infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch

flixo Version 7: validiertes Wärmebrückenprogramm

flixo Version 7 wie auch alle früheren ***flixo***-Versionen erfüllen alle Validierungsbeispiele folgender Europäischer Normen:

- EN ISO 10077-2:2012 (Wärmetechnisches Verhalten von Fenstern, Türen und Abschlüssen - Berechnung des Wärmedurchgangskoeffizienten, Teil 2: Numerisches Verfahren für Rahmen)
- EN ISO 10211:2007 (Wärmebrücken im Hochbau – Wärmeströme und Oberflächentemperaturen, Teil 1: Allgemeine Berechnungsverfahren)

Dies sind die 2 einzigen Normen mit Valdierungsbeispielen 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 Wärmebrücken-programmen. 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.

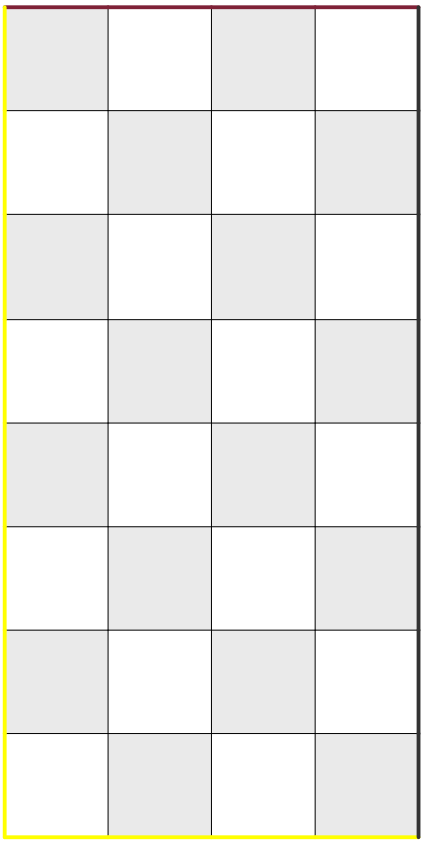
Aus diesen Gründen ist ***flixo*** Version 7 ein voll anerkanntes, normgerechtes Wärmebrücken-Simulationsprogramm und kann entsprechend verwendet werden.

Zürich, 4.10.2012

Walter Schmidli

CEO, Infomind GmbH

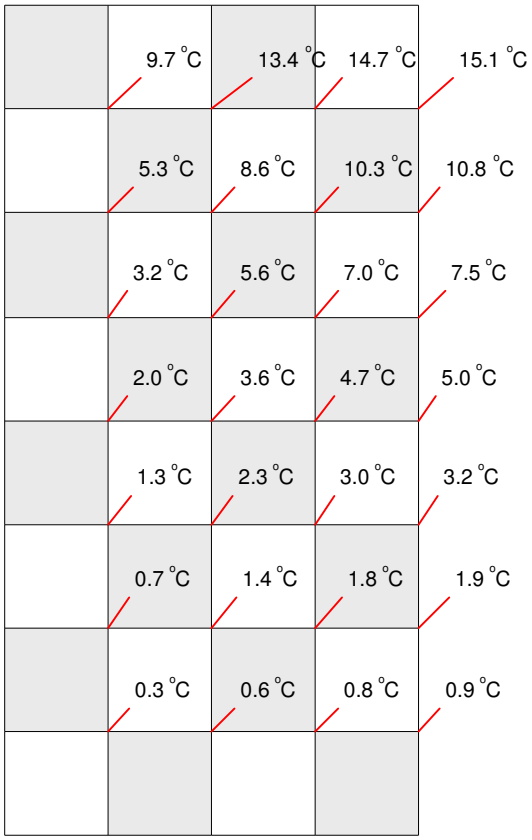
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



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

Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
0 Degree		0.000		
20 Degree		20.000		
Adiabatic	0.000			

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Summary

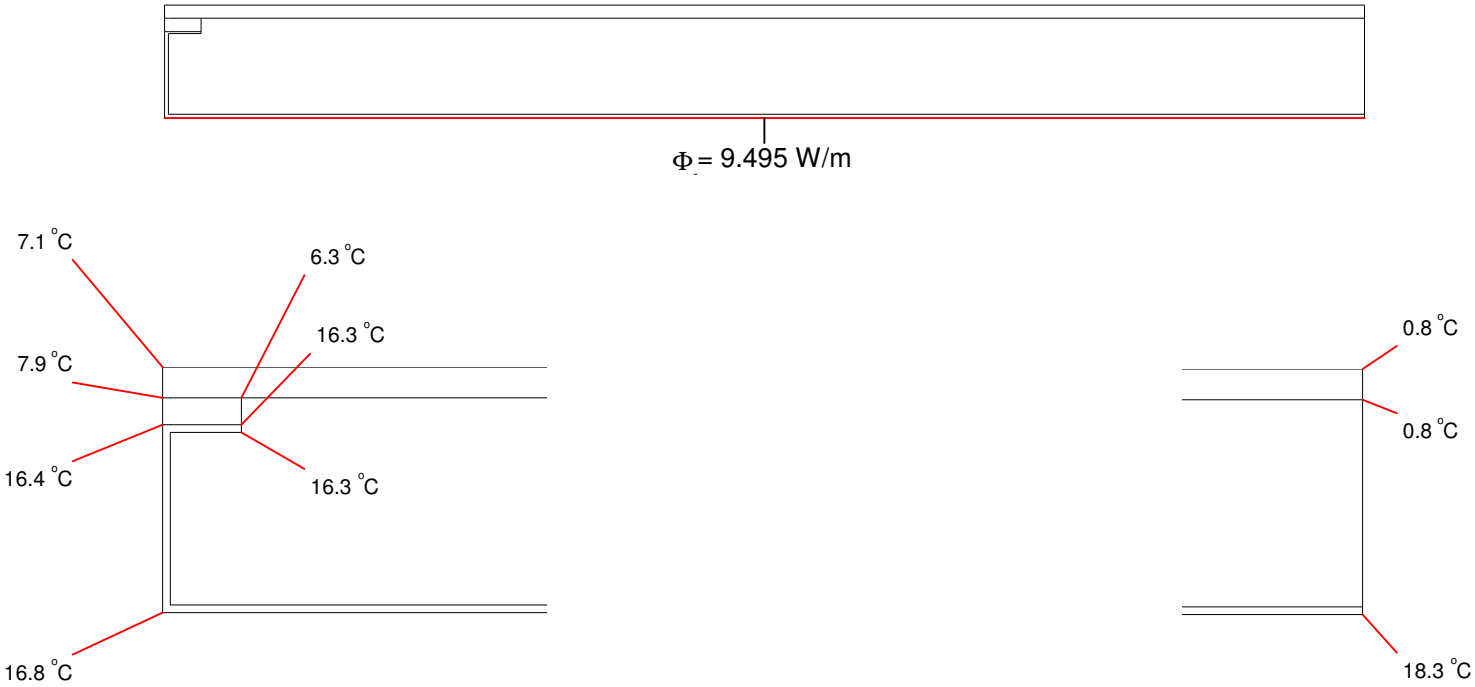
flixo fullfills the criterias for the first validation sample of EN ISO 10211: 2007
- The max. difference between the calculated temperatures and the corresponding temperatures of the Standard is 0.05°C. Therefore all temperatures are in the given acceptance range of 0.1°C.

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch

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

Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
0/0.06		0.000	0.060	
20/0.11		20.000	0.110	
Adiabatic	0.000			

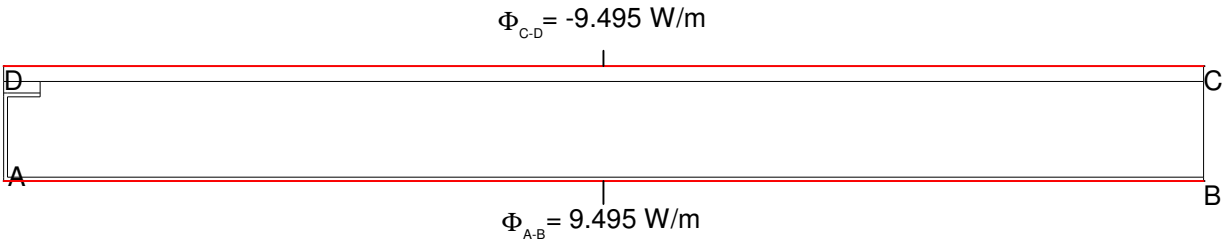
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



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 0.04 °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 0.005 W/m. The heat flux is therefore in the given acceptance range of 0.1 W/m.

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch

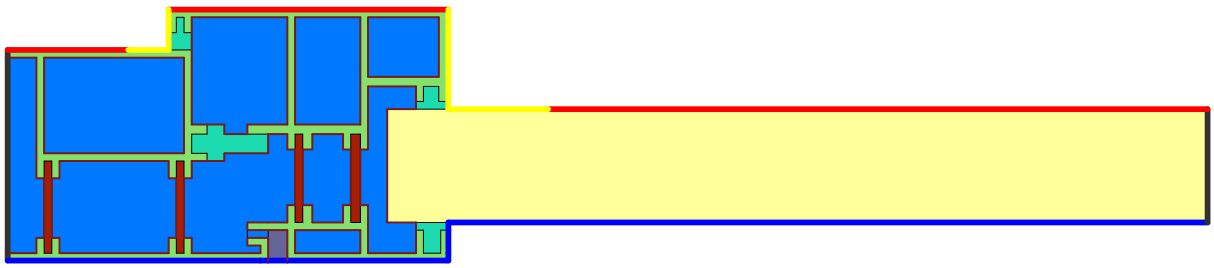


EN ISO 10077-2:2012

Samples V7

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_IS0_10077-2_D1_EN	10.998	**0.550**	0.1100	1.0310	3.218	**0.0%**
D.2	0.263	**0.255**	**0.271**	1.440	EN_IS0_10077-2_D2_EN	5.212	**0.261**	0.1100	0.5470	1.424	**-0.9%**
D.3	0.424	**0.411**	**0.437**	2.070	EN_IS0_10077-2_D3_EN	8.282	**0.414**	0.1100	1.0310	1.984	**-2.3%**
D.4	0.346	**0.336**	**0.356**	1.360	EN_IS0_10077-2_D4_EN	6.916	**0.346**	0.1100	1.0310	1.363	**-0.1%**
D.5	0.408	**0.396**	**0.420**	2.080	EN_IS0_10077-2_D5_EN	7.972	**0.399**	0.0890	1.1690	1.983	**-2.3%**
D.6	0.659	**0.639**	**0.679**	4.670	EN_IS0_10077-2_D6_EN	13.190	**0.660**	0.0950	1.1310	4.680	**0.1%**
D.7	0.285	**0.276**	**0.294**	1.310	EN_IS0_10077-2_D7_EN	5.638	**0.282**	0.0480	1.1690	1.246	**-1.1%**
D.8	0.181	**0.176**	**0.186**	1.030	EN_IS0_10077-2_D8_EN	3.647	**0.182**	0.1770		1.030	**0.7%**
D.9	0.207	**0.201**	**0.213**	3.640	EN_IS0_10077-2_D9_EN	4.136	**0.207**	0.0570		3.628	**-0.1%**
D.10	0.481	**0.467**	**0.495**	0.084	EN_IS0_10077-2_D10_EN	9.620	**0.481**	0.1100	1.3053	0.083	**0.0%**

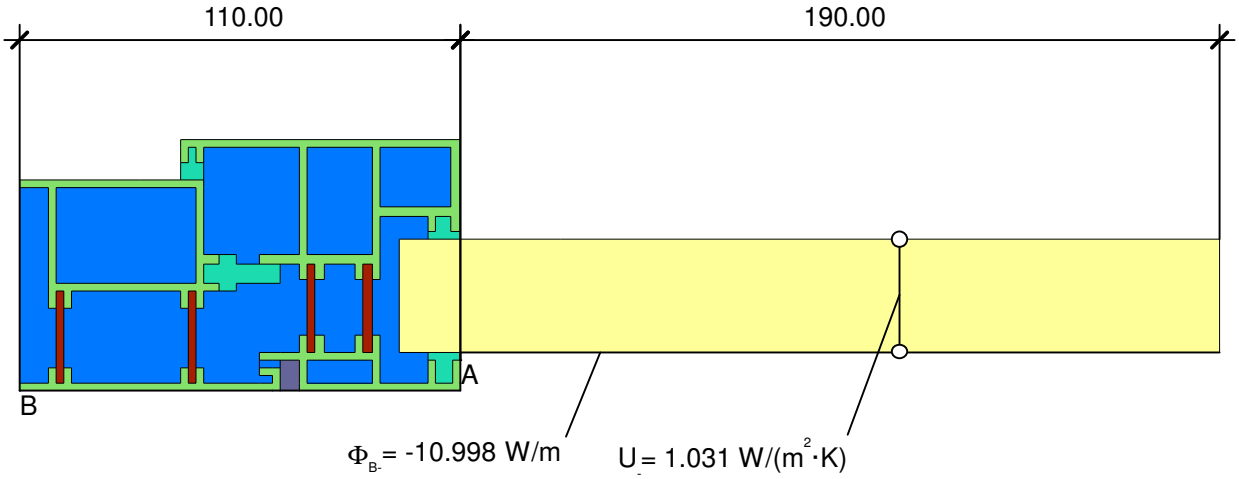
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]	ε
Aluminium (Si alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Panel	0.035	0.900
Polyamid 6.6 with 25% glassfibre	0.300	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

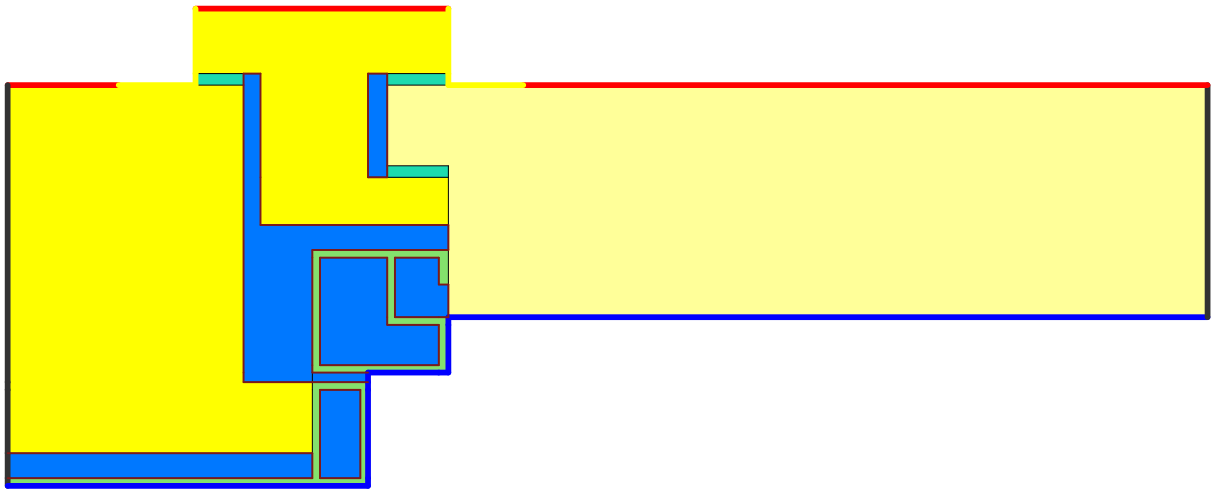
Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		0.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{10.998}{20.000} - 1.031 \cdot 0.190}{0.110} = 3.219 \text{ W/(m}^2\text{·K)}$$

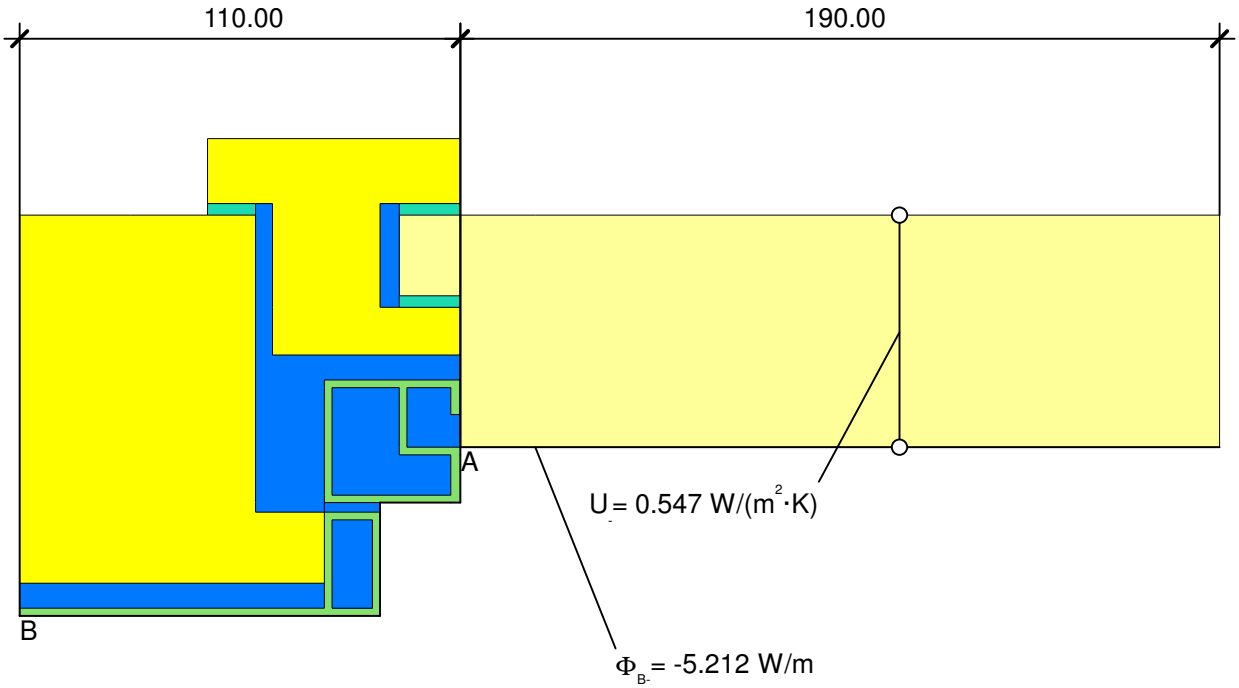
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]	ε
Aluminium (Si alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Panel	0.035	0.900
Softwood (typical construction timber)	0.130	0.900
Unventilated air cavity		

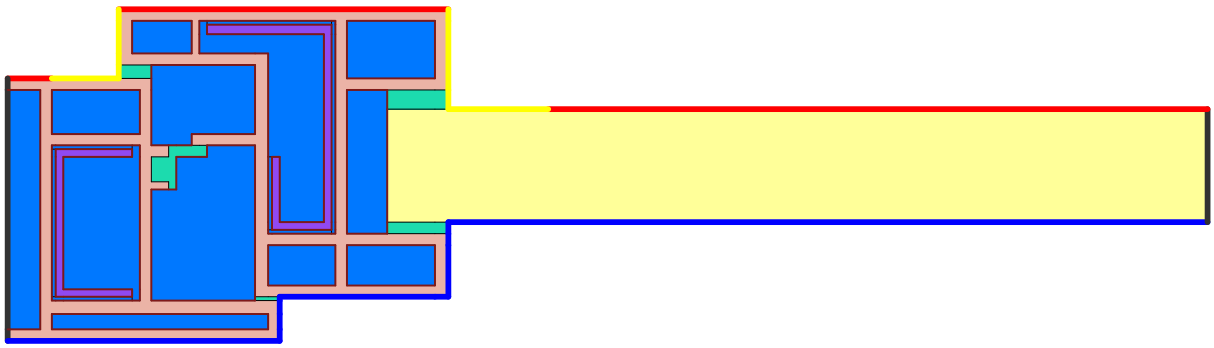
Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		0.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{5.212}{20.000} - 0.547 \cdot 0.190}{0.110} = 1.424 \text{ W/(m}^2\text{·K)}$$

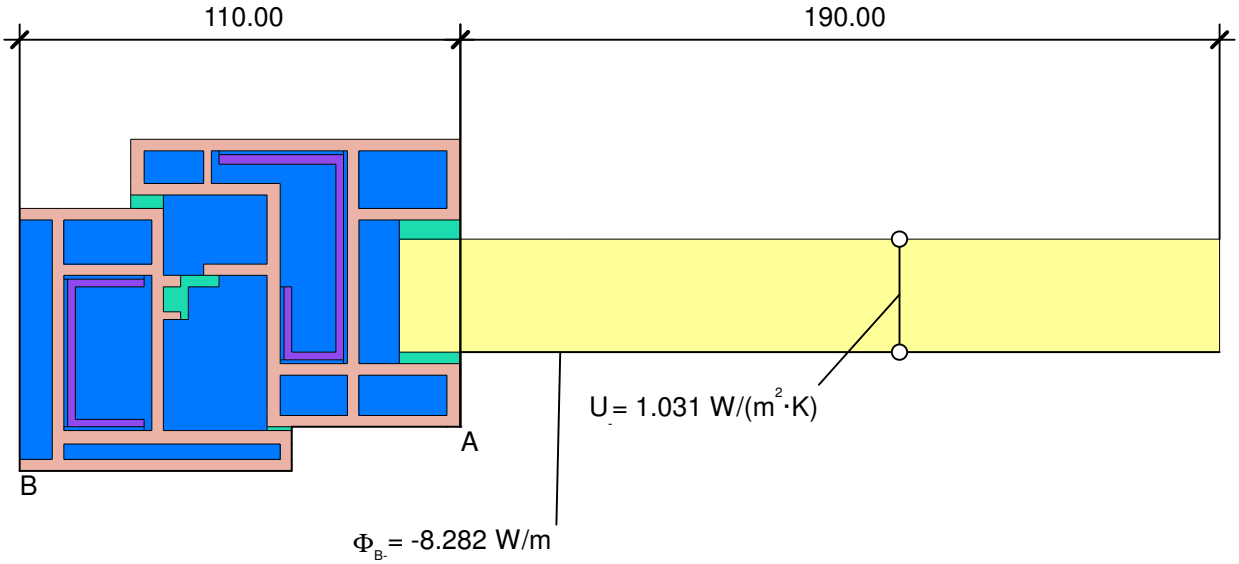
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]	ε
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Steel	50.000	0.900
Unventilated air cavity		

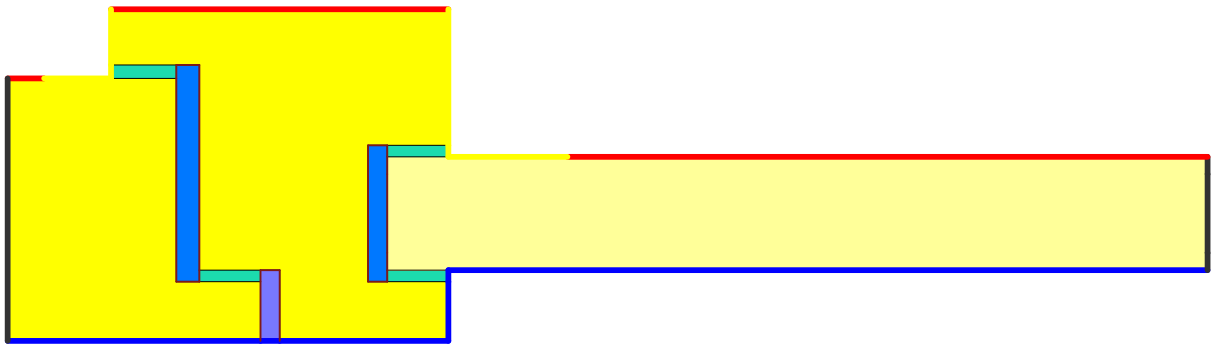
Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		0.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{8.282}{20.000} - 1.031 \cdot 0.190}{0.110} = 1.984 \text{ W/(m}^2\text{·K)}$$

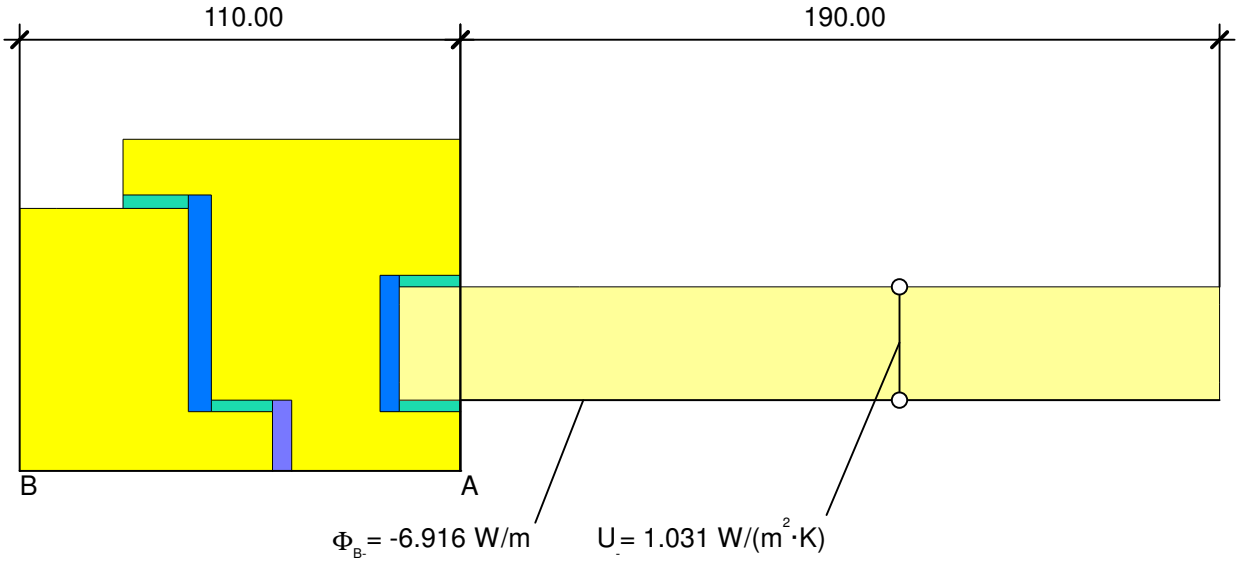
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]	ε
EPDM (ethylene propylene diene monomer)	0.250	0.900
Panel	0.035	0.900
Slightly ventilated air cavity		
Softwood (typical construction timber)	0.130	0.900
Unventilated air cavity		

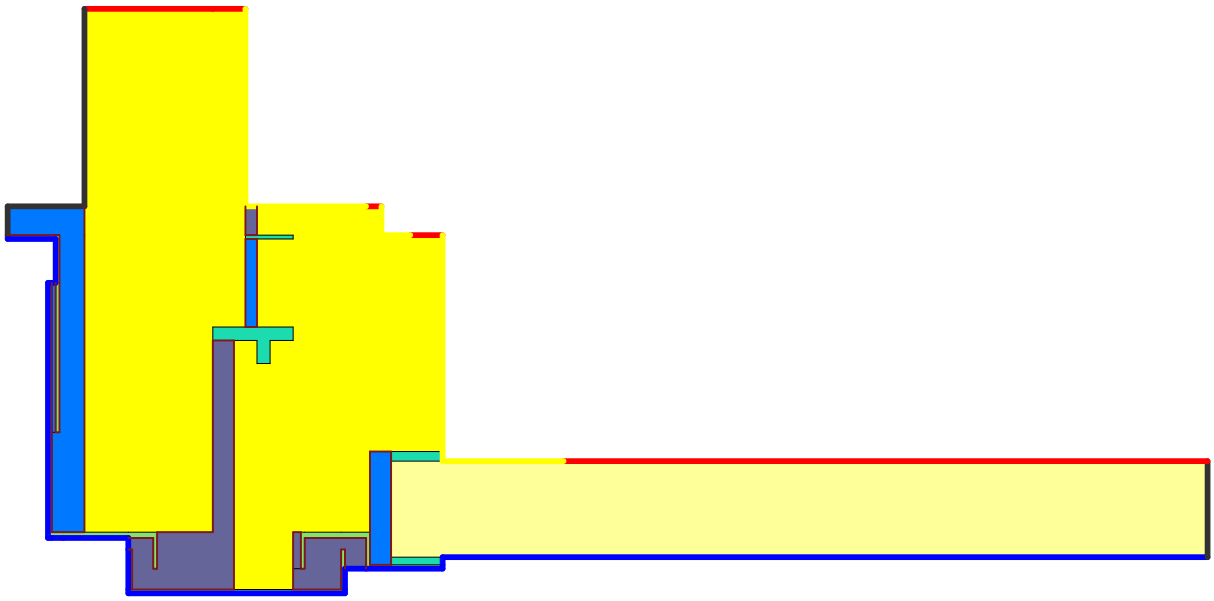
Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		0.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{6.916}{20.000} - 1.031 \cdot 0.190}{0.110} = 1.363 \text{ W/(m}^2\text{·K)}$$

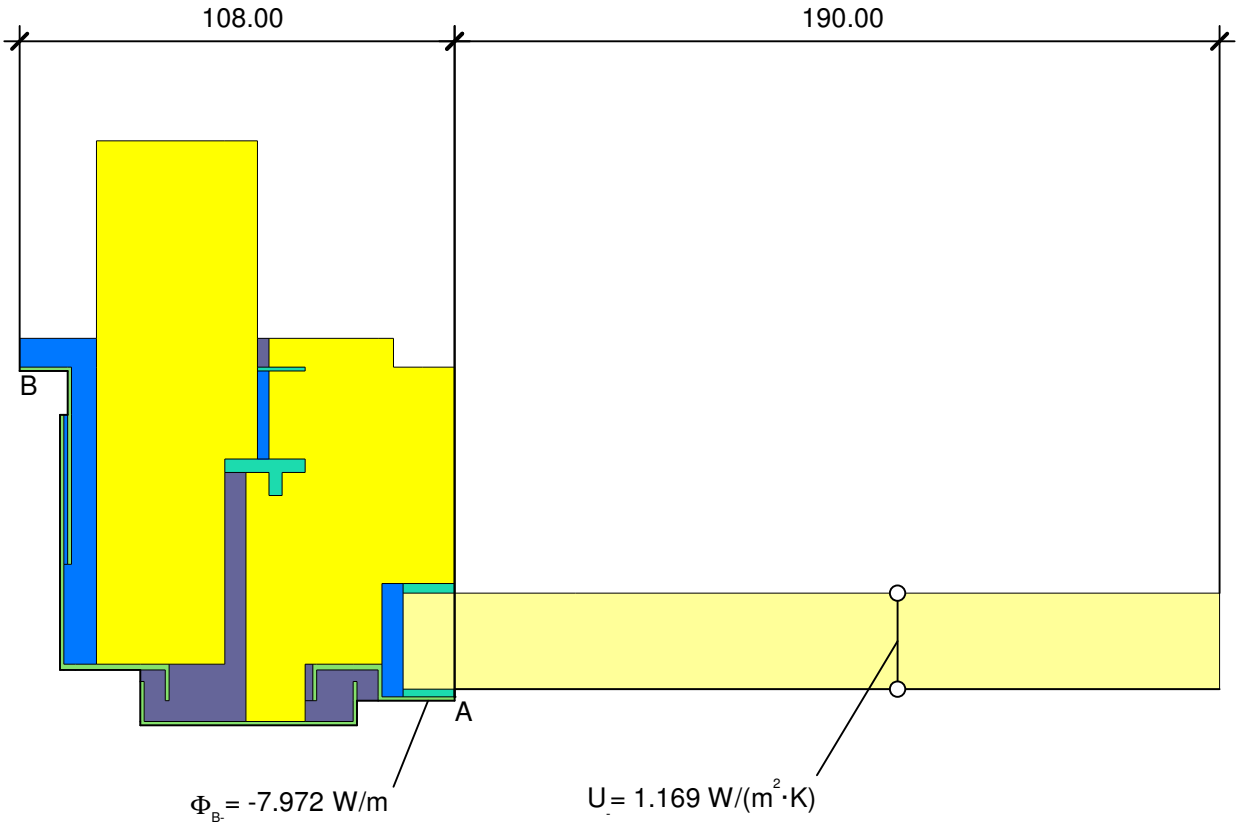
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]	ε
Aluminium (Si alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Panel	0.035	0.900
Slightly ventilated air cavity		
Softwood (typical construction timber)	0.130	0.900
Unventilated air cavity		

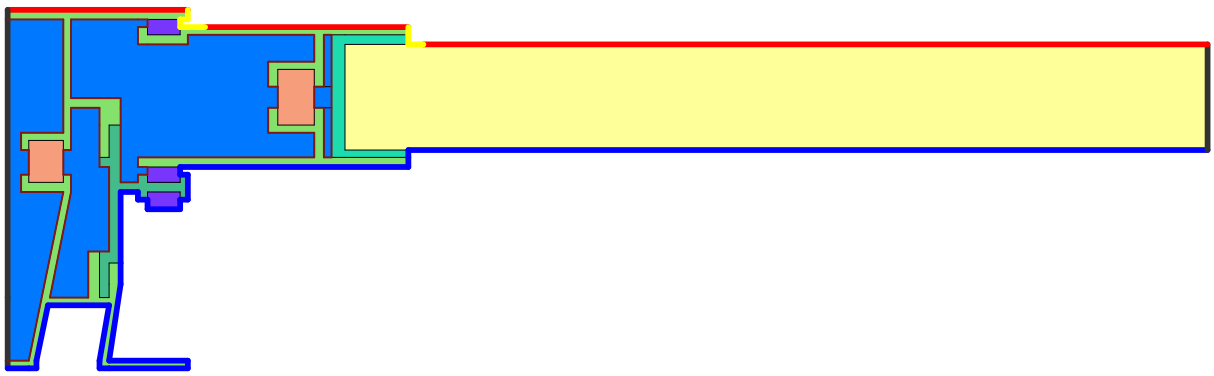
Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		0.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{7.972}{20.000} - 1.169 \cdot 0.190}{0.108} = 1.635 \text{ W/(m}^2\text{·K)}$$

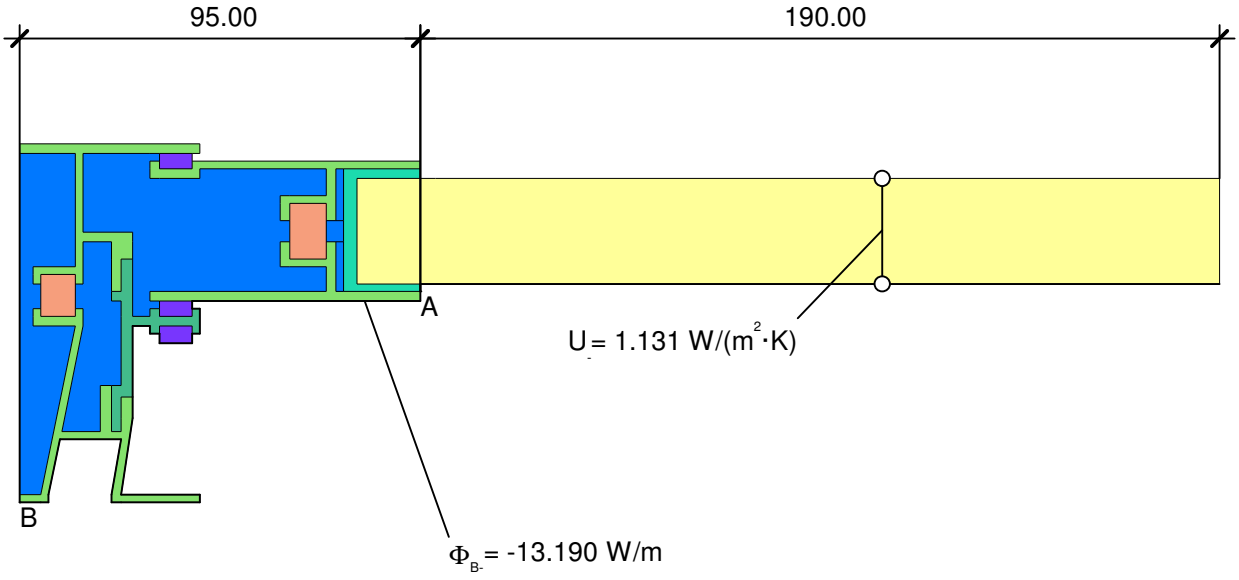
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]	ε
Aluminium (Si alloys)	160.000	0.900
EPDM (ethylene propylene diene monomer)	0.250	0.900
Mohair (polyester) sweep	0.140	0.900
PU (polyurethane), rigid	0.250	0.900
Panel	0.035	
Polyamid (nylon)	0.250	0.900
Unventilated air cavity		

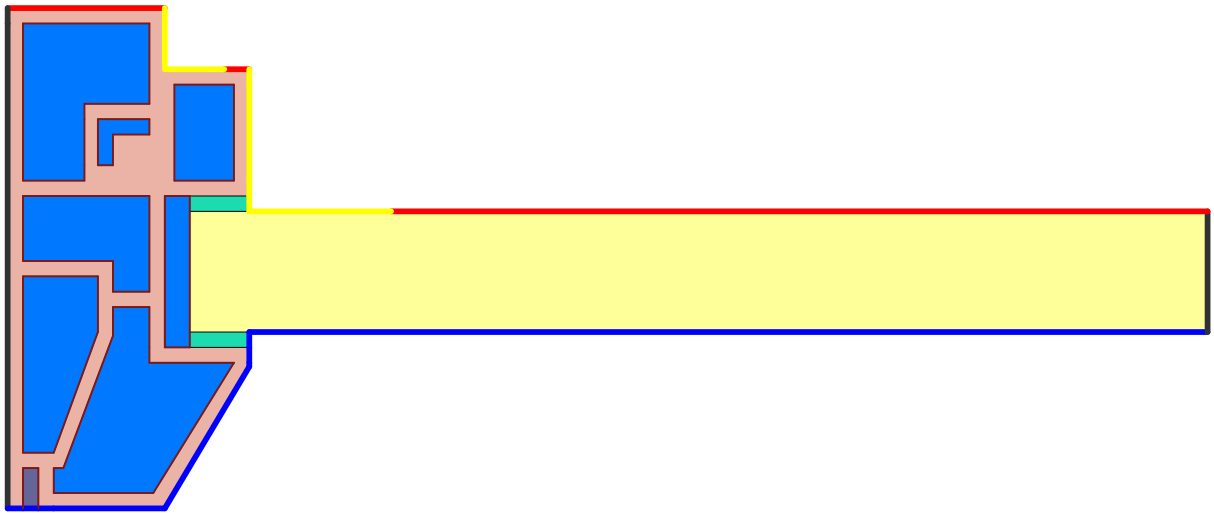
Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		0.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{13.190}{20.000} - 1.131 \cdot 0.190}{0.095} = 4.680 \text{ W/(m}^2\text{·K)}$$

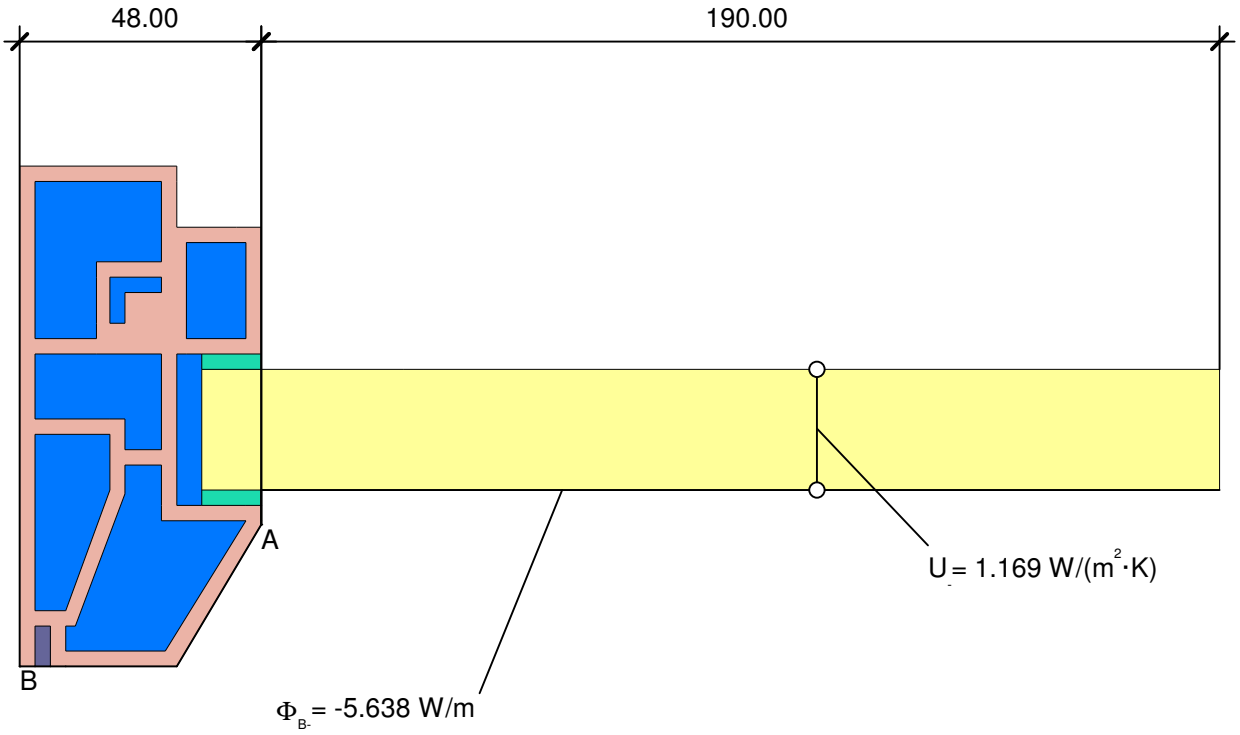
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]	ε
EPDM (ethylene propylene diene monomer)	0.250	0.900
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

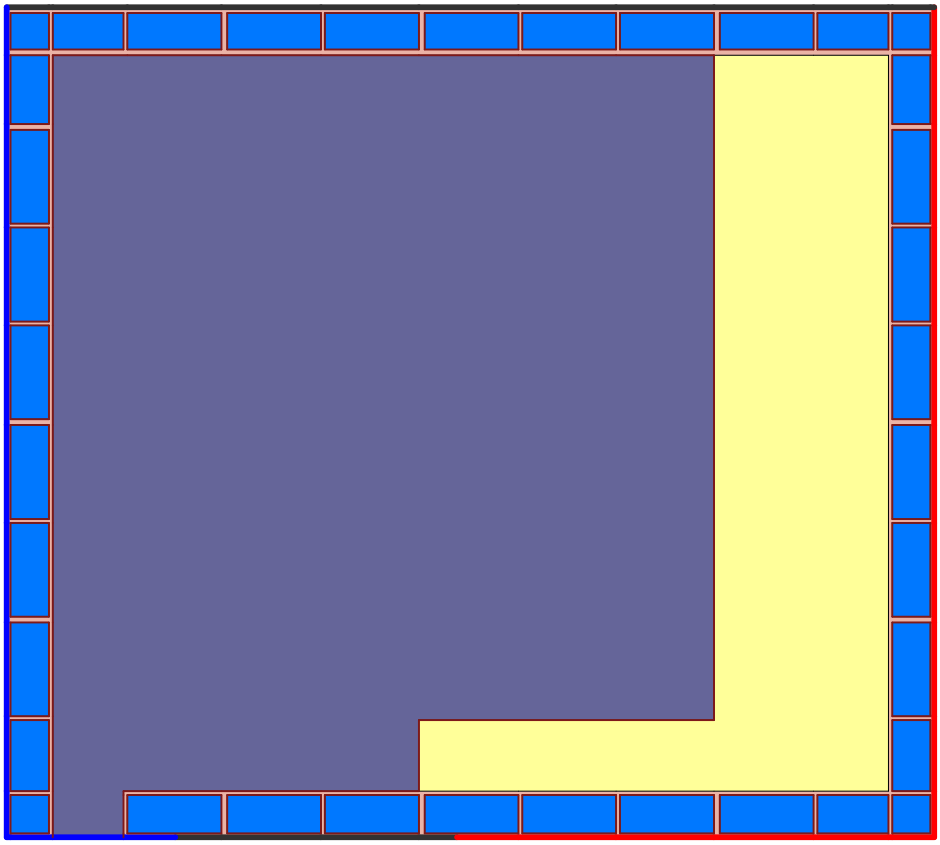
Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		0.000	0.040	
Interior, frame, normal		20.000	0.130	
Interior, frame, reduced		20.000	0.200	
Symmetry/Model section	0.000			

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



$$U_{fA,B} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{5.638}{20.000} - 1.169 \cdot 0.190}{0.048} = 1.247 \text{ W/(m}^2\text{·K)}$$

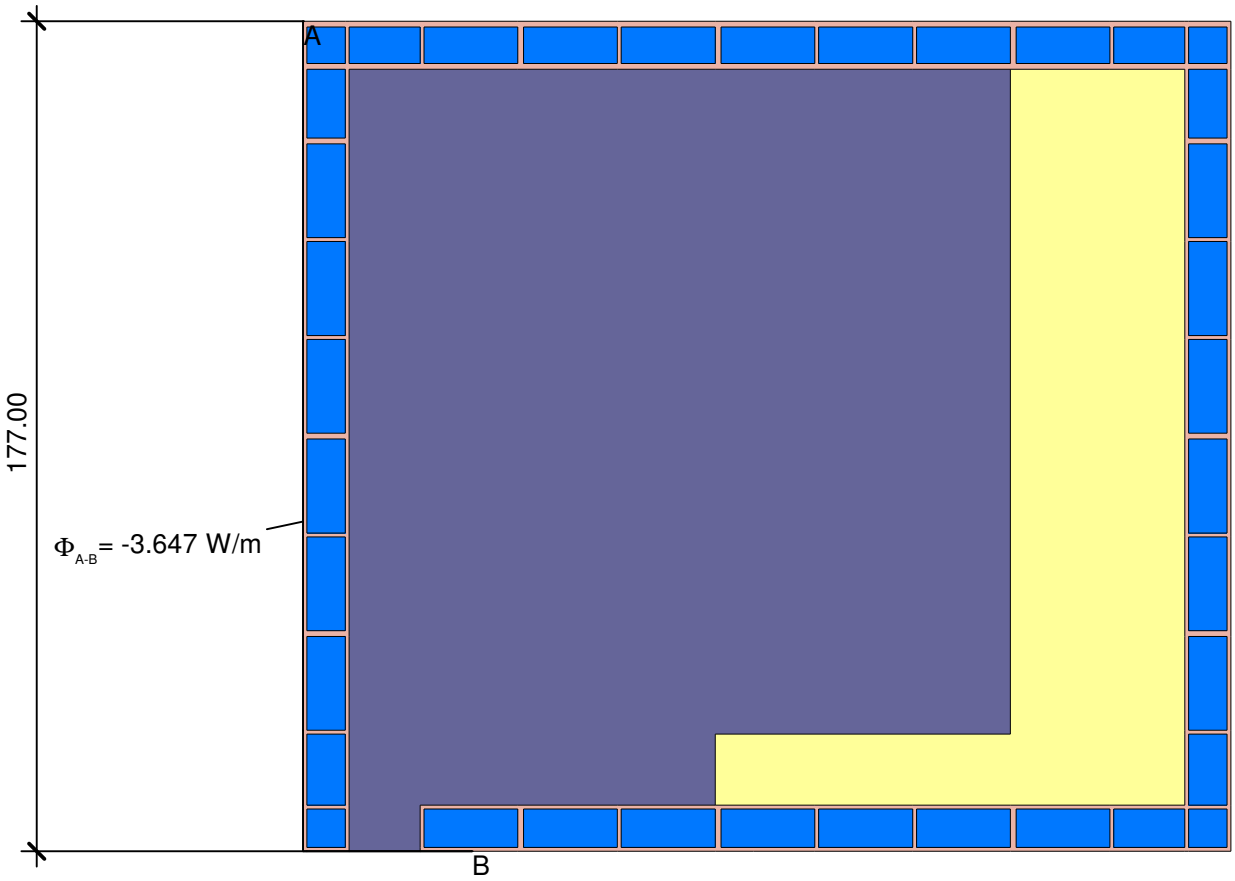
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]	ε
PVC (polyvinylchloride), rigid	0.170	0.900
Panel	0.035	0.900
Slightly ventilated air cavity		
Unventilated air cavity		

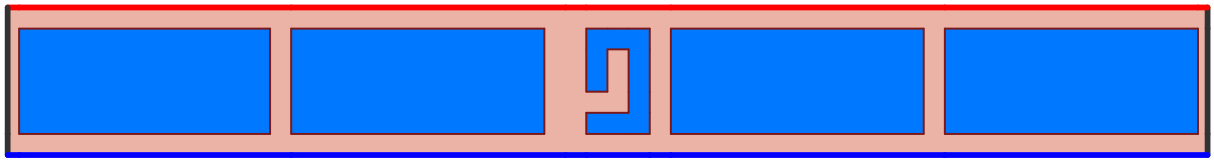
Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		0.000	0.040	
Interior, normal, horizontal		20.000	0.130	
Symmetry/Model section	0.000			

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



$$U_{sbA-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{3.647}{20.000 \cdot 0.177} = 1.030 \text{ W/(m}^2\text{·K)}$$

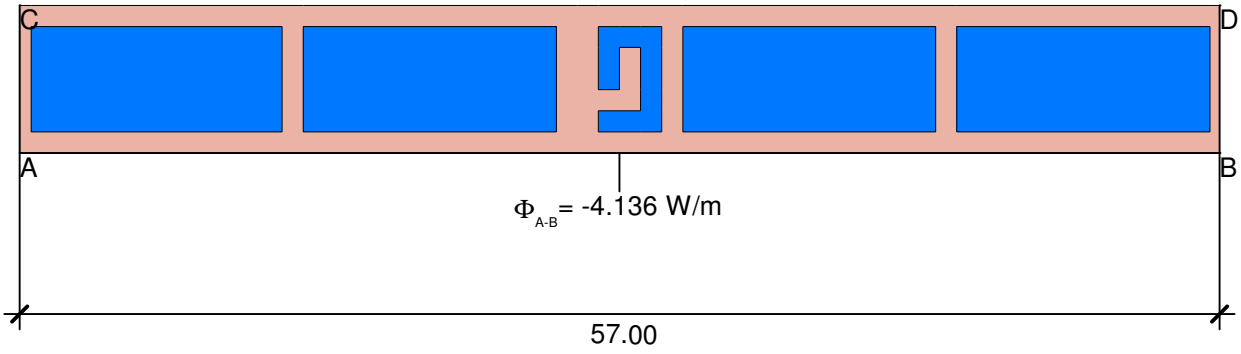
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]	ε
PVC (polyvinylchloride), rigid	0.170	0.900
Unventilated air cavity		

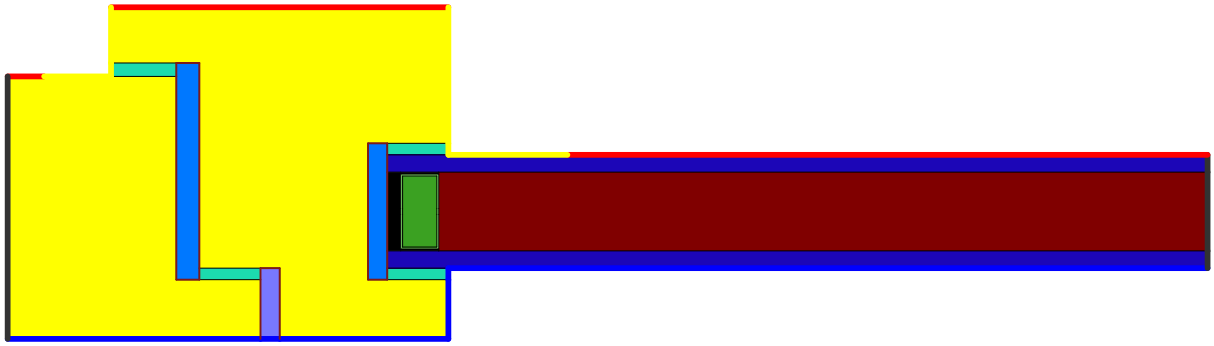
Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
Exterior, frame		0.000	0.040	
Interior, normal, horizontal		20.000	0.130	
Symmetry/Model section	0.000			

infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



$$U_{eqA-B} = \frac{\Phi}{\Delta T \cdot b} = \frac{4.136}{20.000 \cdot 0.057} = 3.628 \text{ W/(m}^2\text{·K)}$$

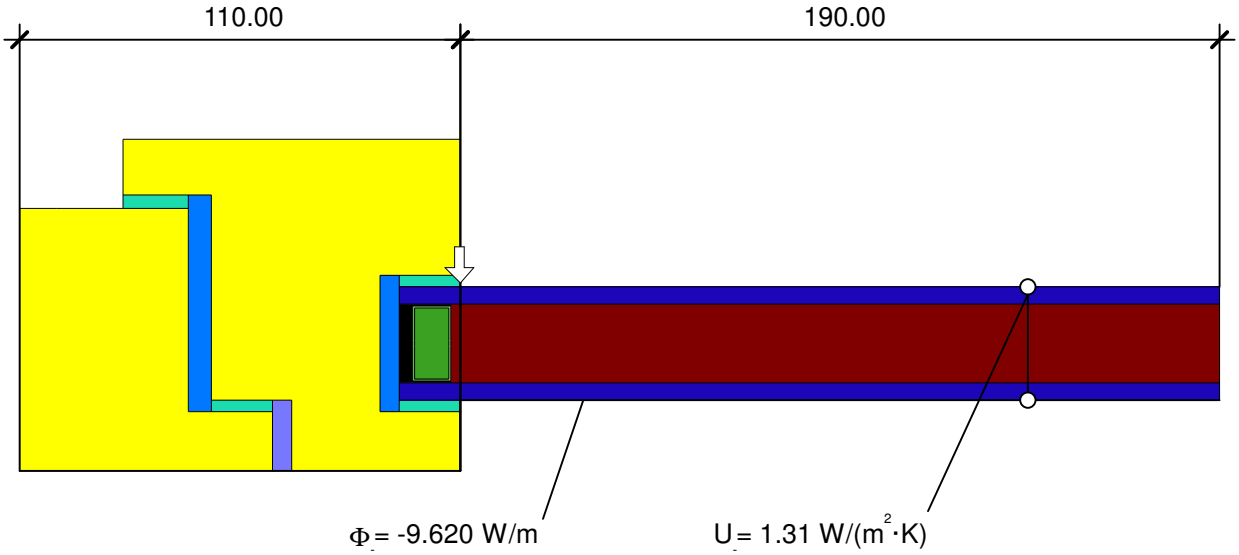
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]	ε
Aluminium (Si alloys)	160.000	
EPDM (ethylene propylene diene monomer)	0.250	0.900
Glazing	0.034	
Polysulfide	0.400	0.900
Silica gel (dessicant)	0.130	
Slightly ventilated air cavity		
Soda lime glass	1.000	0.900
Softwood (typical construction timber)	0.130	0.900
Unventilated air cavity		

Name	q[W/m²]	θ[°C]	R[(m²·K)/W]	ε
Epsilon 0.9				0.900
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			

infomind gmbh
weberstrasse 10
CH - 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



$$\psi = \frac{\Phi}{\Delta T} - U_g \cdot b_g - U_f \cdot b_f = \frac{9.620}{20.000} - 1.305 \cdot 0.190 - 1.363 \cdot 0.110 = 0.083 \text{ W/(m·K)}$$