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 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 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.

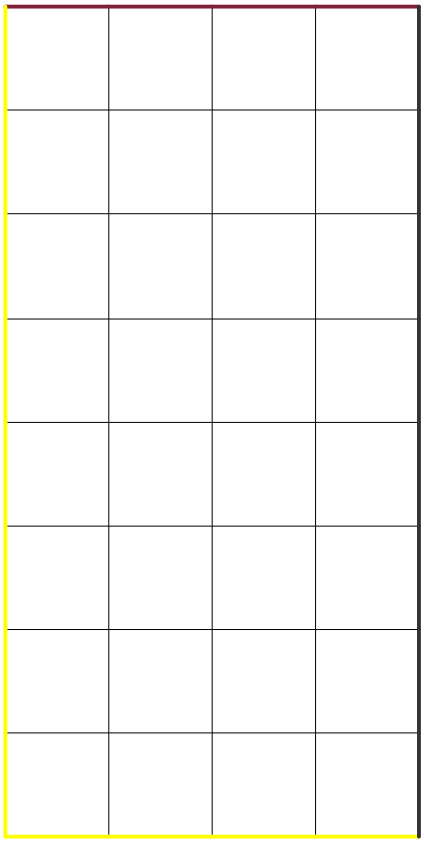
Aus diesen Gründen ist ***flixo*** Version 6 ein voll anerkanntes, normgerechtes Wärmebrücken-Simulationsprogramm und kann entsprechend verwendet werden.

Zürich, 20.7.2009

Walter Schmidli

CEO, Infomind GmbH

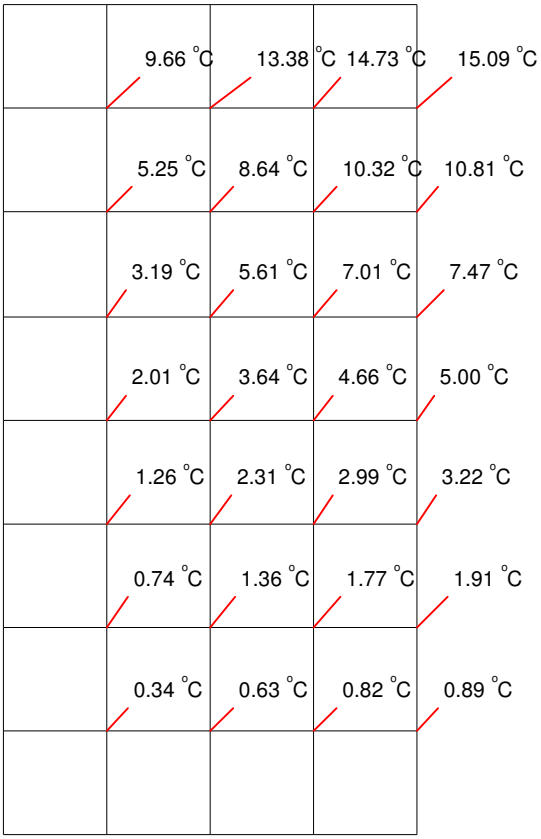
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



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

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

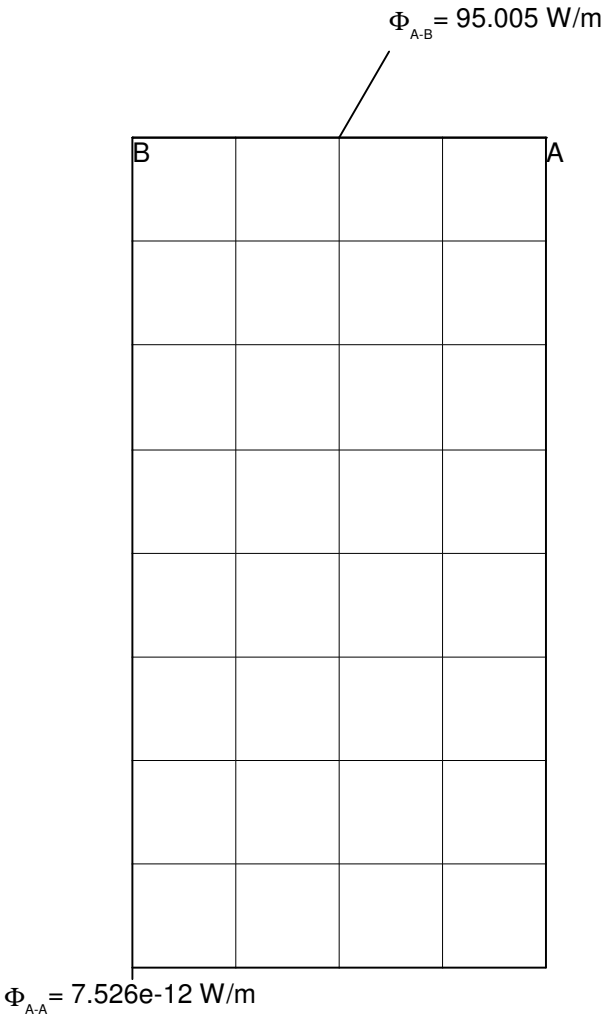
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



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

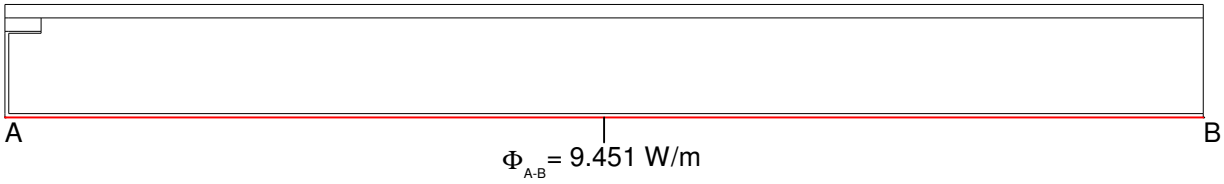


infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch

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]	h[W/(m²·K)]	ε
0/0.06		0.000	16.667	
20/0.11		20.000	9.091	
Adiabatic	0.000			

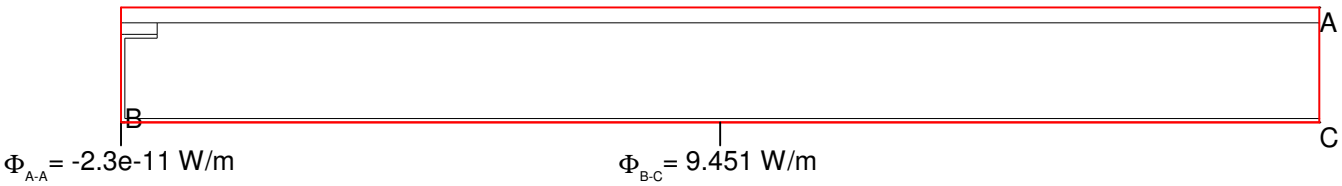
infomind gmbh
weberstrasse 10
CH - 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



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 0.06°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.

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

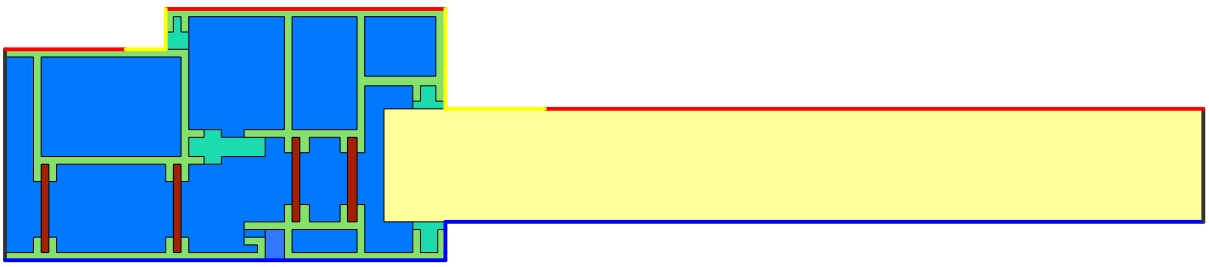


EN ISO 10077-2:2003

Samples

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	11.127	**0.556**	0.1100	1.0310	3.277	**1.2%**
D.2	0.263	**0.255**	**0.271**	1.440	EN_IS0_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_IS0_10077-2_D3_EN	8.273	**0.414**	0.1100	1.0310	1.980	**-2.4%**
D.4	0.346	**0.336**	**0.356**	1.360	EN_IS0_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_IS0_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_IS0_10077-2_D6_EN	13.324	**0.666**	0.0950	1.1310	4.751	**1.1%**
D.7	0.285	**0.276**	**0.294**	1.310	EN_IS0_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_IS0_10077-2_D8_EN	3.568	**0.178**	0.1770		1.008	**-1.4%**
D.9	0.207	**0.201**	**0.213**	3.640	EN_IS0_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_IS0_10077-2_D10_EN	9.600	**0.480**	0.1100	1.3053	0.084	**-0.2%**

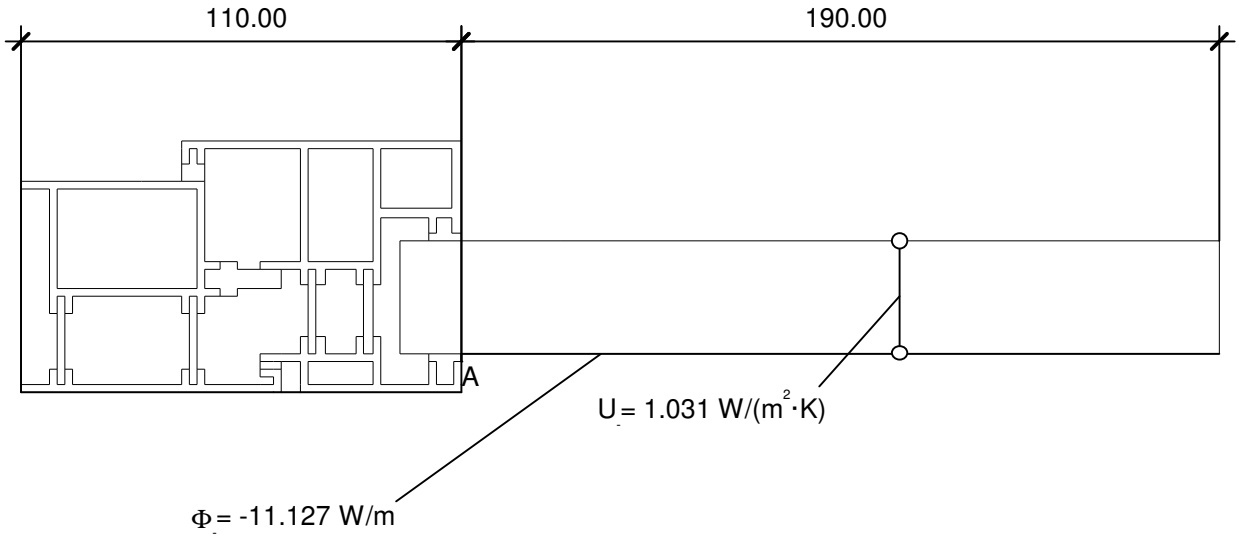
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]
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

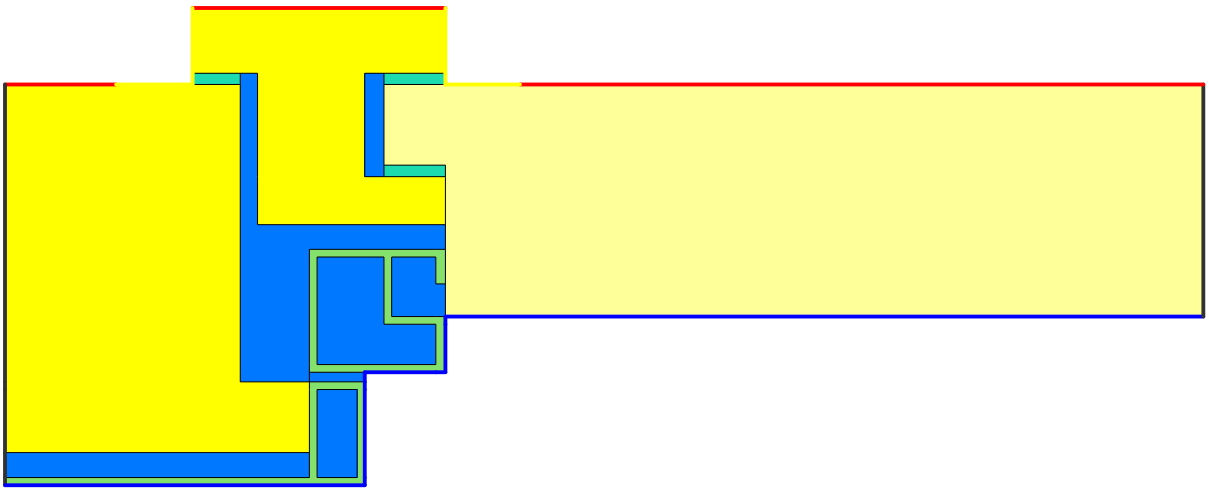
Name	q[W/m²]	θ[°C]	h[W/(m²·K)]	ε
Exterior, frame		0.000	25.000	
Interior, frame, normal		20.000	7.692	
Interior, frame, reduced		20.000	5.000	
Symmetry/Model section	0.000			

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



$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{11.127}{20.000} - 1.031 \cdot 0.190}{0.110} = 3.277 \text{ W/(m}^2\text{·K)}$$

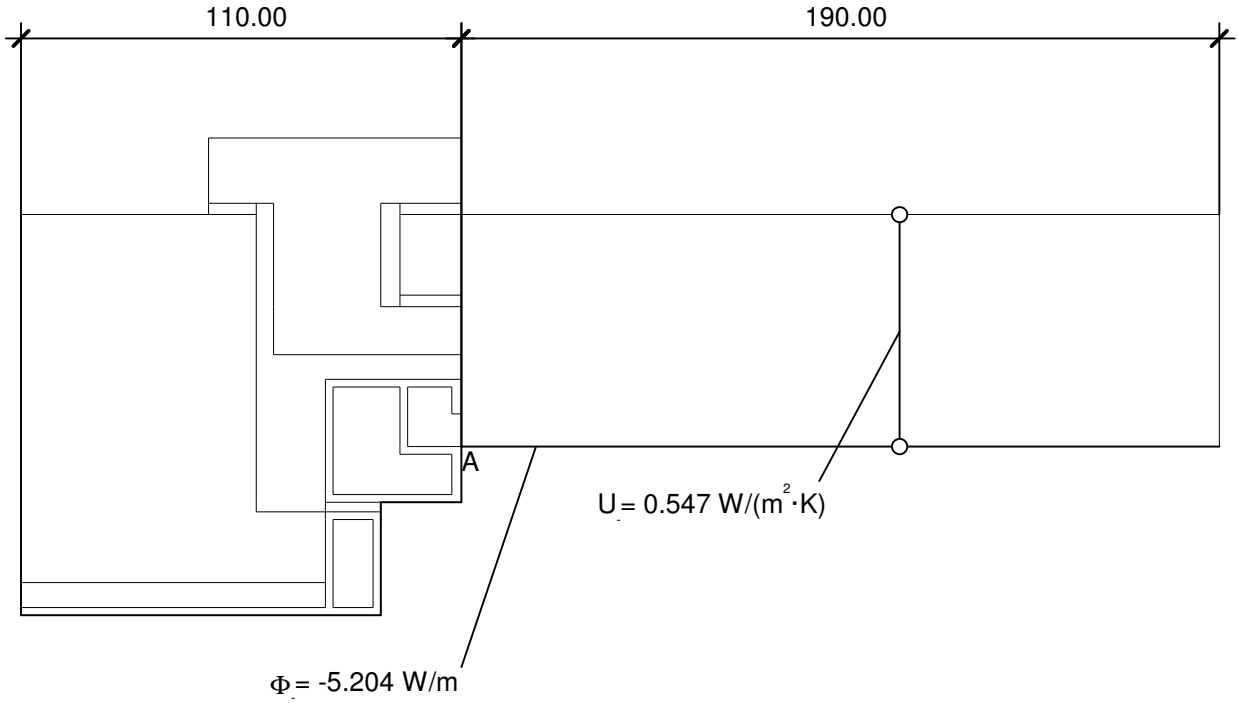
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]
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

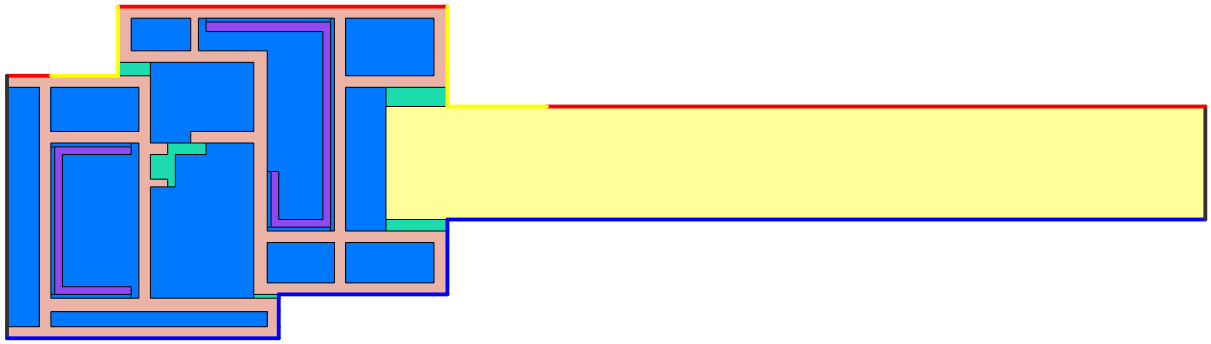
Name	q[W/m²]	θ[°C]	h[W/(m²·K)]	ε
Exterior, frame		0.000	25.000	
Interior, frame, normal		20.000	7.692	
Interior, frame, reduced		20.000	5.000	
Symmetry/Model section	0.000			

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



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

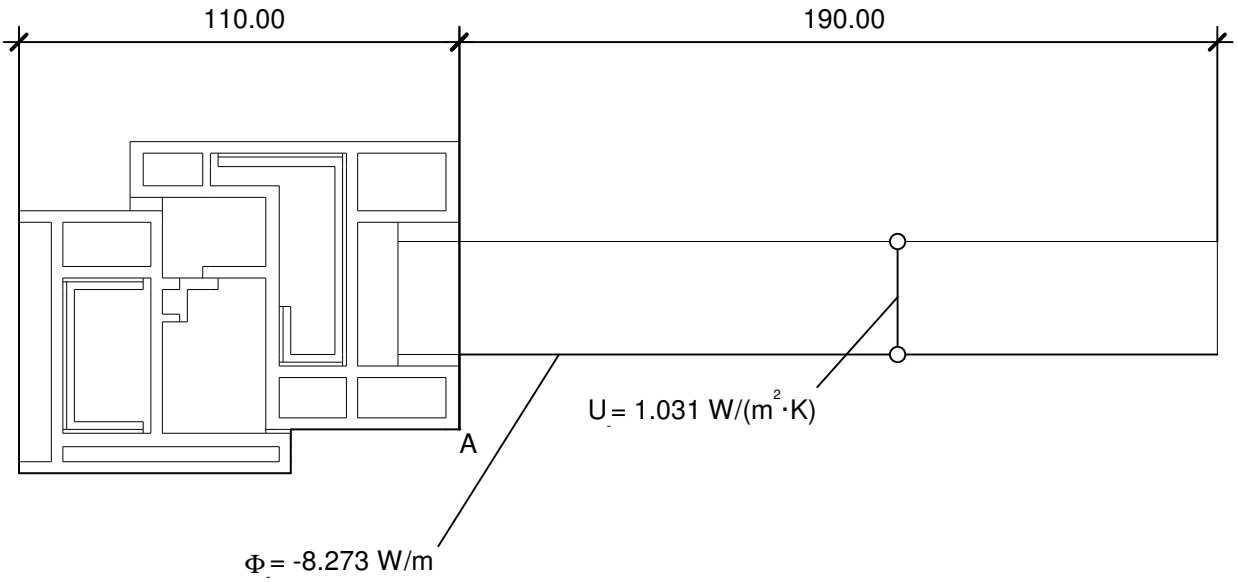
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]
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

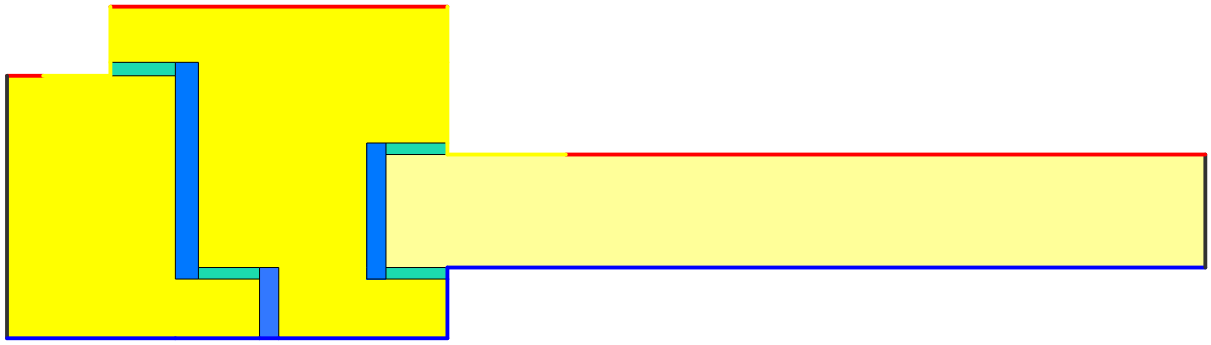
Name	q[W/m²]	θ[°C]	h[W/(m²·K)]	ε
Exterior, frame		0.000	25.000	
Interior, frame, normal		20.000	7.692	
Interior, frame, reduced		20.000	5.000	
Symmetry/Model section	0.000			

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



$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{8.273}{20.000} - 1.031 \cdot 0.190}{0.110} = 1.980 \text{ W/(m}^2\text{·K)}$$

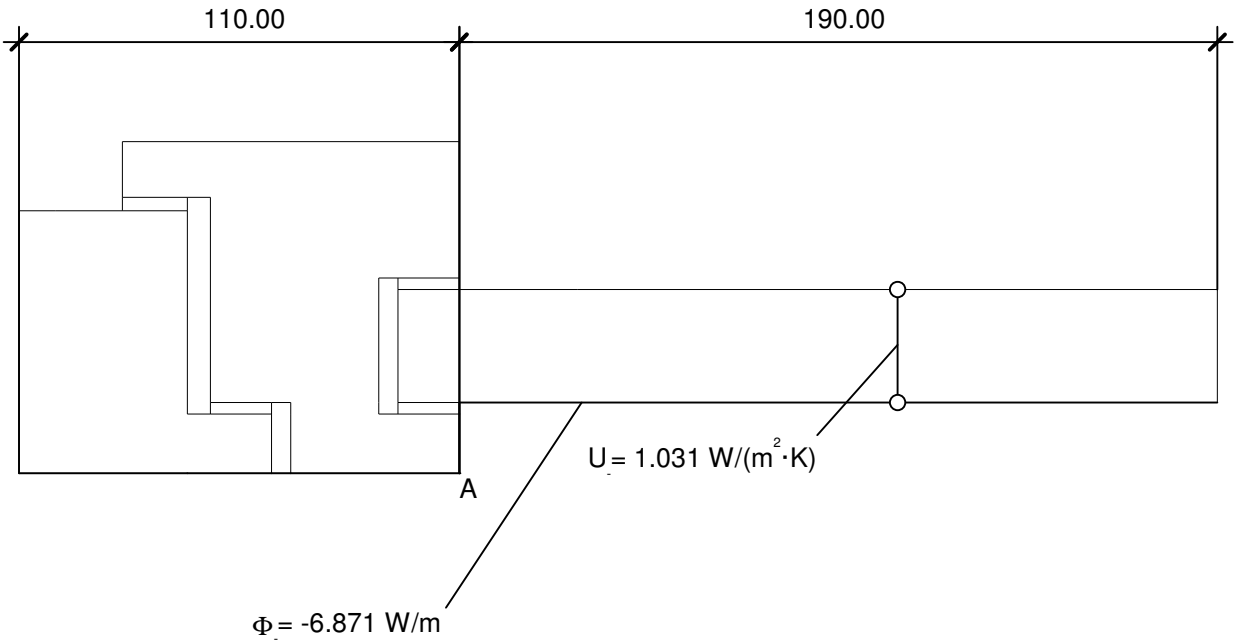
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]
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

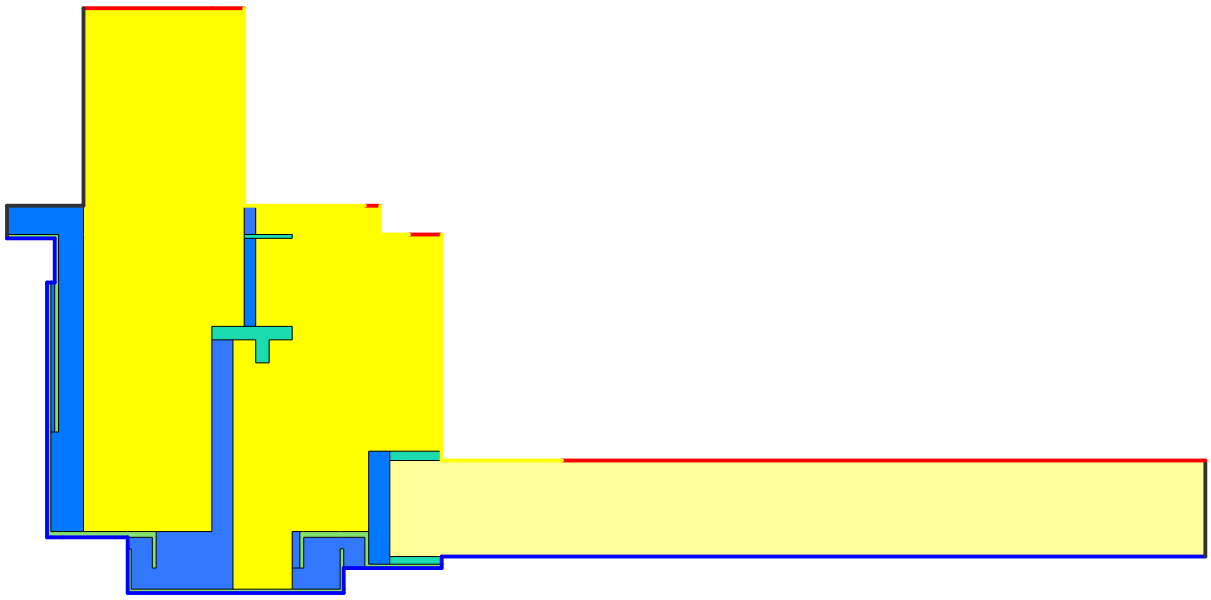
Name	q[W/m²]	θ[°C]	h[W/(m²·K)]	ε
Exterior, frame		0.000	25.000	
Interior, frame, normal		20.000	7.692	
Interior, frame, reduced		20.000	5.000	
Symmetry/Model section	0.000			

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



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

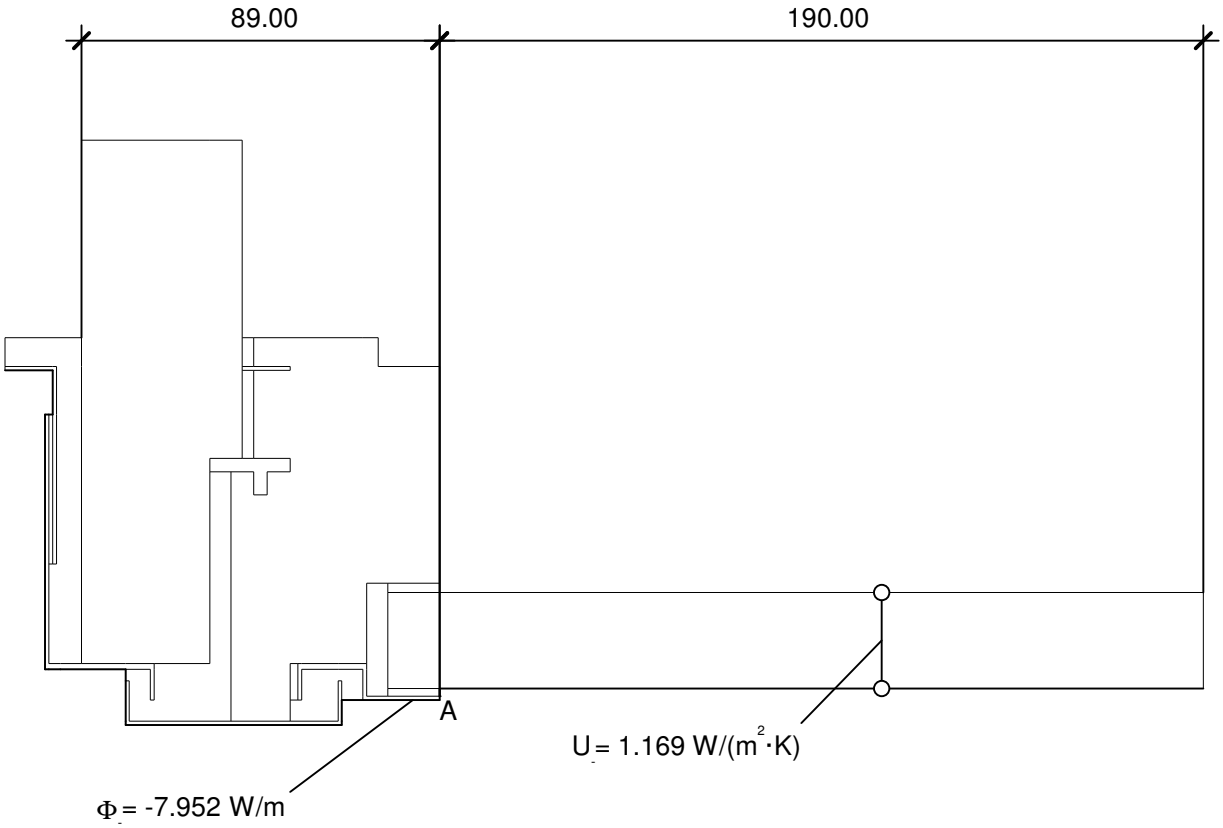
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]
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

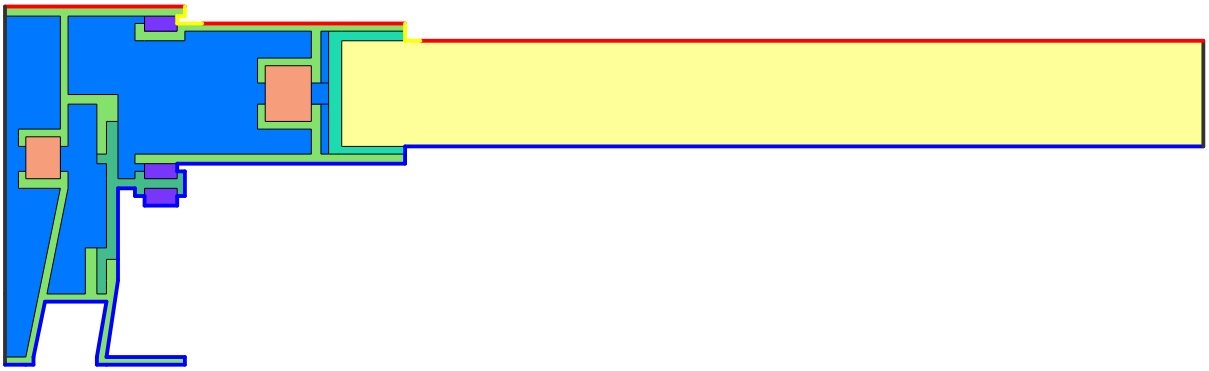
Name	q[W/m²]	θ[°C]	h[W/(m²·K)]	ε
Exterior, frame		0.000	25.000	
Interior, frame, normal		20.000	7.692	
Interior, frame, reduced		20.000	5.000	
Symmetry/Model section	0.000			

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



$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{7.952}{20.000} - 1.169 \cdot 0.190}{0.089} = 1.973 \text{ W/(m}^2\text{·K)}$$

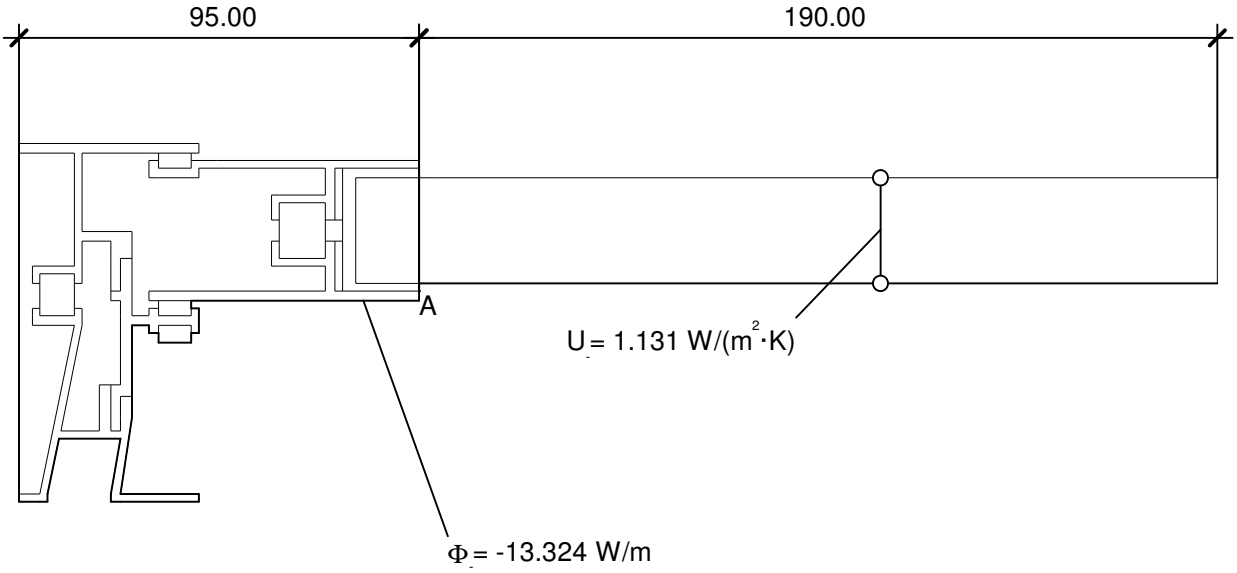
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]
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

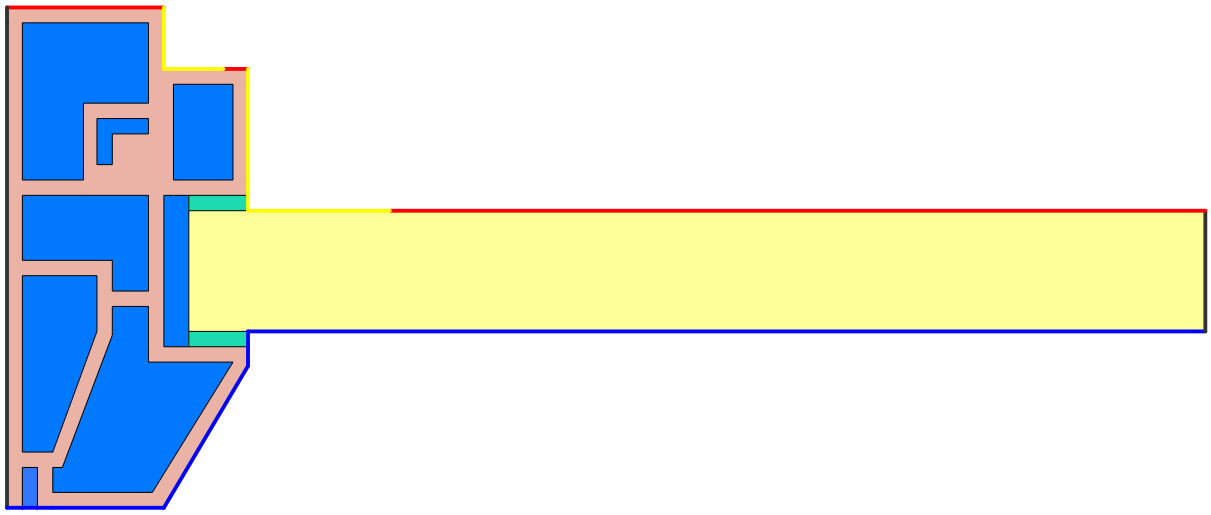
Name	q[W/m²]	θ[°C]	h[W/(m²·K)]	ε
Exterior, frame		0.000	25.000	
Interior, frame, normal		20.000	7.692	
Interior, frame, reduced		20.000	5.000	
Symmetry/Model section	0.000			

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



$$U_{fA} = \frac{\frac{\Phi}{\Delta T} - U_p \cdot b_p}{b_f} = \frac{\frac{13.324}{20.000} - 1.131 \cdot 0.190}{0.095} = 4.751 \text{ W/(m}^2\text{·K)}$$

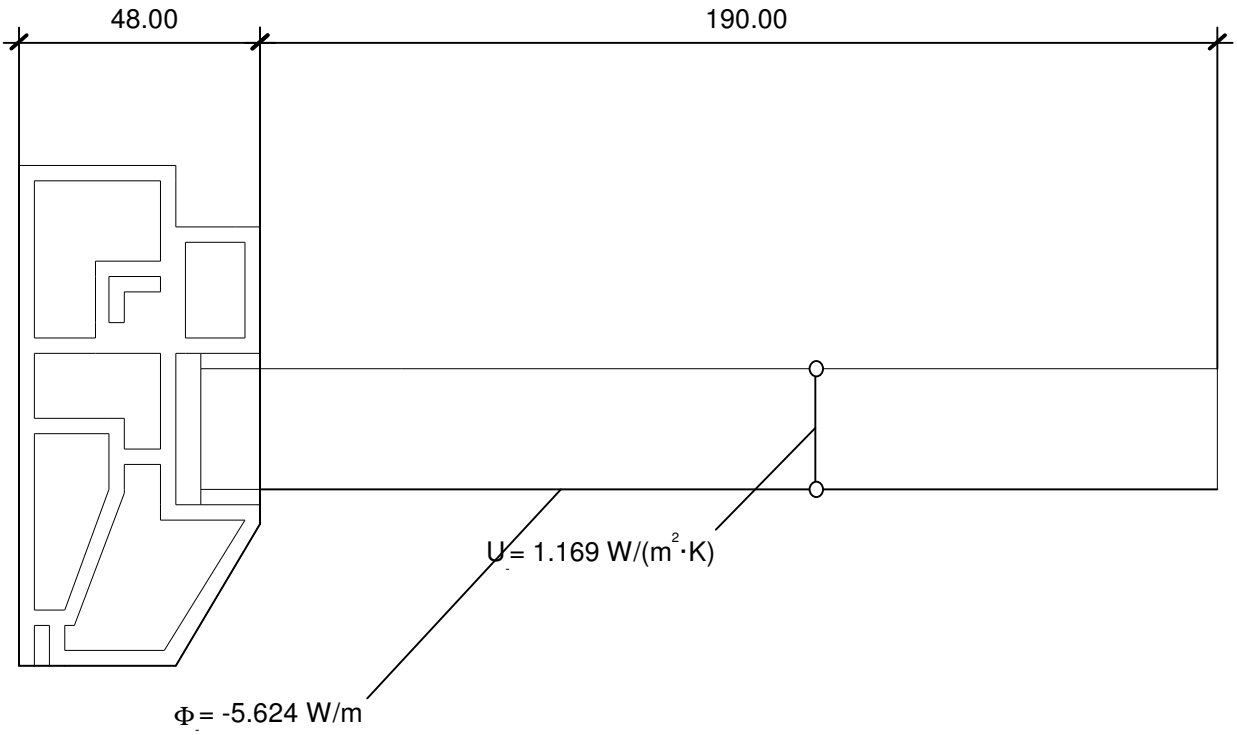
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



Name	λ[W/(m·K)]
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

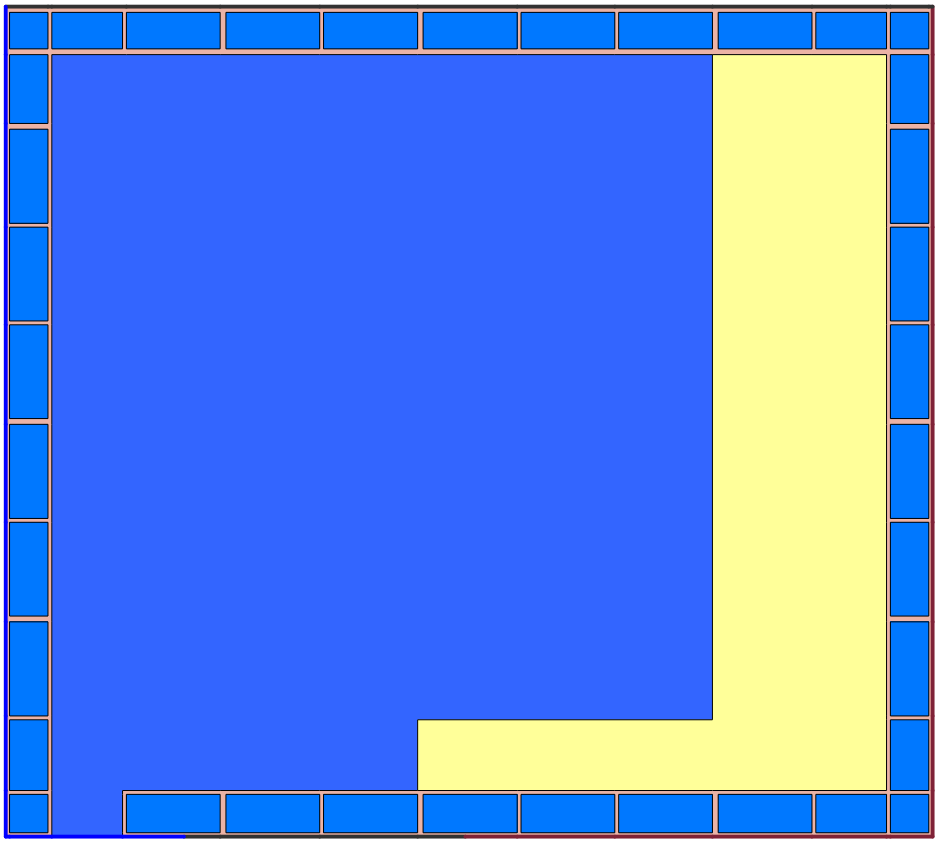
Name	q[W/m²]	θ[°C]	h[W/(m²·K)]	ε
Exterior, frame		0.000	25.000	
Interior, frame, normal		20.000	7.692	
Interior, frame, reduced		20.000	5.000	
Symmetry/Model section	0.000			

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



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

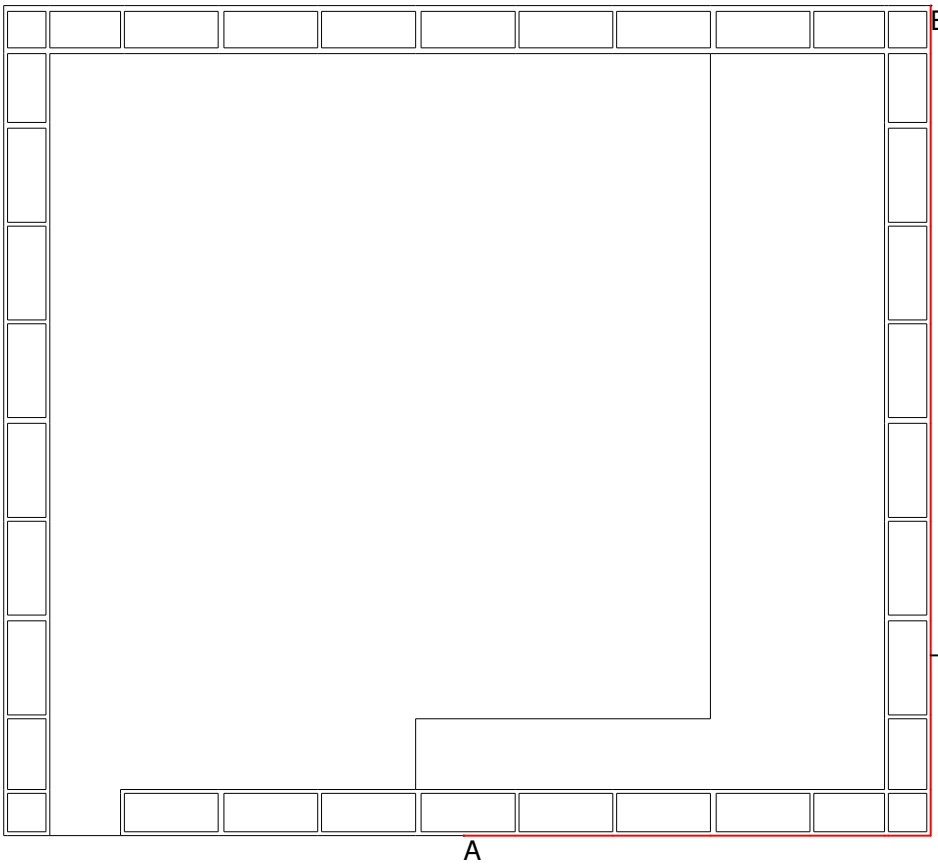
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



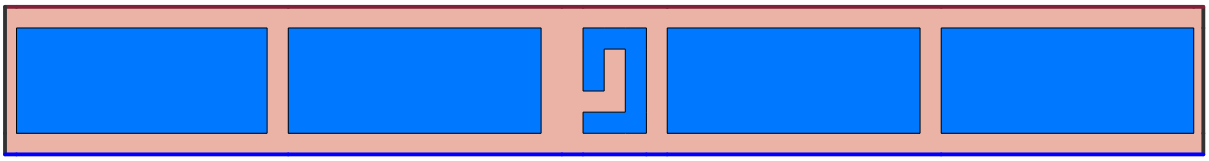
Name	λ[W/(m·K)]
PVC (polyvinylchloride), rigid	0.170
Panel	0.035
Slightly ventilated air cavity, Eps=0.9	Eps=0.9/0.9
Unventilated air cavity, Eps=0.9	Eps=0.9/0.9

Name	q[W/m²]	θ[°C]	h[W/(m²·K)]	ε
Exterior, frame		0.000	25.000	
Interior, normal		20.000	7.692	
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



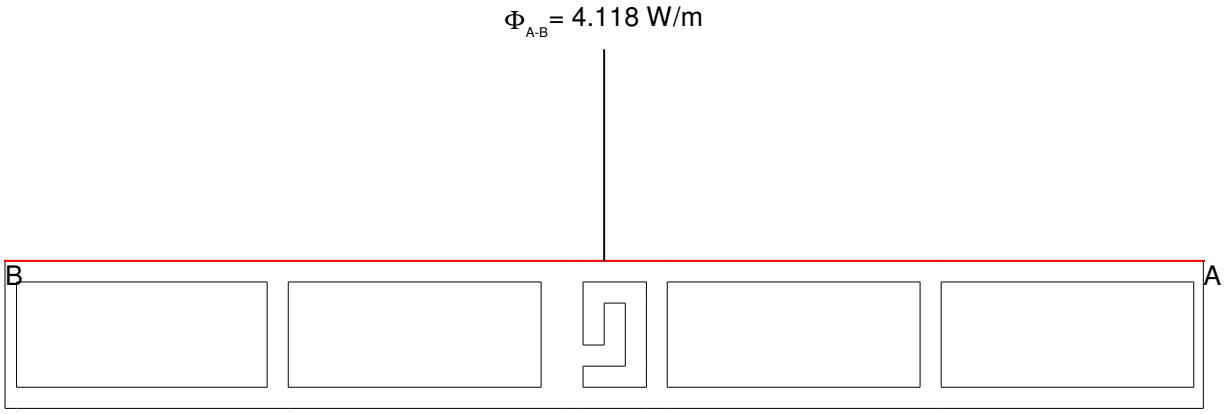
infomind gmbh
weberstrasse 10
CH – 8004 zürich
fon +41 (44) 241 24 86
fax +41 (44) 241 24 89
info@infomind.ch
http://www.infomind.ch



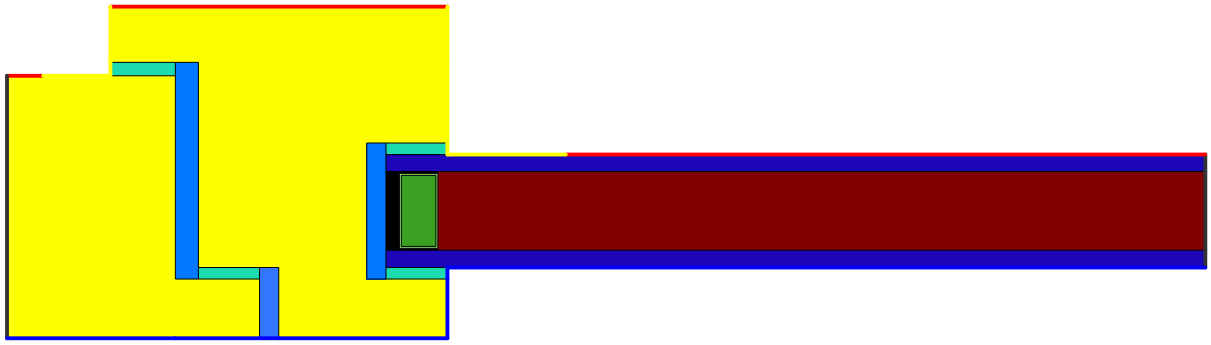
Name	λ[W/(m·K)]
PVC (polyvinylchloride), rigid	0.170
Unventilated air cavity, Eps=0.9	Eps=0.9/0.9

Name	q[W/m²]	θ[°C]	h[W/(m²·K)]	ε
Exterior, frame		0.000	25.000	
Interior, normal		20.000	7.692	
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



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)]
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/m²]	θ[°C]	h[W/(m²·K)]	ε
Exterior, frame		0.000	25.000	
Interior, frame, normal		20.000	7.692	
Interior, frame, reduced		20.000	5.000	
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