MgO SIP externall wall - concrete block cladding

Exterior wall
created on 6.4.2019

Thermal protection

U = 0,20 W/(m²K)

EnEV Bestand*: U<0,24 W/(m²K)

excellent — insufficient

Moisture proofing

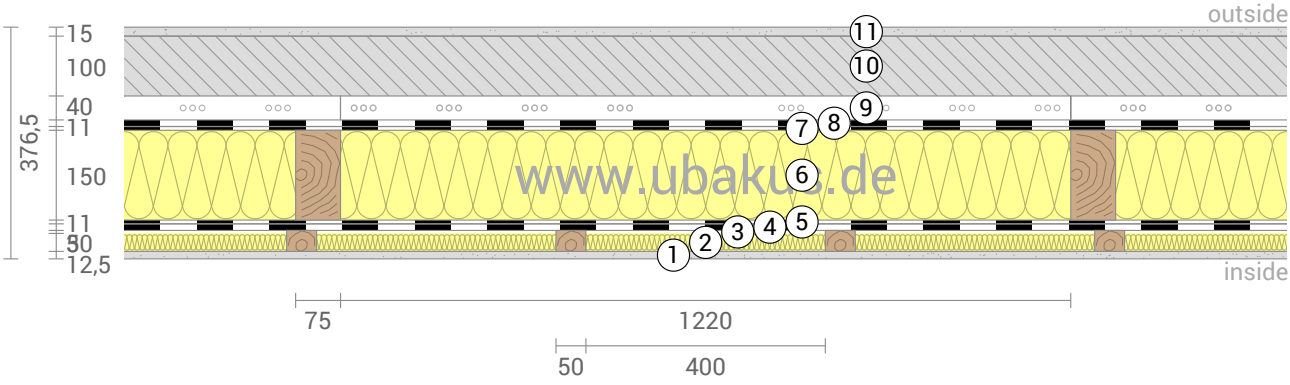
Dries 22 days
Condensate: 79 g/m²
Wood moisture: +0,1%

excellent — insufficient

Heat protection

Temperature amplitude damping: 6,3
phase shift: 7,2 h
Thermal capacity inside: 21 kJ/m²K

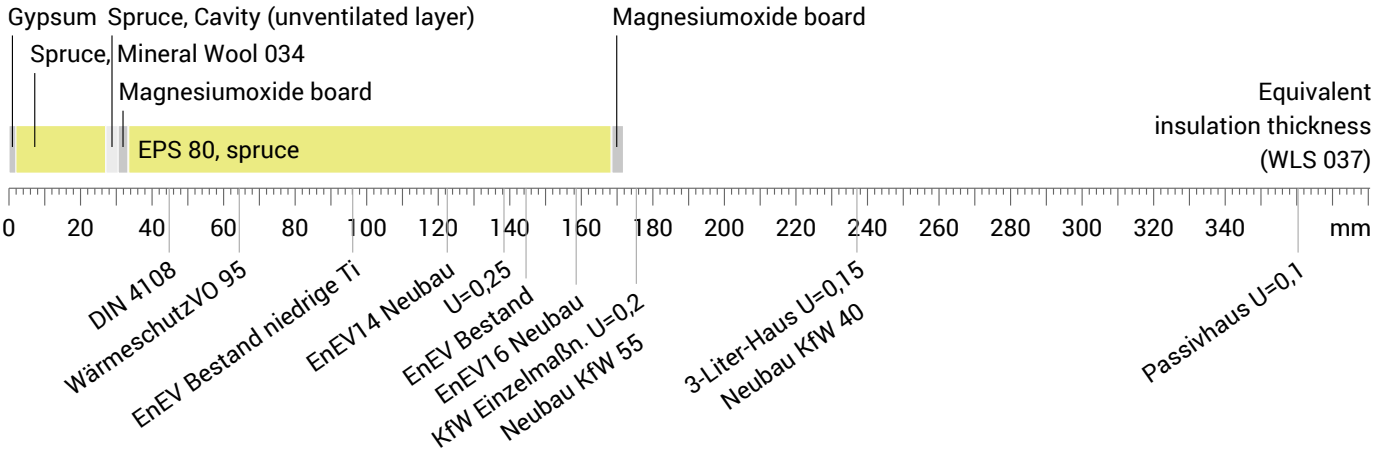
excellent — insufficient



1. Gypsum (12,5 mm)
2. Mineral Wool 034 (30 mm)
3. Cavity (5 mm)
4. Magnesiumoxide board
5. Polyurethane Adhesive Macroplast UR 7225B
6. EPS 80 (150 mm)
7. Polyurethan Adhesive Macroplast UR 7225B
8. Magnesiumoxide board
9. Rear ventilated level (40 mm)
10. Concrete block QUINN (100 mm)
11. cement render (15 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 0,037 W/mK.



Inside air :	20,0°C / 50%			Thickness:	37,7 cm
Outside air:	-5,0°C / 80%	sd-value:	12,4 m	Weight:	269 kg/m²
Surface temperature.:	17,7°C / -4,8°C			Heat capacity:	38 kJ/m²K

*Comparison to the maximum U-value according to the german EnEV 2014/2016 for first-time installation or renewal of Außenwänden (Anlage 3, Tabelle 1, Zeile 1).

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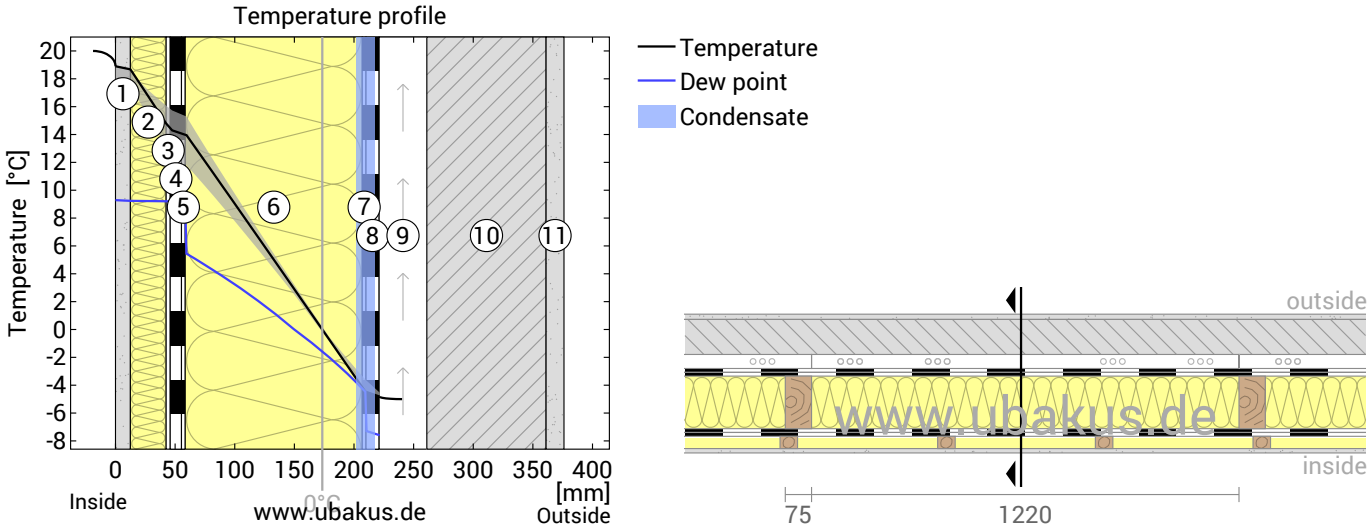
Temperature profile



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⑪ cement render (15 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	λ [W/mK]	R [m²K/W]	Temperatur [°C] min	max	Weight [kg/m²]
		Thermal contact resistance*		0,130	17,7	20,0	
1	1,25 cm	Gypsum	0,250	0,050	17,2	18,9	8,5
2	3 cm	Mineral Wool 034	0,034	0,882	13,0	18,7	0,5
	3,5 cm	Spruce (Width: 5 cm)	0,130	0,269	15,7	18,3	1,9
3	0,5 cm	Cavity (unventilated layer)	0,045	0,110	12,3	16,1	0,0
4	1,1 cm	Magnesiumoxide board	0,155	0,071	11,8	15,7	10,4
5	0,1 cm	Polyurethane Adhesive Macroplast UR 7225B	0,170	0,006	11,8	15,3	0,3
6	15 cm	EPS 80	0,037	4,054	-4,5	15,3	2,3
	15 cm	spruce (5,8%)	0,130	1,154	-3,8	12,7	4,1
7	0,1 cm	Polyurethan Adhesive Macroplast UR 7225B	0,170	0,006	-4,5	-3,6	0,3
8	1,1 cm	Magnesiumoxide board	0,155	0,071	-4,8	-3,7	10,4
		Thermal contact resistance*		0,130	-5,0	-4,5	
9	4 cm	Rear ventilated level (outside air)			-5,0	-5,0	0,0
10	10 cm	Concrete block QUINN			-5,0	-5,0	200,0
11	1,5 cm	cement render			-5,0	-5,0	30,0
	37,65 cm	Whole component		4,889			268,7

*Thermal contact resistances according to DIN 6946 for the U-value calculation. Rsi=0,25 and Rse=0,04 according to DIN 4108-3 were used for moisture proofing and temperature profile.

Surface temperature inside (min / average / max):	17,7°C	18,7°C	18,9°C
Surface temperature outside (min / average / max):	-4,8°C	-4,8°C	-4,5°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: 20°C und 50% Humidity; outside: -5°C und 80% Humidity. This climate complies with DIN 4108-3.

Under these conditions, a total of 0,079 kg of condensation water per square meter is accumulated.This quantity dries in summer in 22 days (Drying season according to DIN 4108-3:2018-10).

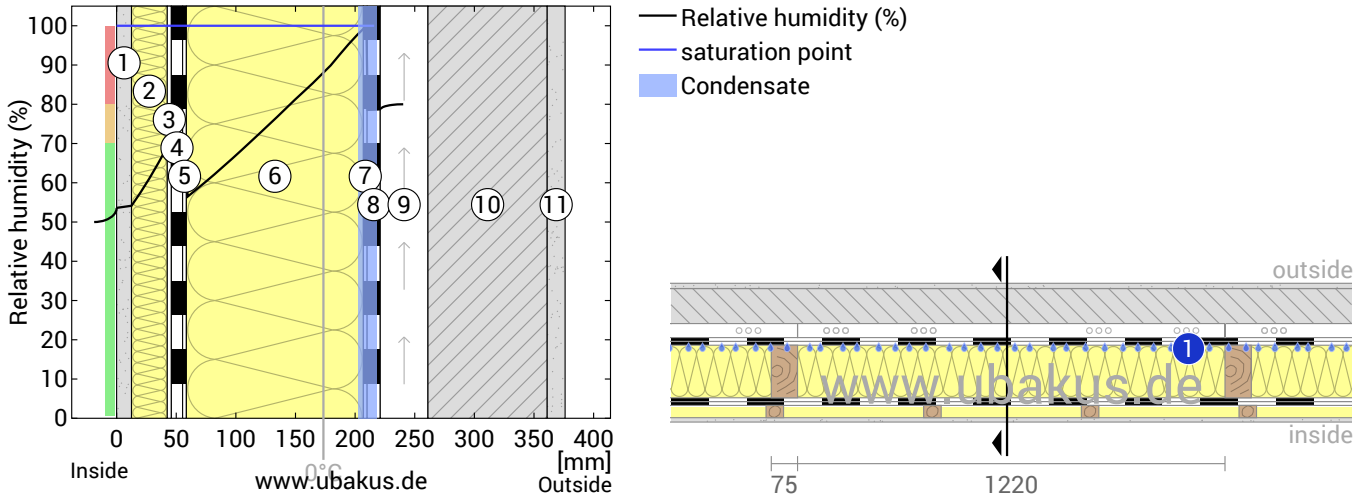
#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	1,25 cm	Gypsum	0,05	-		8,5
2	3 cm	Mineral Wool 034	0,03	-		0,5
	3,5 cm	Spruce (Width: 5 cm)	0,70	-	-	1,9
3	0,5 cm	Cavity (unventilated layer)	0,01	-		0,0
4	1,1 cm	Magnesiumoxide board	0,29	-		10,4
5	0,1 cm	Polyurethane Adhesive Macroplast UR 7225B	3,00	-		0,3
6	15 cm	EPS 80	6,00	0,073		2,3
	15 cm	spruce (5,8%)	3,00	0,0061	0,1	4,1
7	0,1 cm	Polyurethan Adhesive Macroplast UR 7225B	3,00	0,079		0,3
8	1,1 cm	Magnesiumoxide board	0,29	-		10,4
	37,65 cm	Whole component	12,45	0,079		268,7

Condensation areas

1 Condensate: 0,079 kg/m² Affected layers: Polyurethan Adhesive Macroplast UR 7225B, EPS 80, spruce, spruce

Humidity

The temperature of the inside surface is 17,7 °C leading to a relative humidity on the surface of 58%.Mould formation is not expected under these conditions.
The following figure shows the relative humidity inside the component.



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⑪ cement render (15 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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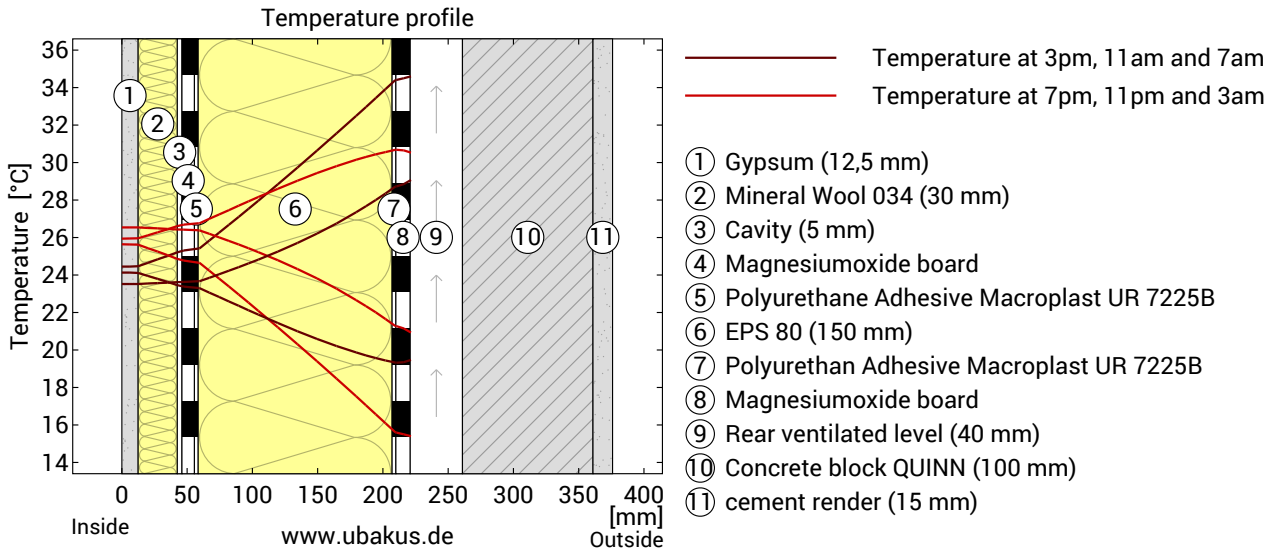
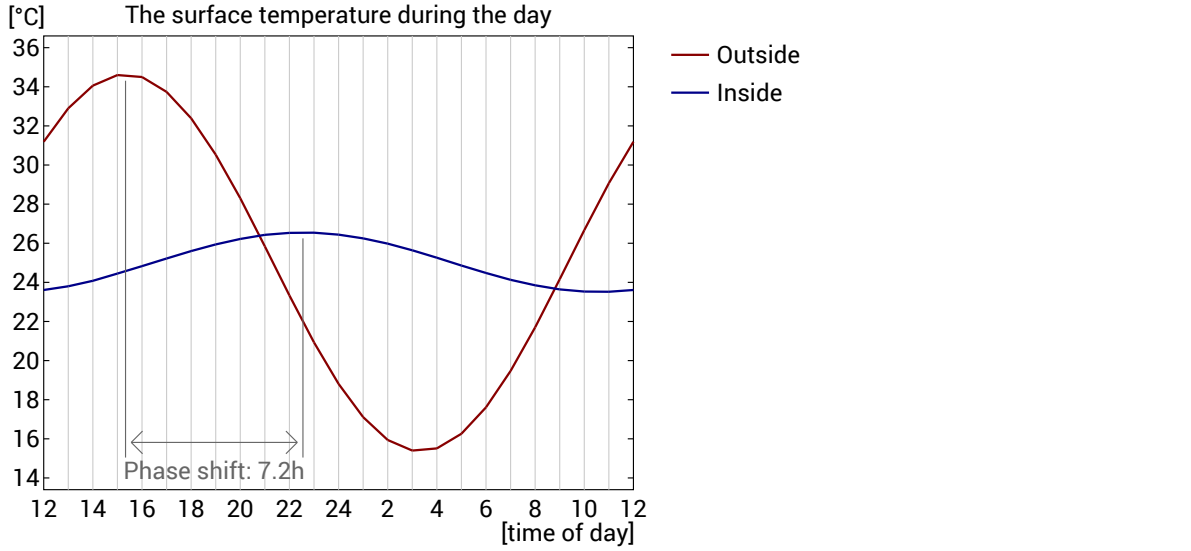
Heat protection

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*	7,2 h	Heat storage capacity (whole component):	38 kJ/m²K
Amplitude attenuation **	6,3	Thermal capacity of inner layers:	21 kJ/m²K
TAV ***	0,158		

* 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 / 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.