Certification report | Zertifizierungsbericht

Passive House Institute

Building system
Bausystem

for the warm, temperate climate

für das warm-gemäßigtes Klima

Product I Produkt:	**Thermochip HOUSING SATE-COAT**
Client I Auftraggeber:	**Thermochip SLU**
Construction | Konstruktion	**Lightweight timber construction | Holzleichtbau**
Contact person Ansprechpartner Website	Diego Rodriguez +34 681 155 131 www.thermochip.com
Date I Datum: Author I Autor:	**16.09.2020** **M. Arch Soraya López García**

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Content

1 Introduction

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 proven, the label "Certified Passive House Component" can be awarded by the Passive House Institute (PHI)

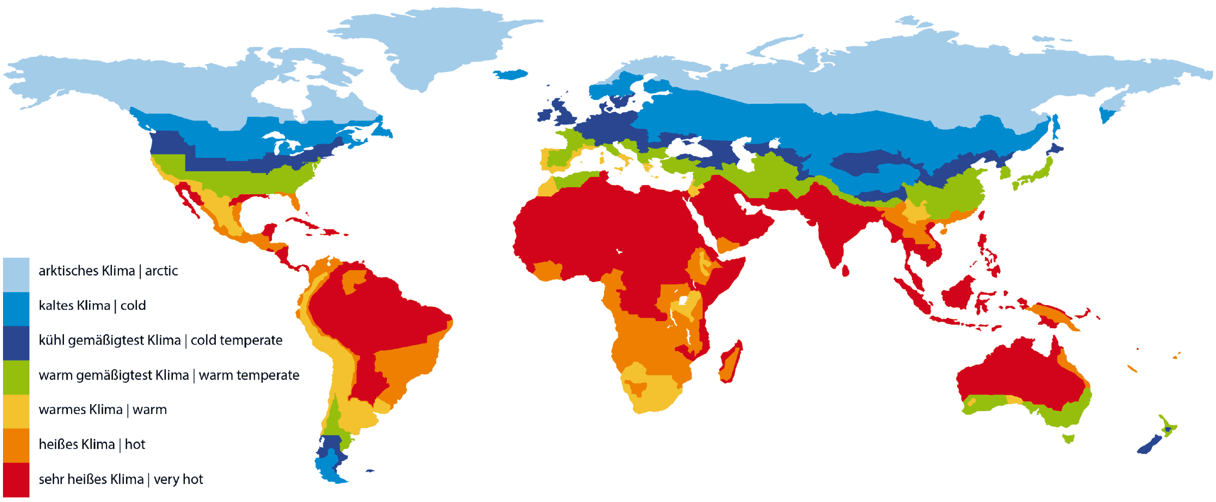
Table 1: Adequate certification criteria

Climate zone	**Hygiene criterion**	**Comfort criterion**	**Efficiency criteria**		
	$f_{Rsi=0.25\ m^2K/W} \geq$ [3]	U-value of the installed window[1] ≤	U-value opaque to ambient $U_{opaque} * f_{PHI}{}^2 \leq$	Purely opaque details $f_{Rsi=0.25\ m^2K/W} \geq$	Absence of thermal bridges $\Psi_a \leq$[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

2.1 Opaque building envelop

With the Thermochip HOUSING Construction System the wintertime thermal insulation of buildings can be ensured. The system is constructed out of timber studs, beams and an outer sandwich panel. The sandwich panel (12/140/12 mm) comprises a board of fibre cement to the outside, a core of XPS (</=0,036 W/mK) and internal composite board with cellulose fibres. To the interior a service cavity provides a space for the building services and protects the airtightness layer.

The certification does not take into account point thermal bridges caused by structural columns or e.g. balcony connections, which must to be as-sessed separately. As investigated, the system is deemed suitable for passive houses in the warm-temperate climate zone, as the regular U-values of the exterior components are below 0,25 W/m²K and the connections meet the criteria of 'thermal bridge free'. The surface temperature of all con-nections (with the exception of window connec-tions) meet the hygiene requirements.

2.2 Windows

For the purposes of certification a standard passive house window (Uw = 1,00 W/m²K with Ug = 0,90 W/m²K) was used. The overall U-value of the installed window of standard size (1,23 m wide by 1,48 m tall) should be no more than 0,05 W/m²K greater than the Uw to ensure occupant comfort - this criteria is met in this instance.

2.3 Airtightness concept

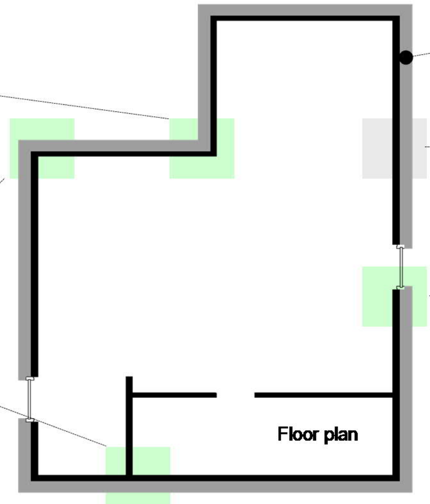
Airtightness of the system is achieved in the following way: windows and doors are installed with permanently elastic sealing materials and suitable airtight connection membranes and profiles. The airtight layer is located in the gypsum fibre board in the inner side of the sandwich panel. Joints between panels and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.

3 Evaluation

The Passive House Institute has defined international component criteria for seven climate zones based on hygiene, comfort and affordability criteria. In principle, components which have been certified for climate zones with higher requirements may also be used in climates with less stringent requirements. Their use might make economic sense in certain circumstances.

4 Summary of the results

(grey)	Thermal bridge not calculated
(light green)	Criteria achieved
(yellow)	Efficieny criteria not achieved
(orange)	Hygiene or comfort criterion not achieved



EW01	External wall
U [W/(m²K)]	0.224
Thickness [m]	0.331

EWIC01	
Ext. wall-inner corner	
Ψ [W//mK]	0.074
$f_{Rsi=0,25\ m^2K/W}$	0.94

EWEJ01	
Ext. wall-panel joint	
Ψ [W/(mK)]	
$f_{Rsi=0,25\ m^2K/W}$	

EWEC01	
Ext. wall-outer corner	
Ψ [W//mK]	-0.059
$f_{Rsi=0,25\ m^2K/W}$	0.87

EWIW01	
Ext. wall-int. wall	
Ψ [W//mK]	-0.001
$f_{Rsi=0,25\ m^2K/W}$	0.97

WISI			Window side
Typ	01	02	03
b_f [m]	0.12		
U_f [W/m²K]	0.99		
$Ψ_g$ [W/mK]	0.028		
$Ψ_i$ [W/mK]	0.009		
$f_{Rsi=0,25\ m^2K/W}$	0.80		

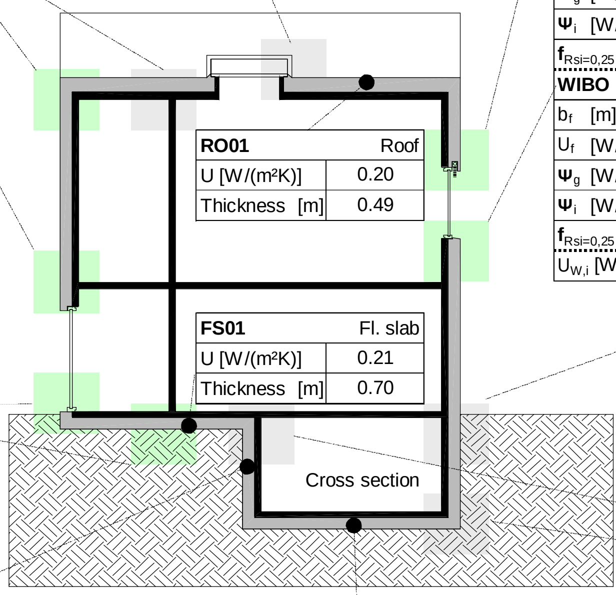
ROVE01	
Verge	
Ψ [W//mK]	-0.049
$f_{Rsi=0,25\ m^2K/W}$	0.88

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

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

WITO			Window top
Typ	01	02	03
b_f [m]	0.12		
U_f [W/m²K]	0.99		
$Ψ_g$ [W/mK]	0.028		
$Ψ_i$ [W/mK]	0.005		
$f_{Rsi=0,25\ m^2K/W}$	0.80		
WIBO			**Window bottom**
b_f [m]	0.12		
U_f [W/m²K]	0.99		
$Ψ_g$ [W/mK]	0.028		
$Ψ_i$ [W/mK]	0.015		
$f_{Rsi=0,25\ m^2K/W}$	0.79		
$U_{W,i}$ [W//m²K]	1.03		

EWCE01	
Ext. wall-ceiling	
Ψ [W//mK]	-0.006
$f_{Rsi=0,25\ m^2K/W}$	0.96



RO01	Roof
U [W/(m²K)]	0.20
Thickness [m]	0.49

FS01	Fl. slab
U [W/(m²K)]	0.21
Thickness [m]	0.70

WITH01	
Window threshold	
b_f [m]	0.145
U_f [W/m²K]	0.97
$Ψ_e$ [W/mK]	0.027
$Ψ_i$ [W/mK]	-0.017
$f_{Rsi=0,25\ m^2K/W}$	0.76
$U_{W,i}$ [W//m²K]	1.00

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

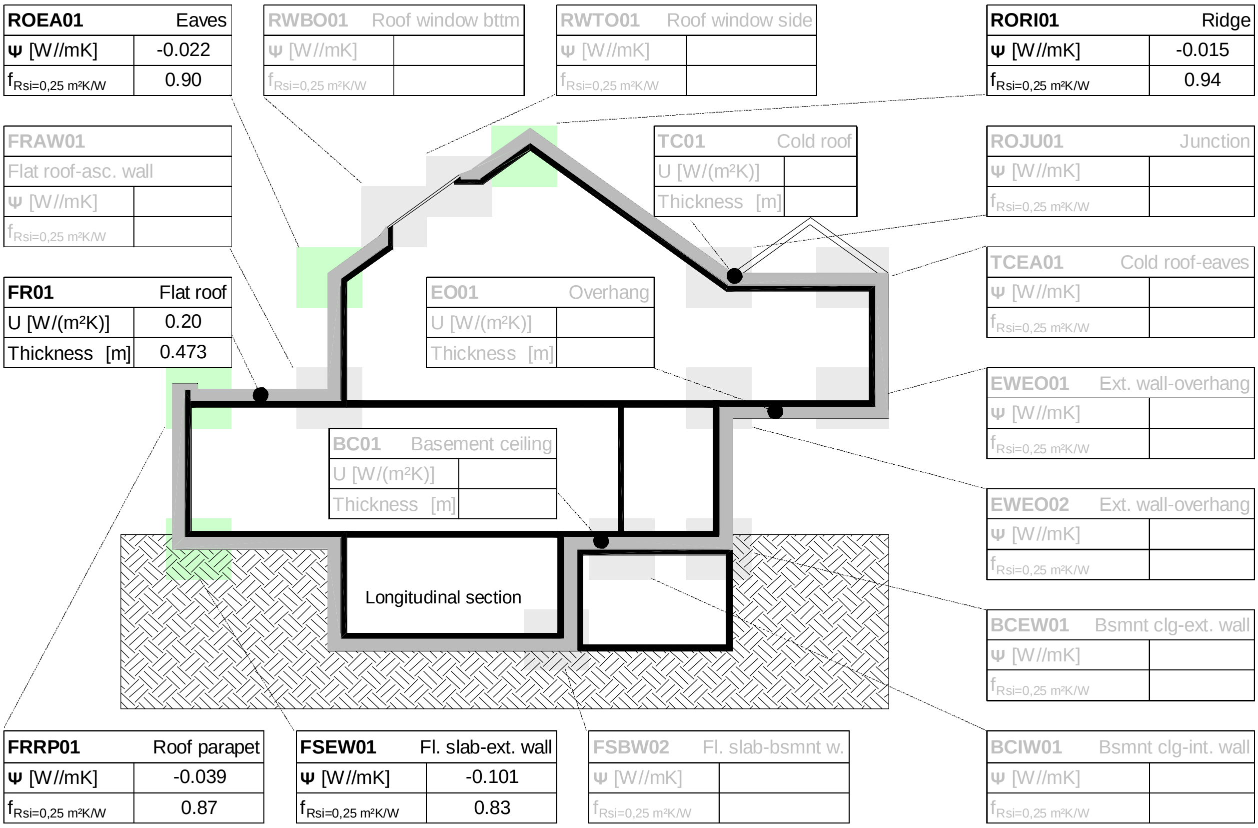
FSIW01	
Fl. slab-int. w.	
Ψ [W//mK]	0.001
$f_{Rsi=0,25\ m^2K/W}$	0.83

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

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

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

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



5 Using the results in the 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.

6 Legal information

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 adapted for specific constructions. Sealing of the construction against moisture and the absence of condensation as well as the check of hygrothermal 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.

Appendix 1: U-value of building assemblies

Thermochip SLU: Thermochip HOUSING SATE-COAT ID: 1625cs04 for the warm, temperate climate

Acronym	Building assembly description	Interior insulation?
FS01	Floor slab	

Orientation of building element: 3-Ground — Adjacent to: - — Heat transmission resistance [m²K/W]: 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]	U-value [W/(m²K)]
4.000	30	24.9263	0.208

U-value determined according to PHPP

Material of Layer	λ [W/(mK)]	Description	Thickness [mm]
Gypsum board with cellulose fibres (fibroyeso)	0.669	according to EN ISO 10456 (2007/2009)	20
Gypsum board with cellulose fibres (fibroyeso)	0.669	according to EN ISO 10456 (2007/2009)	12
XPS (2*80)	0.036	data sheet + conversion factor according to DIN 4108-4	160
Fibro-cement board	1.200	according to EN ISO 10456 (2007/2009)	12
Air layer	2.500	according to EN ISO 6946	200
Air layer	3.750	according to EN ISO 6946	300

Percentage of sec. 1: 100% — Percentage of sec. 2 — Percentage of sec. 3 — Total: 70.4 cm

U-value supplement W/(m²K) — **U-value: 0.207** W/(m²K)

Acronym	Building assembly description	Interior insulation?
EW01	External wall	

Orientation of building element: 2-Wall — Adjacent to: 3-Ventilated — Heat transmission resistance [m²K/W]: interior R_{si} 0.13, exterior R_{se} 0.13

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

length of model [m]	Δθ [K]	thermal flux [W/m]	U-value [W/(m²K)]
1.400	30	9.41041	0.224

U-value determined according to PHPP

Material of Layer	λ [W/(mK)]	Description	Thickness [mm]
Fibro-cement board	1.200	according to EN ISO 10456 (2007/2009)	12
XPS	0.036	data sheet + conversion factor according to DIN 4108-4	140
Gypsum board with cellulose fibres (fibroyeso)	0.669	generic value	12
Air layer + timber studs	0.654	Equivalent value to match ISO 10211 simulation	140
Fibro-cement board	1.200	according to EN ISO 10456 (2007/2009)	12
Gypsum board glass fibre reinforced	0.250	according to EN ISO 10456 (2007/2009)	15

Percentage of sec. 1: 100% — Percentage of sec. 2 — Percentage of sec. 3 — Total: 33.1 cm

U-value supplement W/(m²K) — **U-value: 0.224** W/(m²K)

Acronym	Building assembly description	Interior insulation?
RO01	Roof	

Heat transmission resistance [m²K/W]

Orientation of building element	Adjacent to	interior R_{si}	exterior R_{se}
1-Roof	3-Ventilated	0.10	0.13

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

length of model [m]	Δϑ [K]	thermal flux [W/m]	U-value [W/(m²K)]
1.750	30	10.2719	0.196

U-value determined according to PHPP

Material of Layer	λ [W/(mK)]	Description	Thickness [mm]
Fibro-cement board	1.200	according to EN ISO 10456 (2007/2009)	12
XPS (2*80)	0.036	data sheet + conversion factor according to DIN 4108-4	160
Gypsum board with cellulose fibres (fibroyeso)	0.669	generic value	12
Air layer + timber beams	0.920	Equivalent value to match ISO 10211 simulation	200
Air layer + steal substructure	0.710	Equivalent value to match ISO 10211 simulation	80
Gypsum board with cellulose fibres (fibroyeso)	0.669	generic value	12
Gypsum board glass fibre reinforced	0.250	according to EN ISO 10456 (2007/2009)	15

Percentage of sec. 1 | Percentage of sec. 2 | Percentage of sec. 3 | Total **49.1** cm

100%

U-value supplement: W/(m²K) **U-value: 0.196** W/(m²K)

Acronym	Building assembly description	Interior insulation?
FR01	Flat Roof	

Heat transmission resistance [m²K/W]

Orientation of building element	Adjacent to	interior R_{si}	exterior R_{se}
1-Roof	1-Outdoor air	0.10	0.04

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

length of model [m]	Δϑ [K]	thermal flux [W/m]	U-value [W/(m²K)]
1.750	30	10.4825	0.200

U-value determined according to PHPP

Material of Layer	λ [W/(mK)]	Description	Thickness [mm]
Fibro-cement board	1.200	according to EN ISO 10456 (2007/2009)	12.5
XPS (2*80)	0.036	data sheet + conversion factor according to DIN 4108-4	160
Gypsum board with cellulose fibres (fibroyeso)	0.669	generic value	12.5
Air layer + timber beams	0.900	Equivalent value to match ISO 10211 simulation	180
Air layer + steal substructure	0.710	Equivalent value to match ISO 10211 simulation	80
Gypsum board with cellulose fibres (fibroyeso)	0.669	according to EN ISO 10456 (2007/2009)	12.5
Gypsum board glass fibre reinforced	0.250	according to EN ISO 10456 (2007/2009)	15

Total **47.3** cm

100%

U-value supplement: W/(m²K) **U-value: 0.200** W/(m²K)

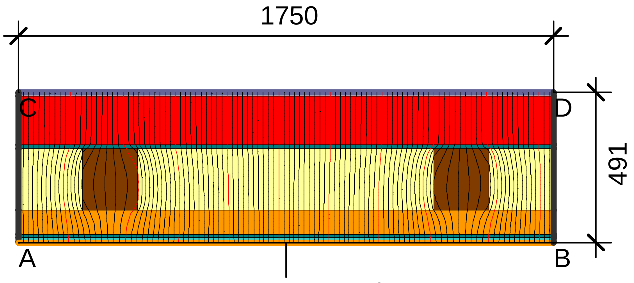
Appendix 2: Thermal simulations | Wärmestromsimulationen

Passive House Institute

Wall, roof, ground | Wand, Dach, Boden
Windows | Fenster
Constructions to ground | Erdberührte Bauteile

Wall, roof, ground | Wand, Dach, Boden

Pitched Roof:

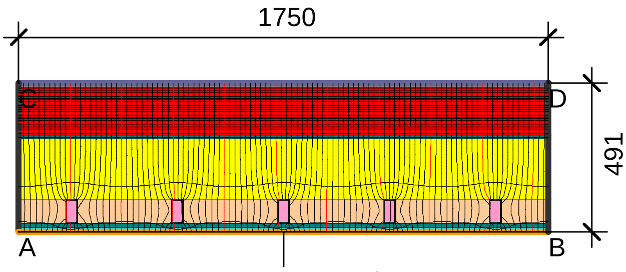


$\Phi_{A\text{-}B}$ = 10.27909 W/m

$$U_{eq\,A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.279}{30.000 \cdot 1.750} = 0.196\ \text{W/(m}^2\text{·K)}$$

Material	λ[W/(m·K)]	ε
EQ_Suspended ceiling	0.710	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, aufwärts, Dicke: 200 mm	1.250	0.900
Wood - parallel 0.29 W/(mK)	0.290	0.900
XPS 036	0.036	0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε	φ[%]
Exterior vent. | Außen belüftet		-10.000	0.130		
Interior up. | Innen auf.		20.000	0.100		
Adiabatic | Adiabat	0.000				

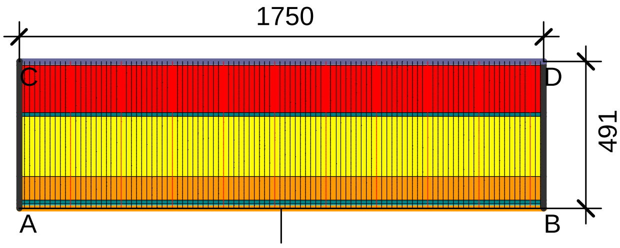


$\Phi_{A\text{-}B}$ = 10.27969 W/m

$$U_{eq\,A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.280}{30.000 \cdot 1.750} = 0.196\ \text{W/(m}^2\text{·K)}$$

Material	λ[W/(m·K)]	ε
EQ-Roof_air layer+timber	0.920	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, aufwärts, Dicke: 70 mm	0.438	0.900
Luftschicht, ruhend, aufwärts, Dicke: 80 mm	0.500	0.900
Steel I Stahl	50.000	0.900
XPS 036	0.036	0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0.000		
Exterior vent. | Außen belüftet		-10.000	0.130
Interior up. | Innen auf.		20.000	0.100



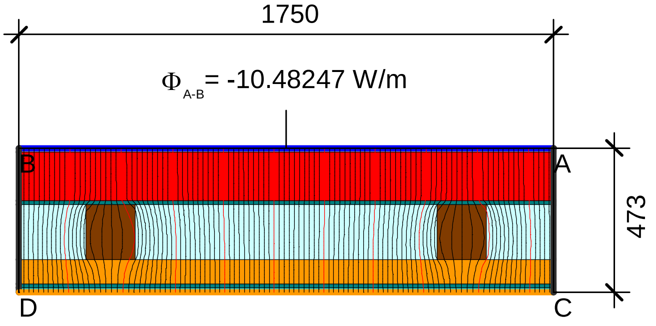
$\Phi_{A\text{-}B}$ = 10.27320 W/m

$$U_{eq\,A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.273}{30.000 \cdot 1.750} = 0.196\ \text{W/(m}^2\text{·K)}$$

Material	λ[W/(m·K)]	ε
EQ-Roof_air layer+timber	0.920	0.900
EQ_Suspended ceiling	0.710	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
XPS 036	0.036	0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Exterior vent. | Außen belüftet		-10.000	0.130	
Interior up. | Innen auf.		20.000	0.100	
Adiabatic | Adiabat	0.000			

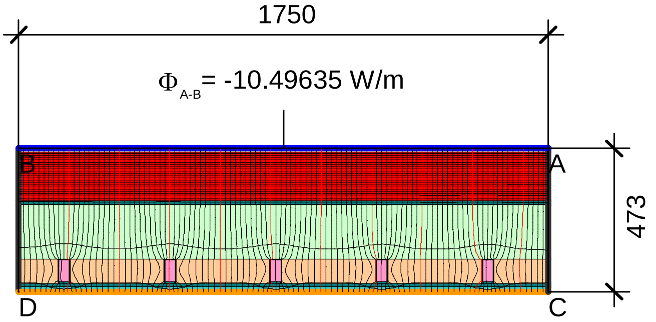
Flat Roof:



$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.482}{30.000 \cdot 1.750} = 0.200\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]	ε
EQ_Suspended ceiling	0.710	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, aufwärts, Dicke: 180 mm	1.125	0.900
Wood - parallel 0.29 W/(mK)	0.290	0.900
XPS 036	0.036	0.900

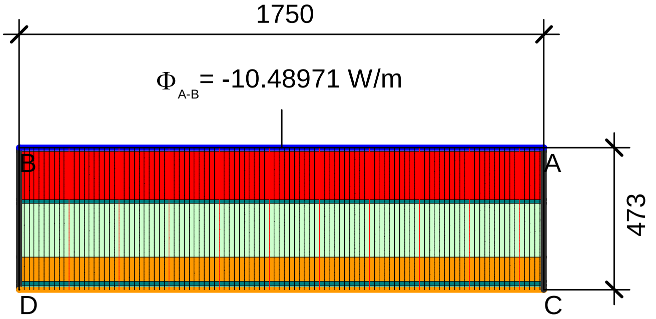
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε	φ[%]
Exterior | Außen		-10.000	0.040		
Interior up. | Innen auf.		20.000	0.100		
Adiabatic | Adiabat	0.000				



$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.496}{30.000 \cdot 1.750} = 0.200\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]	ε
EQ-FR_air layer+timber	0.900	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, aufwärts, Dicke: 70 mm	0.438	0.900
Luftschicht, ruhend, aufwärts, Dicke: 80 mm	0.500	0.900
Steel I Stahl	50.000	0.900
XPS 036	0.036	0.900

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

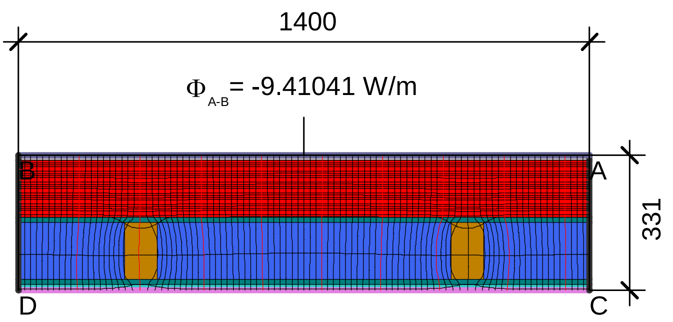


$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.490}{30.000 \cdot 1.750} = 0.200\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]	ε
EQ-FR_air layer+timber	0.900	0.900
EQ_Suspended ceiling	0.710	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
XPS 036	0.036	0.900

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

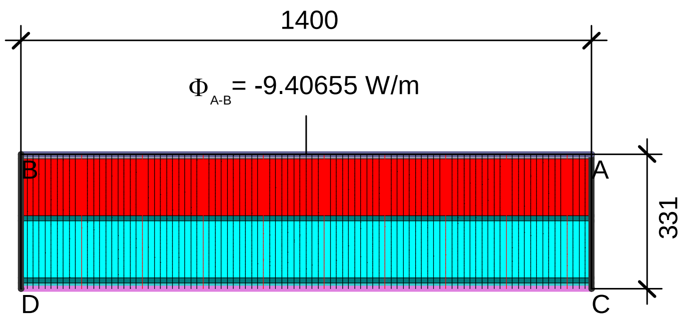
Wall:



$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]	ε
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, horizontal, Dicke: 140 mm (1)	0.778	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

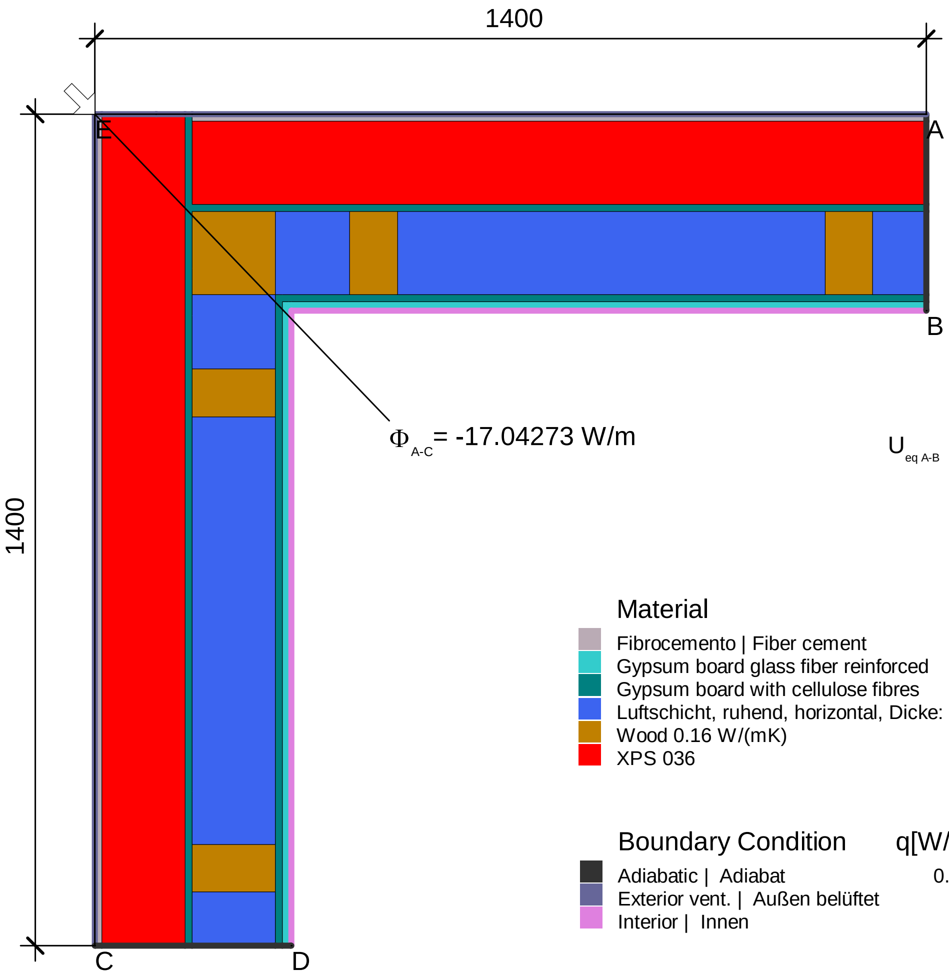
Boundary Condition	$q[W/m^2]$	$\theta[^{\circ}C]$	$R[(m^2 \cdot K)/W]$
Adiabatic | Adiabat	0.000		
Exterior vent. | Außen belüftet		-10.000	0.130
Interior | Innen		20.000	0.130

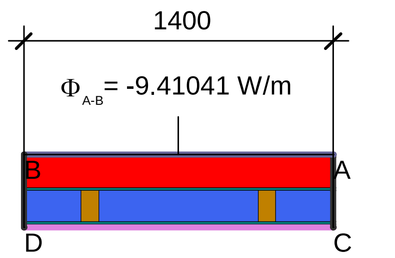


$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.407}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]	ε
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
XPS 036	0.036	0.900

Boundary Condition	$q[W/m^2]$	$\theta[^{\circ}C]$	$R[(m^2 \cdot K)/W]$	ε
Exterior vent. | Außen belüftet		-10.000	0.130	
Interior | Innen		20.000	0.130	
Adiabatic | Adiabat	0.000			



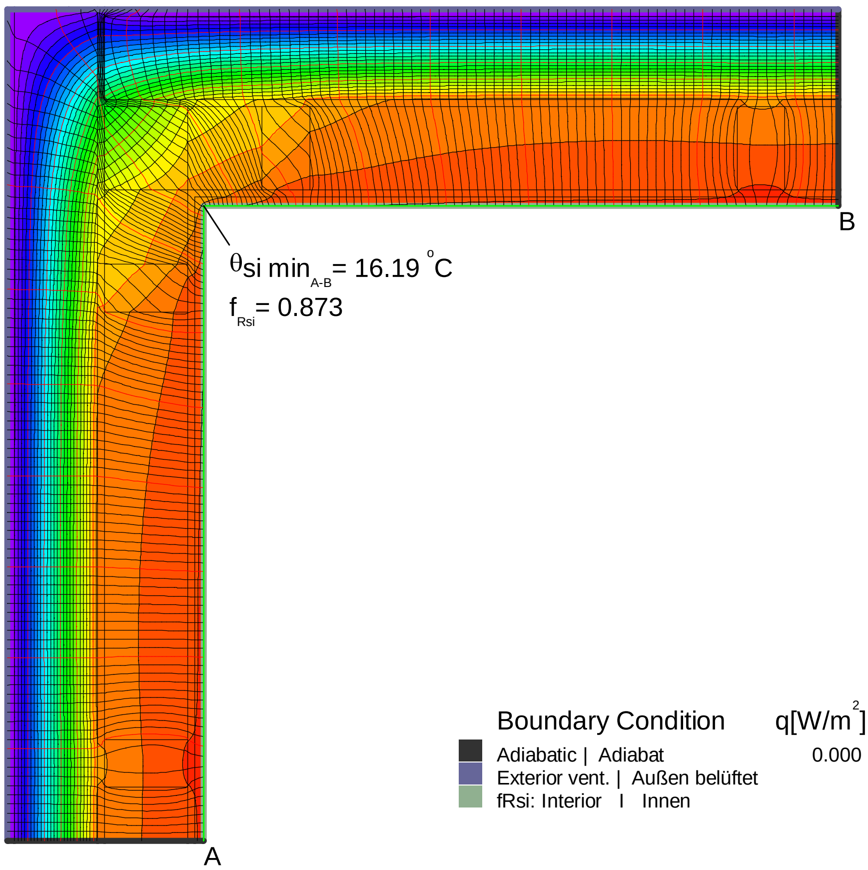


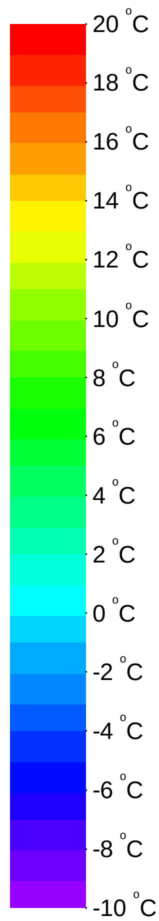
$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]	ε
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, horizontal, Dicke: 140 mm (1)	0.778	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Interior | Innen		20.000	0.130	

$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{17.043}{30.000} - 0.224 \cdot 1.400 - 0.224 \cdot 1.400 = -0.059\ W/(m \cdot K)$$





Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
fRsi: Interior I Innen		20.000	0.250	

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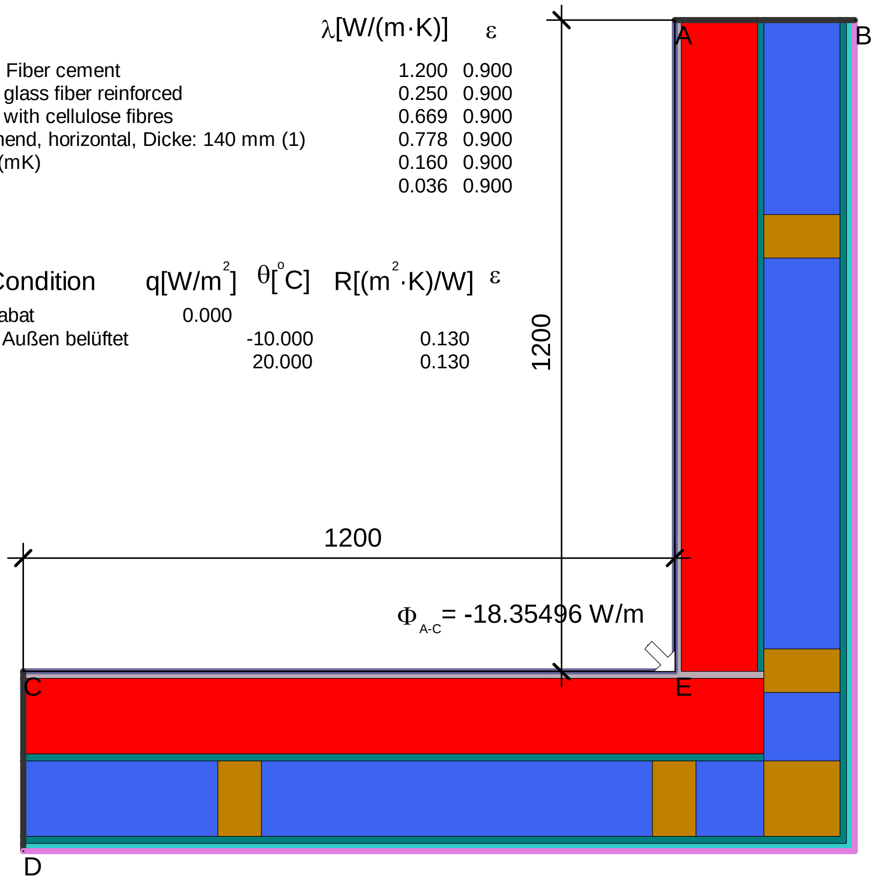
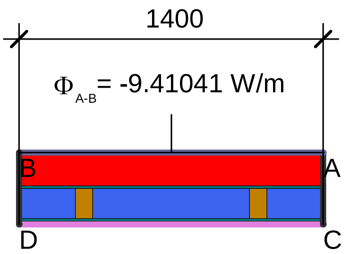
EWEC: WALL EXTERIOR CORNER | WAND AUSSENECKE

Material	λ[W/(m·K)]	ε
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, horizontal, Dicke: 140 mm (1)	0.778	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Interior | Innen		20.000	0.130	

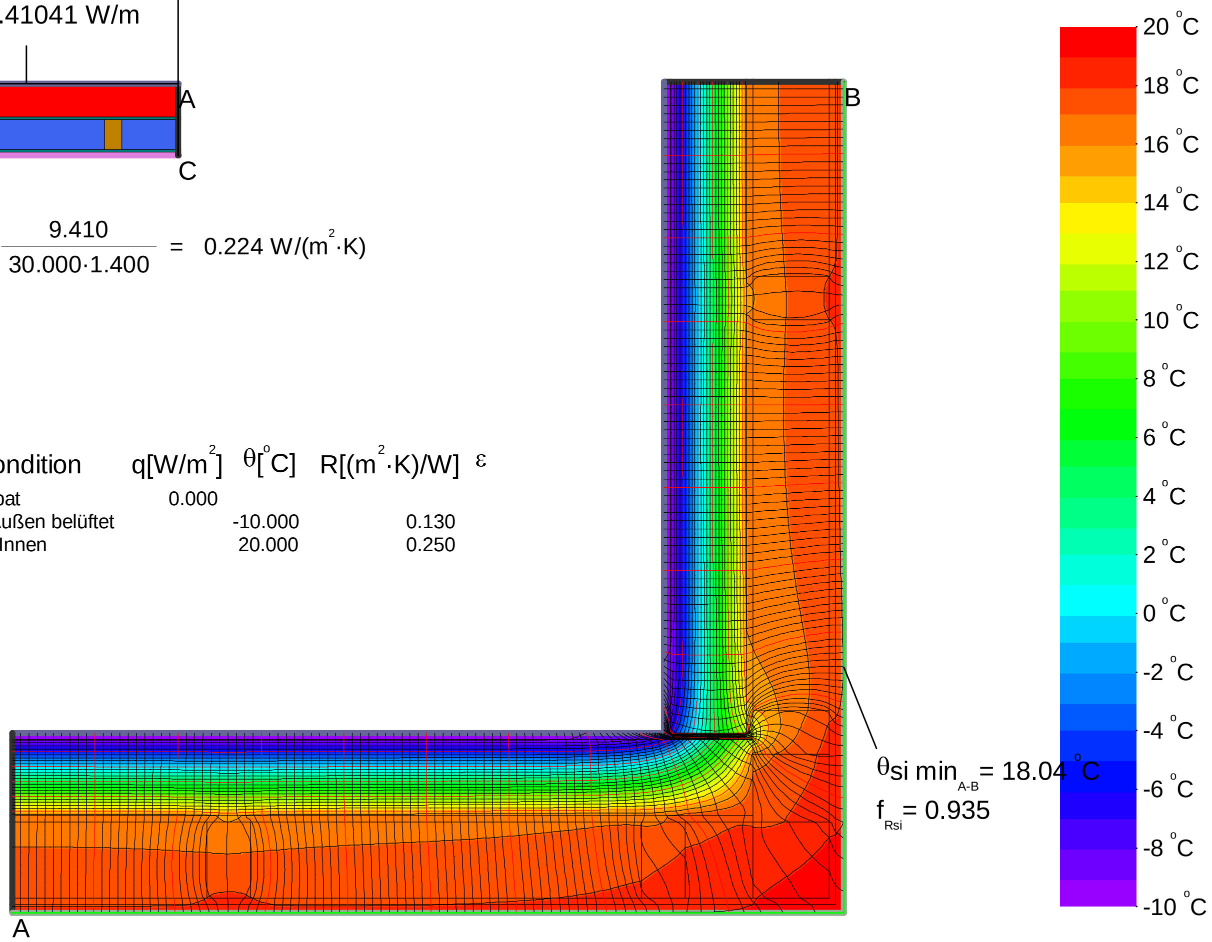


$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{18.355}{30.000} - 0.224 \cdot 1.200 - 0.224 \cdot 1.200 = 0.074 \text{ W/(m·K)}$$



$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2\text{·K)}$$

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
fRsi: Interior I Innen		20.000	0.250	



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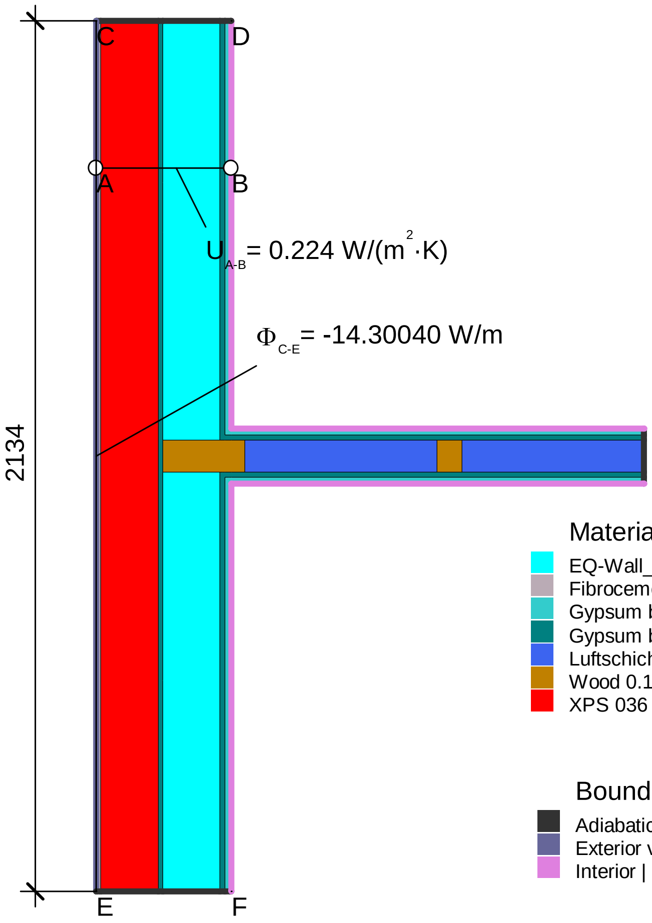
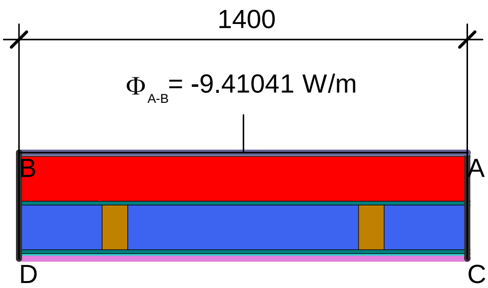


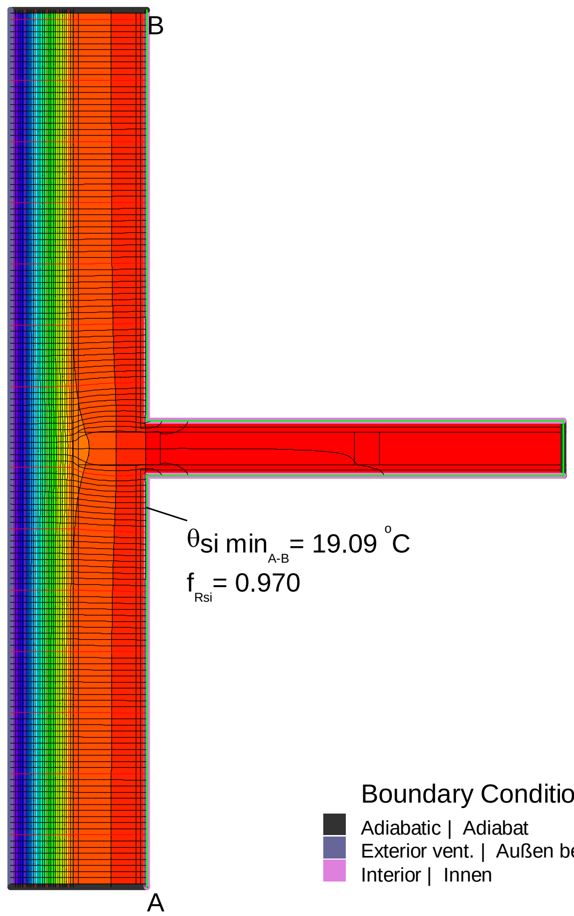


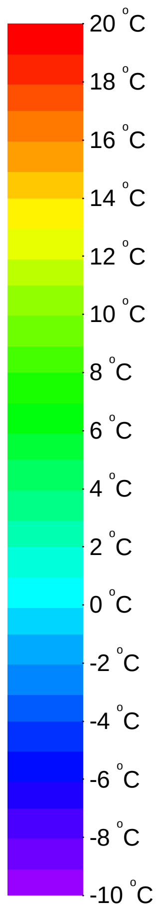
$$U_{eq\,A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]	ε
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, horizontal, Dicke: 140 mm (1)	0.778	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Interior | Innen		20.000	0.130	

$$\psi_{C\text{--}E,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 = \frac{14.300}{30.000} - 0.224 \cdot 2.134 = -0.001\ W/(m \cdot K)$$





Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Interior | Innen		20.000	0.130	

EWIW: Junction exterior wall - interior wall | Innenwandeinbindung

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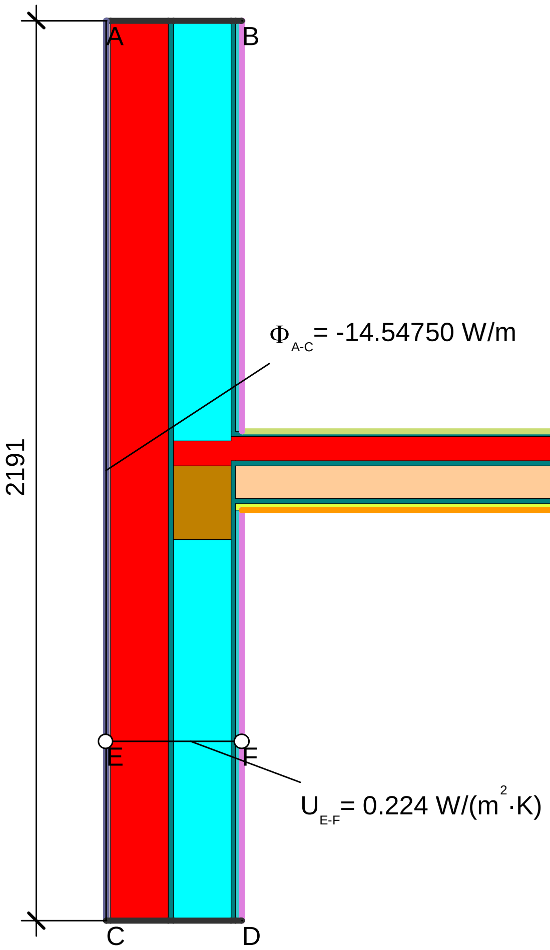
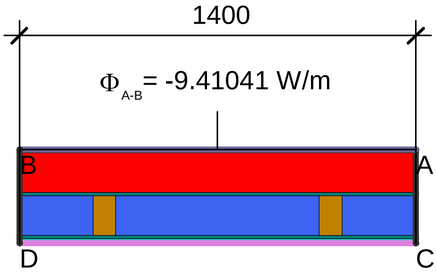


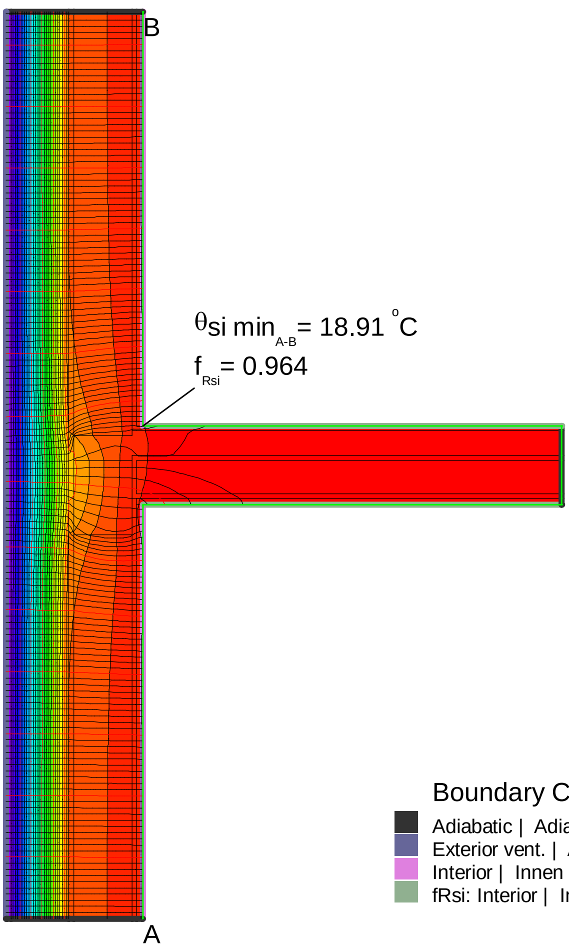


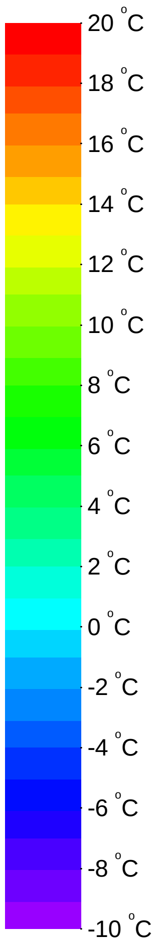
$$U_{eq\,A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

Material	λ[W/(m·K)]	ε
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board I Gipskartonplatten 900 kg/m3 10456	0.250	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, aufwärts, Dicke: 80 mm	0.500	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

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

$$\psi_{A-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 = \frac{14.548}{30.000} - 0.224 \cdot 2.191 = -0.006\ W/(m \cdot K)$$





Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Interior | Innen		20.000	0.130	
fRsi: Interior | Innen		20.000	0.250	

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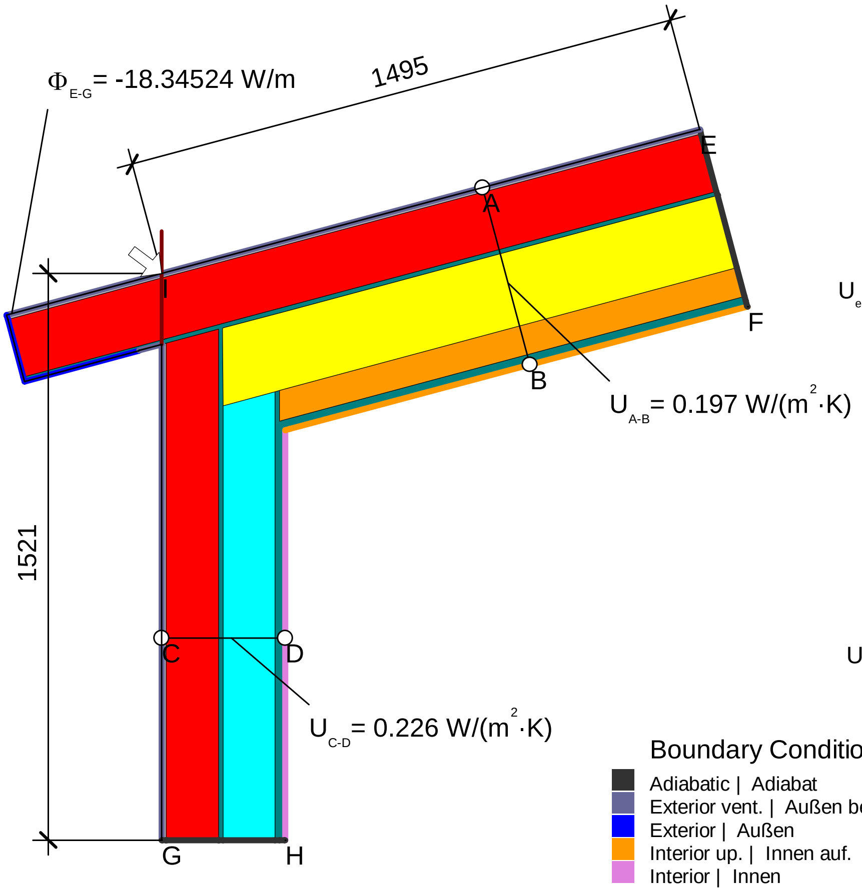
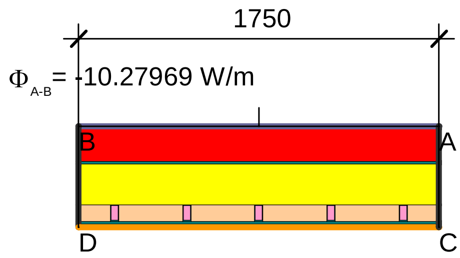
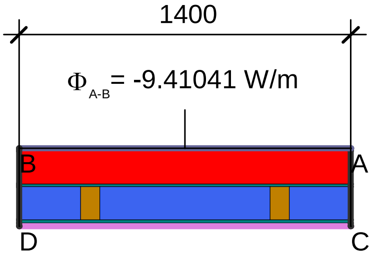




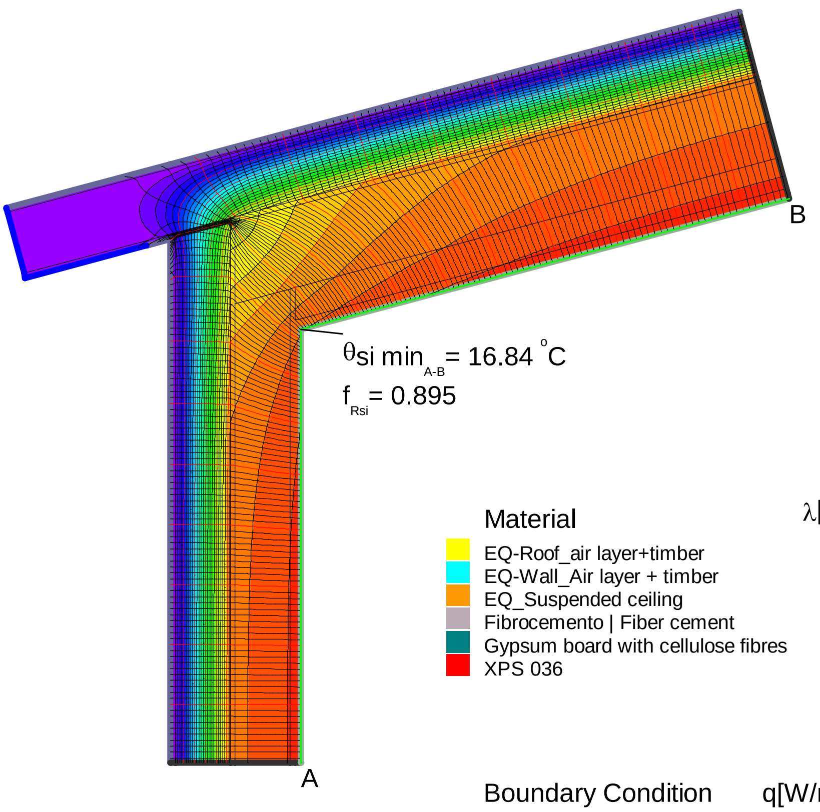
$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.280}{30.000 \cdot 1.750} = 0.196\ W/(m^2 \cdot K)$$

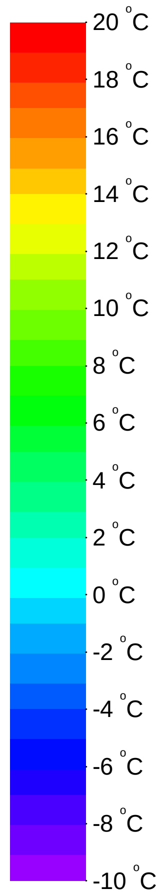


$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Exterior | Außen		-10.000	0.040	
Interior up. | Innen auf.		20.000	0.100	
Interior | Innen		20.000	0.130	

$$\psi_{E\text{-}I\text{-}G,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{18.345}{30.000} - 0.196 \cdot 1.495 - 0.224 \cdot 1.521 = -0.022\ W/(m \cdot K)$$



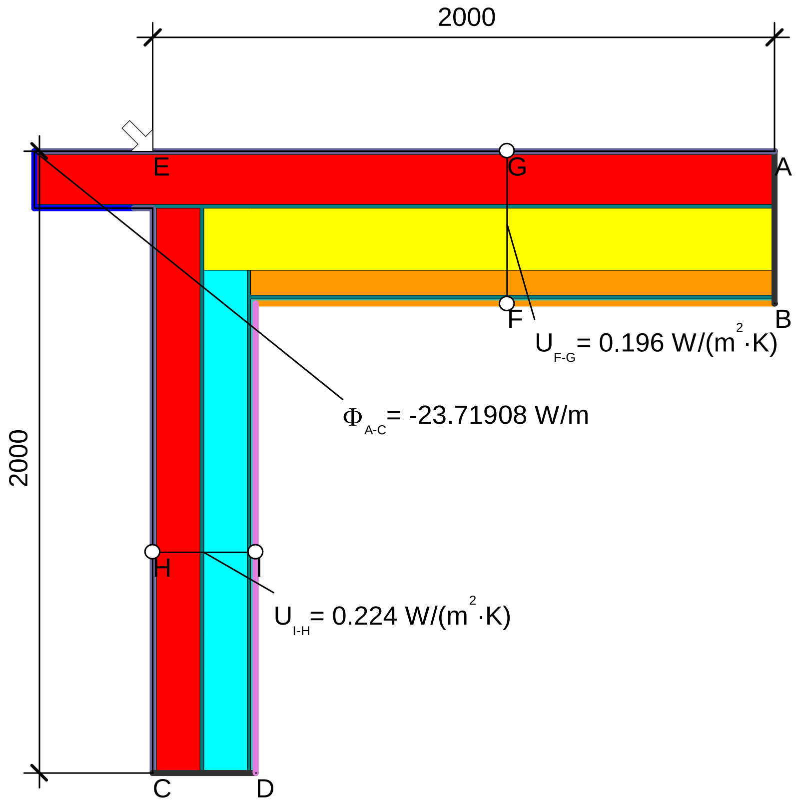


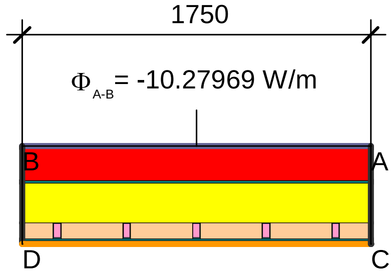
Material	λ[W/(m·K)]	ε
EQ-Roof_air layer+timber	0.920	0.900
EQ-Wall_Air layer + timber	0.666	0.900
EQ_Suspended ceiling	0.710	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board with cellulose fibres	0.669	0.900
XPS 036	0.036	0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Exterior | Außen		-10.000	0.040	
fRsi: Interior | Innen		20.000	0.250	

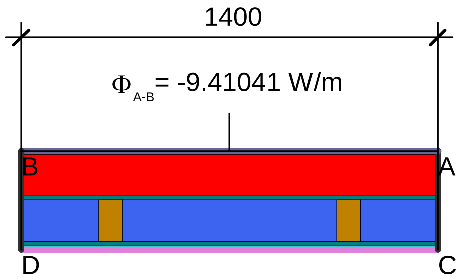
ROEA: EXTERIOR WALL-EAVES | DACH TRAUFEATTIKA

Passive House Institute





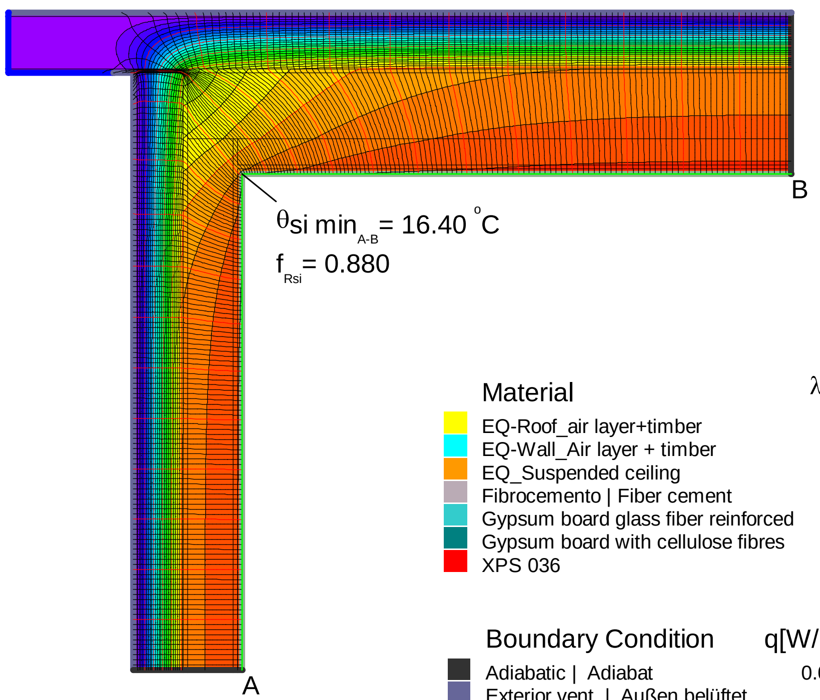
$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.280}{30.000 \cdot 1.750} = 0.196\ W/(m^2 \cdot K)$$



$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

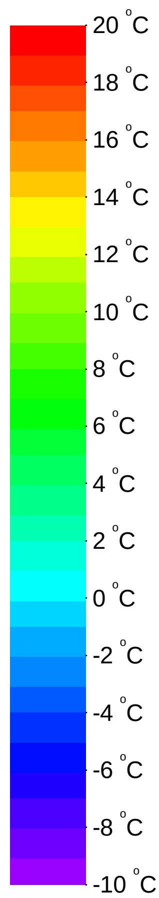
$$\Psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{23.719}{30.000} - 0.196 \cdot 2.000 - 0.224 \cdot 2.000 = -0.049\ W/(m \cdot K)$$

Boundary Condition	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Exterior | Außen		-10.000	0.040	
Interior up. | Innen auf.		20.000	0.100	
Interior | Innen		20.000	0.130	

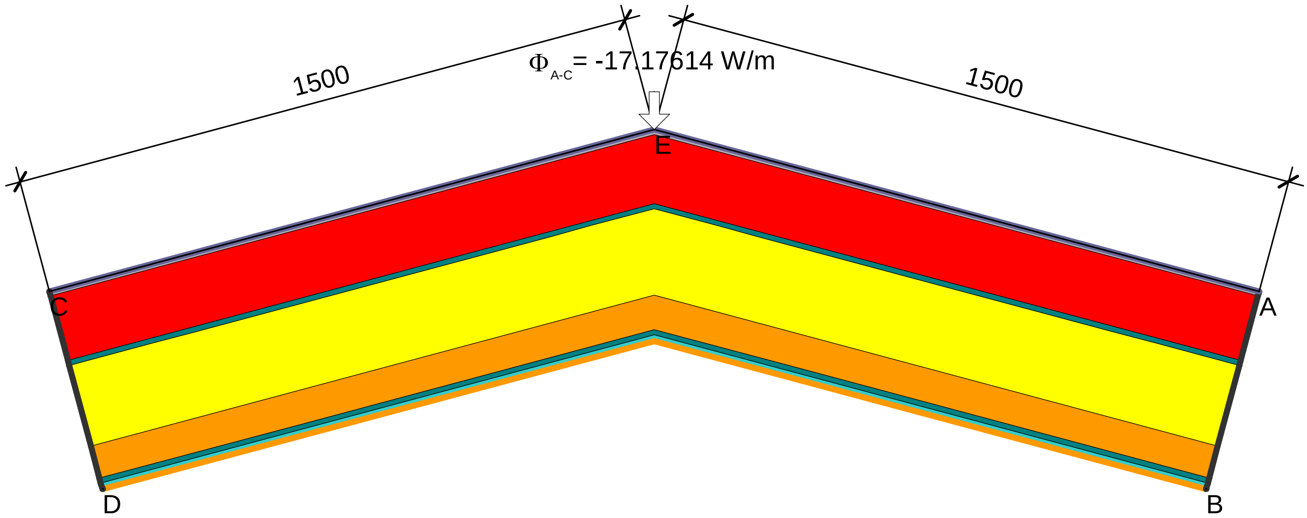


Material	$\lambda[W/(m \cdot K)]$	ε
EQ-Roof_air layer+timber	0.920	0.900
EQ-Wall_Air layer + timber	0.666	0.900
EQ_Suspended ceiling	0.710	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
XPS 036	0.036	0.900

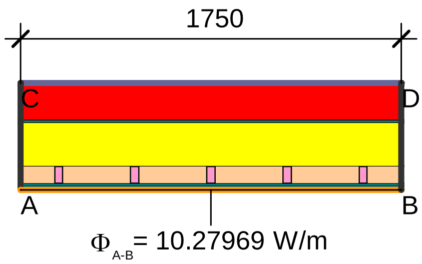
Boundary Condition	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Exterior | Außen		-10.000	0.040	
fRsi: Interior | Innen		20.000	0.250	



ROVE: ROOF VERGE | DACH ORTGANG



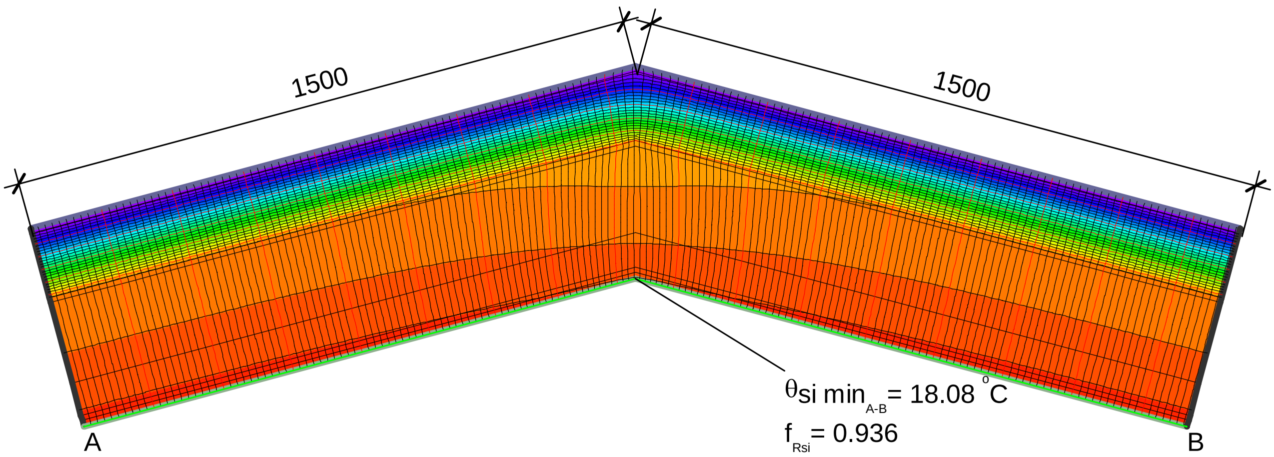
$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{17.176}{30.000} - 0.196 \cdot 1.500 - 0.196 \cdot 1.500 = -0.015 \text{ W/(m·K)}$$

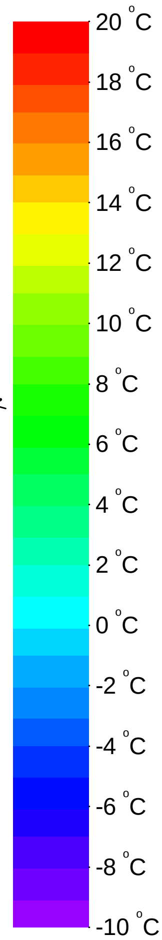


$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.280}{30.000 \cdot 1.750} = 0.196 \text{ W/(m}^2\text{·K)}$$

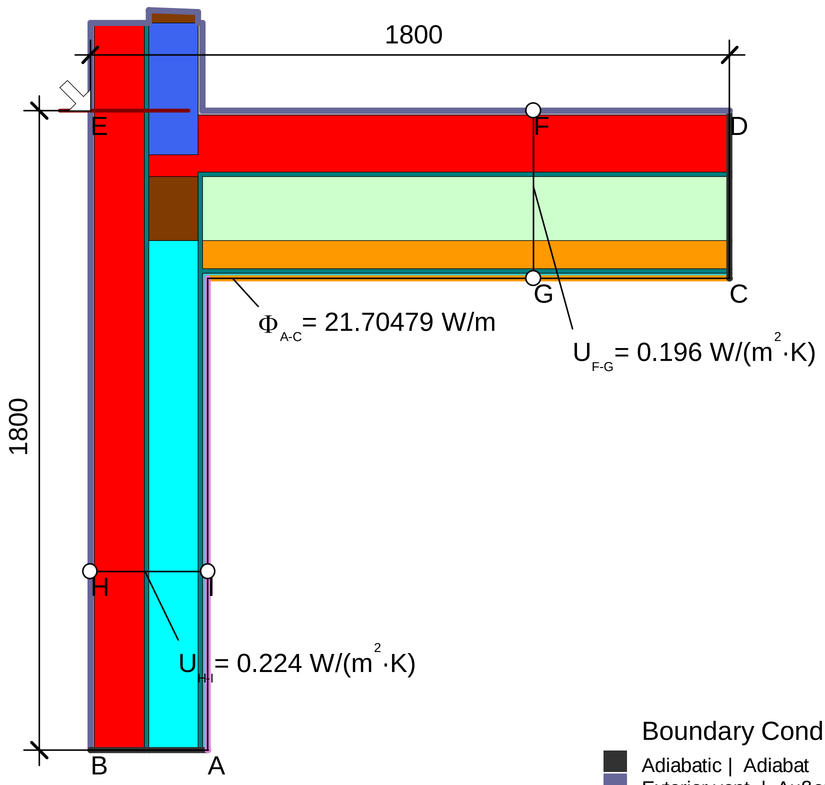
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Interior up. | Innen auf.		20.000	0.100	

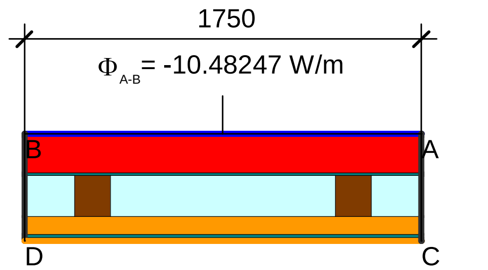
Material	λ[W/(m·K)]	ε
EQ-Roof_air layer+timber	0.920	0.900
EQ_Suspended ceiling	0.710	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
XPS 036	0.036	0.900



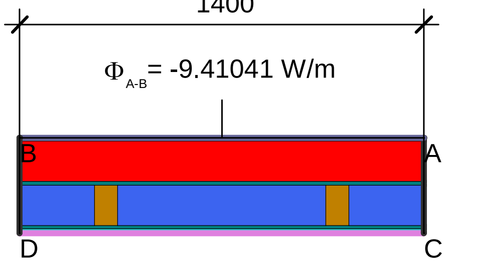


Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
fRsi: Interior | Innen		20.000	0.250	





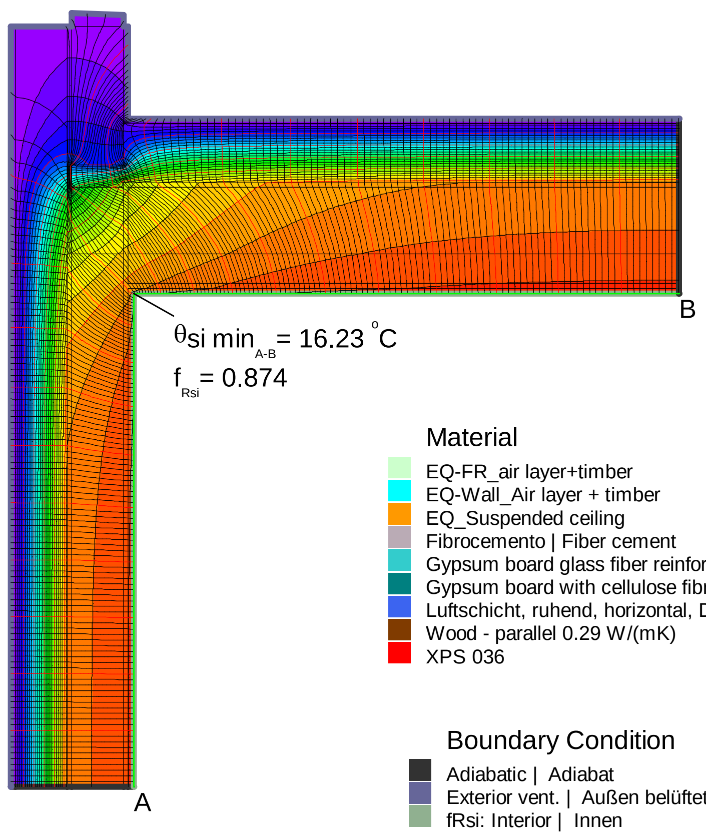
$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.482}{30.000 \cdot 1.750} = 0.200\ W/(m^2 \cdot K)$$



$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Interior up. | Innen auf.		20.000	0.100	
Interior | Innen		20.000	0.130	

$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{21.705}{30.000} - 0.224 \cdot 1.800 - 0.200 \cdot 1.800 = -0.039\ W/(m \cdot K)$$

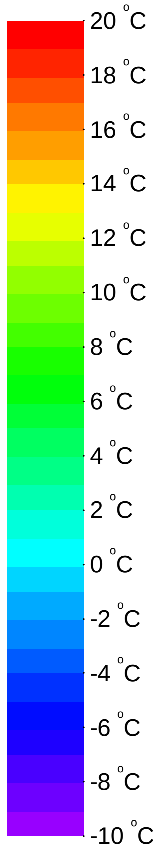


$\theta si\ min_{A-B}$ = 16.23 °C

f_{Rsi} = 0.874

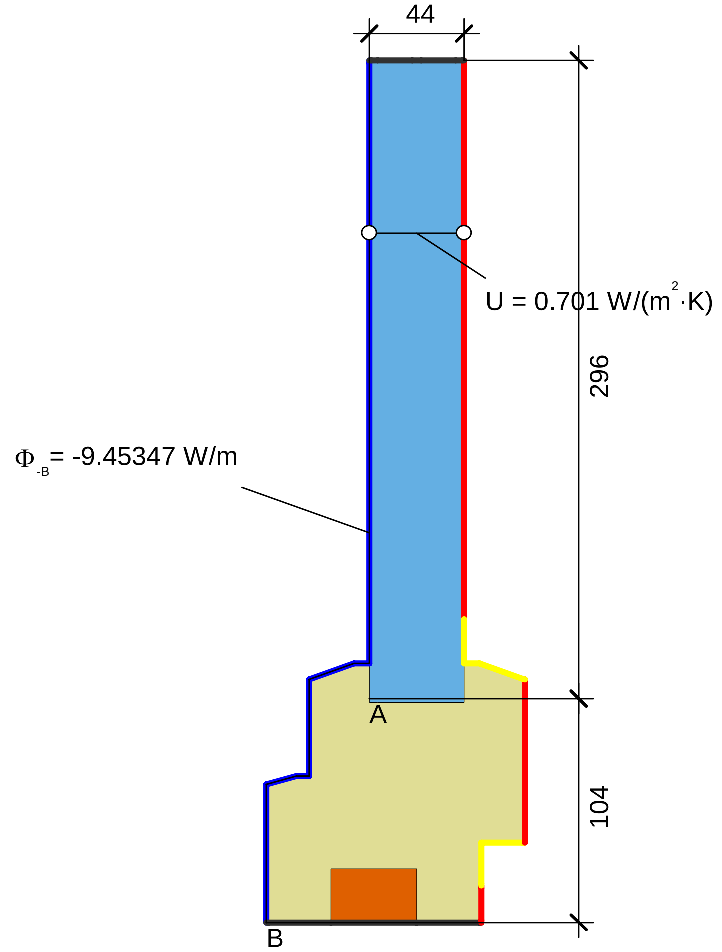
Material	λ[W/(m·K)]	ε
EQ-FR_air layer+timber	0.900	0.900
EQ-Wall_Air layer + timber	0.666	0.900
EQ_Suspended ceiling	0.710	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, horizontal, Dicke: 140 mm (1)	0.778	0.900
Wood - parallel 0.29 W/(mK)	0.290	0.900
XPS 036	0.036	0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
fRsi: Interior | Innen		20.000	0.250	



FRRP: FLAT ROOF-ROOF PARAPET | FLACHDACH-ATTIKA

	Passive House Unit		01			02			03			01
frame values | Rahmenwerte	Spacer I Abstandhalter: phA Spacer		Bottom Unten	Top Oben	Side Seitl.	Bottom Unten	Top Oben	Side Seitl.	Bottom Unten	Top Oben	Side Seitl.	Bottom barrier-free Unten barri-erefrei
	Frame width Rahmenbreite	b_f [mm]	120	120	120							
	U-value frame Rahmen-U-Wert	**Uf** [W/(m²K)]	0.99	0.99	0.99							
	Ψ-glass edge Glasrand-Ψ-Wert	**Ψg** [W/(mK)]	0.028	0.028	0.028							
	U-value window Fenster-U-Wert	**Uw** [W/(m²K)] @U_g = 0,70 W/(m²K)	**0.998**									
	Passive House effiziency class Passivhaus Effizienzklasse		**phC**									
Installation | Einbau		$f_{Rsi=0,25m^2K/W}$	0.801	0.789	0.798							
		$\Psi_{install}$ [W/(mK)]	0.015	0.005	0.009							
		$U_{W, installed}$ [W/(m²K)]	1.03									

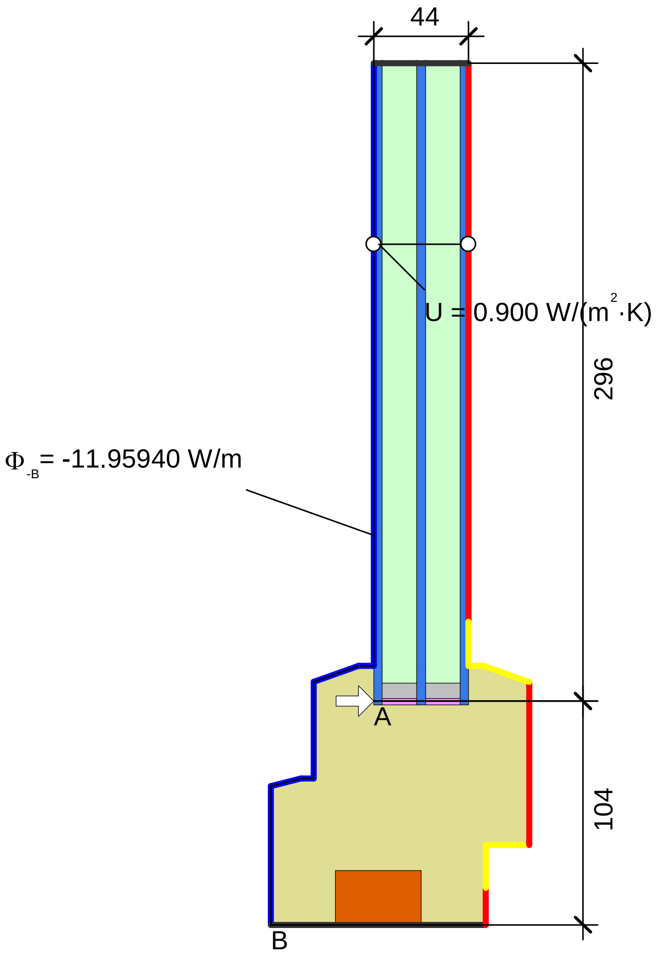


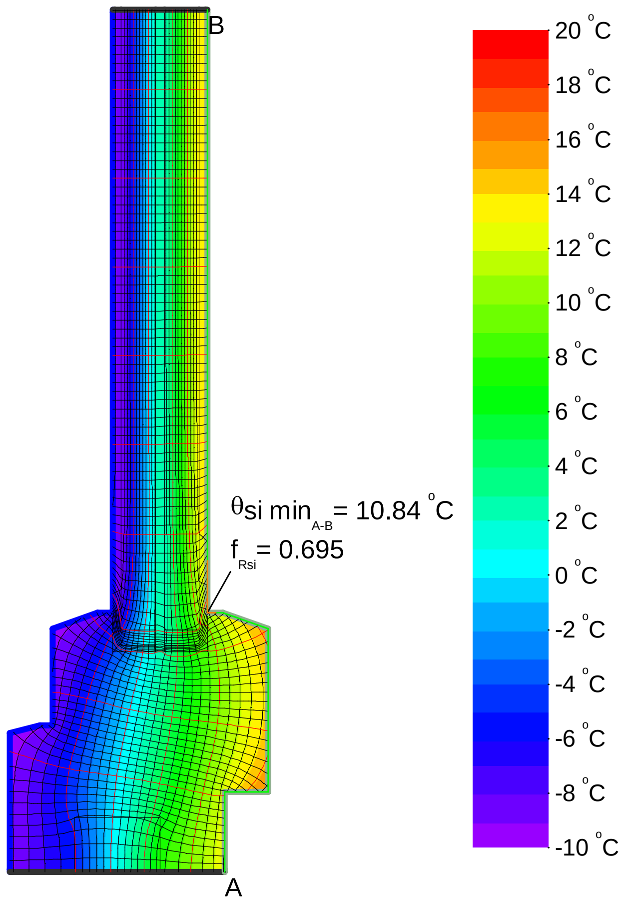
Material	λ[W/(m·K)]	ε
Insulation I Wärmedämmung 050	0.050	0.900
Panel I Maske	0.035	0.900
Softwood, OSB I Weichholz, OSB ISO 10456	0.130	0.900

Boundary Condition	$q[W/m^2]$	$\theta[^{\circ}C]$	$R[(m^2\cdot K)/W]$	ε
Adiabatic	0.000			
Aussen Standard		-10.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	

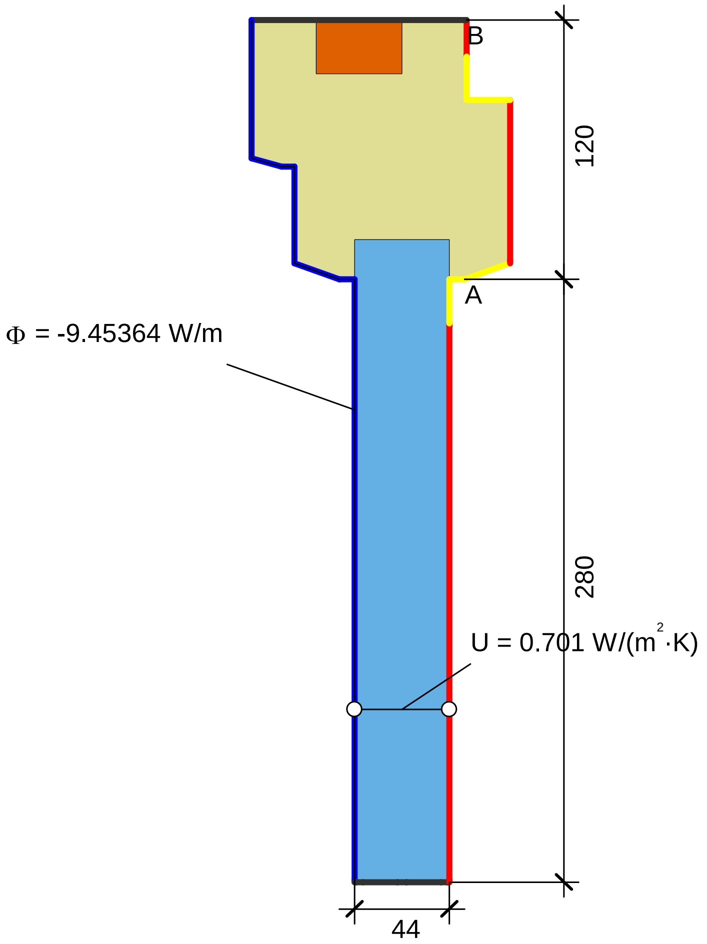
Boundary Condition	$q[W/m^2]$	$\theta[^{\circ}C]$	$R[(m^2\cdot K)/W]$	ε
Adiabatic	0.000			
Aussen Standard		-10.000	0.040	
fRsi: Interior | Innen		20.000	0.250	

$$U_{f\,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{9.453}{30.000} - 0.701\cdot 0.296}{0.104} = 1.036\ W/(m^2\cdot K)$$





$$\Psi_{ed\,A} = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{11.959}{30.000} - 0.900\cdot 0.296 - 1.036\cdot 0.104 = 0.025\ W/(m\cdot K)$$

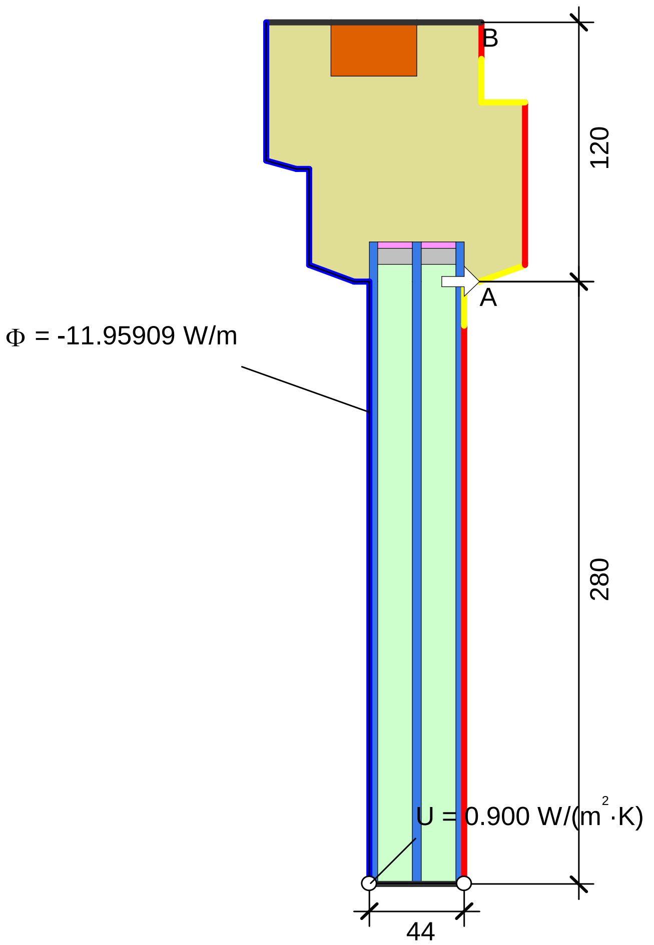


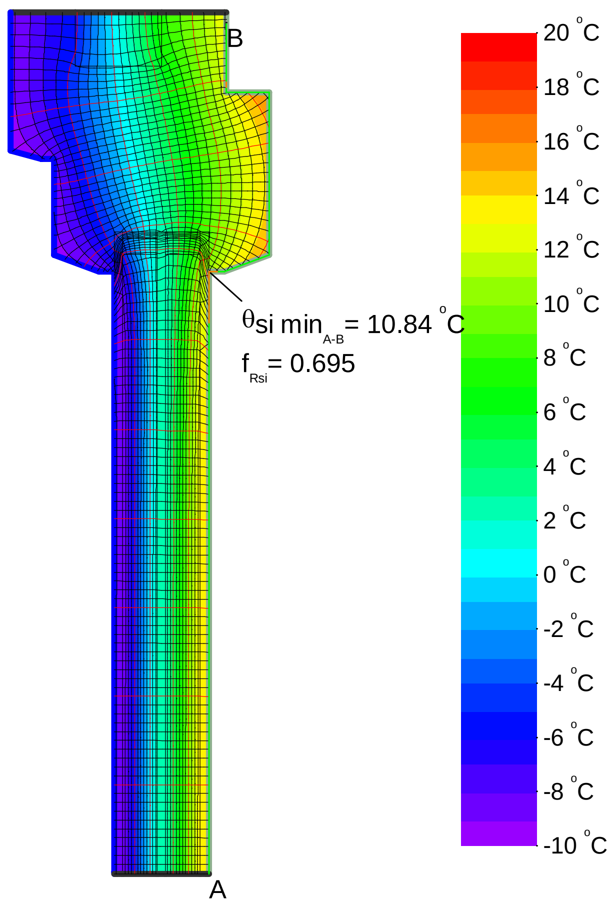
Material	λ[W/(m·K)]	ε
Insulation I Wärmedämmung 050	0.050	0.900
Panel I Maske	0.035	0.900
Softwood, OSB I Weichholz, OSB ISO 10456	0.130	0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Aussen Standard		-10.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Aussen Standard		-10.000	0.040	
fRsi: Interior | Innen		20.000	0.250	

$$U_{f\,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{9.454}{30.000} - 0.701 \cdot 0.280}{0.120} = 0.990\ W/(m^2 \cdot K)$$

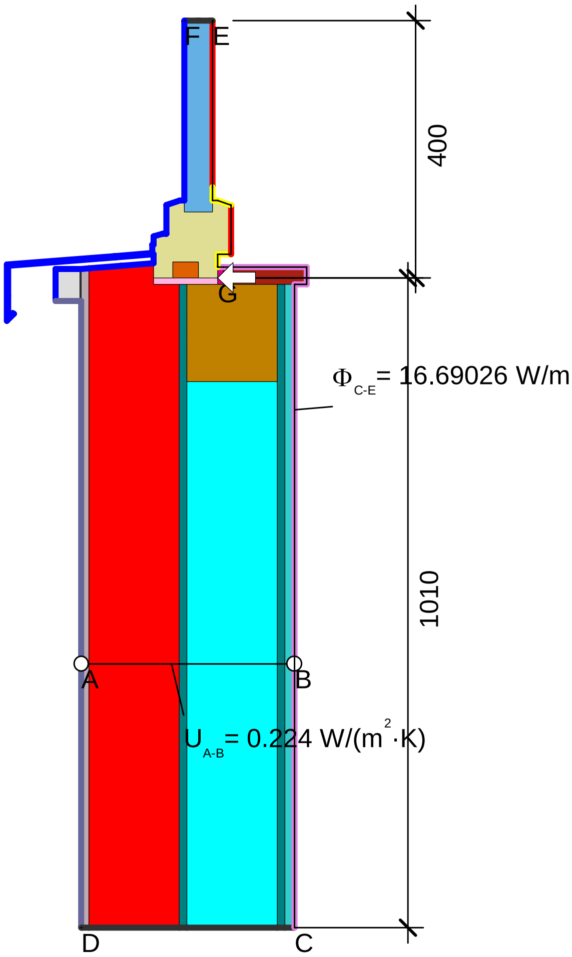


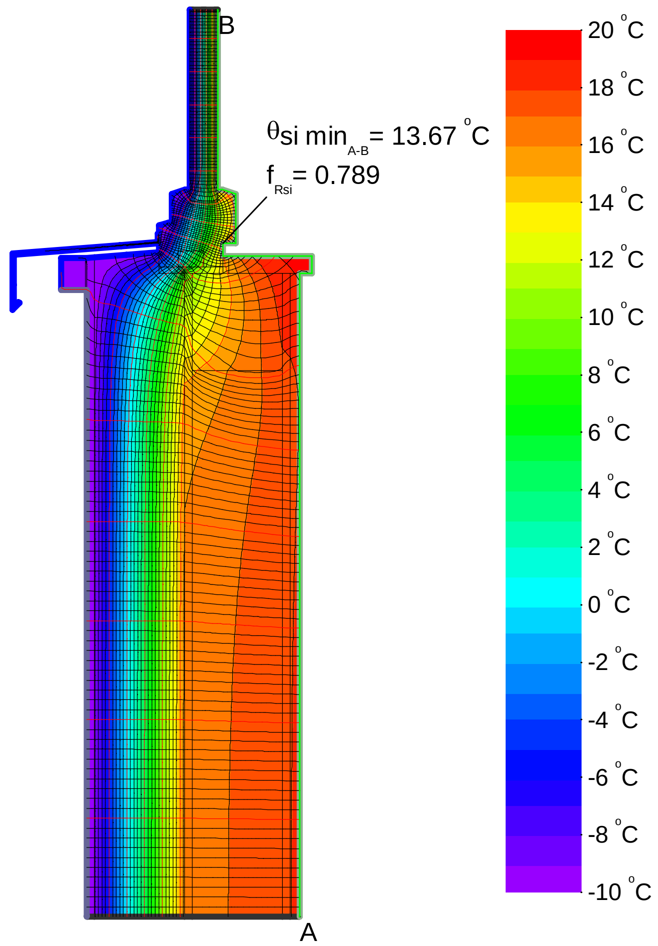


$$\psi_{ed\,A} = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{11.959}{30.000} - 0.900 \cdot 0.280 - 0.990 \cdot 0.120 = 0.028\ W/(m \cdot K)$$

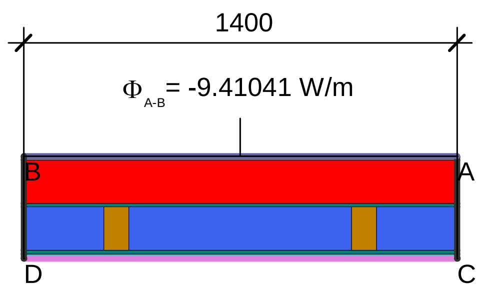
TO: TOP | OBEN

Passive House Institute





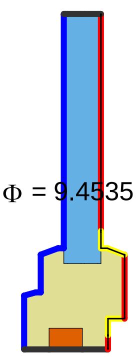
$$\psi_{C\text{-}G\text{-}E,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{16.690}{30.000} - 0.224 \cdot 1.010 - \frac{9.453}{30.000} = 0.015 \text{ W/(m·K)}$$



$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2\text{·K)}$$

Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160.000	0.900
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Hardwood I Hartholz 0.18 700 kg/m3 10456	0.180	0.900
Insulation I Wärmedämmung 050	0.050	0.900
PU in-situ foam I PU-Ortschaum 040	0.040	0.900
Panel I Maske	0.035	0.900
Silicone I Silikon	0.350	0.900
Softwood, OSB I Weichholz, OSB ISO 10456	0.130	0.900
Unvent. cavity I unbel. Hohlr. *		
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

* EN ISO 10077-2:2017, 6.4.3



Φ = 9.4535 W/m

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Exterior | Außen		-10.000	0.040	
Interior | 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

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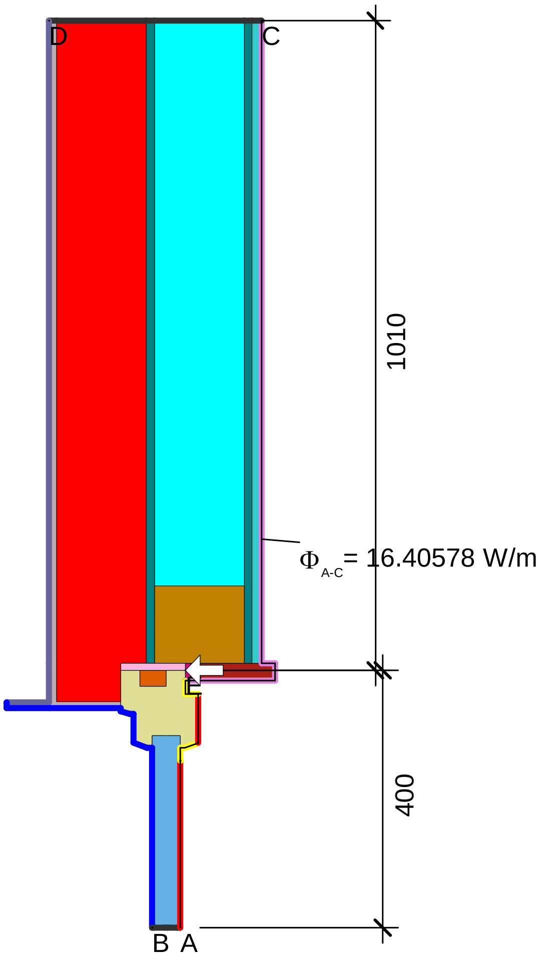
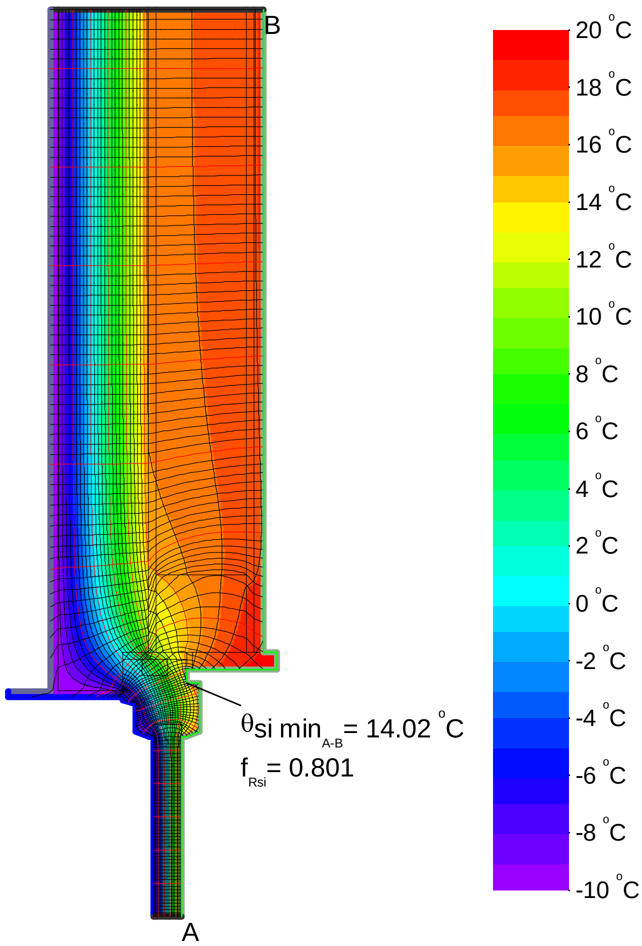
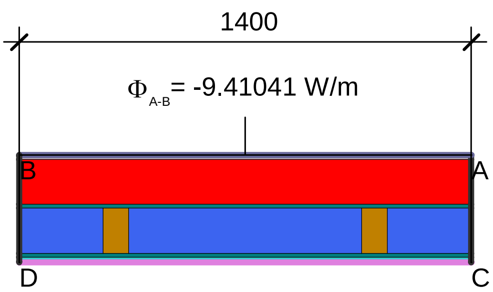
WIBO: BOTTOM-WALL | FENSTERANSCHLUSS UNTEN





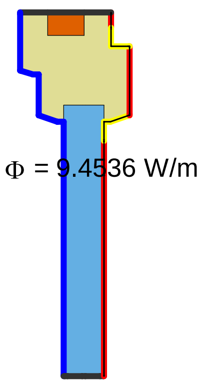
$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_I}{\Delta T} - U_2 \cdot b_2 = \frac{16.406}{30.000} - \frac{9.454}{30.000} - 0.224 \cdot 1.010 = 0.005 \text{ W/(m·K)}$$

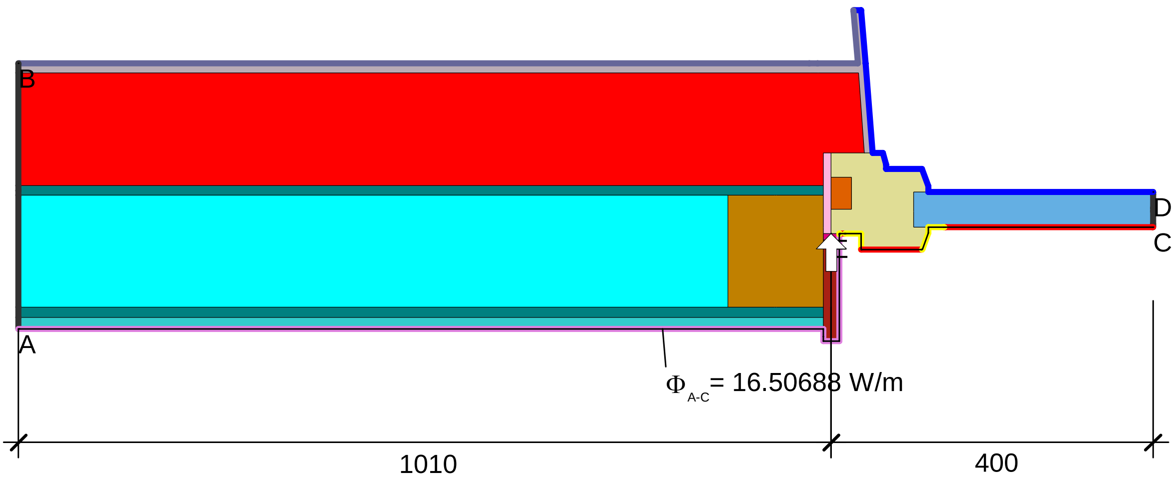


$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2\text{·K)}$$

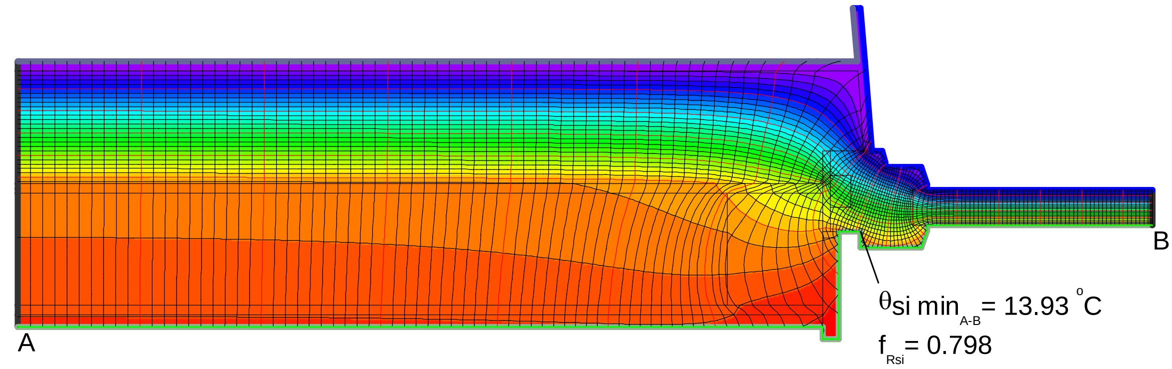
Material	λ[W/(m·K)]	ε
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Hardwood I Hartholz 0.18 700 kg/m3 10456	0.180	0.900
Insulation I Wärmedämmung 050	0.050	0.900
PU in-situ foam I PU-Ortschaum 040	0.040	0.900
Panel I Maske	0.035	0.900
Silicone I Silikon	0.350	0.900
Softwood, OSB I Weichholz, OSB ISO 10456	0.130	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

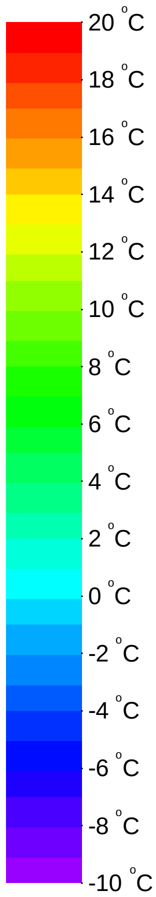
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Aussen Standard		-10.000	0.040	
Exterior vent. | Außen belüftet		-10.000	0.130	
Interior I Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	

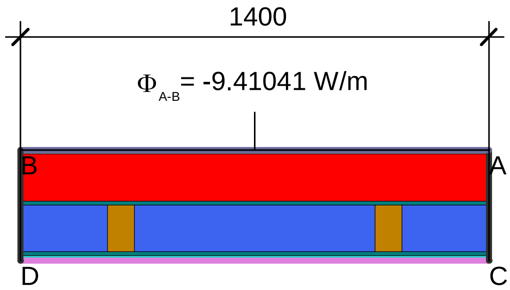




$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{16.507}{30.000} - 0.224 \cdot 1.010 - \frac{9.454}{30.000} = 0.009 \text{ W/(m·K)}$$



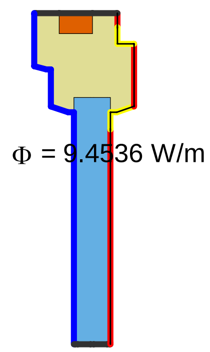




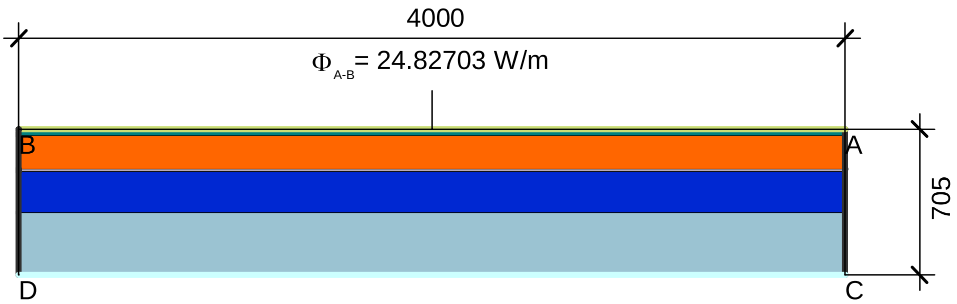
$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2\text{·K)}$$

Material	λ[W/(m·K)]	ε
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Hardwood I Hartholz 0.18 700 kg/m3 10456	0.180	0.900
Insulation I Wärmedämmung 050	0.050	0.900
PU in-situ foam I PU-Ortschaum 040	0.040	0.900
Panel I Maske	0.035	0.900
Silicone I Silikon	0.350	0.900
Softwood, OSB I Weichholz, OSB ISO 10456	0.130	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic | Adiabat	0.000			
Exterior vent. | Außen belüftet		-10.000	0.130	
Exterior | Außen		-10.000	0.040	
Innen Fensterrahmen Reduziert		20.000	0.200	
Innen Fensterrahmen Standard		20.000	0.130	
Interior | Innen		20.000	0.130	



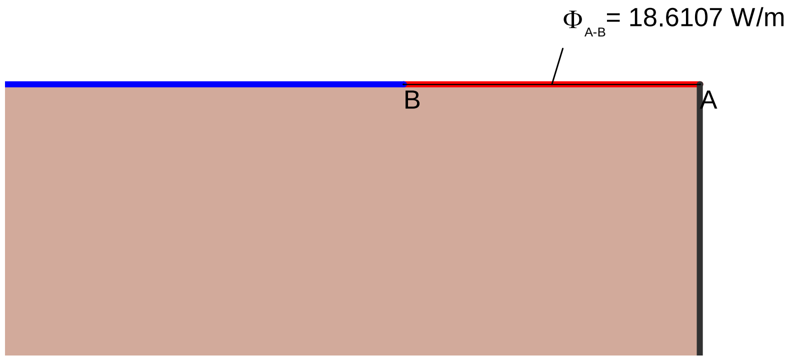
Constructions to ground | Erdberührte Bauteile



$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{24.827}{30.000 \cdot 4.000} = 0.207\ W/(m^2 \cdot K)$$

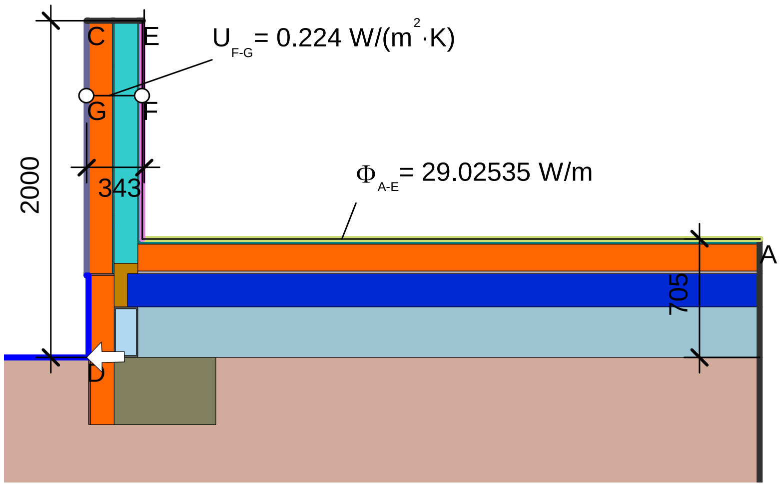
Material	λ[W/(m·K)]	ε
Fibrocemento | Fiber cement	1.200	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, schwach belüftet, aufwärts, Dicke: 200 mm	2.500	0.900
Luftschicht, schwach belüftet, aufwärts, Dicke: 300 mm	3.750	0.900
XPS 036	0.036	0.900

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

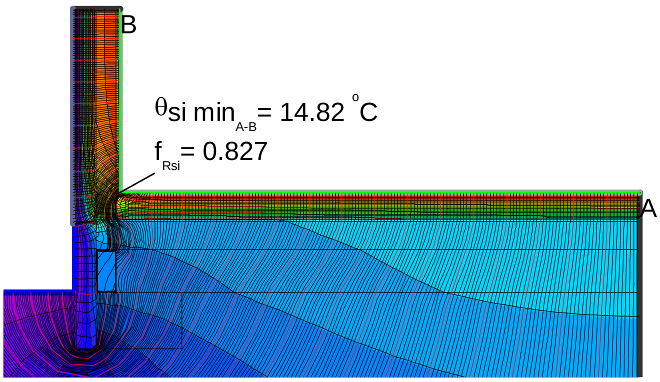


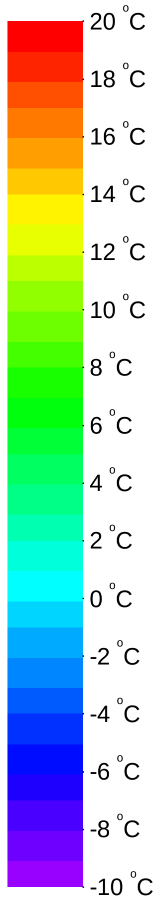
Material	λ[W/(m·K)]	ε
Ground I Erdreich	2.000	0.900

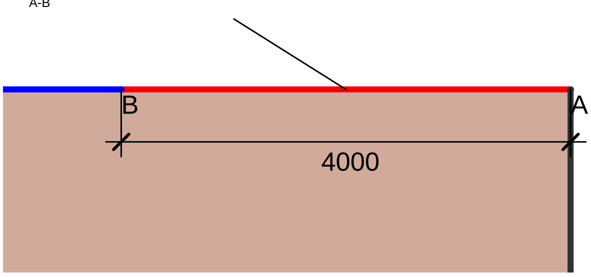
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]
EQ FS: 1/Ufs		20.000	4.833
Exterior I Außen		-10.000	0.040
Adiabatic I Adiabatisch	0.000		



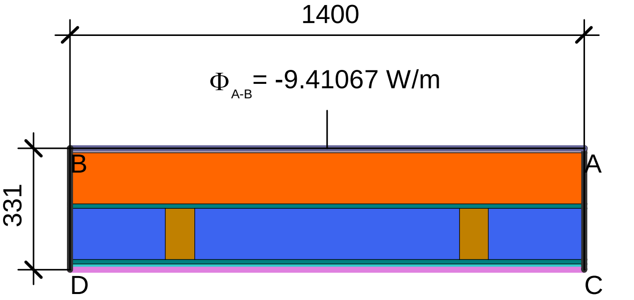
$$\psi_{A\text{-}D\text{-}E,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{29.025}{30.000} - \frac{18.611}{30.000} - 0.224 \cdot 2.000 = -0.101\ \text{W/(m·K)}$$







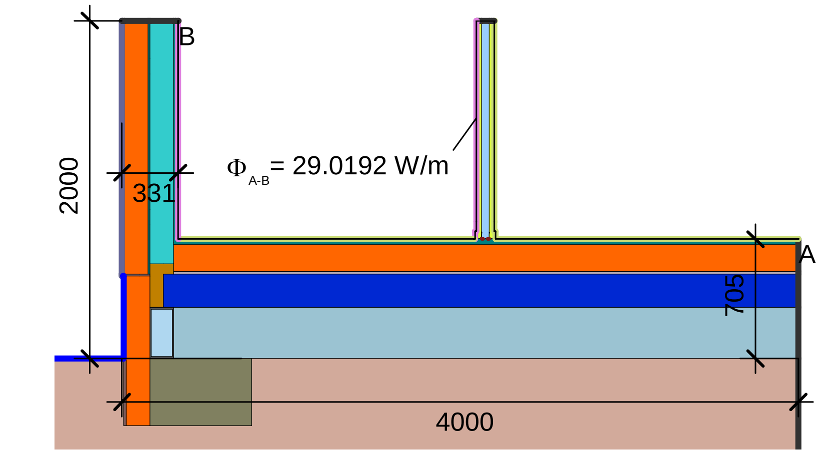
Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160.000	0.900
Concrete, 1% Steel I Beton, 1% Stahl ISO 10456	2.300	0.900
EPDM	0.250	0.900
EQ-Wall_Air layer + timber	0.656	0.900
Fibrocemento | Fiber cement	1.200	0.900
Ground I Erdreich	2.000	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, horizontal, Dicke: 280 mm	1.556	0.900
Luftschicht, schwach belüftet, aufwärts, Dicke: 200 mm	2.500	0.900
Luftschicht, schwach belüftet, aufwärts, Dicke: 300 mm	3.750	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900



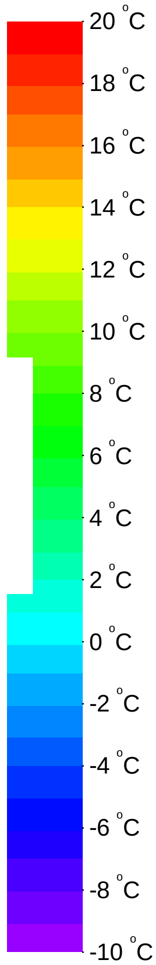
$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.411}{30.000 \cdot 1.400} = 0.224\ \text{W/(m}^2\text{·K)}$$

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

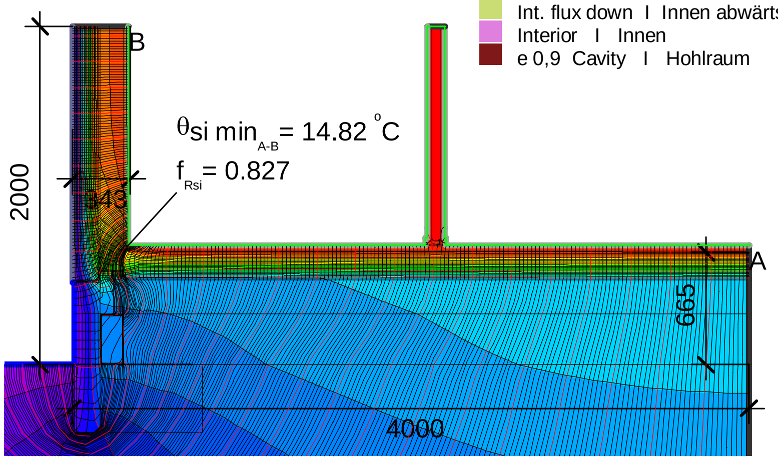
Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic	0.000			
Adiabatic | Adiabat	0.000			
Exterior I Außen		-10.000	0.040	
Exterior vent. | Außen belüftet		-10.000	0.130	
fRsi: Interior I Innen		20.000	0.250	



$\Psi_{FSIW} = (Q_{FSIW} - Q_{FSEW}) / \Delta T = (29.0192 - 28.9846) / 30 = 0{,}001$ W/mK

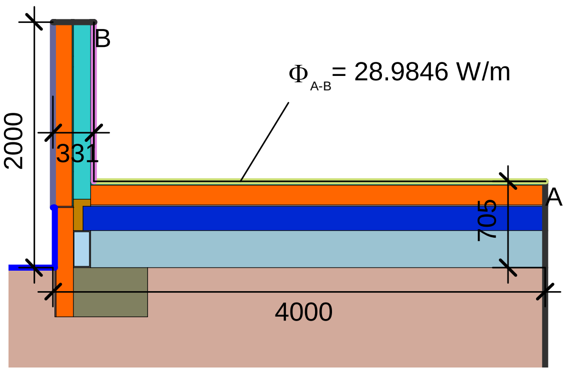


Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic I Adiabatisch	0.000			
Adiabatic | Adiabat	0.000			
Exterior I Außen		-10.000	0.040	
Exterior vent. | Außen belüftet		-10.000	0.130	
Int. flux down I Innen abwärts		20.000	0.170	
Interior I Innen		20.000	0.130	
e 0,9 Cavity I Hohlraum				0.900

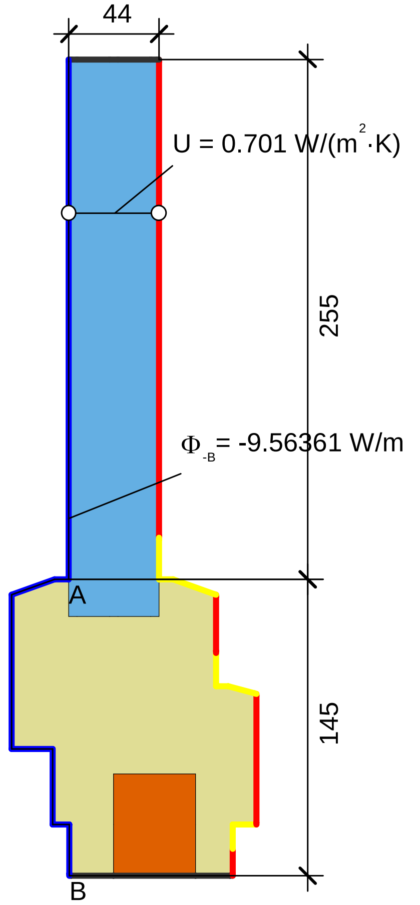


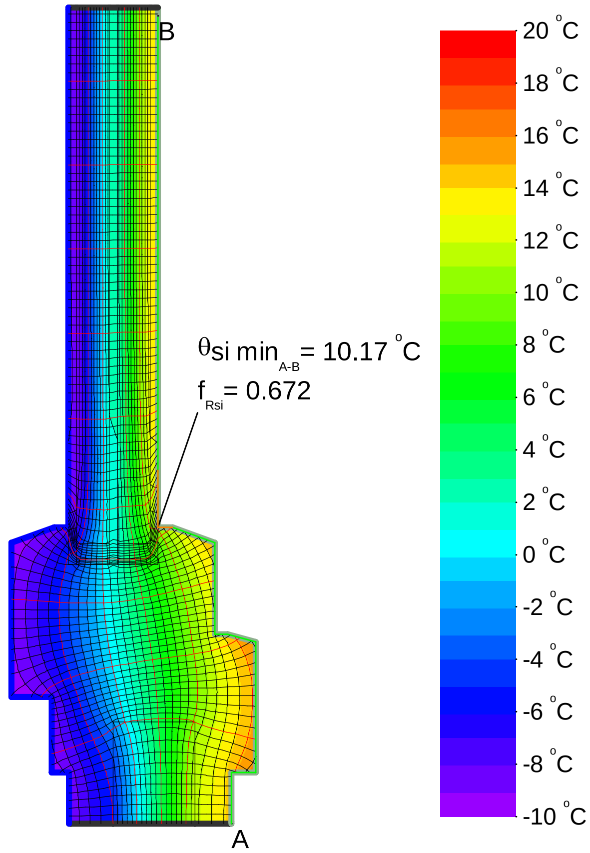
Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160.000	0.900
Concrete, 1% Steel I Beton, 1% Stahl ISO 10456	2.300	0.900
EPDM	0.250	0.900
EQ-Wall_Air layer + timber	0.656	0.900
Eq_1 Service Cavity	0.046	0.900
Fibrocemento | Fiber cement	1.200	0.900
Gips 1500 kg/m3	0.560	0.900
Ground I Erdreich	2.000	0.900
Gypsum board I Gipskartonplatten 900 kg/m3 10456	0.250	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Knauf Ultracoustic Suelo TP 037 +10%	0.041	0.900
Luftschicht, ruhend, horizontal, Dicke: 280 mm	1.556	0.900
Luftschicht, schwach belüftet, aufwärts, Dicke: 200 mm	2.500	0.900
Luftschicht, schwach belüftet, aufwärts, Dicke: 300 mm	3.750	0.900
Polyethylenschaum	0.050	0.900
Steel I Stahl	50.000	0.900
Unvent. cavity I unbel. Hohlr. *		
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

* EN ISO 10077-2:2017, 6.4.3

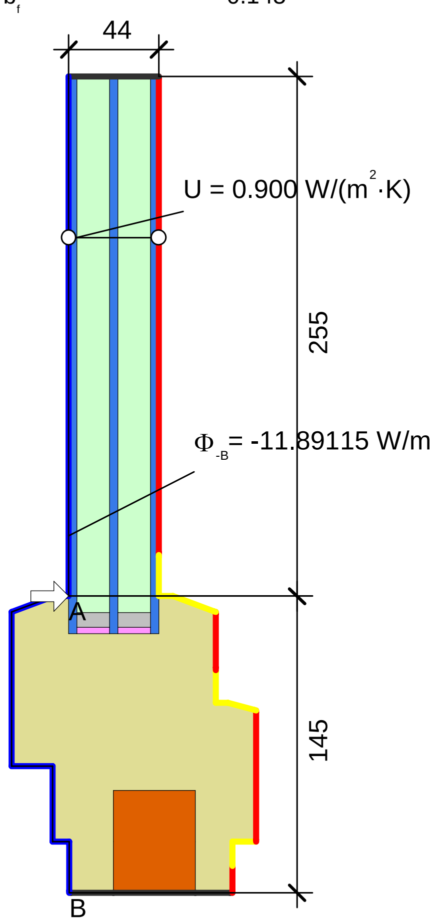


FLOOR SLAB-INTERNAL WALL | BODENPLATTE-INNENWAND





$$U_{f\,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{9.564}{30.000} - 0.701 \cdot 0.255}{0.145} = 0.966\ \mathrm{W/(m^2 \cdot K)}$$



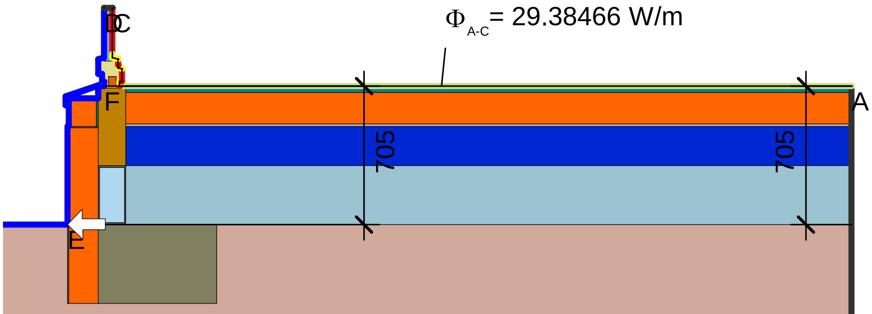
Material	λ[W/(m·K)]	ε
Ar16 in 44 mm U 0,9	0.034	0.900
Glass / Glas	1.000	0.900
Insulation I Wärmedämmung 050	0.050	0.900
Polysulfide / Polysulfid	0.400	0.900
Softwood, OSB I Weichholz, OSB ISO 10456	0.130	0.900
phA-Spacer	0.200	0.900

Boundary Condition	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Adiabatic I Adiabatisch	0.000			
Adiabatic | Adiabat	0.000			
Aussen Standard		-10.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	

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

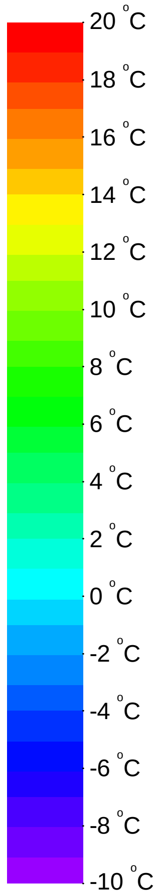
$$\psi_{ed\,A} = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{11.891}{30.000} - 0.900 \cdot 0.255 - 0.966 \cdot 0.145 = 0.027\ \mathrm{W/(m \cdot K)}$$

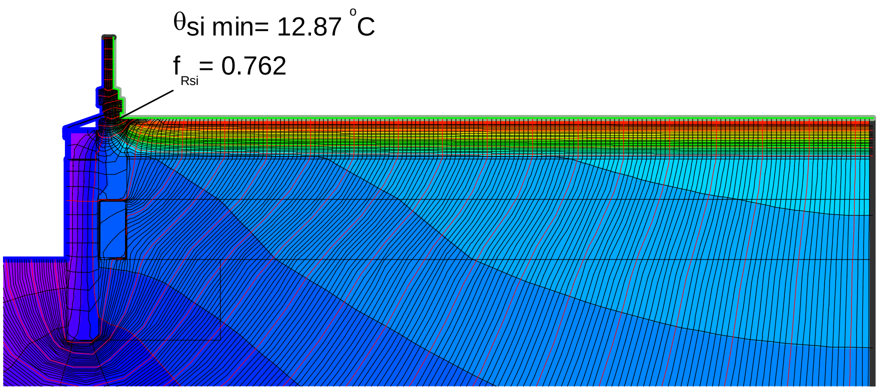
DOOR BOTTOM | TÜR UNTEN

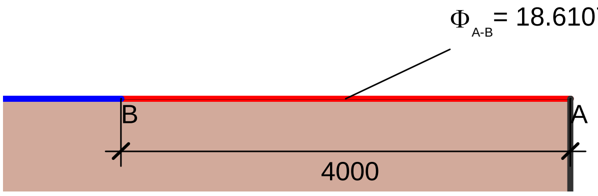


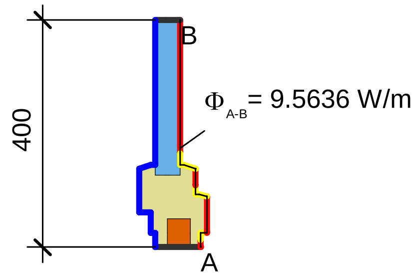
$$\Psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 - \frac{\Phi_3}{\Delta T} = \frac{29.385}{30.000} - \frac{18.611}{30.000} - 0.224 \cdot 0.705 - \frac{9.564}{30.000} = -0.118 \text{ W/(m·K)}$$

$\Psi_{WITH} = \Psi_{FSEW+WITH} - \Psi_{FSEW01} = -0.118 – (-0.101) = -0.017$ W/mK

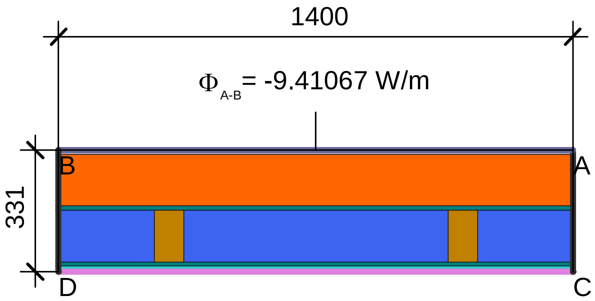








Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160.000	0.900
Concrete, 1% Steel I Beton, 1% Stahl ISO 10456	2.300	0.900
EPDM	0.250	0.900
Fibrocemento | Fiber cement	1.200	0.900
Ground I Erdreich	2.000	0.900
Gypsum board with cellulose fibres	0.669	0.900
Insulation I Wärmedämmung 050	0.050	0.900
Luftschicht, ruhend, horizontal, Dicke: 280 mm	1.556	0.900
Luftschicht, schwach belüftet, aufwärts, Dicke: 200 mm	2.500	0.900
Luftschicht, schwach belüftet, aufwärts, Dicke: 300 mm	3.750	0.900
PU in-situ foam I PU-Ortschaum 040	0.040	0.900
Panel I Maske	0.035	0.900
Softwood, OSB I Weichholz, OSB ISO 10456	0.130	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900



$$U_{eq\,A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.411}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2\text{·K)}$$

Boundary Condition	$q[W/m^2]$	θ[°C]	$R[(m^2·K)/W]$	ε
Adiabatic | Adiabat	0.000			
Exterior | Außen		-10.000	0.040	
Int. flux down I Innen abwärts		20.000	0.170	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	

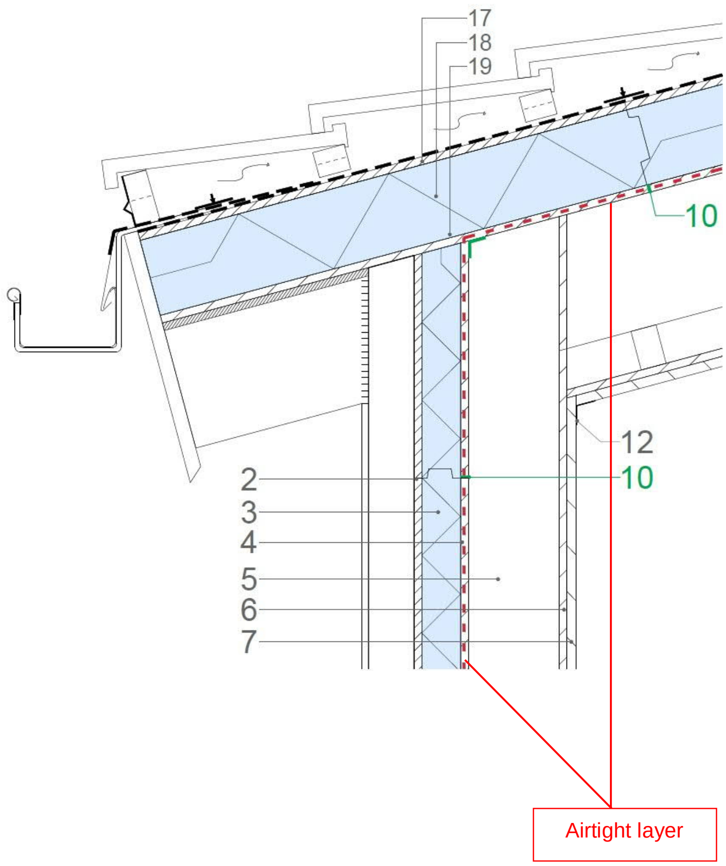
Boundary Condition	$q[W/m^2]$	θ[°C]	$R[(m^2·K)/W]$	ε
Adiabatic | Adiabat	0.000			
Exterior | Außen		-10.000	0.040	
fRsi: Interior I Innen		20.000	0.250	

Passive House Institute

Appendix 3: Manufacturers drawings | Zeichnungen des Herstellers

Lightweight timber construction **Parapet wall connection to flat roof**	Abbreviation Detail_SC-01	THERMOCHIP

Design drawing **– Vertical cross-section**



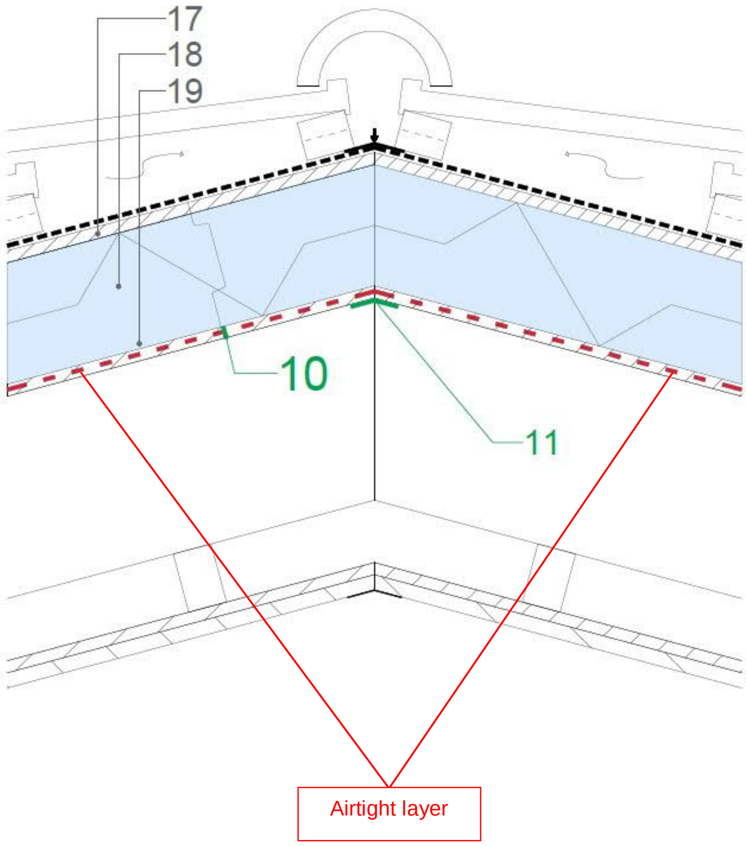
Airtight layer

The airtight layer is the interior gypsum fibre board of the outer panel. Joints and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.

	From the inside towards the outside	λ [W/(mK)]	Thick ness [cm]		From the inside towards the outside	λ [W/(mK)]	Thick ness [cm]
Standard component : Exterior wall (AW_01)				Standard component: Flat roof (DA_01)			
7	Gypsum board glass fibre reinforced	0.250	1.50	23	Gypsum board glass fibre reinforced	0.250	1.50
6	Gypsum fibreboard	0.669	12.5	22	Gypsum fibreboard	0.669	1.25
5	Air layer + timber studs	0.654	14.0	20	Air layer + steal substructure	0.710	8.0
4	Gypsum fibreboard **(Airtight layer)**	0.669	1.25	20	Air layer + timber studs	0.920	20.0
3	XPS(2*80)	0.036	16.00	19	Gypsum fibreboard **(Airtight layer)**	0.669	1.25
2	Fibro-cement board	1.200	1.25	18	XPS (2*80)	0.036	16.0
				17	Fibro-cement board	1.200	1.25
Standard component :[---extend or delete as required---]				Other materials (materials not in the standard components)			
11	Soudal Soudatight SP airtight paint						
10	Fermacell Joint Filler + Soudal Soudatight SP airtight paint						

Lightweight timber construction **Top roof**	Abbreviation Detail_SC-02	THERMOCHIP

Design drawing – **Vertical cross-section**



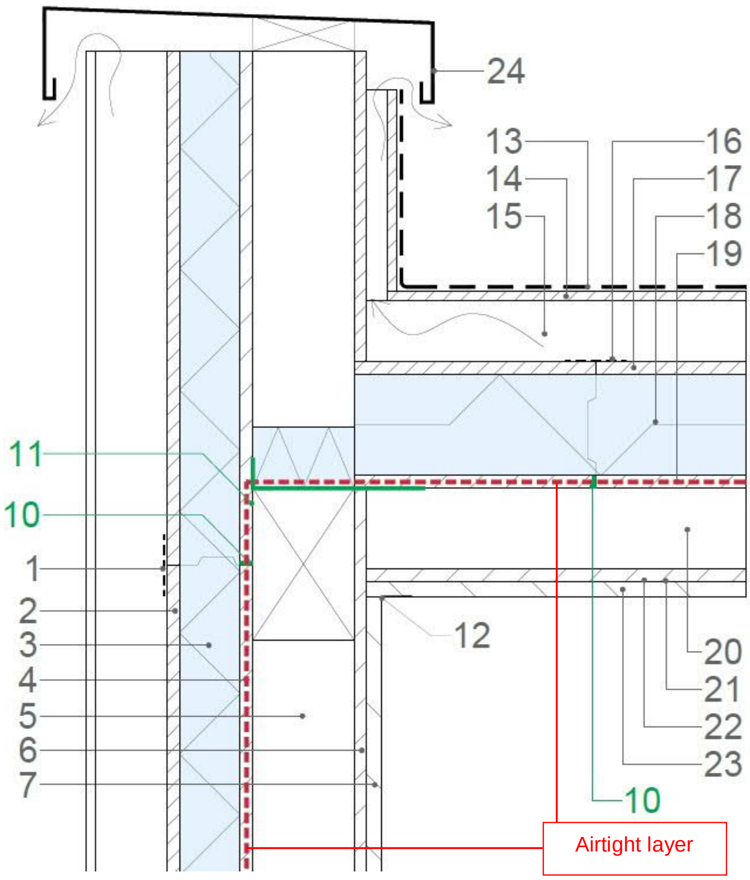
Airtight layer

The airtight layer is the interior gypsum fibre board of the outer panel. Joints and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.

From the inside towards the outside		λ [W/(mK)]	Thick ness [cm]	From the inside towards the outside		λ [W/(mK)]	Thick ness [cm]
Standard component : Exterior wall (AW_01)				Standard component: Flat roof (DA_01)			
9	Gypsum board glass fibre reinforced	0.250	1.50	23	Gypsum board glass fibre reinforced	0.250	1.50
8	Gypsum fibreboard	0.669	12.5	22	Gypsum fibreboard	0.669	1.25
5	Air layer + timber studs	0.654	14.0	20	Air layer + steal substructure	0.710	8.0
4	Gypsum fibreboard **(Airtight layer)**	0.669	1.25	20	Air layer + timber studs	0.920	20.0
3	XPS (2*80)	0.036	16.00	19	Gypsum fibreboard **(Airtight layer)**	0.669	1.25
2	Fibro-cement board	1.200	1.25	18	XPS (2*80)	0.036	16.0
				17	Fibro-cement board	1.200	1.25
Standard component :[---extend or delete as required---]				Other materials (materials not in the standard components)			
11 10	Soudal Soudatight SP airtight paint Fermacell Joint Filler + Soudal Soudatight SP airtight paint						

Lightweight timber construction **Parapet wall connection to flat roof**	Abbreviation Detail_SC-03	THERMOCHIP

Design drawing **– Vertical cross-section**



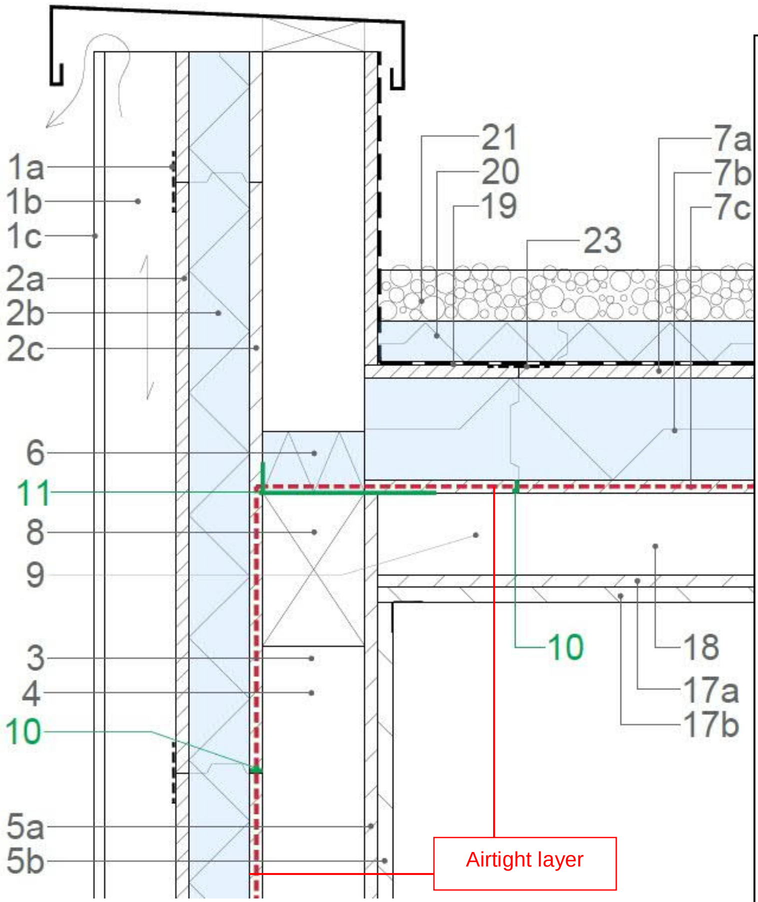
Airtight layer

The airtight layer is the interior gypsum fibre board of the outer panel. Joints and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.

From the inside towards the outside		λ [W/(mK)]	Thickness [cm]	From the inside towards the outside		λ [W/(mK)]	Thickness [cm]
Standard component : Exterior wall (AW_01)				Standard component: Flat roof (DA_01)			
9	Gypsum board glass fibre reinforced	0.250	1.50	23	Gypsum board glass fibre reinforced	0.250	1.50
8	Gypsum fibreboard	0.669	12.5	22	Gypsum fibreboard	0.669	1.25
5	Air layer + timber studs	0.654	14.0	20	Air layer + steal substructure	0.710	8.0
4	Gypsum fibreboard **(Airtight layer)**	0.669	1.25	20	Air layer + timber studs	0.920	20.0
3	XPS (2*80)	0.036	16.00	19	Gypsum fibreboard **(Airtight layer)**	0.669	1.25
2	Fibro-cement board	1.200	1.25	18	XPS (2*80)	0.036	16.0
				17	Fibro-cement board	1.200	1.25
Standard component :[---extend or delete as required---]				Other materials (materials not in the standard components)			
11	Soudal Soudatight SP airtight paint						
10	Fermacell Joint Filler + Soudal Soudatight SP airtight paint						

Lightweight timber construction **Parapet wall connection to flat roof**	Abbreviation Detail_SC-04	THERMOCHIP

Design drawing – **Vertical cross-section**



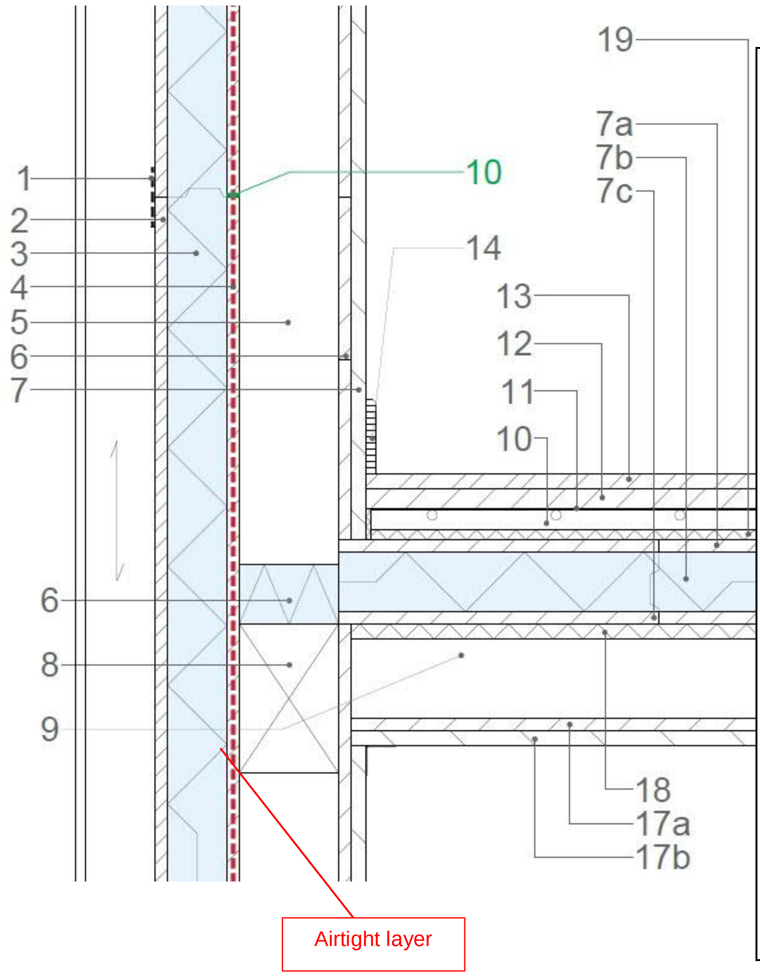
Airtight layer

The airtight layer is the interior gypsum fibre board of the outer panel. Joints and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.

	From the inside towards the outside	λ [W/(mK)]	Thickness [cm]		From the inside towards the outside	λ [W/(mK)]	Thickness [cm]
	Standard component : Exterior wall (AW_01)				Standard component: Flat roof (DA_01)		
9	Gypsum board glass fibre reinforced	0.250	1.50	23	Gypsum board glass fibre reinforced	0.250	1.50
8	Gypsum fibreboard	0.669	12.5	22	Gypsum fibreboard	0.669	1.25
5	Air layer + timber studs	0.654	14.0	20	Air layer + steal substructure	0.710	8.0
4	Gypsum fibreboard **(Airtight layer)**	0.669	1.25	20	Air layer + timber studs	0.920	20.0
3	XPS (2*80)	0.036	16.00	19	Gypsum fibreboard **(Airtight layer)**	0.669	1.25
2	Fibro-cement board	1.200	1.25	18	XPS (2*80)	0.036	16.0
				17	Fibro-cement board	1.200	1.25
	Standard component :[---extend or delete as required---]				Other materials (materials not in the standard components)		
11	Soudal Soudatight SP airtight paint						
10	Fermacell Joint Filler + Soudal Soudatight SP airtight paint						

Lightweight timber construction **Parapet wall connection to interior floor**	Abbreviation Detail_SC-05	THERMOCHIP

Design drawing – **Vertical cross-section**



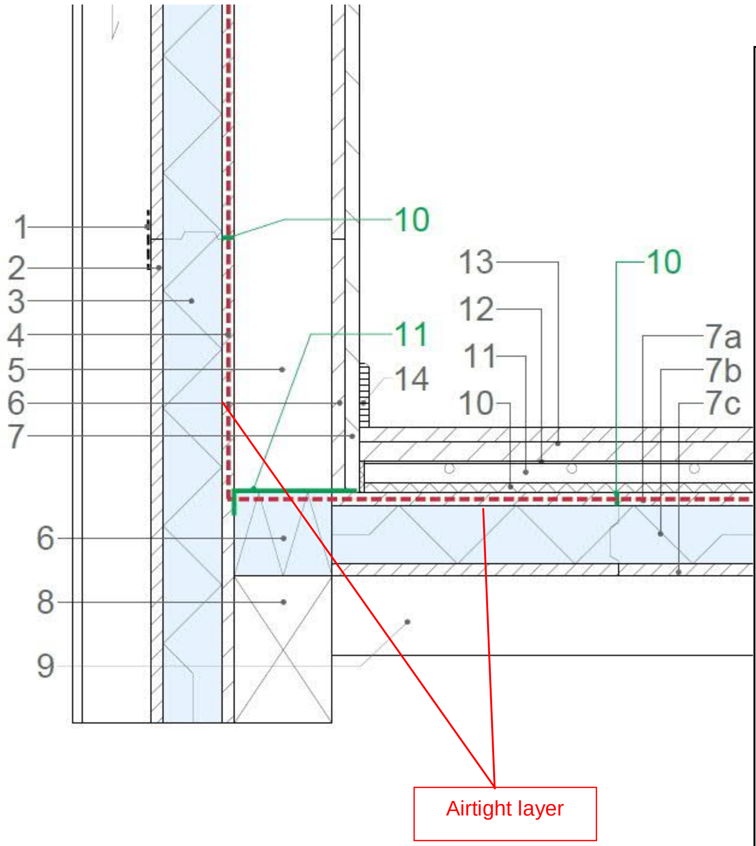
Airtight layer

The airtight layer is the interior gypsum fibre board of the outer panel. Joints and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.

From the inside towards the outside		λ [W/(mK)]	Thick ness [cm]	From the inside towards the outside		λ [W/(mK)]	Thick ness [cm]
Standard component : Exterior wall (AW_01)				Standard component: Flat roof (DA_01)			
9	Gypsum board glass fibre reinforced	0.250	1.50				
8	Gypsum fibreboard	0.669	12.5				
5	Air layer + timber studs	0.654	14.0				
4	Gypsum fibreboard **(Airtight layer)**	0.669	1.25				
3	XPS (2*80)	0.036	16.00				
2	Fibro-cement board	1.200	1.25				
Standard component :[---extend or delete as required---]				Other materials (materials not in the standard components)			
11	Soudal Soudatight SP airtight paint						
10	Fermacell Joint Filler + Soudal Soudatight SP airtight paint						

Lightweight timber construction **Parapet wall connection to floor slab**	Abbreviation Detail_SC-06	THERMOCHIP

Design drawing – **Vertical cross-section**



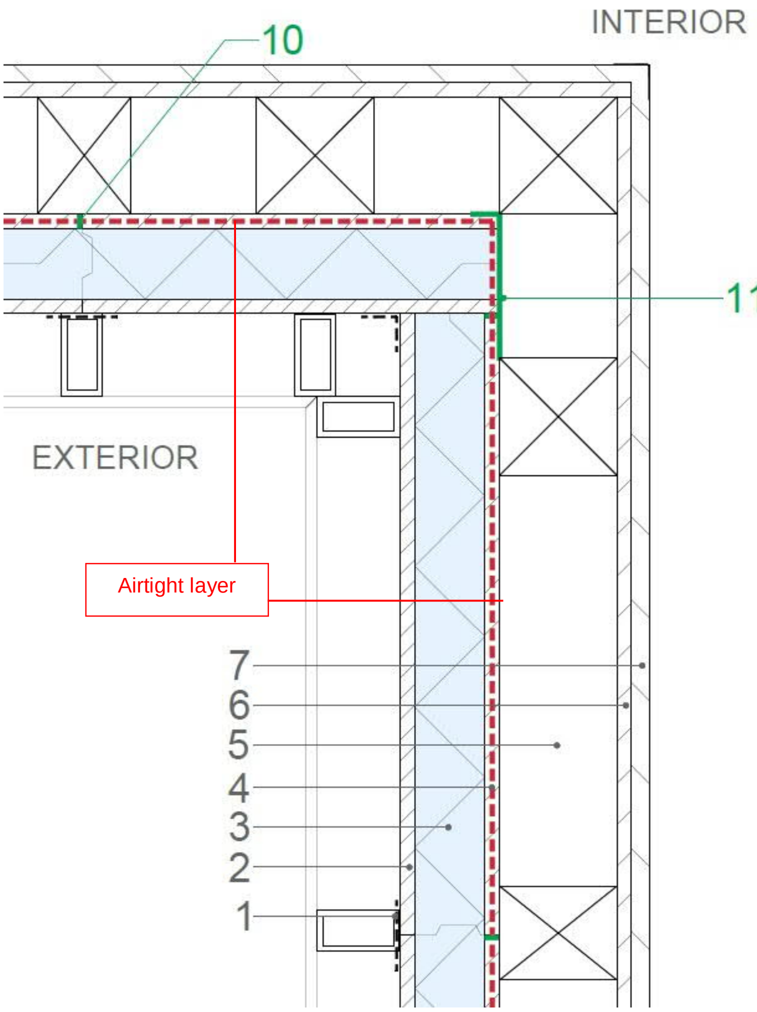
Airtight layer

The airtight layer is the interior gypsum fibre board of the outer panel. Joints and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.

	From the inside towards the outside	λ [W/(mK)]	Thick ness [cm]		From the inside towards the outside	λ [W/(mK)]	Thick ness [cm]
Standard component : Exterior wall (AW_01)				Standard component: Flat roof (DA_01)			
9	Gypsum board glass fibre reinforced	0.250	1.50	12	Gypsum fibreboard glass fibre reinforced	0.669	2.00
8	Gypsum fibreboard	0.669	12.5	22	Gypsum fibreboard **(Airtight layer)**	0.669	1.25
5	Air layer + timber studs	0.654	14.0	18	XPS (2*80)	0.036	16.0
4	Gypsum fibreboard **(Airtight layer)**	0.669	1.25	17	Fibro-cement board	1.200	1.25
3	XPS (2*80)	0.036	16.00				
2	Fibro-cement board	1.200	1.25				
Standard component :[---extend or delete as required---]				Other materials (materials not in the standard components)			
11	Soudal Soudatight SP airtight paint						
10	Fermacell Joint Filler + Soudal Soudatight SP airtight paint						

Lightweight timber construction **Interior corner**	Abbreviation Detail_SC-07	THERMOCHIP

Design drawing **– Horizontal cross-section**



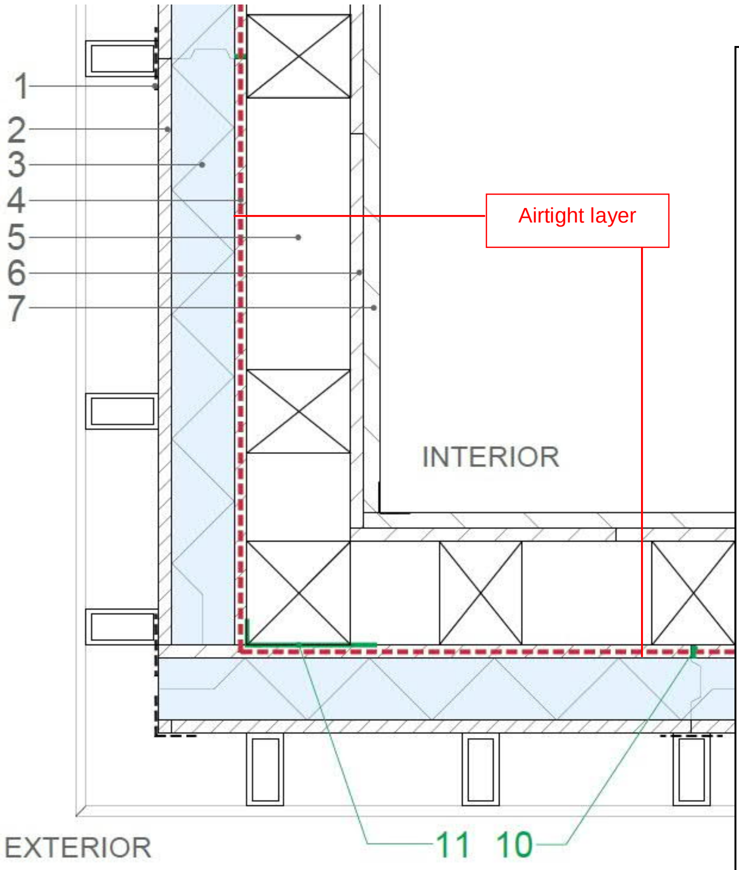
Airtight layer

The airtight layer is the interior gypsum fibre board of the outer panel. Joints and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.

From the inside towards the outside		λ [W/(mK)]	Thick ness [cm]	From the inside towards the outside		λ [W/(mK)]	Thick ness [cm]
Standard component : Exterior wall (AW_01)				Standard component: Flat roof (DA_01)			
9	Gypsum board glass fibre reinforced	0.250	1.50				
8	Gypsum fibreboard	0.669	12.5				
5	Air layer + timber studs	0.654	14.0				
4	Gypsum fibreboard **(Airtight layer)**	0.669	1.25				
3	XPS (2*80)	0.036	16.00				
2	Fibro-cement board	1.200	1.25				
Standard component :[---extend or delete as required---]				Other materials (materials not in the standard components)			
11	Soudal Soudatight SP airtight paint						
10	Fermacell Joint Filler + Soudal Soudatight SP airtight paint						

Lightweight timber construction Exterior corner	Abbreviation Detail_SC-08	THERMOCHIP

Design drawing – **Horizontal cross-section**



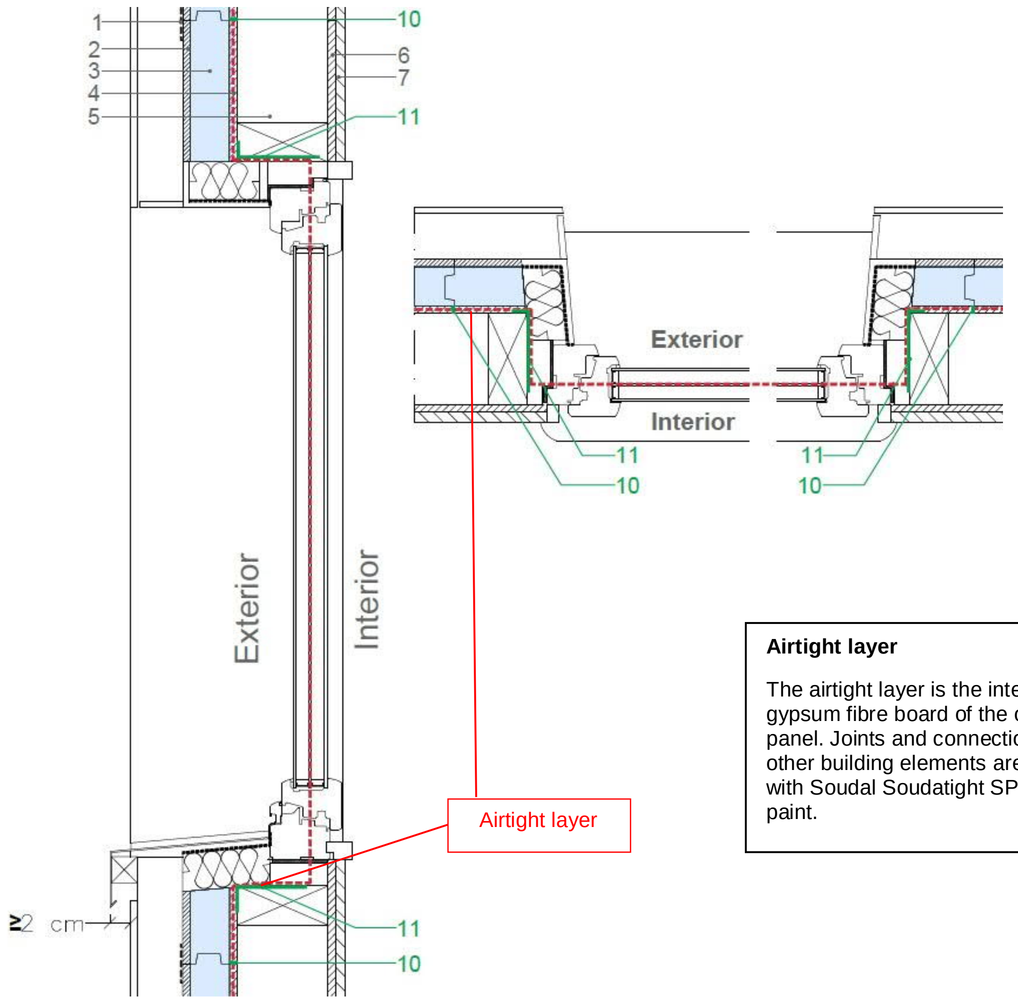
Airtight layer

The airtight layer is the interior gypsum fibre board of the outer panel. Joints and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.

	From the inside towards the outside	λ [W/(mK)]	Thickness [cm]		From the inside towards the outside	λ [W/(mK)]	Thickness [cm]
	Standard component : Exterior wall (AW_01)				Standard component: Flat roof (DA_01)		
9	Gypsum board glass fibre reinforced	0.250	1.50				
8	Gypsum fibreboard	0.669	12.5				
5	Air layer + timber studs	0.654	14.0				
4	Gypsum fibreboard **(Airtight layer)**	0.669	1.25				
3	XPS (2*80)	0.036	16.00				
2	Fibro-cement board	1.200	1.25				
	Standard component :[---extend or delete as required---]				Other materials (materials not in the standard components)		
11	Soudal Soudatight SP airtight paint						
10	Fermacell Joint Filler + Soudal Soudatight SP airtight paint						
p							

Lightweight timber construction Window detail	Abbreviation Detail_SC-09	THERMOCHIP

Design drawing **– Horizontal and vertical cross-section**



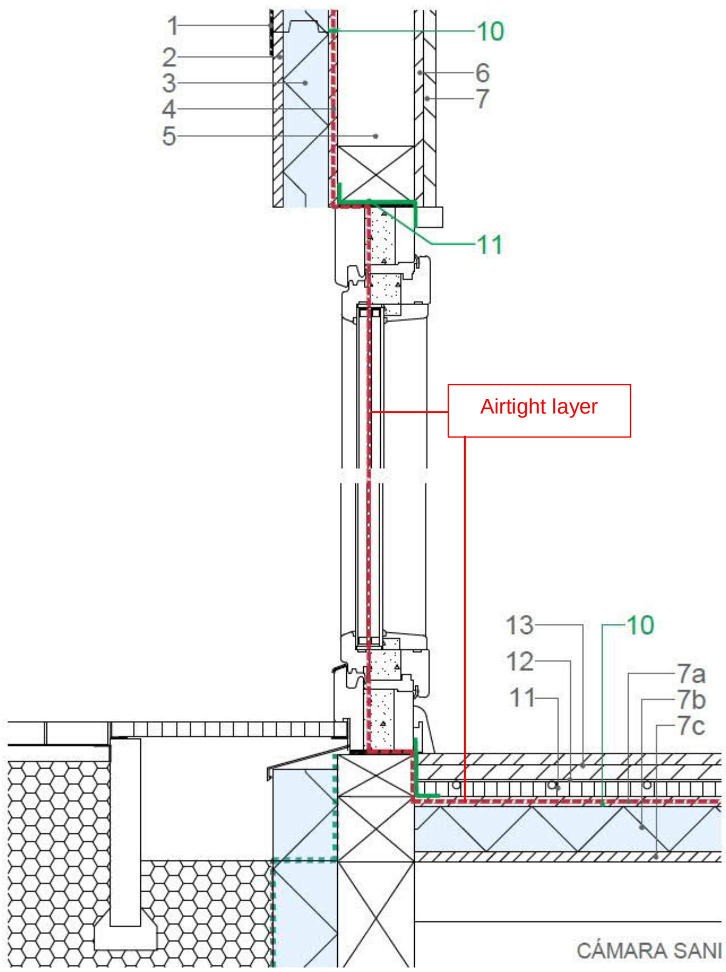
Airtight layer

The airtight layer is the interior gypsum fibre board of the outer panel. Joints and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.

	From the inside towards the outside	λ [W/(mK)]	Thickness [cm]		From the inside towards the outside	λ [W/(mK)]	Thickness [cm]
Standard component : Exterior wall (AW_01)				Standard component: Flat roof (DA_01)			
9	Gypsum board glass fibre reinforced	0.250	1.50				
8	Gypsum fibreboard	0.669	12.5				
5	Air layer + timber studs	0.654	14.0				
4	Gypsum fibreboard **(Airtight layer)**	0.669	1.25				
3	XPS (2*80)	0.036	16.00				
2	Fibro-cement board	1.200	1.25				
Standard component :[---extend or delete as required---]				Other materials (materials not in the standard components)			
11	Soudal Soudatight SP airtight paint						
10	Fermacell Joint Filler + Soudal Soudatight SP airtight paint						

Lightweight timber construction **Parapet wall connection to floor slab**	Abbreviation Detail_SC-10	THERMOCHIP

Design drawing – **Vertical cross-section**



Airtight layer

The airtight layer is the interior gypsum fibre board of the outer panel. Joints and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.

From the inside towards the outside		λ [W/(mK)]	Thickness [cm]	From the inside towards the outside		λ [W/(mK)]	Thickness [cm]
Standard component : Exterior wall (AW_01)				Standard component: Flat roof (DA_01)			
9	Gypsum board glass fibre reinforced	0.250	1.50	12	Gypsum fibreboard	0.669	2.00
8	Gypsum fibreboard	0.669	12.5	22	Gypsum fibreboard **(Airtight layer)**	0.669	1.25
5	Air layer + timber studs	0.654	14.0	18	XPS (2*80)	0.036	16.0
4	Gypsum fibreboard **(Airtight layer)**	0.669	1.25	17	Fibro-cement board	1.200	1.25
3	XPS (2*80)	0.036	16.00				
2	Fibro-cement board	1.200	1.25				
Standard component :[---extend or delete as required---]				Other materials (materials not in the standard components)			
11	Soudal Soudatight SP airtight paint						
10	Fermacell Joint Filler + Soudal Soudatight SP airtight paint						

DECLARACIÓN DE PRESTACIONES N.º PT-10

fibran®

1. Código de identificación única del producto tipo: # FIBRAN*xps* **FABRIC**

2. Tipo:	FIBRAN*xps* **FABRIC**
3. Uso o usos previstos del producto de construcción, con arreglo a la especificación técnica armonizada aplicable, tal como lo establece el fabricante:	Aislamiento térmico para edificación (ThIB) XPS-EN 13164-T3-CS(10\Y)*-DS(70,90)
4. Nombre o marca registrados y dirección de contacto del fabricante	IBERFIBRAN, Poliestireno Extrudido, S.A., Av. 16 de Maio, Z.I. Ovar, Portugal - www.fibran.com.pt
5. En su caso, nombre y dirección de contacto del representante autorizado	No es relevante
6. Sistema o sistemas de evaluación y verificación de la constancia de las prestaciones del producto de construcción tal como figura en el anexo V:	AVCP -- System 3
7. Nombre y número de identificación del organismo notificado	LNEC N° 0856
8. En caso de declaración de prestaciones relativa a un producto de construcción para el que se ha emitido una evaluación técnica europea:	No es relevante

9.a Característica esencial / Espesor (EN 13164)	*Espesor*	*Resistencia a la compresión*	*Conductividad térmica*	*Resistencia térmica*
	4.2.3	*4.3.4*	*4.2.1*	*4.2.1*
	d_N	CS(Y\10)*	λ_D	R_D
	[mm]	[kPa]	[W/m2.K]	[(m2.K)/W]
	20_40	100_300	0,033	0,40_1,20
	41_80	200_500	0,035	1,15_2,25
	81_120		0,037	2,15_3,20

9.b Característica esencial (EN 13164)		**Símbolo**	**Prestación**	**Unidad**	**EN 13164**
Tolerancias dimensionales		T	3	[mm]	4.2.3
Resistencia a tracción perpendicular a las caras		TR	NPD	kPa	4.3.5
Reacción al fuego		-	E	class	4.2.4
Incandescencia contínua			NPD		4.3.12
Índice de absorción acústica			NPD		4.3.10
Permeabilidad al agua- Absorción de agua a largo plazo	*por inmersión total*	WL(T)	NPD	%	4.3.7.1
	por difusión	WD(V)	NPD	%	4.3.7.2
Permeabilidad al vapor de agua	*Factor de resistencia a la difusión del vapor de agua*	MU	NPD	-	4.3.9
Durabilidad de la resistencia a la compresión frente al envejecimiento/degradación	*Fluencia a compresión*	CC (2/1,5/50)	NPD	kPa	4.3.6
Durabilidad de la resistencia térmica frente a calor, intemperie, envejecimiento/degradación	*Resistencia térmica y conductividad térmica*	Véase arriba RD e λD			4.2.1
	Resistencia a congelación-descongelación tras absorción de agua a largo plazo por difusión	FTCD	NPD	-	4.3.8.2
	Resistencia a congelación-descongelación tras absorción de agua a largo plazo por inmersión total	FTCI	NPD	-	4.3.8.3
	Estabilidad dimensional bajo condiciones específicas de temperatura y humedad	DS	(70,90)	-	4.3.2
	Deformación bajo condiciones específicas de carga a compresión y de temperatura	DLT	NPD	-	4.3.3
Durabilidad de la reacción al fuego frente a calor, intemperie, envejecimiento/degradación	Sin cambio en las propiedades de reacción al fuego para productos de XPS				
	La prestación de reacción al fuego del XPS no cambia con el tiempo				
Sustancias peligrosas	Emisión de sustancias peligrosas al ambiente interior		-		4.3.10

10. Las prestaciones del producto identificado en los puntos 1 y 2 son conformes con las prestaciones declaradas en el punto 9.
La presente declaración de prestaciones se emite bajo la sola responsabilidad del fabricante identificado en el punto 4.

Firmado por y en nombre del fabricante por: Filipe Silva

Ovar, 5 de Junio de 2020 Produción & Calidad

Este producto no contiene hexabromociclododecano

NPD - Prestación No Determinada

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