FD_01.01_Folie_MiWo

Roof construction
created on 31.1.2020

Thermal protection

U = 0,20 W/(m²K)

OIB Richtlinie 6*: U<0,2 W/(m²K)

excellent insufficient

Moisture proofing

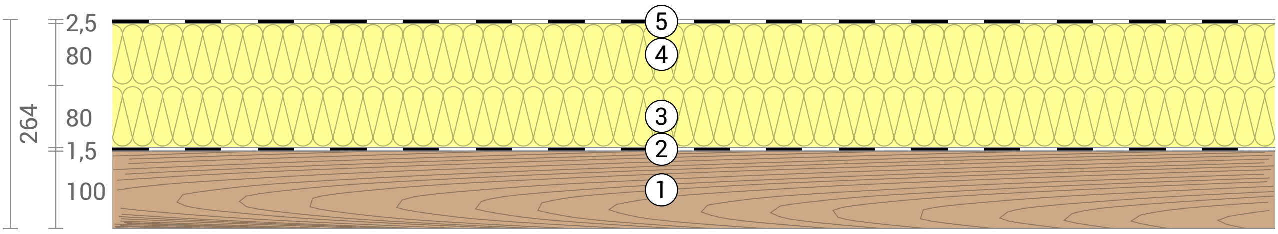
No condensate

excellent insufficient

Heat protection

Temperature amplitude damping: 38
phase shift: 12,8 h
Thermal capacity inside: 78 kJ/m²K

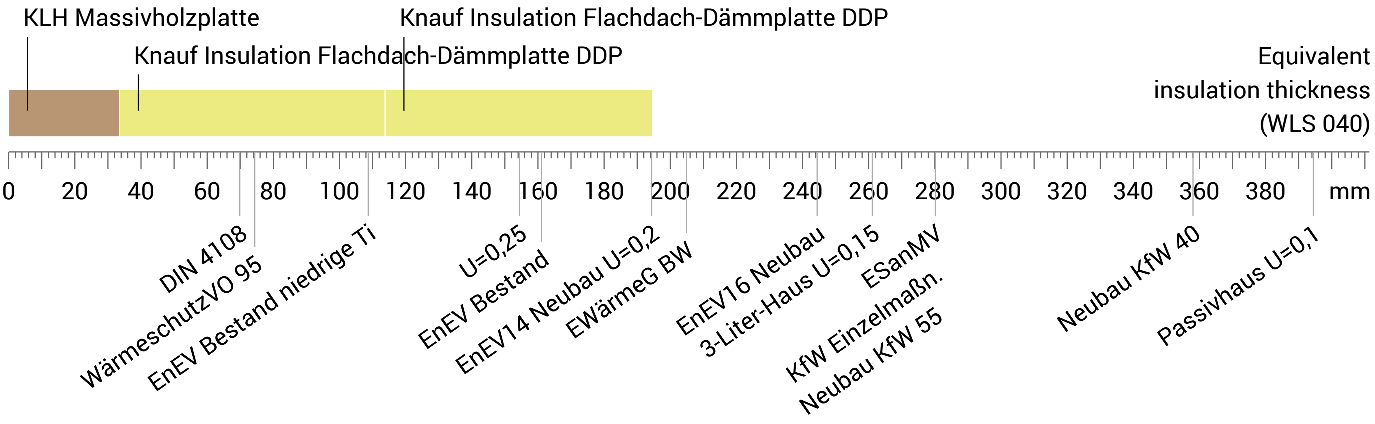
excellent insufficient



1. KLH Massivholzplatte (100 mm)
2. swisspor KSD-NSI
3. Knauf Insulation Flachdach-Dämmplatte DDP (80 mm)
4. Knauf Insulation Flachdach-Dämmplatte DDP (80 mm)
5. Hertalan easy cover

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 0,040 W/mK.



Inside air :	20,0°C / 50%			Thickness:	26,4 cm
Outside air:	-5,0°C / 80%	sd-value:	1677,7 m	Weight:	74 kg/m²
Surface temperature.:	18,8°C / -4,8°C			Heat capacity:	104 kJ/m²K

☑ OIB Richtlinie 6 ☐ ESanMV ☐ EnEV16 Neubau ☑ EnEV14 Neubau

*Comparison of the U-value with Höchstwerten aus OIB Richtlinie 6, Tabelle 10.2; 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)

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FD_01.01_Folie_MiWo, U=0,20 W/(m²K)

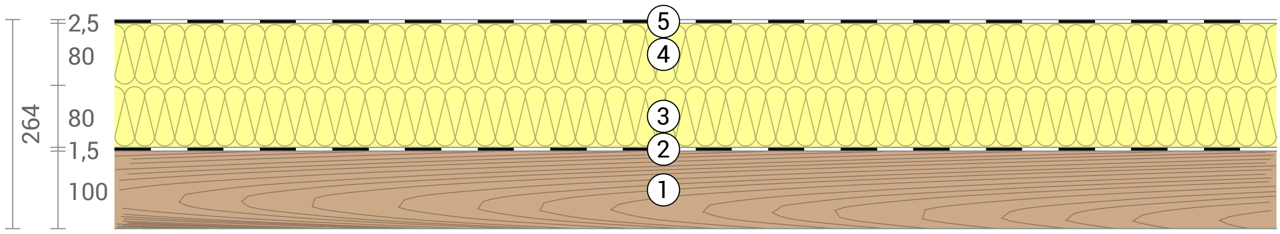
U-Value calculation according to DIN EN ISO 6946

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,100
1	KLH Massivholzplatte	10,00	0,120	0,833
2	swisspor KSD-NSI (at)	0,15	0,170	0,009
3	Knauf Insulation Flachdach-Dämmplatte DDP	8,00	0,040	2,000
4	Knauf Insulation Flachdach-Dämmplatte DDP	8,00	0,040	2,000
5	Hertalan easy cover	0,25	0,250	0,010
	Thermal contact resistance outside (Rse)			0,040
	Whole component	26,4		4,992

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

Thermal resistance R_{tot} = 4,992 m²K/W

Heat transfer coefficient U = 1/R_{tot} = **0,20 W/(m²K)**



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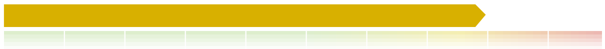
FD_01.01_Folie_MiWo, U=0,20 W/(m²K)

Yearly heat loss und Climate protection

Heat loss: 16 kWh/m² per heating season

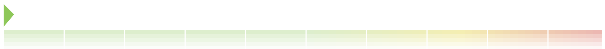


Amount of heat that escapes through one square meter of this component during the heating period. Please note: Due to internal and solar gains, the heating demand is lower than the heat loss.

Primäry energy (non renewable): >208 kWh/m²

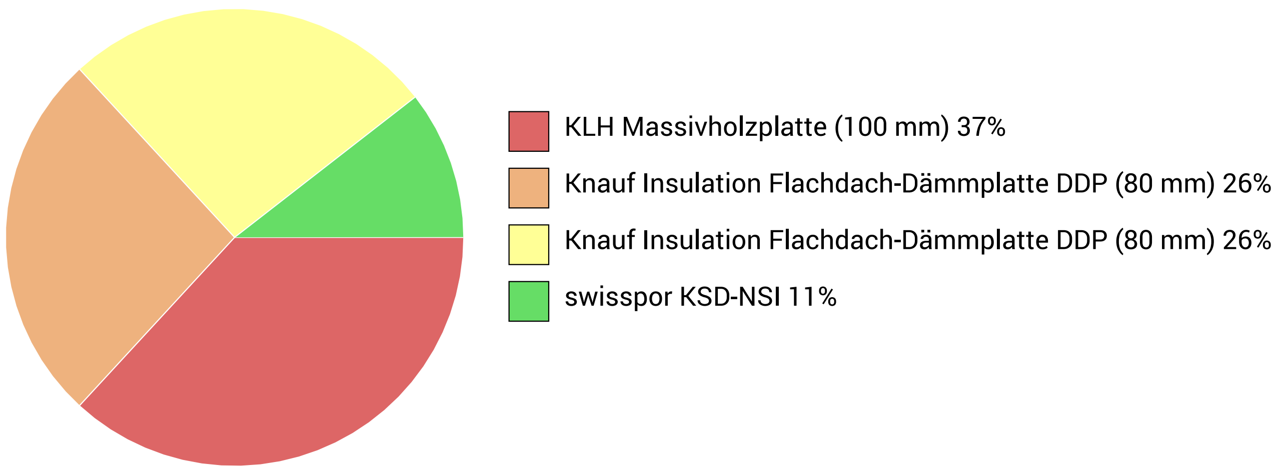
Non-renewable primary energy (= energy from fossil fuels and nuclear energy) that was used to produce the new building materials ("cradle to gate").

Green house gas potential: -24 (?) 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:



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.

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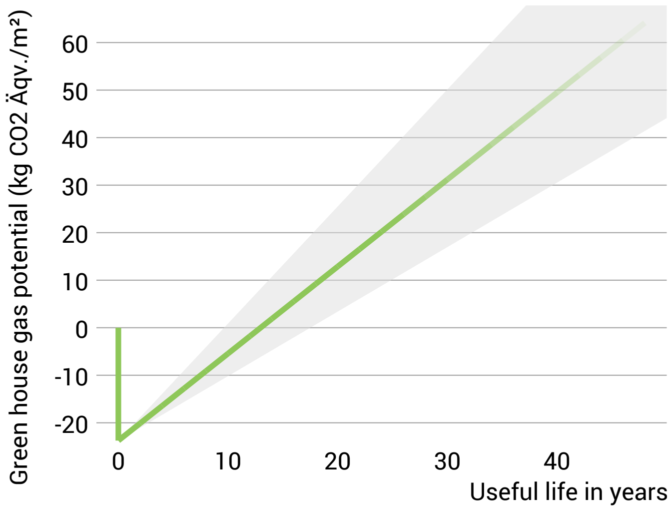
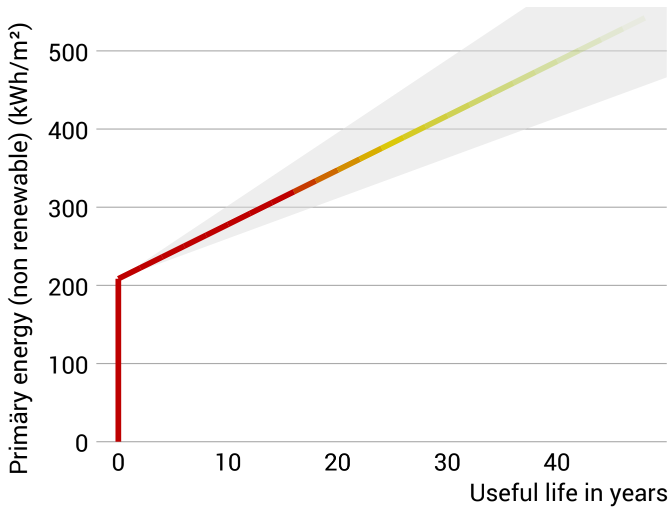
Global warming potential and primary energy for construction and use





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

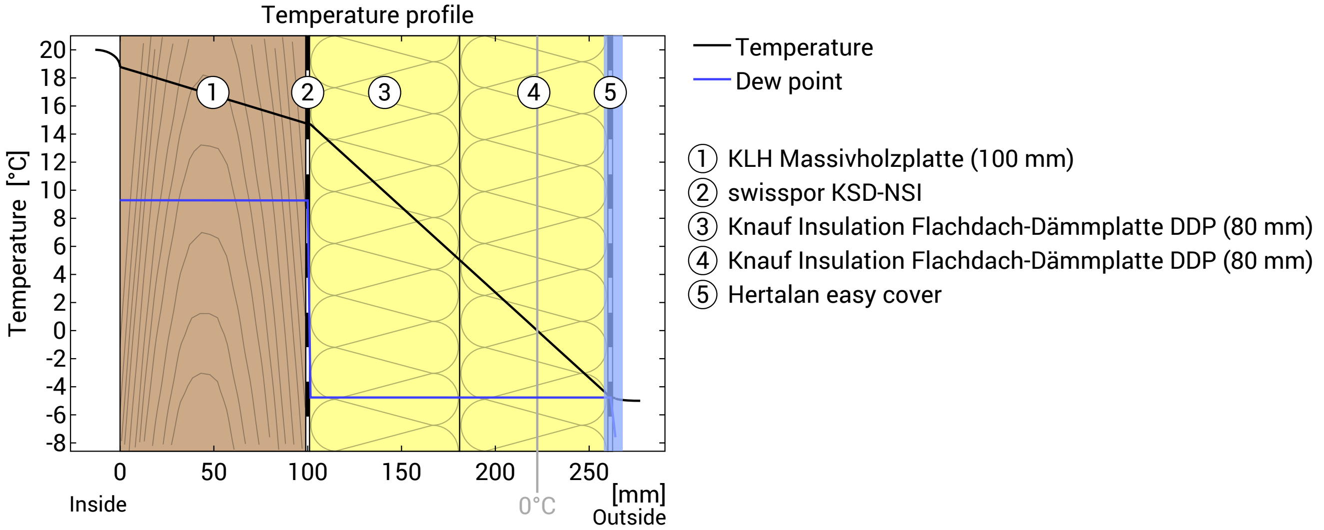
Attention: At least one layer could not be considered because its primary energy content and / or global warming potential is unknown.

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.

FD_01.01_Folie_MiWo, U=0,20 W/(m²K)

Temperature profile



Temperature and dew-point temperature in the component. 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 temperature, no condensation occurs. If the curves have contact, condensation occurs at the corresponding position.

Layers (from inside to outside)

#		Material	λ [W/mK]	R [m²K/W]	Temperatur [°C] min	max	Weight [kg/m²]
		Thermal contact resistance*		0,250	18,8	20,0	
1	10 cm	KLH Massivholzplatte	0,120	0,833	14,7	18,8	47,0
2	0,15 cm	swisspor KSD-NSI (at)	0,170	0,009	14,7	14,7	1,8
3	8 cm	Knauf Insulation Flachdach-Dämmplatte DDP	0,040	2,000	5,0	14,7	11,2
4	8 cm	Knauf Insulation Flachdach-Dämmplatte DDP	0,040	2,000	-4,8	5,0	11,2
5	0,25 cm	Hertalan easy cover	0,250	0,010	-4,8	-4,8	3,1
		Thermal contact resistance*		0,040	-5,0	-4,8	
	26,4 cm	Whole component		4,992			74,3

*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):	18,8°C	18,8°C	18,8°C
Surface temperature outside (min / average / max):	-4,8°C	-4,8°C	-4,8°C

Moisture proofing

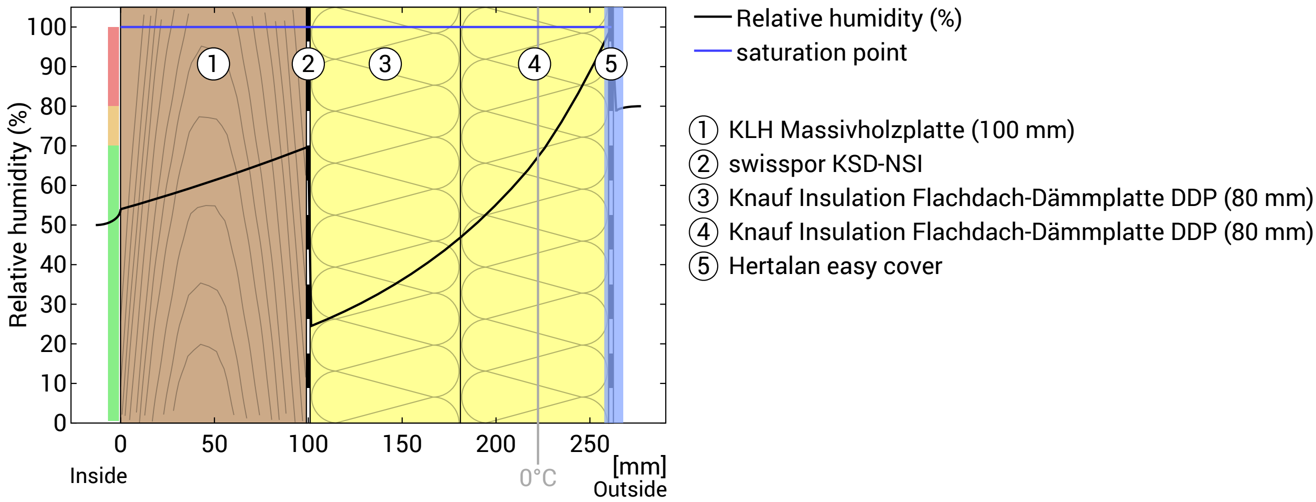
For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 20°C und 50% Humidity; outside: -5°C und 80% Humidity. This climate complies with DIN 4108-3.

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

#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	10 cm	KLH Massivholzplatte	2,50	-	-	47,0
2	0,15 cm	swisspor KSD-NSI (at)	1500	-		1,8
3	8 cm	Knauf Insulation Flachdach-Dämmplatte DDP	0,08	-		11,2
4	8 cm	Knauf Insulation Flachdach-Dämmplatte DDP	0,08	-		11,2
5	0,25 cm	Hertalan easy cover	175,00	-		3,1
	26,4 cm	Whole component	1.677,66			74,3

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.



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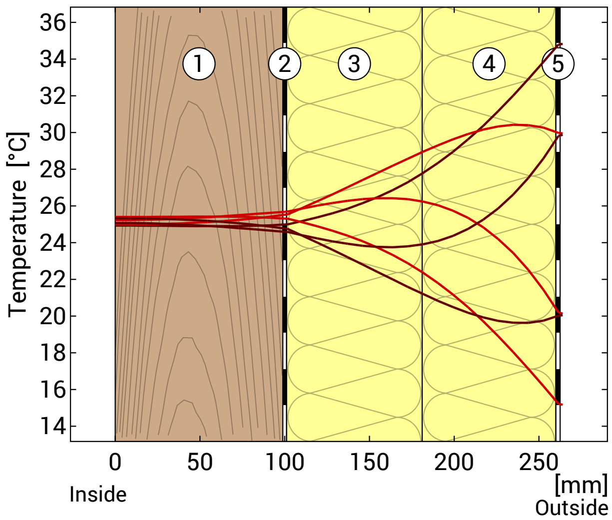
Moisture protection in accordance with DIN 4108-3:2018 Appendix A

DIN 4108-3 may not be applied to insulated, non-ventilated wooden roof structures with metal roofing or with sealing on formwork or planking without ventilation of the waterproofing / underlay.

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:

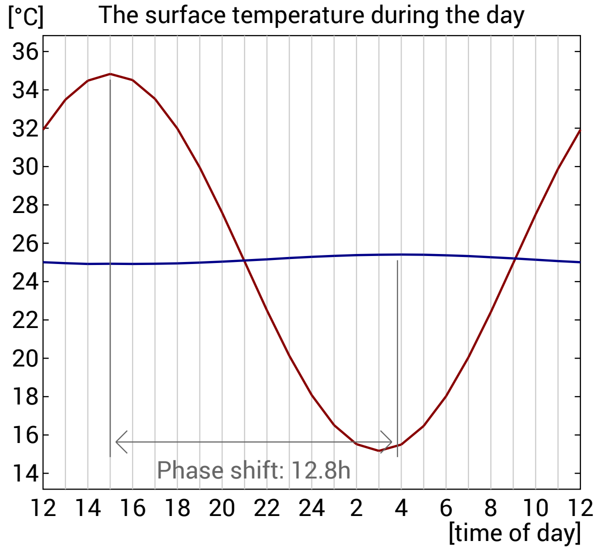
Temperature profile



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

① KLH Massivholzplatte (100 mm)
② swisspor KSD-NSI
③ Knauf Insulation Flachdach-Dämmplatte DDP (80 mm)
④ Knauf Insulation Flachdach-Dämmplatte DDP (80 mm)
⑤ Hertalan easy cover

The surface temperature during the day



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*	12,8 h	Heat storage capacity (whole component):	104 kJ/m²K
Amplitude attenuation **	38,5	Thermal capacity of inner layers:	78 kJ/m²K
TAV ***	0,026		

* 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.

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Hints

Vapour tight construction

Your build-up includes vapour blocking materials on the interior and on the exterior. In case any moisture enters the build-up through flank diffusion, construction defects, ageing or untight conduits, etc, the insulation cannot dry out. Risk of **moisture damages**! If possible, use vapour diffusion open materials on the exterior. Alternatively, a vapour diffusion variable membrane on the inside (rather than a vapour barrier) may solve the problem