IKO Enertherm insulation with CLT elements ALU 24081802

Exterior wall
created on 29.8.2018

Thermal protection

U = 0,11 W/(m²K)

excellent — insufficient

Moisture proofing

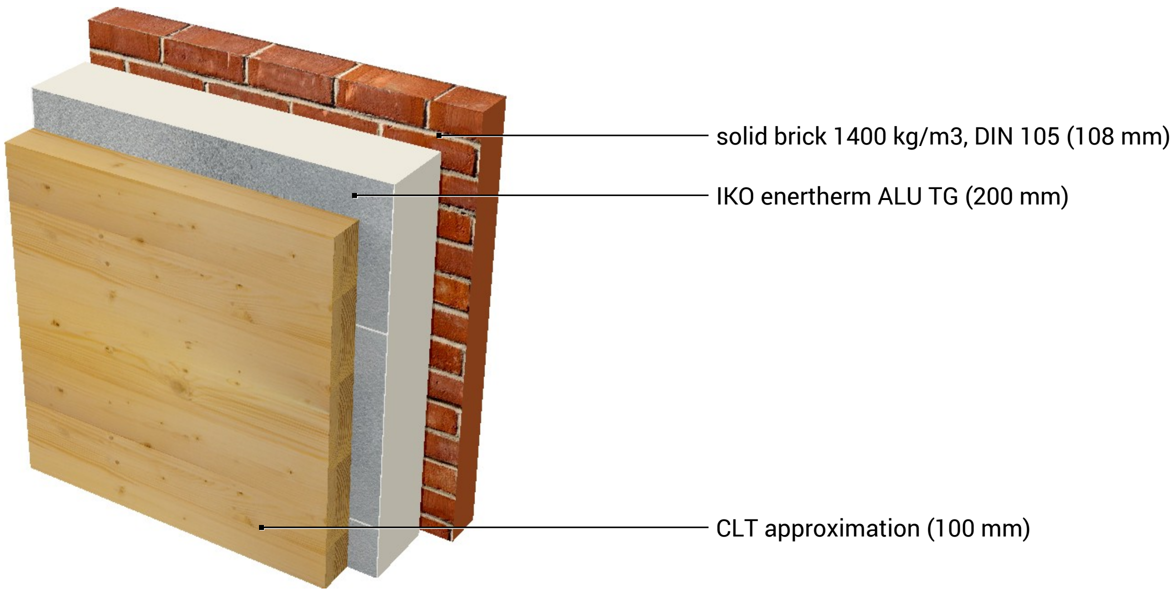
Drying reserve: 389 g/m²a
No condensate

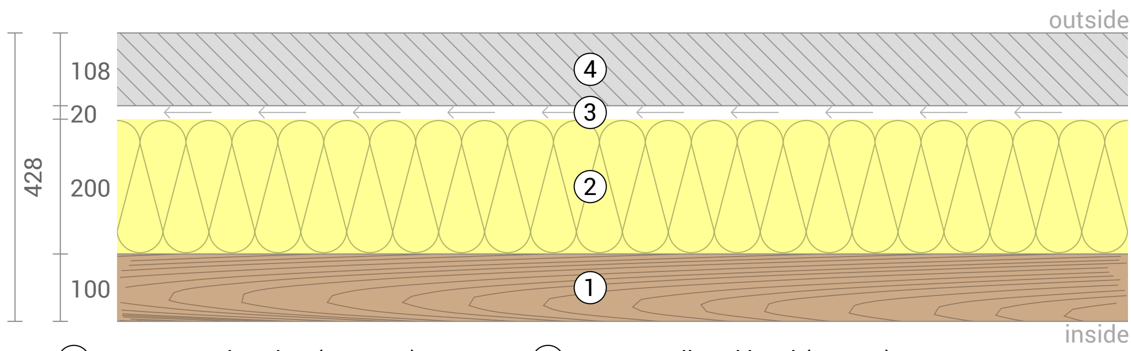
excellent — insufficient

Heat protection

Temperature amplitude damping: 78
phase shift: 12,2 h
Thermal capacity inside: 84 kJ/m²K

excellent — insufficient





1. CLT approximation (100 mm)
2. IKO enertherm ALU TG (200 mm)
3. Rear ventilated level (20 mm)
4. solid brick 1400 kg/m3, DIN 105 (108 mm)

Inside air :	20,0°C / 50%			Thickness:	42,8 cm
Outside air:	-5,0°C / 80%	sd-value:	20002,0 m	Weight:	210 kg/m²
Surface temperature.:	19,7°C / -4,9°C	Drying reserve:	389 g/m²a	Heat capacity:	92 kJ/m²K

*Comparison of the U-value with den Höchstwerten aus EnEV 2014 Anlage 3 Tabelle 1 (EnEV Bestand); den Höchstwerten aus EnEV 2014 Anlage 3 Tabelle 1 (EnEV Bestand, niedrige InnenTemp.); 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)

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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	CLT approximation	10,00	0,130	0,769
2	IKO enertherm ALU TG	20,00	0,022	9,091
	Thermal contact resistance outside (Rse)			0,040
	Whole component	42,8		10,030

Rsi: User-defined
Rse: User-defined

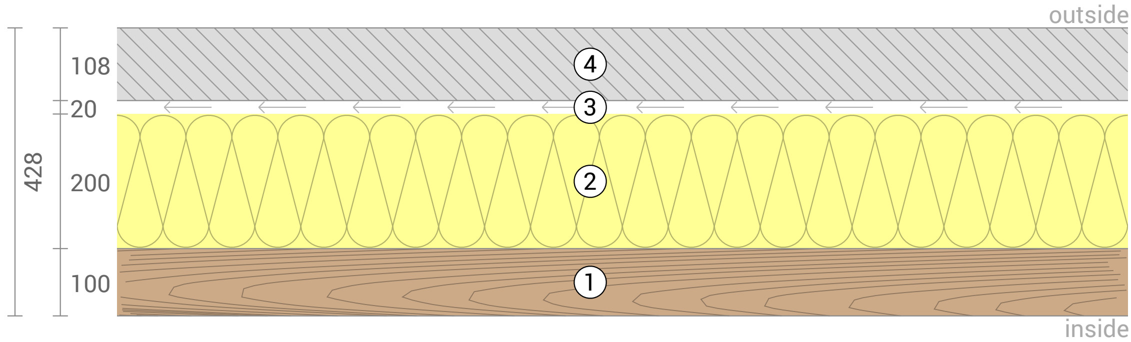
Thermal resistance R_{tot} = 10,03 m²K/W

Heat transfer coefficient U = 1/R_{tot} = 0,0997 W/(m²K)

Corrections for air gaps / mechanical fastening elements

Anchorage of layer 2 (IKO enertherm ALU TG) ΔU = 0,010 W/(m²K)

Corrected heat transfer coefficient **U_C = 0,11 W/(m²K)**



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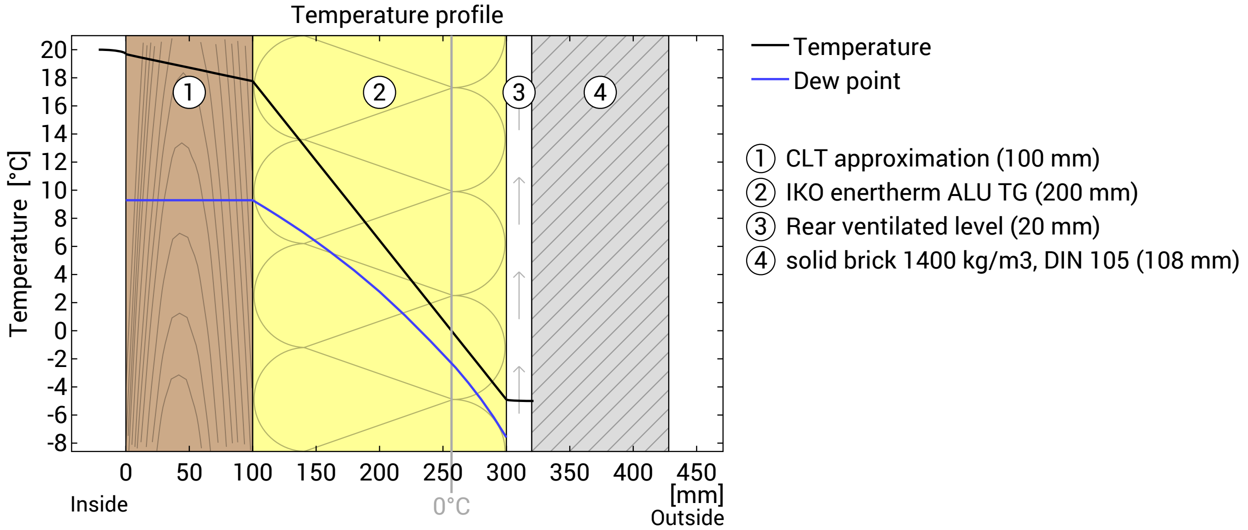
Yearly heat loss

Heat loss due to this component: 8,5 kWh per m² and heating period (approx. 0,85 liter of heating oil per m²)

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
Note: The climate and energy data underlying this calculation vary and may deviate considerably from the actual value in some cases.

IKO Enertherm insulation with CLT elements ALU 24081802, U=0,11 W/(m²K)

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*		0,130	19,7	20,0	
1	10 cm	CLT approximation	0,130	0,769	17,8	19,7	52,0
2	20 cm	IKO enertherm ALU TG	0,022	9,091	-4,9	17,8	6,4
		Thermal contact resistance*		0,040	-5,0	-4,9	
3	2 cm	Rear ventilated level (outside air)			-5,0	-5,0	0,0
4	10,8 cm	solid brick 1400 kg/m3, DIN 105			-5,0	-5,0	151,2
	42,8 cm	Whole component		10,030			209,6

*Assuming free circulating air at the inside surface.

Thermal bridges

The U-value includes the following surcharges for air gaps and / or mechanical fasteners in accordance with DIN 6946:
Anchorage of layer 2 (IKO enertherm ALU TG) 0,010 W/(m²K)

Surface temperature inside (min / average / max):	19,7°C	19,7°C	19,7°C
Surface temperature outside (min / average / max):	-4,9°C	-4,9°C	-4,9°C

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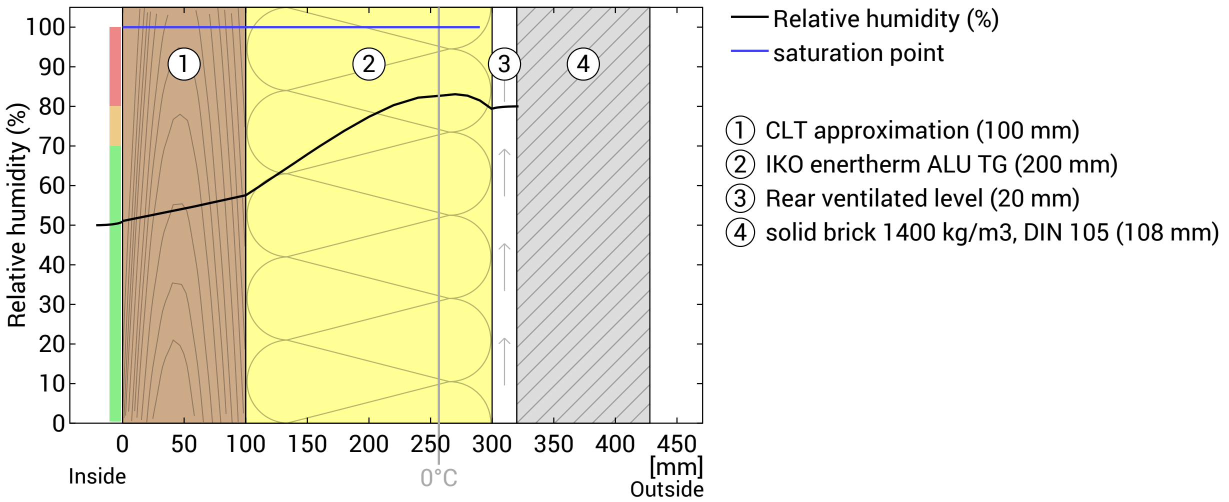
Moisture proofing

This component is free of condensate under the given climate conditions.
The drying reserve of this component is 389 g/(m²a). Required by DIN 68800-2: at least 100 g/(m²a).

#		Material	sd-value [m]	Condensate [kg/m²]	Condensate [Gew.-%]	Weight [kg/m²]
1	10 cm	CLT approximation	2,00	-	-	52,0
2	20 cm	IKO enertherm ALU TG	20000	-		6,4
	42,8 cm	Whole component	20.002,00			209,6

Humidity

The temperature of the inside surface is 19,7 °C leading to a relative humidity on the surface of 51%.Mould formation is not expected under these conditions.
The following figure show the relative humidity inside the component.



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Moisture protection in accordance with DIN 4108-3:2014-11 Appendix A

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]	∑sd [m]
		Thermal contact resistance		0,250					
							19,38	2250	0
1	10 cm	CLT approximation	0,130	0,769	2	520			
							17,49	1999	2
2	20 cm	IKO enertherm ALU TG	0,022	9,091	20000	32			
							-4,90	405	20002
		Thermal contact resistance		0,040					

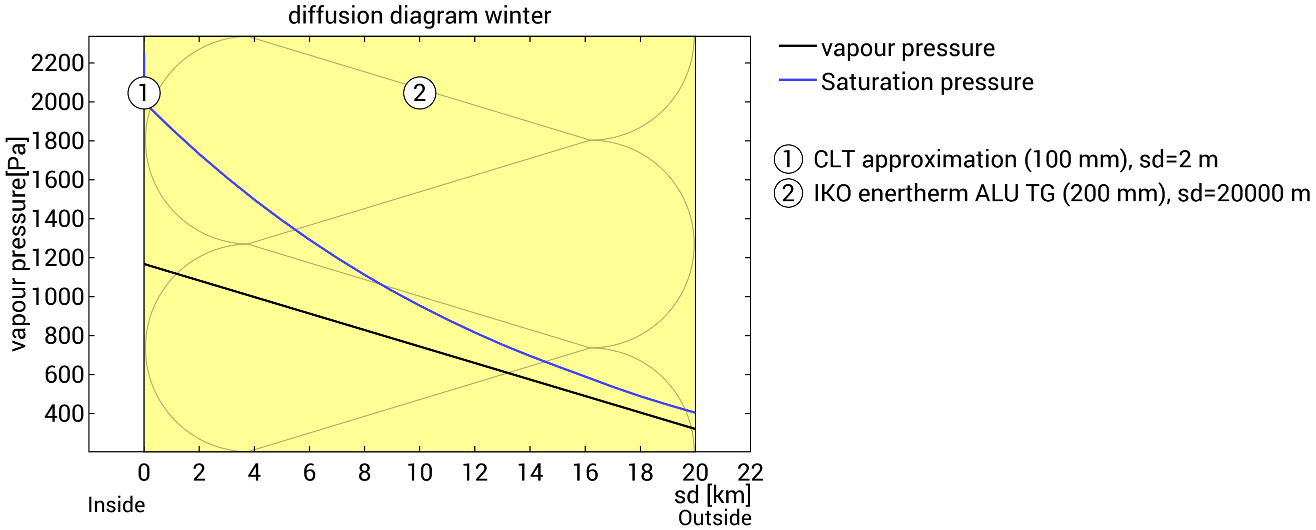
Temperature (T), vapor saturation pressure (ps), and the sum of the sd-values (Σsd) apply to the layer boundary.

Luftfeuchte an der Bauteiloberfläche

Die relative Luftfeuchtigkeit auf der raumseitigen Bauteiloberfläche beträgt 52%. Anforderungen zur Vermeidung von Baustoffkorrosion hängen von Material und Beschichtung ab und wurden nicht untersucht. ✓

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 = 20.002,00 m



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

Calculate evaporation potential for the drying reserve in the dew period for the plane with the lowest evaporation potential (at $sd_{ev=14.002,00 \text{ m and ps}=696 \text{ pa}}$):

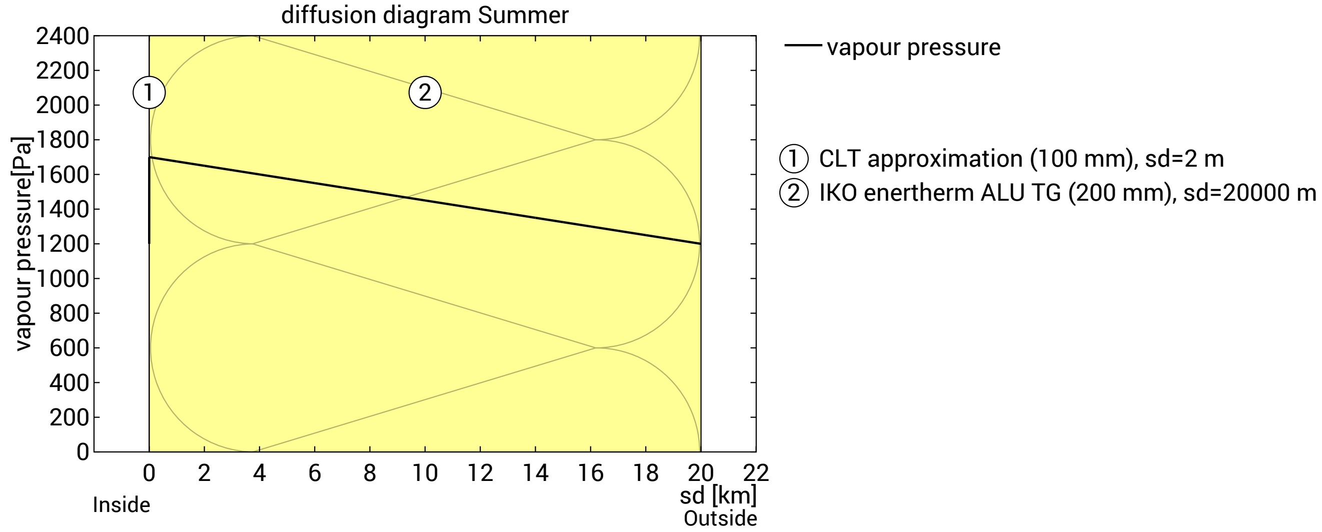
Mev,Tauperiode = tc * δ0 * ((ps-pi)/sd_{ev} + (ps-pe)/(sd_e-sd_{ev})) = **0,000 kg/m²**

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.	

Condensate-free component: The maximum possible evaporation mass for the drying reserve is calculated. Considering the plane with the lowest evaporation mass within the wood-containing area:
Within layer CLT approximation
at sd=2,00 m

Evaporation mass: Mev = δ0 * tev * [(ps-pi)/sd + (ps-pe)/(sde-sd)] = **0,39 kg/m^2**



Evaluation according to DIN 4108-3

The component is permissible regarding the moisture protection.

Drying reserve (DIN 68800-2)

Dew-water-free component: The evaporation potential of the dew period is also taken into account.
Drying reserve: Mr = (Mev + Mev,Tauperiode) * 1000 = **389 g/m^2/a**
Minimum requested for walls and ceilings: 100 g/m^2/a ✓

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.

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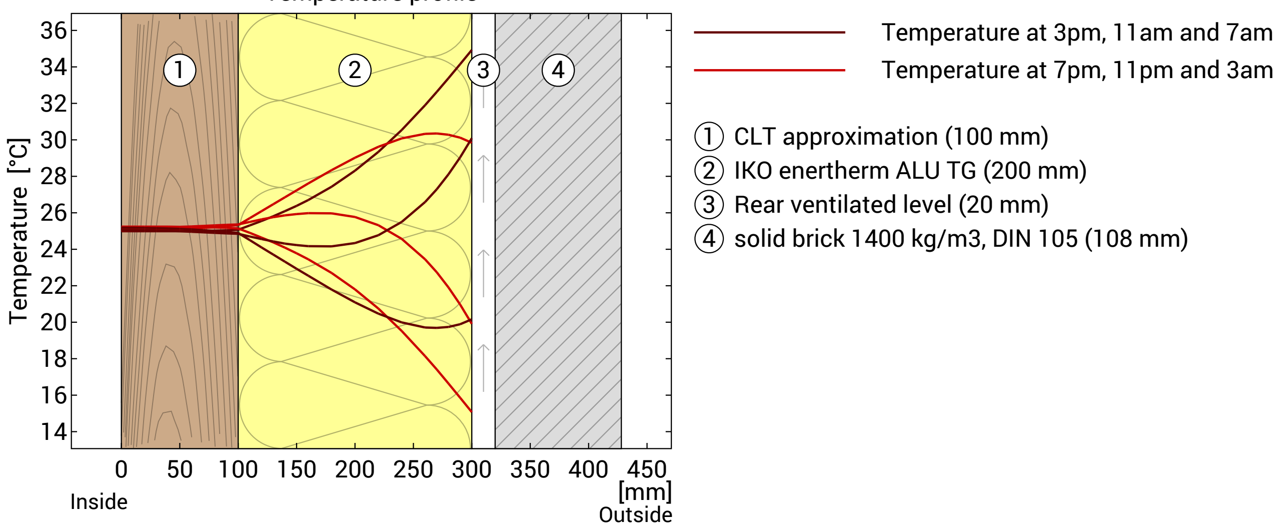
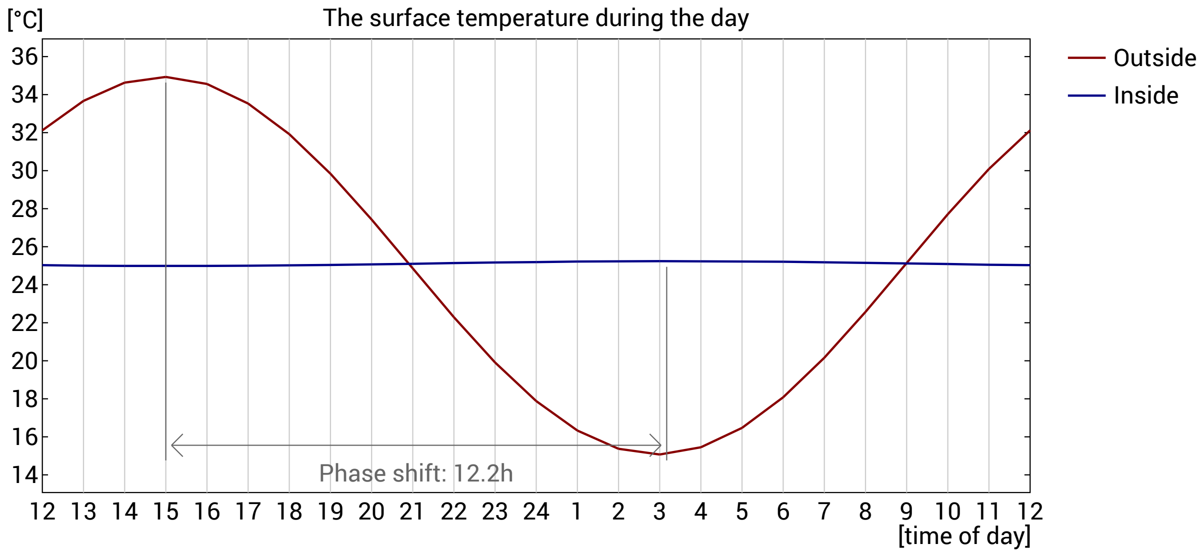
Heat protection

For the analysis of the heat protection, the temperature changes within the component were simulated during a hot summer day:

Temperature profile



The surface temperature during the day



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*	12,2 h	Time of maximum interior temperature	3:15
Amplitude attenuation **	77,5	Thermal fluctuation on exterior surface:	19,9°C
TAV ***	0,013	Temperature fluctuation on interior surface	0,3°C

* 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

Hints

Rear ventilation level

The thickness of the rear ventilation level is 2 cm. Generally, the thickness should be at least 3 cm. If the inclination of the rear ventilation plane is less than 40°, e.g. for (flat) roofs, a larger value must be selected. The same applies if the air inlet and the air outlet are particularly far apart.

The part of your component that is relevant to the calculation ends at the inside of the rear ventilation level. Outlying layers do not need to be entered.

Beams and joists which penetrate the rear ventilation level are only considered up to the inside of the rear ventilation level.

Please note: The U-value calculator basically assumes that a rear ventilation level is adequately permeated by outside air. Whether this is actually the case depends not only on the thickness of the rear ventilation level, but also on their width and length and possible obstacles in the air inlet and outlet and can not be assessed by the U-value calculator.

Interior insulation

Your component seems to be an interior insulation. Interior insulation generally requires more attention during planning, because condensation on the cold inside of the masonry can hardly be avoided. A vapor barrier seems to solve this problem, but in practice it often does not have the hoped-for effect.

Further information (in german):

- What you should know about interior insulation