KLH

AW_14.01_WDVS Hanf

Exterior wall
created on 31.1.2020

Thermal protection

U = 0,17 W/(m²K)

OIB Richtlinie 6*: U<0,35 W/(m²K)

excellent insufficient

Moisture proofing

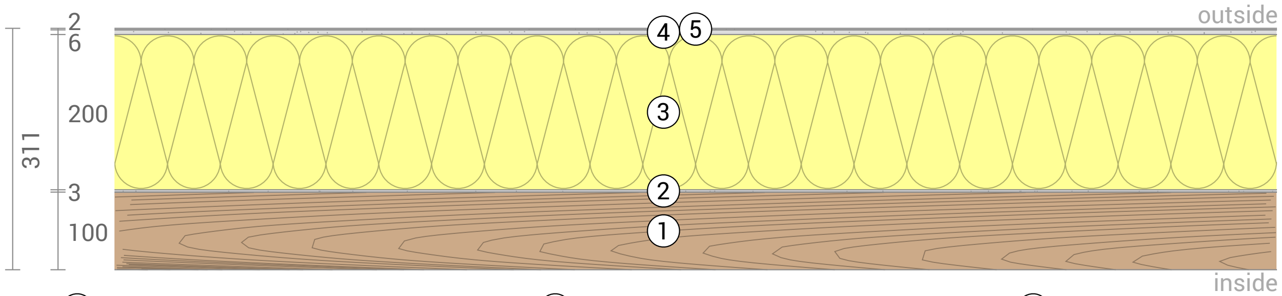
No condensate

excellent insufficient

Heat protection

Temperature amplitude damping: 45
phase shift: 12,5 h
Thermal capacity inside: 79 kJ/m²K

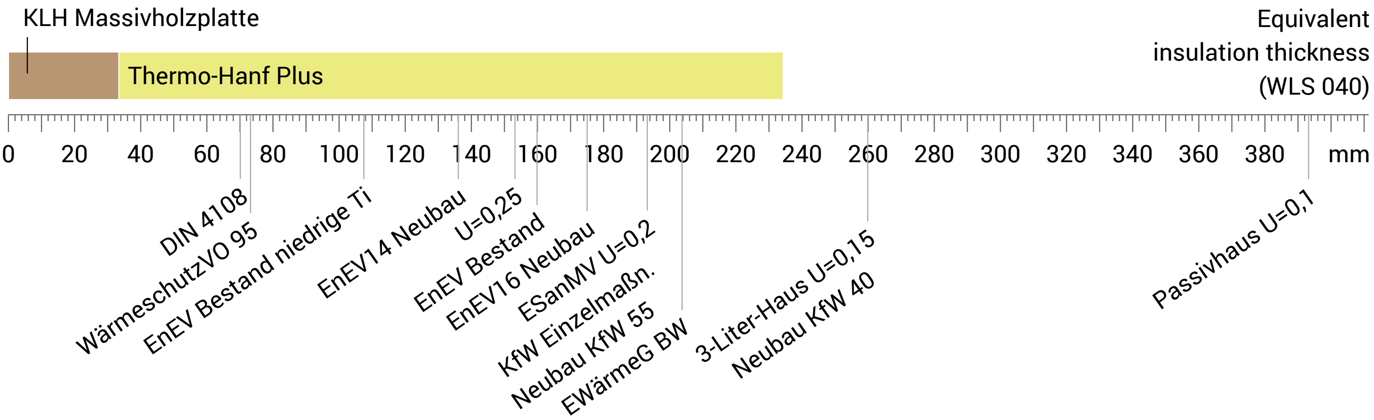
excellent insufficient



1. KLH Massivholzplatte (100 mm)
2. Adhesive / armour render (3 mm)
3. Thermo-Hanf Plus (200 mm)
4. Adhesive / armour render (6 mm)
5. HECK SIP (2 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 0,040 W/mK.



Inside air :	20,0°C / 50%			Thickness:	31,1 cm
Outside air:	-5,0°C / 80%	sd-value:	2,9 m	Weight:	71 kg/m²
Surface temperature.:	19,0°C / -4,8°C			Heat capacity:	109 kJ/m²K

☑ OIB Richtlinie 6 ☑ ESanMV ☑ EnEV16 Neubau ☑ EnEV14 Neubau

*Comparison of the U-value with Höchstwerten aus OIB Richtlinie 6, Tabelle 10.2; den Höchstwerten der Energetische Sanierungsmaßnahmen-Verordnung (ESanMV); 80% des U-Werts der Referenzausführung aus EnEV 2014 Anlage 1 Tabelle 1 (EnEV16 Neubau); der Referenzausführung aus EnEV 2014 Anlage 1 Tabelle 1 (EnEV14 Neubau)

AW_14.01_WDVS Hanf, U=0,17 W/(m²K)

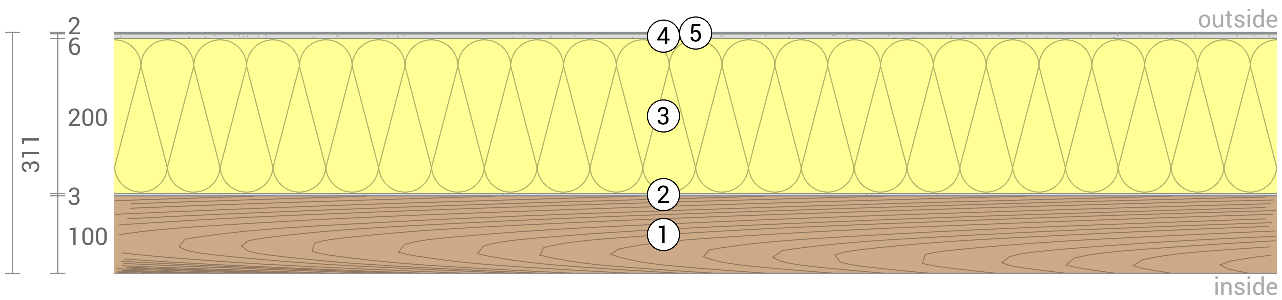
U-Value calculation according to DIN EN ISO 6946

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,130
1	KLH Massivholzplatte	10,00	0,120	0,833
2	Adhesive / armour render	0,30	1,000	0,003
3	Thermo-Hanf Plus	20,00	0,040	5,000
4	Adhesive / armour render	0,60	1,000	0,006
5	HECK SIP (Silikatputz)	0,20	0,930	0,002
	Thermal contact resistance outside (Rse)			0,040
	Whole component	31,1		6,014

Thermal contact resistances have been taken from DIN 6946 Table 7.
Rsi: heat flow direction horizontally
Rse: heat flow direction horizontally, outside: Direct contact to outside air

Thermal resistance R_{tot} = 6,014 m²K/W

Heat transfer coefficient U = 1/R_{tot} = **0,17 W/(m²K)**



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Yearly heat loss und Climate protection

Heat loss: 13 kWh/m² per heating season

Amount of heat that escapes through one square meter of this component during the heating period. Please note: Due to internal and solar gains, the heating demand is lower than the heat loss.

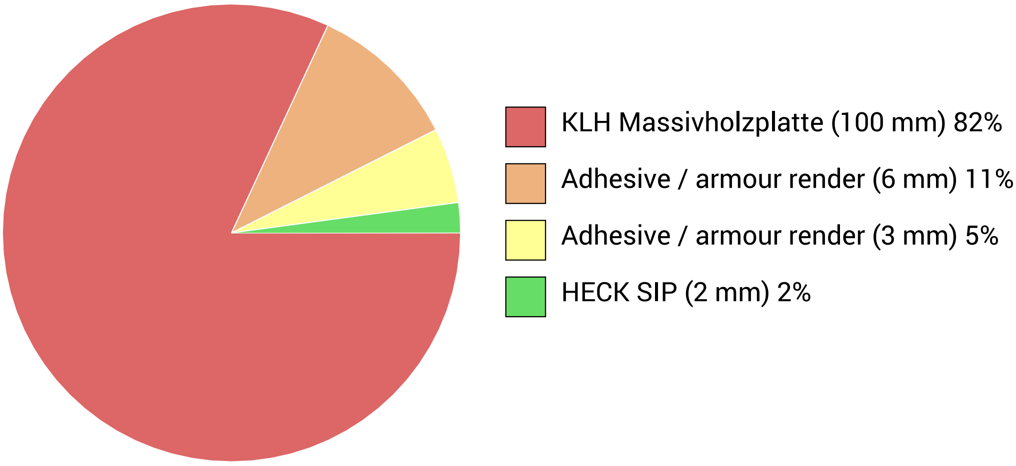
Primäry energy (non renewable): >93 kWh/m²

Non-renewable primary energy (= energy from fossil fuels and nuclear energy) that was used to produce the new building materials ("cradle to gate").

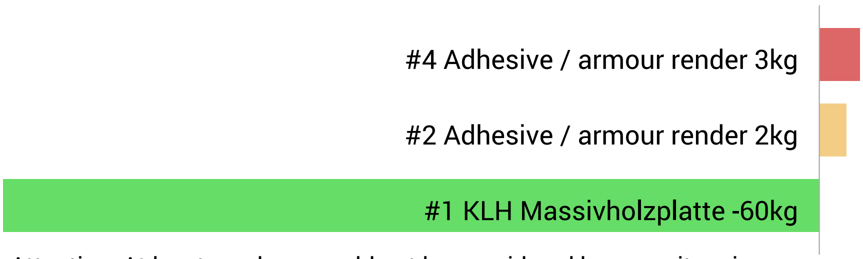
Green house gas potential: -54 (?) kg CO2 Äqv./m²

For the production of the building materials used, more greenhouse gases were withdrawn from the atmosphere than emitted.

Composition of non-renewable primary energy of production:

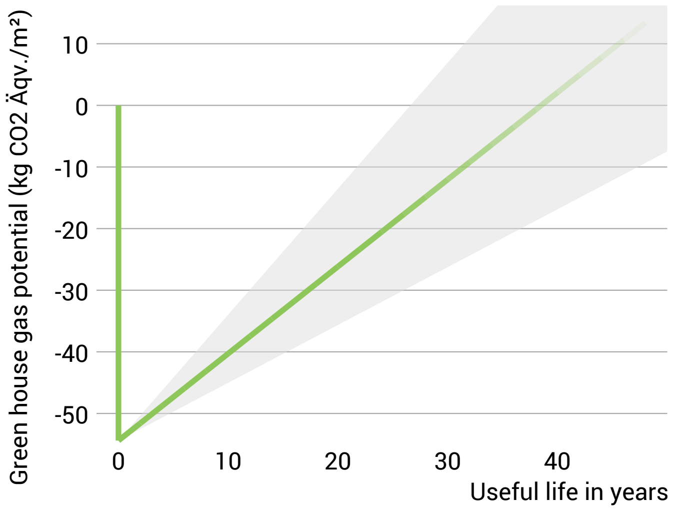


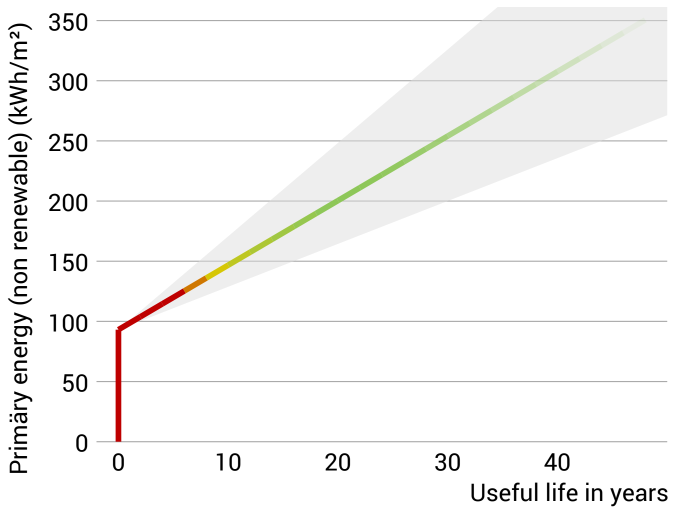
Composition of the greenhouse potential of production:



Attention: At least one layer could not be considered because its primary energy content and / or global warming potential is unknown.

Global warming potential and primary energy for construction and use





The **left figure** shows the global warming potential of the production of the component in the vertical part of the curve. Greenhouse gas emissions (through heating) arising during use of the building are indicated by the upward curve.

The **figure at the bottom left** shows the non-renewable primary energy expenditure for the production of the component in the vertical part of the curve. The primary energy required during use of the building (through heating) is represented by the upward curve.

The longer the component is used unchanged, the more environmentally friendly it is, because the production costs contribute less to the total emissions (indicated by the color of the curve).

Due to unknown solar and internal gains, the heating demand can only be estimated. Accordingly, primary energy consumption and global warming potential during the use phase are only vaguely known. For the estimation it was assumed that solar and internal profits contribute with 4 kWh/a/m² component area. The light gray area indicates the area in which the curve is located with great certainty. For heat generation, a primary energy input of 0,60 kWh per kWh of heat and a global warming potential of 0,16 kg CO2 eqv/m² per kWh of heat was used. Heat source: Heat pump (air-water).

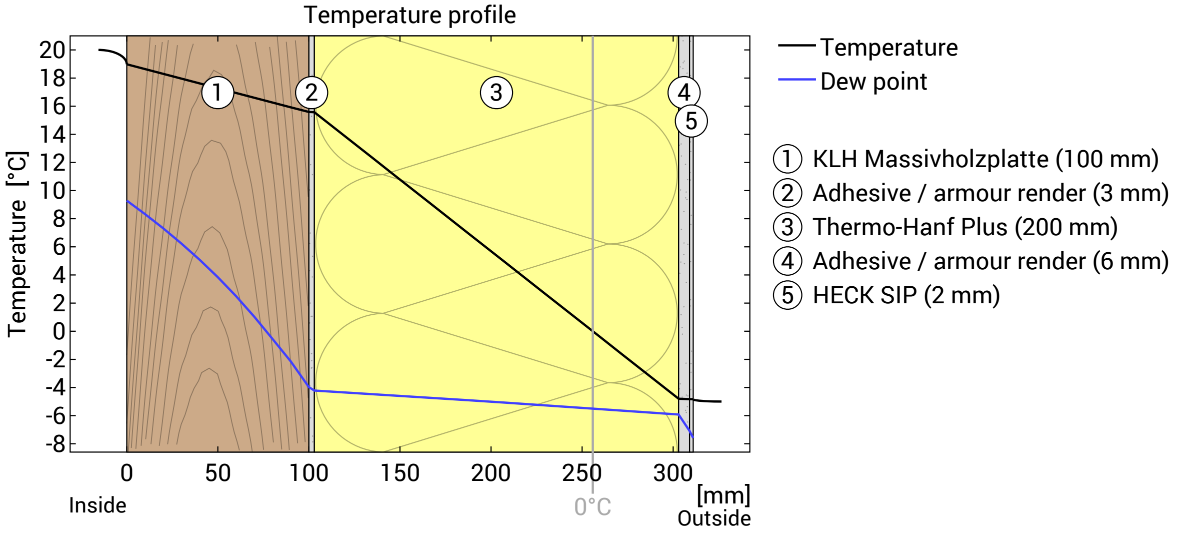
Hints

Attention: At least one layer could not be considered because its primary energy content and / or global warming potential is unknown.

Calculated for the location DIN V 18599, heating period from Mid of October to End of April. The calculation is based on monthly average temperatures. Source: DIN V 18599-10:2007-02

The climate and energy data on which this calculation is based can, in some cases, show considerable fluctuations and, in individual cases, deviate considerably from the actual value.

Temperature profile



Temperature and dew-point temperature in the component. 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 temperature, no condensation occurs. If the curves have contact, condensation occurs at the corresponding position.

Layers (from inside to outside)

#		Material	λ [W/mK]	R [m²K/W]	Temperatur [°C] min	max	Weight [kg/m²]
		Thermal contact resistance*		0,250	19,0	20,0	
1	10 cm	KLH Massivholzplatte	0,120	0,833	15,6	19,0	47,0
2	0,3 cm	Adhesive / armour render	1,000	0,003	15,6	15,6	4,5
3	20 cm	Thermo-Hanf Plus	0,040	5,000	-4,8	15,6	7,2
4	0,6 cm	Adhesive / armour render	1,000	0,006	-4,8	-4,8	9,0
5	0,2 cm	HECK SIP (Silikatputz)	0,930	0,002	-4,8	-4,8	3,5
		Thermal contact resistance*		0,040	-5,0	-4,8	
	31,1 cm	Whole component		6,014			71,2

*Thermal contact resistances according to DIN 4108-3 for moisture protection and temperature profile. The values for the U-value calculation can be found on the page 'U-value calculation'.

	min	average	max
Surface temperature inside (min / average / max):	19,0°C	19,0°C	19,0°C
Surface temperature outside (min / average / max):	-4,8°C	-4,8°C	-4,8°C

Moisture proofing

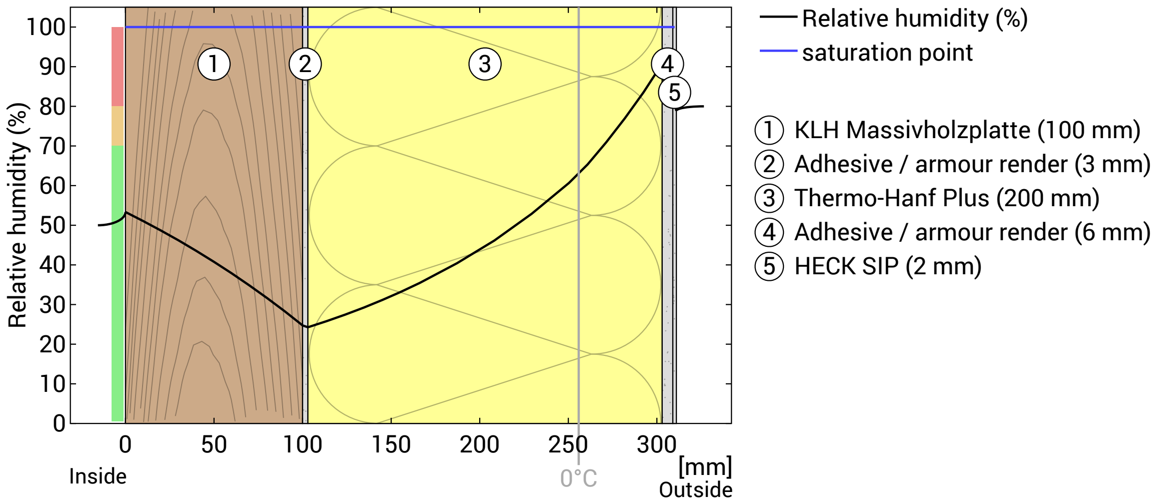
For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 20°C und 50% Humidity; outside: -5°C und 80% Humidity. This climate complies with DIN 4108-3.

This component is free of condensate under the given climate conditions.

#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	10 cm	KLH Massivholzplatte	2,50	-	-	47,0
2	0,3 cm	Adhesive / armour render	0,03	-		4,5
3	20 cm	Thermo-Hanf Plus	0,20	-		7,2
4	0,6 cm	Adhesive / armour render	0,12	-		9,0
5	0,2 cm	HECK SIP (Silikatputz)	0,05	-		3,5
	31,1 cm	Whole component	2,90			71,2

Humidity

The temperature of the inside surface is 19,0 °C leading to a relative humidity on the surface of 53%.Mould formation is not expected under these conditions.
The following figure shows the relative humidity inside the component.



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.

AW_14.01_WDVS Hanf, U=0,17 W/(m²K)

Moisture protection in accordance with DIN 4108-3:2018 Appendix A

This moisture proofing is only valid for **non-air-conditioned** residential buildings.

The calculation of the **drying reserve was deactivated by the user**. This is only permissible if this component does not contain any endangered wooden components.

Please note the hints at the end of these moisture proofing calculations.

#		Material	λ [W/mK]	R [m²K/W]	sd [m]	ρ [kg/m³]	T [°C]	ps [Pa]	Σsd [m]
		Thermal contact resistance		0,250			18,98	2193	0
1	10 cm	KLH Massivholzplatte	0,120	0,833	2,5	470	15,59	1770	2,5
2	0,3 cm	Adhesive / armour render	1,000	0,003	0,03	1500	15,57	1769	2,53
3	20 cm	Thermo-Hanf Plus	0,040	5,000	0,2	36	-4,80	408	2,73
4	0,6 cm	Adhesive / armour render	1,000	0,006	0,12	1500	-4,83	407	2,85
5	0,2 cm	HECK SIP (Silikatputz)	0,930	0,002	0,05	1750	-4,84	407	2,9
		Thermal contact resistance		0,040					

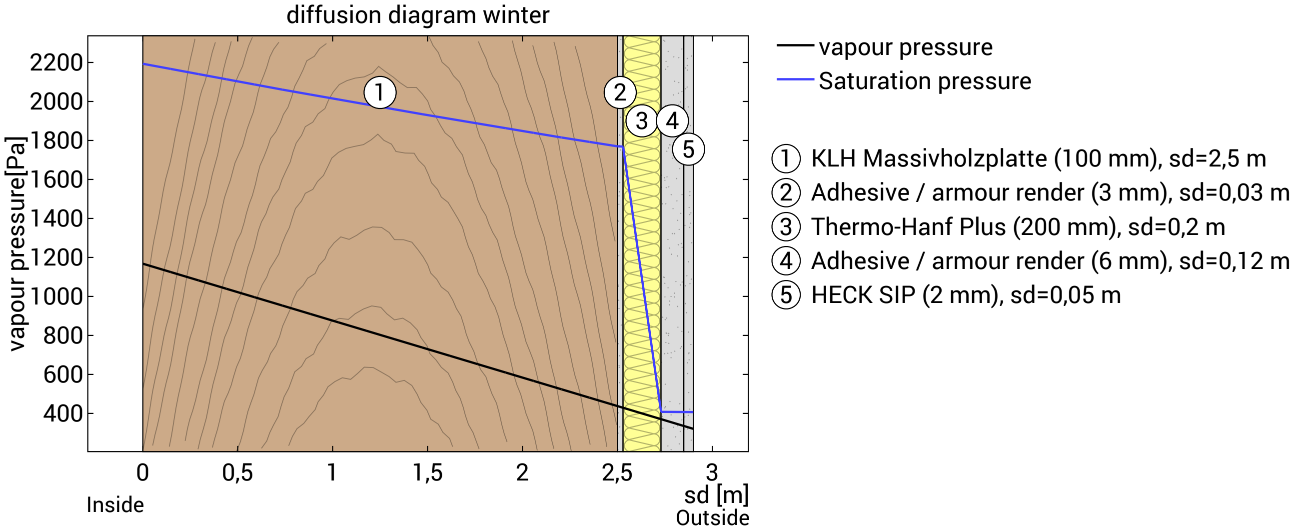
Temperature (T), vapor saturation pressure (ps), and the sum of the sd-values (Σsd) apply to the layer boundary.

Relative air humidity on the surface

The relative humidity on the interior surface is 53%. Requirements for the prevention of building material corrosion depend on material and coating and have not been investigated. ✓

Dew period (winter)

Boundary conditions	
Vapor pressure inside at 20°C and 50% humidity	pi = 1168 Pa
Vapor pressure outside at -5°C and 80% humidity	pe = 321 Pa
Duration of condensation period (90 days)	tc = 7776000 s
Water vapor diffusion coefficient in static air	δ0 = 2.0E-10 kg/(m*s*Pa)
sd-value (Whole component.)	sde = 2,90 m



The section under investigation is free of condensate under the given climate conditions. ✓

Evaporation period (summer)

Boundary conditions	
Interior vapor pressure	pi = 1200 Pa
Exterior vapor pressure	pe = 1200 Pa
Saturation vapour pressure in the condensation area	ps = 1700 Pa
Length of drying season (90 days)	tev = 7776000 s
sd-values remain unchanged.	

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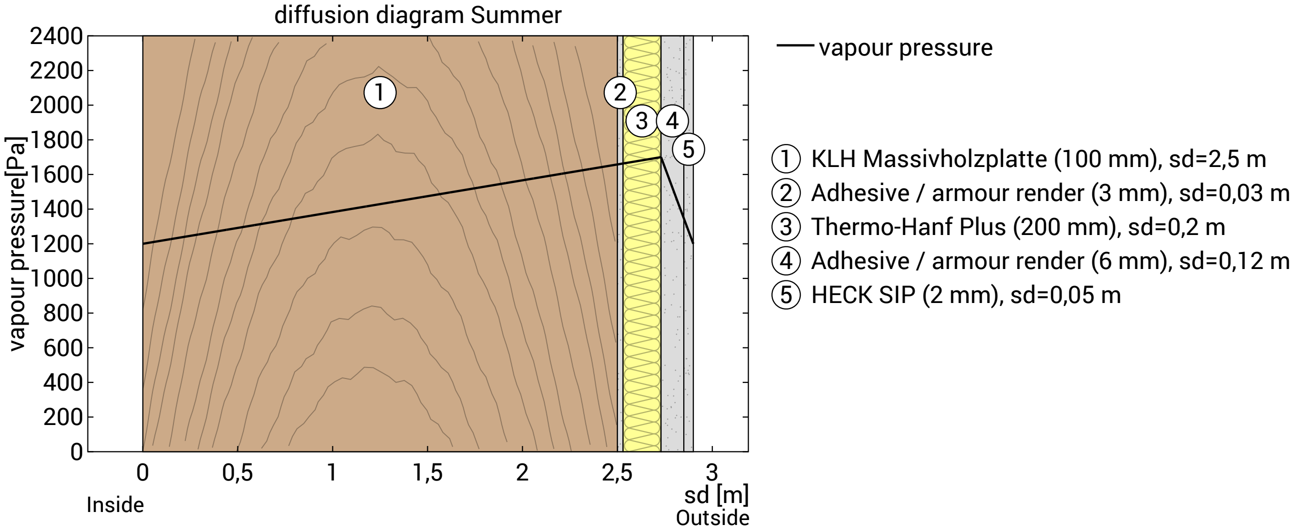
Condensate-free component: The maximum possible evaporation mass for the drying reserve is calculated. Consider the level that has the lowest evaporation potential in the dew period, at sd=2,73 m; x=30,3 cm:
Layer boundary between Thermo-Hanf Plus and Adhesive / armour render
Evaporation mass: Mev = δ0 * tev * [(ps-pi)/sd + (ps-pe)/(sde-sd)] = **4,86 kg/m²**



Evaluation according to DIN 4108-3

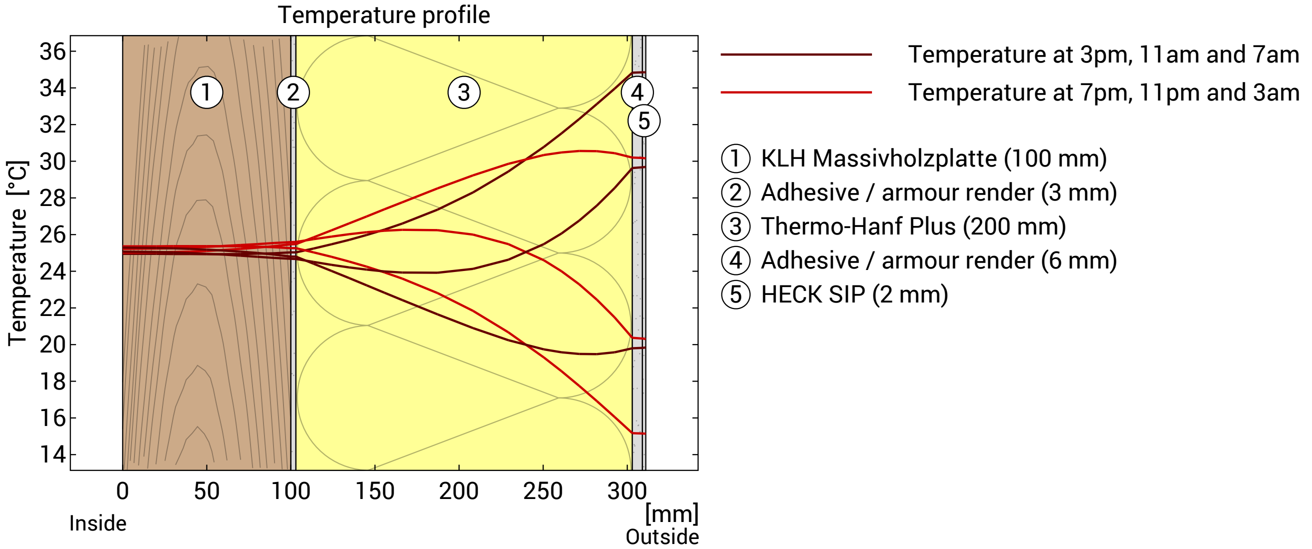
The component is permissible regarding the moisture protection.

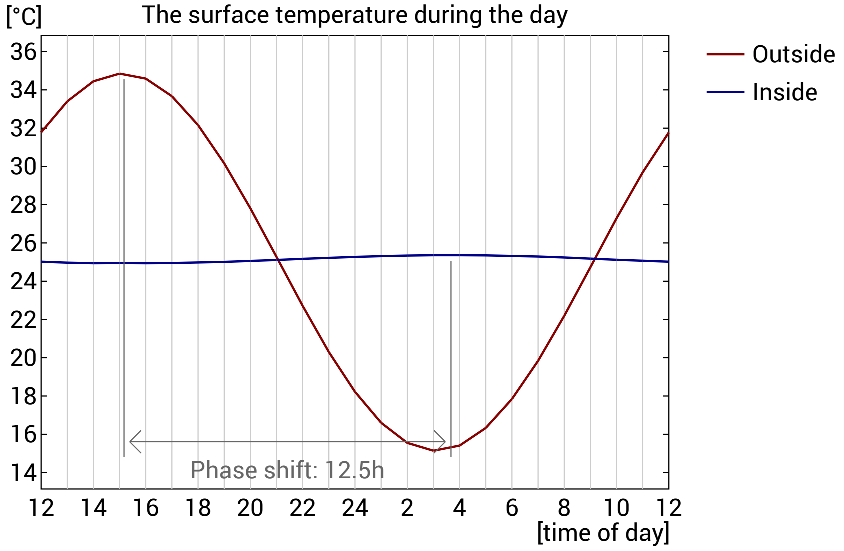
Hints

DIN 4108-3 describes in Section 5.3 components for which no moisture proofing is required as there is no risk of condensation water or the method is not suitable for the assessment. It is not possible to assess whether the component under test is underneath.

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*	12,5 h	Heat storage capacity (whole component):	109 kJ/m²K
Amplitude attenuation **	44,8	Thermal capacity of inner layers:	79 kJ/m²K
TAV ***	0,022		

* 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.

Hints

There are no hints available for your calculation.