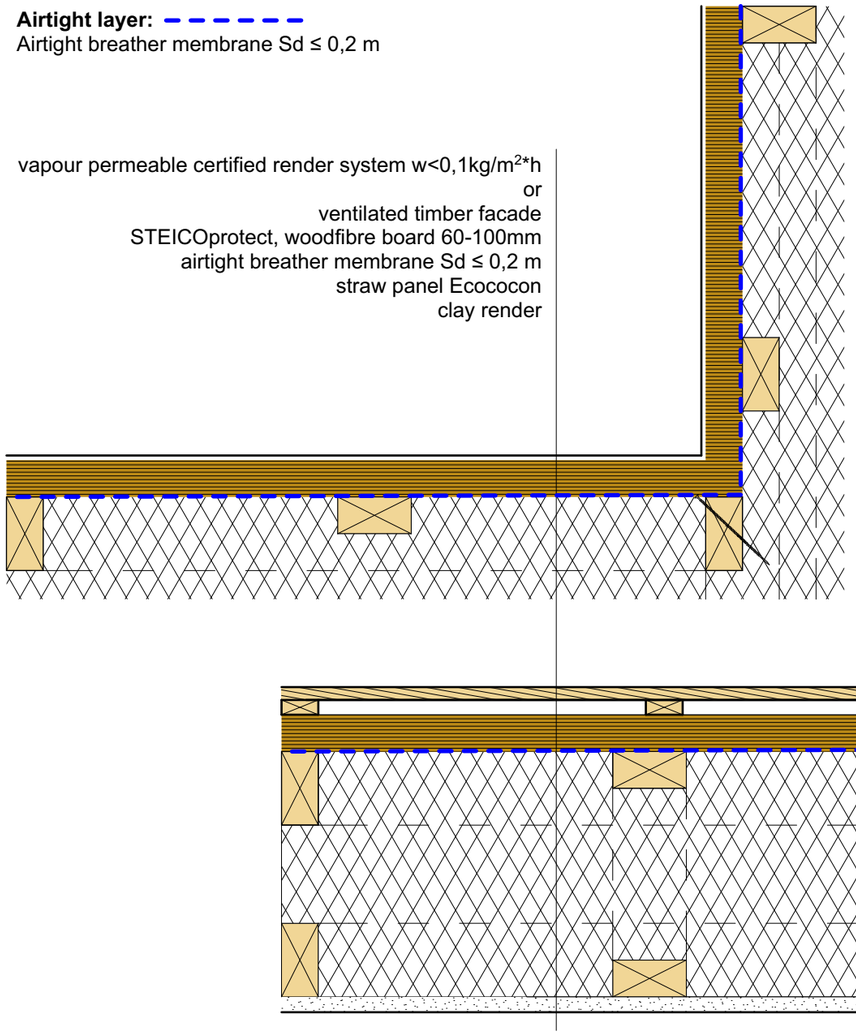
EWEC 01

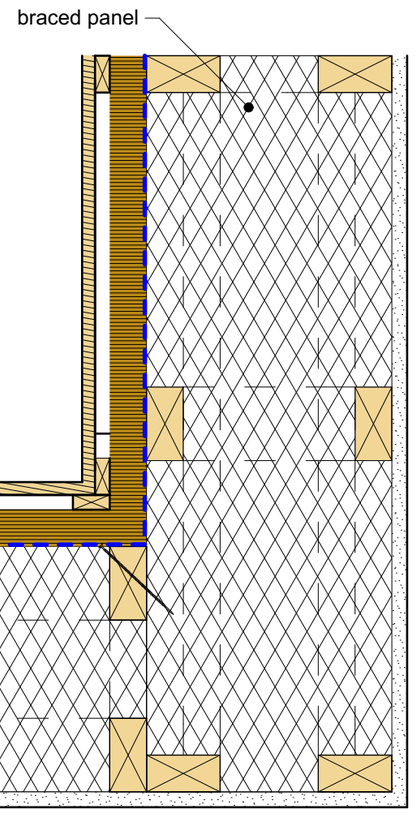
Wall External Corner, Wand Aussenecke

ECO COCON
Nurtured by nature

Airtight layer:
Airtight breather membrane Sd ≤ 0,2 m

vapour permeable certified render system w<0,1kg/m²*h
or
ventilated timber facade
STEICOprotect, woodfibre board 60-100mm
airtight breather membrane Sd ≤ 0,2 m
straw panel Ecococon
clay render





0,050 W/(mK) - Steico Protect Typ H 60mm

0,0645 W/(mK) - Straw/Wood Ecococon Panel

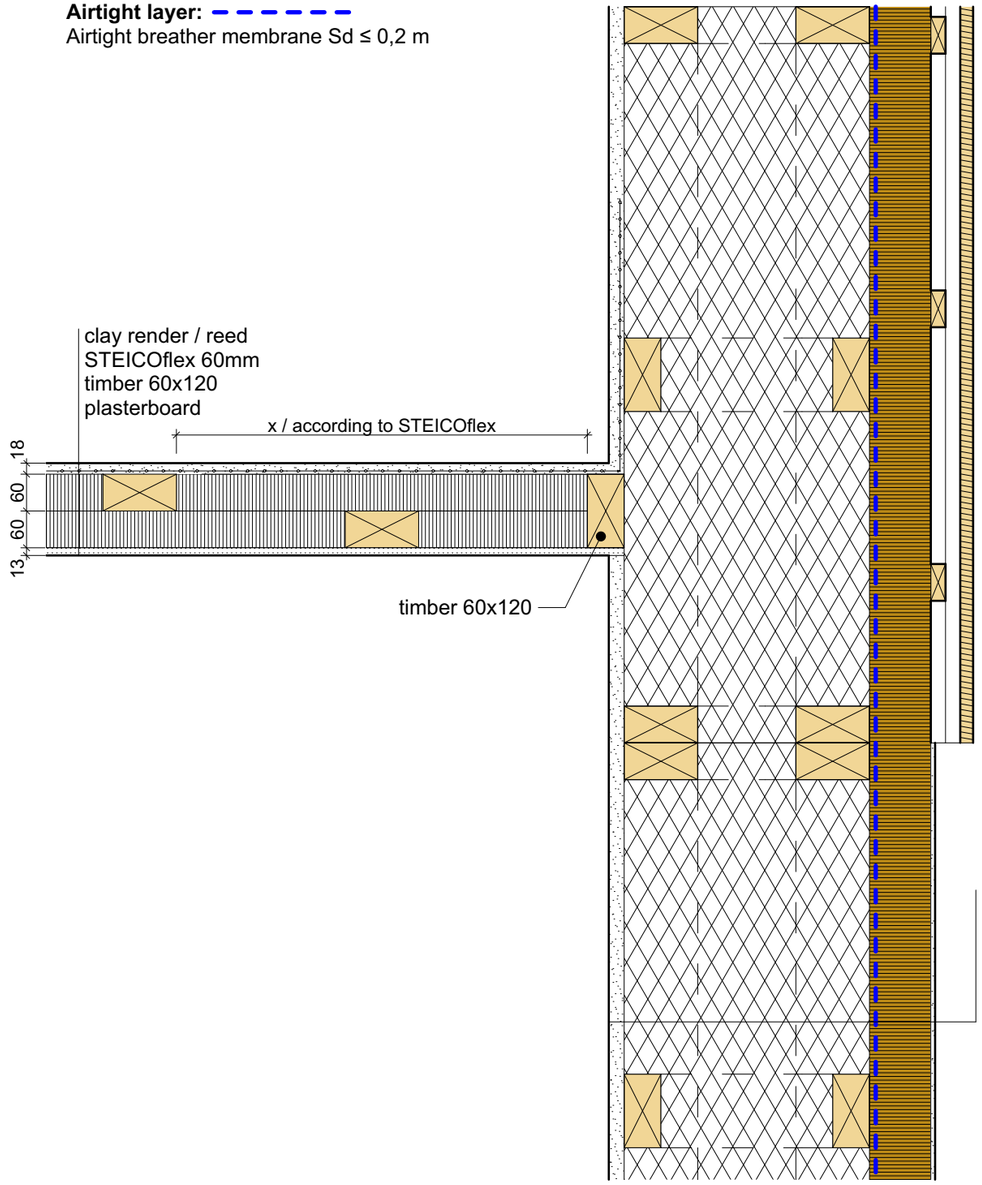
0,039 W/(mK) - Steico Flex

PH CERTIFICATION

EWIC 01

External Wall Internal Corner, Wand Innenecke

ECO COCON
Nurtured by nature



0,050 W/(mK) - Steico Protect Typ H 60mm

0,0645 W/(mK) - Straw/Wood Ecococon Panel

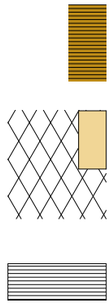
0,039 W/(mK) - Steico Flex

PH CERTIFICATION

EWIW 01

Junction Internal wall - External wall, Innenwandeinbindung

ECO COCON
Nurtured by nature

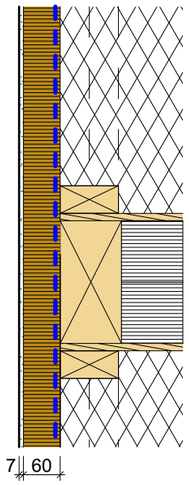


0,050 W/(mK) - Steico Protect Typ H 60mm

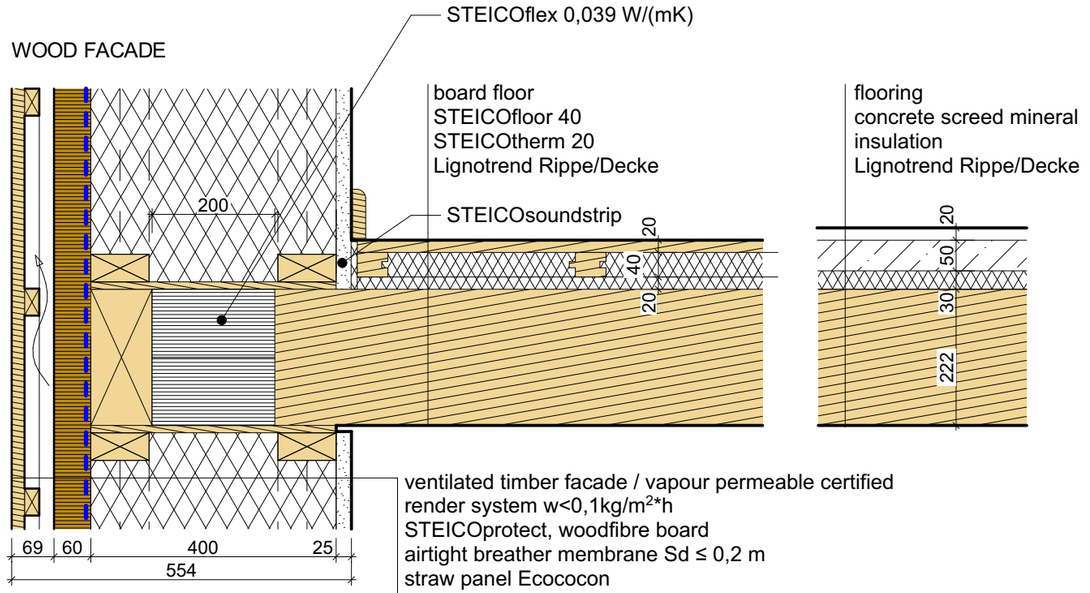
0,0645 W/(mK) - Straw/Wood Ecococon Panel

0,039 W/(mK) - Steico Flex

RENDER



WOOD FACADE



PH CERTIFICATION

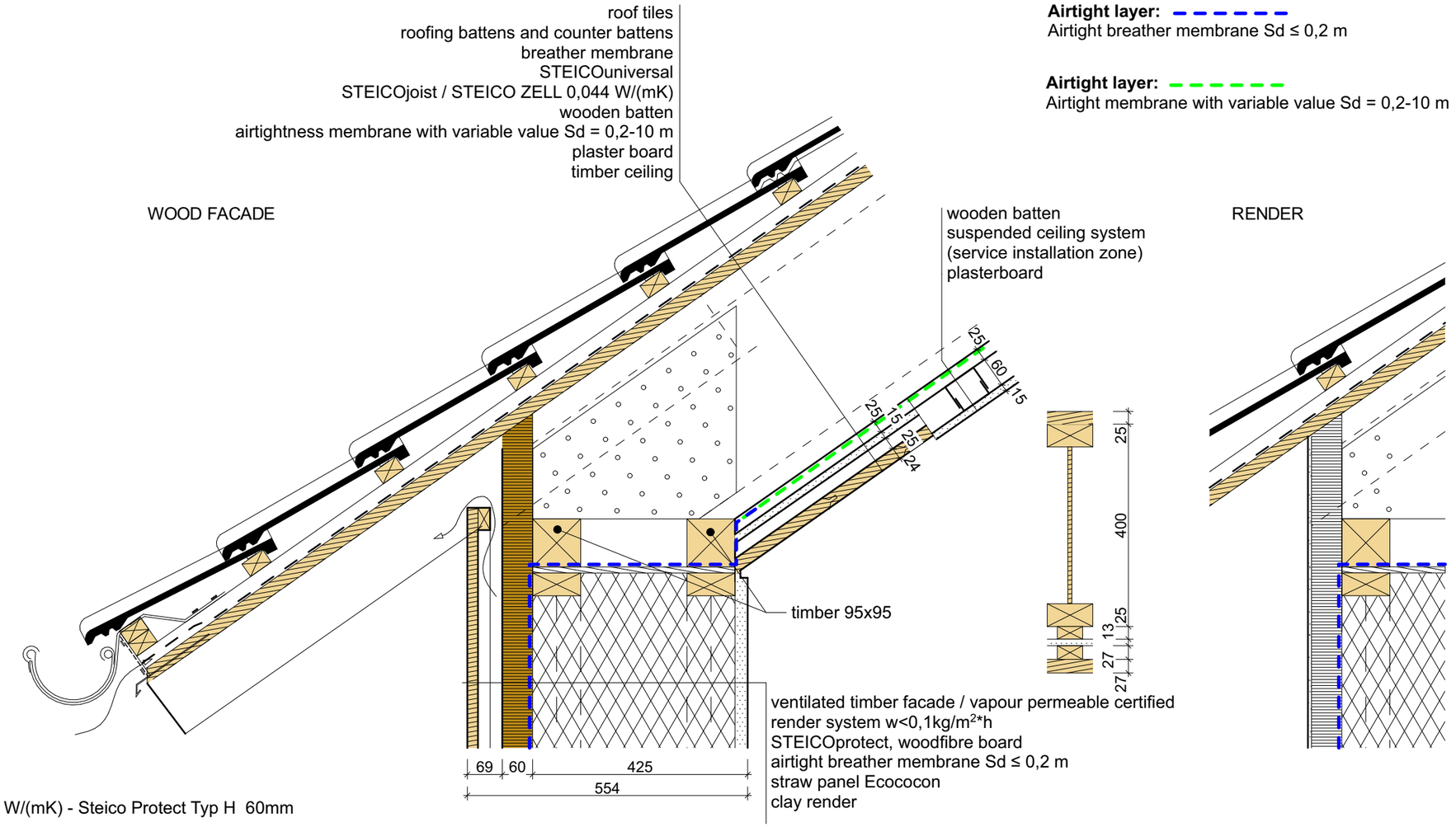
EWCE 01

Wall-Ceiling (CLT), Wand Deckeneinbindung (KLH)

ECO COCON
Nurtured by nature

Airtight layer:
Airtight breather membrane Sd ≤ 0,2 m

Airtight layer:
Airtight membrane with variable value Sd = 0,2-10 m



0,050 W/(mK) - Steico Protect Typ H 60mm

0,0645 W/(mK) - Straw/Wood Ecococon Panel

PH CERTIFICATION

ROEA 01

Roof Eaves (I-beam), Dach Traufe (I-Träger)

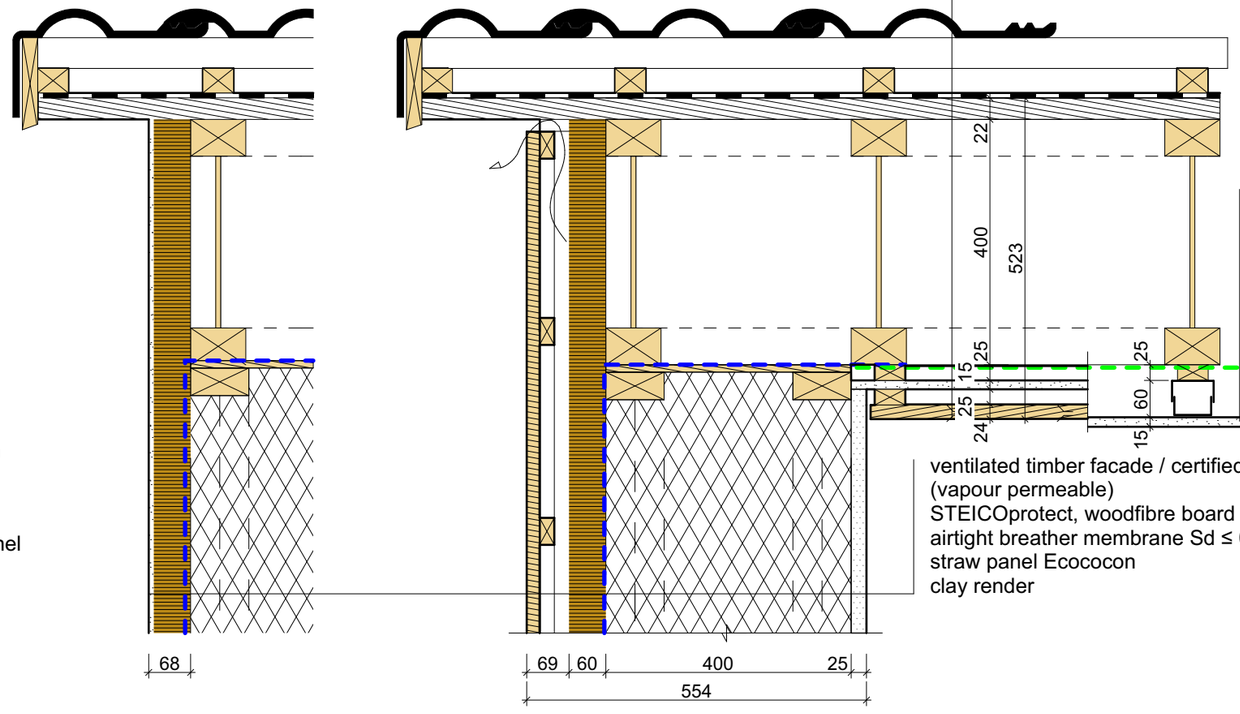
ECO COCON
Nurtured by nature

Airtight layer:
Airtight breather membrane Sd ≤ 0,2 m

Airtight layer:
Airtight membrane with variable value Sd = 0,2-10 m

RENDER

WOOD FACADE



Roof tiles
counter battons
roof battons
roof membrane
OSB/Plywood/Wooden boards 22 mm
STEICOjoist with STEICO ZELL 0,044 W/(mK)
airtight membrane with variable value Sd = 0,2-10 m
wooden batton
plaster board
timber ceiling

wooden batten
suspended ceiling system
(service installation zone)
plasterboard

ventilated timber facade / certified render system
(vapour permeable)
STEICOprotect, woodfibre board
airtight breather membrane Sd ≤ 0,2 m
straw panel Ecococon
clay render

0,050 W/(mK) - Steico Protect Typ H 60mm

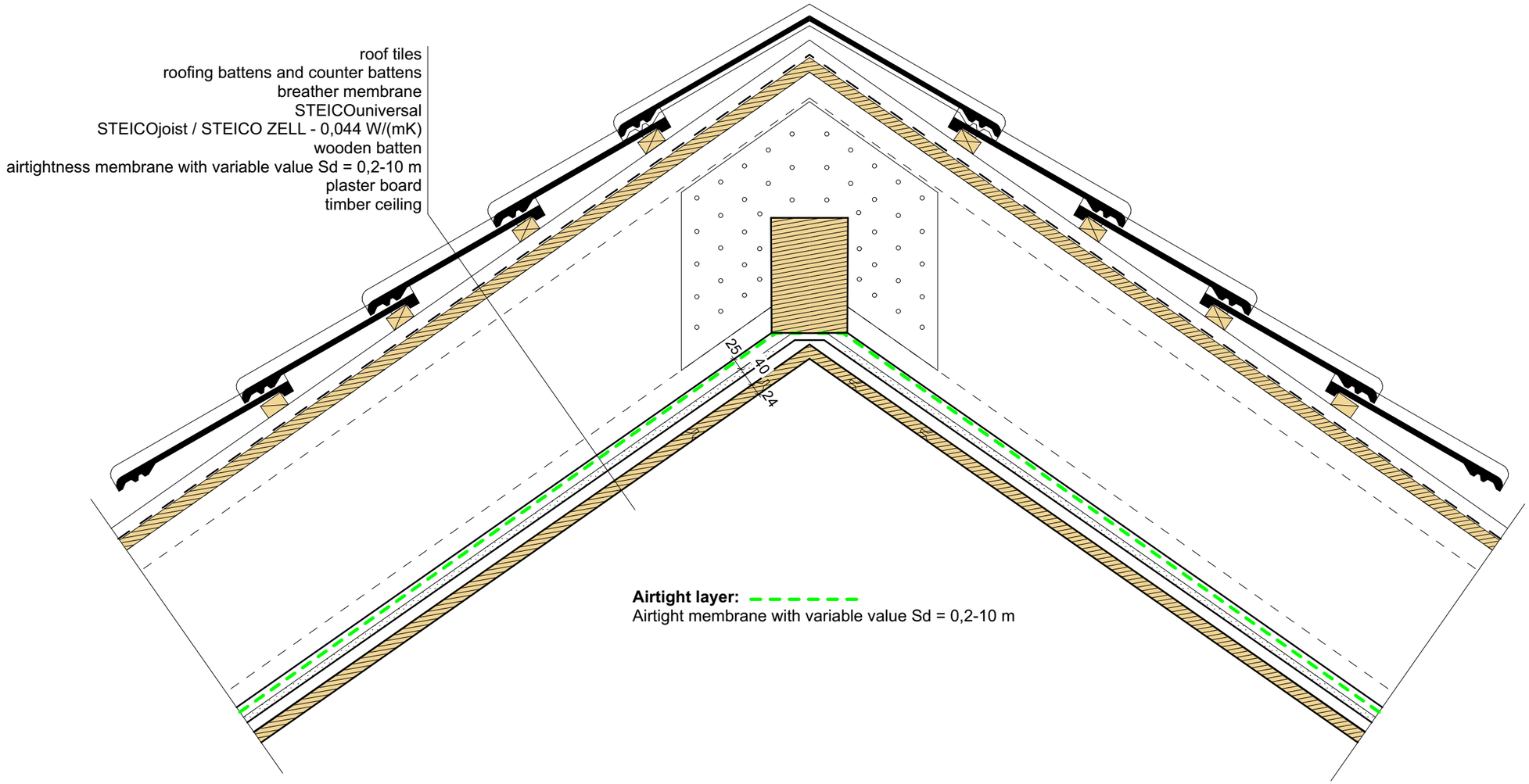
0,0645 W/(mK) - Straw/Wood Ecococon Panel

PH CERTIFICATION

ROVE 01

Roof Verge (I-beam), Dach Ortgang (I-Träger)

ECO COCON
Nurtured by nature

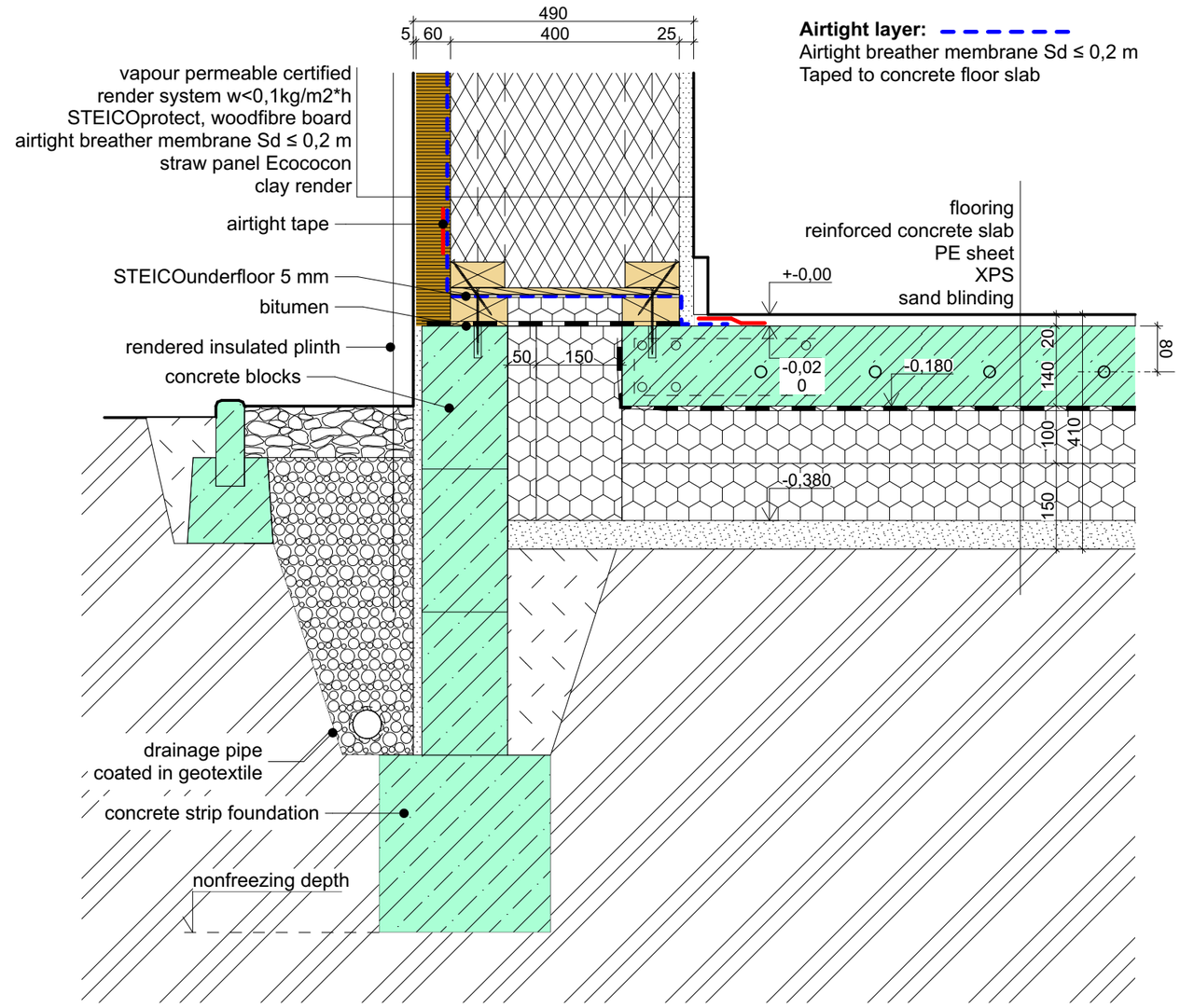


PH CERTIFICATION

RORI 01

Roof Ridge (I-beams), Dach First (I-Träger)

ECO COCON
Nurtured by nature



0,050 W/(mK) - Steico Protect Typ H 60mm

0,037 W/(mK) - XPS (Extruded Polystyrene)

0,0645 W/(mK) - Straw/Wood Ecococon Panel

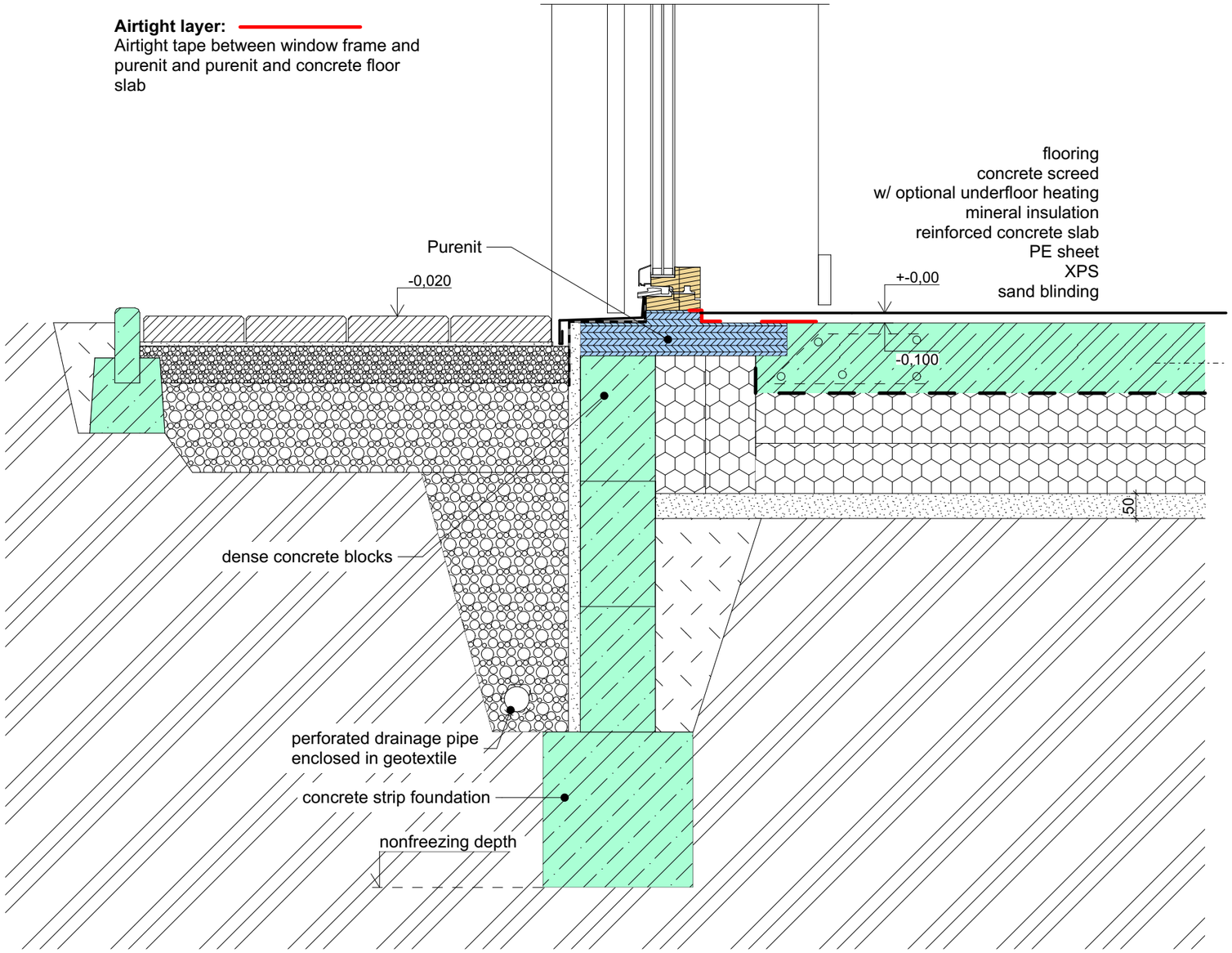
PH CERTIFICATION

FSEW 01

Floorslab-Wall, Bodenplatte-Wand

ECO COCON
Nurtured by nature

Airtight layer:
Airtight tape between window frame and purenit and purenit and concrete floor slab



0,037 W/(mK) - XPS (Extruded Polystyrene)

0,0645 W/(mK) - Straw/Wood Ecococon Panel

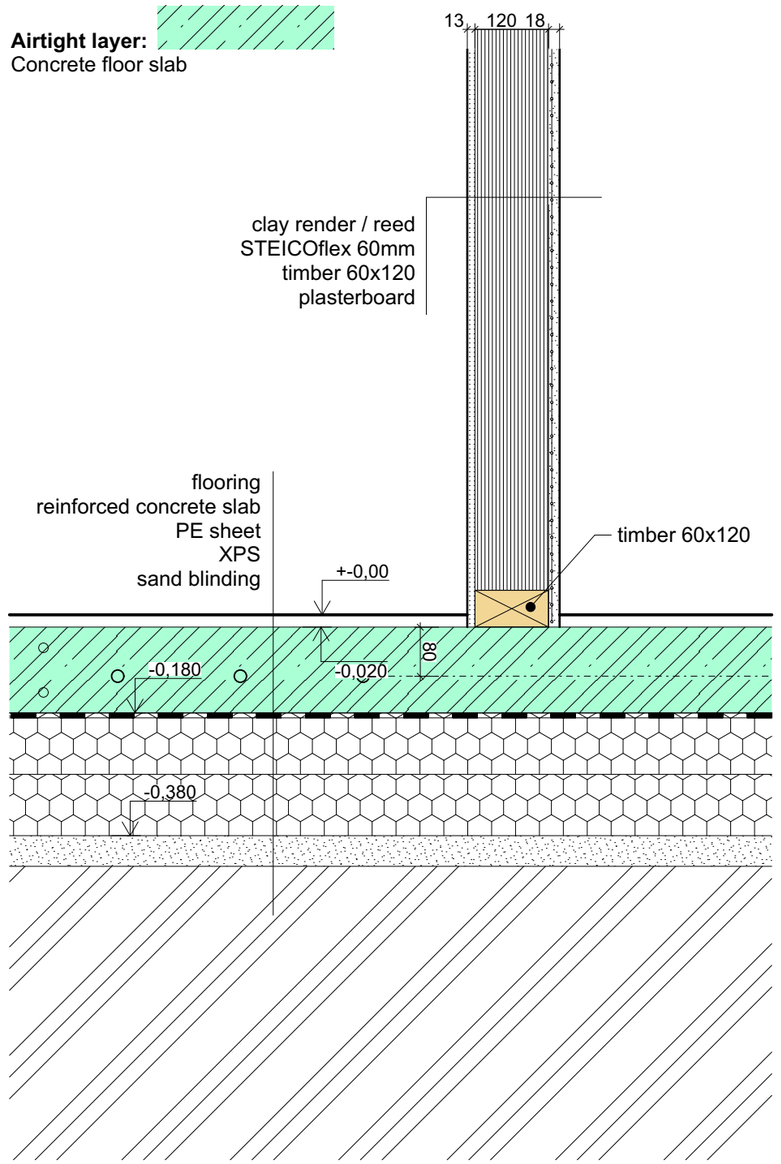
0,086 W/(mK) - Purenit 500 M

PH CERTIFICATION

WITH 01

Threshold, Schwelle

ECO COCON
Nurtured by nature



0,037 W/(mK) - XPS (Extruded Polystyrene)

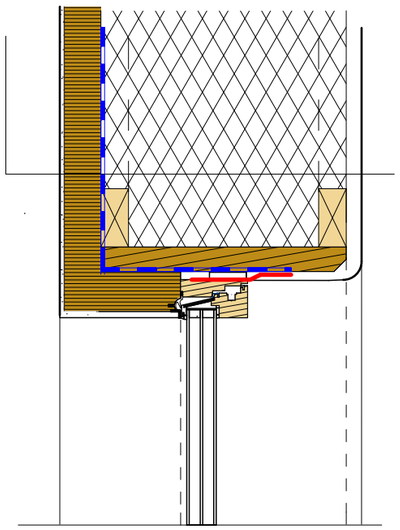
PH CERTIFICATION

FSIW 01

Floor slab - Interior Wall, Bodenplatte - Innenwand

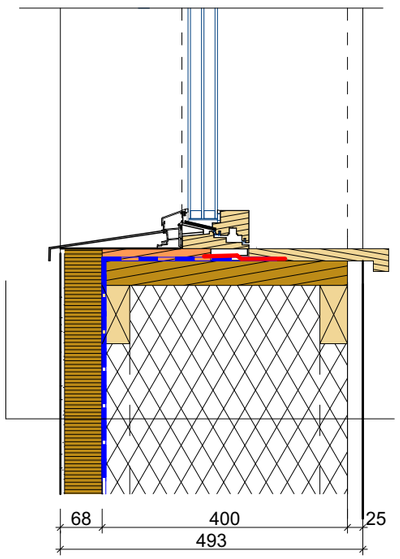
ECO COCON
Nurtured by nature

vapour permeable certified render system w<0,1kg/m²*h
STEICOprotect, woodfibre board
airtight breather membrane Sd ≤ 0,2 m
straw panel Ecococon
clay render

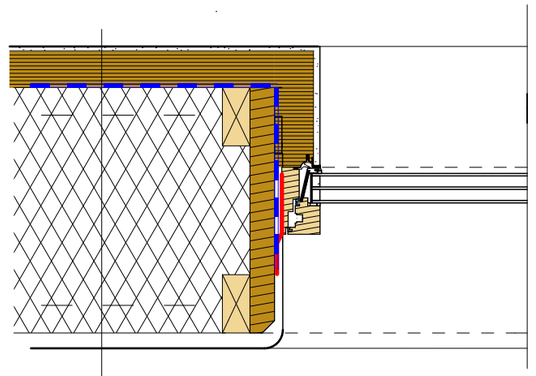


Airtight layer:
Airtight breather membrane Sd ≤ 0,2 m

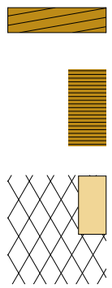
Airtight layer:
Airtight tape beteen frame and membrane



vapour permeable certified render system w<0,1kg/m²*h
STEICOprotect, woodfibre board
airtight breather membrane Sd ≤ 0,2 m
straw panel Ecococon
clay render



vapour permeable certified render system w<0,1kg/m²*h
STEICOprotect, woodfibre board
airtight breather membrane Sd ≤ 0,2 m
straw panel Ecococon
clay render



0,055 W/(mK) - Agepan THD Static 40mm

0,050 W/(mK) - Steico Protect Typ H 60mm

0,0645 W/(mK) - Straw/Wood Ecococon Panel

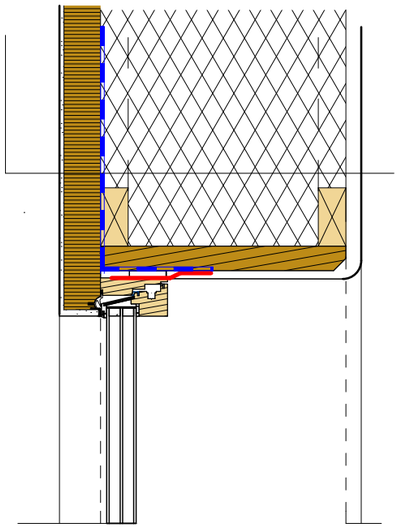
PH CERTIFICATION

WIBO 01, WITO 01, WISI 01

Smartwin Solar - Wall connection 01

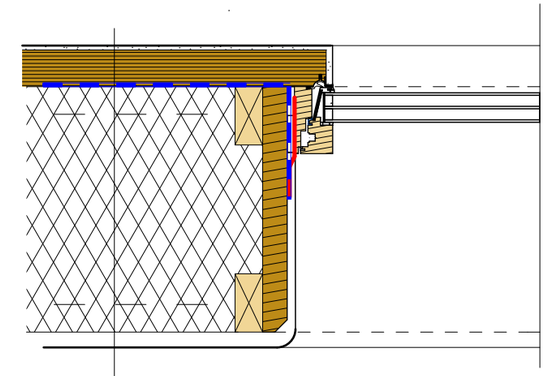
ECO COCON
Nurtured by nature

vapour permeable certified render system w<0,1kg/m²*h
STEICOprotect, woodfibre board
airtight breather membrane Sd ≤ 0,2 m
straw panel Ecococon
clay render

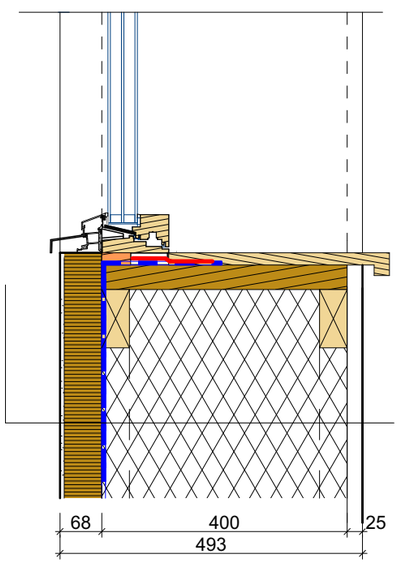


Airtight layer:
Airtight breather membrane Sd ≤ 0,2 m

Airtight layer:
Airtight tape beteen frame and membrane



vapour permeable certified render system w<0,1kg/m²*h
STEICOprotect, woodfibre board
airtight breather membrane Sd ≤ 0,2 m
straw panel Ecococon
clay render



0,055 W/(mK) - Agepan THD Static 40mm

0,050 W/(mK) - Steico Protect Typ H 60mm

0,0645 W/(mK) - Straw/Wood Ecococon Panel

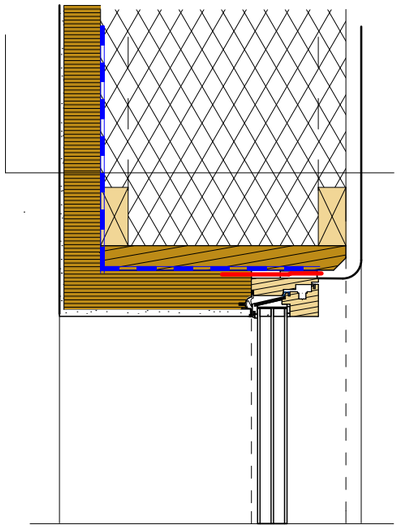
PH CERTIFICATION

WIBO 02, WITO 02, WISI 02

Smartwin Solar - Wall connection 02

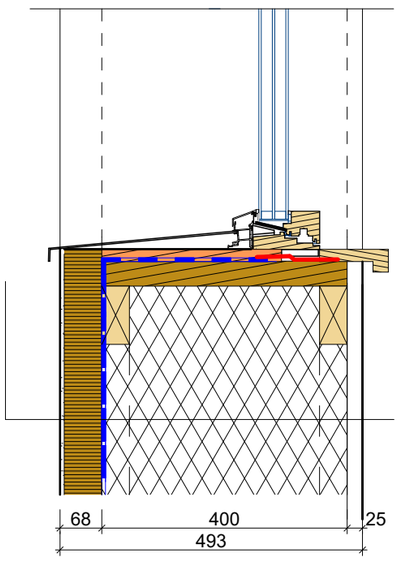
ECO COCON
Nurtured by nature

vapour permeable certified render system w<0,1kg/m²*h
STEICOprotect, woodfibre board
airtight breather membrane Sd ≤ 0,2 m
straw panel Ecococon
clay render

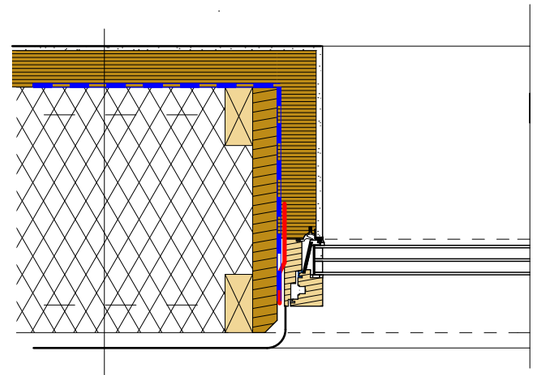


Airtight layer:
Airtight breather membrane Sd ≤ 0,2 m

Airtight layer:
Airtight tape beteen frame and membrane



vapour permeable certified render system w<0,1kg/m²*h
STEICOprotect, woodfibre board
airtight breather membrane Sd ≤ 0,2 m
straw panel Ecococon
clay render



vapour permeable certified render system w<0,1kg/m²*h
STEICOprotect, woodfibre board
airtight breather membrane Sd ≤ 0,2 m
straw panel Ecococon
clay render

0,055 W/(mK) - Agepan THD Static 40mm

0,050 W/(mK) - Steico Protect Typ H 60mm

0,0645 W/(mK) - Straw/Wood Ecococon Panel

PH CERTIFICATION

WIBO 03, WITO 03, WISI 03

Smartwin Solar - Wall connection 03

ECO COCON
Nurtured by nature