Certification report | Zertifizierungsbericht

Passive House Institute

Building system
Bausystem

for warm, temperate climate

für warm-gemäßigtes Klima

Product I Produkt:	**Structura**
Client I Auftraggeber:	**Hispalyt** Orense 10 28020 Madrid, SPAIN
Construction type Konstruktionsart	**Zweischalige Konstruktion I Cavity Walls**
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Date I Datum:	**01.07.2024**
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1 Introduction | *Einleitung*

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

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

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

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

Table 1: Certification criteria depending on the climate zone

Climate zone	**Hygiene criterion**[8]	**Comfort criterion**	**Efficiency criteria**			**Moisture criteria**[6]	
	$f_{Rsi=0.25\ m^2K/W} \geq$[3]	U-value of the installed window[1] ≤	U-value of the exterior building component $U_{opaque} * f_{R\ PHI}$[2] ≤	Purely opaque details $f_{Rsi=0.25\ m^2K/W} \geq$[3]	Absence of thermal bridges $\Psi_a \leq$[4]	Condensation	Ma limit according to DIN EN ISO 13788 ≤
	[-]	[W/(m²K)]	[W/(m²K)]	[-]	[W/(mK)]	[-]	[g/m²]
1 Arctic	0.80	0.45 (0.35)	0.09	0.90		Condensation should be completely evaporated at the end of 12 months	
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	0.010[5]		200[7]
5 Warm	0.55	1.25 (1.10)	0.50	0.74			
6 Hot	None	1.25 (1.10)	0.50	0.74			
7 Very hot	None	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 1.0, exception: areas in contact with the ground and towards the unheated basement in the climate zones 1 – 4: 1.6; e.g. for climate zone 3 the U-value criterion becomes 0.25 W/(m²K).

3 $f_{Rsi=0.25\ m^2K/W}$ ≥ see certification criteria.

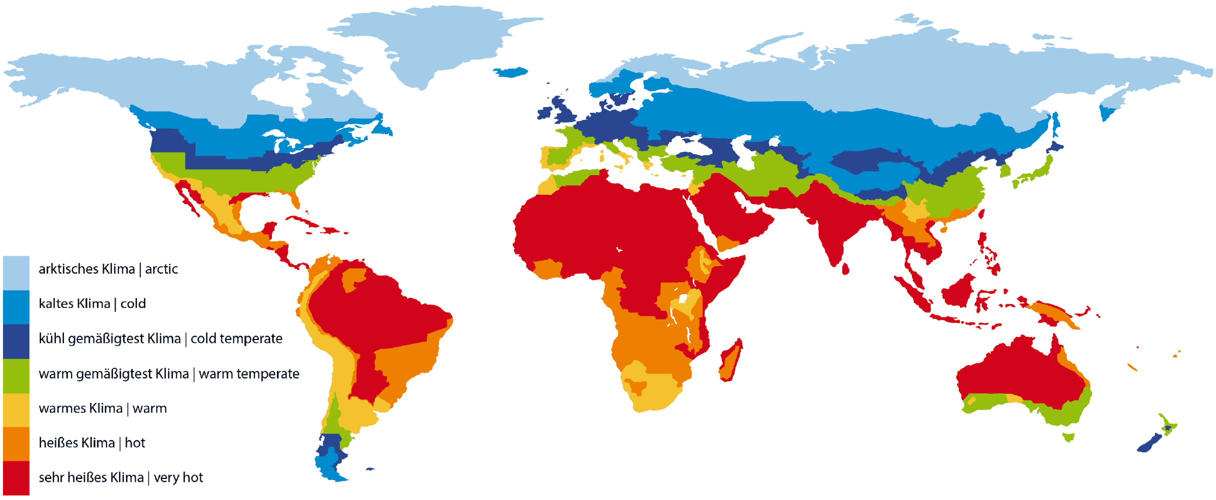
4 as a thermal bridge loss coefficient based on external dimensions and length. Specific constructions such as inner edges are exempted from this criterion.

5 Geometric thermal bridges, where the insulation thickness around the junction is consistent, but the calculation methodology results in a Psi-value of > 0.010 W/(mK), are exempt from this criterion.

6 These criteria are based on the Glaser Method and allow an assessment of the likelihood of the occurrence of interstitial condensation during the winter. This method brings more reliable results for lightweight and airtight components used in cool and non-humid locations away from the equator that do not contain materials with a large water or heat storage capacity. Where the criteria are not met following this approach, a dynamic simulation according to EN 15026 can be carried out to provide greater detail. It is the responsibility of the architect to ensure the appropriate assessments have been carried out for specific buildings, which may include more detailed analyses than those carried out for this certification. In addition on-site measurements like airtightness testing as well as trained tradespeople help to ensure construction quality.

7 The Ma limit (maximum accumulated moisture content) is based on the ISO 13788 and reflects the maximum amount of condensate in order to prevent run-off of liquid water from watertight surfaces. It may make sense in certain cases to calculate a more specific Ma limit according to the materials present in the wall, roof and floor constructions.

8 For door thresholds the dew point criterion applies according to the certification criteria.



2 Description of the certified system

2.1 Opaque building envelope

Structura is a cavity wall system with an interior brick layer consisting of 7 cm Hispalyt double hollow bricks (930 kg/m³; partition 60 mm < E < 90 mm), an insulation layer of 15 cm with mineral wool insulation (0.040 W/(mK)) and an exterior brick layer consisting of Hispalyt 1/2 foot perforated bricks (1020 kg/m³). In the U-value of the wall a steel mesh in the exterior brick layer was considered. For the thermal bridges, connecting anchors in the connection points are taken into account.
The interior wall corner connection does not pass the efficiency criteria due to the geometric effect. The connections of interior walls to the exterior wall as well as the ceiling integration into the exterior wall also do not pass the efficiency criteria. As the main insulation layer is continuous around the details and interior surface temperatures are high enough this is acceptable, however. With this the Passive House Standard can still plausibly be achieved.

2.2 Windows

For the purposes of certification a generic triple-glazed passive house window (U_w = 1.0 W/(m²K) with U_g = 0.90 W/(m²K), featuring phA thermal values for the spacer and a polysulfide secondary seal 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. The calculations undertaken demonstrate that the window installation locations are suited to the warm-temperate climate zone, with no risk of surface condensation or subsequent mold growth.

Mounting of the windows are ensured through the use of a timber support frame around the window. The windows are then screwed into this support frame.

2.3 Airtightness concept

Airtightness is ensured by the interior plaster layer. Connections to interior ceilings, windows, roof and floor slab are to be sealed with airtight tape.

3 Evaluation

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

Summary of the results | *Zusammenfassung der Ergebnisse*

Junctions	U1	U2	Ψ-value Ψ W/(m · K)	Temp. factor $f_{Rsi=0.25}$ [-]
	W/(m² · K)			
ceiling integration 1 (EW1_EW1_CE_1)	0.23	0.23	0.015	0.944
exterior corner (EW1_EW1_ec1)	0.23	0.23	–0.084	0.903
interior corner (EW1_EW1_ic1)	0.23	0.23	0.087	0.936
internal wall integration into exterior wall (EW1_EW1_IW)	0.23	0.23	0.021	0.936
roof parapet 1 (EW1_FR1_rp_1)	0.23	0.25	–0.081	0.892
bottom connection 1 (EW1_OB1_1)	0.23	0.92	0.022	0.798
top connection operable window (EW1_OH1_1)	0.23	0.92	0.009	0.800
side connection operable window 1 (EW1_OJ1_1)	0.23	0.92	0.009	0.800
roof eave (EW1_RO1_ea1)	0.23	0.23	–0.038	0.903
roof verge (EW1_RO1_ve1)	0.23	0.23	–0.058	0.886
wall base to floor slab 1 (FS1_EW1_1)	0.24	0.23	–0.089	0.868
threshold connection to floor slab (FS1_OT1_1)	0.24	0.92	0.003	0.770

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

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

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

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

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

5 Legal information | Rechtliche Hinweise

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

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

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

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

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

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

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

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

Appendix 1: U-value of building assemblies

Anhang 1: Bauteil-U-Werte

2285cs04 – Structura

Acronym	Building assembly description		Interior insulation?
RO1	**Pitched roof (not part of the system)**		

Heat transmission resistance [m²K/W]

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

U-value determined according to PHPP

Material of Layer	λ [W/(mK)]	Description	Thickness [mm]
Interior Plaster	0,57	according to ISO 10456	15
reinforced concrete	2,3	according to ISO 10456	300
mineral wool	0,040	generic value	150
Softwood, OSB	0,13	according to ISO 10456	20

Total **48,5** cm

U-value: 0,235 W/(m²K)

U-value supplement: W/(m²K) | **U-value: 0,235** W/(m²K)

Acronym	Building assembly description		Interior insulation?
FR1	**Flat roof (not part of the system)**		

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

Area section 1	λ [W/(mK)]	Area section 2 (optiona	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Interior Plaster	0,57	according to ISO 10456				15
reinforced concrete	2,3	according to ISO 10456				300
mineral wool	0,040	generic value				150

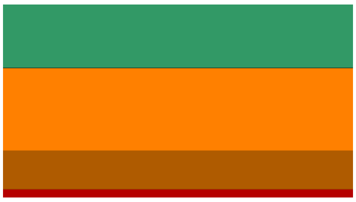
Total **46,5** cm

U-value supplement W/(m²K) | **U-value: 0,247** W/(m²K)

Acronym	Building assembly description	Interior insulation?
EW1	**Exterior wall**	

Heat transmission resistance [m²K/W]

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



U-value determined according to PHPP

Material of Layer	λ [W/(mK)]	Description	Thickness [mm]
Interior Plaster	0,570	according to ISO 10456	15
Hispalyt double hollow brick 930 kg/m³	0,375	partition 60 mm < E < 90 mm; according to Código Técnico de la Edificación (CTE)	70
mineral wool	0,040	generic value	150
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh	0,59596	metric or catalan 60 mm < G 80 mm; according to Código Técnico de la Edificación (CTE)	115

Total: **35,0** cm

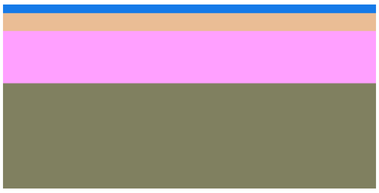
U-value: 0,231 W/(m²K)

U-value supplement W/(m²K) | **U-value: 0,231** W/(m²K)

Acronym	Building assembly description	Interior insulation?
FS1	**Floor slab (not part of the system)**	

Heat transmission resistance [m²K/W]

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



U-value determined according to PHPP

Material of Layer	λ [W/(mK)]	Description	Thickness [mm]
artificial stone	1,3	according to ISO 10456	25
cement screed	1,4	according to DIN 4108-4	50
XPS insulation	0,040	generic value	150
reinforced concrete	2,3	according to ISO 10456	300

Total: **52,5** cm

U-value: 0,244 W/(m²K)

U-value supplement W/(m²K) | **U-value: 0,244** W/(m²K)

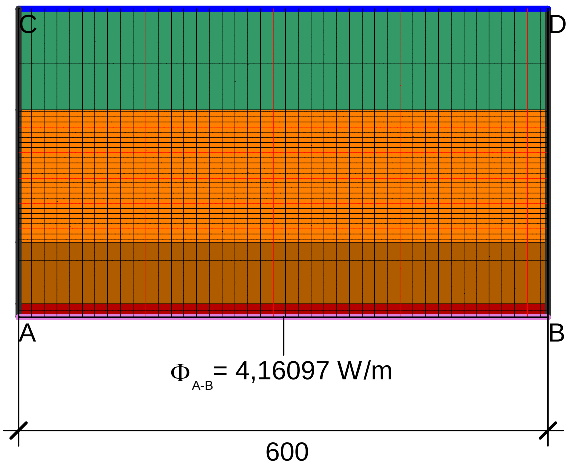
Appendix 2: Thermal simulations | Wärmestromsimulationen

Passive House Institute

Wall, roof, ground | Wand, Dach, Boden
Windows | Fenster

Wall, roof, ground | Wand, Dach, Boden

EW1

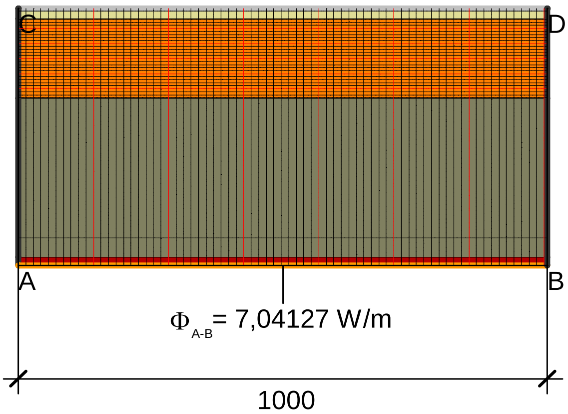


Randbedingung	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior | Innen		20,000	0,130

$$U_{eq\,A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4,161}{30,000 \cdot 0,600} = 0,231\ W/(m^2 \cdot K)$$

Material	$\lambda[W/(m \cdot K)]$	ε
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596	0,900
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375	0,900
Insulation I Wärmedämmung 040	0,040	0,900
Interior plaster I Gipsputz 10456	0,570	0,900

RO1

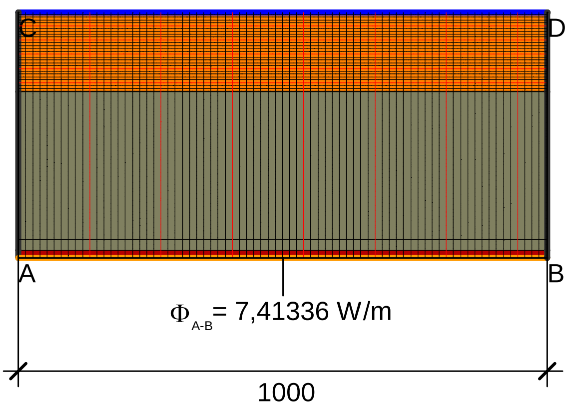


Material	$\lambda[W/(m \cdot K)]$	ε
Concrete, 1% Steel I Beton, 1% Stahl 10456	2,300	0,900
Insulation I Wärmedämmung 040	0,040	0,900
Interior plaster I Gipsputz 10456	0,570	0,900
Softwood, OSB I Weichholz, OSB 10456	0,130	0,900

Randbedingung	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$
Adiabatic | Adiabat	0,000		
Exterior roof | Außen Dach		-10,000	0,100
Interior up. | Innen auf.		20,000	0,100

$$U_{eq\,A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{7,041}{30,000 \cdot 1,000} = 0,235\ W/(m^2 \cdot K)$$

FR1

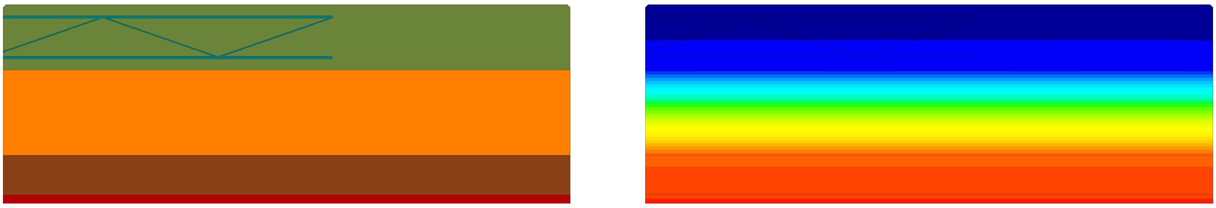


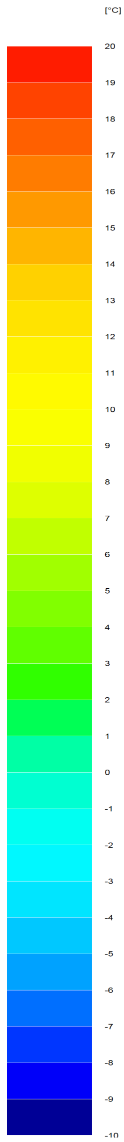
Material	$\lambda[W/(m \cdot K)]$	ε
Concrete, 1% Steel I Beton, 1% Stahl 10456	2,300	0,900
Insulation I Wärmedämmung 040	0,040	0,900
Interior plaster I Gipsputz 10456	0,570	0,900

Randbedingung	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior up. | Innen auf.		20,000	0,100

$$U_{eq\,A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{7,413}{30,000 \cdot 1,000} = 0,247\ W/(m^2 \cdot K)$$

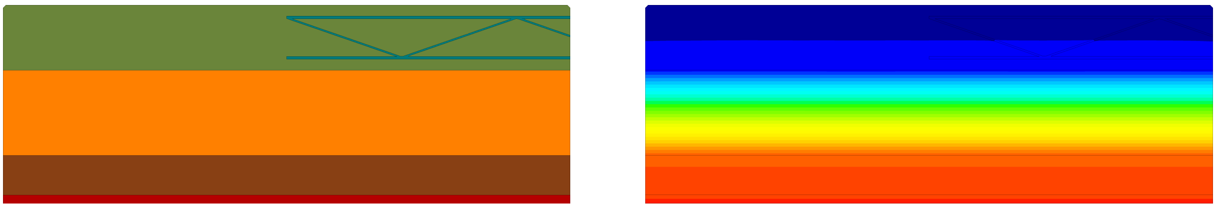
Calculation of equivalent thermal conducitivity of the exterior brick layer including the steel mesh





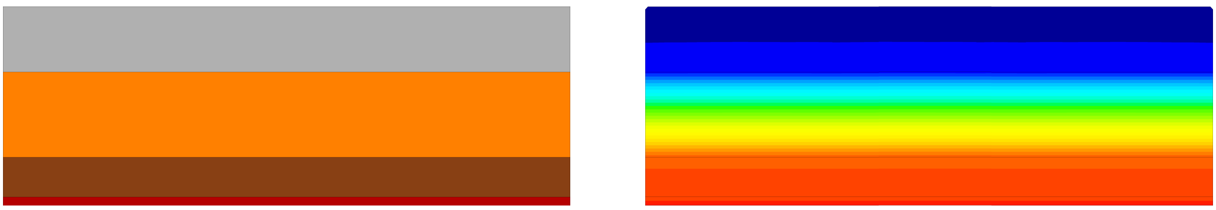
Model 1 – cut 1: 3D-model with horizontal cut through the steel mesh on the left

Φ_1 = 6,937 W/K



Model 1 – cut 2: 3D-model with horizontal cut through the steel mesh on the right

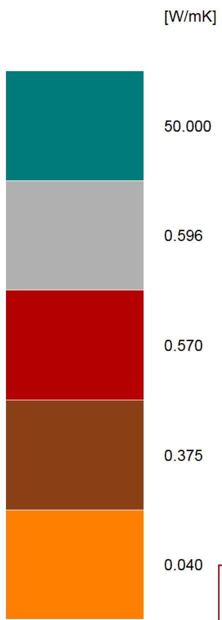
Φ_1 = 6,937 W/K



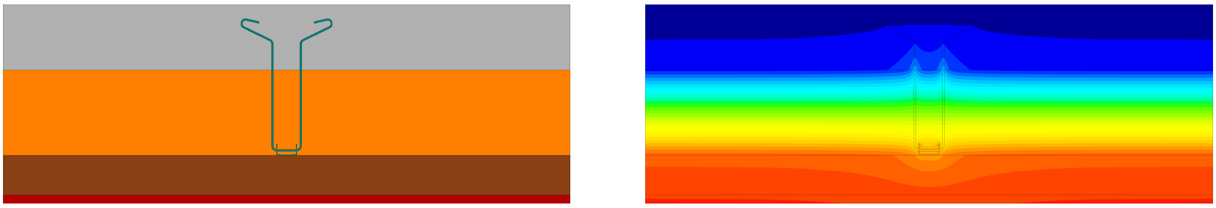
Model 2: 3D-model of the wall assembly with the equivalent thermal conductivity for the exterior brick layer

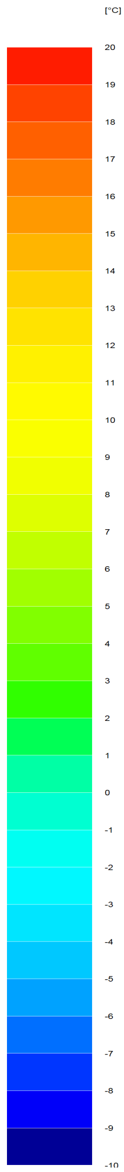
Φ_2 = 6,937 W/K

Thermal conductivity of the exterior brick layer in the eqivalent model is iterated until the resulting heat flow is exactly the same.



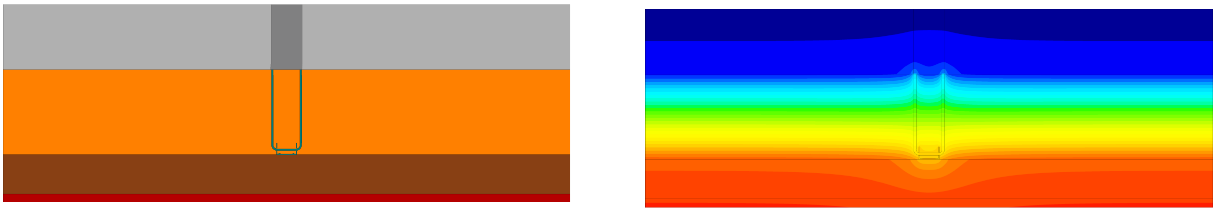
Calculation of equivalent thermal conducitivity of the exterior brick layer including the steel mesh





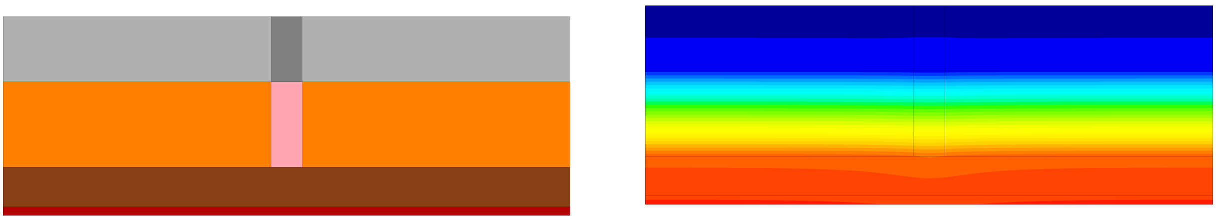
Model 3: 3D-model with horizontal cut through the brick connecting anchor

Φ3 = 4,338 W/K



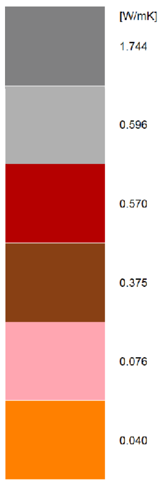
Model 4: 3D-model with horizontal cut through the brick connecting anchor and one part of the equivalent block

Φ4 = 4,338 W/K

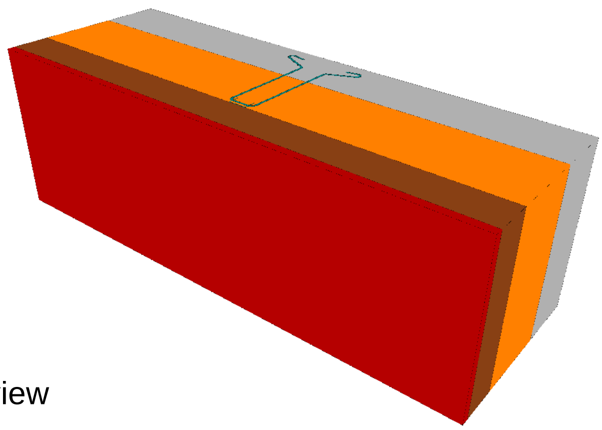


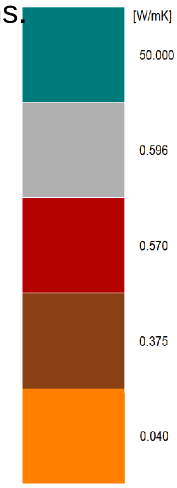
Model 5: 3D-model with equivalent thermal conductivities for the respective area of the brick connecting anchors
The width of this area is 55 mm.

Φ5 = 4,338 W/K

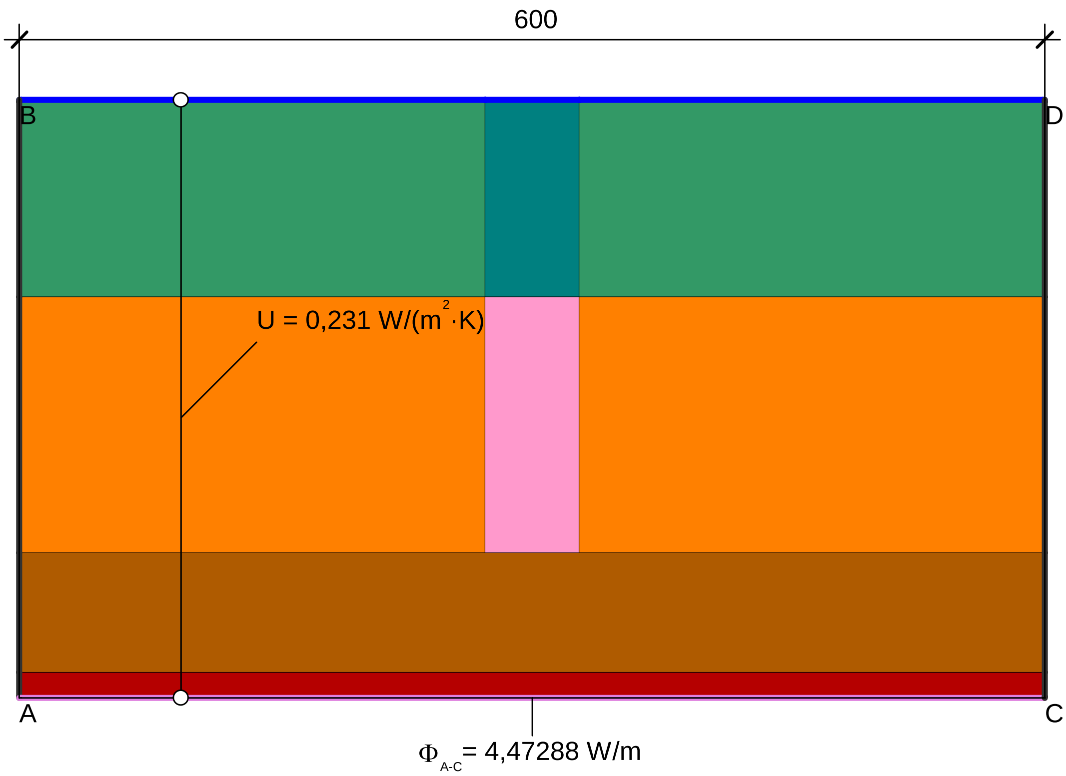


All model are simulated with an heat transfer resistance of 0,13 m²K/W for the inside surface and 0,04 m²K/W for the outside surface. The inside temperature is 20 °C and outside temperature -10 °C according to the 2D-simulations.





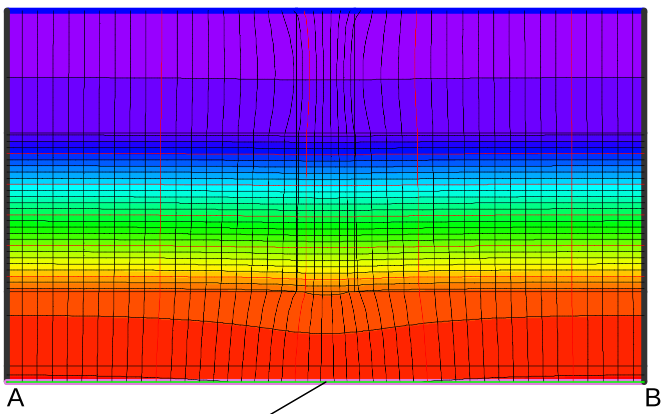
Model 3: 3D-view

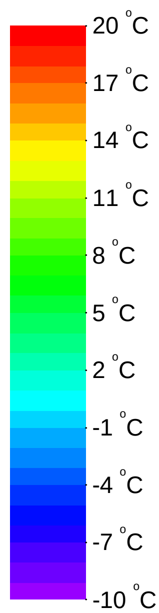


$$\psi_{A\text{-}C} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 = \frac{4,473}{30,000} - 0,231 \cdot 0,600 = 0,010\ W/(m \cdot K)$$

Material	λ[W/(m·K)]
EQ_EW1 insulation 040 & anchors @ 60 cm	0,076
EQ_EW1 perforated brick & steel mesh & anchors @ 60 cm	1,744
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570

Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior | Innen		20,000	0,130

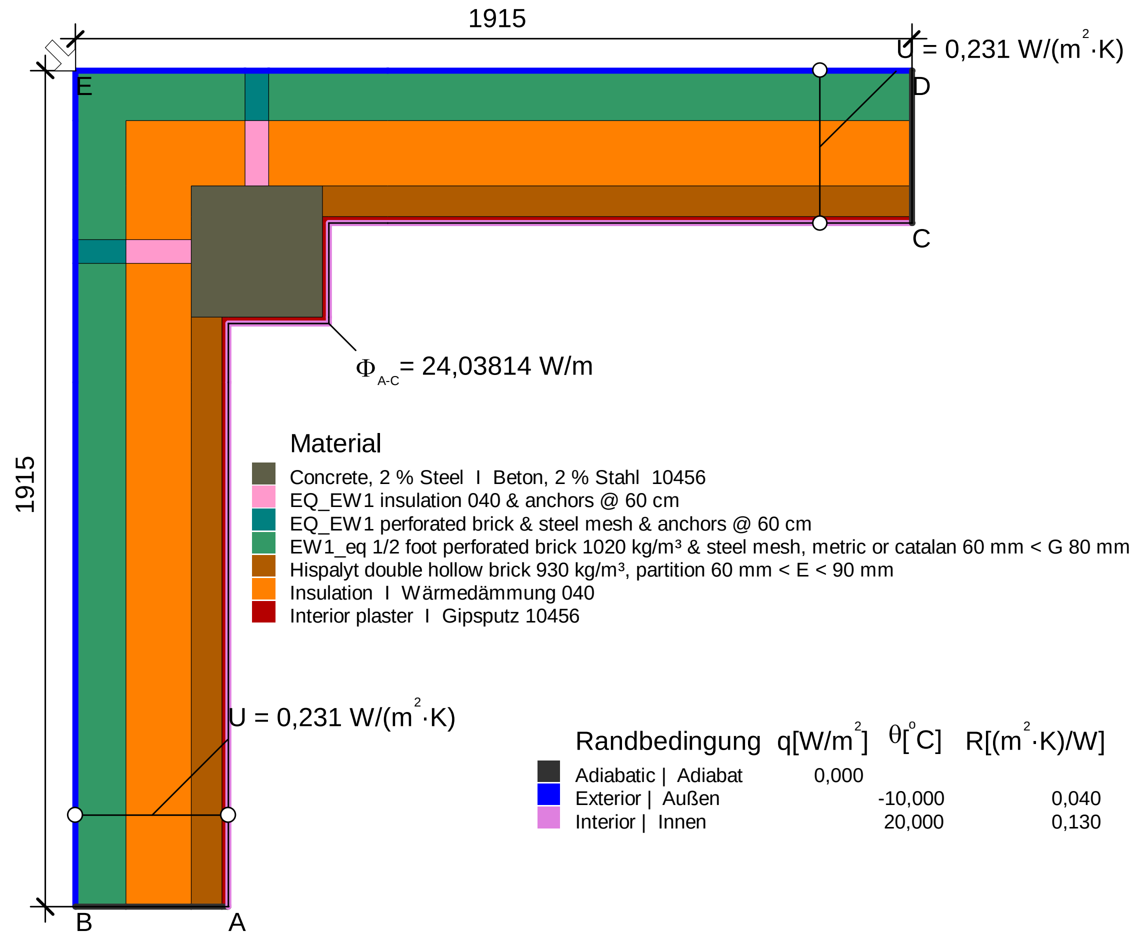




$\theta si\ min_{A\text{-}B} = 18,94\ °C$

$f_{Rsi} = 0,965$

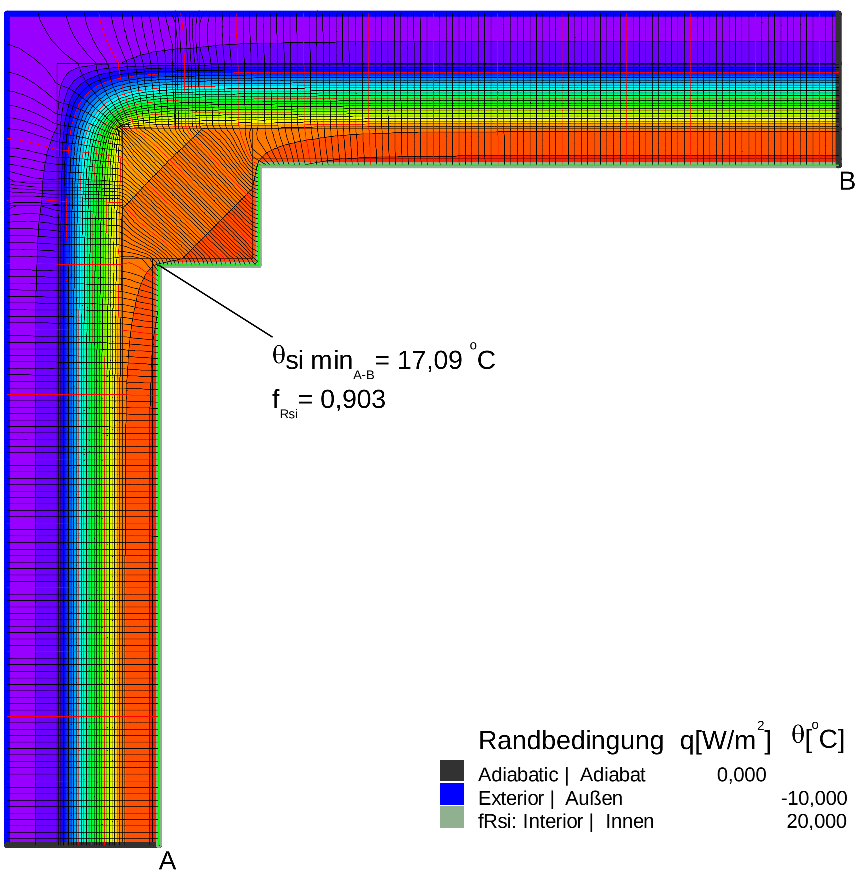
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior | Innen		20,000	0,130

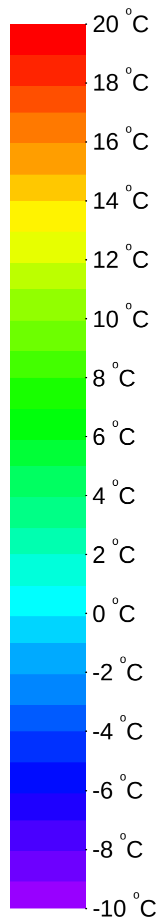


Material	λ[W/(m·K)]
Concrete, 2 % Steel I Beton, 2 % Stahl 10456	2,500
EQ_EW1 insulation 040 & anchors @ 60 cm	0,076
EQ_EW1 perforated brick & steel mesh & anchors @ 60 cm	1,744
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570

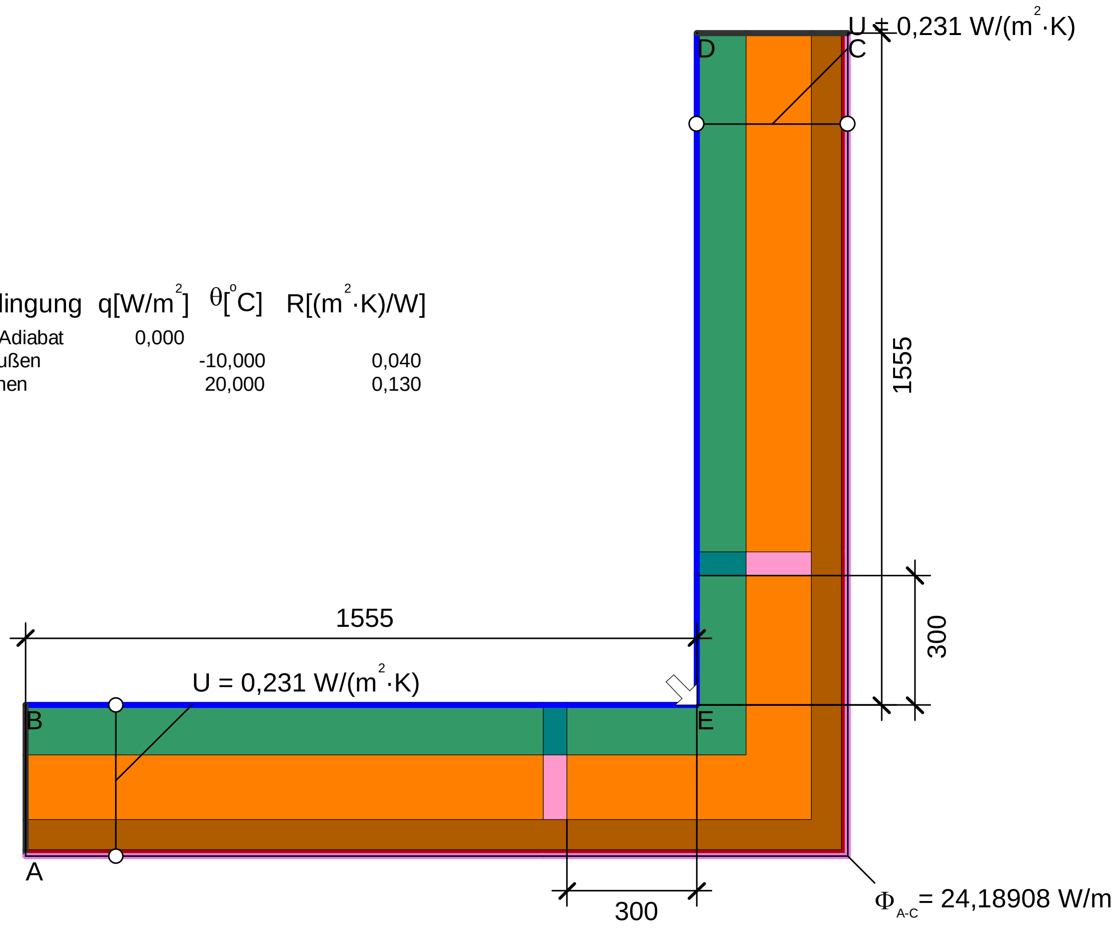
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior | Innen		20,000	0,130

$$\psi_{A\text{-}E\text{-}C} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{24{,}038}{30{,}000} - 0{,}231 \cdot 1{,}915 - 0{,}231 \cdot 1{,}915 = -0{,}084 \text{ W/(m·K)}$$



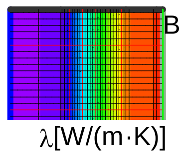


Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250



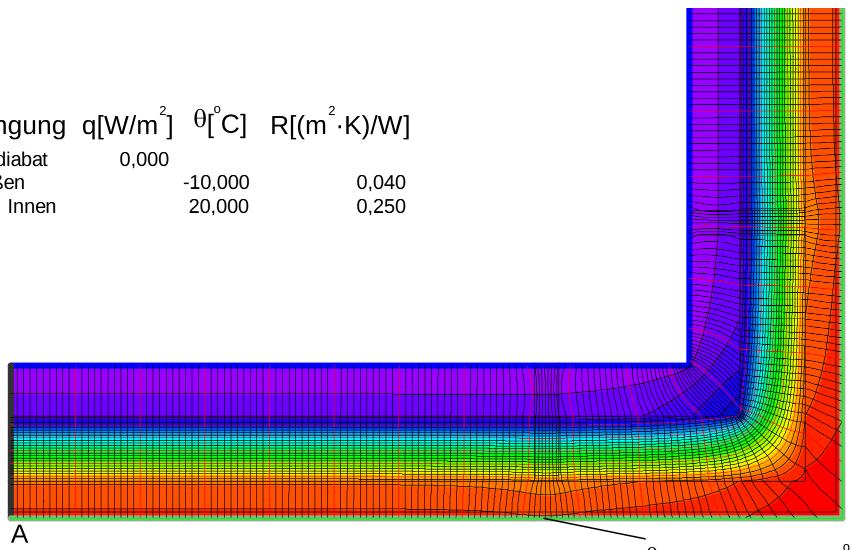
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior | Innen		20,000	0,130

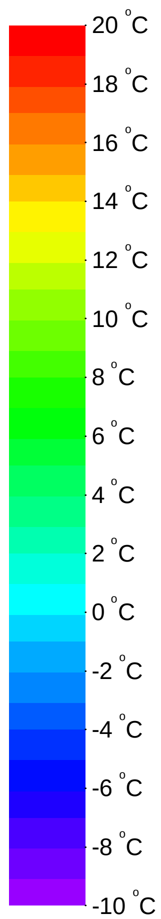
$$\psi_{A\text{-}E\text{-}C} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{24{,}189}{30{,}000} - 0{,}231 \cdot 1{,}555 - 0{,}231 \cdot 1{,}555 = 0{,}087 \text{ W/(m·K)}$$



Material	λ[W/(m·K)]
EQ_EW1 insulation 040 & anchors @ 60 cm	0,076
EQ_EW1 perforated brick & steel mesh & anchors @ 60 cm	1,744
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570

Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250

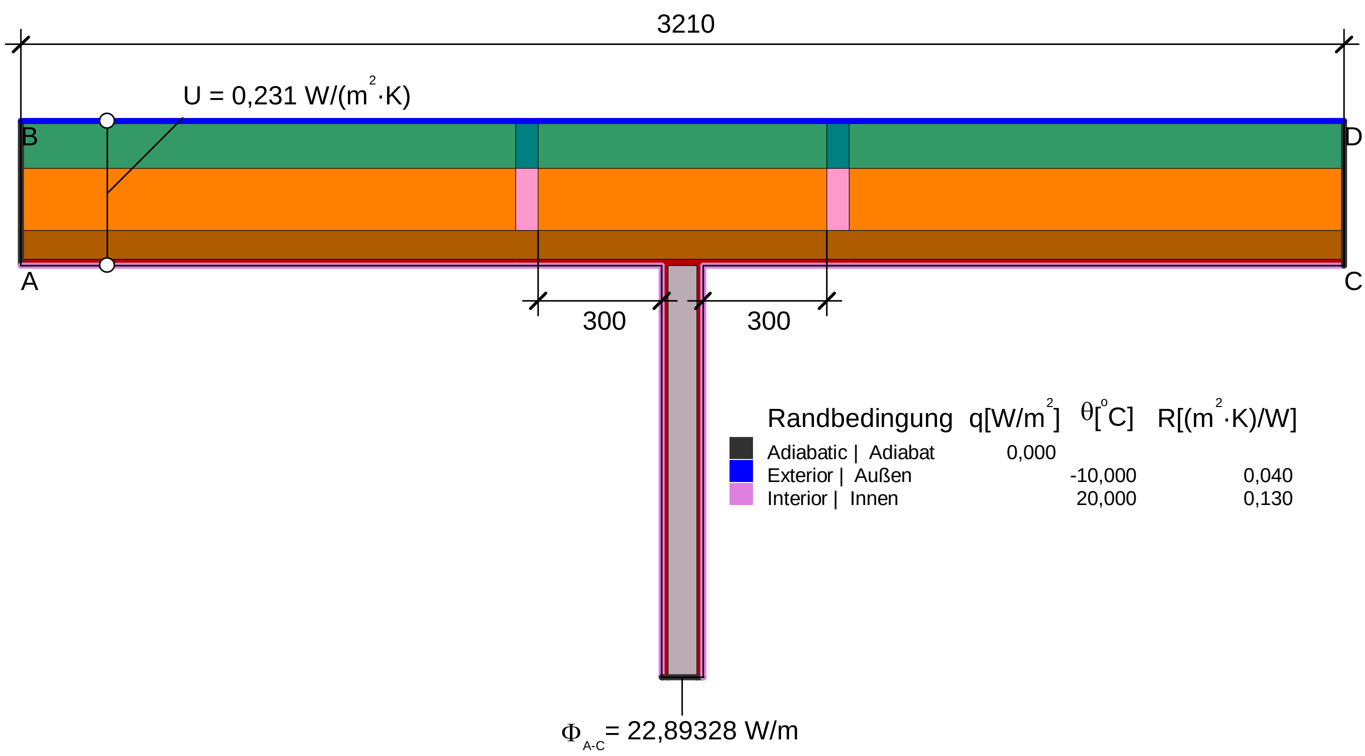




$\theta_{si\ min\ A\text{-}B}$ = 18,08 °C

f_{Rsi} = 0,936

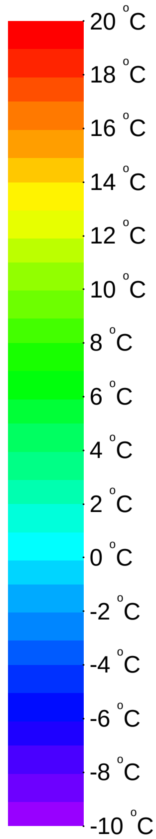
EW1_EW1_ic1: WALL INTERIOR CORNER | WAND INNENECKE

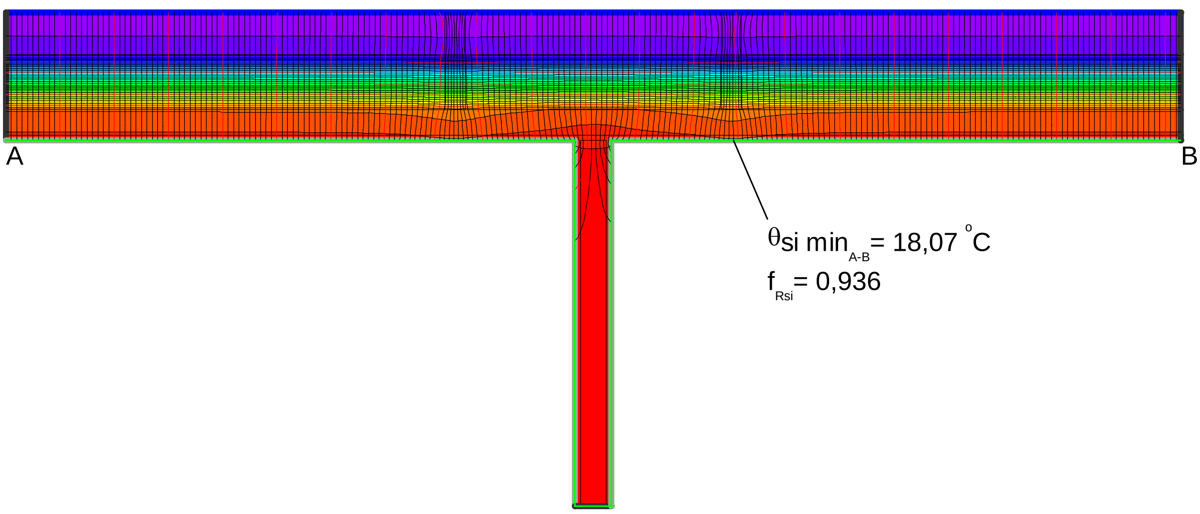


Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior | Innen		20,000	0,130

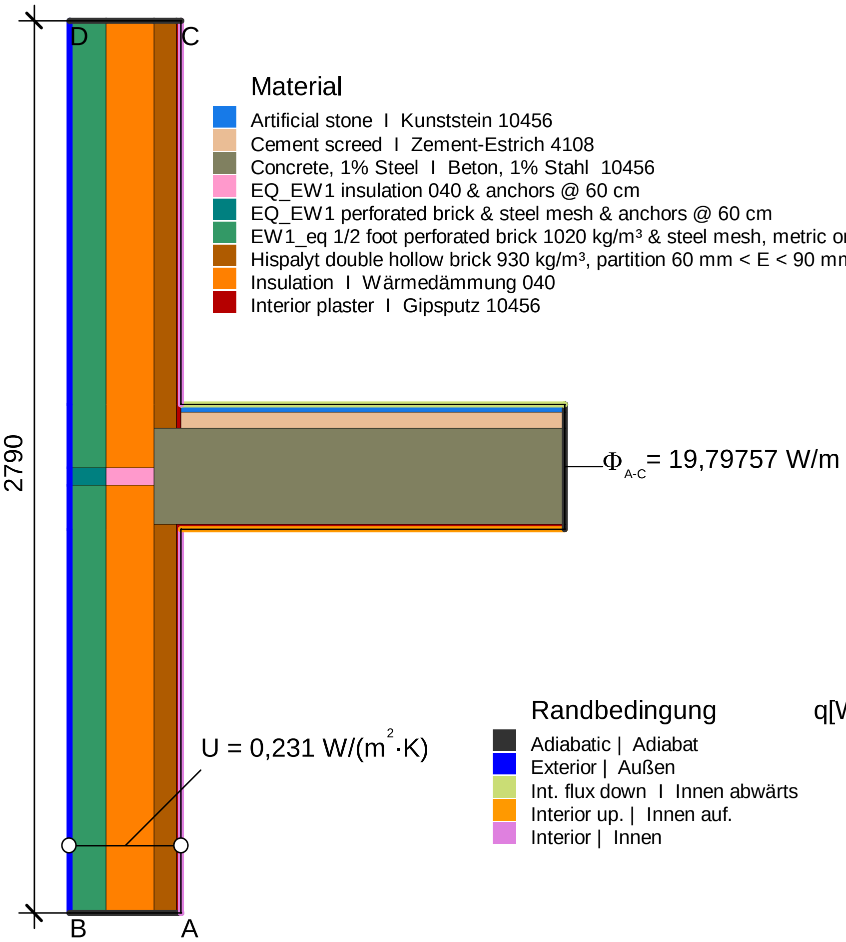
$$\psi_{A-C} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 = \frac{22,893}{30,000} - 0,231 \cdot 3,210 = 0,021 \text{ W/(m·K)}$$

Material	λ[W/(m·K)]
EQ_EW1 insulation 040 & anchors @ 60 cm	0,076
EQ_EW1 perforated brick & steel mesh & anchors @ 60 cm	1,744
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570
Sand-lime stone I Kalksandstein 1745	1,000





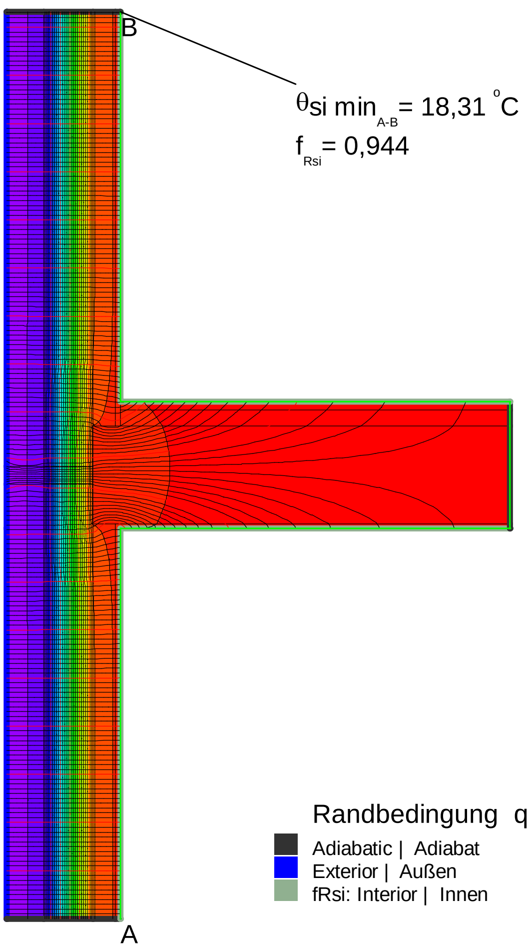
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250

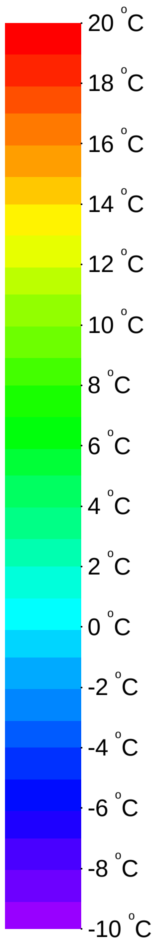


Material	λ[W/(m·K)]
Artificial stone I Kunststein 10456	1,300
Cement screed I Zement-Estrich 4108	1,400
Concrete, 1% Steel I Beton, 1% Stahl 10456	2,300
EQ_EW1 insulation 040 & anchors @ 60 cm	0,076
EQ_EW1 perforated brick & steel mesh & anchors @ 60 cm	1,744
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570

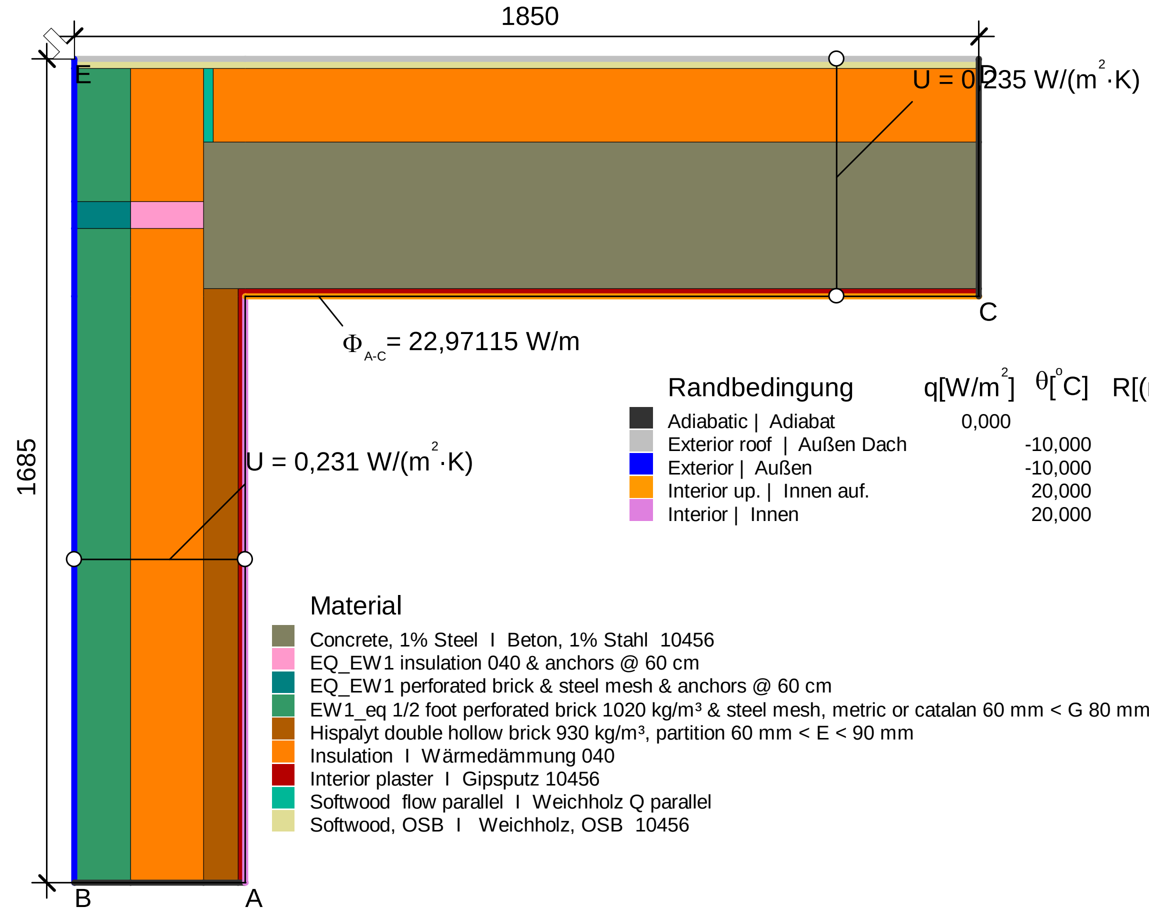
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Int. flux down I Innen abwärts		20,000	0,170
Interior up. | Innen auf.		20,000	0,100
Interior | Innen		20,000	0,130

$$\psi_{A-C} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 = \frac{19,798}{30,000} - 0,231 \cdot 2,790 = 0,015 \text{ W/(m·K)}$$





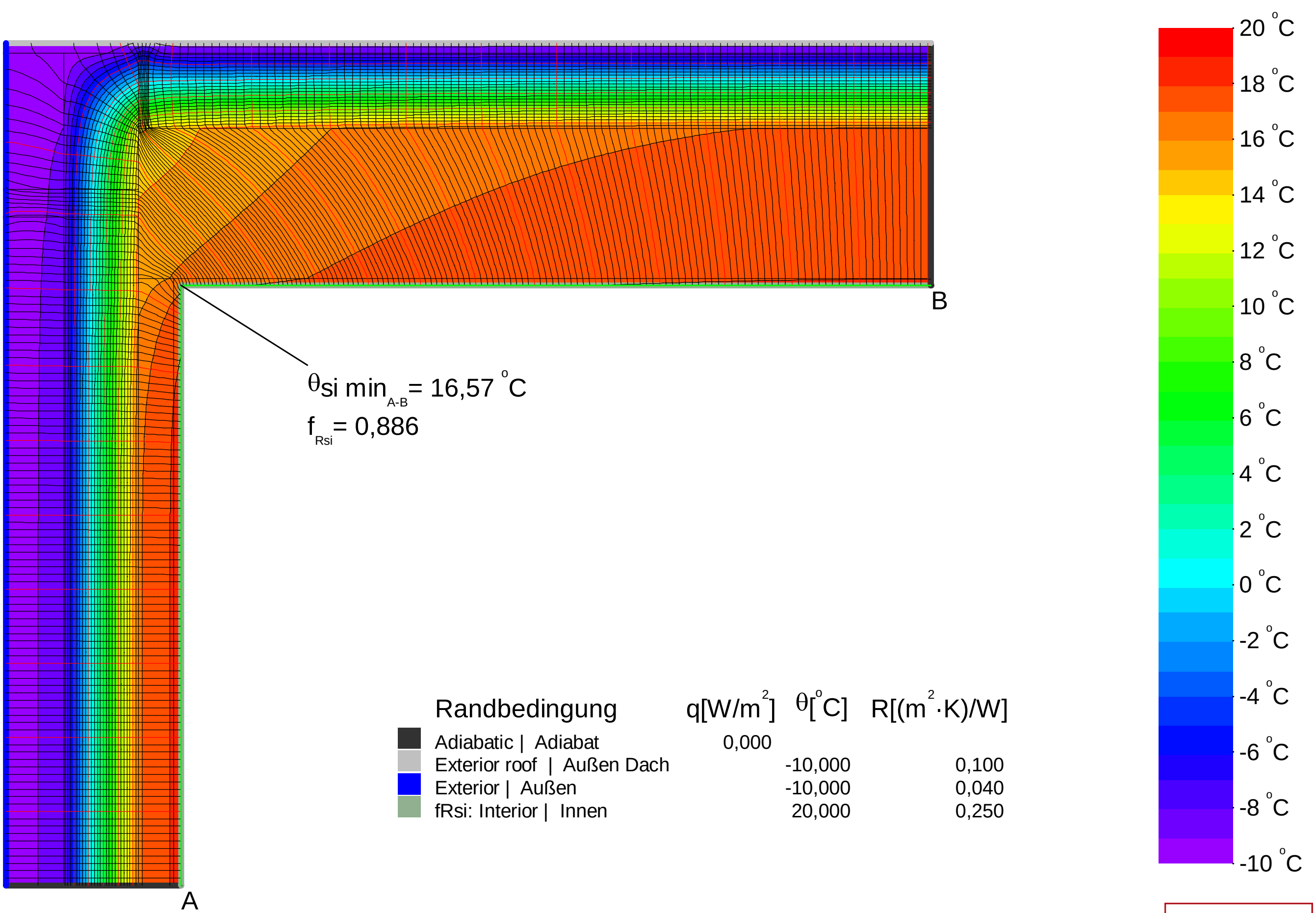
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250



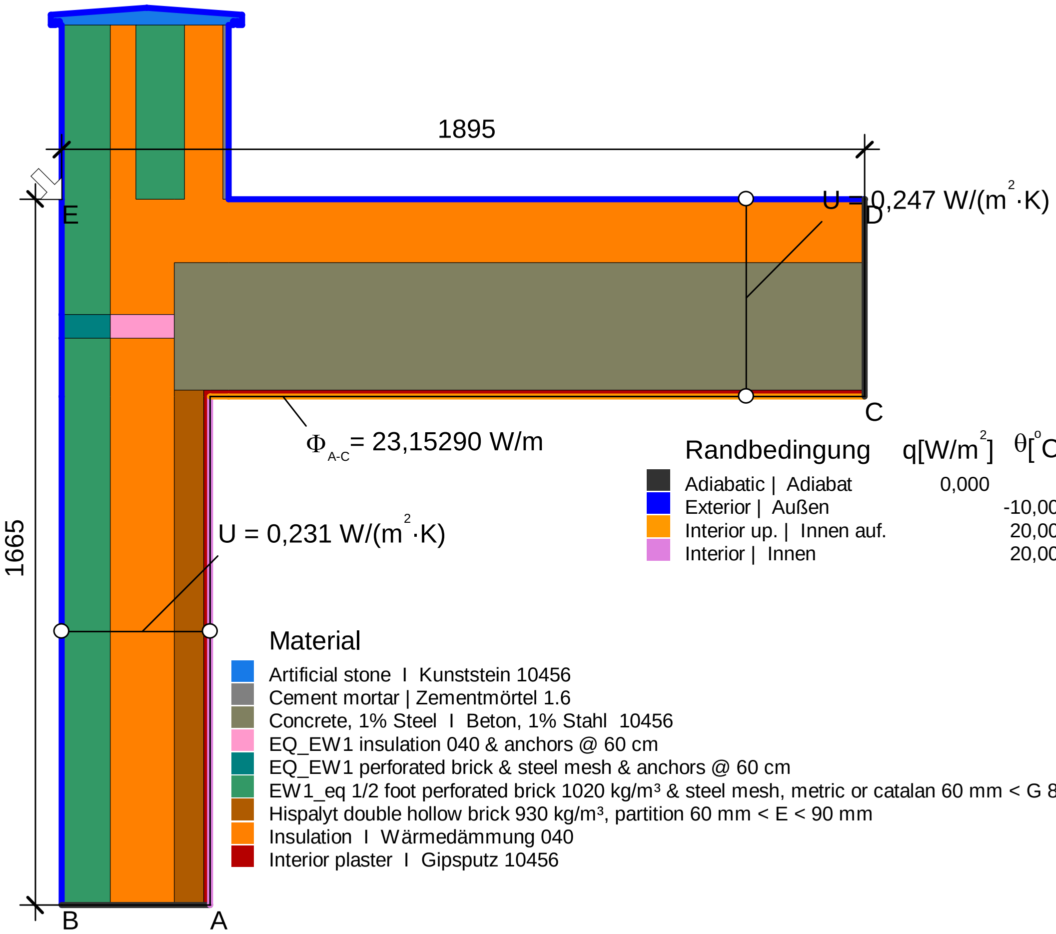
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior roof | Außen Dach		-10,000	0,100
Exterior | Außen		-10,000	0,040
Interior up. | Innen auf.		20,000	0,100
Interior | Innen		20,000	0,130

Material	λ[W/(m·K)]
Concrete, 1% Steel I Beton, 1% Stahl 10456	2,300
EQ_EW1 insulation 040 & anchors @ 60 cm	0,076
EQ_EW1 perforated brick & steel mesh & anchors @ 60 cm	1,744
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570
Softwood flow parallel I Weichholz Q parallel	0,290
Softwood, OSB I Weichholz, OSB 10456	0,130

$$\psi_{A\text{-}E\text{-}C} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{22{,}971}{30{,}000} - 0{,}231 \cdot 1{,}685 - 0{,}235 \cdot 1{,}850 = -0{,}058 \text{ W/(m·K)}$$



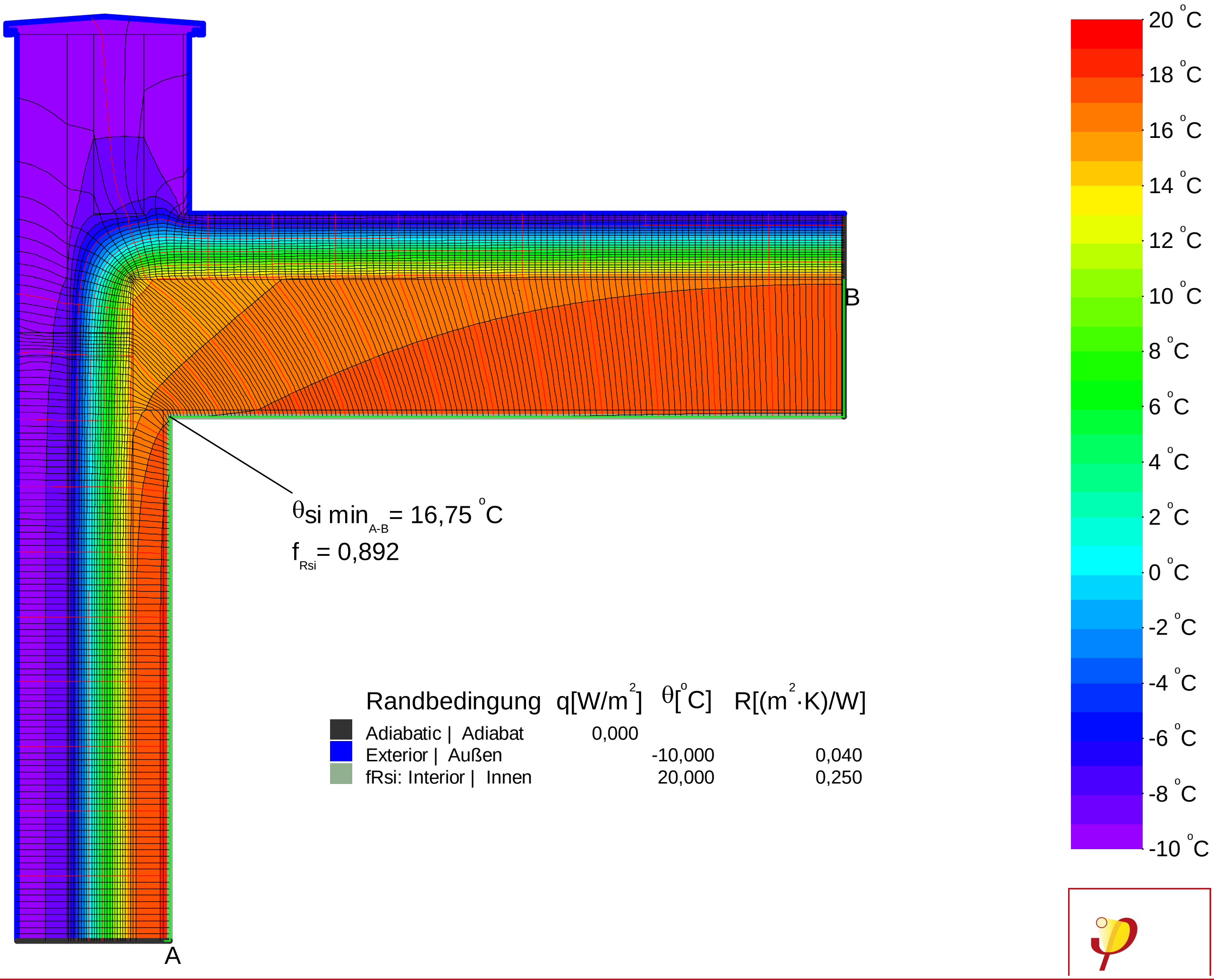
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior roof | Außen Dach		-10,000	0,100
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250



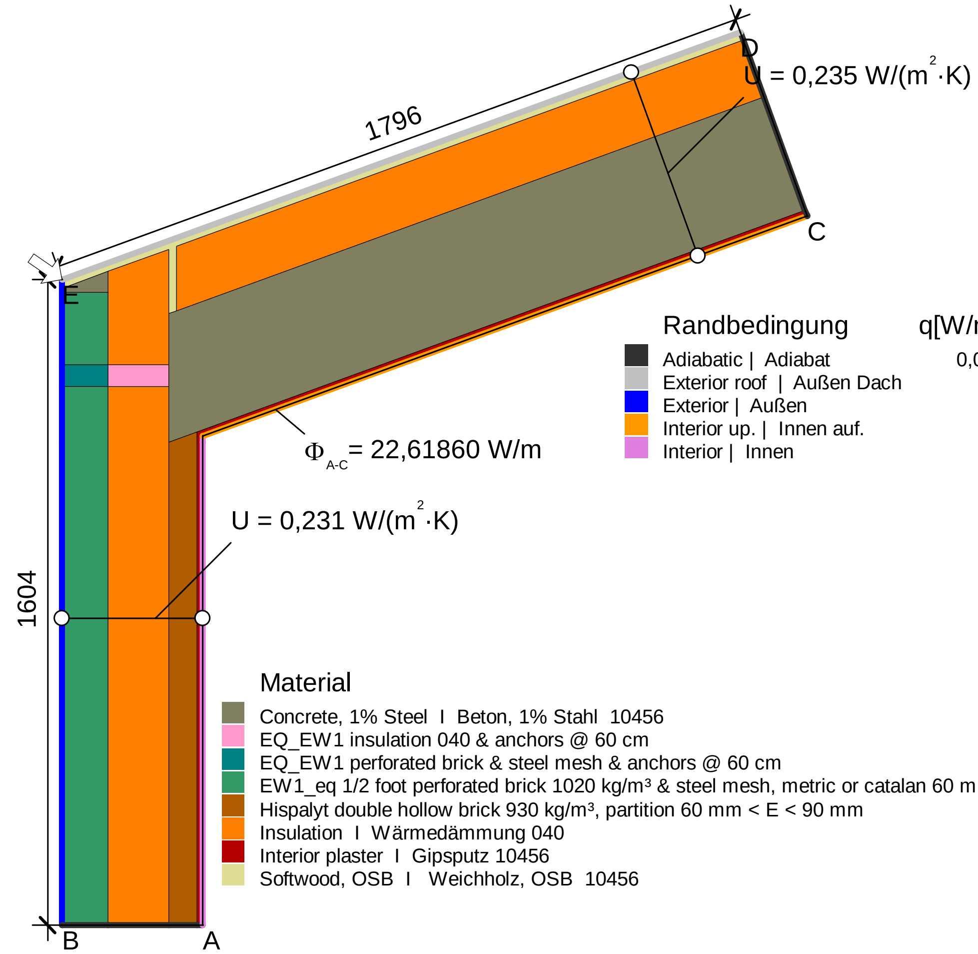
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior up. | Innen auf.		20,000	0,100
Interior | Innen		20,000	0,130

Material	λ[W/(m·K)]
Artificial stone I Kunststein 10456	1,300
Cement mortar | Zementmörtel 1.6	1,600
Concrete, 1% Steel I Beton, 1% Stahl 10456	2,300
EQ_EW1 insulation 040 & anchors @ 60 cm	0,076
EQ_EW1 perforated brick & steel mesh & anchors @ 60 cm	1,744
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570

$$\psi_{A\text{-}E\text{-}C} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{23,153}{30,000} - 0,231 \cdot 1,665 - 0,247 \cdot 1,895 = -0,081 \text{ W/(m·K)}$$



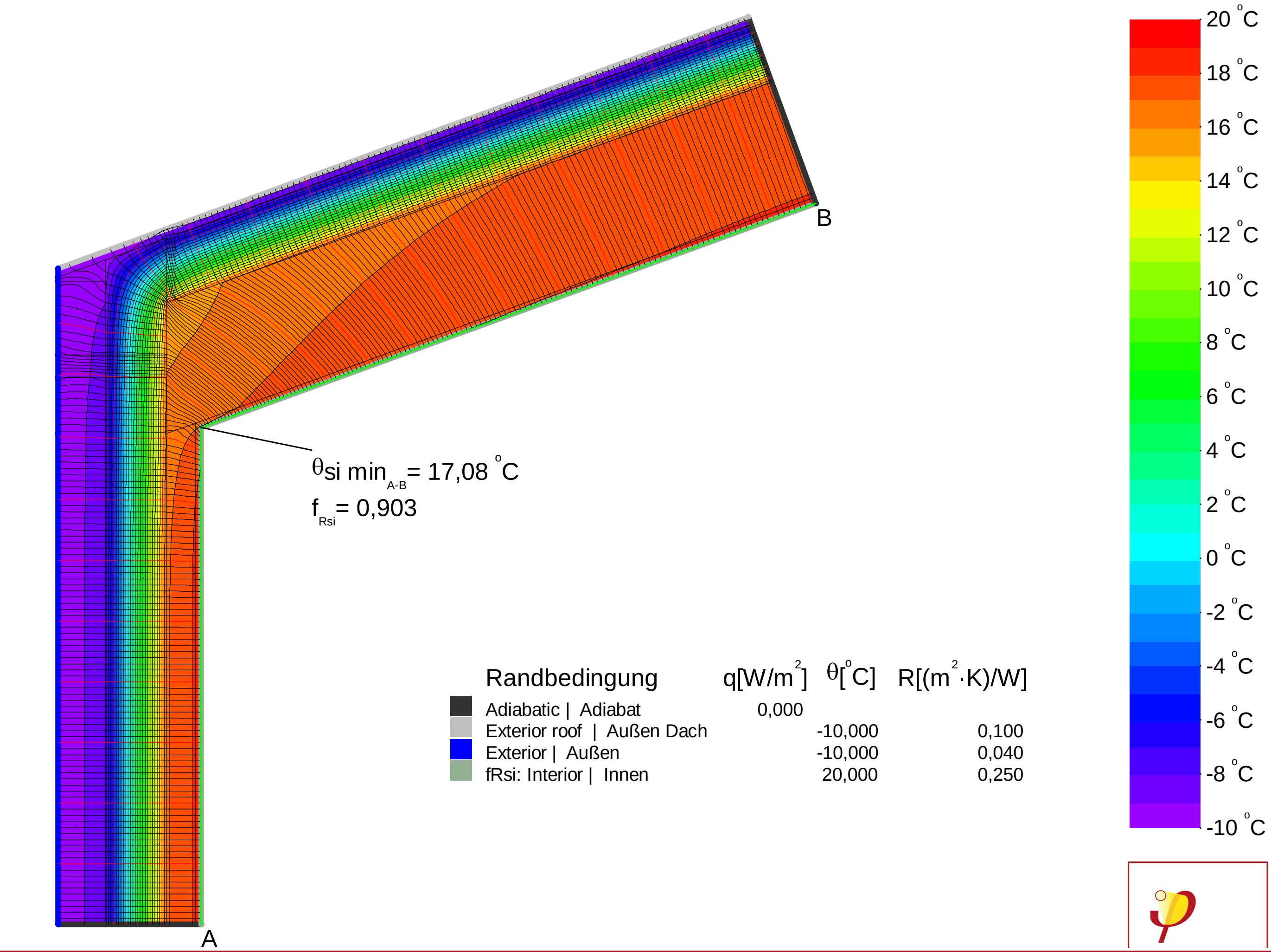
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250



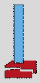
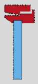
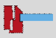
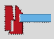
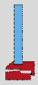
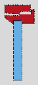
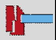
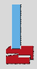
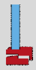
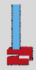
Randbedingung	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$
Adiabatic | Adiabat	0,000		
Exterior roof | Außen Dach		-10,000	0,100
Exterior | Außen		-10,000	0,040
Interior up. | Innen auf.		20,000	0,100
Interior | Innen		20,000	0,130

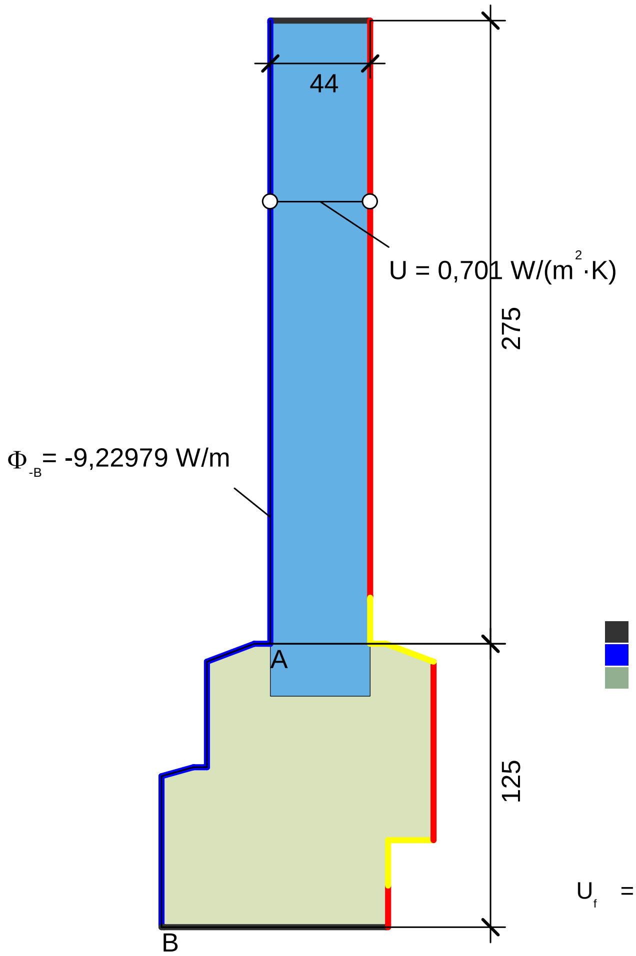
Material	$\lambda[W/(m \cdot K)]$
Concrete, 1% Steel I Beton, 1% Stahl 10456	2,300
EQ_EW1 insulation 040 & anchors @ 60 cm	0,076
EQ_EW1 perforated brick & steel mesh & anchors @ 60 cm	1,744
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570
Softwood, OSB I Weichholz, OSB 10456	0,130

$$\psi_{A\text{-}E\text{-}C} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 = \frac{22{,}619}{30{,}000} - 0{,}231 \cdot 1{,}604 - 0{,}235 \cdot 1{,}796 = -0{,}038\ W/(m \cdot K)$$



Randbedingung	$q[W/m^2]$	$\theta[^\circ C]$	$R[(m^2 \cdot K)/W]$
Adiabatic | Adiabat	0,000		
Exterior roof | Außen Dach		-10,000	0,100
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250

			1			2			3			1	2	3
Frame values | Rahmenwerte	Spacer I Abstandhalter: Musterabstandhalter Secondary seal I Sekundärdichtung: Polysulfid		Bottom	Top	Side	Bottom	Top	Side	Bottom	Top	Side	Bottom barrier-free	Bottom barrier-free	Bottom barrier-free
			Unten	Oben	Seitl.	Unten	Oben	Seitl.	Unten	Oben	Seitl.	Unten barrierefrei	Unten barrierefrei	Unten barrierefrei
														
	Frame width Rahmenbreite	b_f [mm]	125	125	125	125	125	125				125		
	U-value frame Rahmen-U-Wert	**Uf** [W/(m²K)]	0,92	0,92	0,92	0,92	0,92	0,92				0,92		
	Ψ-glass edge Glasrand-Ψ-Wert	**Ψg** [W/(mK)]	0,038	0,038	0,038	0,038	0,038	0,038				0,038		
	U-value window Fenster-U-Wert	Uw [W/(m²K)] @Ug = 0,9 W/(m²K)	**0,999**			**0,999**								
	Passive House effiziency class Passivhaus Effizienzklasse		**phC**			**phC**								
Installation | Einbau		$f_{Rsi = 0,25 m^2K/W}$	0,80	0,80	0,80	0,80	0,80	0,80				0,77		
		$\Psi_{install}$ [W/(mK)]	0,022	0,009	0,009	0,022	0,009	0,013				0,003		
		$U_{W, installed}$ [W/(m²K)]	1,03			1,04								
Window description	Dummy Passive House Window													
Beschreibung des Fensters	Ersatzmodell Passivhausfenster													

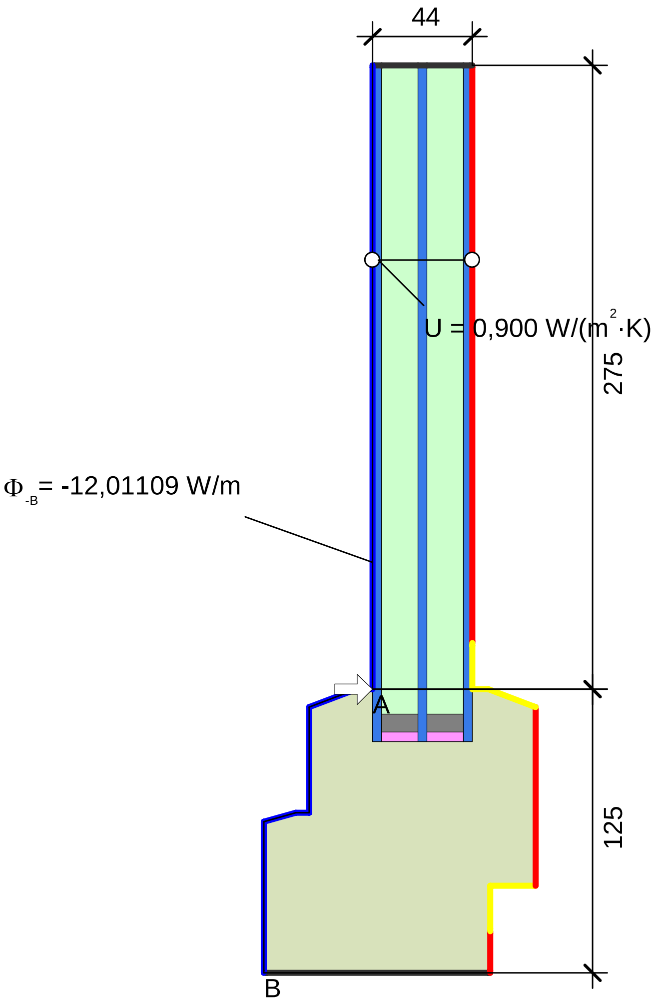


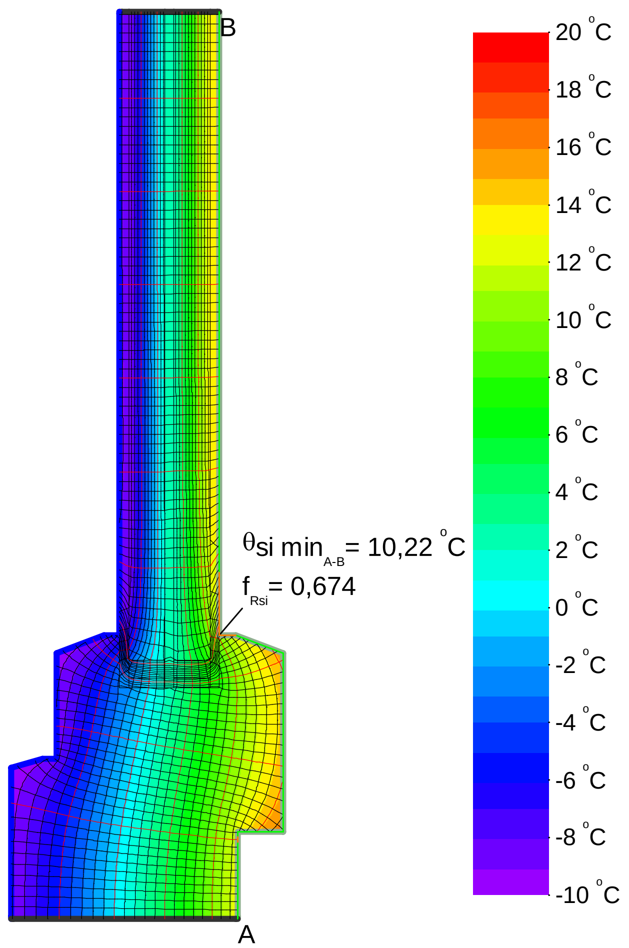
Material	λ[W/(m·K)]
Panel I Maske	0,035
Standard frame | Standardrahmen	0,113

Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior, frame, normal		20,000	0,130
Interior, frame, reduced		20,000	0,200

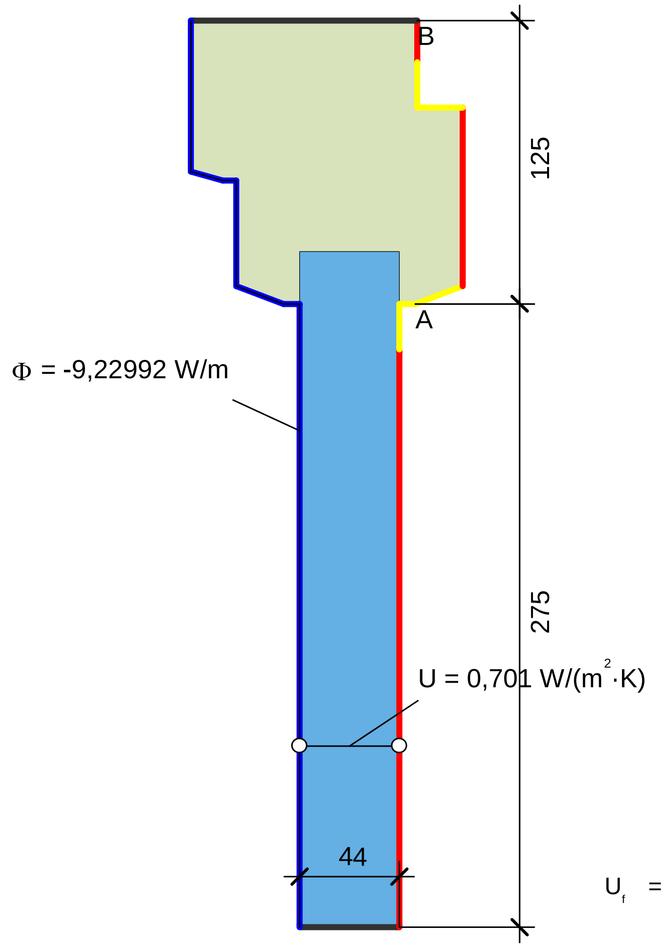
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{9,230}{30,000} - 0,701 \cdot 0,275}{0,125} = 0,920\ W/(m^2 \cdot K)$$





$$\psi_{ed\,A} = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{12,011}{30,000} - 0,900 \cdot 0,275 - 0,920 \cdot 0,125 = 0,038\ W/(m \cdot K)$$

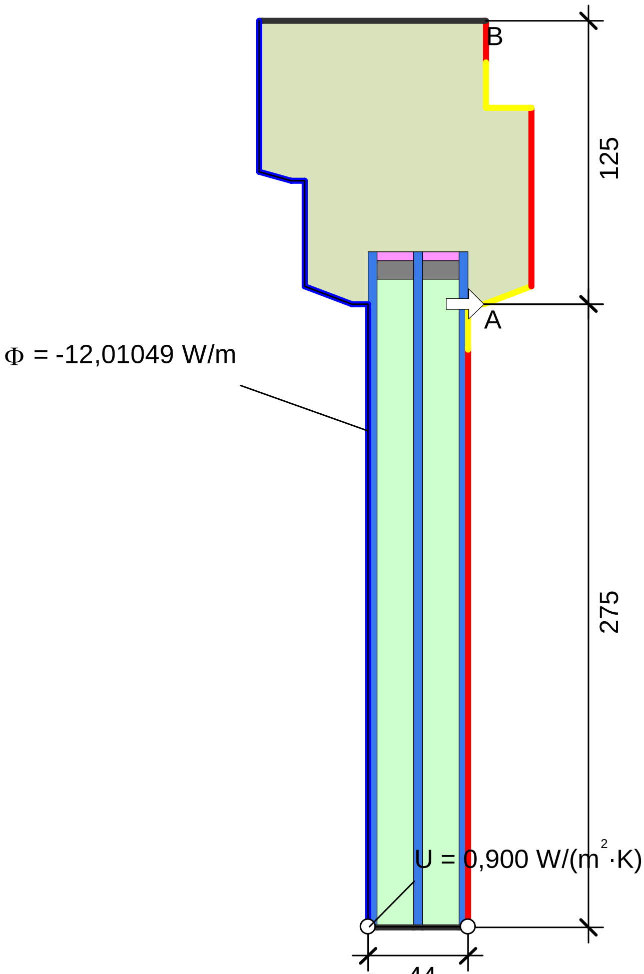


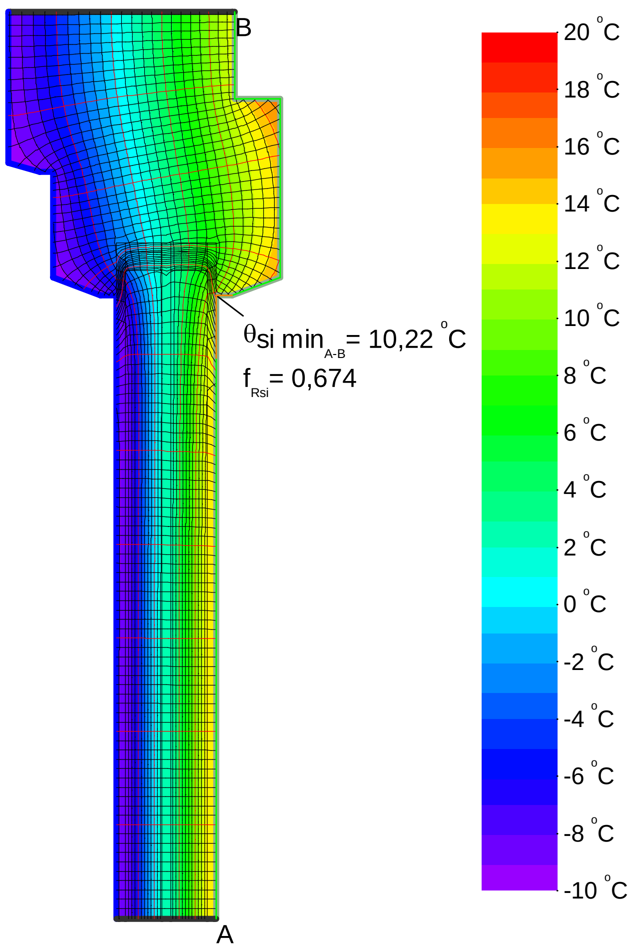
Material	λ[W/(m·K)]
Panel I Maske	0,035
Standard frame | Standardrahmen	0,113

Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior, frame, normal		20,000	0,130
Interior, frame, reduced		20,000	0,200

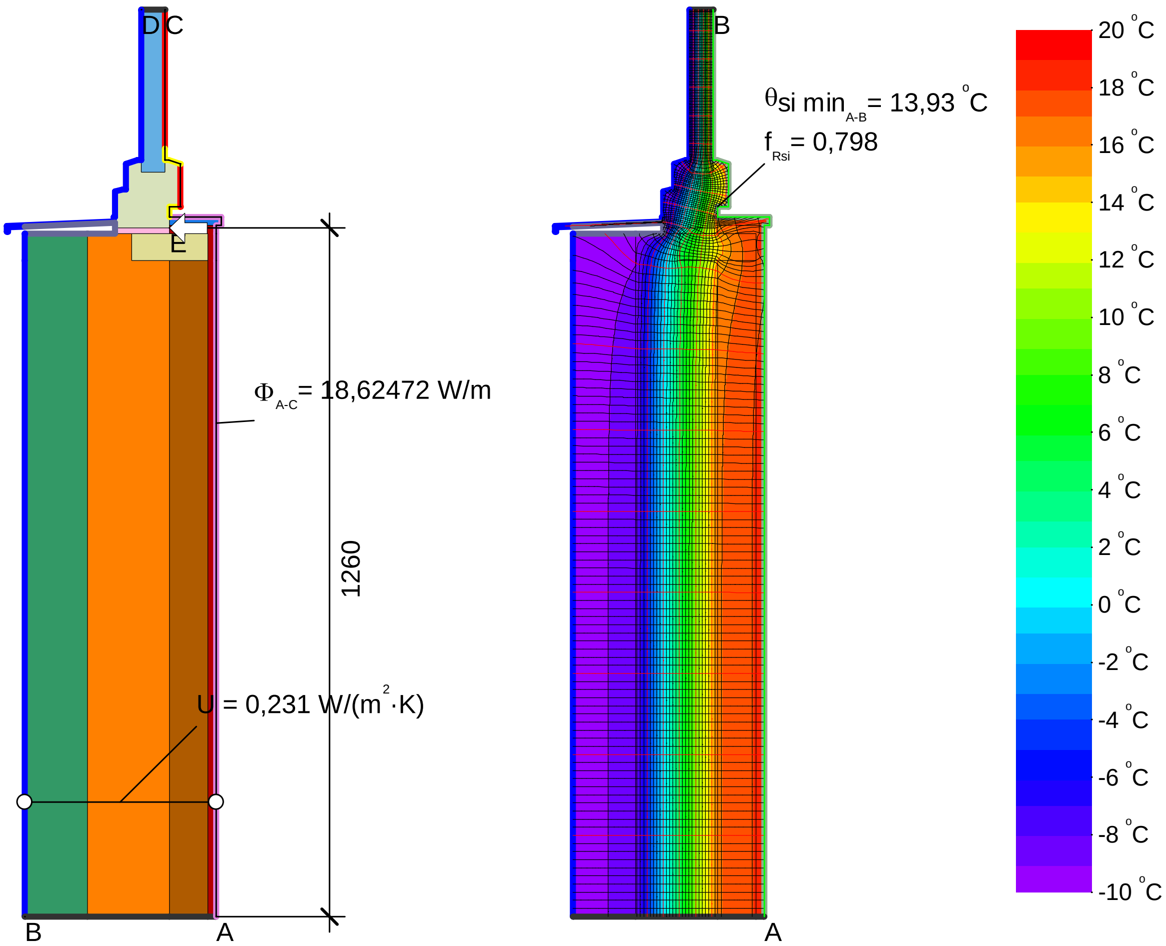
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250

$$U_f = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{9,230}{30,000} - 0,701 \cdot 0,275}{0,125} = 0,920\ W/(m^2 \cdot K)$$





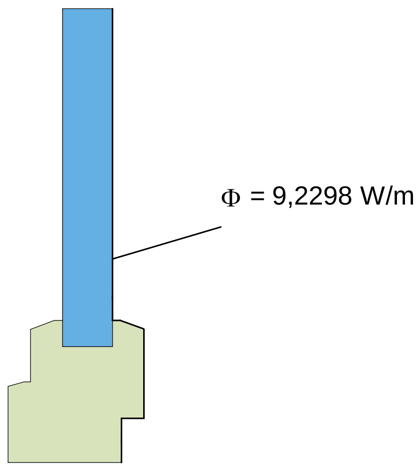
$$\psi_{ed\ A} = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{12,010}{30,000} - 0,900 \cdot 0,275 - 0,920 \cdot 0,125 = 0,038\ W/(m \cdot K)$$

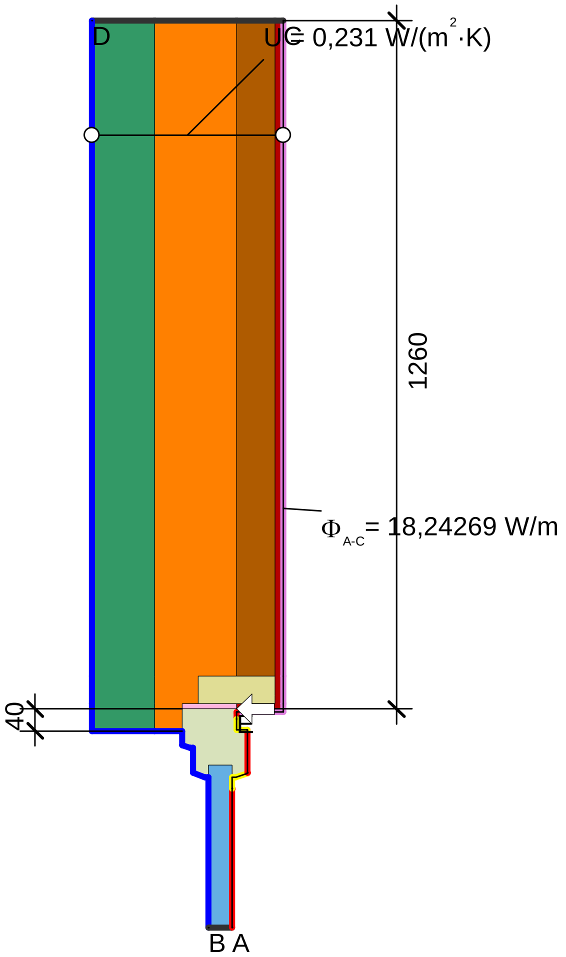


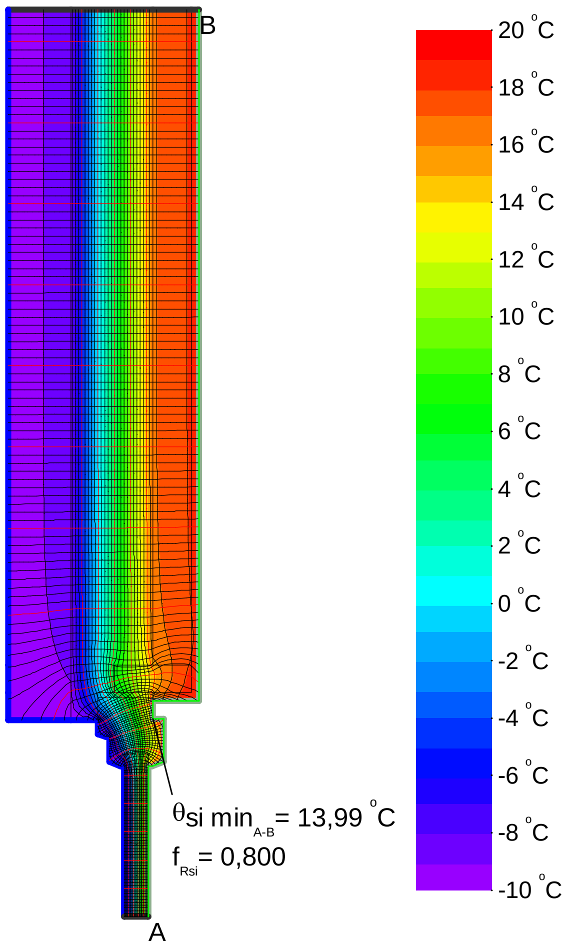
$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{18{,}625}{30{,}000} - 0{,}231 \cdot 1{,}260 - \frac{9{,}230}{30{,}000} = 0{,}022 \text{ W/(m·K)}$$

Material	λ[W/(m·K)]
Aluminum I Aluminium 10456	160,000
Artificial stone I Kunststein 10456	1,300
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570
PU in-situ foam I PU-Ortschaum 040	0,040
Panel I Maske	0,035
Softwood, OSB I Weichholz, OSB 10456	0,130
Standard frame | Standardrahmen	0,113

Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior vent. | Außen belüftet		-10,000	0,130
Exterior | Außen		-10,000	0,040
Interior | Innen		20,000	0,130
Interior, frame, normal		20,000	0,130
Interior, frame, reduced		20,000	0,200



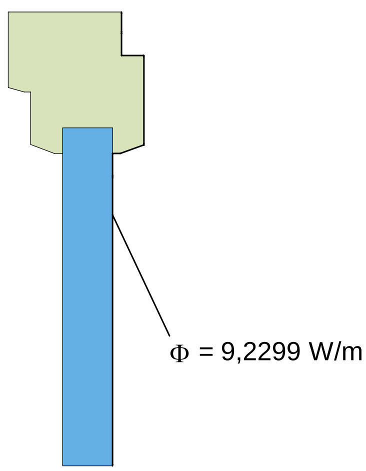


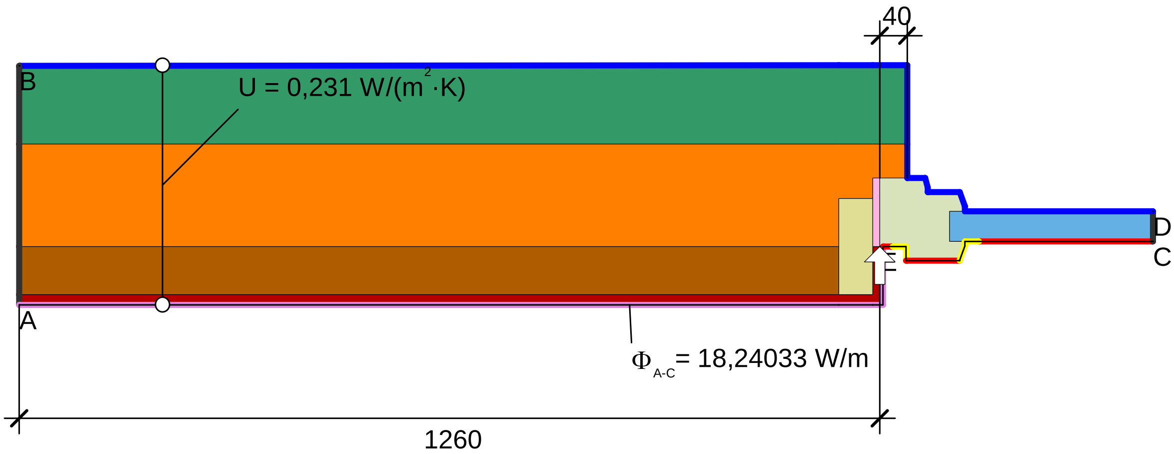


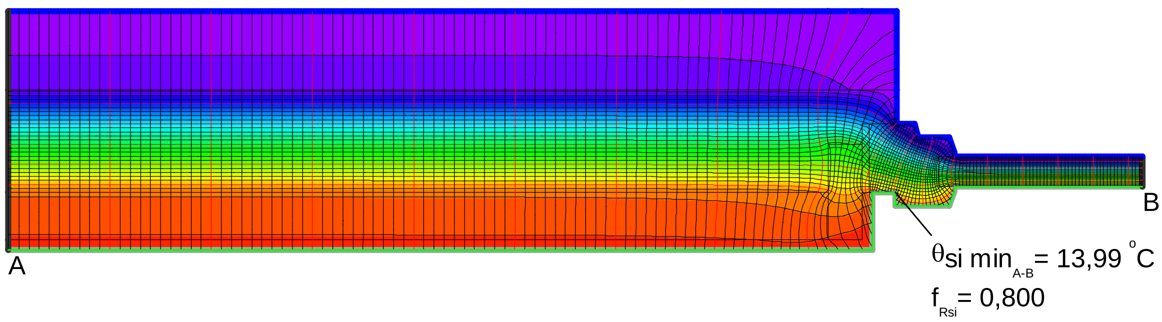
$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_I}{\Delta T} - U_2 \cdot b_2 = \frac{18,243}{30,000} - \frac{9,230}{30,000} - 0,231 \cdot 1,260 = 0,009 \text{ W/(m·K)}$$

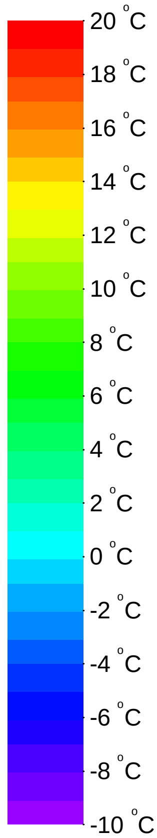
Material	λ[W/(m·K)]
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570
PU in-situ foam I PU-Ortschaum 040	0,040
Panel I Maske	0,035
Softwood, OSB I Weichholz, OSB 10456	0,130
Standard frame | Standardrahmen	0,113

Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
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



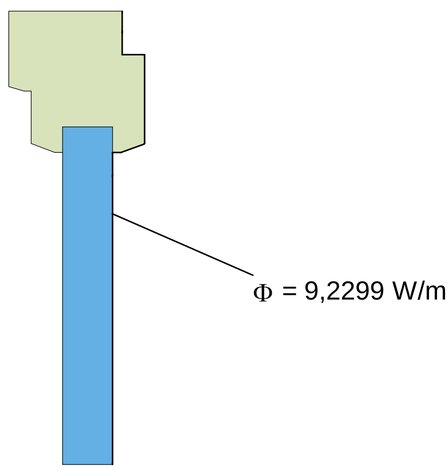






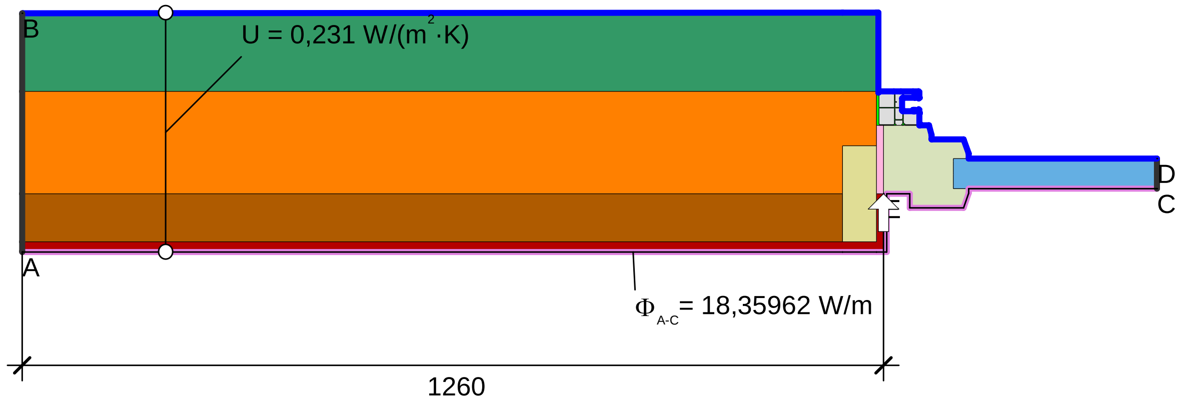
$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{18{,}240}{30{,}000} - 0{,}231 \cdot 1{,}260 - \frac{9{,}230}{30{,}000} = 0{,}009 \text{ W/(m·K)}$$

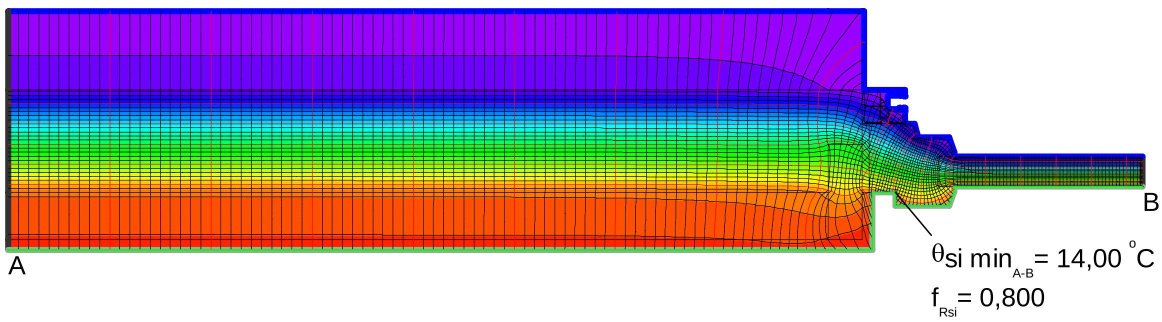
Material	λ[W/(m·K)]
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570
PU in-situ foam I PU-Ortschaum 040	0,040
Panel I Maske	0,035
Softwood, OSB I Weichholz, OSB 10456	0,130
Standard frame | Standardrahmen	0,113

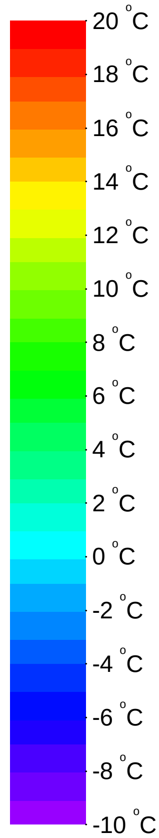


Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior | Innen		20,000	0,130
Interior, frame, normal		20,000	0,130
Interior, frame, reduced		20,000	0,200

EW1_OJ1_1: WINDOW CONNECTION - JAM



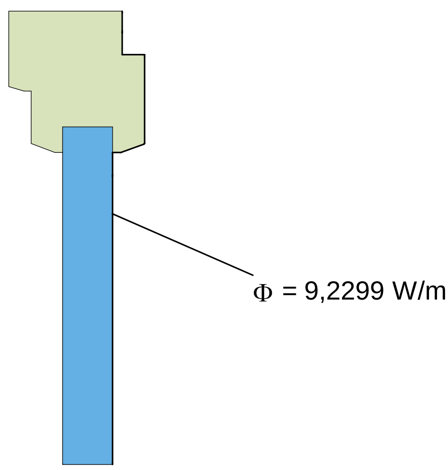




$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{18{,}360}{30{,}000} - 0{,}231 \cdot 1{,}260 - \frac{9{,}230}{30{,}000} = 0{,}013 \text{ W/(m·K)}$$

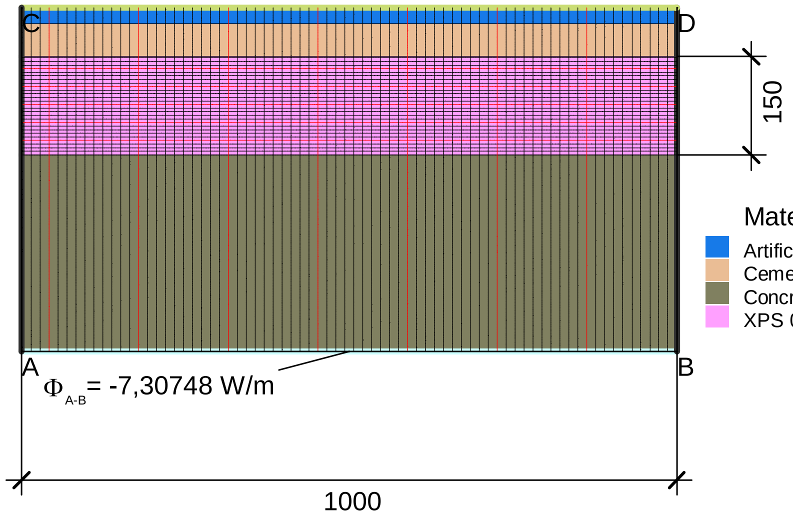
Material	λ[W/(m·K)]
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375
Insulation I Wärmedämmung 040	0,040
Interior plaster I Gipsputz 10456	0,570
PU in-situ foam I PU-Ortschaum 040	0,040
PVC (polyvinylchloride), rigid	0,170
Panel I Maske	0,035
Softwood, OSB I Weichholz, OSB 10456	0,130
Standard frame | Standardrahmen	0,113
Unvent. cavity I unbel. Hohlr. *	

* EN ISO 10077-2:2017, 6.4.3



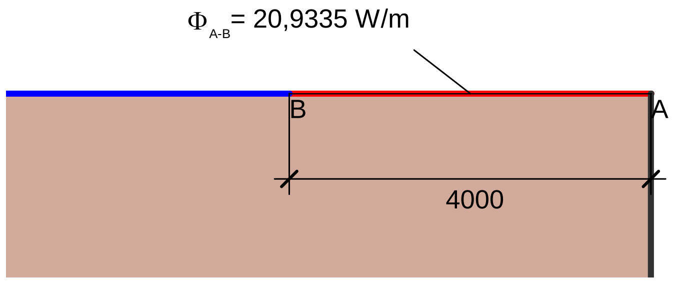
Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior | Innen		20,000	0,130

Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Gorund I Erdreich		-10,000	
Int. flux down I Innen abwärts		20,000	0,170

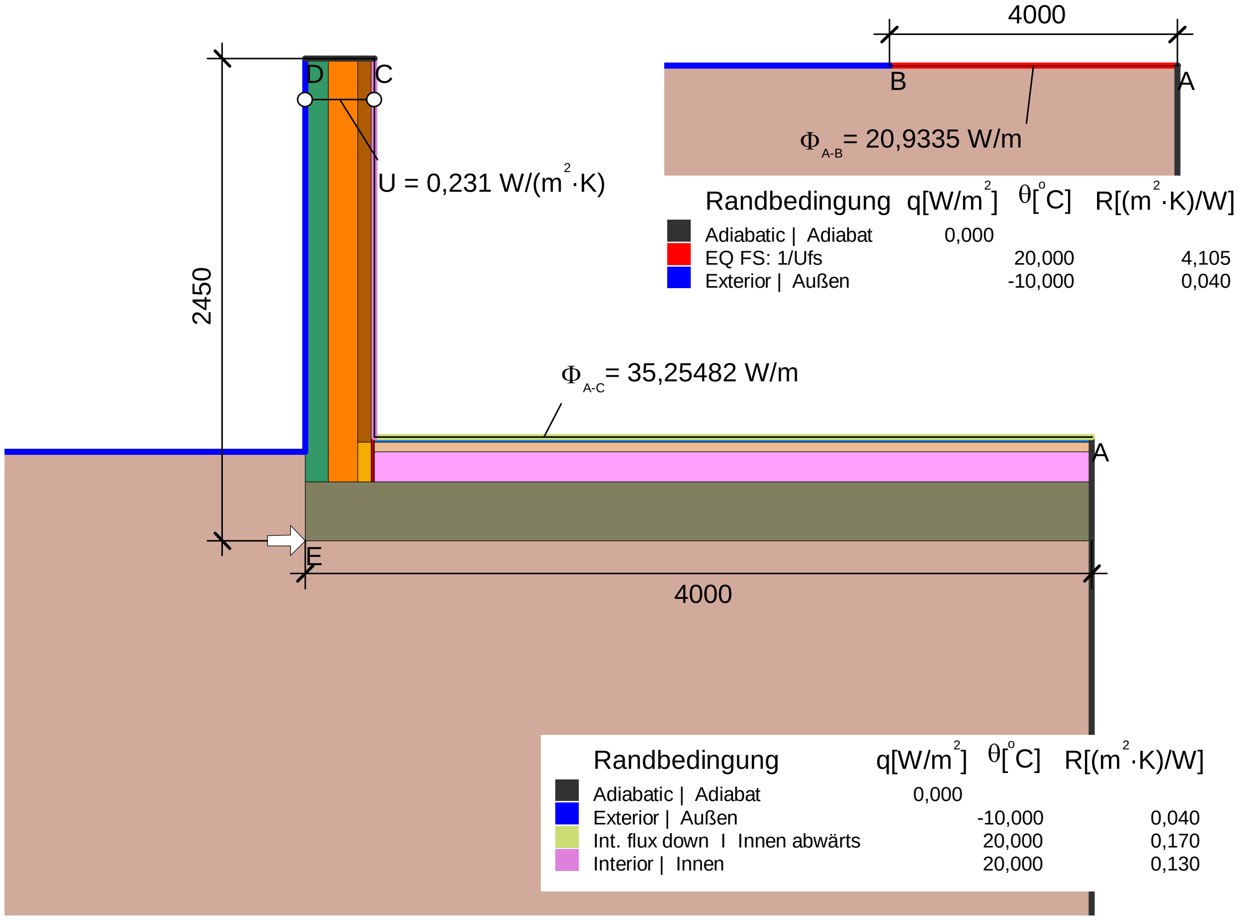


Material	λ[W/(m·K)]
Artificial stone I Kunststein 10456	1,300
Cement screed I Zement-Estrich 4108	1,400
Concrete, 1% Steel I Beton, 1% Stahl 10456	2,300
XPS 040	0,040

$$U_{eq\ A\text{-}B} = \frac{\Phi}{\Delta T \cdot b} = \frac{7{,}307}{30{,}000 \cdot 1{,}000} = 0{,}244\ W/(m^2 \cdot K)$$

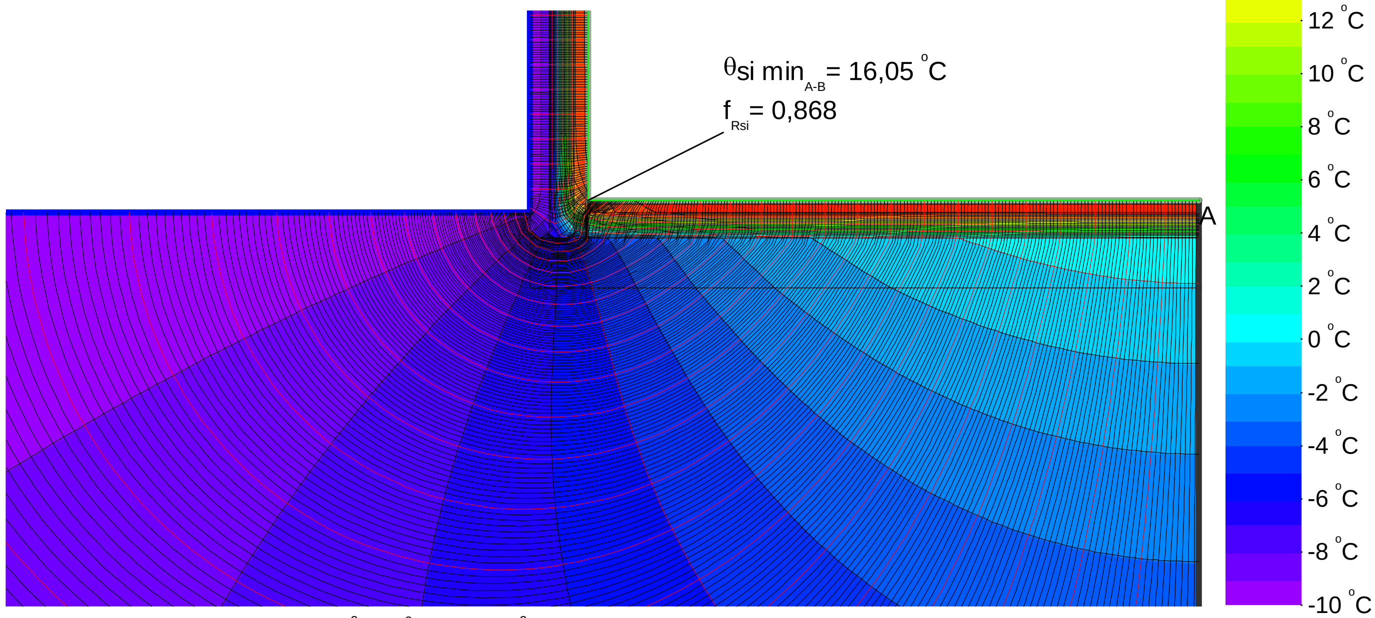


Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
EQ FS: 1/Ufs		20,000	4,105
Exterior | Außen		-10,000	0,040

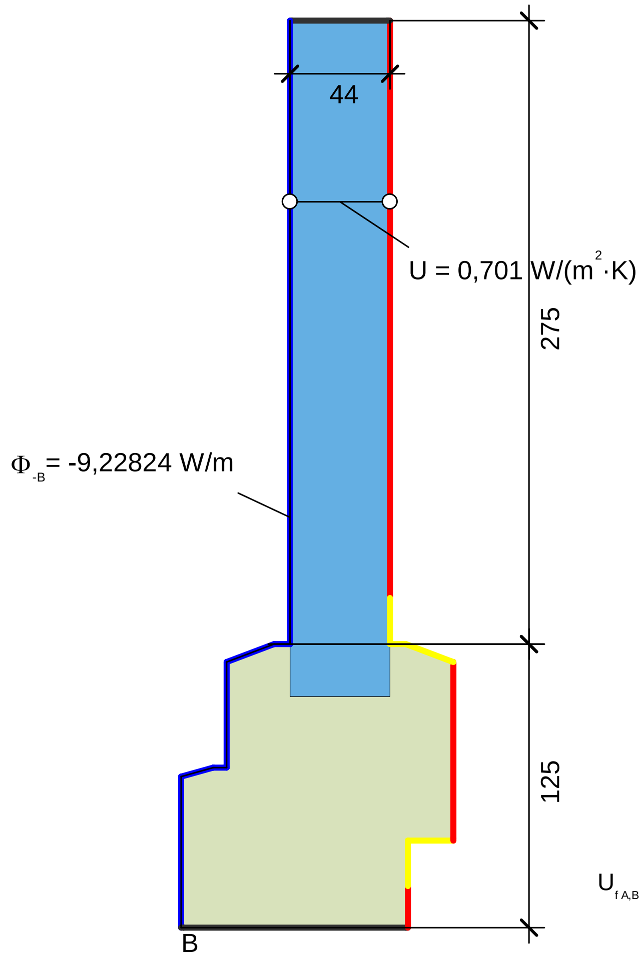


$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{35{,}255}{30{,}000} - \frac{20{,}934}{30{,}000} - 0{,}231 \cdot 2{,}450 = -0{,}089\ \text{W/(m·K)}$$

Material	λ[W/(m·K)]	ε
Artificial stone I Kunststein 10456	1,300	0,900
Cement screed I Zement-Estrich 4108	1,400	0,900
Concrete, 1% Steel I Beton, 1% Stahl 10456	2,300	0,900
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596	0,900
Ground I Erdreich	2,000	0,900
Hispalyt double hollow brick 930 kg/m³, partition 60 mm < E < 90 mm	0,375	0,900
Insulation I Wärmedämmung 040	0,040	0,900
Interior plaster I Gipsputz 10456	0,570	0,900
XPS 040	0,040	0,900
YTONG 7 cm 550 kg/m³	0,140	0,900



Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250

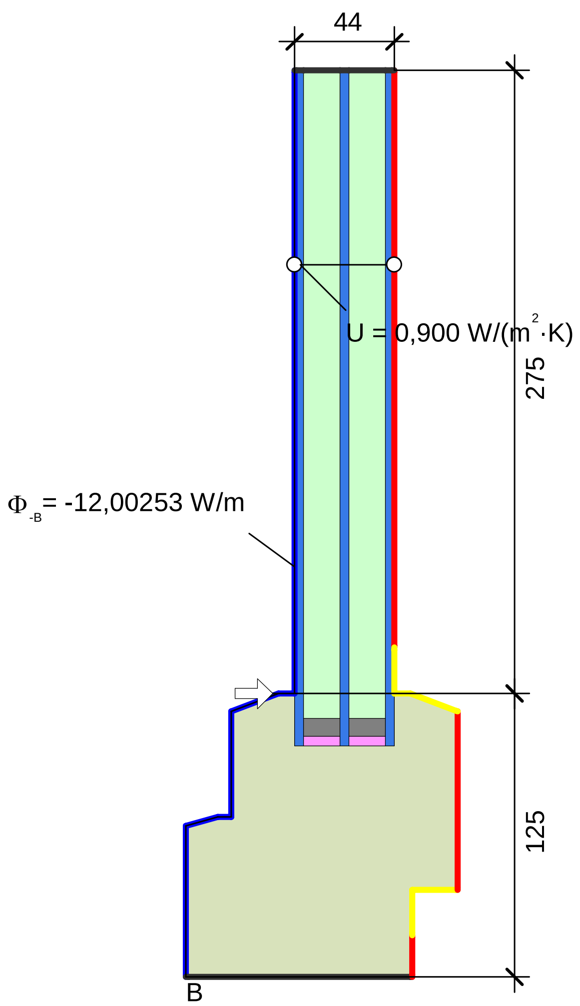


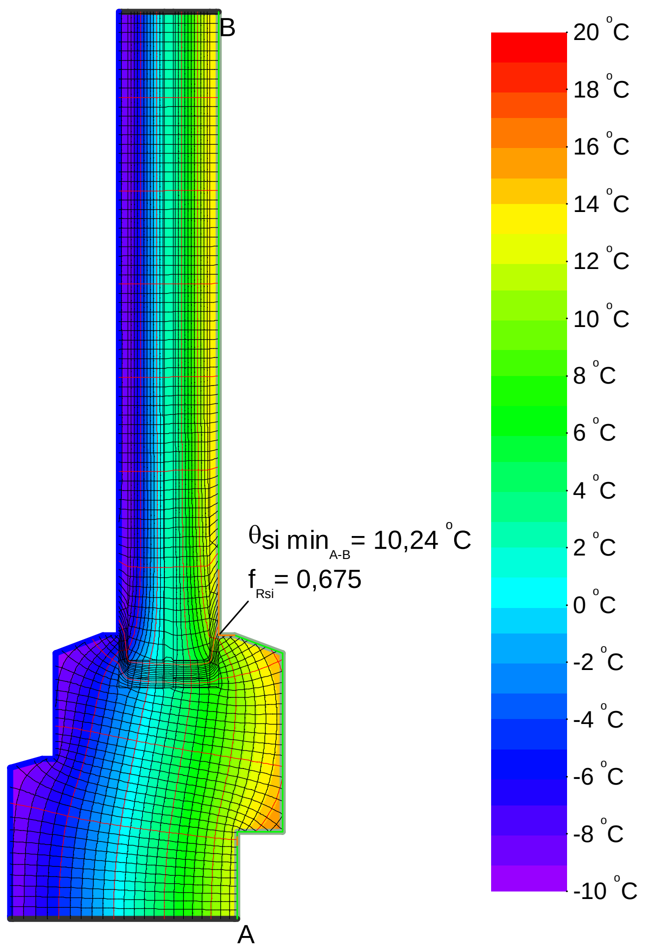
Material	λ[W/(m·K)]
Panel I Maske	0,035
Standard frame | Standardrahmen	0,113

Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
Interior, frame, normal		20,000	0,130
Interior, frame, reduced		20,000	0,200

Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250

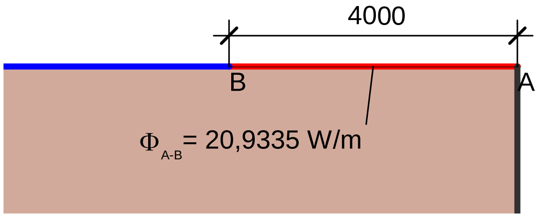
$$U_{f\,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{9{,}228}{30{,}000} - 0{,}701 \cdot 0{,}275}{0{,}125} = 0{,}919\ W/(m^2 \cdot K)$$

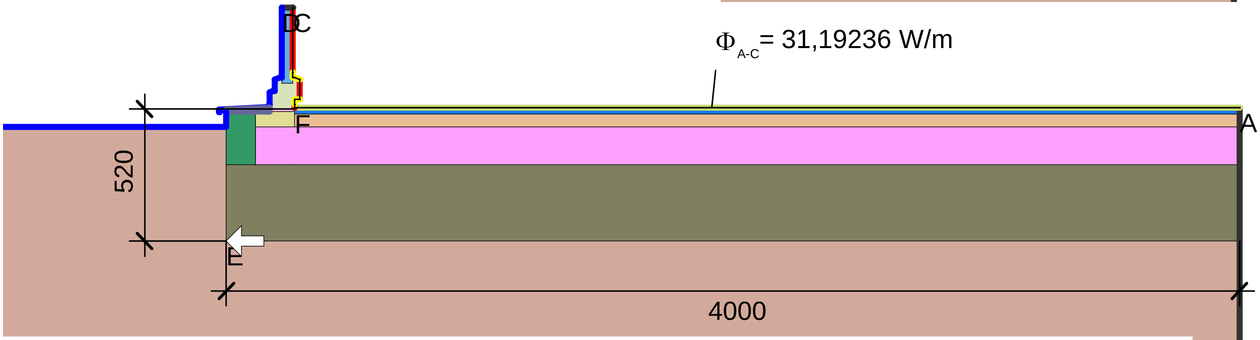




$$\psi_{ed\,A} = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{12{,}003}{30{,}000} - 0{,}900 \cdot 0{,}275 - 0{,}919 \cdot 0{,}125 = 0{,}038\ W/(m \cdot K)$$

Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
EQ FS: 1/Ufs		20,000	4,105
Exterior | Außen		-10,000	0,040

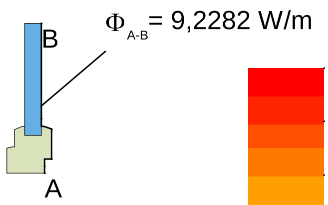




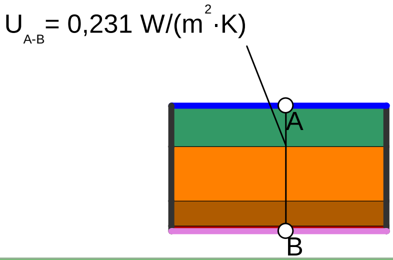
Material	λ[W/(m·K)]	ε
Aluminum I Aluminium 10456	160,000	0,900
Artificial stone I Kunststein 10456	1,300	0,900
Cement screed I Zement-Estrich 4108	1,400	0,900
Concrete, 1% Steel I Beton, 1% Stahl 10456	2,300	0,900
EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh, metric or catalan 60 mm < G 80 mm	0,596	0,900
Ground I Erdreich	2,000	0,900
PU in-situ foam I PU-Ortschaum 040	0,040	0,900
Panel I Maske	0,035	0,900
Softwood, OSB I Weichholz, OSB 10456	0,130	0,900
Standard frame | Standardrahmen	0,113	0,900
XPS 040	0,040	0,900

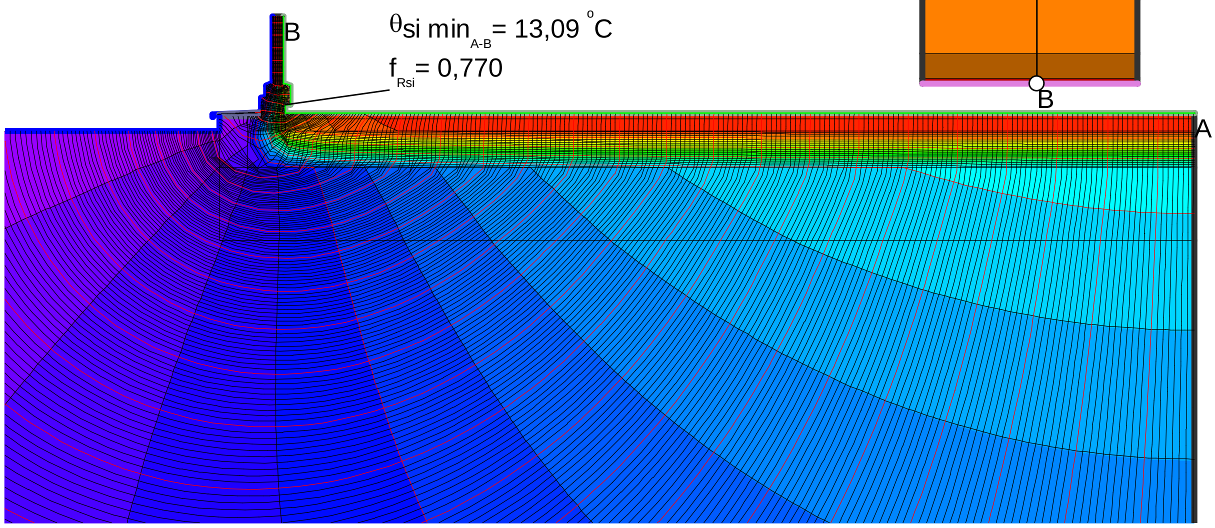
$$\psi_{A\text{-}E\text{-}C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 - \frac{\Phi_3}{\Delta T} = \frac{31{,}192}{30{,}000} - \frac{20{,}934}{30{,}000} - 0{,}231 \cdot 0{,}520 - \frac{9{,}228}{30{,}000} = -0{,}086 \text{ W/(m·K)}$$

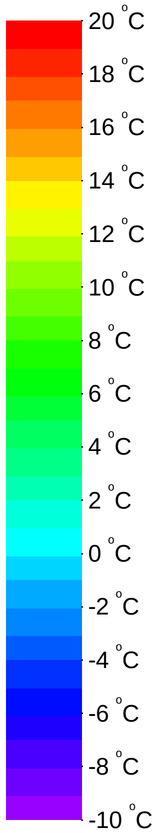
$$\Psi_{FS1\_OT1} = \Psi_{(FS1\_EW1 + EW1\_OT1)} - \Psi_{FS1\_EW1} = -0{,}086 - (-0{,}089) = 0{,}003 \text{ W/(mK)}$$



Randbedingung	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat		
Ext. vented horizontal | Außen belüftet hor.	-10,000	0,130
Exterior | Außen	-10,000	0,040
Int. flux down I Innen abwärts	20,000	0,170
Interior, frame, normal	20,000	0,130
Interior, frame, reduced	20,000	0,200





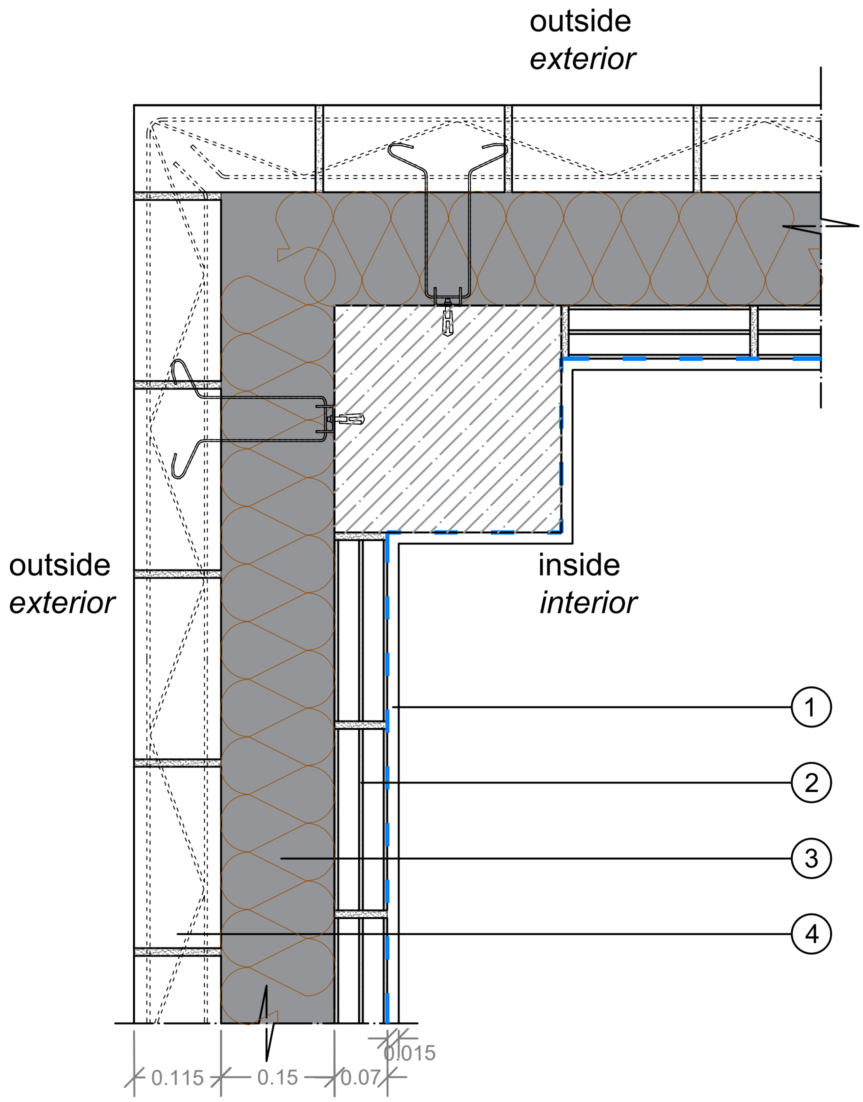


Randbedingung	q[W/m²]	θ[°C]	R[(m²·K)/W]
Adiabatic | Adiabat	0,000		
Ext. vented horizontal | Außen belüftet hor.		-10,000	0,130
Exterior | Außen		-10,000	0,040
fRsi: Interior | Innen		20,000	0,250

Appendix 3: Passive House Details of the System

Exterior Wall - exterior corner_ *Muro exterior - esquina exterior*	01 EW1_EW1_ec1 EWEC	HISPALYT CERÁMICA PARA CONSTRUIR

Design drawing - Horizontal cross-section *Detalle constructivo - Sección horizontal* E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso.
Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

NOTE
The retaining anchors are fixed to slab fronts and columns.

NOTA
Los anclajes de retención se fijan a frentes de forjado y pilares.

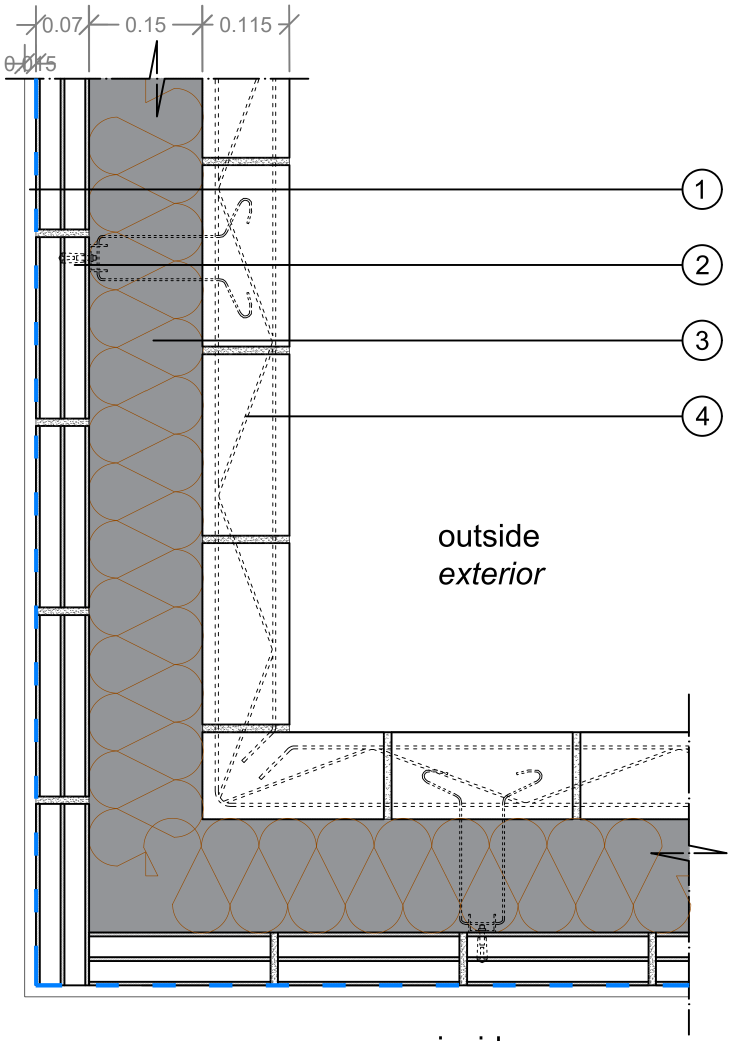
airtight layer_ *capa hermética*

insulation layer_ *aislamiento*

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 componente: Exterior Wall							
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5				
2	double hollow bricks_ *trasdosado LHD*	0,375	7				
3	thermal insulation_ *aislamiento térmico*	0,040	15				
4	facing bricks_ *1/2 pie LCV*	0,595	11,5				
				Other materials (material not in the standard components)			

External Wall- interior corner_ *Muro exterior - esquina interior*	02 EW1_EW1_ic1 (EWIC)	HISPALYT CERÁMICA PARA CONSTRUIR

Design drawing - Horizontal cross-section *Detalle constructivo - Sección horizontal* E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso. Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

NOTE
The retaining anchors are fixed to slab fronts and columns.

NOTA
Los anclajes de retención se fijan a frentes de forjado y pilares.

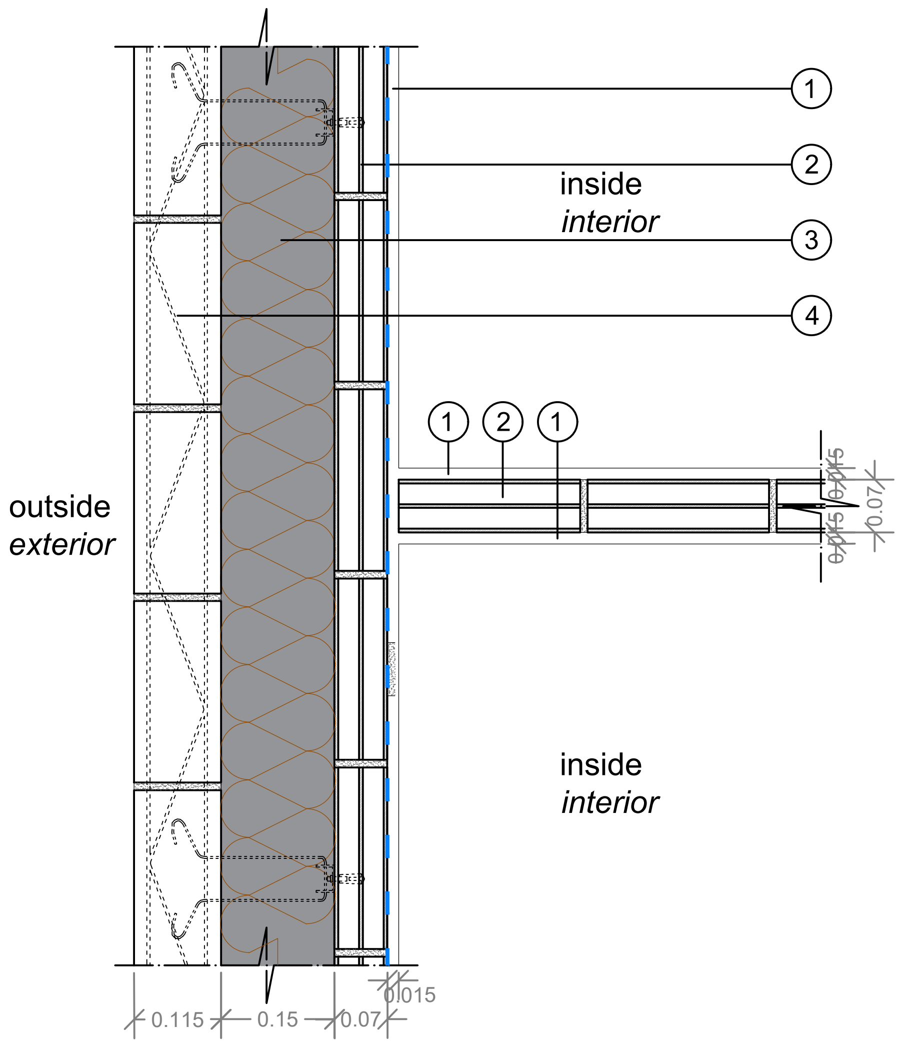
airtight layer_ *capa hermética*

insulation layer_ *aislamiento*

	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 componente: Exterior Wall							
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5				
2	double hollow bricks_ *trasdosado LHD*	0,375	7				
3	thermal insulation_ *aislamiento térmico*	0,040	15				
4	facing bricks_ *1/2 pie LCV*	0,595	11,5				
Other materials (material not in the standard components)							

External Wall - interior Wall_ *Muro exterior - tabique interior*	03 EW1_IW1 (EWIW)	HISPALYT CERÁMICA PARA CONSTRUIR

Design drawing - Horizontal cross-section *Detalle constructivo - Sección horizontal* E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso.
Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

NOTE
The retaining anchors are fixed to slab fronts and columns.

NOTA
Los anclajes de retención se fijan a frentes de forjado y pilares.

airtight layer_ *capa hermética*

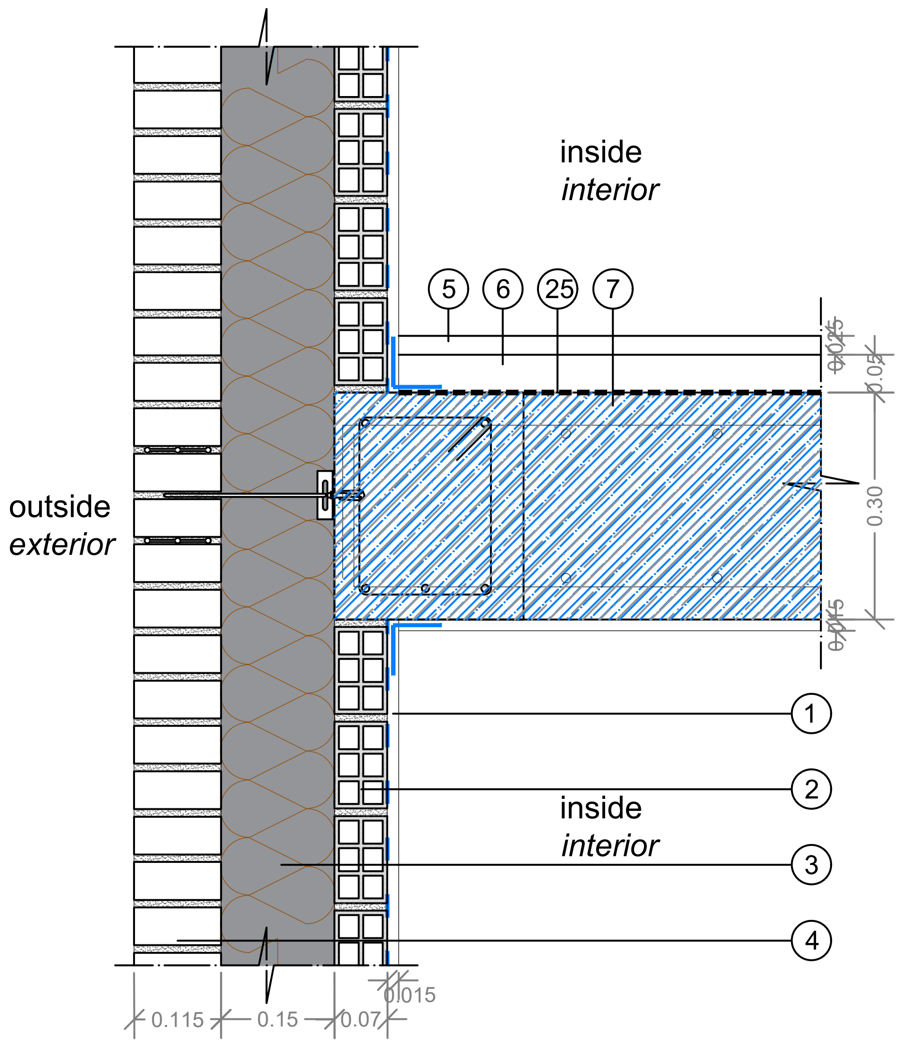
insulation layer_ *aislamiento*

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 componente: Exterior Wall				Standard componente: Interior Wall			
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5	1	gypsum plaster_ *enlucido de yeso*	0,570	1,5
2	double hollow bricks_ *trasdosado LHD*	0,375	7	2	double hollow bricks_ *tabique LHD*	0,375	7
3	thermal insulation_ *aislamiento térmico*	0,040	15	1	gypsum plaster_ *enlucido de yeso*	0,570	1,5
4	Facing bricks_ *1/2 pie LCV*	0,595	11,5				
Other materials (material not in the standard components)							

Ceiling connection_ *Muro exterior - forjado intermedio*	04 EW1_EW1_CE1 (EWCE)	HISPALYT CERÁMICA PARA CONSTRUIR

Design drawing - Vertical cross-section *Detalle constructivo - Sección vertical*

E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso.
Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

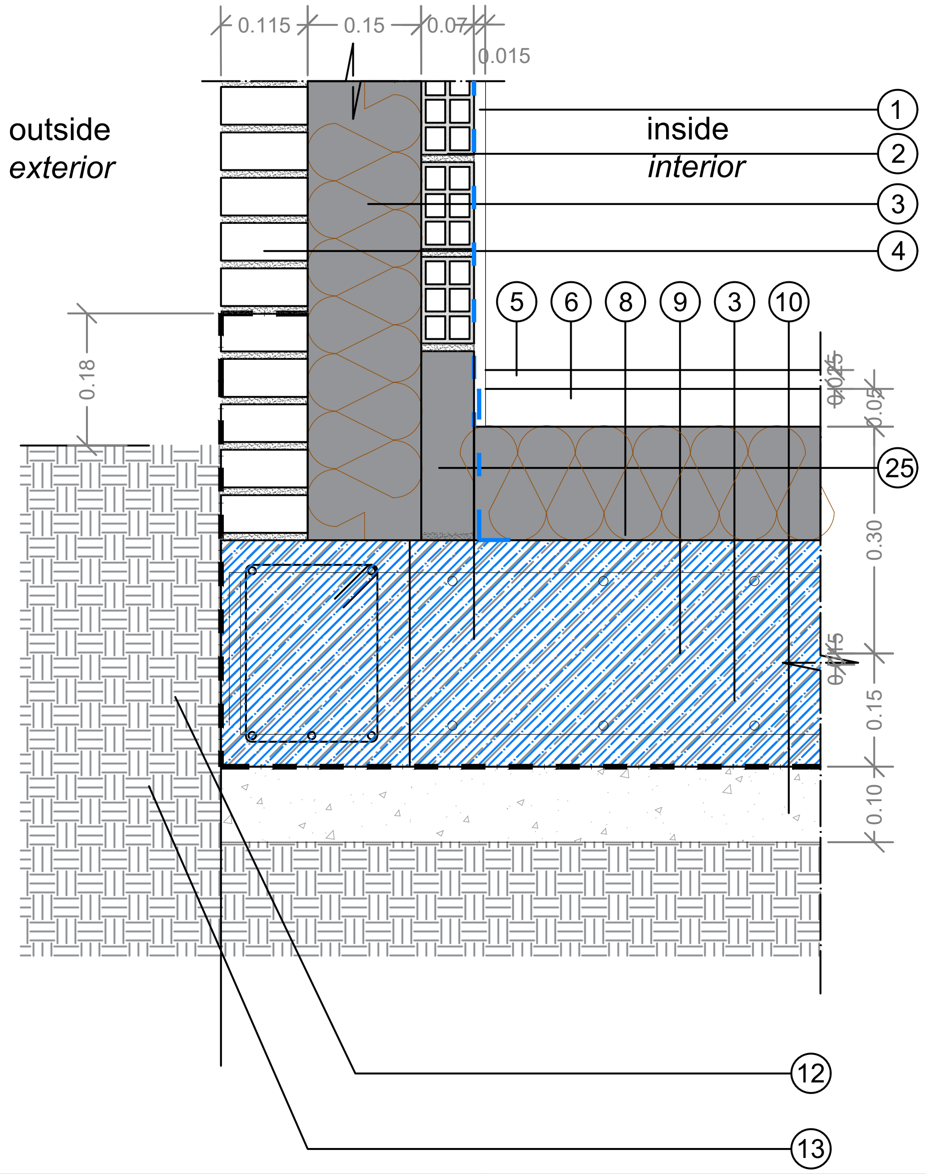
airtight layer_ *capa hermética*

insulation layer_ *aislamiento*

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 componente: Exterior Wall				Standard componente: Ceiling			
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5	5	ceramic finishing_ *baldosa cerámica*	1,000	2,5
2	double hollow bricks_ *trasdosado LHD*	0,375	7	6	cement mortar_ *mortero de cemento*	1,000	5
3	thermal insulation_ *aislamiento térmico*	0,040	15	25	anti-impact sheet_ *lámina anti-impacto*	-	-
4	facing bricks_ *1/2 pie LCV*	0,595	11,5	7	concrete floor_ *forjado de hormigón*	0,938	30
Other materials (material not in the standard components)							

Floor slab edge_ *Muro exterior - losa*	05 FS1_EW1 (FSEW)	HISPALYT CERÁMICA PARA CONSTRUIR

Design drawing - Vertical cross-section *Detalle constructivo - Sección vertical* E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

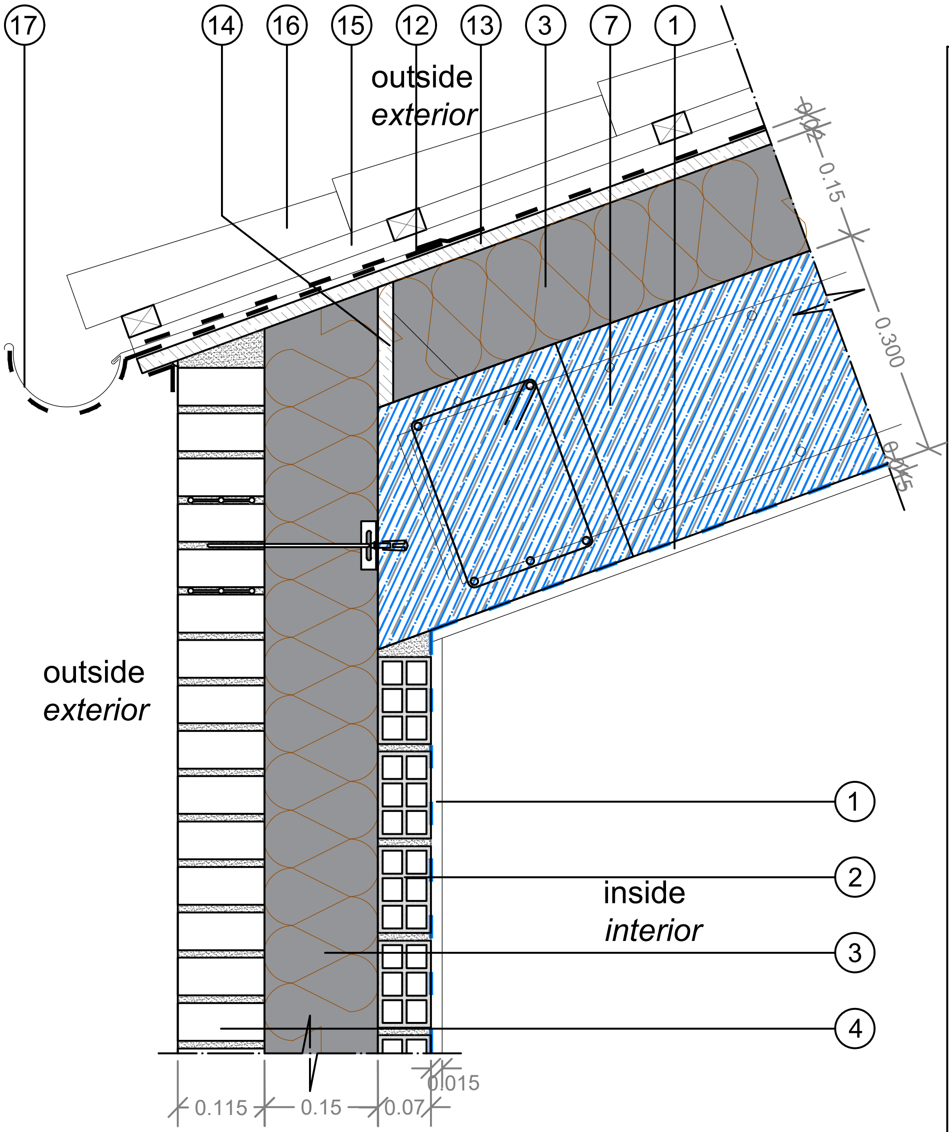
Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso. Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

airtight layer_ *capa hermética*
insulation layer_ *aislamiento*

	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 componente: Exterior Wall				Standard componente:Floor slab			
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5	5	ceramic finishing_ *baldosa cerámica*	1,000	2,5
2	double hollow bricks_ *trasdosado LHD*	0,375	7	6	cement mortar_ *mortero de cemento*	1,000	5
3	thermal insulation_ *aislamiento térmico*	0,040	15	8	concrete slab_ *losa de hormigón*	2,500	30
4	facing bricks_ *1/2 pie LCV*	0,595	11,5	9	PE sheet_ *lámina de PE*	-	-
				3	thermal insulation_ *aislamiento térmico*	0,040	15
				10	concrete_ *hormigón de limpieza*	2,000	10
				Other materials (material not in the standard components)			
				12	thermal insulation_ *aislamiento térmico*	0,040	10
				13	waterproofing_ *impermeabilización*	-	-
				25	Ytong block_ *bloque de Ytong*	0,140	-

Eaves_ *Muro exterior - cubierta inclinada*	06 EW1_RO1_ea1 (ROEA)	HISPALYT CERÁMICA PARA CONSTRUIR

Design drawing - Vertical cross-section *Detalle constructivo - Sección vertical* E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso. Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

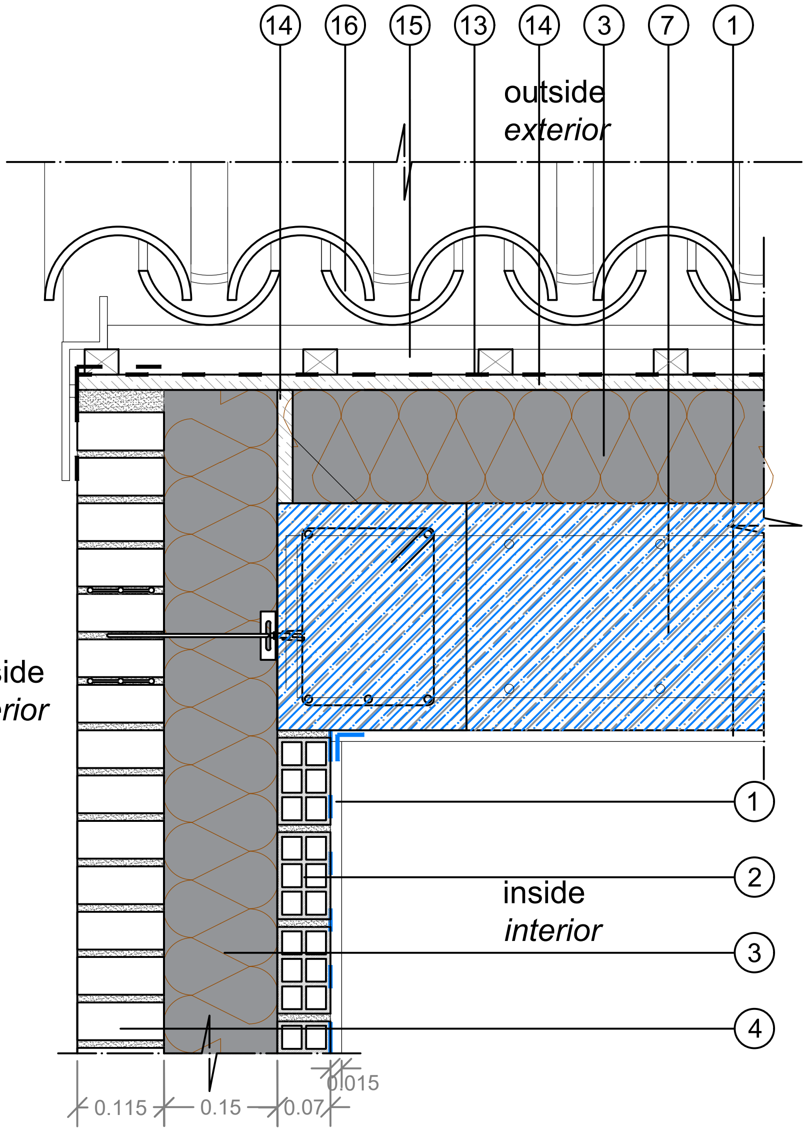
airtight layer_ *capa hermética*
insulation layer_ *aislamiento*

From the inside towards the outside		ʎ [W/(mK)]	Thick-ness [cm]	From the inside towards the outside		ʎ [W/(mK)]	Thick-ness [cm]
Standard componente: Exterior Wall				Standard componente:Pitched roof			
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5	1	gypsum plaster_ *enlucido de yeso*	0,570	1,5
2	double hollow bricks_ *trasdosado LHD*	0,375	7	7	concrete floor_ *forjado de hormigón*	0,938	30
3	thermal insulation_ *aislamiento térmico*	0,040	15	3	thermal insulation_ *aislamiento térmico*	0,040	15
4	facing bricks_ *1/2 pie LCV*	0,595	11,5	14	wooden board_ *tablero de madera*	0,130	2
				13	waterproofing_ *impermeabilización*	-	-
				15	wood profile_ *doble rastrel*	-	-
				16	tiles_ *tejas*	-	-
				Other materials (material not in the standard components)			
				14	wooden board_ *tablero de madera*	0,130	2
				17	gutter_ *canalón*	-	-

Verge_ *Muro exterior - cubierta inclinada*	07 EW1_RO1_ve1 (ROVE)	HISPALYT CERÁMICA PARA CONSTRUIR

Design drawing - Vertical cross-section *Detalle constructivo - Sección vertical*

E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso. Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

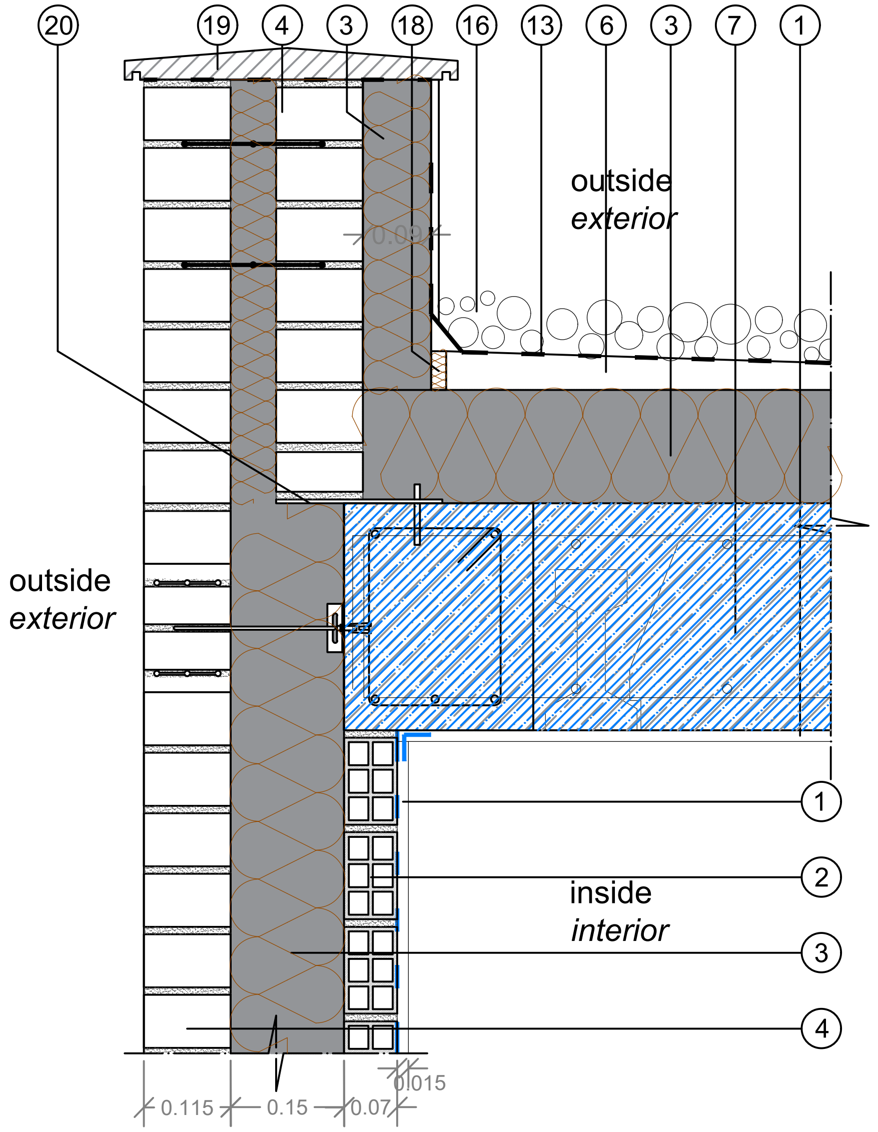
airtight layer_ *capa hermética*

insulation layer_ *aislamiento*

From the inside towards the outside		ʎ [W/(mK)]	Thick-ness [cm]	From the inside towards the outside		ʎ [W/(mK)]	Thick-ness [cm]
Standard componente: Exterior Wall				Standard componente:Pitched roof			
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5	1	gypsum plaster_ *enlucido de yeso*	0,570	1,5
2	double hollow bricks_ *trasdosado LHD*	0,375	7	7	concrete floor_ *forjado de hormigón*	0,938	30
3	thermal insulation_ *aislamiento térmico*	0,040	15	3	thermal insulation_ *aislamiento térmico*	0,040	15
4	facing bricks_ *1/2 pie LCV*	0,595	11,5	14	wooden board_ *tablero de madera*	0,130	2
				13	waterproofing_ *impermeabilización*	-	-
				15	wood profile_ *doble rastrel*	-	-
				16	tiles_ *tejas*	-	-
				Other materials (material not in the standard components)			
				14	wooden board_ *tablero de madera*	0,130	20

Verge_ *Muro exterior - cubierta plana*	08 EW1_RO1_ve2 (ROVE)	HISPALYT CERÁMICA PARA CONSTRUIR

Design drawing - Vertical cross-section *Detalle constructivo - Sección vertical* E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso. Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

NOTE
Perforated ceramic brick in parapets with the same modulation as the facing brick.

NOTA
Ladrillo cerámico perforado en petos de la misma modulación que el ladrillo cara vista.

airtight layer_ *capa hermética*

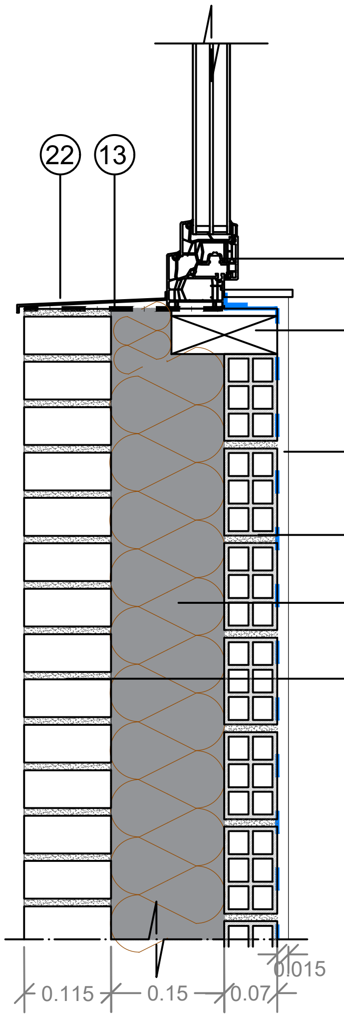
insulation layer_ *aislamiento*

	From the inside towards the outside	ʎ [W/(mK)]	Thick-ness [cm]
	Standard componente: Exterior Wall		
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5
2	double hollow bricks_ *trasdosado LHD*	0,375	7
3	thermal insulation_ *aislamiento térmico*	0,040	15
4	facing bricks_ *1/2 pie LCV*	0,595	11,5

	From the inside towards the outside	ʎ [W/(mK)]	Thick-ness [cm]
	Standard componente:Flat roof		
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5
7	concrete floor_ *forjado de hormigón*	0,938	30
3	thermal insulation_ *aislamiento térmico*	0,040	15
6	cement mortar_ *mortero de cemento*	1,000	5
13	waterproofing_ *impermeabilización*	-	-
16	gravel_ *grava*	-	-
	Other materials (material not in the standard components)		
18	joint_ *junta*	-	-
19	coping stone_ *albardilla*	-	-
20	placa de acero galvaniza	-	-

Window bottom connection_ *Muro exterior - ventana inferior*	09 EW1_OB1_1 (WIBO)	HISPALYT CERÁMICA PARA CONSTRUIR

Design drawing - Vertical cross-section *Detalle constructivo - Sección vertical* E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso.
Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

airtight layer_ *capa hermética*

insulation layer_ *aislamiento*

	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 componente: Exterior Wall							
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5				
2	double hollow bricks_ *trasdosado LHD*	0,375	7				
3	thermal insulation_ *aislamiento térmico*	0,040	15				
4	facing bricks_ *1/2 pie LCV*	0,595	11,5				
				Other materials (material not in the standard components)			
				13	waterproofing_ *impermeabilización*	-	-
				21	wooden subframe_ *precerco madera*	-	-
				22	coping stone_ *albardilla*	-	-
				24	PVC piece_ *pieza PVC*	-	-

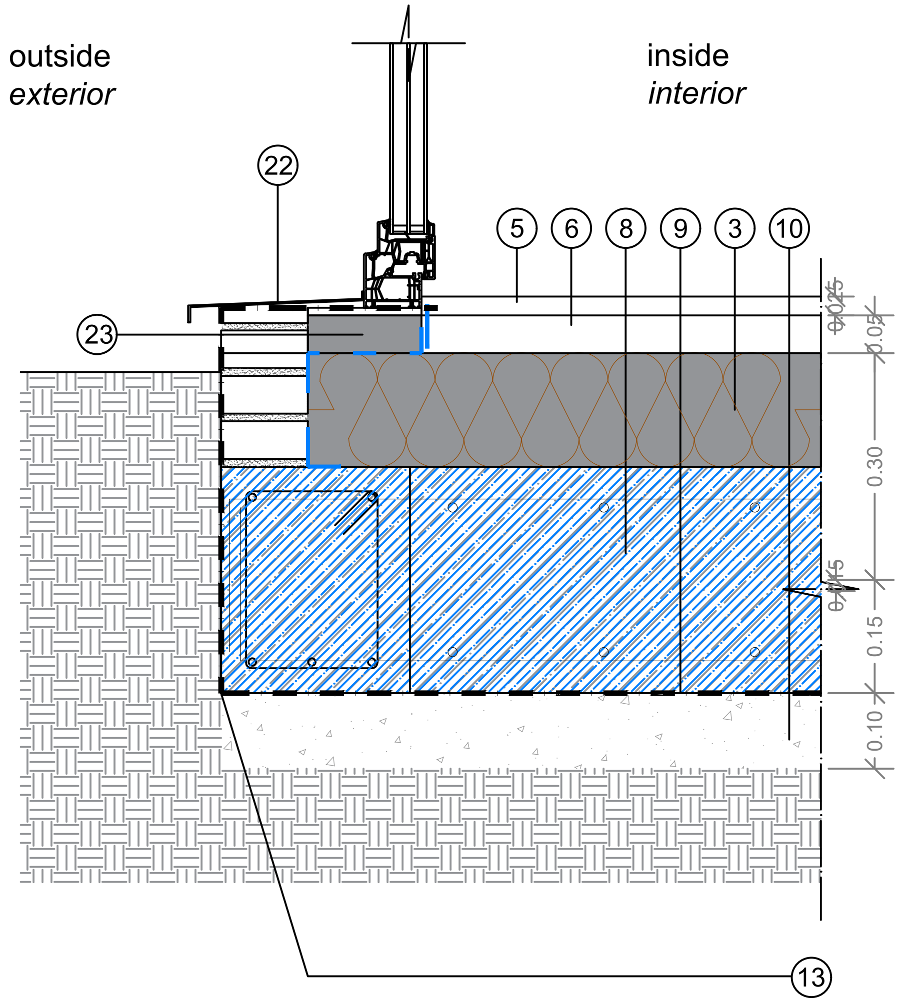
Window bottom, floor slab_
Muro exterior - umbral terreno

10 FS1_OB1_1
(WITH)

HISPALYT
CERÁMICA PARA CONSTRUIR

Design drawing - Vertical cross-section *Detalle constructivo - Sección vertical*

E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso.
Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

airtight layer_ *capa hermética*

insulation layer_ *aislamiento*

From the inside towards the outside		λ [W/(mK)]	Thick-ness [cm]
Standard componente: Exterior Wall			
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5
2	double hollow bricks_ *trasdosado LHD*	0,375	7
3	thermal insulation_ *aislamiento térmico*	0,040	15
4	facing bricks_ *1/2 pie LCV*	0,595	11,5

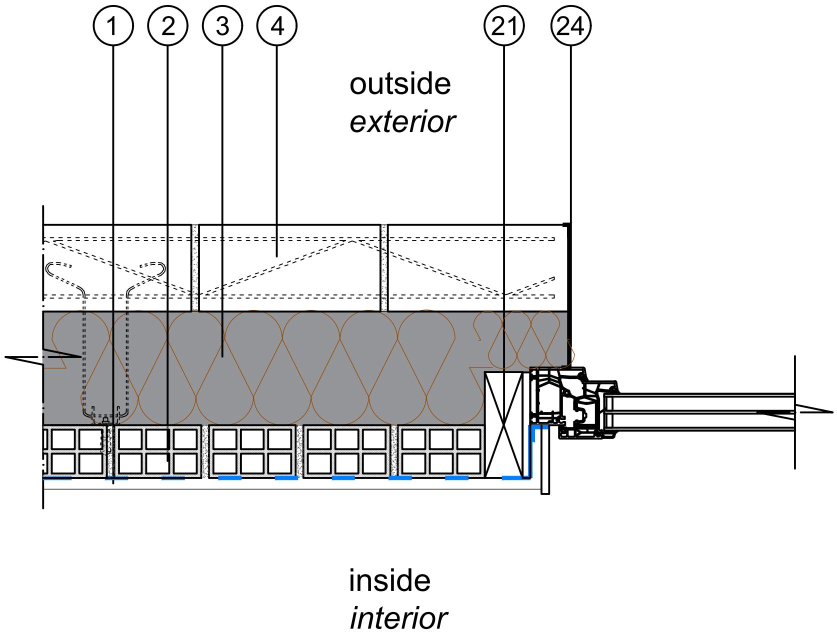
From the inside towards the outside		λ [W/(mK)]	Thick-ness [cm]
Standard componente:Floor slab			
5	ceramic finishing_ *baldosa cerámica*	1,000	2,5
6	cement mortar_ *mortero de cemento*	1,000	5
8	concrete slab_ *losa de hormigón*	2,500	30
9	PE sheet_ *lámina de PE*	-	-
3	thermal insulation_ *aislamiento térmico*	0,040	15
10	concrete_ *hormigón de limpieza*	2,000	10
Other materials (material not in the standard components)			
13	waterproofing_ *impermeabilización*	-	-
21	steel angle_ *angular de acero*	-	-
22	coping stone_ *albardilla*	-	-
23	wood_ *premarco de madera*	-	-

Window side connection_
Muro exterior - ventana lateral

11 EW1_OJ1_1a
(WISI)

HISPALYT
CERÁMICA PARA CONSTRUIR

Design drawing - Horizontal cross-section *Detalle constructivo - Sección horizontal* E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso.
Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

NOTE
The retaining anchors are fixed to slab fronts and columns.

NOTA
Los anclajes de retención se fijan a frentes de forjado y pilares.

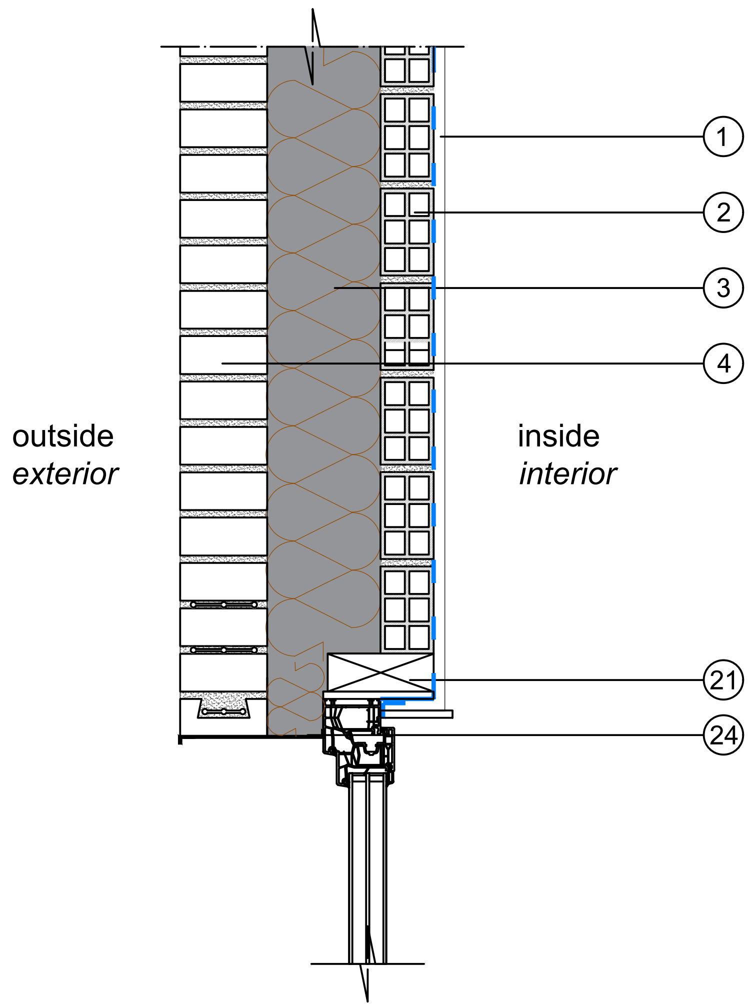
airtight layer_ *capa hermética*

insulation layer_ *aislamiento*

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 componente: Exterior Wall							
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5	1	gypsum plaster_ *enlucido de yeso*	0,570	1,5
2	double hollow bricks_ *trasdosado LHD*	0,375	7	2	double hollow bricks_ *trasdosado LHD*	0,375	7
3	thermal insulation_ *aislamiento térmico*	0,040	15	3	thermal insulation_ *aislamiento térmico*	0,040	15
4	facing bricks_ *1/2 pie LCV*	0,595	11,5	4	facing bricks_ *1/2 pie LCV*	0,595	11,5
				Other materials (material not in the standard components)			
				21	wooden subframe_ *precerco madera*	-	-
				24	PVC piece_ *pieza PVC*	-	-

Window top connection_ *Muro exterior - ventana superior*	12 EW1_OH1_2a (WITO)	HISPALYT CERÁMICA PARA CONSTRUIR

Design drawing - Vertical cross-section *Detalle constructivo - Sección vertical* E.: 1/10



Airtight layer
To achieve airtightness in the walls, a layer of gypsum plaster is applied in the interior of the bricks.
Sealing with windows, concrete slab etc by tapes. Surfaces must be clean, without dust and treated if necessary.

Capa hermética
La capa hermética en los muros se consigue mediante enlucido de yeso. Uniones con ventanas, hormigón etc con cintas.
Las superficies deben estar limpias, sin polvo y con tratamiento previo si es necesario.

airtight layer_ *capa hermética*

insulation layer_ *aislamiento*

From the inside towards the outside		ʎ [W/(mK)]	Thick-ness [cm]	From the inside towards the outside		ʎ [W/(mK)]	Thick-ness [cm]
Standard componente: Exterior Wall							
1	gypsum plaster_ *enlucido de yeso*	0,570	1,5				
2	double hollow bricks_ *trasdosado LHD*	0,375	7				
3	thermal insulation_ *aislamiento térmico*	0,040	15				
4	facing bricks_ *1/2 pie LCV*	0,595	11,5				
				Other materials (material not in the standard components)			
				21	wooden subframe_ *precerco madera*	-	-
				24	PVC piece_ *pieza PVC*	-	-

Appendix 4: Condensation check | Überprüfung Kondensatbildung

To check for condensation Glaser method was carried out with PHI condensation tool according to DIN EN ISO 13788 for the exterior wall assembly:

Location temperatures	Heating load [° C]	**2,5**	Cooling load [° C]	**24,5**		*Hours*	24
		Climate!L248					
Assembly definition	*θe [° C]*	8,0	*φe (θe)*	70%	*θi [° C]* 20,0	*φi (θi)*	88%
		Climate!F589		Climate!G589			Climate!J589

Assembly no.	Building assembly description	Interior insulation?	Ft	Radiation effect	Solar rad.	Sol. rad. fact.	Eff. Solar rad.
Wall .1	**External wall**	**No**	1,00	**Active**	750	1,0	**750**
					[W/m²]	[-]	[W/m²]

		Heat transmission resistance [m²K/W]		DT Roof 13788	Radiation attributes				Limits	PHI	User defined
Orientation of building element	**2 - Wall**	interior Rsi:	0,13	0,00	Reflectivity:	0,25	Clima zone	4	U-value	0,30	
Adjacent to	**3 - Ventilated**	exterior Rse:	0,13		Absorptivity:	0,90	Region	Warm-temperate	fRsi min 0,25	0,82	
For condensation or mould growth on opaque surfaces		interior Rsi:	0,25		Emissivity:	0,90	Location	ES0029b-Vitoria-Gasteiz			

Pos.	Area section	λ [W/(mK)]	Thickness [mm]	μ [-]	S_d [m]	R [m²K/W]	Temperature [° C]	p_v [Pa]	RH [%]
i	Interior air						**20,00**	**2049**	**88%**
0	Rsi - Interior surface					0,130	21,73	2049	79%
1	**Interior Plaster**	**0,57000**	**15**	**10,0**	0,15	0,026	22,07	1958	74%
2	**Hispalyt double hollow brick 930 kg/m³**	**0,375**	**70**	**10,0**	0,70	0,187	24,55	1534	50%
3	**mineral wool**	**0,040**	**150**	**1,0**	0,15	3,750	74,33	1443	4%
4	**EW1_eq 1/2 foot perforated brick 1020 kg/m³ & steel mesh**	**0,596**	**115**	**10,0**	1,15	0,193	76,89	747	2%
5									
6									
7									
8									
9									
10									
0	Rse - Exterior surface					0,130	76,89	747	2%
e	Exterior air						**78,62**	**747**	**70%**

Total Values	**35,00**		**2,15**	**4,416**	**-13,27**	**1,21E-07**	**0**
	[cm]		[m]	[m²K/W]	**q tot** [W/m2]	**g** [kg/(m²s)]	Cond. Interfaces
Radiation effect Active		Surfaces DT					
Exterior Sol-Air Temperature	**78,62**	**1,73**	**58,62**	SRI value **25**		Aged SRI value	**23**
	[°C]	[Int DT°C]	[Ext-Int DT°C]	[-]			[-]

Verifications

	Condensation Rsi 0,25 [° C]		
	T_{min}	T_{si} Project	Verified
13	17,89	**23,23**	**Yes**

1

	Mold growth Rsi 0,25 [° C]		
13 / 1	T_{min}	T_{si} Project	Verified
66	21,49	**23,23**	**Yes**

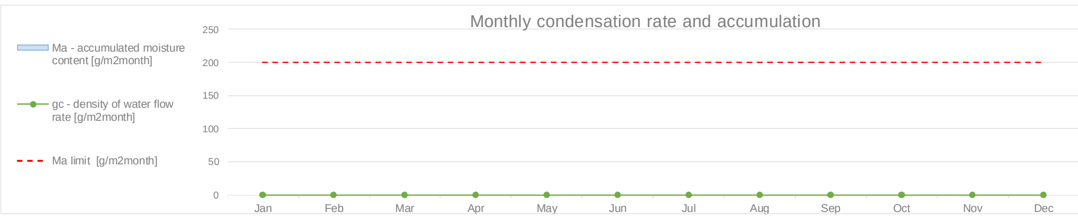
30

	f_{Rsi}		
125	$f_{Rsi\ min}$	f_{Rsi} Project	Verified
	0,82	**0,94**	**Yes**

gc [g/m² * h]
g_c
0,00

U-Value [W/(m²K)]		
min	Project	Verified
0,300	**0,226**	**Yes**

Monthly Condensation rate and accumulation within the whole assembly



	1	2	3	4	5	6	7	8	9	10	11	12
Days	31	28	31	30	31	30	31	31	30	31	30	31
Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
gc - density of water flow rate [g/m²month]	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Ma - accumulated moisture content [g/m²month]	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Ma limit [g/m²month]	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 - Long term evaluation

Verifications

Assembly no.		Verification status:
Wall .1		**Assembly verified**

	Verification status per month: Is the 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
	One or more months have internal surface condensation temperature not verified. Please revise the assembly.											
Mold growth Rsi 0,25 [° C]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	One or more months have internal surface mould growth temperature below the mould growth surface temperature											
f_{Rsi}	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Temp. factor at the internal surface	One or more months have the temperature factor at the internal surface not verified. Please revise the assembly.											
Ma [g/m2month]	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Max acc. Moisture content	Condensation is completely evaporated											
Ma [g/m2month]												Yes
Moisture evaporation	Maximum accumulation of condensate does not exceed the Ma limit											
Drying potential												Yes
Over 10 years	The drying potential of building component is verified over a period of 10 years.											