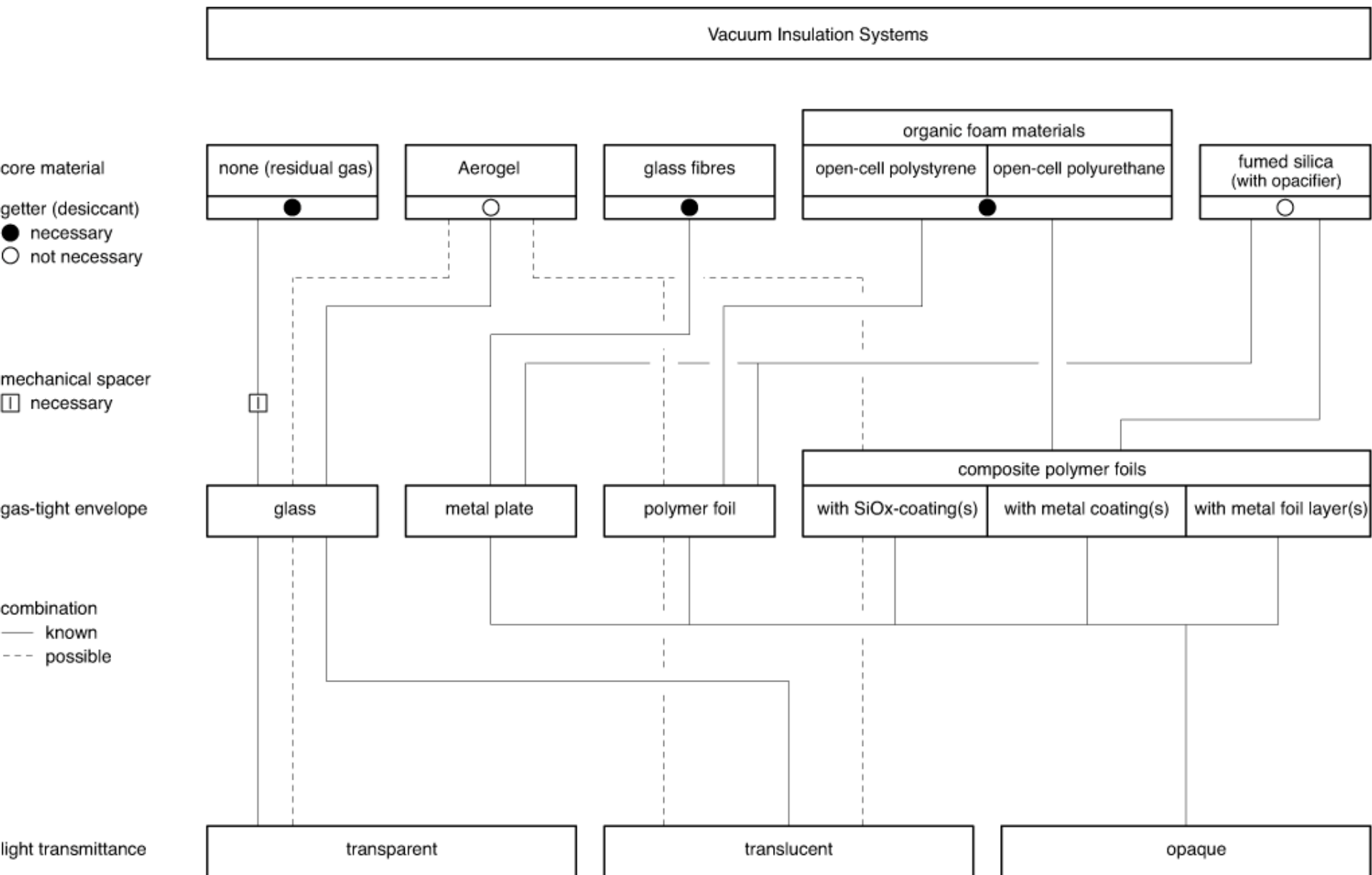




Teschnische Universität München
Chair of Building Technology
Prof. Dr. (Univ.Rom) Thomas Herzog

Typology of Applications for Opaque and Translucent VIP in the Building Envelope and their Potential for Temporary Thermal Insulation

Jan Cremers, dipl.-ing. architect







121B

Criteria for the Set-up of a Typology of VIP-Applications in the Building Envelope

**Light Transmittance of
Vacuum Insulating System**

opaque

diaphane

Area of Application

Facade

Roof

**Considered Part of
Building Envelope**

without Aperture

with Aperture

Implementation

not movable

movable

**Correlation to the Primary
Layer of Thermal Break**

identical

additive

**Local Correlation to the
Primary Thermal Break**

inside

same layer

outside

Criteria for the Set-up of a Typology of VIP-Applications in the Building Envelope

**Light Transmittance of
Vacuum Insulating System**

opaque

diaphane

Area of Application

Facade

Roof

**Considered Part of
Building Envelope**

without Aperture

with Aperture

Implementation

not movable

movable

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Layer of Thermal Break**

identical

additive

**Local Correlation to the
Primary Thermal Break**

inside

same layer

outside

Criteria for the Set-up of a Typology of VIP-Applications in the Building Envelope

**Light Transmittance of
Vacuum Insulating System**

opaque

diaphane

Area of Application

Facade

Roof

**Considered Part of
Building Envelope**

without Aperture

with Aperture

Implementation

not movable

movable

**Correlation to the Primary
Layer of Thermal Break**

identical

additive

**Local Correlation to the
Primary Thermal Break**

inside

same layer

outside

Criteria for the Set-up of a Typology of VIP-Applications in the Building Envelope

**Light Transmittance of
Vacuum Insulating System**

opaque

diaphane

Area of Application

Facade

Roof

**Considered Part of
Building Envelope**

without Aperture

with Aperture

Implementation

not movable

movable

**Correlation to the Primary
Layer of Thermal Break**

identical

additive

**Local Correlation to the
Primary Thermal Break**

inside

same layer

outside

Criteria for the Set-up of a Typology of VIP-Applications in the Building Envelope

**Light Transmittance of
Vacuum Insulating System**

opaque

diaphane

Area of Application

Facade

Roof

**Considered Part of
Building Envelope**

without Aperture

with Aperture

Implementation

not movable

movable

**Correlation to the Primary
Layer of Thermal Break**

identical

additive

**Local Correlation to the
Primary Thermal Break**

inside

same layer

outside

Criteria for the Set-up of a Typology of VIP-Applications in the Building Envelope

**Light Transmittance of
Vacuum Insulating System**

opaque

diaphane

Area of Application

Facade

Roof

**Considered Part of
Building Envelope**

without Aperture

with Aperture

Implementation

not movable

movable

**Correlation to the Primary
Layer of Thermal Break**

identical

additive

**Local Correlation to the
Primary Thermal Break**

inside

same layer

outside

Area of Application

Considered Part of Building Envelope
with / without Aperture

Implementation
(not movable / movable)

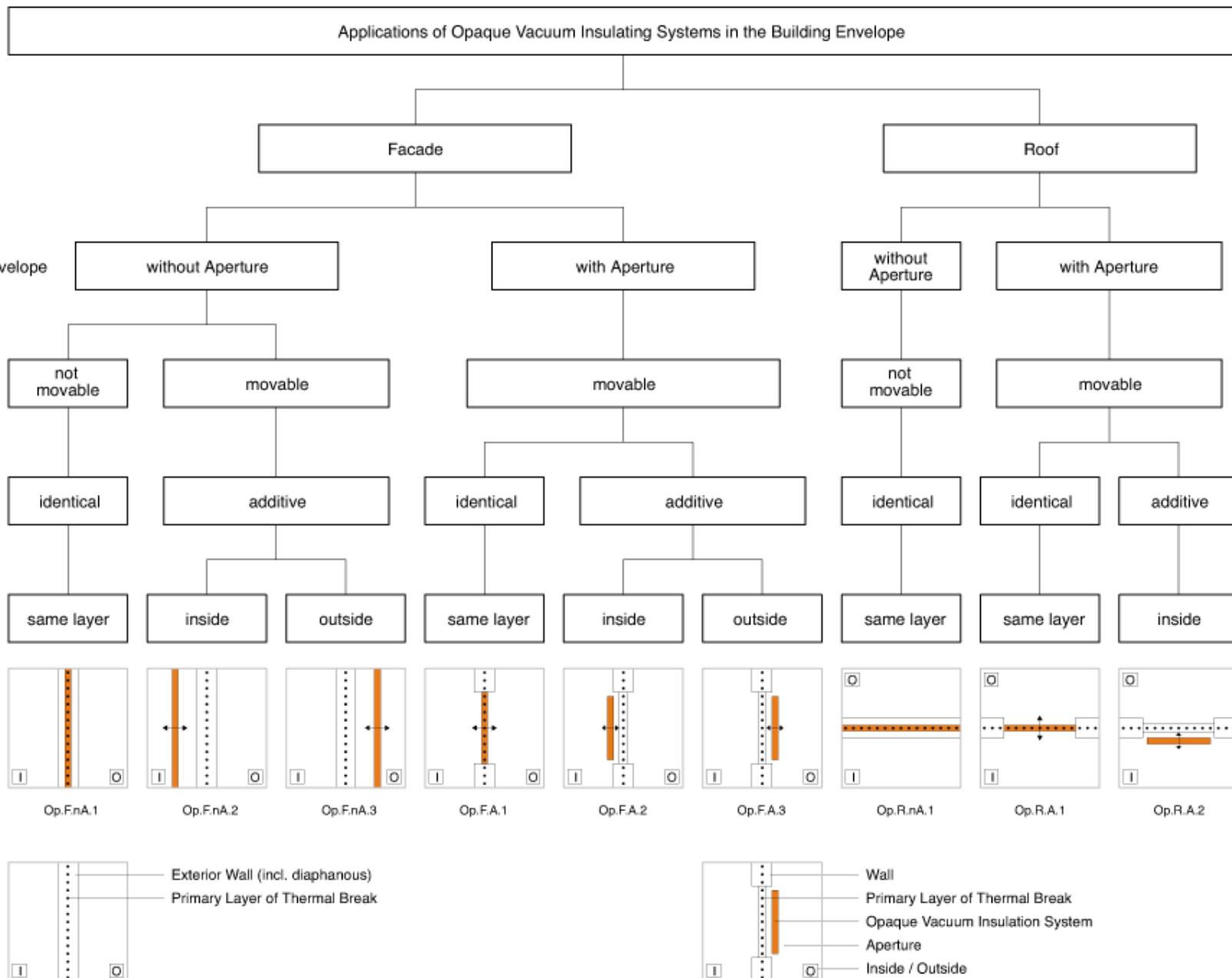
Correlation to the Primary
Layer of Thermal Break
(identical / additive)

Local Correlation to the
Primary Thermal Break

Pictogram of Principle

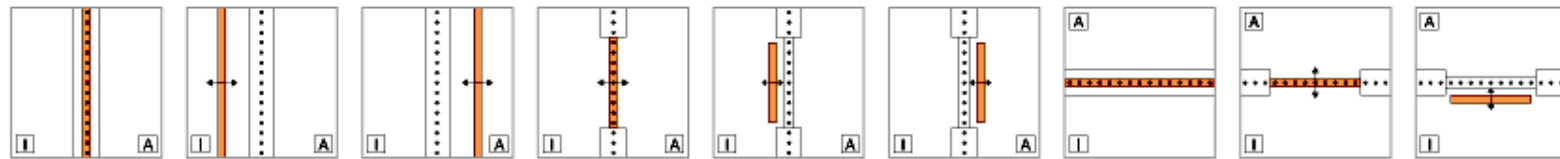
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Legend



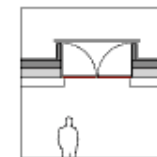
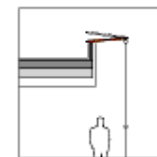
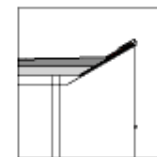
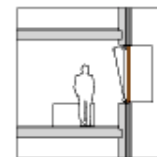
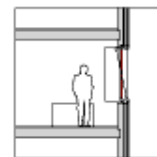
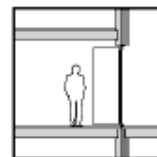
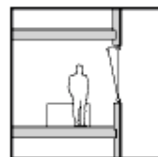
Applications of Opaque Vacuum Insulating Systems in the Building Envelope

Pictogram of Principle

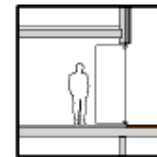
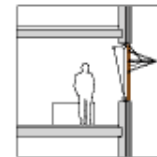
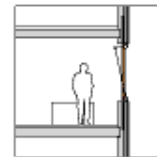
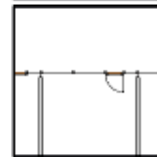
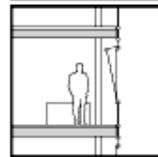


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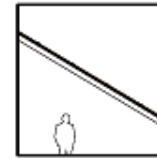
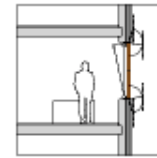
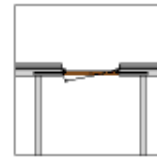
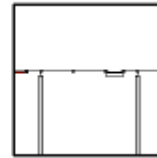
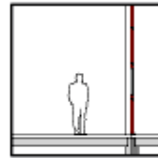
Example 1



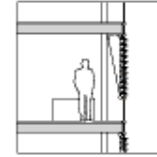
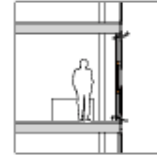
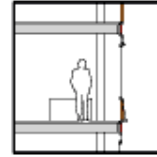
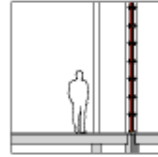
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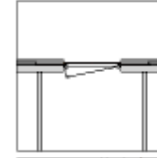
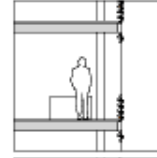
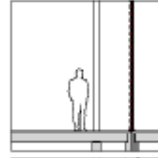
Example 3



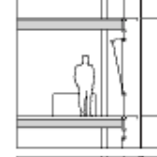
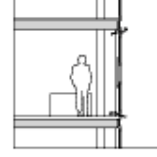
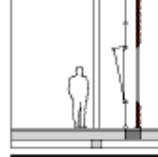
Example 4



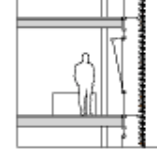
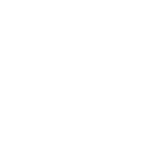
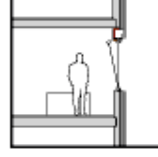
Example 5



Example 6



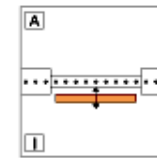
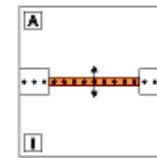
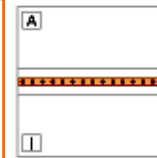
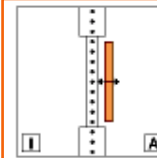
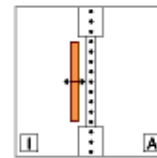
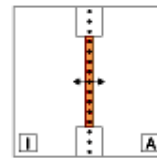
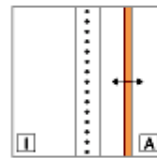
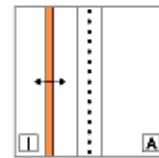
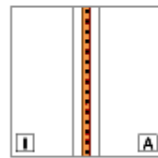
Example 7



Selection of Applications

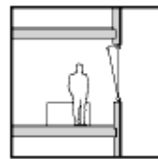
Applications of Opaque Vacuum Insulating Systems in the Building Envelope

Pictogram of Principle

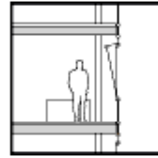


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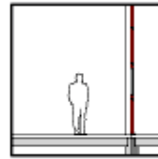
Example 1



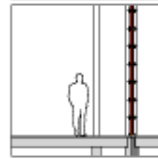
Example 2



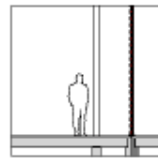
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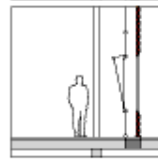
Example 4



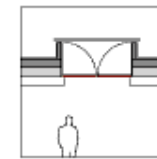
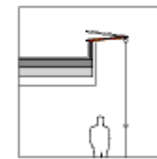
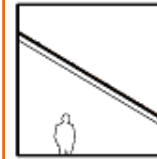
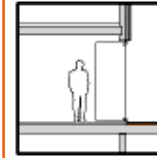
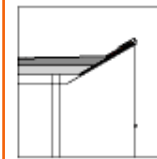
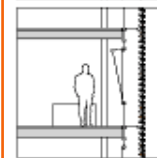
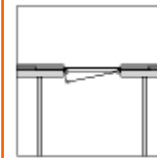
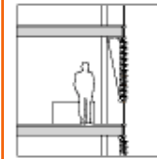
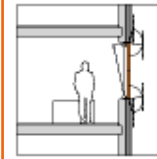
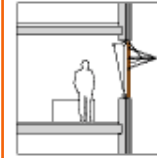
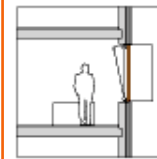
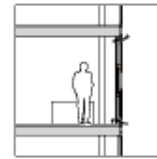
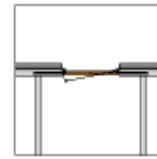
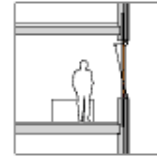
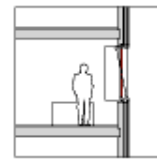
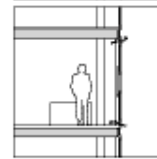
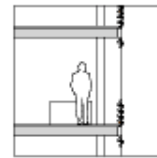
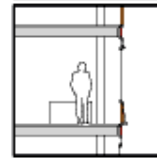
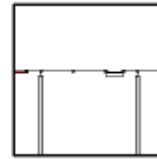
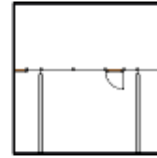
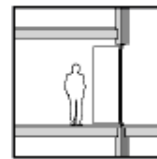
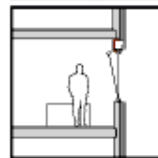
Example 5



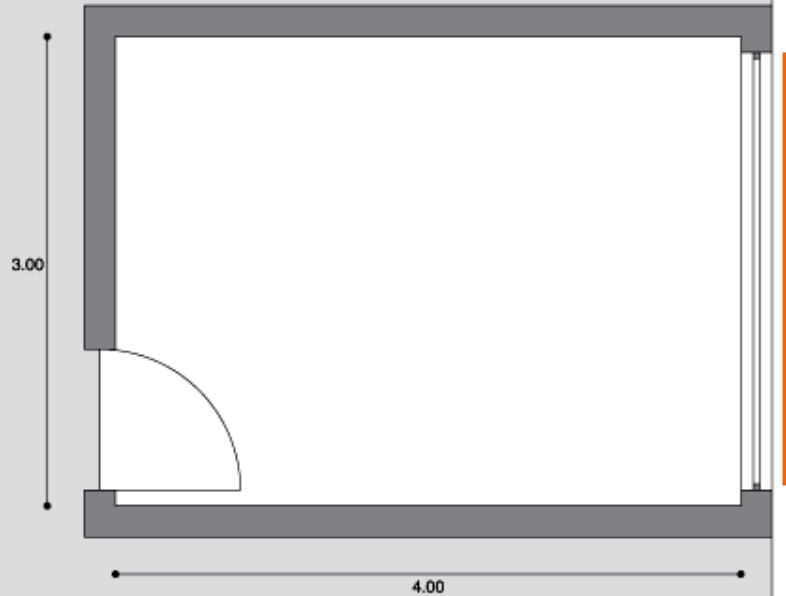
Example 6



Example 7



Selection of Applications



Study on the Effect of Temporary Thermal Protection

The scenario (a standard office room) is shown left: floor-plan and section.

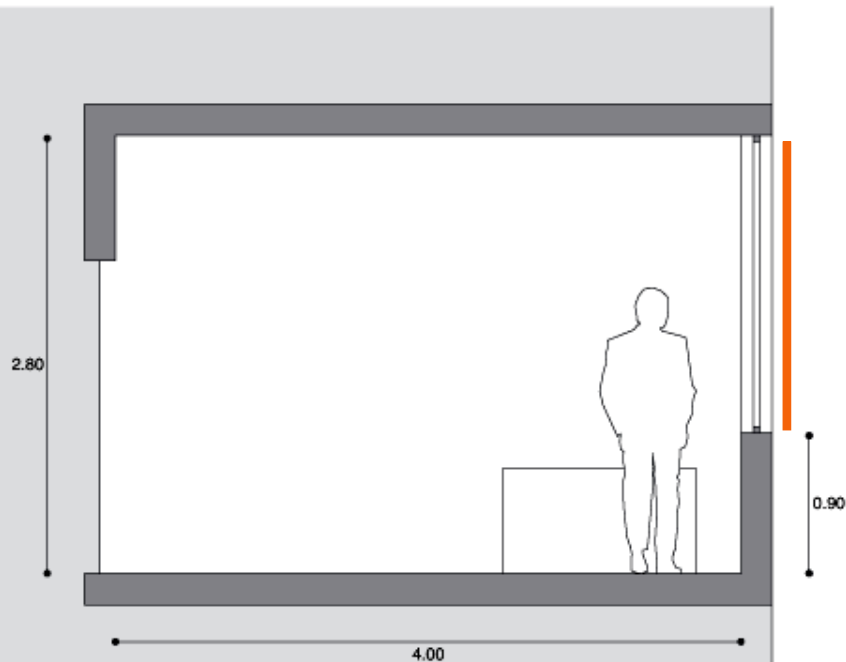
Facade Orientations calc.: N, E, S, W

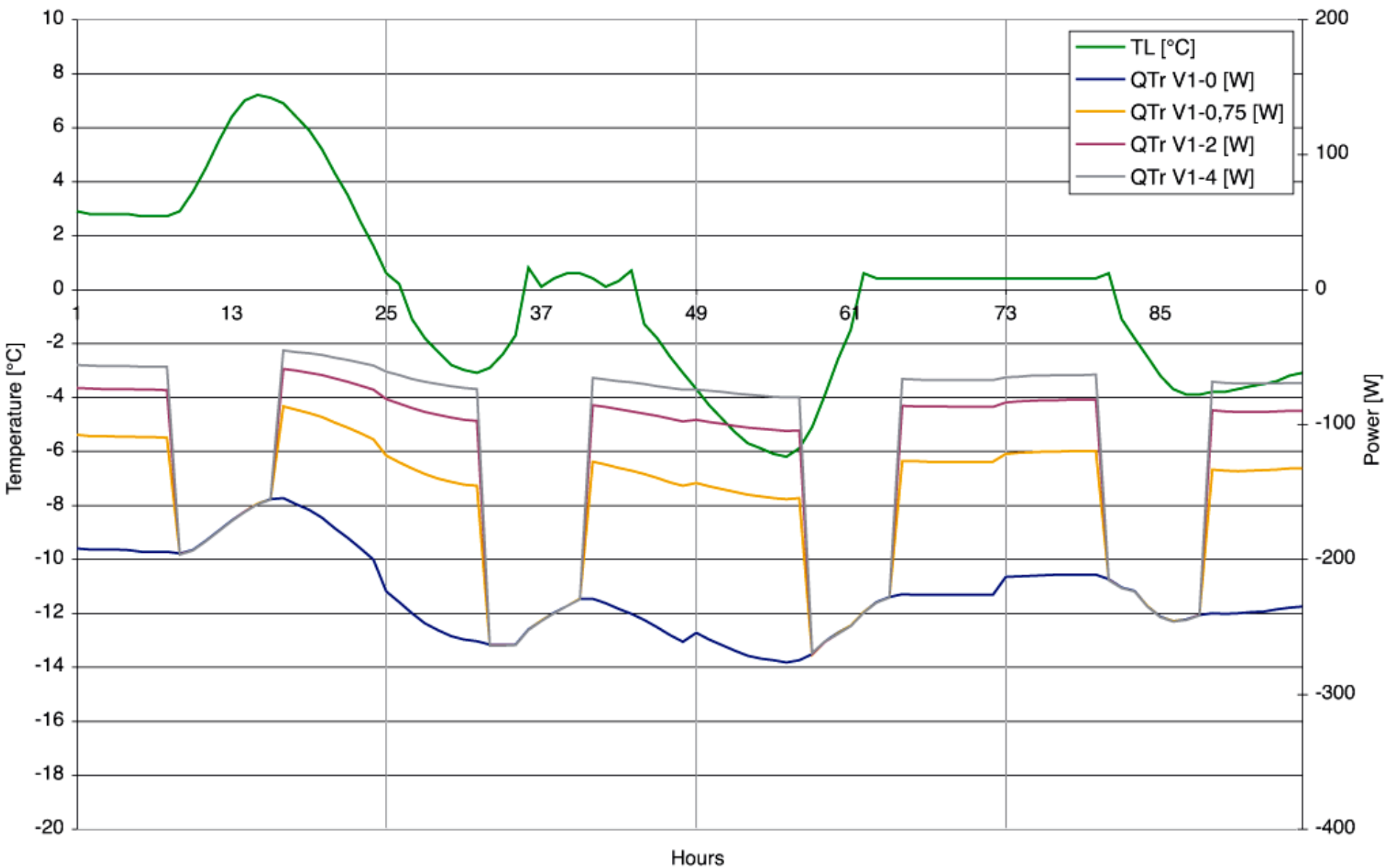
Standard-Window: $U_w = 1.6 \text{ W} / (\text{m}^2\text{K})$

Comp.-Simulation-Tool: HELIOS (Empa)

Different values for additional heat transmission resistance at night:

1. $R_N = 0$ $\text{m}^2\text{K} / \text{W}$ (-)
2. $R_N = 0.75$ $\text{m}^2\text{K} / \text{W}$ (simple chipboard shutter)
3. $R_N = 2$ $\text{m}^2\text{K} / \text{W}$ (VIP fitted lamellae)
4. $R_N = 4$ $\text{m}^2\text{K} / \text{W}$ (VIP fitted shutter)





additional heat transmission resistance during the night (R):

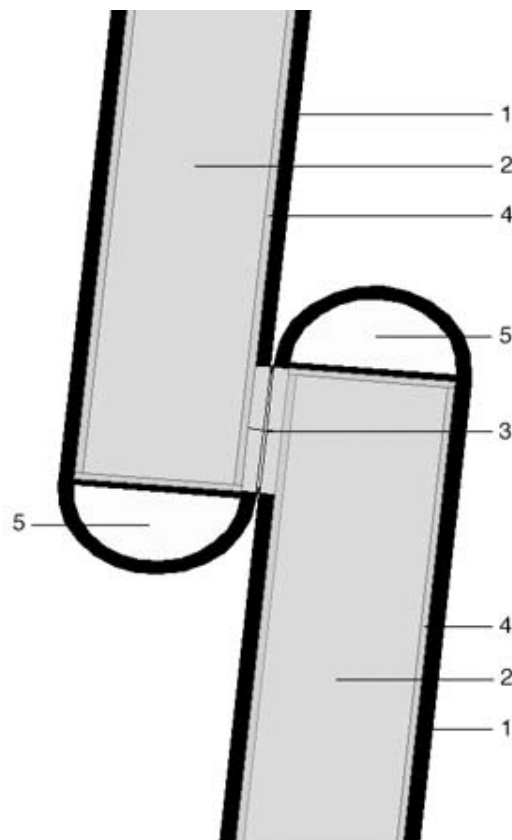
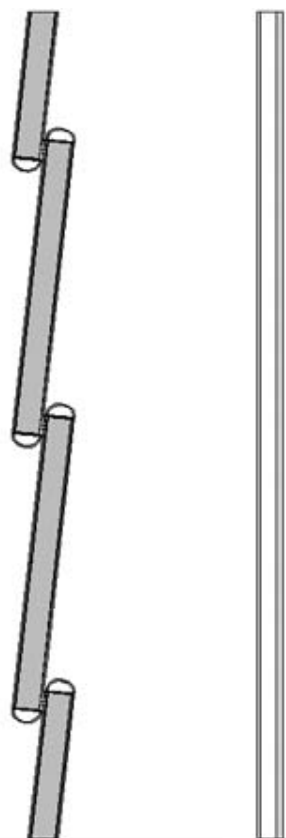
V1-0 : 0 m2K/W
 V1-0,75 : 0,75 m2K/W
 V1-2 : 2 m2K/W
 V1-4 : 4 m2K/W
 TL: outside temperature

Transmission Losses through Aperture, Orientation North, January 4th to 7th

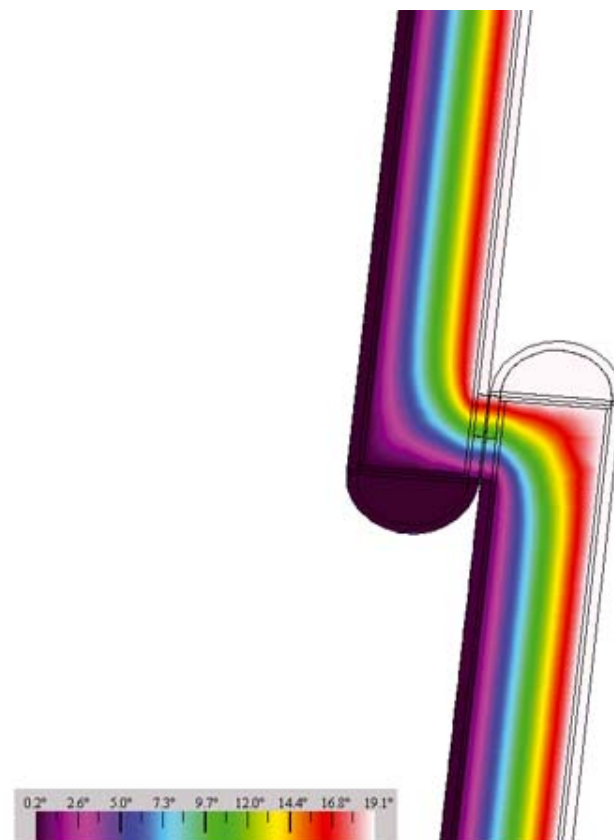
schematic drawing of the examined scenario: a standard office room with a glazed aperture, all sides assumed to be adiabatic except for the facade - different solutions for temporary thermal protection at night																	
examined principle of temporary thermal protection		reference: no temporary thermal protection				insulating lamellae ⁽¹⁾				simple wooden shutter (5mm)				VIP-insulated shutter (5mm chipboard + 15mm VIP + 5mm chipboard)			
additional heat transmission resistance during the night ⁽¹⁾		not existent				2,0 m²K/W				0,75 m²K/W				4,0 m²K/W			
U _g -value of the window (including temporary thermal protection)		1,66 W/(m²K)				0,35 W/(m²K)				0,72 W/(m²K)				0,22 W/(m²K)			
orientation of the office room		north	east	south	west	north	east	south	west	north	east	south	west	north	east	south	west
annual transmission losses through the window	[kWh/a]	751	766	775	765	413	429	439	428	512	528	538	527	365	381	391	380
relation to reference (same orientation)		-	-	-	-	55 %	56 %	57 %	56 %	68 %	69 %	69 %	69 %	49 %	50 %	51 %	50 %

Summary of a Study of the Effect of Temporary Thermal Protection by the Computer-aided Thermal Simulation of a Standard Office Room.
Simulation Tool used: HELIOS (EMPA)

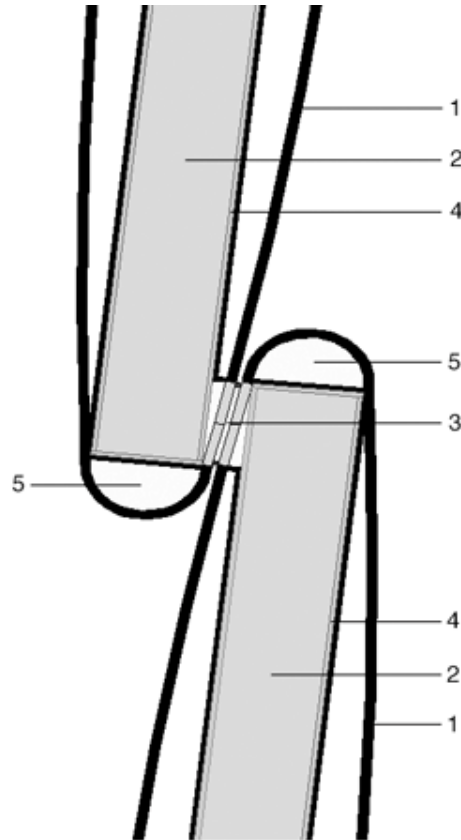
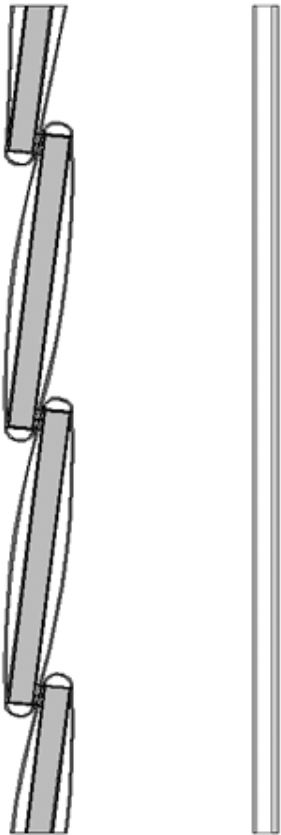
annotation: (1) Temporary thermal protection: Reduction of the U-value of the glazing at a solar radiation of 0 W/m² on the actual facade.



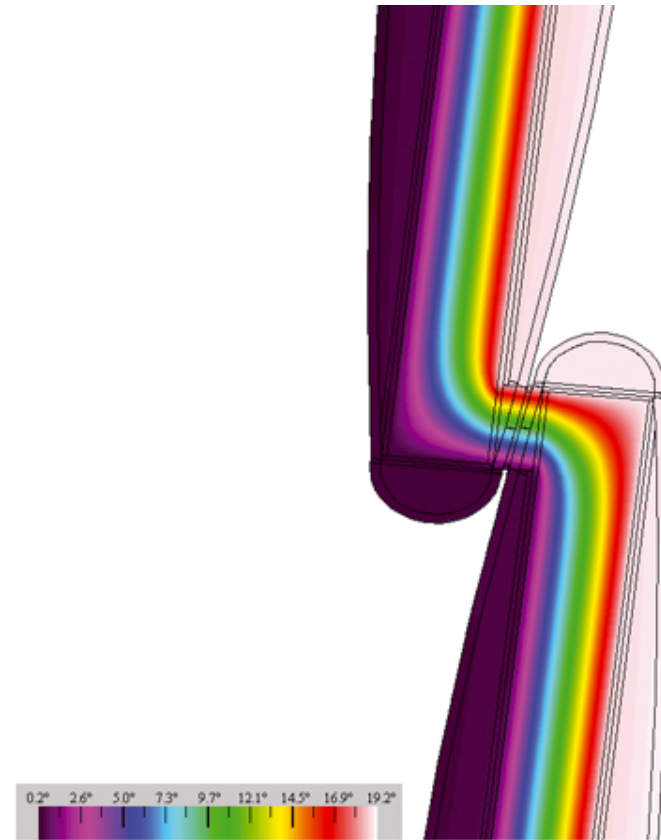
- 1 Shell Material: Aluminium
- 2 Core-Material VIP: Silica
- 3 Material Thermal Break: PA
- 4 Standard VIP-Foil
- 5 no insulation in Lamella-'head'



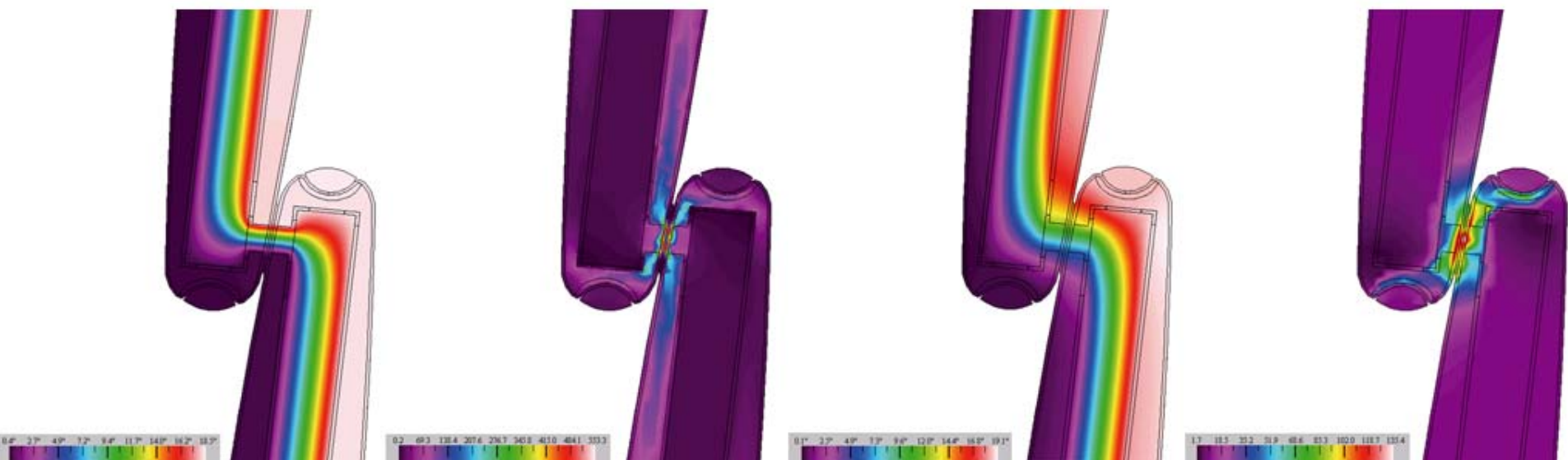
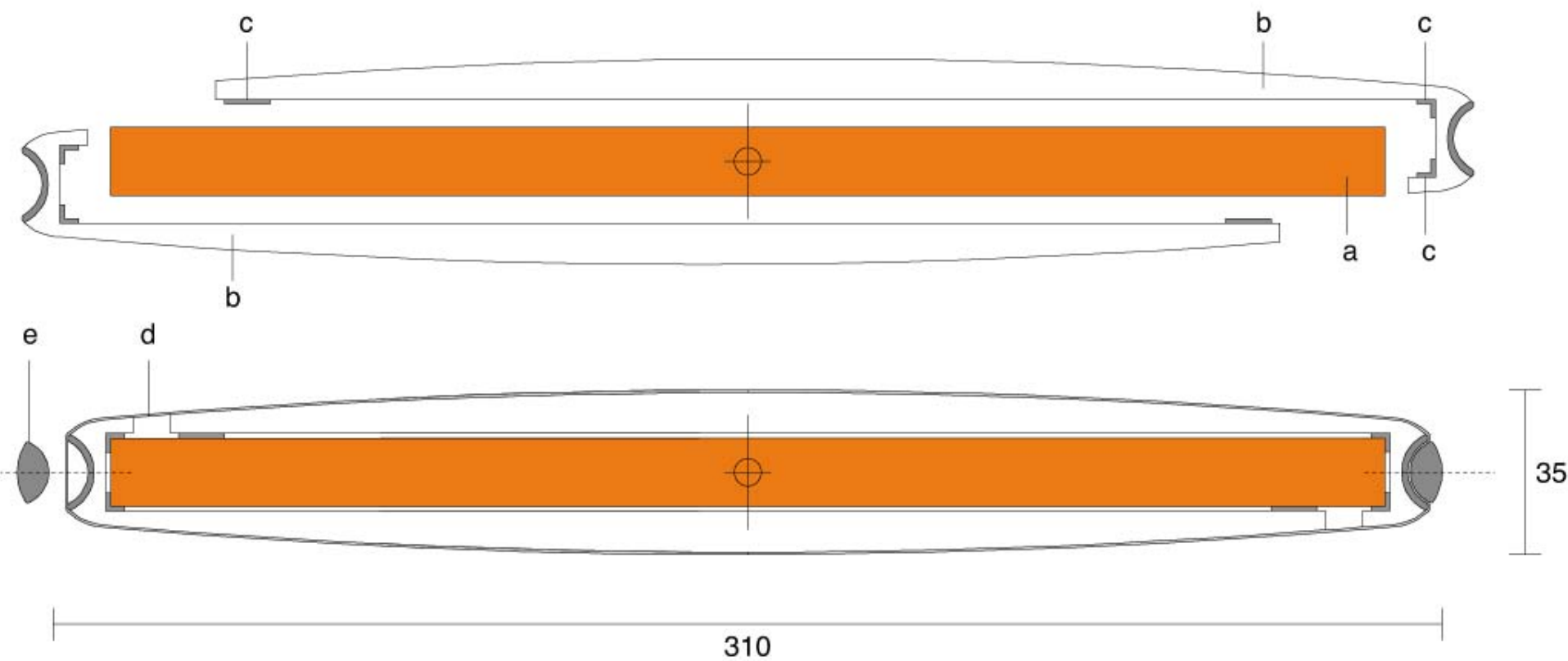
U-Value (calc.) ~ 0,43 W/(m²K)

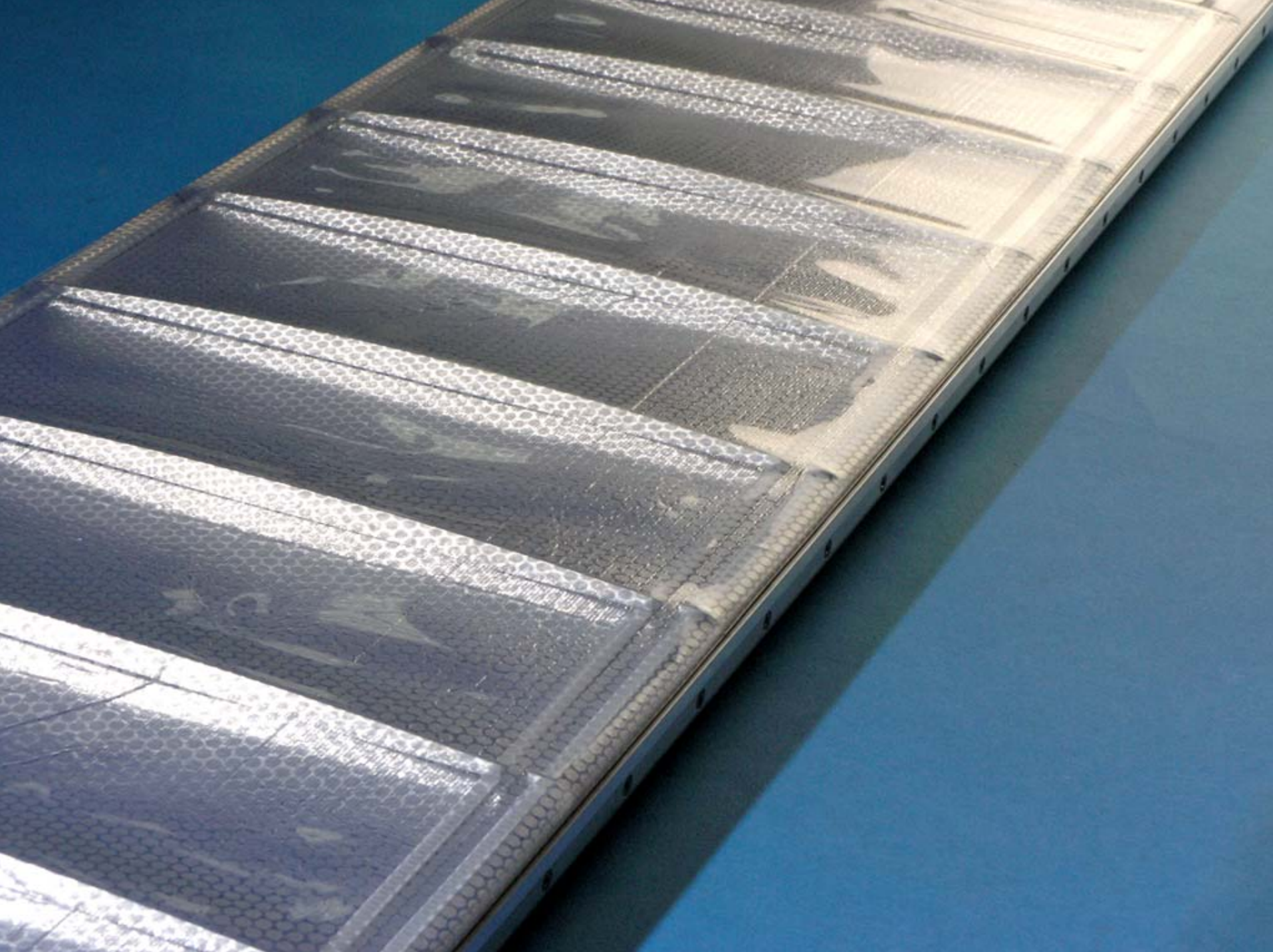


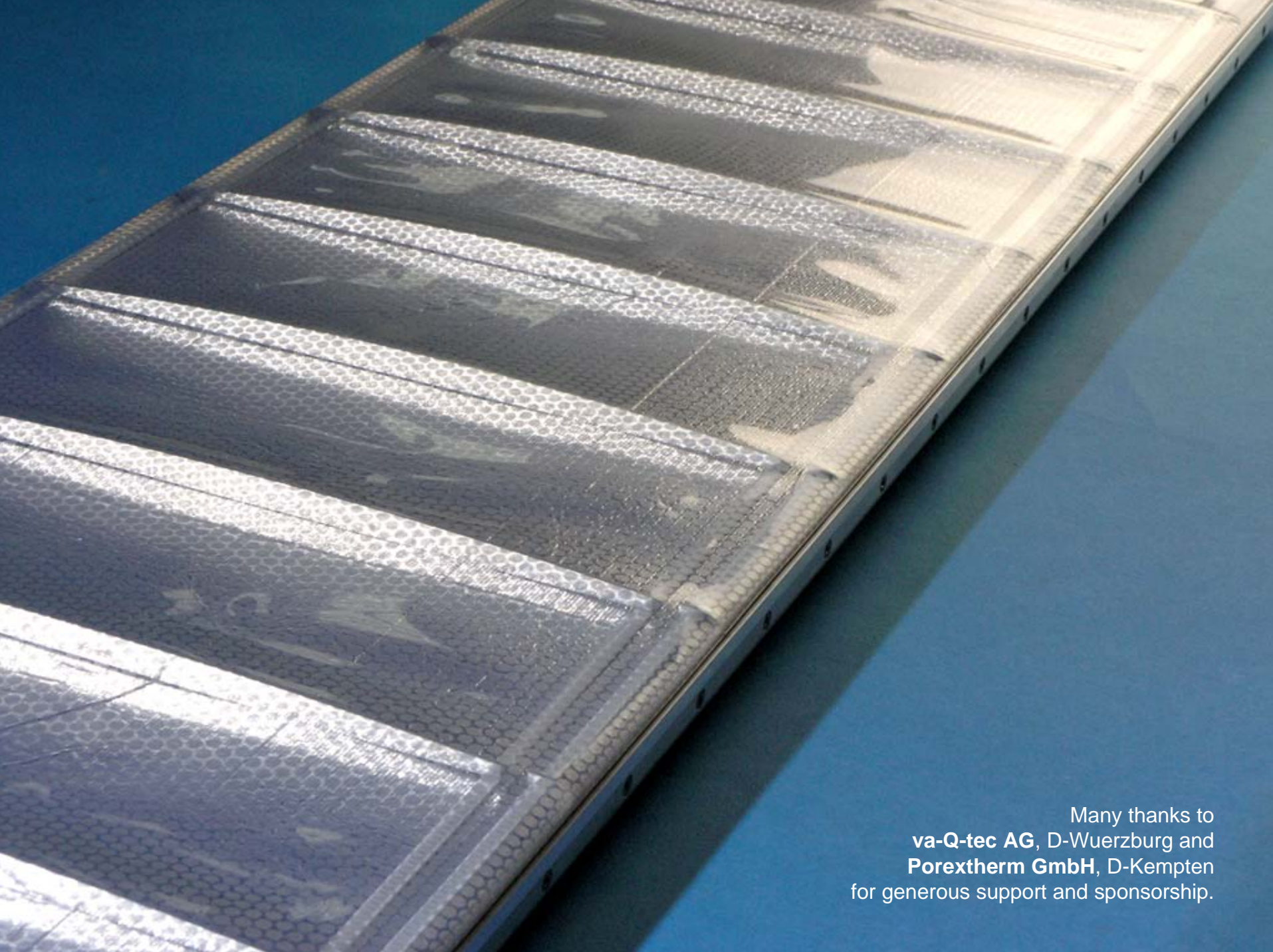
- 1 Shell Material: Aluminium
- 2 Core-Material VIP: Silica
- 3 Material Thermal Break: PA
- 4 Standard VIP-Foil
- 5 no insulation in Lamella-'head'



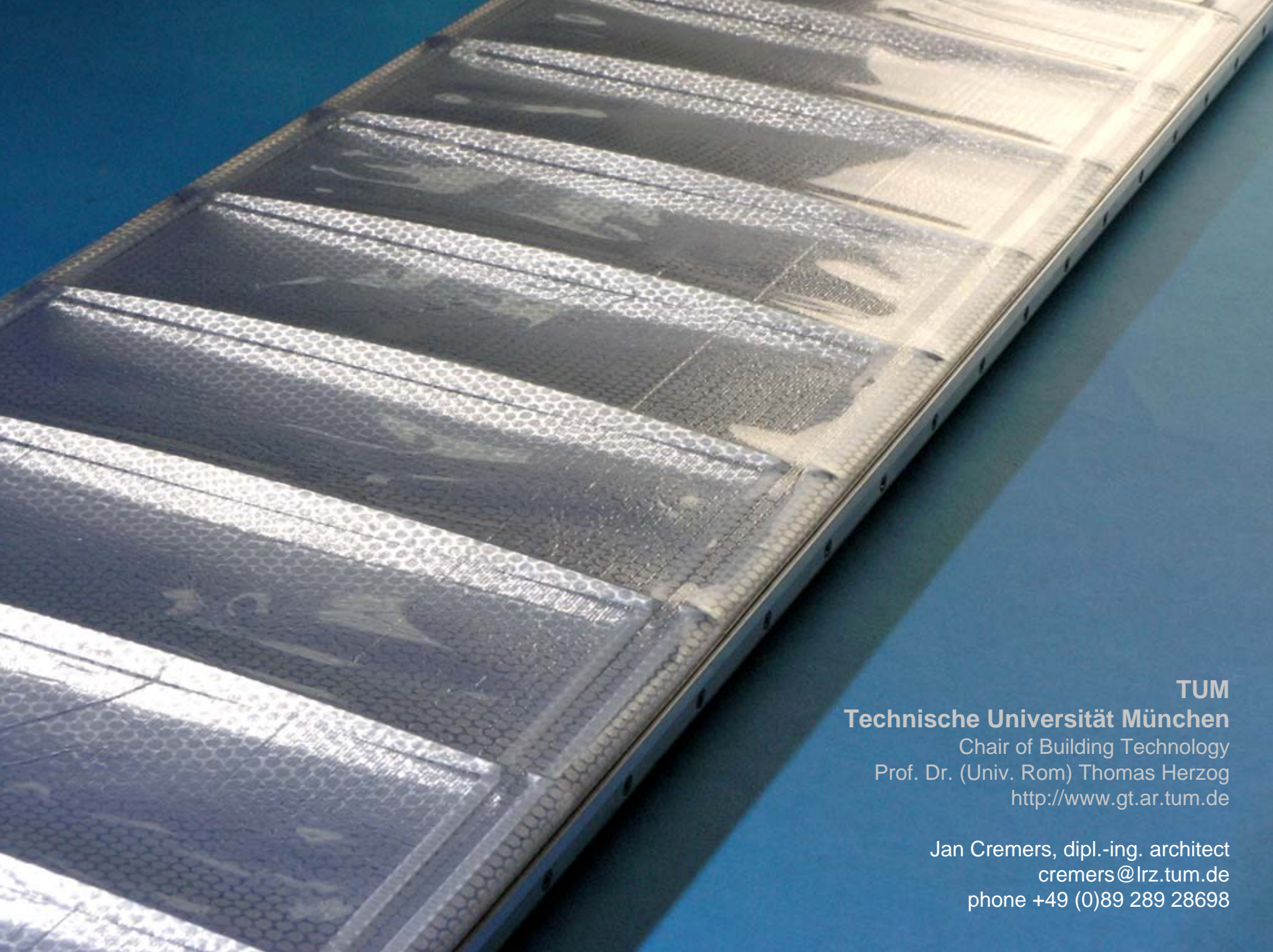
U-Value (calc.) ~ 0,47 W/(m²K)







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