

Roof A2

Roof construction
created on 16.9.2023

Thermal protection

$U = 0,09 \text{ W/(m}^2\text{K)}$

GEG 2020 Bestand*: $U < 0,24 \text{ W/(m}^2\text{K)}$

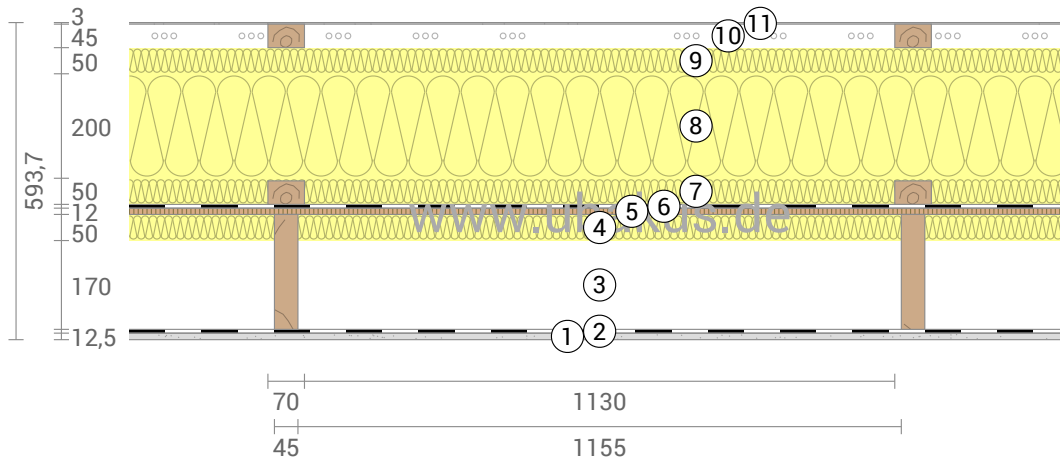


Moisture proofing

No condensate

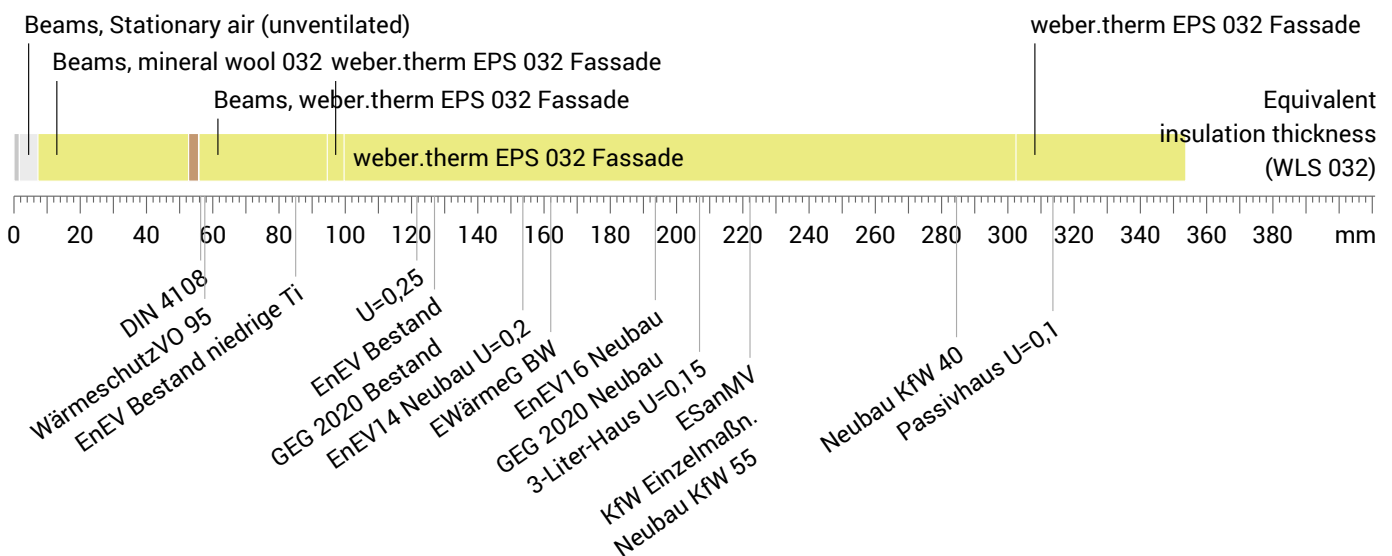
Heat protection

Temperature amplitude damping: 19
phase shift: 10,2 h
Thermal capacity inside: 27 kJ/m²K



- ① Gypsum board (12,5 mm)
- ② Majrex 200
- ③ Stationary air (170 mm)
- ④ mineral wool 032 (50 mm)
- ⑤ Lamination (12 mm)
- ⑥ Majcoat 200
- ⑦ weber.therm EPS 032 Fassade (50 mm)
- ⑧ weber.therm EPS 032 Fassade (200 mm)
- ⑨ weber.therm EPS 032 Fassade (50 mm)
- ⑩ Rear ventilated level (45 mm)
- ⑪ Steel (3 mm)

Impact of each layer and comparison to reference values



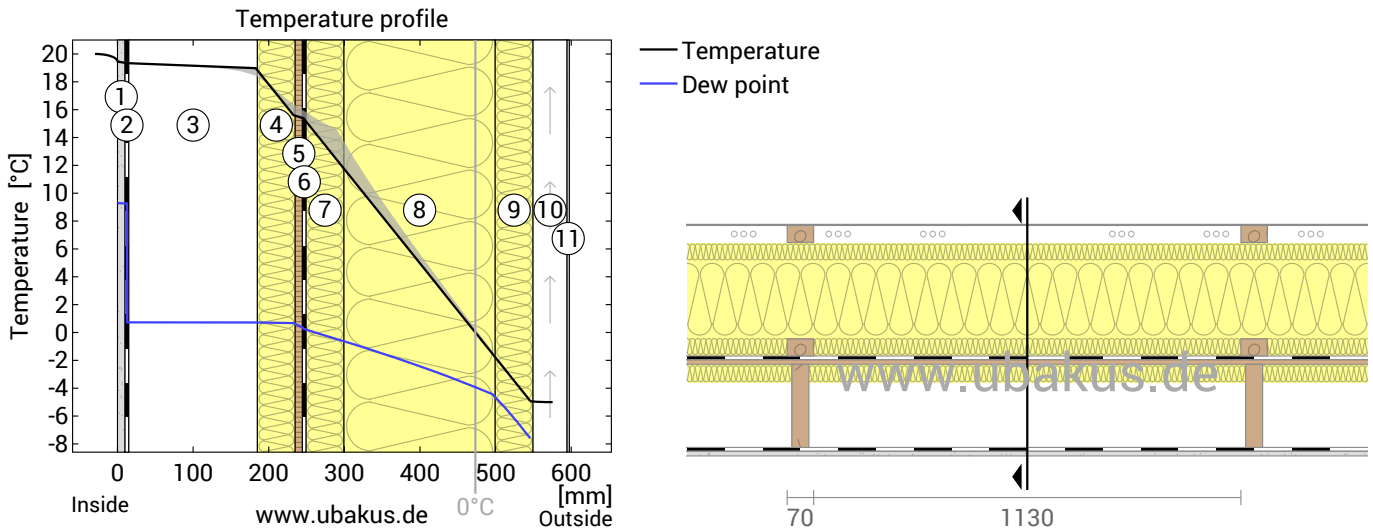
Inside air : 20,0°C / 50%
Outside air: -5,0°C / 80%
Surface temperature.: 19,4°C / -4,9°C

sd-value: 21,1 m

Thickness: 59,4 cm
Weight: 51 kg/m²
Heat capacity: 32 kJ/m²K

Roof A2, U=0,09 W/(m²K)

Temperature profile



- | | | |
|----------------------------|--|---------------------------------------|
| ① Gypsum board (12,5 mm) | ⑤ Lamination (12 mm) | ⑨ weber.therm EPS 032 Fassade (50 mm) |
| ② Majrex 200 | ⑥ Majcoat 200 | ⑩ Rear ventilated level (45 mm) |
| ③ Stationary air (170 mm) | ⑦ weber.therm EPS 032 Fassade (50 mm) | ⑪ Steel (3 mm) |
| ④ mineral wool 032 (50 mm) | ⑧ weber.therm EPS 032 Fassade (200 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]		Weight [kg/m²]
				min	max	
	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	0,03 cm Majrex 200	2,300	0,000	19,3	19,4	0,2
3	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
4	5 cm mineral wool 032	0,032	1,563	15,6	19,0	1,0
5	1,2 cm Lamination	0,130	0,092	15,4	16,4	6,0
6	0,09 cm Majcoat 200 (SOB)	0,200	0,005	15,4	16,0	0,2
7	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
8	20 cm weber.therm EPS 032 Fassade	0,032	6,250	-1,5	14,1	3,6
9	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	
10	4,5 cm Rear ventilated level (outside air)			-5,0	-5,0	0,0
11	0,3 cm Steel			-5,0	-5,0	23,4
59,37 cm Whole component			11,236			50,8

*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 A2, 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.

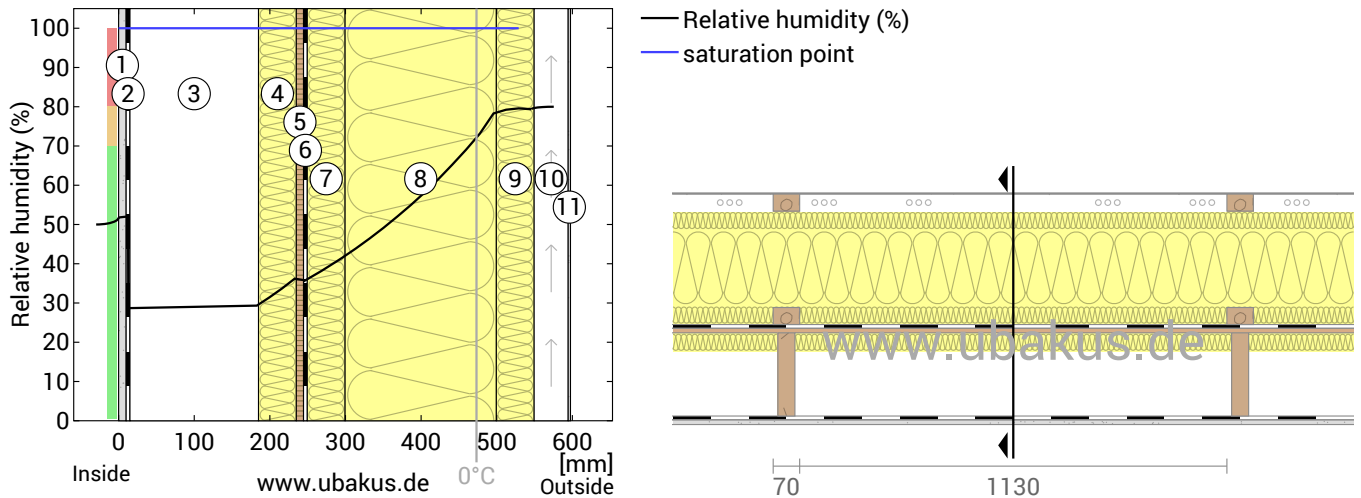
This component is free of condensate under the given climate conditions.

#	Material	sd-value [m]	Condensate [kg/m²] [Gew.-%]	Weight [kg/m²]
1	1,25 cm Gypsum board	0,05	-	8,5
2	0,03 cm Majrex 200	13,00	-	0,2
3	17 cm Stationary air (unventilated)	0,01	-	0,2
4	22 cm Beams (Width: 4,5 cm)	4,40	-	3,7
5	5 cm mineral wool 032	0,05	-	1,0
6	1,2 cm Lamination	0,36	-	6,0
7	0,09 cm Majcoat 200 (SOB)	0,09	-	0,2
8	5 cm weber.therm EPS 032 Fassade	1,00	-	0,9
9	4,5 cm Beams (Width: 7 cm)	0,90	-	1,2
10	20 cm weber.therm EPS 032 Fassade	4,00	-	3,6
11	5 cm weber.therm EPS 032 Fassade	2,50	-	0,9
59,37 cm Whole component		21,12	0	50,8

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.



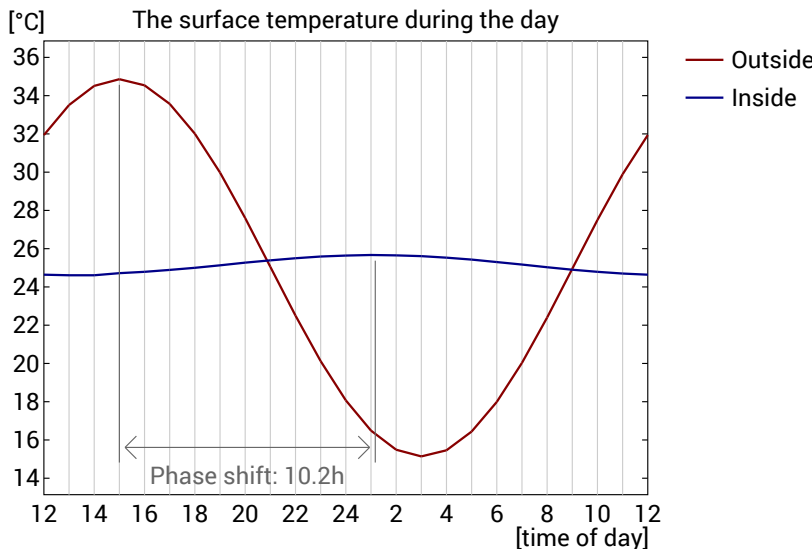
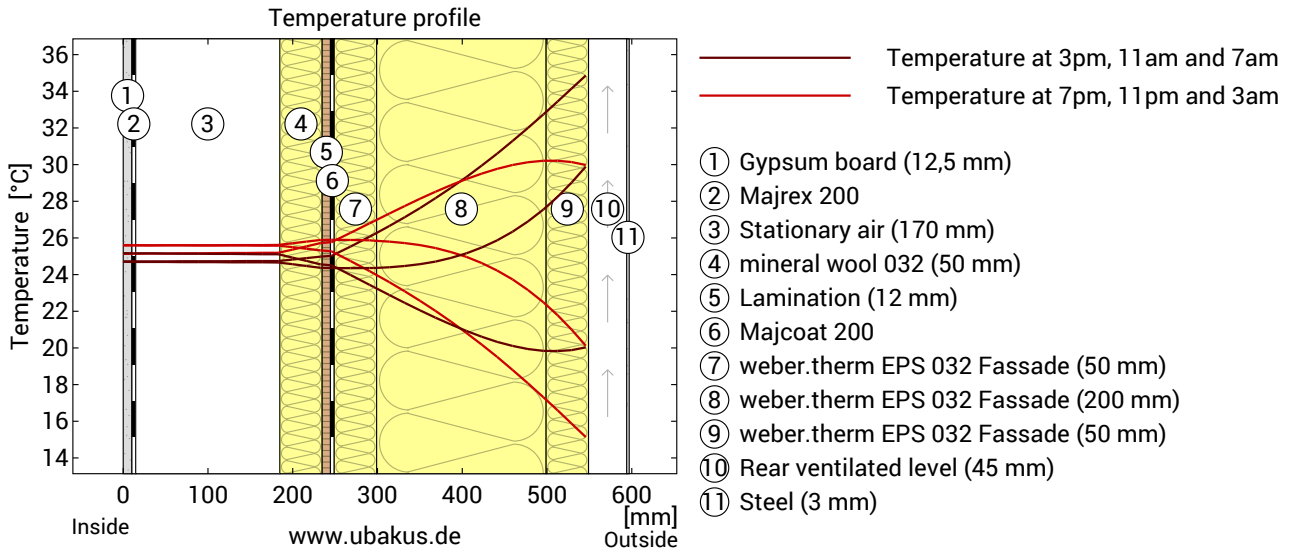
- | | | |
|----------------------------|--|---------------------------------------|
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| ② Majrex 200 | ⑥ Majcoat 200 | ⑩ Rear ventilated level (45 mm) |
| ③ Stationary air (170 mm) | ⑦ weber.therm EPS 032 Fassade (50 mm) | ⑪ Steel (3 mm) |
| ④ mineral wool 032 (50 mm) | ⑧ weber.therm EPS 032 Fassade (200 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 A2, 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 **	18,6	Thermal capacity of inner layers:	27 kJ/m²K
TAV ***	0,054		

* 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.