

MURO doblpost-PAJA-plywood-bv-tarima

Exterior wall
created on 11.7.2019

Strohballenwand mit tragendem Holzständerwerk und Verkleidung mit Plattenwerkstoffen.

Thermal protection

$U = 0,14 \text{ W/(m}^2\text{K)}$

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



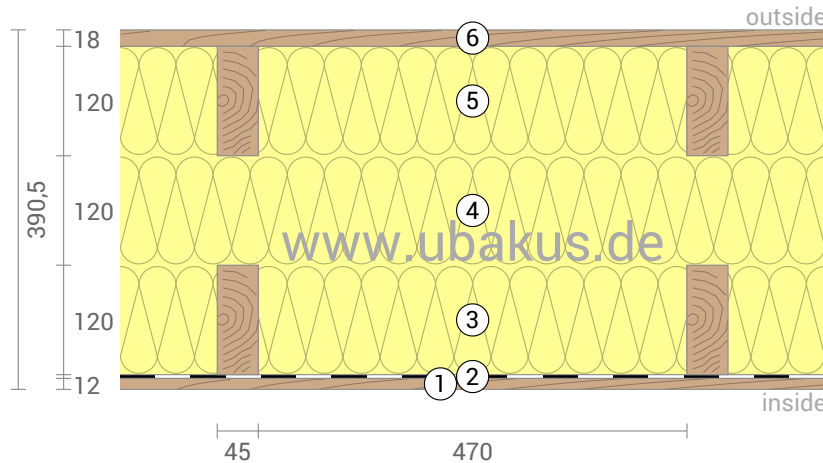
Moisture proofing

No condensate



Heat protection

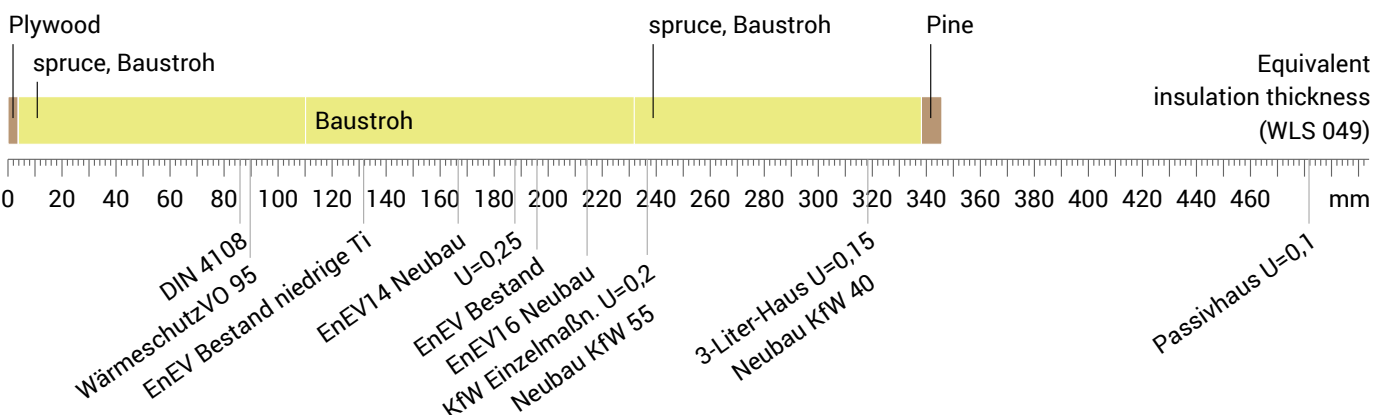
Temperature amplitude damping: >100
phase shift: non relevant
Thermal capacity inside: $58 \text{ kJ/m}^2\text{K}$



- | | | |
|-------------------------|---------------------|---------------------|
| ① Plywood (12 mm) | ③ Baustroh (120 mm) | ⑤ Baustroh (120 mm) |
| ② Vapor retarder sd=10m | ④ Baustroh (120 mm) | ⑥ Pine (18 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 $0,049 \text{ W/mK}$.



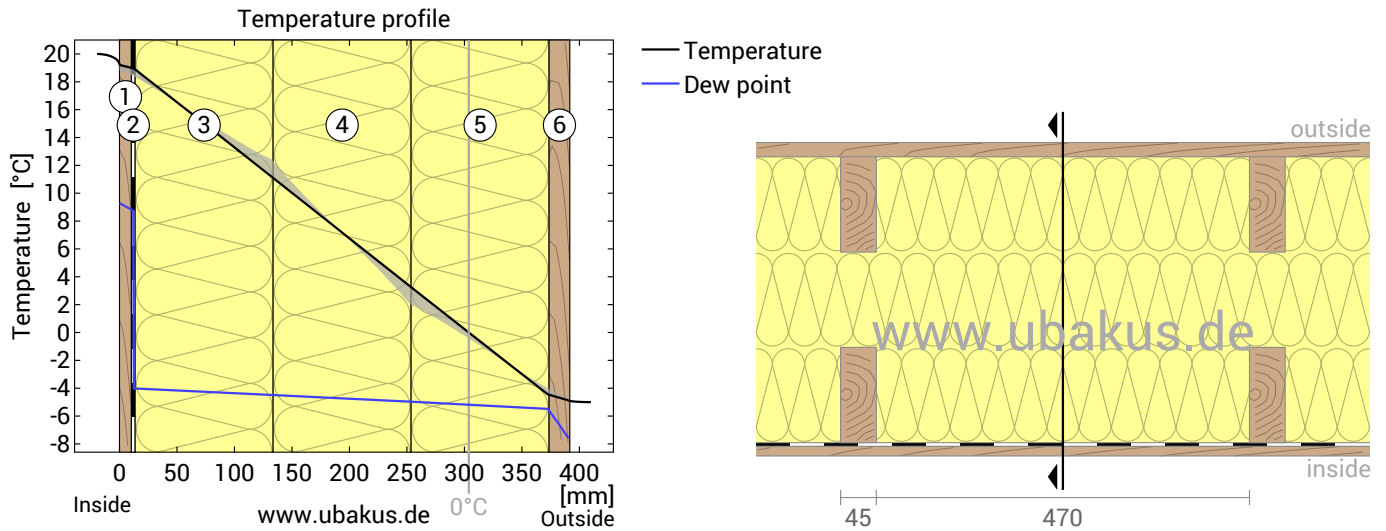
Inside air : $20,0^\circ\text{C} / 50\%$
Outside air: $-5,0^\circ\text{C} / 80\%$
Surface temperature.: $18,8^\circ\text{C} / -4,9^\circ\text{C}$

sd-value: 12,6 m

Thickness: 39,0 cm
Weight: 60 kg/m^2
Heat capacity: $114 \text{ kJ/m}^2\text{K}$

MURO doblpost-PAJA-plywood-bv-tarima, $U=0,14 \text{ W/(m}^2\text{K)}$

Temperature profile



- ① Plywood (12 mm) ③ Baustroh (120 mm) ⑤ Baustroh (120 mm)
- ② Vapor retarder sd=10m ④ Baustroh (120 mm) ⑥ Pine (18 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 [m ² K/W]	Temperatur [°C]		Weight [kg/m ²]
				min	max	
	Thermal contact resistance*		0,130	18,8	20,0	
1	1,2 cm Plywood	0,160	0,075	18,4	19,2	7,2
2	0,05 cm Vapor retarder sd=10m	0,220	0,002	18,4	19,0	0,1
3	12 cm Baustroh	0,049	2,449	11,2	19,0	11,0
	12 cm spruce (8,7%)	0,130	0,923	12,4	18,5	4,7
4	12 cm Baustroh	0,049	2,449	2,0	12,4	12,0
5	12 cm Baustroh	0,049	2,449	-4,4	3,3	11,0
	12 cm spruce (8,7%)	0,130	0,923	-4,0	2,3	4,7
6	1,8 cm Pine	0,130	0,138	-4,9	-4,0	9,4
	Thermal contact resistance*		0,040	-5,0	-4,8	
	39,05 cm Whole component		7,212			60,0

*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): 18,8°C 19,1°C 19,2°C

Surface temperature outside (min / average / max): -4,9°C -4,9°C -4,8°C

MURO doblpost-PAJA-plywood-bv-tarima, $U=0,14 \text{ W/(m}^2\text{K)}$

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°C und 50% Humidity; outside: -5°C und 80% Humidity. This climate complies with DIN 4108-3.

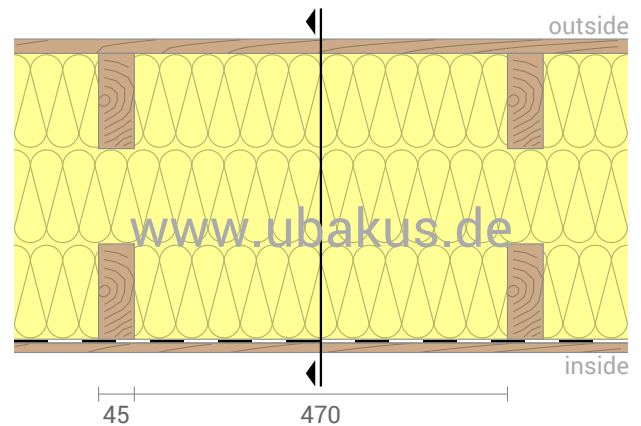
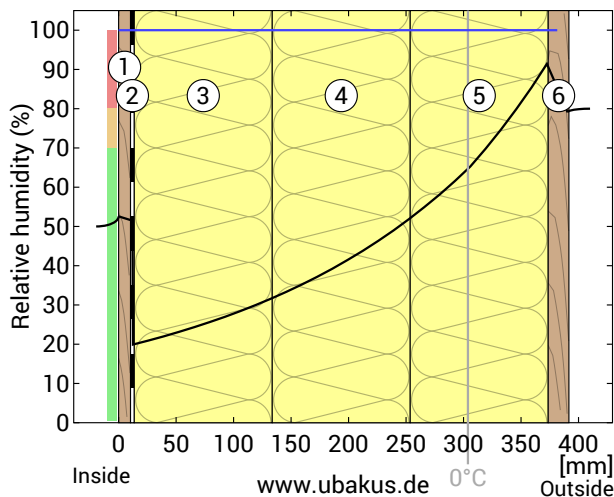
This component is free of condensate under the given climate conditions.

#	Material	sd-value [m]	Condensate [kg/m ²] [Gew.-%]	Weight [kg/m ²]
1	1,2 cm Plywood	0,60	-	7,2
2	0,05 cm Vapor retarder sd=10m	10,00	-	0,1
3	12 cm Baustroh	0,24	-	11,0
	12 cm spruce (8,7%)	2,40	-	4,7
4	12 cm Baustroh	0,24	-	12,0
5	12 cm Baustroh	0,24	-	11,0
	12 cm spruce (8,7%)	6,00	-	4,7
6	1,8 cm Pine	0,90	-	9,4
	39,05 cm Whole component	12,56		60,0

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.



- ① Plywood (12 mm)
② Vapor retarder sd=10m

- ③ Baustroh (120 mm)
④ Baustroh (120 mm)

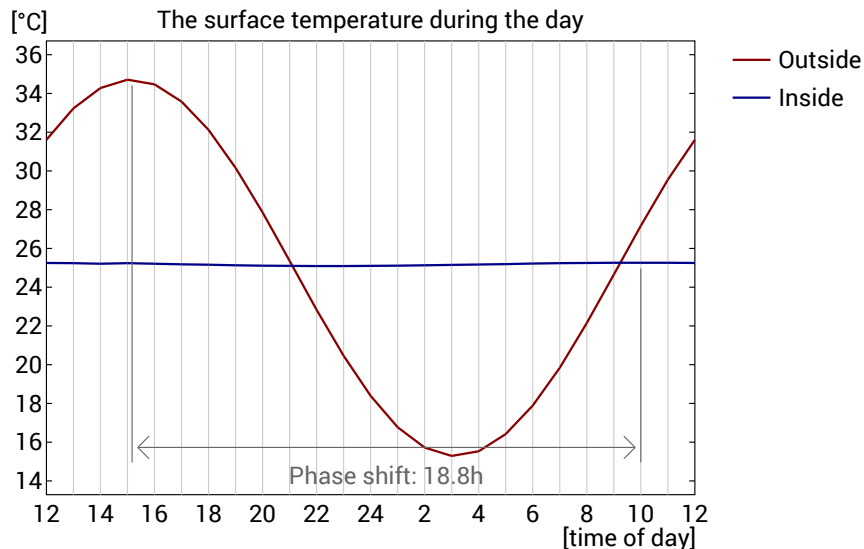
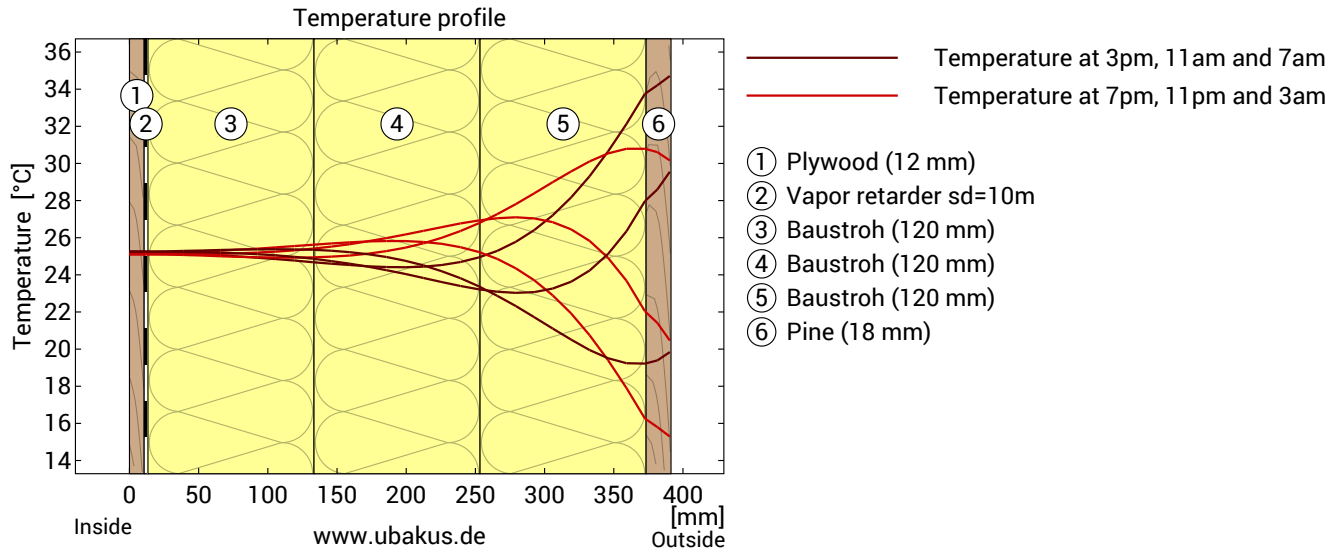
- ⑤ Baustroh (120 mm)
⑥ Pine (18 mm)

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.

MURO doblpost-PAJA-plywood-bv-tarima, $U=0,14 \text{ W/(m}^2\text{K)}$

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*	non relevant	Heat storage capacity (whole component):	114 kJ/m ² K
Amplitude attenuation **	>100	Thermal capacity of inner layers:	58 kJ/m ² K
TAV ***	0,009		

* 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.