SS-1 Tallinn

Exterior wall

Thermal protection

U = 0,39 W/(m²K)

GEG 2020 Bestand*: U<0,24 W/(m²K)

excellent insufficient

Moisture proofing

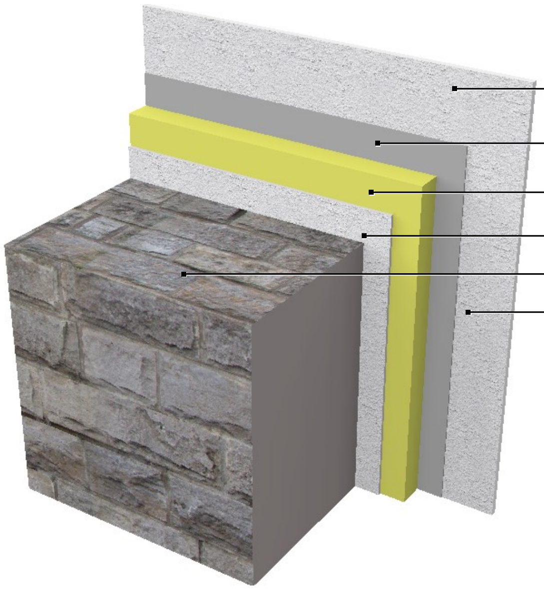
No condensate

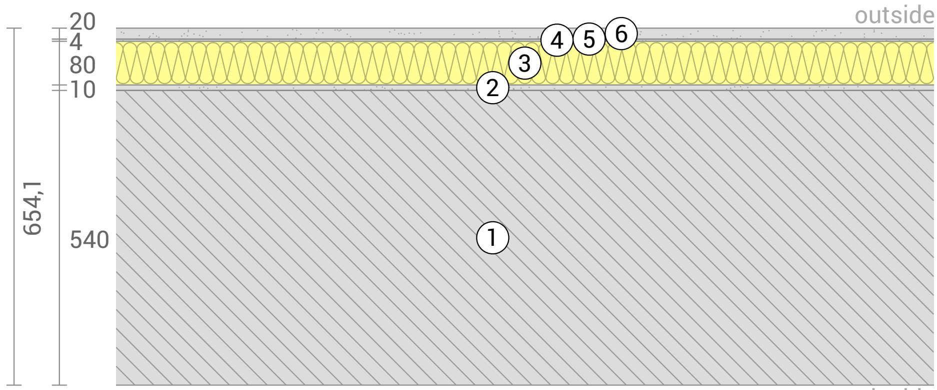
excellent insufficient

Heat protection

Temperature amplitude damping: >100
phase shift: non relevant
Thermal capacity inside: 925 kJ/m²K

excellent insufficient





1. Paekivimüür (540 mm)
2. Lubitsementkrohv (10 mm)
3. Polüstüreen EPS 100 (80 mm)
4. Armeeringkiht (4 mm)
5. Krunt (0,1 mm)
6. Lubitsementkrohv (20 mm)

Inside air :	20,0°C / 50%		Thickness:	65,4 cm
Outside air:	-5,0°C / 80%	sd-value: 24,2 m	Weight:	1138 kg/m²
Surface temperature.:	17,7°C / -4,6°C		Heat capacity:	1138 kJ/m²K

☐ GEG 2020 Bestand ☐ EnEV Bestand ☐ BEG Einzelmaßn. ☐ GEG 2020 Neubau

*Comparison of the U-value with den Höchstwerten aus GEG 2020 Anlage 7 (GEG 2020 Bestand); den Höchstwerten aus EnEV 2014 Anlage 3 Tabelle 1 (EnEV Bestand); den techn. Mindestanforderungen für BEG Einzelmaßnahmen; 80% des U-Werts der Referenzausführung aus GEG 2020 Anlage 1 (GEG20 Neubau)

SS-1 Tallinn, U=0,39 W/(m²K)

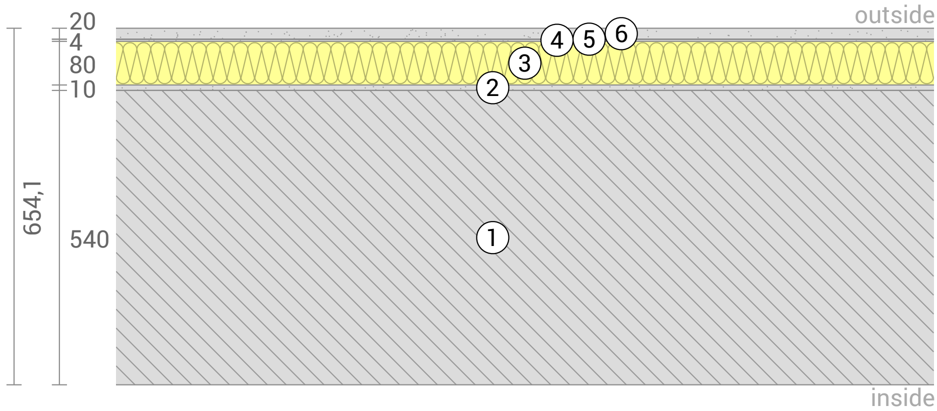
U-Value calculation according to DIN EN ISO 6946

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,130
1	Paekivimüür	54,00	1,400	0,386
2	Lubitsementkrohv	1,00	1,000	0,010
3	Polüstüreen EPS 100	8,00	0,040	2,000
4	Armeeringkiht	0,40	0,700	0,006
5	Krunt	0,01	1,000	0,000
6	Lubitsementkrohv	2,00	1,000	0,020
	Thermal contact resistance outside (Rse)			0,040

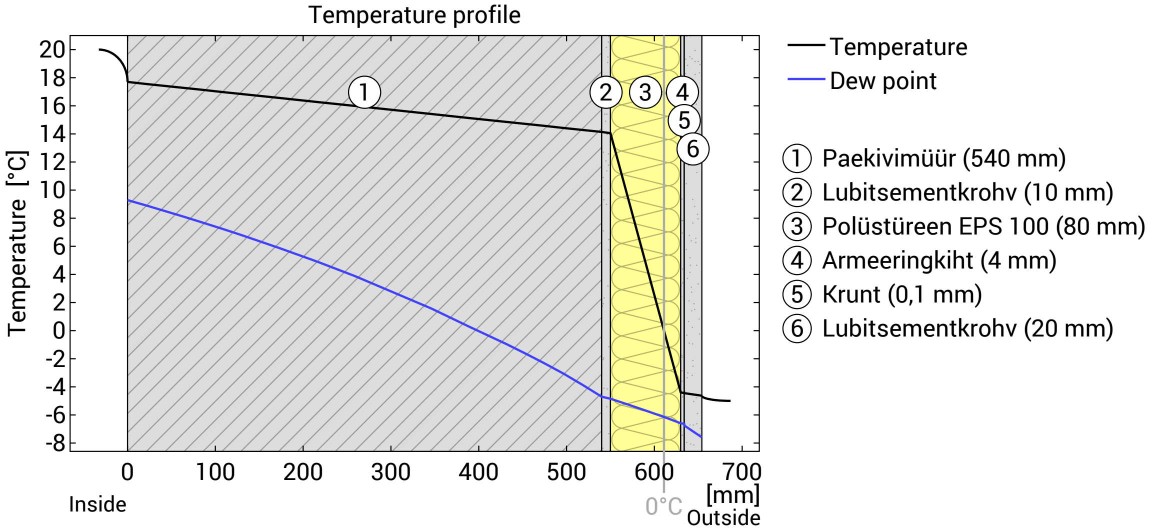
Thermal contact resistances have been taken from DIN 6946 Table 7.
Rsi: heat flow direction horizontally
Rse: heat flow direction horizontally, outside: Direct contact to outside air

Thermal resistance R_{tot} = 2,592 m²K/W

Heat transfer coefficient U = 1/R_{tot} = **0,39 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*		0,250	17,7	20,0	
1	54 cm	Paekivimüür	1,400	0,386	14,1	17,7	1.080,0
2	1 cm	Lubitsementkrohv	1,000	0,010	14,0	14,1	18,0
3	8 cm	Polüstüreen EPS 100	0,040	2,000	-4,4	14,0	1,1
4	0,4 cm	Armeeringkiht	0,700	0,006	-4,4	-4,4	3,2
5	0,01 cm	Krunt	1,000	0,000	-4,4	-4,4	0,1
6	2 cm	Lubitsementkrohv	1,000	0,020	-4,6	-4,4	36,0
		Thermal contact resistance*		0,040	-5,0	-4,6	
	65,41 cm	Whole component		2,592			1.138,5

*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'.

Surface temperature inside (min / average / max):	17,7°C	17,7°C	17,7°C
Surface temperature outside (min / average / max):	-4,6°C	-4,6°C	-4,6°C

Moisture proofing

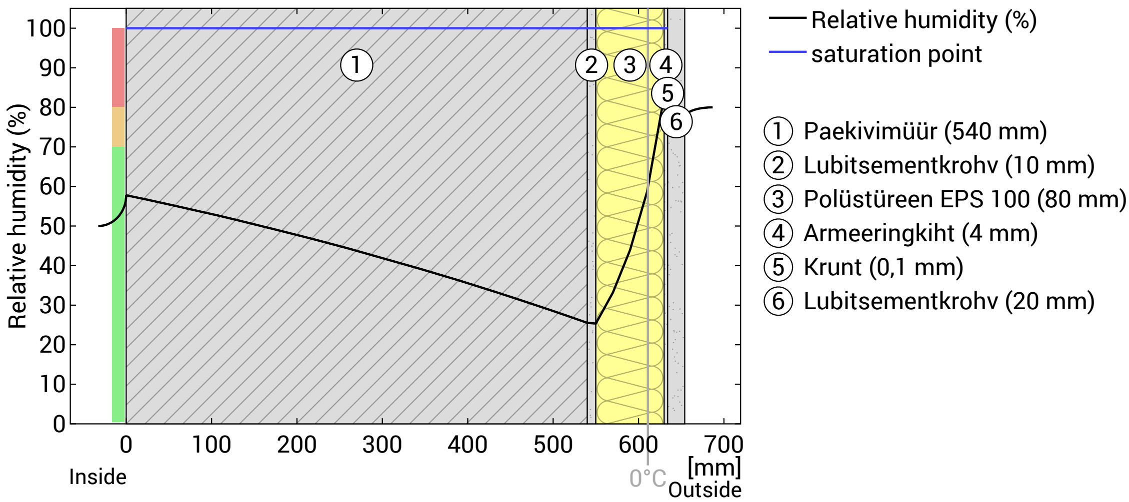
For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 20°C und 50% Humidity; outside: -5°C und 80% Humidity. This climate complies with DIN 4108-3.

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

#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	54 cm	Paekivimüür	21,60	-		1.080,0
2	1 cm	Lubitsementkrohv	0,15	-		18,0
3	8 cm	Polüstüreen EPS 100	1,60	-		1,1
4	0,4 cm	Armeeringkiht	0,04	-		3,2
5	0,01 cm	Krunt	0,10	-		0,1
6	2 cm	Lubitsementkrohv	0,70	-		36,0
	65,41 cm	Whole component	24,19			1.138,5

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.



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.

SS-1 Tallinn, U=0,39 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.

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					
1	54 cm	Paekivimüür	1,400	0,386	21,6	2000	17,70	2025	0
2	1 cm	Lubitsementkrohv	1,000	0,010	0,15	1800	14,14	1613	21,6
3	8 cm	Polüstüreen EPS 100	0,040	2,000	1,6	14	14,05	1603	21,8
4	0,4 cm	Armeeringkiht	0,700	0,006	0,04	800	-4,39	423	23,4
5	0,01 cm	Krunt	1,000	0,000	0,1	1400	-4,45	421	23,4
6	2 cm	Lubitsementkrohv	1,000	0,020	0,7	1800	-4,45	421	23,5
		Thermal contact resistance		0,040			-4,63	414	24,2

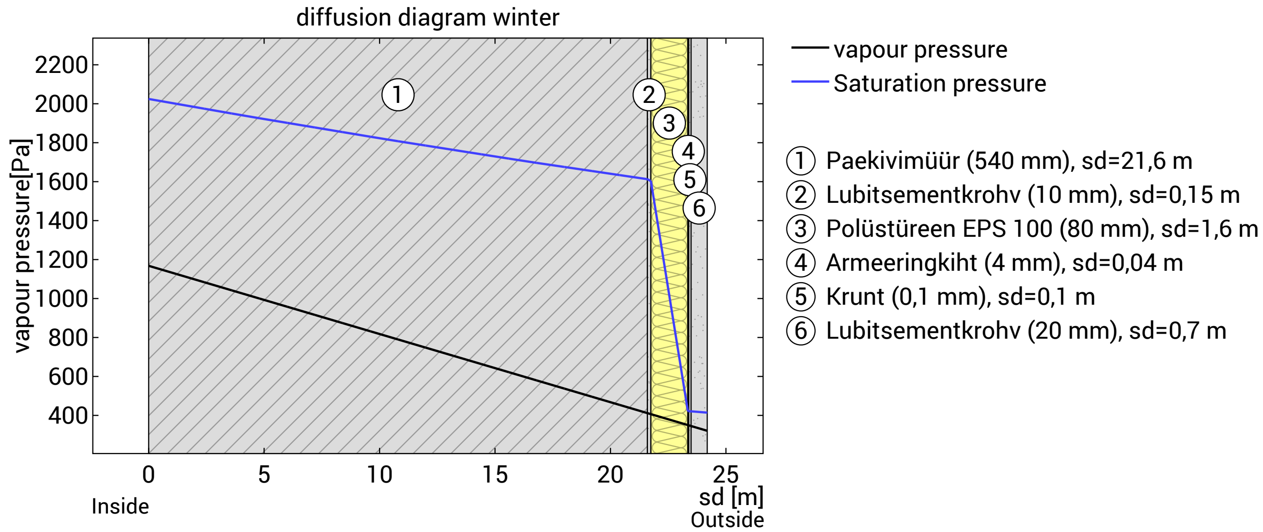
Temperature (T), vapor saturation pressure (ps), and the sum of the sd-values (Σsd) apply to the layer boundary.

Relative air humidity on the surface

The relative humidity on the interior surface is 58%. 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 = 24,19 m

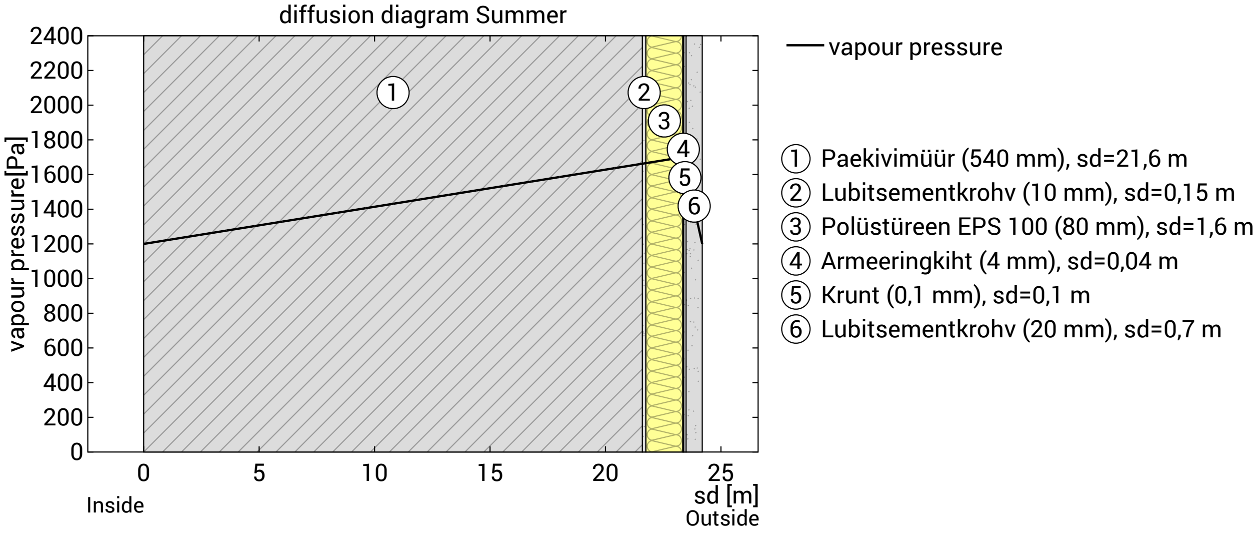


The section under investigation is free of condensate under the given climate conditions. ✓

SS-1 Tallinn, U=0,39 W/(m²K)

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. Consider the level that has the lowest evaporation potential in the dew period, at sd=23,35 m; x=63 cm:
Layer boundary between Polüstüreen EPS 100 and Armeeringkiht
Evaporation mass: Mev = δ0 * tev * [(ps-pi)/sd + (ps-pe)/(sde-sd)] = **0,96 kg/m²**

Evaluation according to DIN 4108-3

The component is permissible regarding the moisture protection.

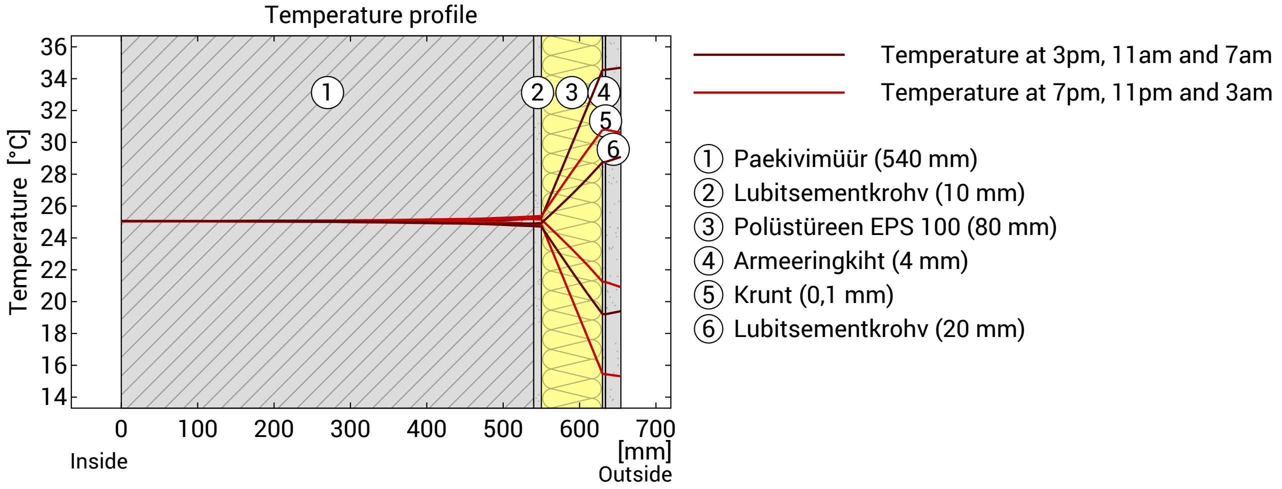
Hints

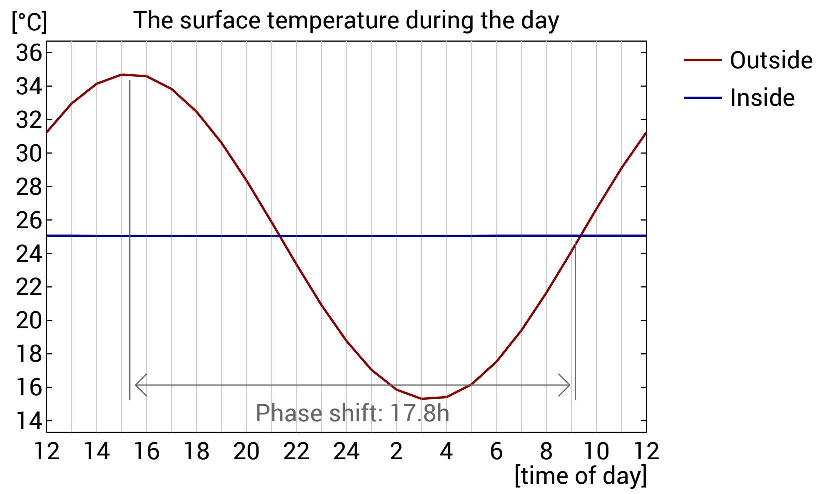
DIN 4108-3 describes in Section 5.3 components for which no moisture proofing is required as there is no risk of condensation water or the method is not suitable for the assessment. It is not possible to assess whether the component under test is underneath.

SS-1 Tallinn, U=0,39 W/(m²K)

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*	non relevant	Heat storage capacity (whole component):	1138 kJ/m²K
Amplitude attenuation **	>100	Thermal capacity of inner layers:	925 kJ/m²K
TAV ***	0,001		

* 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.

VS-01 Palksein Tallinn

Exterior wall

Thermal protection

U = 0,33 W/(m²K)

EnEV Bestand*: U<0,24 W/(m²K)

excellent insufficient

Moisture proofing

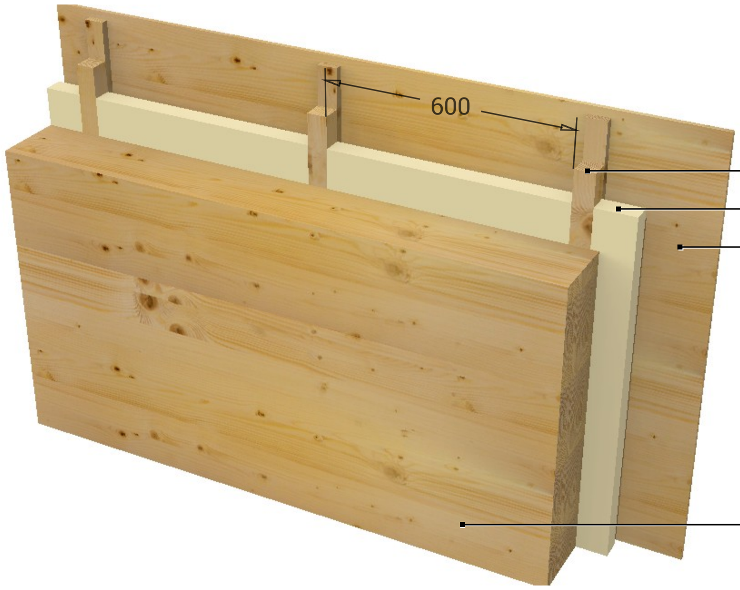
No condensate

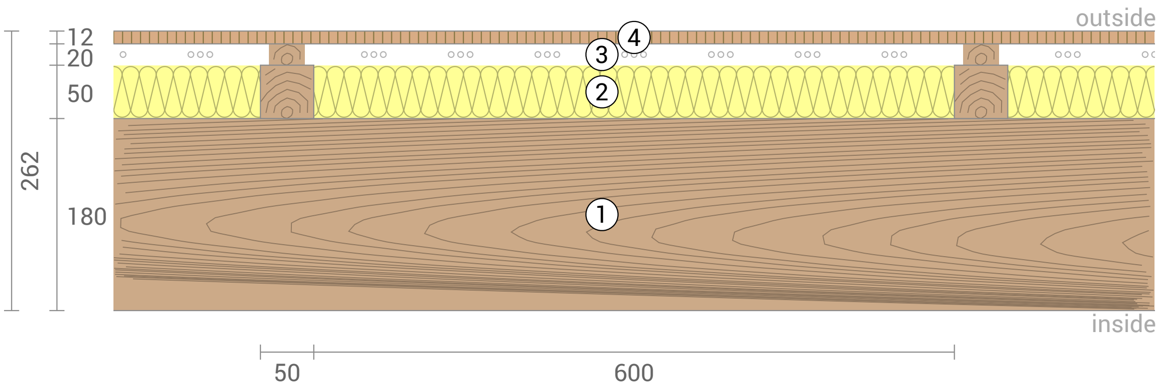
excellent insufficient

Heat protection

Temperature amplitude damping: 41
phase shift: 12,7 h
Thermal capacity inside: 107 kJ/m²K

excellent insufficient





1. Püstplanksein (180 mm)
2. Mineraalvill Isover RJK-31 (50 mm)
3. Õhukiht (20 mm)
4. Krohvikandeplaat (12 mm)

Inside air :	20,0°C / 50%		Thickness:	26,2 cm
Outside air:	-10,0°C / 80%	sd-value: 3,7 m	Weight:	112 kg/m²
Surface temperature.:	17,4°C / -9,6°C		Heat capacity:	154 kJ/m²K

☐ GEG 2020 Bestand ☐ EnEV Bestand ☐ BEG Einzelmaßn. ☐ GEG 2020 Neubau

*Comparison of the U-value with den Höchstwerten aus GEG 2020 Anlage 7 (GEG 2020 Bestand); den Höchstwerten aus EnEV 2014 Anlage 3 Tabelle 1 (EnEV Bestand); den techn. Mindestanforderungen für BEG Einzelmaßnahmen; 80% des U-Werts der Referenzausführung aus GEG 2020 Anlage 1 (GEG20 Neubau)

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	Püstplanksein	18,00	0,130	1,385
2	Mineraalvill Isover RJK-31	5,00	0,031	1,613
	Saematerjal (7,7%)	5,00	0,130	0,385
	Thermal contact resistance outside (Rse)			0,130

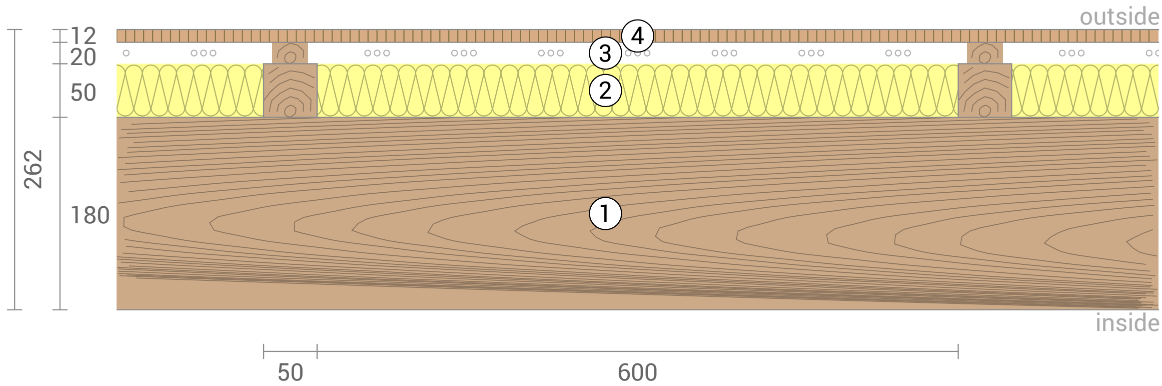
Thermal contact resistances have been taken from DIN 6946 Table 7.
Rsi: heat flow direction horizontally
Rse: heat flow direction horizontally, outside: Ventilation level

Upper limit of thermal resistance $R_{tot;upper}$ = 3,113 m²K/W.
Lower limit of thermal resistance $R_{tot;lower}$ = 2,939 m²K/W.
Check applicability: $R_{tot;upper}$ / $R_{tot;lower}$ = 1,059 (maximum allowed: 1,5)

The procedure may be used.

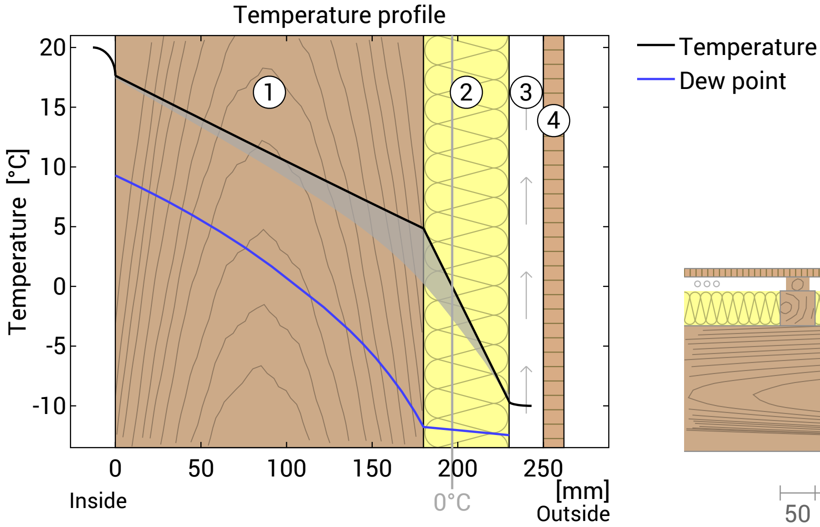
Thermal resistance $R_{tot} = (R_{tot;upper} + R_{tot;lower})/2$ = 3,026 m²K/W
Estimated maximum relative uncertainty according to section 6.7.2.5: 2,9%

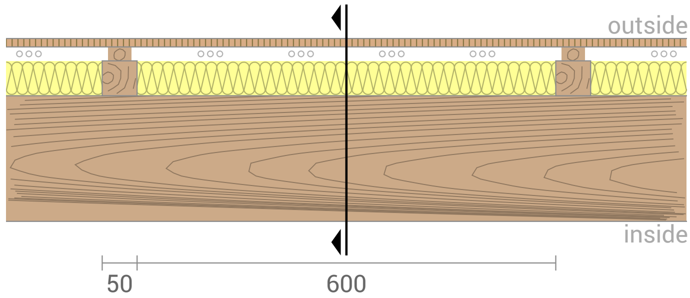
Heat transfer coefficient U = 1/R_{tot} = **0,33 W/(m²K)**



VS-01 Palksein Tallinn, U=0,33 W/(m²K)

Temperature profile





① Püstplanksein (180 mm)
② Mineraalvill Isover RJK-31 (50 mm)
③ Õhukiht (20 mm)
④ Krohvikandeplaat (12 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*		0,250	17,4	20,0	
1	18 cm	Püstplanksein	0,130	1,385	0,2	17,6	93,6
2	5 cm	Mineraalvill Isover RJK-31	0,031	1,613	-9,7	4,8	0,6
	5 cm	Saematerjal (7,7%)	0,130	0,385	-9,1	0,9	2,0
		Thermal contact resistance*		0,040	-10,0	-9,1	
3	2 cm	Õhukiht			-10,0	-10,0	0,0
4	1,2 cm	Krohvikandeplaat			-10,0	-10,0	16,2
	26,2 cm	Whole component		3,030			112,4

*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'.

Surface temperature inside (min / average / max):	17,4°C	17,5°C	17,6°C
Surface temperature outside (min / average / max):	-9,7°C	-9,6°C	-9,1°C

Moisture proofing

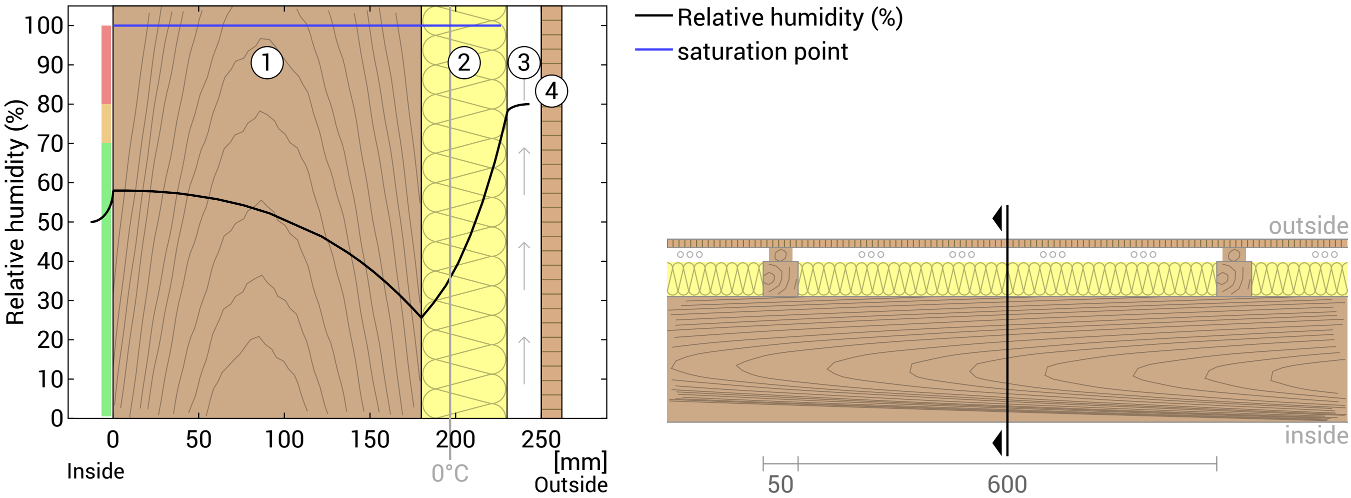
For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 20°C und 50% Humidity; outside: -10°C und 80% Humidity (Climate according to user input).

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

#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	18 cm	Püstplanksein	3,60	-	-	93,6
2	5 cm	Mineraalvill Isover RJK-31	0,05	-		0,6
	5 cm	Saematerjal (7,7%)	2,50	-	-	2,0
	26,2 cm	Whole component	3,72			112,4

Humidity

The temperature of the inside surface is 17,4 °C leading to a relative humidity on the surface of 59%.Mould formation is not expected under these conditions.
The following figure shows the relative humidity inside the component.



① Püstplanksein (180 mm)
② Mineraalvill Isover RJK-31 (50 mm)
③ Õhukiht (20 mm)
④ Krohvikandeplaat (12 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.

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

The temperatures and / or humidities you specified are not in accordance with DIN 4108-3. This analysis was carried out with the values specified by DIN 4108-3: 20°C / 50% humidity inside and -5°C / 80% humidity outside.

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

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			18,10	2076	0
1	18 cm	Püstplanksein	0,130	1,385	3,6	520	7,57	1041	3,6
2	5 cm	Mineraalvill Isover RJK-31	0,031	1,613	0,05	12	-4,70	412	3,65
		Thermal contact resistance		0,040					

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

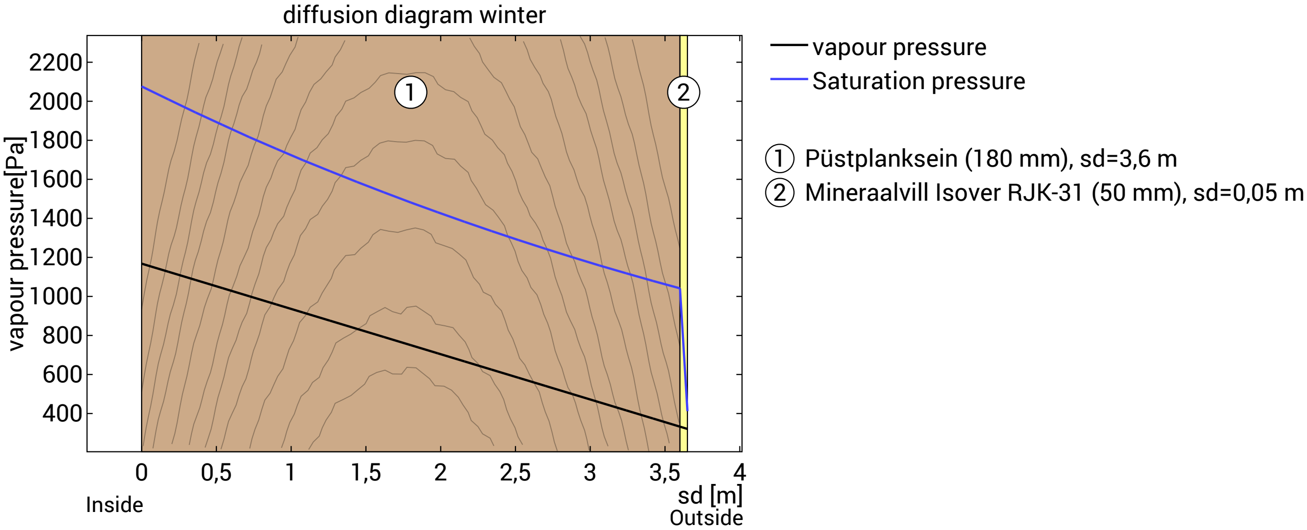
Relative air humidity on the surface

The relative humidity on the interior surface is 56%. 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 = 3,65 m



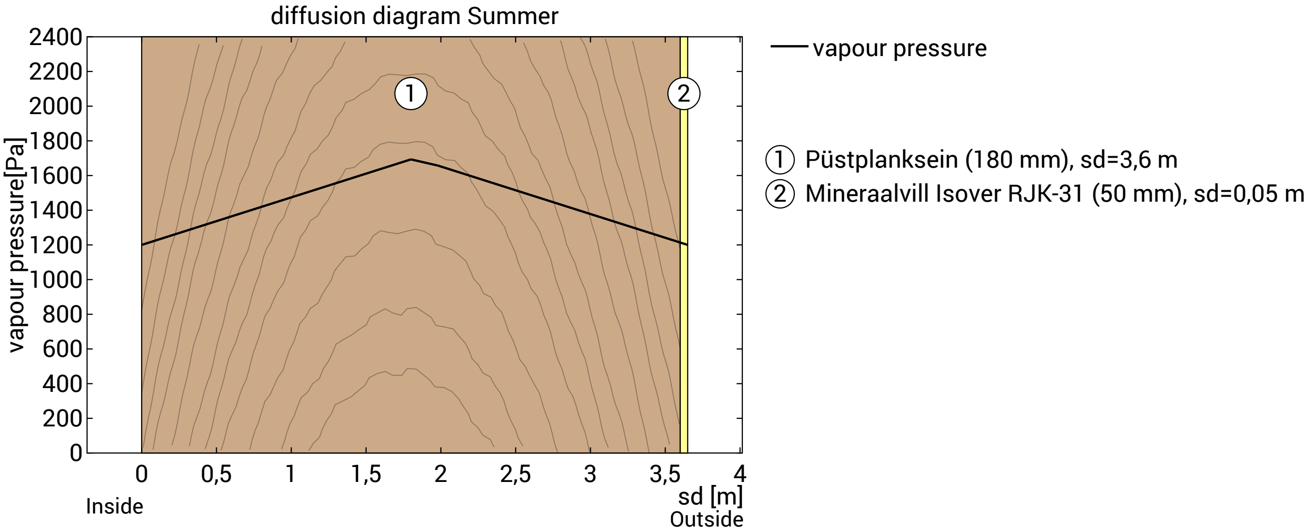
The section under investigation is free of condensate under the given climate conditions.

✓

VS-01 Palksein , Tallinn, U=0,33 W/(m²K)

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:
at sd=1,83 m, within layer Püstplanksein:
Evaporation mass: Mev = δ0 * tev * [(ps-pi)/sd + (ps-pe)/(sde-sd)] = **0,85 kg/m²**

Evaluation according to DIN 4108-3

The component is permissible regarding the moisture protection.

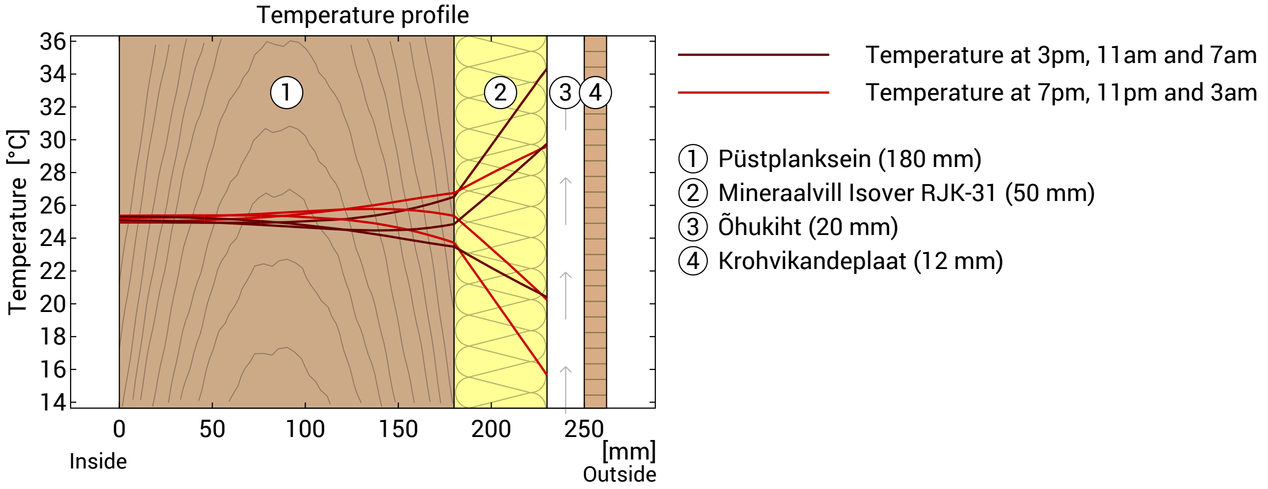
Hints

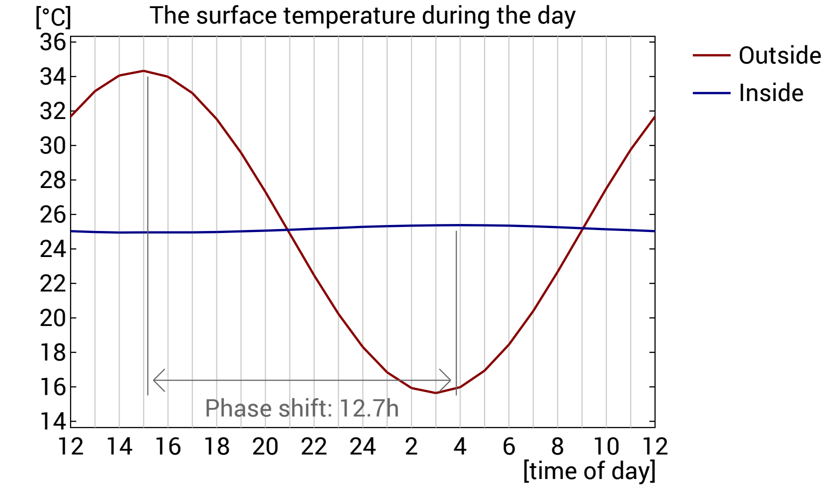
In the case of inhomogeneous constructions, such as skeleton-, stand- or frame constructions, as well as in wooden beam, rafter or half-timbered constructions or the like, the one-dimensional diffusion calculations are only to be demonstrated for the compartment area. Exceptional cases are special constructions in which, for example, The diffusion-inhibiting layer is also laid section-wise over the outer area. In these exceptional cases, the calculation performed here is invalid.

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*	12,7 h	Heat storage capacity (whole component):	154 kJ/m²K
Amplitude attenuation **	41,3	Thermal capacity of inner layers:	107 kJ/m²K
TAV ***	0,024		

* 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.