

Insulated log cabin description

ANPOTM.

Mobile home Argo is fully insulated, meaning it comes with double slow-grown wall logs with stunning 100mm insulation kit in the wall cavity, floor and roof! All of the windows are double glazed, however you can also upgrade to plastic PVC windows, too. These features allow this cabin to be easily used all year round.

Specifications of Insulated log cabin

190355



Material	Natural certified Nordic pine/ Scandinavian spruce
External dimensions (width x depth)	5000mm x 7000mm
Wall	44mm + 100mm + 44mm
Eaves height	221cm (7'3")
Ridge height	266cm (8'7")
Roof Material	20mm thick boards
Floor Material	20mm thick boards
Door (width x height)	85cm x 192cm (4 units)
Windows (width x height)	70cm x 101cm (1 units) , 138cm x 101cm (3 units) and 50cm x 50cm (1 unit)
Glazing	Double-glazed
Anti Rot Warranty	10 Years

READING BOROUGH COUNCIL
27 FEB 2019
PLANNING

UK floor 100

Thermal protection

$U = 0,251 \text{ W/m}^2\text{K}$

EnEV16 Neubau*: $U < 0,28 \text{ W/m}^2\text{K}$



Moisture proofing

Dries 87 days

Condensate: 159 g/m^2

Wood moisture: $+0,6\%$

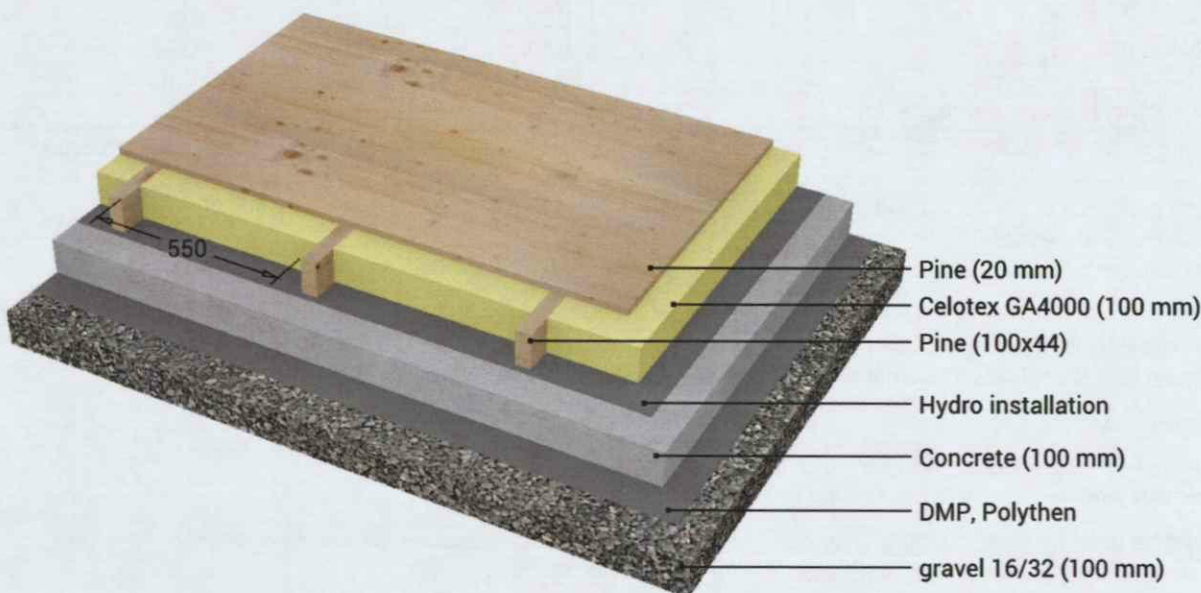


Heat protection

Component is adjacent to earth:

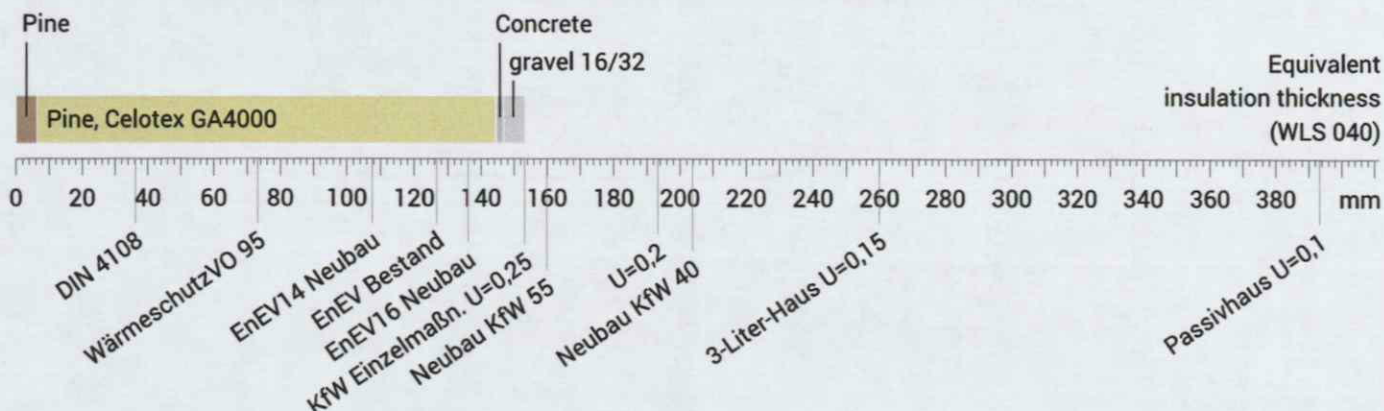
TAV and phase non relevant

Thermal capacity inside: $37 \text{ kJ/m}^2\text{K}$



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 $0,040 \text{ W/mK}$.



Inside air: $20,0^\circ\text{C} / 50\%$

Outside air: $0,0^\circ\text{C} / 100\%$

Surface temperature.: $17,5^\circ\text{C} / 0,2^\circ\text{C}$

sd-value: 168,5 m

Thickness: 32,2 cm

Weight: 439 kg/m^2

Heat capacity: 437 $\text{kJ/m}^2\text{K}$

☒ EnEV16 Neubau ☒ EnEV14 Neubau ☒ EnEV Bestand ☐ EnEV Bestand (Nichtwohngeb.)

UK floor 100, $U=0,251 \text{ W/m}^2\text{K}$

U-value calculation

#	Material	Dicke [cm]	λ [W/mK]	R [m ² K/W]
	Thermal contact resistance inside (Rsi)			0,170
1	Pine	2,00	0,130	0,154
2	Celotex GA4000	10,00	0,022	4,545
	Pine (7,4%)	10,00	0,130	0,769
3	Hydro installation	0,10	0,230	0,004
4	Concrete	10,00	2,000	0,050
5	DMP, Polythen	0,10	0,500	0,002
6	gravel 16/32	10,00	0,700	0,143
	Thermal contact resistance outside (Rse)			0,000
	Whole component	32,2		

Thermal contact resistances have been taken from DIN 6946 Table 1.

Rsi: heat flow direction downward

Rse: heat flow direction downward, outside: Ground

Upper limit of thermal resistance $R'_T = 4,168 \text{ m}^2\text{K/W}$.

Lower limit of thermal resistance $R''_T = 3,857 \text{ m}^2\text{K/W}$.

Check applicability: $R'_T / R''_T = 1,081$ (maximum allowed: 1,5)

The procedure may be used.

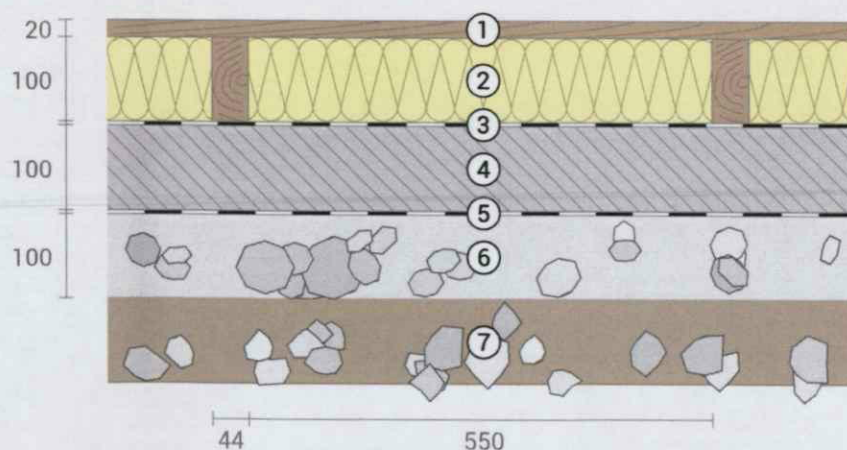
Thermal resistance $R_T = (R'_T + R''_T)/2 = 4,013 \text{ m}^2\text{K/W}$

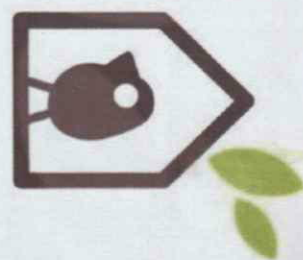
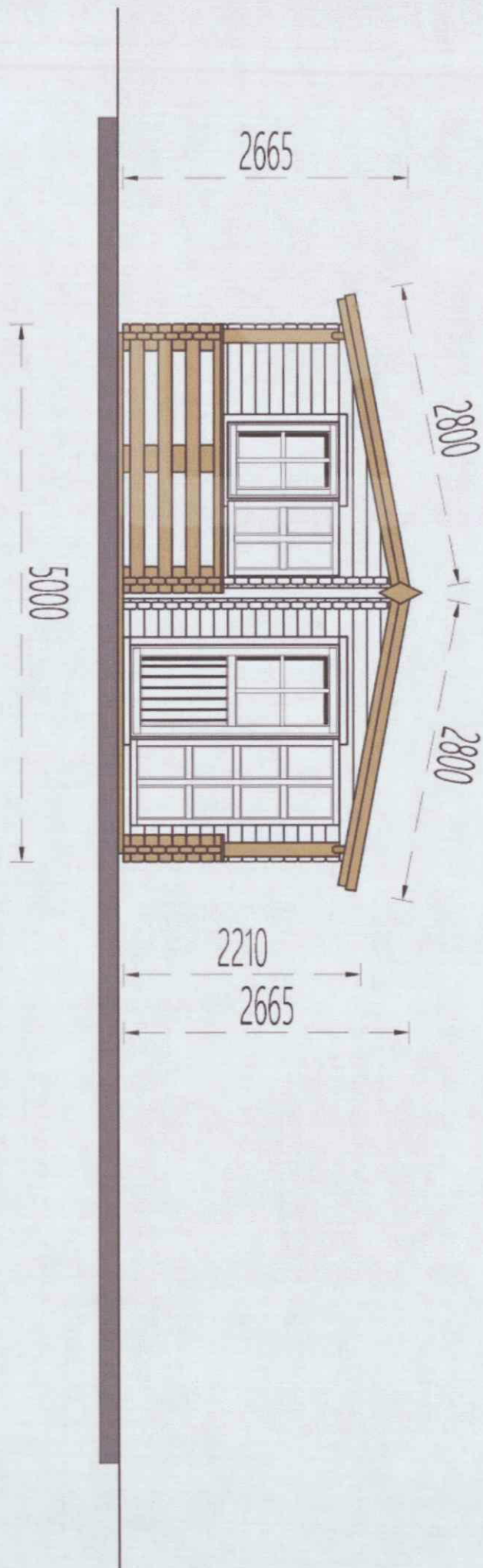
Estimated maximum relative uncertainty according to section 6.2.5: 3,9%

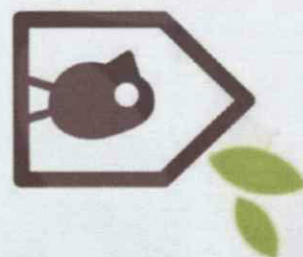
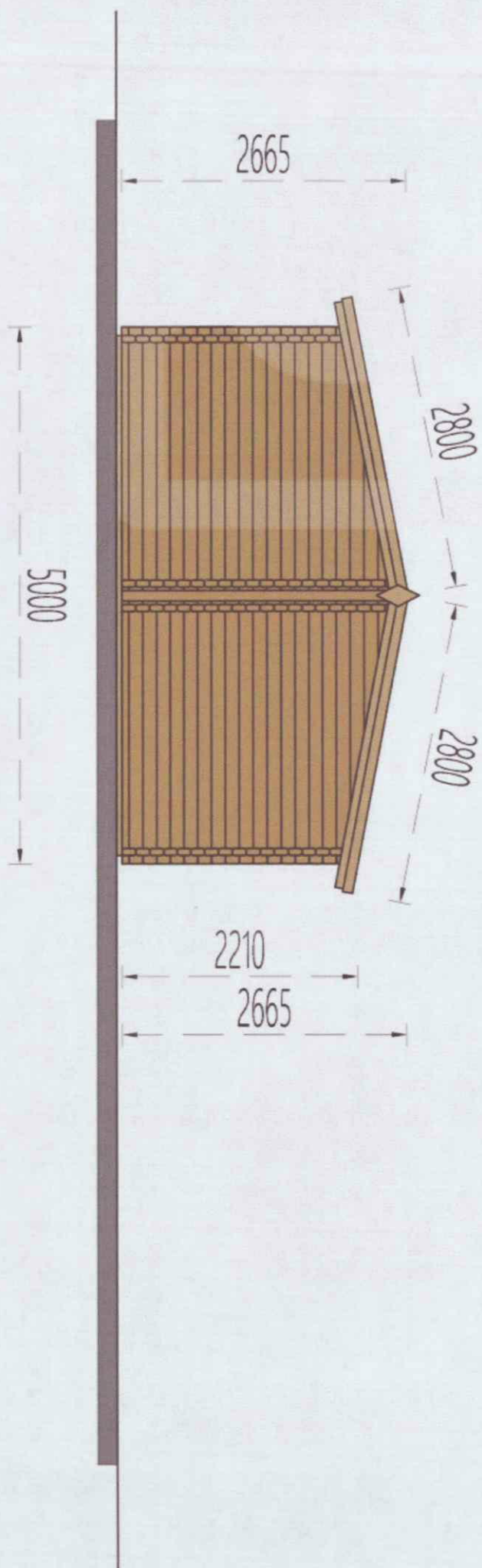
DIN 6946 may not be used for earth-contacting components. However, for the alternative method from DIN V 4108-6 Annex E, the required data on the size and position of this component are missing.

Heat transfer coefficient $U = 1/R_T = 0,25 \text{ W/m}^2\text{K}$

The constructive U-value was calculated. Heat losses across the ground or basement were not considered because the necessary data are missing.

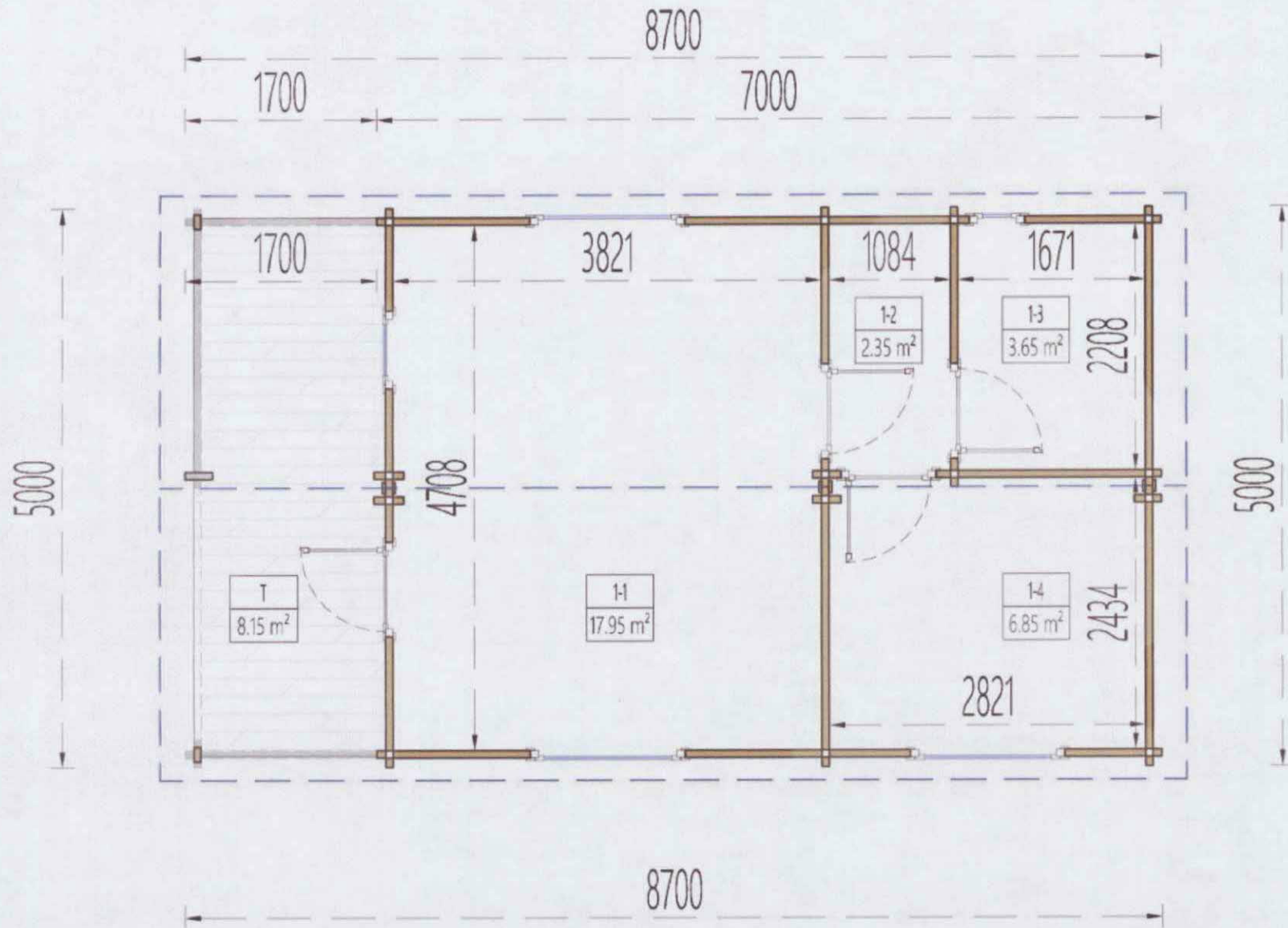








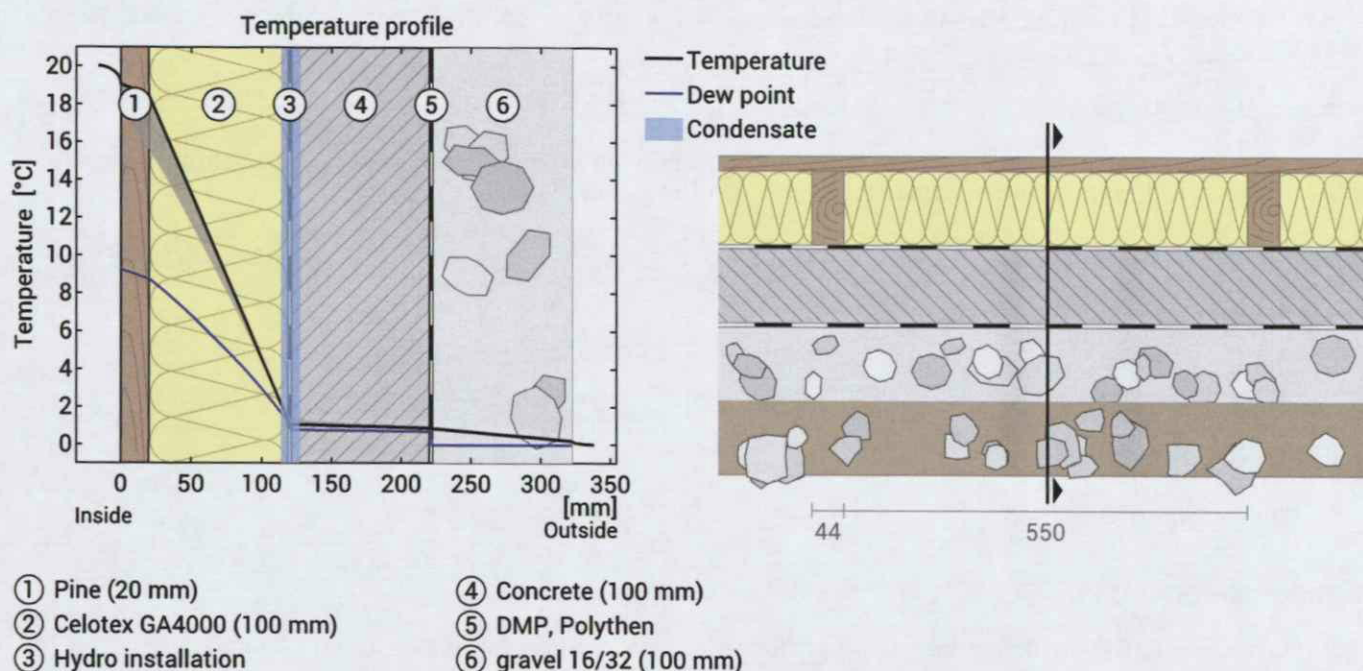






UK floor 100, $U=0,251 \text{ W/m}^2\text{K}$

Temperature profile



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 [m ² K/W]	Temperatur [°C]		Weight [kg/m ²]
				min	max	
	Thermal contact resistance*		0,250	17,5	20,0	
1	2 cm Pine	0,130	0,154	15,6	19,0	10,4
2	10 cm Celotex GA4000	0,022	4,545	1,1	18,5	3,0
	10 cm Pine (7,4%)	0,130	0,769	1,5	16,2	3,9
3	0,1 cm Hydro installation	0,230	0,004	1,1	1,5	1,1
4	10 cm Concrete	2,000	0,050	0,9	1,4	240,0
5	0,1 cm DMP, Polythen	0,500	0,002	0,8	1,0	1,0
6	10 cm gravel 16/32	0,700	0,143	0,2	1,0	180,0
	Thermal contact resistance*		0,040	0,0	0,2	
7	Soil			0,0	0,0	54,7
32,2 cm Whole component			3,989			439,3

*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): 17,5°C 18,8°C 19,0°C
Surface temperature outside (min / average / max): 0,2°C 0,2°C 0,2°C

UK floor 100, $U=0,251 \text{ W/m}^2\text{K}$

Moisture proofing

This calculation was carried out with a user-defined climate for the winter period, which deviates from DIN 4108-3.

This calculation: inside: 20°C 50% outside: 0°C 100%
Requested by DIN 4108-4: inside: 20°C 50% outside: -5°C 80%

During the winter season of 90 days, a total of 0,159 kg of condensation water per square meter is generated. This quantity dries in summer in 87 days (Drying season according to DIN 4108-3:2014-11).

#	Material	sd-value [m]	Condensate [kg/m ²] [Gew.-%]	Weight [kg/m ²]
1	2 cm Pine	0,40	-	10,4
2	10 cm Celotex GA4000	5,00	0,14	3,0
	10 cm Pine (7,4%)	2,00	0,022	3,9
3	0,1 cm Hydro installation	50,00	-	1,1
4	10 cm Concrete	13,00	-	240,0
5	0,1 cm DMP, Polythen	100,00	-	1,0
6	10 cm gravel 16/32	0,30	-	180,0
	32,2 cm Whole component	168,45	0,16	439,3

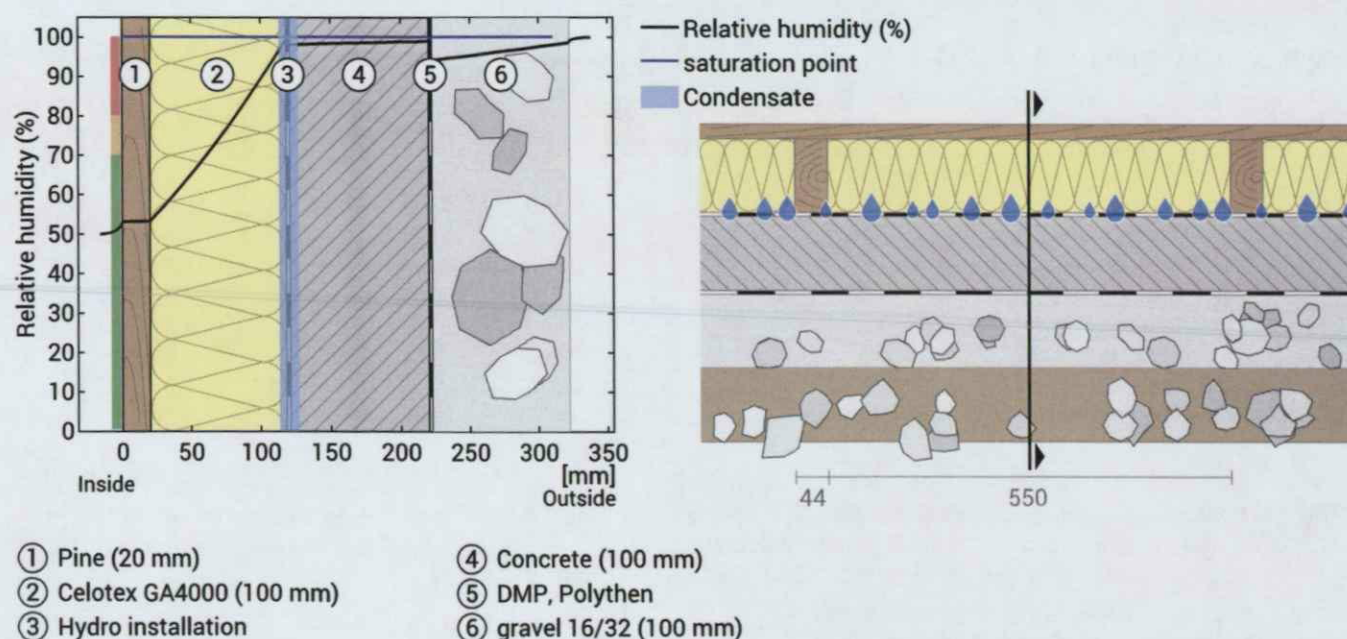
Condensation areas

① Condensate: 0,16 kg/m² Drying time: 87 Days Affected layers: Hydro installation, Pine, Celotex GA4000, Pine

Humidity

The temperature of the inside surface is 17,5 °C leading to a relative humidity on the surface of 58%. Mold formation is not expected under these conditions.

The following figure show the relative humidity inside the component.



Please note: DIN 4108-3 is not applicable to this construction. In order to investigate the moisture proofing, a proprietary calculation procedure based on DIN 4108-3 was used. Further information in the input form under 'Moisture protection'.

UK floor 100, $U=0,251 \text{ W/m}^2\text{K}$

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

DIN 4108-3 can not be used with components which are in contact with ground.

Exterior wall, $U=0,194 \text{ W/m}^2\text{K}$

Exterior wall, $U=0,194 \text{ W/m}^2\text{K}$
created on 8.5.2017

thermal protection

$U = 0,194 \text{ W/m}^2\text{K}$

EnEV Bestand*: $U < 0,24 \text{ W/m}^2\text{K}$



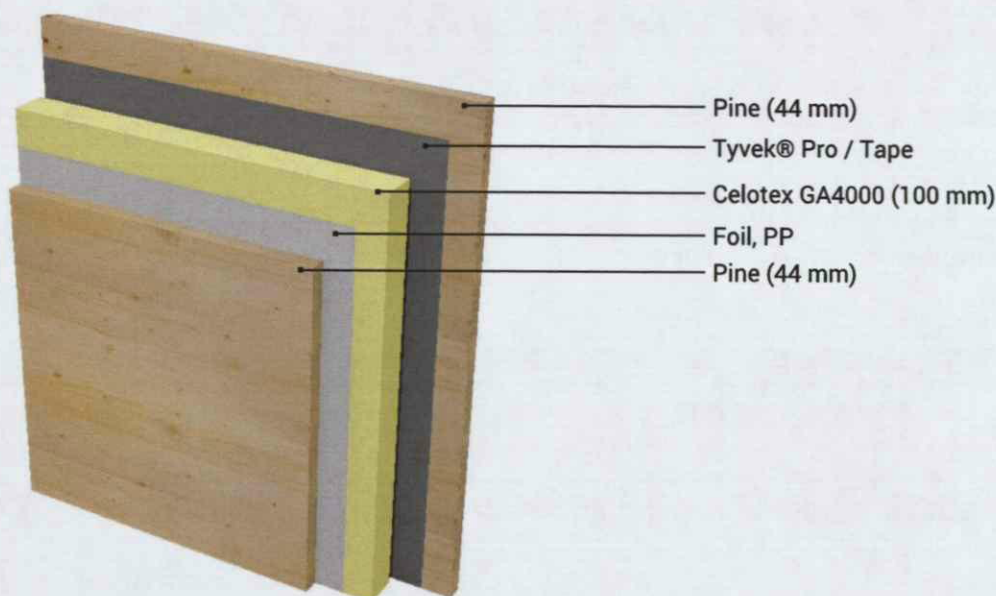
Moisture proofing

Drying reserve: $286 \text{ g/m}^2\text{a}$
No condensate



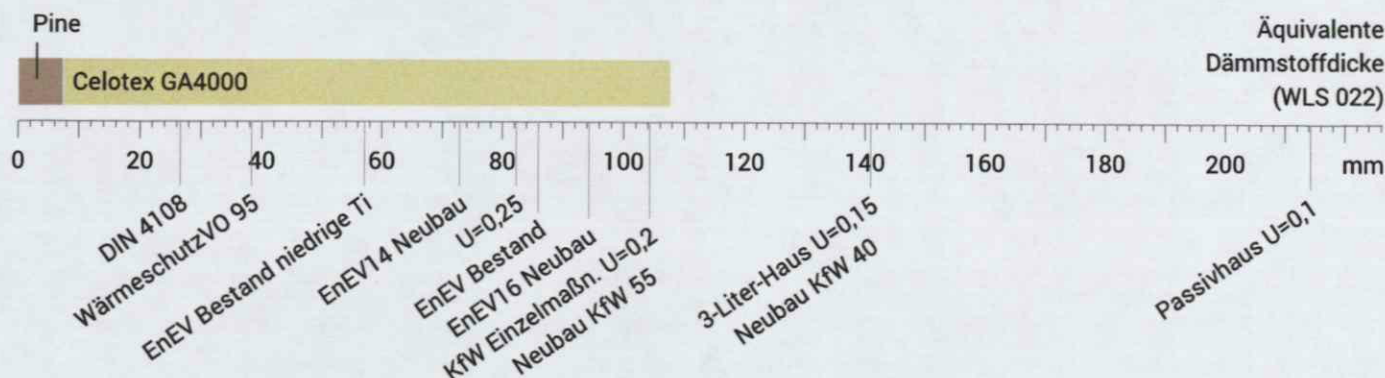
Heat protection

Temperature amplitude damping: 13
phase shift: 6,9 h
Thermal capacity inside: $36 \text{ kJ/m}^2\text{K}$



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 $0,022 \text{ W/mK}$.



Inside air : $20,0^\circ\text{C} / 50\%$
Outside air: $-5,0^\circ\text{C} / 80\%$
Surface temperature.: $19,4^\circ\text{C} / -4,8^\circ\text{C}$

sd-value: 10,9 m
Drying reserve: $286 \text{ g/m}^2\text{a}$

Thickness: 20,9 cm
Weight: 49 kg/m^2
Heat capacity: $40 \text{ kJ/m}^2\text{K}$

☒ EnEV Bestand ☒ EnEV16 Neubau ☒ EnEV14 Neubau ☒ EnEV Bestand (Nichtwohnggeb.)

Exterior wall, $U=0,194 \text{ W/m}^2\text{K}$, $U=0,194 \text{ W/m}^2\text{K}$

U-Wert-Berechnung nach DIN EN ISO 6946

#	Material	Dicke [cm]	λ [W/mK]	R [m ² K/W]
	Thermal contact resistance inside (Rsi)			0,130
1	Pine	4,40	0,130	0,338
2	Foil, PP	0,02	0,220	0,001
3	Celotex GA4000	10,00	0,022	4,545
	Thermal contact resistance outside (Rse)			0,130
	Whole component	20,858		5,145

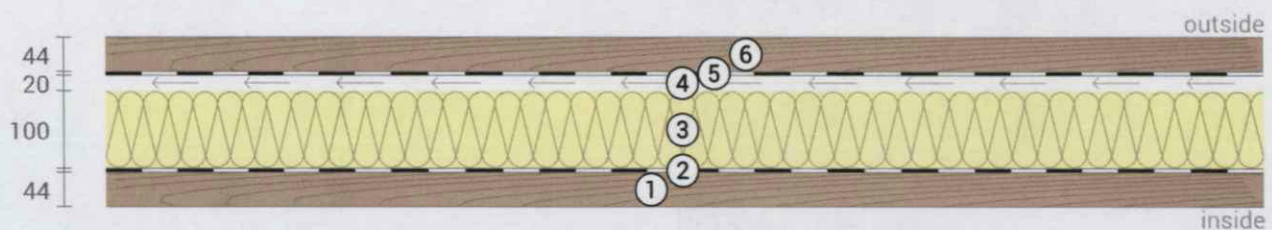
Thermal contact resistances have been taken from DIN 6946 Table 1.

Rsi: heat flow direction horizontally

Rse: heat flow direction horizontally, outside: Ventilation level

Thermal resistance $R_T = 5,145 \text{ m}^2\text{K/W}$

Heat transfer coefficient $U = 1/R_T = 0,19 \text{ W/m}^2\text{K}$



Exterior wall, $U=0,194 \text{ W/m}^2\text{K}$, $U=0,194 \text{ W/m}^2\text{K}$

Yearly heat loss

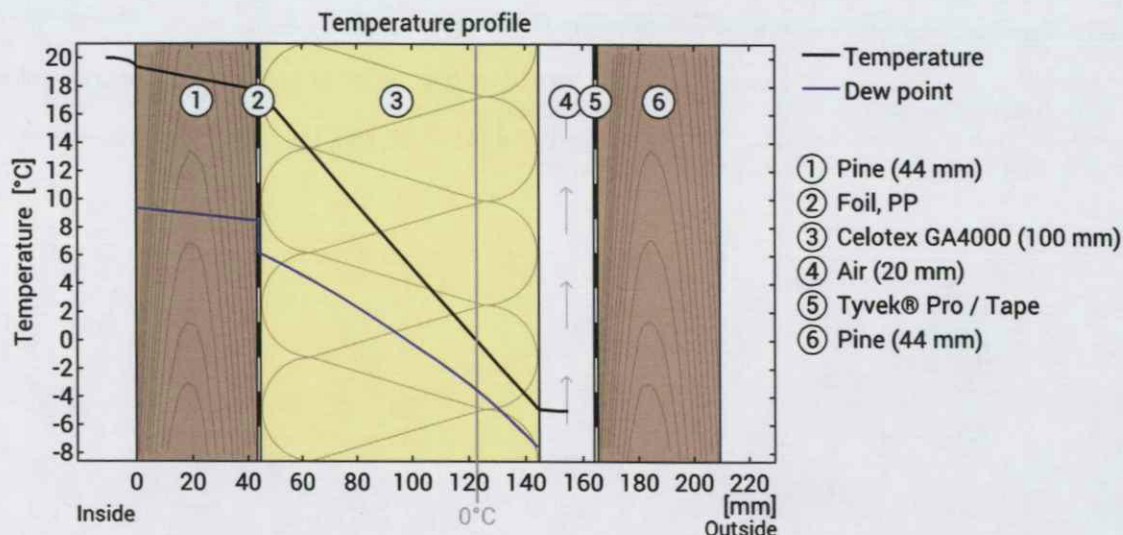
Wärmeverlust durch dieses Bauteil: 15,1 kWh pro m^2 und Heizperiode (ca. 1,50 Liter Heizöl pro m^2)

Calculated for the location Deutschland, heating period from Beginning of October to End of April. Die Berechnung basiert auf monatlichen Temperatur-Mittelwerten. Quelle: DIN V 18599-10:2007-02

Hinweis: Die dieser Berechnung zugrunde liegenden Klima- und Energiedaten können zum Teil starke Schwankungen aufweisen und im Einzelfall erheblich vom tatsächlichen Wert abweichen.

Exterior wall, $U=0,194 \text{ W/m}^2\text{K}$, $U=0,194 \text{ W/m}^2\text{K}$

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]		Weight [kg/m²]
				min	max	
	Thermal contact resistance*		0,130	19,4	20,0	
1	4,4 cm Pine	0,130	0,338	17,7	19,4	22,9
2	0,02 cm Foil, PP	0,220	0,001	17,7	17,7	0,2
3	10 cm Celotex GA4000	0,022	4,545	-4,8	17,7	3,2
	Thermal contact resistance*		0,040	-5,0	-4,8	
4	2 cm Air (ventilated layer)			-5,0	-5,0	0,0
5	0,038 cm Tyvek® Pro / Tape			-5,0	-5,0	0,1
6	4,4 cm Pine			-5,0	-5,0	22,9
	20,858 cm Whole component		5,145			49,3

*Assuming free circulating air at the inside surface.

Surface temperature inside (min / average / max): 19,4°C 19,4°C 19,4°C

Oberflächentemperatur außen (min / mittel / max): -4,8°C -4,8°C -4,8°C

Exterior wall, $U=0,194 \text{ W/m}^2\text{K}$, $U=0,194 \text{ W/m}^2\text{K}$

Moisture proofing

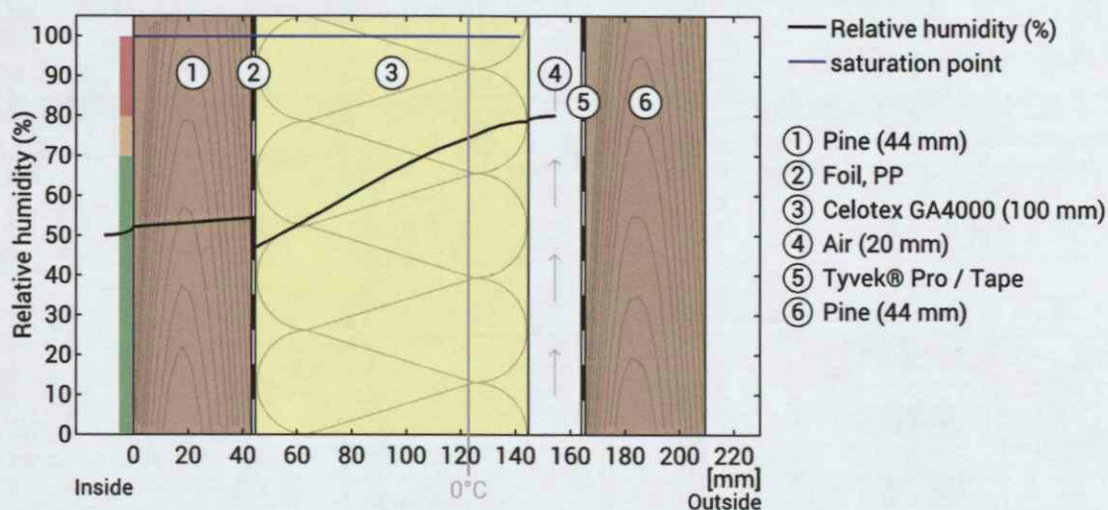
This component is free of condensate under the given climate conditions.

#	Material	sd-value [m]	Condensate		Weight
			[kg/m ²]	[Gew.-%]	[kg/m ²]
1	4,4 cm Pine	0,88	-	-	22,9
2	0,02 cm Foil, PP	2,00	-	-	0,2
3	10 cm Celotex GA4000	8,00	-	-	3,2
	20,858 cm Whole component	10,88			49,3

Humidity

The temperature of the inside surface is 19,4 °C leading to a relative humidity on the surface of 52%.Mould formation is not expected under these conditions.

The following figure show the relative humidity inside the component.



Exterior wall, $U=0,194 \text{ W/m}^2\text{K}$, $U=0,194 \text{ W/m}^2\text{K}$

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

Bitte beachten Sie die Hinweise am Ende dieser Feuchteschutzberechnungen.

#	Material	λ [W/mK]	R [m ² K/W]	sd [m]	ρ [kg/m ³]	T [°C]	ps [Pa]	Σsd [m]
Thermal contact resistance			0,250					
1	4,4 cm Pine	0,130	0,338	0,88	520	18,79	2168	0
2	0,02 cm Foil, PP	0,220	0,001	2	910	17,16	1957	0,88
3	10 cm Celotex GA4000	0,022	4,545	8	32	17,15	1956	2,88
Thermal contact resistance			0,040			-4,81	408	10,9

Temperatur (T), Dampfsättigungsdruck (ps) und die Summe der sd-Werte (Σsd) gelten jeweils an den Schichtgrenzen.

Luftfeuchte an der Bauteiloberfläche

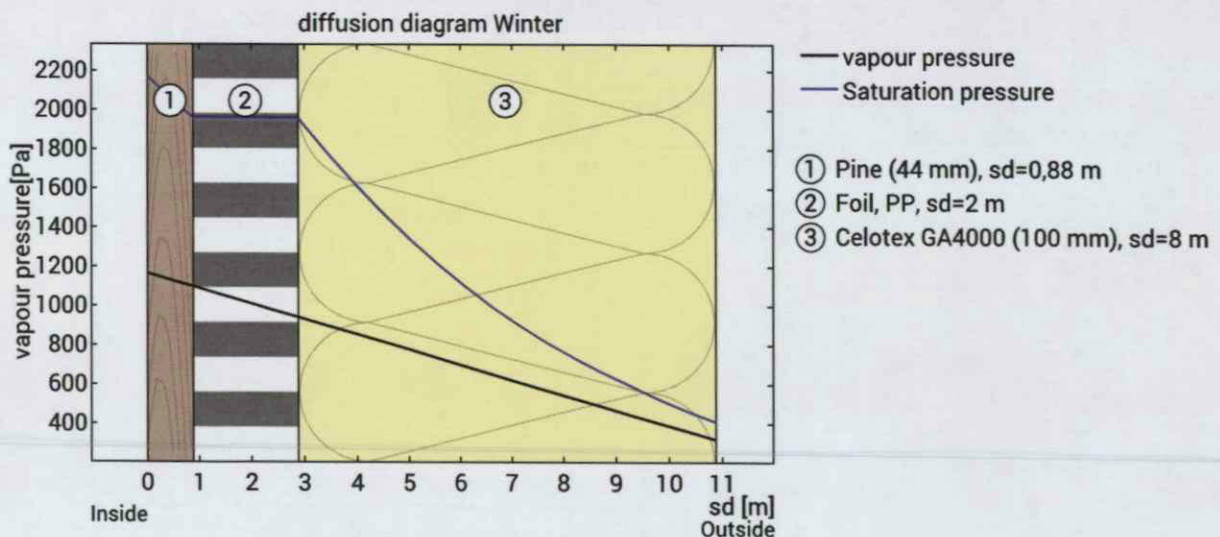
Die relative Luftfeuchtigkeit auf der raumseitigen Bauteiloberfläche beträgt 54%. Anforderungen zur Vermeidung von Baustoffkorrosion hängen von Material und Beschichtung ab und wurden nicht untersucht.



Berechnung der Tauwassermenge

Randbedingungen

Dampfdruck innen bei 20°C und 50% Luftfeuchtigkeit	$p_i = 1168 \text{ Pa}$
Dampfdruck außen bei -5°C und 80% Luftfeuchtigkeit	$p_e = 321 \text{ Pa}$
Dauer Tauperiode (90 Tage)	$t_c = 7776000 \text{ s}$
Wasserdampf-Diffusionskoeffizient in ruhender Luft	$\delta_0 = 2.0E-10 \text{ kg/(m}^2\text{sPa)}$
sd-value (Whole component.)	$s_{de} = 10,88 \text{ m}$



Unter den angenommenen Bedingungen ist der untersuchte Querschnitt frei von Tauwasserbildung im Bauteilinneren.



Berechnung der Verdunstungsmenge

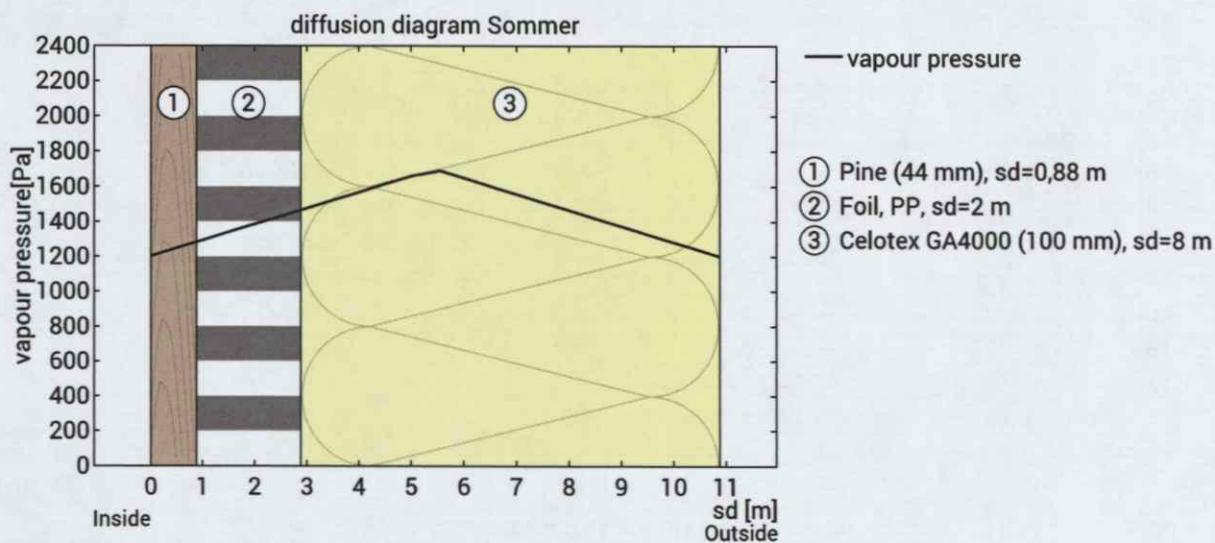
Randbedingungen

Interior vapor pressure	$p_i = 1200 \text{ Pa}$
Exterior vapor pressure	$p_e = 1200 \text{ Pa}$
Saturation vapour pressure in the condensation area	$p_s = 1700 \text{ Pa}$
Dauer Verdunstungsperiode (90 Tage)	$t_{ev} = 7776000 \text{ s}$
sd-Werte bleiben unverändert.	

Exterior wall, $U=0,194 \text{ W/m}^2\text{K}$, $U=0,194 \text{ W/m}^2\text{K}$

Tauwasserfreies Bauteil: Es wird die maximal mögliche Verdunstungsmasse für die Trocknungsreserve berechnet. Betrachtet wird die Ebene mit der geringsten Verdunstungsmasse innerhalb des Holz enthaltenden Bereichs:
Innerhalb Schicht Celotex GA4000
bei $s_d=5,44 \text{ m}$

Evaporation mass: $M_{ev} = 50 \cdot t_{ev} \cdot \left[\frac{(p_s - p_i)}{s_d} + \frac{(p_s - p_e)}{(s_d - s_d)} \right] = 0,29 \text{ kg/m}^2$



Bewertung gemäß DIN 4108-3

Das Bauteil ist diffusionstechnisch zulässig.

Trocknungsreserve (DIN 68800-2)

Drying reserve: $M_r = M_{ev} \cdot 1000 = 286 \text{ g/m}^2/\text{a}$

Minimum requested for walls and ceilings: $100 \text{ g/m}^2/\text{a}$



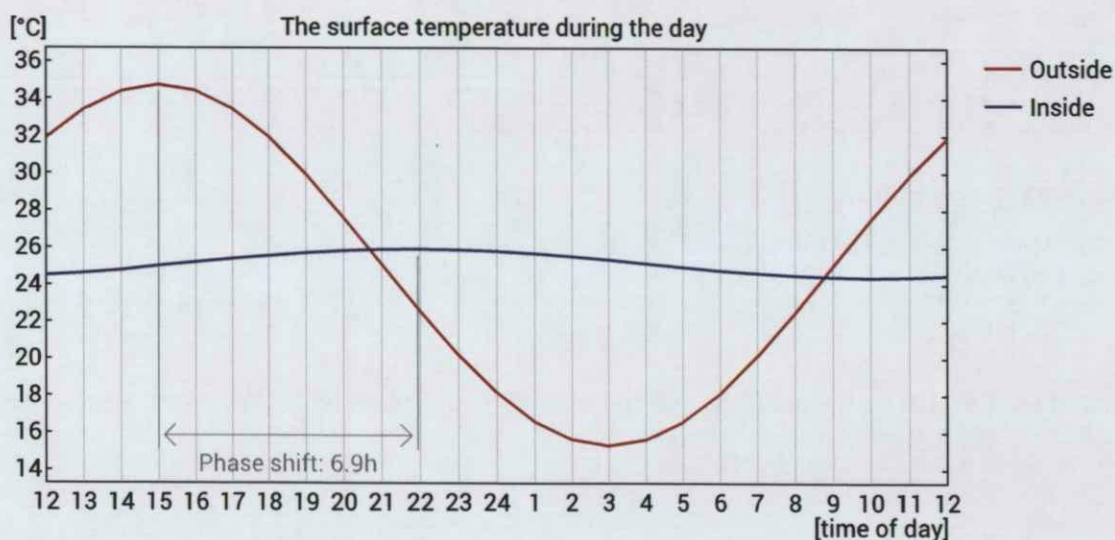
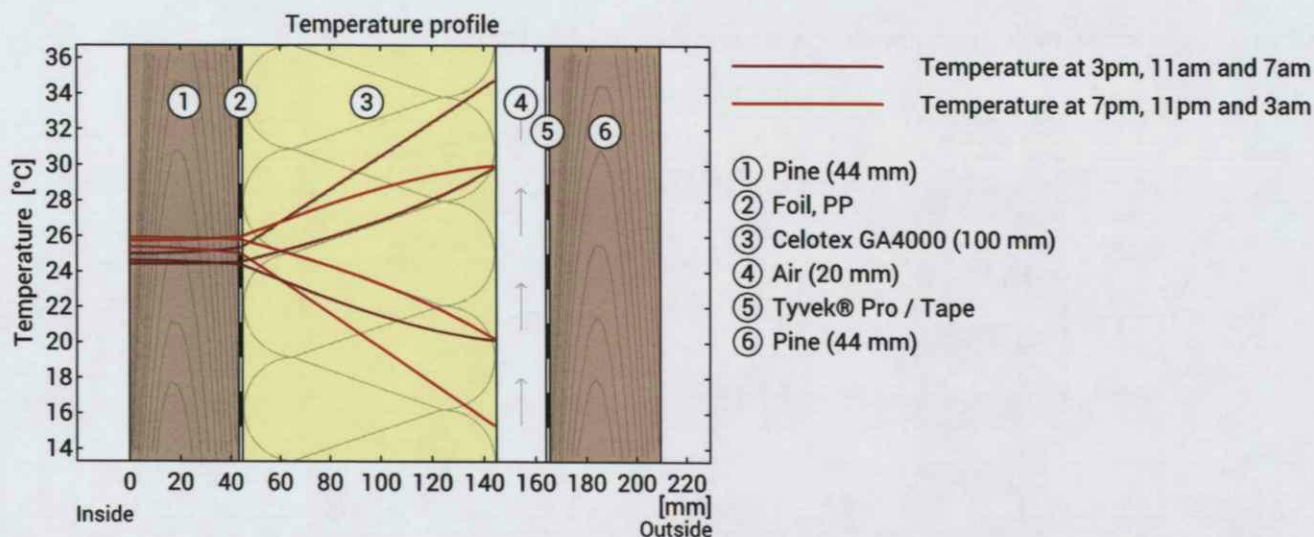
Hints

DIN 4108-3 beschreibt in Abschnitt 5.3 Bauteile, für die kein rechnerischer Tauwassernachweis erforderlich ist, da kein Tauwasserrisiko besteht oder das Verfahren für die Beurteilung nicht geeignet ist. Ob das hier untersuchte Bauteil darunter ist, kann mit den vorliegenden Informationen nicht beurteilt werden.

Exterior wall, $U=0,194 \text{ W/m}^2\text{K}$, $U=0,194 \text{ W/m}^2\text{K}$

Heat protection

For the analysis of the heat protection, the temperature changes within the component were simulated during a hot summer 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*	6,9 h	Time of maximum interior temperature	21:60
Amplitude attenuation **	12,8	Thermal fluctuation on exterior surface:	19,4°C
TAV***	0,078	Temperature fluctuation on interior surface	1,5°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: $TAV = 1 / \text{amplitude attenuation}$

roof

Roof construction, $U=0,262 \text{ W/m}^2\text{K}$
created on 25.9.2017

Thermal protection

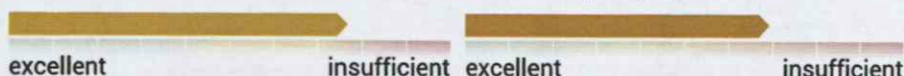
$U = 0,26 \text{ W/m}^2\text{K}$

EnEV Bestand*: $U < 0,24 \text{ W/m}^2\text{K}$



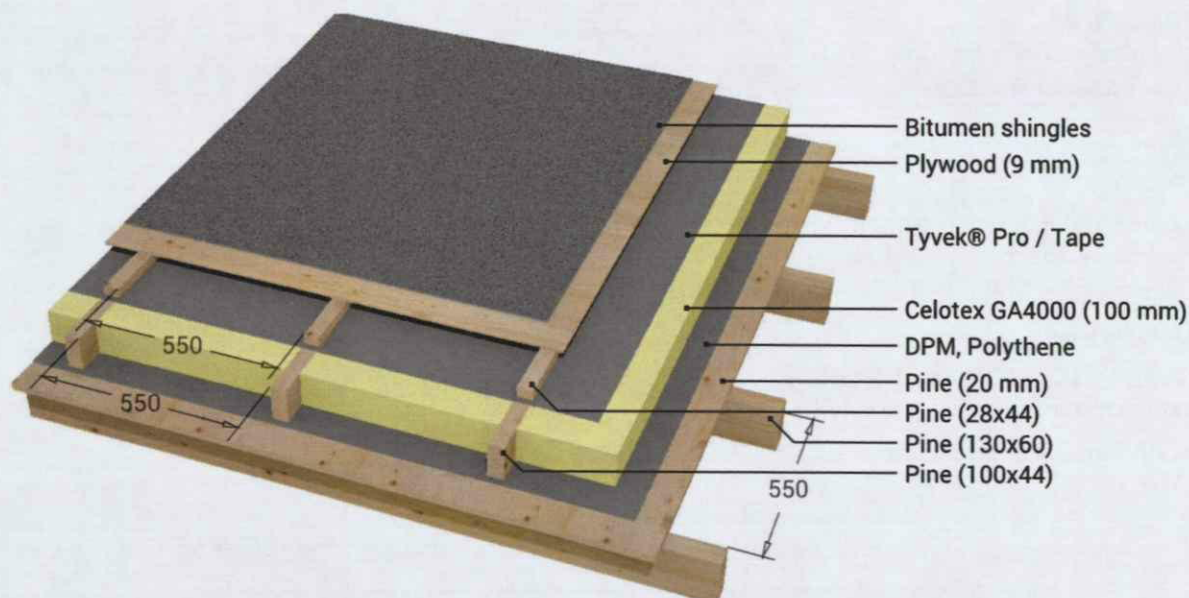
Moisture proofing

Drying reserve: $168 \text{ g/m}^2\text{a}$
No condensate



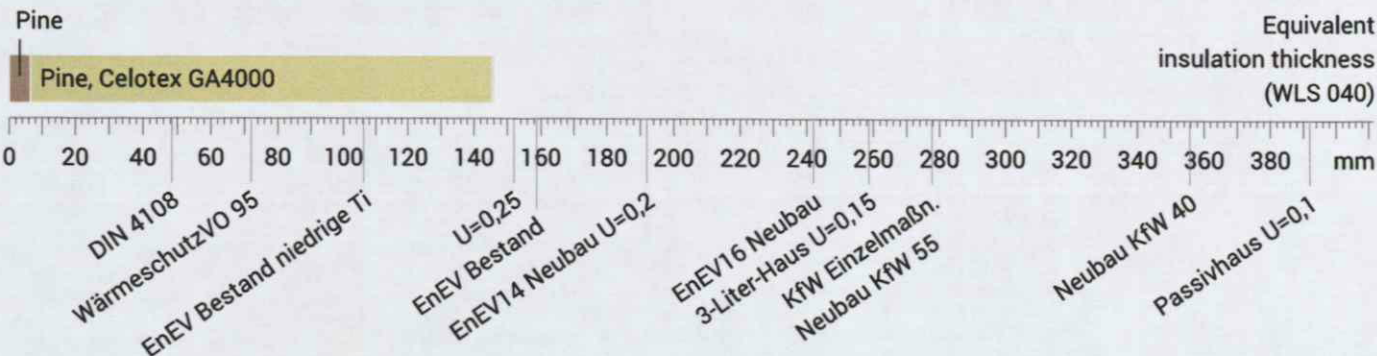
Heat protection

Temperature amplitude damping: 6,7
phase shift: 6,2 h
Thermal capacity inside: $22 \text{ kJ/m}^2\text{K}$



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 $0,040 \text{ W/mK}$.



Inside air : $20,0^\circ\text{C} / 50\%$
Outside air: $-5,0^\circ\text{C} / 80\%$
Surface temperature.: $18,5^\circ\text{C} / -4,7^\circ\text{C}$

sd-value: 108,2 m
Drying reserve: $168 \text{ g/m}^2\text{a}$

Thickness: 29,4 cm
Weight: 30 kg/m^2
Heat capacity: $28 \text{ kJ/m}^2\text{K}$

☐ EnEV Bestand ☐ EnEV16 Neubau ☐ EnEV14 Neubau ☒ EnEV Bestand (Nichtwohngeb.)

roof, $U=0,262 \text{ W/m}^2\text{K}$

U-Value calculation according to DIN EN ISO 6946

#	Material	Dicke [cm]	λ [W/mK]	R [m ² K/W]
	Thermal contact resistance inside (Rsi)			0,100
2	Pine	2,00	0,130	0,154
3	DPM, Polythene	0,10	0,330	0,003
4	Celotex GA4000	10,00	0,022	4,545
	Pine (7,4%)	10,00	0,130	0,769
5	Tyvek® Pro / Tape	0,04	0,230	0,002
	Thermal contact resistance outside (Rse)			0,100
	Whole component	29,358		

Rsi: User-defined

Rse: User-defined

Upper limit of thermal resistance $R'_T = 3,929 \text{ m}^2\text{K/W}$.

Lower limit of thermal resistance $R''_T = 3,692 \text{ m}^2\text{K/W}$.

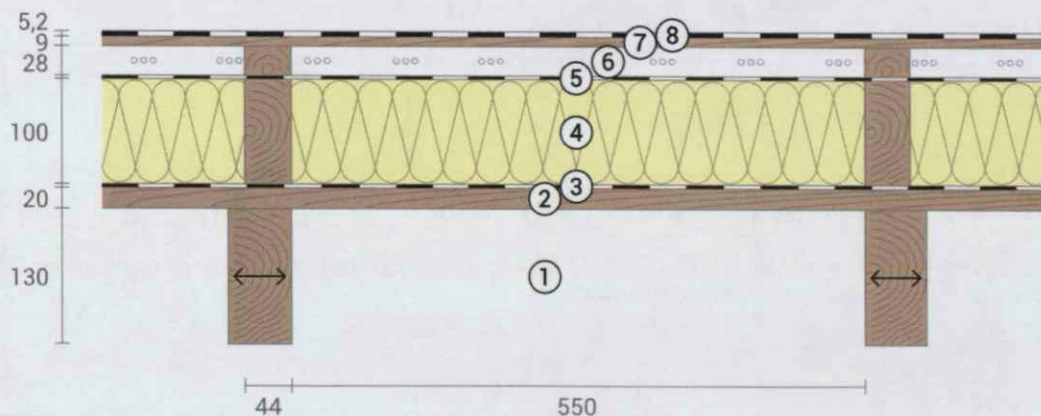
Check applicability: $R'_T / R''_T = 1,064$ (maximum allowed: 1,5)

The procedure may be used.

Thermal resistance $R_T = (R'_T + R''_T)/2 = 3,811 \text{ m}^2\text{K/W}$

Estimated maximum relative uncertainty according to section 6.2.5: 3,1%

Heat transfer coefficient $U = 1/R_T = 0,26 \text{ W/m}^2\text{K}$





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roof, $U=0,262 \text{ W/m}^2\text{K}$

Yearly heat loss

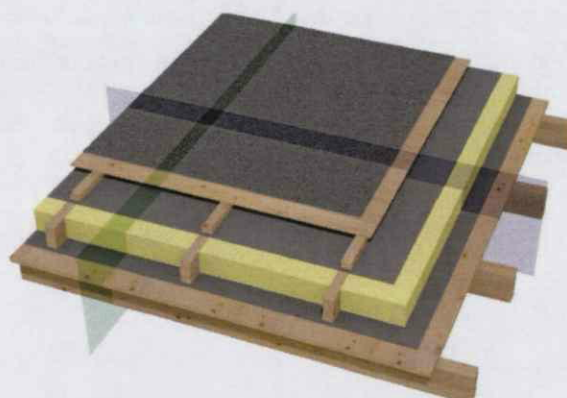
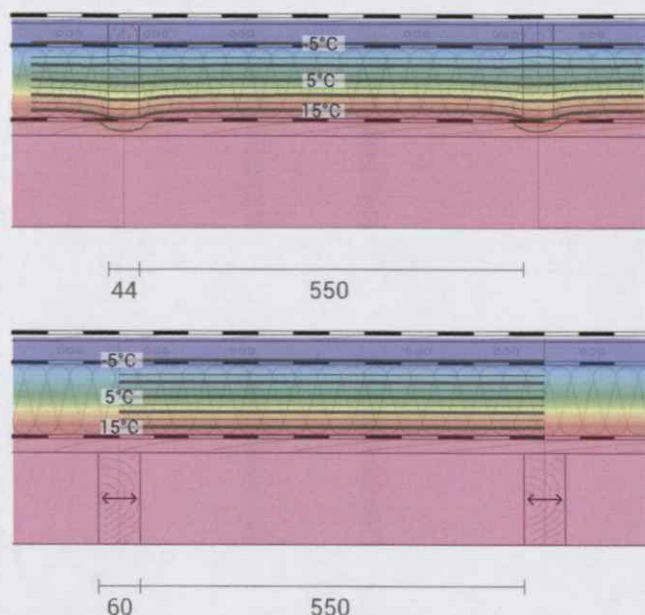
Heat loss due to this component: 20,4 kWh per m^2 and heating period (approx. 2,03 liter of heating oil per m^2)

Calculated for the location Deutschland, heating period from Beginning 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.

roof, $U=0,262 \text{ W/m}^2\text{K}$

Temperature profile



Top left: Temperature profile in the blue section (see right illustration). Bottom left: Temperature profile in the green section.

Layers (from inside to outside)

#	Material	λ [W/mK]	R [m ² K/W]	Temperatur [°C]		Weight [kg/m ²]
				min	max	
1	13 cm Rear ventilated level (room air)					
	Thermal contact resistance*		0,100	18,5	20,0	0,0
2	2 cm Pine	0,130	0,154	15,8	19,5	10,4
3	0,1 cm DPM, Polythene	0,330	0,003	15,7	18,7	0,9
4	10 cm Celotex GA4000	0,022	4,545	-4,8	18,7	3,0
	10 cm Pine (7,4%)	0,130	0,769	-4,1	16,4	3,9
5	0,038 cm Tyvek® Pro / Tape	0,230	0,002	-4,8	-4,0	0,1
	Thermal contact resistance*		0,040	-5,0	-4,0	
6	2,8 cm Ventilated level (outside air)			-5,0	-5,0	0,0
7	0,9 cm Plywood			-5,0	-5,0	5,4
8	0,52 cm Bitumen shingles			-5,0	-5,0	5,7
29,358 cm Whole component			3,839			30,5

*Assuming free circulating air at the inside surface.

Surface temperature inside (min / average / max): 18,5°C 19,3°C 19,5°C
Surface temperature outside (min / average / max): -4,8°C -4,7°C -4,0°C

roof, $U=0,262 \text{ W/m}^2\text{K}$

Moisture proofing

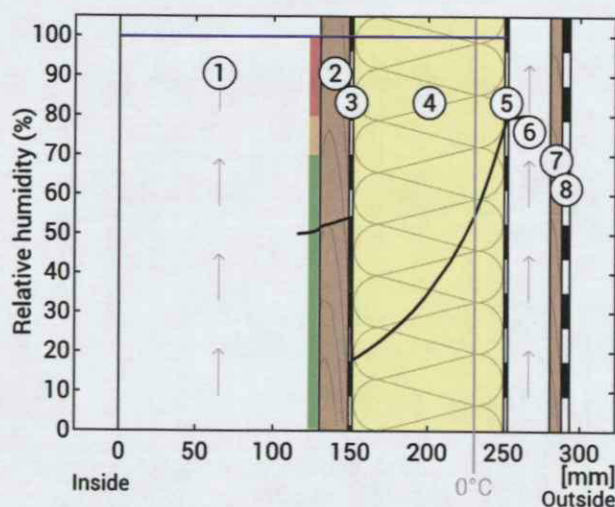
This component is free of condensate under the given climate conditions.

#	Material	sd-value [m]	Condensate		Weight [kg/m ²]
			[kg/m ²]	[Gew.-%]	
2	2 cm Pine	0,40	-	-	10,4
3	0,1 cm DPM, Polythene	100,00	-	-	0,9
4	10 cm Celotex GA4000	8,00	-	-	3,0
	10 cm Pine (7,4%)	5,00	-	-	3,9
5	0,038 cm Tyvek® Pro / Tape	0,02	-	-	0,1
	29,358 cm Whole component	108,18			30,5

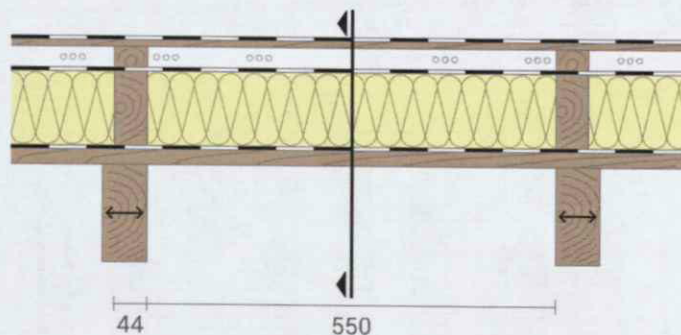
Humidity

The temperature of the inside surface is 18,5 °C leading to a relative humidity on the surface of 55%.Mould formation is not expected under these conditions.

The following figure show the relative humidity inside the component.



— Relative humidity (%)
- - - saturation point



① Rear ventilated level (130 mm)

② Pine (20 mm)

③ DPM, Polythene

④ Celotex GA4000 (100 mm)

⑤ Tyvek® Pro / Tape

⑥ Ventilated level (28 mm)

⑦ Plywood (9 mm)

⑧ Bitumen shingles

To calculate the diffusion currents a two-dimensional finite element method was used. More information on the section 'humidity' on the input form.

Layers marked with <-> run parallel to the illustrated cutting plane and were not taken into account in the moisture protection calculation.

roof, $U=0,262 \text{ W/m}^2\text{K}$

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 [m ² K/W]	sd [m]	ρ [kg/m ³]	T [°C]	ps [Pa]	Σsd [m]
Thermal contact resistance			0,250			18,75	2163	0
1	2 cm Pine	0,130	0,154	0,4	520	17,98	2060	0,4
2	0,1 cm DPM, Polythene	0,330	0,003	100	920	17,96	2058	100
3	10 cm Celotex GA4000	0,022	4,545	8	32	-4,79	409	108
4	0,038 cm Tyvek® Pro / Tape	0,230	0,002	0,02	326	-4,80	408	108
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

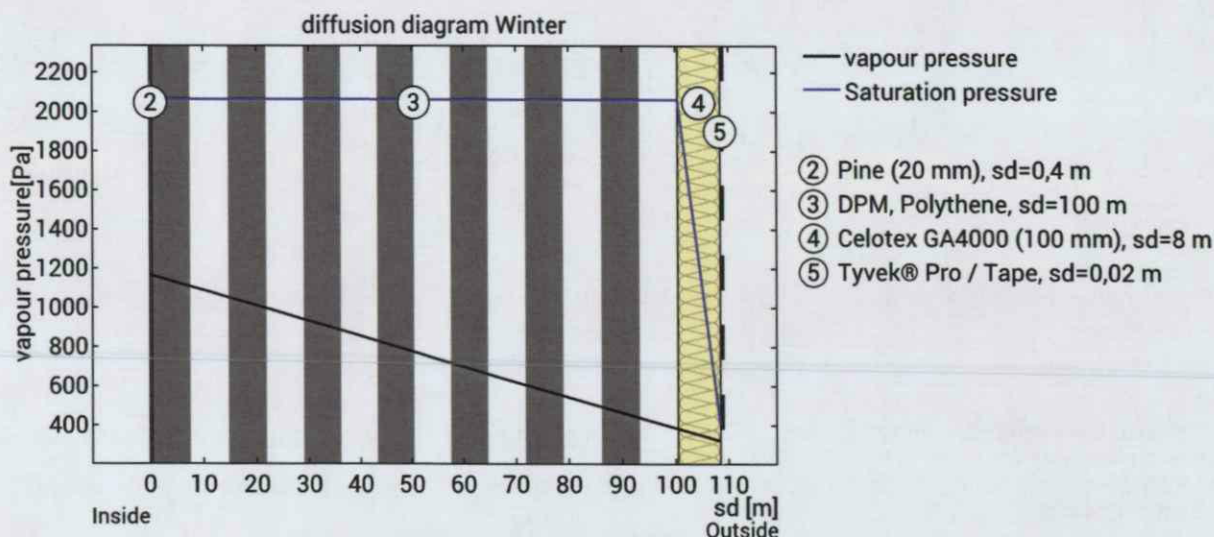
Die relative Luftfeuchtigkeit auf der raumseitigen Bauteiloberfläche beträgt 54%. Anforderungen zur Vermeidung von Baustoffkorrosion hängen von Material und Beschichtung ab und wurden nicht untersucht.



Calculation of condensate amount

Boundary conditions

Vapor pressure inside at 20°C and 50% humidity	$p_i = 1168 \text{ Pa}$
Vapor pressure outside at -5°C and 80% humidity	$p_e = 321 \text{ Pa}$
Duration of condensation period (90 days)	$t_c = 7776000 \text{ s}$
Water vapor diffusion coefficient in static air	$\delta_0 = 2.0 \cdot 10^{-10} \text{ kg/(m}^2\text{sPa)}$
sd-value (Whole component.)	$s_{de} = 108,42 \text{ m}$



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



Calculation of the evaporation mass

Boundary conditions

Interior vapor pressure	$p_i = 1200 \text{ Pa}$
Exterior vapor pressure	$p_e = 1200 \text{ Pa}$
Saturation vapour pressure in the condensation area	$p_s = 2000 \text{ Pa}$ (Roof against outside air)
Length of drying season (90 days)	$t_{ev} = 7776000 \text{ s}$
sd-values remain unchanged.	

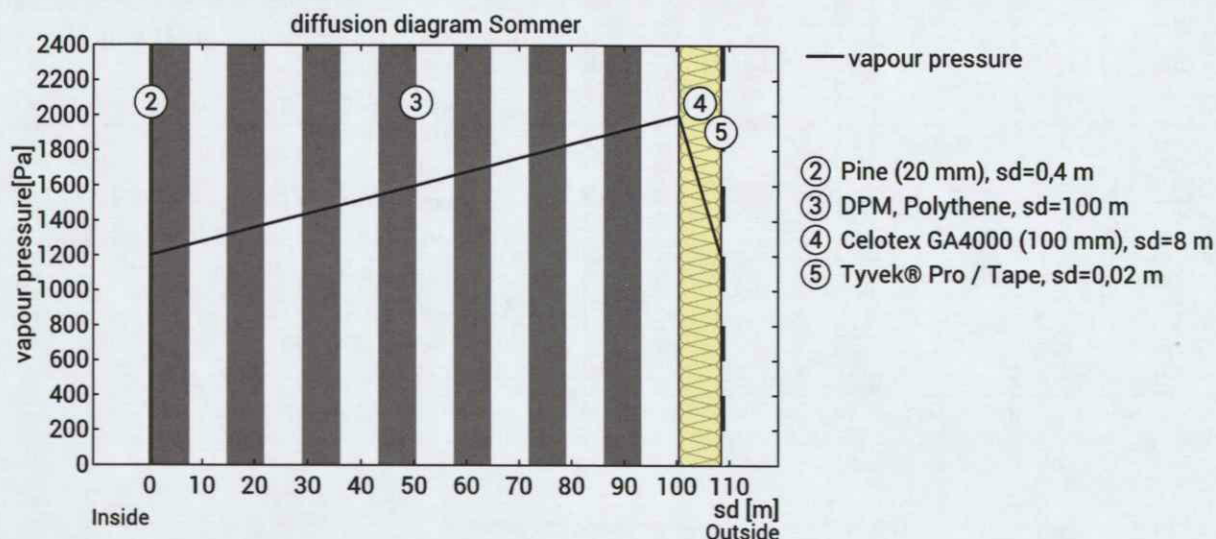
roof, $U=0,262 \text{ W/m}^2\text{K}$

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:

Layer boundary between DPM, Polythene and Celotex GA4000

at $s_d=100,40 \text{ m}$; $x=2,1 \text{ cm}$

Evaporation mass: $M_{ev} = 50 \cdot t_{ev} \cdot \left[\frac{(p_s - p_i)}{s_d} + \frac{(p_s - p_e)}{(s_{de} - s_d)} \right] = 0,17 \text{ kg/m}^2$



Evaluation according to DIN 4108-3

The component is permissible regarding the moisture protection.

Drying reserve (DIN 68800-2)

Drying reserve: $M_r = M_{ev} \cdot 1000 = 168 \text{ g/m}^2/\text{a}$

Minimum requested for roofs: $250 \text{ g/m}^2/\text{a}$

Demand not met!

Hints

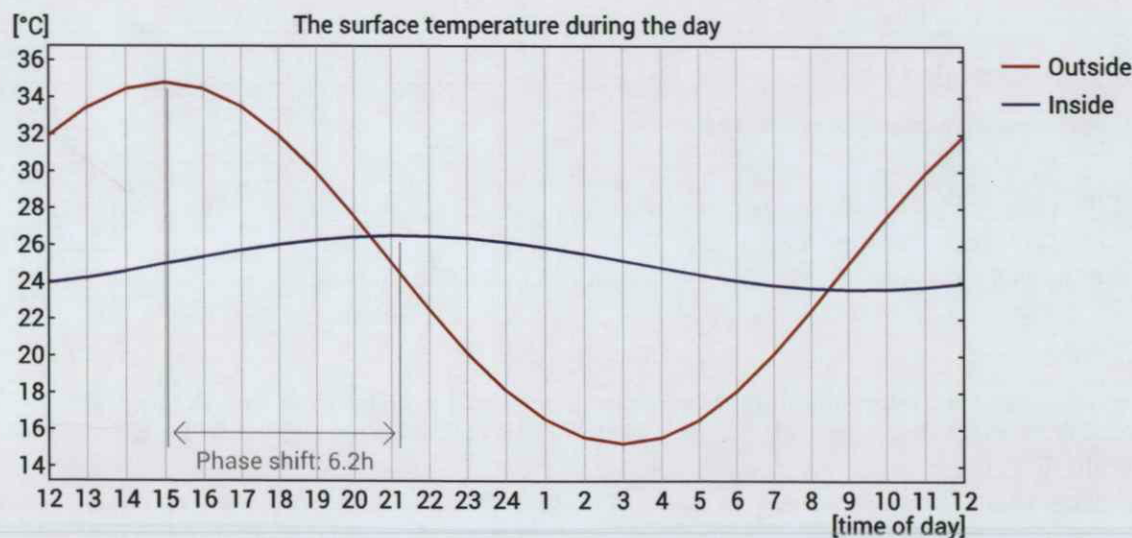
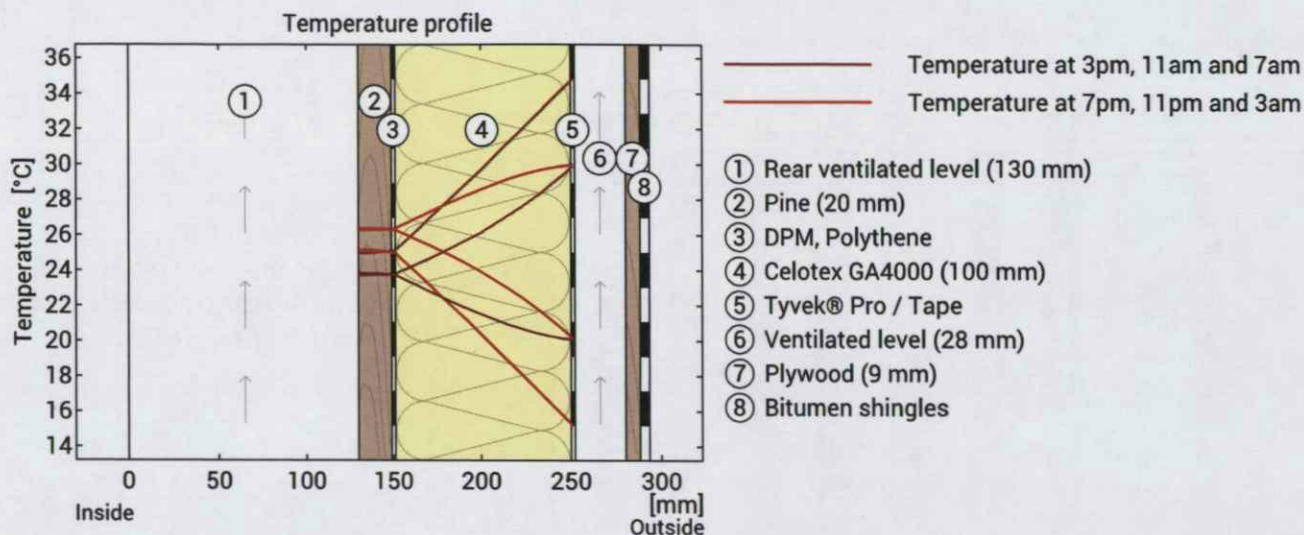
DIN 4108-3 describes in Section 5.3 components for which no moisture proofing is required as there is no risk of condensation water or the method is not suitable for the assessment. It is not possible to assess whether the component under test is underneath.

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.

roof, $U=0,262 \text{ W/m}^2\text{K}$

Heat protection

For the analysis of the heat protection, the temperature changes within the component were simulated during a hot summer 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*	6,2 h	Time of maximum interior temperature	21:15
Amplitude attenuation **	6,7	Thermal fluctuation on exterior surface:	19,6°C
TAV ***	0,150	Temperature fluctuation on interior surface	2,9°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: $TAV = 1 / \text{amplitude attenuation}$

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