Roof A1

Roof construction
created on 16.9.2023

Thermal protection

U = 0,09 W/(m²K)

GEG 2020 Bestand*: U<0,24 W/(m²K)

excellent — insufficient

Moisture proofing

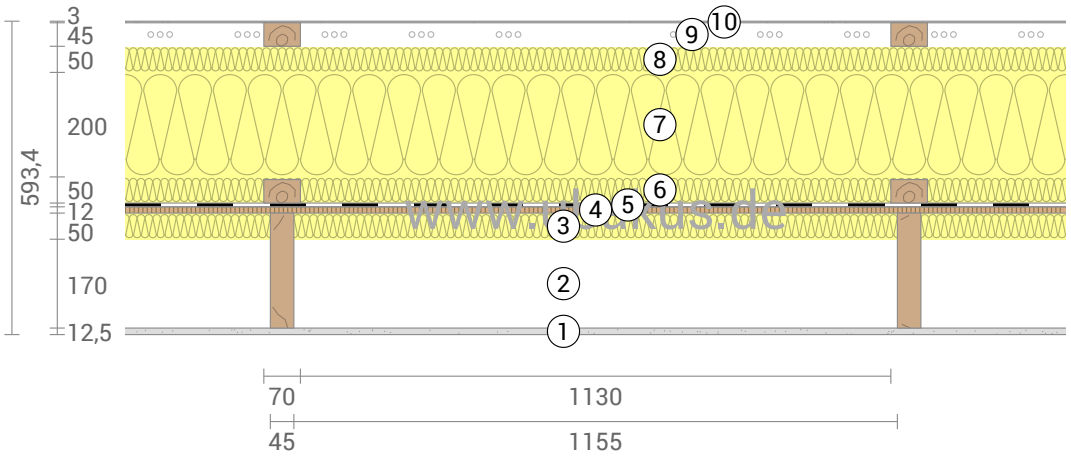
Dries 8 days
Condensate: 39 g/m²

excellent — insufficient

Heat protection

Temperature amplitude damping: 18
phase shift: 10,2 h
Thermal capacity inside: 27 kJ/m²K

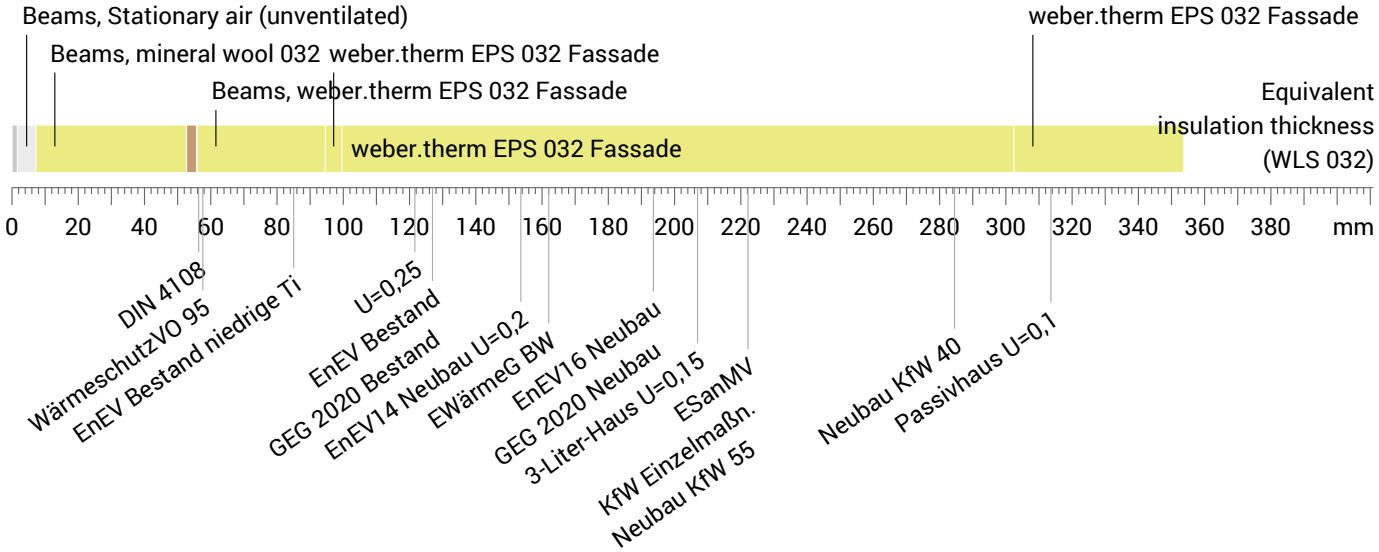
excellent — insufficient



1. Gypsum board (12,5 mm)
2. Stationary air (170 mm)
3. mineral wool 032 (50 mm)
4. Lamination (12 mm)
5. Majcoat 200
6. weber.therm EPS 032 Fassade (50 mm)
7. weber.therm EPS 032 Fassade (200 mm)
8. weber.therm EPS 032 Fassade (50 mm)
9. Rear ventilated level (45 mm)
10. Steel (3 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.

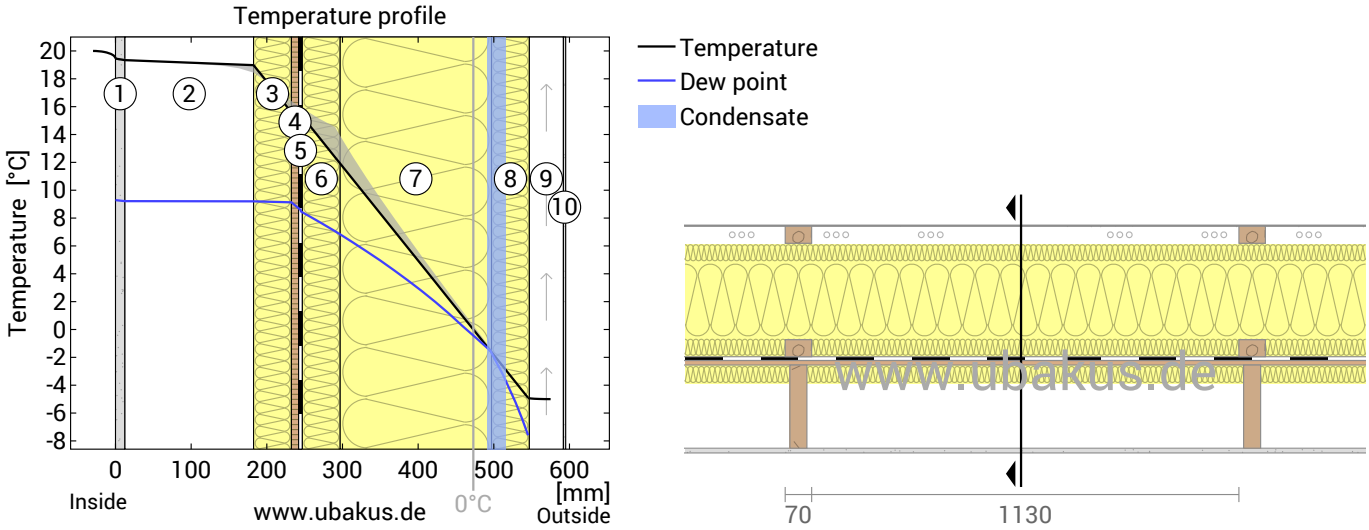


Inside air :	20,0°C / 50%			Thickness:	59,3 cm
Outside air:	-5,0°C / 80%	sd-value:	8,1 m	Weight:	51 kg/m²
Surface temperature.:	19,4°C / -4,9°C			Heat capacity:	32 kJ/m²K

*Vergleich mit dem Höchstwert gemäß GEG 2020 für erstmaligen Einbau, Ersatz oder Erneuerung von Decken, Dächer und Dachschrägen (Anlage 7, Zeile 5a,5b).

Roof A1, U=0,09 W/(m²K)

Temperature profile



① Gypsum board (12,5 mm)
② Stationary air (170 mm)
③ mineral wool 032 (50 mm)
④ Lamination (12 mm)
⑤ Majcoat 200
⑥ weber.therm EPS 032 Fassade (50 mm)
⑦ weber.therm EPS 032 Fassade (200 mm)
⑧ weber.therm EPS 032 Fassade (50 mm)
⑨ Rear ventilated level (45 mm)
⑩ Steel (3 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*		0,100	19,4	20,0	
1	1,25 cm	Gypsum board	0,250	0,050	19,3	19,5	8,5
2	17 cm	Stationary air (unventilated)	1,018	0,167	18,7	19,4	0,2
	22 cm	Beams (Width: 4,5 cm)	0,130	1,692	16,4	19,4	3,7
3	5 cm	mineral wool 032	0,032	1,563	15,6	19,0	1,0
4	1,2 cm	Lamination	0,130	0,092	15,4	16,4	6,0
5	0,09 cm	Majcoat 200 (SOB)	0,200	0,005	15,4	16,0	0,2
6	5 cm	weber.therm EPS 032 Fassade	0,032	1,563	12,0	15,9	0,9
	4,5 cm	Beams (Width: 7 cm)	0,130	0,346	14,4	15,9	1,2
7	20 cm	weber.therm EPS 032 Fassade	0,032	6,250	-1,5	14,1	3,6
8	5 cm	weber.therm EPS 032 Fassade	0,032	1,563	-4,9	-1,3	0,9
		Thermal contact resistance*		0,100	-5,0	-4,9	
9	4,5 cm	Rear ventilated level (outside air)			-5,0	-5,0	0,0
10	0,3 cm	Steel			-5,0	-5,0	23,4
	59,34 cm	Whole component		11,236			50,7

*Thermal contact resistances according to DIN 6946 for the U-value calculation. Rsi=0,25 and Rse=0,04 according to DIN 4108-3 were used for moisture proofing and temperature profile.

Surface temperature inside (min / average / max):	19,4°C	19,4°C	19,5°C
Surface temperature outside (min / average / max):	-4,9°C	-4,9°C	-4,9°C

Roof A1, U=0,09 W/(m²K)

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.

Under these conditions, a total of 0,039 kg of condensation water per square meter is accumulated.This quantity dries in summer in 8 days (Drying season according to DIN 4108-3:2018-10).

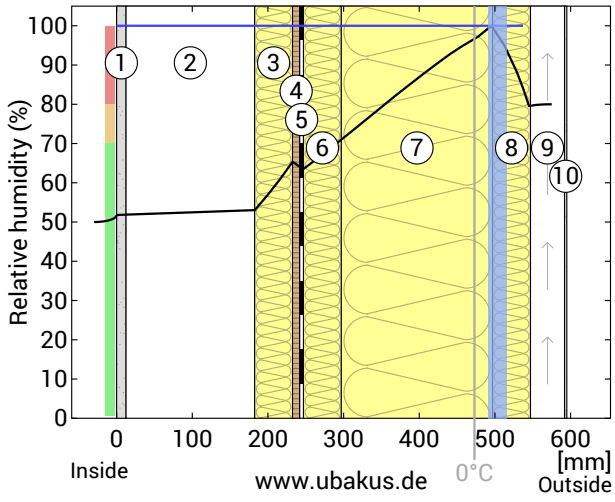
#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	1,25 cm	Gypsum board	0,05	-		8,5
2	17 cm	Stationary air (unventilated)	0,01	-		0,2
	22 cm	Beams (Width: 4,5 cm)	4,40	-	-	3,7
3	5 cm	mineral wool 032	0,05	-		1,0
4	1,2 cm	Lamination	0,36	-	-	6,0
5	0,09 cm	Majcoat 200 (SOB)	0,09	-		0,2
6	5 cm	weber.therm EPS 032 Fassade	1,00	-		0,9
	4,5 cm	Beams (Width: 7 cm)	0,90	-	-	1,2
7	20 cm	weber.therm EPS 032 Fassade	4,00	0,039		3,6
8	5 cm	weber.therm EPS 032 Fassade	2,50	0,039		0,9
	59,34 cm	Whole component	8,11	0,039		50,7

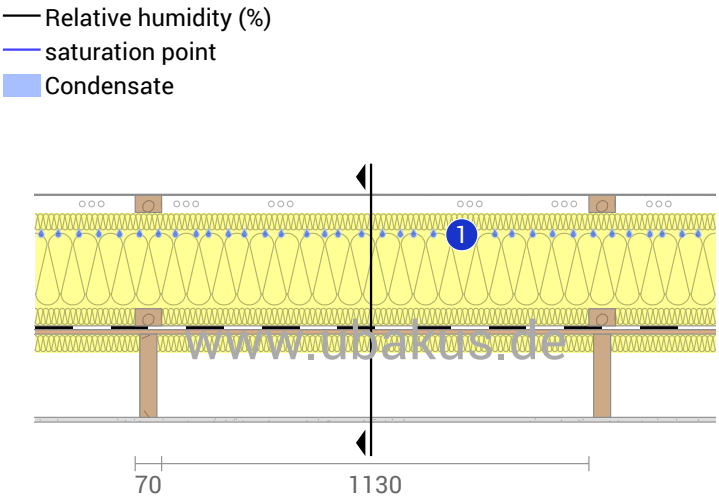
Condensation areas

1 Condensate: 0,039 kg/m² Affected layers: weber.therm EPS 032 Fassade, weber.therm EPS 032 Fassade

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 shows the relative humidity inside the component.





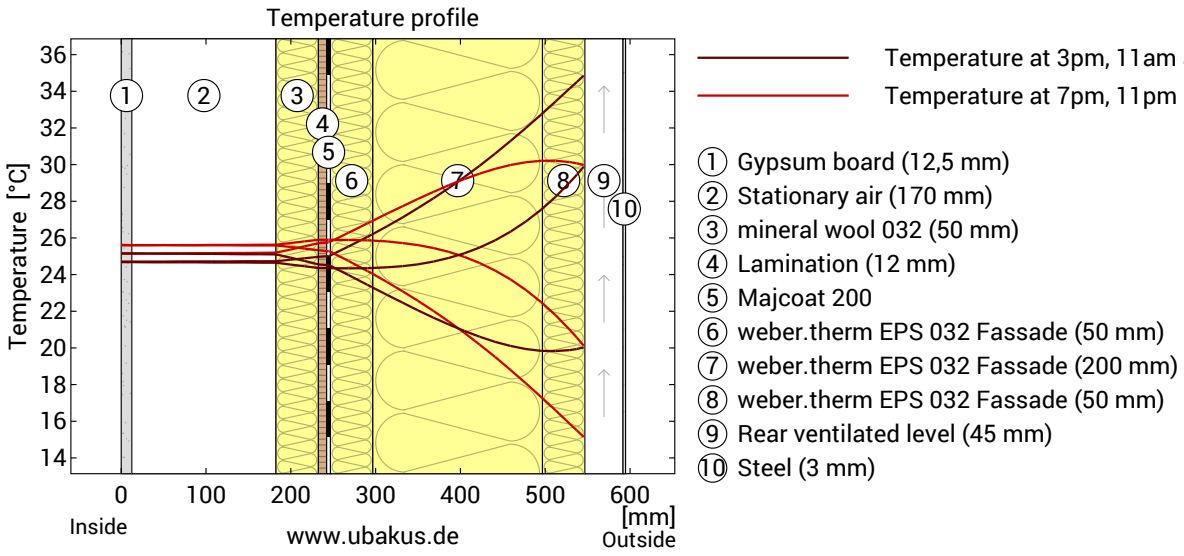
① Gypsum board (12,5 mm)
② Stationary air (170 mm)
③ mineral wool 032 (50 mm)
④ Lamination (12 mm)
⑤ Majcoat 200
⑥ weber.therm EPS 032 Fassade (50 mm)
⑦ weber.therm EPS 032 Fassade (200 mm)
⑧ weber.therm EPS 032 Fassade (50 mm)
⑨ Rear ventilated level (45 mm)
⑩ Steel (3 mm)

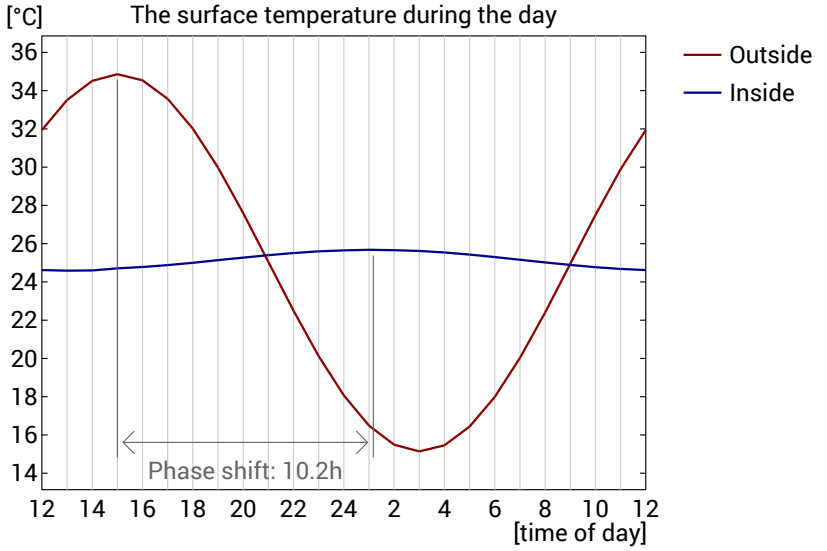
Notes: Calculation using the Ubakus 2D-FE method. Convection and the capillarity of the building materials were not considered. The drying time may take longer under unfavorable conditions (shading, damp / cool summers) than calculated here.

Roof A1, U=0,09 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*	10,2 h	Heat storage capacity (whole component):	32 kJ/m²K
Amplitude attenuation **	18,2	Thermal capacity of inner layers:	27 kJ/m²K
TAV ***	0,055		

* 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.