thomson architecture inc

R 2x10 3xGPS Econo Crawlspace

Floor
created on 17.4.2025

Thermal protection

RSI = 6.066 m²K/W

DIN 4108*: R>1,74 m²K/W + R_{si} + R_{se}

excellent insufficient

Moisture proofing

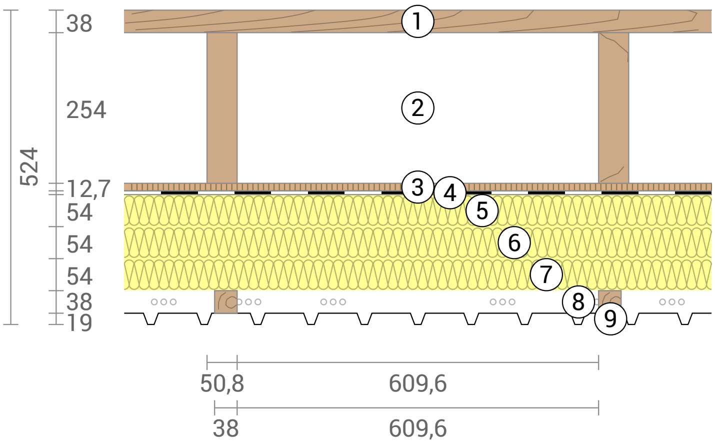
Drying reserve: 605 g/m²a
No condensate

excellent insufficient

Heat protection

Temperature amplitude damping: 17
phase shift: 7,9 h
Thermal capacity inside: 54 kJ/m²K

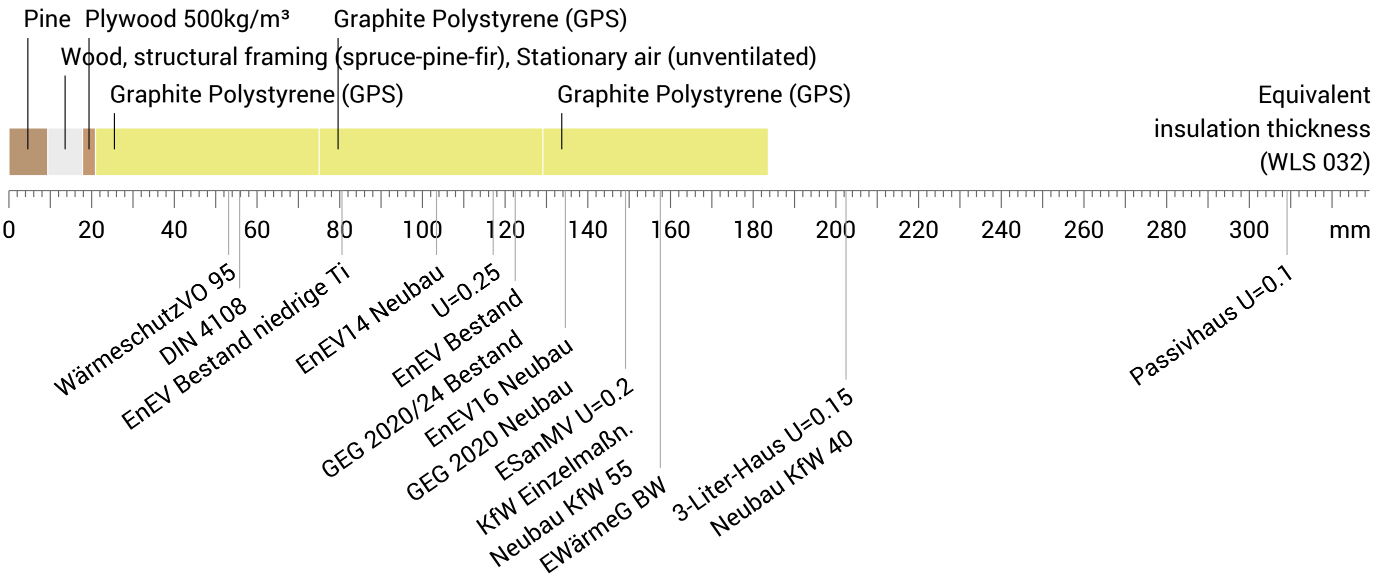
excellent insufficient



1. Pine (38 mm)
2. Stationary air (254 mm)
3. Plywood 500kg/m³ (12,7 mm)
4. Majrex 200
5. Graphite Polystyrene (54 mm)
6. Graphite Polystyrene (54 mm)
7. Graphite Polystyrene (54 mm)
8. Rear ventilated level (38 mm)
9. trapezoidal sheet (19 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 0,032 W/mK.



Inside air :	20.0°C / 50%		Thickness:	52,4 cm
Outside air:	-20.0°C / 80%	sd-value: 19,8 m	Weight:	41 kg/m²
Surface temperature.:	18,8°C / -19,7°C		Heat capacity:	60 kJ/m²K

☑ BEG Einzelmaßn. ☑ GEG 2020/24 Bestand ☑ GEG 2023/24 Neubau ☑ DIN 4108

*Comparison of the U-value with den techn. Mindestanforderungen für BEG Einzelmaßnahmen; den Höchstwerten aus GEG Anlage 7 (GEG 2020-2024 Bestand); 70% des U-Werts der Referenzausführung aus GEG 2023/2024 Anlage 1 (GEG Neubau); den R-Werten aus DIN 4108-2 Tabelle 3

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R 2x10 3xGPS Econo Crawlspace, RSI=6.066 m²K/W

U-Value calculation according to DIN EN ISO 6946

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,170
1	Pine	3,80	0,130	0,292
2	Stationary air (unventilated)	25,40	1,037	0,245
	Wood, structural framing (spruce-pine-fir) (7.7%)	25,40	0,118	2,159
3	Plywood 500kg/m³	1,27	0,130	0,098
4	Majrex 200	0,03	2,300	0,000
5	Graphite Polystyrene (GPS)	5,40	0,032	1,688
6	Graphite Polystyrene (GPS)	5,40	0,032	1,688
7	Graphite Polystyrene (GPS)	5,40	0,032	1,688
	Thermal contact resistance outside (Rse)			0,170

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

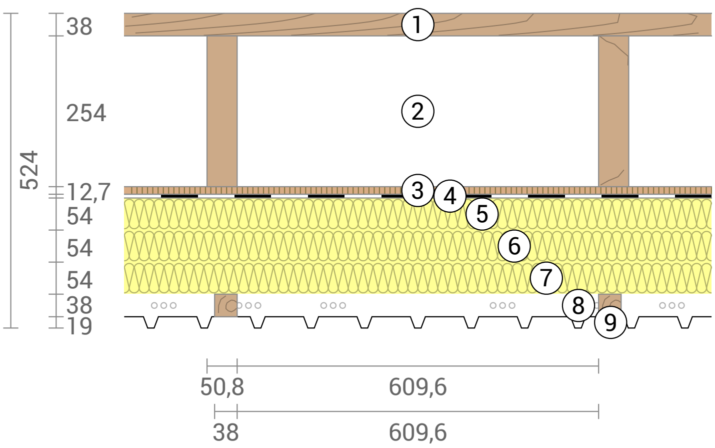
Thermal transfer resistances of resting air layers were calculated as follows:
Layer 2.1: Thickness 25.4 cm, Width 60.96 cm, DIN EN ISO 6946 Appendix D.4, heat flow direction downward, Temperature ca. 16°C, Emissionsgrad der Oberflächen: 0.9

Upper limit of thermal resistance $R_{tot;upper}$ = 6,152 m²K/W.
Lower limit of thermal resistance $R_{tot;lower}$ = 6,056 m²K/W.
Check applicability: $R_{tot;upper}$ / $R_{tot;lower}$ = 1,016 (maximum allowed: 1,5)

The procedure may be used.

Thermal resistance R_{tot} = ($R_{tot;upper}$ + $R_{tot;lower}$)/2 = 6.104 m²K/W
Estimated maximum relative uncertainty according to section 6.7.2.5: 0.79%

Heat transfer coefficient U = 1/R_{tot} = **0,16 W/(m²K)**



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R 2x10 3xGPS Econo Crawlspace, RSI=6.066 m²K/W

LCA

Heat loss: 17 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.

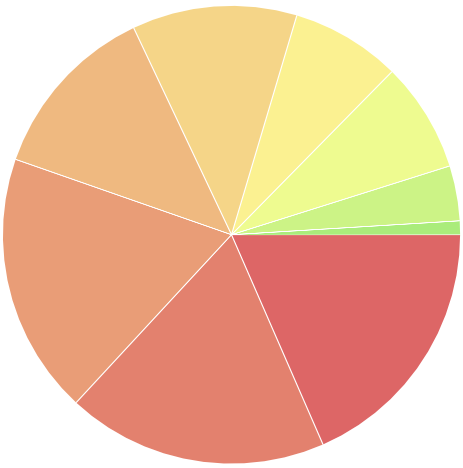
Primary energy (non renewable): 104 kWh/m²

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: -42 kg CO2 Äqv./m²

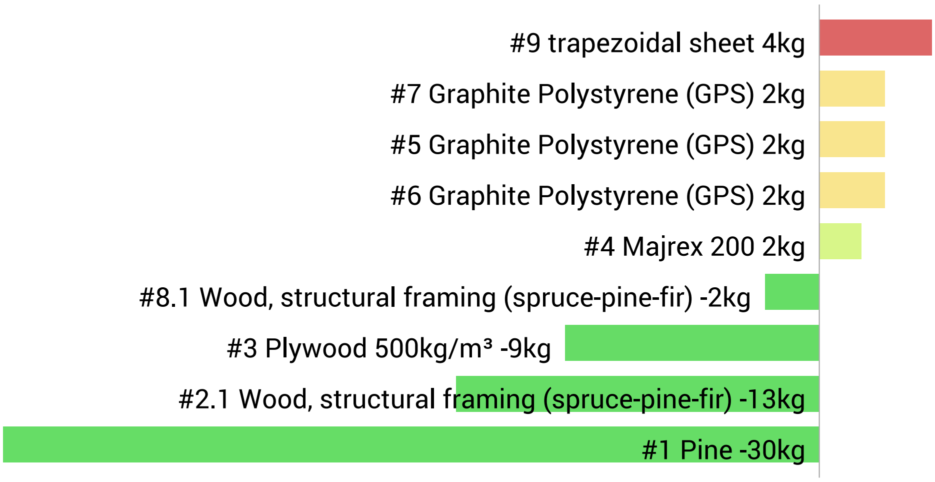
For the production of the building materials used, more greenhouse gases were withdrawn from the atmosphere than emitted.

Composition of non-renewable primary energy of production:



- Graphite Polystyrene (54 mm) 18%
- Graphite Polystyrene (54 mm) 18%
- Graphite Polystyrene (54 mm) 18%
- trapezoidal sheet (19 mm) 13%
- Plywood 500kg/m³ (12,7 mm) 12%
- Pine (38 mm) 8%
- Majrex 200 8%
- Wood, structural framing (254x50.8) 4%
- Wood, structural framing (38x38) 1%

Composition of the greenhouse potential of production:



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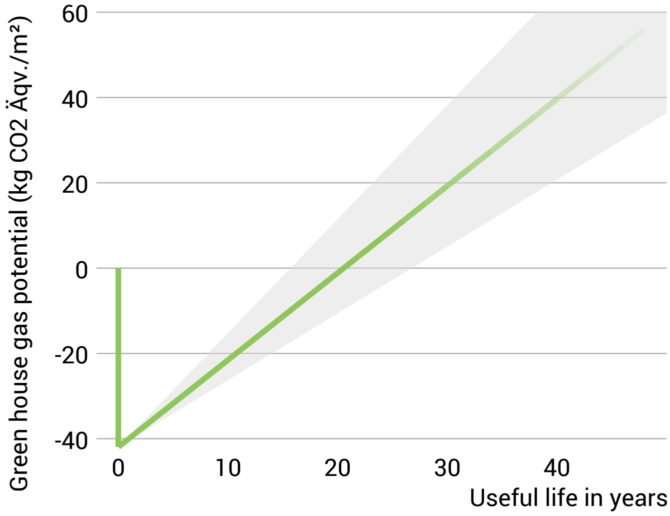
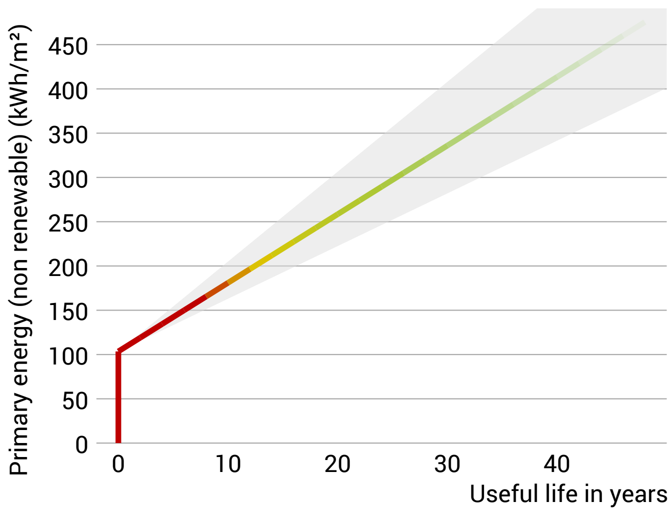
Global warming potential and primary energy for construction and use





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).

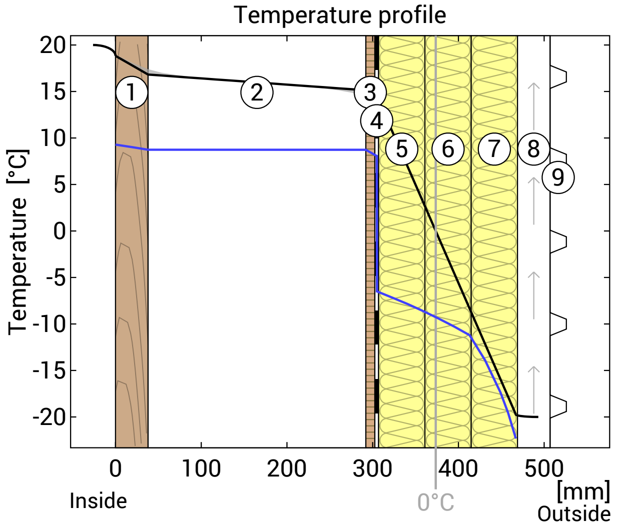
Hints

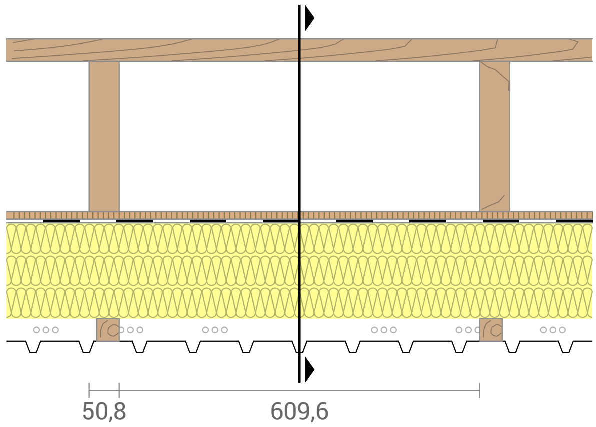
Calculated for the location ON:BARRIE-ORO, heating period from Mid of October to End of April. The calculation is based on monthly average temperatures. Source: Canadian Weather Year for Energy Calculation (2016)

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.

R 2x10 3xGPS Econo Crawlspace, RSI=6.066 m²K/W

Temperature profile





① Pine (38 mm)
② Stationary air (254 mm)
③ Plywood 500kg/m³ (12,7 mm)
④ Majrex 200
⑤ Graphite Polystyrene (54 mm)
⑥ Graphite Polystyrene (54 mm)
⑦ Graphite Polystyrene (54 mm)
⑧ Rear ventilated level (38 mm)
⑨ trapezoidal sheet (19 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]	RSI [m²K/W]	Temperatur [°C] min	max	Weight [kg/m²]
		Thermal contact resistance*		0,170	18,8	20,0	
1	3,8 cm	Pine	0,130	0,292	16,8	19,0	19,8
2	25,4 cm	Stationary air (unventilated)	1,037	0,245	14,9	17,0	0,3
	25,4 cm	Wood, structural framing (spruce-pine-fir) (7.7%)	0,118	2,159	14,4	17,4	8,8
3	1,27 cm	Plywood 500kg/m³	0,130	0,098	13,9	15,1	6,4
4	0,03 cm	Majrex 200	2,300	0,000	13,9	14,5	0,2
5	5,4 cm	Graphite Polystyrene (GPS)	0,032	1,688	2,9	14,5	0,8
6	5,4 cm	Graphite Polystyrene (GPS)	0,032	1,688	-8,4	3,1	0,8
7	5,4 cm	Graphite Polystyrene (GPS)	0,032	1,688	-19,7	-8,3	0,8
		Thermal contact resistance*		0,040	-20,0	-19,7	
8	3.8 cm	Rear ventilated level (outside air)			-20,0	-20,0	0,0
9	1.9 cm	trapezoidal sheet			-20,0	-20,0	1,9
	52.4 cm	Whole component		6,066			41,0

*Assuming free circulating air at the inside surface.

Surface temperature inside (min / average / max):	18,8°C	18,9°C	19,0°C
Surface temperature outside (min / average / max):	-19,7°C	-19,7°C	-19,7°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: -20°C und 80% Humidity (Climate according to user input).

Interior heat transfer resistance Rsi (user input deviating from DIN 4108-3):0.17 m²K/W

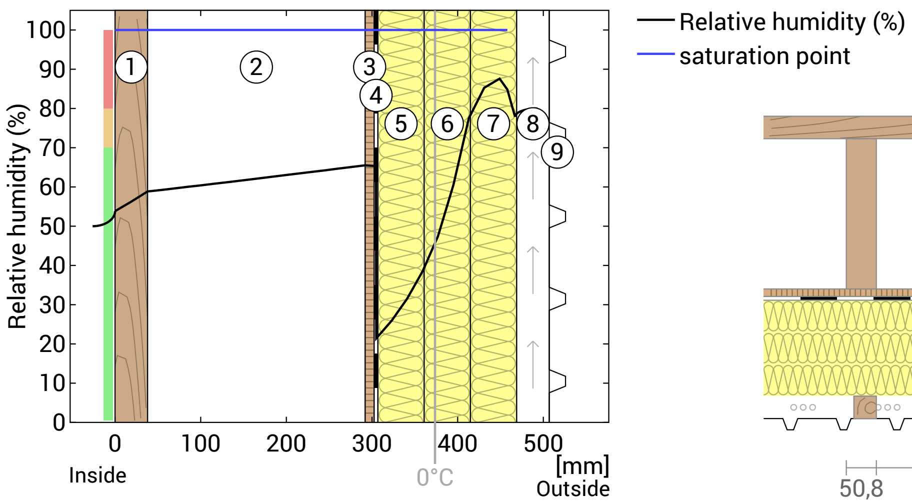
This component is free of condensate under the given climate conditions.

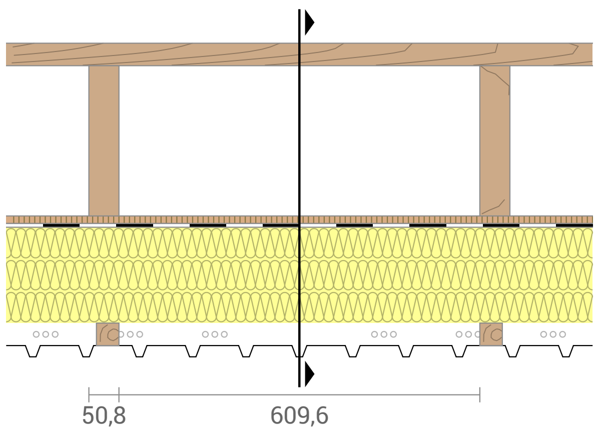
Drying reserve according to Ubakus 2D-FE method: 605 g/(m²a)
At least required by DIN 68800-2: 100 g/(m²a)

#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	3,8 cm	Pine	0,76	-	-	19,8
2	25,4 cm	Stationary air (unventilated)	0,01	-		0,3
	25,4 cm	Wood, structural framing (spruce-pine-fir) (7.7%)	5,08	-	-	8,8
3	1,27 cm	Plywood 500kg/m³	0,89	-	-	6,4
4	0,03 cm	Majrex 200	13,00	-		0,2
5	5,4 cm	Graphite Polystyrene (GPS)	1,08	-		0,8
6	5,4 cm	Graphite Polystyrene (GPS)	1,08	-		0,8
7	5,4 cm	Graphite Polystyrene (GPS)	2,70	-		0,8
	52.4 cm	Whole component	19,75	0		41,0

Humidity

The temperature of the inside surface is 18,8 °C leading to a relative humidity on the surface of 54%.Mould formation is not expected under these conditions.
The following figure shows the relative humidity inside the component.





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⑧ Rear ventilated level (38 mm)
⑨ trapezoidal sheet (19 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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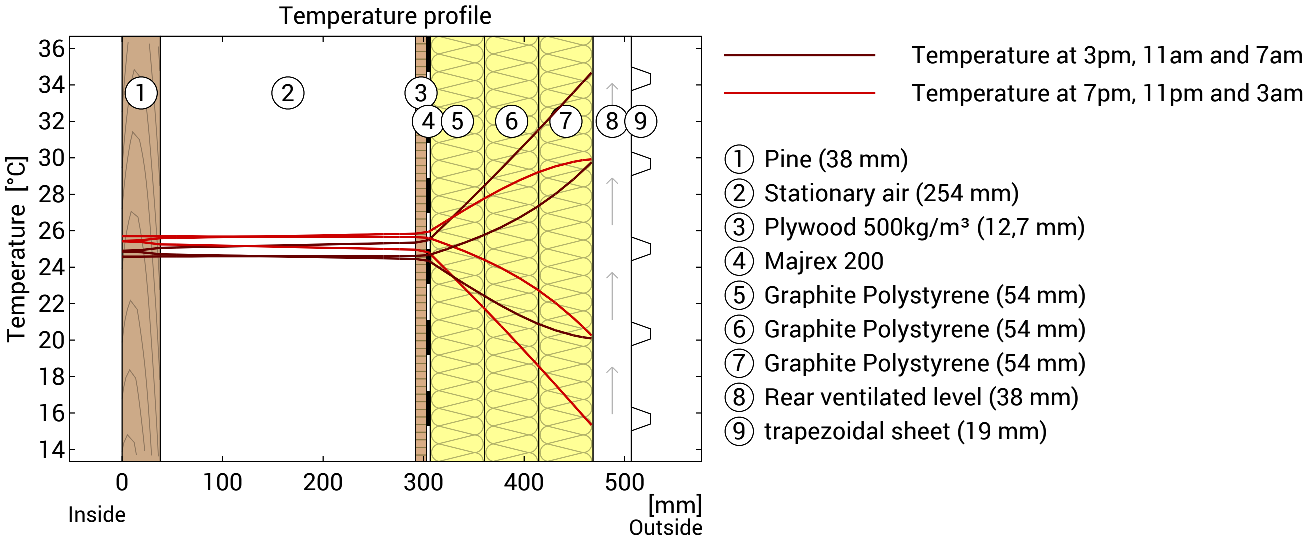
Moisture protection in accordance with DIN 4108-3:2018 Appendix A

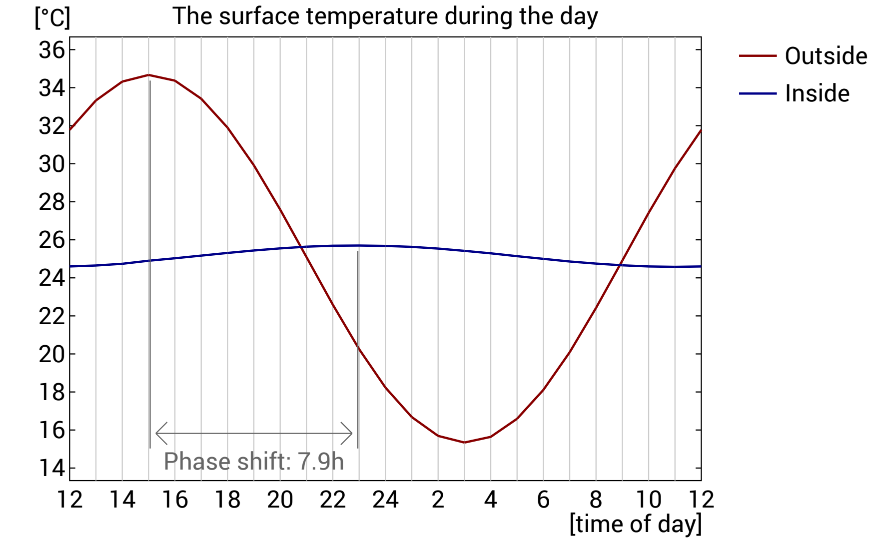
The temperatures and / or humidities you specify are not in accordance with DIN 4108-3. The following values are given by DIN 4108-3: 20°C / 50% humidity inside and -5°C / 80% humidity outside. Change the values in the input form to enable the calculation according to DIN 4108-3.

R 2x10 3xGPS Econo Crawlspace, RSI=6.066 m²K/W

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*	7,9 h	Heat storage capacity (whole component):	60 kJ/m²K
Amplitude attenuation **	17,2	Thermal capacity of inner layers:	54 kJ/m²K
TAV ***	0,058		

* 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.

Hints

Mindestwärmeschutz nach DIN 4108-2

Der Höchstwert U < 0.48 W/m²K gilt nur für homogene Bauteile ohne Abdichtungen. Daneben gilt gemäß Absatz 5.1.3 die folgende Anforderung:

"Bei thermisch inhomogenen Bauteilen, wie sie beispielsweise bei Skelett-, Rahmen- oder Holzständerbauweisen, aber auch bei Fassaden als Pfosten-Riegel-Konstruktion vorkommen, ist im Bereich des Gefachs ein Wärmedurchlasswiderstand $R_G \geq$ 1,75 m²K/W einzuhalten. Zusätzlich gilt für das gesamte Bauteil im Mittel ein Anforderungswert von $R_m \geq$ 1,0 m²K/W."

Für Umkehrdächer und Perimeterdämmungen beschreibt Absatz 5.2.2 zusätzliche Anforderungen.

Die Einhaltung dieser Anforderungen (falls zutreffend) ist vom verantwortlichen Planer zu prüfen.

Rear ventilation level

The thickness of the rear ventilation level is 3.8 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.

Non-ventilated air layers

A stationary air layer is a cavity enclosed on all sides, which does not have any connections to the room or outside air. Two adjacent air layers are only calculated correctly if no air exchange is possible between the two layers, e.g. if the air layers are separated by a thin foil. Otherwise, the entire cavity must be modelled as a single layer.

An air layer as the most interiour or exterior layer of a building component, which thus has a connection to the room or outside air, is not considered a resting air layer. In this case, Ubakus tries to treat the air layer as a rear ventilation layer, room air or outside air. However, the calculation result may then contain significant uncertainties.

Resting air has a very low thermal conductivity. Above a certain layer thickness, however, convection occurs, which greatly reduces the insulation effect. If the layer thickness is more than 30 cm, the air layer can no longer be taken into account correctly.

If the air layer has openings to the outside air whose size exceeds 1,500 mm² per m length for vertical air layers or 1,500 mm² per m² surface for horizontal air layers, it is a rear ventilation layer. You will find rear ventilation levels in the building material menu under Various.