Gablok

Standard

Exterior wall

Thermal protection

U = 0,14 W/(m²K)

GEG 2020/24 Bestand*: U<0,24 W/(m²K)

excellent insufficient

Moisture proofing

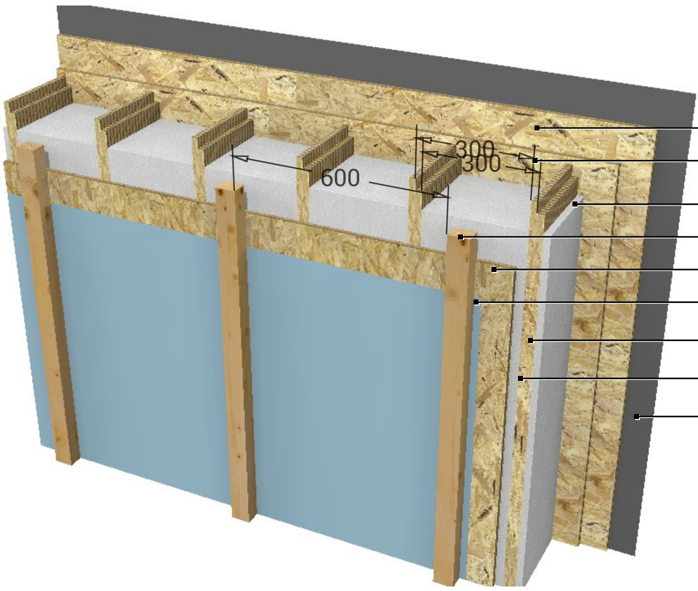
Drying reserve: 335 g/m²a
No condensate

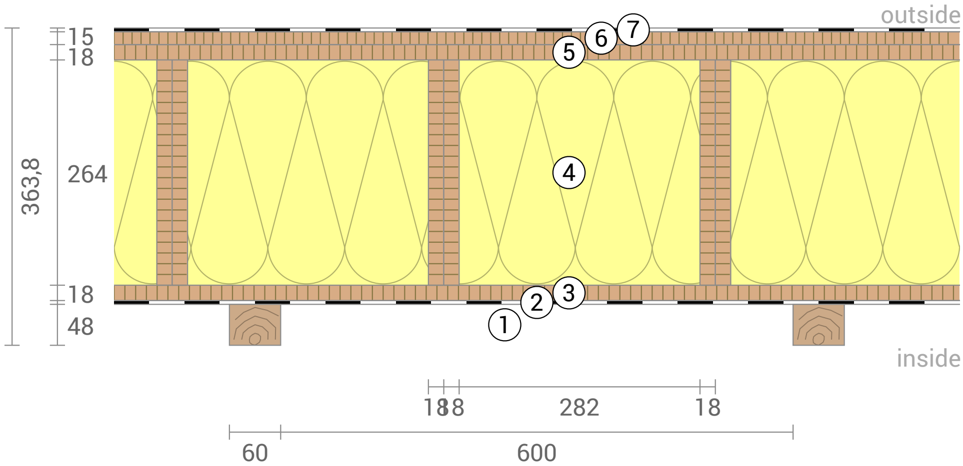
excellent insufficient

Heat protection

Temperature amplitude damping: 15
phase shift: 7,5 h
Thermal capacity inside: 43 kJ/m²K

excellent insufficient





1. Air layer (48 mm)
2. Rothoblaas VAPOR IN 120
3. elka esb P5 (18 mm)
4. EPS-grau 032 WDV (264 mm)
5. elka esb P5 (18 mm)
6. elka esb P5 (15 mm)
7. Rothoblaas TRASPIR 110

Inside air :	20,0°C / 50%			Thickness:	36,4 cm
Outside air:	-5,0°C / 80%	sd-value:	34,1 m	Weight:	60 kg/m²
Surface temperature.:	20,0°C / -4,9°C	Drying reserve:	335 g/m²a	Heat capacity:	100 kJ/m²K

☑ GEG 2020/24 Bestand ☑ BEG Einzelmaßn. ☑ GEG 2023/24 Neubau ☑ DIN 4108

*Comparison of the U-value with den Höchstwerten aus GEG Anlage 7 (GEG 2020-2024 Bestand); den techn. Mindestanforderungen für BEG Einzelmaßnahmen; 70% des U-Werts der Referenzausführung aus GEG 2023/2024 Anlage 1 (GEG Neubau); den R-Werten aus DIN 4108-2 Tabelle 3

Standard, U=0,14 W/(m²K)

U-Value calculation according to DIN EN ISO 6946

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,130
2	Rothoblaas VAPOR IN 120	0,04	0,300	0,001
3	elka esb P5	1,80	0,120	0,150
	structural timber (Width: 6 cm)	4,80	0,130	0,369
4	EPS-grau 032 WDV	26,40	0,032	8,250
	elka esb P5 (5,7%)	26,40	0,120	2,200
	elka esb P5 (5,7%)	26,40	0,120	2,200
5	elka esb P5	1,80	0,120	0,150
6	elka esb P5	1,50	0,120	0,125
7	Rothoblaas TRASPIR 110	0,04	0,300	0,001
	Thermal contact resistance outside (Rse)			0,040

Thermal contact resistances have been taken from DIN 6946 Table 7.
Rsi: heat flow direction horizontally
Rse: heat flow direction horizontally, outside: Direct contact to outside air

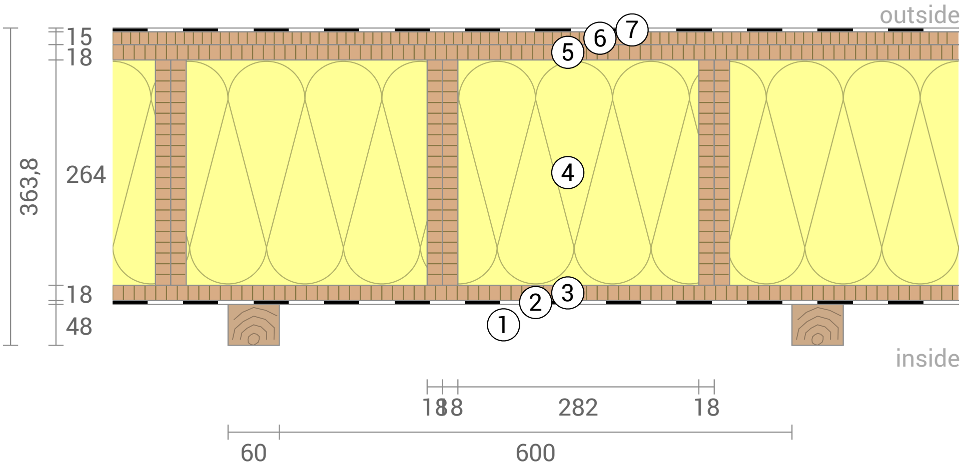
Upper limit of thermal resistance $R_{tot;upper}$ = 7,159 m²K/W.
Lower limit of thermal resistance $R_{tot;lower}$ = 6,944 m²K/W.
Check applicability: $R_{tot;upper}$ / $R_{tot;lower}$ = 1,031 (maximum allowed: 1,5)

The procedure may be used.

Thermal resistance R_{tot} = ($R_{tot;upper}$ + $R_{tot;lower}$)/2 = 7,051 m²K/W
Estimated maximum relative uncertainty according to section 6.7.2.5: 1,5%

Heat transfer coefficient U = 1/R_{tot} = **0,14 W/(m²K)**

This component includes several inhomogeneous layers of different overall width. For all the calculations it was assumed that the layer arrangement is repeated in width all 66 cm. This, however, is not true for at least layer 4 with a total width of 31,8 cm and can cause increased inaccuracy of the U-value.

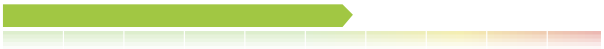


Gablok

Standard, U=0,14 W/(m²K)

LCA

Heat loss: 11 kWh/m² per heating season

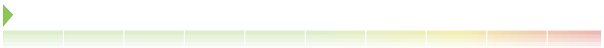


Amount of heat that escapes through one square meter of this component during the heating period. Please note: Due to internal and solar gains, the heating demand is lower than the heat loss.

Primary energy (non renewable): 208 kWh/m²

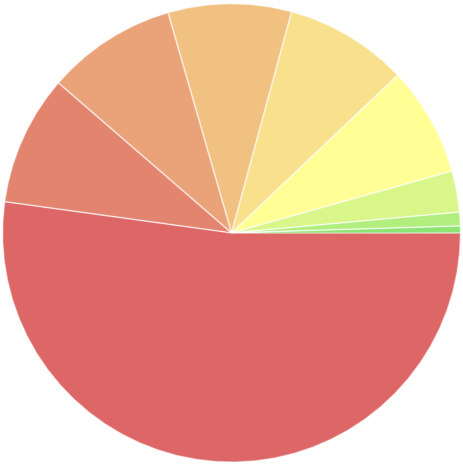
Non-renewable primary energy (= energy from fossil fuels and nuclear energy) that was used to produce the new building materials ("cradle to gate").

Green house gas potential: -54 kg CO2 Äqv./m²



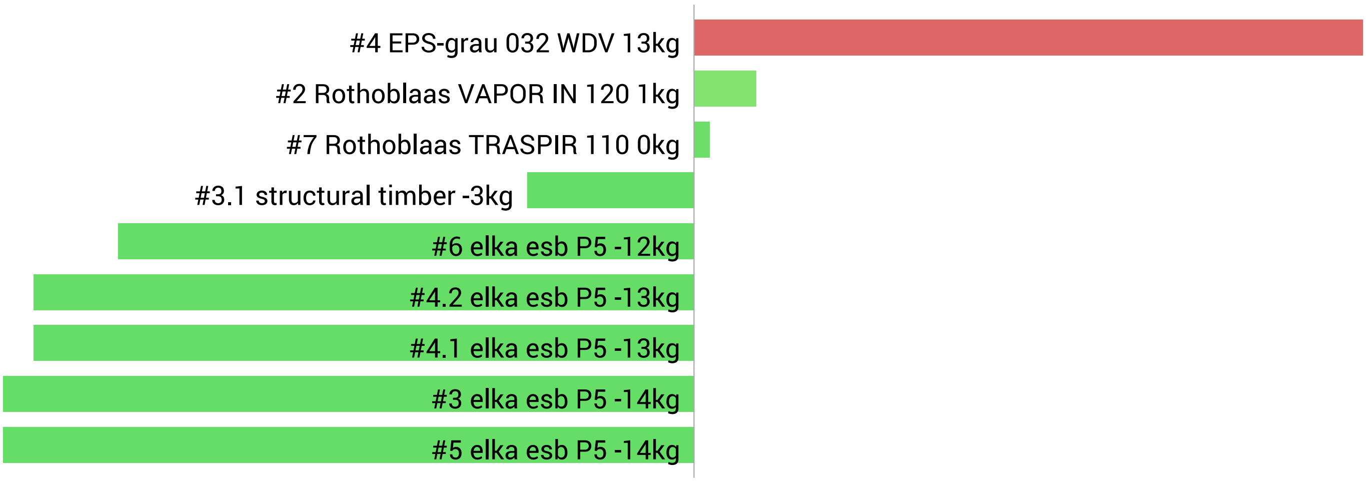
For the production of the building materials used, more greenhouse gases were withdrawn from the atmosphere than emitted.

Composition of non-renewable primary energy of production:



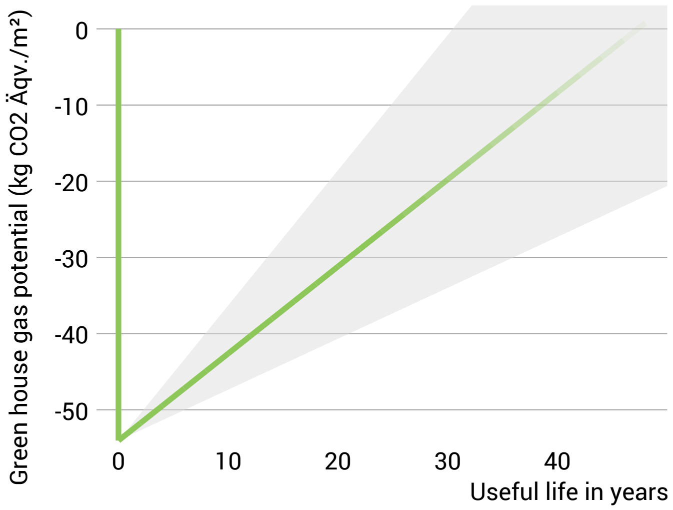
- EPS-grau 032 WDV (264 mm) 52%
- elka esb P5 (18 mm) 9%
- elka esb P5 (18 mm) 9%
- elka esb P5 (264x18) 9%
- elka esb P5 (264x18) 9%
- elka esb P5 (15 mm) 8%
- Rothoblaas VAPOR IN 120 3%
- Rothoblaas TRASPIR 110 1%
- structural timber (48x60) 0%

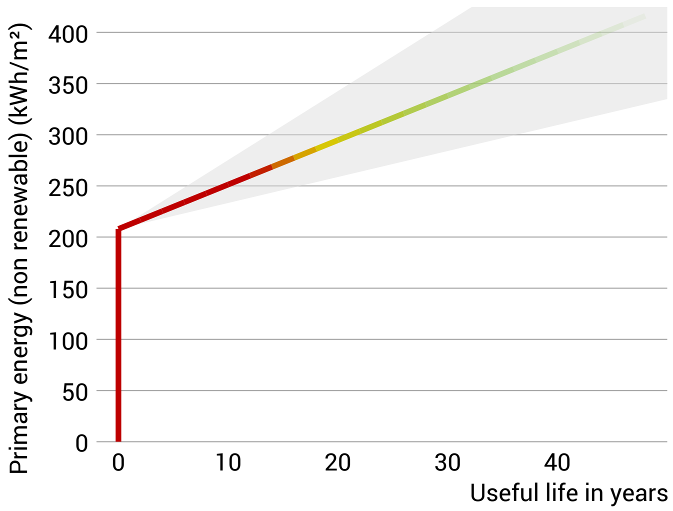
Composition of the greenhouse potential of production:



Standard, U=0,14 W/(m²K)

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 kWh/a/m² 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 kWh per kWh of heat and a global warming potential of 0,16 kg CO2 eqv/m² per 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.

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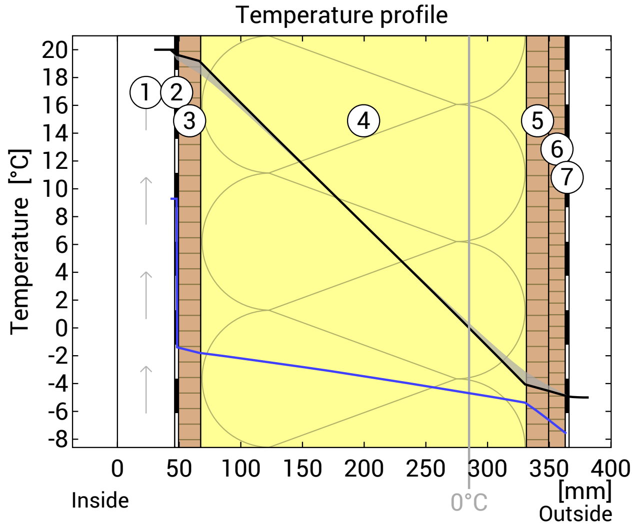
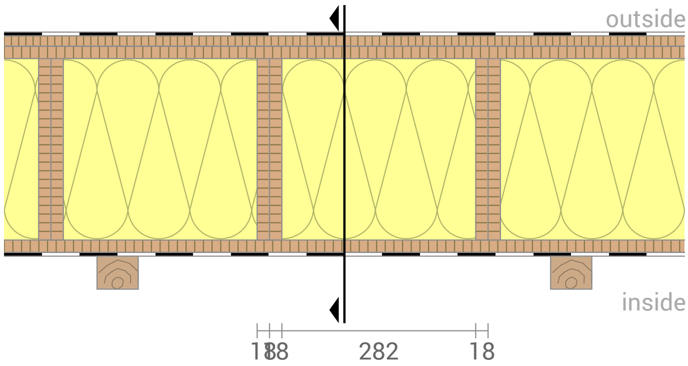
Standard, U=0,14 W/(m²K)

Temperature profile





① Air layer (48 mm)
② Rothoblaas VAPOR IN 120
③ elka esb P5 (18 mm)
④ EPS-grau 032 WDV (264 mm)
⑤ elka esb P5 (18 mm)
⑥ elka esb P5 (15 mm)
⑦ Rothoblaas TRASPIR 110

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]
1	4,8 cm	Air layer (ventilated)				20,0	0,1
		Thermal contact resistance*		0,250	19,3	20,0	
2	0,04 cm	Rothoblaas VAPOR IN 120	0,300	0,001	19,3	19,6	0,1
3	1,8 cm	elka esb P5	0,120	0,150	18,3	19,6	11,2
	4,8 cm	structural timber (Width: 6 cm)	0,130	0,369	-100,0	100,0	2,2
4	26,4 cm	EPS-grau 032 WDV	0,032	8,250	-4,1	19,2	4,6
	26,4 cm	elka esb P5 (5,7%)	0,120	2,200	-3,3	18,5	10,7
	26,4 cm	elka esb P5 (5,7%)	0,120	2,200	-3,1	18,5	10,7
5	1,8 cm	elka esb P5	0,120	0,150	-4,5	-3,1	11,2
6	1,5 cm	elka esb P5	0,120	0,125	-4,9	-4,1	9,3
7	0,04 cm	Rothoblaas TRASPIR 110	0,300	0,001	-4,9	-4,8	0,1
		Thermal contact resistance*		0,040	-5,0	-4,8	
	36,38 cm	Whole component		6,930			60,1

*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):	-4,9°C	-4,9°C	-4,8°C

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Standard, U=0,14 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.

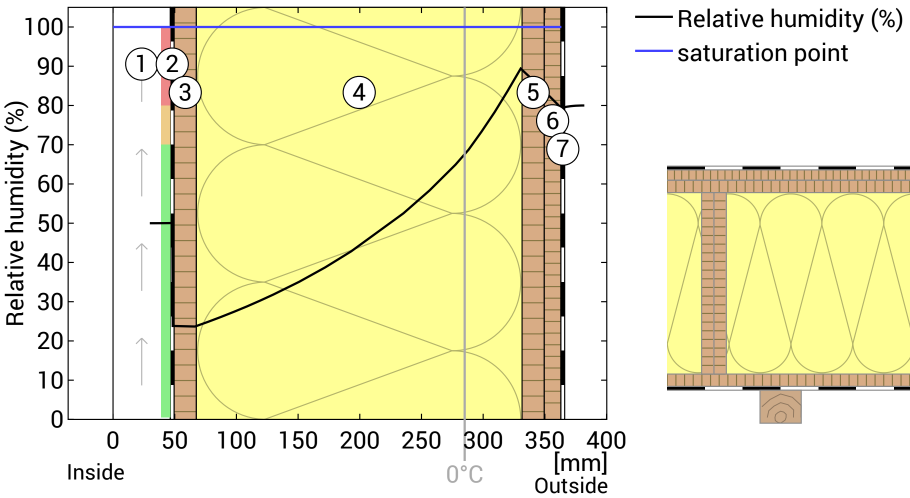
This component is free of condensate under the given climate conditions.

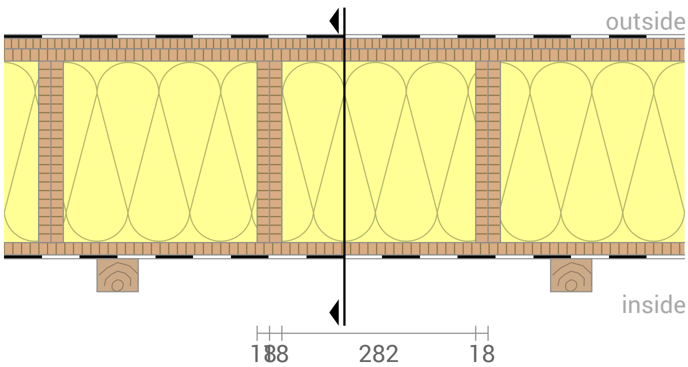
Drying reserve according to DIN 4108-3:2018:	335 g/(m²a)
At least required by DIN 68800-2:	100 g/(m²a)

#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
2	0,04 cm	Rothoblaas VAPOR IN 120	25,00	-		0,1
3	1,8 cm	elka esb P5	0,72	-	-	11,2
	4,8 cm	structural timber (Width: 6 cm)	0,00	-	-	2,2
4	26,4 cm	EPS-grau 032 WDV	5,28	-		4,6
	26,4 cm	elka esb P5 (5,7%)	10,56	-	-	10,7
	26,4 cm	elka esb P5 (5,7%)	10,56	-	-	10,7
5	1,8 cm	elka esb P5	1,44	-	-	11,2
6	1,5 cm	elka esb P5	1,20	-	-	9,3
7	0,04 cm	Rothoblaas TRASPIR 110	0,03	-		0,1
	36,38 cm	Whole component	34,11	0		60,1

Humidity

The temperature of the inside surface is 19,3 °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 Air layer (48 mm)
② Rothoblaas VAPOR IN 120
③ elka esb P5 (18 mm)
④ EPS-grau 032 WDV (264 mm)
⑤ elka esb P5 (18 mm)
⑥ elka esb P5 (15 mm)
⑦ Rothoblaas TRASPIR 110

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.

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Standard, U=0,14 W/(m²K)

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

This moisture proofing is only valid for **non-air-conditioned** residential buildings.

Please note the hints at the end of these moisture proofing calculations.

#		Material	λ [W/mK]	R [m²K/W]	sd [m]	ρ [kg/m³]	T [°C]	ps [Pa]	Σsd [m]
		Thermal contact resistance		0,250					
							19,30	2239	0
2	0,04 cm	Rothoblaas VAPOR IN 120	0,300	0,001	25	300			
							19,30	2238	25
3	1,8 cm	elka esb P5	0,120	0,150	0,72	621			
							18,88	2180	25,7
4	26,4 cm	EPS-grau 032 WDV	0,032	8,250	5,28	20			
							-4,12	433	31
5	1,8 cm	elka esb P5	0,120	0,150	1,44	621			
							-4,54	418	32,4
6	1,5 cm	elka esb P5	0,120	0,125	1,2	621			
							-4,88	405	33,6
7	0,04 cm	Rothoblaas TRASPIR 110	0,300	0,001	0,1	280			
							-4,89	405	33,7
		Thermal contact resistance		0,040					

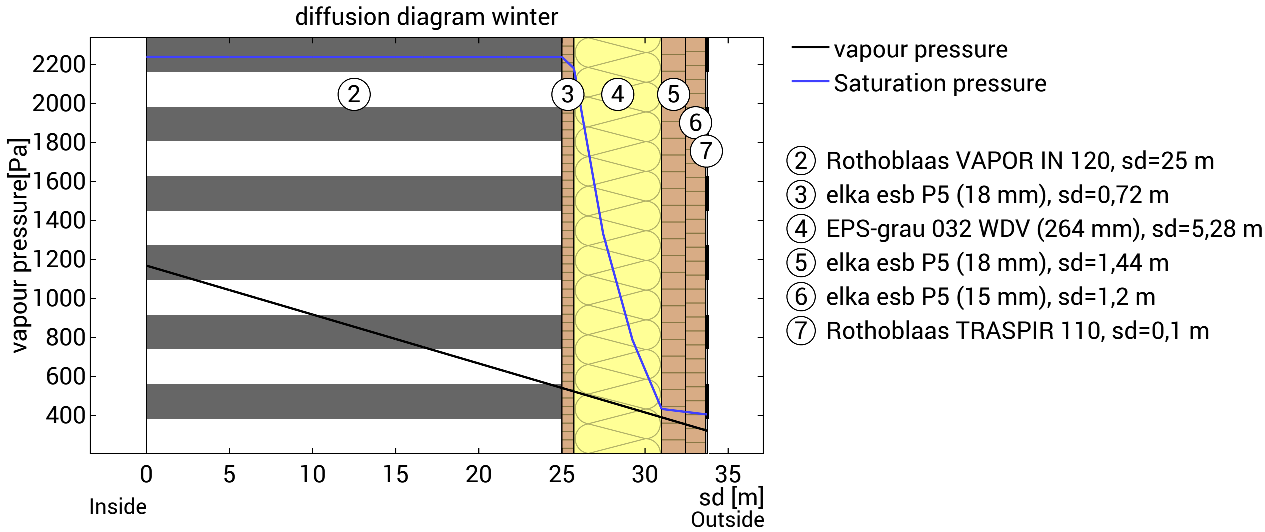
Temperature (T), vapor saturation pressure (ps), and the sum of the sd-values (Σsd) apply to the layer boundary.

Relative air humidity on the surface

The relative humidity on the interior surface is 52%. Requirements for the prevention of building material corrosion depend on material and coating and have not been investigated. ✓

Dew period (winter)

Boundary conditions	
Vapor pressure inside at 20°C and 50% humidity	pi = 1168 Pa
Vapor pressure outside at -5°C and 80% humidity	pe = 321 Pa
Duration of condensation period (90 days)	tc = 7776000 s
Water vapor diffusion coefficient in static air	δ0 = 2.0E-10 kg/(m*s*Pa)
sd-value (Whole component.)	sde = 33,74 m



The section under investigation is free of condensate under the given climate conditions. ✓

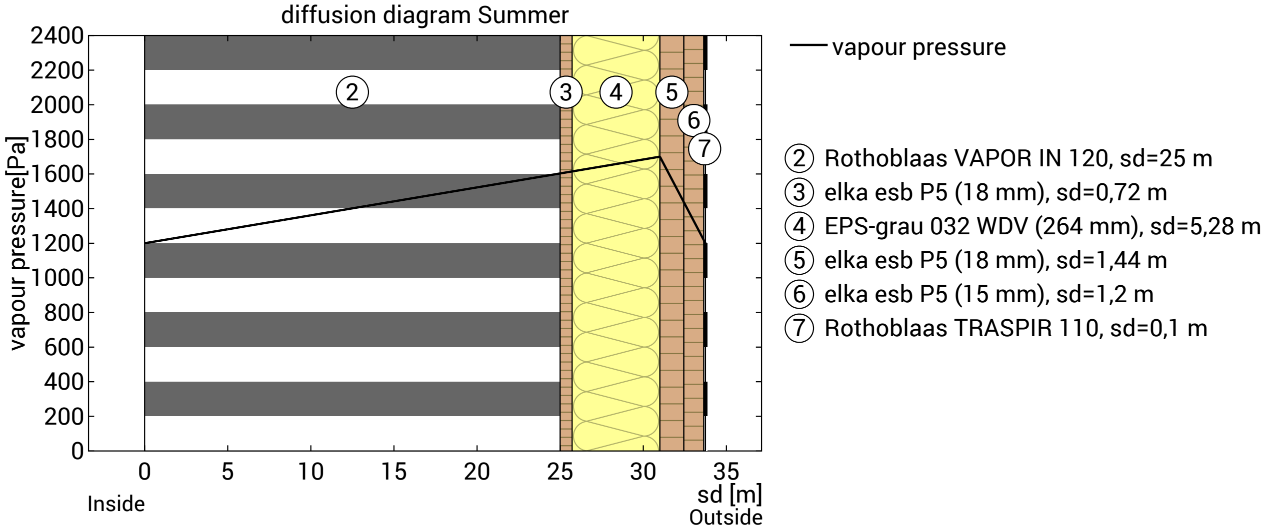
Calculate evaporation potential for the drying reserve in the dew period for the plane with the lowest evaporation potential:
sd=31,00 m; x=28,24 cm; ps=433 pa:
Layer boundary between EPS-grau 032 WDV and elka esb P5

Mev,Tauperiode = tc * δ0 * ((ps-pi)/sd_{ev} + (ps-pe)/(sd_e-sd_{ev})) = **0,027 kg/m²**

Standard, U=0,14 W/(m²K)

Evaporation period (summer)

Boundary conditions	
Interior vapor pressure	pi = 1200 Pa
Exterior vapor pressure	pe = 1200 Pa
Saturation vapour pressure in the condensation area	ps = 1700 Pa
Length of drying season (90 days)	tev = 7776000 s
sd-values remain unchanged.	



Condensate-free component: The maximum possible evaporation mass for the drying reserve is calculated. Consider the level that has the lowest evaporation potential in the dew period, at sd=31,00 m; x=28,24 cm:
Layer boundary between EPS-grau 032 WDV and elka esb P5
Evaporation mass: Mev = δ0 * tev * [(ps-pi)/sd + (ps-pe)/(sde-sd)] = **0,31 kg/m²**

Drying reserve (DIN 68800-2)

Dew-water-free component: The evaporation potential of the dew period is also taken into account.
Drying reserve: Mr = (Mev + Mev,Tauperiode) * 1000 = **335 g/m²/a**
Minimum requested for walls and ceilings: 100 g/m²/a

✓

Evaluation according to DIN 4108-3

The component is permissible regarding the moisture protection.

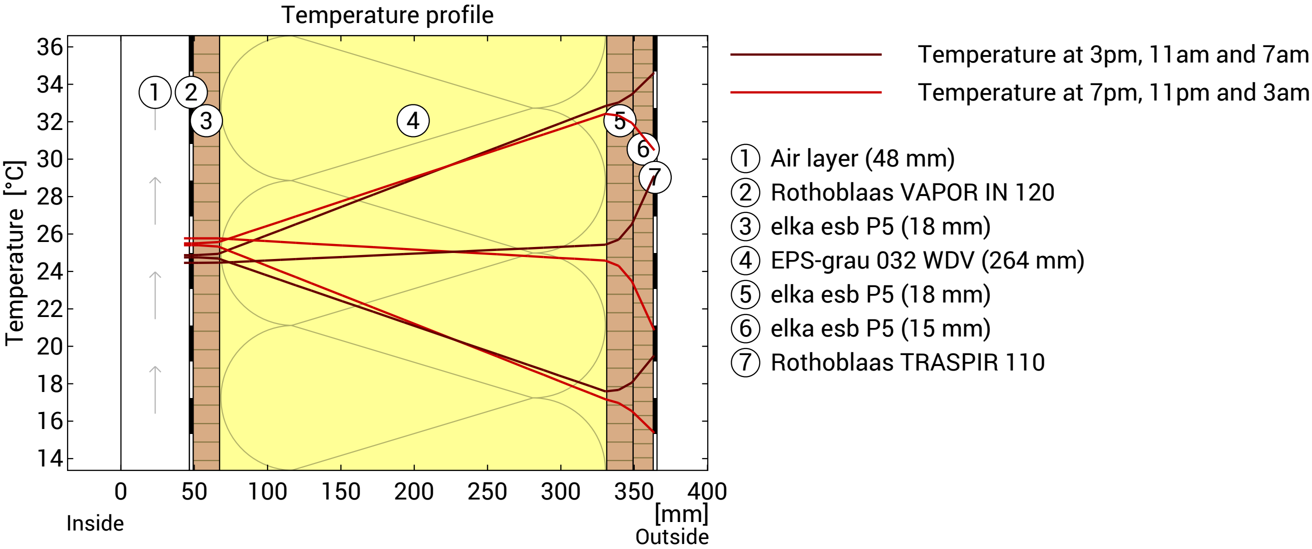
Hints

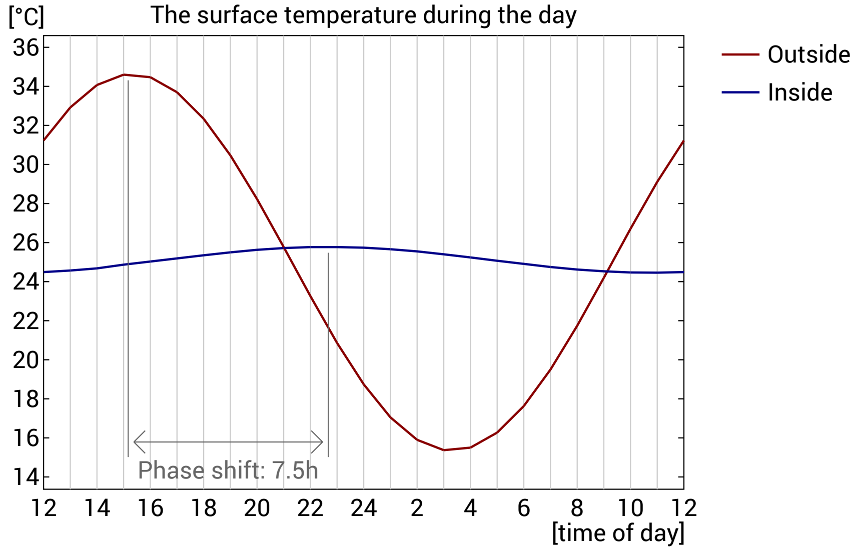
In the case of inhomogeneous constructions, such as skeleton-, stand- or frame constructions, as well as in wooden beam, rafter or half-timbered constructions or the like, the one-dimensional diffusion calculations are only to be demonstrated for the compartment area. Exceptional cases are special constructions in which, for example, The diffusion-inhibiting layer is also laid section-wise over the outer area. In these exceptional cases, the calculation performed here is invalid.

DIN 4108-3 describes in Section 5.3 components for which no moisture proofing is required as there is no risk of condensation water or the method is not suitable for the assessment. It is not possible to assess whether the component under test is underneath.

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*	7,5 h	Heat storage capacity (whole component):	100 kJ/m²K
Amplitude attenuation **	14,7	Thermal capacity of inner layers:	43 kJ/m²K
TAV ***	0,068		

* 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.

Gablok

External Thermal Insulation Composite

Exterior wall

Thermal protection

U = 0,11 W/(m²K)

GEG 2020/24 Bestand*: U<0,24 W/(m²K)

excellent insufficient

Moisture proofing

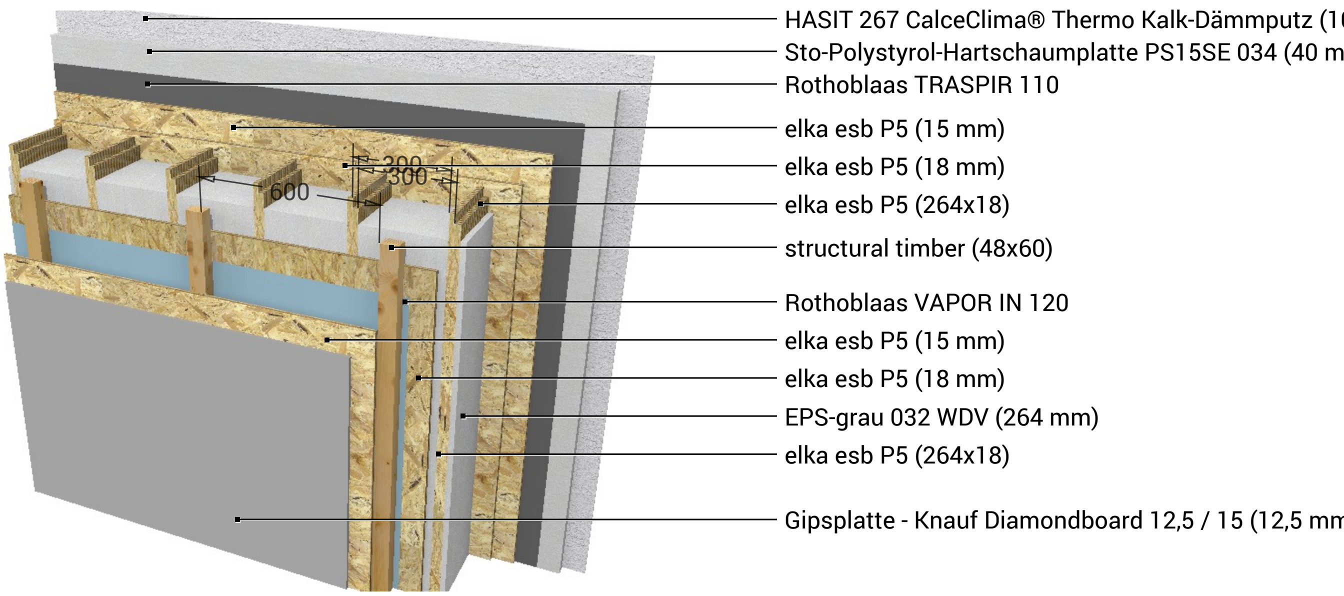
Drying reserve: 231 g/m²a
No condensate

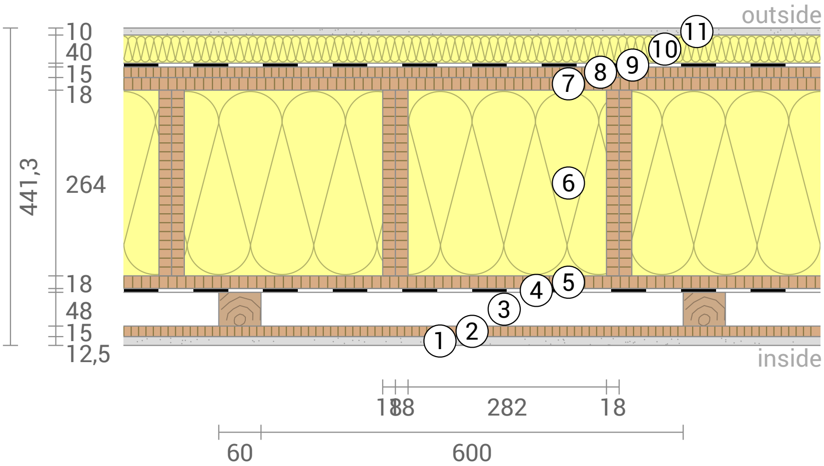
excellent insufficient

Heat protection

Temperature amplitude damping: >100
phase shift: non relevant
Thermal capacity inside: 82 kJ/m²K

excellent insufficient





1. Gipsplatte - Knauf Diamondboard 12,5 / 15 (12,5 mm)
2. elka esb P5 (15 mm)
3. Installation level (48 mm)
4. Rothoblaas VAPOR IN 120
5. elka esb P5 (18 mm)
6. EPS-grau 032 WDV (264 mm)
7. elka esb P5 (18 mm)
8. elka esb P5 (15 mm)
9. Rothoblaas TRASPIR 110
10. Sto-Polystyrol-Hartschaumplatte PS15SE 034 (40 mm)
11. HASIT 267 CalceClima® Thermo Kalk-Dämmputz (10 mm)

Inside air :	20,0°C / 50%			Thickness:	44,1 cm
Outside air:	-5,0°C / 80%	sd-value:	37,0 m	Weight:	86 kg/m²
Surface temperature.:	19,2°C / -4,9°C	Drying reserve:	231 g/m²a	Heat capacity:	138 kJ/m²K

☑ GEG 2020/24 Bestand ☑ BEG Einzelmaßn. ☑ GEG 2023/24 Neubau ☑ DIN 4108

*Comparison of the U-value with den Höchstwerten aus GEG Anlage 7 (GEG 2020-2024 Bestand); den techn. Mindestanforderungen für BEG Einzelmaßnahmen; 70% des U-Werts der Referenzausführung aus GEG 2023/2024 Anlage 1 (GEG Neubau); den R-Werten aus DIN 4108-2 Tabelle 3

Gablok

External Thermal Insulation Composite, U=0,11 W/(m²K)

U-Value calculation according to DIN EN ISO 6946

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,130
1	Gipsplatte - Knauf Diamondboard 12,5 / 15	1,25	0,300	0,042
2	elka esb P5	1,50	0,120	0,125
3	Installation level	4,80	0,267	0,180
4	Rothoblaas VAPOR IN 120	0,04	0,300	0,001
5	elka esb P5	1,80	0,120	0,150
	structural timber (Width: 6 cm)	4,80	0,130	0,369
6	EPS-grau 032 WDV	26,40	0,032	8,250
	elka esb P5 (5,7%)	26,40	0,120	2,200
	elka esb P5 (5,7%)	26,40	0,120	2,200
7	elka esb P5	1,80	0,120	0,150
8	elka esb P5	1,50	0,120	0,125
9	Rothoblaas TRASPIR 110	0,04	0,300	0,001
10	Sto-Polystyrol-Hartschaumplatte PS15SE 034	4,00	0,034	1,176
11	HASIT 267(vorher 840) CalceClima® Thermo Kalk-Dämmputz	1,00	0,067	0,149
	Thermal contact resistance outside (Rse)			0,040

Thermal contact resistances have been taken from DIN 6946 Table 7.
Rsi: heat flow direction horizontally
Rse: heat flow direction horizontally, outside: Direct contact to outside air

Thermal transfer resistances of resting air layers were calculated as follows:
Layer 3: Thickness 4.8 cm, Width 60 cm, DIN EN ISO 6946 Table 8, heat flow direction horizontally

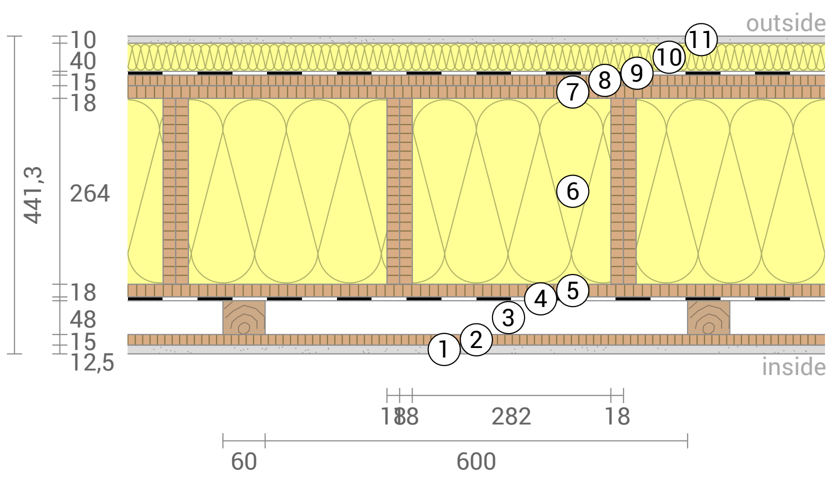
Upper limit of thermal resistance $R_{tot;upper}$ = 9,179 m²K/W.
Lower limit of thermal resistance $R_{tot;lower}$ = 8,625 m²K/W.
Check applicability: $R_{tot;upper}$ / $R_{tot;lower}$ = 1,064 (maximum allowed: 1,5)

The procedure may be used.

Thermal resistance R_{tot} = ($R_{tot;upper}$ + $R_{tot;lower}$)/2 = 8,902 m²K/W
Estimated maximum relative uncertainty according to section 6.7.2.5: 3,1%

Heat transfer coefficient U = 1/R_{tot} = **0,11 W/(m²K)**

This component includes several inhomogeneous layers of different overall width. For all the calculations it was assumed that the layer arrangement is repeated in width all 66 cm. This, however, is not true for at least layer 6 with a total width of 31,8 cm and can cause increased inaccuracy of the U-value.

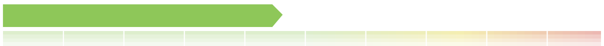


Gablok

External Thermal Insulation Composite, U=0,11 W/(m²K)

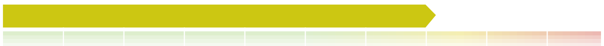
LCA

Heat loss: 9 kWh/m² per heating season



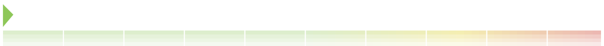
Amount of heat that escapes through one square meter of this component during the heating period. Please note: Due to internal and solar gains, the heating demand is lower than the heat loss.

Primary energy (non renewable): >245 kWh/m²



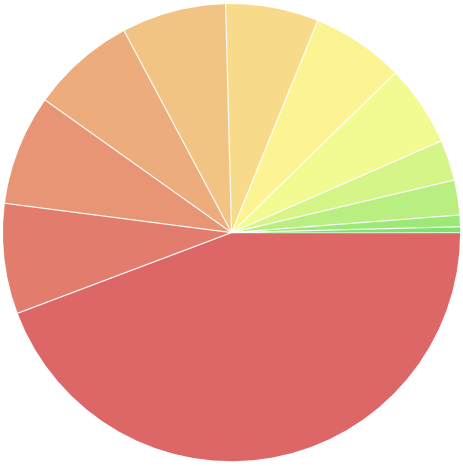
Non-renewable primary energy (= energy from fossil fuels and nuclear energy) that was used to produce the new building materials ("cradle to gate").

Green house gas potential: -61 (?) kg CO_2 Äqv./m²



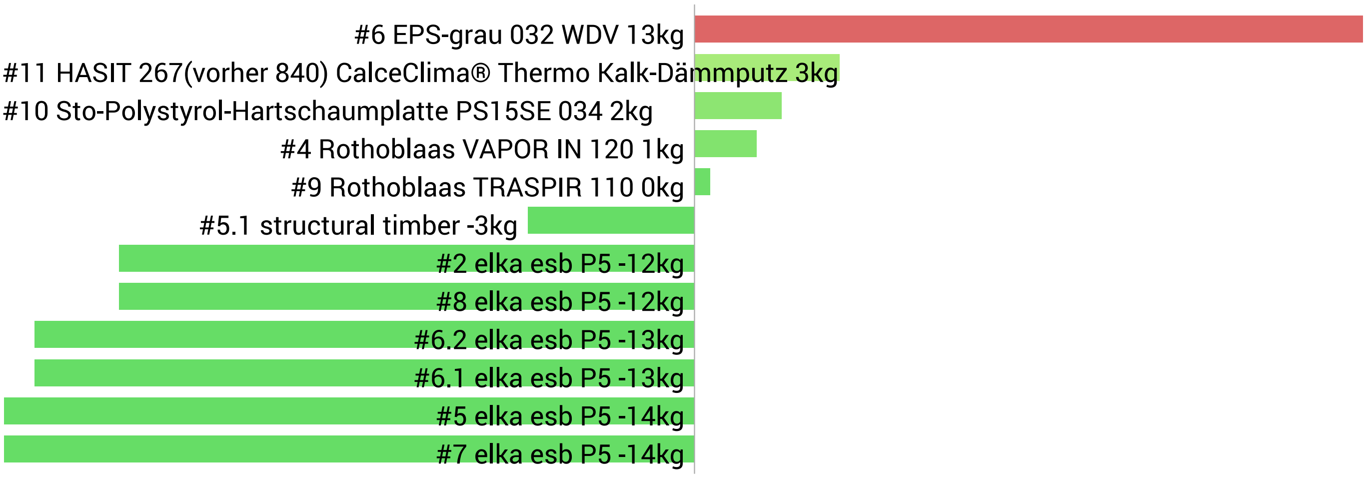
For the production of the building materials used, more greenhouse gases were withdrawn from the atmosphere than emitted.

Composition of non-renewable primary energy of production:



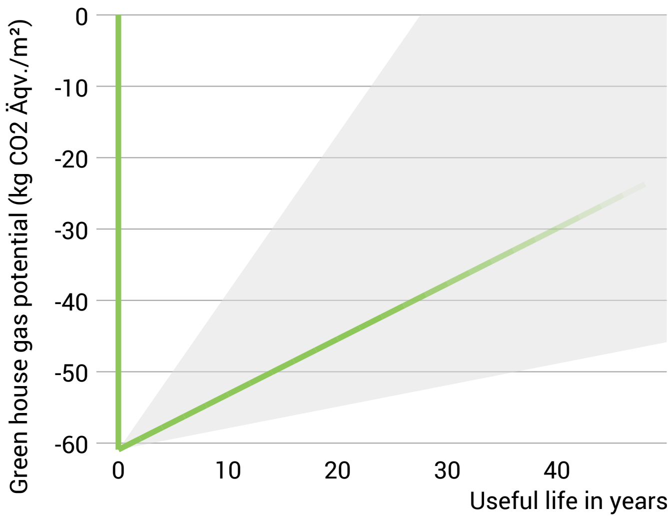
- EPS-grau 032 WDV (264 mm) 44%
- elka esb P5 (18 mm) 8%
- elka esb P5 (18 mm) 8%
- elka esb P5 (264x18) 7%
- elka esb P5 (264x18) 7%
- elka esb P5 (15 mm) 7%
- elka esb P5 (15 mm) 7%
- Sto-Polystyrol-Hartschaumplatte PS15SE 034 (40 mm) 6%
- HASIT 267 CalceClima® Thermo Kalk-Dämmputz (10 mm) 3%
- Rothoblaas VAPOR IN 120 2%
- Rothoblaas TRASPIR 110 1%
- structural timber (48x60) 0%

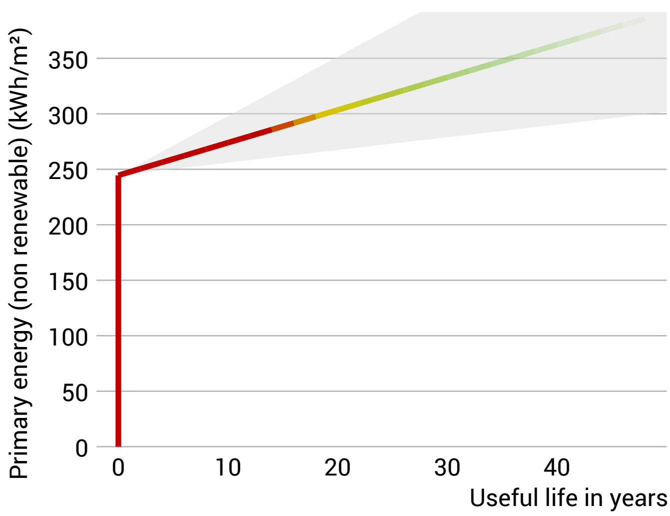
Composition of the greenhouse potential of production:



Attention: At least one layer could not be considered because its primary energy content and / or global warming potential is unknown.

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 kWh/a/m² 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 kWh per kWh of heat and a global warming potential of 0,16 kg CO2 eqv/m² per kWh of heat was used. Heat source: Heat pump (air-water).

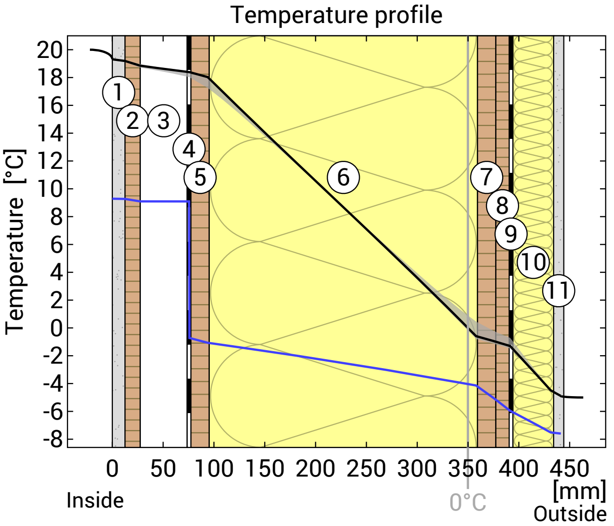
Hints

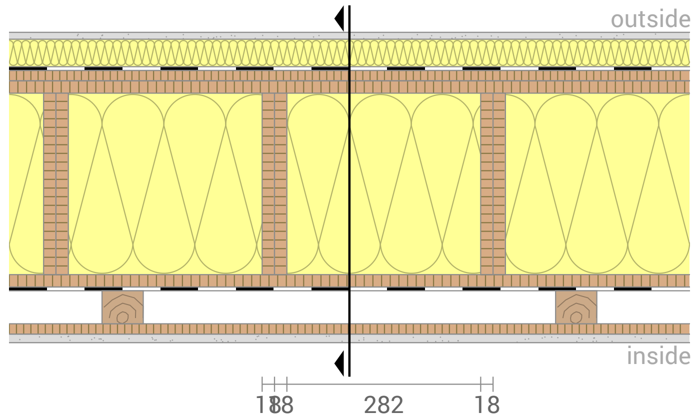
Attention: At least one layer could not be considered because its primary energy content and / or global warming potential is unknown.

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.

Temperature profile





1. Gipsplatte - Knauf Diamondboard 1...
2. elka esb P5 (15 mm)
3. Installation level (48 mm)
4. Rothoblaas VAPOR IN 120
5. elka esb P5 (18 mm)
6. EPS-grau 032 WDV (264 mm)
7. elka esb P5 (18 mm)
8. elka esb P5 (15 mm)
9. Rothoblaas TRASPIR 110
10. Sto-Polystyrol-Hartschaumplatte ...
11. HASIT 267 CalceClima® Thermo K...

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	Temperatur [°C] max	Weight [kg/m²]
		Thermal contact resistance*		0,250	19,2	20,0	
1	1,25 cm	Gipsplatte - Knauf Diamondboard 12,5 / 15	0,300	0,042	19,1	19,4	12,5
2	1,5 cm	elka esb P5	0,120	0,125	18,7	19,3	9,3
3	4,8 cm	Installation level	0,267	0,180	18,0	18,9	0,1
4	0,04 cm	Rothoblaas VAPOR IN 120	0,300	0,001	18,0	18,5	0,1
5	1,8 cm	elka esb P5	0,120	0,150	17,3	18,5	11,2
	4,8 cm	structural timber (Width: 6 cm)	0,130	0,369	18,2	19,0	2,2
6	26,4 cm	EPS-grau 032 WDV	0,032	8,250	-0,8	18,1	4,6
	26,4 cm	elka esb P5 (5,7%)	0,120	2,200	0,3	17,4	10,7
	26,4 cm	elka esb P5 (5,7%)	0,120	2,200	0,4	17,4	10,7
7	1,8 cm	elka esb P5	0,120	0,150	-1,2	0,5	11,2
8	1,5 cm	elka esb P5	0,120	0,125	-1,5	-0,2	9,3
9	0,04 cm	Rothoblaas TRASPIR 110	0,300	0,001	-1,5	-0,7	0,1
10	4 cm	Sto-Polystyrol-Hartschaumplatte PS15SE 034	0,034	1,176	-4,5	-0,7	0,6
11	1 cm	HASIT 267(vorher 840) CalceClima® Thermo Kalk-Dämmputz	0,067	0,149	-4,9	-4,4	3,0
		Thermal contact resistance*		0,040	-5,0	-4,9	
	44,13 cm	Whole component		8,738			85,5

*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):	19,2°C	19,3°C	19,4°C
Surface temperature outside (min / average / max):	-4,9°C	-4,9°C	-4,9°C

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.

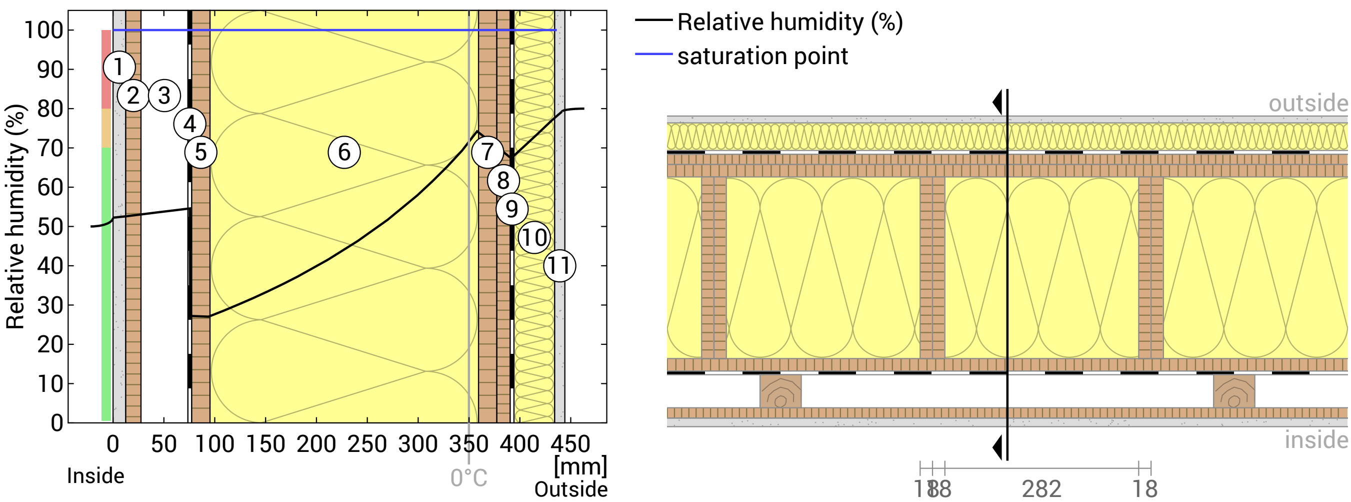
This component is free of condensate under the given climate conditions.

Drying reserve according to DIN 4108-3:2018: 231 g/(m²a)
At least required by DIN 68800-2: 100 g/(m²a)

#		Material	sd-value	Condensate		Weight
			[m]	[kg/m²]	[Gew.-%]	[kg/m²]
1	1,25 cm	Gipsplatte - Knauf Diamondboard 12,5 / 15	0,05	-		12,5
2	1,5 cm	elka esb P5	0,60	-	-	9,3
3	4,8 cm	Installation level	0,01	-		0,1
4	0,04 cm	Rothoblaas VAPOR IN 120	25,00	-		0,1
5	1,8 cm	elka esb P5	0,72	-	-	11,2
	4,8 cm	structural timber (Width: 6 cm)	1,92	-	-	2,2
6	26,4 cm	EPS-grau 032 WDV	5,28	-		4,6
	26,4 cm	elka esb P5 (5,7%)	10,56	-	-	10,7
	26,4 cm	elka esb P5 (5,7%)	10,56	-	-	10,7
7	1,8 cm	elka esb P5	1,44	-	-	11,2
8	1,5 cm	elka esb P5	1,20	-	-	9,3
9	0,04 cm	Rothoblaas TRASPIR 110	0,03	-		0,1
10	4 cm	Sto-Polystyrol-Hartschaumplatte PS15SE 034	2,00	-		0,6
11	1 cm	HASIT 267(vorher 840) CalceClima® Thermo Kalk-Dämmputz	0,10	-		3,0
	44,13 cm	Whole component	36,98	0		85,5

Humidity

The temperature of the inside surface is 19,2 °C leading to a relative humidity on the surface of 53%.Mould formation is not expected under these conditions.
The following figure shows the relative humidity inside the component.



① Gipsplatte - Knauf Diamondboard 1...
② elka esb P5 (15 mm)
③ Installation level (48 mm)
④ Rothoblaas VAPOR IN 120
⑤ elka esb P5 (18 mm)
⑥ EPS-grau 032 WDV (264 mm)
⑦ elka esb P5 (18 mm)
⑧ elka esb P5 (15 mm)
⑨ Rothoblaas TRASPIR 110
⑩ Sto-Polystyrol-Hartschaumplatte ...
⑪ HASIT 267 CalceClima® Thermo K...

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.

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

This moisture proofing is only valid for **non-air-conditioned** residential buildings.

Please note the hints at the end of these moisture proofing calculations.

#		Material	λ [W/mK]	R [m²K/W]	sd [m]	ρ [kg/m³]	T [°C]	ps [Pa]	Σsd [m]
		Thermal contact resistance		0,250					
							19,41	2254	0
1	1,25 cm	Gipsplatte - Knauf Diamondboard 12,5 / 15	0,300	0,042	0,05	1000			
							19,31	2240	0,05
2	1,5 cm	elka esb P5	0,120	0,125	0,6	621			
							19,02	2199	0,65
3	4,8 cm	Installation level	0,267	0,180	0,01	1			
							18,60	2143	0,66
4	0,04 cm	Rothoblaas VAPOR IN 120	0,300	0,001	25	300			
							18,59	2142	25,7
5	1,8 cm	elka esb P5	0,120	0,150	0,72	621			
							18,24	2095	26,4
6	26,4 cm	EPS-grau 032 WDV	0,032	8,250	5,28	20			
							-1,14	556	31,7
7	1,8 cm	elka esb P5	0,120	0,150	1,44	621			
							-1,49	540	33,1
8	1,5 cm	elka esb P5	0,120	0,125	1,2	621			
							-1,79	527	34,3
9	0,04 cm	Rothoblaas TRASPIR 110	0,300	0,001	0,1	280			
							-1,79	526	34,4
10	4 cm	Sto-Polystyrol-Hartschaumplatte PS15SE 034	0,034	1,176	2	15			
							-4,56	417	36,4
11	1 cm	HASIT 267(vorher 840) CalceClima® Thermo Kalk-Dämmputz	0,067	0,149	0,1	300			
							-4,91	404	36,5
		Thermal contact resistance		0,040					

Temperature (T), vapor saturation pressure (ps), and the sum of the sd-values (Σsd) apply to the layer boundary.

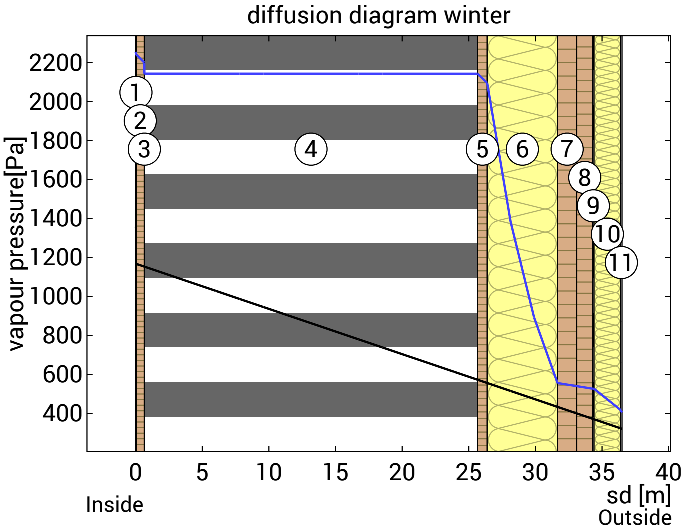
Relative air humidity on the surface

The relative humidity on the interior surface is 52%. Requirements for the prevention of building material corrosion depend on material and coating and have not been investigated. ✓

Dew period (winter)

Boundary conditions	
Vapor pressure inside at 20°C and 50% humidity	pi = 1168 Pa
Vapor pressure outside at -5°C and 80% humidity	pe = 321 Pa
Duration of condensation period (90 days)	tc = 7776000 s
Water vapor diffusion coefficient in static air	δ0 = 2.0E-10 kg/(m*s*Pa)
sd-value (Whole component.)	sde = 36,50 m

diffusion diagram winter



vapour pressure
Saturation pressure

1. Gipsplatte - Knauf Diamondboard 12,5 / 15 (12,5 mm), sd=0,05 m
2. elka esb P5 (15 mm), sd=0,6 m
3. Installation level (48 mm), sd=0,01 m
4. Rothoblaas VAPOR IN 120, sd=25 m
5. elka esb P5 (18 mm), sd=0,72 m
6. EPS-grau 032 WDV (264 mm), sd=5,28 m
7. elka esb P5 (18 mm), sd=1,44 m
8. elka esb P5 (15 mm), sd=1,2 m
9. Rothoblaas TRASPIR 110, sd=0,1 m
10. Sto-Polystyrol-Hartschaumplatte PS15SE 034 (40 mm), sd=2 m
11. HASIT 267 CalceClima® Thermo Kalk-Dämmputz (10 mm), sd=0,1 m

The section under investigation is free of condensate under the given climate conditions. ✓

Gablok

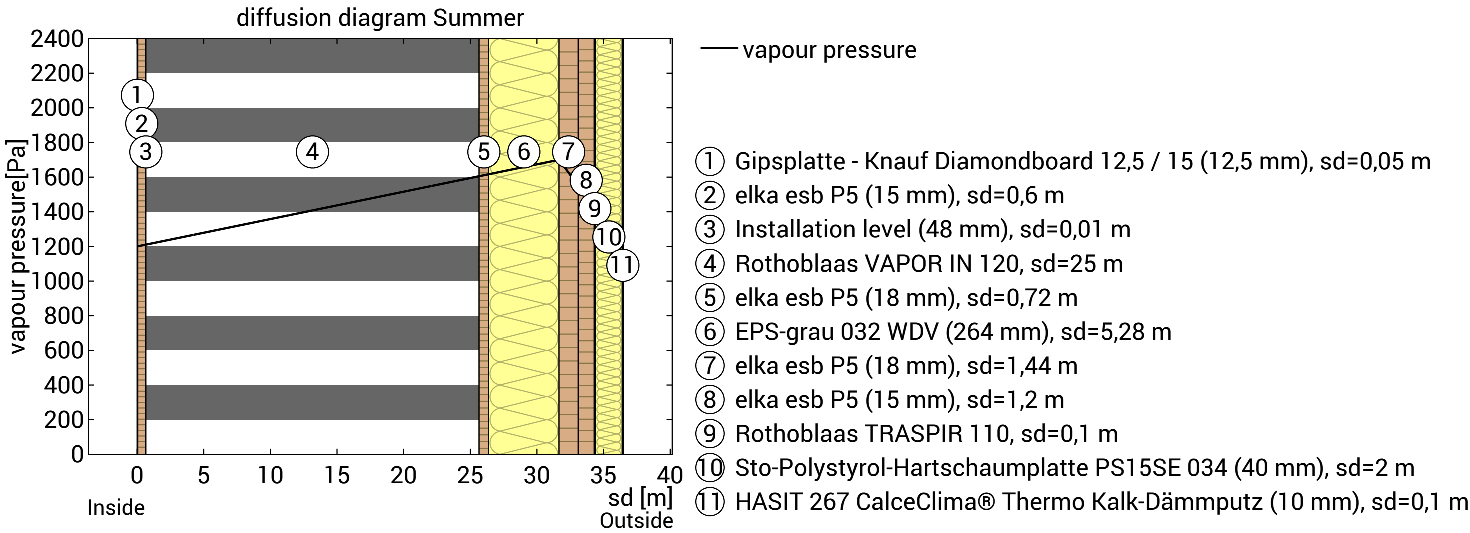
External Thermal Insulation Composite, U=0,11 W/(m²K)

Calculate evaporation potential for the drying reserve in the dew period for the plane with the lowest evaporation potential: sd=31,66 m; x=35,79 cm; ps=556 pa:
Layer boundary between EPS-grau 032 WDV and elka esb P5

Mev,Tauperiode = tc * δ0 * ((ps-pi)/sd_{ev} + (ps-pe)/(sd_e-sd_{ev})) = **0,045 kg/m²**

Evaporation period (summer)

Boundary conditions	
Interior vapor pressure	pi = 1200 Pa
Exterior vapor pressure	pe = 1200 Pa
Saturation vapour pressure in the condensation area	ps = 1700 Pa
Length of drying season (90 days)	tev = 7776000 s
sd-values remain unchanged.	



Condensate-free component: The maximum possible evaporation mass for the drying reserve is calculated. Consider the level that has the lowest evaporation potential in the dew period, at sd=31,66 m; x=35,79 cm:
Layer boundary between EPS-grau 032 WDV and elka esb P5
Evaporation mass: Mev = δ0 * tev * [(ps-pi)/sd + (ps-pe)/(sde-sd)] = **0,19 kg/m²**

Drying reserve (DIN 68800-2)

Dew-water-free component: The evaporation potential of the dew period is also taken into account.
Drying reserve: Mr = (Mev + Mev,Tauperiode) * 1000 = **231 g/m²/a**
Minimum requested for walls and ceilings: 100 g/m²/a

✓

Evaluation according to DIN 4108-3

The component is permissible regarding the moisture protection.

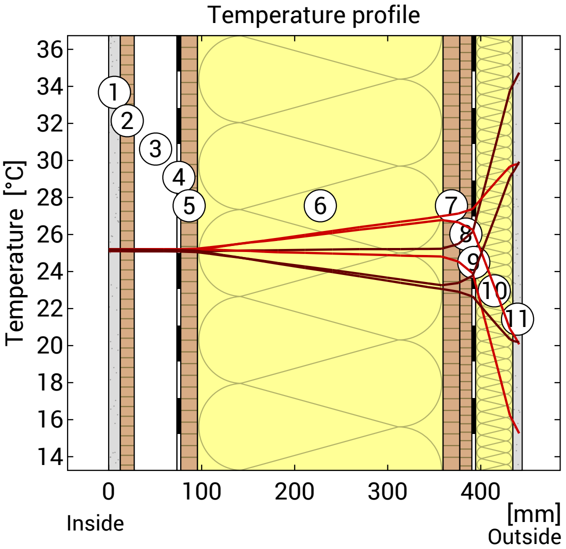
Hints

In the case of inhomogeneous constructions, such as skeleton-, stand- or frame constructions, as well as in wooden beam, rafter or half-timbered constructions or the like, the one-dimensional diffusion calculations are only to be demonstrated for the compartment area. Exceptional cases are special constructions in which, for example, The diffusion-inhibiting layer is also laid section-wise over the outer area. In these exceptional cases, the calculation performed here is invalid.

DIN 4108-3 describes in Section 5.3 components for which no moisture proofing is required as there is no risk of condensation water or the method is not suitable for the assessment. It is not possible to assess whether the component under test is underneath.

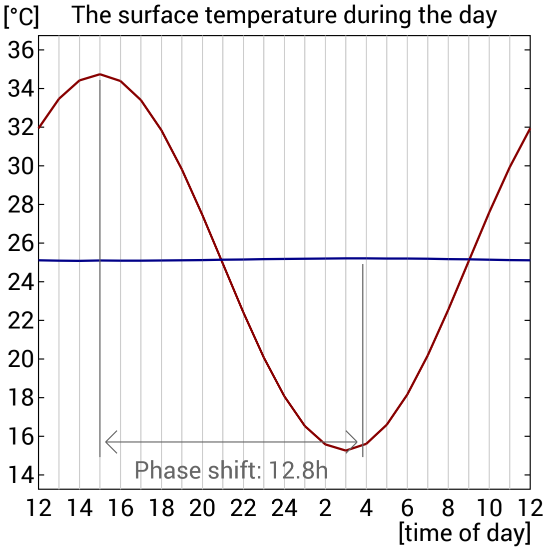
Heat protection

The following results are properties of the tested component alone and do not make any statement about the heat protection of the entire room:



Temperature at 3pm, 11am and 7am
Temperature at 7pm, 11pm and 3am

1. Gipsplatte - Knauf Diamondboard 12,5 / 15 (12,5 mm)
2. elka esb P5 (15 mm)
3. Installation level (48 mm)
4. Rothoblaas VAPOR IN 120
5. elka esb P5 (18 mm)
6. EPS-grau 032 WDV (264 mm)
7. elka esb P5 (18 mm)
8. elka esb P5 (15 mm)
9. Rothoblaas TRASPIR 110
10. Sto-Polystyrol-Hartschaumplatte PS15SE 034 (40 mm)
11. HASIT 267 CalceClima® Thermo Kalk-Dämmputz (10 mm)



Outside
Inside

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):	138 kJ/m²K
Amplitude attenuation **	>100	Thermal capacity of inner layers:	82 kJ/m²K
TAV ***	0,007		

* 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.