



Report - Certified Passive House Component | Bericht - Zertifizierte Passivhaus Komponente

Passive House Institute

Recommended for | Empfohlen für
Cold climate | Kaltes Klima



Passive House Institute
Rheinstraße 44/46
64283 Darmstadt
GERMANY

+49.6151.82699.0

mail@passiv.de
www.passiv.de

Product | Produkt: **ENERsign primus**

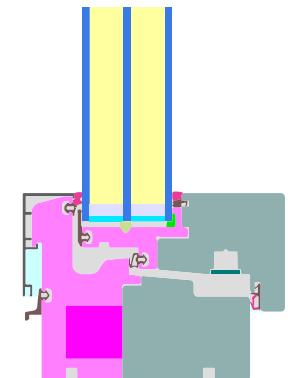
Client | Auftraggeber: **ENERsign GmbH**

Spacer | Abstandhalter: **SWISSPACER Ultimate**

Date | Datum: **06.03.2018**

Author | Autor: **Dr.-Ing. Benjamin Krick**

Window system
Fenstersystem
1194ws02



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.

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.

Wird keine gezielte Heizwärmefuhr unter den Fenstern vorgesehen, darf der Wärmedurchgangskoeffizient der

If no radiator is placed under the window, its thermal transmittance U_w (U-value) may not exceed a climate-dependent value in order to prevent unpleasant radiation losses and cold down droughts. For a given quality of glazing, this results in restriction of the thermal losses of the window frame and the glass edge. In that context, the installation situation of the window in the wall is relevant. Because of that, a $U_{w,\text{installed}}$ exemplary tested for the certification has been defined.

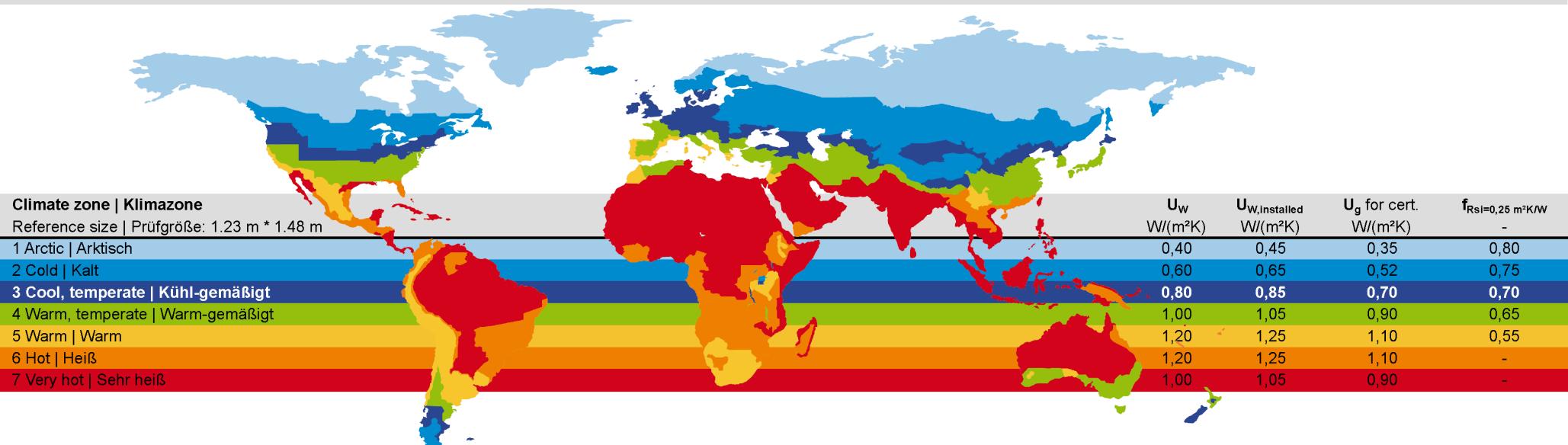
verwendeten Fenster (Fenster-U-Wert) U_w einen vom Klima abhängigen Höchstwert nicht überschreiten, damit es nicht zu störendem Strahlungswärmeentzug und Kaltluftabfall am Fenster kommt. Daraus ergeben sich bei gegebener Verglasungsqualität Grenzen für den Wärmeverlust im Bereich des Fensterrahmens. In diesem Kontext ist die Einbausituation des Fensters relevant. Darum wurde auch für $U_{w,\text{eingebaut}}$ ein Maximalwert festgelegt, der im Rahmen der Zertifizierung beispielhaft geprüft wurde.

Also the hygiene criterion must be met. For reasons of hygiene, this criterion limits the minimum individual temperature on window surfaces to prevent condensate and mold growth.

The below stated requirements for awarding the label "Certified Passive House Component" have been set by the Passive House Institute (PHI).

Des Weiteren ist das Hygienekriterium zu erfüllen. Dieses Kriterium begrenzt die minimale Einzeltemperatur an der Innenseite der Fensteroberfläche, um Tauwasserausfall und Schimmelbildung zu vermeiden.

Durch das Passivhaus Institut (PHI) wurden die unten stehenden Anforderungen zum Erlangen der Auszeichnung "Zertifizierte Passivhaus Komponente" festgesetzt.



Certified windows are ranked by the thermal losses through the not transparent parts. These **efficiency classes** include the U-Value of the frame, the frame width, the Ψ -Value of the Glass edge and the length of the Glass edge.

Relevant for passive houses is the energy balance, the sum out of losses and gains. Because the solar gains are difficult to quote it is useful to rate the parts of the window, which do not allow solar gains. This is determined by Ψ_{opaque} .

Die Fenster werden abhängig von den Wärmeverlusten durch den opaken Teil in **Effizienzklassen** eingestuft. In diese Wärmeverluste gehen die Rahmen-U-Werte, die Rahmenbreiten, die Glasrand- Ψ -Werte und die Glasrandlängen ein. Für das Passivhaus ist die Bilanz aus Wärmeverlusten und Wärmegewinnen relevant. Da die solaren Gewinne schwer fassbar sind, ist es zweckmäßig, die Verluste über die Bereiche zu quantifizieren und zu einer Bilanzierung heran zu ziehen, über die keine solaren Gewinne möglich sind. Dies leistet Ψ_{opak} .

$$\Psi_{\text{opak}} = \Psi_g + \frac{U_f \cdot A_f}{l_g}$$

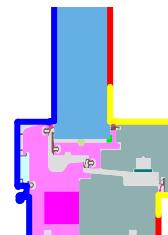
max. Ψ_{opak} [W/(mK)]	Efficiency class Effizienzklasse	Name Bezeichnung
0,065	phA+	Very advanced component
0,110	phA	Advanced component
0,155	phB	Basic component
0,200	phC	Certifiable component

The simulation of the thermal values of the frame sections are based on the regulations of the standard ISO 10077-1:2010 and 10077-2:2012. The thermal conductivities of the used materials refer to relevant standards, technical approvals or have been determined by measured values according to ISO 10077-2:2012, chapter 5.1. In case of one glazing, the models are to 40 cm height, in case of 2 glazing 60 cm in height.

The **spacers** were modeled according to the actual 2-Box-models of the working group "Warm Edge" of

Die **Berechnung der thermischen Kennwerte** der Rahmenschnitte erfolgte auf der Grundlage der ISO 10077-1:2010 und 10077-2:2012. Die Wärmeleitfähigkeiten stammen aus einschlägigen Normen, bauaufstichtlichen Zulassungen oder wurden anhand von messwerten nach den Regeln der ISO 10077-2:2012 Abschnitt 5.1 determiniert. Dabei sind die Modelle mit einem Glasteil stets 40 cm, Modelle mit 2 Glasteilen stets 60 cm hoch.

Zur Abbildung der **Abstandhalter** wurde auf die jeweils aktuellen 2-Box-Modelle des Arbeitskreises Warne Kante des Bundesverbandes Flachglas zurückgegriffen.



Randbedingung
Adiabatic | Adiabat
Exterior | Außen
e 0,9 Cavity | Hohlräum
fRsi: Interior | Innen

q[W/m²] θ[°C] R[(m²·K)/W] ε
0,000 -10,000 0,040 0,900
-10,000 20,000 0,130
20,000 20,000 0,200
0,900

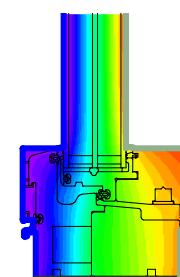
the Federal glass association (Bundesverband Flachglas) of Germany. Thermal bridge coefficients were calculated for typical **installation situations**. These values may be used in case of identical installations only in energy balance calculations. The wall-models are 1.41 m in height, glass and frame are 40 cm height, the installation gap is 1 cm.

For modeling and simulations, the software Flixo 7 of Infomind was used. For the used **boundary conditions**, please have a look at following drawings and tables.

Die **Wärmebrückenverlustkoeffizienten** wurden beispielhaft für typische **Wandaufbauten** berechnet. Diese dürfen in der Gebäudeenergiebilanzierung nur bei identischer Konstruktion zum Ansatz gebracht werden. Die Modelle für Wandaufbauten sind stets 1,41 m hoch, wobei die Höhe des Glases und Rahmens 40 cm beträgt. Es wird eine Einbaufuge von 1 cm angesetzt.

Zur Berechnung der Bildung der Modelle und zur Berechnung der Wärmeströme wurde das Programm Flixo 7 Professional der Firma Infomind genutzt. Die Randbedingungen wurden wie unten gezeigt angesetzt.

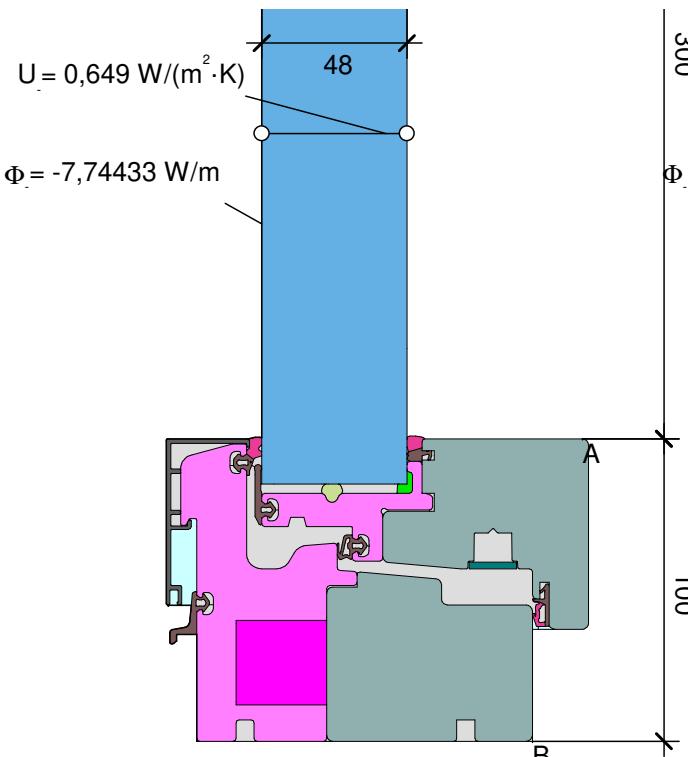
Randbedingung	q[W/m ²]	θ[°C]	R[(m ² ·K)/W]	ε
Adiabatic Adiabat	0,000			
Exterior Außen	-10,000		0,040	
e 0,9 Cavity Hohlräum	20,000		0,900	
fRsi: Interior Innen	20,000		0,250	



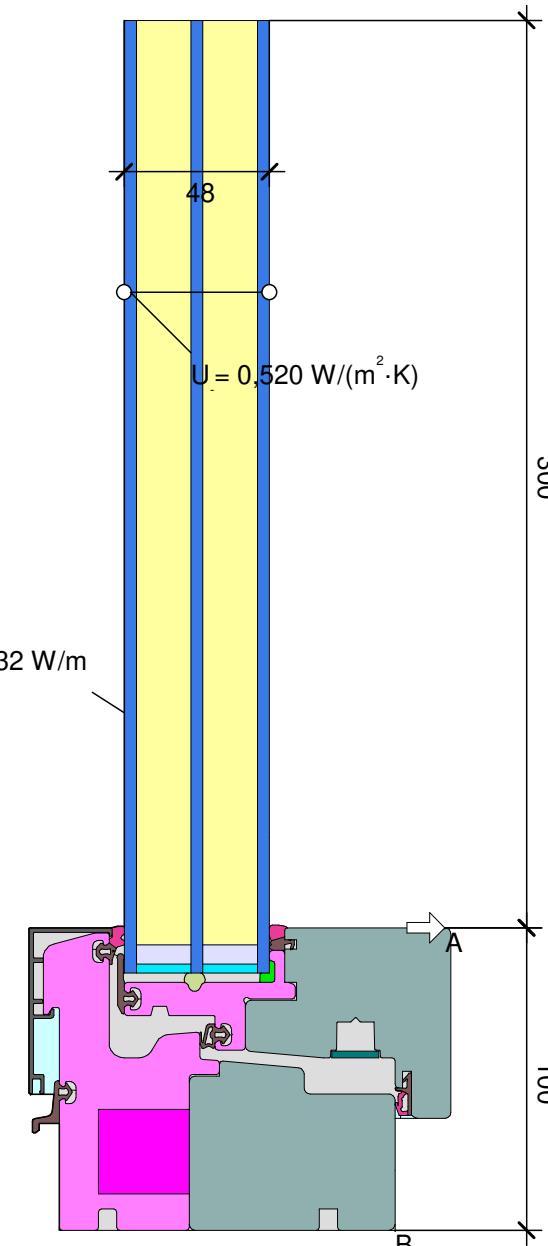
	ENERsign GmbH		bo Bottom	to Top	s Side	bof Bottom fixed	tof Top fixed	sf Side fixed	th Thresh- hold	sh Side door	fm Flying mullion	ec2 Corner	m1 Mullion	m Mullion fixed	ec Corner	t1 Transom	t1 Transom	t Transom fixed
ENERsign primus		Unten	Oben	Seitl.	Unten fest	Oben fest	Seitl. fest	Schwe- lle	Seite Tür	Stulp	Ecke	Pfosten fest	Ecke	Riegel	Riegel	Riegel fest		
Spacer I Abstandhalter: SWISSPACER Ultimate																		
frame values Rahmenwerte	Temperaturefactor Temperaturfaktor	$f_{Rsi=0,25m^2k/W}$	0,77	0,77	0,77	0,78	0,78	0,78	0,71	0,74	0,77	0,78	0,77	0,78	0,75	0,77	0,77	0,78
frame values Rahmenwerte	Frame width Rahmenbreite	b_f [mm]	100	100	100	100	100	100	100	171	100	594	120	120	342	120	120	120
	U-value frame Rahmen-U-Wert	U_f [W/(m ² K)]	0,64	0,64	0,64	0,61	0,58	0,58	1,09	0,70	0,65	0,28	0,63	0,58	0,31	0,66	0,64	0,61
	Ψ_g [W/(mK)]	0,020	0,020	0,020	0,019	0,019	0,019	0,022	0,022	0,020	0,019	0,020	0,019	0,019	0,020	0,020	0,019	
	U-value window Fenster-U-Wert	U_w [W/(m ² K)] @Ug= 0,52 W/(m ² K)	0,603				0,588											
	Ψ_{opaque} Ψ_{opak}	Ψ_{opaque} W/(mK)	0,089				0,083											
	Passive House efficiency class Passivhaus Effizienzklasse	phA				phA												
Installation Einbau	EIFS WDVS U-Wall = 0,102 W/(m ² K)										Contact person Ansprechpartner							
	$\Psi_{install}$ [W/(mK)]	0,011	-0,002	-0,002	0,011	-0,002	0,000			0,028	ENERsign GmbH, Josef Schilz + 49 (0)6571 95398 0 info@enersign.com							
	$U_{W, installed}$ [W/(m ² K)]	0,61				0,59												
	Lightweight timber construction Holzleichtbau U-Wall = 0,102 W/(m ² K)										Construction: Aluminium cladded timber frame (0,11 W/(mK)), insulated by ENERcell (0,06 W/(mK)) and EPS-Foam (0,032 W/(mK)). Q100 = 0,16 m ³ /(hm) tested at a window with flying mullion Stulpfenster (2,26 * 2,51 m).							
	$\Psi_{install}$ [W/(mK)]	0,030	0,015	0,008	0,030	0,015	0,008											
	$U_{W, installed}$ [W/(m ² K)]	0,65				0,63												
	Formwork blocks Betonschalungsstein U-Wall = 0,114 W/(m ² K)										Konstruktion: Holz-Aluminium Integralrahmen (Fichte/Tanne 0,11 W/(mK)) mit Dämmung aus ENERcell (0,06 W/(m ² K)) und EPS (0,032 W/(mK)). Q100 = 0,16 m ³ /(hm) based on a window (2,26 * 2,51 m).							
	$\Psi_{install}$ [W/(mK)]	0,029	0,011	0,000	0,029	0,011	0,002											
	$U_{W, installed}$ [W/(m ² K)]	0,63				0,62												
	Ventilated facade Vorhangsfassade U-Wall = 0,133 W/(m ² K)										Calculation Berechnung Passivhaus Institut Darmstadt 06.03.2018							
	$\Psi_{install}$ [W/(mK)]																	
	$U_{W, installed}$ [W/(m ² K)]																	
	Cavity wall Zweischaliges Mauerwerk U-Wall = 0,130 W/(m ² K)																	
	$\Psi_{install}$ [W/(mK)]																	
	$U_{W, installed}$ [W/(m ² K)]																	



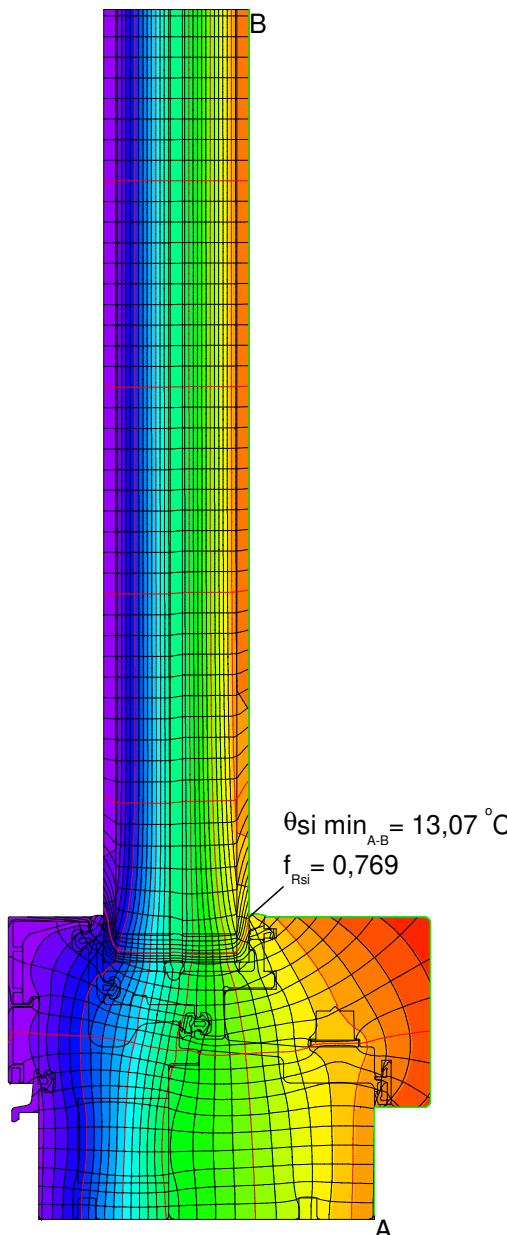
- █ Aluminum | Aluminium 10456
- █ Ar18 in 48 mm U 0,52
- █ ENERcell
- █ EPDM
- █ EPDM foam | Moosgummi
- █ Glass | Glas
- █ Glue | Klebestoff
- █ Insulation Wärmedämmung 032
- █ PE-Insulation | Wärmedämmung 035
- █ PU-Seal | PU Dichtung
- █ SWISSP. Ultimate Box 2
- █ Spruce, Fir | Fichte, Tanne
- █ Steel | Stahl
- █ Unvent. cavity | unbel. Hohlr. **
- █ slightly vent. cav. | leicht bel. Hohlr. *
- █ ** EN ISO 10077-2:2017, 6.4.3



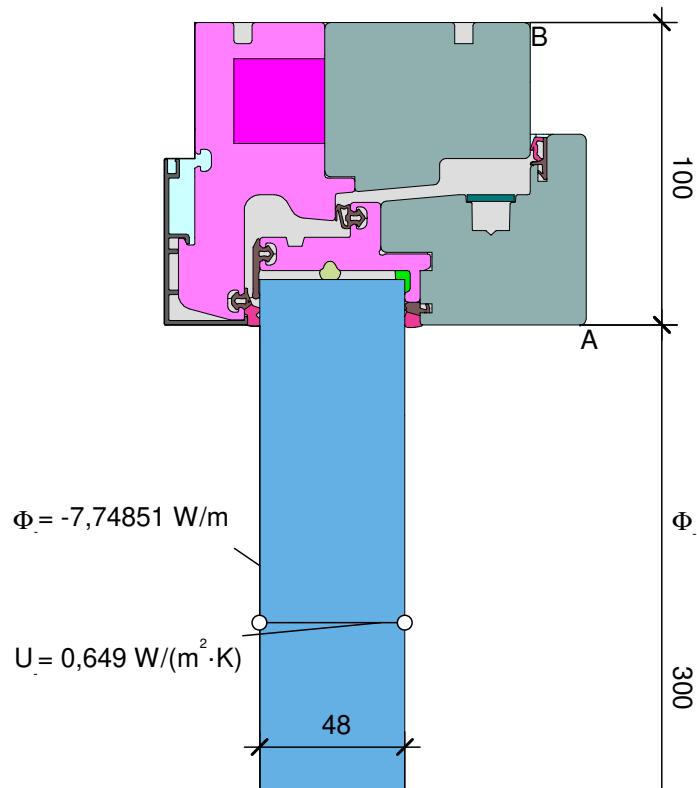
$$U_{A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_i} = \frac{\frac{7,744}{30,000} - 0,649 \cdot 0,300}{0,100} = 0,635 \text{ W/(m}^2\text{K)}$$



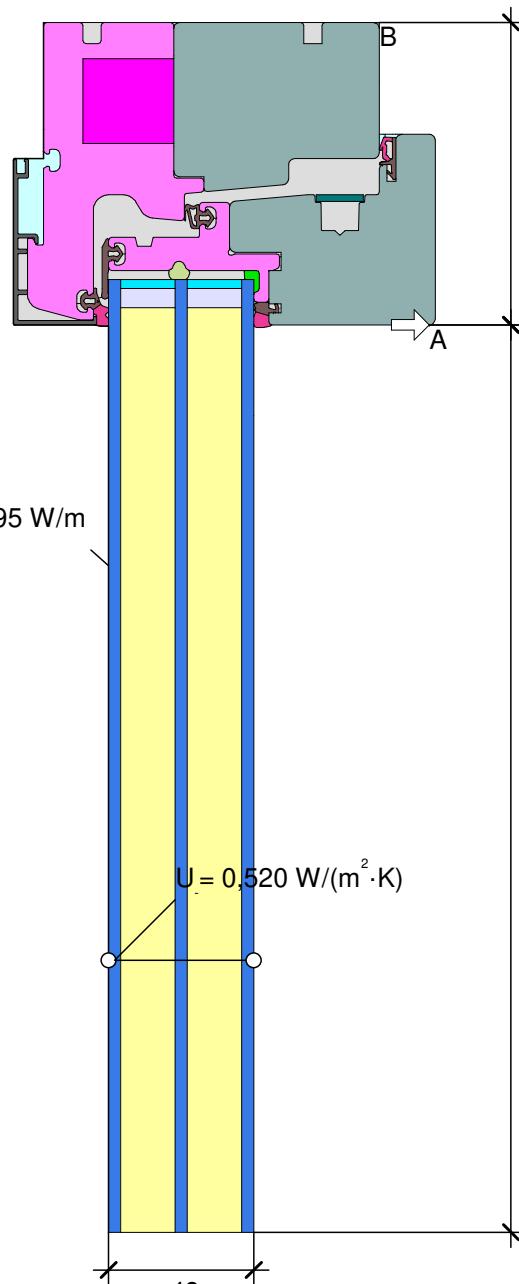
$$\psi_A = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{7,188}{30,000} - 0,520 \cdot 0,300 - 0,635 \cdot 0,100 = 0,020 \text{ W/(m}\cdot\text{K)}$$



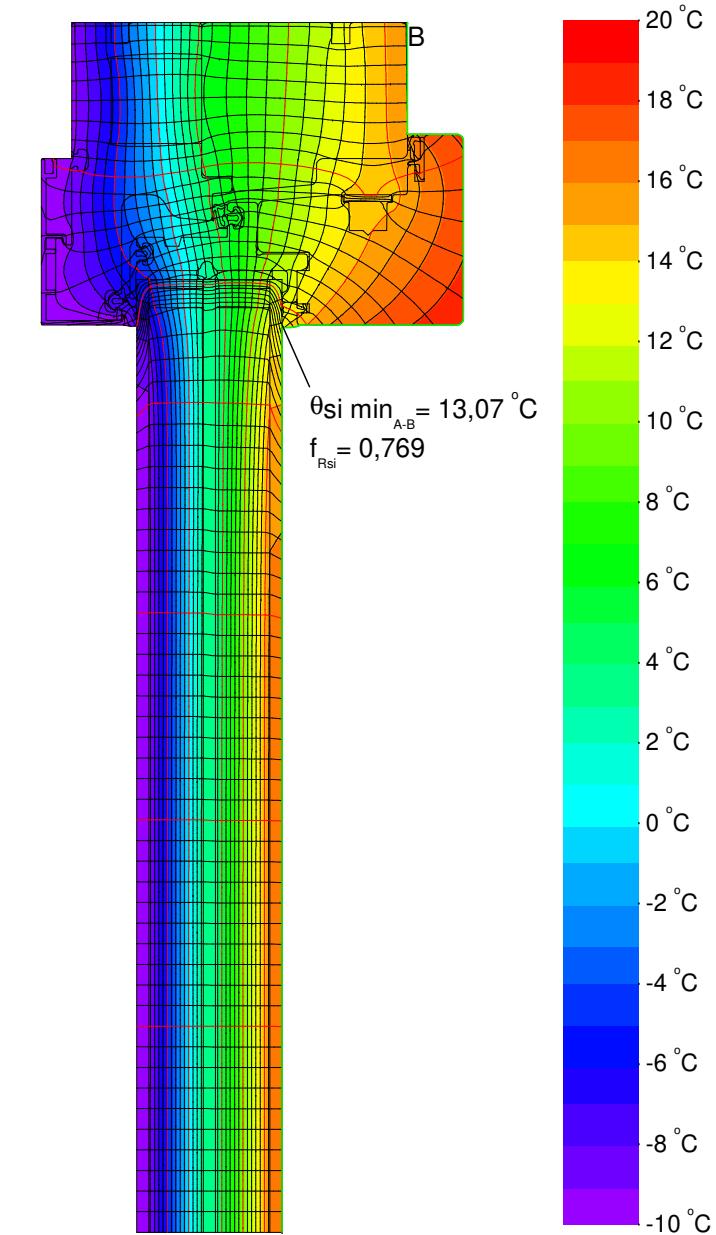
bo - BOTTOM | UNTER



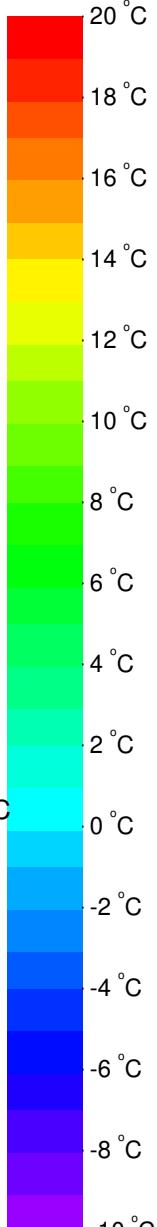
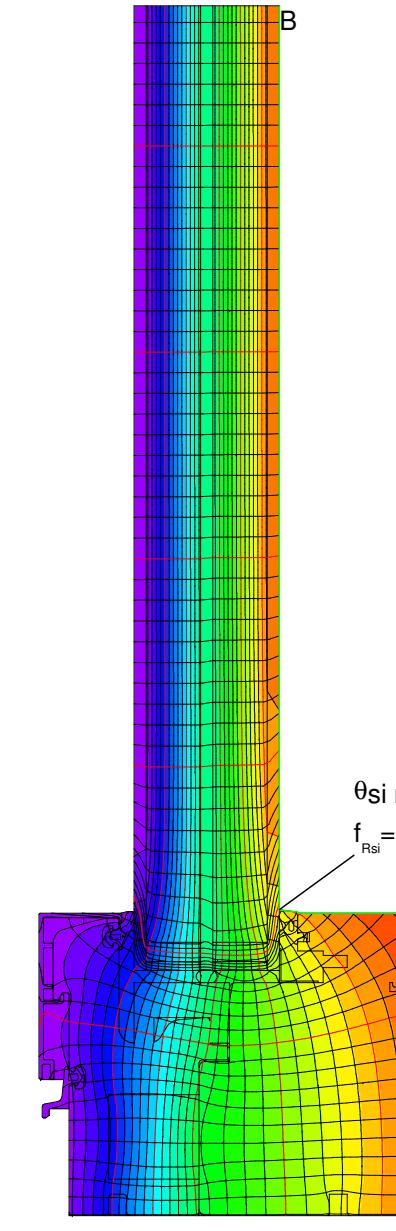
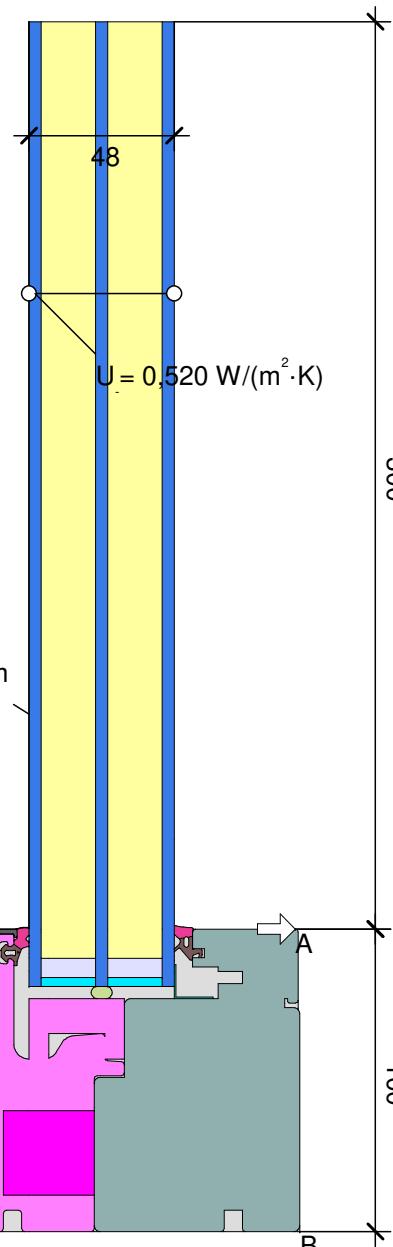
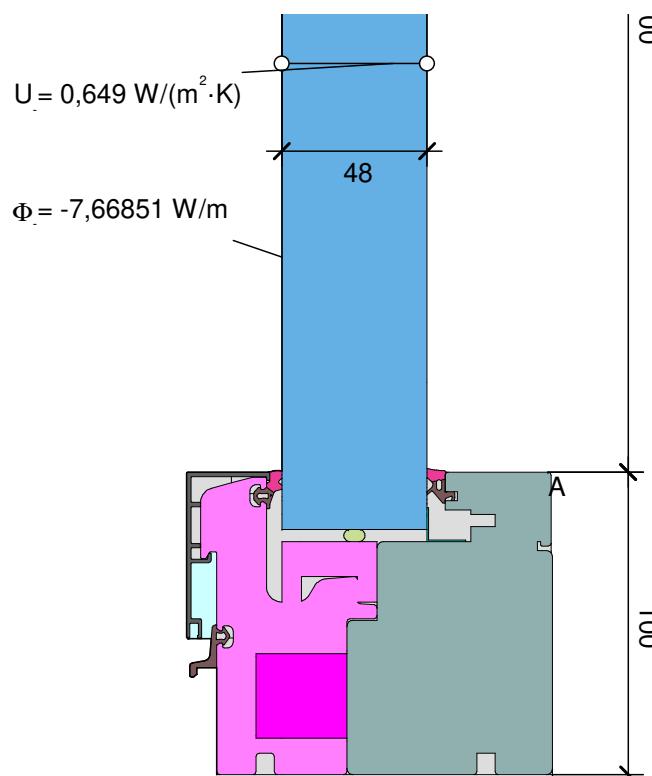
$$U_{f,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{7,749}{30,000}}{0,100} - 0,649 \cdot 0,300 = 0,637 \text{ W/(m}^2\cdot\text{K)}$$



$$\Psi_A = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{7,192}{30,000} - 0,520 \cdot 0,300 - 0,637 \cdot 0,100 = 0,020 \text{ W/(m}\cdot\text{K)}$$



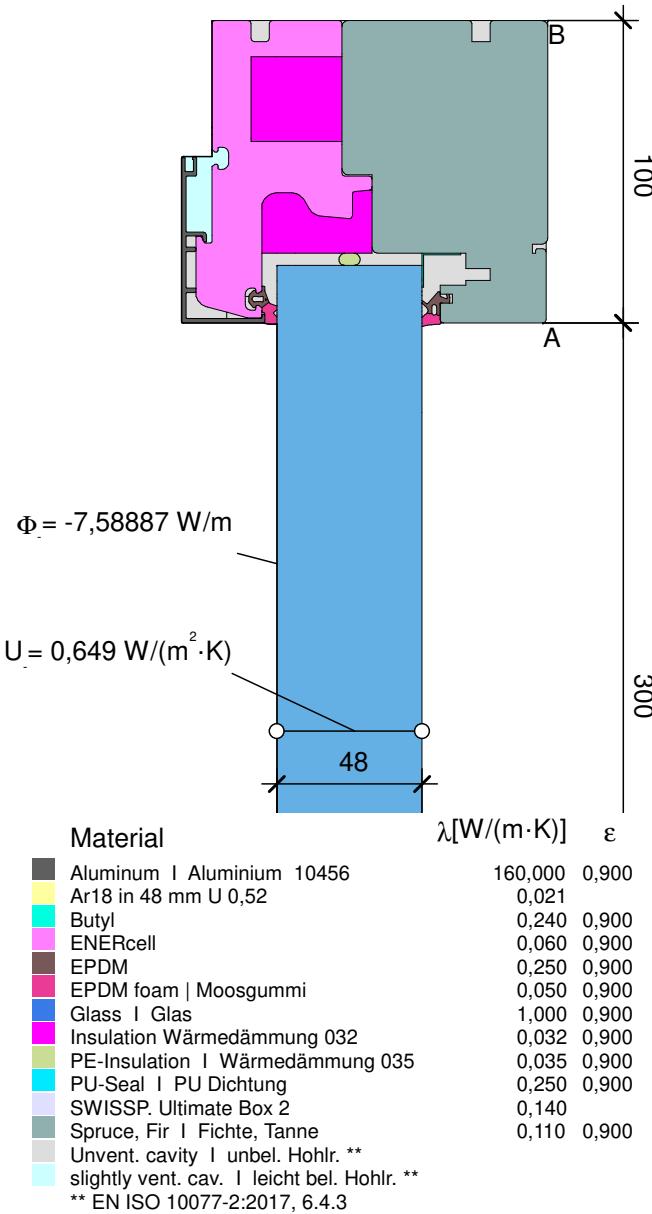
Material	$\lambda [W/(m \cdot K)]$	ϵ
Aluminum I Aluminium 10456	160,000	0,900
Ar18 in 48 mm U 0,52	0,021	
Butyl	0,240	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glass I Glas	1,000	0,900
Insulation Wärmedämmung 032	0,032	
PE-Insulation I Wärmedämmung 035	0,035	0,900
PU-Seal I PU Dichtung	0,250	0,900
SWISSP. Ultimate Box 2	0,140	
Spruce, Fir I Fichte, Tanne	0,110	0,900
Unvent. cavity I unbel. Hohlr. **		
slightly vent. cav. I leicht bel. Hohlr. **		
** EN ISO 10077-2:2017, 6.4.3		



$$U_{f,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{7,669}{30,000} - 0,649 \cdot 0,300}{0,100} = 0,610 \text{ W/(m}^2\text{·K})$$

$$\psi_A = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{7,081}{30,000} - 0,520 \cdot 0,300 - 0,610 \cdot 0,100 = 0,019 \text{ W/(m·K)}$$

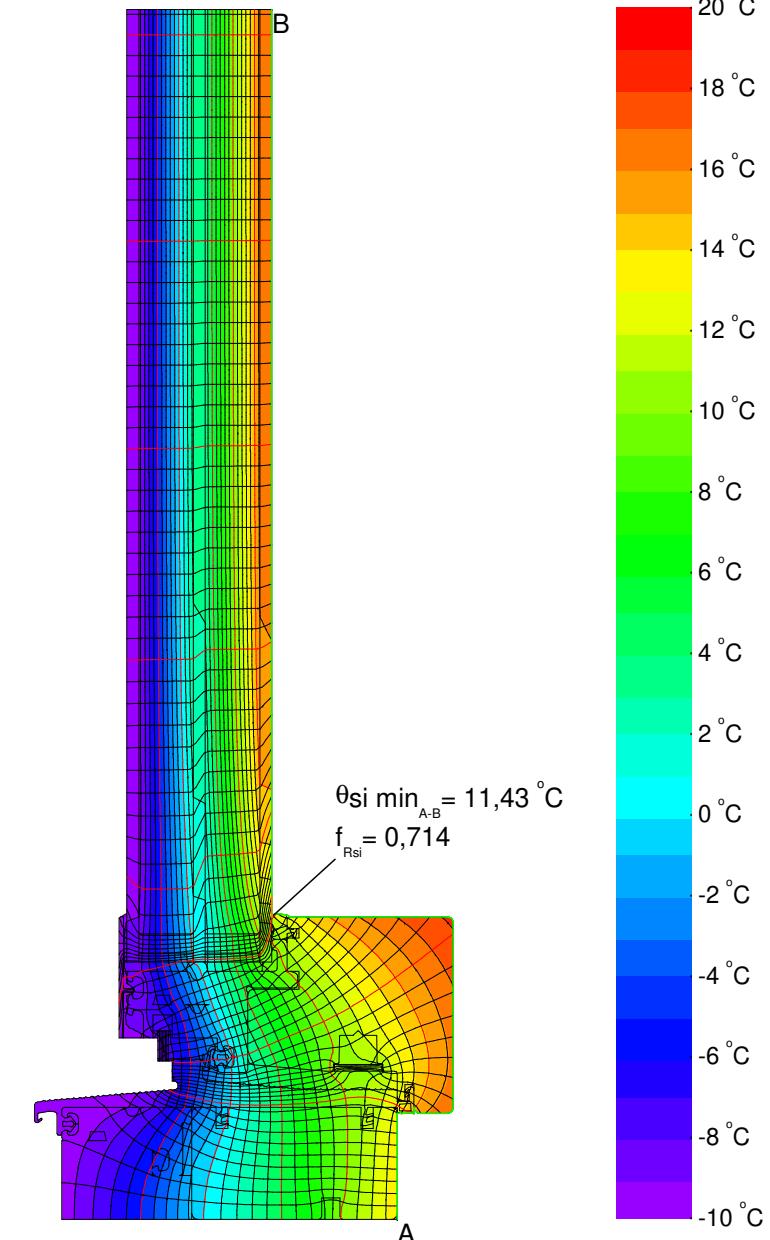
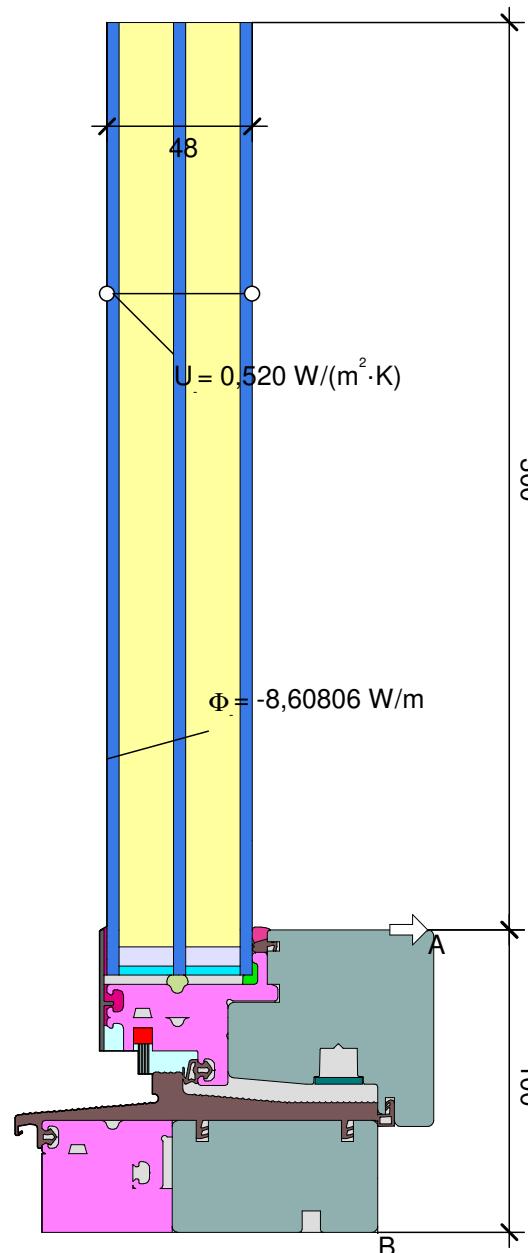
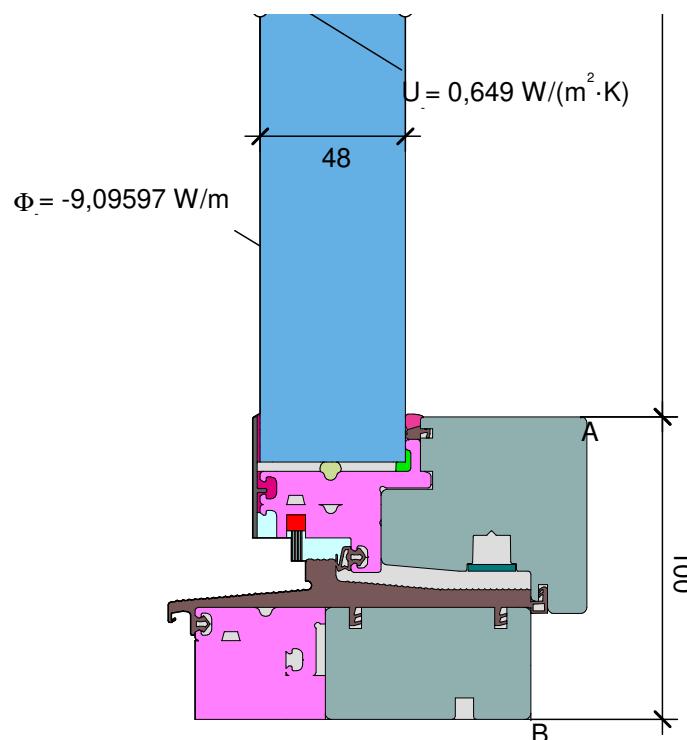




$$U_{f,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{7,589}{30,000}}{0,100} - 0,649 \cdot 0,300 = 0,583 \text{ W}/(\text{m}^2 \cdot \text{K})$$

$$\psi_A = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{7,002}{30,000} - 0,520 \cdot 0,300 - 0,583 \cdot 0,100 = 0,019 \text{ W}/(\text{m} \cdot \text{K})$$

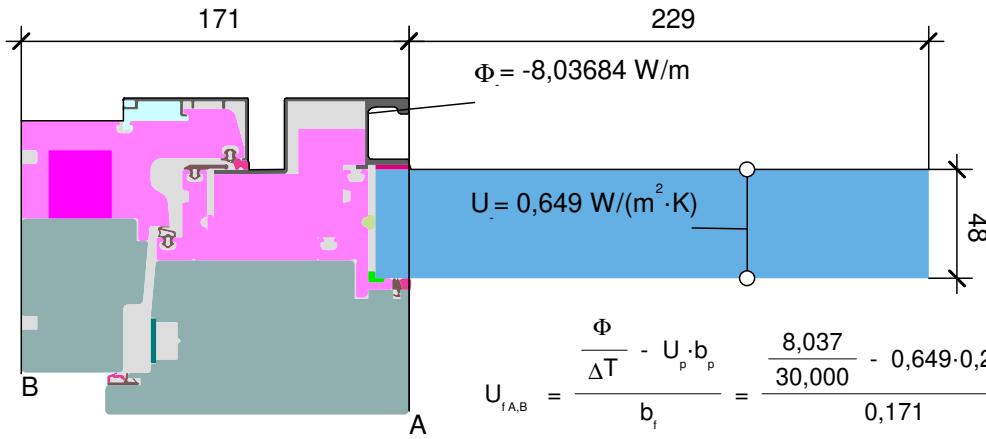
Material	$\lambda [W/(m \cdot K)]$	ϵ
Aluminum I Aluminium 10456	160,000	0,900
Ar18 in 48 mm U 0,52	0,021	
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glass I Glas	1,000	0,900
Glue I Klebestoff	0,310	0,900
PE-Insulation I Wärmedämmung 035	0,035	0,900
PU-Seal I PU Dichtung	0,250	0,900
Polyamide 25% Glassfiber	0,300	0,900
SWISSP. Ultimate Box 2	0,140	
Silicone I Silikon	0,350	0,900
Spruce, Fir I Fichte, Tanne	0,110	0,900
Steel I Stahl	50,000	0,900
Unvent. cavity I unbel. Hohlr. **		
slightly vent. cav. I leicht bel. Hohlr. **		
** EN ISO 10077-2:2017, 6.4.3		



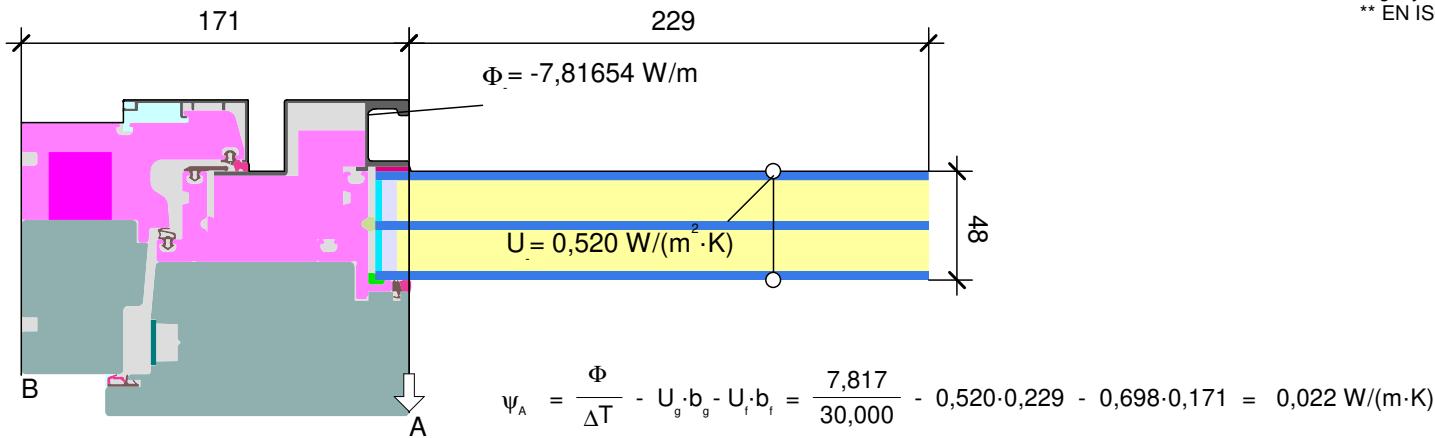
$$U_{f,A,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{9,096}{30,000} - 0,649 \cdot 0,300}{0,100} = 1,086 \text{ W}/(\text{m}^2 \cdot \text{K})$$

$$\Psi_A = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_i \cdot b_i = \frac{8,608}{30,000} - 0,520 \cdot 0,300 - 1,086 \cdot 0,100 = 0,022 \text{ W}/(\text{m} \cdot \text{K})$$

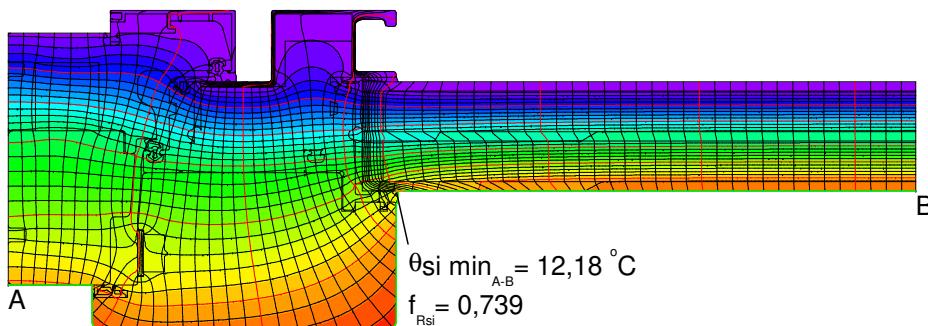




$$U_{fA,B} = \frac{\Phi}{\Delta T} - U_p \cdot b_p = \frac{8,037}{30,000} - 0,649 \cdot 0,229 = 0,698 \text{ W/(m}^2\cdot\text{K})$$

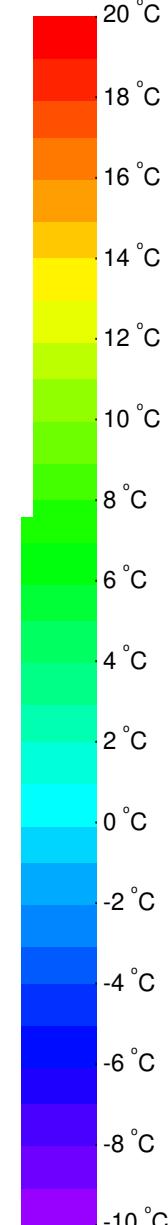


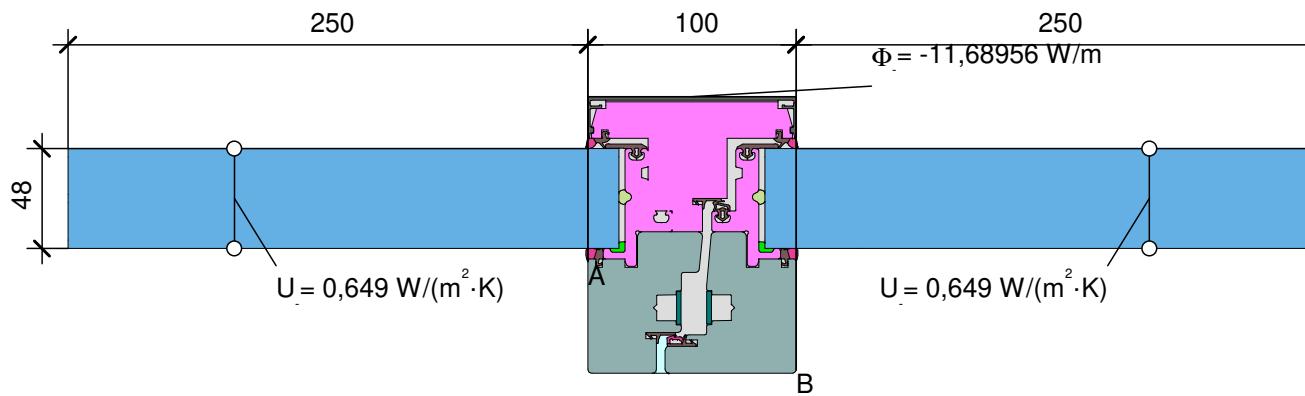
$$\psi_A = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{7,817}{30,000} - 0,520 \cdot 0,229 - 0,698 \cdot 0,171 = 0,022 \text{ W/(m}\cdot\text{K)}$$



Material

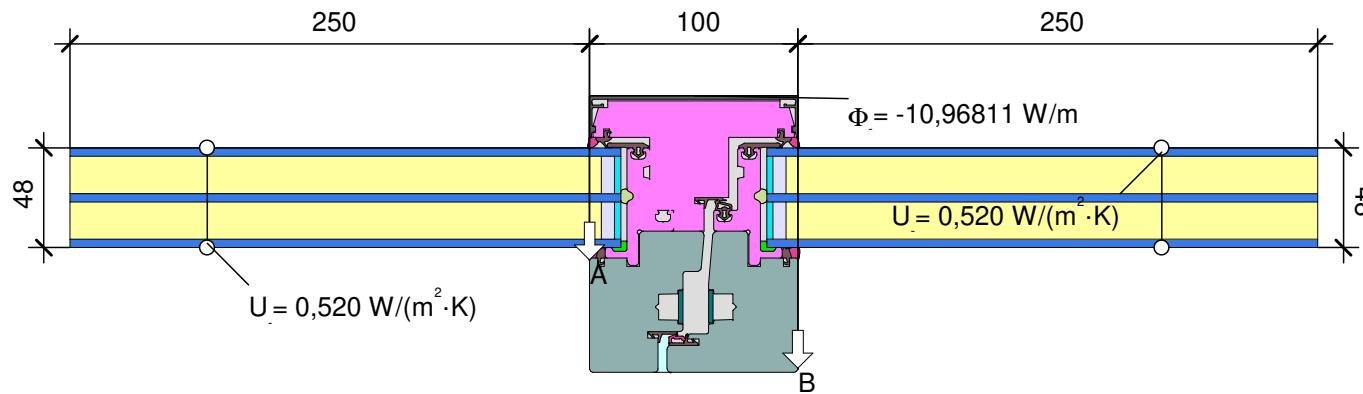
	$\lambda [\text{W}/(\text{m}\cdot\text{K})]$	ϵ
Aluminum Aluminium 10456	160,000	0,900
Ar18 in 48 mm U 0,52	0,021	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glass Glas	1,000	0,900
Glue Klebestoff	0,310	0,900
Insulation Wärmedämmung 032	0,032	
PE-Insulation Wärmedämmung 035	0,035	0,900
PU-Seal PU Dichtung	0,250	0,900
SWISSP. Ultimate Box 2	0,140	
Silicone Silikon	0,350	0,900
Spruce, Fir Fichte, Tanne	0,110	0,900
Steel Stahl	50,000	0,900
Unvent. cavity unbel. Hohlr. **		
slightly vent. cav. leicht bel. Hohlr. **		
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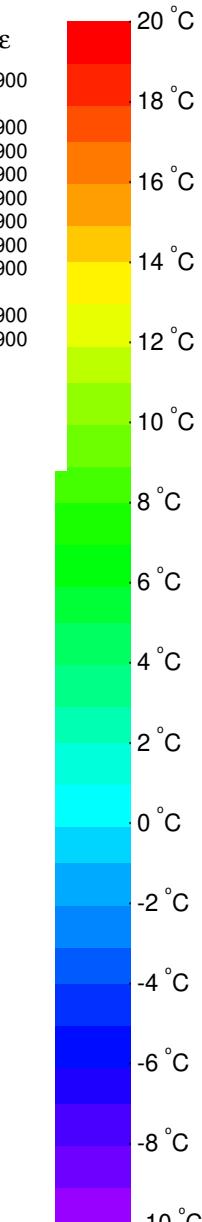
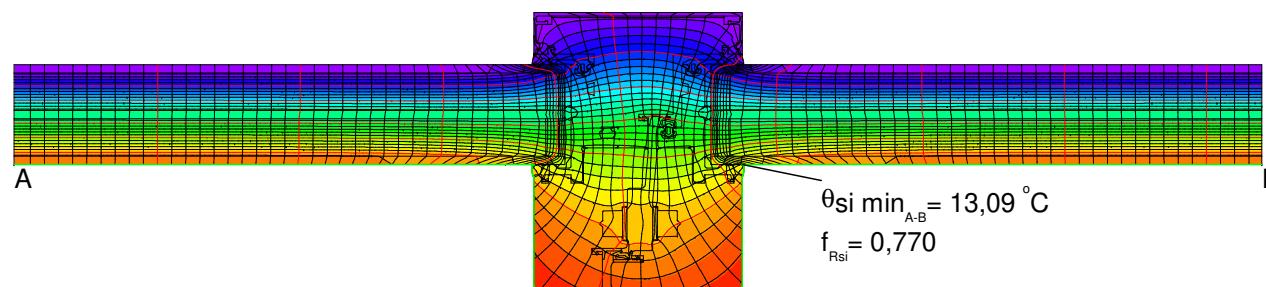


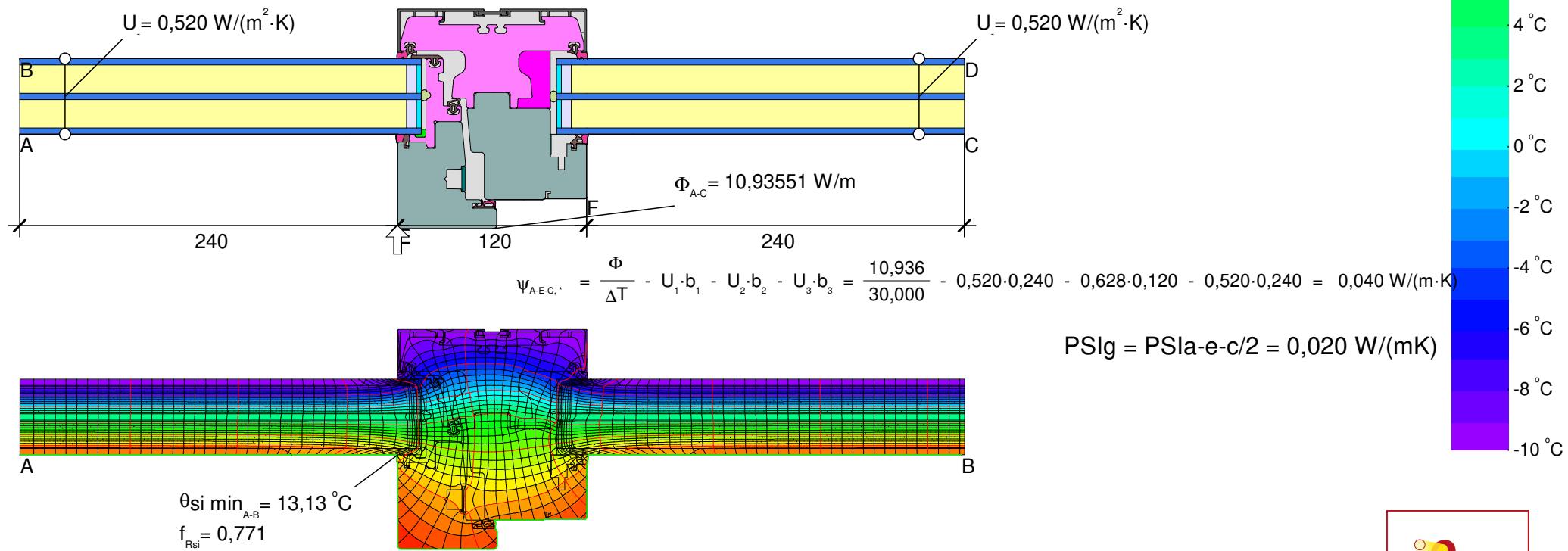
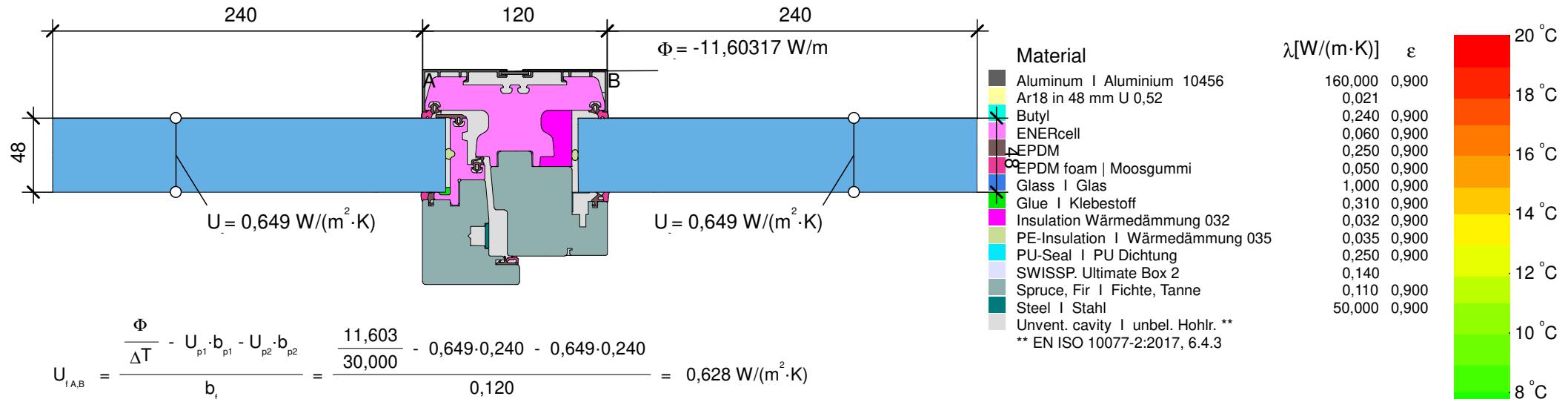
Material	$\lambda [W/(m \cdot K)]$	ϵ
Aluminum Aluminium 10456	160,000	0,900
Ar18 in 48 mm U 0,52	0,021	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glass Glas	1,000	0,900
Glue Klebestoff	0,310	0,900
PE-Insulation Wärmedämmung 035	0,035	0,900
PU-Seal PU Dichtung	0,250	0,900
SWISSP. Ultimate Box 2	0,140	
Spruce, Fir Fichte, Tanne	0,110	0,900
Steel Stahl	50,000	0,900
Unvent. cavity unbel. Hohlr. **		
slightly vent. cav. leicht bel. Hohlr. **		
** EN ISO 10077-2:2017, 6.4.3		

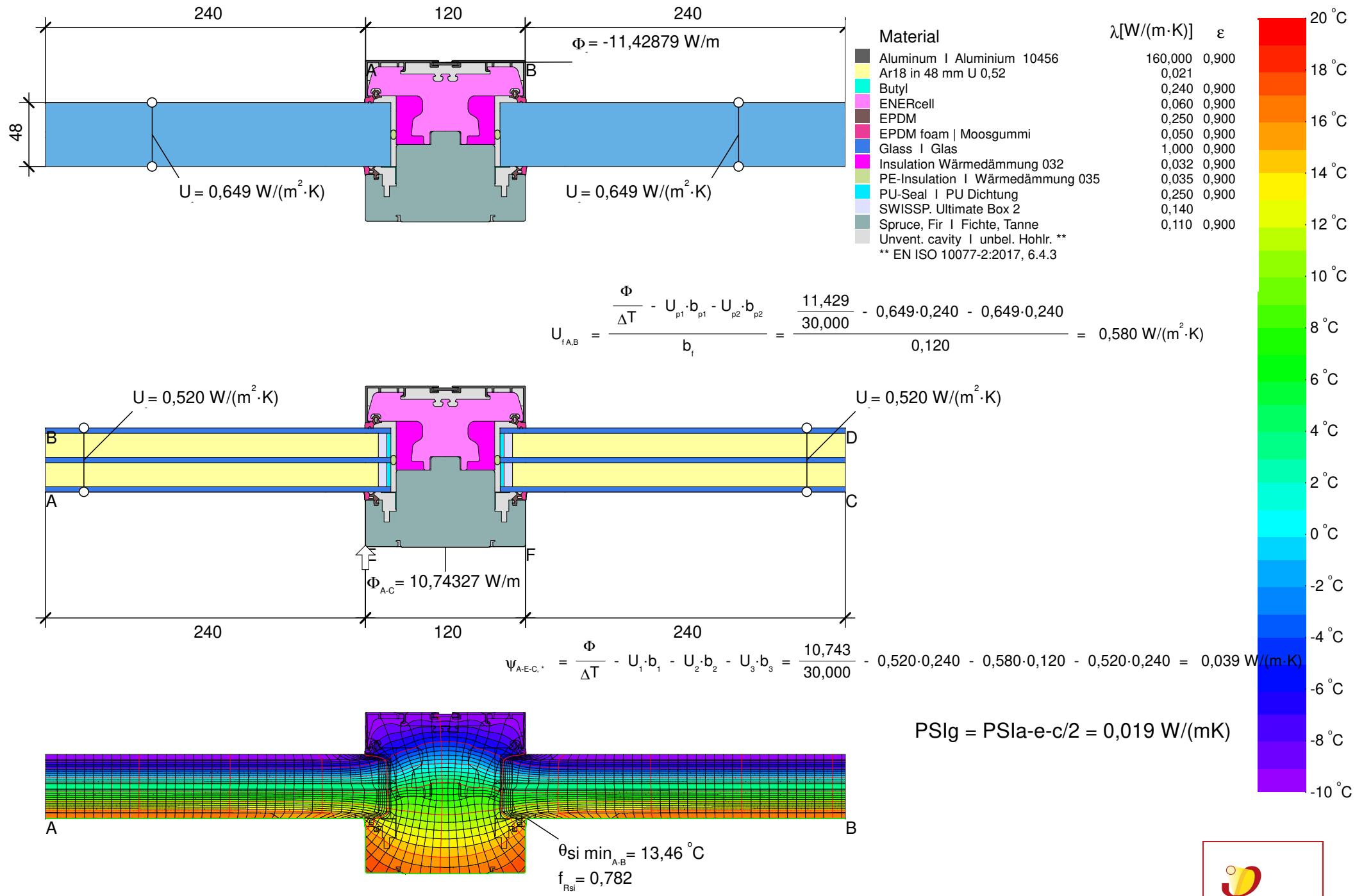
$$U_{f,A,B} = \frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2} = \frac{11,690}{30,000} - 0,649 \cdot 0,250 - 0,649 \cdot 0,250 = 0,653 \text{ W}/(\text{m}^2 \cdot \text{K})$$

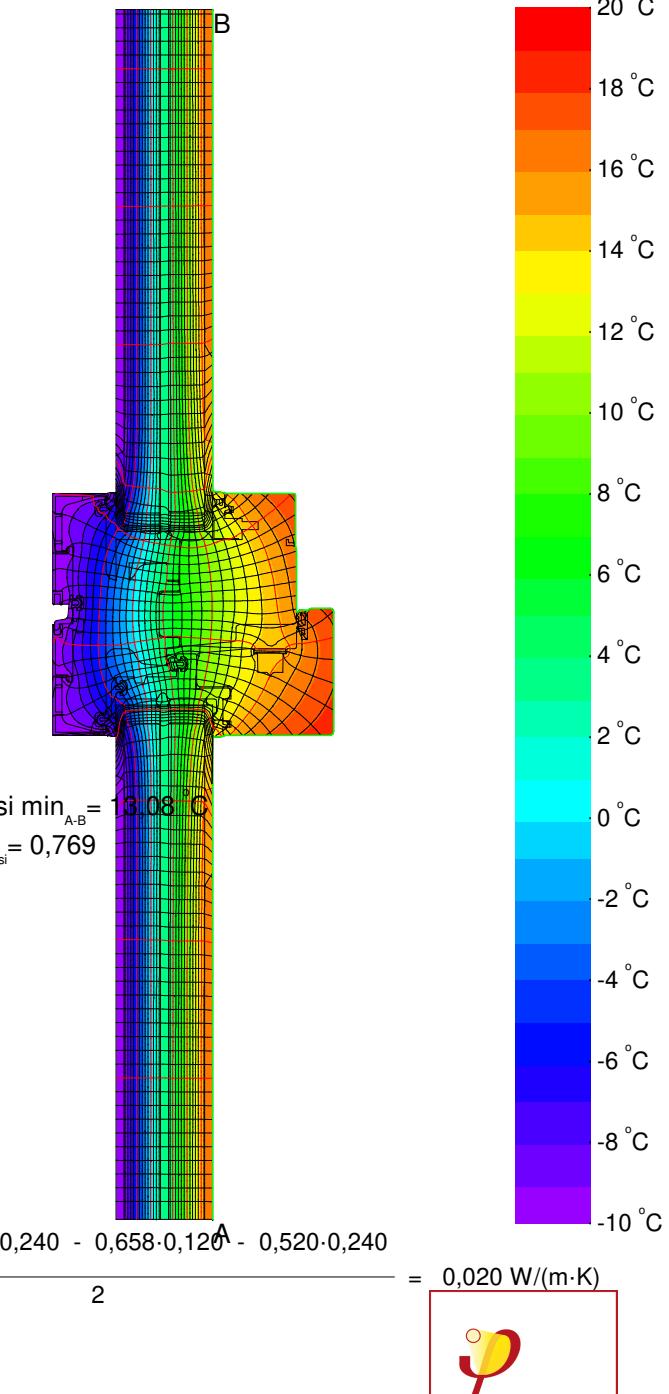
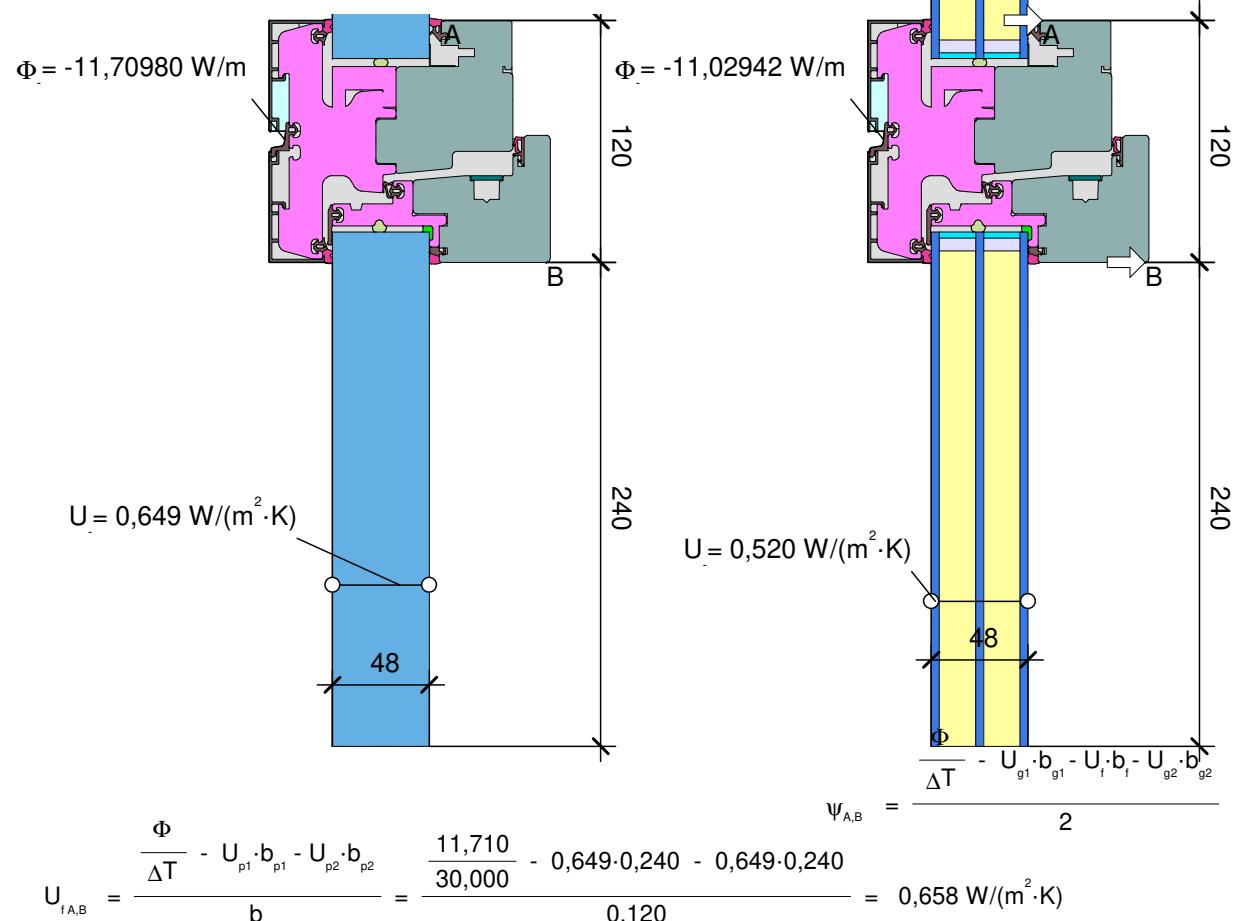
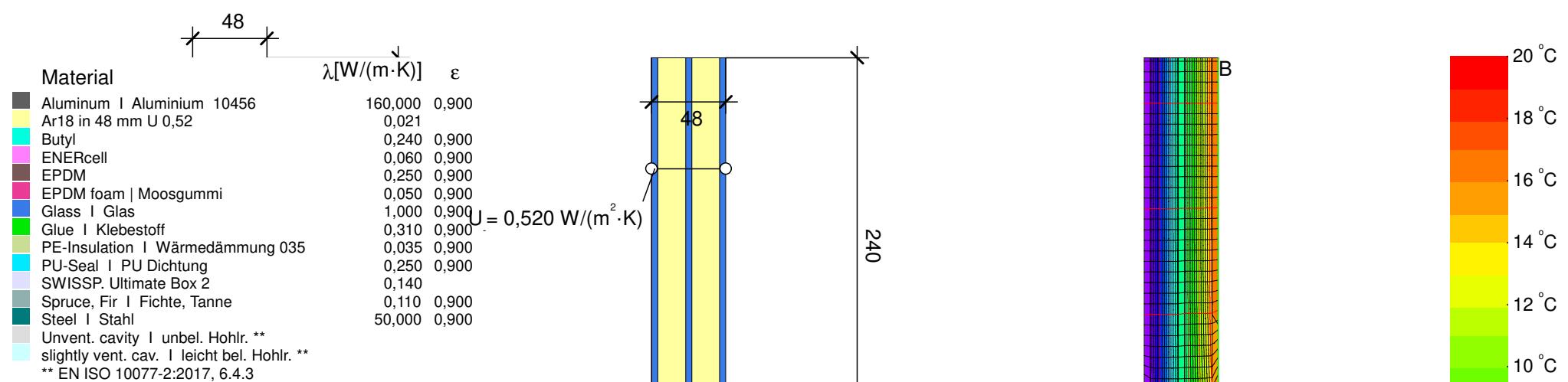


$$\psi_{A,B} = \frac{\Phi}{\Delta T} - \frac{U_g \cdot b_g}{2} - \frac{U_f \cdot b_f}{2} - \frac{U_g \cdot b_g}{2} = \frac{10,968}{30,000} - \frac{0,520 \cdot 0,250}{2} - \frac{0,653 \cdot 0,100}{2} - \frac{0,520 \cdot 0,250}{2} = 0,020 \text{ W}/(\text{m} \cdot \text{K})$$



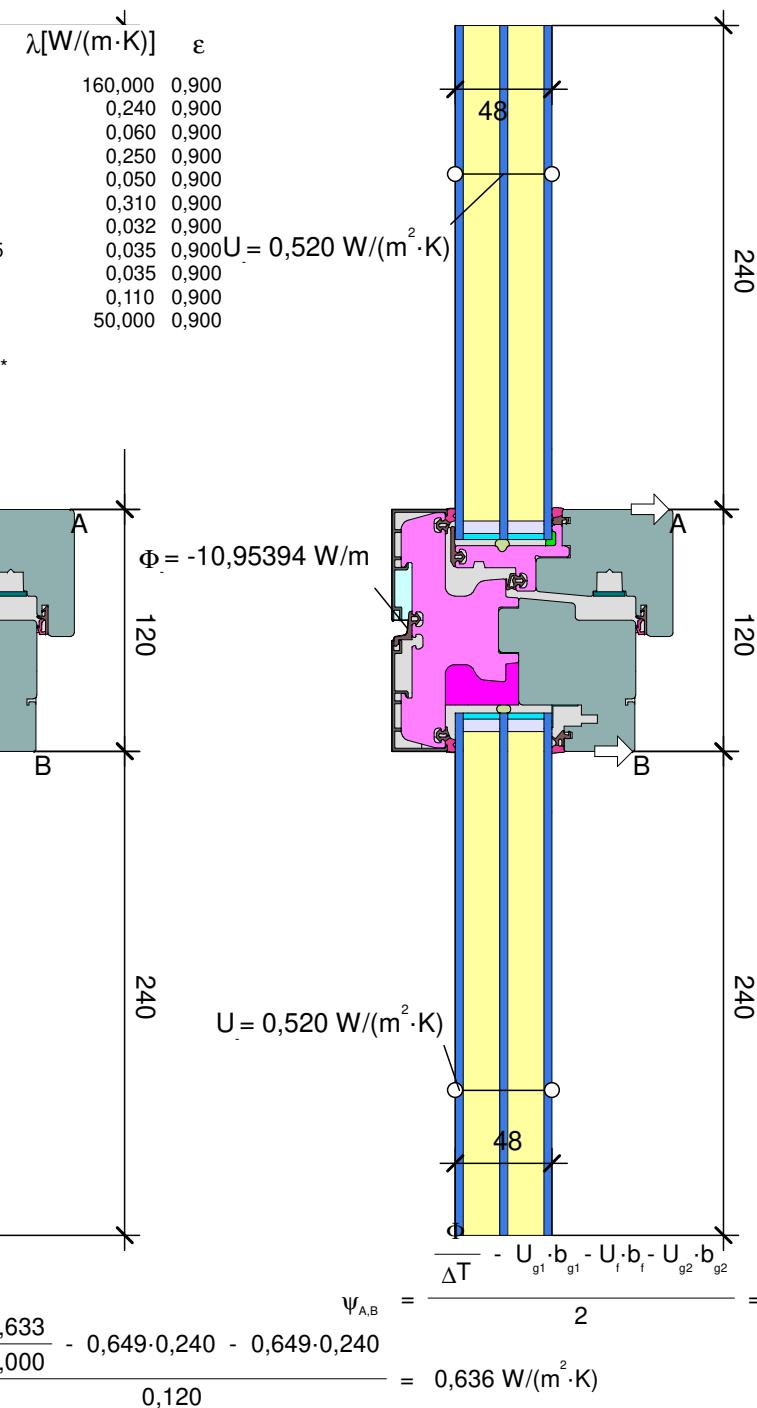
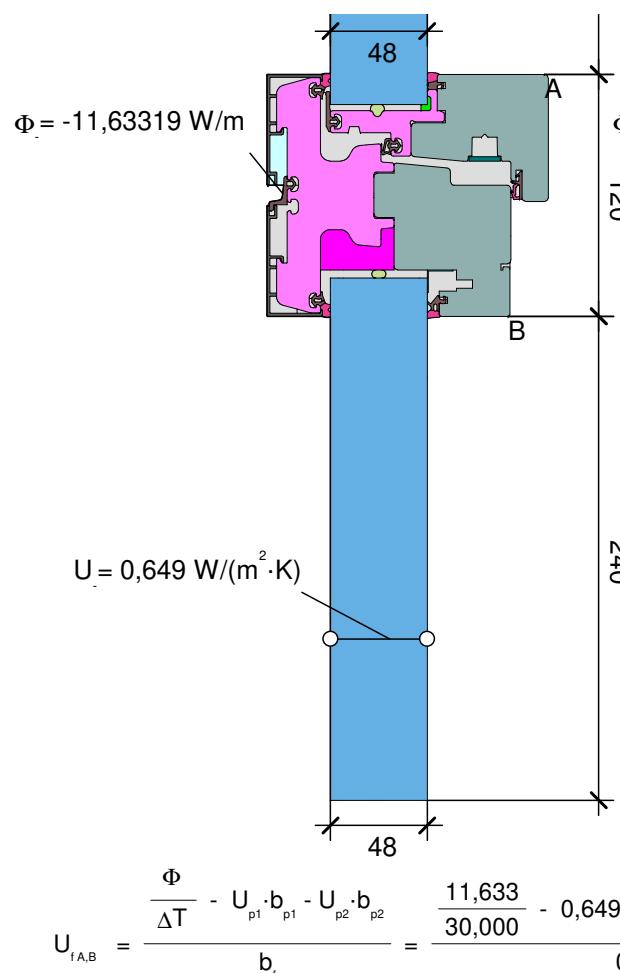






Material

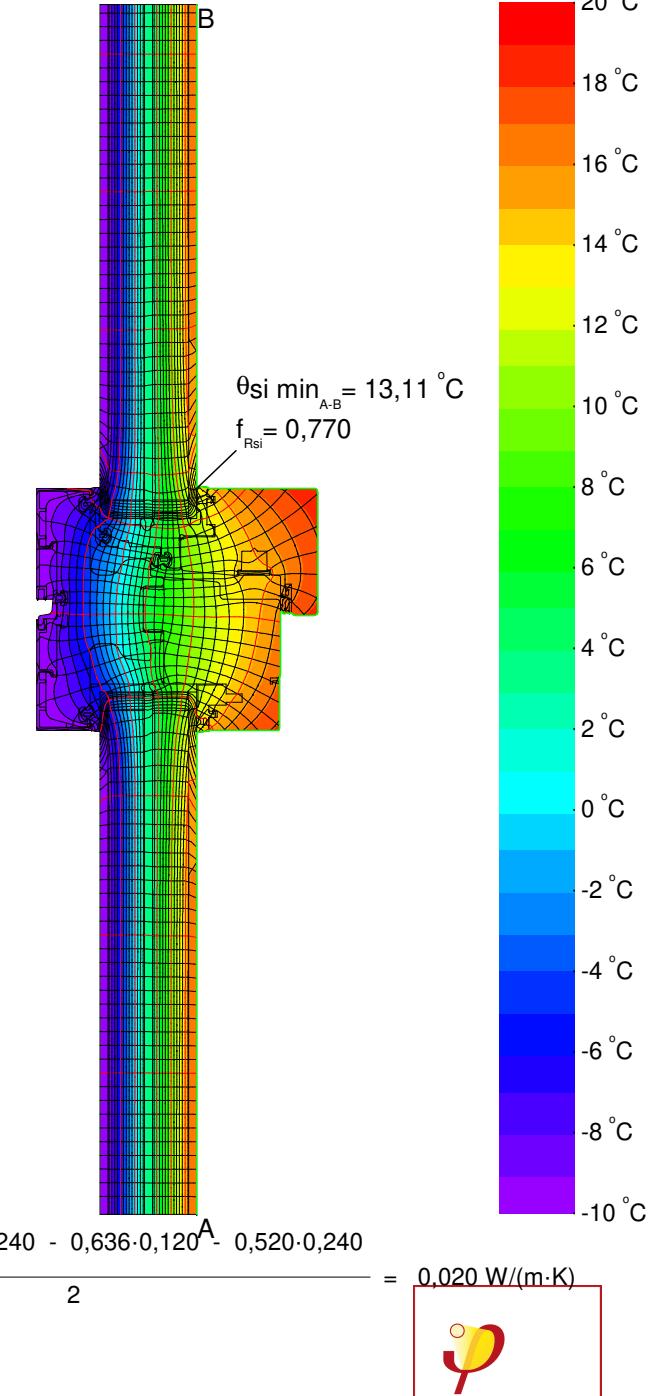
Aluminum Aluminium 10456	$\lambda [W/(m \cdot K)]$	ϵ
Butyl	0,240	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glue Klebestoff	0,310	0,900
Insulation Wärmedämmung 032	0,032	0,900
PE-Insulation Wärmedämmung 035	0,035	0,900
Panel Maske	0,035	0,900
Spruce, Fir Fichte, Tanne	0,110	0,900
Steel Stahl	50,000	0,900
Unvent. cavity unbel. Hohlr. **		
slightly vent. cav. leicht bel. Hohlr. **		
** EN ISO 10077-2:2017, 6.4.3		



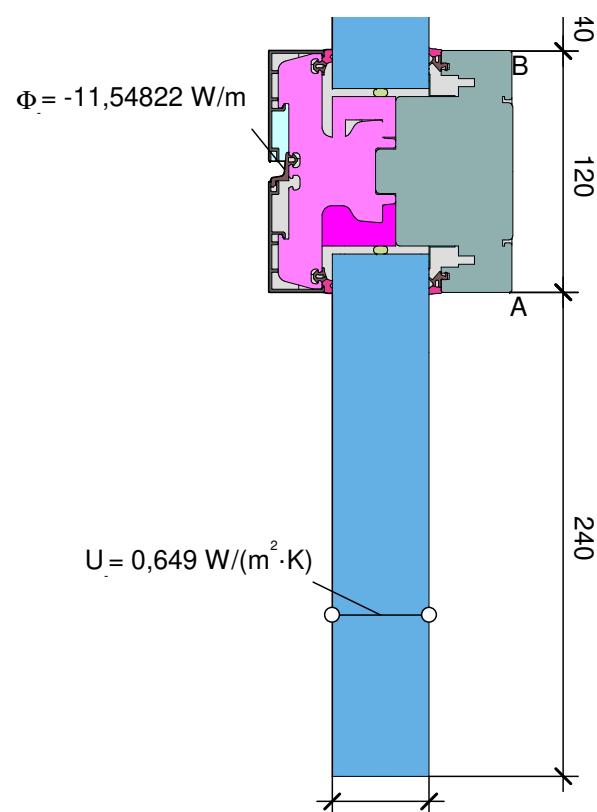
$$\Psi_{A,B} = \frac{\Phi}{\Delta T} = \frac{10,954}{30,000} = 0,3636 \text{ W}/(\text{m}^2 \cdot \text{K})$$

$$U_{f,A,B} = \frac{\Phi}{b_f} = \frac{11,633}{30,000} = 0,649 \cdot 0,240 + 0,649 \cdot 0,240 = 0,649 \cdot 0,240$$

$$\Psi_{A,B} = \frac{\Phi}{\Delta T} = \frac{10,954}{30,000} = 0,3636 \text{ W}/(\text{m}^2 \cdot \text{K})$$



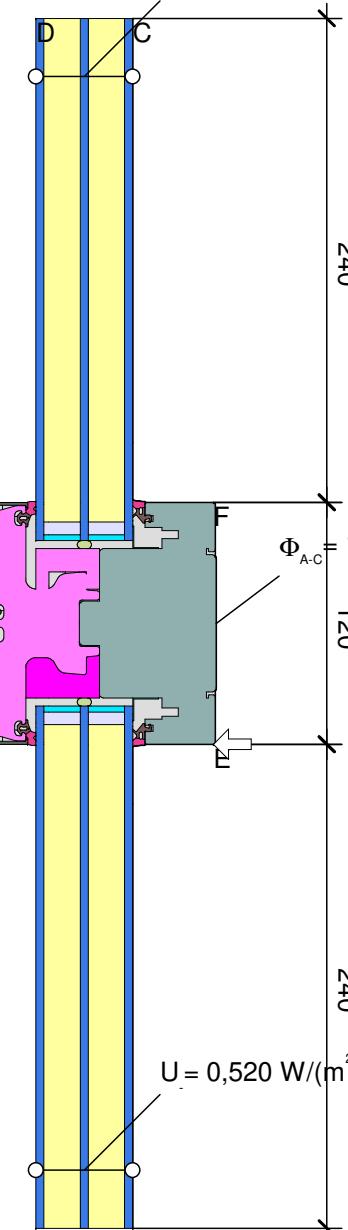
Material	$\lambda [W/(m \cdot K)]$	ϵ
Aluminum I Aluminium 10456	160,000	0,900
Ar18 in 48 mm U 0,52	0,021	
Butyl	0,240	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glass I Glas	1,000	0,900
Insulation Wärmedämmung 032	0,032	0,900
PE-Insulation I Wärmedämmung 035	0,035	0,900
PU-Seal I PU Dichtung	0,250	0,900
SWISSP. Ultimate Box 2	0,140	
Spruce, Fir I Fichte, Tanne	0,110	0,900
Unvent. cavity I unbel. Hohlr. **		
slightly vent. cav. I leicht bel. Hohlr. **		
** EN ISO 10077-2:2017, 6.4.3		



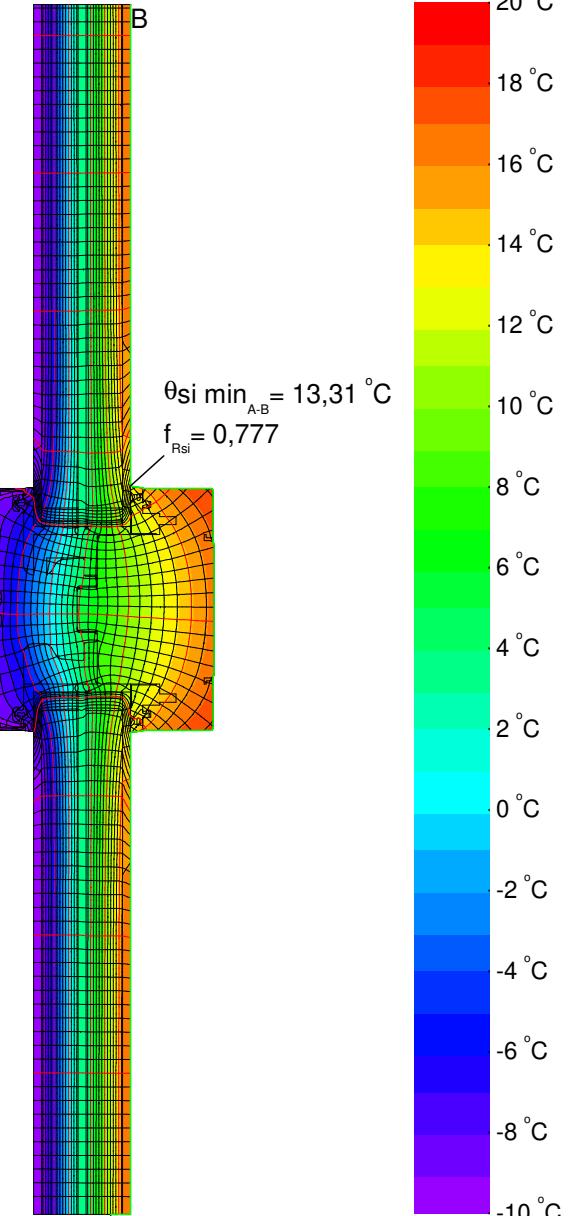
$$U_{f_{A,B}} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{11,548}{30,000} - 0,649 \cdot 0,240 - 0,649 \cdot 0,240}{0,120} = 0,613 \text{ W}/(\text{m}^2 \cdot \text{K})$$

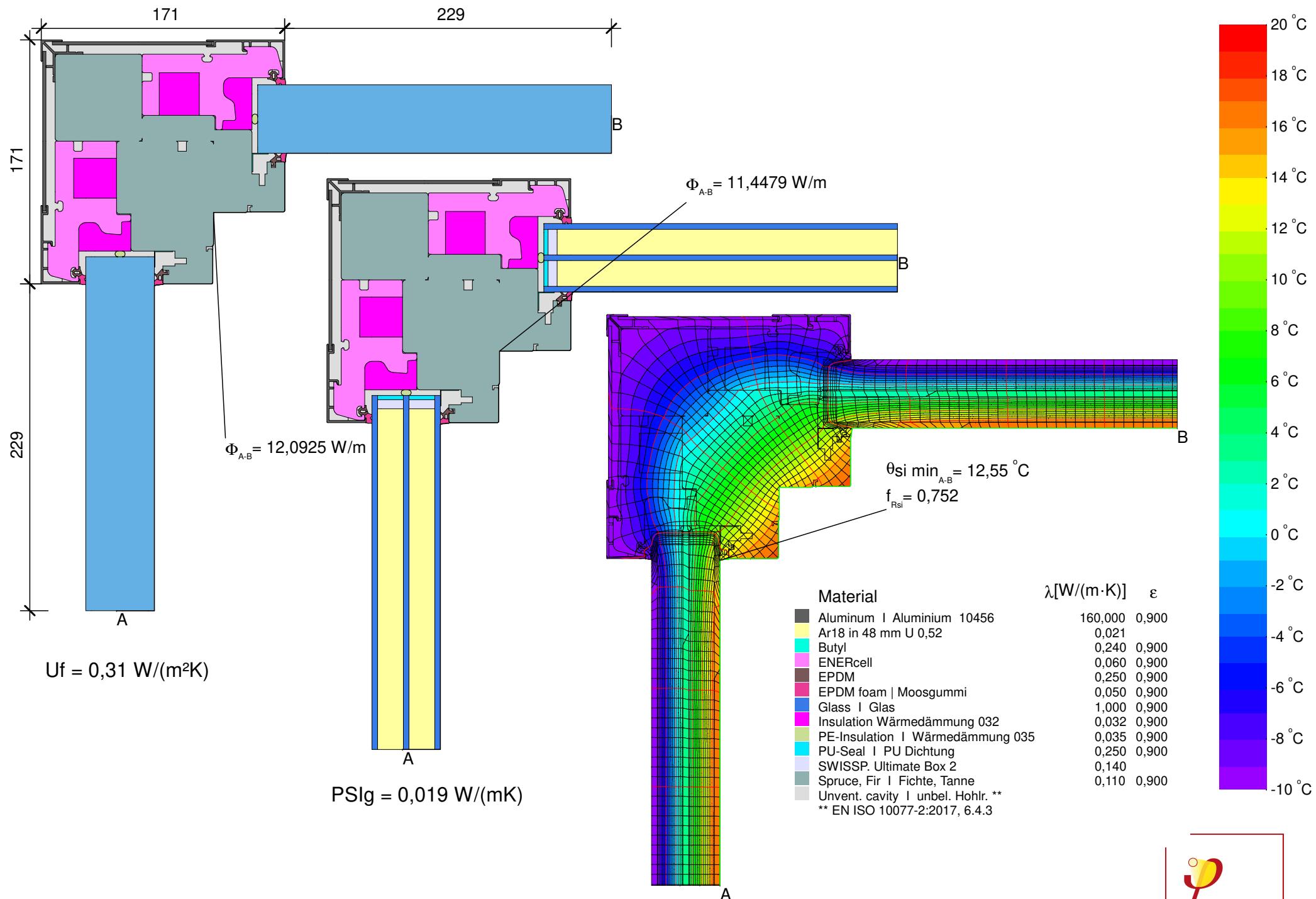
$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - U_2 \cdot b_2 - U_3 \cdot b_3 = \frac{10,840}{30,000} - 0,520 \cdot 0,240 - 0,613 \cdot 0,120 - 0,520 \cdot 0,240 = 0,038 \text{ W}/(\text{m} \cdot \text{K})$$

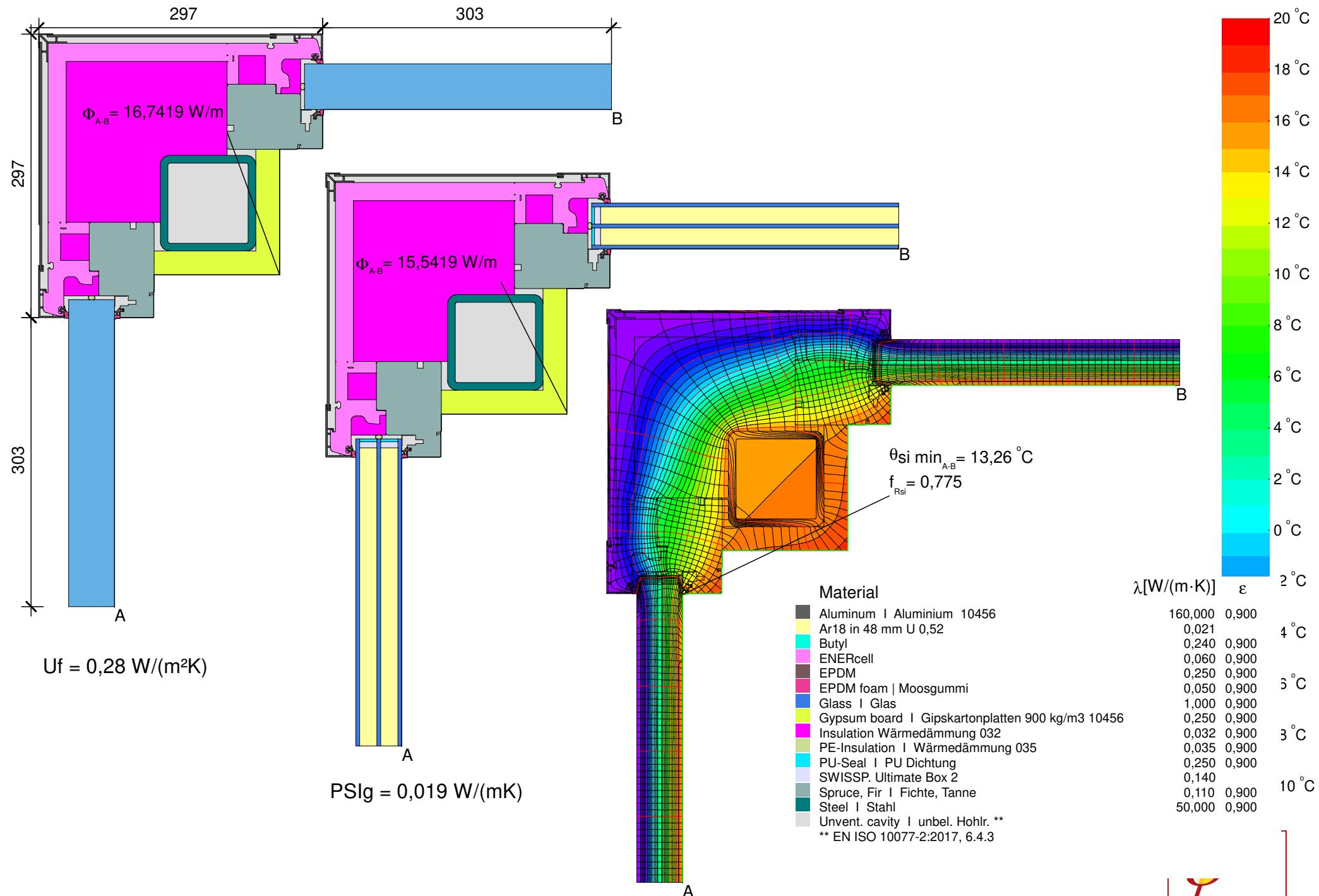
$U = 0,520 \text{ W}/(\text{m}^2 \cdot \text{K})$

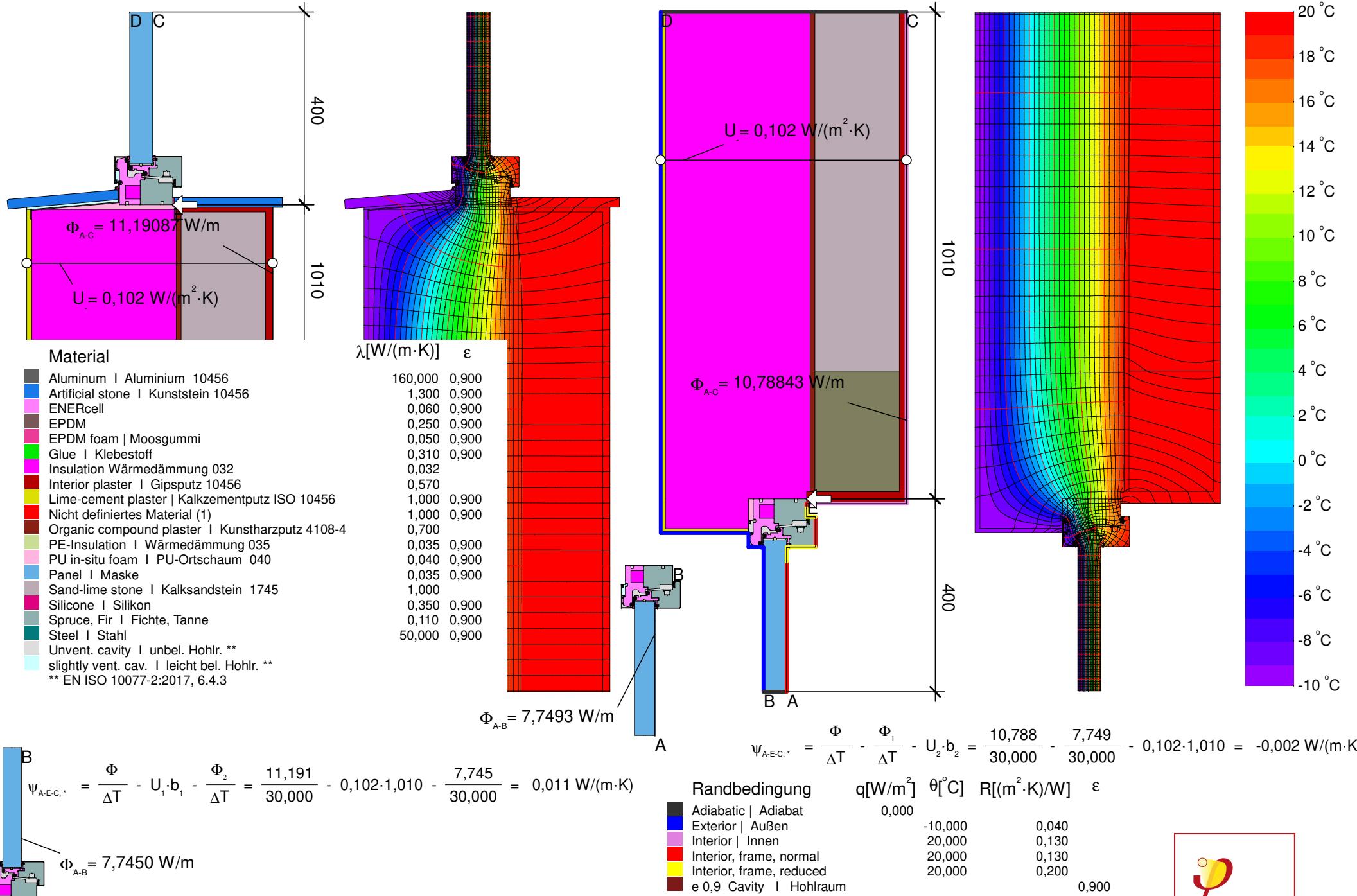


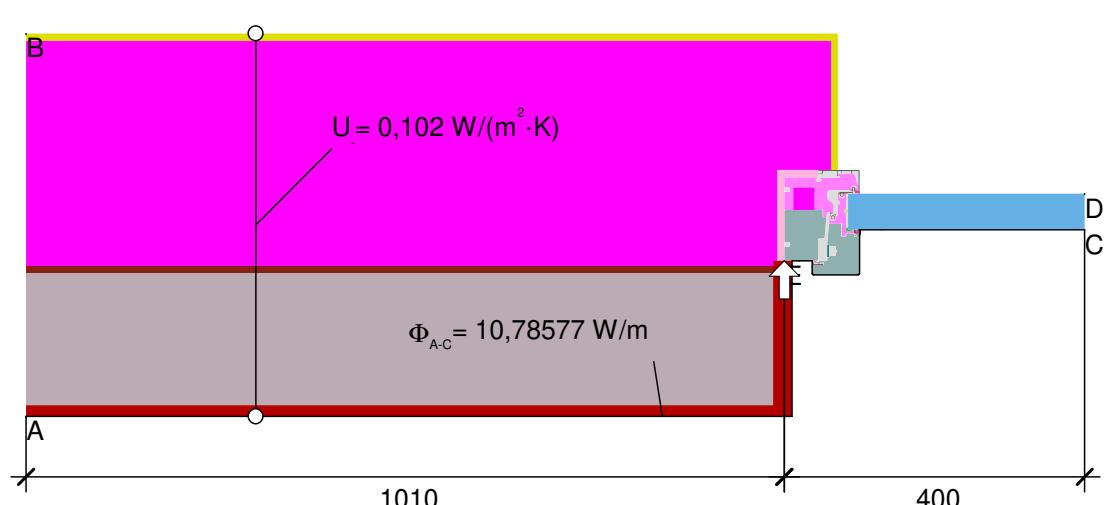
$$U_{f_{A,B}} = \frac{\frac{\Phi}{\Delta T} - U_{p1} \cdot b_{p1} - U_{p2} \cdot b_{p2}}{b_f} = \frac{\frac{10,840}{30,000} - 0,520 \cdot 0,240 - 0,613 \cdot 0,120}{0,120} = 0,019 \text{ W}/(\text{m} \cdot \text{K})$$









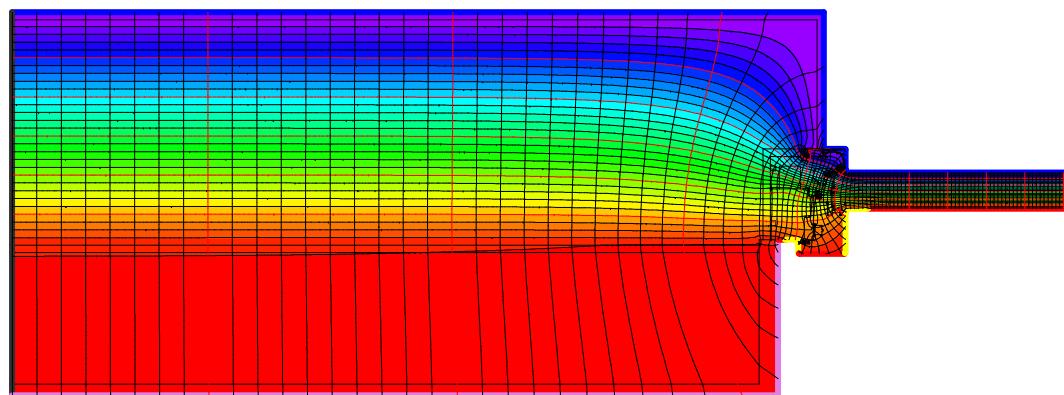


$$\Phi_{A-B} = 7,7493 \text{ W}/\text{m}$$

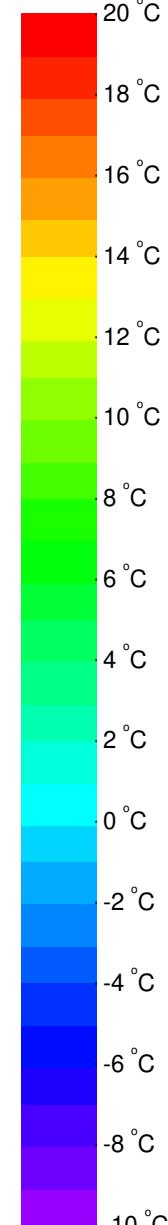
Material

	$\lambda [\text{W}/(\text{m} \cdot \text{K})]$	ϵ
Aluminum Aluminium 10456	160,000	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glue Klebestoff	0,310	0,900
Insulation Wärmedämmung 032	0,032	
Interior plaster Gipsputz 10456	0,570	0,900
Lime-cement plaster Kalkzementputz ISO 10456	1,000	
Organic compound plaster Kunstharzputz 4108-4	0,700	
PE-Insulation Wärmedämmung 035	0,035	0,900
PU in-situ foam PU-Ortschaum 040	0,040	0,900
Panel Maske	0,035	0,900
Sand-lime stone Kalksandstein 1745	1,000	
Spruce, Fir Fichte, Tanne	0,110	0,900
Steel Stahl	50,000	0,900
Unvent. cavity unbel. Hohlr. **		
slightly vent. cav. leicht bel. Hohlr. **		

** EN ISO 10077-2:2017, 6.4.3

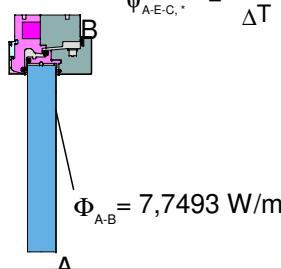
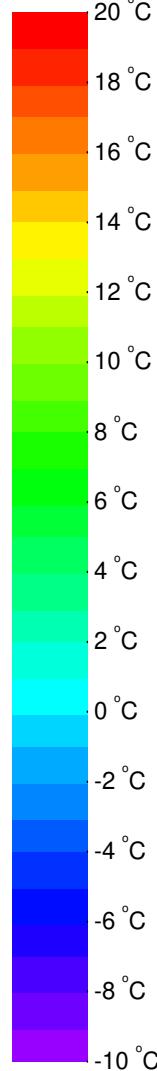
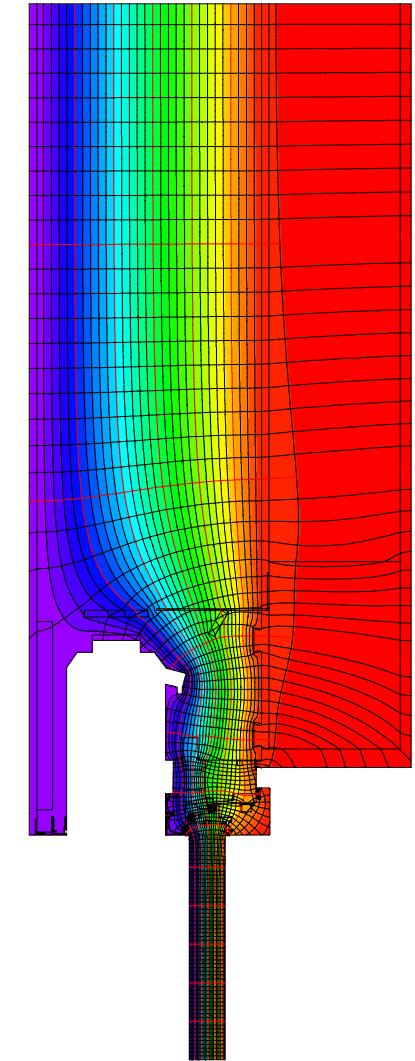
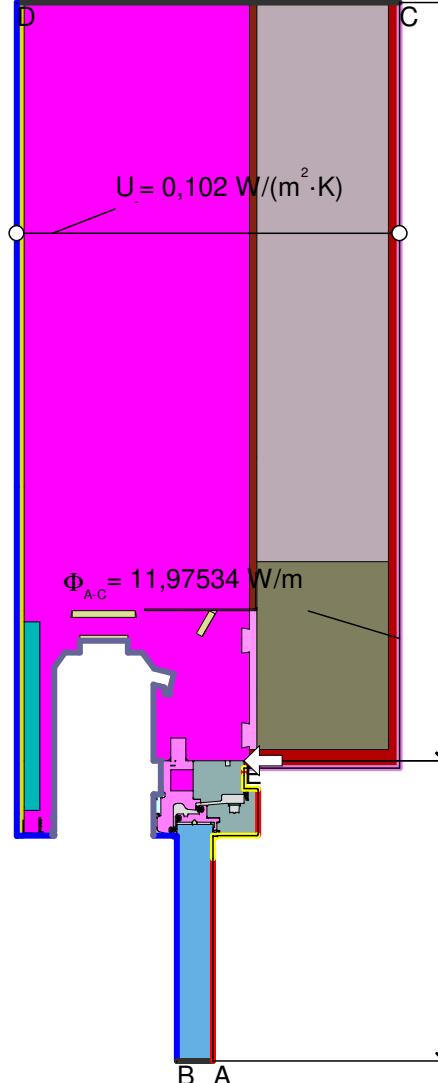
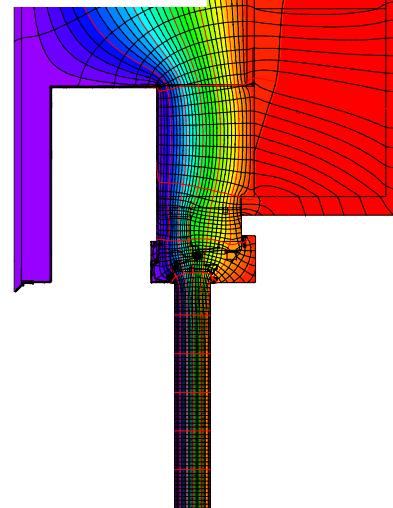
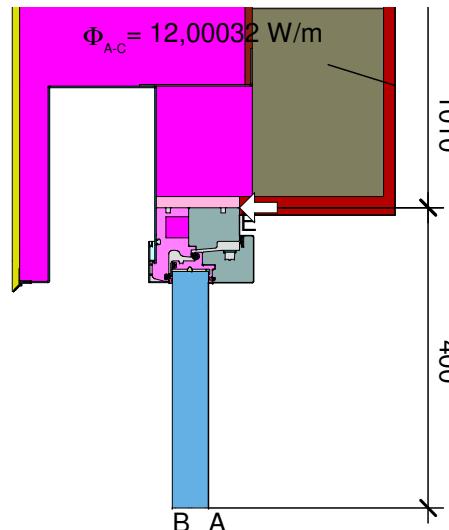
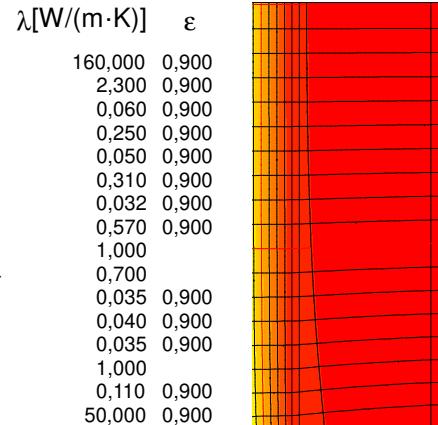


Randbedingung	$q [\text{W}/\text{m}^2]$	$\theta [{}^\circ\text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$	ϵ
Adiabatic Adiabat	0,000			
Exterior Außen	-10,000		0,040	
Interior Innen	20,000		0,130	
Interior, frame, normal	20,000		0,130	
Interior, frame, reduced	20,000		0,200	
e 0,9 Cavity Hohlraum				0,900



Material

Aluminum Aluminium 10456	
Concrete, 1% Steel Beton, 1% Stahl 10456	
ENERcell	
EPDM	
EPDM foam Moosgummi	
Glue Klebestoff	
Insulation Wärmedämmung 032	
Interior plaster Gipsputz 10456	
Lime-cement plaster Kalkzementputz ISO 10456	
Organic compound plaster Kunstharzputz 4108-4	
PE-Insulation Wärmedämmung 035	
PU in-situ foam PU-Ortschaum 040	
Panel Maske	
Sand-lime stone Kalksandstein 1745	
Spruce, Fir Fichte, Tanne	
Steel Stahl	
Unvent. cavity unbel. Hohlr. **	
slightly vent. cav. leicht bel. Hohlr. **	
** EN ISO 10077-2:2017, 6.4.3	



$$\Psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{12,000}{30,000} - \frac{7,749}{30,000} - 0,102 \cdot 1,010 = 0,038 \text{ W}/(\text{m} \cdot \text{K})$$

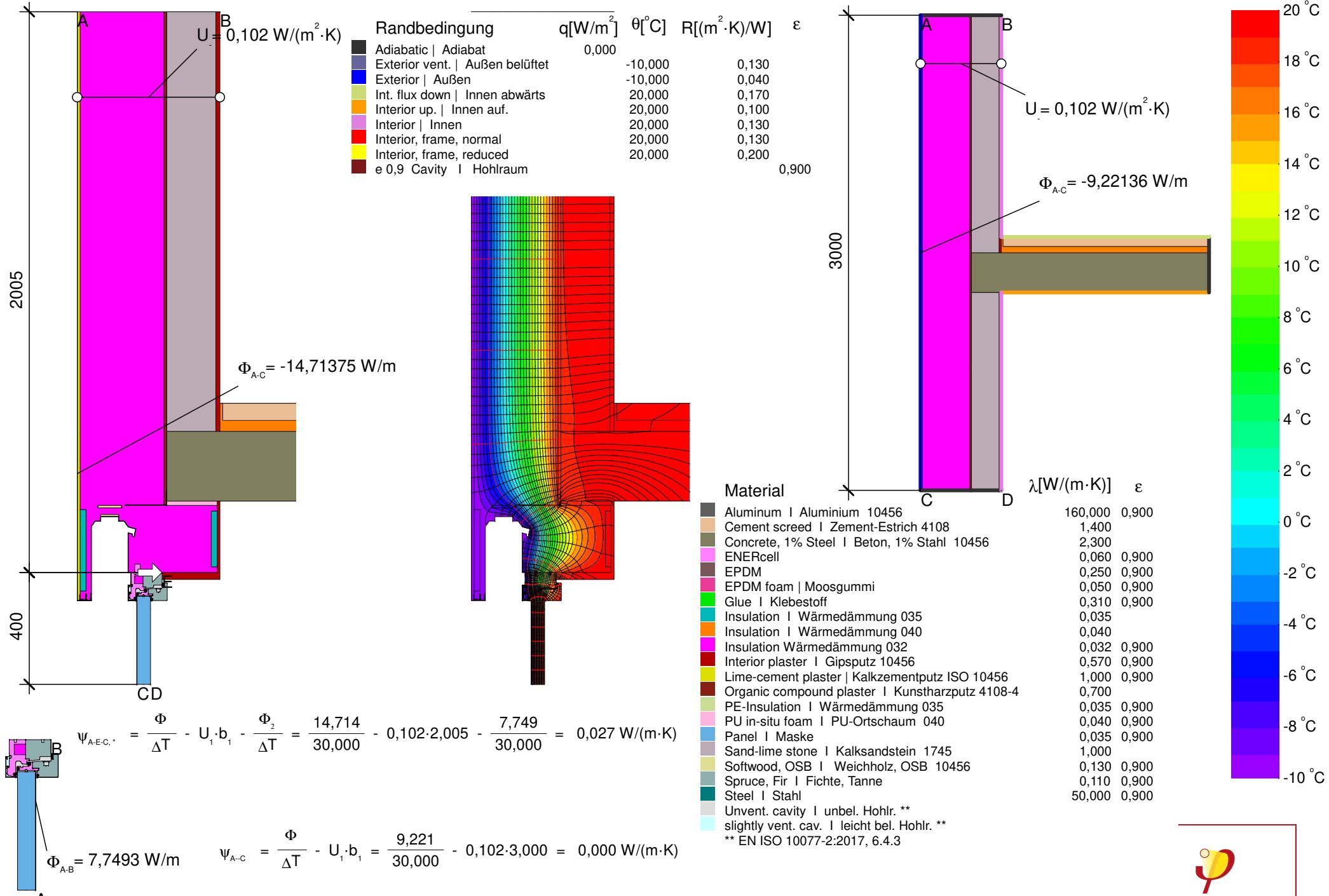
$$\Psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{11,975}{30,000} - \frac{7,749}{30,000} - 0,102 \cdot 1,010 = 0,037 \text{ W}/(\text{m} \cdot \text{K})$$

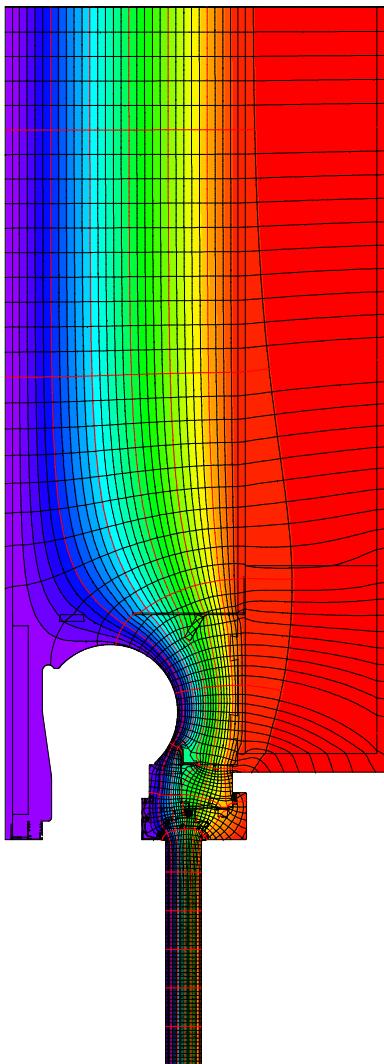
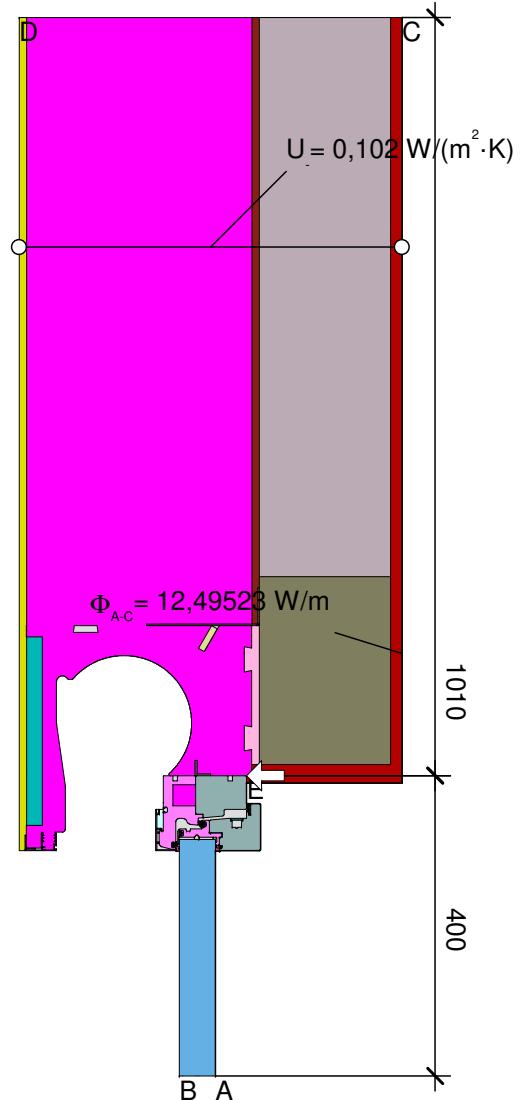
Randbedingung

Adiabatic Adiabat	0,000
Exterior vent. Außen belüftet	-10,000
Exterior Außen	-10,000
Interior Innen	20,000
Interior, frame, normal	20,000
Interior, frame, reduced	20,000
e 0,9 Cavity Hohlraum	0,900

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





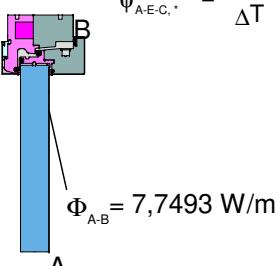
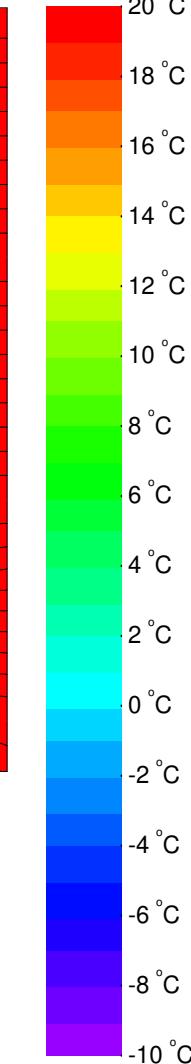


Material

Aluminum Aluminium 10456	160,000	0,900
Concrete, 1% Steel Beton, 1% Stahl 10456	2,300	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glue Klebestoff	0,310	0,900
Insulation Wärmedämmung 035	0,035	
Insulation Wärmedämmung 032	0,032	0,900
Interior plaster Gipsputz 10456	0,570	0,900
Lime-cement plaster Kalkzementputz ISO 10456	1,000	0,900
Nicht definierter Material (1)	1,000	
Organic compound plaster Kunstharzputz 4108-4	0,700	
PE-Insulation Wärmedämmung 035	0,035	0,900
PU in-situ foam PU-Ortschaum 040	0,040	0,900
Panel Maske	0,035	0,900
Sand-lime stone Kalksandstein 1745	1,000	
Softwood, OSB Weichholz, OSB 10456	0,130	0,900
Spruce, Fir Fichte, Tanne	0,110	0,900
Steel Stahl	50,000	0,900
Unvent. cavity unbel. Hohlr. **		
slightly vent. cav. leicht bel. Hohlr. **		

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

160,000	0,900
2,300	0,900
0,060	0,900
0,250	0,900
0,050	0,900
0,310	0,900
0,035	
0,032	0,900
0,570	0,900
1,000	0,900
1,000	
0,700	
0,035	0,900
0,040	0,900
0,035	0,900
1,000	
0,130	0,900
0,110	0,900
50,000	0,900



$$\Psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{12,495}{30,000} - \frac{7,749}{30,000} - 0,102 \cdot 1,010 = 0,055 \text{ W}/(\text{m} \cdot \text{K})$$

$$\Psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{11,536}{30,000} - \frac{7,749}{30,000} - 0,102 \cdot 1,010 = 0,023 \text{ W}/(\text{m} \cdot \text{K})$$

Randbedingung

Adiabatic Adiabat	0,000
Exterior Außen	-10,000
Interior Innen	20,000
Interior, frame, normal	20,000
Interior, frame, reduced	20,000
e 0,9 Cavity Hohlräum	0,900

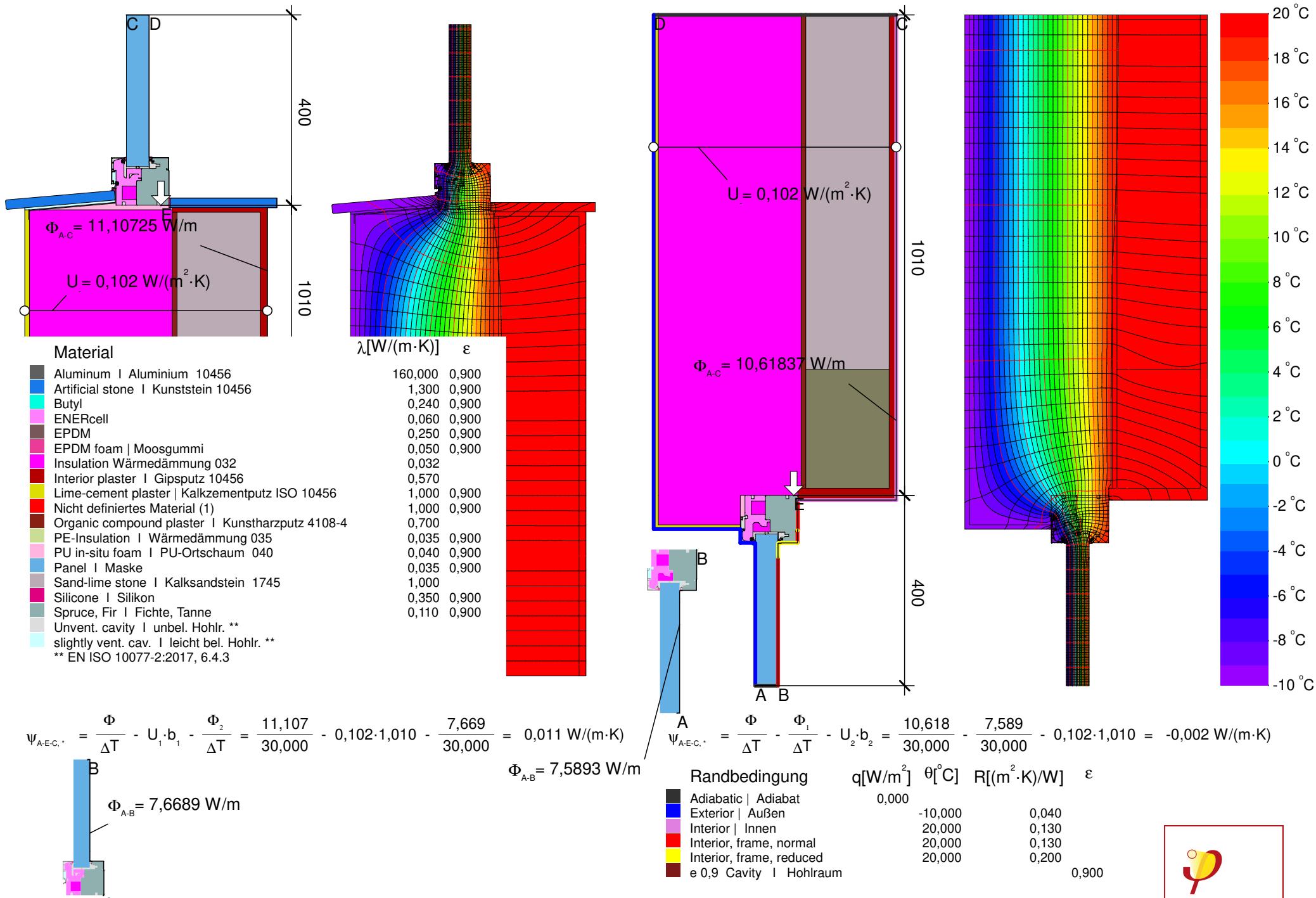
$q[\text{W}/\text{m}^2]$

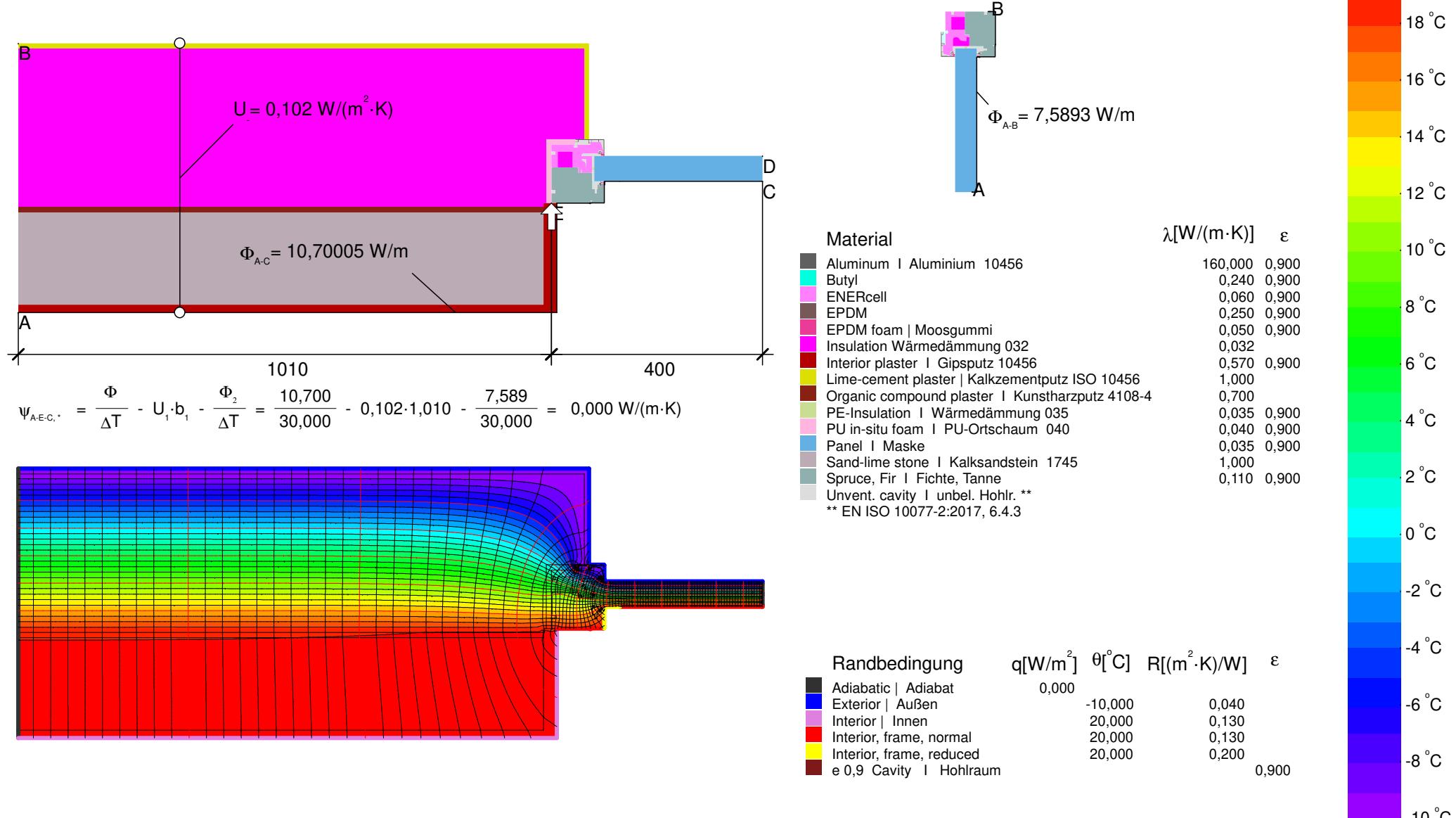
$\theta[^\circ\text{C}]$

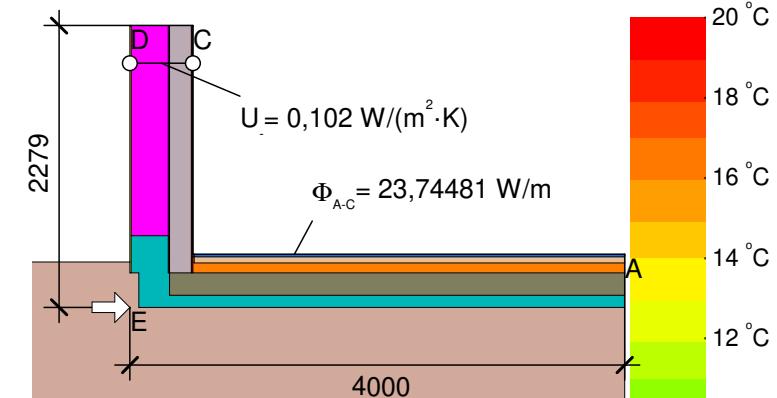
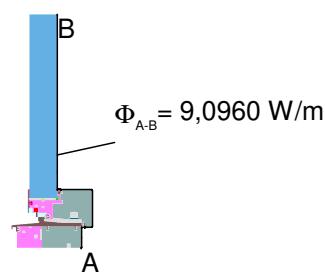
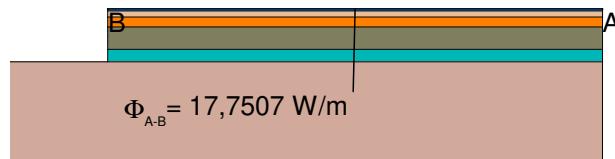
$R[(\text{m}^2 \cdot \text{K})/\text{W}]$

ε



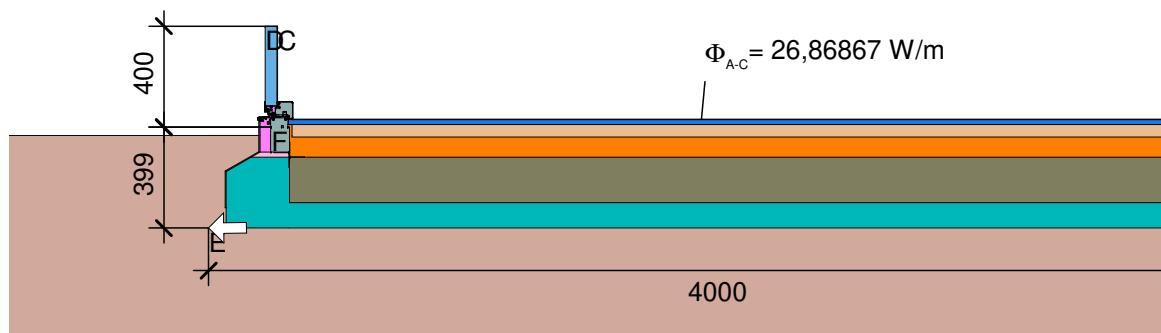




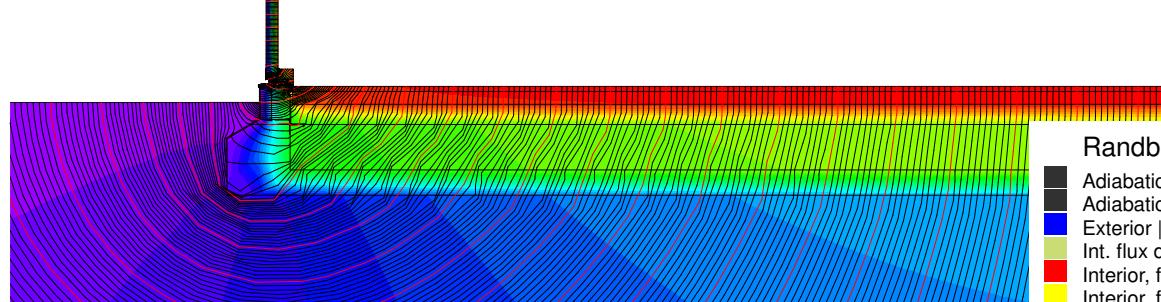


$$\Psi_{A-E,C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{23,745}{30,000} - \frac{17,751}{30,000} - 0,102 \cdot 2,279 = -0,033 \text{ W/(m·K)}$$

$$\Psi_{WITH} = \Psi_{FSEW+WITH} - \Psi_{FSEW} = -0,040 - -0,033 \text{ W/(mK)} = -0,007 \text{ W/(mK)}$$



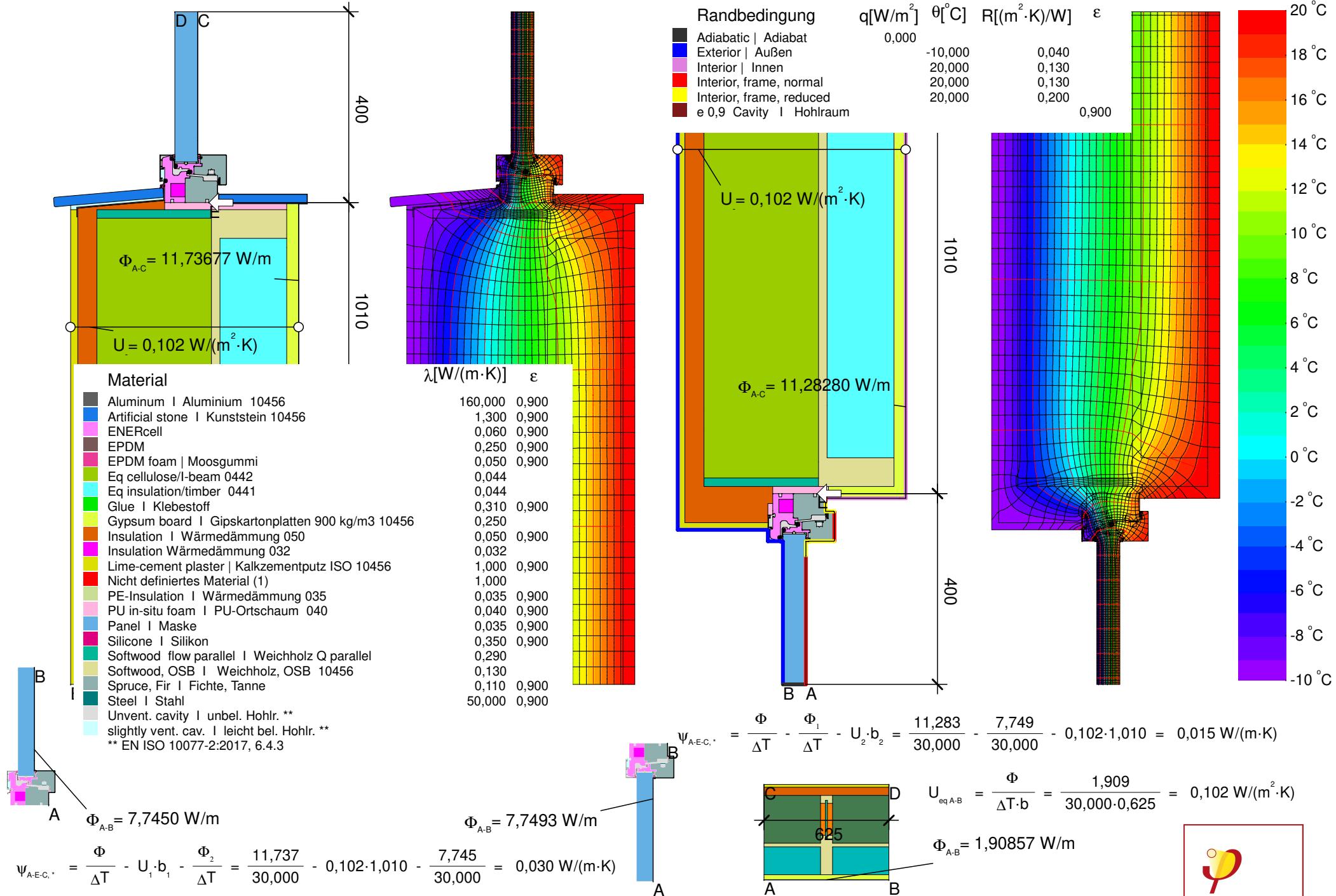
$$\Psi_{A-E,C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 - \frac{\Phi_3}{\Delta T} = \frac{26,869}{30,000} - \frac{17,751}{30,000} - 0,102 \cdot 0,399 - \frac{9,096}{30,000} = -0,040 \text{ W/(m·K)}$$

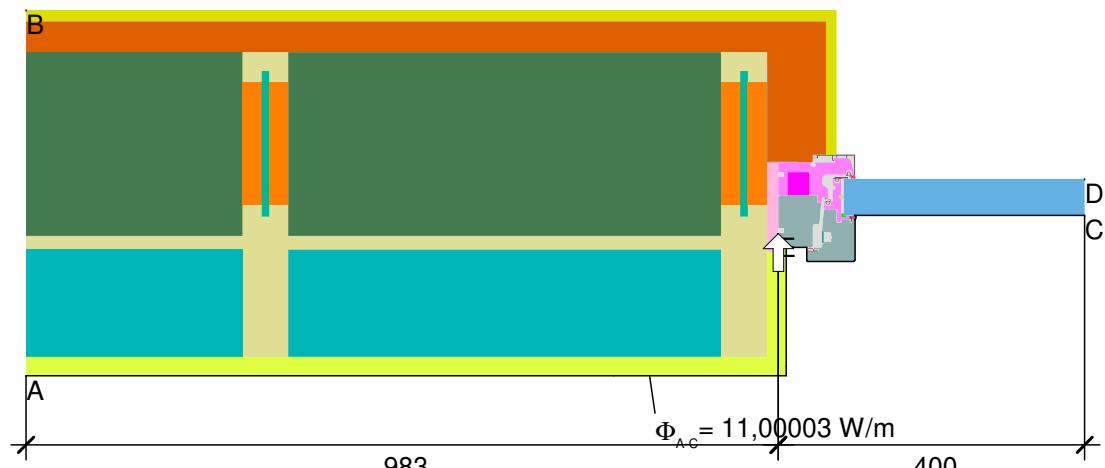


Material	$\lambda[\text{W}/(\text{m} \cdot \text{K})]$	ϵ
Aluminum Aluminium 10456	160,000	0,900
Artificial stone Kunststein 10456	1,300	0,900
Cement screed Zement-Estrich 4108	1,400	
Concrete, 1% Steel Beton, 1% Stahl 10456	2,300	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glass Glas	1,000	
Glue Klebstoff	0,310	0,900
Ground Erdreich	2,000	
Insulation Wärmedämmung 035	0,035	
Insulation Wärmedämmung 040	0,040	0,900
Nicht definiertes Material (1)	1,000	0,900
PE-Insulation Wärmedämmung 035	0,035	0,900
PU in-situ foam PU-Ortschaum 040	0,040	
Panel Maske	0,035	0,900
Polyamide 25% Glassfiber	0,300	0,900
Silicone Silikon	0,350	0,900
Spruce, Fir Fichte, Tanne	0,110	0,900
Steel Stahl	50,000	0,900
Unvent. cavity unbel. Hohlr. **		
slightly vent. cav. leicht bel. Hohlr. **		
** EN ISO 10077-2:2017, 6.4.3		

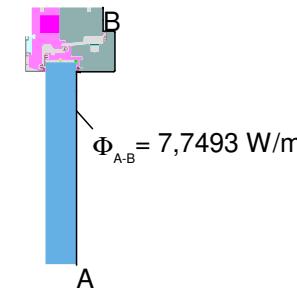
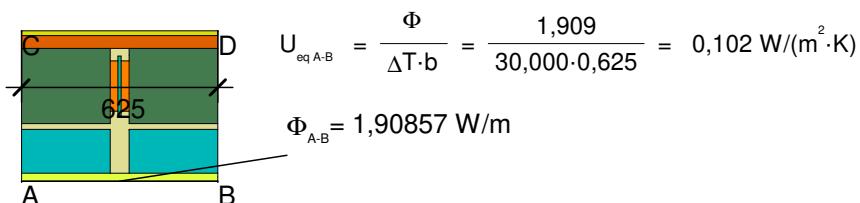
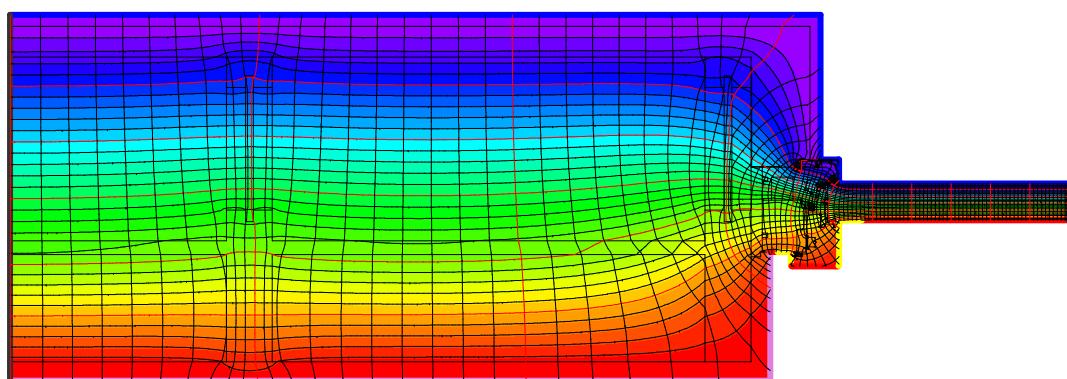
Randbedingung	$q[\text{W}/\text{m}^2]$	$\theta[{}^\circ\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ϵ
Adiabatic Adiabatisch	0,000	0,000		
Adiabatic Adiabat				
Exterior Außen		-10,000	0,040	
Int. flux down Innen abwärts	20,000		0,170	
Interior, frame, normal	20,000		0,130	
Interior, frame, reduced	20,000		0,200	
e 0,9 Cavity Hohlraum				0,900







$$\psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{11,000}{30,000} - 0,102 \cdot 0,983 - \frac{7,749}{30,000} = 0,008 \text{ W/(m}\cdot\text{K)}$$

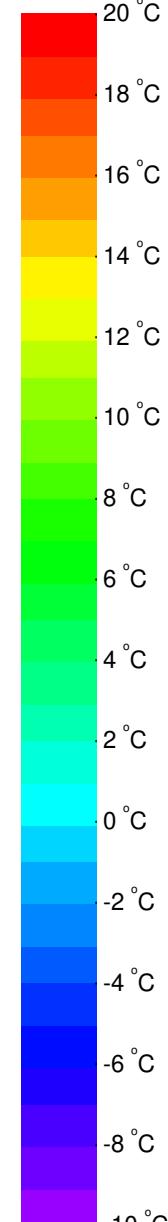


Material

	$\lambda[\text{W}/(\text{m}\cdot\text{K})]$	ϵ
Aluminum Aluminium 10456	160,000	0,900
Cellulose Zellulose 040	0,040	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glue Klebestoff	0,310	0,900
Gypsum board Gipskartonplatten 900 kg/m³ 10456	0,250	0,900
Insulation Wärmedämmung 035	0,035	
Insulation Wärmedämmung 040	0,040	
Insulation Wärmedämmung 050	0,050	0,900
Insulation Wärmedämmung 032	0,032	
Lime-cement plaster Kalkzementputz ISO 10456	1,000	
PE-Insulation Wärmedämmung 035	0,035	0,900
PU in-situ foam PU-Ortschaum 040	0,040	0,900
Panel Maske	0,035	0,900
Softwood flow parallel Weichholz Q parallel	0,290	
Softwood, OSB Weichholz, OSB 10456	0,130	
Spruce, Fir Fichte, Tanne	0,110	0,900
Steel Stahl	50,000	0,900
Unvent. cavity unbel. Hohlr. **		
slightly vent. cav. leicht bel. Hohlr. **		
** EN ISO 10077-2:2017, 6.4.3		

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

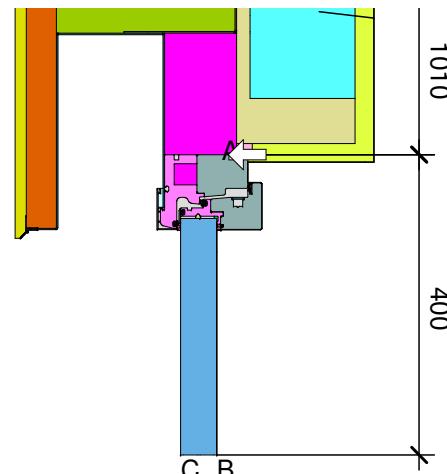
Aluminum Aluminium 10456	160,000	0,900
Cellulose Zellulose 040	0,040	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glue Klebestoff	0,310	0,900
Gypsum board Gipskartonplatten 900 kg/m³ 10456	0,250	0,900
Insulation Wärmedämmung 035	0,035	
Insulation Wärmedämmung 040	0,040	
Insulation Wärmedämmung 050	0,050	0,900
Insulation Wärmedämmung 032	0,032	
Lime-cement plaster Kalkzementputz ISO 10456	1,000	
PE-Insulation Wärmedämmung 035	0,035	0,900
PU in-situ foam PU-Ortschaum 040	0,040	0,900
Panel Maske	0,035	0,900
Softwood flow parallel Weichholz Q parallel	0,290	
Softwood, OSB Weichholz, OSB 10456	0,130	
Spruce, Fir Fichte, Tanne	0,110	0,900
Steel Stahl	50,000	0,900
Unvent. cavity unbel. Hohlr. **		
slightly vent. cav. leicht bel. Hohlr. **		
** EN ISO 10077-2:2017, 6.4.3		



Material

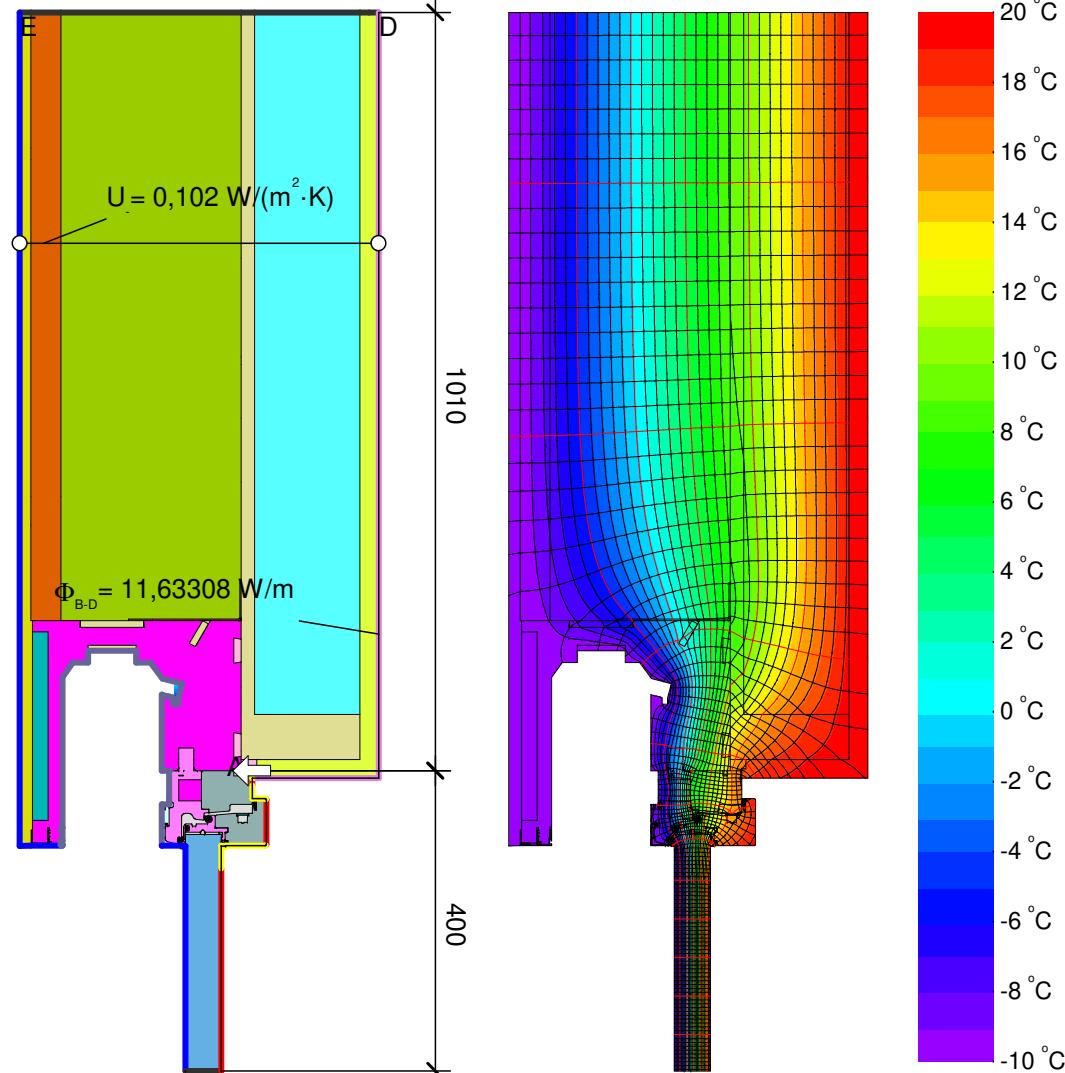
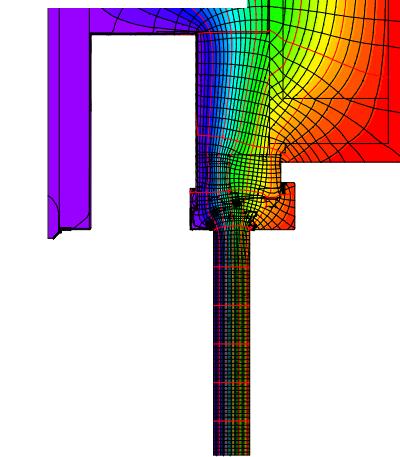
Aluminum I	Aluminium 10456
ENERcell	
EPDM	
EPDM foam Moosgummi	
Eq cellulose/l-beam 0442	
Eq insulation/timber 0441	
Glue Klebestoff	
Gypsum board I	Gipskartonplatten 900 kg/m³ 10456
Insulation I	Wärmedämmung 050
Insulation Wärmedämmung 032	
Lime-cement plaster Kalkzementputz ISO 10456	
Nicht definiertes Material (1)	
PE-Insulation I	Wärmedämmung 035
PU in-situ foam I	PU-Ortschaum 040
Panel I	Maske
Softwood, OSB I	Weichholz, OSB 10456
Spruce, Fir I	Fichte, Tanne
Steel I	Stahl
Unvent. cavity I	unbel. Hohlr. **
slightly vent. cav. I	leicht bel. Hohlr. **
** EN ISO 10077-2:2017, 6.4.3	

Material	$\lambda [W/(m \cdot K)]$	ϵ
Aluminum I	160,000	0,900
0,060	0,900	
0,250	0,900	
0,050	0,900	
0,044	0,900	
0,044		
0,310	0,900	
0,250	0,900	
0,050		
0,032	0,900	
1,000		
1,000	0,900	
0,035	0,900	
0,040	0,900	
0,035	0,900	
0,130	0,900	
0,110	0,900	
50,000	0,900	



$$\Psi_{B-A-D,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{11,730}{30,000} - \frac{7,749}{30,000} - 0,102 \cdot 1,010 = 0,030 \text{ W/(m·K)}$$

$\Phi_{A-B} = 7,749 \text{ W/m}$

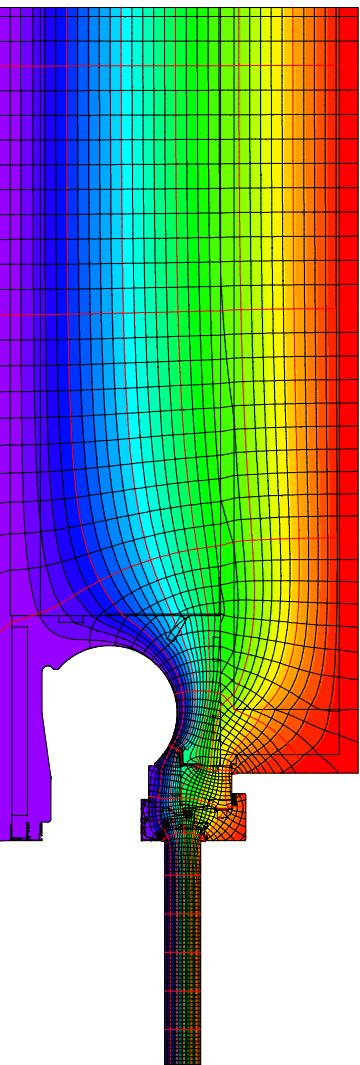
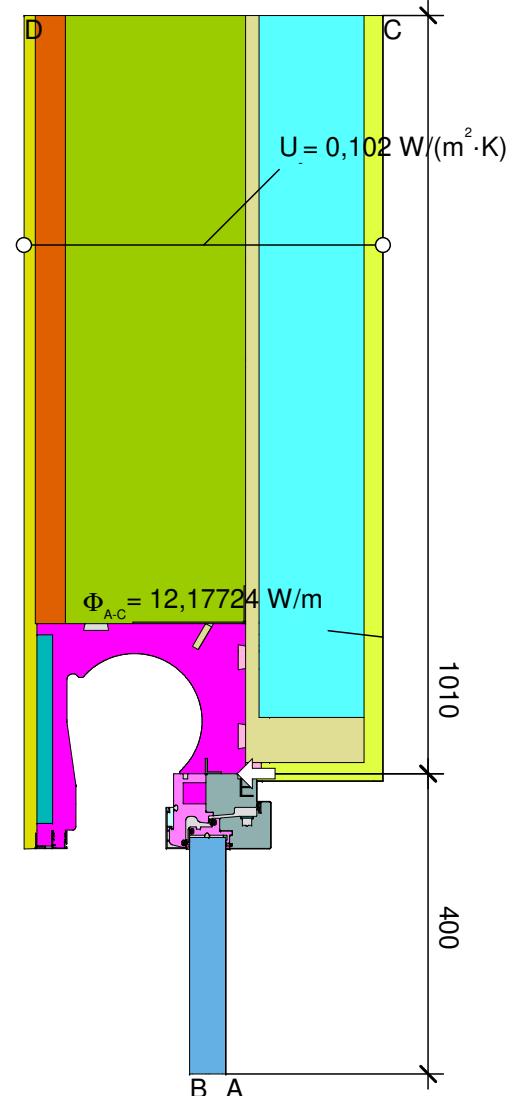


Randbedingung

Adiabatic Adiabat
Exterior vent. Außen belüftet
Exterior Außen
Interior Innen
Interior, frame, normal
Interior, frame, reduced
e 0,9 Cavity Hohlräum

q[W/m²]	$\theta [{}^\circ \text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ϵ
0,000			
-10,000	0,130		
-10,000	0,040		
20,000	0,130		
20,000	0,130		
20,000	0,200		
			0,900





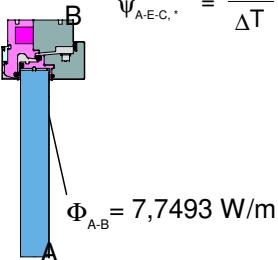
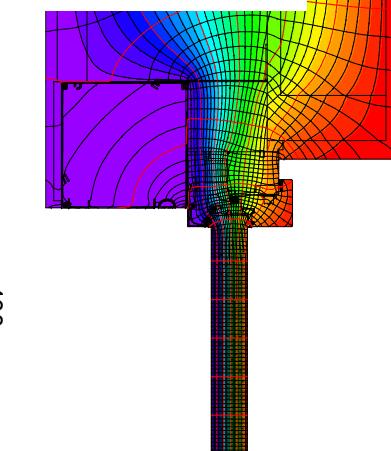
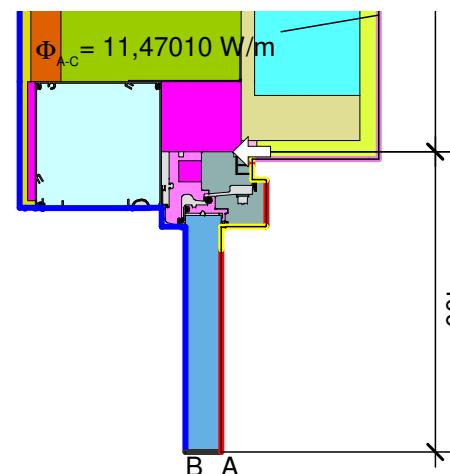
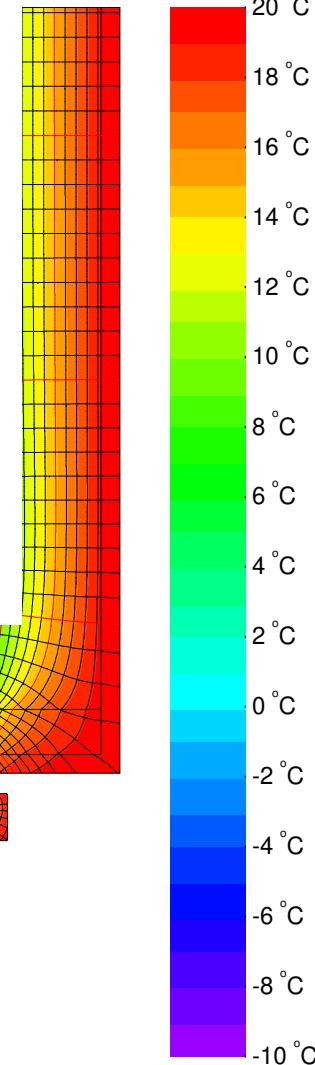
Material

Aluminum Aluminium 10456	160,000	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Eq cellulose/l-beam 0442	0,044	0,900
Eq insulation/timber 0441	0,044	0,900
Glue Klebestoff	0,310	0,900
Gypsum board Gipskartonplatten 900 kg/m³ 10456	0,250	0,900
Insulation Wärmedämmung 035	0,035	
Insulation Wärmedämmung 050	0,050	
Insulation Wärmedämmung 032	0,032	0,900
Interior plaster Gipsputz 10456	0,570	
Lime-cement plaster Kalkzementputz ISO 10456	1,000	0,900
Nicht definierter Material (1)	1,000	
PE-Insulation Wärmedämmung 035	0,035	0,900
PU in-situ foam PU-Ortschaum 040	0,040	0,900
Panel Maske	0,035	0,900
Softwood, OSB Weichholz, OSB 10456	0,130	0,900
Spruce, Fir Fichte, Tanne	0,110	0,900
Steel Stahl	50,000	0,900
Unvent. cavity unbel. Hohlr. **		
slightly vent. cav. leicht bel. Hohlr. **		

** EN ISO 10077-2:2017, 6.4.3

$\lambda[W/(m·K)]$ ϵ

20 °C	160,000	0,900
18 °C	0,060	0,900
16 °C	0,250	0,900
14 °C	0,050	0,900
12 °C	0,044	0,900
10 °C	0,310	0,900
8 °C	0,250	0,900
6 °C	0,035	0,900
4 °C	0,044	0,900
2 °C	0,310	0,900
0 °C	0,250	0,900
-2 °C	0,035	0,900
-4 °C	0,040	0,900
-6 °C	0,130	0,900
-8 °C	0,110	0,900
-10 °C	50,000	0,900



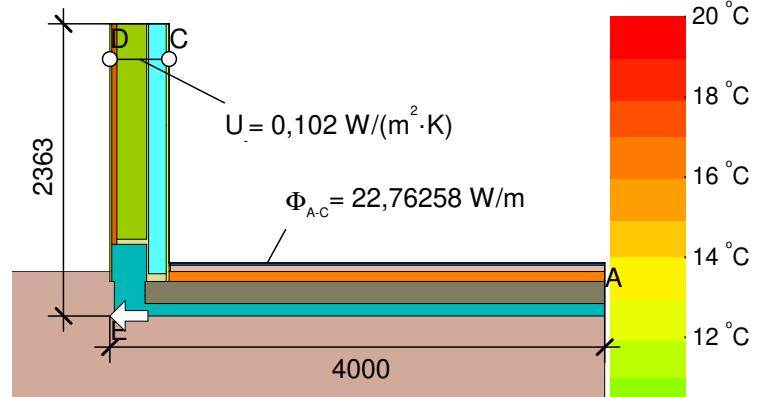
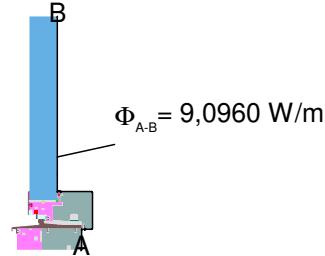
$$\Psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{12,177}{30,000} - \frac{7,749}{30,000} - 0,102 \cdot 1,010 = 0,045 \text{ W}/(\text{m} \cdot \text{K})$$

$$\Psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{11,470}{30,000} - \frac{7,749}{30,000} - 0,102 \cdot 1,010 = 0,021 \text{ W}/(\text{m} \cdot \text{K})$$

$$\text{Randbedingung} \quad q[\text{W}/\text{m}^2] \quad \theta[°\text{C}] \quad R[(\text{m}^2 \cdot \text{K})/\text{W}] \quad \epsilon$$

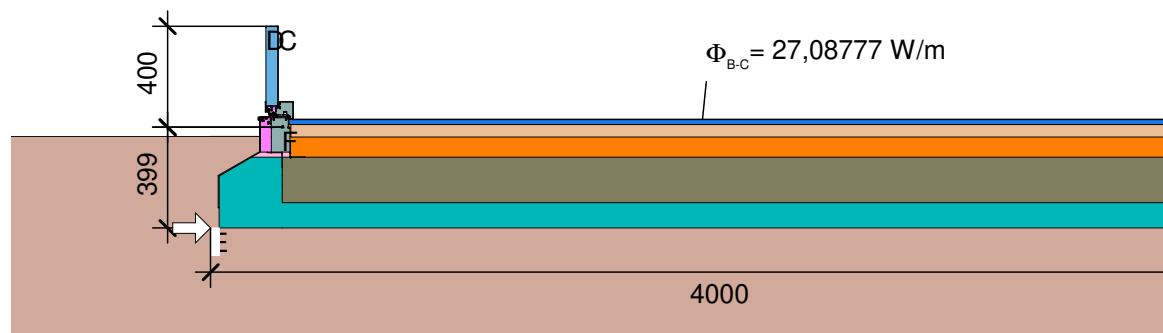
Adiabatic Adiabatisch	0,000		
Adiabatic Adiabat	0,000		
Exterior Außen	-10,000	0,040	
Interior Innen	20,000	0,130	
Interior, frame, normal	20,000	0,130	
Interior, frame, reduced	20,000	0,200	
e 0,9 Cavity Hohlräum			0,900



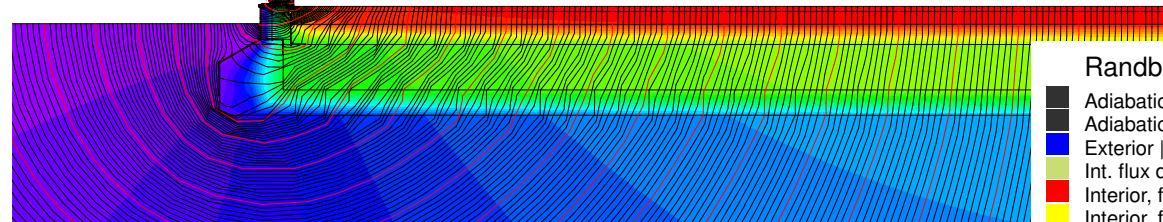


$$\Psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{22,763}{30,000} - \frac{17,751}{30,000} - 0,102 \cdot 2,363 = -0,073 \text{ W/(m·K)}$$

$$\Psi_{WITH} = \Psi_{FSEW+WITH} - \Psi_{FSEW} = -0,033 - -0,073 \text{ W/(mK)} = 0,040 \text{ W/(mK)}$$



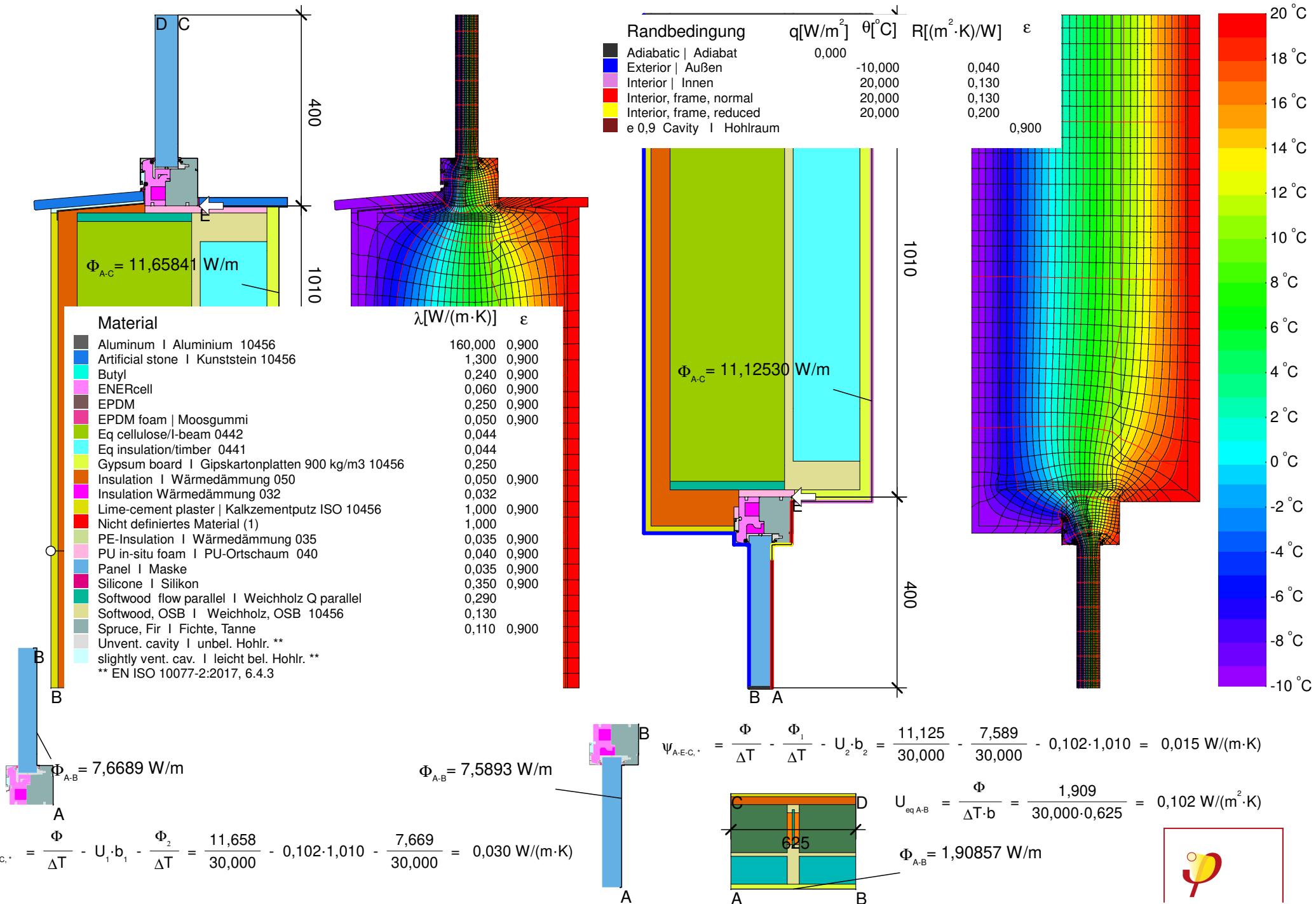
$$\Psi_{B-E-C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 - \frac{\Phi_3}{\Delta T} = \frac{27,088}{30,000} - \frac{17,751}{30,000} - 0,102 \cdot 0,399 - \frac{9,096}{30,000} = -0,033 \text{ W/(m·K)}$$



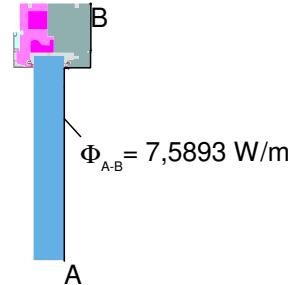
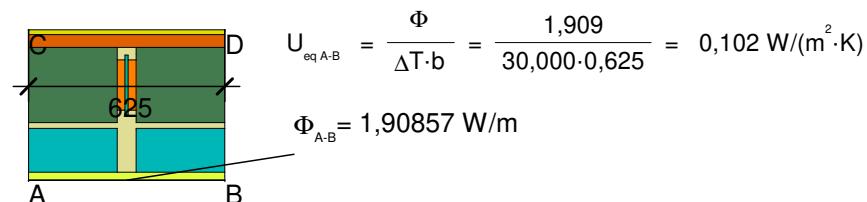
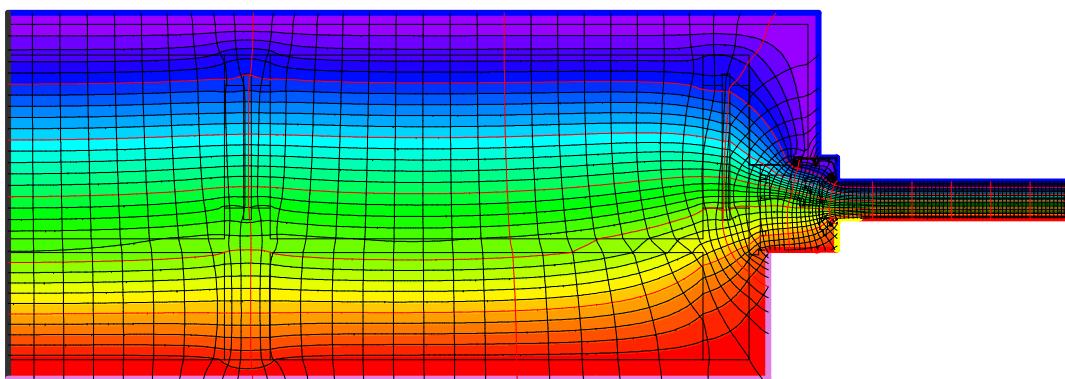
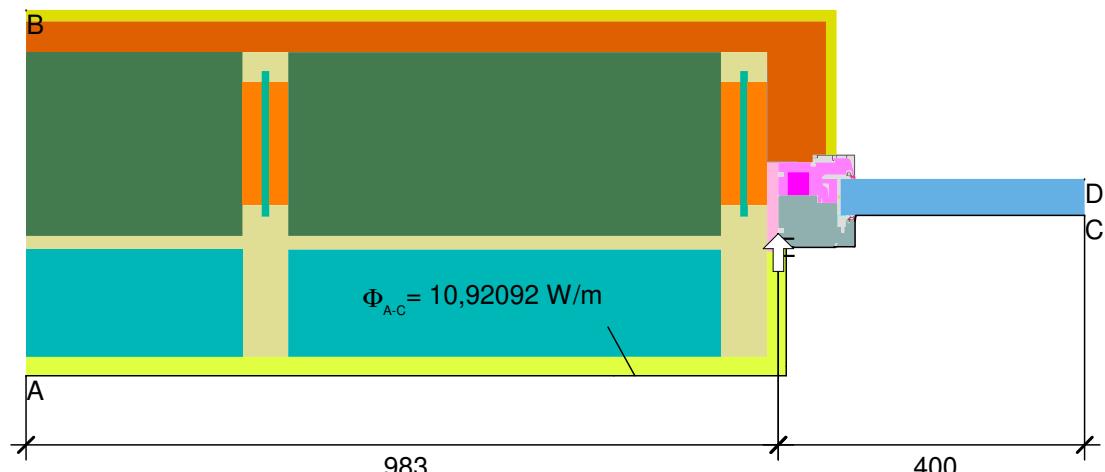
Material	$\lambda[\text{W}/(\text{m} \cdot \text{K})]$	ϵ
Aluminum I Aluminium 10456	160,000	0,900
Artificial stone I Kunststein 10456	1,300	0,900
Cement screed I Zement-Estrich 4108	1,400	
Concrete, 1% Steel I Beton, 1% Stahl 10456	2,300	
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glass I Glas	1,000	
Glue I Klebstoff	0,310	0,900
Ground I Erdreich	2,000	
Insulation I Wärmedämmung 035	0,035	
Insulation I Wärmedämmung 040	0,040	0,900
Nicht definiertes Material (1)	1,000	0,900
PE-Insulation I Wärmedämmung 035	0,035	0,900
PU in-situ foam I PU-Ortschaum 040	0,040	
Panel I Maske	0,035	0,900
Polyamide 25% Glassfiber	0,300	0,900
Silicone I Silikon	0,350	0,900
Spruce, Fir I Fichte, Tanne	0,110	0,900
Steel I Stahl	50,000	0,900
Unvent. cavity I unbel. Hohlr. **		
slightly vent. cav. I leicht bel. Hohlr. **		
** EN ISO 10077-2:2017, 6.4.3		

Randbedingung	$q[\text{W}/\text{m}^2]$	$\theta[^{\circ}\text{C}]$	$R[(\text{m}^2 \cdot \text{K})/\text{W}]$	ϵ
Adiabatic I Adiabatisch	0,000	0,000		
Adiabatic Adiabat				
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	
e 0,9 Cavity Hohlraum				0,900





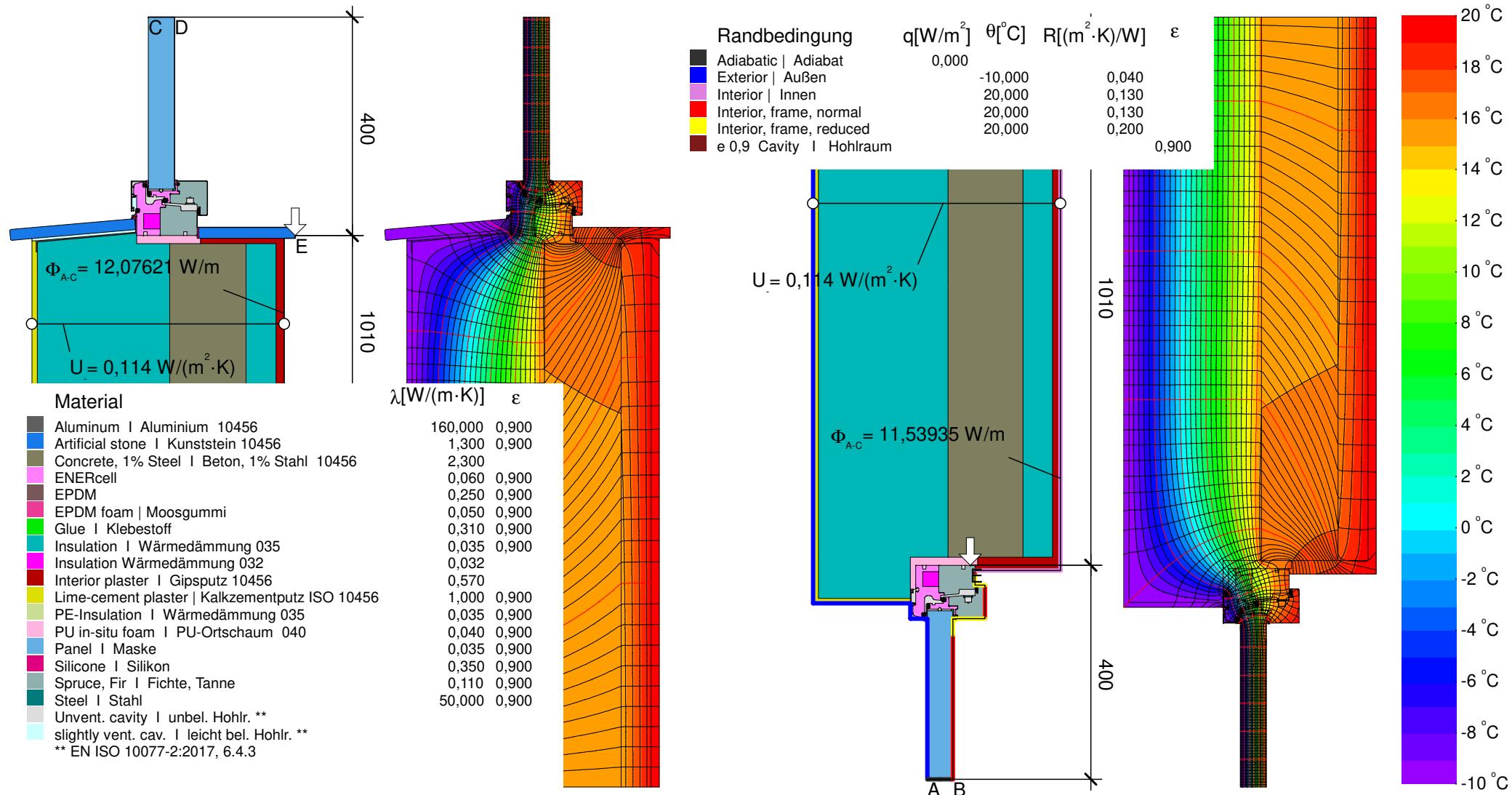
$$\Psi_{A-E-C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{11,658}{30,000} - 0,102 \cdot 1,010 - \frac{7,669}{30,000} = 0,030 W/(m \cdot K)$$



Material	$\lambda[\text{W}/(\text{m}\cdot\text{K})]$	ϵ
Aluminum Aluminium 10456	160,000	0,900
Butyl	0,240	0,900
Cellulose Zellulose 040	0,040	
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Gypsum board Gipskartonplatten 900 kg/m³ 10456	0,250	0,900
Insulation Wärmedämmung 035	0,035	
Insulation Wärmedämmung 040	0,040	
Insulation Wärmedämmung 050	0,050	0,900
Insulation Wärmedämmung 032	0,032	
Lime-cement plaster Kalkzementputz ISO 10456	1,000	
PE-Insulation Wärmedämmung 035	0,035	0,900
PU in-situ foam PU-Ortschaum 040	0,040	0,900
Panel Maske	0,035	0,900
Softwood flow parallel Weichholz Q parallel	0,290	
Softwood, OSB Weichholz, OSB 10456	0,130	
Spruce, Fir Fichte, Tanne	0,110	0,900
Unvent. cavity unbel. Hohlr. **		
** EN ISO 10077-2:2017, 6.4.3		

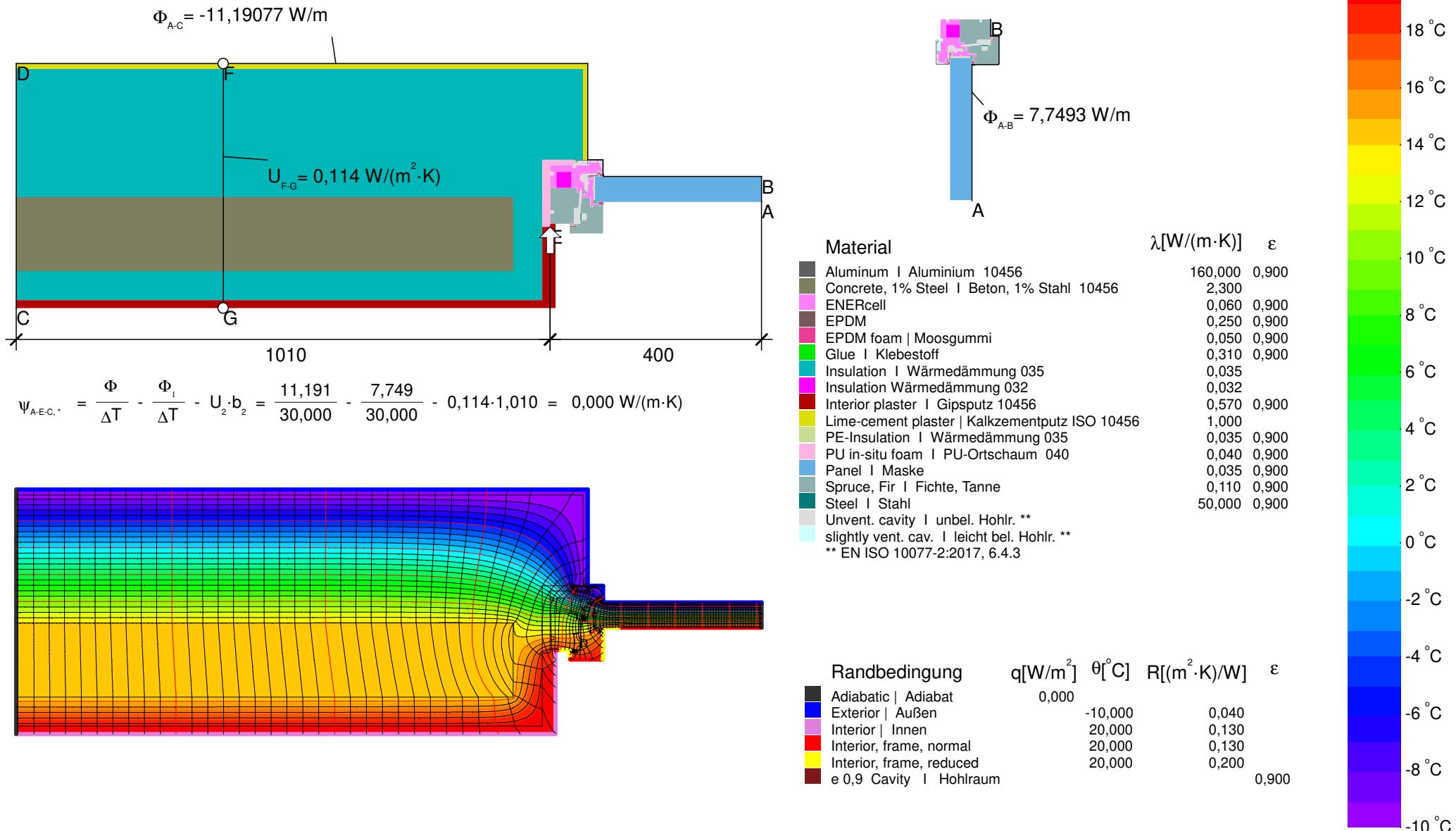
Randbedingung	$q[\text{W}/\text{m}^2]$	$\theta^{\circ}\text{C}$	$R[(\text{m}^2\cdot\text{K})/\text{W}]$	ϵ
Adiabatic Adiabat	0,000			
Exterior Außen	-10,000		0,040	
Interior Innen	20,000		0,130	
Interior, frame, normal	20,000		0,130	
Interior, frame, reduced	20,000		0,200	
e 0,9 Cavity Hohlraum				0,900

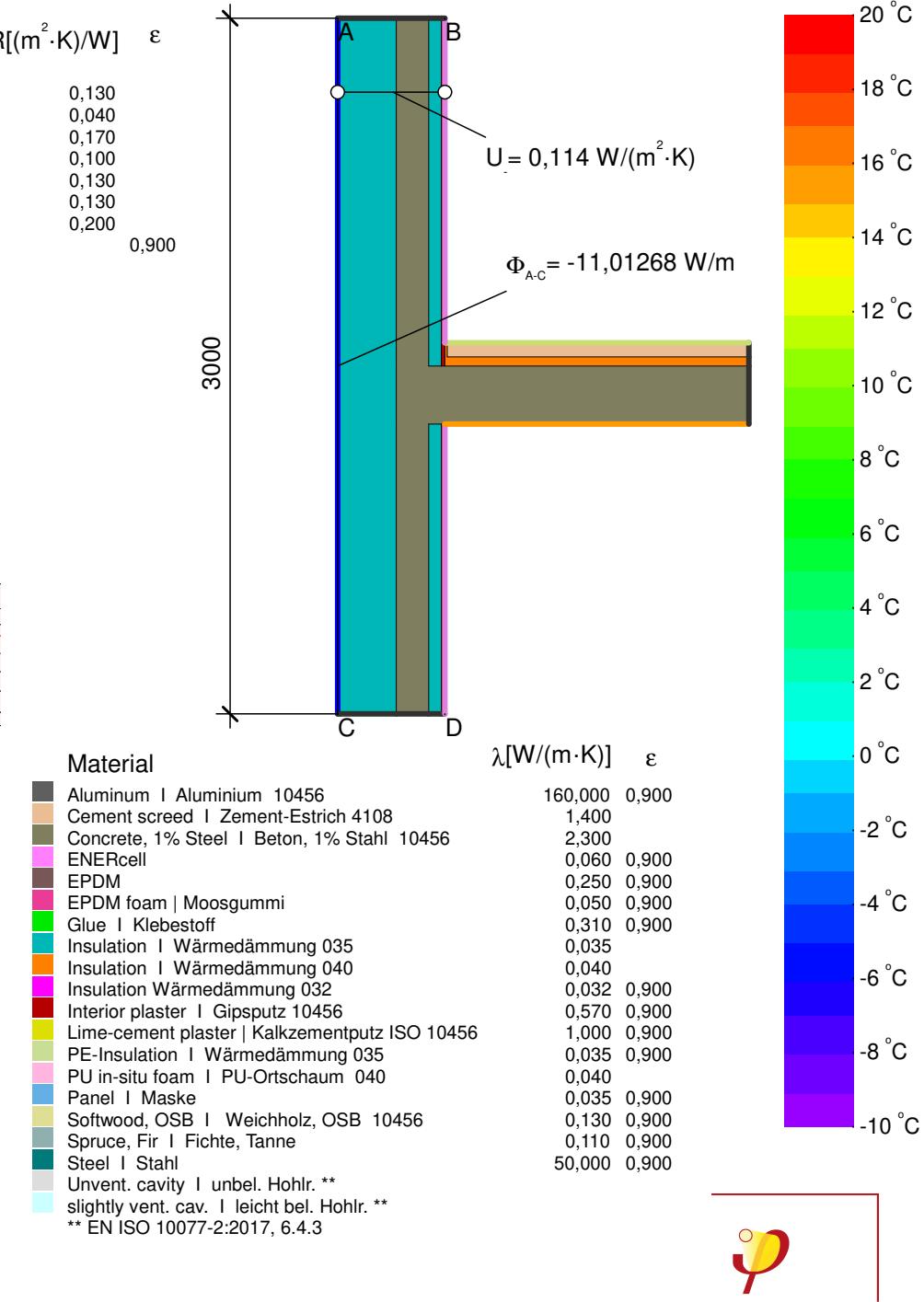
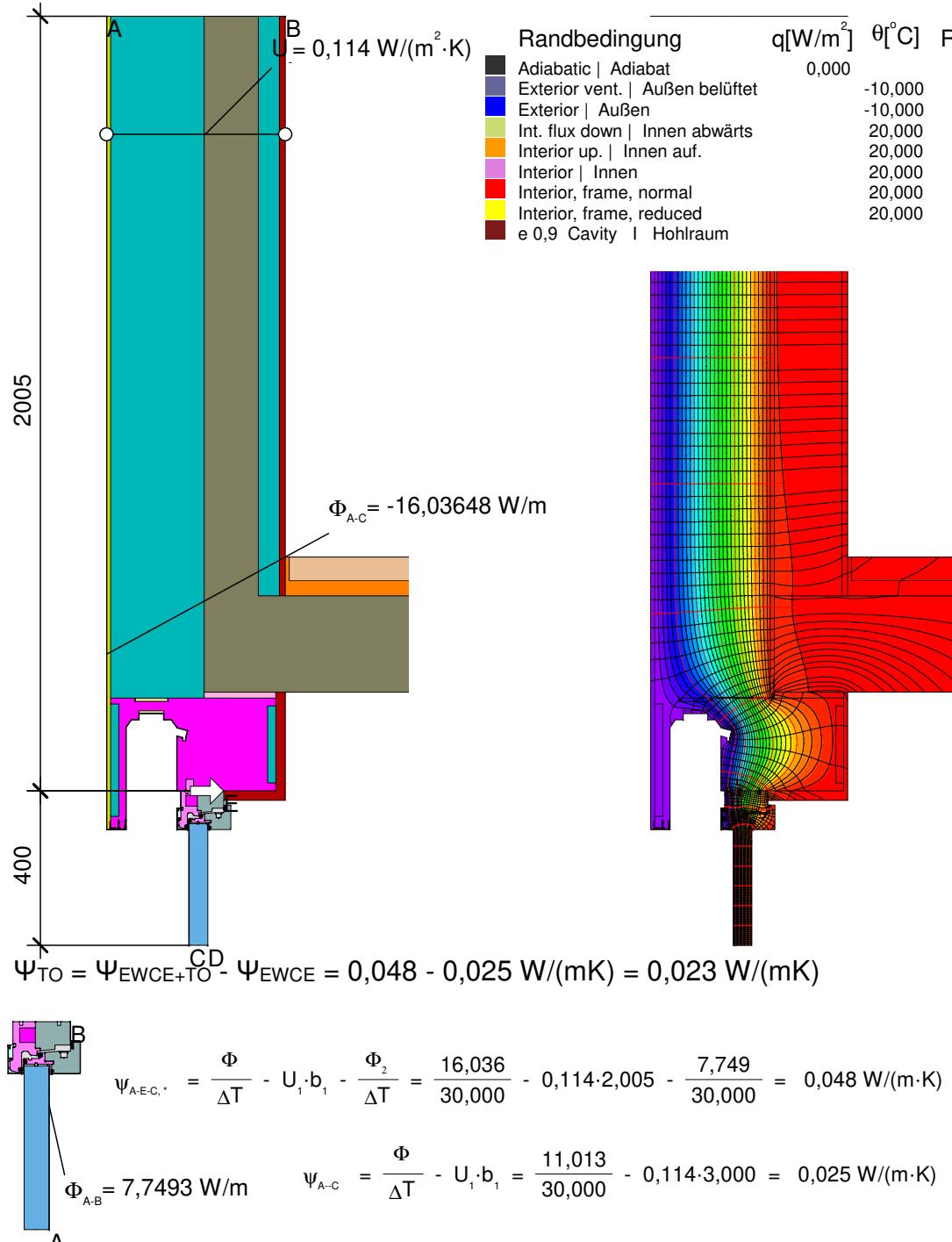


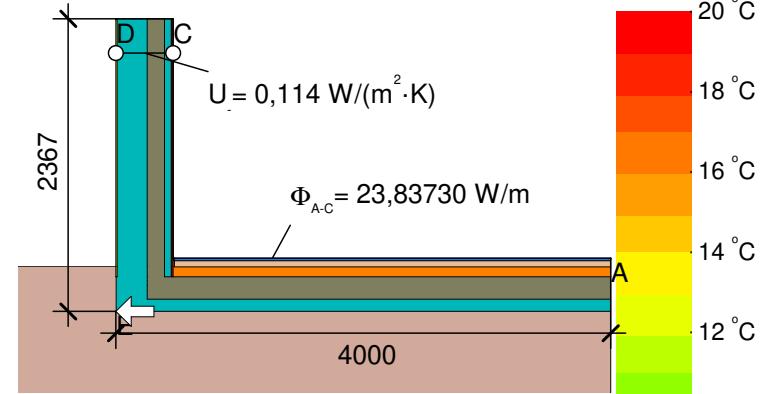
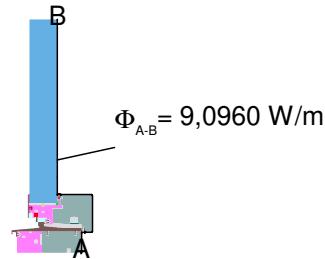


$$\Psi_{A-E,C,*} = \frac{\Phi}{\Delta T} - U_1 \cdot b_1 - \frac{\Phi_2}{\Delta T} = \frac{12,076}{30,000} - 0,114 \cdot 1,010 - \frac{7,745}{30,000} = 0,029 \text{ W/(m}\cdot\text{K)}$$

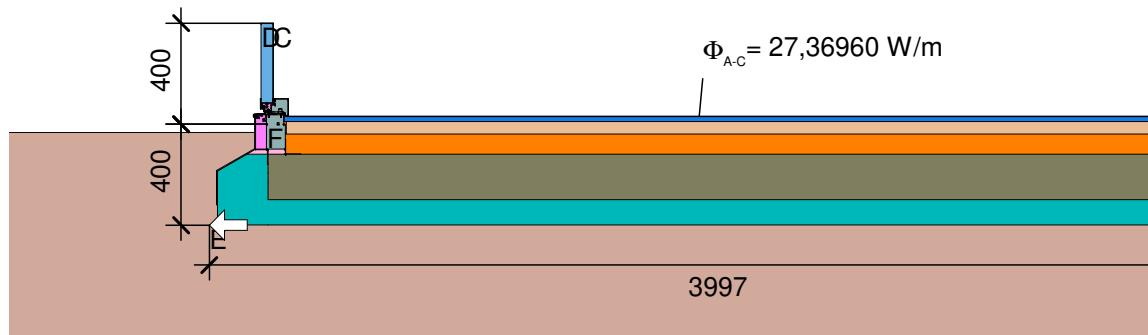
$$\Psi_{A-E,C,*} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 = \frac{11,539}{30,000} - \frac{7,749}{30,000} - 0,114 \cdot 1,010 = 0,011 \text{ W/(m}\cdot\text{K)}$$



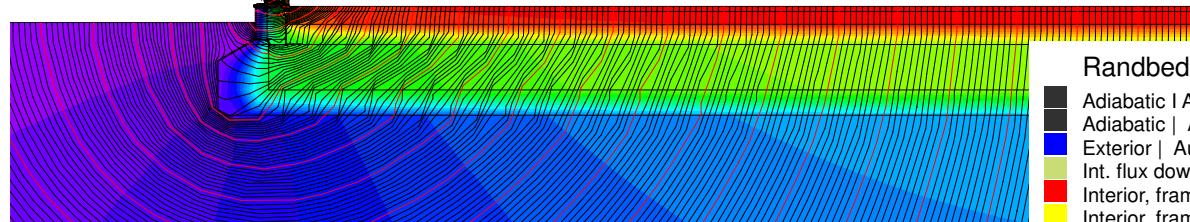




$$\Psi_{\text{WITH}} = \Psi_{\text{FSEW+WITH}} - \Psi_{\text{FSEW}} = -0,028 - -0,067 \text{ W/(mK)} = 0,029 \text{ W/(mK)}$$



$$\Psi_{\text{A-E,C,*}} = \frac{\Phi}{\Delta T} - \frac{\Phi_1}{\Delta T} - U_2 \cdot b_2 - \frac{\Phi_3}{\Delta T} = \frac{27,370}{30,000} - \frac{17,751}{30,000} - 0,114 \cdot 0,400 - \frac{9,096}{30,000} = -0,028 \text{ W/(m·K)}$$



Material

	$\lambda [\text{W}/(\text{m} \cdot \text{K})]$	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	
Concrete, 1% Steel I Beton, 1% Stahl 10456	2,300	0,900
ENERcell	0,060	0,900
EPDM	0,250	0,900
EPDM foam Moosgummi	0,050	0,900
Glass I Glas	1,000	
Glue I Klebestoff	0,310	0,900
Ground I Erdreich	2,000	
Insulation I Wärmedämmung 035	0,035	
Insulation I Wärmedämmung 040	0,040	0,900
PE-Insulation I Wärmedämmung 035	0,035	0,900
PU in-situ foam I PU-Ortschaum 040	0,040	0,900
Panel I Maske	0,035	0,900
Polyamide 25% Glassfiber	0,300	0,900
Silicone I Silikon	0,350	0,900
Spruce, Fir I Fichte, Tanne	0,110	0,900
Steel I Stahl	50,000	0,900
Unvent. cavity unbel. Hohlr. **		
slightly vent. cav. leicht bel. Hohlr. **		
** EN ISO 10077-2:2017, 6.4.3		

Randbedingung

	$q [\text{W}/\text{m}^2]$	$\theta [{}^\circ\text{C}]$	$R [(\text{m}^2 \cdot \text{K})/\text{W}]$	ϵ
Adiabatic Adiabatisch	0,000	0,000		
Adiabatic Adiabat				
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	
e 0,9 Cavity Hohlraum				0,900



