

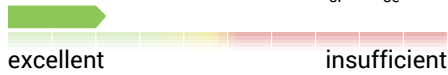
## STROP międzypietrowy

Ceiling

### Thermal protection

$U = 0,205 \text{ W}/(\text{m}^2\text{K})$

DIN 4108\*:  $R > 1,76 \text{ m}^2\text{K}/\text{W} + R_{si} + R_{se}$



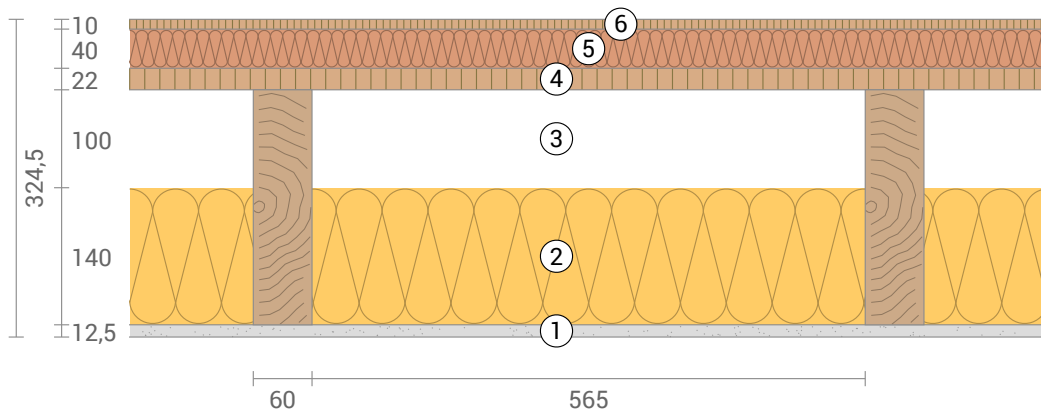
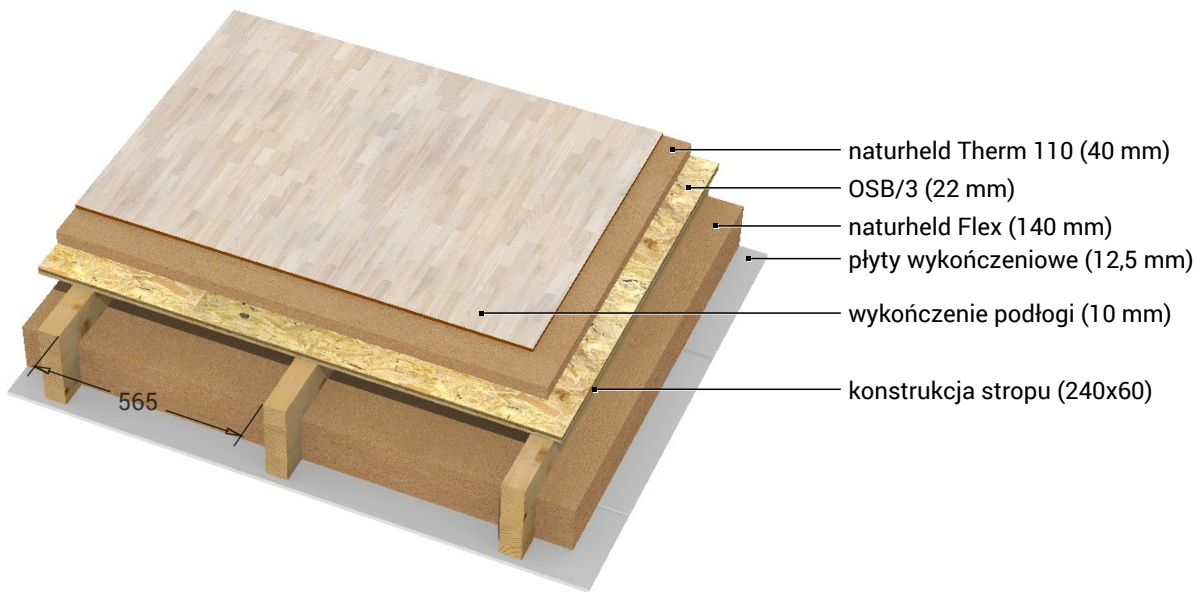
### Moisture proofing

Drying reserve:  $0 \text{ g}/\text{m}^2\text{a}$   
(leads to devaluation)  
No condensate



### Heat protection

Temperature amplitude damping: 13  
phase shift: 12,2 h  
Thermal capacity inside:  $32 \text{ kJ}/\text{m}^2\text{K}$



- |  |                               |
|--|-------------------------------|
| ① płyty wykończeniowe (12,5 mm)          | ④ OSB/3 (22 mm)               |
| ② naturheld Flex (140 mm)                | ⑤ naturheld Therm 110 (40 mm) |
| ③ pustka powietrzna/installacje (100 mm) | ⑥ wykończenie podłogi (10 mm) |

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

Inside air 2:  $20,0^\circ\text{C} / 50\%$

Surface temperature.:  $20,0^\circ\text{C} / 20,0^\circ\text{C}$

sd-value: 8,1 m

Drying reserve:  $0 \text{ g}/\text{m}^2\text{a}$

Thickness: 32,5 cm

Weight:  $48 \text{ kg}/\text{m}^2$

Heat capacity:  $79 \text{ kJ}/\text{m}^2\text{K}$

BEG Einzelmaßn.

GEG 2020/24 Bestand

GEG 2023/24 Neubau

DIN 4108

STROP międzypietrowy,  $U=0,205 \text{ W}/(\text{m}^2\text{K})$

## U-Value calculation according to DIN EN ISO 6946

#	Material	Dicke [cm]	$\lambda$ [W/mK]	R [m <sup>2</sup> K/W]
	Thermal contact resistance inside (Rsi)			0,100
1	plyty wykończeniowe	1,25	0,250	0,050
2	naturheld Flex konstrukcja stropu (Width: 6 cm)	14,00	0,036	3,889
3	pustka powietrzna/instalacje	24,00	0,130	1,846
4	OSB/3	10,00	0,631	0,158
5	naturheld Therm 110	2,20	0,130	0,169
6	wykończenie podłogi	4,00	0,041	0,976
	Thermal contact resistance outside (Rse)			0,100

Thermal contact resistances have been taken from DIN 6946 Table 7.

Rsi: heat flow direction upwards

Rse: heat flow direction upwards, outside: Heated room

Thermal transfer resistances of resting air layers were calculated as follows:

Layer 3: Thickness 10 cm, Width 56.5 cm, DIN EN ISO 6946 Appendix D.4, heat flow direction upwards, Temperature ca. 20°C, Emissionsgrad der Oberflächen: 0,9

Upper limit of thermal resistance  $R_{\text{tot;upper}} = 5,189 \text{ m}^2\text{K}/\text{W}$ .

Lower limit of thermal resistance  $R_{\text{tot;lower}} = 4,753 \text{ m}^2\text{K}/\text{W}$ .

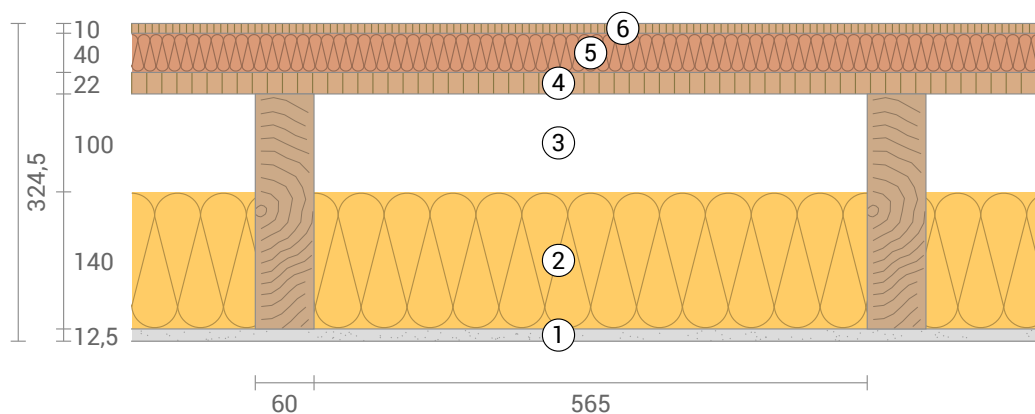
Check applicability:  $R_{\text{tot;upper}} / R_{\text{tot;lower}} = 1,092$  (maximum allowed: 1,5)

The procedure may be used.

Thermal resistance  $R_{\text{tot}} = (R_{\text{tot;upper}} + R_{\text{tot;lower}})/2 = 4,971 \text{ m}^2\text{K}/\text{W}$

Estimated maximum relative uncertainty according to section 6.7.2.5: 4,4%

Heat transfer coefficient  $U = 1/R_{\text{tot}} = 0,20 \text{ W}/(\text{m}^2\text{K})$



STROP międzypietrowy,  $U=0,205 \text{ W}/(\text{m}^2\text{K})$

### LCA

Heat loss:  $16 \text{ kWh}/\text{m}^2$  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):  $103 \text{ kWh}/\text{m}^2$



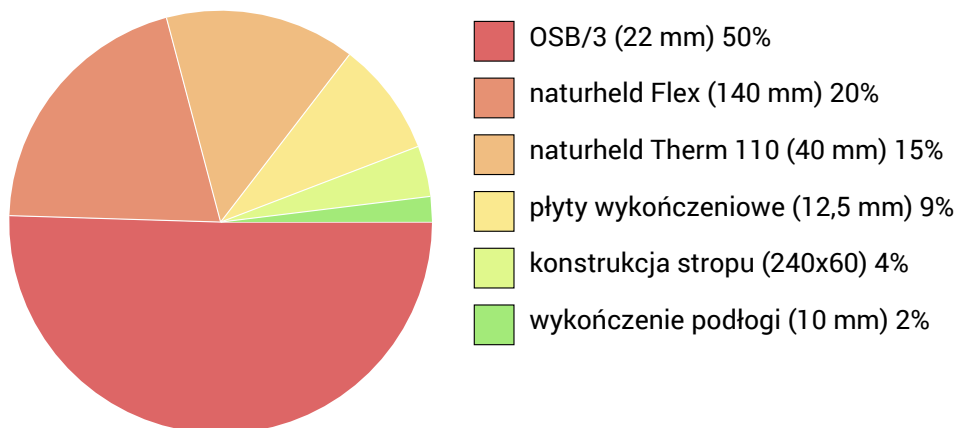
Non-renewable primary energy (= energy from fossil fuels and nuclear energy) that was used to produce the new building materials ("cradle to gate").

Green house gas potential:  $-45 \text{ kg CO}_2 \text{ Äqv.}/\text{m}^2$

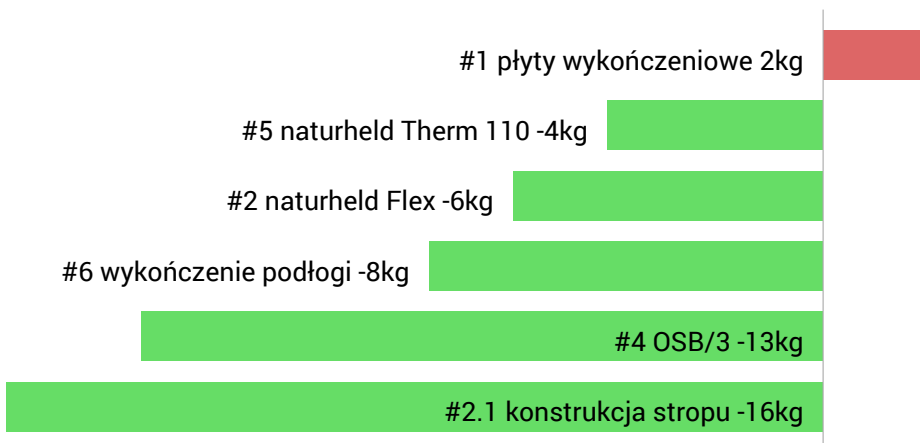


For the production of the building materials used, more greenhouse gases were withdrawn from the atmosphere than emitted.

Composition of non-renewable primary energy of production:

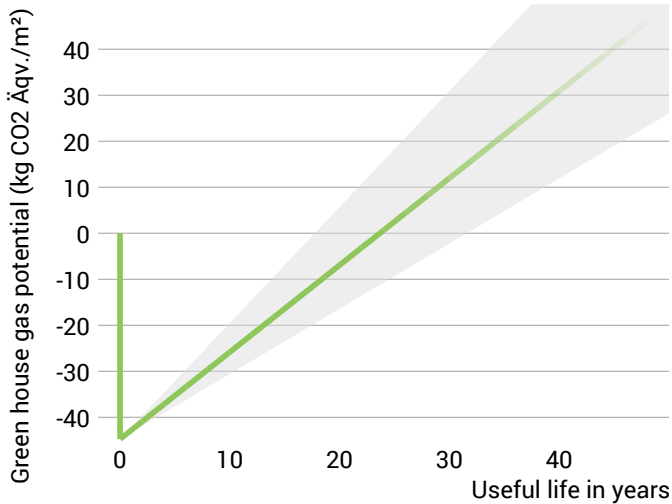


Composition of the greenhouse potential of production:



STROP międzypietrowy,  $U=0,205 \text{ W}/(\text{m}^2\text{K})$

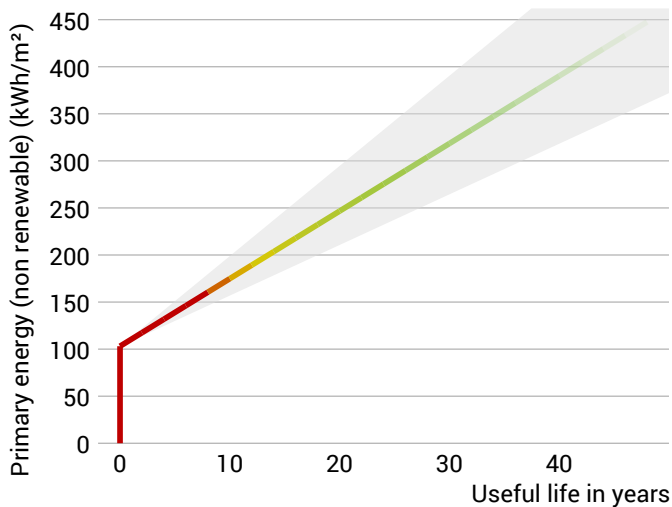
## Global warming potential and primary energy for construction and use



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  $4 \text{ kWh/a/m}^2$  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  $0,60 \text{ kWh}$  per  $\text{kWh}$  of heat and a global warming potential of  $0,16 \text{ kg CO}_2 \text{ eqv/m}^2$  per  $\text{kWh}$  of heat was used. Heat source: Heat pump (air-water).

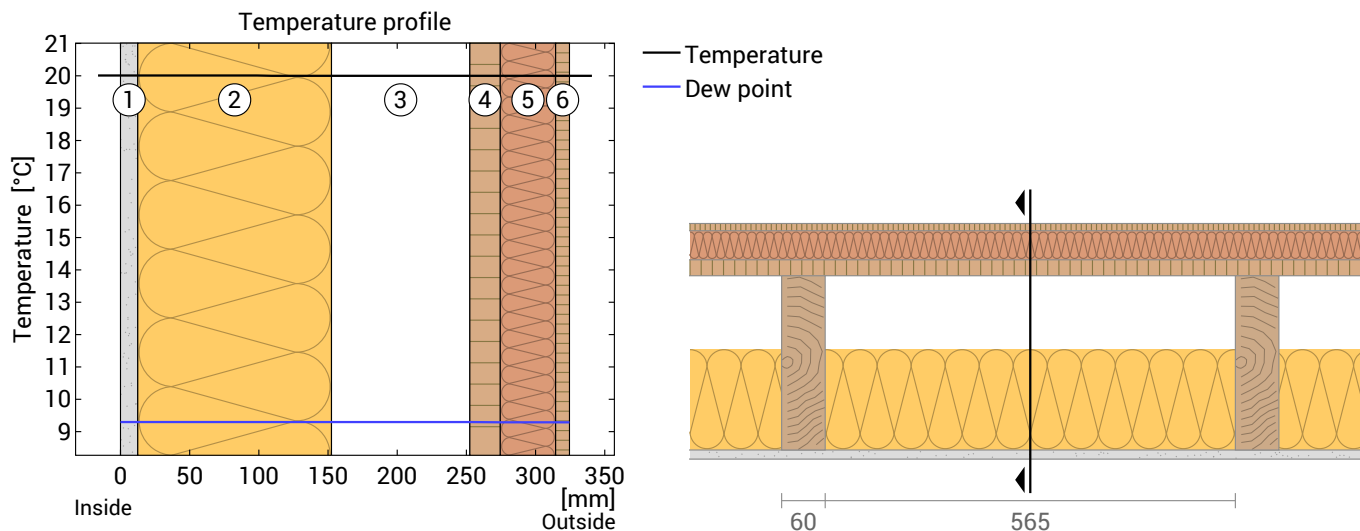
### Hints

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.

STROP międzypietrowy,  $U=0,205 \text{ W}/(\text{m}^2\text{K})$

## Temperature profile



- ① płyty wykończeniowe (12,5 mm)      ③ pustka powietrzna/instalacje (100 mm)      ⑤ naturheld Therm 110 (40 mm)  
 ② naturheld Flex (140 mm)              ④ OSB/3 (22 mm)                              ⑥ wykończenie podłogi (10 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	$\lambda$ [W/mK]	R [m <sup>2</sup> K/W]	Temperatur [°C]		Weight [kg/m <sup>2</sup> ]
				min	max	
	Thermal contact resistance*		0,250	20,0	20,0	
1	1,25 cm płyty wykończeniowe	0,250	0,050	20,0	20,0	8,5
2	14 cm naturheld Flex	0,036	3,889	20,0	20,0	6,3
	24 cm konstrukcja stropu (Width: 6 cm)	0,130	1,846	20,0	20,0	10,4
3	10 cm pustka powietrzna/instalacje	0,631	0,158	20,0	20,0	0,1
4	2,2 cm OSB/3	0,130	0,169	20,0	20,0	13,6
5	4 cm naturheld Therm 110	0,041	0,976	20,0	20,0	4,4
6	1 cm wykończenie podłogi	0,130	0,077	20,0	20,0	5,0
	Thermal contact resistance*		0,040	20,0	20,0	
	32,45 cm Whole component		4,878			48,3

\*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): 20,0°C 20,0°C 20,0°C

Surface temperature outside (min / average / max): 20,0°C 20,0°C 20,0°C

STROP międzypietrowy,  $U=0,205 \text{ W}/(\text{m}^2\text{K})$

## Moisture proofing

For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 20.01°C und 50% Humidity; outside: 20°C und 50% Humidity (Climate according to user input).

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

Drying reserve according to DIN 4108-3:2001: 0 g/(m<sup>2</sup>a)

At least required by DIN 68800-2: 100 g/(m<sup>2</sup>a)

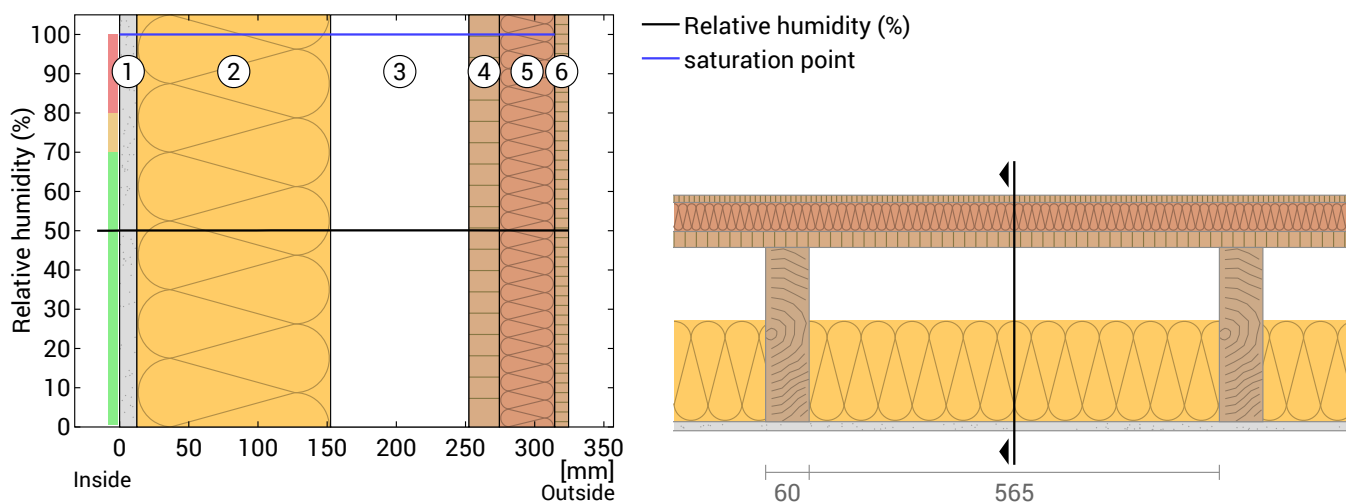
The moisture protection of this component is therefore rated poorly.

#	Material	sd-value [m]	Condensate [kg/m <sup>2</sup> ] [Gew.-%]	Weight [kg/m <sup>2</sup> ]
1	1,25 cm płyty wykończeniowe	0,05	-	8,5
2	14 cm naturheld Flex	0,28	-	6,3
	24 cm konstrukcja stropu (Width: 6 cm)	4,80	-	10,4
3	10 cm pustka powietrzna/instalacje	0,01	-	0,1
4	2,2 cm OSB/3	6,60	-	13,6
5	4 cm naturheld Therm 110	0,12	-	4,4
6	1 cm wykończenie podłogi	0,80	-	5,0
	32,45 cm Whole component	8,08	0	48,3

## Humidity

The temperature of the inside surface is 20,0 °C leading to a relative humidity on the surface of 50%. Mould formation is not expected under these conditions.

The following figure shows the relative humidity inside the component.



- ① płyty wykończeniowe (12,5 mm)      ③ pustka powietrzna/instalacje (100 mm)      ⑤ naturheld Therm 110 (40 mm)  
 ② naturheld Flex (140 mm)      ④ OSB/3 (22 mm)      ⑥ wykończenie podłogi (10 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.

STROP międzypietrowy,  $U=0,205 \text{ W}/(\text{m}^2\text{K})$

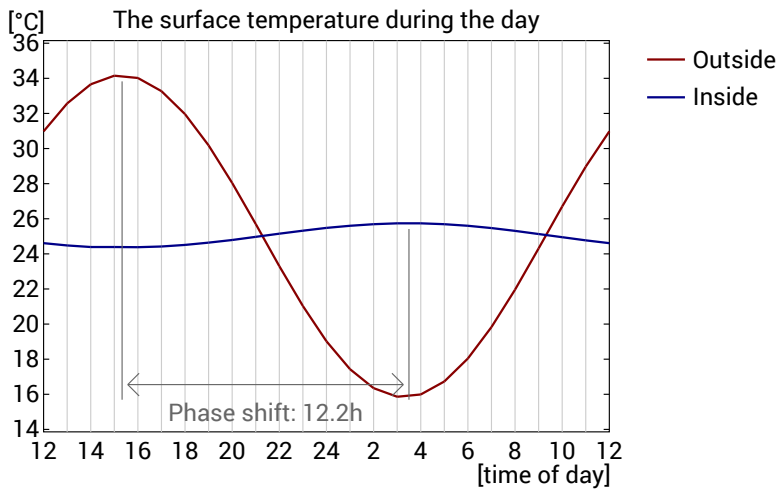
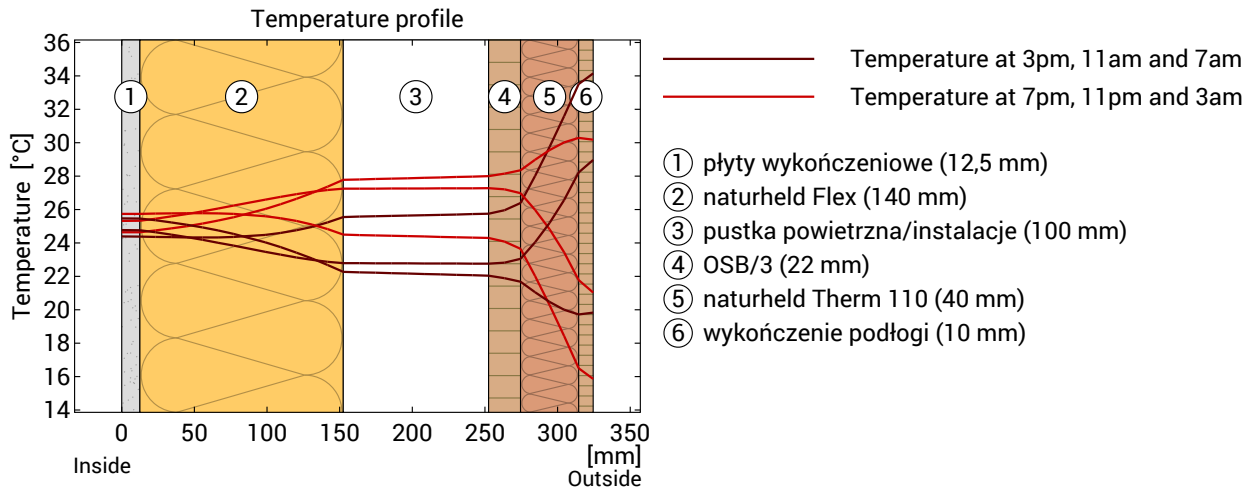
## Moisture protection in accordance with DIN 4108-3:2018 Appendix A

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.

STROP międzypietrowy,  $U=0,205 \text{ W}/(\text{m}^2\text{K})$

## 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*	12,2 h	Heat storage capacity (whole component):	79 kJ/m <sup>2</sup> K
Amplitude attenuation **	13,1	Thermal capacity of inner layers:	32 kJ/m <sup>2</sup> K
TAV ***	0,077		

\* 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:  $TAV = 1 / \text{amplitude attenuation}$

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.