Spær 145 mm og briiso u-værdi 0,10

Exterior wall
created on 22.7.2020

Thermal protection

U = 0,10 W/(m²K)

EnEV Bestand*: U<0,24 W/(m²K)

excellent insufficient

Moisture proofing

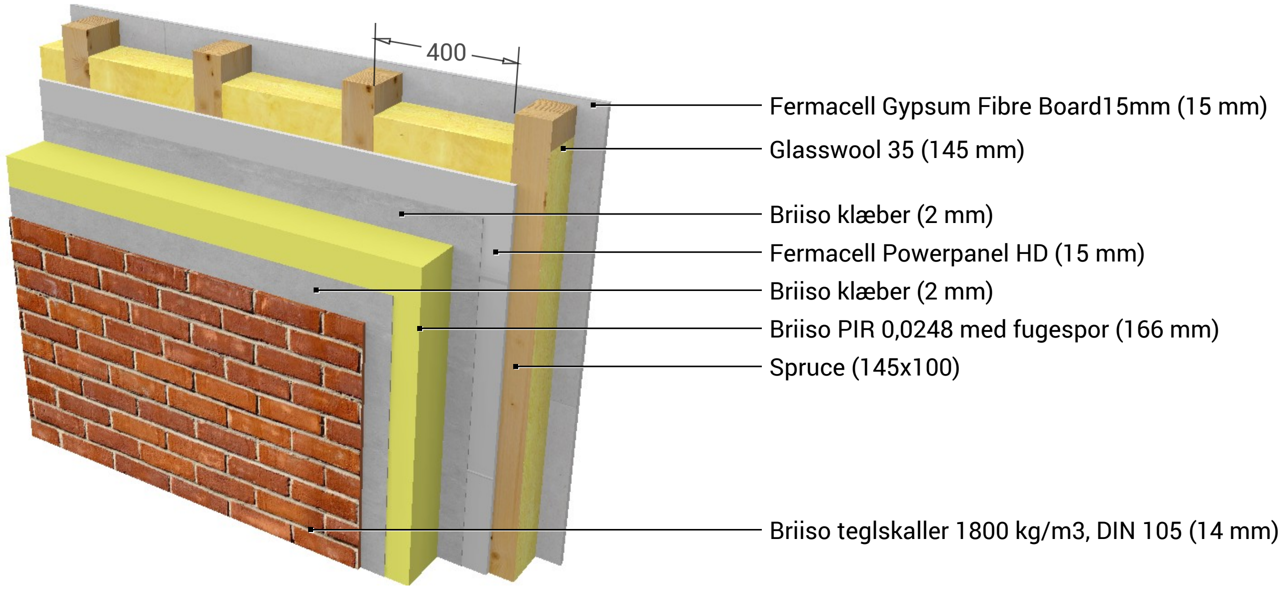
Drying reserve: 0 g/m²a
(leads to devaluation)
No condensate

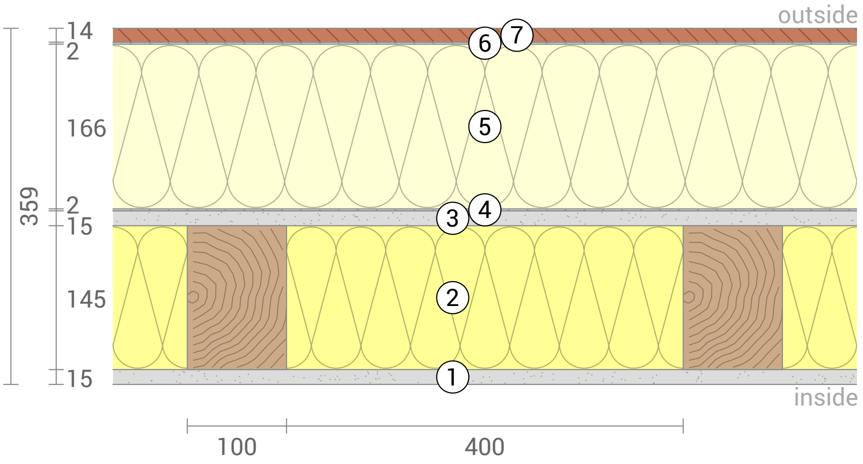
excellent insufficient

Heat protection

Temperature amplitude damping: 75
phase shift: 13,3 h
Thermal capacity inside: 54 kJ/m²K

excellent insufficient





- ① Fermacell Gypsum Fibre Board15mm (15 mm)
- ② Glasswool 35 (145 mm)
- ③ Fermacell Powerpanel HD (15 mm)
- ④ Briiso klæber (2 mm)
- ⑤ Briiso PIR 0,0248 med fugespor (166 mm)
- ⑥ Briiso klæber (2 mm)
- ⑦ Briiso teglskaller 1800 kg/m3, DIN 105 (14 mm)

Inside air :	20,0°C / 50%			Thickness:	35,9 cm
Outside air:	-5,0°C / 80%	sd-value:	16601,7 m	Weight:	86 kg/m²
Surface temperature.:	19,0°C / -4,9°C	Drying reserve:	0 g/m²a	Heat capacity:	98 kJ/m²K

☑ EnEV Bestand ☑ ESanMV ☑ EnEV16 Neubau ☑ EnEV14 Neubau

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*Comparison of the U-value with den Höchstwerten aus EnEV 2014 Anlage 3 Tabelle 1 (EnEV Bestand); den Höchstwerten der Energetische Sanierungsmaßnahmen-Verordnung (ESanMV); 80% des U-Werts der Referenzausführung aus EnEV 2014 Anlage 1 Tabelle 1 (EnEV16 Neubau); der Referenzausführung aus EnEV 2014 Anlage 1 Tabelle 1 (EnEV14 Neubau)

Click here to edit the construction on www.ubakus.de.

Spær 145 mm og briiso u-værdi 0,10, U=0,10 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	Fermacell Gypsum Fibre Board15mm	1,50	0,320	0,047
2	Glasswool 35	14,50	0,035	4,143
	Spruce (20%)	14,50	0,130	1,115
3	Fermacell Powerpanel HD	1,50	0,400	0,038
4	Briiso klæber	0,20	1,400	0,001
5	Briiso PIR 0,0248 med fugespor	16,60	0,025	6,694
6	Briiso klæber	0,20	1,400	0,001
7	Briiso teglskaller 1800 kg/m3, DIN 105	1,40	0,810	0,017
	Thermal contact resistance outside (Rse)			0,040
	Whole component	35,9		

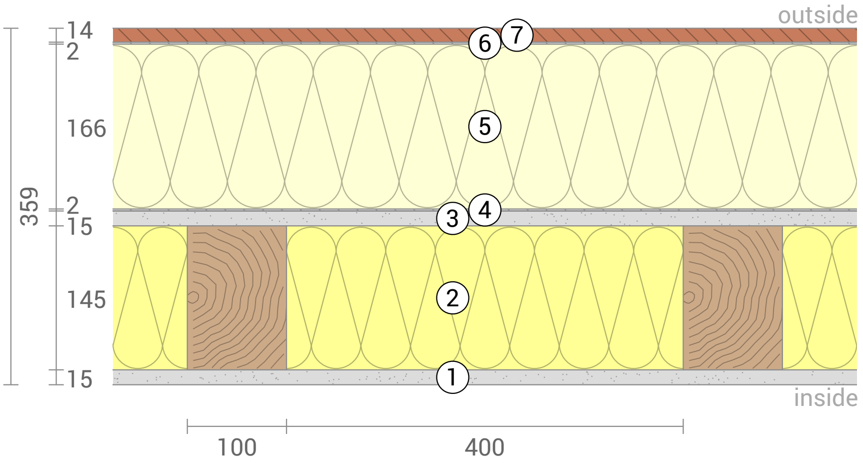
Thermal contact resistances have been taken from DIN 6946 Table 7.
Rsi: heat flow direction horizontally
Rse: heat flow direction horizontally, outside: Direct contact to outside air

Upper limit of thermal resistance $R_{tot;upper}$ = 10,337 m²K/W.
Lower limit of thermal resistance $R_{tot;lower}$ = 9,653 m²K/W.
Check applicability: $R_{tot;upper}$ / $R_{tot;lower}$ = 1,071 (maximum allowed: 1,5)

The procedure may be used.

Thermal resistance $R_{tot} = (R_{tot;upper} + R_{tot;lower})/2$ = 9,995 m²K/W
Estimated maximum relative uncertainty according to section 6.7.2.5: 3,4%

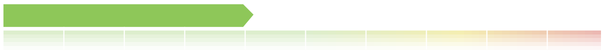
Heat transfer coefficient U = $1/R_{tot}$ = **0,10 W/(m²K)**



Spær 145 mm og briiso u-værdi 0,10, U=0,10 W/(m^{2}K)

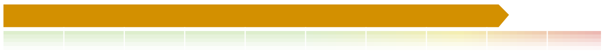
LCA

Heat loss: 8 kWh/m^2 per heating season



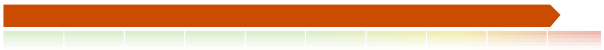
Amount of heat that escapes through one square meter of this component during the heating period. Please note: Due to internal and solar gains, the heating demand is lower than the heat loss.

Primary energy (non renewable): 287 kWh/m^2



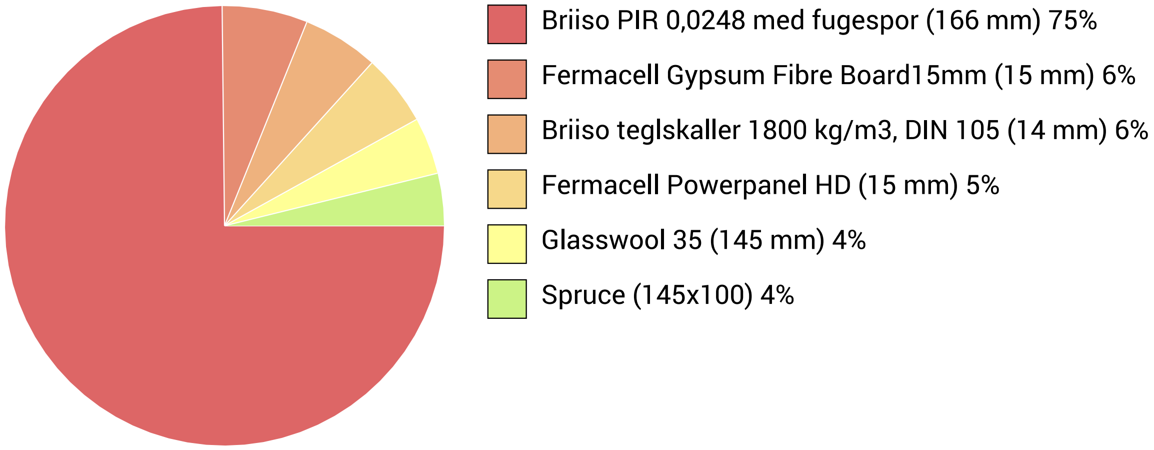
Non-renewable primary energy (= energy from fossil fuels and nuclear energy) that was used to produce the new building materials ("cradle to gate").

Green house gas potential: 36 kg CO2 Äqv./m^2

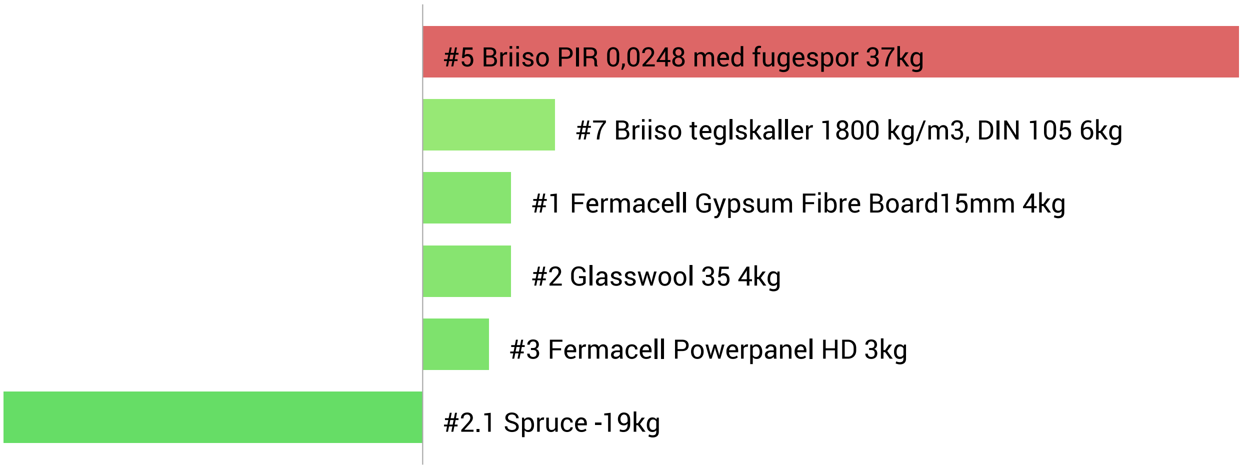


Quantity of released greenhouse gases in the production of building materials used ("cradle to gate").

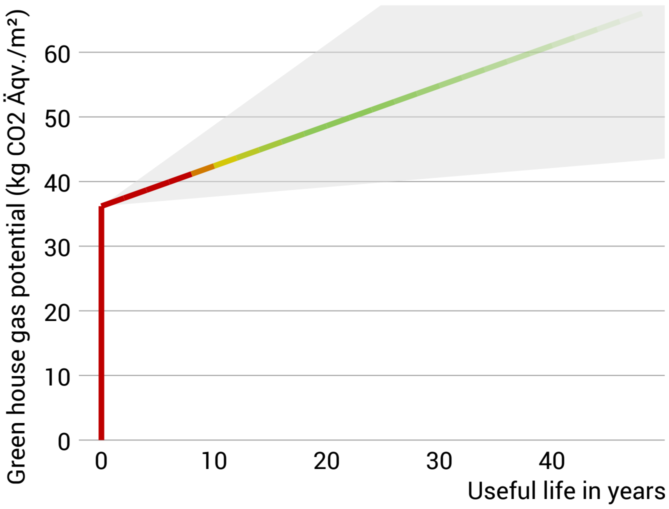
Composition of non-renewable primary energy of production:

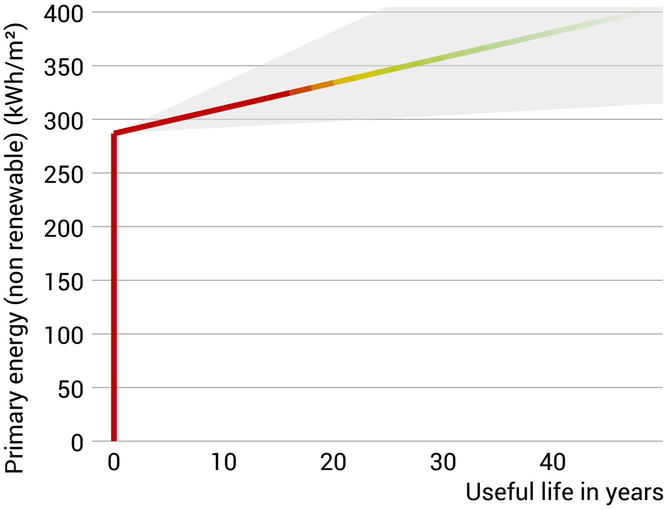


Composition of the greenhouse potential of production:



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).

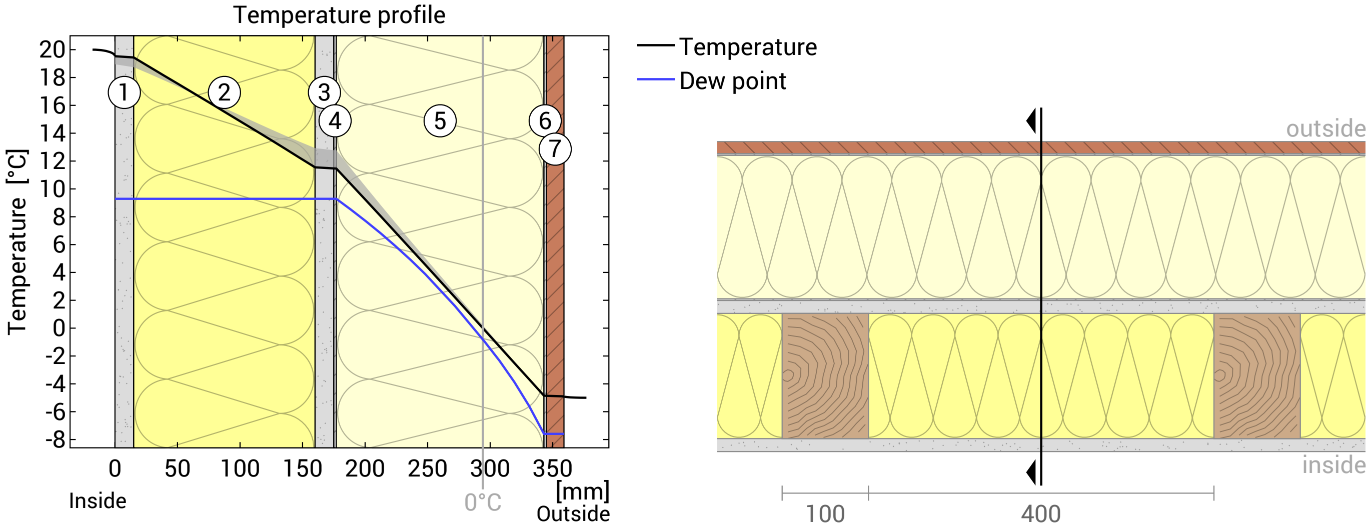
Due to unknown solar and internal gains, the heating demand can only be estimated. Accordingly, primary energy consumption and global warming potential during the use phase are only vaguely known. For the estimation it was assumed that solar and internal profits contribute with 4 kWh/a/m² component area. 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.

Temperature profile



① Fermacell Gypsum Fibre Board15...
② Glasswool 35 (145 mm)
③ Fermacell Powerpanel HD (15 mm)
④ Briiso klæber (2 mm)
⑤ Briiso PIR 0,0248 med fugespor (...
⑥ Briiso klæber (2 mm)
⑦ Briiso teglskaller 1800 kg/m3, DIN...

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*		0,250	19,0	20,0	
1	1,5 cm	Fermacell Gypsum Fibre Board15mm	0,320	0,047	18,7	19,5	17,3
2	14,5 cm	Glasswool 35	0,035	4,143	11,5	19,4	2,3
	14,5 cm	Spruce (20%)	0,130	1,115	12,8	19,0	13,1
3	1,5 cm	Fermacell Powerpanel HD	0,400	0,038	11,5	12,9	14,3
4	0,2 cm	Briiso klæber	1,400	0,001	11,5	12,8	4,0
5	16,6 cm	Briiso PIR 0,0248 med fugespor	0,025	6,694	-4,9	12,8	6,1
6	0,2 cm	Briiso klæber	1,400	0,001	-4,9	-4,8	4,0
7	1,4 cm	Briiso teglskaller 1800 kg/m3, DIN 105	0,810	0,017	-4,9	-4,9	25,2
		Thermal contact resistance*		0,040	-5,0	-4,9	
	35,9 cm	Whole component		9,810			86,2

*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'.

	min	average	max
Surface temperature inside (min / average / max):	19,0°C	19,4°C	19,5°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.

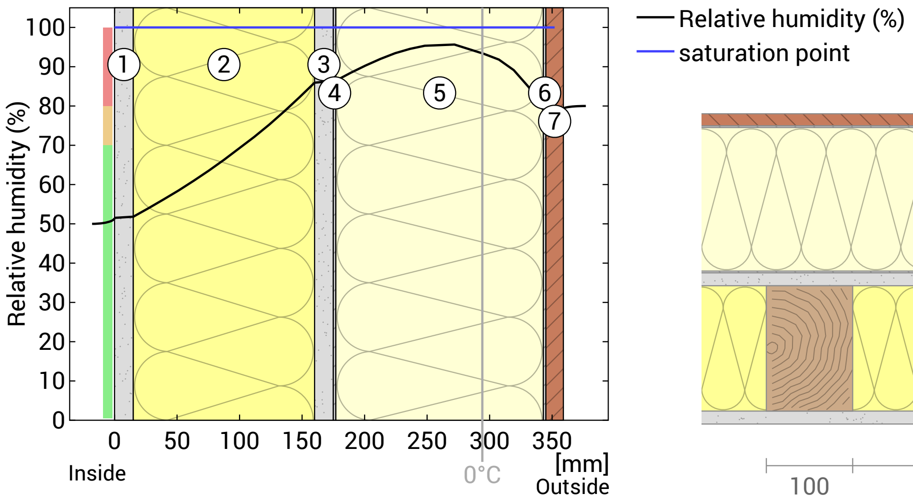
Drying reserve according to DIN 4108-3:2001:	0 g/(m²a)
At least required by DIN 68800-2:	100 g/(m²a)

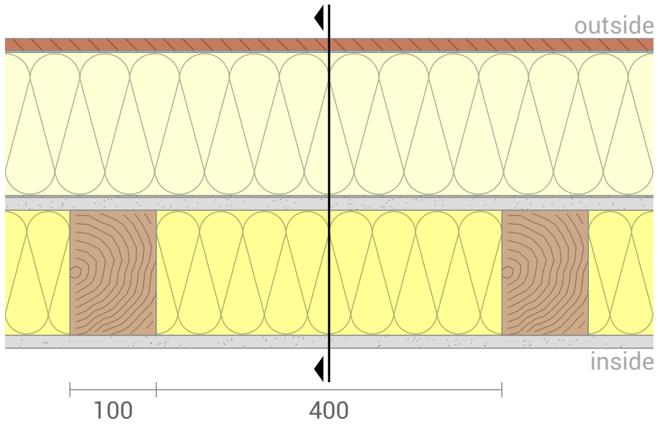
The moisture protection of this component is therefore rated poorly.

#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	1,5 cm	Fermacell Gypsum Fibre Board15mm	0,20	-		17,3
2	14,5 cm	Glasswool 35	0,15	-		2,3
	14,5 cm	Spruce (20%)	2,90	-	-	13,1
3	1,5 cm	Fermacell Powerpanel HD	0,60	-		14,3
4	0,2 cm	Briiso klæber	0,03	-		4,0
5	16,6 cm	Briiso PIR 0,0248 med fugespor	16600	-		6,1
6	0,2 cm	Briiso klæber	0,07	-		4,0
7	1,4 cm	Briiso teglskaller 1800 kg/m3, DIN 105	0,14	-		25,2
	35,9 cm	Whole component	16.601,67			86,2

Humidity

The temperature of the inside surface is 19,0 °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 Fermacell Gypsum Fibre Board15...
② Glasswool 35 (145 mm)
③ Fermacell Powerpanel HD (15 mm)
④ Briiso klæber (2 mm)
⑤ Briiso PIR 0,0248 med fugespor (...
⑥ Briiso klæber (2 mm)
⑦ Briiso teglskaller 1800 kg/m3, DIN...

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.

Spær 145 mm og briiso u-værdi 0,10, U=0,10 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]
		Thermal contact resistance		0,250		
1	1,5 cm	Fermacell Gypsum Fibre Board15mm	0,320	0,047	0,2	1150
2	14,5 cm	Glasswool 35	0,035	4,143	0,15	20
3	1,5 cm	Fermacell Powerpanel HD	0,400	0,038	0,6	950
4	0,2 cm	Briiso klæber	1,400	0,001	0,03	2000
5	16,6 cm	Briiso PIR 0,0248 med fugespor	0,025	6,694	16600	37
6	0,2 cm	Briiso klæber	1,400	0,001	0,07	2000
7	1,4 cm	Briiso teglskaller 1800 kg/m3, DIN 105	0,810	0,017	0,14	1800
		Thermal contact resistance		0,040		

T [°C]	ps [Pa]	Σsd [m]
19,44	2259	0
19,34	2244	0,2
10,12	1237	0,34
10,03	1230	0,94
10,03	1230	0,97
-4,87	406	16601
-4,87	406	16601
-4,91	404	16601

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

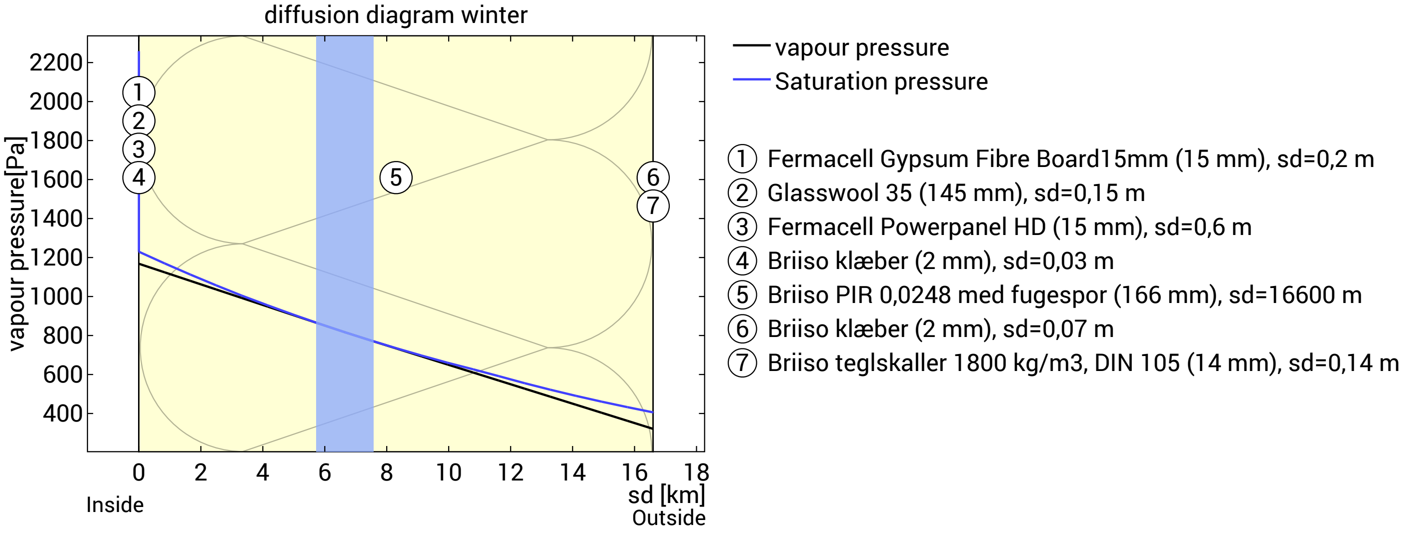
Relative air humidity on the surface

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 = 16.601,18 m



Condensation area c_1: Condensate in layer Briiso PIR 0,0248 med fugespor
von sd_{c1i}=6.640,97m until sd_{c1e}=7.470,97m; p_{c1i}=817Pa until p_{c1e}=775Pa; x ~ 24,34 cm

Condensate amount: $Mc = tc * δ0 * ((p_i-p_{c1i})/sd_{c1i} - (p_{c1e}-p_e)/(sd_e-sd_{c1e}))$ = **0,000 kg/m²**

No layer boundary in the condensation water area.

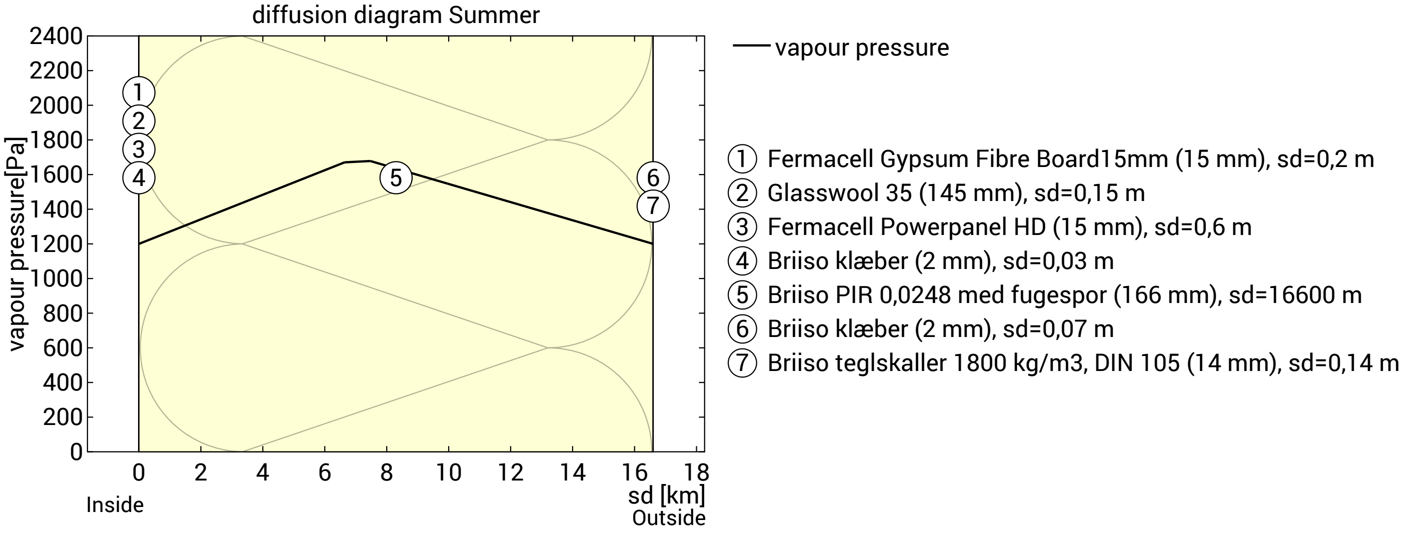
Condensation occurs within a layer. The maximum allowed amount of condensation water is therefore 1 kg/m².
Total amount of condensate: Mc = **0,000 kg/m²**

✓

Spær 145 mm og briiso u-værdi 0,10, U=0,10 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.	



Condensation water from area c_1 is added to the center of the area in the diffusion diagram, sd_{c1} = 7.055,97 m
Maximum possible evaporation mass
Mev = tc * δ0 * ((ps-pi)/sd_{c1} + (ps-pe)/(sd_e-sd_{c1})) = **0,000 kg/m²**
The condensation water can dry completely.

✓

Drying reserve (DIN 68800-2)

Using the block climate from DIN 4108-3:2001 for the calculation of the drying reserve. This climate was used when the limits were set in DIN 68800-2.

#		Material	λ [W/mK]	R [m²K/W]	sd [m]	ρ [kg/m³]	T [°C]	ps [Pa]	Σsd [m]
		Thermal contact resistance		0,130			19,65	2288	0
1	1,5 cm	Fermacell Gypsum Fibre Board15mm	0,320	0,047	0,2	1150	19,52	2270	0,2
2	14,5 cm	Glasswool 35	0,035	4,143	0,15	20	8,34	1097	0,34
3	1,5 cm	Fermacell Powerpanel HD	0,400	0,038	0,6	950	8,24	1090	0,94
4	0,2 cm	Briiso klæber	1,400	0,001	0,07	2000	8,23	1089	1,01
5	16,6 cm	Briiso PIR 0,0248 med fugespor	0,025	6,694	16600	37	-9,84	263	16601
6	0,2 cm	Briiso klæber	1,400	0,001	0,07	2000	-9,85	263	16601
7	1,4 cm	Briiso teglskaller 1800 kg/m3, DIN 105	0,810	0,017	0,14	1800	-9,89	262	16601
		Thermal contact resistance		0,040					

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

Dew period (winter)

Boundary conditions	
Vapor pressure inside at 20°C and 50% humidity	pi = 1168 Pa
Vapor pressure outside at -10°C and 80% humidity	pe = 208 Pa
Duration of condensation period (60 days)	tc = 5184000 s
Water vapor diffusion coefficient in static air	δ0 = 1.852E-10 kg/(m*s*Pa)
sd-value (Whole component.)	sde = 16.601,22 m

Condensation area c_1: Layers Glasswool 35 and Fermacell Powerpanel HD
von sd_{c1i}=0,34m until sd_{c1e}=6.641,01m; p_{c1i}=1097Pa until p_{c1e}=656Pa; x ~ 16 cm

Condensate amount: $Mc1 = tc * δ0 * ((p_i\text{-}p_{c1i})/sd_{c1i} - (p_{c1e}\text{-}p_{c2i})/(sd_{c2i}\text{-}sd_{c1e}))$ = **0,200 kg/m²**

Für Schicht Glasswool 35 wurde noch kein Wasseraufnahmekoeffizient hinterlegt. Es wird deshalb angenommen, dass mindestens eine Schicht nicht kapillar wasseraufnahmefähig ist.
Fermacell Powerpanel HD wird als wasseraufnahmefähig eingestuft weil Aw ≥ 0.1 ist.

Condensation area c_2: Condensate in layer Briiso PIR 0,0248 med fugespor
von sd_{c2i}=8.301,01m until sd_{c2e}=10.791,01m; p_{c2i}=572Pa until p_{c2e}=455Pa; x ~ 26 cm

Condensate amount: $Mc2 = tc * δ0 * ((p_{c1e}\text{-}p_{c2i})/(sd_{c2i}\text{-}sd_{c1e}) - (p_{c2e}\text{-}p_e)/(sd_e\text{-}sd_{c2e}))$ = **0,000 kg/m²**

No layer boundary in the condensation water area.

The maximum allowed amount of condensation water is at least 0,5 kg/m².
Total amount of condensate: Mc = **0,200 kg/m²**

Evaporation period (summer)

Boundary conditions	
Interior vapor pressure	pi = 982 Pa
Exterior vapor pressure	pe = 982 Pa
Saturation vapour pressure in the condensation area	ps = 1403 Pa
Length of drying season (90 days)	tev = 7776000 s
sd-values remain unchanged.	

Condensation water from area c_1 is added to the center of the area in the diffusion diagram, sd_{c1} = 3.320,68 m
Condensation water from area c_2 is added to the center of the area in the diffusion diagram, sd_{c2} = 9.546,01 m
Tauwasserausfall in zwei Ebenen. Berechnung der von den beiden Tauwasserebenen weg diffundierenden Diffusionsstromdichten:
gev1 = δ0 * (ps-pi)/sd_{c1} = 2.347e-11 kg/(m²s)
gev2 = δ0 * (ps-pe)/(sde-sd_{c2}) = 1.105e-11 kg/(m²s)

Evaporation times:
tev1 = Mc1 / gev1 = 8538599031 s (98.826,4 Tage)
tev2 = Mc2 / gev2 = 703073 s (8,1 Tage)

Layer 2 dries first. Calculate the total potential evaporation mass:
Mev2 = gev2 * tev2 = 0,000 kg/m²
Mev1 = gev1 * tev2 + [gev1 + δ0 * (ps-pe)/(16601.22-3320.675)] * (tev-tev2) = 0,000 kg/m²
Evaporation mass: Mev = Mev1 + Mev2 = **0,000 kg/m²**
The condensation amount of 0,200 kg/m² can not dry completely.

No drying reserve! (Mev < Mc)
Minimum requested for walls and ceilings: 100 g/m²/a

Demand not met!

Evaluation according to DIN 4108-3

The component is not permissible regarding the moisture protection.

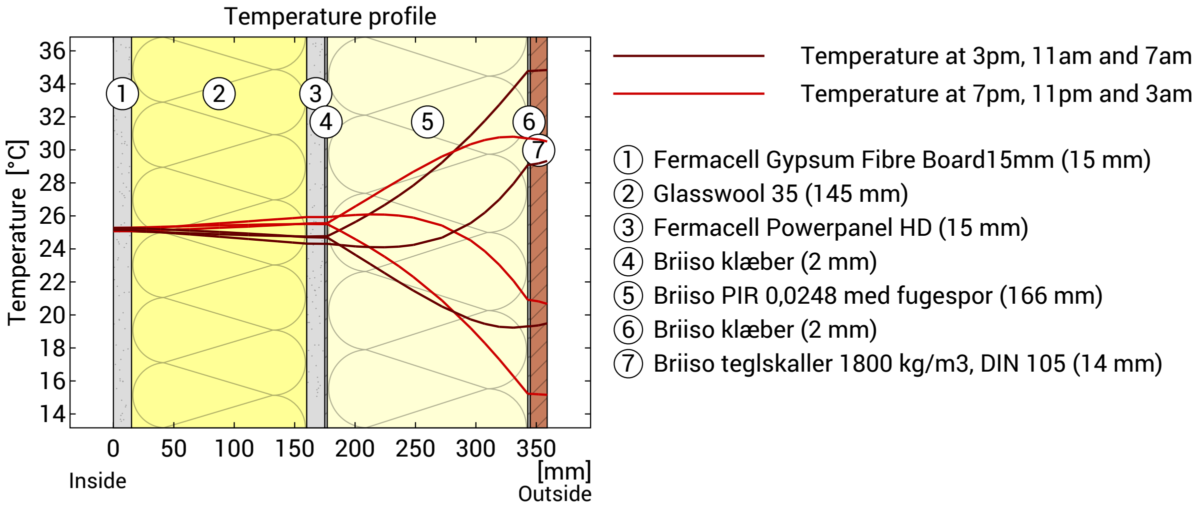
Hints

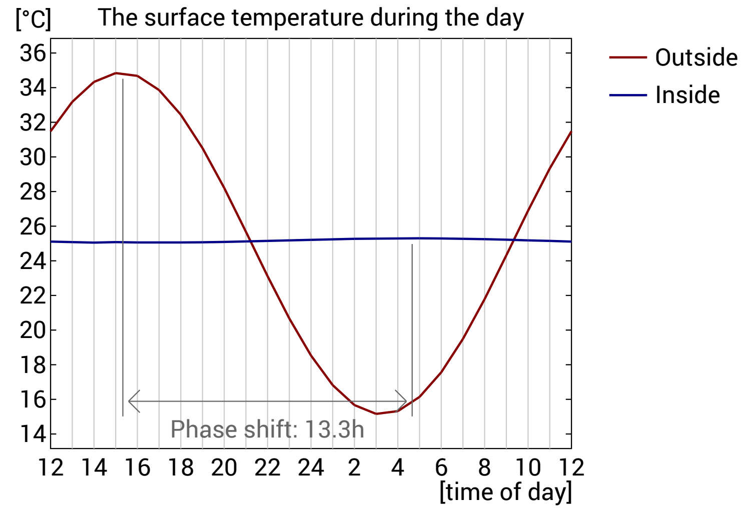
In the case of inhomogeneous constructions, such as skeleton-, stand- or frame constructions, as well as in wooden beam, rafter or half-timbered constructions or the like, the one-dimensional diffusion calculations are only to be demonstrated for the compartment area. Exceptional cases are special constructions 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*	13,3 h	Heat storage capacity (whole component):	98 kJ/m²K
Amplitude attenuation **	75,2	Thermal capacity of inner layers:	54 kJ/m²K
TAV ***	0,013		

* 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.