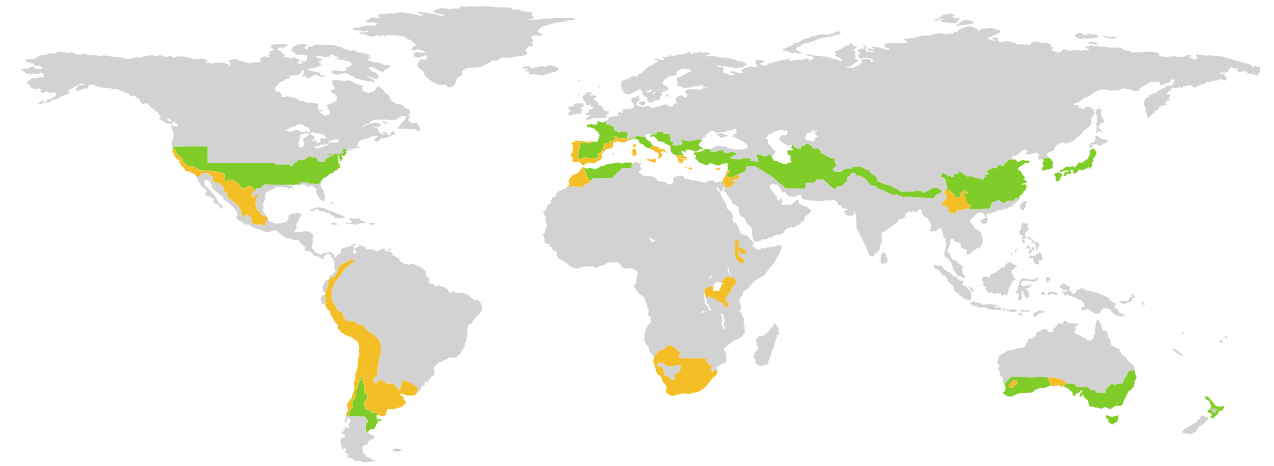


CERTIFICATE

Certified Passive House Component

ID: 1598cs04 valid until 31. December 2021

Passive House Institute
Dr. Wolfgang Feist
64342 Darmstadt
GERMANY



Category	Construction system Lightweight timber construction
Manufacturer	Thermochip SLU Carballada de Valdeorras (Ourense) España
Product name	Thermochip HOUSING SATE-WALL

This certificate for the warm, temperate climate zone was awarded based on the following criteria

Hygiene criterion

The minimum temperature factor of the interior surfaces is

$$f_{Rsi=0,25m^2K/W} \geq 0.65$$

Comfort criterion

The U-value of the installed windows is

$$U_{W,i} \leq 1.05 \text{ W/(m}^2\text{K)}$$

Efficiency criteria

Heat transfer coefficient of building envelope

$$U \cdot f_{PHI} \leq 0.30 \text{ W/(m}^2\text{K)}$$

Temperature factor of opaque junctions

$$f_{Rsi=0,25m^2K/W} \geq 0.82$$

Thermal bridge-free design for key connection details

$$\Psi \leq 0.01 \text{ W/(mK)}$$

An airtightness concept for all components and connection details was provided



Opaque building envelope

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 two sandwich panels. The external sandwich panel (12/80/12 mm) comprises a board of fibre cement to the outside, a core of XPS ($\leq 0,036$ W/mK) and internal composite board with cellulose fibres. The internal sandwich panel (12/60/12 mm) uses the same core of XPS but two composite boards with cellulose fibres. The assembly is thereby insulated both to the outside and inside.

For the purpose of certification, a three-dimensional simulation was carried out to determine the effect of the timber roof beams which penetrates the external wall at eaves level.

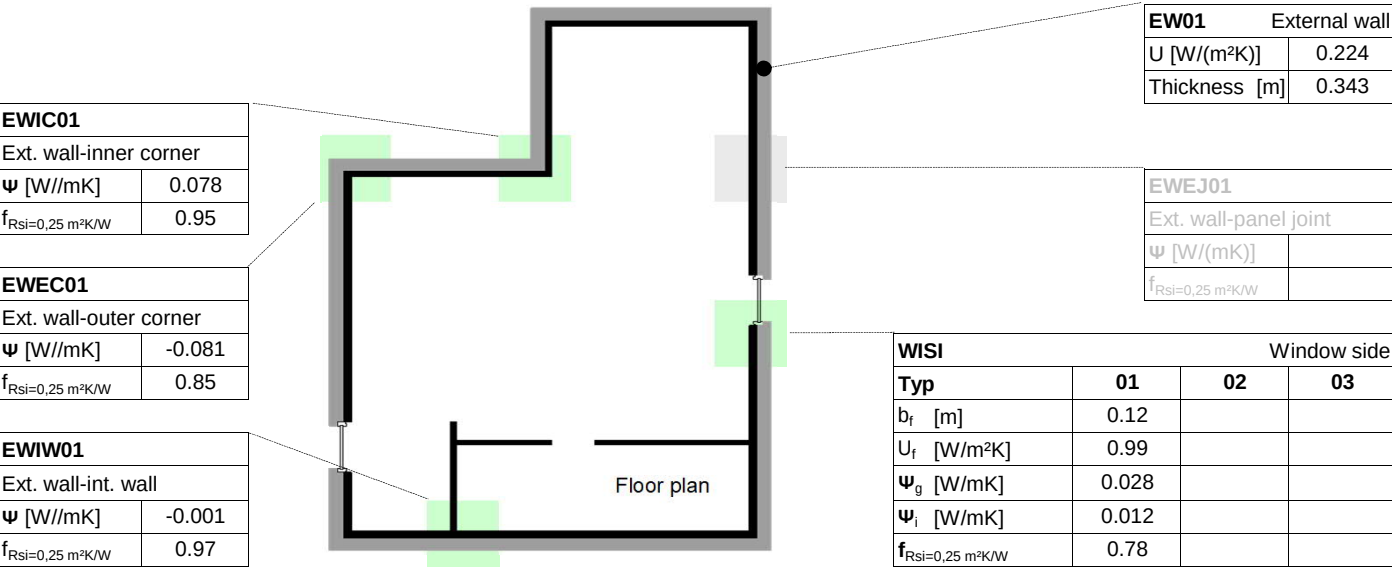
The certification does not take into account point thermal bridges caused by structural columns or e.g. balcony connections, which must to be assessed separately. As investigated, the system is deemed suitable for passive houses in the warm-temperate climate zone, as the regular U-values of the exterior components are below $0,25$ W/m²K and the connections meet the criteria of 'thermal bridge free'.

Explanatory notes

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.

Thermal bridge not calculated
Criteria achieved

Efficiency criteria not achieved
Hygiene or comfort criterion not achieved

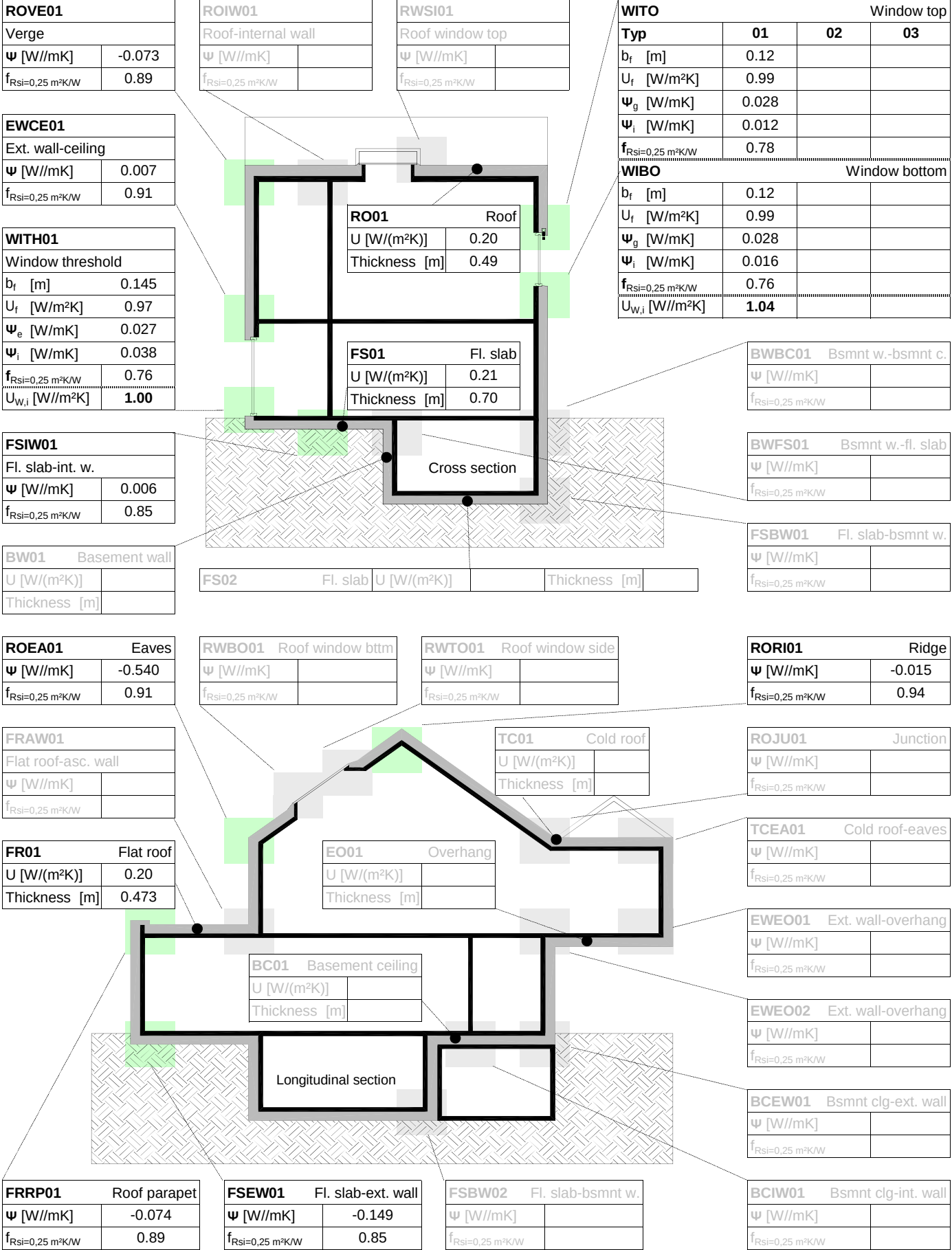


Windows

For the purposes of certification a standard passive house window ($U_w = 1,00$ W/m²K with $U_g = 0,90$ 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 U_w to ensure occupant comfort - this criteria is met in this instance.

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 of the wall is the interior gypsum fibre board of the outer panel. In the roof and floor slab where only one sandwich panel is used, the air tight layer remains on the interior gypsum fibre board of the panel. Joints between panels and connections with other building elements are sealed with Soudal Soudatight SP airtight paint.





Certification report | Zertifizierungsbericht

Passive House Institute

Building system Bausystem



for the warm, temperate climate
für das warm-gemäßigtes Klima

Product | Produkt:

Thermochip HOUSING SATE-WALL

Client | Auftraggeber:

Thermochip SLU

Construction | Konstruktion

**Lightweight timber construction |
Holzleichtbau**

Contact person
Ansprechpartner
Website

Diego Rodriguez
+34 681 155 131
www.thermochip.com

Date | Datum:
Author | Autor:

15.09.2020
M. Arch Soraya López García

+49.6151.82699.0
mail@passiv.de
www.passiv.de

Passive House Institute
Rheinstraße 44/46
64283 Darmstadt
GERMANY

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Appendix 1: U-values, equivalent conductivities

Appendix 2: Thermal simulations

Appendix 3: Manufacturers drawings



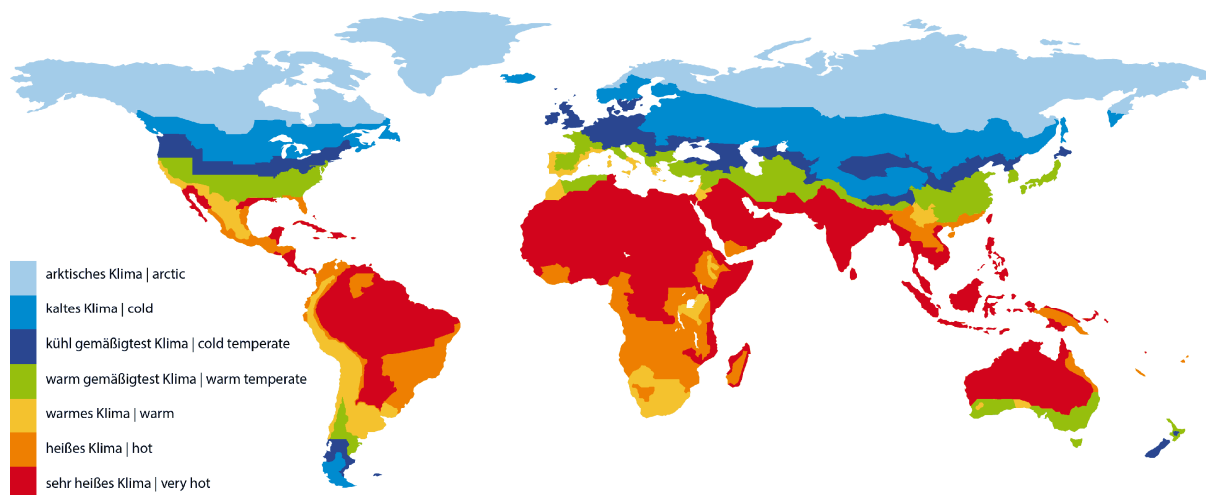
1 Introduction

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		
	$f_{Rsi}=0.25 \text{ m}^2\text{K/W} \geq^3$	U-value of the installed window ¹ $\leq$	U-value opaque to ambient $U_{opaque} * f_{PHI}^2 \leq$	Purely opaque details $f_{Rsi}=0.25 \text{ m}^2\text{K/W} \geq$	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 components 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 two sandwich panels. The external sandwich panel (12/80/12 mm) comprises a board of fibre cement to the outside, a core of XPS ($\leq 0,036 \text{ W/mK}$) and internal composite board with cellulose fibres. The internal sandwich panel (12/60/12 mm) uses the same core of XPS but two composite boards with cellulose fibres. The assembly is thereby insulated both to the outside and inside.

For the purpose of certification, a three-dimensional simulation was carried out to determine the effect of

the timber roof beams which penetrates the external wall at eaves level.

The certification does not take into account point thermal bridges caused by structural columns or e.g. balcony connections, which must to be assessed 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 $0,25 \text{ W/m}^2\text{K}$ and the connections meet the criteria of 'thermal bridge free'. The surface temperature of all connections (with the exception of window connections) meet the hygiene requirements.

2.2 Windows

For the purposes of certification a standard passive house window ($U_w = 1,00 \text{ W/m}^2\text{K}$ with $U_g = 0,90 \text{ W/m}^2\text{K}$) 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 $0,05 \text{ W/m}^2\text{K}$ greater than the U_w 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 of the wall is the interior gypsum fibre board of the outer panel. In the roof and floor slab

where only one sandwich panel is used, the air tight layer remains on the interior gypsum fibre board of the 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

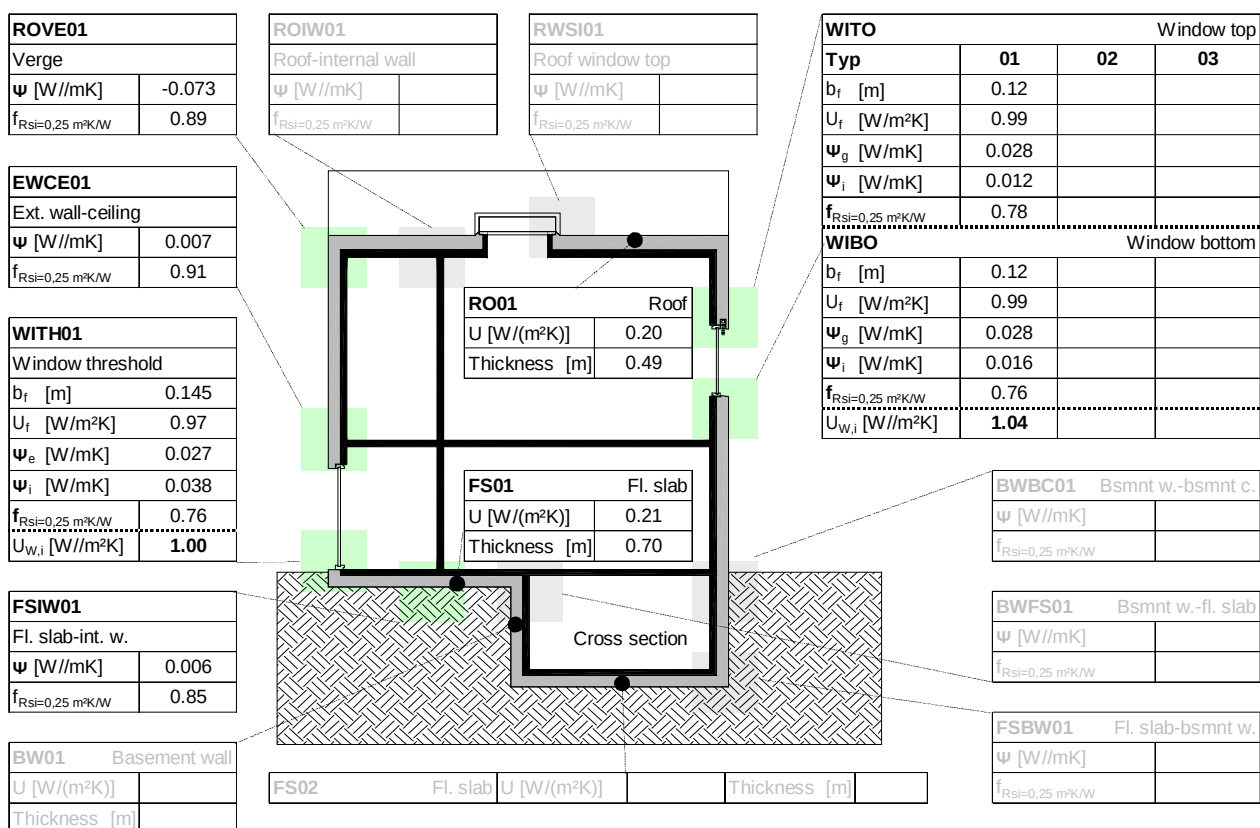
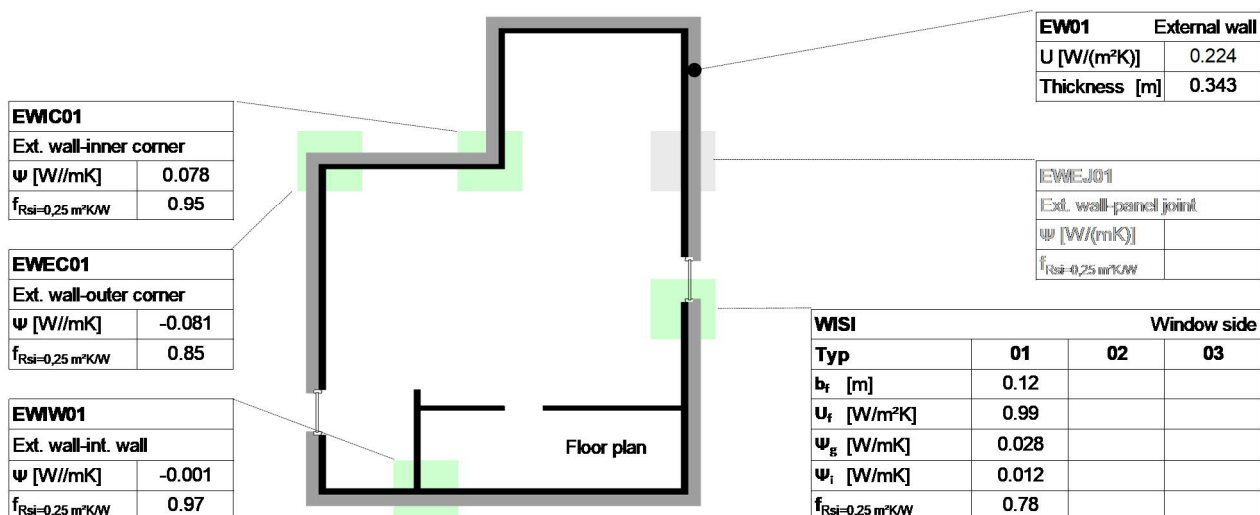
for climate zones with higher requirements may also be used in climates with less stringent requirements. Their use might make economic sense in certain circumstances.

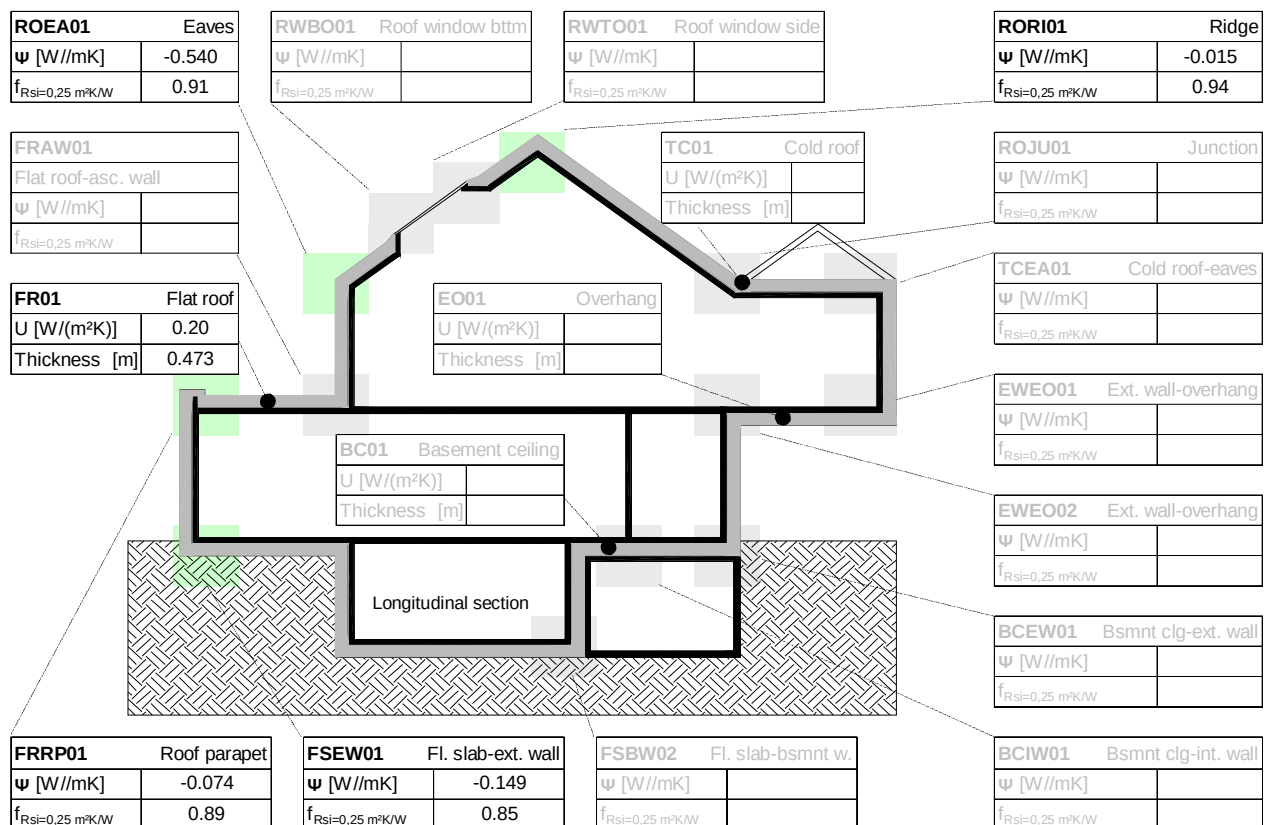


4 Summary of the results

Thermal bridge not calculated
Criteria achieved

Efficiency criteria not achieved
Hygiene or comfort criterion not achieved





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-WALL ID: 1598cs04 for the warm, temperate climate



Acronym	Building assembly description		Interior insulation?	
FS01	Floor slab			
Heat transmission resistance [m²K/W]				
Orientation of building element	3-Ground	Adjacent to	interior R _{si}	exterior R _{se}
			0.17	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		Percentage of sec. 2	Percentage of sec. 3	Total
100%				70.4 cm
U-value supplement		W/(m²K)	U-value:	0.207 W/(m²K)

Acronym	Building assembly description		Interior insulation?	
EW01	External wall			
Heat transmission resistance [m²K/W]				
Orientation of building element	2-Wall	Adjacent to	interior R _{si}	exterior R _{se}
		3-Ventilated	0.13	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	9.39803	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	80	
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	
Gypsum board with cellulose fibres (fibroyeso)	0.669	generic value	12	
XPS	0.036	data sheet + conversion factor according to DIN 4108-4	60	
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
100%				34.3 cm
U-value supplement		W/(m²K)	U-value:	0.224 W/(m²K)

Acronym	Building assembly description		Interior insulation?
R001	Roof		
Heat transmission resistance [m²K/W]			
Orientation of building element	1-Roof	Adjacent to	3-Ventilated
interior R _{si}		0.10	exterior R _{se}
		0.13	
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
100%			
Total			49.1 cm
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	1-Roof	Adjacent to	1-Outdoor air
interior R _{si}		0.10	exterior R _{se}
		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
Percentage of sec. 1		Percentage of sec. 2	Percentage of sec. 3
100%			
Total			47.3 cm
U-value supplement:		W/(m²K)	U-value: 0.200 W/(m²K)



Appendix 2: Thermal simulations | Wärmestromsimulationen

Passive House Institute

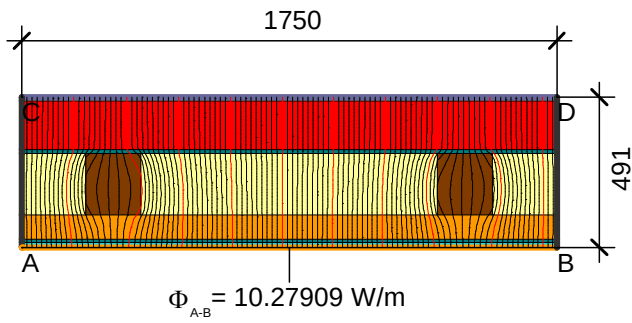
Wall, roof, ground | Wand, Dach, Boden
Windows | Fenster
Constructions to ground | Erdberührte Bauteile



Wall, roof, ground | Wand, Dach, Boden



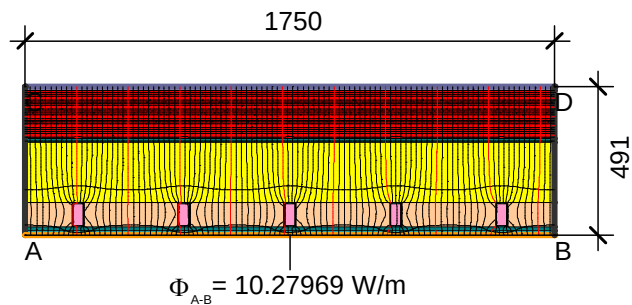
Pitched Roof:



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

Material	$\lambda [\text{W/(m} \cdot \text{K)}]$	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

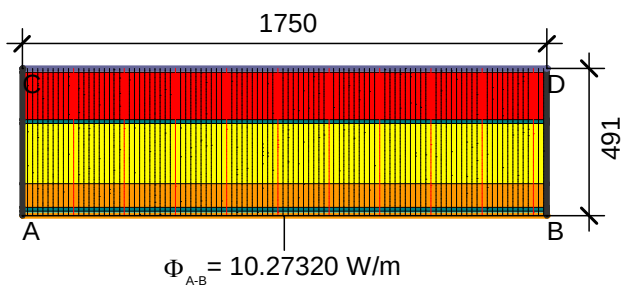
Boundary Condition	$q [\text{W/m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$	ε	$\phi [\%]$
Exterior vent. Außen belüftet		-10.000		0.130	
Interior up. Innen auf.		20.000		0.100	
Adiabatic Adiatat	0.000				



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

Material	$\lambda [\text{W/(m} \cdot \text{K)}]$	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 Stahl	50.000	0.900
XPS 036	0.036	0.900

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



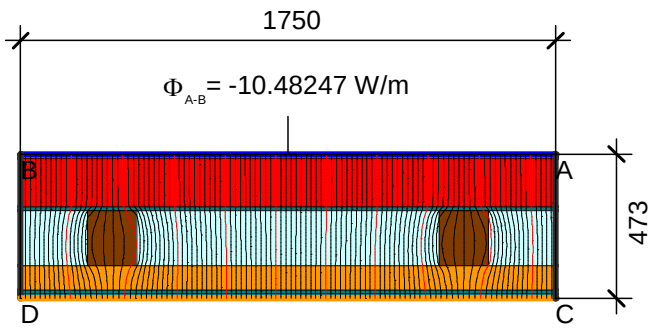
$$U_{\text{eq A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.273}{30.000 \cdot 1.750} = 0.196 \text{ W/(m}^2 \cdot \text{K)}$$

Material	$\lambda [\text{W/(m} \cdot \text{K)}]$	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	$q [\text{W/m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
Exterior vent. Außen belüftet		-10.000		0.130
Interior up. Innen auf.		20.000		0.100
Adiabatic Adiatat	0.000			



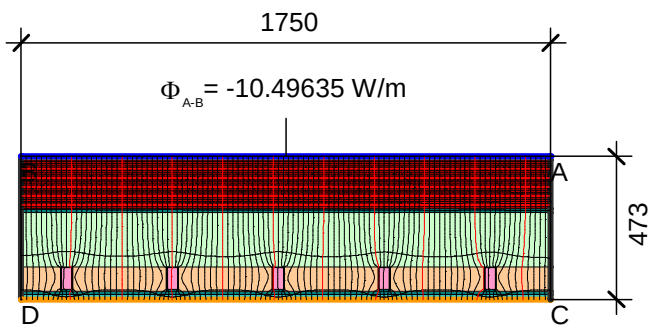
Flat Roof:



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

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: 180 mm	1.125	0.900
Wood - parallel 0.29 W/(mK)	0.290	0.900
XPS 036	0.036	0.900

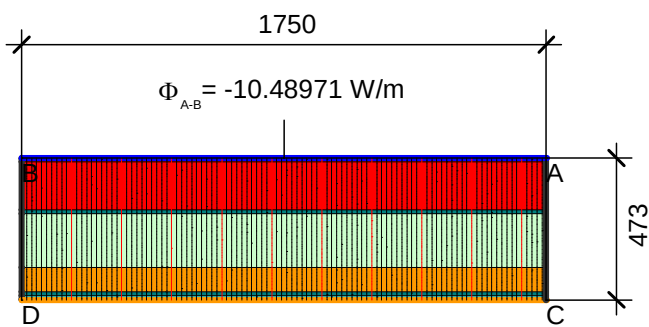
Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ϵ	ϕ [%]
Exterior Außen		-10.000		0.040	
Interior up. Innen auf.		20.000		0.100	
Adiabatic Adiabat	0.000				



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

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 Stahl	50.000	0.900
XPS 036	0.036	0.900

Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]
Adiabatic Adiabat	0.000		
Exterior Außen		-10.000	0.040
Interior up. Innen auf.		20.000	0.100



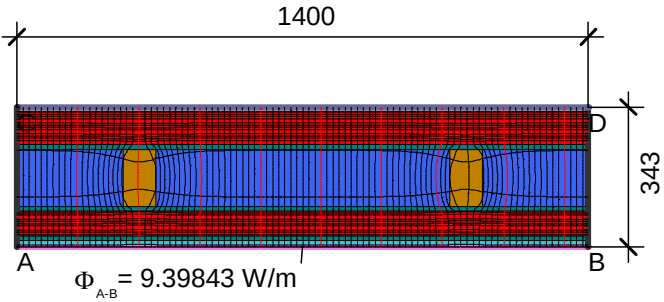
$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.490}{30.000 \cdot 1.750} = 0.200 \text{ W/(m}^2 \cdot \text{K)}$$

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/m ²]	θ [°C]	R [(m ² ·K)/W]	ϵ
Exterior Außen		-10.000		0.040
Interior up. Innen auf.		20.000		0.100
Adiabatic Adiabat	0.000			



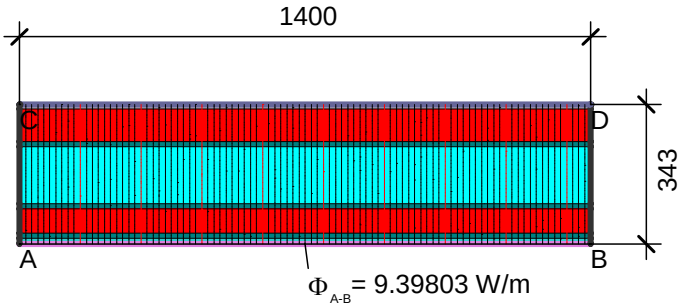
Wall:



$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.398}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

Material	$\lambda[W/(m \cdot K)]$	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 Adiatat	0.000		
Exterior vent. Außen belüftet		-10.000	0.130
Interior Innen		20.000	0.130



$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.398}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

Material	$\lambda[W/(m \cdot K)]$	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 Adiatat	0.000			



Assembly - Verification

Thermochip SATE-WALL

Monthly Condensation rate and accumulation

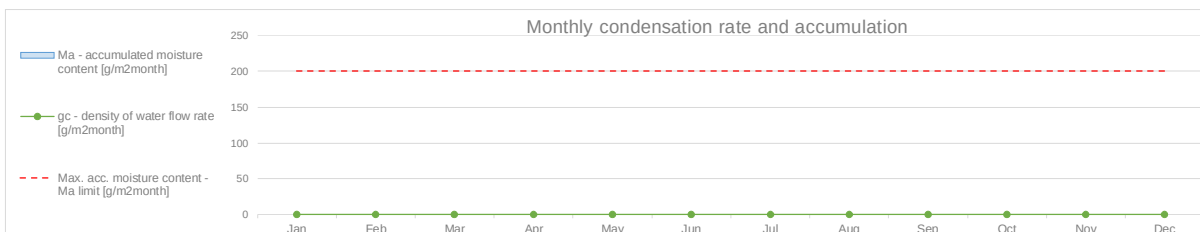
Limit accumulated moisture content

Max. acc. moisture content - Ma limit [g/m ² month]	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
200	200	200	200	200	200	200	200	200	200	200	200	200

* To Standard limits

The maximum accumulated moisture content have to be considered according to regulatory requirements and other guidance in product standards.

Monthly Condensation rate and accumulation within the whole assembly



Days	1	2	3	4	5	6	7	8	9	10	11	12
Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
gc - density of water flow rate [g/m ² month]	0	0	0	0	0	0	0	0	0	0	0	0
Ma - accumulated moisture content [g/m ² month]	0	0	0	0	0	0	0	0	0	0	0	0
Ma limit [g/m ² month]	200	200	200	200	200	200	200	200	200	200	200	200
Comments												
Interfaces with condensation	0	0	0	0	0	0	0	0	0	0	0	0

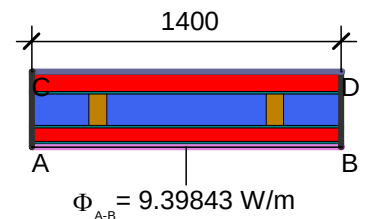
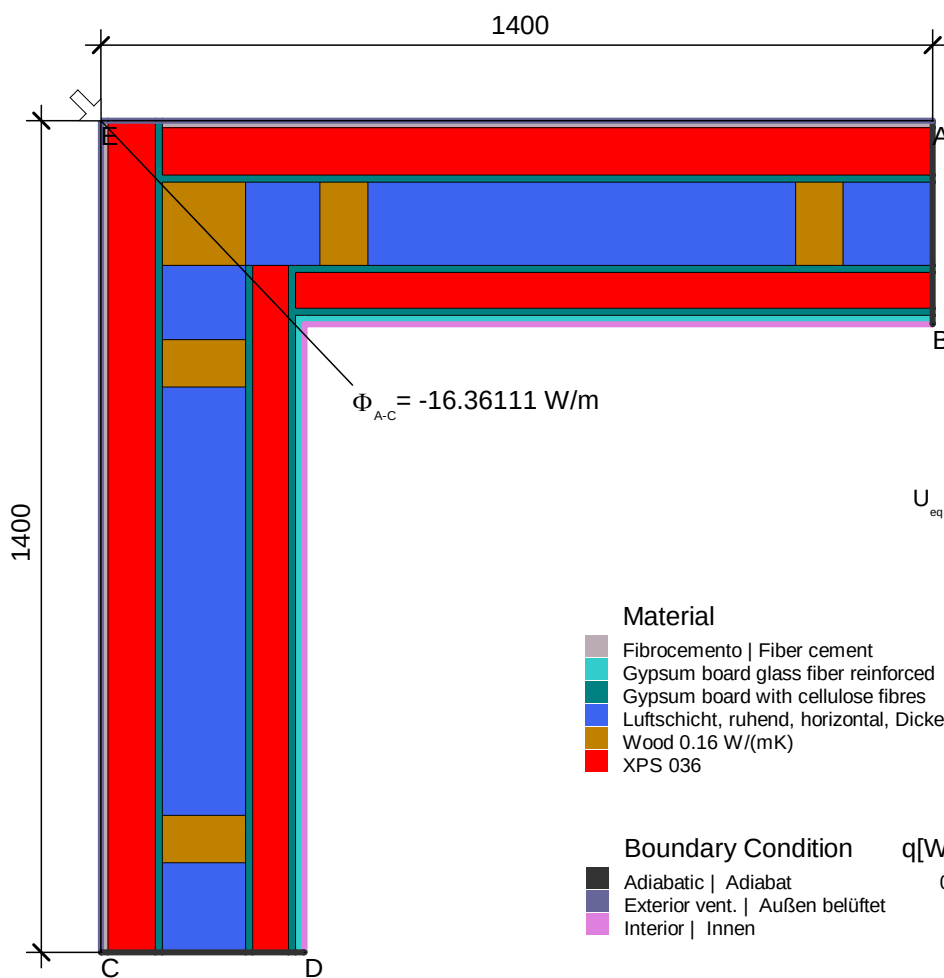
Monthly Condensation rate and accumulation within each layer

Drying potential

Verifications

Assembly no.	Thermochip SATE-WALL											Verification status: Assembly verified
Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Condensation Rsi 0,25 [° C]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
All months have the internal surface condensation temperature positively verified.												
Mold growth Rsi 0,25 [° C]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
All months have the internal surface mould growth temperature positively verified.												
f _{Rsi} Temp. factor at the internal surface	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
All months have the temperature factor at the internal surface positively verified.												
Ma [g/m ² month] Max acc. Moisture content	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Condensation is completely evaporated												
Ma [g/m ² month] Moisture evaporation	Maximum accumulation of condensate does not exceed the Ma limit											Yes
Drying potential Over 10 years	The drying potential of building component is verified over a period of 10 years.											Yes





$$U_{\text{eq A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.398}{30.000 \cdot 1.400} = 0.224 \text{ W}/(\text{m}^2 \cdot \text{K})$$

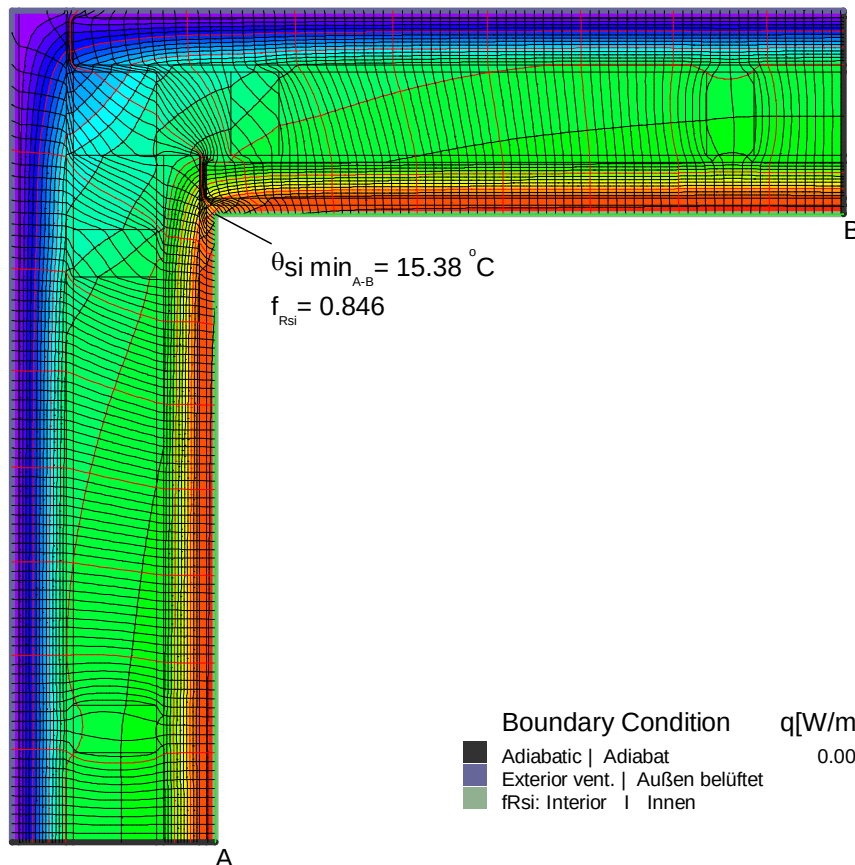
Material

	$\lambda[\text{W}/(\text{m} \cdot \text{K})]$	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

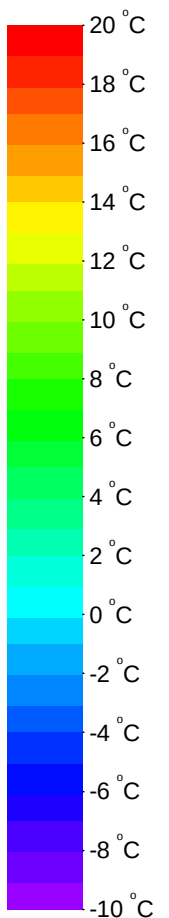
	$q[\text{W}/\text{m}^2]$	$\theta[^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
Adiabatic Adiat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Interior Innen		20.000	0.130	

$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{16.361}{30.000} - 0.224 \cdot 1.400 - 0.224 \cdot 1.400 = -0.081 \text{ W}/(\text{m} \cdot \text{K})$$



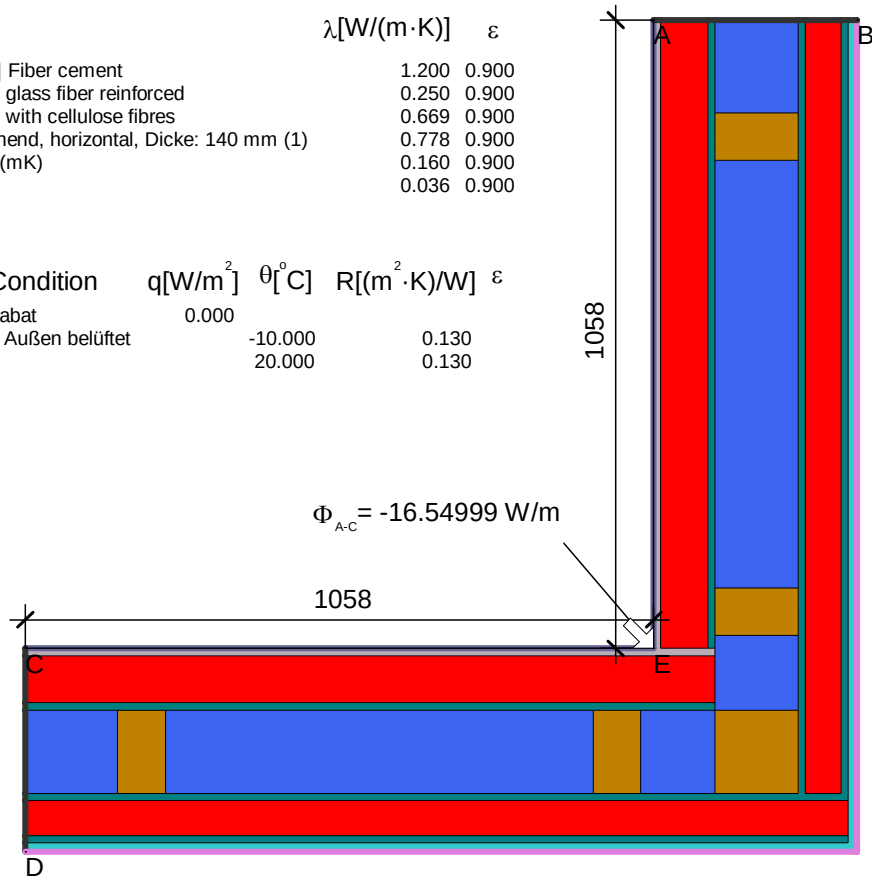
Boundary Condition

	$q[\text{W}/\text{m}^2]$	$\theta[^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
Adiabatic Adiat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
fRsi: Interior Innen		20.000	0.250	

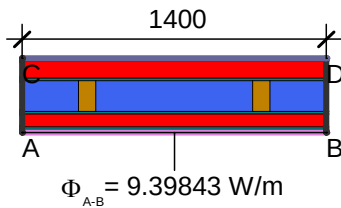


Material	λ [W/(m·K)]	ε
Fibrocemento Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, horizontal, Dicke: 140 mm (1)	0.778	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ε
Adiabatic Adiatat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Interior Innen		20.000	0.130	

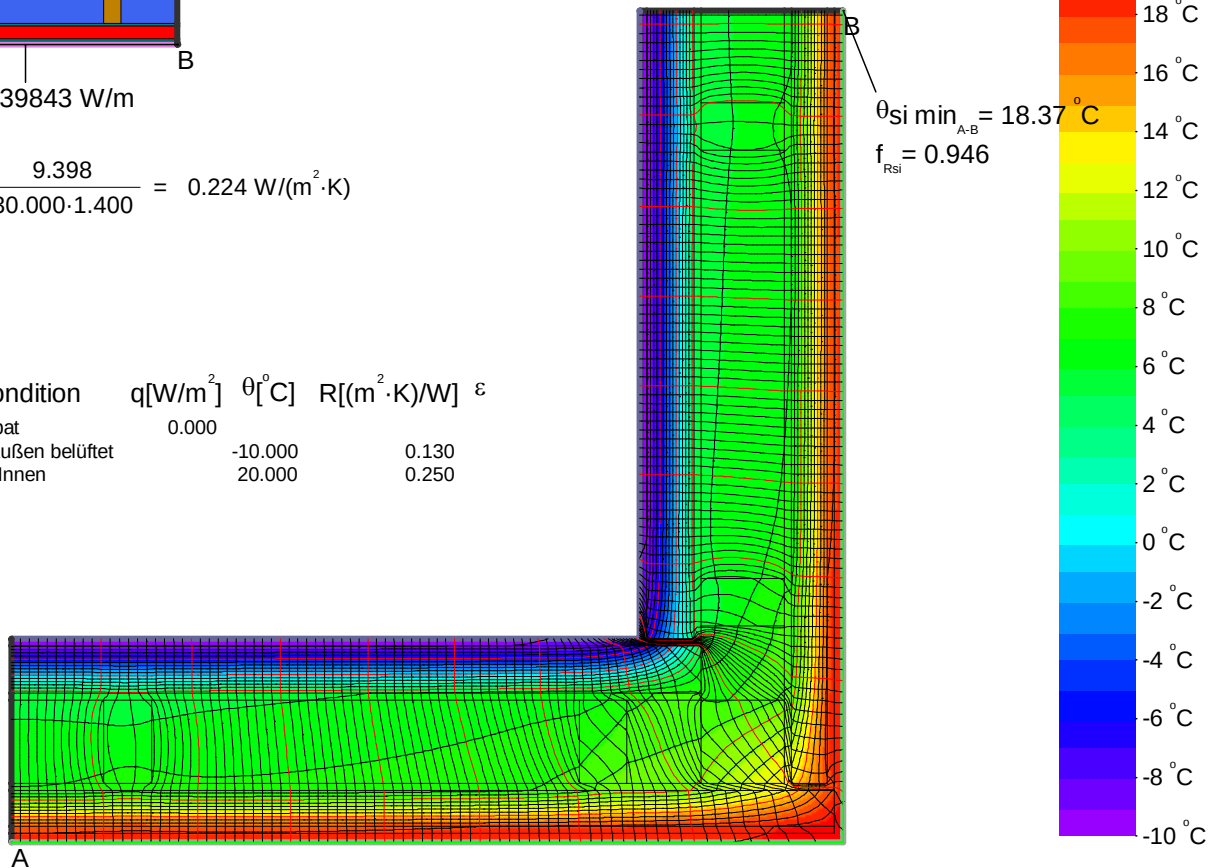


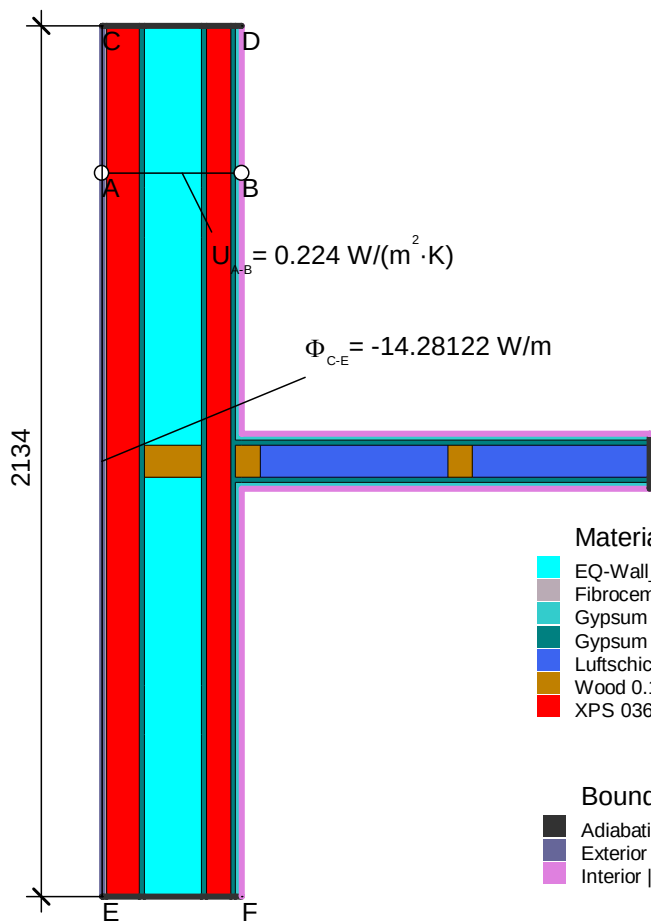
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{16.550}{30.000} - 0.224 \cdot 1.058 - 0.224 \cdot 1.058 = 0.078 \text{ W/(m·K)}$$



$$U_{eq A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.398}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2 \cdot \text{K)}$$

Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ε
Adiabatic Adiatat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
fRsi: Interior Innen		20.000	0.250	



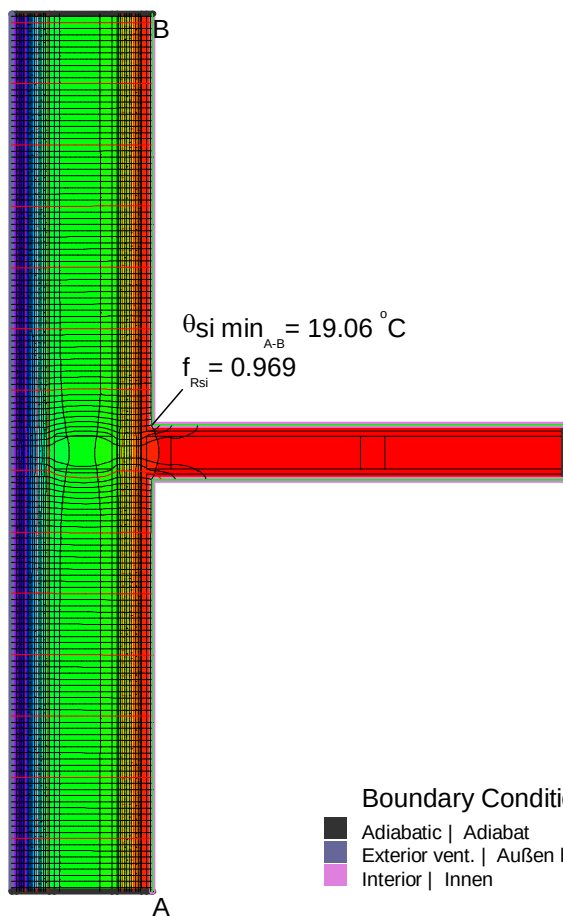


$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.398}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

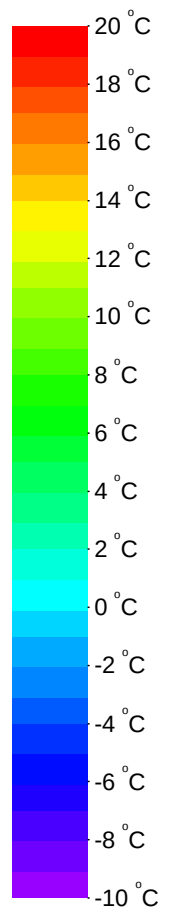
Material	$\lambda[W/(m \cdot K)]$	ε
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, horizontal, Dicke: 140 mm (1)	0.778	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS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

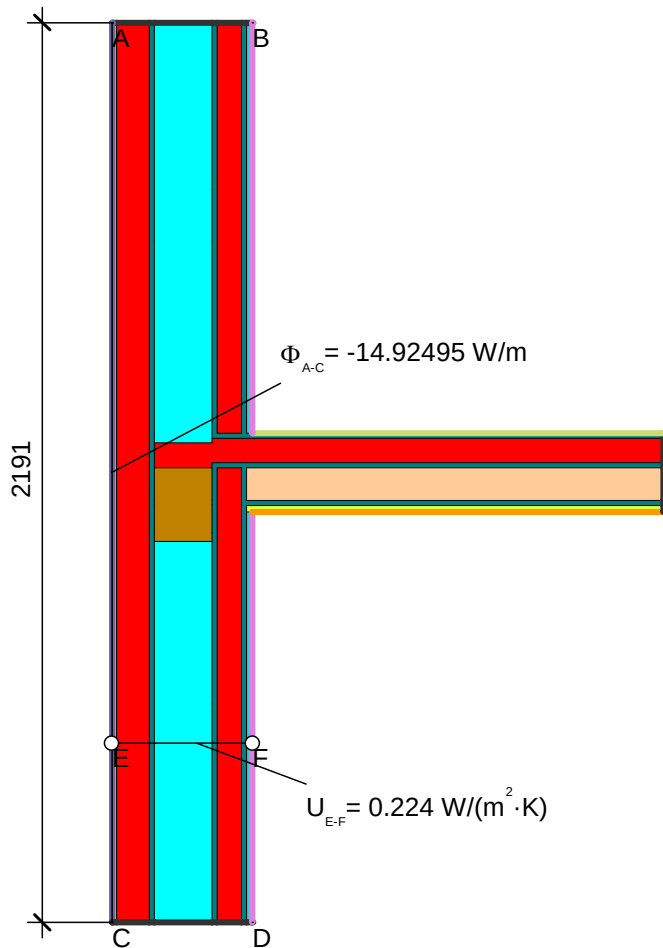
Boundary Condition	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$	ε
Adiabatic Adiabat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Interior Innen		20.000	0.130	

$$\Psi_{C-E,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 = \frac{14.281}{30.000} - 0.224 \cdot 2.134 = -0.001\ W/(m \cdot K)$$



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	
Interior Innen		20.000	0.130	





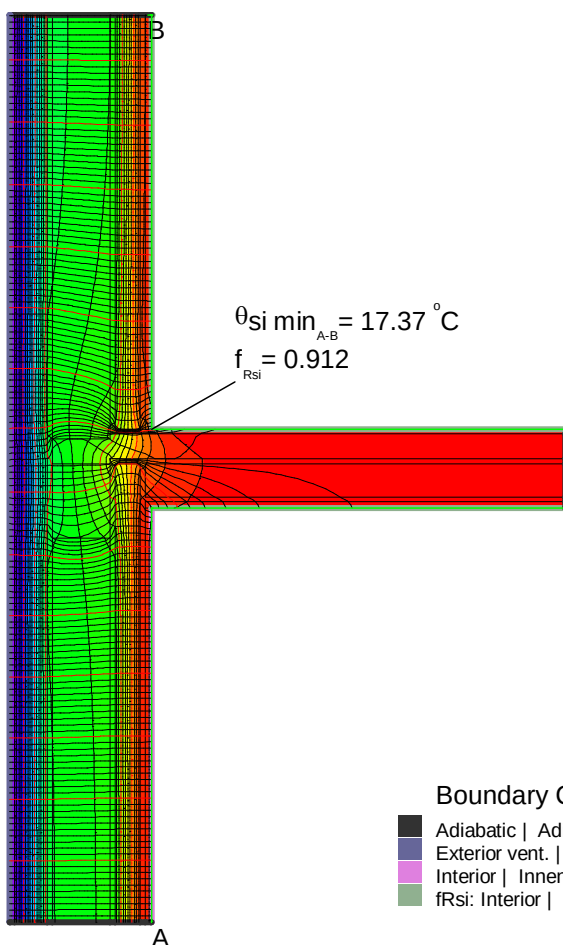
$$\Phi_{A-B} = -9.39843 \text{ W/m}$$

$$U_{eq A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.398}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2 \cdot \text{K)}$$

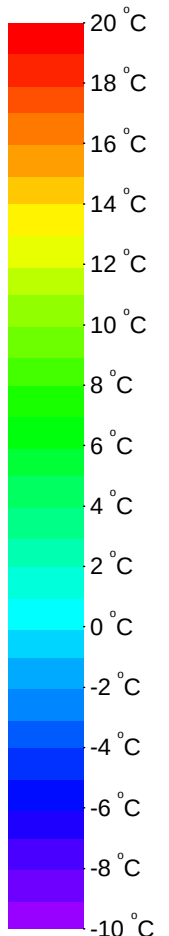
Material	λ [W/(m·K)]	ϵ
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento Fiber cement	1.200	0.900
Gypsum board Gipskartonplatten 900 kg/m3 10456	0.250	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, aufwärts, Dicke: 80 mm	0.500	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 Adiat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Int. flux down Innen abwärts		20.000	0.170	
Interior Innen		20.000	0.130	
Interior up. Innen auf.		20.000	0.100	
Interior Innen		20.000	0.130	

$$\psi_{A-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 = \frac{14.925}{30.000} - 0.224 \cdot 2.191 = 0.007 \text{ W/(m·K)}$$



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

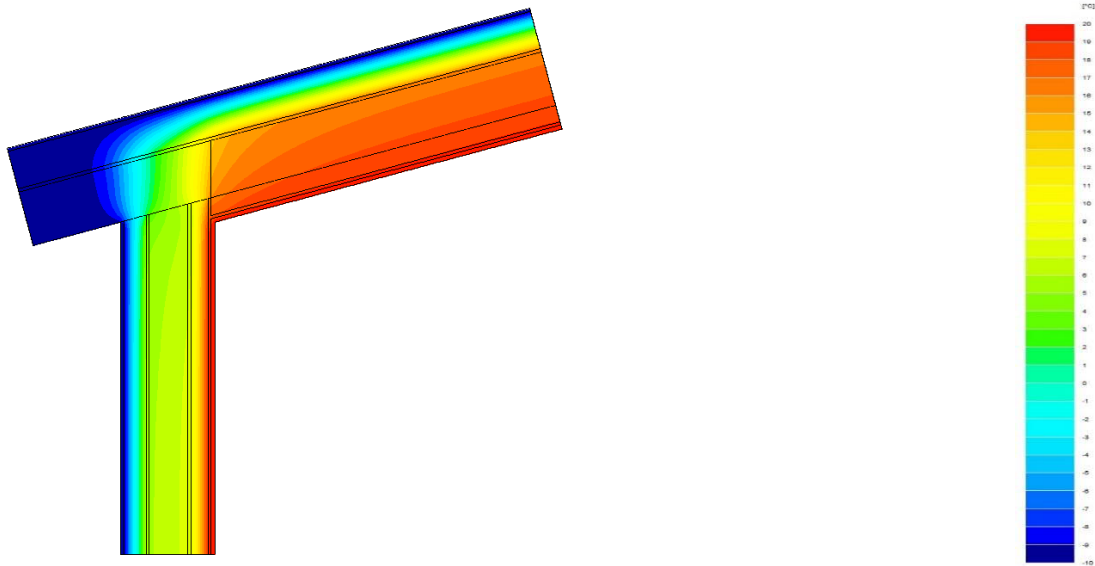


External wall to roof connection

An adjusted thermal conductivity for the joint between the wall and the roof of the system was established; these values were then used in the two-dimensional heat flow calculations shown on subsequent page. The models were created using AutoCAD and Physibel Solido based on the geometry provided by Thermochip in the cad file on the 27.05.2020.

Results assume a thermal conductivity of 0,080 W/(mK) for the replacement section at the junction between roof and wall.

Disturbed model isothermal view:



Materials properties:

Col.	Type	CEN-rule	Name	Pat.	Mesh	Raster	λ [W/mK]	ϵ [-]	θ [°C]	h [W/m²K]	q [W/m²]	θ_a [°C]	W/h
2	BC_SIMPL	NIHIL	14_BC_ext		100.00	NORMAL			-10.0	25.00	0		
3	BC_SIMPL	NIHIL	13_BC_ext_ventilated		100.00	NORMAL			-10.0	7.69	0		
4	BC_SIMPL	NIHIL	12_BC_int_hori		100.00	NORMAL			20.0	7.69	0		
30	MATERIAL		2_GFRB_25		100.00	NORMAL	0.250						
67	MATERIAL		3_Gypsumboard_21		100.00	NORMAL	0.210						
84	MATERIAL		5_EQ_suspended-ceiling_70318		100.00	NORMAL	0.703						
89	MATERIAL		4_EQ_Wall_Aircavity-timber_85599		100.00	NORMAL	0.656						
122	MATERIAL		6_EQ_Roof_AirCavity-timber_9173		100.00	NORMAL	0.917						
123	BC_SIMPL	NIHIL	11_BC_int_up		100.00	NORMAL			20.0	10.00	0		
125	MATERIAL		8_EQ_Roof_AirCavity-timber_81594		100.00	NORMAL	0.816						
126	MATERIAL		Roof_Beam-timber_29		100.00	NORMAL	0.290						
188	MATERIAL		1_insulation_038		100.00	NORMAL	0.038						

Boundary conditions:

The following boundary conditions were applied:

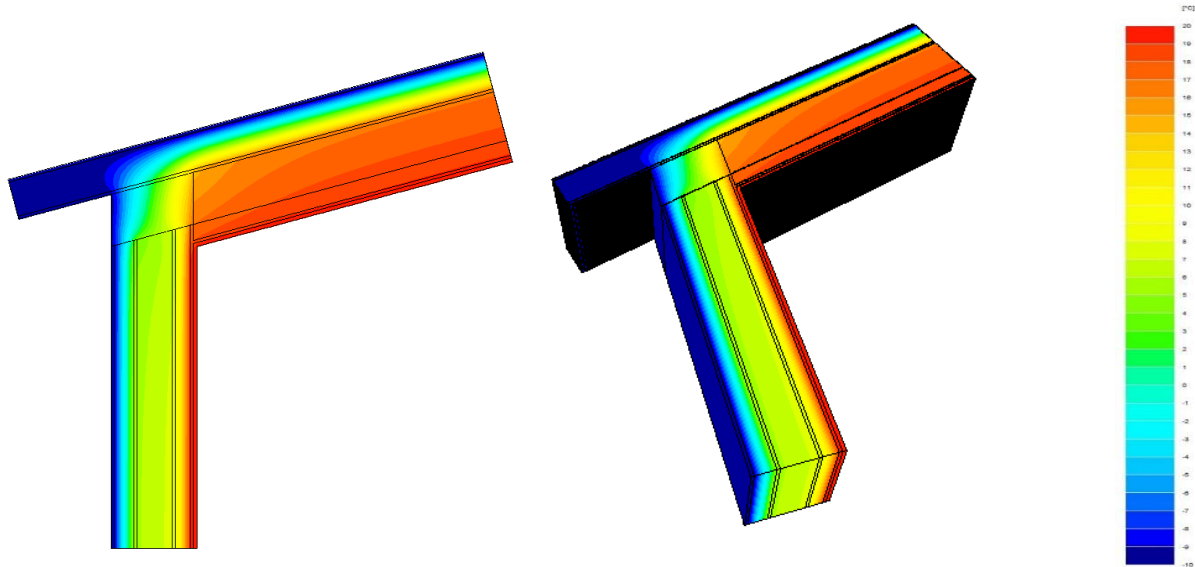
Temperature of external air (°C)	-10
Heat transfer coefficient of external air (W/(m²K)) @ 0,04 m²K/W	25
Temperature of internal air (°C)	20
Heat transfer coefficient of interior (horizontal, (W/(m²K)) @ 0,13 m²K/W	7,69
Temperature of internal air (°C)	20
Heat transfer coefficient of interior (upwards, (W/(m²K)) @ 0,10 m²K/W	10
Temperature of internal air (°C)	20
Heat transfer coefficient of interior (horizontal, (W/(m²K)) @ 0,25 m²K/W	4



External wall to roof connection

No surface temperature detection was carried out for this model to determine the fRsi-value.

Undisturbed model isothermal views:



Materials properties:

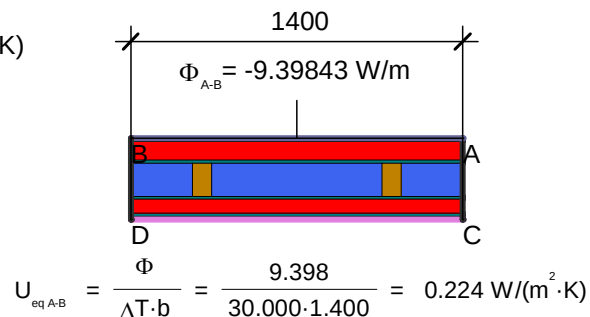
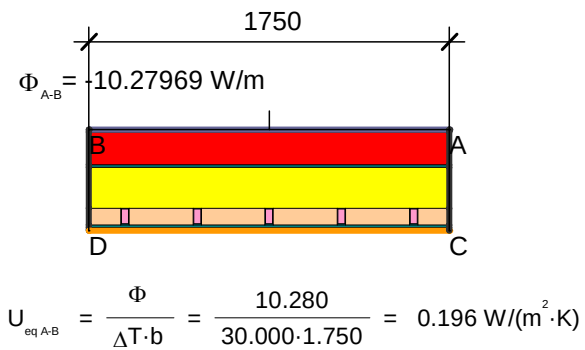
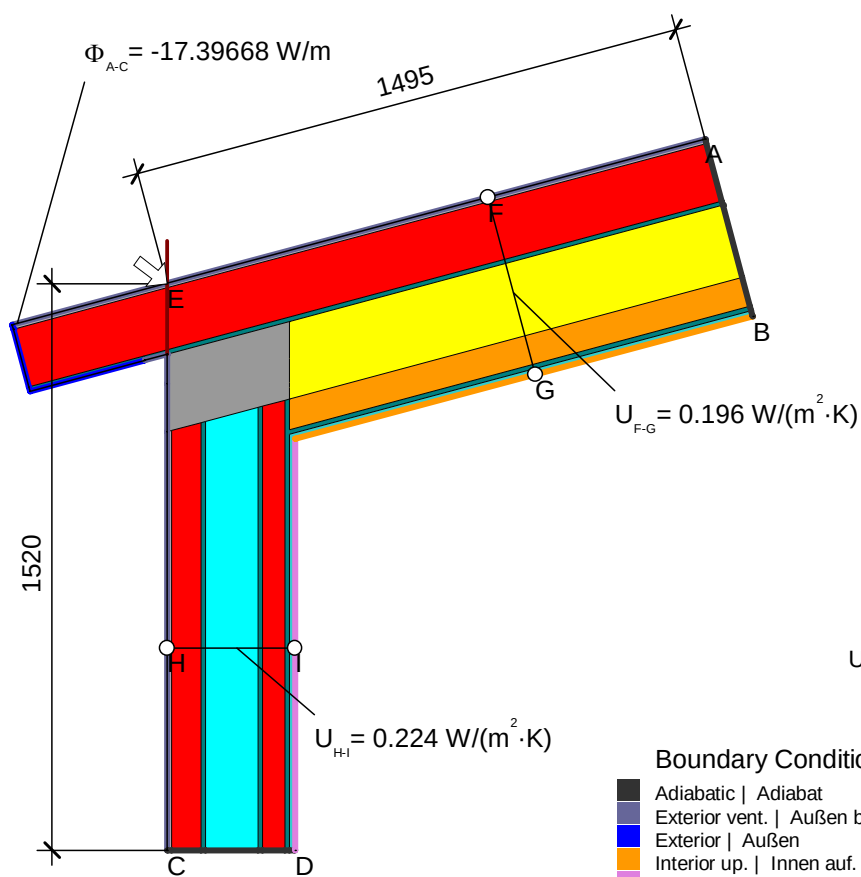
Col.	Type	CEN-rule	Name	Pat.	Mesh	Raster	λ [W/mK]	ϵ [-]	θ [°C]	h [W/m²K]	g [W/m²]	θ_a [°C]	h_c [W/m²K]	P_c [W]	θ_r [°C]
2	BC_SIMPL	NIHIL			100.00	NORMAL			-10.0	25.00	0				
3	BC_SIMPL	NIHIL	13_BC_ext_ventilated		100.00	NORMAL			-10.0	7.69	0				
4	BC_SIMPL	NIHIL			100.00	NORMAL			20.0	7.69	0				
30	MATERIAL				100.00	NORMAL	0.250								
67	MATERIAL				100.00	NORMAL	0.210								
84	MATERIAL				100.00	NORMAL	0.703								
89	MATERIAL				100.00	NORMAL	0.656								
123	BC_SIMPL	NIHIL			100.00	NORMAL			20.0	10.00	0				
188	MATERIAL				100.00	NORMAL	0.038								
250	MATERIAL				100.00	NORMAL	0.917								
251	MATERIAL				100.00	NORMAL	0.080								

Boundary conditions:

The following boundary conditions were applied:

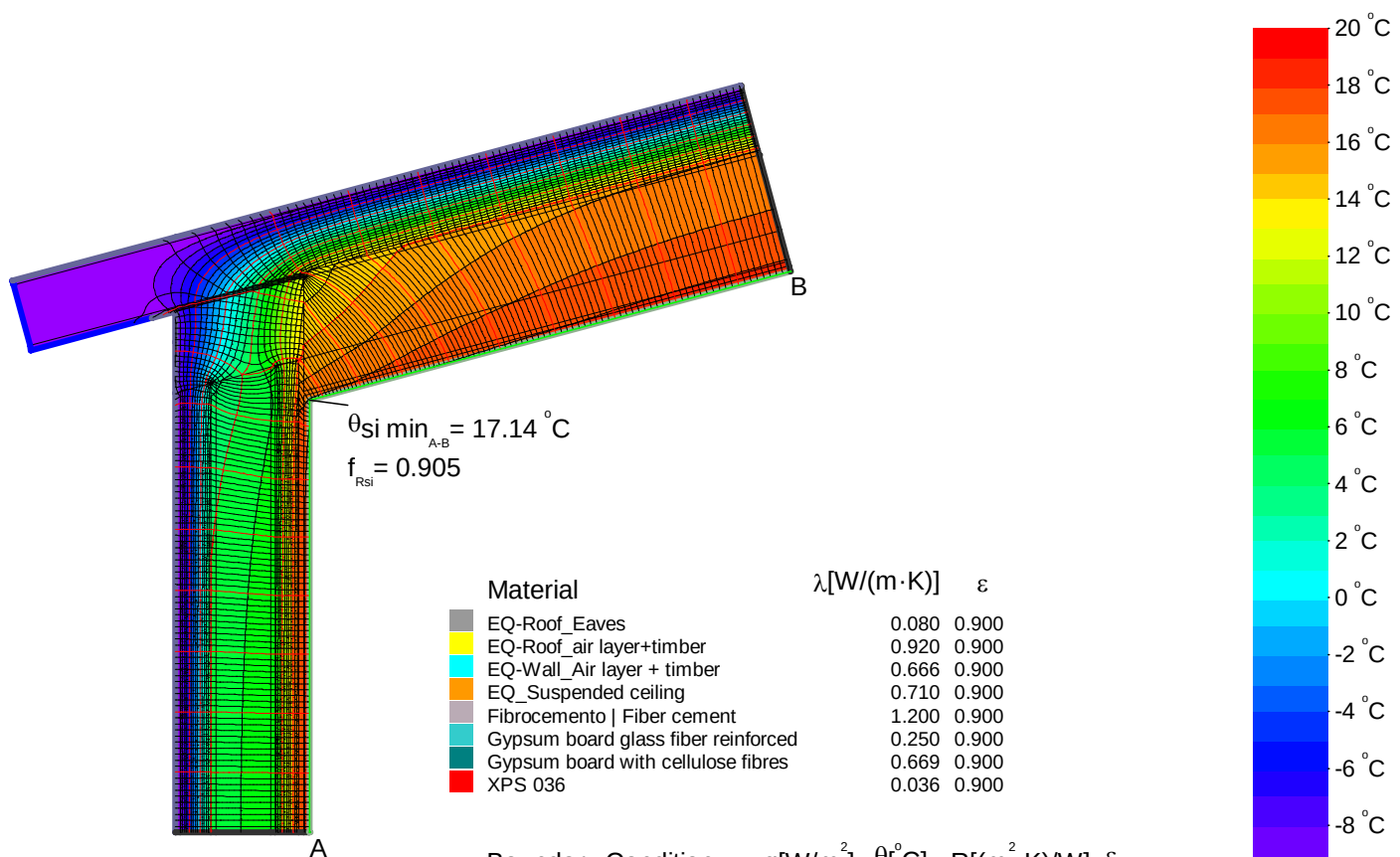
Temperature of external air (°C)	-10
Heat transfer coefficient of external air (W/(m²K)) @ 0,04 m²K/W	25
Temperature of internal air (°C)	20
Heat transfer coefficient of interior (horizontal, (W/(m²K)) @ 0,13 m²K/W	7,69
Temperature of internal air (°C)	20
Heat transfer coefficient of interior (upwards, (W/(m²K)) @ 0,10 m²K/W	10
Temperature of internal air (°C)	20
Heat transfer coefficient of interior (horizontal, (W/(m²K)) @ 0,25 m²K/W	4





Boundary Condition	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$	ε
Adiabatic Adiat	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	

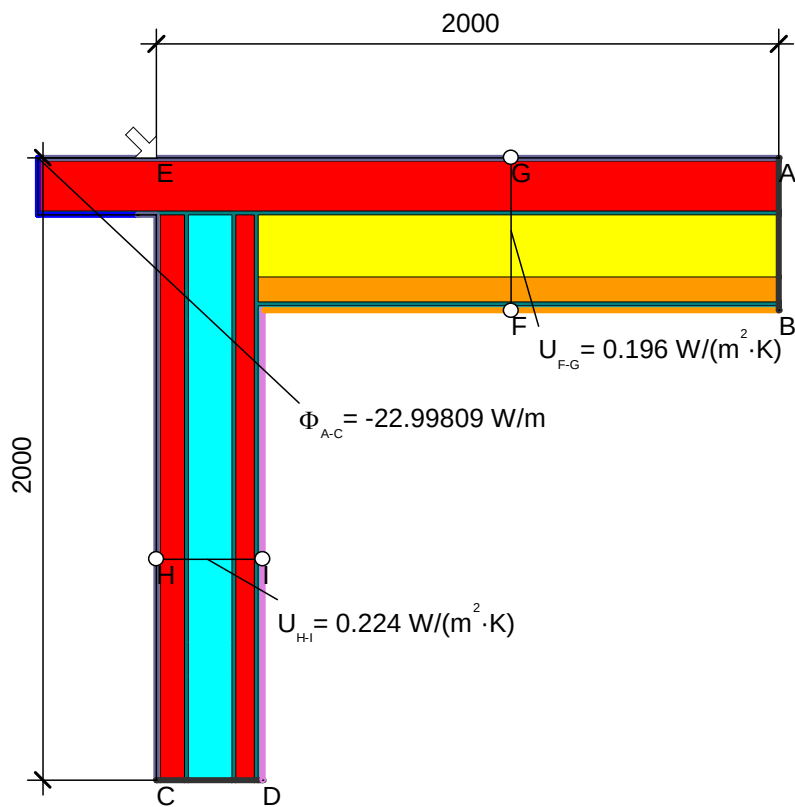
$$\psi_{A-E,C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{17.397}{30.000} - 0.196 \cdot 1.495 - 0.224 \cdot 1.520 = -0.053 W/(m \cdot K)$$



Material	$\lambda[W/(m \cdot K)]$	ε
EQ-Roof_Eaves	0.080	0.900
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 Adiat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Exterior Außen		-10.000	0.040	
fRsi: Interior Innen		20.000	0.250	





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

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

$$\Phi_{A-B} = -9.39843 \text{ W/m}$$

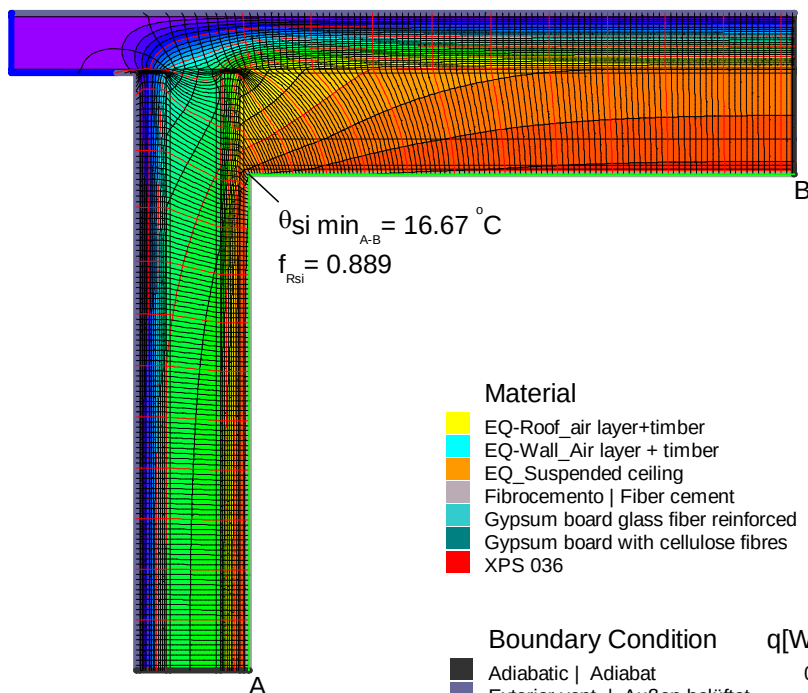
$$U_{eq A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.398}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2 \cdot \text{K)}$$

$$\Psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{22.998}{30.000} - 0.196 \cdot 2.000 - 0.224 \cdot 2.000 = -0.073 \text{ W/(m} \cdot \text{K)}$$

Boundary Condition

Adiabatic Adiat	0.000
Exterior vent. Außen belüftet	-10.000
Exterior Außen	-10.000
Interior up. Innen auf.	20.000
Interior Innen	20.000

$q[\text{W/m}^2]$	$\theta[^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
0.000	-10.000	0.130	
	-10.000	0.040	
	20.000	0.100	
	20.000	0.130	



Material

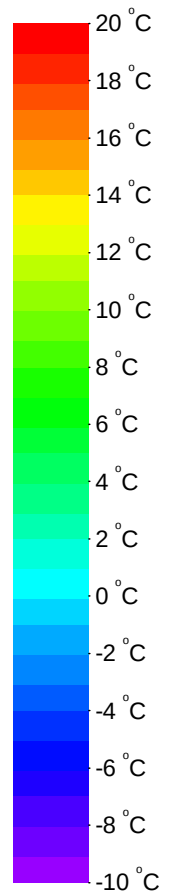
EQ-Roof_air layer+timber	0.920	0.900
EQ-Wall_Air layer + timber	0.666	0.900
EQ_Suspended ceiling	0.710	0.900
Fibrocemento Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
XPS 036	0.036	0.900

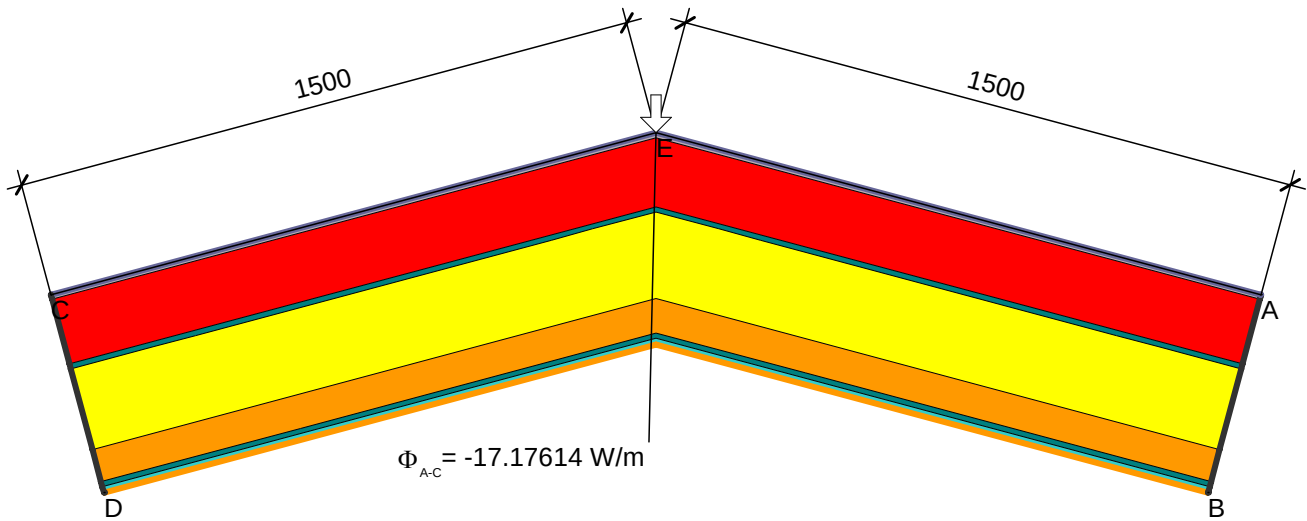
$\lambda[\text{W/(m} \cdot \text{K)}]$	ε
0.920	0.900
0.666	0.900
0.710	0.900
1.200	0.900
0.250	0.900
0.669	0.900
0.036	0.900

Boundary Condition

Adiabatic Adiat	0.000
Exterior vent. Außen belüftet	-10.000
Exterior Außen	-10.000
fRsi: Interior Innen	20.000

$q[\text{W/m}^2]$	$\theta[^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
0.000	-10.000	0.130	
	-10.000	0.040	
	20.000	0.250	



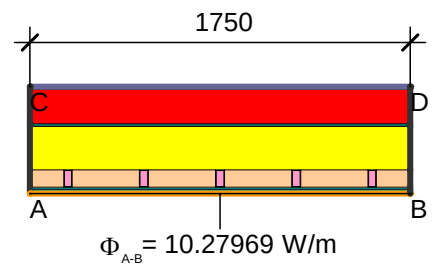


$$\Phi_{A-C} = -17.17614 \text{ W/m}$$

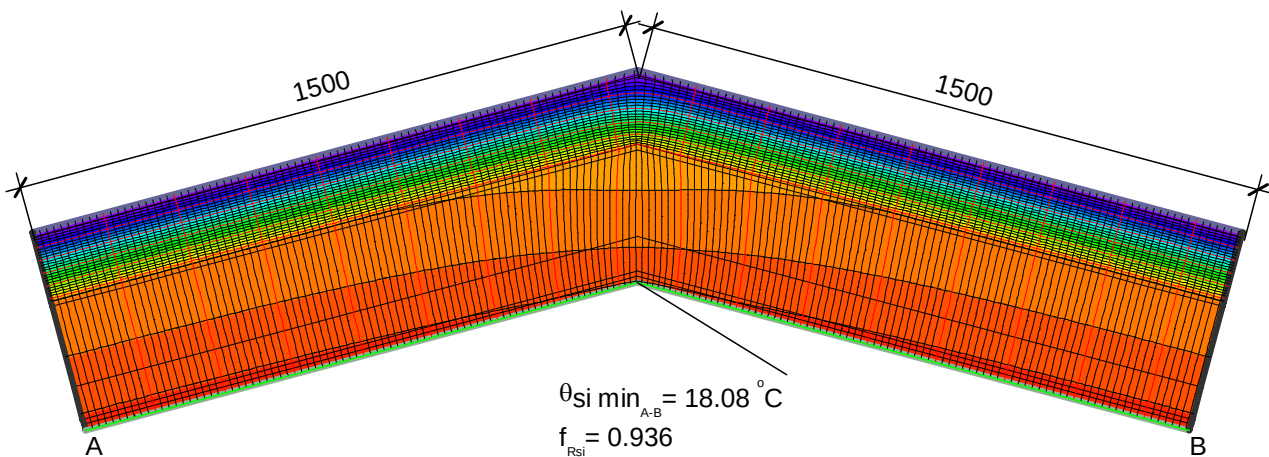
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{17.176}{30.000} - 0.196 \cdot 1.500 - 0.196 \cdot 1.500 = -0.015 \text{ W/(m} \cdot \text{K)}$$

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

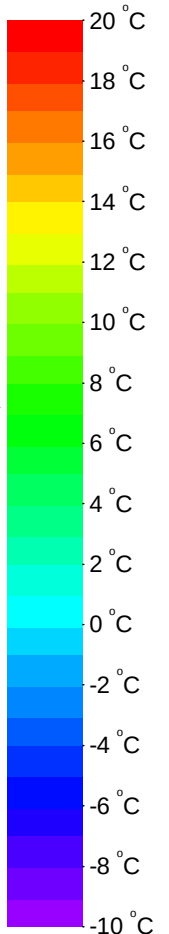
Material	$\lambda[\text{W/(m} \cdot \text{K)}]$	ε
EQ-Roof_air layer+timber	0.920	0.900
EQ_Suspended ceiling	0.710	0.900
Fibrocemento Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
XPS 036	0.036	0.900

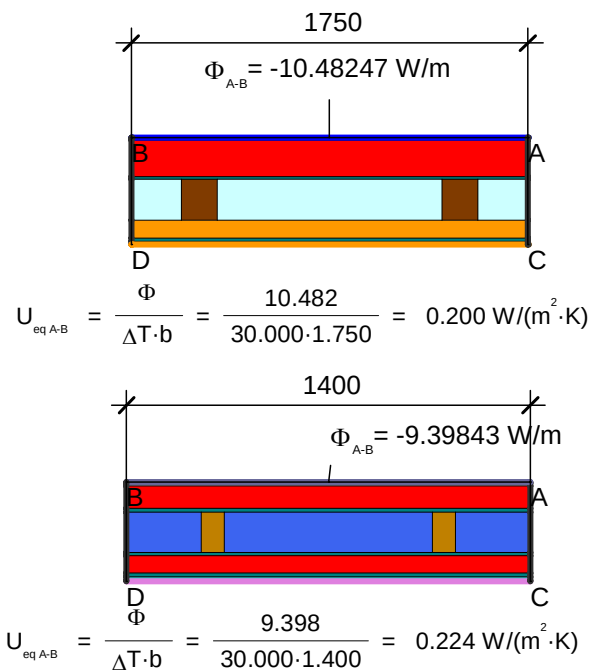


$$U_{\text{eq A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.280}{30.000 \cdot 1.750} = 0.196 \text{ W/(m}^2 \cdot \text{K)}$$



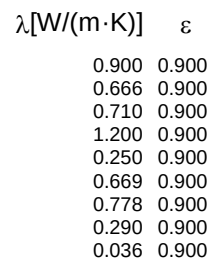
Boundary Condition	$q[\text{W/m}^2]$	$\theta[^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
Adiabatic Adiat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
fRsi: Interior Innen		20.000	0.250	



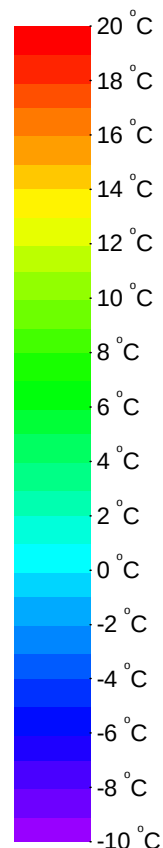


Boundary Condition	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$	ε
Adiabatic Adiatat	0.000			
Exterior vent. Außen belüftet		-10.000		0.130
Interior Innen		20.000		0.130
Interior up. Innen auf.		20.000		0.100

$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{20.648}{30.000} - 0.224 \cdot 1.800 - 0.200 \cdot 1.800 = -0.074 \text{ W/(m}\cdot\text{K)}$$



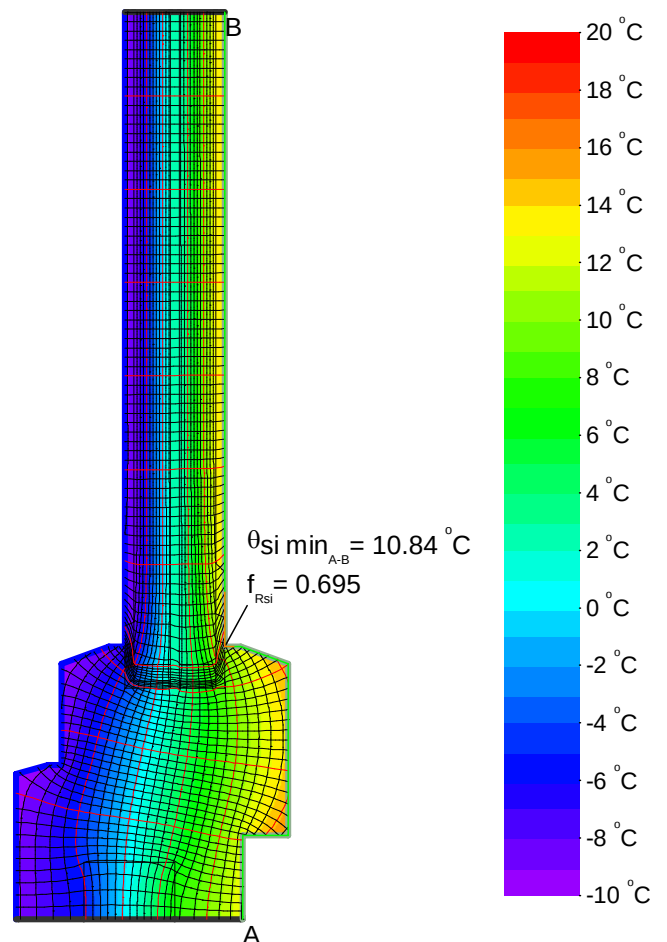
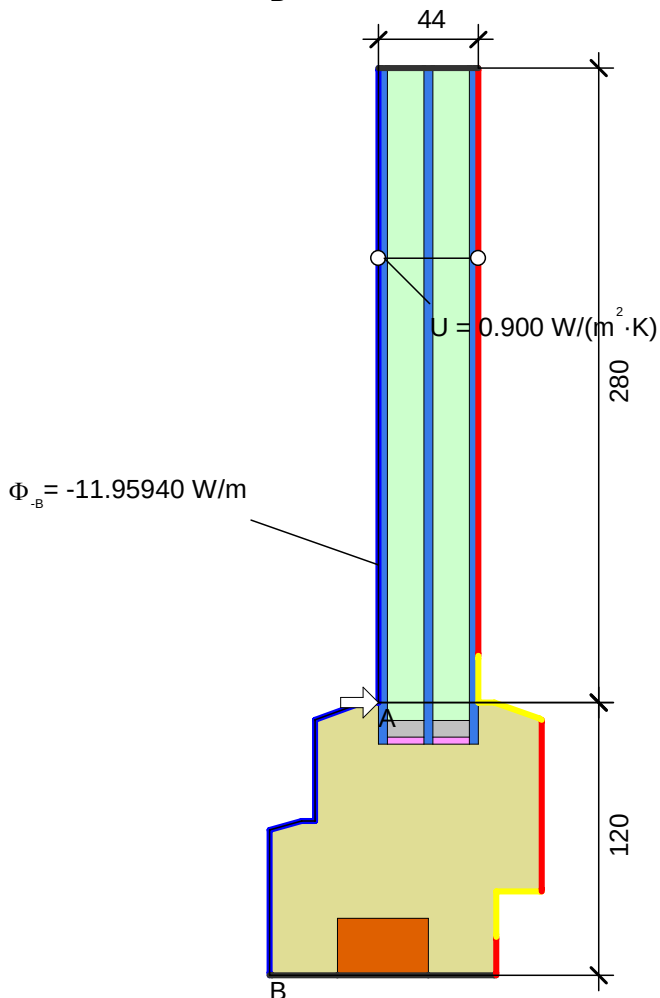
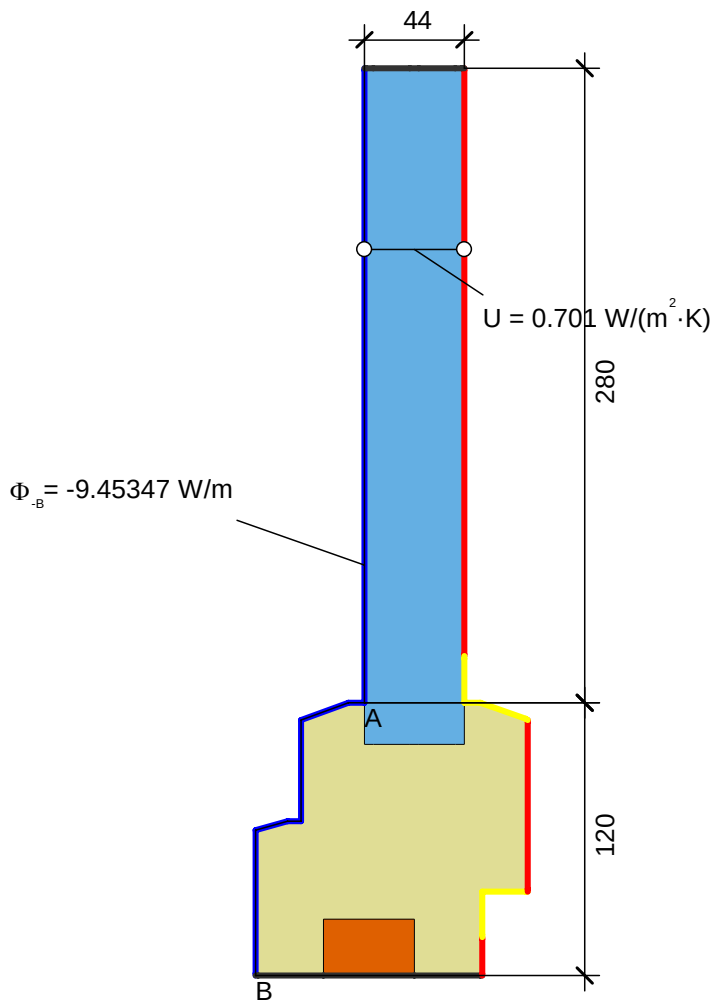
Boundary Condition	$q[W/m^2]$	$\theta [^\circ C]$	$R[(m^2 \cdot K)/W]$	ε
Adiabatic Adiabat	0.000			
Exterior vent. Außen belüftet		-10.000		0.130
fRsi: Interior Innen		20.000		0.250

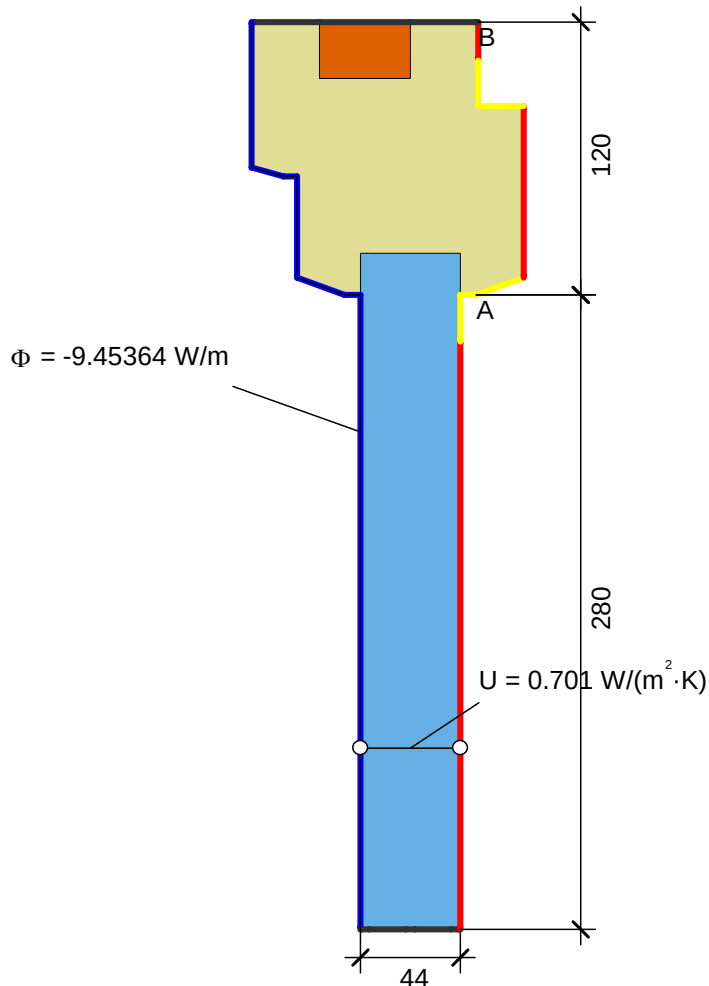


Windows | Fenster

Passive House Unit		01			02			03			01	
frame values Rahmenwerte	Spacer Abstandhalter: phA Spacer		Bottom	Top	Side	Bottom	Top	Side	Bottom	Top	Side	Bottom barrier-free
			Unten	Oben	Seitl.	Unten	Oben	Seitl.	Unten	Oben	Seitl.	Unten barrierefrei
												
	Frame width Rahmenbreite	b_f [mm]	120	120	120							
	U-value frame Rahmen-U-Wert	U_f [W/(m²K)]	0.99	0.99	0.99							
	Ψ-glass edge Glasrand-Ψ-Wert	Ψ_g [W/(mK)]	0.028	0.028	0.028							
	U-value window Fenster-U-Wert	U_w [W/(m²K)] @U _g = 0,70 W/(m²K)	0.998									
	Passive House efficiency class Passivhaus Effizienzklasse		phC									
	Installation Einbau											
f_{Rsi} =0,25m²K/W		0.756	0.778	0.782								
Ψ_{install} [W/(mK)]		0.016	0.012	0.012								
	U_{w, installed} [W/(m²K)]		1.04									





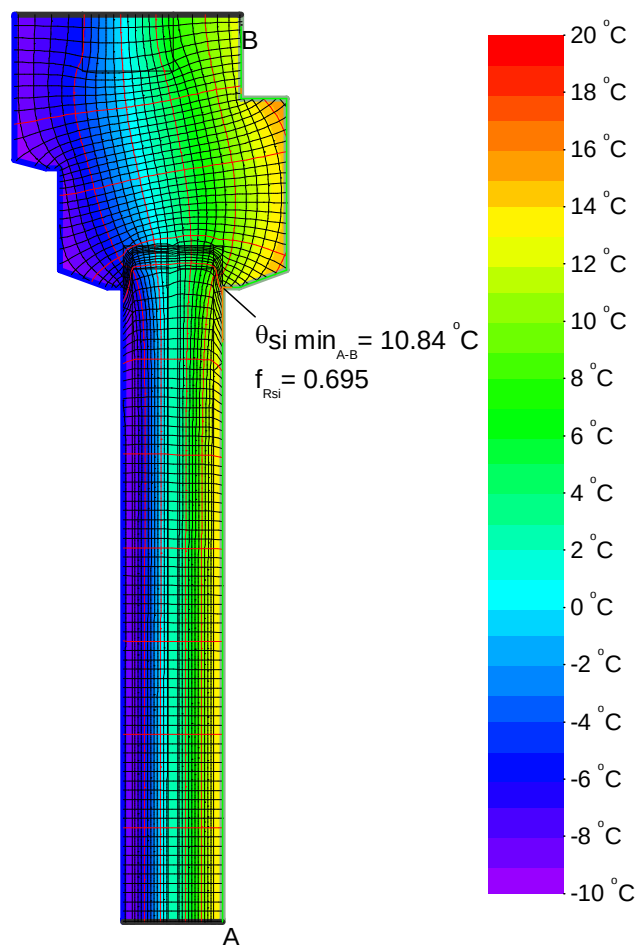
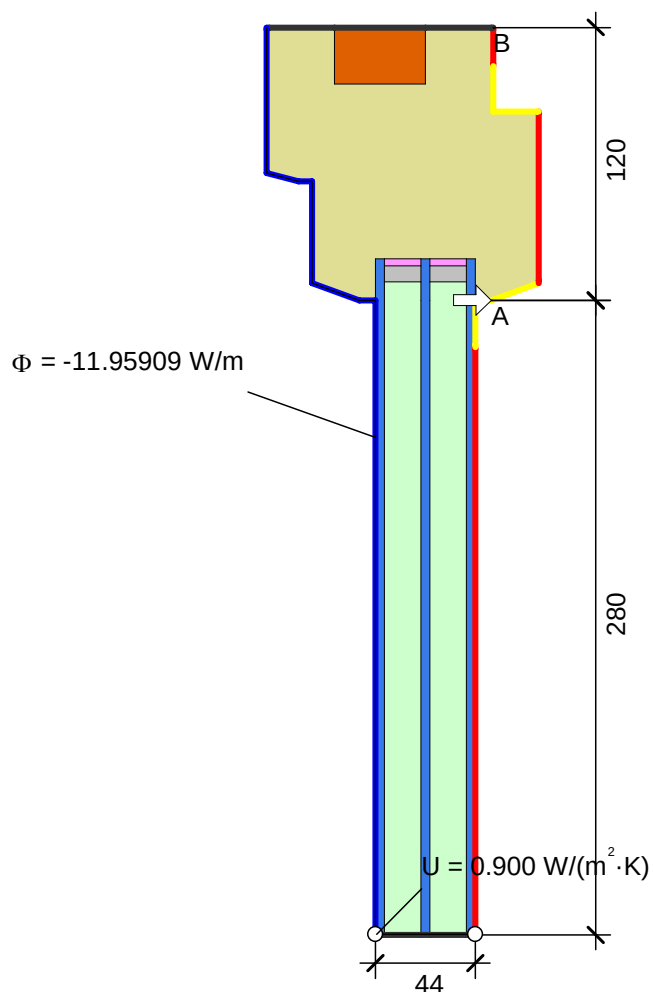


Material	$\lambda[\text{W/(m}\cdot\text{K)}]$	ε
Insulation I Wärmedämmung 050	0.050	0.900
Panel I Maske	0.035	0.900
Softwood, OSB I Weichholz, OSB ISO 10456	0.130	0.900

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

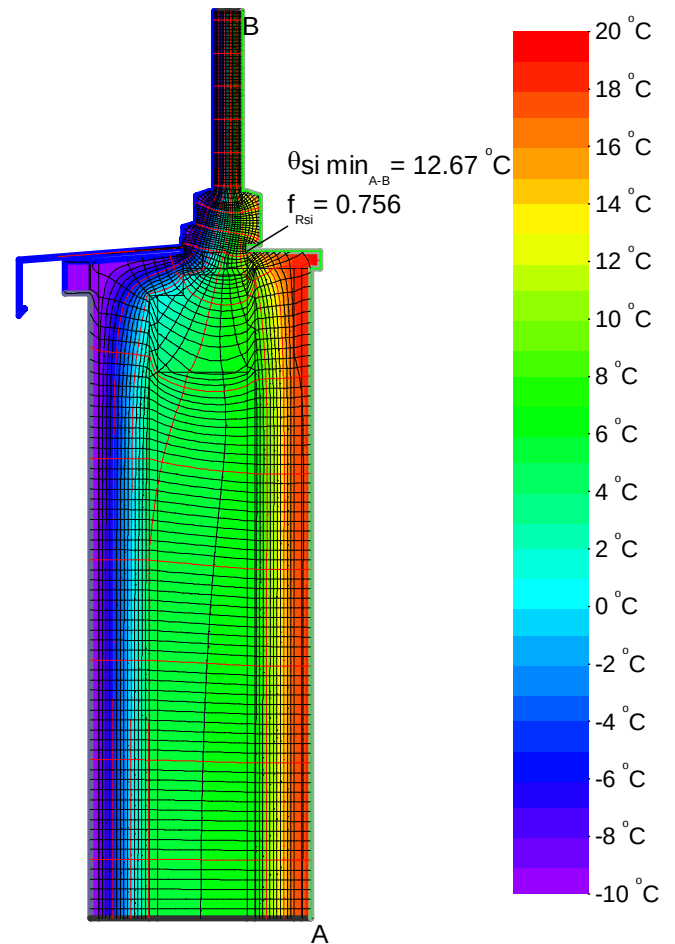
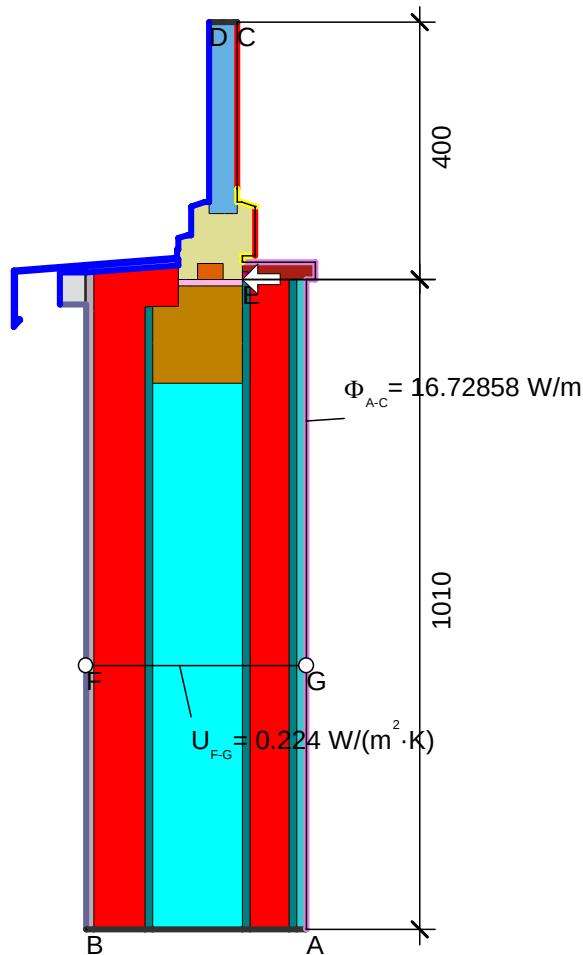
Boundary Condition	$q[\text{W/m}^2]$	$\theta[^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
Adiabatic	0.000			
Aussen Standard		-10.000	0.040	
fRsi: Interior Innen		20.000	0.250	

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



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

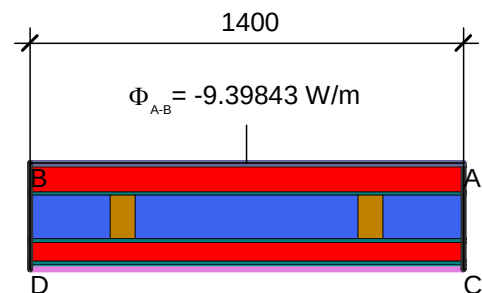




$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{16.729}{30.000} - 0.224 \cdot 1.010 - \frac{9.453}{30.000} = 0.016 \text{ W/(m} \cdot \text{K)}$$

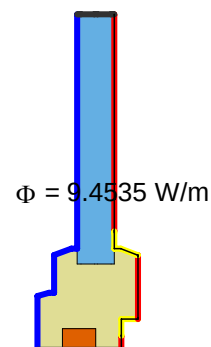
Material	λ [W/(m·K)]	ε
Aluminum Aluminium 10456	160.000	0.900
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Hardwood Hartholz 0.18 700 kg/m3 10456	0.180	0.900
Insulation Wärmedämmung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

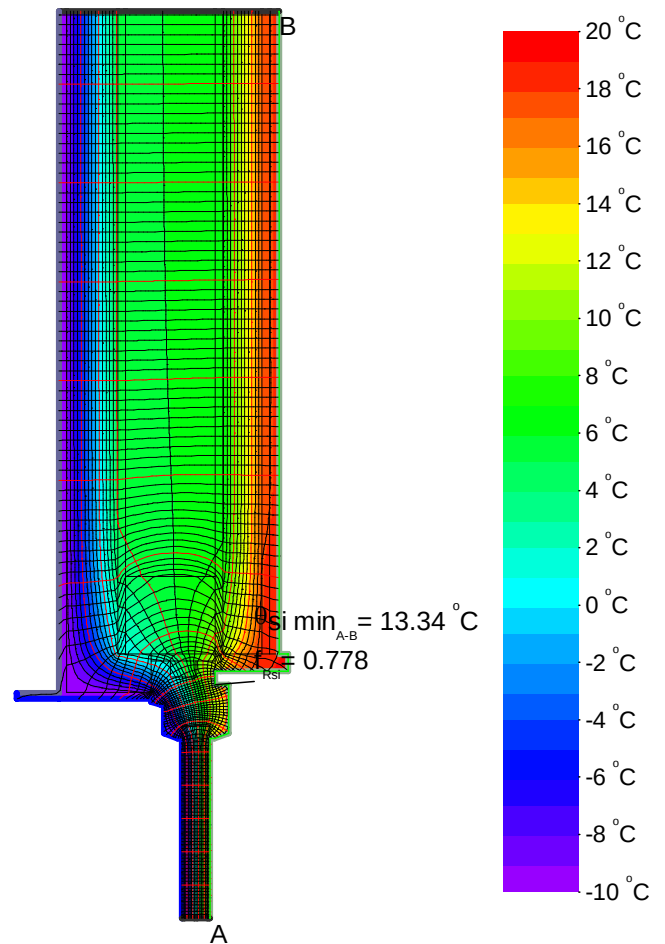
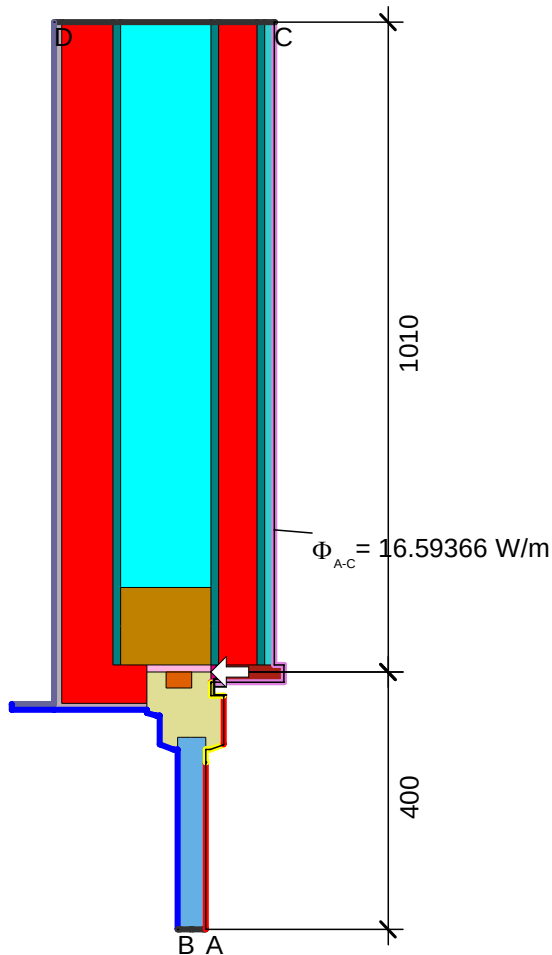
* EN ISO 10077-2:2017, 6.4.3



$$U_{eq A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.398}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2 \cdot \text{K)}$$

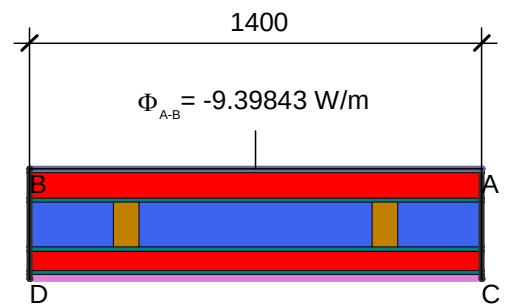
Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ε
Adiabatic Adiat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Exterior Außen		-10.000	0.040	
Innen Fensterrahmen Reduziert		20.000	0.200	
Innen Fensterrahmen Standard		20.000	0.130	
Interior Innen		20.000	0.130	
e 0,9 Cavity Hohlraum				0.900





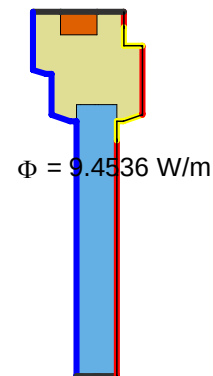
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_i}{\Delta T} - U_2 \cdot b_2 = \frac{16.594}{30.000} - \frac{9.454}{30.000} - 0.224 \cdot 1.010 = 0.012 \text{ W/(m} \cdot \text{K)}$$

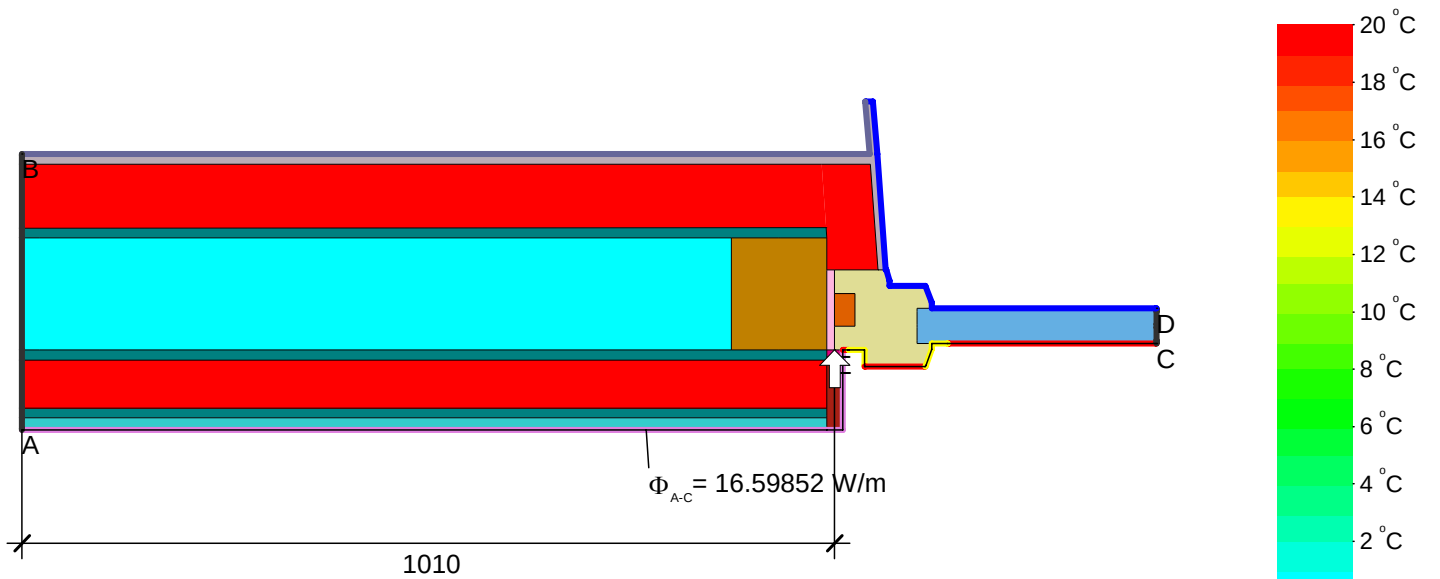
Material	λ [W/(m·K)]	ε
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Hardwood Hartholz 0.18 700 kg/m ³ 10456	0.180	0.900
Insulation Wärmedämmung 050	0.050	0.900
PU in-situ foam PU-Ortschaum 040	0.040	0.900
Panel Maske	0.035	0.900
Silicone Silikon	0.350	0.900
Softwood, OSB Weichholz, OSB ISO 10456	0.130	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900



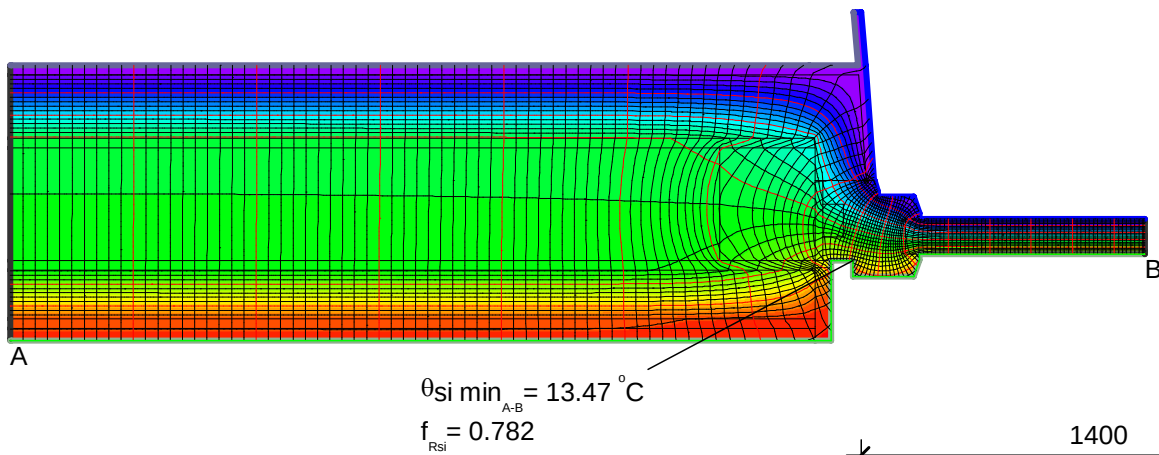
$$U_{eq \text{ A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.398}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2 \cdot \text{K)}$$

Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ε
Adiabatic Adiabat	0.000			
Aussen Standard		-10.000	0.040	
Exterior vent. Außen belüftet		-10.000	0.130	
Innen Fensterrahmen Reduziert		20.000	0.200	
Innen Fensterrahmen Standard		20.000	0.130	
Interior Innen		20.000	0.130	

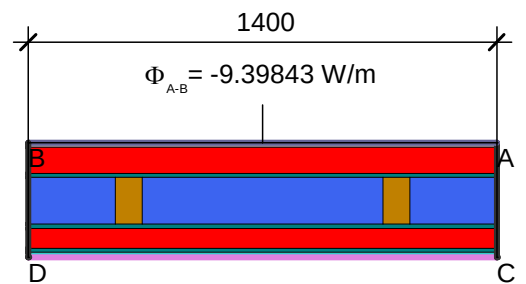




$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{16.599}{30.000} - 0.224 \cdot 1.010 - \frac{9.454}{30.000} = 0.012 \text{ W/(m} \cdot \text{K)}$$

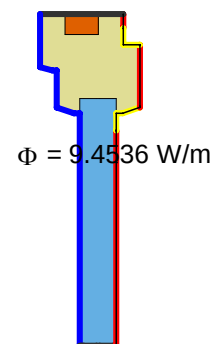


Material	$\lambda [\text{W/(m} \cdot \text{K)}]$	ϵ
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Hardwood Hartholz 0.18 700 kg/m ³ 10456	0.180	0.900
Insulation Wärmedämmung 050	0.050	0.900
PU in-situ foam PU-Ortschaum 040	0.040	0.900
Panel Maske	0.035	0.900
Silicone Silikon	0.350	0.900
Softwood, OSB Weichholz, OSB ISO 10456	0.130	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900



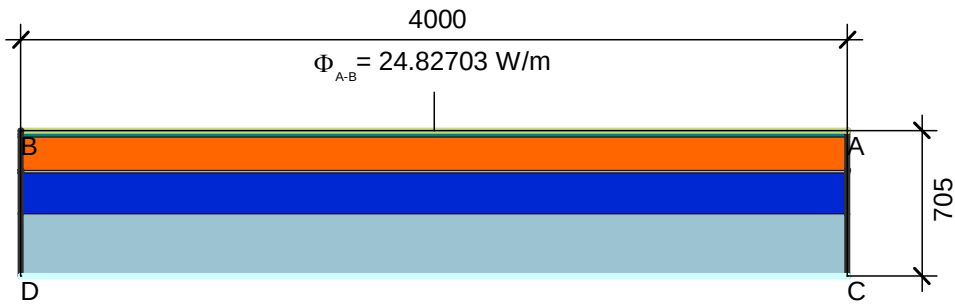
$$U_{eq \text{ A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.398}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2 \cdot \text{K)}$$

Boundary Condition	$q [\text{W/m}^2]$	$\theta [^{\circ}\text{C}]$	$R [\text{m}^2 \cdot \text{K/W}]$	ϵ
Adiabatic Adiatat	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

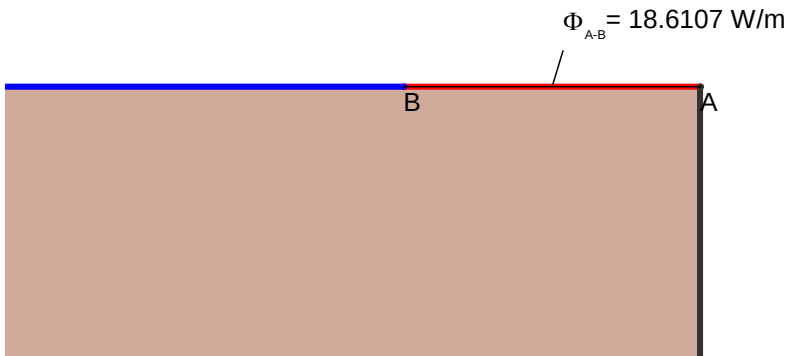




$$U_{\text{eq A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{24.827}{30.000 \cdot 4.000} = 0.207 \text{ W}/(\text{m}^2 \cdot \text{K})$$

Material	$\lambda [\text{W}/(\text{m} \cdot \text{K})]$	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

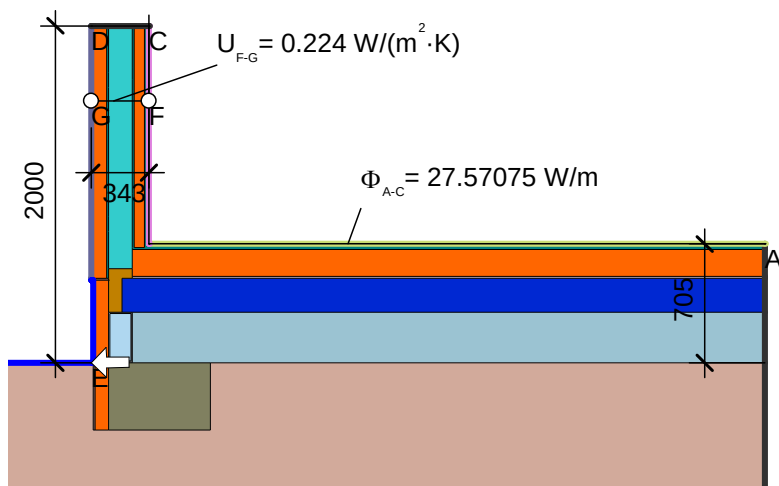
Boundary Condition	$q [\text{W}/\text{m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
Gorund Erdreich		-10.000	
Int. flux down Innen abwärts		20.000	0.170
Adiabatic Adiabatisch	0.000		



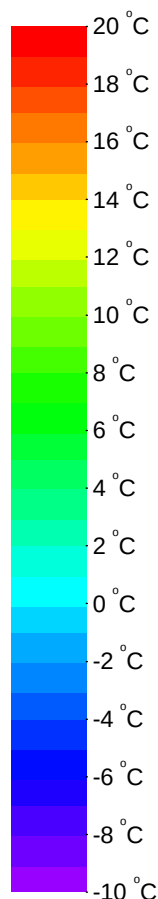
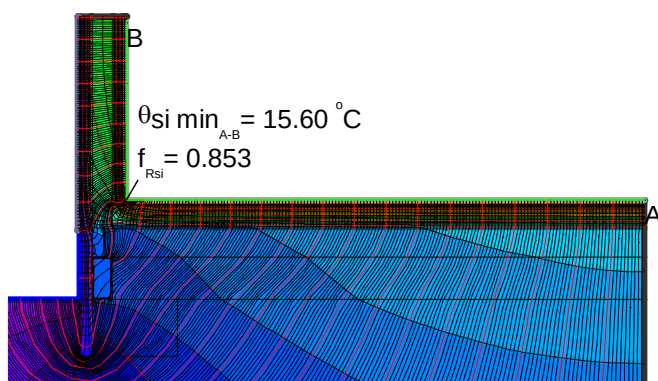
Material	$\lambda [\text{W}/(\text{m} \cdot \text{K})]$	ε
Ground Erdreich	2.000	0.900

Boundary Condition	$q [\text{W}/\text{m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
EQ FS: 1/Ufs		20.000	4.833
Exterior Außen		-10.000	0.040
Adiabatic Adiabatisch	0.000		

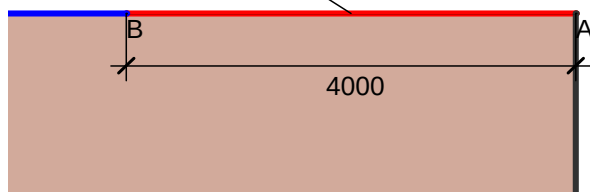




$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{27.571}{30.000} - \frac{18.611}{30.000} - 0.224 \cdot 2.000 = -0.149 \text{ W/(m·K)}$$



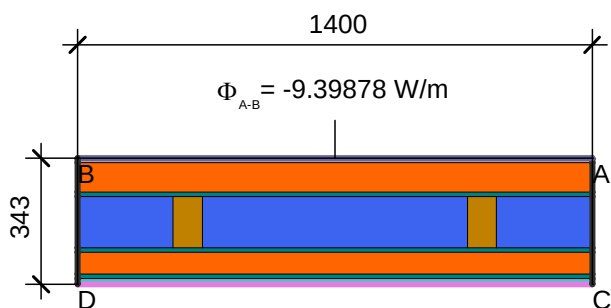
$$\Phi_{A-B} = 18.6107 \text{ W/m}$$



Material

Aluminum Aluminium 10456	160.000	0.900
Concrete, 1% Steel 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 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

$$\lambda[\text{W/(m·K)}] \quad \varepsilon$$



$$U_{eq A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.399}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2 \cdot \text{K)}$$

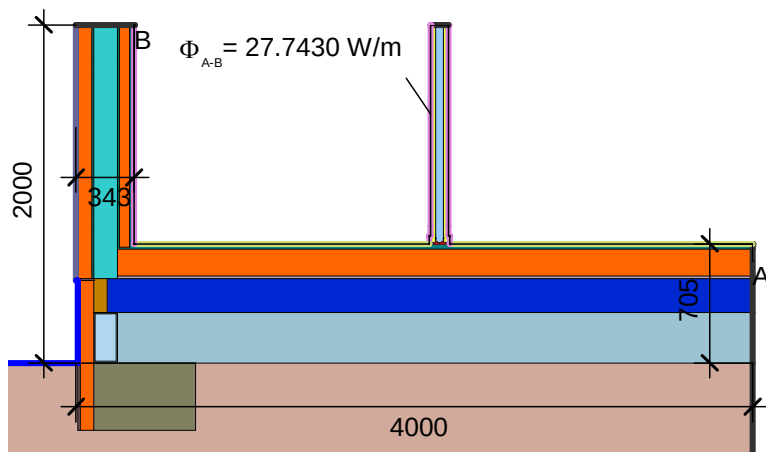
Boundary Condition

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

Boundary Condition

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



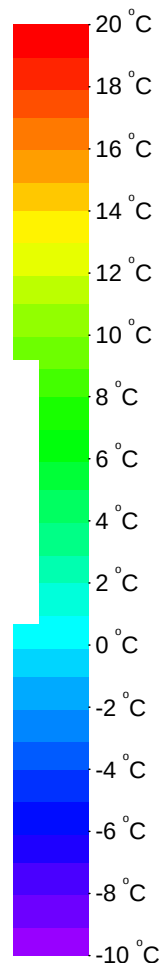
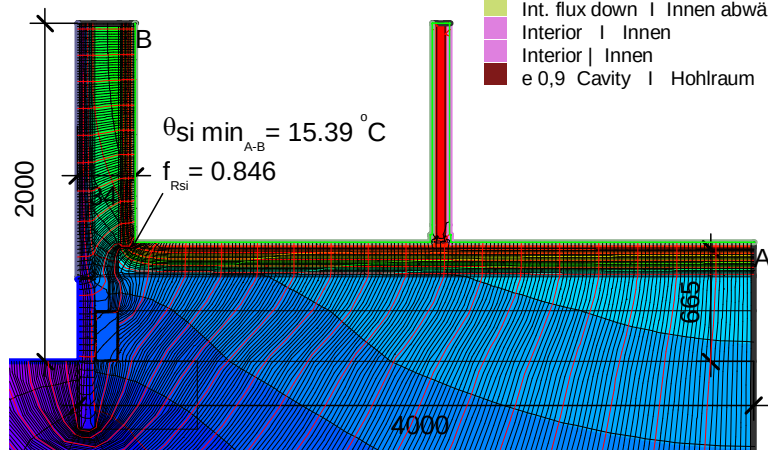


$$\psi_{FSIW} = (Q_{FSIW} - Q_{FSEW}) / \Delta T = (27.7430 - 27.5708) / 30 = 0,006 \text{ W/mK}$$

Boundary Condition

Adiabatic Adiabatisch	0.000
Adiabatic Adiabatisch	0.000
Exterior Außen	-10.000
Exterior vent. Außen belüftet	-10.000
Int. flux down Innen abwärts	20.000
Interior Innen	20.000
Interior Innen	20.000
e 0,9 Cavity Hohlraum	0.130

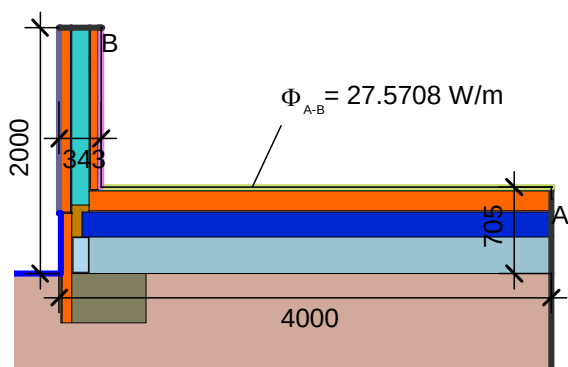
q[W/m ²]	θ[°C]	R[(m ² ·K)/W]	ε
0.000			
0.000			
-10.000		0.040	
-10.000		0.130	
20.000		0.170	
20.000		0.130	
20.000		0.130	
			0.900

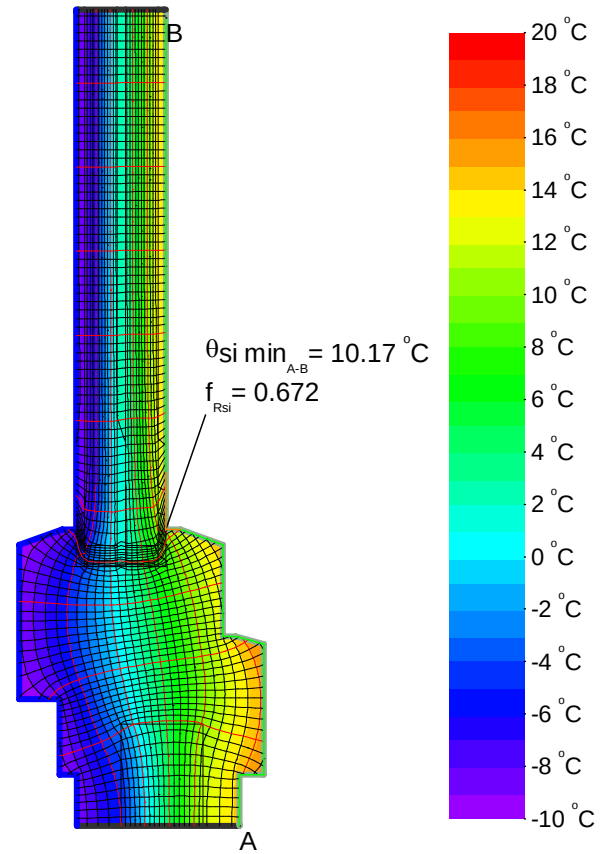
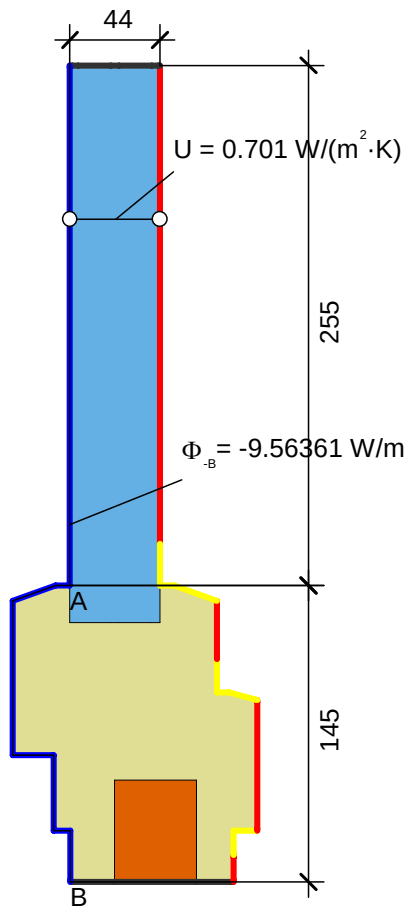


Material

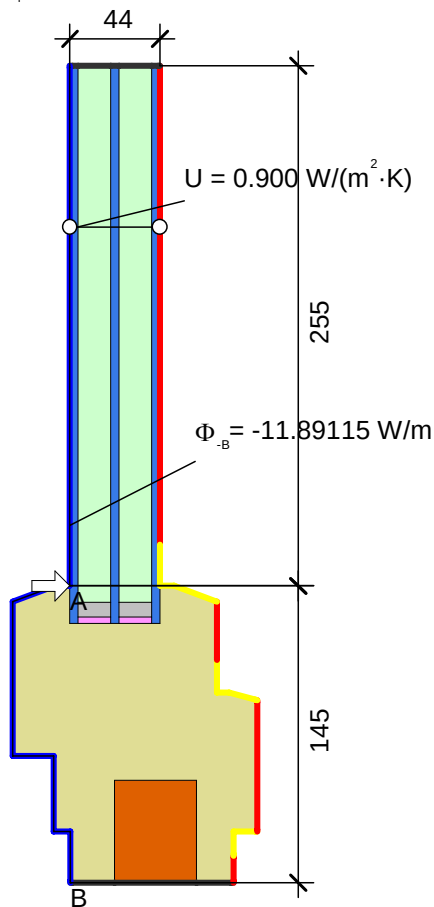
Aluminum Aluminium 10456	160.000	0.900
Concrete, 1% Steel Beton, 1% Stahl ISO 10456	2.300	0.900
EPDM	0.250	0.900
EQ-Wall_Air layer + timber	0.656	0.900
Eq_1 Service Cavity	0.046	0.900
Fibrocemento Fiber cement	1.200	0.900
Gips 1500 kg/m3	0.560	0.900
Ground Erdreich	2.000	0.900
Gypsum board Gipskartonplatten 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 Stahl	50.000	0.900
Unvent. cavity 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





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



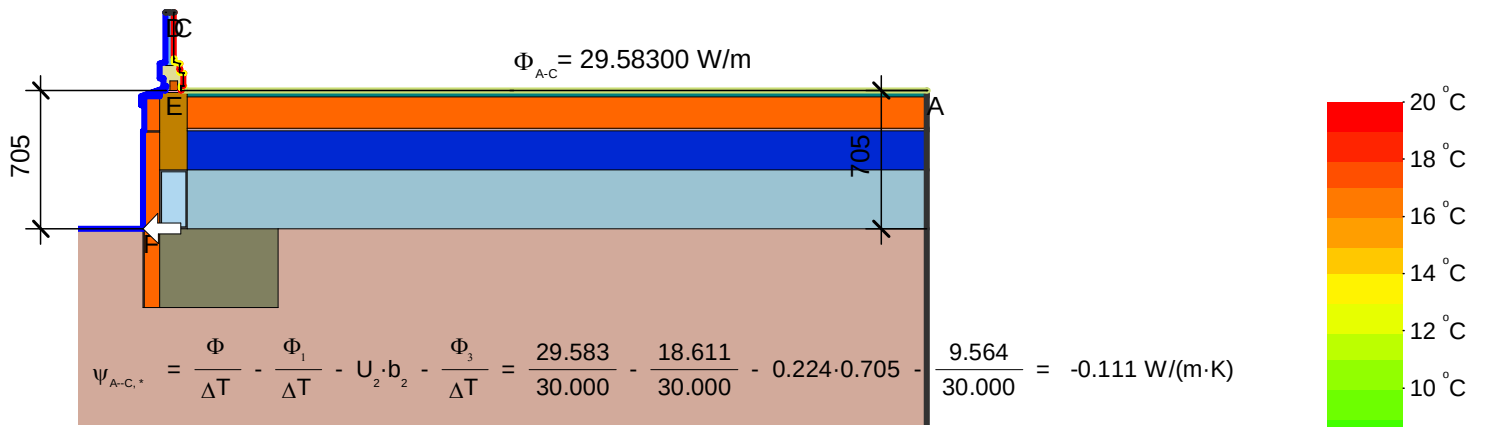
Material	λ [W/(m·K)]	ε
Ar16 in 44 mm U 0,9	0.034	0.900
Glass / Glas	1.000	0.900
Insulation I Wärmedämmung 050	0.050	0.900
Polysulfide / Polysulfid	0.400	0.900
Softwood, OSB I Weichholz, OSB ISO 10456	0.130	0.900
phA-Spacer	0.200	0.900

Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ε
Adiabatic I Adiabatisch	0.000			
Adiabatic Adiat	0.000			
Aussen Standard		-10.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	

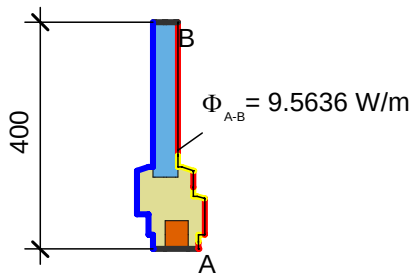
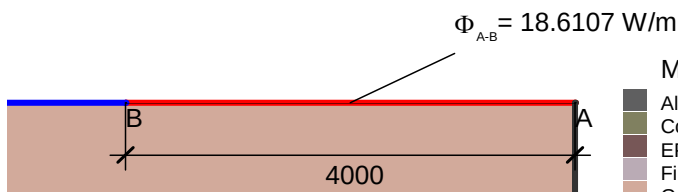
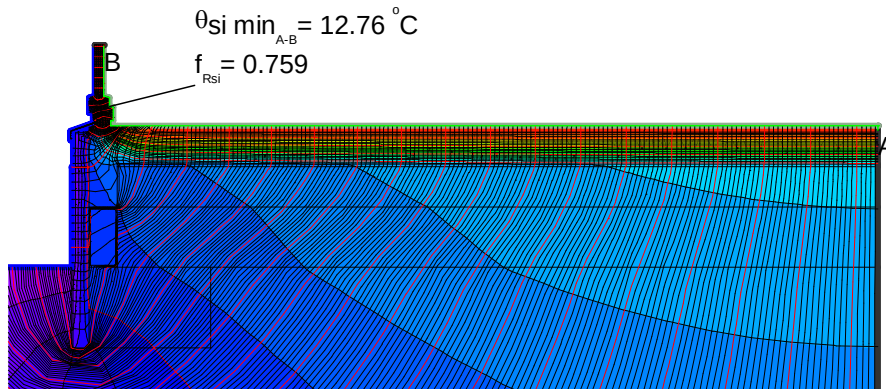
Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ε
Adiabatic I Adiabatisch	0.000			
Aussen Standard		-10.000	0.040	
fRsi: Interior I Innen		20.000	0.250	

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

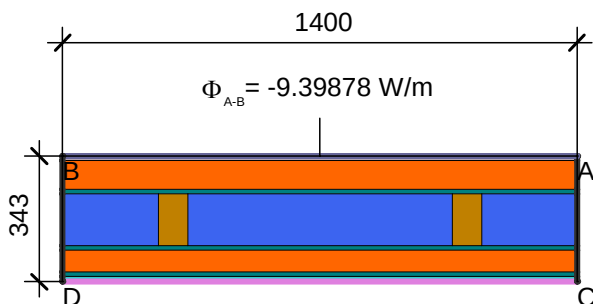




$$\Psi_{\text{WITH}} = \Psi_{\text{FSEW+WITH}} - \Psi_{\text{FSEW01}} = -0.111 - (-0.149) = 0.038 \text{ W/mK}$$



Material	$\lambda[\text{W/(m}\cdot\text{K)}]$	ϵ
Aluminum Aluminium 10456	160.000	0.900
Concrete, 1% Steel Beton, 1% Stahl ISO 10456	2.300	0.900
EPDM	0.250	0.900
Fibrocemento Fiber cement	1.200	0.900
Ground Erdreich	2.000	0.900
Gypsum board with cellulose fibres	0.669	0.900
Insulation 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 PU-Ortschaum 040	0.040	0.900
Panel Maske	0.035	0.900
Softwood, OSB 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	$q[\text{W/m}^2]$	$\theta[^\circ\text{C}]$	$R[(\text{m}^2\cdot\text{K})/\text{W}]$	ϵ
Adiabatic Adiatat	0.000			
Exterior Außen		-10.000	0.040	
Int. flux down Innen abwärts		20.000	0.170	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	

$$U_{\text{eq A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.399}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2\cdot\text{K)}$$

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





Appendix 3: Manufacturers drawings | Zeichnungen des Herstellers

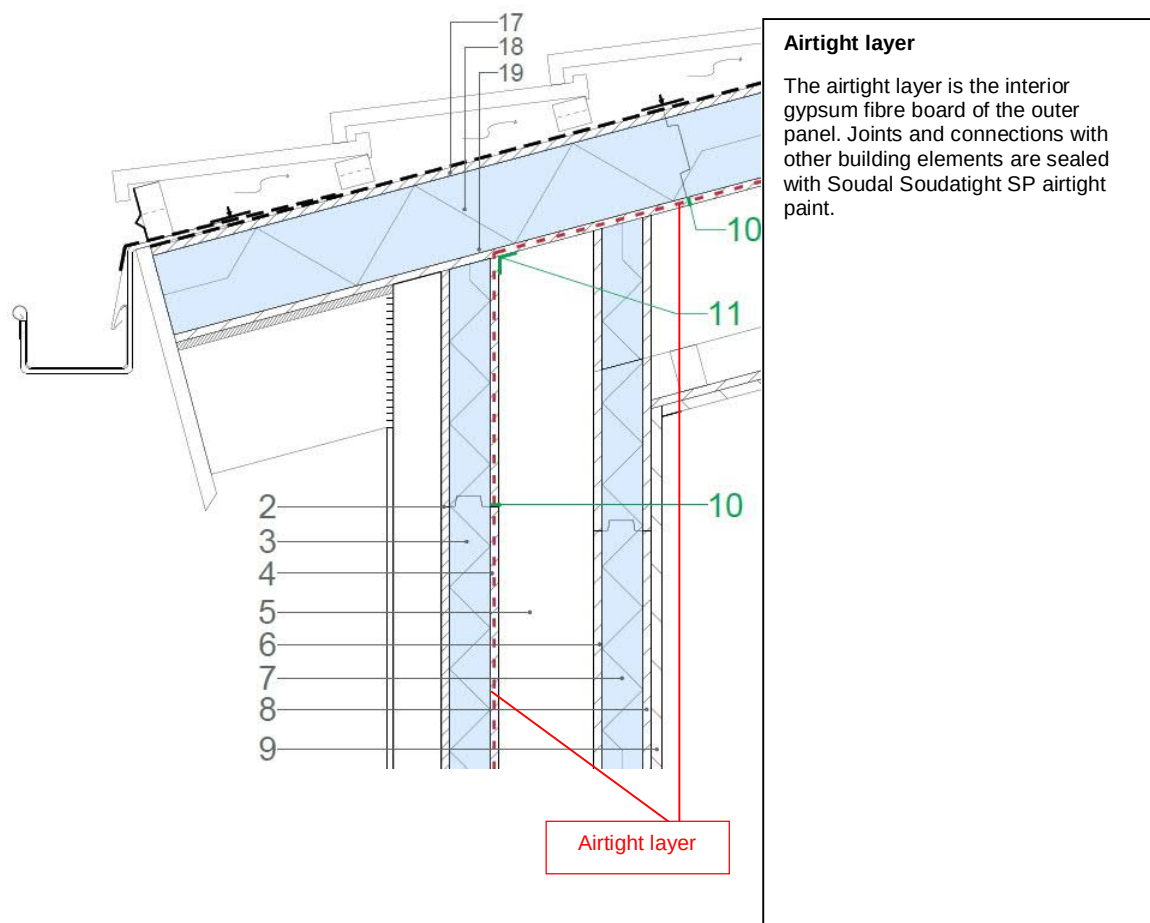
Passive House Institute



Passive House Institute

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

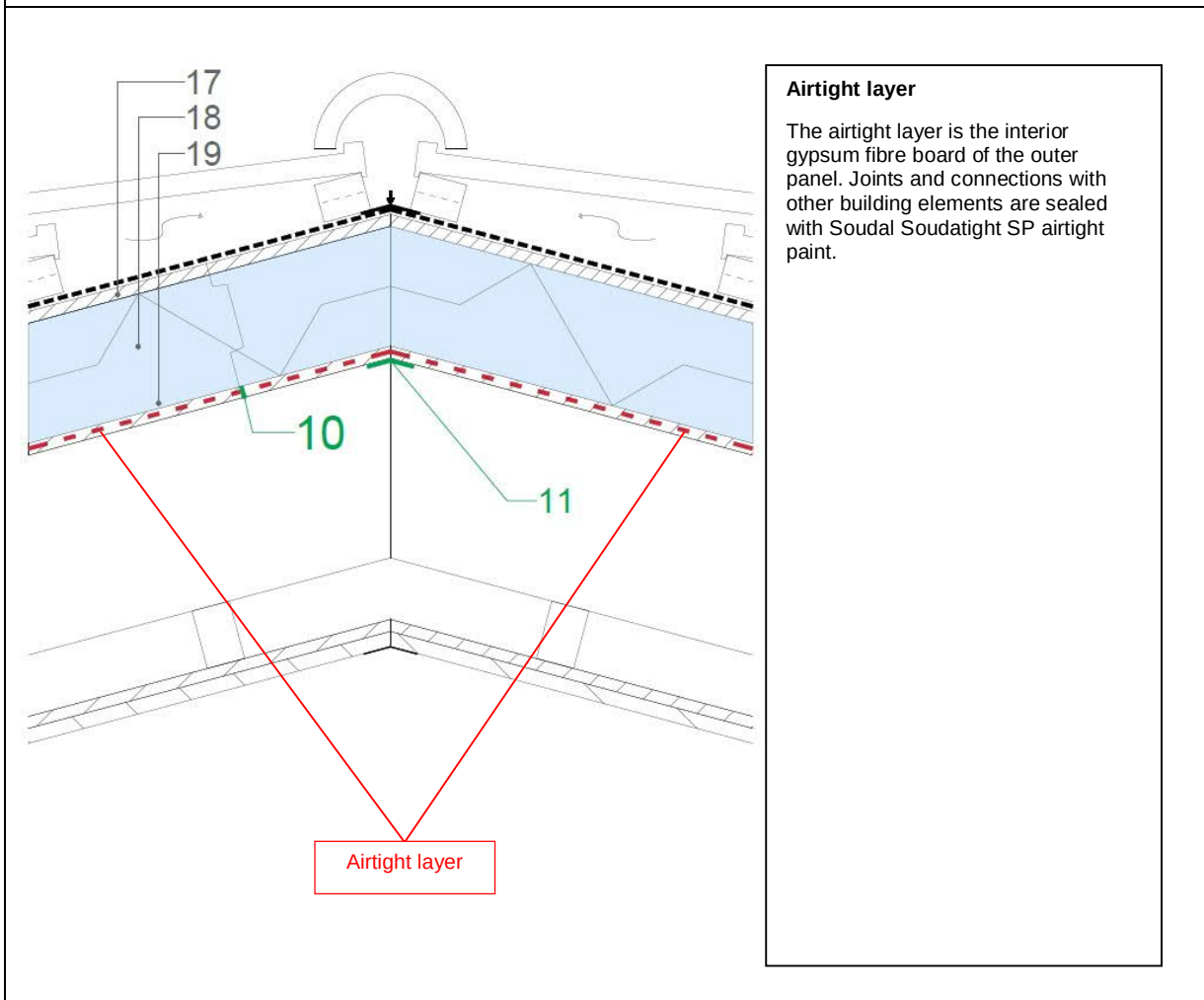
Design drawing – Vertical cross-section



From the inside towards the outside		λ [W/(m K)]	Thickn ess [cm]	From the inside towards the outside		λ [W/(m K)]	Thickn ess [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	0.250	1.50
8	Gypsum fibreboard	0.669	12.5	22	Gypsum fibreboard	0.669	1.25
7	XPS	0.036	6.00	20	Air layer + steel substructure	0.710	8.0
6	Gypsum fibreboard	0.669	1.25	20	Air layer + timber studs	0.920	20.0
5	Air layer + timber studs	0.654	14.0	19	Gypsum fibreboard (Airtight layer)	0.669	1.25
4	Gypsum fibreboard (Airtight layer)	0.669	1.25	18	XPS (2*80)	0.036	16.0
3	XPS	0.036	8.00	17	Fibro-cement board	1.200	1.25
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	Abbreviation	THERMOCHIP
Top roof	Detail_SW-02	

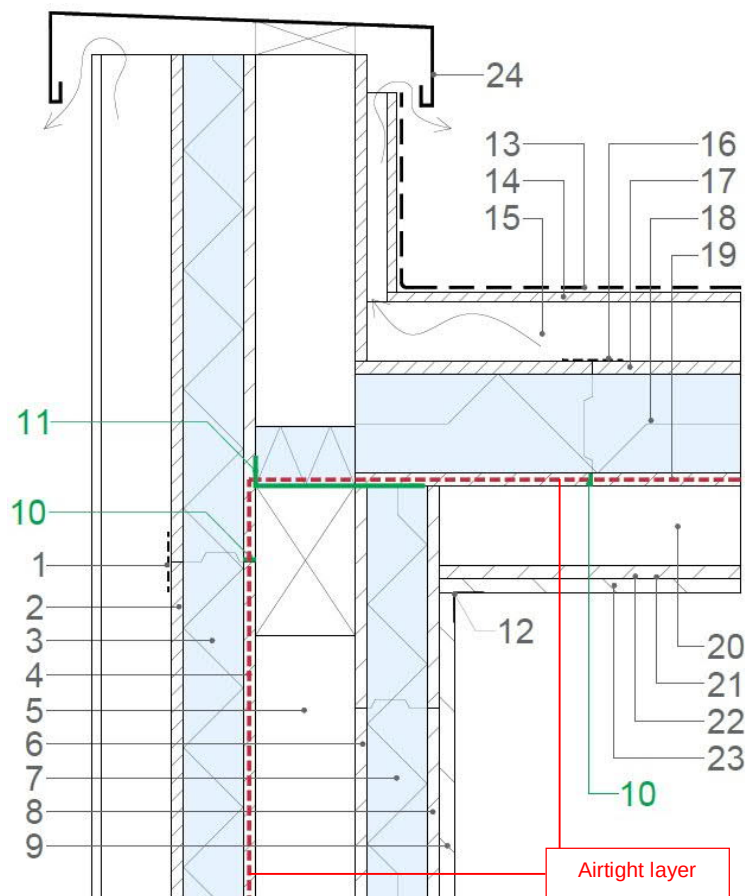
Design drawing – Vertical cross-section



From the inside towards the outside				From the inside towards the outside			
		λ [W/(mK)]	Thick ness [cm]			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	0.250	1.50
8	Gypsum fibreboard	0.669	12.5	22	Gypsum fibreboard	0.669	1.25
7	XPS	0.036	6.00	20	Air layer + steel substructure	0.710	8.0
6	Gypsum fibreboard	0.669	1.25	20	Air layer + timber studs	0.920	20.0
5	Air layer + timber studs	0.654	14.0	19	Gypsum fibreboard (Airtight layer)	0.669	1.25
4	Gypsum fibreboard (Airtight layer)	0.669	1.25	18	XPS (2*80)	0.036	16.0
3	XPS	0.036	8.00	17	Fibro-cement board	1.200	1.25
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	Abbreviation	THERMOCHIP
Parapet wall connection to flat roof	Detail_SW-03	

Design drawing – **Vertical cross-section**



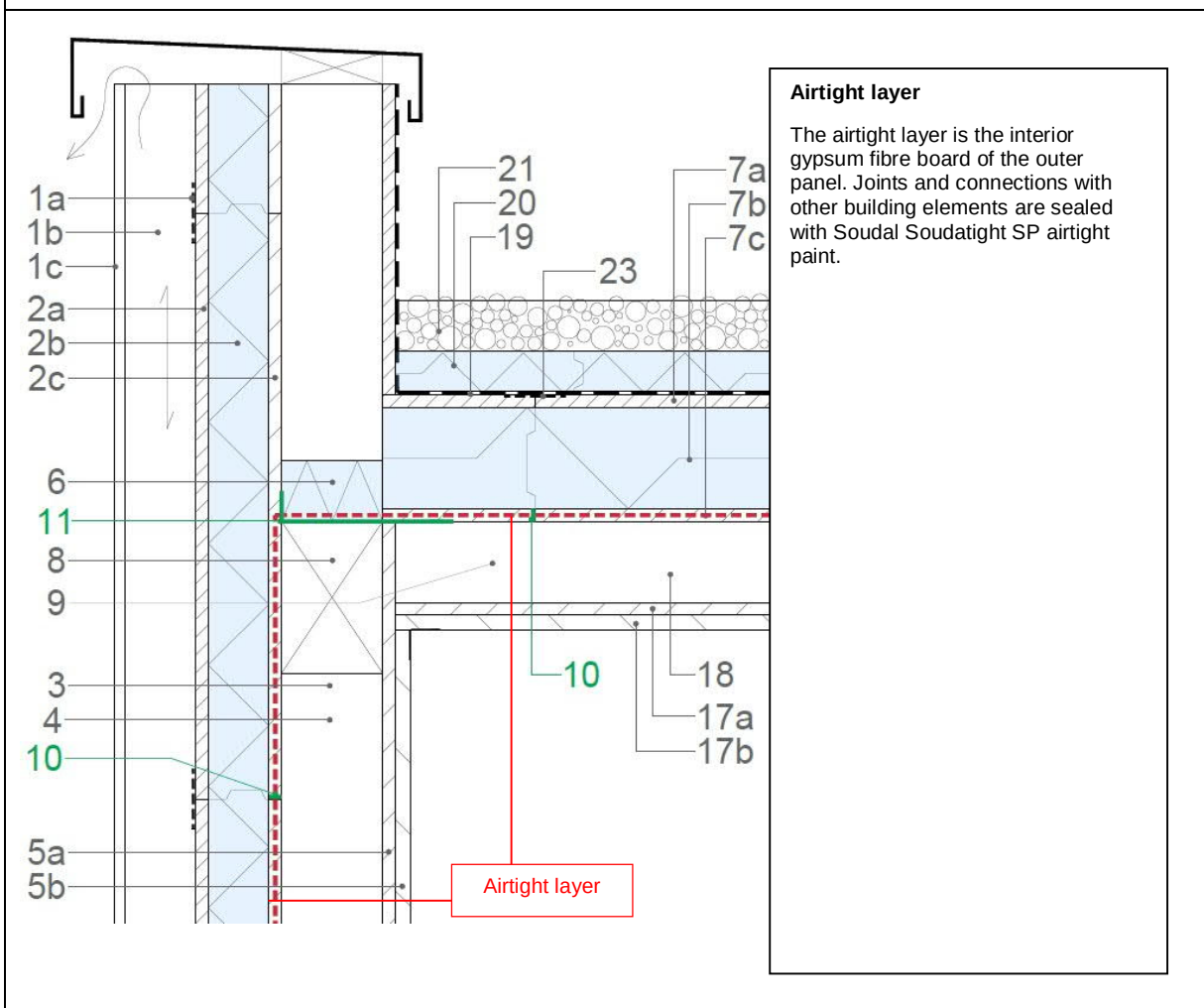
Airtight layer

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
7	XPS	0.036	6.00	20	Air layer + steal substructure	0.710	8.0
6	Gypsum fibreboard	0.669	1.25	20	Air layer + timber studs	0.920	20.0
5	Air layer + timber studs	0.654	14.0	19	Gypsum fibreboard (Airtight layer)	0.669	1.25
4	Gypsum fibreboard (Airtight layer)	0.669	1.25	18	XPS (2*80)	0.036	16.0
3	XPS	0.036	8.00	17	Fibro-cement board	1.200	1.25
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	Abbreviation	THERMOCHIP
Parapet wall connection to flat roof	Detail_SW-04	

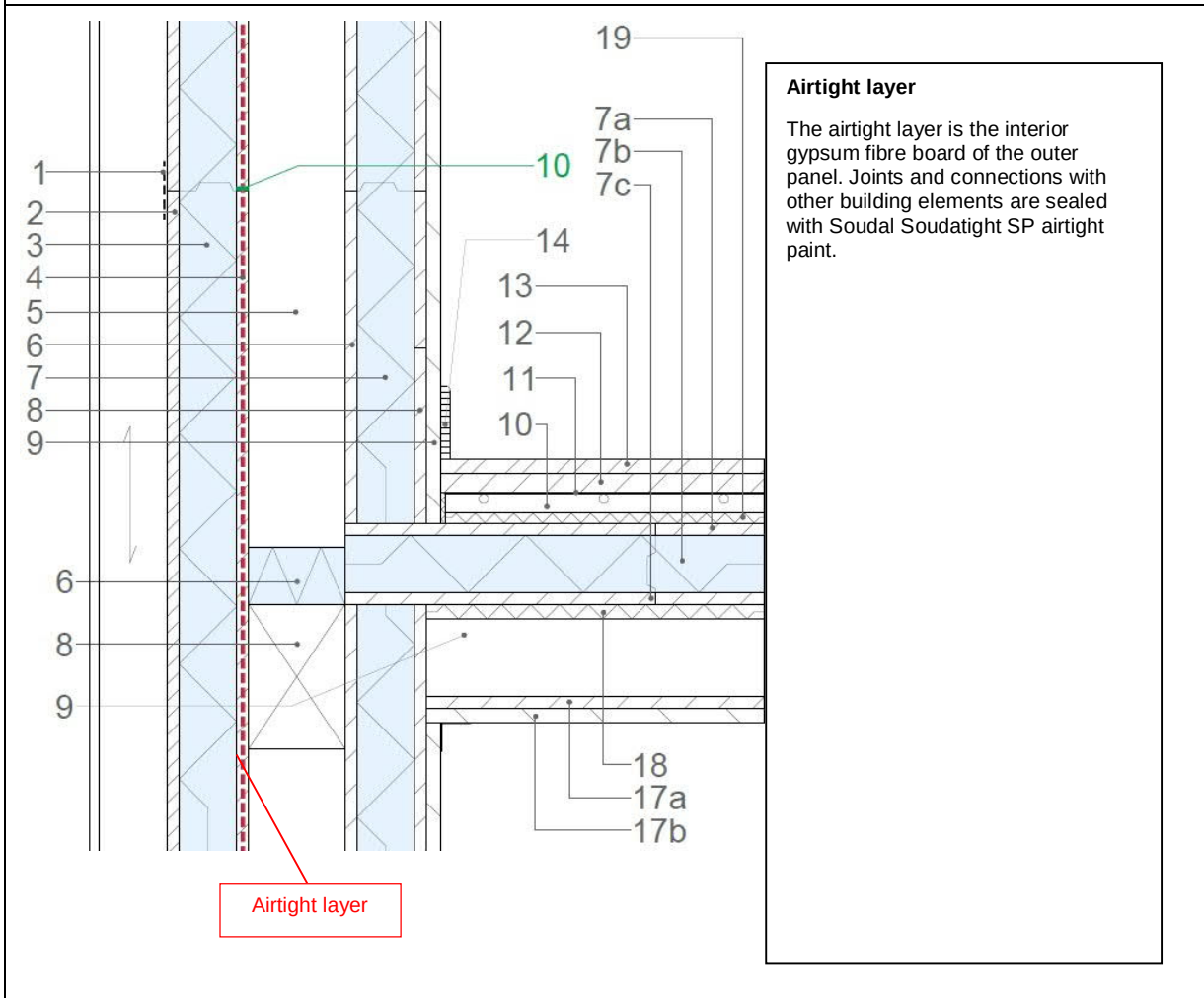
Design drawing – Vertical cross-section



From the inside towards the outside				From the inside towards the outside			
		λ [W/(mK)]	Thick ness [cm]			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	0.250	1.50
8	Gypsum fibreboard	0.669	12.5	22	Gypsum fibreboard	0.669	1.25
7	XPS	0.036	6.00	20	Air layer + steel substructure	0.710	8.0
6	Gypsum fibreboard	0.669	1.25	20	Air layer + timber studs	0.920	20.0
5	Air layer + timber studs	0.654	14.0	19	Gypsum fibreboard (Airtight layer)	0.669	1.25
4	Gypsum fibreboard (Airtight layer)	0.669	1.25	18	XPS (2*80)	0.036	16.0
3	XPS	0.036	8.00	17	Fibro-cement board	1.200	1.25
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	Abbreviation	THERMOCHIP
Parapet wall connection to interior floor	Detail_SW-05	

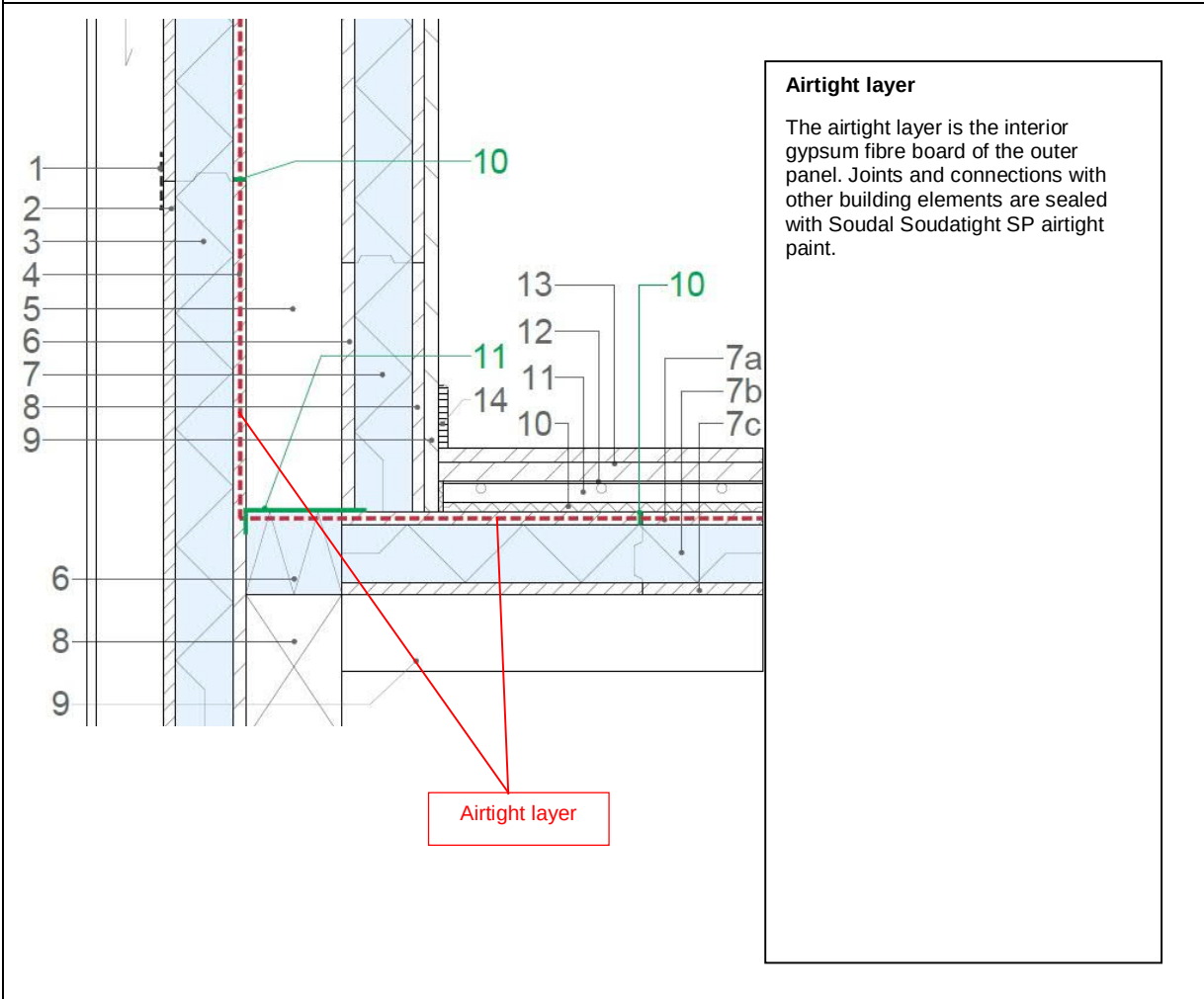
Design drawing – Vertical cross-section



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	0.250	1.50
8	Gypsum fibreboard	0.669	12.5	22	Gypsum fibreboard	0.669	1.25
7	XPS	0.036	6.00	20	Air layer + steal substructure	0.710	8.0
6	Gypsum fibreboard	0.669	1.25	20	Air layer + timber studs	0.920	20.0
5	Air layer + timber studs	0.654	14.0	19	Gypsum fibreboard (Airtight layer)	0.669	1.25
4	Gypsum fibreboard (Airtight layer)	0.669	1.25	18	XPS (2*80)	0.036	16.0
3	XPS	0.036	8.00	17	Fibro-cement board	1.200	1.25
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	Abbreviation	THERMOCHIP
Parapet wall connection to floor slab	Detail_SW-06	

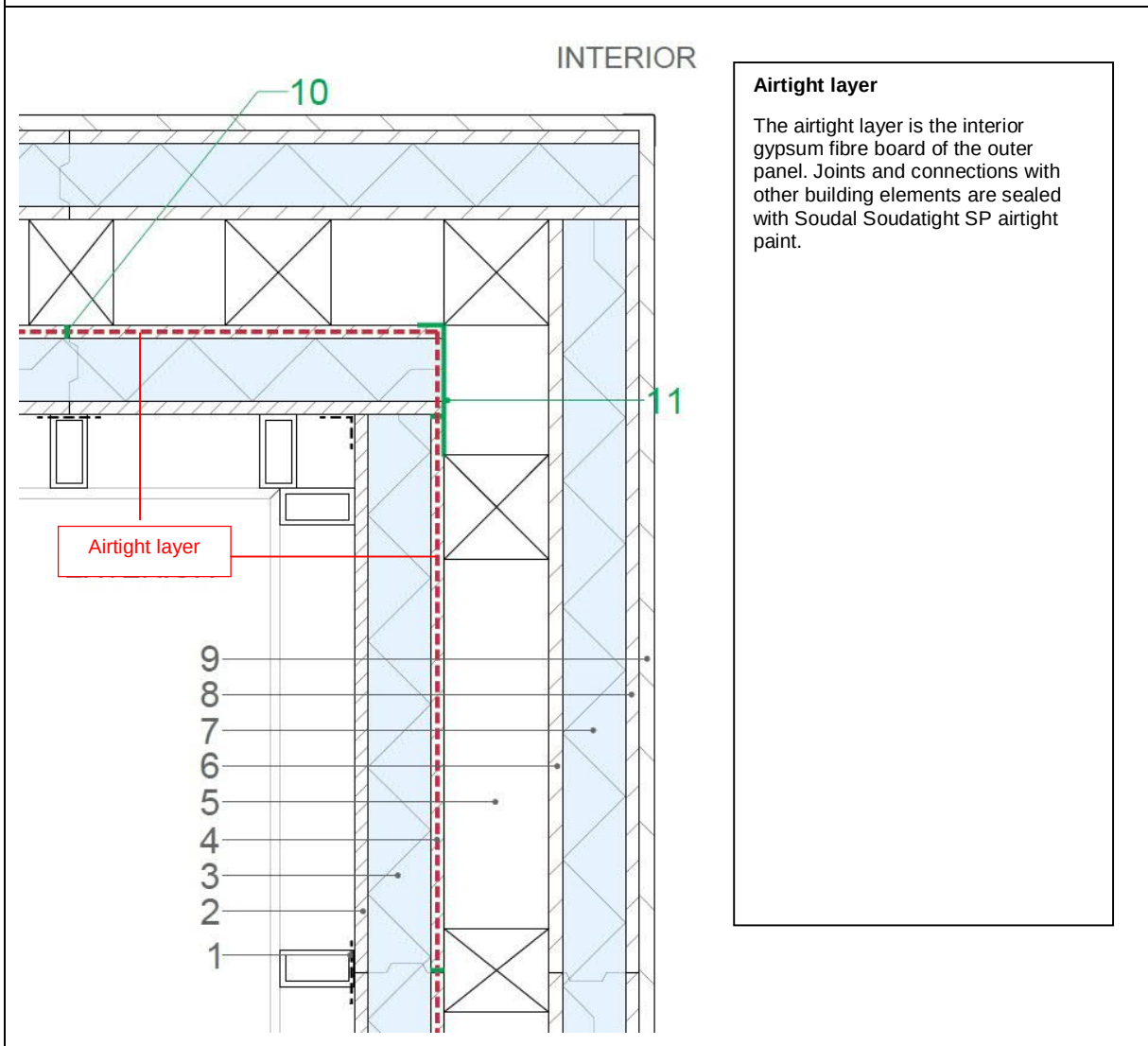
Design drawing – Vertical cross-section



From the inside towards the outside				From the inside towards the outside			
		λ [W/(mK)]	Thick ness [cm]			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
7	XPS	0.036	6.00	18	XPS (2*80)	0.036	16.0
6	Air layer + timber studs	0.654	14.0	17	Fibro-cement board	1.200	1.25
5	Gypsum fibreboard	0.669	12.5				
4	Gypsum fibreboard (Airtight layer)	0.669	1.25				
3	XPS	0.036	8.00				
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_SW-07	THERMOCHIP
--	------------------------------	-------------------

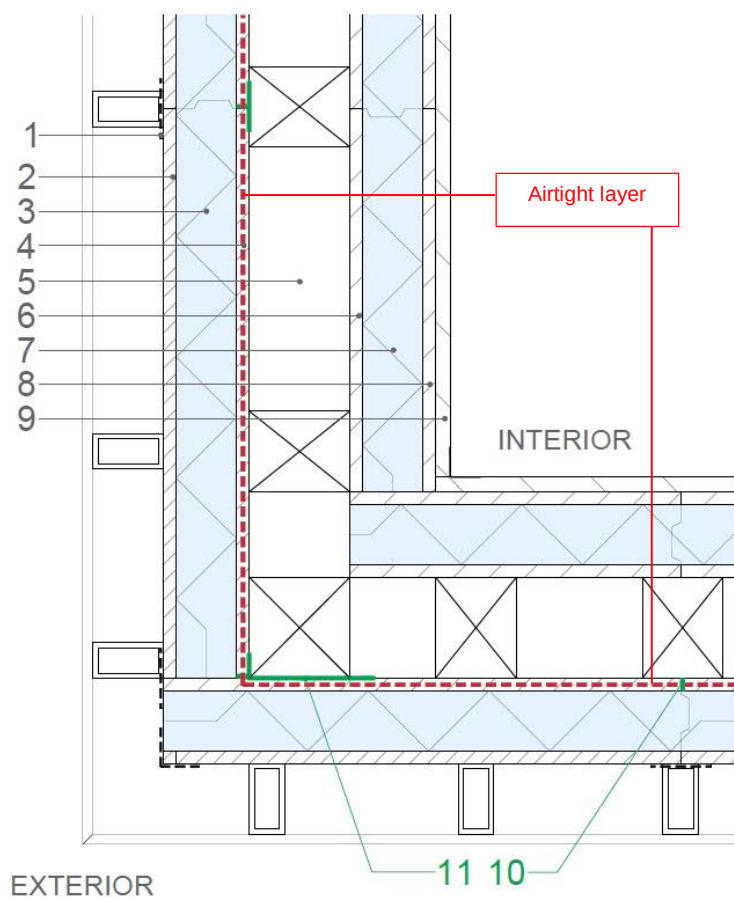
Design drawing – **Horizontal cross-section**



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				
7	XPS	0.036	6.00				
6	Gypsum fibreboard	0.669	1.25				
5	Air layer + timber studs	0.654	14.0				
4	Gypsum fibreboard (Airtight layer)	0.669	1.25				
3	XPS	0.036	8.00				
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	Abbreviation	THERMOCHIP
Exterior corner	Detail_SW-08	

Design drawing – Horizontal cross-section



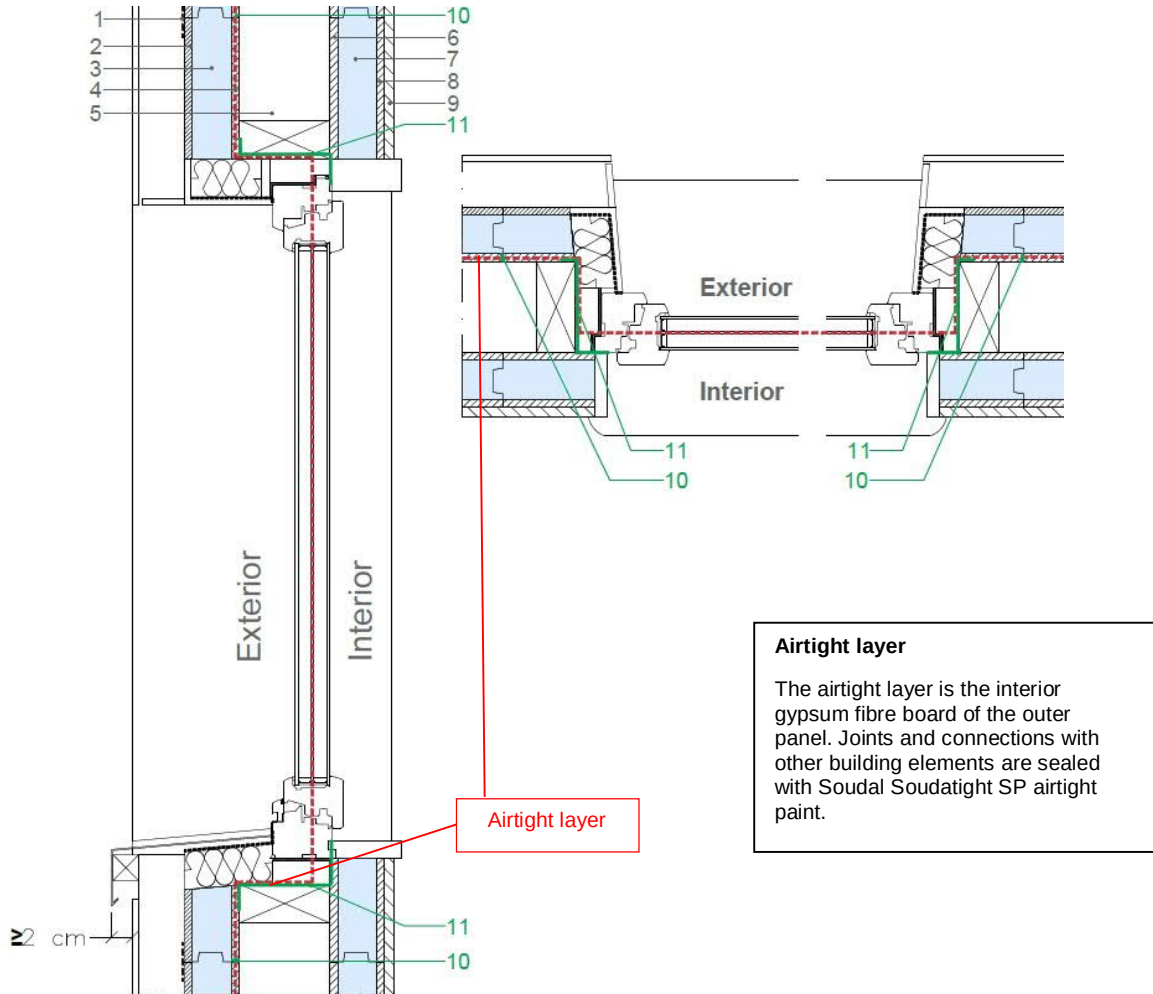
Airtight layer

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			From the inside towards the outside		
	λ [W/(mK)]	Thick ness [cm]		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		
7	XPS	0.036	6.00		
6	Gypsum fibreboard	0.669	1.25		
5	Air layer + timber studs	0.654	14.0		
4	Gypsum fibreboard (Airtight layer)	0.669	1.25		
3	XPS	0.036	8.00		
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	Abbreviation	THERMOCHIP
Window detail	Detail_SW-09	

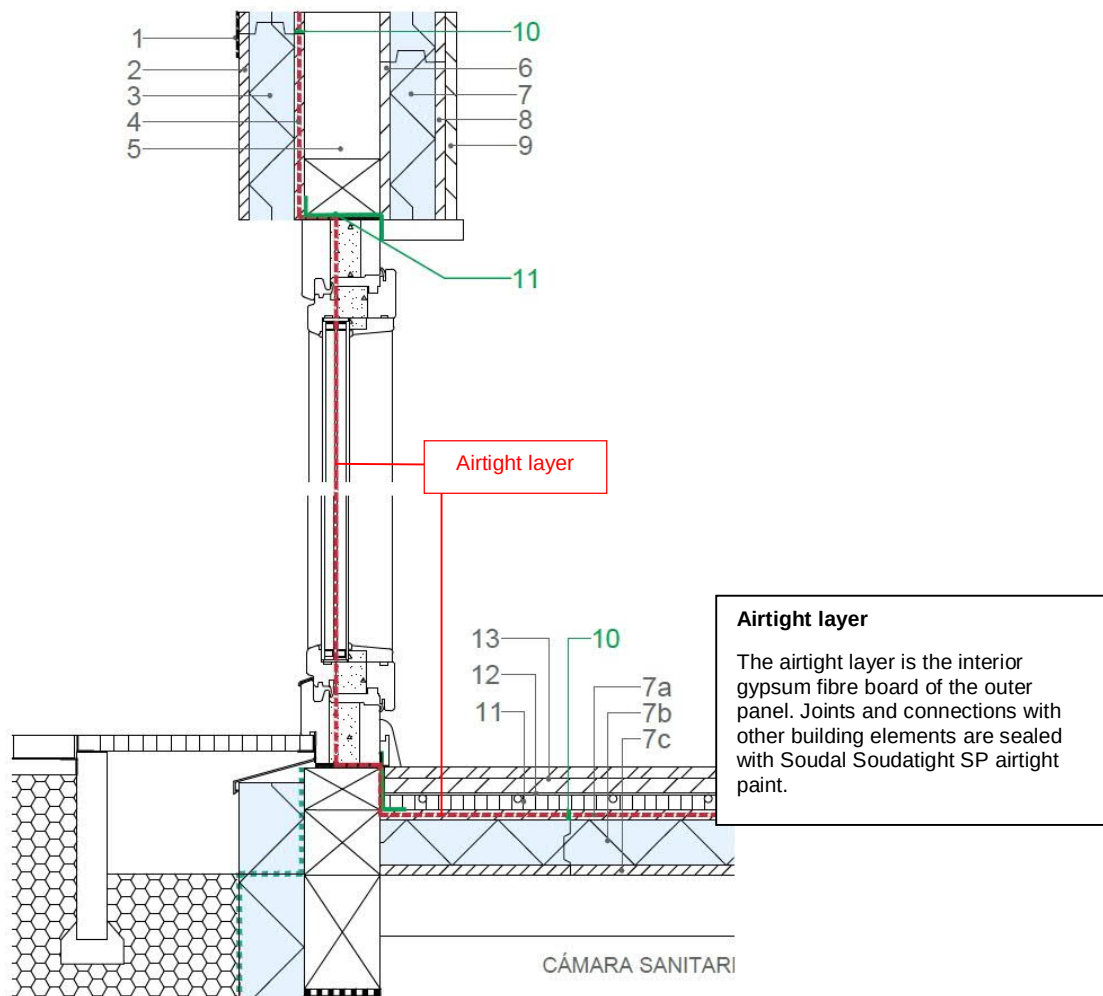
Design drawing – Horizontal and vertical cross-section



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				
7	XPS	0.036	6.00				
6	Gypsum fibreboard	0.669	1.25				
5	Air layer + timber studs	0.654	14.0				
4	Gypsum fibreboard (Airtight layer)	0.669	1.25				
3	XPS	0.036	8.00				
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	Abbreviation	THERMOCHIP
Parapet wall connection to floor slab	Detail_SW-10	

Design drawing – Vertical cross-section



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	0.669	2.00		
8	Gypsum fibreboard	0.669	12.5	22	Gypsum fibreboard (Airtight layer)	0.669	1.25		
7	XPS	0.036	6.00	18	XPS (2*80)	0.036	16.0		
6	Gypsum fibreboard	0.669	1.25	17	Fibro-cement board	1.200	1.25		
5	Air layer + timber studs	0.654	14.0						
4	Gypsum fibreboard (Airtight layer)	0.669	1.25						
3	XPS	0.036	8.00						
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								

FIBRANxps FABRIC

1. Código de identificación única del producto tipo:

2. Tipo:	FIBRANxps 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.º 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 continua		NPD		4.3.12
Índice de absorción acústica		NPD		4.3.10
Permeabilidad al agua- Absorción de agua a largo plazo	por inmersión total por difusión	WL(T) WD(V)	% %	4.3.7.1 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 λ_D			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:
Ovar, 5 de Junio de 2020

Filipe Silva
Producción & Calidad

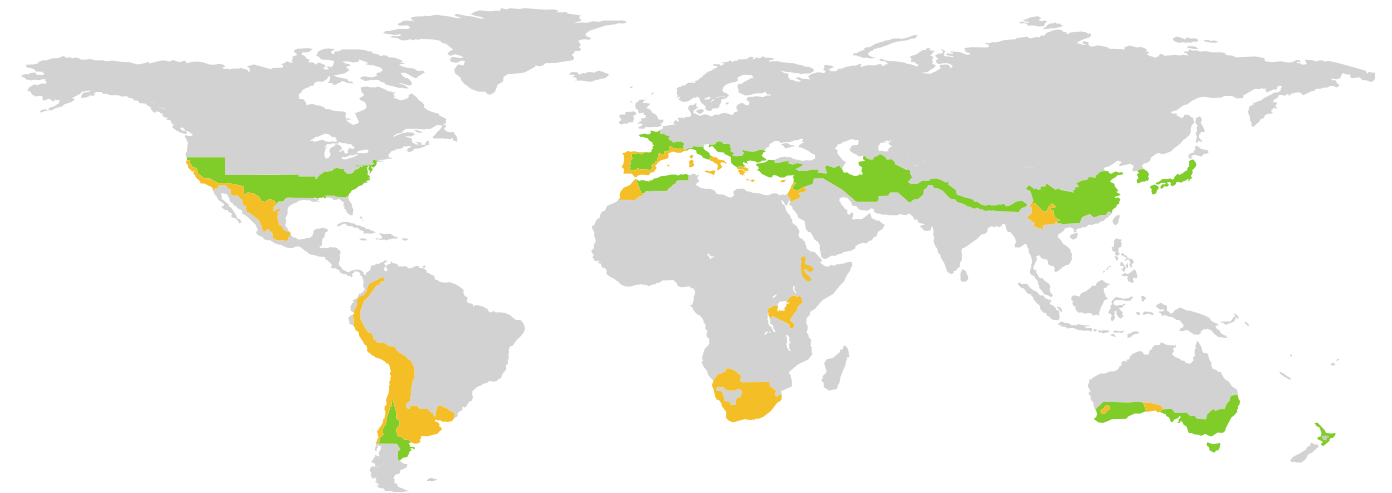
Este producto no contiene hexabromociclododecano
NPD - Prestación No Determinada

CERTIFICATE

Certified Passive House Component

ID: 1625cs04 valid until 31. December 2021

Passive House Institute
Dr. Wolfgang Feist
64342 Darmstadt
GERMANY



Category **Construction system | Lightweight timber construction**
Manufacturer **Thermochip SLU**
Carballada de Valdeorras (Ourense)
España
Product name **Thermochip HOUSING SATE-COAT**

This certificate for the warm, temperate climate zone was awarded based on the following criteria

Hygiene criterion

The minimum temperature factor of the interior surfaces is

$$f_{Rsi=0,25m^2K/W} \geq 0.65$$

Comfort criterion

The U-value of the installed windows is

$$U_{W,i} \leq 1.05 \text{ W/(m}^2\text{K)}$$

Efficiency criteria

Heat transfer coefficient of building envelope

$$U \cdot f_{PHI} \leq 0.30 \text{ W/(m}^2\text{K)}$$

Temperature factor of opaque junctions

$$f_{Rsi=0,25m^2K/W} \geq 0.82$$

Thermal bridge-free design for key connection details

$$\Psi \leq 0.01 \text{ W/(mK)}$$

An airtightness concept for all components and connection details was provided



Opaque building envelope

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 ($\leq 0,036$ 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.

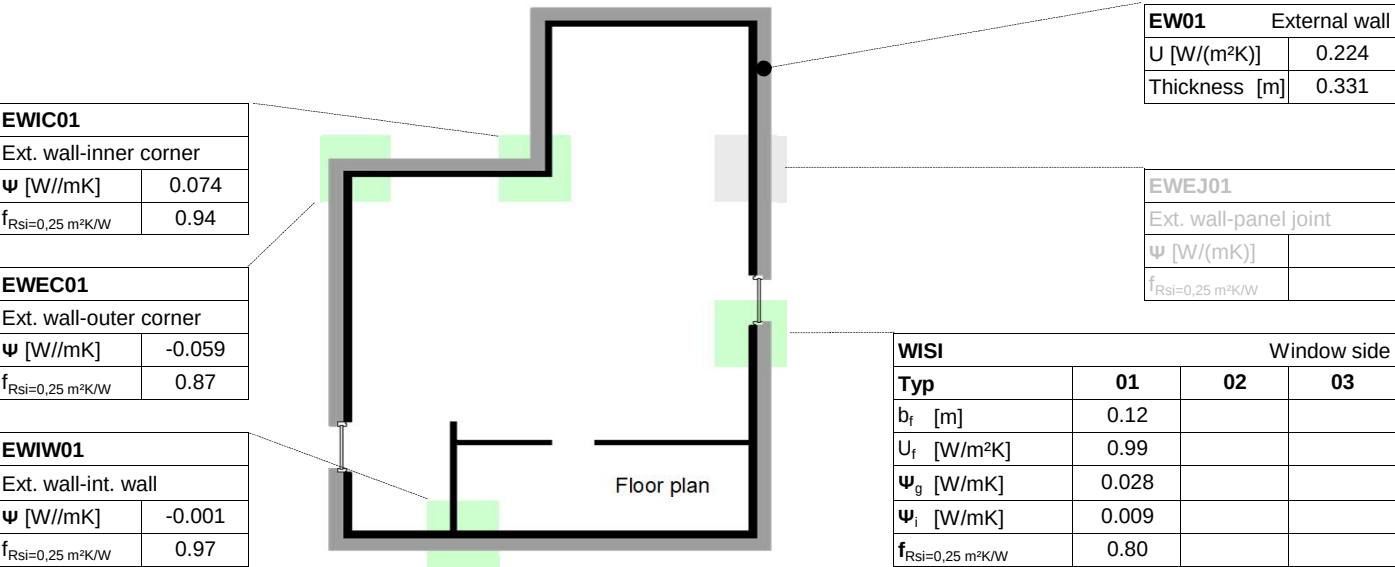
The certification does not take into account point thermal bridges caused by structural columns or e.g. balcony connections, which must to be assessed separately. As investigated, the system is deemed suitable for passive houses in the warm-temperate climate zone, as the regular U-values of the exterior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

Explanatory notes

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.

Thermal bridge not calculated
Criteria achieved

Efficiency criteria not achieved
Hygiene or comfort criterion not achieved

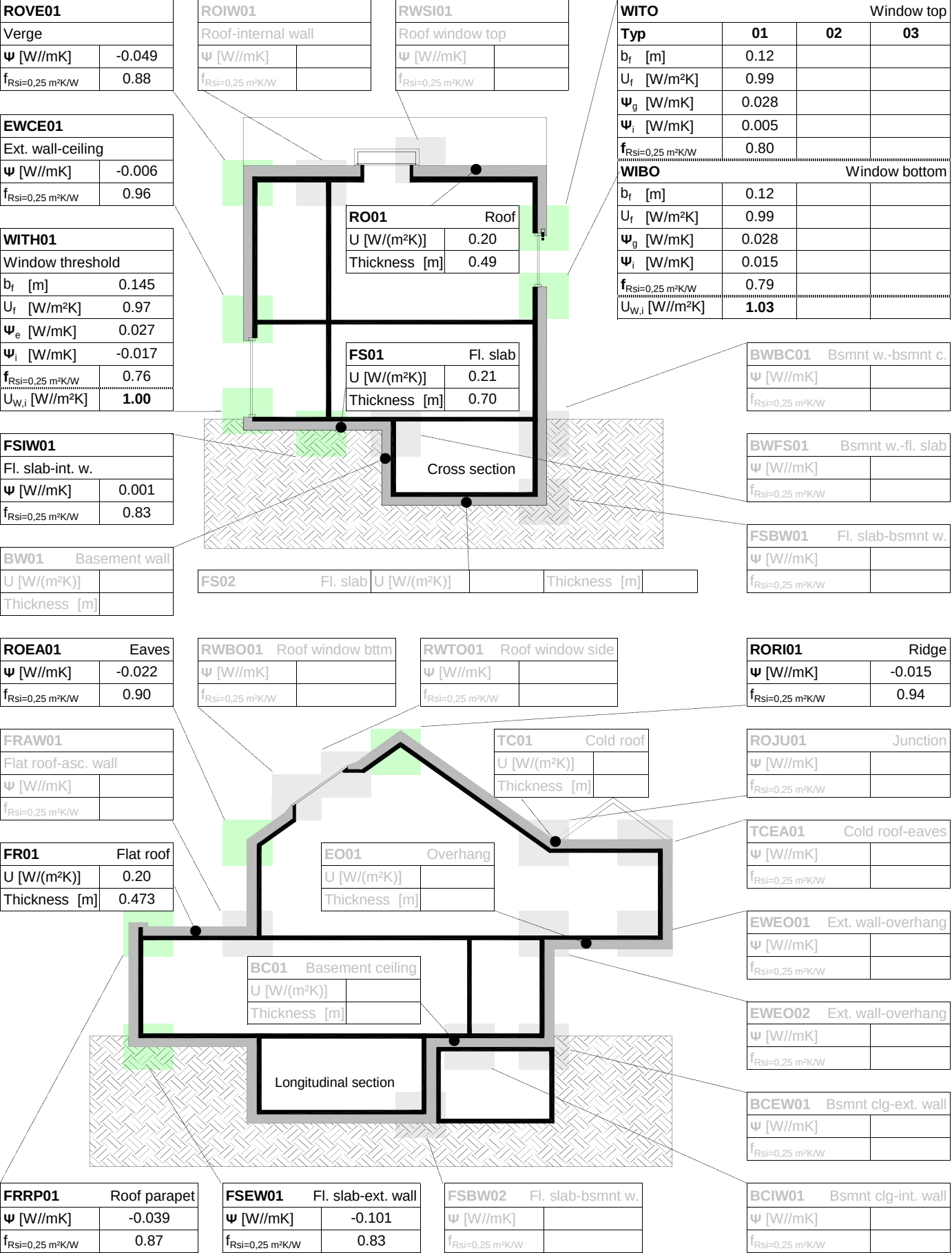


Windows

For the purposes of certification a standard passive house window ($U_w = 1,00$ W/m²K with $U_g = 0,90$ 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 U_w to ensure occupant comfort - this criteria is met in this instance.

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.





Certification report | Zertifizierungsbericht

Passive House Institute

Building system Bausystem



for the warm, temperate climate
für das warm-gemäßigtes Klima

Product | Produkt:

Thermochip HOUSING SATE-COAT

Client | Auftraggeber:

Thermochip SLU

Construction | Konstruktion

**Lightweight timber construction |
Holzleichtbau**

Contact person
Ansprechpartner
Website

Diego Rodriguez
+34 681 155 131
www.thermochip.com

Date | Datum:
Author | Autor:

16.09.2020
M. Arch Soraya López García

+49.6151.82699.0
mail@passiv.de
www.passiv.de

Passive House Institute
Rheinstraße 44/46
64283 Darmstadt
GERMANY



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5	Using the results in the PHPP.....	6
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Appendix 1: U-values, equivalent conductivities

Appendix 2: Thermal simulations

Appendix 3: Manufacturers drawings



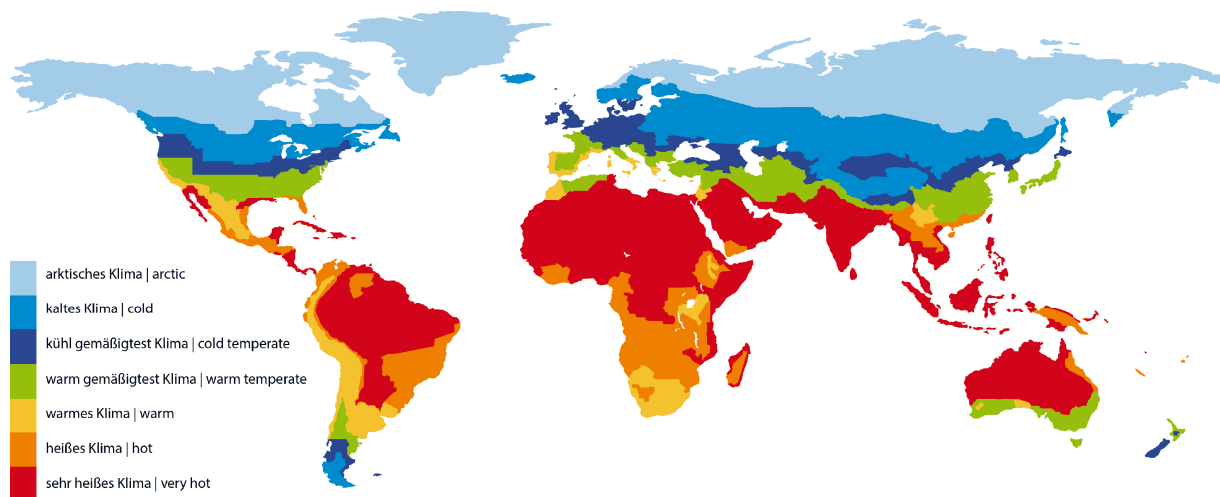
1 Introduction

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		
	$f_{Rsi}=0.25 \text{ m}^2\text{K/W} \geq^3$	U-value of the installed window ¹ $\leq$	U-value opaque to ambient $U_{opaque} * f_{PHI}^2 \leq$	Purely opaque details $f_{Rsi}=0.25 \text{ m}^2\text{K/W} \geq$	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 components 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 ($\leq 0,036 \text{ W/mK}$) 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 be assessed 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 $0,25 \text{ W/m}^2\text{K}$ and the connections meet the criteria of 'thermal bridge free'. The surface temperature of all connections (with the exception of window connections) meet the hygiene requirements.

2.2 Windows

For the purposes of certification a standard passive house window ($U_w = 1,00 \text{ W/m}^2\text{K}$ with $U_g = 0,90 \text{ W/m}^2\text{K}$) 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 $0,05 \text{ W/m}^2\text{K}$ greater than the U_w 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

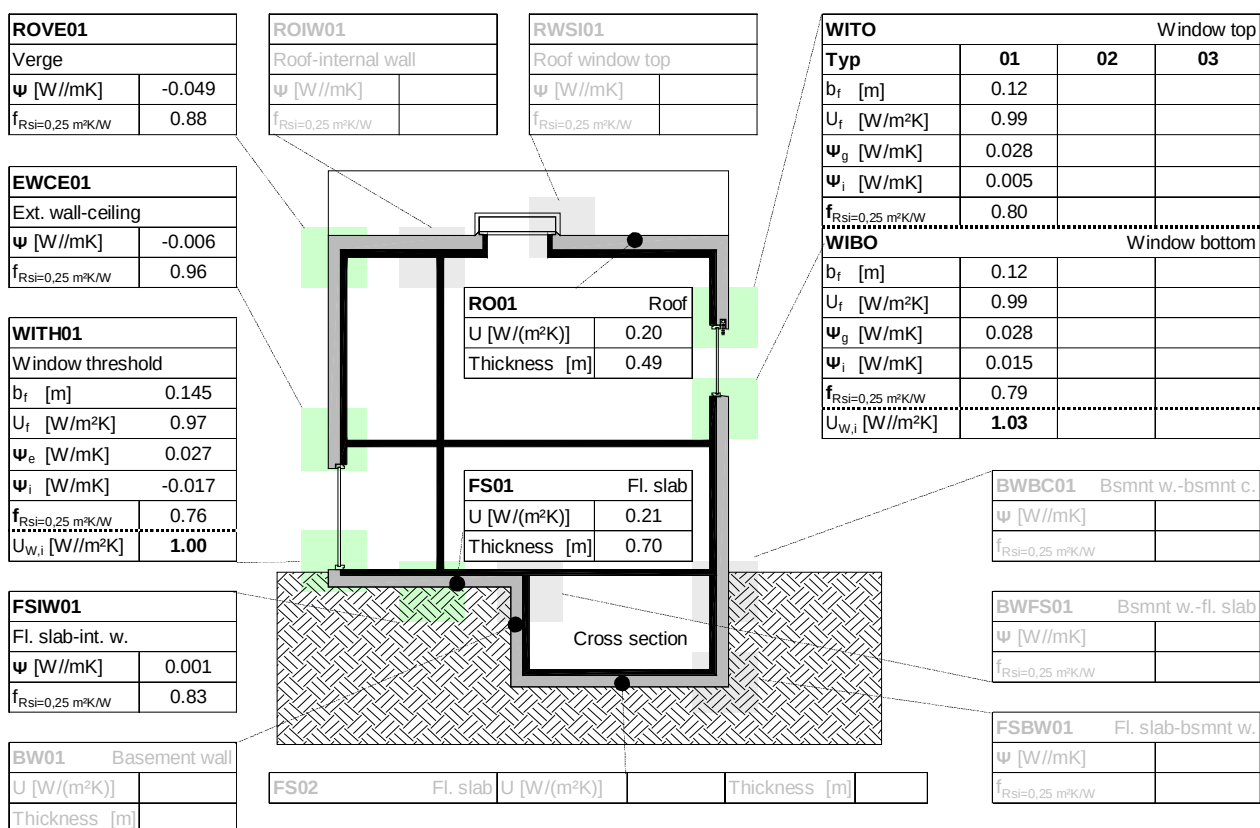
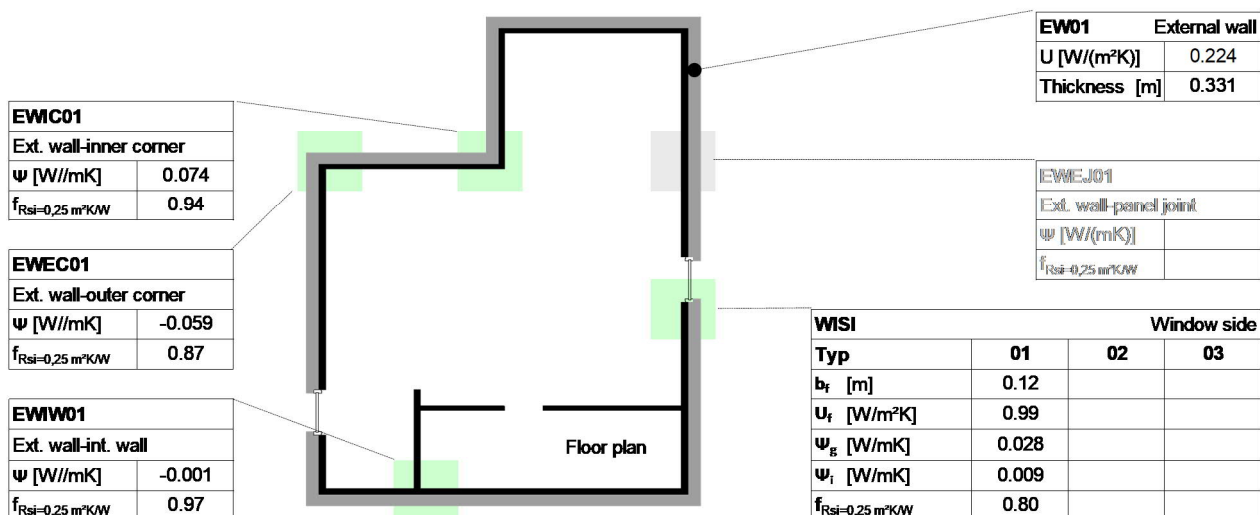
for climate zones with higher requirements may also be used in climates with less stringent requirements. Their use might make economic sense in certain circumstances.

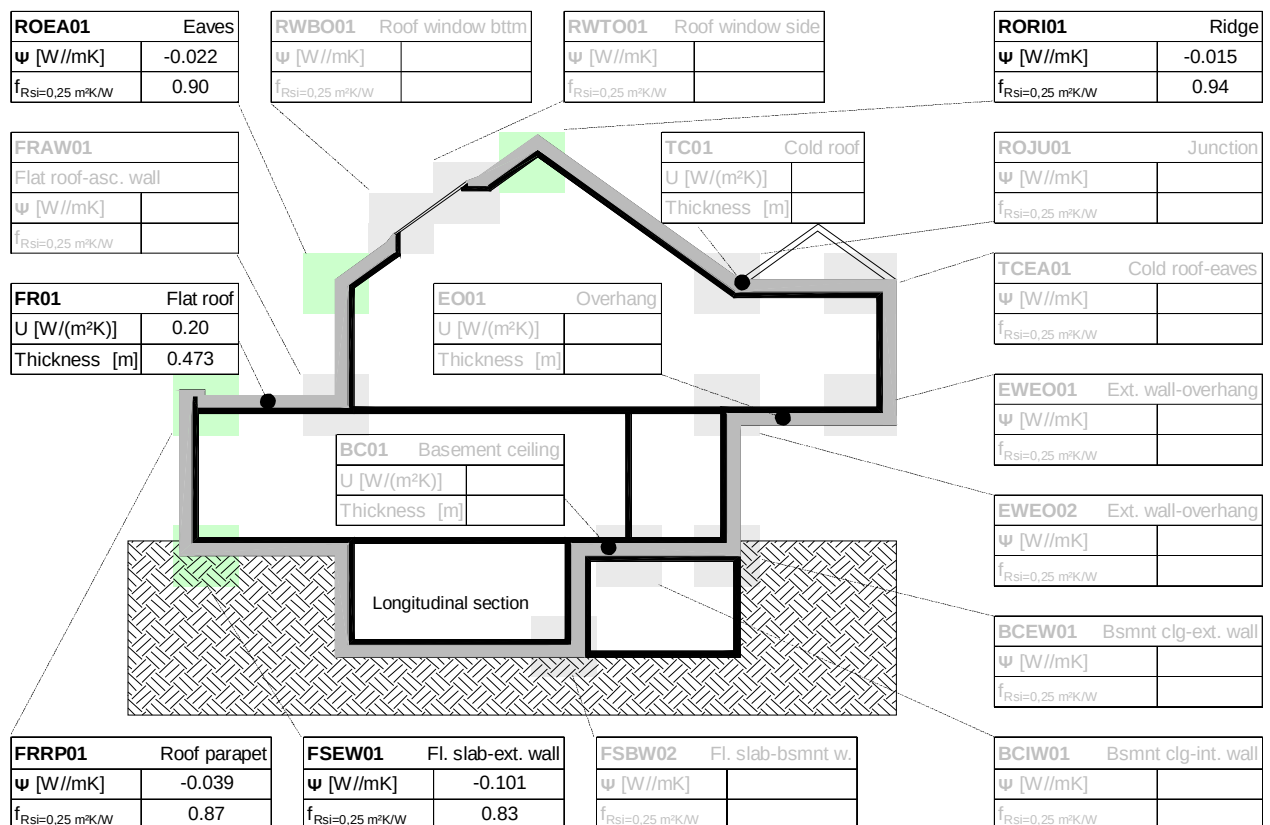


4 Summary of the results

Thermal bridge not calculated
Criteria achieved

Efficiency criteria not achieved
Hygiene or comfort criterion not achieved





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

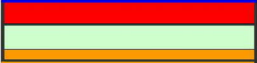
Thermochip SLU: Thermochip HOUSING SATE-COAT ID: 1625cs04 for the warm, temperate climate



Acronym	Building assembly description		Interior insulation?	
FS01	Floor slab			
Heat transmission resistance [m²K/W]				
Orientation of building element	3-Ground	Adjacent to	interior R _{si}	exterior R _{se}
			0.17	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		Percentage of sec. 2	Percentage of sec. 3	Total
100%				70.4 cm
U-value supplement		W/(m²K)	U-value: 0.207 W/(m²K)	

Acronym	Building assembly description		Interior insulation?	
EW01	External wall			
Heat transmission resistance [m²K/W]				
Orientation of building element	2-Wall	Adjacent to	interior R _{si}	exterior R _{se}
		3-Ventilated	0.13	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 grass more reinforced	0.250	according to EN ISO 10456 (2007/2009)	15	
Percentage of sec. 1		Percentage of sec. 2	Percentage of sec. 3	Total
100%				33.1 cm
U-value supplement		W/(m²K)	U-value: 0.224 W/(m²K)	

Acronym	Building assembly description			Interior insulation?
R001	Roof			
Heat transmission resistance [m²K/W]				
Orientation of building element	1-Roof	Adjacent to	3-Ventilated	interior R _{si} 0.10 exterior R _{se} 0.13
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
100%				49.1 cm
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	1-Roof	Adjacent to	1-Outdoor air	interior R _{si} 0.10 exterior R _{se} 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	
Percentage of sec. 1		Percentage of sec. 2	Percentage of sec. 3	Total
100%				47.3 cm
U-value supplement:		W/(m²K)	U-value:	0.200 W/(m²K)



Appendix 2: Thermal simulations | Wärmestromsimulationen

Passive House Institute

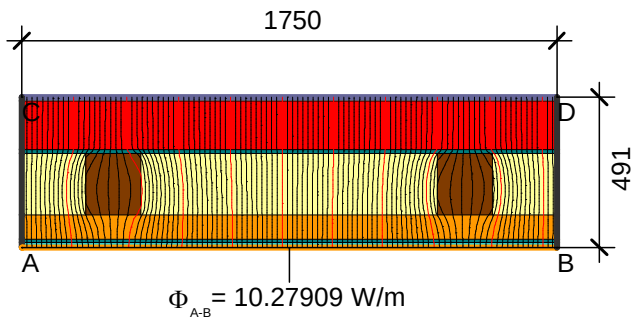
Wall, roof, ground | Wand, Dach, Boden
Windows | Fenster
Constructions to ground | Erdberührte Bauteile



Wall, roof, ground | Wand, Dach, Boden



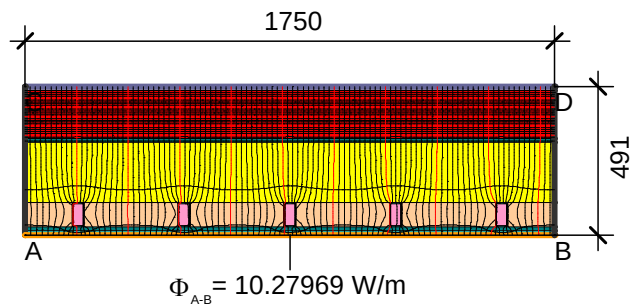
Pitched Roof:



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

Material	$\lambda [\text{W/(m} \cdot \text{K)}]$	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

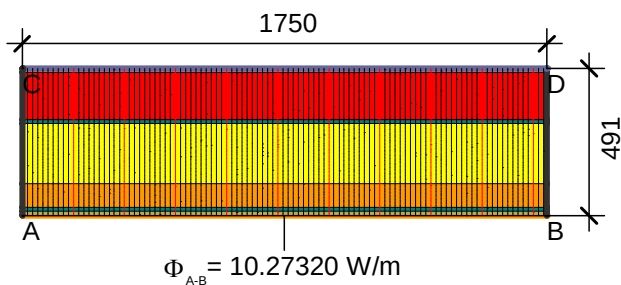
Boundary Condition	$q [\text{W/m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$	ε	$\phi [\%]$
Exterior vent. Außen belüftet	-10.000		0.130		
Interior up. Innen auf.	20.000		0.100		
Adiabatic Adiatat	0.000				



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

Material	$\lambda [\text{W/(m} \cdot \text{K)}]$	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 Stahl	50.000	0.900
XPS 036	0.036	0.900

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



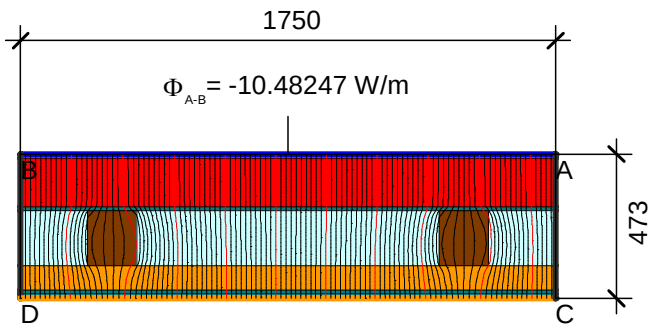
$$U_{eq \text{ A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.273}{30.000 \cdot 1.750} = 0.196 \text{ W/(m}^2 \cdot \text{K)}$$

Material	$\lambda [\text{W/(m} \cdot \text{K)}]$	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	$q [\text{W/m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
Exterior vent. Außen belüftet	-10.000		0.130	
Interior up. Innen auf.	20.000		0.100	
Adiabatic Adiatat	0.000			



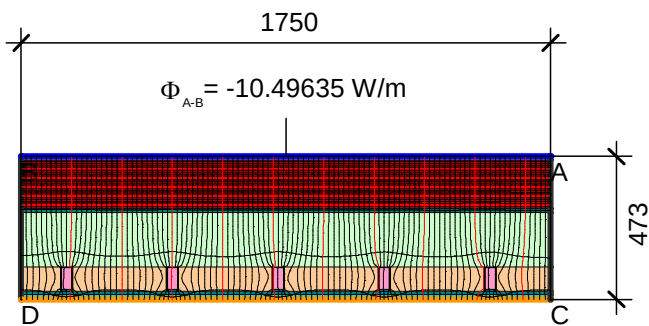
Flat Roof:



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

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: 180 mm	1.125	0.900
Wood - parallel 0.29 W/(mK)	0.290	0.900
XPS 036	0.036	0.900

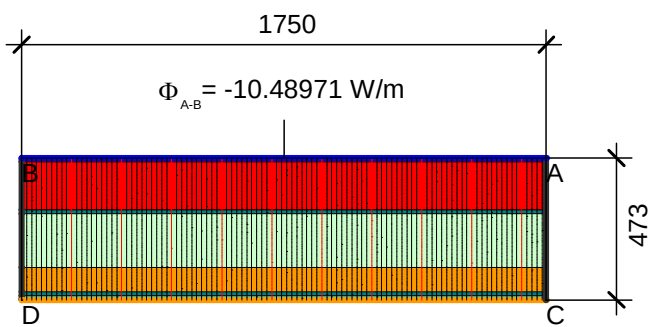
Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ϵ	ϕ [%]
Exterior Außen		-10.000		0.040	
Interior up. Innen auf.		20.000		0.100	
Adiabatic Adiat	0.000				



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

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 Stahl	50.000	0.900
XPS 036	0.036	0.900

Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]
Adiabatic Adiat	0.000		
Exterior Außen		-10.000	0.040
Interior up. Innen auf.		20.000	0.100



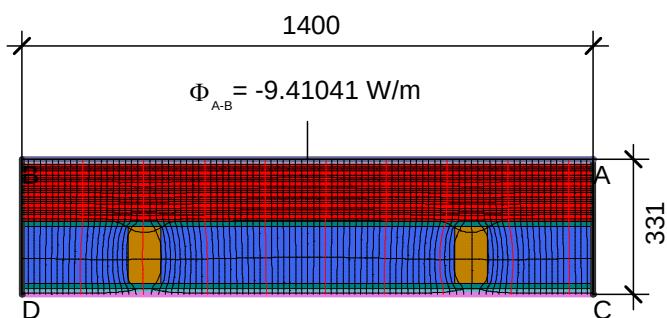
$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.490}{30.000 \cdot 1.750} = 0.200 \text{ W/(m}^2 \cdot \text{K)}$$

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/m ²]	θ [°C]	R [(m ² ·K)/W]	ϵ
Exterior Außen		-10.000		0.040
Interior up. Innen auf.		20.000		0.100
Adiabatic Adiat	0.000			



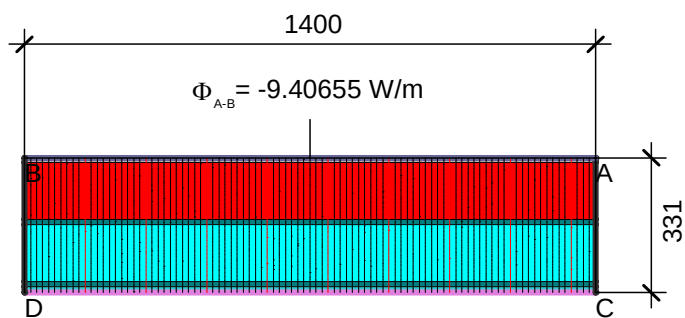
Wall:



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

Material	$\lambda[W/(m \cdot K)]$	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 Adiat	0.000		
Exterior vent. Außen belüftet		-10.000	0.130
Interior Innen		20.000	0.130

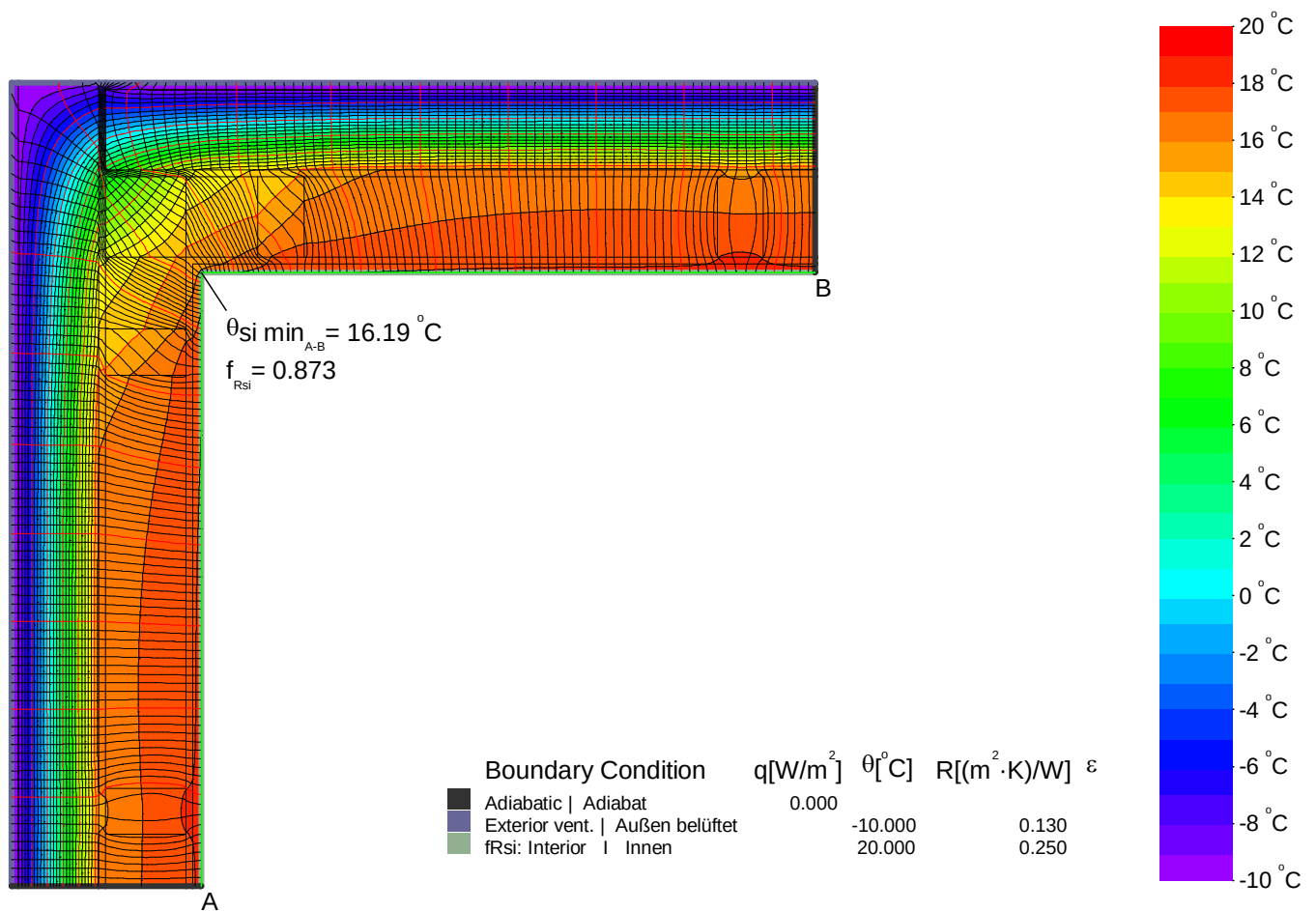
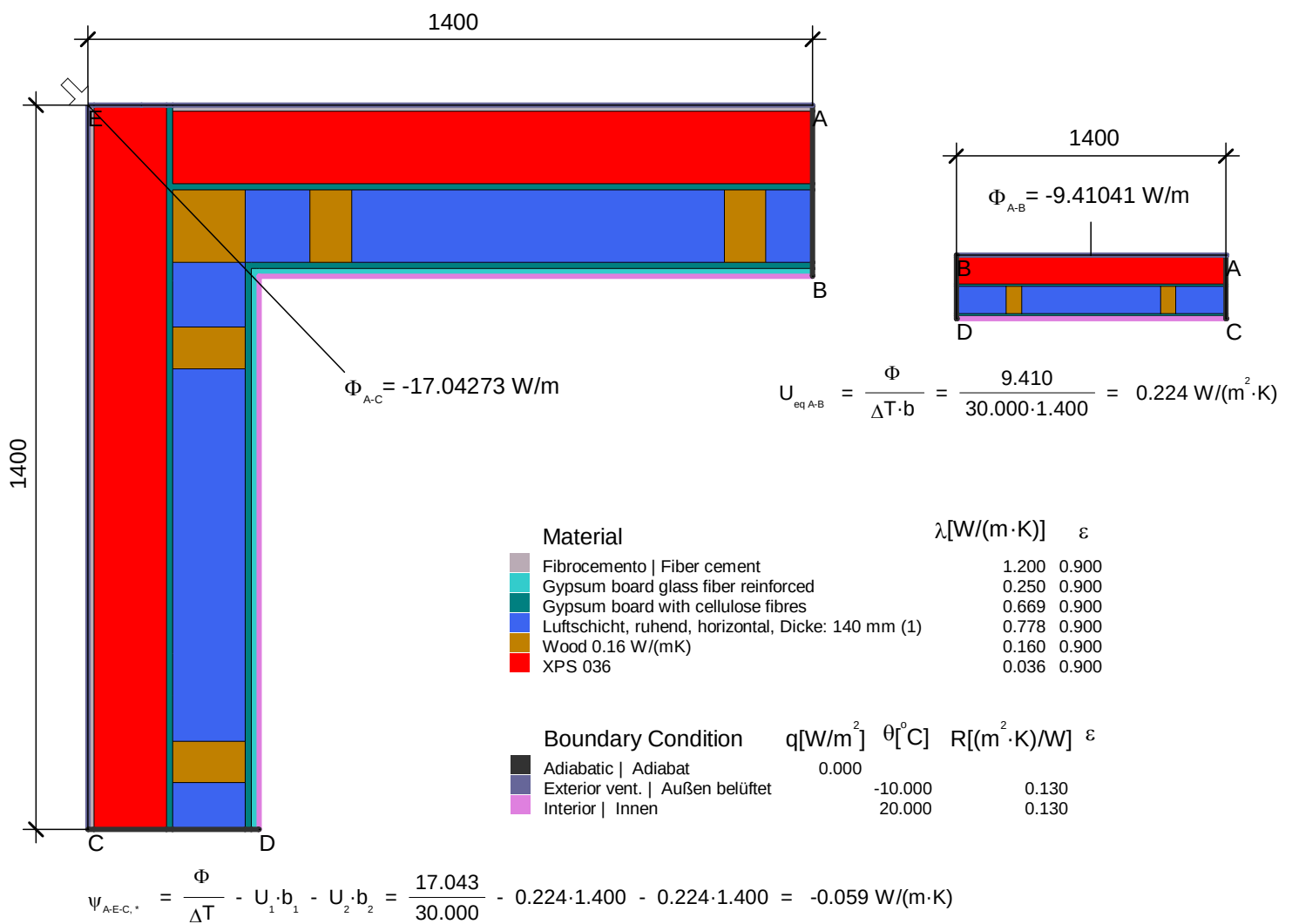


$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.407}{30.000 \cdot 1.400} = 0.224\ W/(m^2 \cdot K)$$

Material	$\lambda[W/(m \cdot K)]$	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

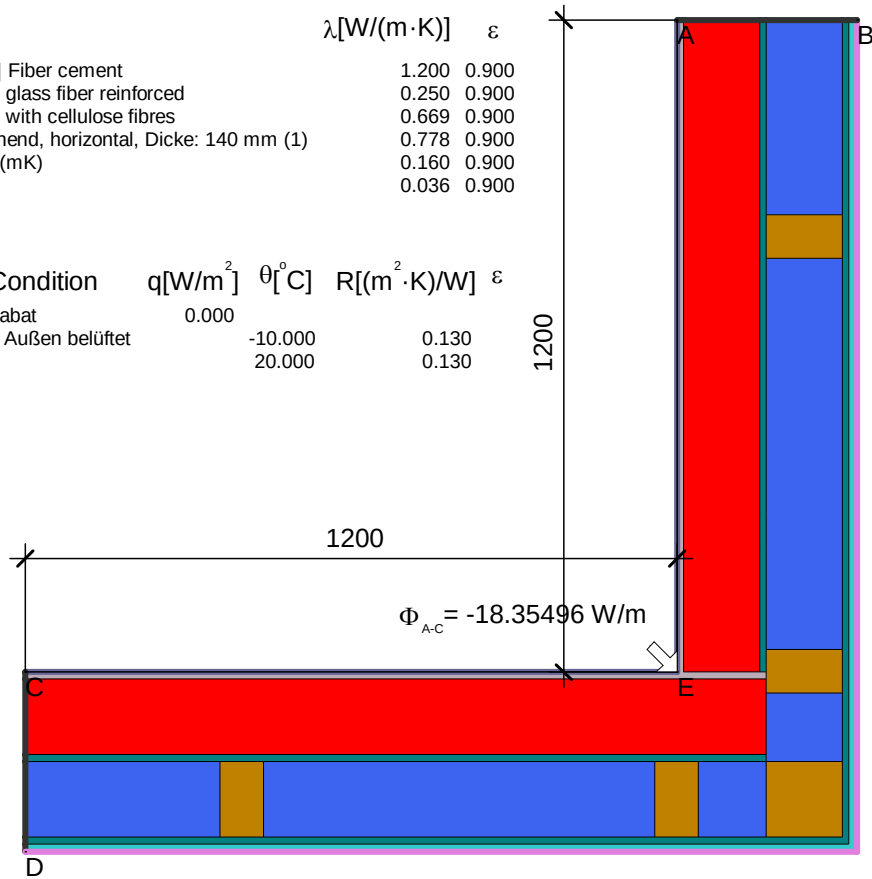
Boundary Condition	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$	ϵ
Exterior vent. Außen belüftet		-10.000	0.130	
Interior Innen		20.000	0.130	
Adiabatic Adiat	0.000			



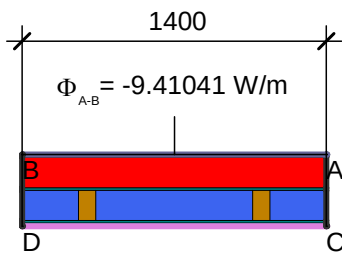


Material	λ [W/(m·K)]	ϵ
Fibrocemento Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, horizontal, Dicke: 140 mm (1)	0.778	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ϵ
Adiabatic Adiabat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Interior Innen		20.000	0.130	

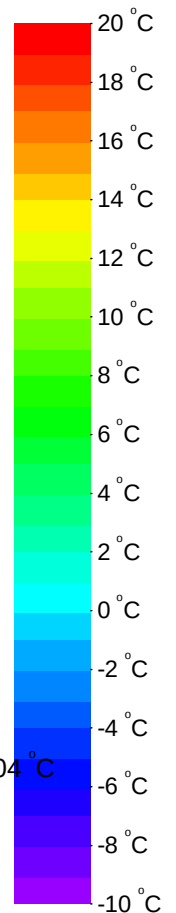
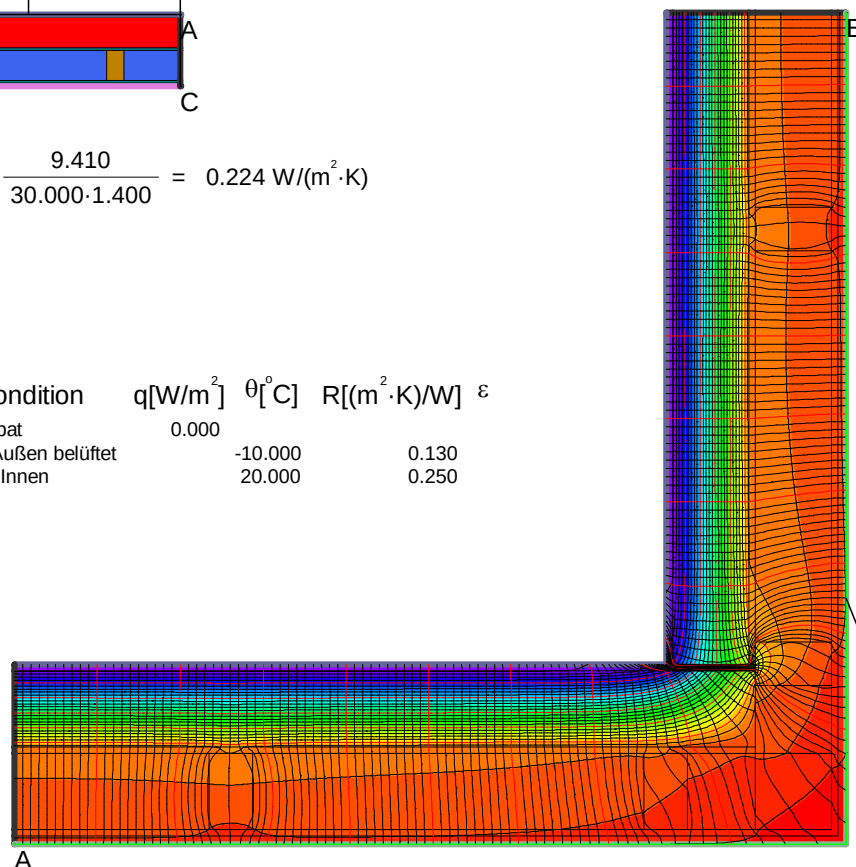


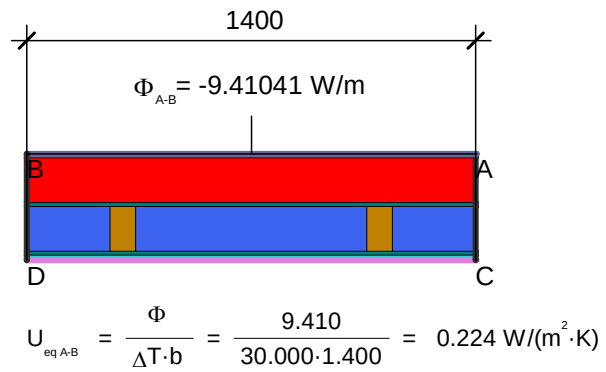
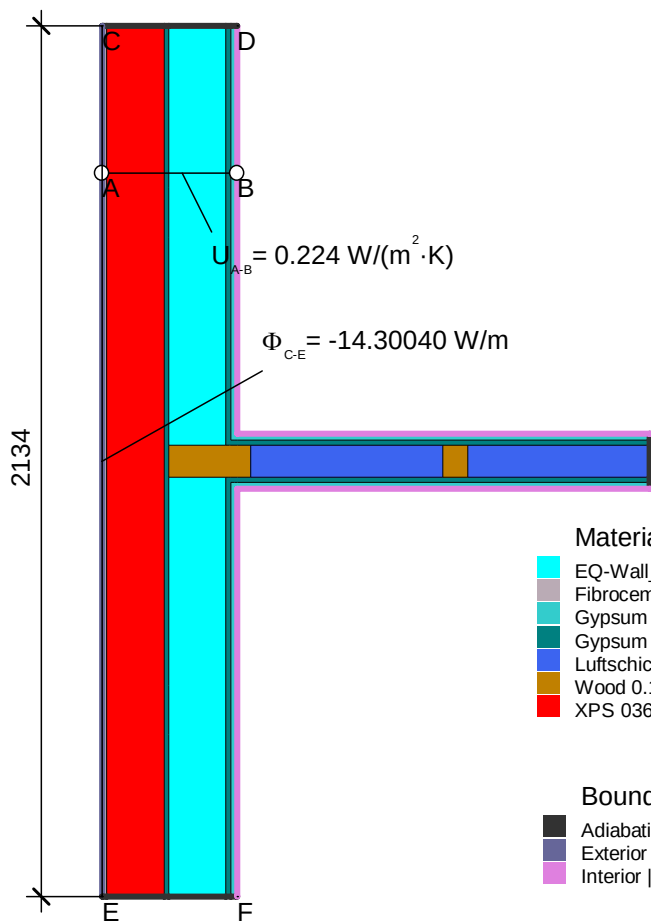
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{18.355}{30.000} - 0.224 \cdot 1.200 - 0.224 \cdot 1.200 = 0.074 \text{ W/(m·K)}$$



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

Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ϵ
Adiabatic Adiabat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
fRsi: Interior Innen		20.000	0.250	

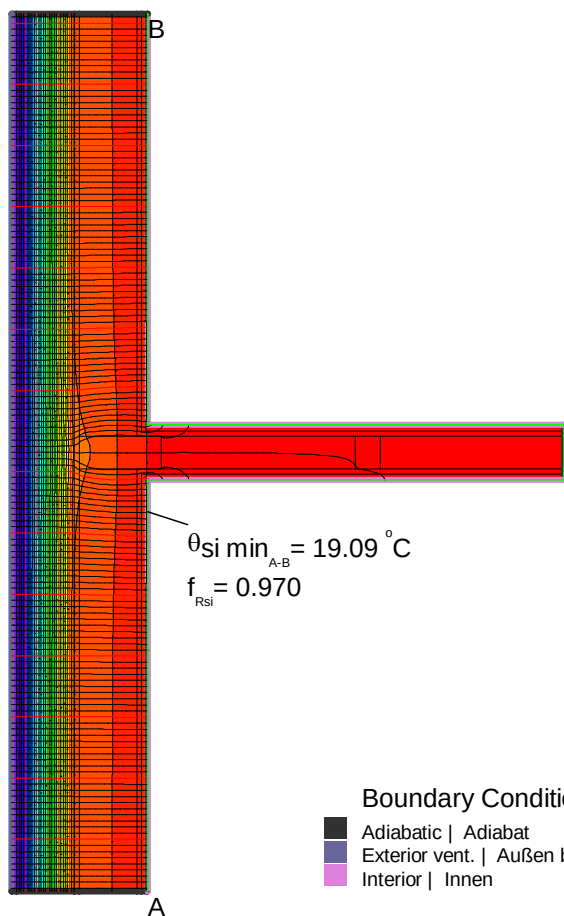




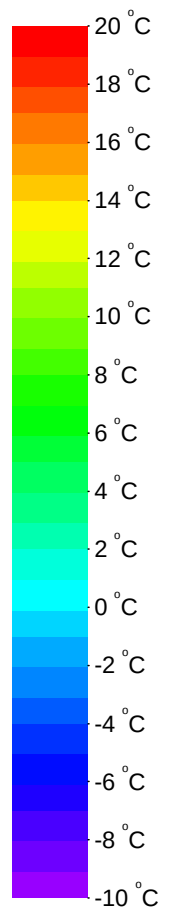
Material	$\lambda [\text{W/(m} \cdot \text{K)}]$	ε
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend, horizontal, Dicke: 140 mm (1)	0.778	0.900
Wood 0.16 W/(mK)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

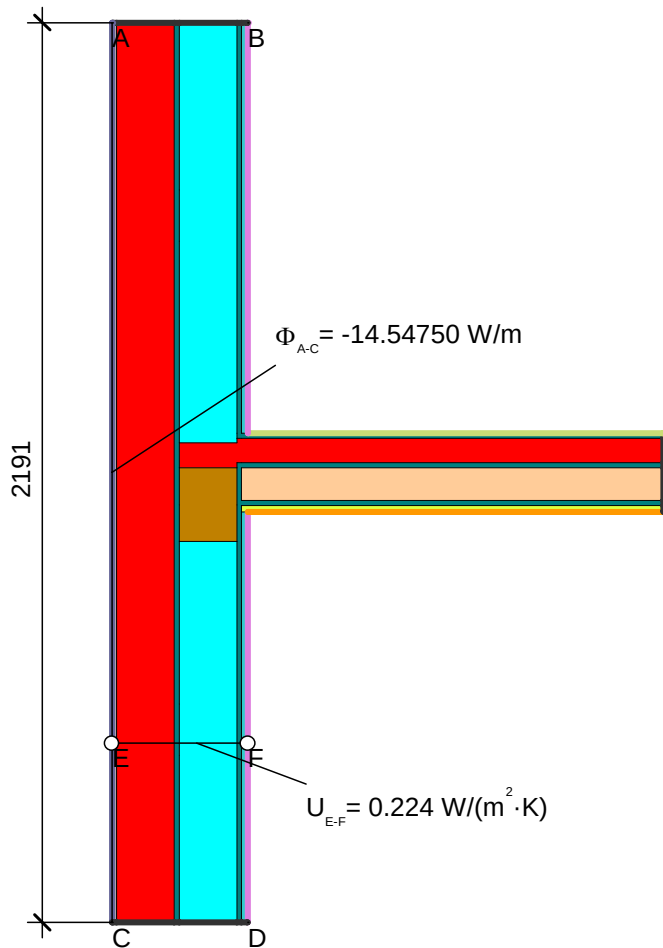
Boundary Condition	$q [\text{W/m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
Adiabatic Adiat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Interior Innen		20.000	0.130	

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



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





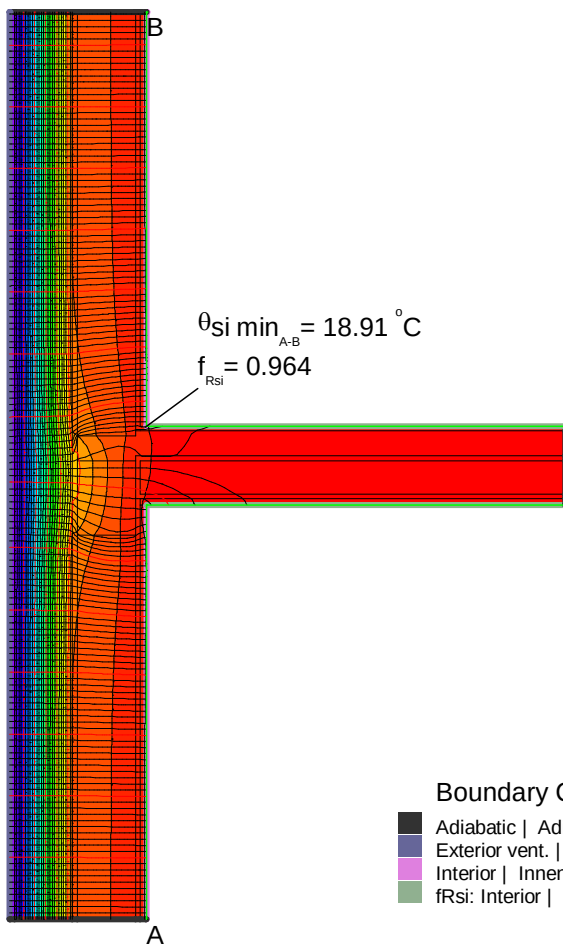
$$\Phi_{A-B} = -9.41041 \text{ W/m}$$

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

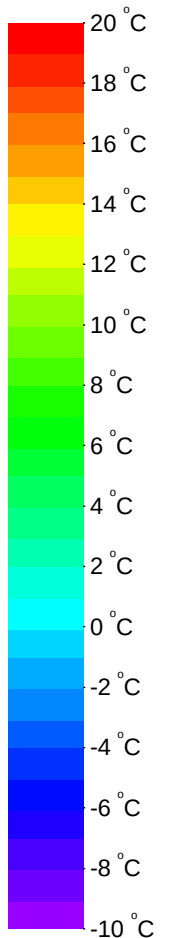
Material	$\lambda [\text{W/(m} \cdot \text{K)}]$	ϵ
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento Fiber cement	1.200	0.900
Gypsum board Gipskartonplatten 900 kg/m3 10456	0.250	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Luftschicht, ruhend,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

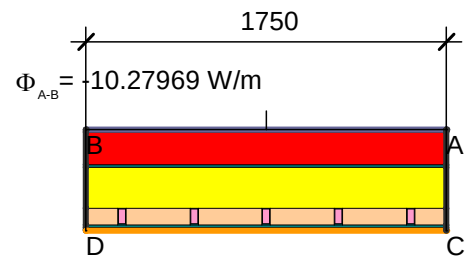
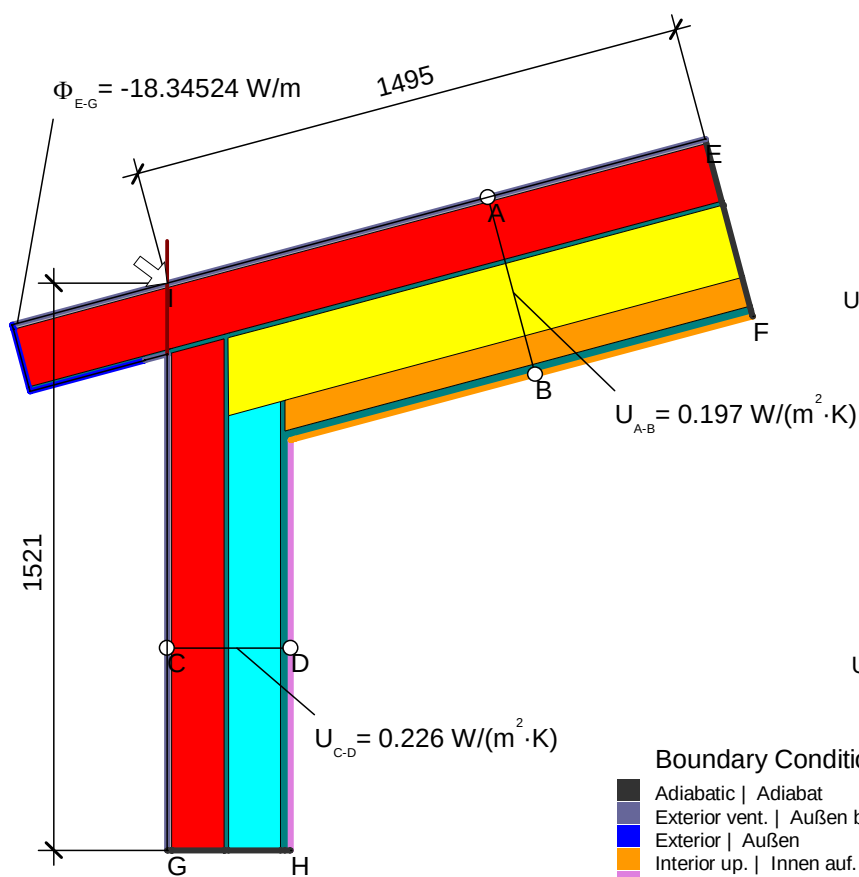
Boundary Condition	$q [\text{W/m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$	ϵ
Adiabatic Adiat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Int. flux down Innen abwärts		20.000	0.170	
Interior up. Innen auf.		20.000	0.100	
Interior Innen		20.000	0.130	

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

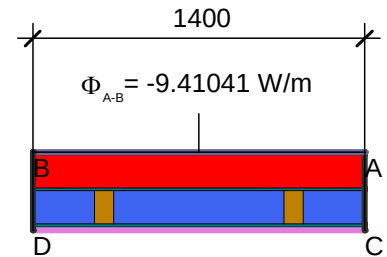


Boundary Condition	$q [\text{W/m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$	ϵ
Adiabatic Adiat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Interior Innen		20.000	0.130	
fRsi: Interior Innen		20.000	0.250	





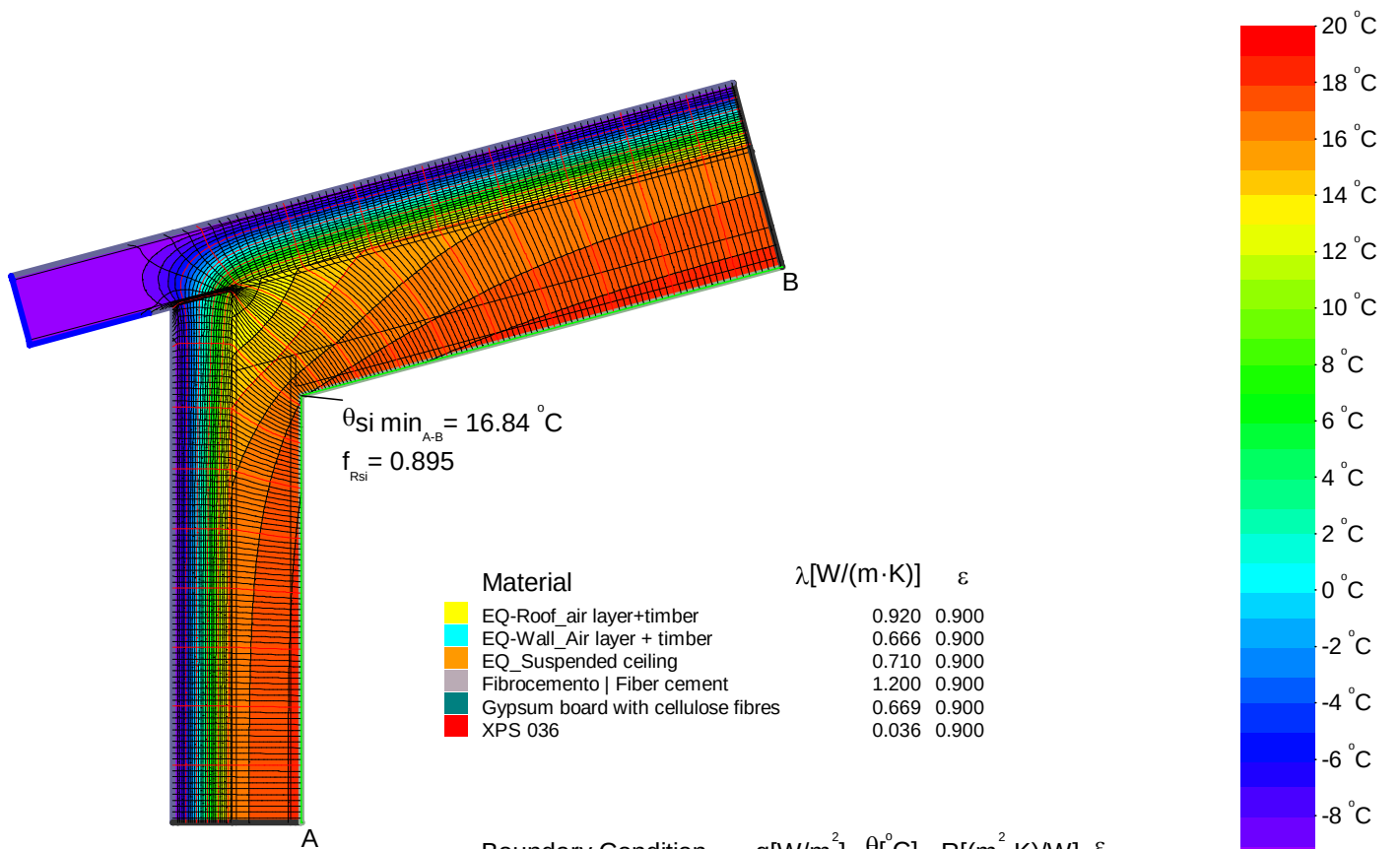
$$U_{eq\ A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.280}{30.000 \cdot 1.750} = 0.196\ W/(m^2 \cdot K)$$



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

Boundary Condition	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$	ε
Adiabatic Adiat	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	

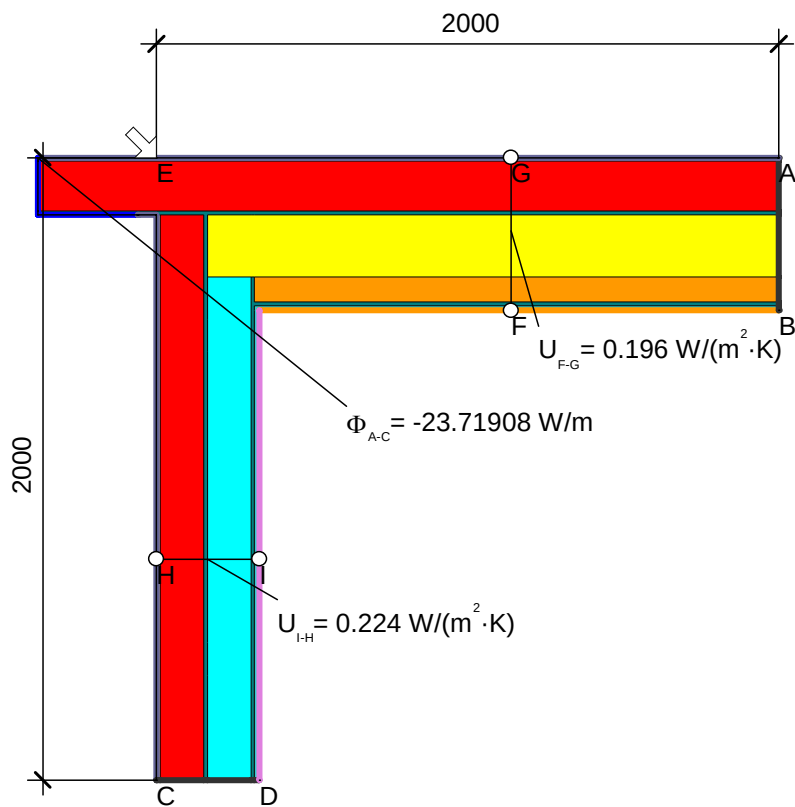
$$\psi_{E+G,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{18.345}{30.000} - 0.196 \cdot 1.495 - 0.224 \cdot 1.521 = -0.022\ W/(m \cdot K)$$



Material	$\lambda[W/(m \cdot K)]$	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 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 Adiat	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Exterior Außen		-10.000	0.040	
fRsi: Interior Innen		20.000	0.250	





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

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

$$\Phi_{A-B} = -9.41041 \text{ W/m}$$

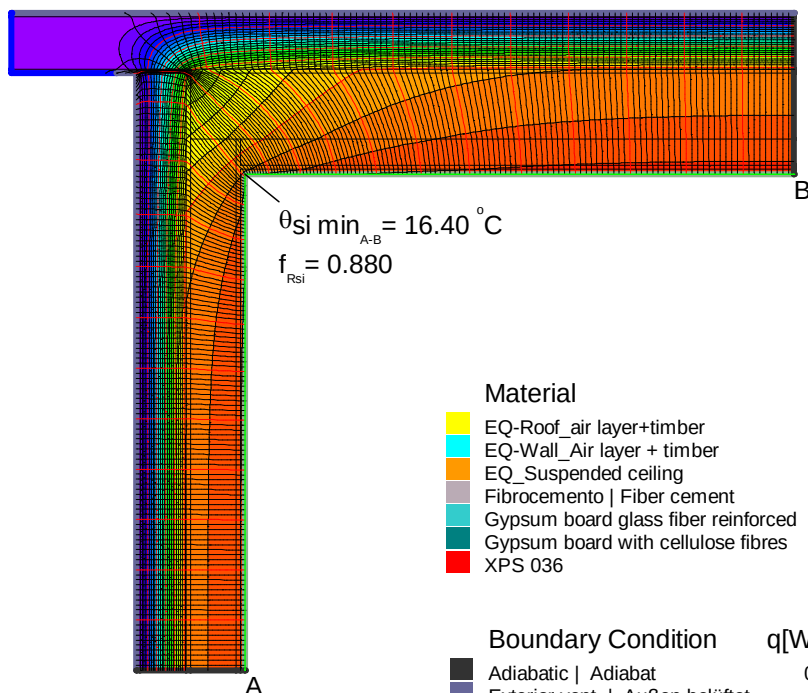
$$U_{eq A-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224 \text{ W/(m}^2 \cdot \text{K)}$$

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

Boundary Condition

Adiabatic Adiat
Exterior vent. Außen belüftet
Exterior Außen
Interior up. Innen auf.
Interior Innen

$q[\text{W/m}^2]$	$\theta[^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
0.000	-10.000	0.130	
	-10.000	0.040	
	20.000	0.100	
	20.000	0.130	



Material

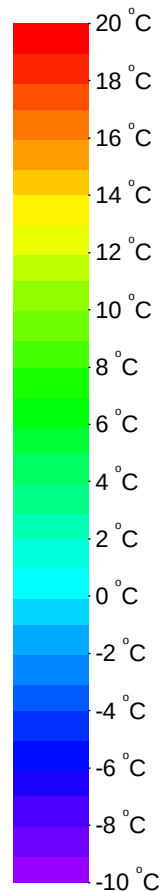
EQ-Roof_air layer+timber
EQ-Wall_Air layer + timber
EQ_Suspended ceiling
Fibrocemento Fiber cement
Gypsum board glass fiber reinforced
Gypsum board with cellulose fibres
XPS 036

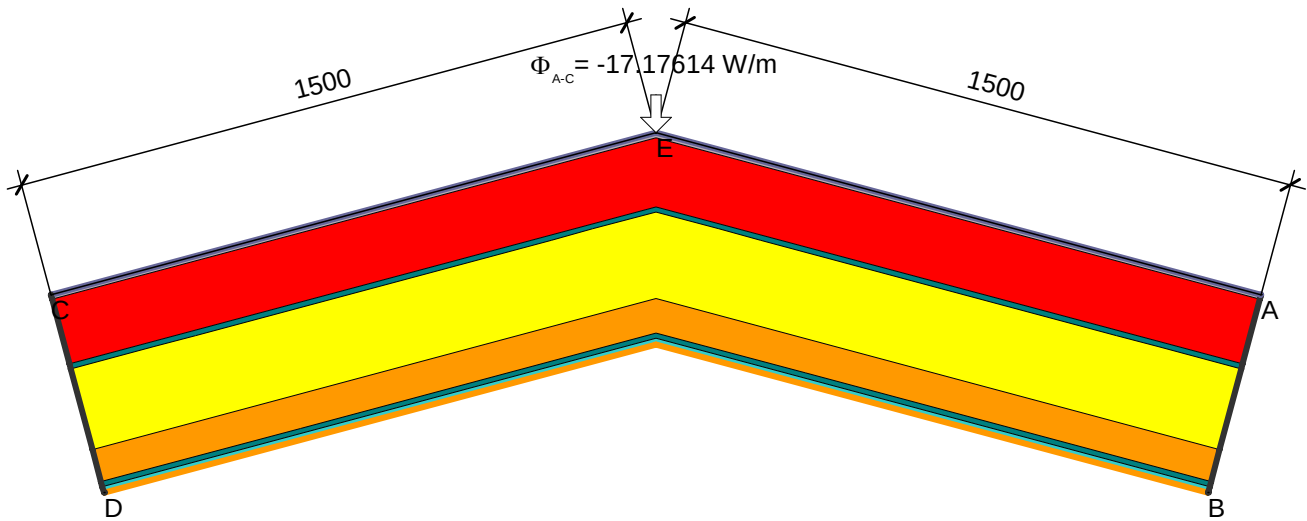
$\lambda[\text{W/(m} \cdot \text{K)}]$	ε
0.920	0.900
0.666	0.900
0.710	0.900
1.200	0.900
0.250	0.900
0.669	0.900
0.036	0.900

Boundary Condition

Adiabatic Adiat
Exterior vent. Außen belüftet
Exterior Außen
fRsi: Interior Innen

$q[\text{W/m}^2]$	$\theta[^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
0.000	-10.000	0.130	
	-10.000	0.040	
	20.000	0.250	

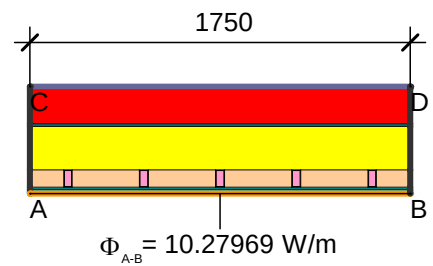




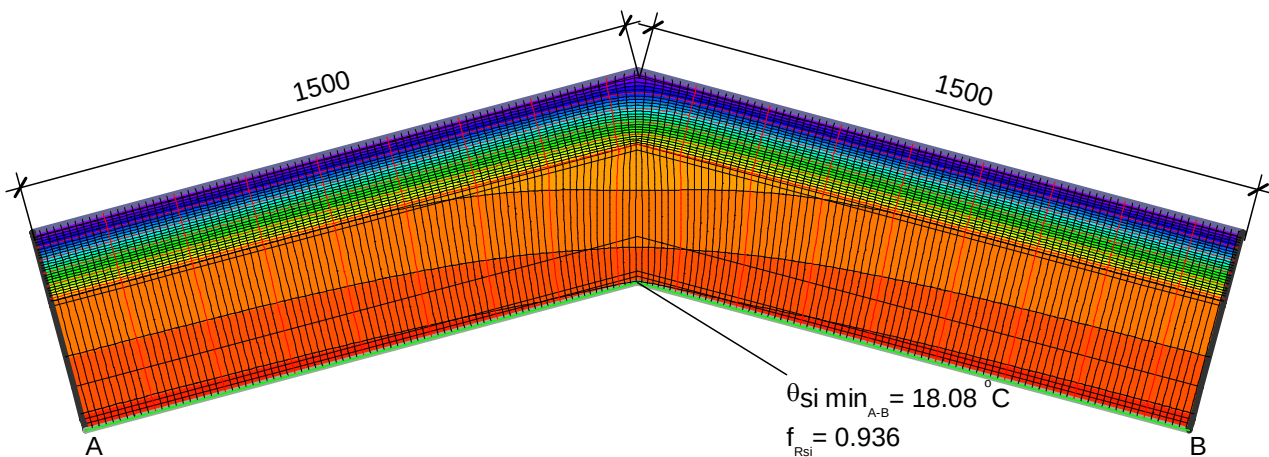
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{17.176}{30.000} - 0.196 \cdot 1.500 - 0.196 \cdot 1.500 = -0.015 \text{ W/(m}\cdot\text{K)}$$

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

Material	$\lambda[\text{W/(m}\cdot\text{K)}]$	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

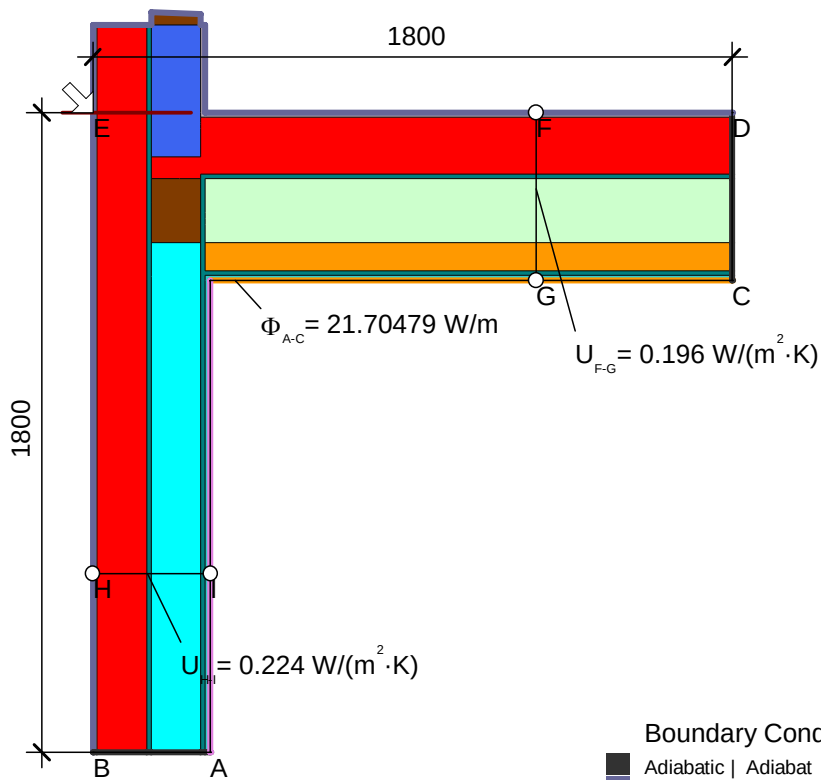


$$U_{\text{eq A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.280}{30.000 \cdot 1.750} = 0.196 \text{ W/(m}^2 \cdot \text{K)}$$



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

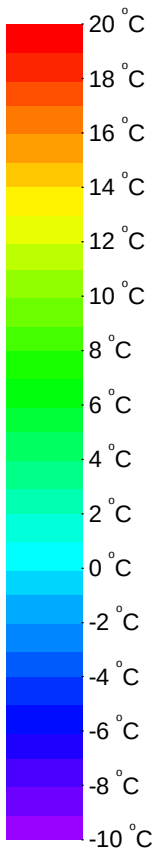
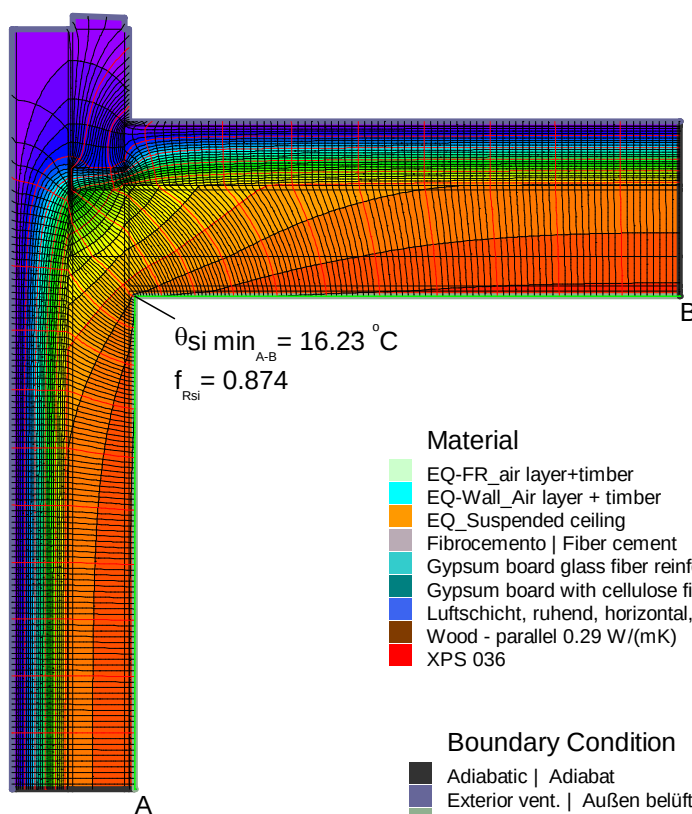




$$U_{\text{eq A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{10.482}{30.000 \cdot \frac{1750}{1400}} = 0.200 \text{ W/(m}^2 \cdot \text{K)}$$

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

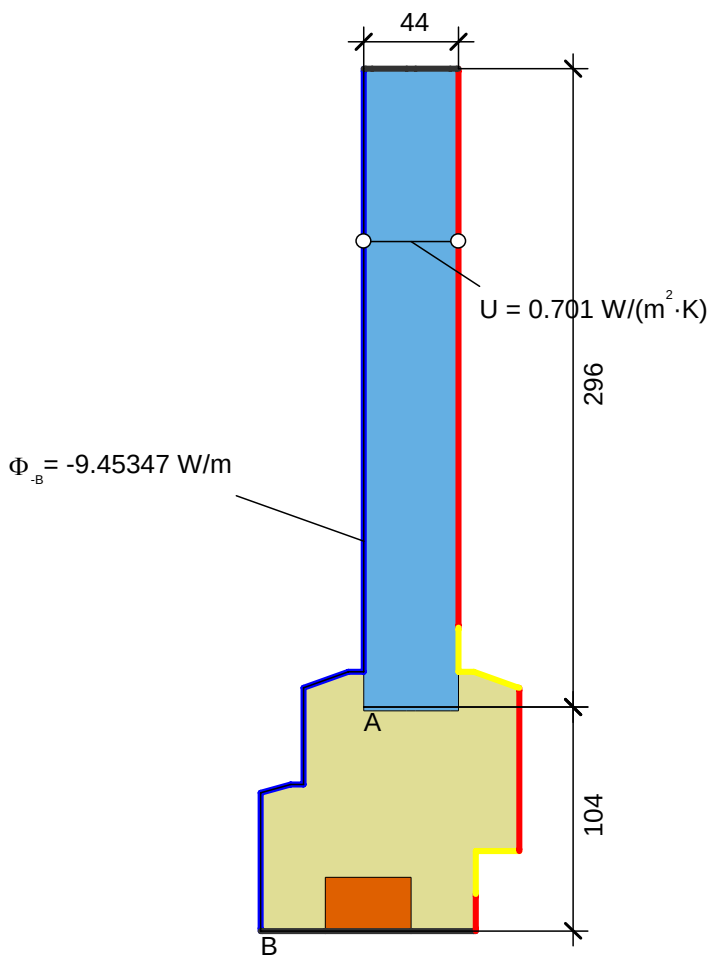
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{21.705}{30.000} - 0.224 \cdot 1.800 - 0.200 \cdot 1.800 = -0.039 \text{ W/(m} \cdot \text{K)}$$



Windows | Fenster

Passive House Unit		01			02			03			01	
frame values Rahmenwerte	Spacer Abstandhalter: phA Spacer		Bottom	Top	Side	Bottom	Top	Side	Bottom	Top	Side	Bottom barrier-free
			Unten	Oben	Seitl.	Unten	Oben	Seitl.	Unten	Oben	Seitl.	Unten barrier-free
	Frame width Rahmenbreite	b_f [mm]	120	120	120							
	U-value frame Rahmen-U-Wert	U_f [W/(m²K)]	0.99	0.99	0.99							
	Ψ-glass edge Glasrand-Ψ-Wert	Ψ_g [W/(mK)]	0.028	0.028	0.028							
	U-value window Fenster-U-Wert	U_w [W/(m²K)] @U _g = 0,70 W/(m²K)	0.998									
	Passive House efficiency class Passivhaus Effizienzklasse		phC									
	Installation Einbau											
f_{Rsi} =0,25m²K/W		0.801	0.789	0.798								
Ψ_{install} [W/(mK)]		0.015	0.005	0.009								
U_{w, installed} [W/(m²K)]		1.03										



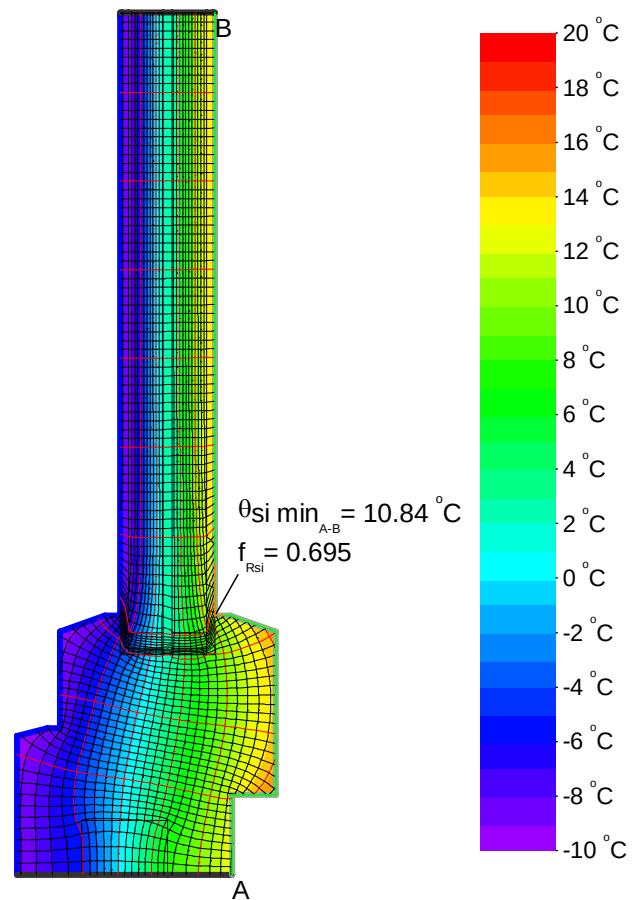
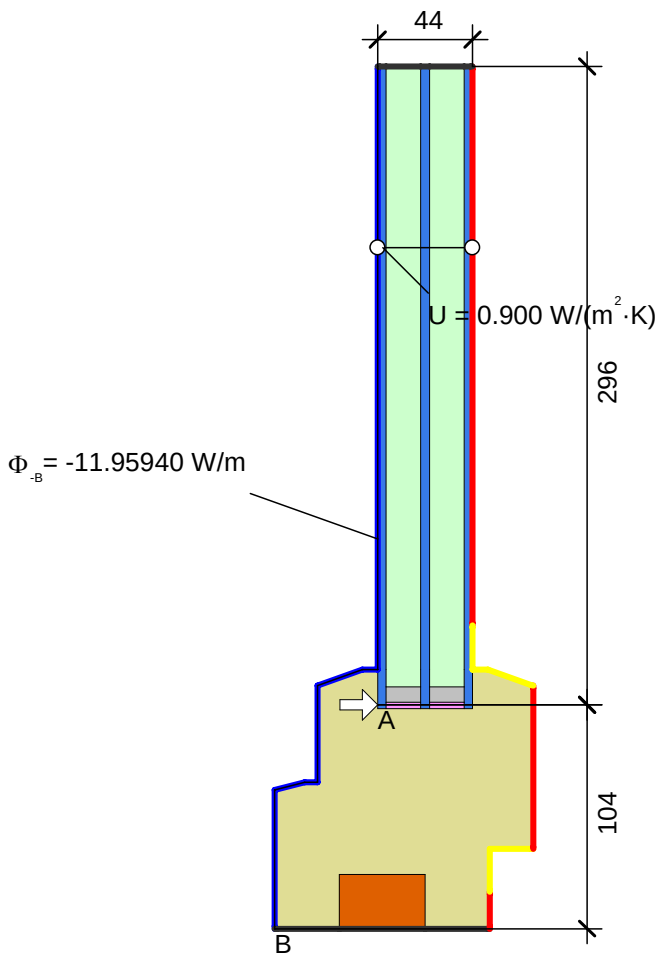


Material	$\lambda [\text{W/(m} \cdot \text{K)}]$	ε
Insulation Wärmedämmung 050	0.050	0.900
Panel Maske	0.035	0.900
Softwood, OSB Weichholz, OSB ISO 10456	0.130	0.900

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

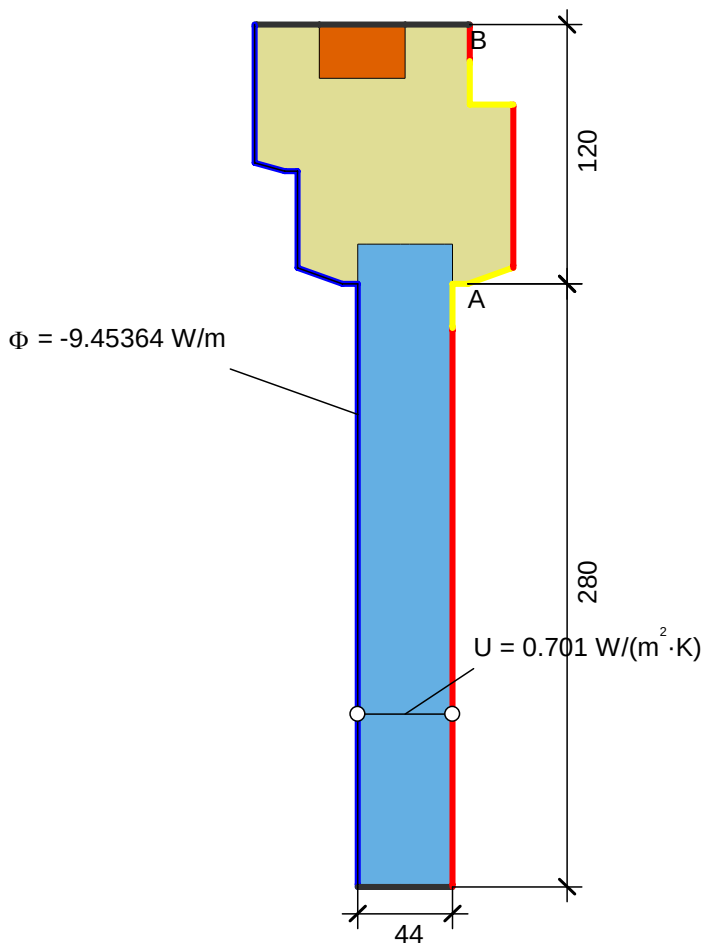
Boundary Condition	$q [\text{W/m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
Adiabatic	0.000			
Aussen Standard		-10.000	0.040	
fRsi: Interior Innen		20.000	0.250	

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



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



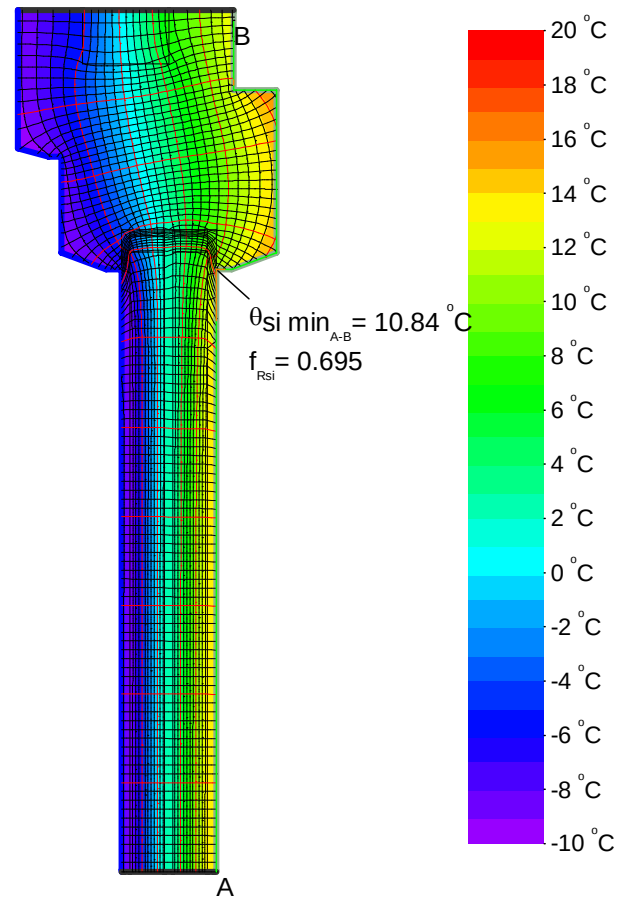
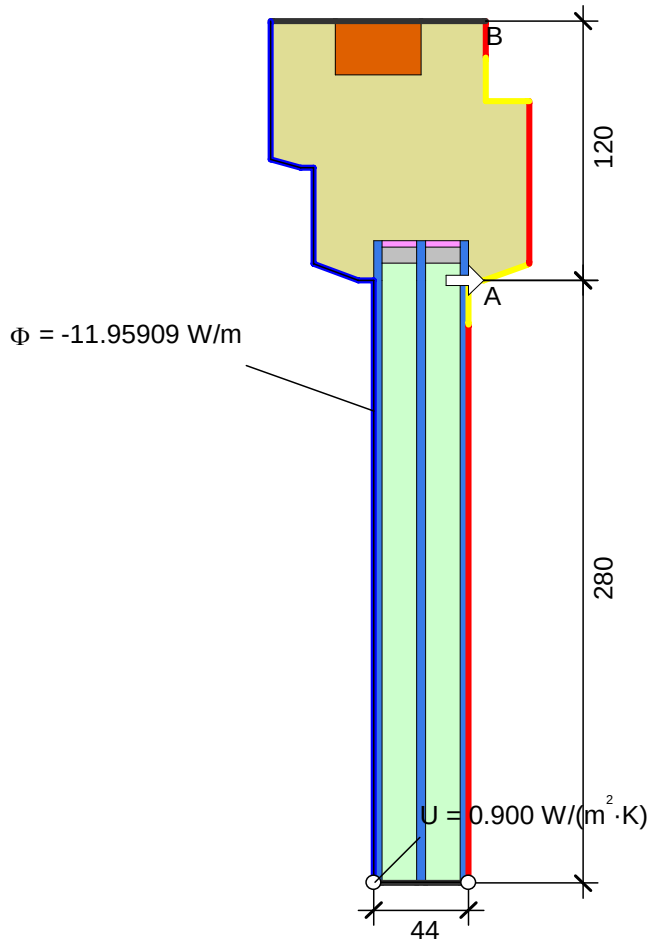


Material	$\lambda[\text{W/(m}\cdot\text{K)}]$	ε
Insulation Wärmedämmung 050	0.050	0.900
Panel Maske	0.035	0.900
Softwood, OSB Weichholz, OSB ISO 10456	0.130	0.900

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

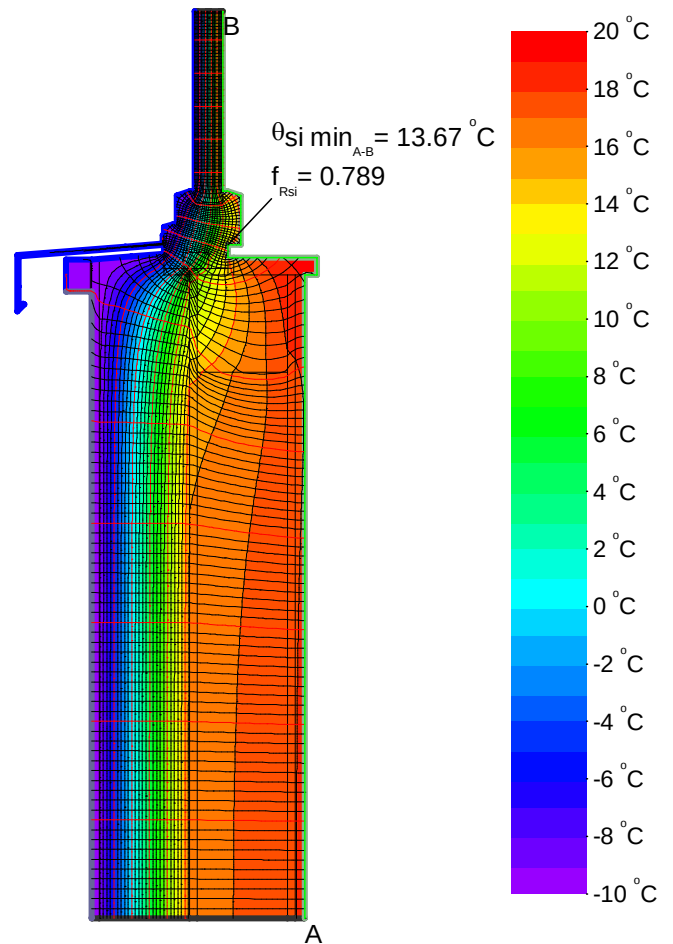
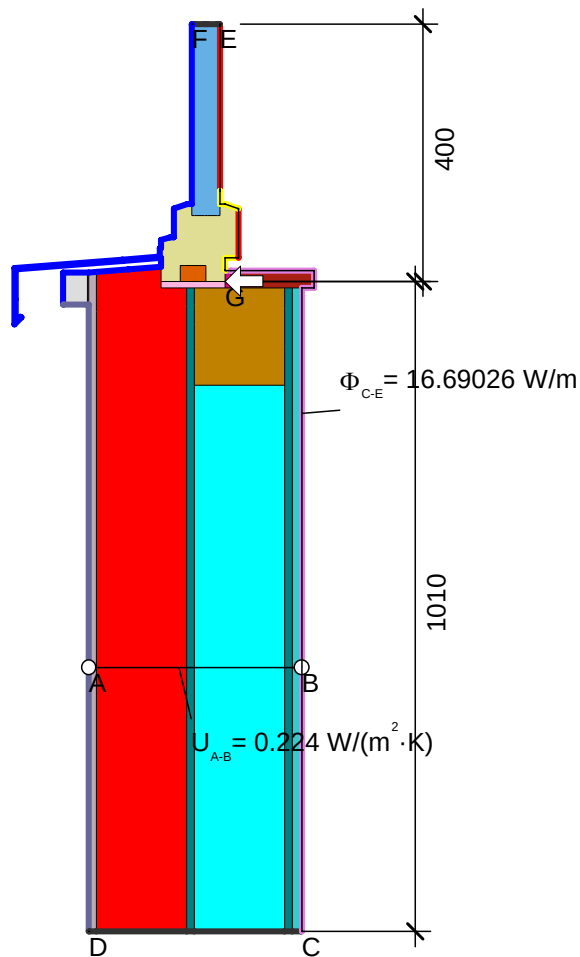
Boundary Condition	$q[\text{W/m}^2]$	$\theta[^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
Adiabatic	0.000			
Aussen Standard		-10.000	0.040	
fRsi: Interior Innen		20.000	0.250	

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



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



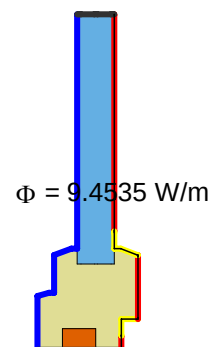
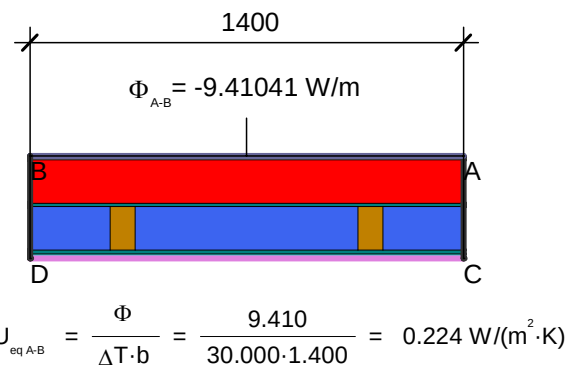


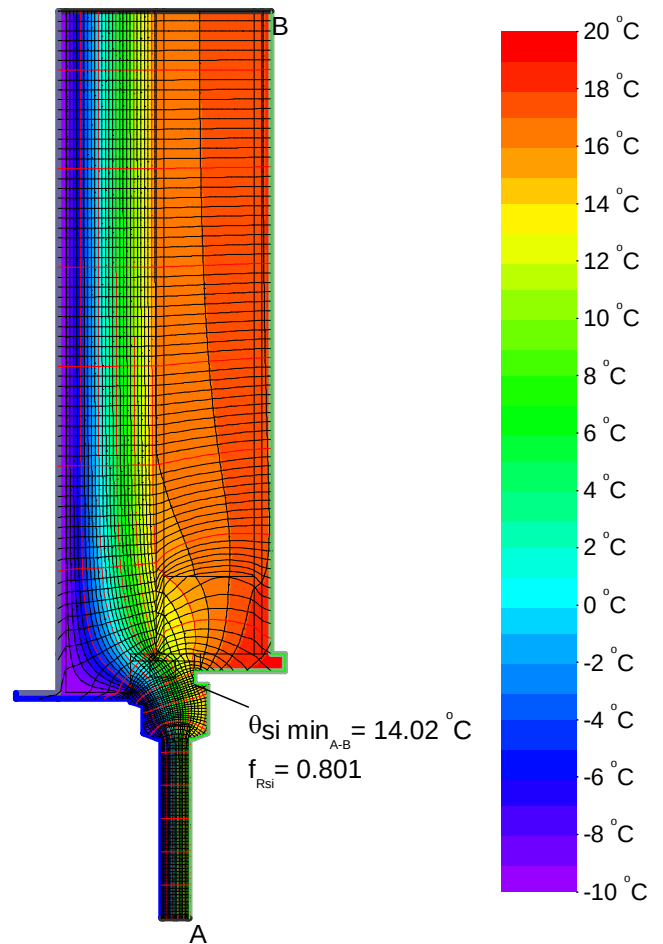
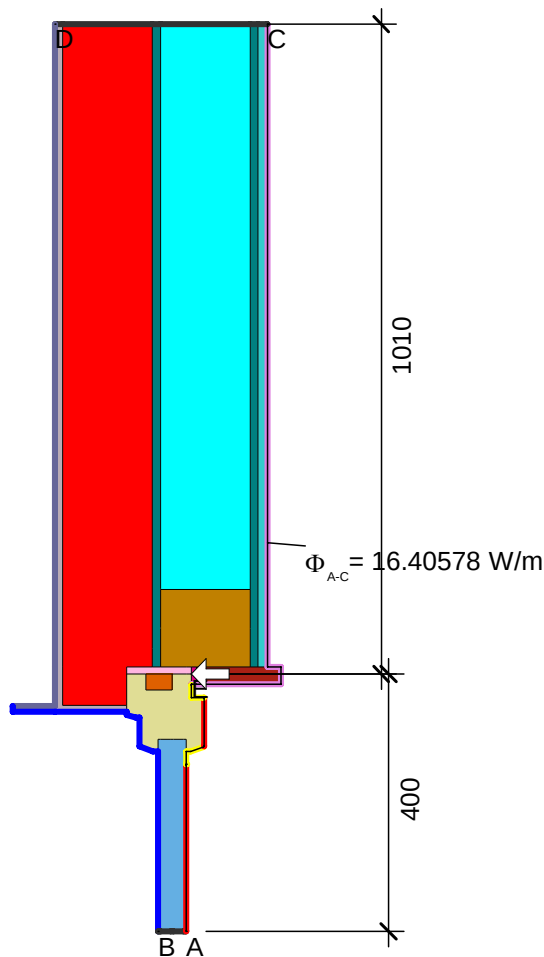
$$\psi_{C-G-E,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{16.690}{30.000} - 0.224 \cdot 1.010 - \frac{9.453}{30.000} = 0.015 \text{ W/(m} \cdot \text{K)}$$

Material	$\lambda[\text{W/(m} \cdot \text{K)}]$	ε
Aluminum 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 Hartholz 0.18 700 kg/m ³ 10456	0.180	0.900
Insulation Wärmedämmung 050	0.050	0.900
PU in-situ foam PU-Ortschaum 040	0.040	0.900
Panel Maske	0.035	0.900
Silicone Silikon	0.350	0.900
Softwood, OSB Weichholz, OSB ISO 10456	0.130	0.900
Unvent. cavity 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

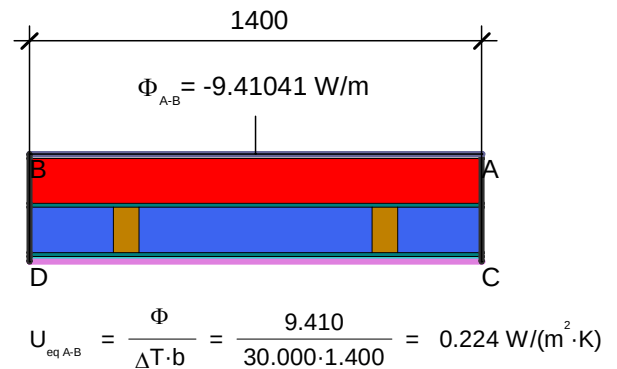
Boundary Condition	$q[\text{W/m}^2]$	$\theta[^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ε
Adiabatic Adiab	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Exterior Außen		-10.000	0.040	
Interior Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
e 0,9 Cavity Hohlraum				0.900





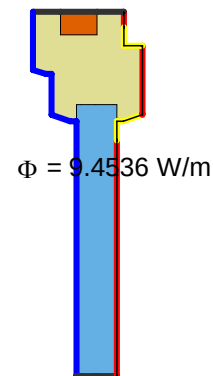
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_i}{\Delta T} - U_2 \cdot b_2 = \frac{16.406}{30.000} - \frac{9.454}{30.000} - 0.224 \cdot 1.010 = 0.005 \text{ W}/(\text{m} \cdot \text{K})$$

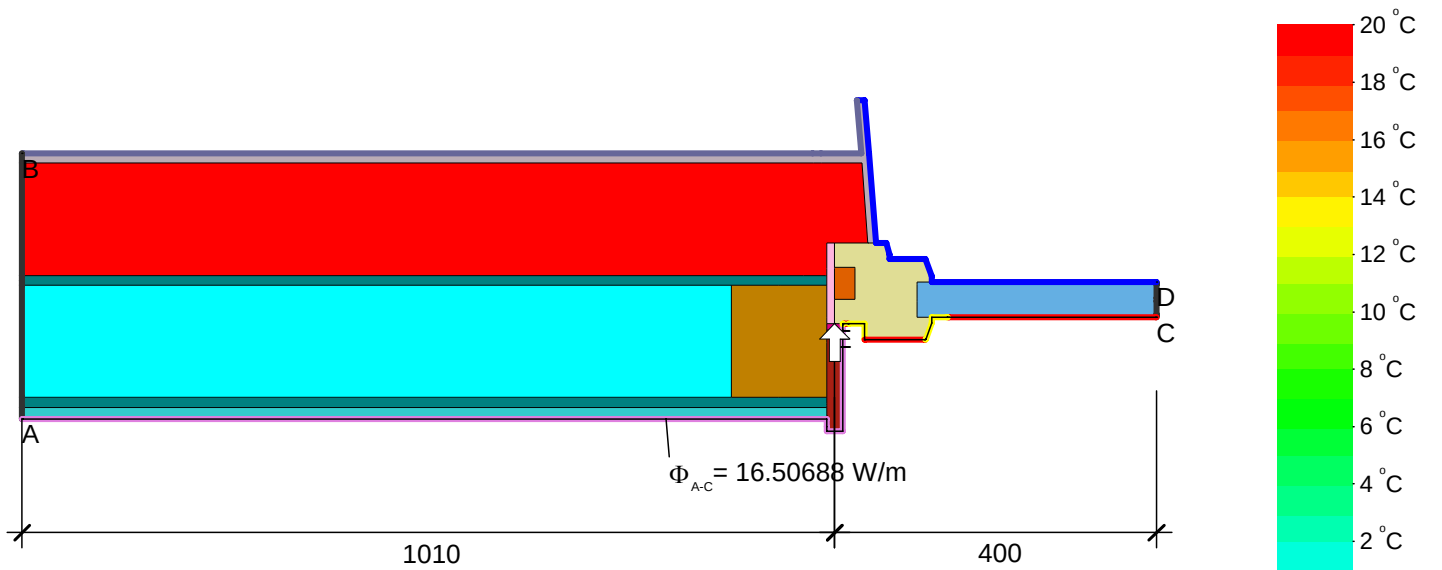
Material	λ [W/(m·K)]	ε
EQ-Wall_Air layer + timber	0.666	0.900
Fibrocemento Fiber cement	1.200	0.900
Gypsum board glass fiber reinforced	0.250	0.900
Gypsum board with cellulose fibres	0.669	0.900
Hardwood Hartholz 0.18 700 kg/m ³ 10456	0.180	0.900
Insulation Wärmedämmung 050	0.050	0.900
PU in-situ foam PU-Ortschaum 040	0.040	0.900
Panel Maske	0.035	0.900
Silicone Silikon	0.350	0.900
Softwood, OSB Weichholz, OSB ISO 10456	0.130	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900



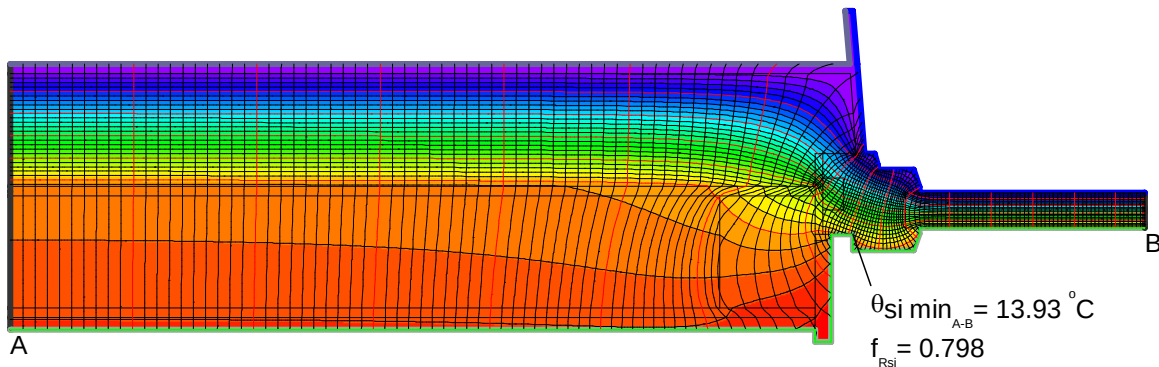
$$U_{eq \text{ A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{9.410}{30.000 \cdot 1.400} = 0.224 \text{ W}/(\text{m}^2 \cdot \text{K})$$

Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ε
Adiabatic Adiabat	0.000			
Aussen Standard		-10.000	0.040	
Exterior vent. Außen belüftet		-10.000	0.130	
Interior Innen		20.000	0.130	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	

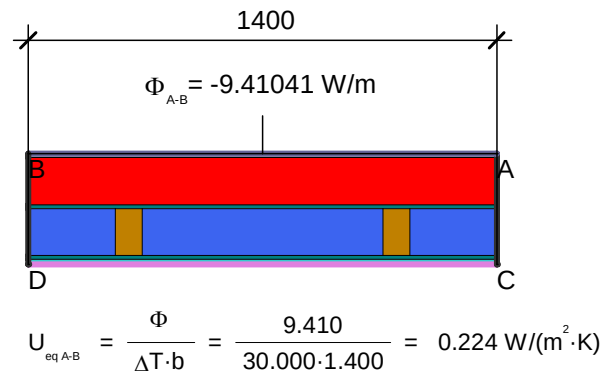




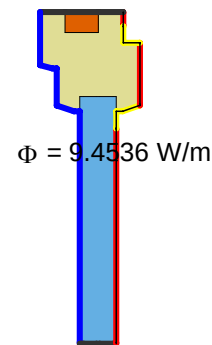
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{16.507}{30.000} - 0.224 \cdot 1.010 - \frac{9.454}{30.000} = 0.009 \text{ W/(m} \cdot \text{K)}$$



Material	$\lambda[\text{W/(m} \cdot \text{K)}]$	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 Harholz 0.18 700 kg/m3 10456	0.180	0.900
Insulation Wärmedämmung 050	0.050	0.900
PU in-situ foam PU-Ortschaum 040	0.040	0.900
Panel Maske	0.035	0.900
Silicone Silikon	0.350	0.900
Softwood, OSB Weichholz, OSB ISO 10456	0.130	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

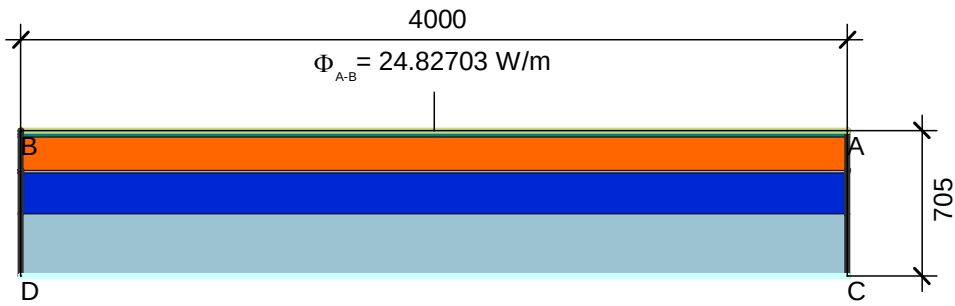


Boundary Condition	$q[\text{W/m}^2]$	$\theta[^{\circ}\text{C}]$	$R[\text{m}^2 \cdot \text{K/W}]$	ϵ
Adiabatic Adiabatic	0.000			
Exterior vent. Außen belüftet		-10.000	0.130	
Exterior Außen		-10.000	0.040	
Innen Fensterrahmen Reduziert		20.000	0.200	
Innen Fensterrahmen Standard		20.000	0.130	
Interior Innen		20.000	0.130	



Constructions to ground | Erdberührte Bauteile

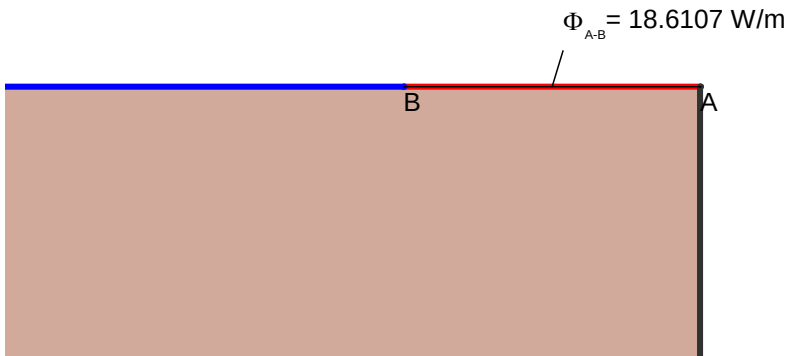




$$U_{\text{eq A-B}} = \frac{\Phi}{\Delta T \cdot b} = \frac{24.827}{30.000 \cdot 4.000} = 0.207 \text{ W}/(\text{m}^2 \cdot \text{K})$$

Material	$\lambda [\text{W}/(\text{m} \cdot \text{K})]$	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

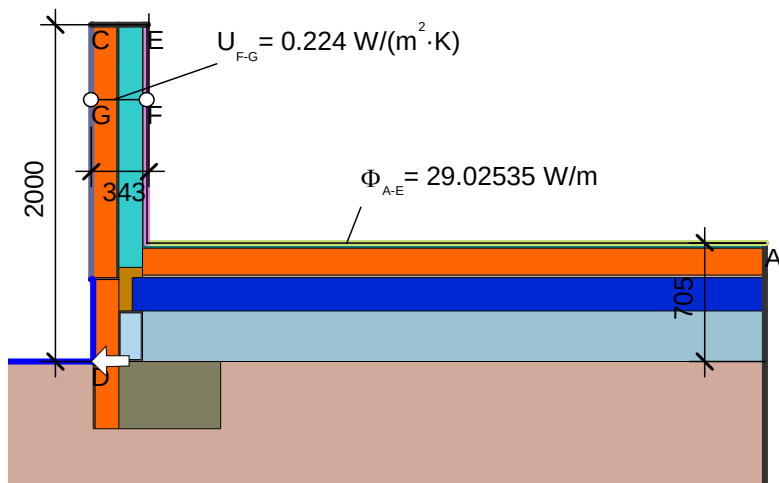
Boundary Condition	$q [\text{W}/\text{m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
Gorund Erdreich		-10.000	
Int. flux down Innen abwärts		20.000	0.170
Adiabatic Adiabatisch	0.000		



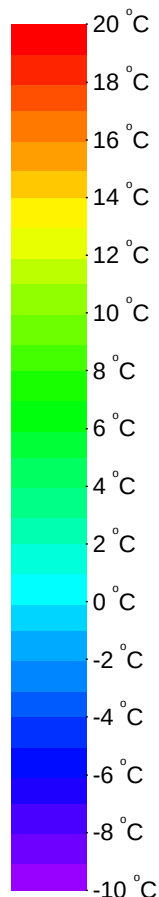
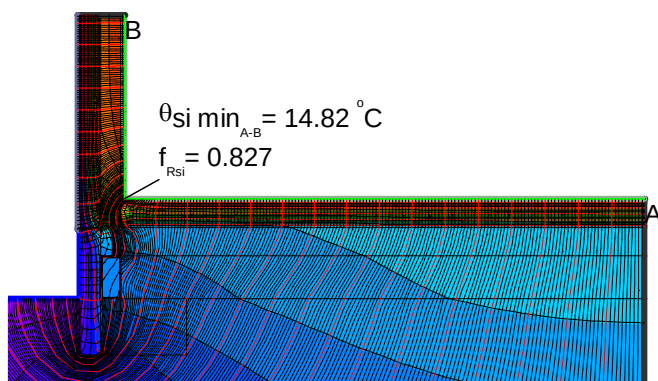
Material	$\lambda [\text{W}/(\text{m} \cdot \text{K})]$	ε
Ground Erdreich	2.000	0.900

Boundary Condition	$q [\text{W}/\text{m}^2]$	$\theta [^\circ \text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$
EQ FS: 1/Ufs		20.000	4.833
Exterior Außen		-10.000	0.040
Adiabatic Adiabatisch	0.000		

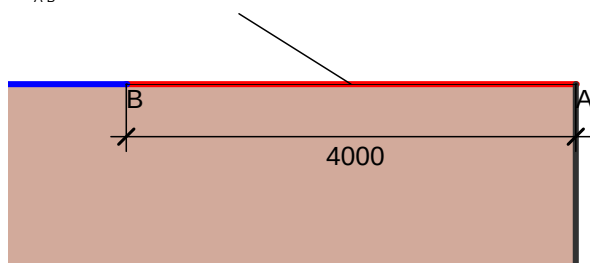




$$\psi_{A-D-E,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{29.025}{30.000} - \frac{18.611}{30.000} - 0.224 \cdot 2.000 = -0.101 \text{ W/(m} \cdot \text{K)}$$

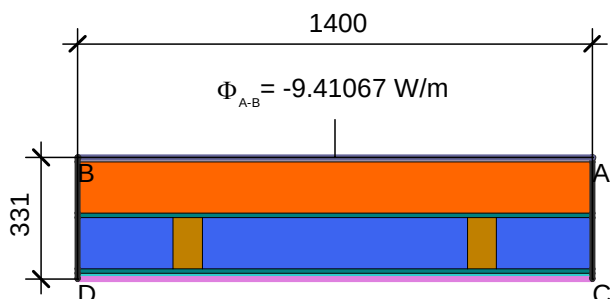


$\Phi_{A-B} = 18.6107 \text{ W/m}$



Material

Material	λ [W/(m·K)]	ε
Aluminum Aluminium 10456	160.000	0.900
Concrete, 1% Steel 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 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



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

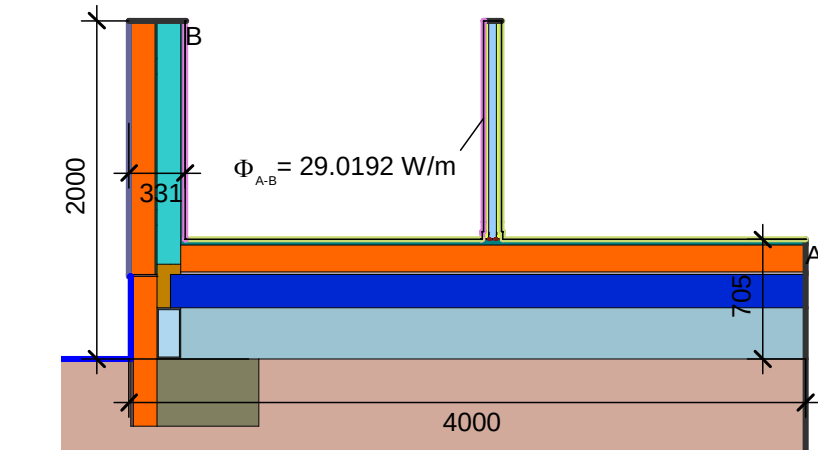
Boundary Condition

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

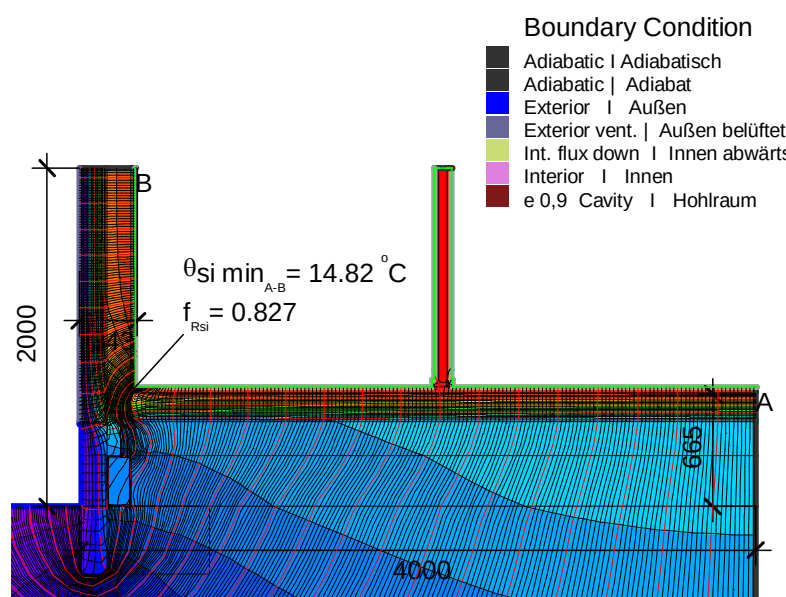
Boundary Condition

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





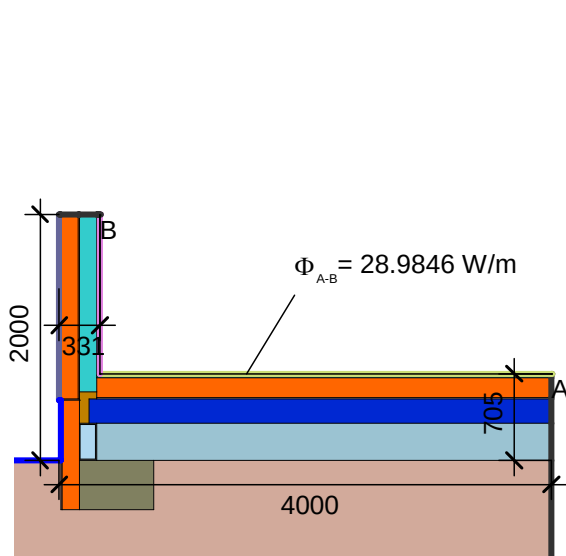
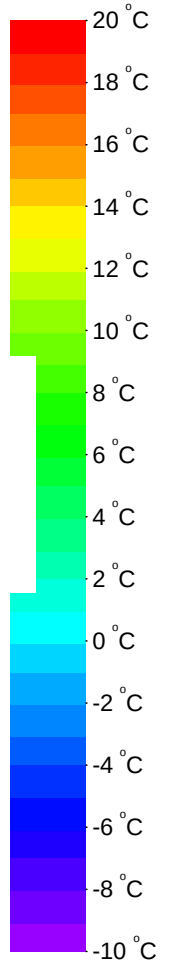
$$\psi_{\text{FSIW}} = (Q_{\text{FSIW}} - Q_{\text{FSEW}}) / \Delta T = (29.0192 - 28.9846) / 30 = 0,001 \text{ W/mK}$$



Boundary Condition

Adiabatic Adiabatisch	0.000
Adiabatic Adiaabat	0.000
Exterior Außen	-10.000
Exterior vent. Außen belüftet	-10.000
Int. flux down Innen abwärts	20.000
Interior Innen	20.000
e 0,9 Cavity Hohlraum	

q[W/m ²]	θ[°C]	R[(m ² ·K)/W]	ε
0.000			
0.000			
	-10.000	0.040	
	-10.000	0.130	
	20.000	0.170	
	20.000	0.130	
			0.900



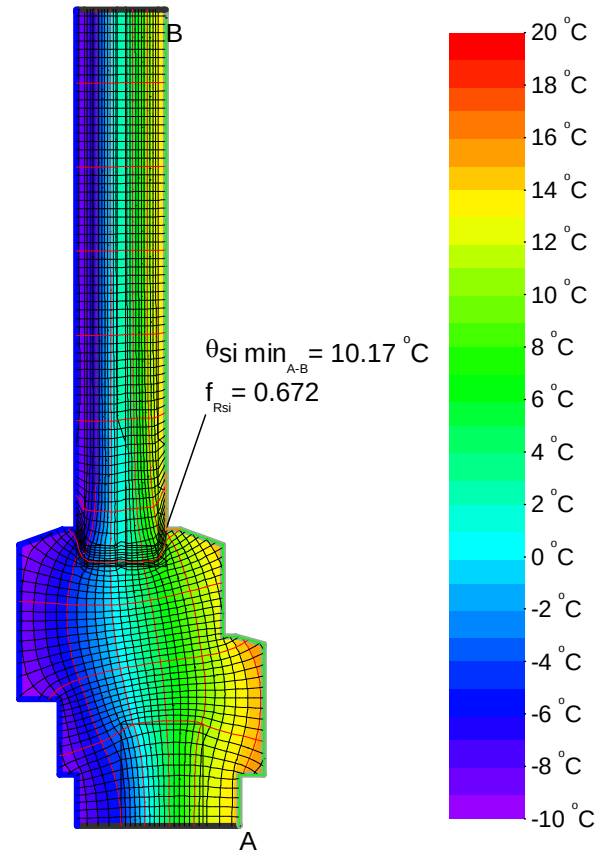
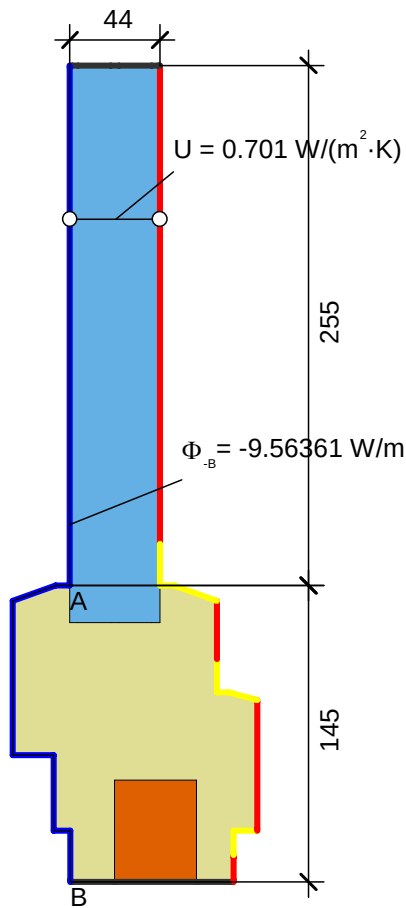
Material

Aluminum Aluminium 10456	160.000	0.900
Concrete, 1% Steel 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 Erdreich	2.000	0.900
Gypsum board 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
Polyethylenschäum	0.050	0.900
Steel Stahl	50.000	0.900
Unvent. cavity unbel. Hohlr. *		
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

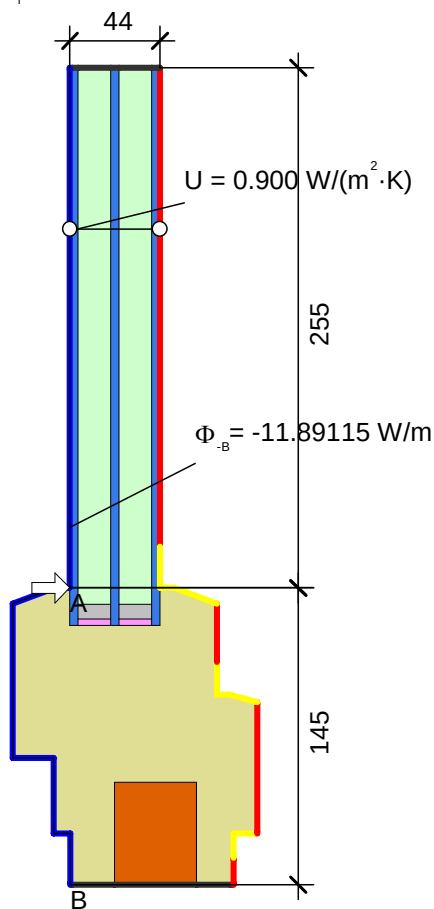
* EN ISO 10077-2:2017, 6.4.3

λ[W/(m·K)]	ε
160.000	0.900
2.300	0.900
0.250	0.900
0.656	0.900
0.046	0.900
1.200	0.900
0.560	0.900
2.000	0.900
0.250	0.900
0.250	0.900
0.669	0.900
0.041	0.900
1.556	0.900
2.500	0.900
3.750	0.900
0.050	0.900
50.000	0.900
0.160	0.900
0.036	0.900





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



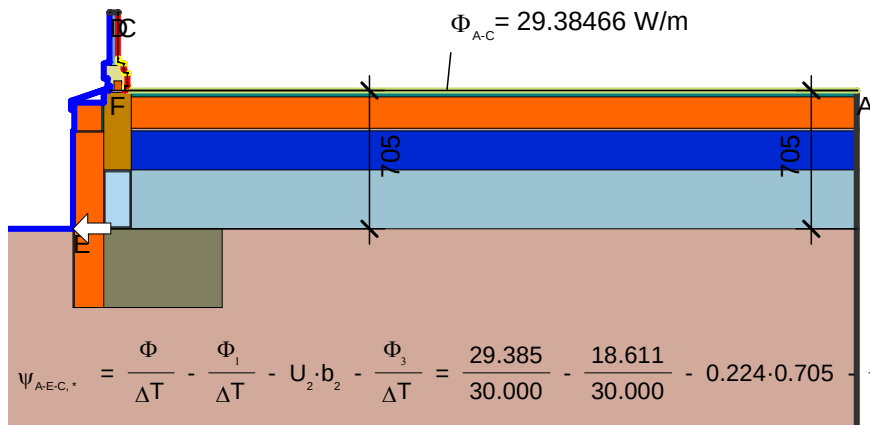
Material	λ [W/(m·K)]	ε
Ar16 in 44 mm U 0,9	0.034	0.900
Glass / Glas	1.000	0.900
Insulation I Wärmedämmung 050	0.050	0.900
Polysulfide / Polysulfid	0.400	0.900
Softwood, OSB I Weichholz, OSB ISO 10456	0.130	0.900
phA-Spacer	0.200	0.900

Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ε
Adiabatic I Adiabatisch	0.000			
Adiabatic Adiat	0.000			
Aussen Standard		-10.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	

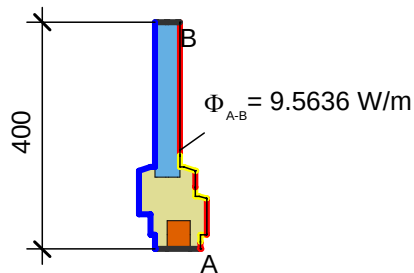
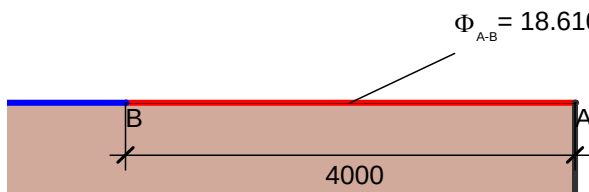
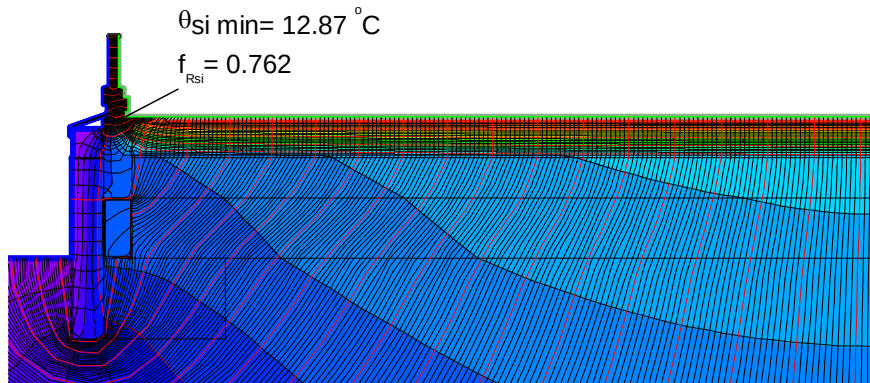
Boundary Condition	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ε
Adiabatic I Adiabatisch	0.000			
Aussen Standard		-10.000	0.040	
fRsi: Interior I Innen		20.000	0.250	

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





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



Material

Aluminum Aluminium 10456	160.000	0.900
Concrete, 1% Steel Beton, 1% Stahl ISO 10456	2.300	0.900
EPDM	0.250	0.900
Fibrocemento Fiber cement	1.200	0.900
Ground Erdreich	2.000	0.900
Gypsum board with cellulose fibres	0.669	0.900
Insulation 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 PU-Ortschaum 040	0.040	0.900
Panel Maske	0.035	0.900
Softwood, OSB Weichholz, OSB ISO 10456	0.130	0.900
Wood 0.16 W/(mK)	0.160	0.900
XPS 036	0.036	0.900

$\lambda [\text{W/(m} \cdot \text{K)}]$

ϵ

160.000	0.900
2.300	0.900
0.250	0.900
1.200	0.900
2.000	0.900
0.669	0.900
0.050	0.900
1.556	0.900
2.500	0.900
3.750	0.900
0.040	0.900
0.035	0.900
0.130	0.900
0.160	0.900
0.036	0.900

Boundary Condition

Adiabatic Adiatat	
Exterior Außen	
Int. flux down Innen abwärts	
Interior, frame, normal	
Interior, frame, reduced	

$q [\text{W/m}^2]$ $\theta [^{\circ}\text{C}]$ $R [(\text{m}^2 \cdot \text{K})/\text{W}]$ ϵ

0.000	-10.000	0.040
	20.000	0.170
	20.000	0.130
	20.000	0.200

Boundary Condition

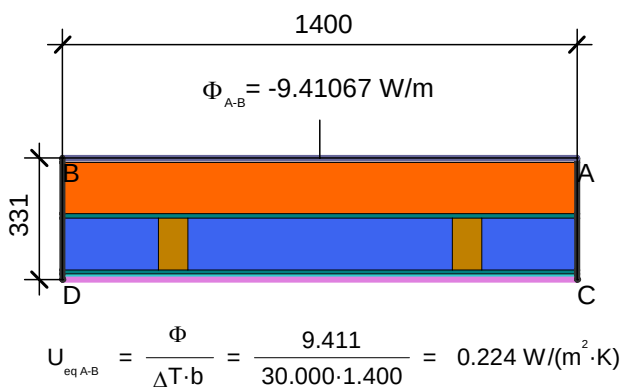
Adiabatic | Adiatat

Exterior | Außen

fRsi: Interior | Innen

$q [\text{W/m}^2]$ $\theta [^{\circ}\text{C}]$ $R [(\text{m}^2 \cdot \text{K})/\text{W}]$ ϵ

0.000	-10.000	0.040
	20.000	0.250



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





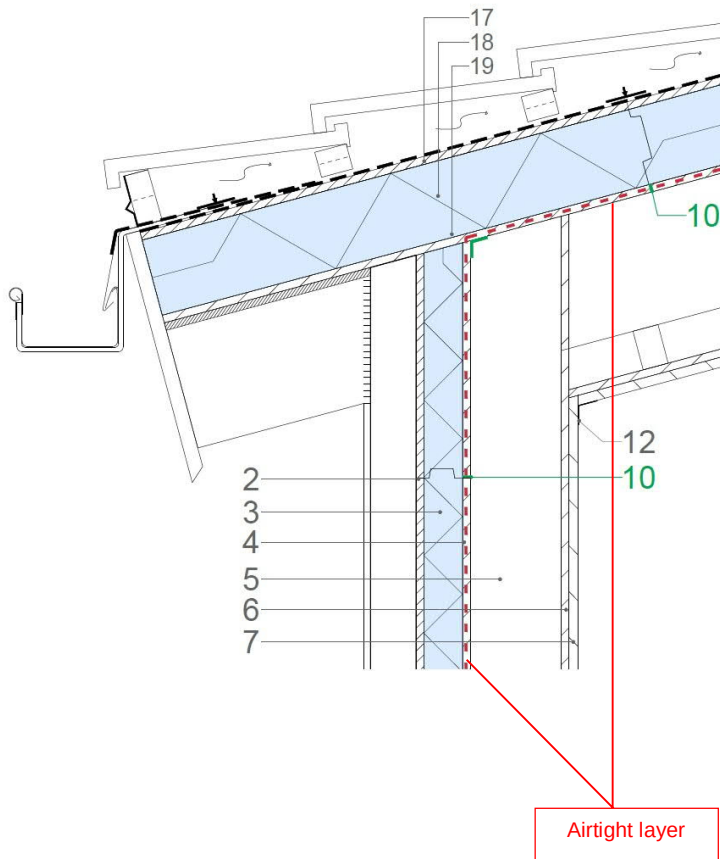
Appendix 3: Manufacturers drawings | Zeichnungen des Herstellers

Passive House Institute



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

Design drawing – Vertical cross-section



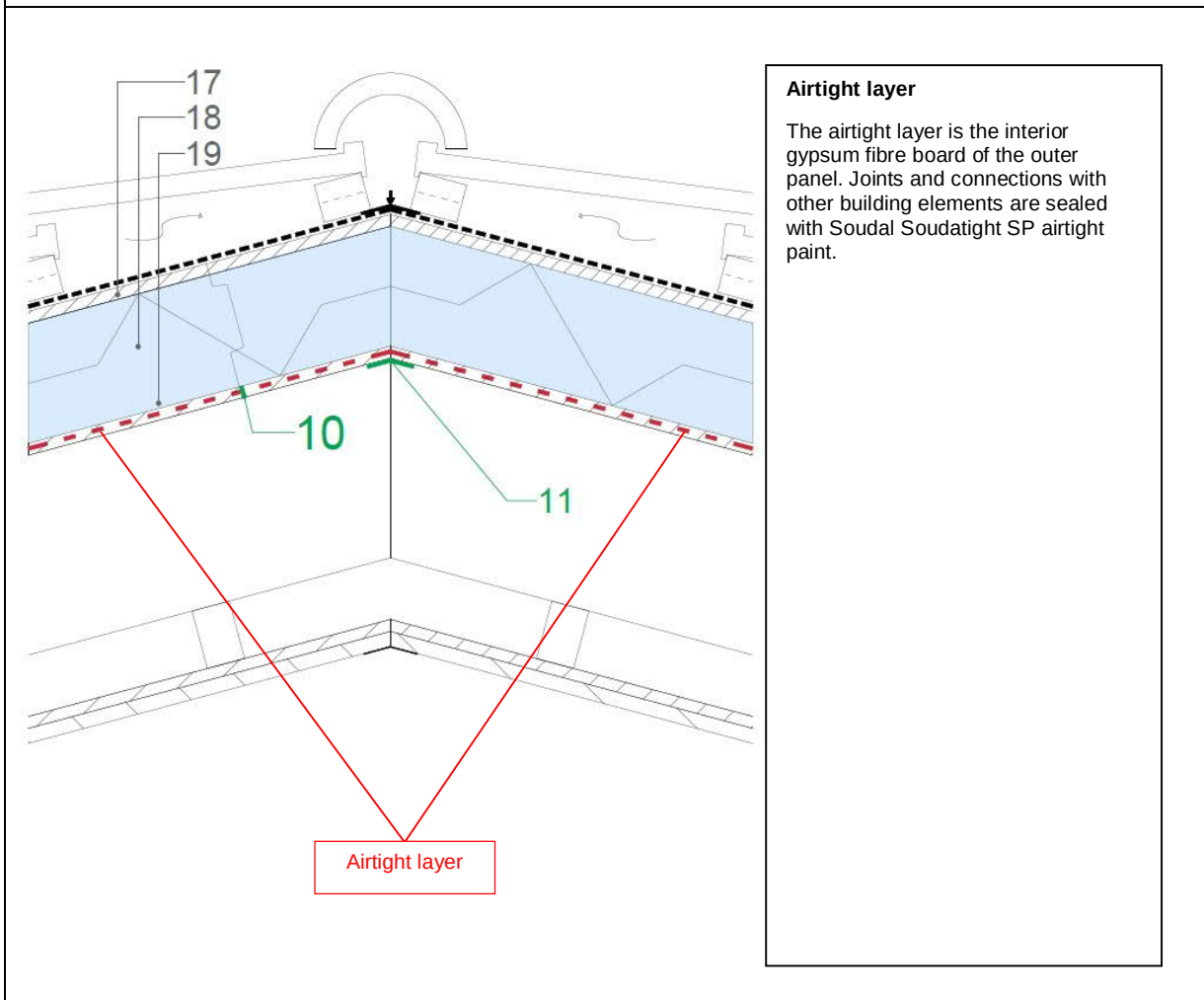
Airtight layer

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				From the inside towards the outside			
		λ [W/(mK)]	Thick ness [cm]			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 + steel 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	Abbreviation	THERMOCHIP
Top roof	Detail_SC-02	

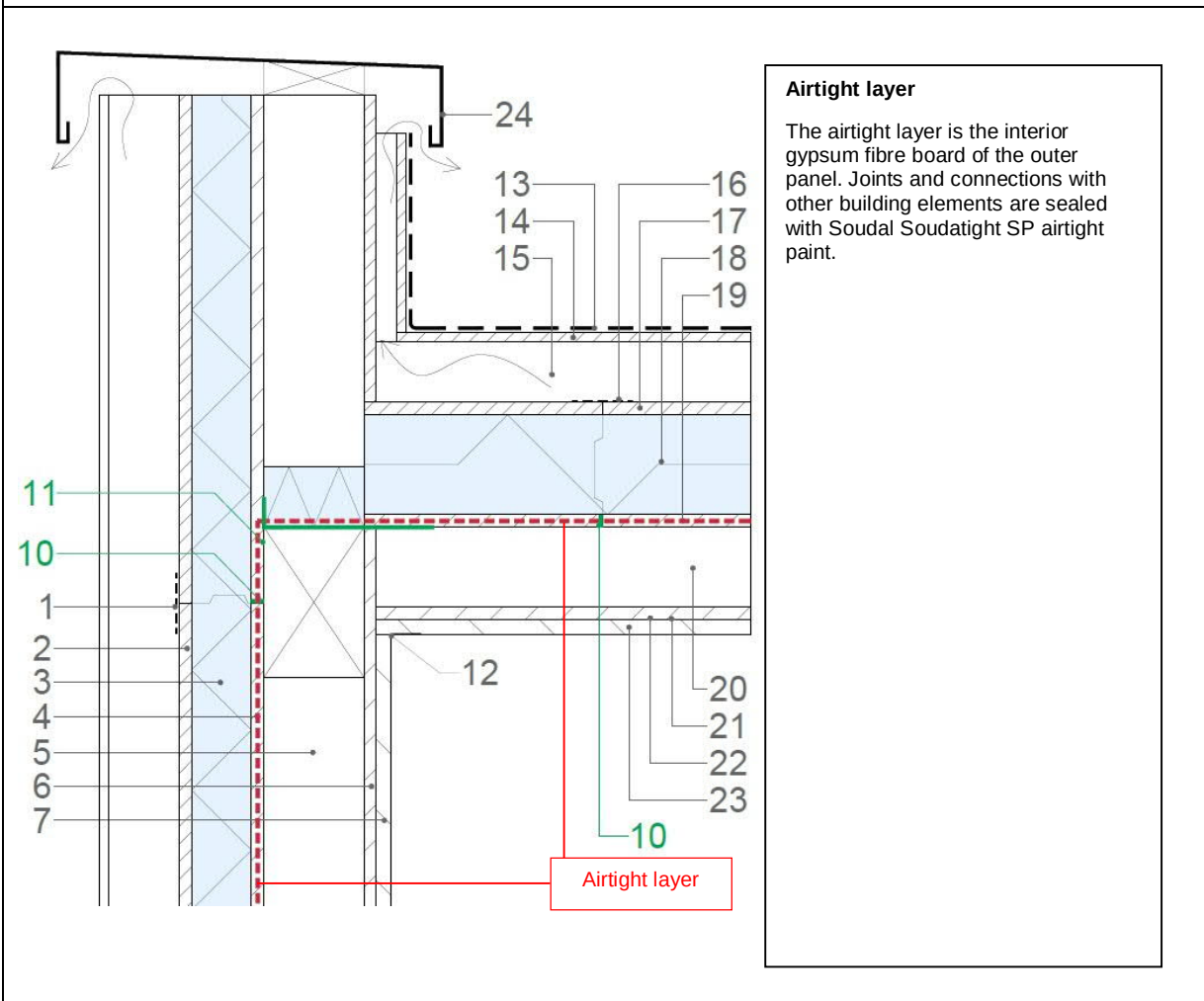
Design drawing – Vertical cross-section



From the inside towards the outside				From the inside towards the outside			
		λ [W/(mK)]	Thick ness [cm]			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	Soudal Soudatight SP airtight paint						
10	Fermacell Joint Filler + Soudal Soudatight SP airtight paint						

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

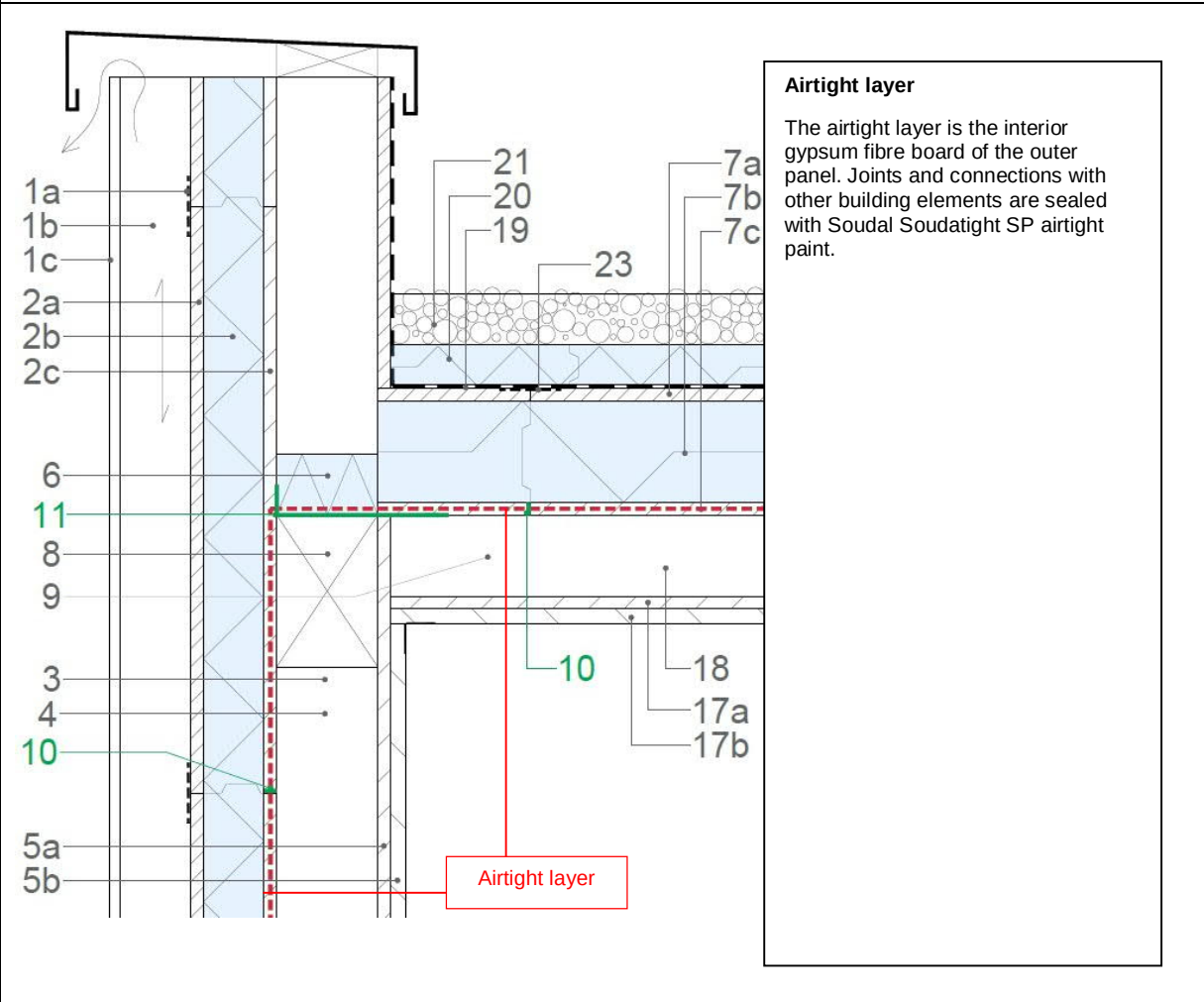
Design drawing – Vertical cross-section



From the inside towards the outside				From the inside towards the outside			
λ [W/(mK)]				λ [W/(mK)]			
Thick ness [cm]				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 + steel 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	Abbreviation	THERMOCHIP
Parapet wall connection to flat roof	Detail_SC-04	

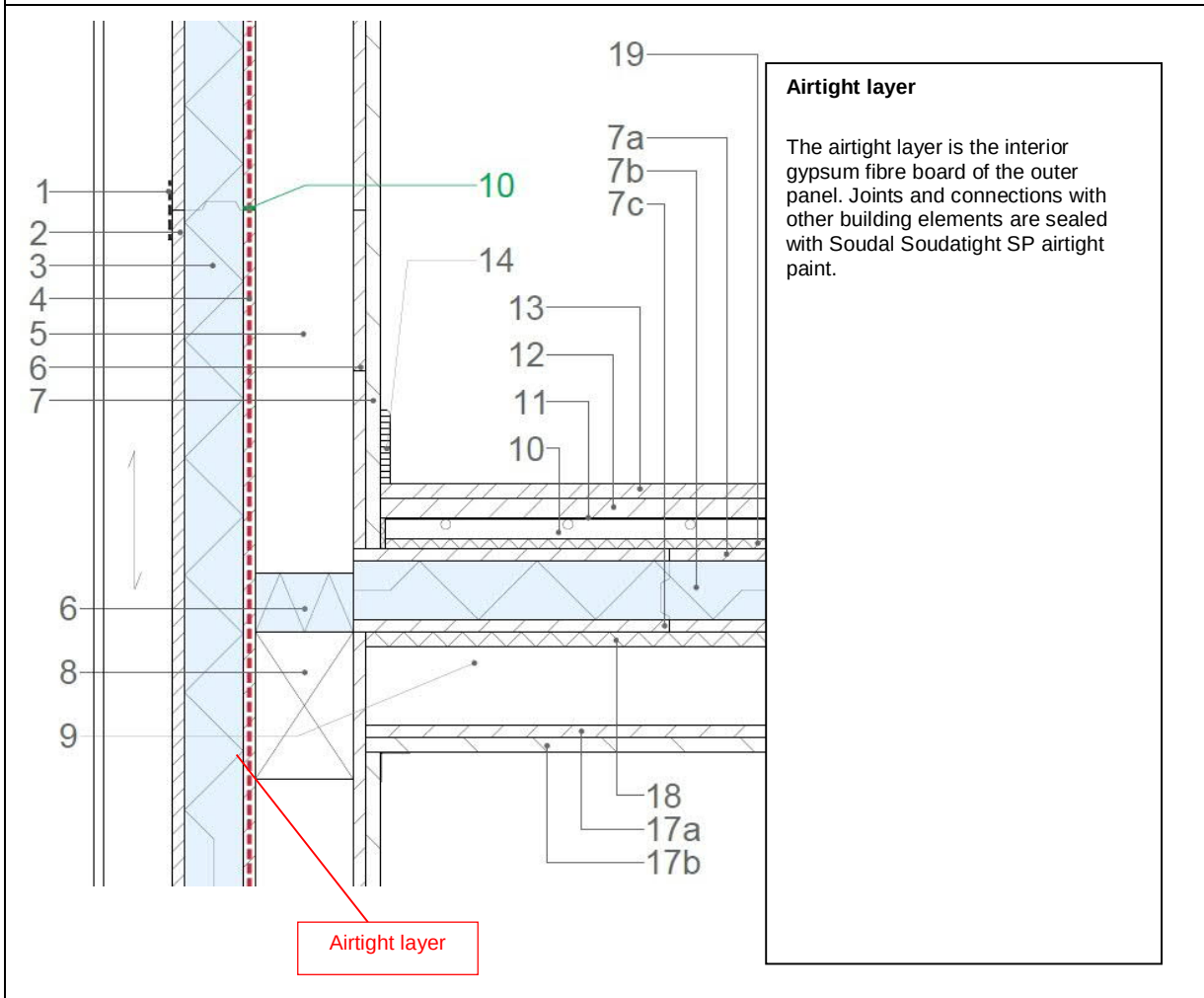
Design drawing – Vertical cross-section



From the inside towards the outside				From the inside towards the outside			
		λ [W/(mK)]	Thick ness [cm]			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 + steel 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	Abbreviation	THERMOCHIP
Parapet wall connection to interior floor	Detail_SC-05	

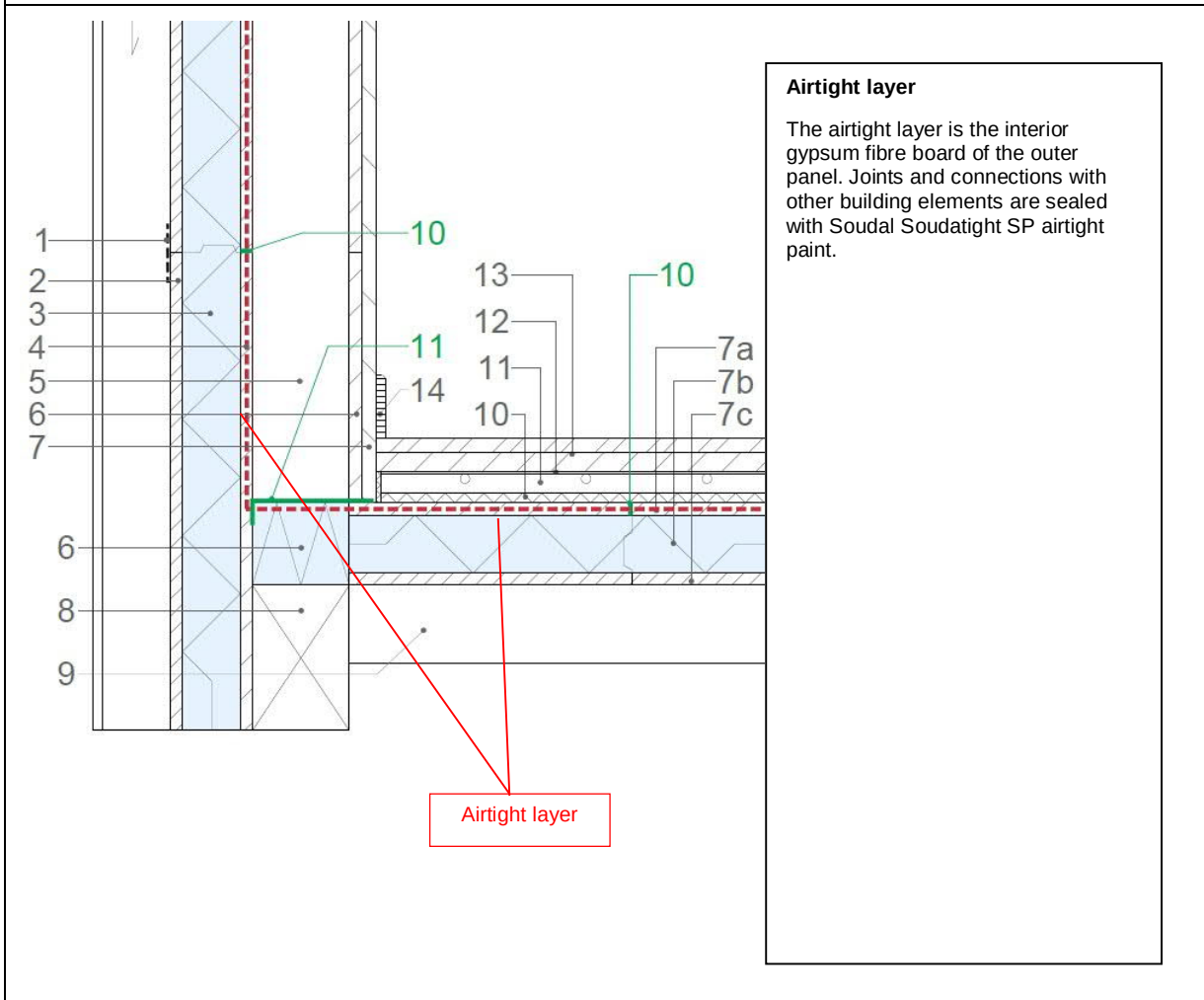
Design drawing – Vertical cross-section



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	Abbreviation	THERMOCHIP
Parapet wall connection to floor slab	Detail_SC-06	

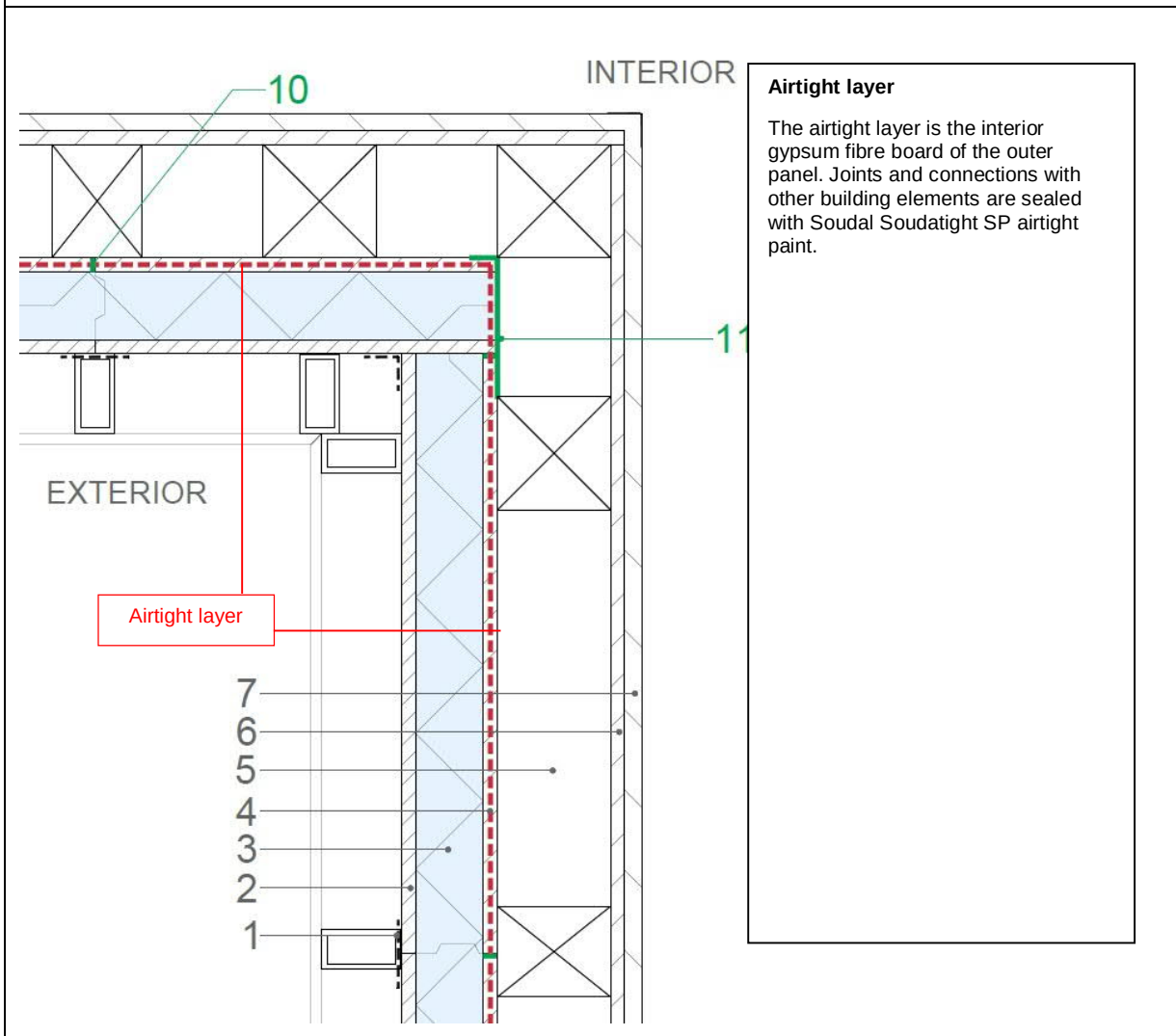
Design drawing – Vertical cross-section



From the inside towards the outside				From the inside towards the outside			
		λ [W/(mK)]	Thick ness [cm]			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	Abbreviation	THERMOCHIP
Interior corner	Detail_SC-07	

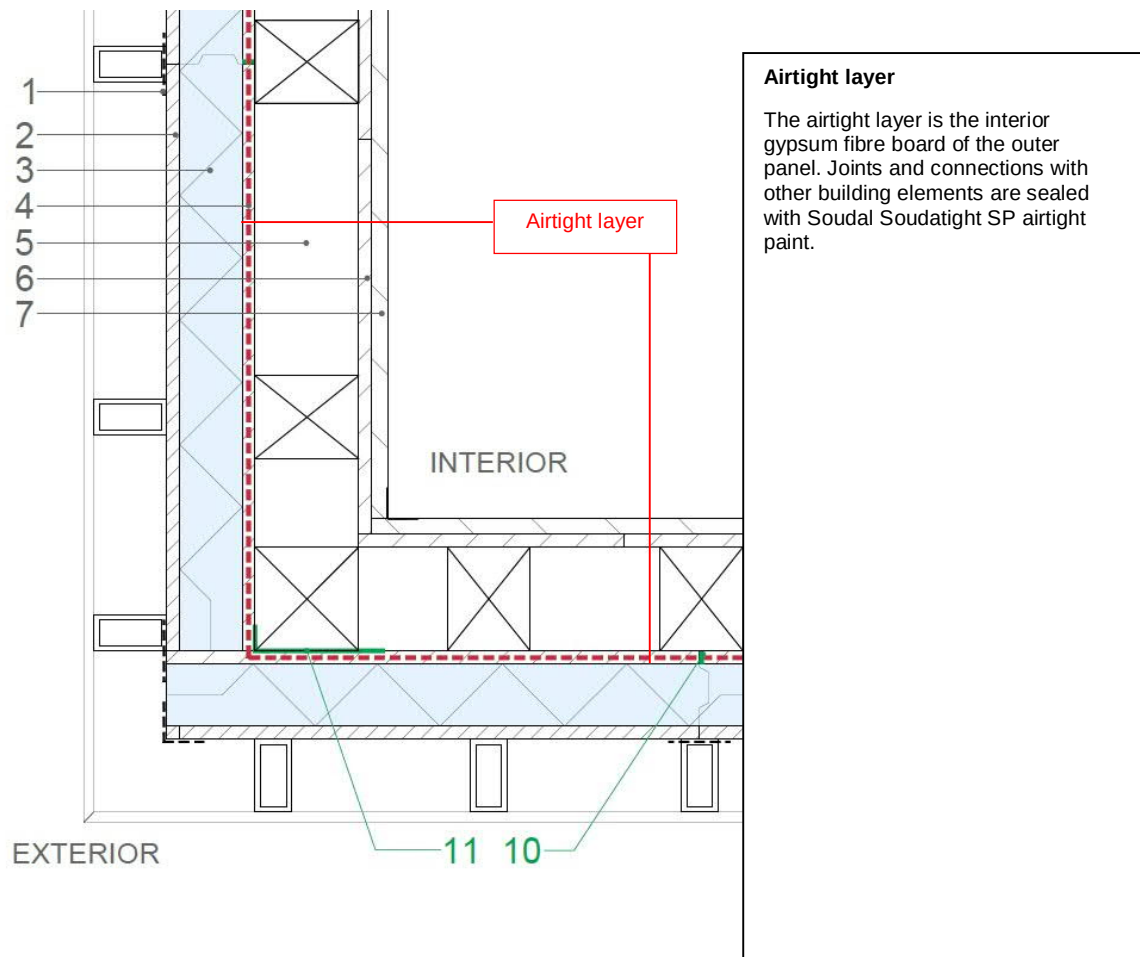
Design drawing – Horizontal cross-section



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	Abbreviation	THERMOCHIP
Exterior corner	Detail_SC-08	

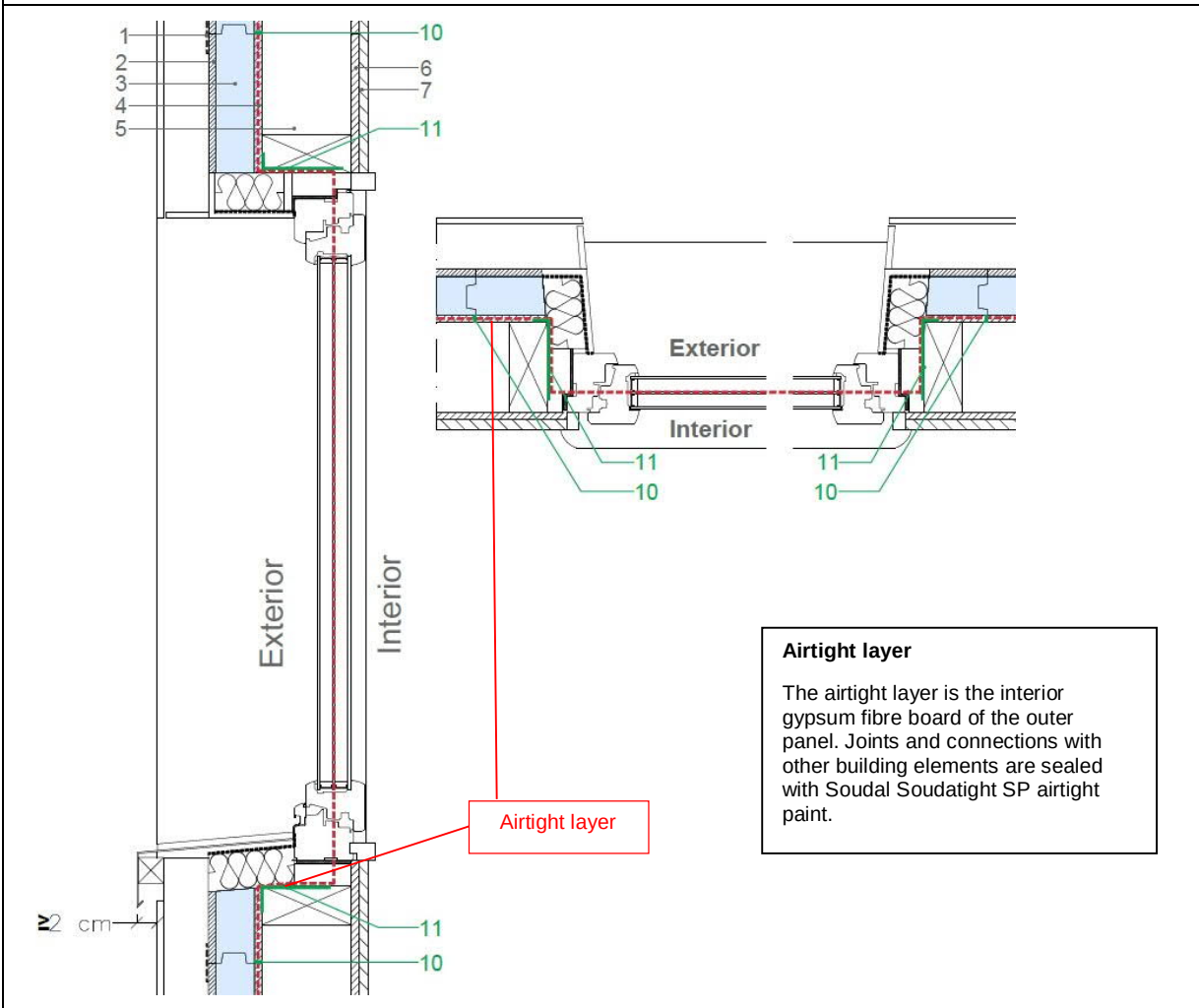
Design drawing – Horizontal cross-section



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 +								
p	Soudal Soudatight SP airtight paint								

Lightweight timber construction	Abbreviation	THERMOCHIP
Window detail	Detail_SC-09	

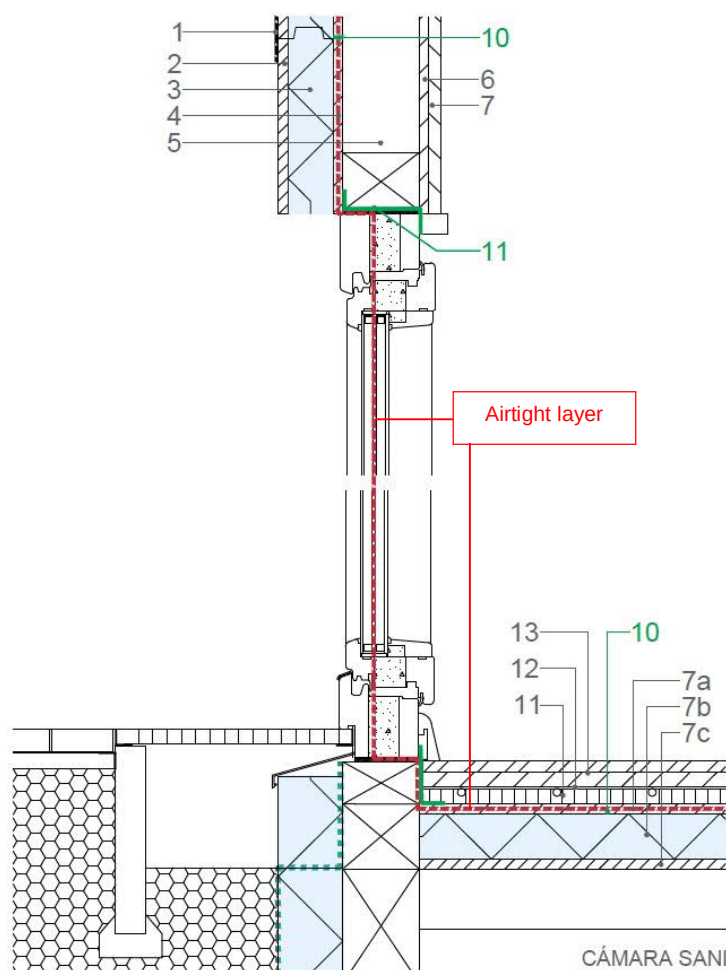
Design drawing – Horizontal and vertical cross-section



From the inside towards the outside			From the inside towards the outside		
	λ [W/(mK)]	Thick ness [cm]		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-10	THERMOCHIP
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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	12	Gypsum fibreboard	0.669
8	Gypsum fibreboard	0.669	22	Gypsum fibreboard (Airtight layer)	0.669
5	Air layer + timber studs	0.654	18	XPS (2*80)	0.036
4	Gypsum fibreboard (Airtight layer)	0.669	17	Fibro-cement board	1.200
3	XPS (2*80)	0.036			
2	Fibro-cement board	1.200			
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				

FIBRANxps FABRIC

1. Código de identificación única del producto tipo:

2. Tipo:	FIBRANxps 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.º 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(Y10)*	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 continua		NPD		4.3.12
Índice de absorción acústica		NPD		4.3.10
Permeabilidad al agua- Absorción de agua a largo plazo	por inmersión total por difusión	WL(T) WD(V)	% %	4.3.7.1 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 λ_D			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:
Ovar, 5 de Junio de 2020

Filipe Silva
Producción & Calidad

Este producto no contiene hexabromociclododecano
NPD - Prestación No Determinada