

flixo Version 6: validiertes Wärmebrückenprogramm

flixo Version 6 als auch alle früheren **flixo** Versionen erfüllen alle Validerungsbeispiele folgender Europäischer Normen:

- § EN ISO 10211: 2007 (Wärmebrücken im Hochbau – Wärmeströme und Oberflächentemperaturen – Detaillierte Berechnungen)
- § EN ISO 10077-2:2003 (Wärmetechnisches Verhalten von Fenstern, Türen und Abschlüssen - Berechnung des Wärmedurchgangskoeffizienten, Teil 2: Numerisches Verfahren für Rahmen)

Dies sind die 2 einzigen Normen mit Validierungsbeispielen für thermische Simulationsprogramme im Bau. Anbei sind die Resultate aller Berechnungen der Validierungsbeispiele mit **flixo** als auch die Zusammenfassung des Vergleichs mit den Normen.

Infomind unterstützt und begrüsst eine Europaweite Zertifizierung von Wärmebrückenprogrammen. Bis jetzt existiert leider kein weitergehendes Verfahren oder Institut etc., welches Europaweit Wärmebrücken-Programme zertifiziert oder auszeichnet. Die Zertifizierung erfolgt einzig und allein durch den Nachweis, dass alle Kriterien der Validierungsbeispiele der Normen erfüllt sind.

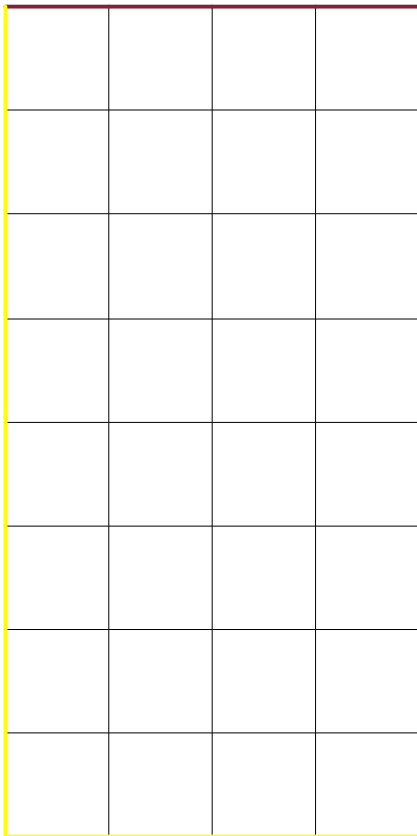
Aus diesen Gründen ist **flixo** Version 6 ein voll anerkanntes, normgerechtes Wärmebrücken-Simulationsprogramm und kann entsprechend verwendet werden.

Zürich, 20.7.2009



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Name	λ [W/(m·K)]
Material1	1.000
Material1A	1.000

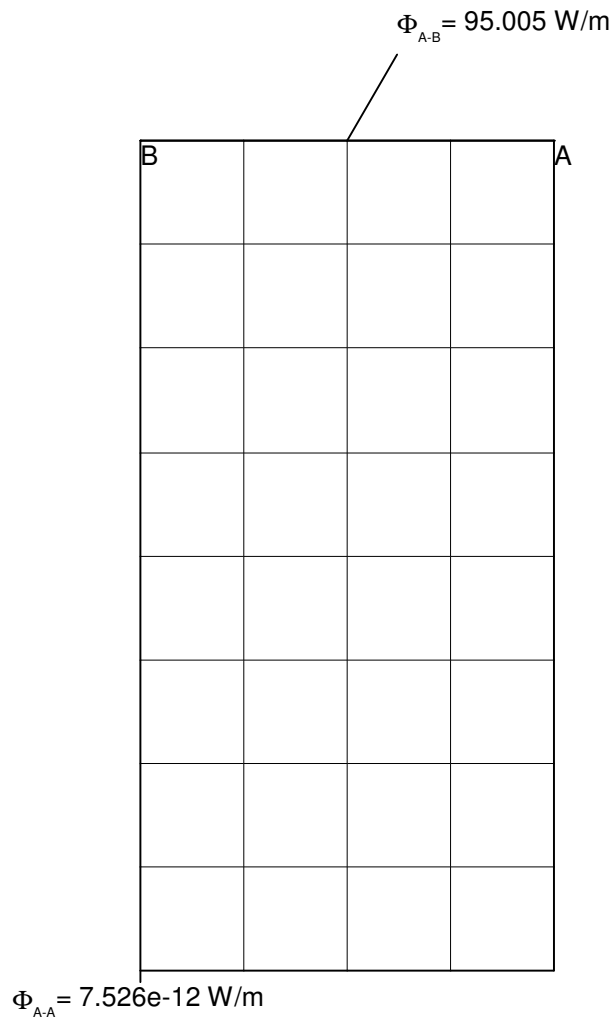
Name	q[W/m ²]	θ [°C]	h[W/(m ² ·K)]	ϵ
0 Degree		0.000		
20 Degree		20.000		
Adiabatic	0.000			

	9.66 °C	13.38 °C	14.73 °C	15.09 °C
	5.25 °C	8.64 °C	10.32 °C	10.81 °C
	3.19 °C	5.61 °C	7.01 °C	7.47 °C
	2.01 °C	3.64 °C	4.66 °C	5.00 °C
	1.26 °C	2.31 °C	2.99 °C	3.22 °C
	0.74 °C	1.36 °C	1.77 °C	1.91 °C
	0.34 °C	0.63 °C	0.82 °C	0.89 °C

Summary

flixo fullfills the criterias for the first validation sample of EN ISO 10211: 2007

- The max. difference between the calculated temperatures and the corresponding temperatures of the Standard is 0.05 °C. Therefore all temperatures are in the given acceptance range of 0.1 °C.

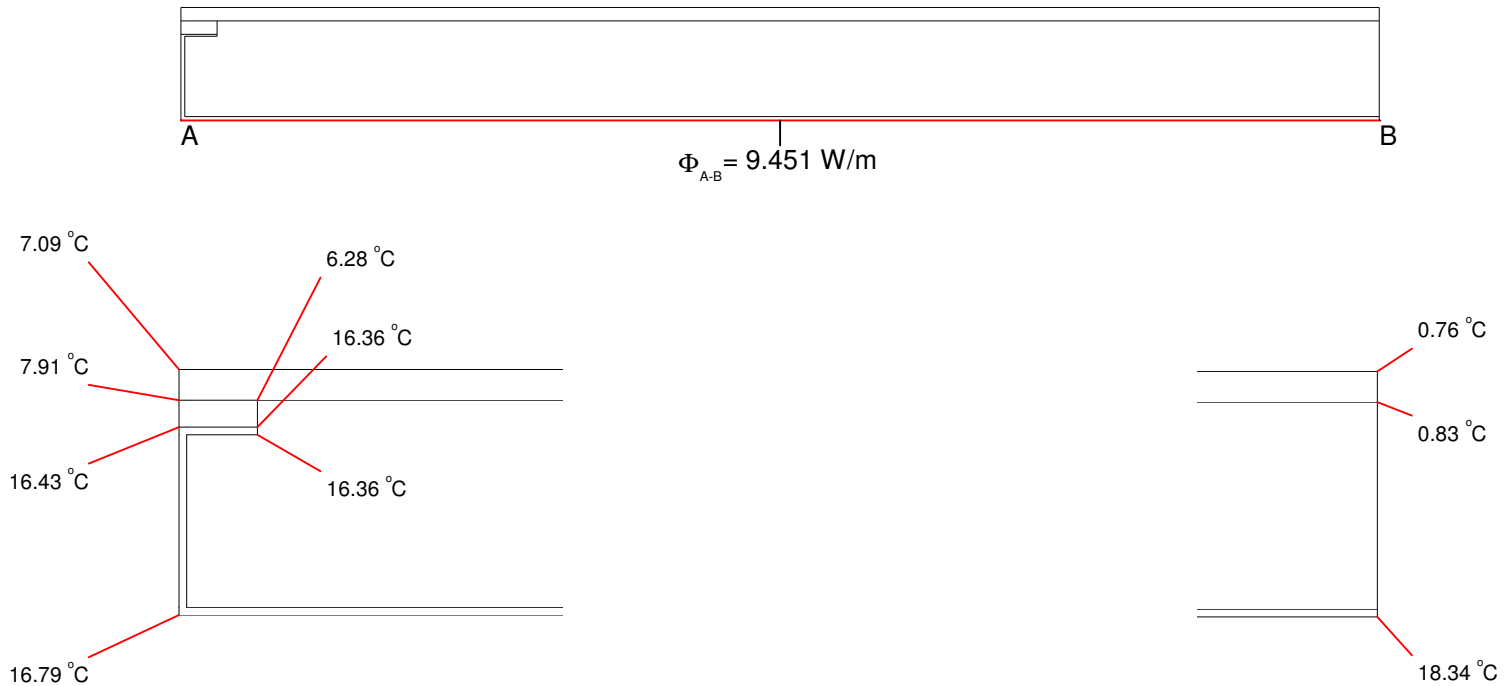


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Name	λ [W/(m·K)]
Material 1	1.150
Material 2	0.120
Material 3	0.029
Material 4	230.000

Name	q[W/m ²]	θ [°C]	h[W/(m ² ·K)]	ϵ
0/0.06		0.000		16.667
20/0.11		20.000		9.091
Adiabatic	0.000			

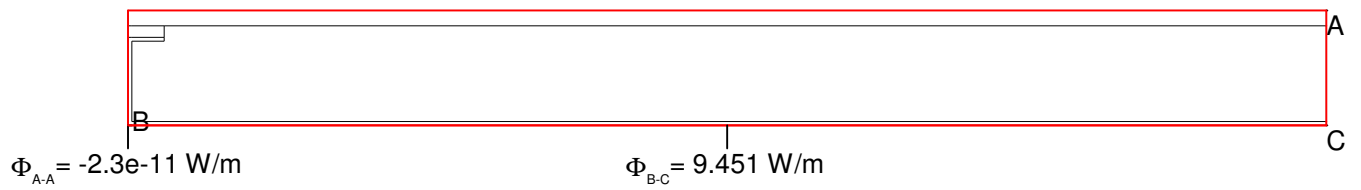


Summary

flixo fullfills all criterias for the second validation sample of EN ISO 10211: 2007

- The max. difference between the calculated temperatures and the corresponding temperatures of the Standard is 0.06°C . Therefore all temperatures are in the given acceptance range of 0.1°C .
- The difference between the calculated heat flux and the given heat flux of the Standard is 0.049 W/m . The heat flux is therefore in the given acceptance range of 0.1 W/m .

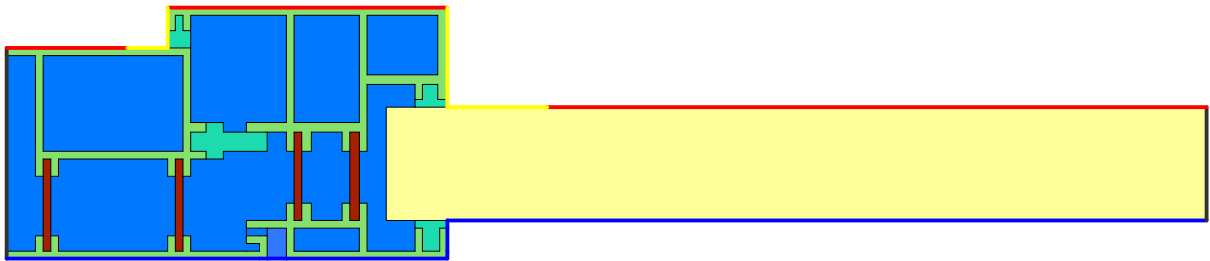
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EN ISO 10077-2:2003

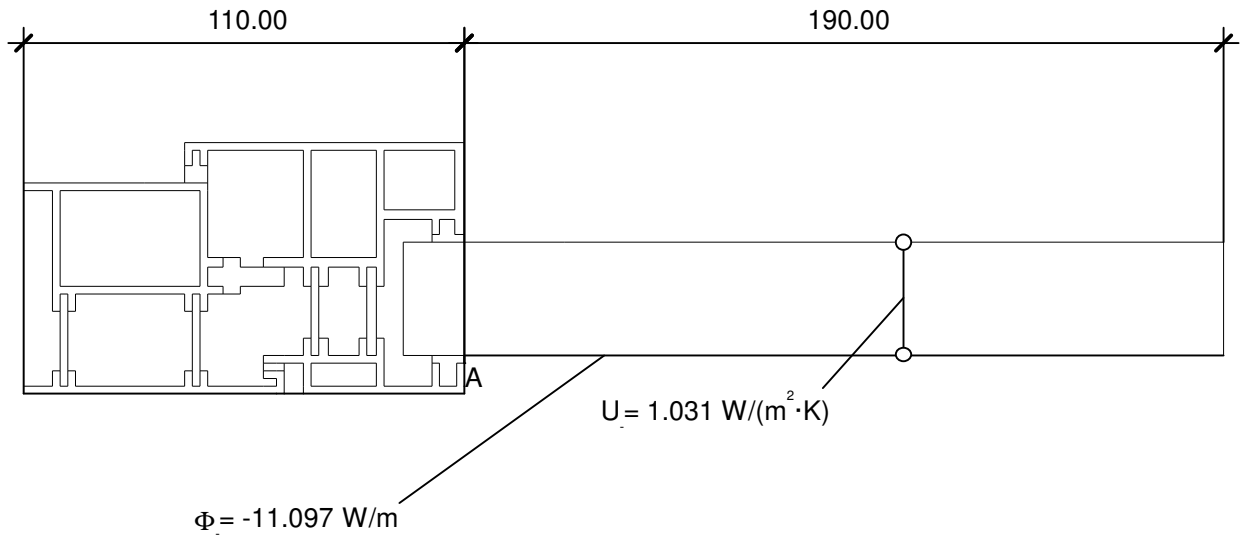
Samples V6.1

Standard					flixo						
Name	Standard	min	max	Uf/Psi	Name	Q	L	bf	Up/Ug	Uf/Psi	Rel. Conductance Diff.
D.1	0.550	0.534	0.567	3.220	EN_ISO_10077-2_D1_EN	11.097	0.555	0.1100	1.0310	3.263	0.9%
D.2	0.263	0.255	0.271	1.440	EN_ISO_10077-2_D2_EN	5.204	0.260	0.1100	0.5470	1.421	-1.1%
D.3	0.424	0.411	0.437	2.070	EN_ISO_10077-2_D3_EN	8.271	0.414	0.1100	1.0310	1.979	-2.5%
D.4	0.346	0.336	0.356	1.360	EN_ISO_10077-2_D4_EN	6.871	0.344	0.1100	1.0310	1.342	-0.7%
D.5	0.408	0.396	0.420	2.080	EN_ISO_10077-2_D5_EN	7.952	0.398	0.0890	1.1690	1.972	-2.5%
D.6	0.659	0.639	0.679	4.670	EN_ISO_10077-2_D6_EN	13.285	0.664	0.0950	1.1310	4.730	0.8%
D.7	0.285	0.276	0.294	1.310	EN_ISO_10077-2_D7_EN	5.624	0.281	0.0480	1.1690	1.231	-1.3%
D.8	0.181	0.176	0.186	1.030	EN_ISO_10077-2_D8_EN	3.543	0.177	0.1770		1.001	-2.1%
D.9	0.207	0.201	0.213	3.640	EN_ISO_10077-2_D9_EN	4.118	0.206	0.0570		3.612	-0.5%
D.10	0.481	0.467	0.495	0.084	EN_ISO_10077-2_D10_EN	9.600	0.480	0.1100	1.3053	0.084	-0.2%

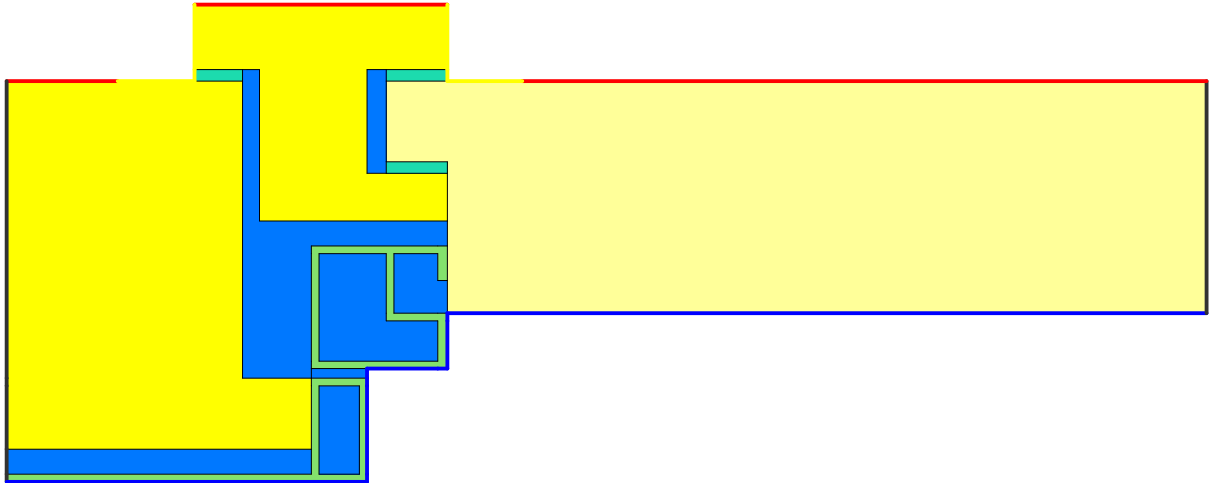


Name	λ [W/(m·K)]
Aluminium (Si alloys)	160.000
EPDM (ethylene propylene diene monomer)	0.250
Panel	0.035
Polyamid 6.6 with 25% glassfibre	0.300
Slightly ventilated air cavity, Eps=0.9	Eps=0.9/0.9
Unventilated air cavity, Eps=0.9	Eps=0.9/0.9

Name	q[W/m ²]	θ [°C]	R[(m ² ·K)/W]	ϵ
Exterior, frame	0.000		0.040	
Interior, frame, normal	20.000		0.130	
Interior, frame, reduced	20.000		0.200	
Symmetry/Model section	0.000			

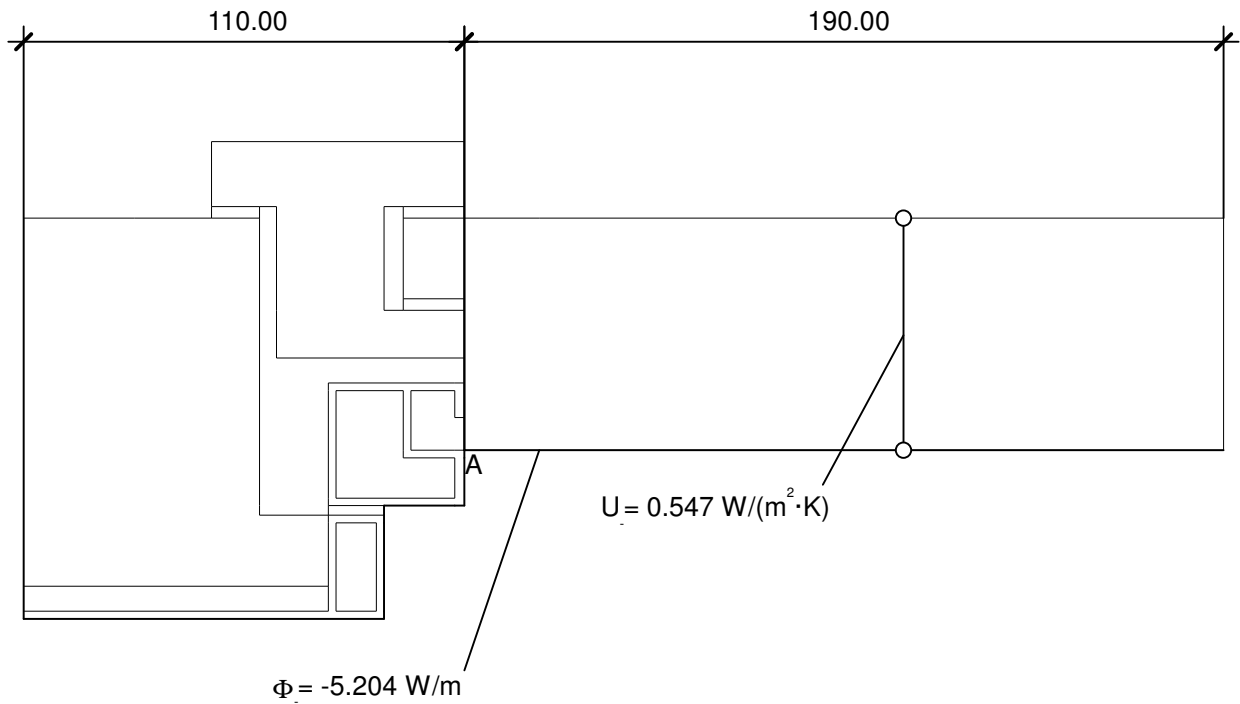


$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.097}{20.000} - 1.031 \cdot 0.190}{0.110} = 3.263 \text{ W}/(\text{m}^2 \cdot \text{K})$$

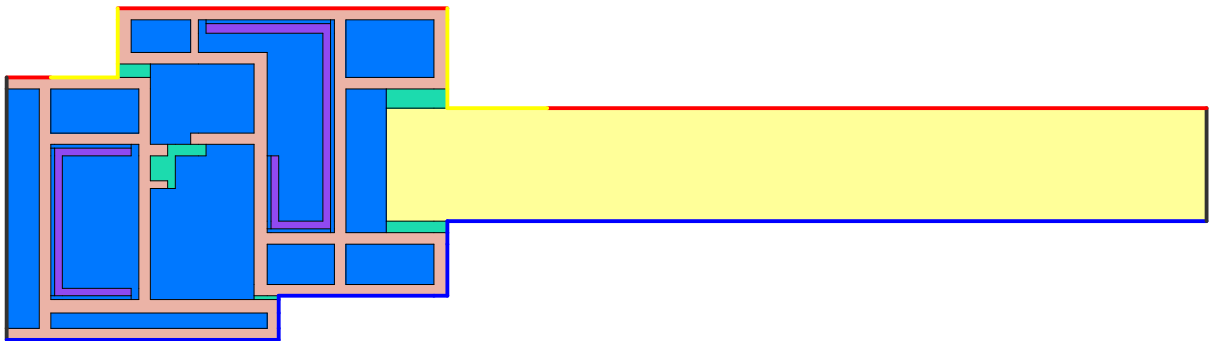


Name	λ [W/(m·K)]
Aluminium (Si alloys)	160.000
EPDM (ethylene propylene diene monomer)	0.250
Panel	0.035
Softwood (typical construction timber)	0.130
Unventilated air cavity, Eps=0.9	Eps=0.9/0.9

Name	q[W/m ²]	θ [°C]	R[(m ² ·K)/W]	ϵ
Exterior, frame	0.000		0.040	
Interior, frame, normal	20.000		0.130	
Interior, frame, reduced	20.000		0.200	
Symmetry/Model section	0.000			

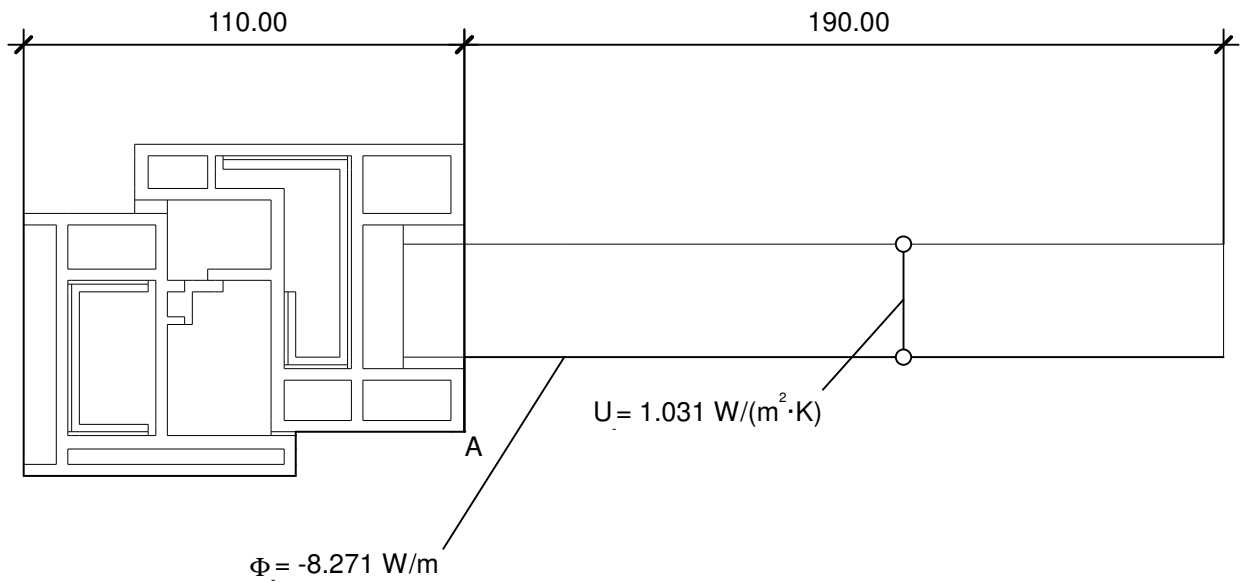


$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{5.204}{20.000} - 0.547 \cdot 0.190}{0.110} = 1.420 \text{ W}/(\text{m}^2 \cdot \text{K})$$

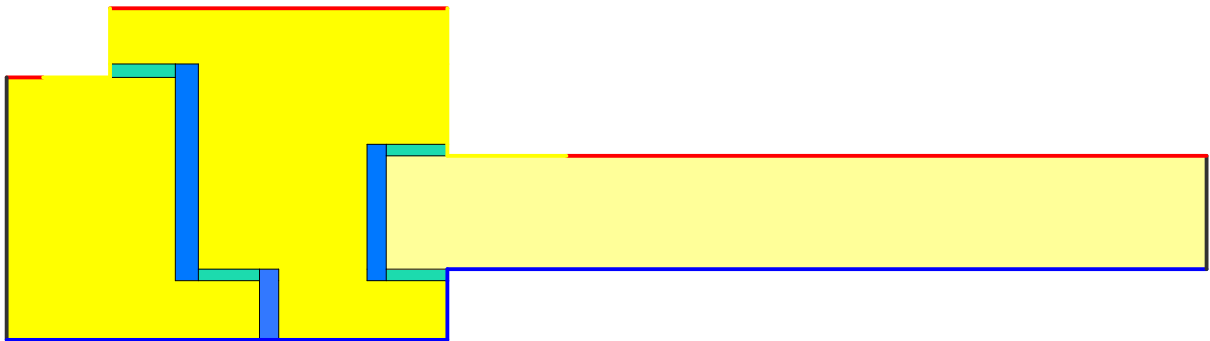


Name	λ [W/(m·K)]
EPDM (ethylene propylene diene monomer)	0.250
PVC (polyvinylchloride), rigid	0.170
Panel	0.035
Steel	50.000
Unventilated air cavity, Eps=0.9	Eps=0.9/0.9

Name	q[W/m ²]	θ [°C]	R[(m ² ·K)/W]	ϵ
Exterior, frame		0.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

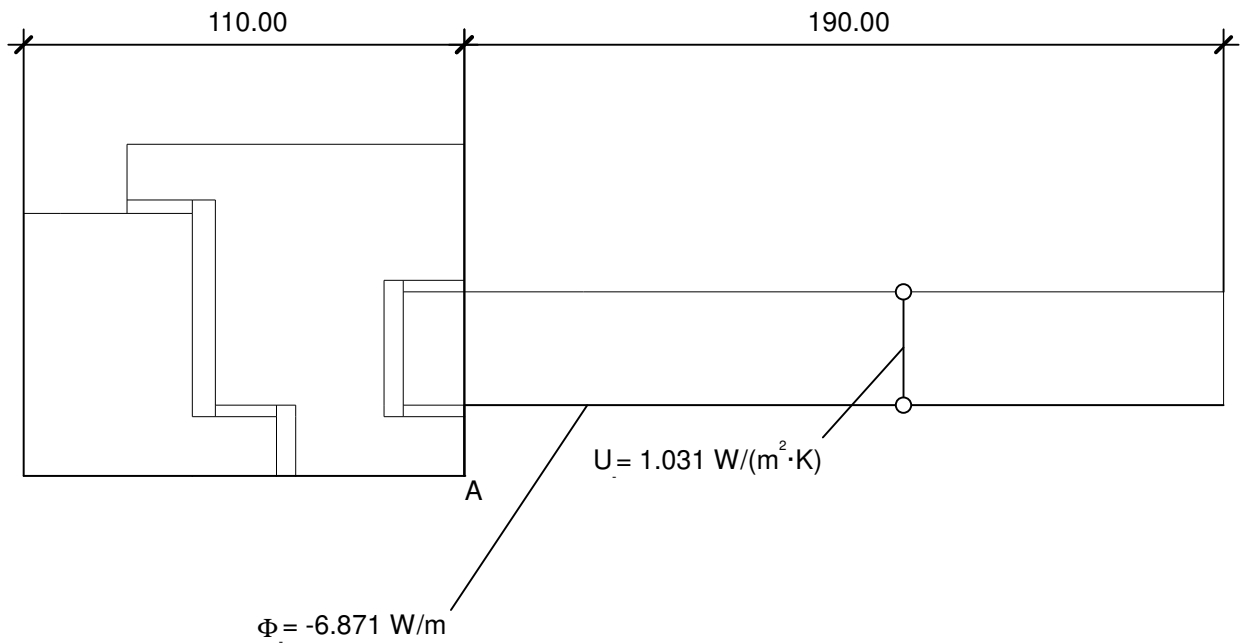


$$U_{IA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{8.271}{20.000} - 1.031 \cdot 0.190}{0.110} = 1.979 \text{ W/(m}^2 \cdot \text{K)}$$

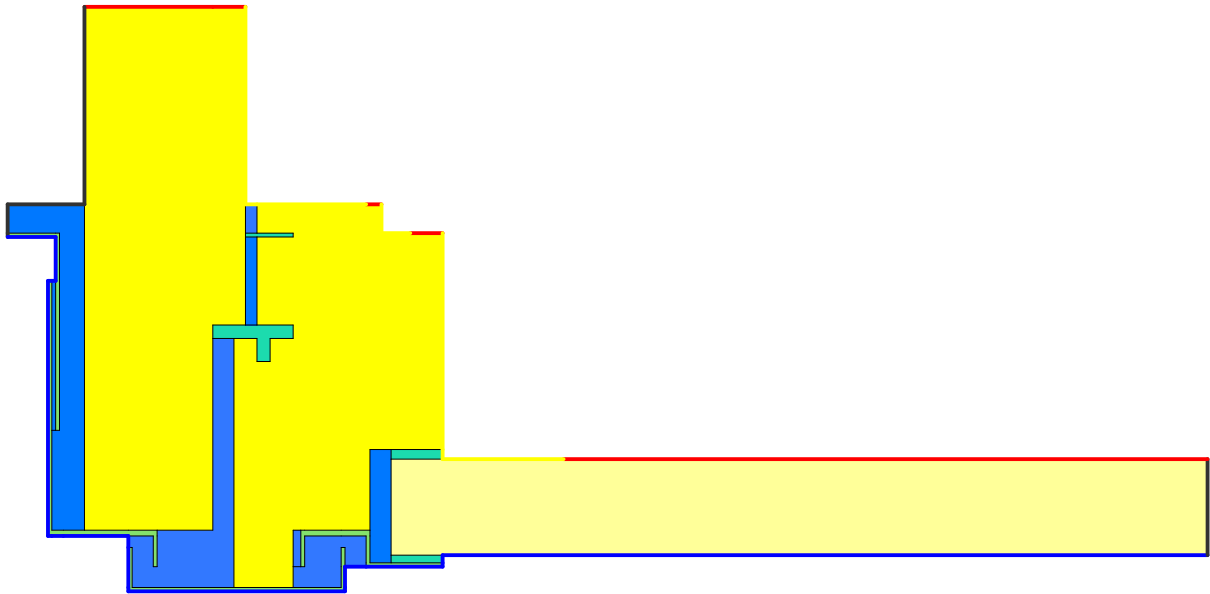


Name	λ [W/(m·K)]
Belüftete Hohlräume, Eps=0.9	Eps=0.9/0.9
EPDM (Ethylen Propylen Dien Monomer)	0.250
Maske	0.035
Unbelüftete Hohlräume, Eps=0.9	Eps=0.9/0.9
Weich-Holz (typisches Bauholz)	0.130

Name	q[W/m ²]	θ [°C]	R[(m ² ·K)/W]	ϵ
Exterior, frame	0.000		0.040	
Interior, frame, normal	20.000		0.130	
Interior, frame, reduced	20.000		0.200	
Symmetry/Model section	0.000			

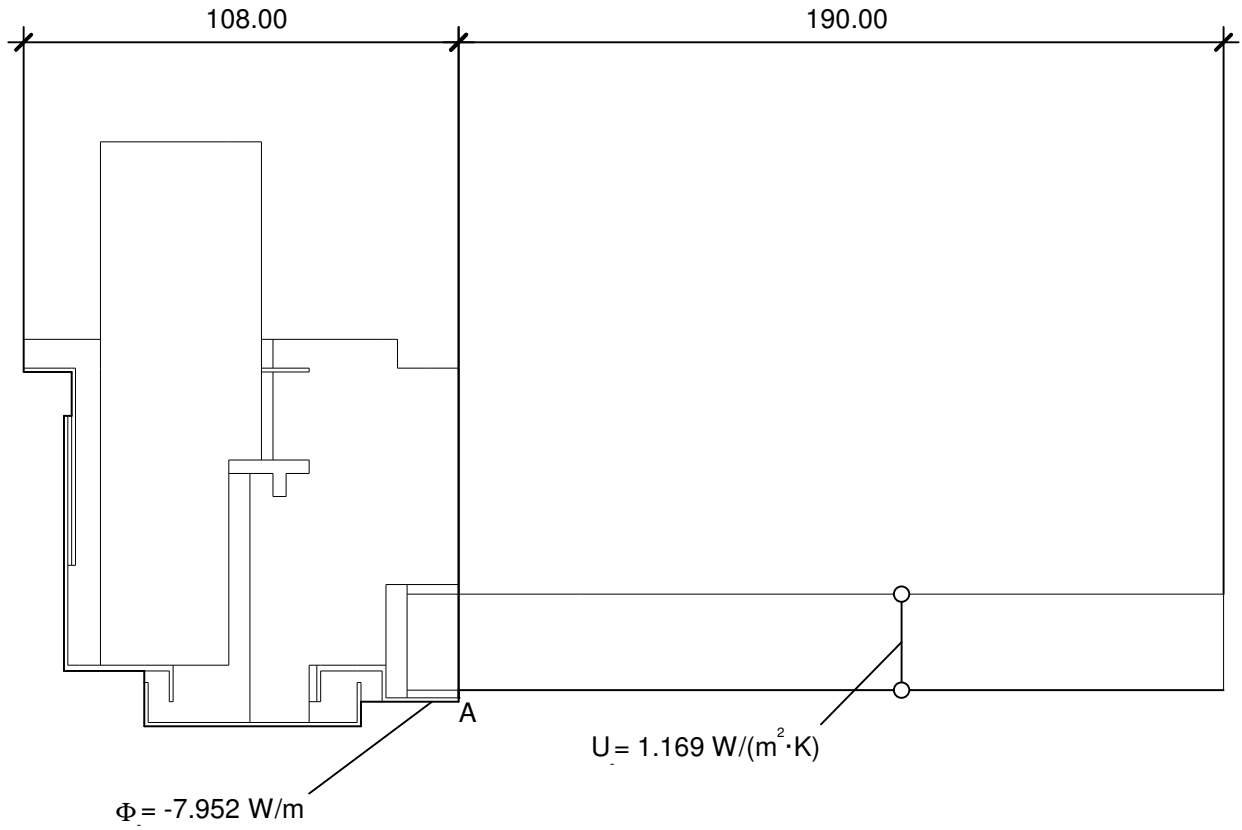


$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.871}{20.000} - 1.031 \cdot 0.190}{0.110} = 1.343 \text{ W}/(\text{m}^2 \cdot \text{K})$$

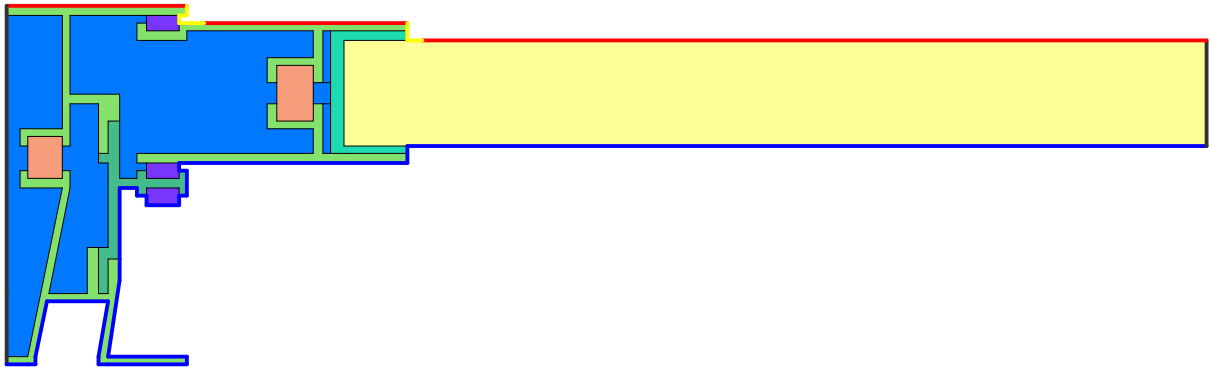


Name	λ [W/(m·K)]
Aluminium (Si alloys)	160.000
EPDM (ethylene propylene diene monomer)	0.250
Panel	0.035
Slightly ventilated air cavity, Eps=0.9	Eps=0.9/0.9
Softwood (typical construction timber)	0.130
Unventilated air cavity, Eps=0.9	Eps=0.9/0.9

Name	q[W/m ²]	θ [°C]	R[(m ² ·K)/W]	ϵ
Exterior, frame	0.000		0.040	
Interior, frame, normal	20.000		0.130	
Interior, frame, reduced	20.000		0.200	
Symmetry/Model section	0.000			

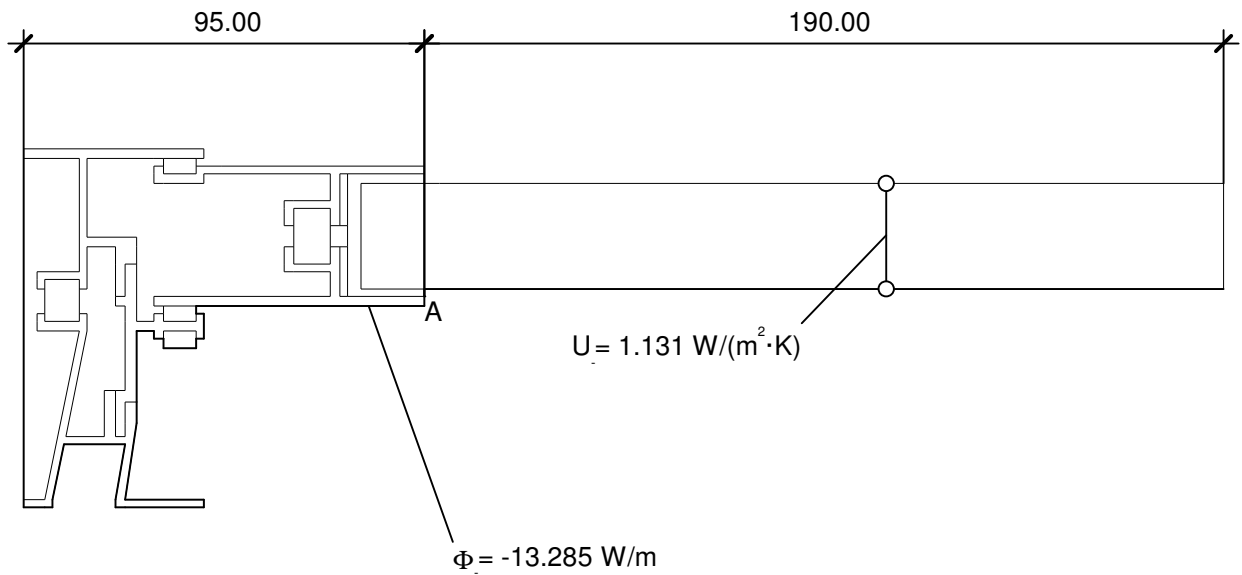


$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{7.952}{20.000} - 1.169 \cdot 0.190}{0.108} = 1.626 \text{ W}/(\text{m}^2 \cdot \text{K})$$



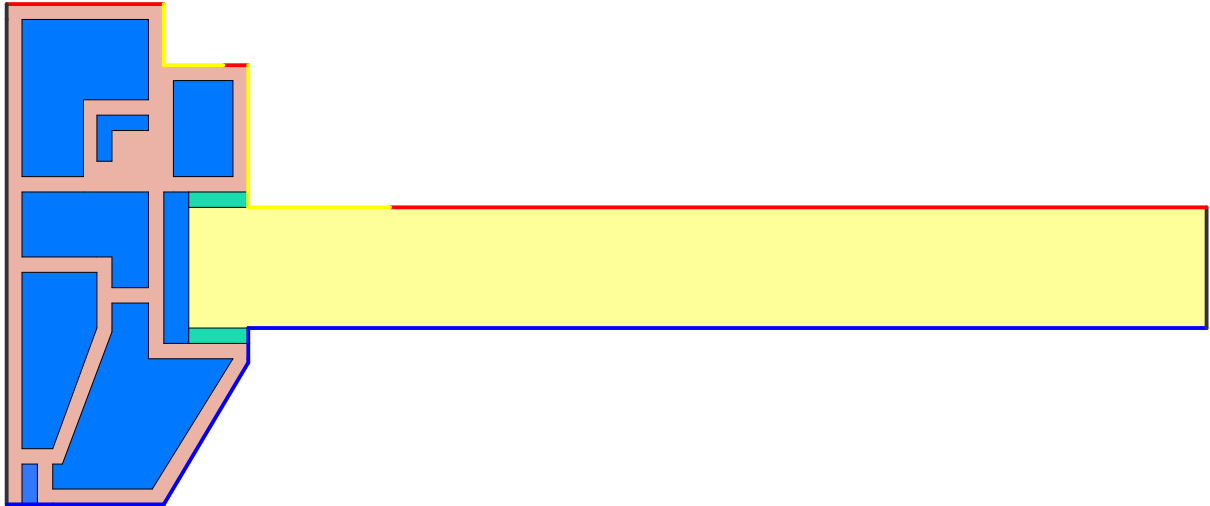
Name	λ [W/(m·K)]
Aluminium (Si alloys)	160.000
EPDM (ethylene propylene diene monomer)	0.250
Mohair (polyester) sweep	0.140
PU (polyurethane), rigid	0.250
Panel	0.035
Polyamid (nylon)	0.250
Unventilated air cavity, Eps=0.9	Eps=0.9/0.9

Name	q[W/m ²]	θ [°C]	R[(m ² ·K)/W]	ϵ
Exterior, frame		0.000		0.040
Interior, frame, normal		20.000		0.130
Interior, frame, reduced		20.000		0.200
Symmetry/Model section	0.000			



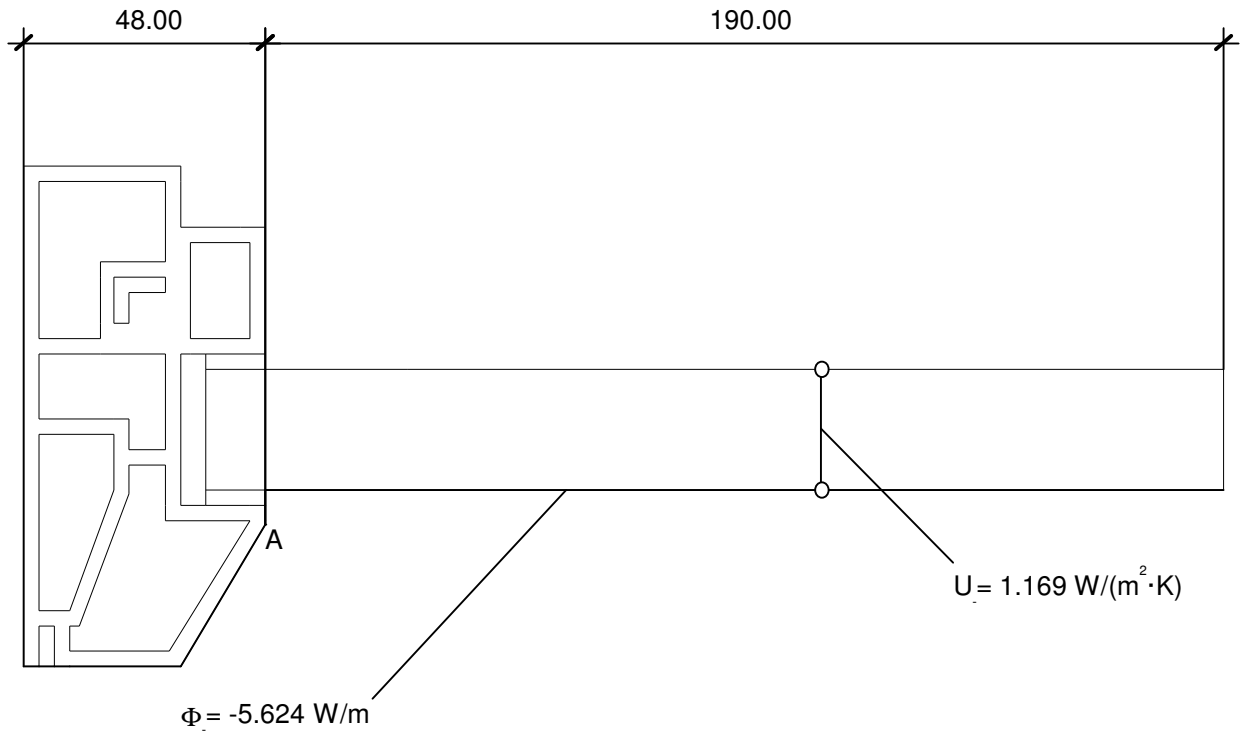
$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{13.285}{20.000} - 1.131 \cdot 0.190}{0.095} = 4.730 \text{ W}/(\text{m}^2 \cdot \text{K})$$

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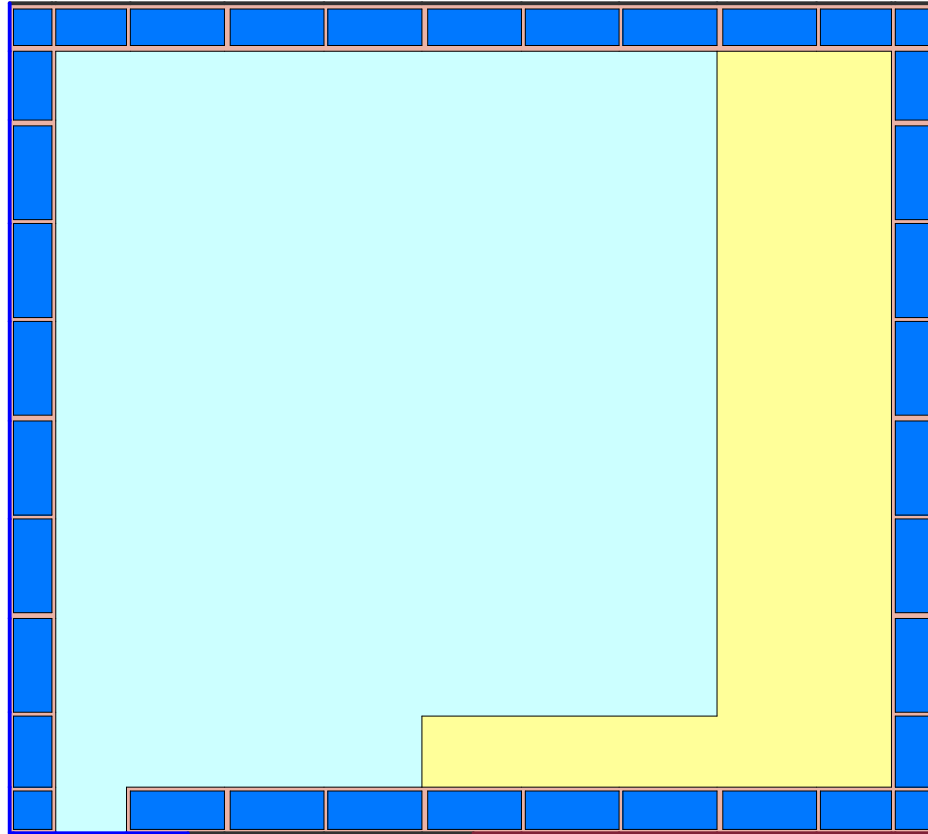
Name	λ [W/(m·K)]
EPDM (ethylene propylene diene monomer)	0.250
PVC (polyvinylchloride), rigid	0.170
Panel	0.035
Slightly ventilated air cavity, Eps=0.9	Eps=0.9/0.9
Unventilated air cavity, Eps=0.9	Eps=0.9/0.9

Name	q[W/m ²]	θ [°C]	R[(m ² ·K)/W]	ϵ
Exterior, frame	0.000		0.040	
Interior, frame, normal	20.000		0.130	
Interior, frame, reduced	20.000		0.200	
Symmetry/Model section	0.000			



$$U_{iA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{5.624}{20.000} - 1.169 \cdot 0.190}{0.048} = 1.233 \text{ W}/(\text{m}^2 \cdot \text{K})$$

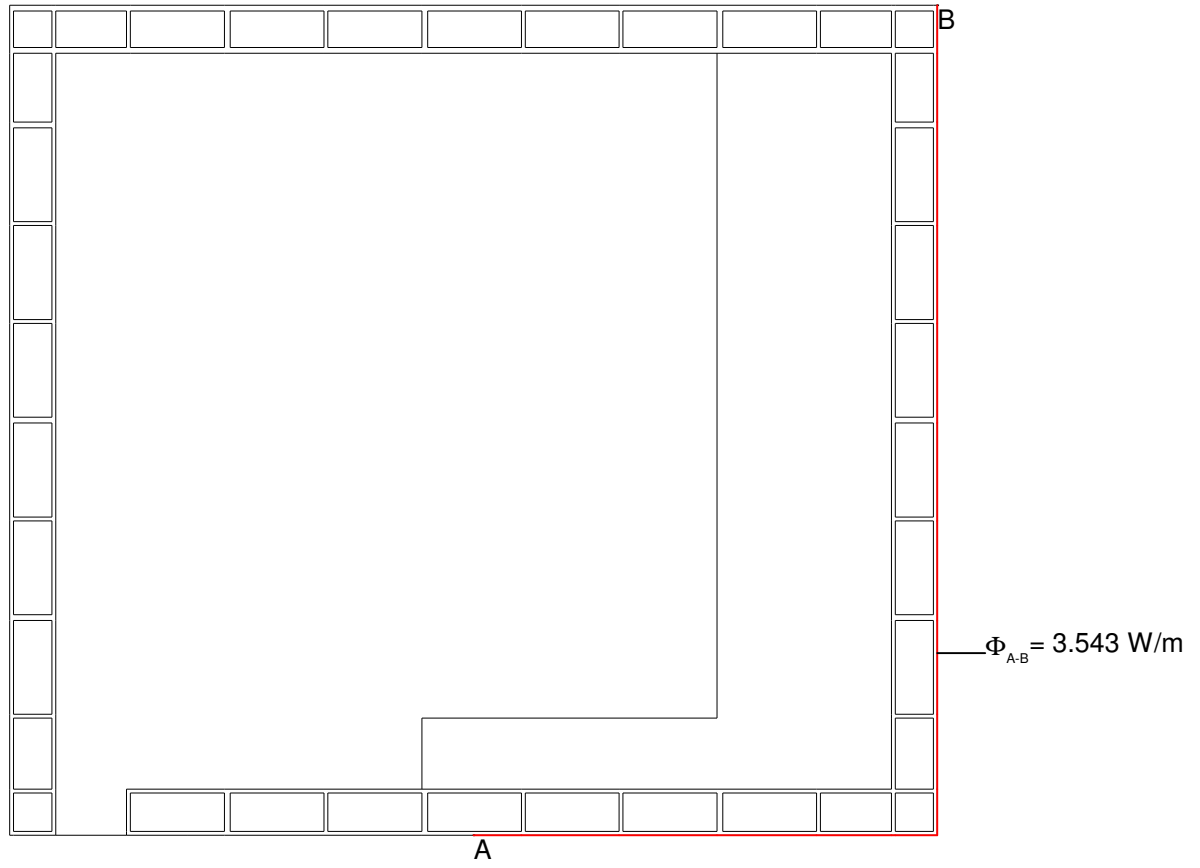
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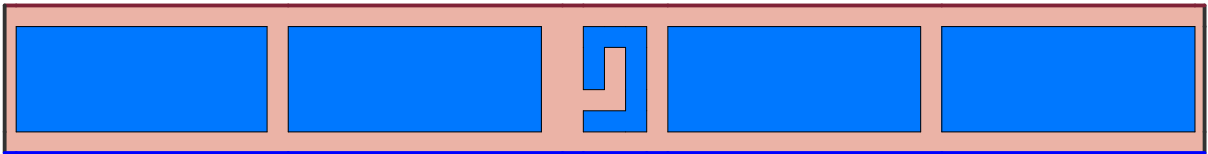
Name	λ [W/(m·K)]
PVC (polyvinylchloride), rigid	0.170
Panel	0.035
Slightly ventilated air cavity, Eps=0.9	Eps=0.9/0.9
Unventilated air cavity, Eps=0.9	Eps=0.9/0.9

Name	q [W/m ²]	θ [°C]	R [(m ² ·K)/W]	ϵ
Exterior, frame	0.000		0.040	
Interior, normal	20.000		0.130	
Symmetry/Model section	0.000			

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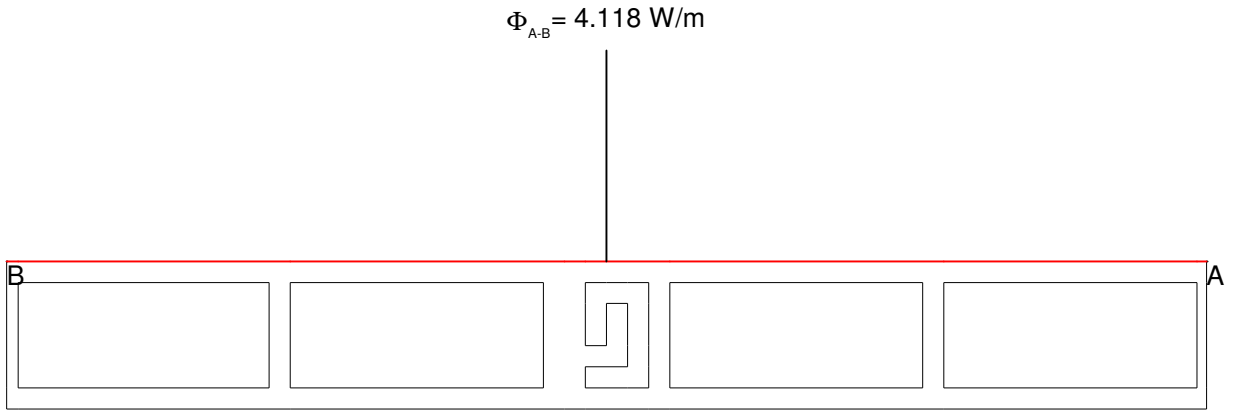
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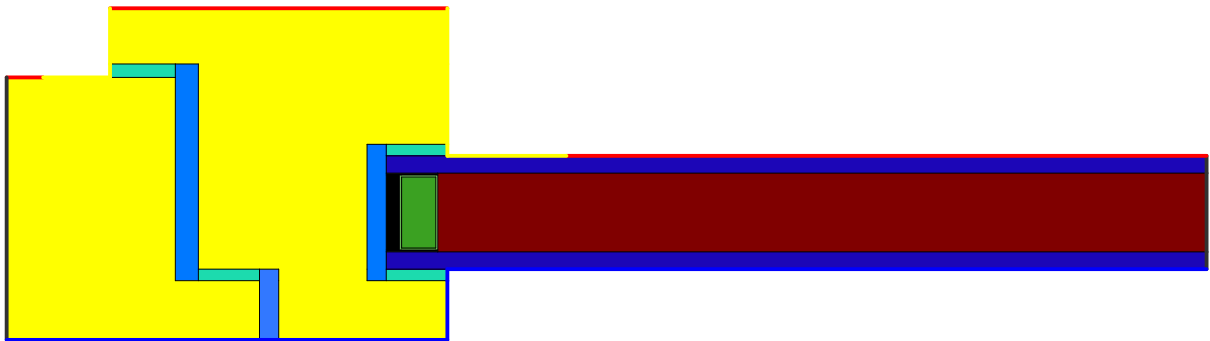


Name	λ [W/(m·K)]
PVC (polyvinylchloride), rigid	0.170
Unventilated air cavity, Eps=0.9	Eps=0.9/0.9

Name	q[W/m ²]	θ [°C]	R[(m ² ·K)/W]	ϵ
Exterior, frame	0.000		0.040	
Interior, normal	20.000		0.130	
Symmetry/Model section	0.000			

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Name	λ [W/(m·K)]
Aluminium (Si alloys)	160.000
EPDM (ethylene propylene diene monomer)	0.250
Glasin filling	0.034
Polysulfide (1)	0.400
Silica gel (dessicant) (1)	0.130
Slightly ventilated air cavity, Eps=0.9	Eps=0.9/0.9
Soda lime glass	1.000
Softwood (typical construction timber)	0.130
Unventilated air cavity, Eps=0.9	Eps=0.9/0.9

Name	q[W/m ²]	θ [°C]	R[(m ² ·K)/W]	ϵ
Exterior, frame		0.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

