

Roof construction

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created on 24.4.2018

Thermal protection

 $U = 0,235 \text{ W}/(\text{m}^2\text{K})$

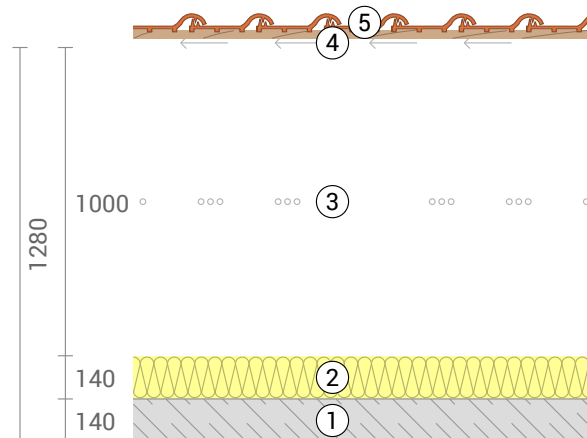
EnEV Bestand*: $U < 0,24 \text{ W}/(\text{m}^2\text{K})$


Moisture proofing

No condensate



Heat protection

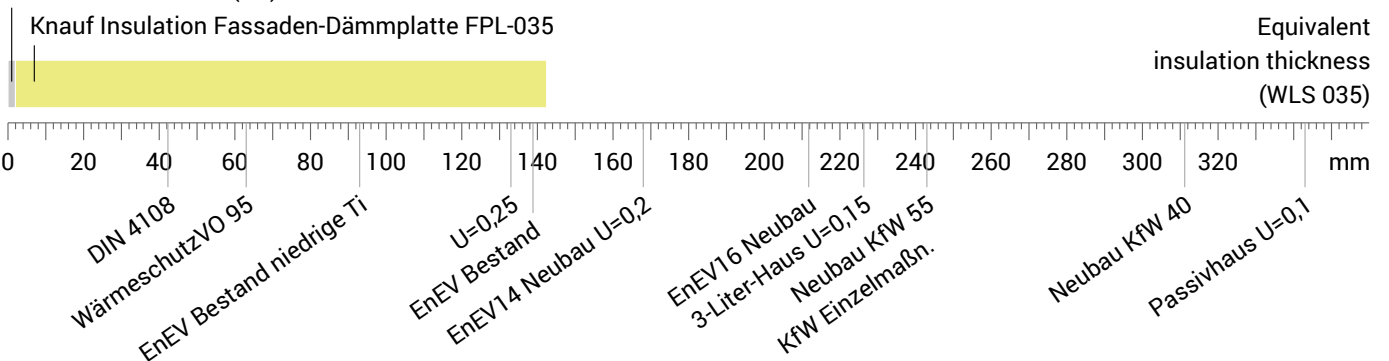
Temperature amplitude damping: 88
phase shift: 8,0 h
Thermal capacity inside: 281 kJ/m²K


- ① Reinforced concrete (140 mm)
- ② Knauf Insulation Fassaden-Dämmplatte FPL-035 (140 mm)
- ③ Rear ventilated level (1000 mm)
- ④ Rear ventilated level
- ⑤ Dachziegel inkl. Lattung

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 0,035 W/mK.

Reinforced concrete (2%)



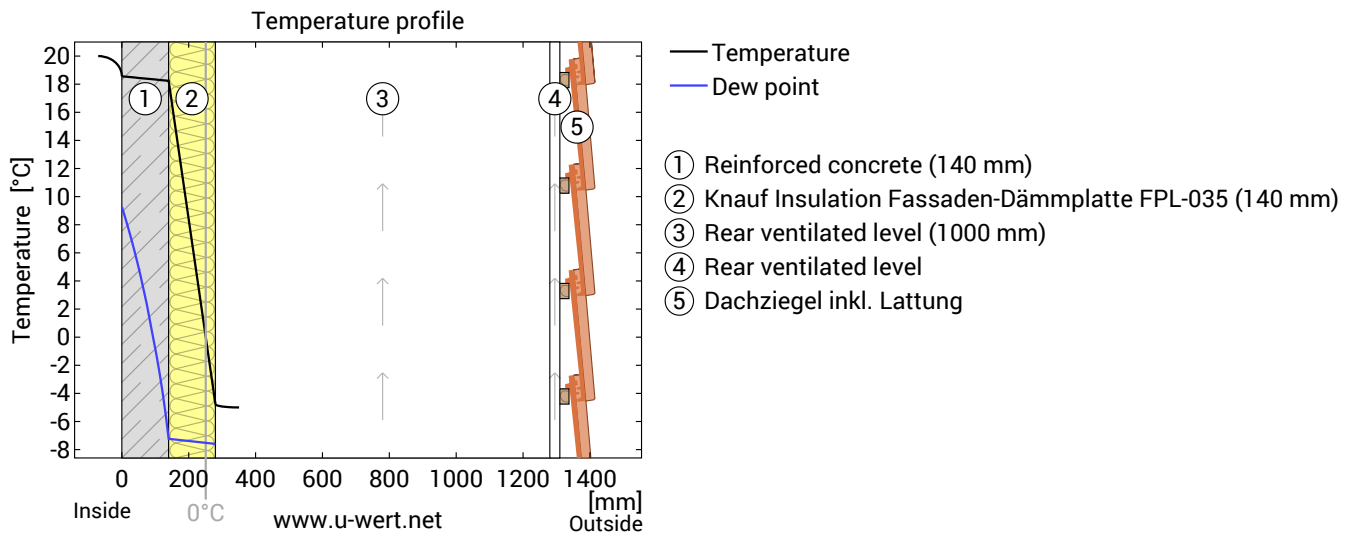
Inside air : 20,0°C / 50%
Outside air: -5,0°C / 80%
Surface temperature.: 18,6°C / -4,8°C

sd-value: 11,3 m

Thickness: 141,3 cm
Weight: 394 kg/m²
Heat capacity: 303 kJ/m²K

Roof construction, $U=0,23 \text{ W/(m}^2\text{K)}$

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 [m ² K/W]	Temperatur [°C]		Weight [kg/m ²]
				min	max	
	Thermal contact resistance*		0,100	18,6	20,0	
1	14 cm Reinforced concrete (2%)	2,500	0,056	18,2	18,6	336,0
2	14 cm Knauf Insulation Fassaden-Dämmplatte FPL-035	0,035	4,000	-4,8	18,2	7,0
	Thermal contact resistance*		0,100	-5,0	-4,8	
3	100 cm Rear ventilated level (outside air)			-5,0	-5,0	0,0
4	Rear ventilated level (outside air)			-5,0	-5,0	0,0
5	Dachziegel inkl. Lattung			-5,0	-5,0	51,5
141,3 cm Whole component			4,256			394,5

*Thermal contact resistances according to DIN 6946 for the U-value calculation. $R_{si}=0,25$ and $R_{se}=0,04$ according to DIN 4108-3 were used for moisture proofing and temperature profile.

Surface temperature inside (min / average / max): 18,6°C 18,6°C 18,6°C
Surface temperature outside (min / average / max): -4,8°C -4,8°C -4,8°C

Roof construction, $U=0,23 \text{ W}/(\text{m}^2\text{K})$

Moisture proofing

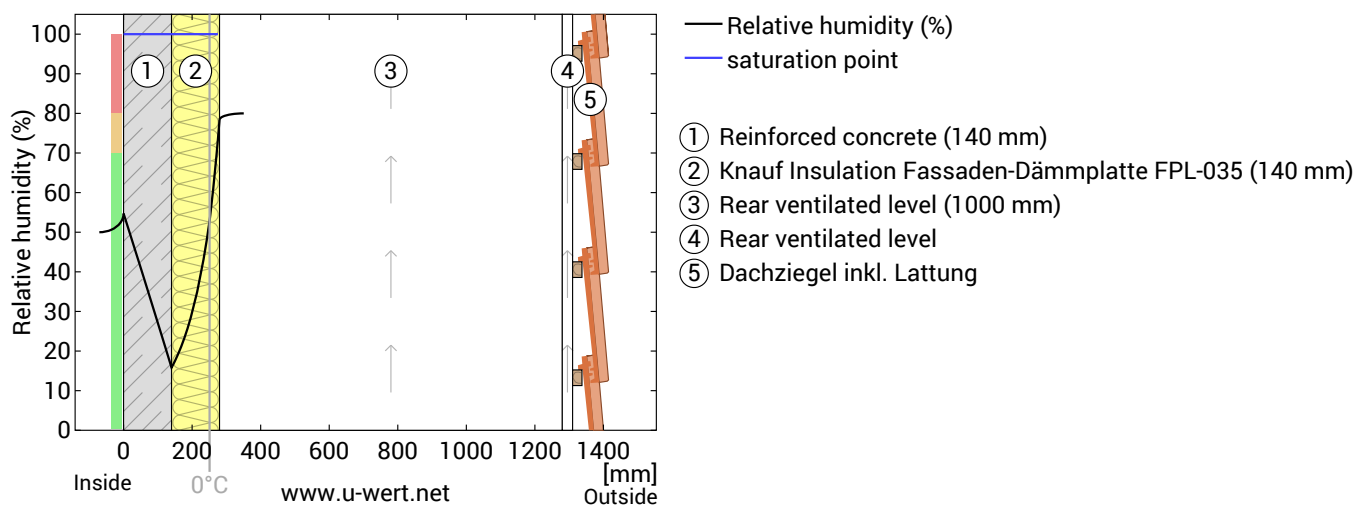
This component is free of condensate under the given climate conditions.

#	Material	sd-value [m]	Condensate [kg/m ²] [Gew.-%]	Weight [kg/m ²]
1	14 cm Reinforced concrete (2%)	11,20	-	336,0
2	14 cm Knauf Insulation Fassaden-Dämmplatte FPL-035	0,14	-	7,0
141,3 cm Whole component		11,34		394,5

Humidity

The temperature of the inside surface is 18,6 °C leading to a relative humidity on the surface of 55%.Mould formation is not expected under these conditions.

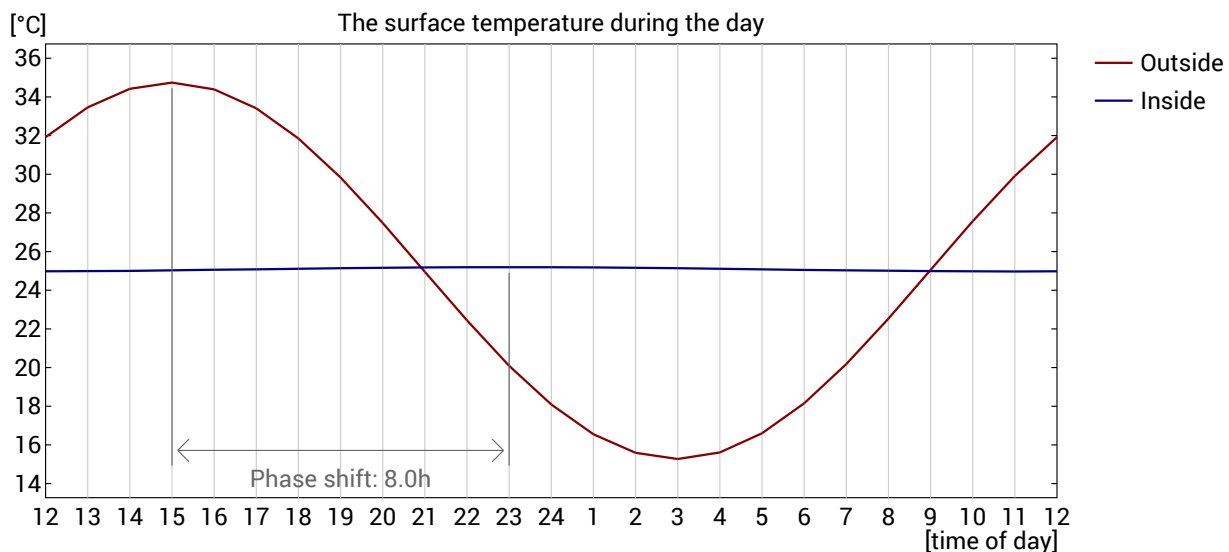
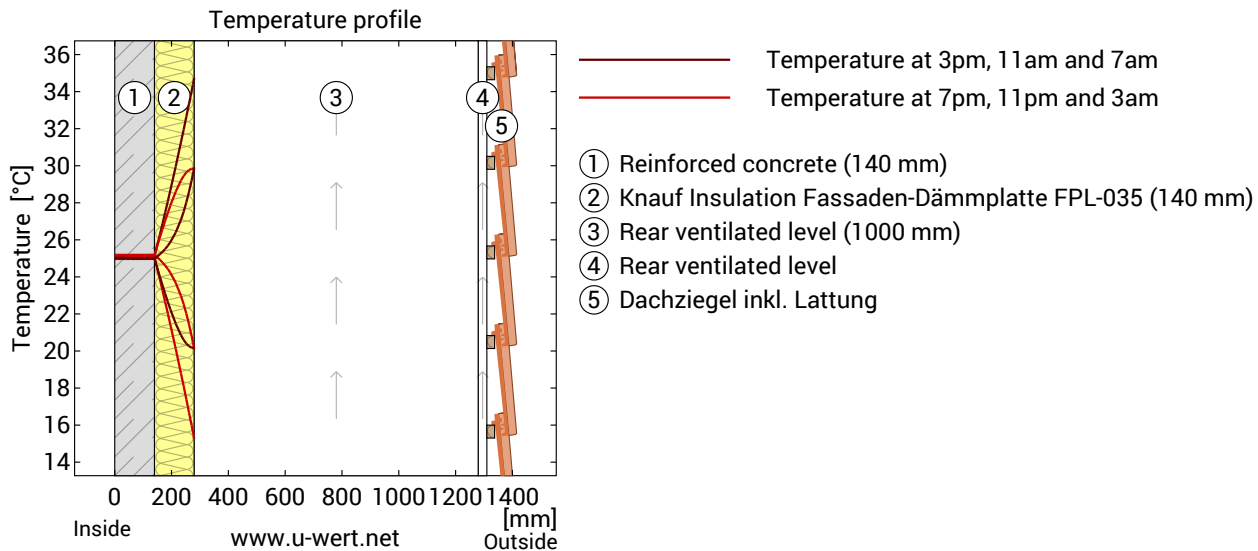
The following figure show the relative humidity inside the component.



Roof construction, $U=0,23 \text{ W/(m}^2\text{K)}$

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*	8,0 h	Time of maximum interior temperature	23:00
Amplitude attenuation **	88,5	Thermal fluctuation on exterior surface:	19,5°C
TAV ***	0,011	Temperature fluctuation on interior surface	0,2°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: $TAV = 1 / \text{amplitude attenuation}$