

# 2025-03-15 the wall from the air heating towards outside

Exterior wall  
created on 15.3.2025

## Thermal protection

$U = 0,13 \text{ W}/(\text{m}^2\text{K})$

GEG 2020/24 Bestand\*:  $U < 0,24 \text{ W}/(\text{m}^2\text{K})$

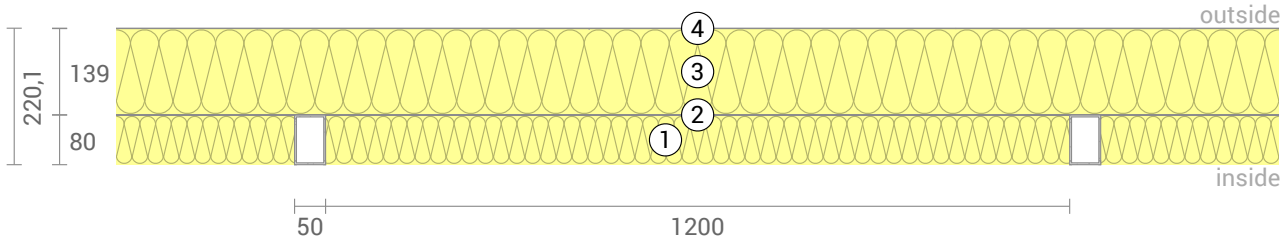


## Moisture proofing

Condensate:  $342 \text{ g}/\text{m}^2$   
Dries 24 days

## Heat protection

Temperature amplitude damping: 2,9  
phase shift: 6,6 h  
Thermal capacity inside:  $7,4 \text{ kJ}/\text{m}^2\text{K}$

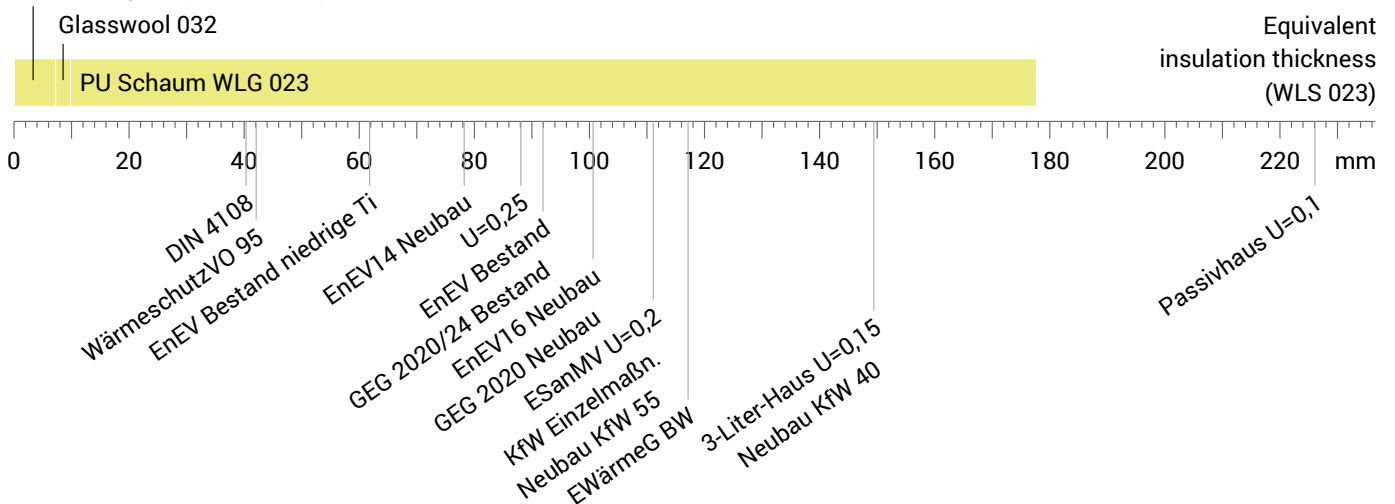


- ① Glasswool 032 (80 mm)
- ② Steel (0,5 mm)
- ③ PU Schaum WLG 023 (139 mm)
- ④ Steel (0,6 mm)

## Impact of each layer and comparison to reference values

For the following figure, the thermal resistances of the individual layers were converted in millimeters insulation. The scale refers to an insulation of thermal conductivity  $0,023 \text{ W}/\text{mK}$ .

Stationary air (unventilated), Steel, Glasswool 032



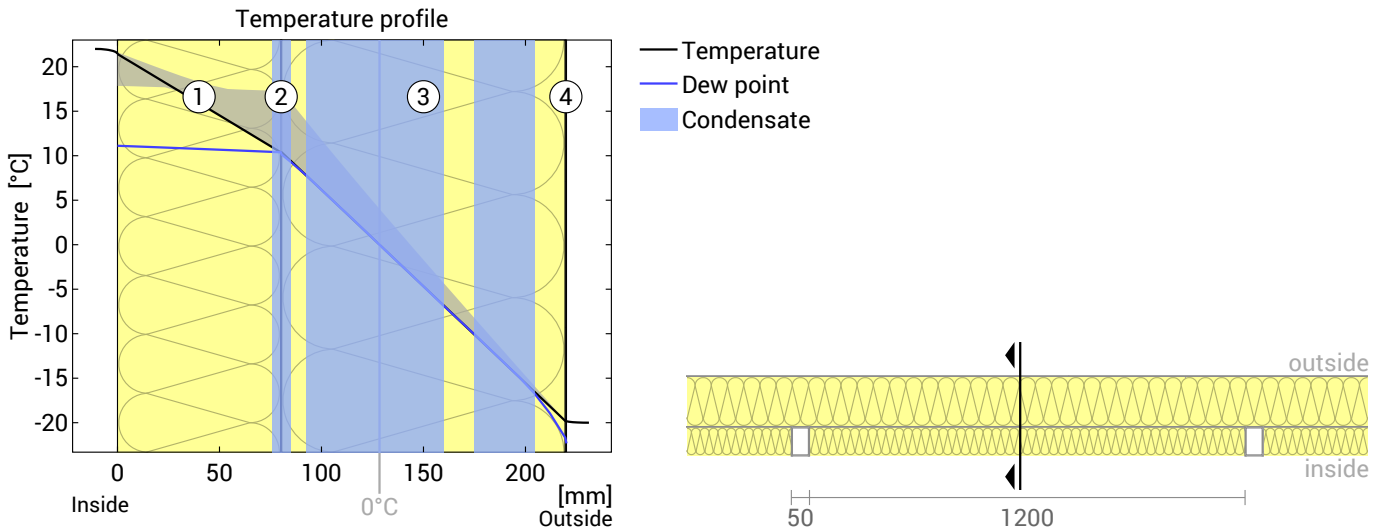
Inside air :  $22,0^\circ\text{C} / 50\%$   
Outside air:  $-20,0^\circ\text{C} / 80\%$   
Surface temperature.:  $17,8^\circ\text{C} / -19,8^\circ\text{C}$

sd-value: 142110,6 m

Thickness: 22,0 cm  
Weight:  $20 \text{ kg}/\text{m}^2$   
Heat capacity:  $13,7 \text{ kJ}/\text{m}^2\text{K}$

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## Temperature profile



- ① Glasswool 032 (80 mm)                      ③ PU Schaum WLG 023 (139 mm)  
 ② Steel (0,5 mm)                              ④ Steel (0,6 mm)

**Left:** Temperature and dew-point temperature at the place marked in the right figure. The dew-point indicates the temperature, at which water vapour condensates. As long as the temperature of the component is everywhere above the dew point, no condensation occurs. If the curves have contact, condensation occurs at the corresponding position.

**Right:** The component, drawn to scale.

## Layers (from inside to outside)

#	Material	$\lambda$ [W/mK]	R [m <sup>2</sup> K/W]	Temperatur [°C]		Weight [kg/m <sup>2</sup> ]
				min	max	
	Thermal contact resistance*		0,130	17,8	22,0	
1	8 cm Glasswool 032	0,032	2,500	10,4	21,6	2,3
	8 cm Steel (0,24%)	50,000	0,002	17,3	17,8	1,4
	8 cm Steel (0,24%)	50,000	0,002	17,3	17,8	1,4
	0,3 cm Steel (Width: 5 cm)	50,000	0,000	17,3	17,3	0,9
	0,3 cm Steel (Width: 5 cm)	50,000	0,000	17,8	17,9	0,9
	7,4 cm Stationary air (unventilated) (Width: 4,4 cm)	0,411	0,180	17,3	17,9	0,0
2	0,05 cm Steel	50,000	0,000	10,4	17,3	3,9
3	13,9 cm PU Schaum WLG 023	0,023	6,043	-19,8	17,3	4,2
4	0,06 cm Steel	50,000	0,000	-19,8	-19,8	4,7
	Thermal contact resistance*		0,040	-20,0	-19,8	
	22,01 cm Whole component		7,881			19,7

\*Assuming free circulating air at the inside surface.

Surface temperature inside (min / average / max): 17,8°C 21,3°C 21,6°C

Surface temperature outside (min / average / max): -19,8°C -19,8°C -19,8°C

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## Moisture proofing

For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 22°C und 50% Humidity; outside: -20°C und 80% Humidity (Climate according to user input).

Interior heat transfer resistance Rsi (user input deviating from DIN 4108-3): 0.13 m<sup>2</sup>K/W

Under these conditions, a total of 0,34 kg of condensation water per square meter is accumulated. This quantity dries in summer in 24 days (Drying season according to DIN 4108-3:2018-10).

#	Material	sd-value [m]	Condensate [kg/m <sup>2</sup> ] [Gew.-%]	Weight [kg/m <sup>2</sup> ]
1	8 cm Glasswool 032	0,08	0,34	2,3
	8 cm Steel (0,24%)	1500		1,4
	8 cm Steel (0,24%)	1500		1,4
	0,3 cm Steel (Width: 5 cm)	1500		0,9
	0,3 cm Steel (Width: 5 cm)	1500		0,9
	7,4 cm Stationary air (unventilated) (Width: 4,4 cm)	0,01		0,0
	0,05 cm Steel	1500		3,9
2	0,05 cm Steel	1500	-	3,9
3	13,9 cm PU Schaum WLG 023	139000	-	4,2
4	0,06 cm Steel	1500	-	4,7
22,01 cm Whole component		142.110,61	0,34	19,7

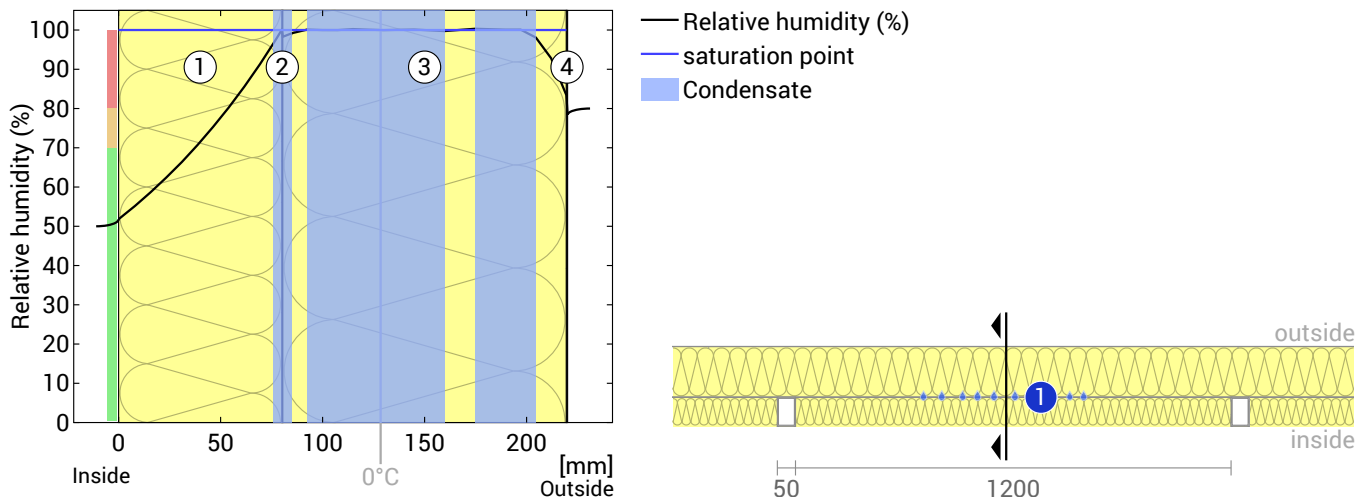
## Condensation areas

- ① Condensate: 0,34 kg/m<sup>2</sup> Affected layers: Steel, Glasswool 032
- ② Condensate: ~0 kg/m<sup>2</sup> Affected layers: PU Schaum WLG 023

## Humidity

The temperature of the inside surface is 17,8 °C leading to a relative humidity on the surface of 65%. Mould formation is not expected under these conditions.

The following figure shows the relative humidity inside the component.



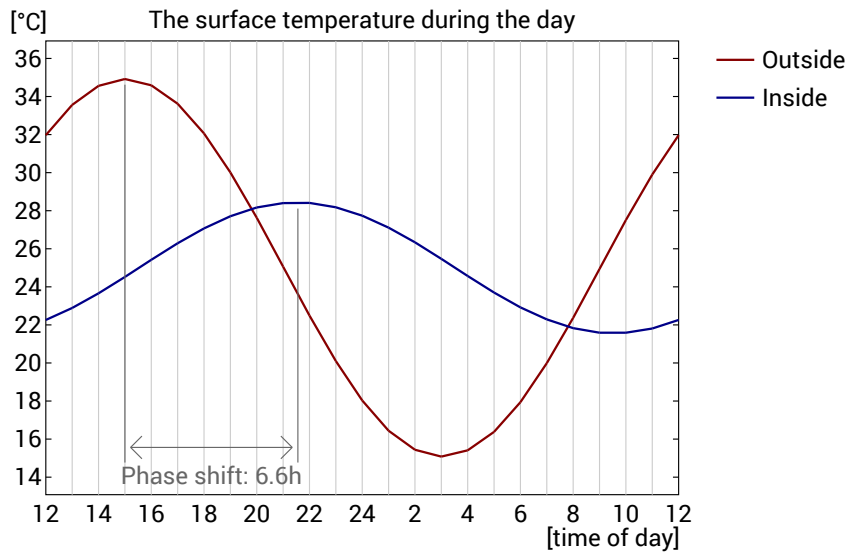
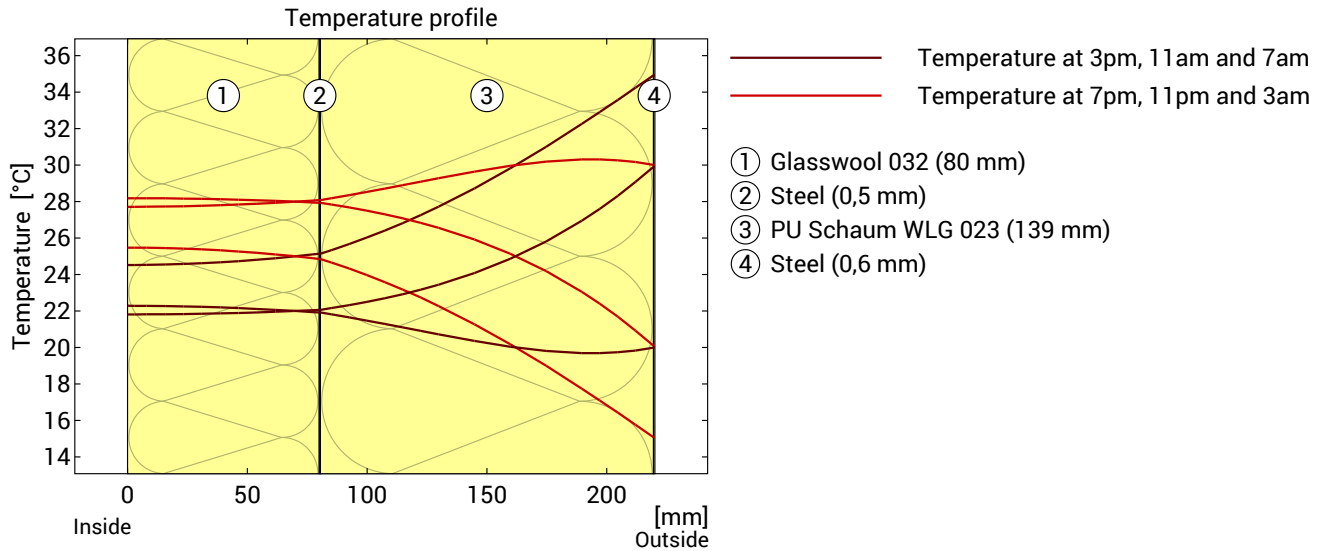
- ① Glasswool 032 (80 mm)
- ② Steel (0,5 mm)
- ③ PU Schaum WLG 023 (139 mm)
- ④ Steel (0,6 mm)

Notes: Calculation using the Ubakus 2D-FE method. Convection and the capillarity of the building materials were not considered. The drying time may take longer under unfavorable conditions (shading, damp / cool summers) than calculated here.

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## Heat protection

The following results are properties of the tested component alone and do not make any statement about the heat protection of the entire room:



**Top:** Temperature profile within the component at different times. From top to bottom, brown lines: at 3 pm, 11 am and 7 am and red lines at 7 pm, 11 pm and 3 am.

**Bottom:** Temperature on the outer ( red ) and inner ( blue ) surface in the course of a day. The arrows indicate the location of the temperature maximum values . The maximum of the inner surface temperature should preferably occur during the second half of the night.

Phase shift*	6,6 h	Heat storage capacity (whole component):	13.7 kJ/m <sup>2</sup> K
Amplitude attenuation **	2,9	Thermal capacity of inner layers:	7.4 kJ/m <sup>2</sup> K
TAV ***	0,347		

\* The phase shift is the time in hours after which the temperature peak of the afternoon reaches the component interior.

\*\* The amplitude attenuation describes the attenuation of the temperature wave when passing through the component. A value of 10 means that the temperature on the outside varies 10x stronger than on the inside, e.g. outside 15-35 °C, inside 24-26 °C.

\*\*\* The temperature amplitude ratio TAV is the reciprocal of the attenuation:  $TAV = 1 / \text{amplitude attenuation}$

Note: The heat protection of a room is influenced by several factors, but essentially by the direct solar radiation through windows and the total amount of heat storage capacity (including floor, interior walls and furniture). A single component usually has only a very small influence on the heat protection of the room.

The calculations presented above have been created for a 1-dimensional cross-section of the component.