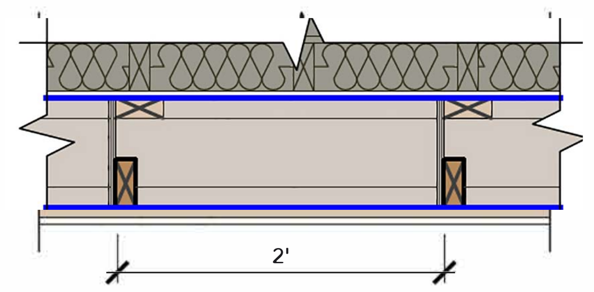
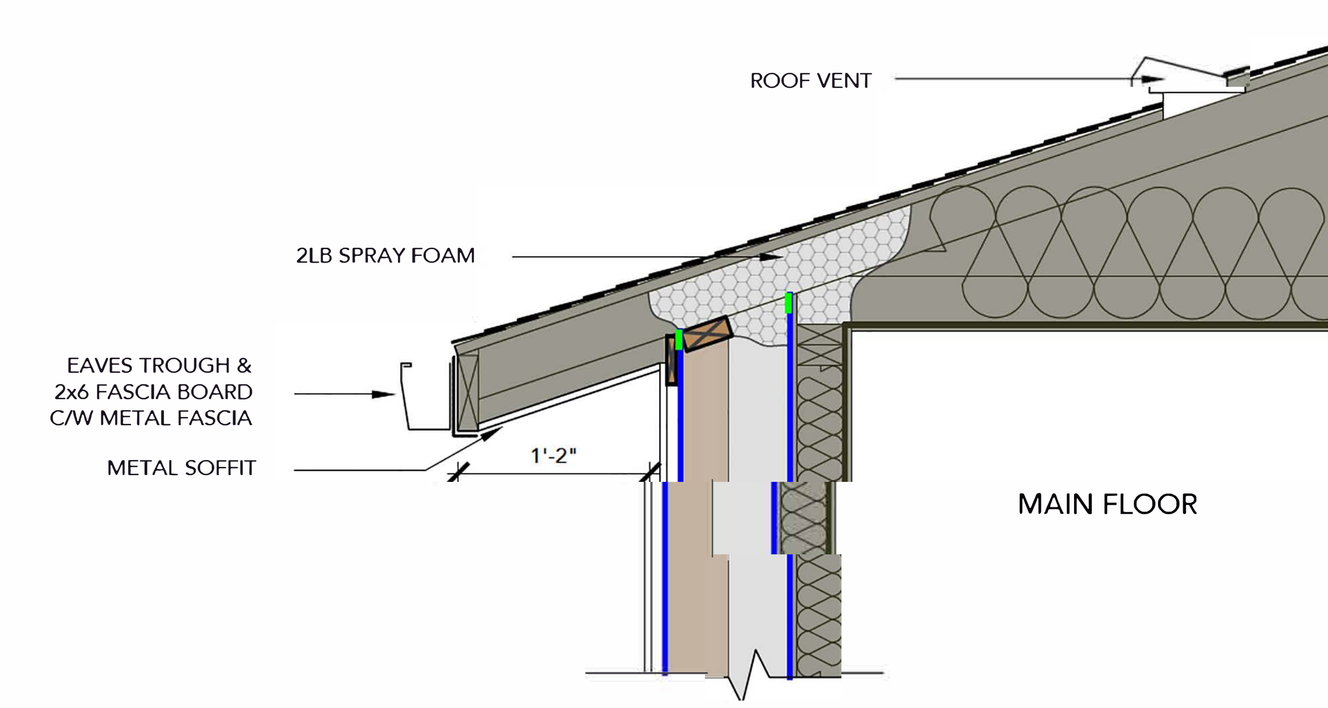


1 A100 TYP. WALL GUSSET PLAN DETAIL
SCALE: 1" = 1'-0"



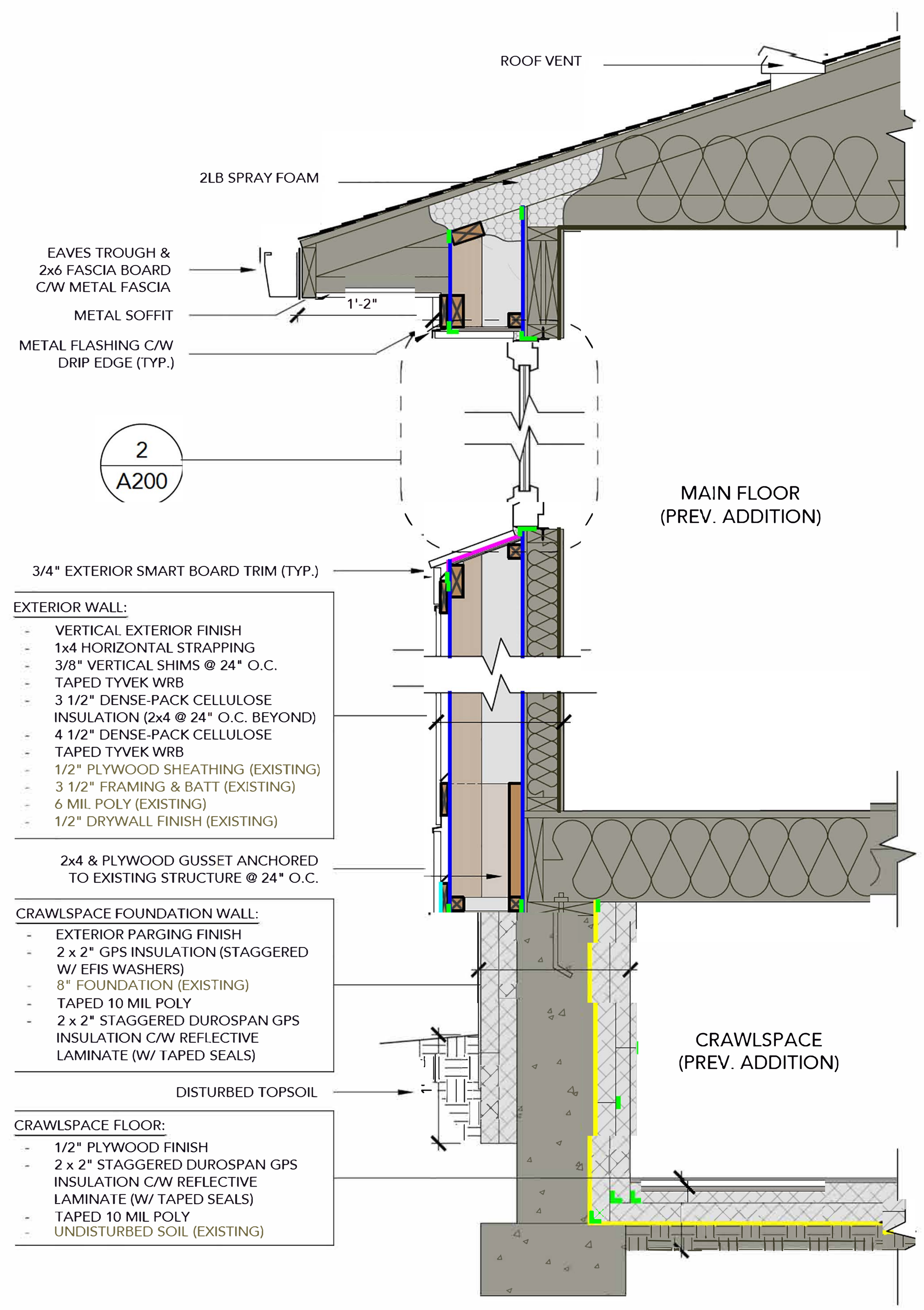
2 A100 TYP. EAVE SECTION (INITIAL CONST.)
SCALE: 1" = 1'-0"

INSULATION LEGEND

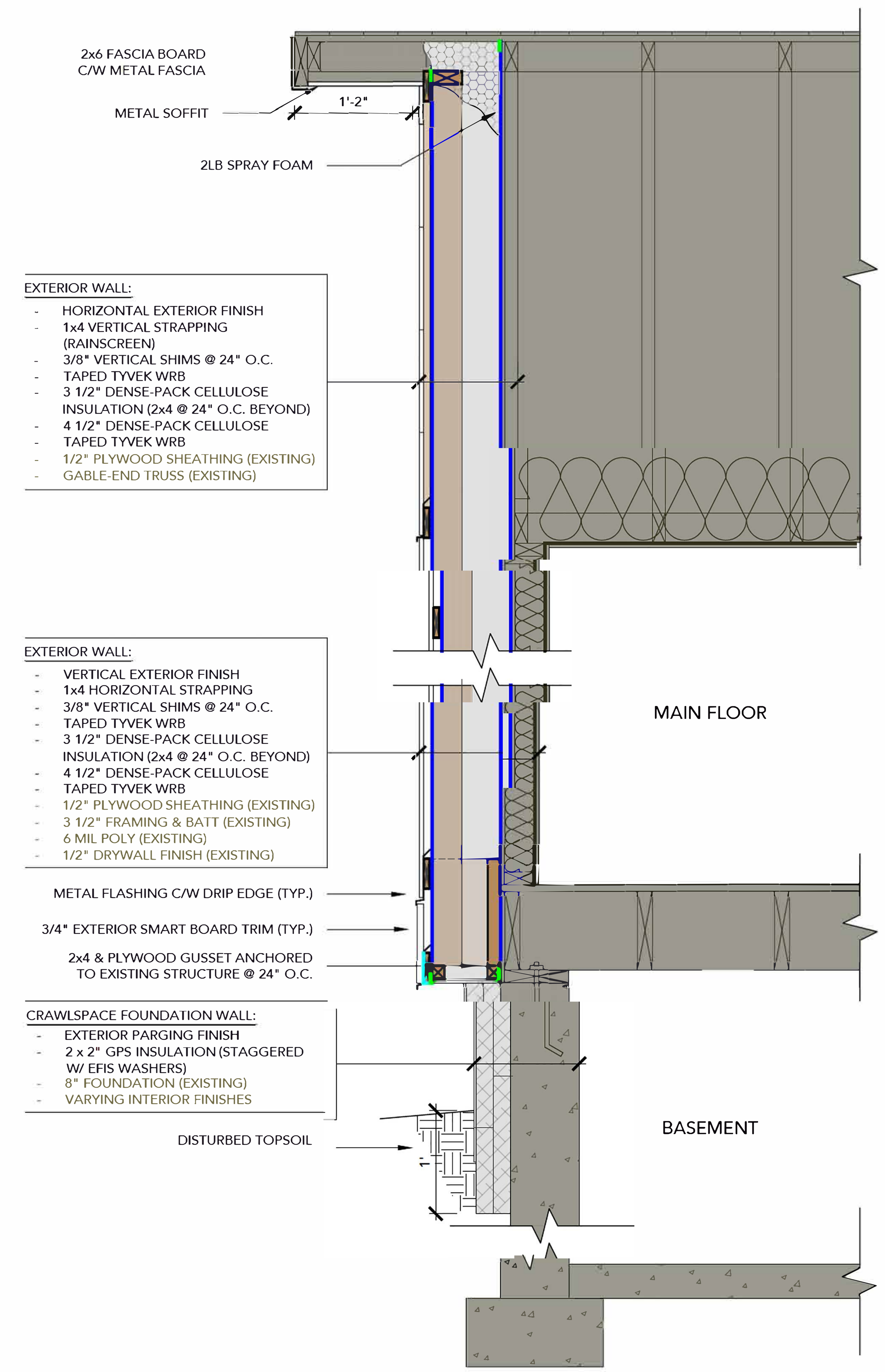
- DENSE-PACK CELLULOSE
- GPS INSULATION
- SPRAY FOAM

COLOUR LEGEND

- TAPED TYVEK WRB
- PEEL & STICK MEMBRANE
- 10 MIL POLY
- SEALANT TAPE
- BUG SCREEN
- EXISTING STRUCTURE
- LUMBER & FRAMING
- TEXT — EXISTING LABEL



3 A100 TYP. EAVE SECTION (PREV. ADDITION)
SCALE: 1" = 1'-0"



4 A100 TYP. GABLE SECTION (INITIAL CONST.)
SCALE: 1" = 1'-0"

BOW CROW DESIGN

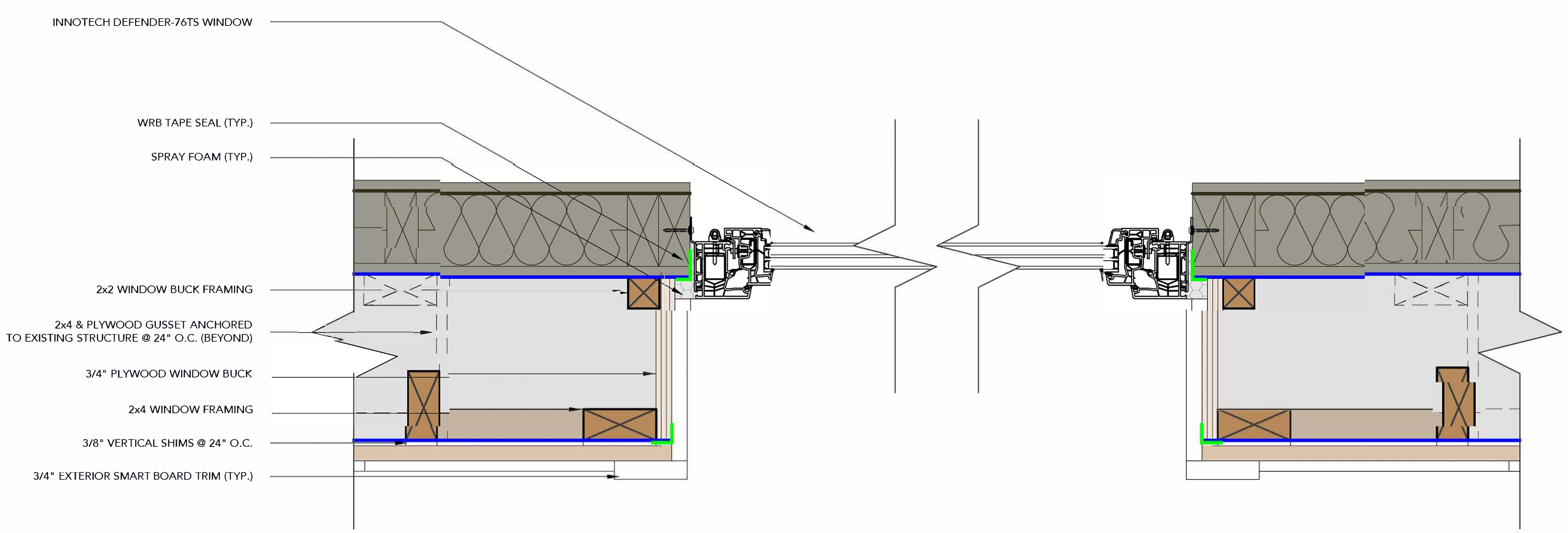
CONSTRUCTION SECTIONS & DETAILS

TREMBLAY RESIDENCE

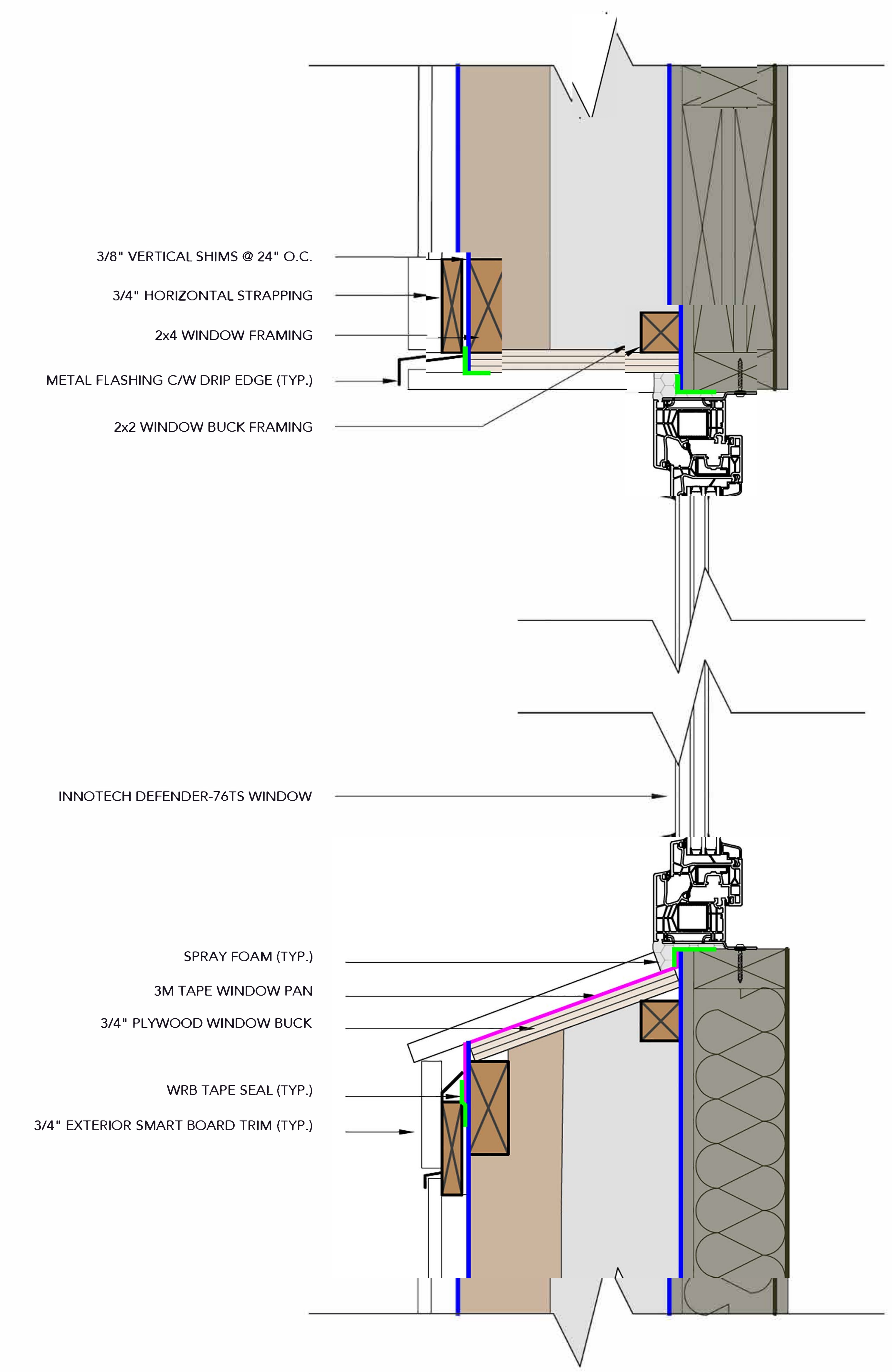
A100

SCALE: 1"=1'-0"

ISSUED: 04/02/2025



1 / A200 TYP. WINDOW PLAN DETAIL
SCALE: 3" = 1'-0"



2 / A200 TYP. WINDOW SECTION DETAIL
SCALE: 3" = 1'-0"

COLOUR LEGEND

- TAPED TYVEK WRB
- PEEL & STICK MEMBRANE
- SEALANT TAPE
- EXISTING STRUCTURE
- LUMBER & FRAMING

INSULATION LEGEND

- DENSE-PACK CELLULOSE
- SPRAY FOAM

BOW CROW DESIGN

WINDOW DETAILS

TREMBLAY RESIDENCE

A200

SCALE:
3"=1'-0"

ISSUED:
04/02/2025

Calculations for thermal insulation, moisture protection and heat protection

created on 20.1.2025 21:16

Content

	Component	U-value W/m²K	Condensate kg	TA-Attenuation	Thickness cm	Weight kg/m²	Page
1	Tremblay Wall	0.14	-	16,6	35,62	36,4	2
2	Tremblay Crawlspace Wall (Ground)	0.14	-	128,2	43,21	516,7	9
3	Tremblay Crawlspace Wall (Exposed)	0.14	-	128,2	43,23	516,6	13
4	Tremblay Crawlspace Floor	0.21	<0,001	2,0	12,07	5,7	20
5	Tremblay Basement Wall (Remaining Ground)	4.3	-	1,7	20,32	487,7	24
6	Tremblay Basement Wall (Ground)	0.28	-	122,0	32,39	514,7	28
7	Tremblay Basement Wall (Exposed)	0.27	0,021	122,0	32,39	514,7	32

Comparison with different maximum values*

Component	BEG Einzelmaßn.	GEG 2020/24 Bestand	GEG 2023/24 Neubau	DIN 4108
Tremblay Wall	✓	✓	✓	✓
Tremblay Crawlspace Wall (Ground)	✓	✓	✓	✓
Tremblay Crawlspace Wall (Exposed)	✓	✓	✓	✓
Tremblay Crawlspace Floor	✓	✓	✓	✓
Tremblay Basement Wall (Remaining Ground)				
Tremblay Basement Wall (Ground)		✓		✓
Tremblay Basement Wall (Exposed)				✓

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

Tremblay Wall

Exterior wall
created on 20.1.2025

Thermal protection

U = 0,14 W/(m²K)

DIN 4108*: R>1,74 m²K/W + R_{si} + R_{se}

excellent — insufficient

Moisture proofing

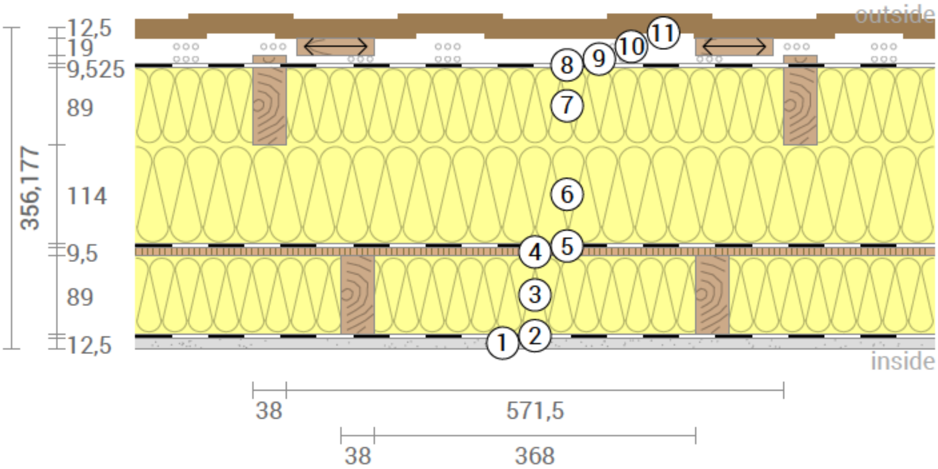
Drying reserve: 645 g/m²a
No condensate

excellent — insufficient

Heat protection

Temperature amplitude damping: 17
phase shift: 12,7 h
Thermal capacity inside: 29 kJ/m²K

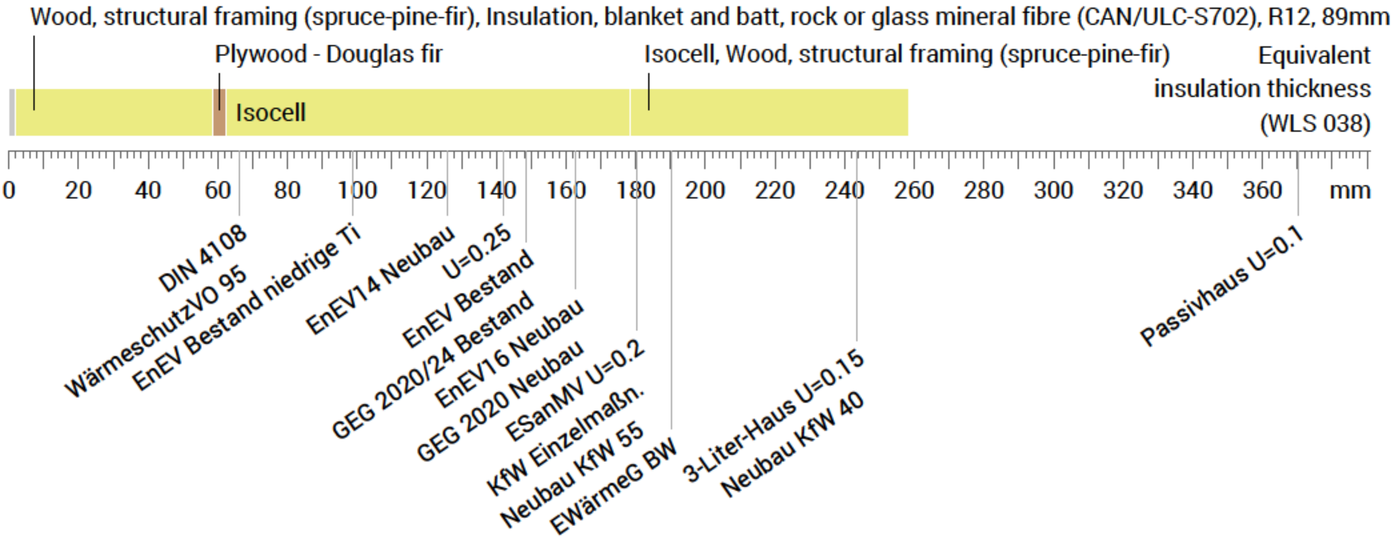
excellent — insufficient



1. Gypsum board (12,5 mm)
2. Foil, PE
3. Insulation, blanket and batt, rock or glass mineral fibre, R12, 89mm (89 mm)
4. Plywood - Douglas fir (9,5 mm)
5. Tyvek® HomeWrap®
6. Isocell (114 mm)
7. Isocell (89 mm)
8. Tyvek® HomeWrap®
9. Rear ventilated level (9,525 mm)
10. Rear ventilated level (19 mm)
11. Vertical cladding (12,5 mm)

<-> Layers marked by arrows are perpendicular to the main axis.

Impact of each layer and comparison to reference values



Inside air :	21.0°C / 40%		Thickness:	35,6 cm
Outside air:	-25.0°C / 80%	sd-value: 16,7 m	Weight:	36 kg/m²
Surface temperature.:	19,1°C / -24,7°C		Heat capacity:	50 kJ/m²K

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

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

Tremblay Wall, 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
1	Gypsum board	1,25	0,250	0,050
2	Foil, PE	0,02	0,400	0,000
3	Insulation, blanket and batt, rock or glass mineral fibre (CAN/ULC-S702), R12, 89mm	8,90	0,055	1,618
	Wood, structural framing (spruce-pine-fir) (9.4%)	8,90	0,118	0,757
4	Plywood - Douglas fir	0,95	0,090	0,106
5	Tyvek® HomeWrap®	0,05	0,400	0,001
6	Isocell	11,40	0,038	3,000
7	Isocell	8,90	0,038	2,342
	Wood, structural framing (spruce-pine-fir) (6.2%)	8,90	0,118	0,757
8	Tyvek® HomeWrap®	0,05	0,400	0,001
	Thermal contact resistance outside (Rse)			0,130

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

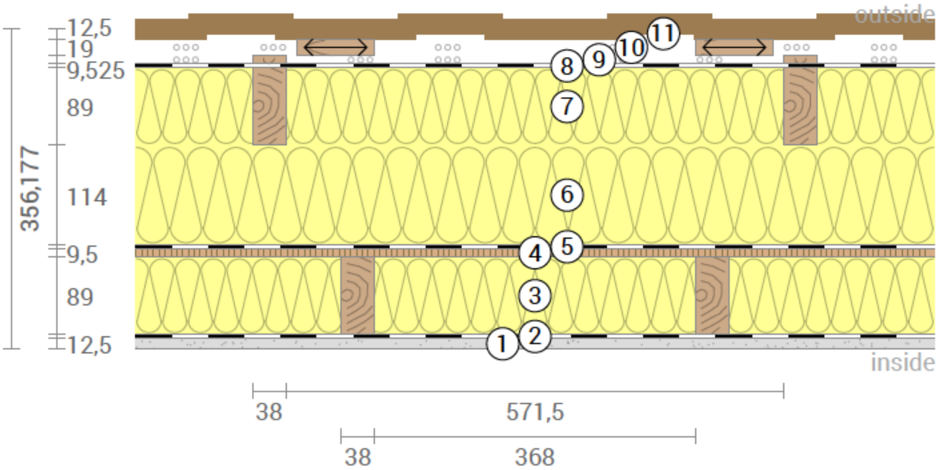
Upper limit of thermal resistance $R_{tot;upper}$ = 7,167 m²K/W.
Lower limit of thermal resistance $R_{tot;lower}$ = 6,951 m²K/W.
Check applicability: $R_{tot;upper}$ / $R_{tot;lower}$ = 1,031 (maximum allowed: 1,5)

The procedure may be used.

Thermal resistance R_{tot} = ($R_{tot;upper}$ + $R_{tot;lower}$)/2 = 7.059 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 61 cm. This, however, is not true for at least layer 3 with a total width of 40,6 cm and can cause increased inaccuracy of the U-value.



LCA

Heat loss: 19 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.

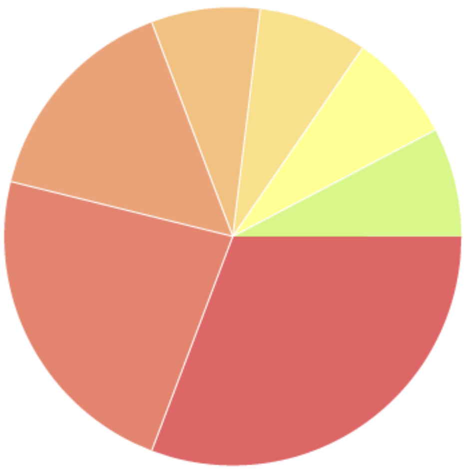
Primary energy (non renewable): 13 kWh/m²

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: -25 kg CO2 Äqv./m²

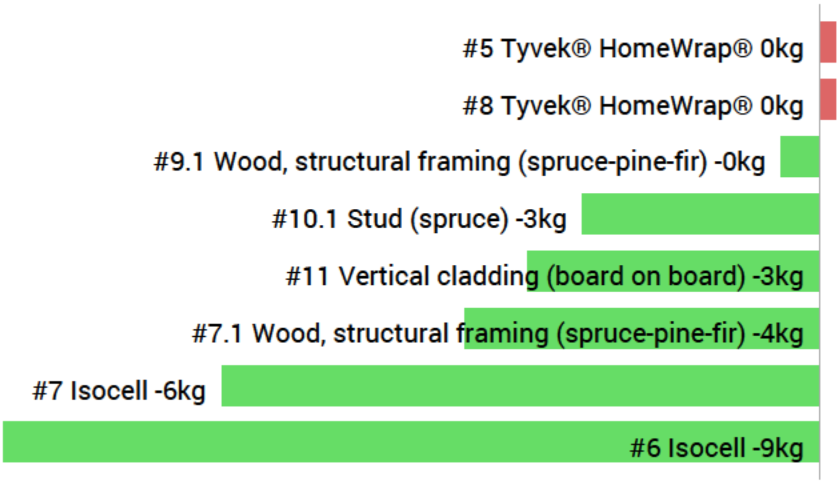
For the production of the building materials used, more greenhouse gases were withdrawn from the atmosphere than emitted.

Composition of non-renewable primary energy of production:



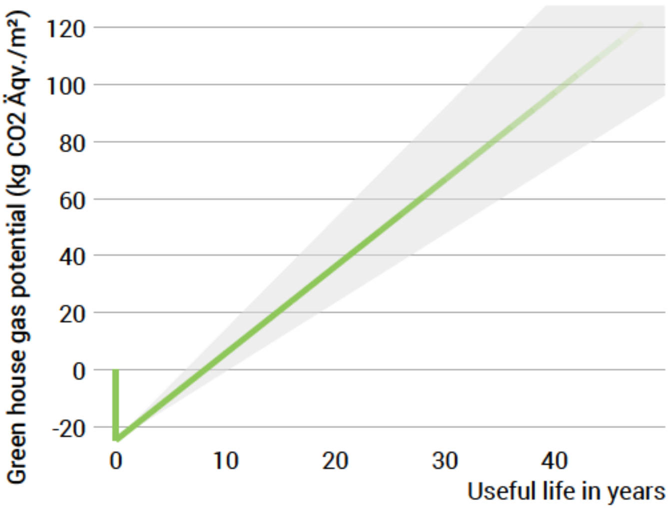
- Isocell (114 mm) 31%
- Isocell (89 mm) 23%
- Vertical cladding (12,5 mm) 15%
- Tyvek® HomeWrap® 8%
- Wood, structural framing (89x38) 8%
- Tyvek® HomeWrap® 8%
- Stud (19x89) 8%

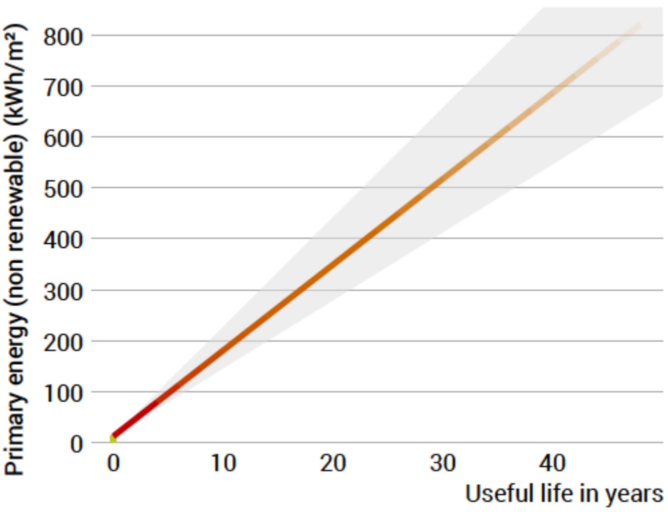
Composition of the greenhouse potential of production:



Tremblay Wall, 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 1.2 kWh per kWh of heat and a global warming potential of 0.21 kg CO_2 eqv/m² per kWh of heat was used. Heat source: Natural gas H.

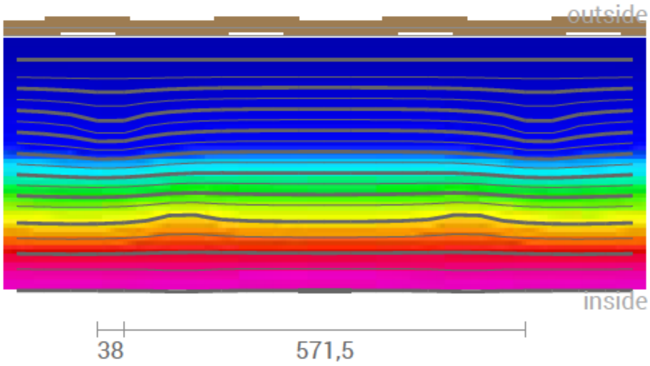
Hints

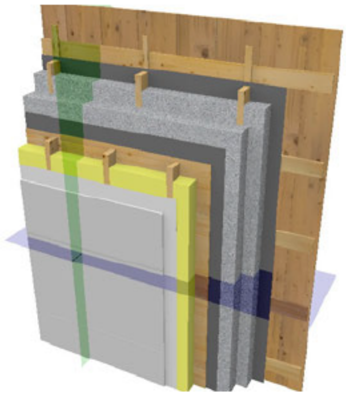
Calculated for the location AB:ABEE AGDM, heating period from Mid of October to End of April. The calculation is based on monthly average temperatures. Source: Canadian Weather Year for Energy Calculation (2016)

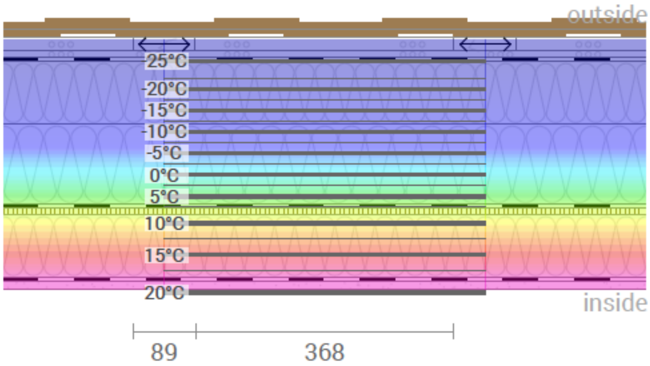
The climate and energy data on which this calculation is based can, in some cases, show considerable fluctuations and, in individual cases, deviate considerably from the actual value.

Keine Berechnung möglich.

Temperature profile







Top left: Temperature profile in the blue section (see right illustration). Bottom left: Temperature profile in the green section.

Layers (from inside to outside)

#		Material	λ [W/mK]	RSI [m²K/W]	Temperatur [°C] min	Temperatur [°C] max	Weight [kg/m²]
		Thermal contact resistance*		0,250	19,1	21,0	
1	1,25 cm	Gypsum board	0,250	0,050	18,6	19,5	8,5
2	0,015 cm	Foil, PE	0,400	0,000	18,6	19,2	0,1
3	8,9 cm	Insulation, blanket and batt, rock or glass mineral fibre (CAN/ULC-S702), R12, 89mm	0,055	1,618	8,8	19,2	2,6
	8,9 cm	Wood, structural framing (spruce-pine-fir) (9.4%)	0,118	0,757	10,7	18,8	3,8
4	0,95 cm	Plywood - Douglas fir	0,090	0,106	8,1	10,7	2,9
5	0,05 cm	Tyvek® HomeWrap®	0,400	0,001	8,1	9,8	0,1
6	11,4 cm	Isocell	0,038	3,000	-13,5	9,8	6,8
7	8,9 cm	Isocell	0,038	2,342	-24,8	-10,0	5,0
	8,9 cm	Wood, structural framing (spruce-pine-fir) (6.2%)	0,118	0,757	-24,6	-13,5	2,5
8	0,05 cm	Tyvek® HomeWrap®	0,400	0,001	-24,8	-24,6	0,1
		Thermal contact resistance*		0,040	-25,0	-24,6	
9	0.9525 cm	Rear ventilated level (outside air)			-25,0	-25,0	0,0
10	1.9 cm	Rear ventilated level (outside air)			-25,0	-25,0	0,0
11	1.25 cm	Vertical cladding (board on board)			-25,0	-25,0	2,2
	35.61774 cm	Whole component		7,059			36,4

*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):	19,1°C	19,4°C	19,5°C
Surface temperature outside (min / average / max):	-24,8°C	-24,7°C	-24,6°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: 21°C und 40% Humidity; outside: -25°C und 80% Humidity (Climate according to user input).

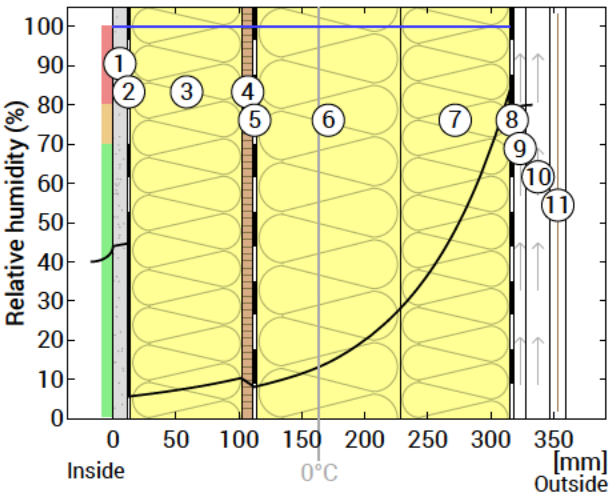
This component is free of condensate under the given climate conditions.

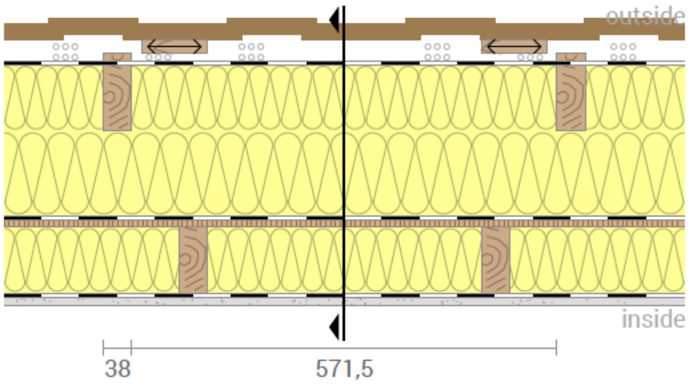
Drying reserve according to Ubakus 2D-FE method: 645 g/(m²a)
At least required by DIN 68800-2: 100 g/(m²a)

#		Material	sd-value [m]	Condensate [kg/m²]	Condensate [Gew.-%]	Weight [kg/m²]
1	1,25 cm	Gypsum board	0,05	-		8,5
2	0,015 cm	Foil, PE	15,24	-		0,1
3	8,9 cm	Insulation, blanket and batt, rock or glass mineral fibre (CAN/ULC-S702), R12, 89mm	0,09	-		2,6
	8,9 cm	Wood, structural framing (spruce-pine-fir) (9.4%)	1,78	-	-	3,8
4	0,95 cm	Plywood - Douglas fir	0,48	-	-	2,9
5	0,05 cm	Tyvek® HomeWrap®	0,06	-		0,1
6	11,4 cm	Isocell	0,34	-		6,8
7	8,9 cm	Isocell	0,27	-		5,0
	8,9 cm	Wood, structural framing (spruce-pine-fir) (6.2%)	4,45	-	-	2,5
8	0,05 cm	Tyvek® HomeWrap®	0,06	-		0,1
	35.61774 cm	Whole component	16,65	0		36,4

Humidity

The temperature of the inside surface is 19,1 °C leading to a relative humidity on the surface of 45%.Mould formation is not expected under these conditions.
The following figure shows the relative humidity inside the component.





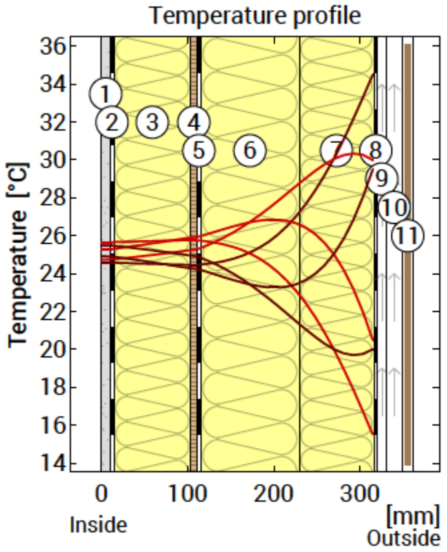
① Gypsum board (12,5 mm)
② Foil, PE
③ Insulation, blanket and batt, rock ...
④ Plywood - Douglas fir (9,5 mm)
⑤ Tyvek® HomeWrap®
⑥ Isocell (114 mm)
⑦ Isocell (89 mm)
⑧ Tyvek® HomeWrap®
⑨ Rear ventilated level (9,53 mm)
⑩ Rear ventilated level (19 mm)
⑪ Vertical cladding (12,5 mm)

Layers marked with <-> run parallel to the illustrated cutting plane and were not taken into account in the moisture protection calculation.
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.

Tremblay Wall, U=0,14 W/(m²K)

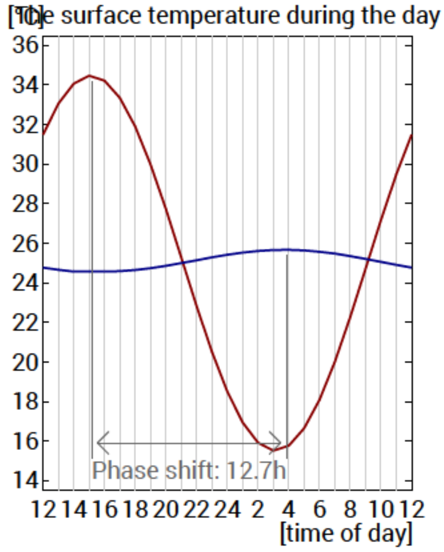
Heat protection

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



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

① Gypsum board (12,5 mm)
② Foil, PE
③ Insulation, blanket and batt, rock or glass mineral fibre, R12, 89mm (89 mm)
④ Plywood - Douglas fir (9,5 mm)
⑤ Tyvek® HomeWrap®
⑥ Isocell (114 mm)
⑦ Isocell (89 mm)
⑧ Tyvek® HomeWrap®
⑨ Rear ventilated level (9,53 mm)
⑩ Rear ventilated level (19 mm)
⑪ Vertical cladding (12,5 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*	12,7 h	Heat storage capacity (whole component):	50 kJ/m²K
Amplitude attenuation **	16,6	Thermal capacity of inner layers:	29 kJ/m²K
TAV ***	0,060		

* 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.

Tremblay Crawlspace Wall (Ground)

Exterior wall
created on 20.1.2025

Thermal protection

U = 0,14 W/(m²K)

DIN 4108*: R>1,2 m²K/W + R_{si} + R_{se}

excellent — insufficient

Moisture proofing

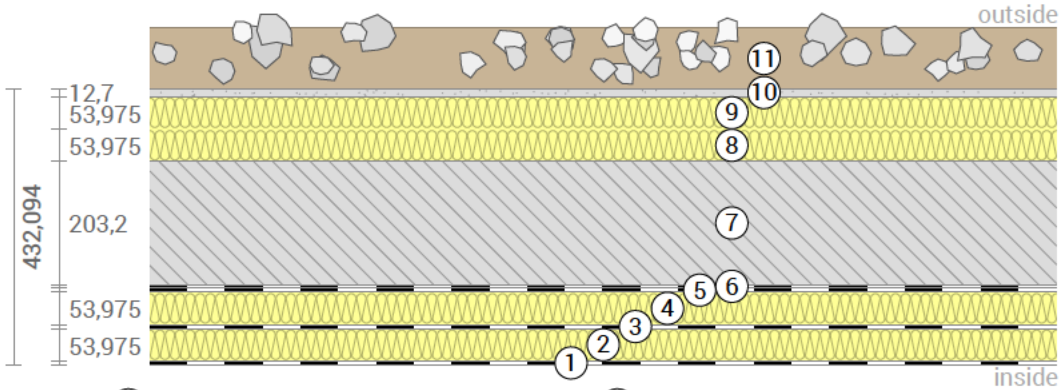
No condensate

excellent — insufficient

Heat protection

Component is adjacent to earth:
TAV and phase non relevant
Thermal capacity inside: 228 kJ/m²K

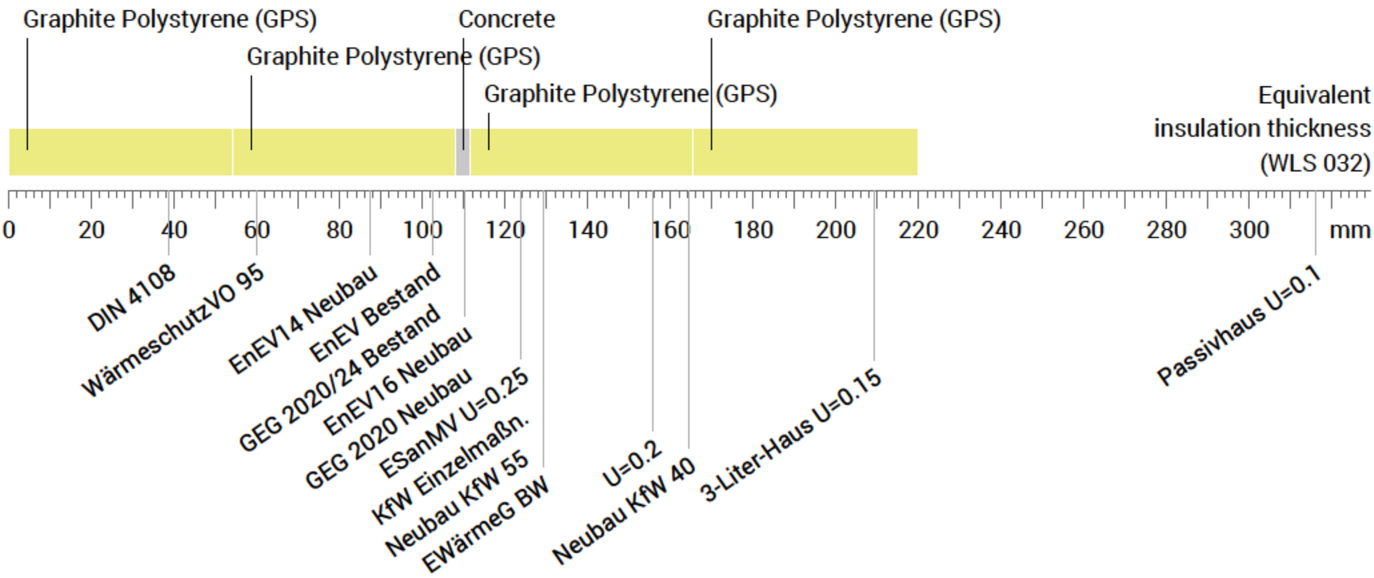
excellent — insufficient



1. Aluminum foil
2. Graphite Polystyrene (53,975 mm)
3. Aluminum foil
4. Graphite Polystyrene (53,975 mm)
5. Aluminum foil
6. Foil, PE
7. Concrete (203,2 mm)
8. Graphite Polystyrene (53,975 mm)
9. Graphite Polystyrene (53,975 mm)
10. Cement plaster (12,7 mm)
11. Soil

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 0,032 W/mK.



Inside air :	21.0°C / 40%			Thickness:	43,2 cm
Ground:	0.0°C / 100%	sd-value:	4560,3 m	Weight:	517 kg/m²
Surface temperature.:	20,3°C / 0,1°C			Heat capacity:	494 kJ/m²K

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

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

U-value calculation

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,130
1	Aluminum foil (coated)	0,00	160,000	0,000
2	Graphite Polystyrene (GPS)	5,40	0,032	1,687
3	Aluminum foil (coated)	0,00	160,000	0,000
4	Graphite Polystyrene (GPS)	5,40	0,032	1,687
5	Aluminum foil (coated)	0,00	160,000	0,000
6	Foil, PE	0,03	0,400	0,001
7	Concrete	20,32	2,000	0,102
8	Graphite Polystyrene (GPS)	5,40	0,032	1,687
9	Graphite Polystyrene (GPS)	5,40	0,032	1,687
10	Cement plaster	1,27	1,400	0,009
	Thermal contact resistance outside (Rse)			0,000

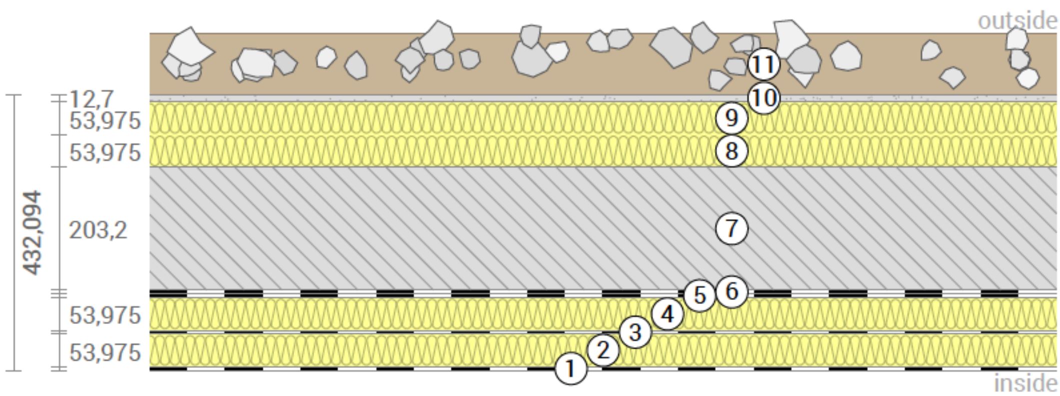
Thermal contact resistances have been taken from DIN 6946 Table 7.
Rsi: heat flow direction horizontally
Rse: heat flow direction horizontally, outside: Ground

Thermal resistance R_{tot} = 6.989 m²K/W

DIN 6946 may not be used for earth-contacting components. However, for the alternative method from DIN V 4108-6 Annex E, the required data on the size and position of this component are missing.

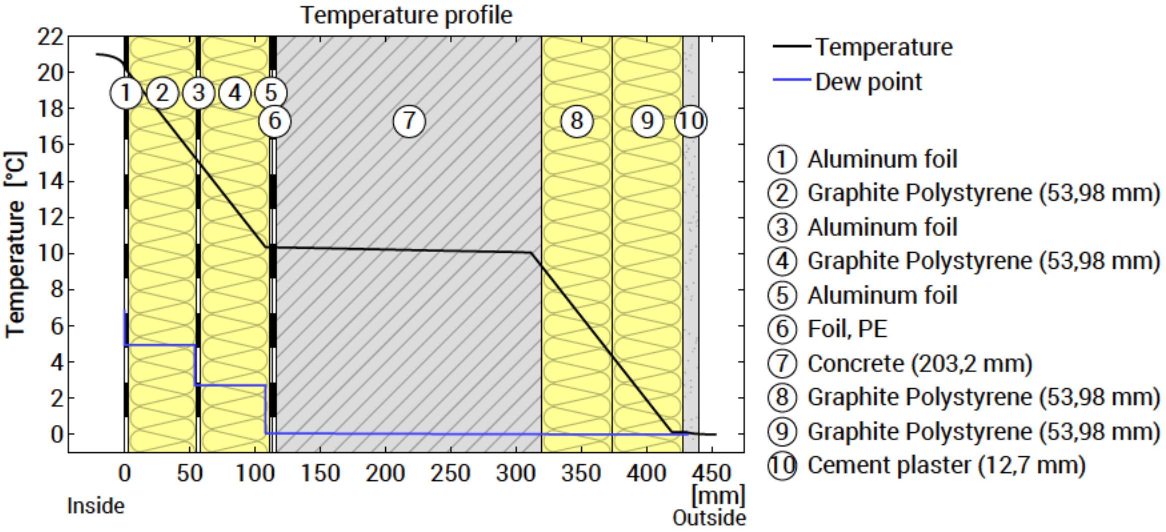
Heat transfer coefficient U = $1/R_{tot}$ = **0,14 W/(m²K)**

The constructive U-value was calculated. Heat losses across the ground or basement were not considered because the necessary data are missing.



Tremblay Crawlspace Wall (Ground), U=0,14 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]	RSI [m²K/W]	Temperatur [°C] min	max	Weight [kg/m²]
		Thermal contact resistance*		0,250	20,3	21,0	
1	0,001 cm	Aluminum foil (coated)	160,000	0,000	20,3	20,3	0,0
2	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	15,3	20,3	0,8
3	0,002 cm	Aluminum foil (coated)	160,000	0,000	15,3	15,3	0,1
4	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	10,4	15,3	0,8
5	0,001 cm	Aluminum foil (coated)	160,000	0,000	10,4	10,4	0,0
6	0,025 cm	Foil, PE	0,400	0,001	10,4	10,4	0,2
7	20,32 cm	Concrete	2,000	0,102	10,1	10,4	487,7
8	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	5,1	10,1	0,8
9	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	0,1	5,1	0,8
10	1,27 cm	Cement plaster	1,400	0,009	0,1	0,1	25,4
		Thermal contact resistance*		0,040	0,0	0,1	
11		Soil			0,0	0,0	73,5
	43.2094 cm	Whole component		6,989			516,7

*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):	20,3°C	20,3°C	20,3°C
Surface temperature outside (min / average / max):	0,1°C	0,1°C	0,1°C

Tremblay Crawlspace Wall (Ground), U=0,14 W/(m²K)

Moisture proofing

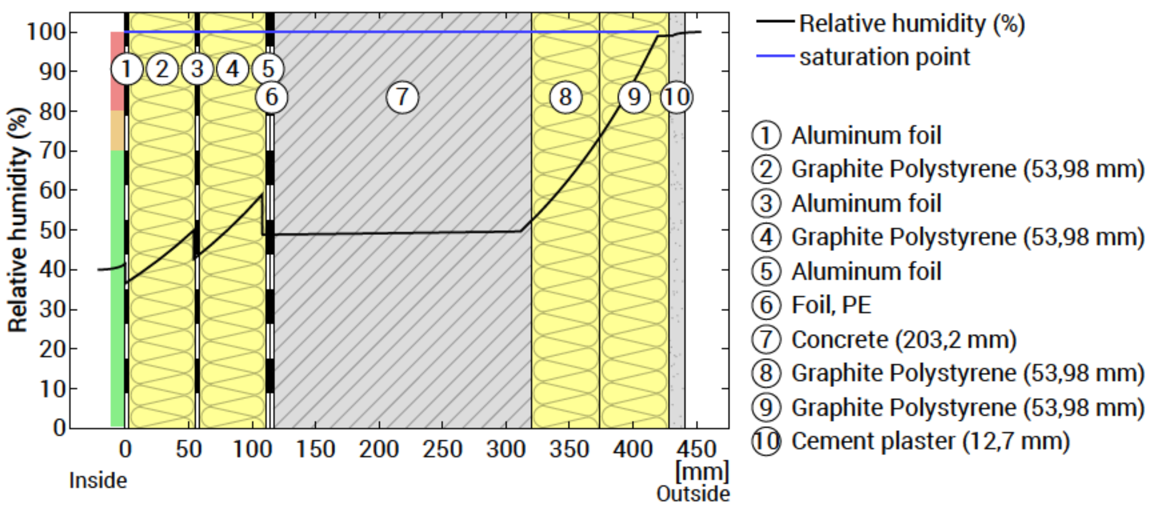
For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 21°C und 40% Humidity; outside: 0°C und 100% Humidity (Climate according to user input).

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

#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	0,001 cm	Aluminum foil (coated)	1500	-		0,0
2	5,398 cm	Graphite Polystyrene (GPS)	1,08	-		0,8
3	0,002 cm	Aluminum foil (coated)	1500	-		0,1
4	5,398 cm	Graphite Polystyrene (GPS)	1,08	-		0,8
5	0,001 cm	Aluminum foil (coated)	1500	-		0,0
6	0,025 cm	Foil, PE	25,40	-		0,2
7	20,32 cm	Concrete	26,42	-		487,7
8	5,398 cm	Graphite Polystyrene (GPS)	2,70	-		0,8
9	5,398 cm	Graphite Polystyrene (GPS)	2,70	-		0,8
10	1,27 cm	Cement plaster	0,44	-		25,4
	43.2094 cm	Whole component	4.560,31	0		516,7

Humidity

The temperature of the inside surface is 20,3 °C leading to a relative humidity on the surface of 42%.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.

Tremblay Crawlspace Wall (Exposed)

Exterior wall
created on 20.1.2025

Thermal protection

U = 0,14 W/(m²K)

DIN 4108*: R>1,2 m²K/W + R_{si} + R_{se}

excellent insufficient

Moisture proofing

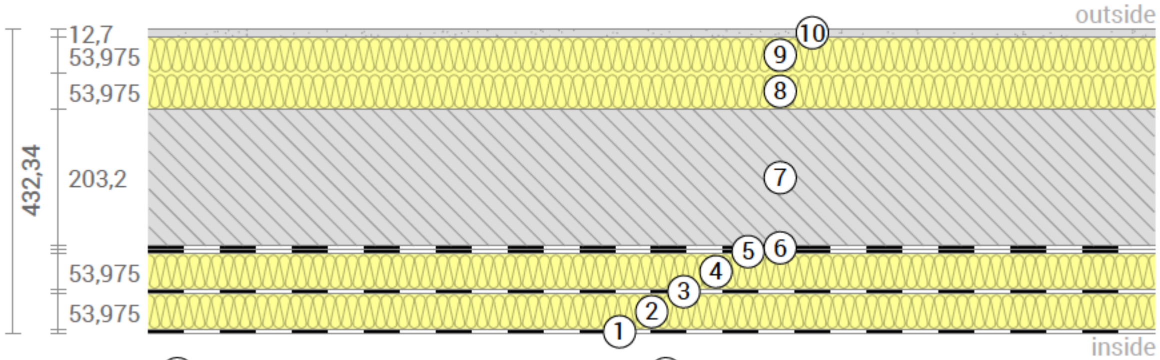
No condensate

excellent insufficient

Heat protection

Temperature amplitude damping: >100
phase shift: non relevant
Thermal capacity inside: 228 kJ/m²K

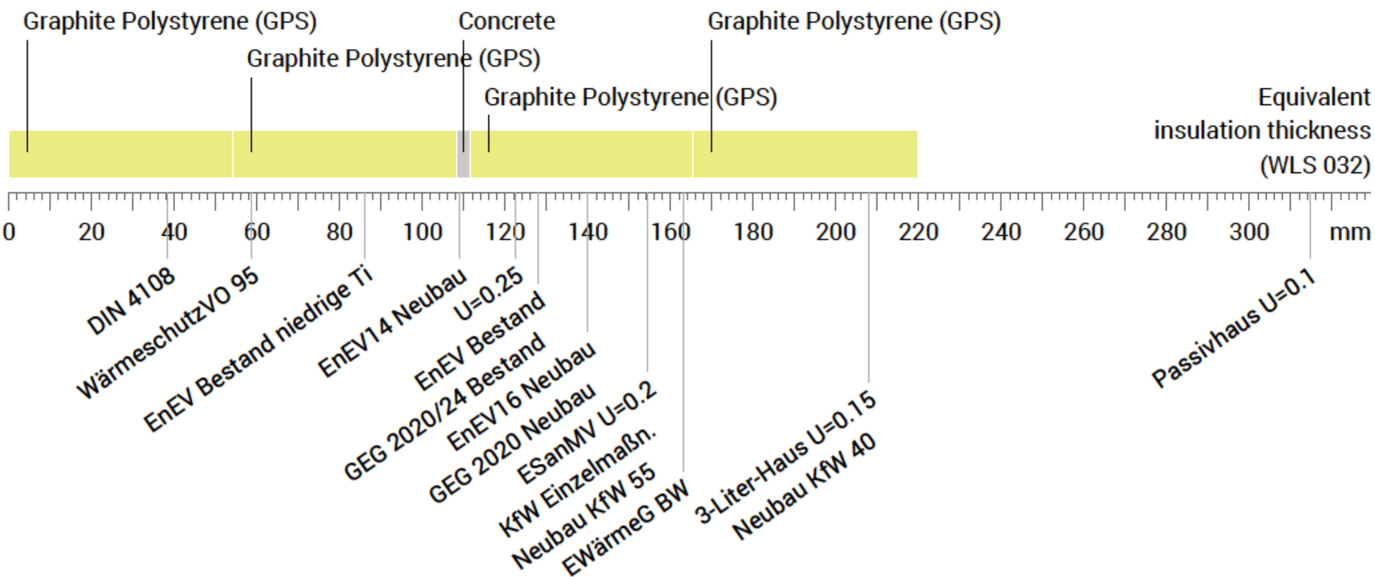
excellent insufficient



1. Aluminum foil
2. Graphite Polystyrene (53,975 mm)
3. Aluminum foil
4. Graphite Polystyrene (53,975 mm)
5. Aluminum foil
6. Vapor retarder sd=10m
7. Concrete (203,2 mm)
8. Graphite Polystyrene (53,975 mm)
9. Graphite Polystyrene (53,975 mm)
10. Cement plaster (12,7 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 0,032 W/mK.



Inside air :	21.0°C / 40%		Thickness:	43,2 cm
Outside air:	-25.0°C / 80%	sd-value: 4544,9 m	Weight:	517 kg/m²
Surface temperature.:	19,4°C / -24,7°C		Heat capacity:	494 kJ/m²K

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

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

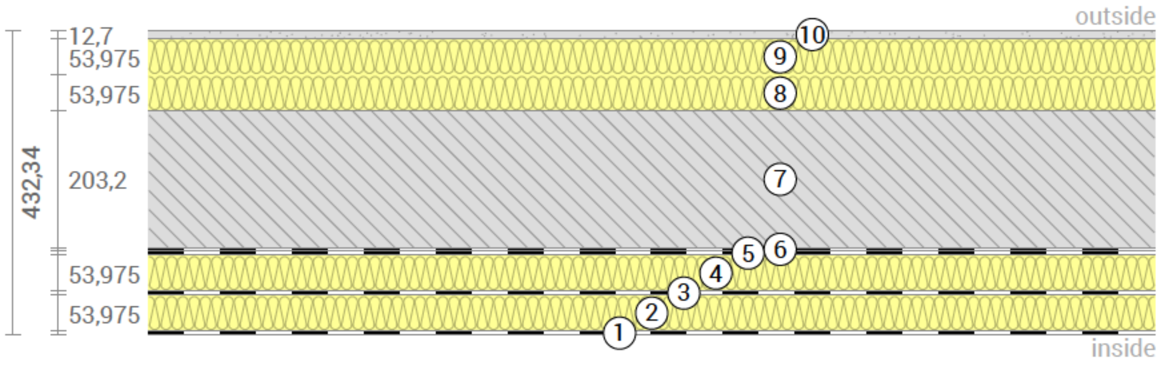
U-Value calculation according to DIN EN ISO 6946

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,130
1	Aluminum foil (coated)	0,00	160,000	0,000
2	Graphite Polystyrene (GPS)	5,40	0,032	1,687
3	Aluminum foil (coated)	0,00	160,000	0,000
4	Graphite Polystyrene (GPS)	5,40	0,032	1,687
5	Aluminum foil (coated)	0,00	160,000	0,000
6	Vapor retarder sd=10m	0,05	0,220	0,002
7	Concrete	20,32	2,000	0,102
8	Graphite Polystyrene (GPS)	5,40	0,032	1,687
9	Graphite Polystyrene (GPS)	5,40	0,032	1,687
10	Cement plaster	1,27	1,400	0,009
	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 resistance R_{tot} = 7.030 m²K/W

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



Tremblay Crawlspace Wall (Exposed), U=0,14 W/(m²K)

LCA

Heat loss: 15 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.

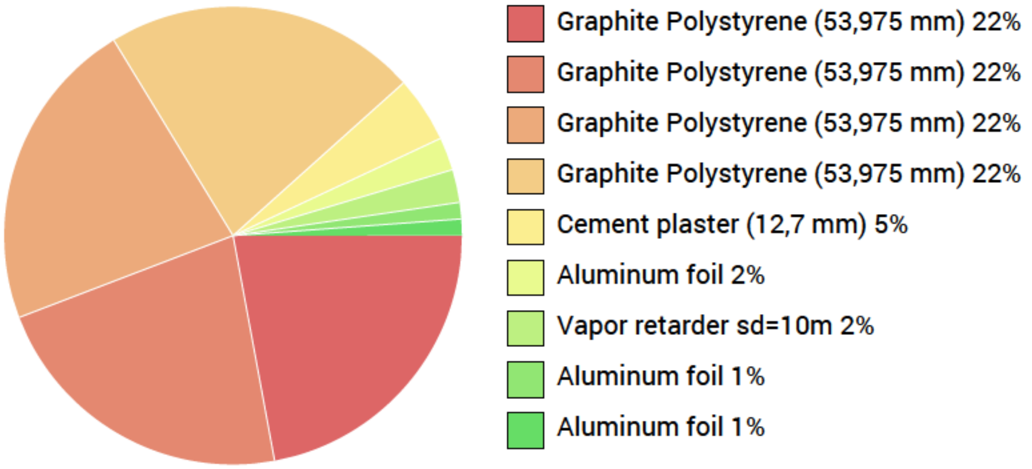
Primary energy (non renewable): 88 kWh/m²

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

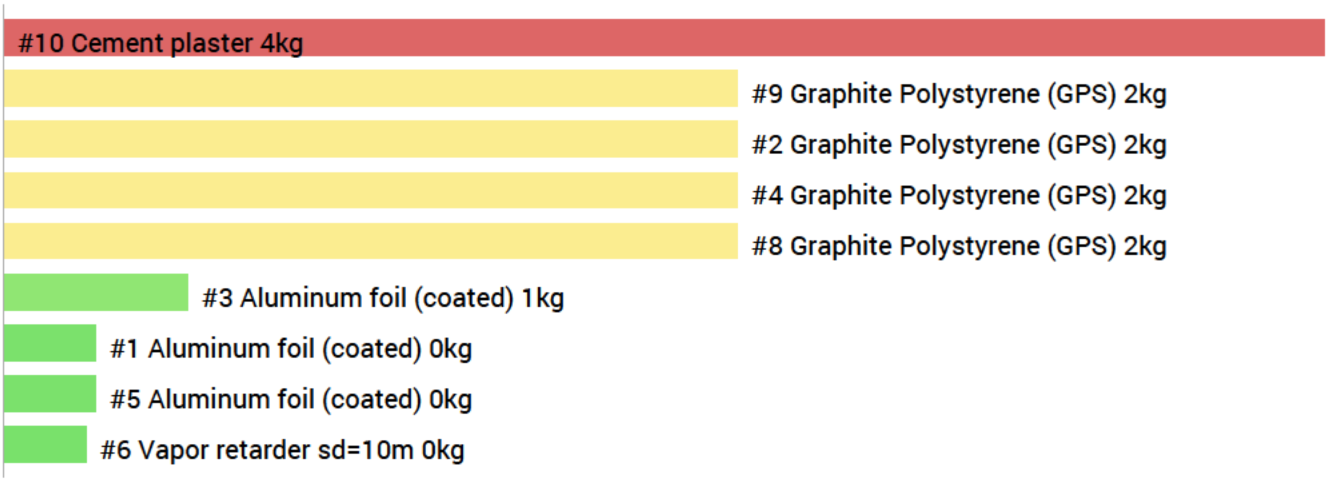
Green house gas potential: 16 kg CO2 Äqv./m²

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

Composition of non-renewable primary energy of production:

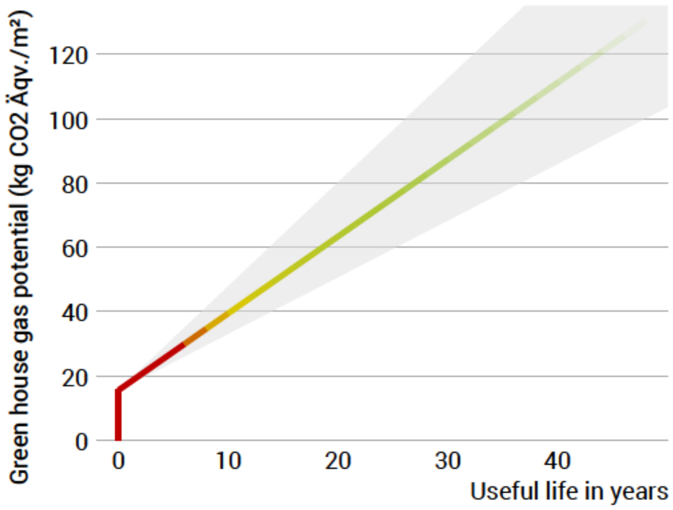


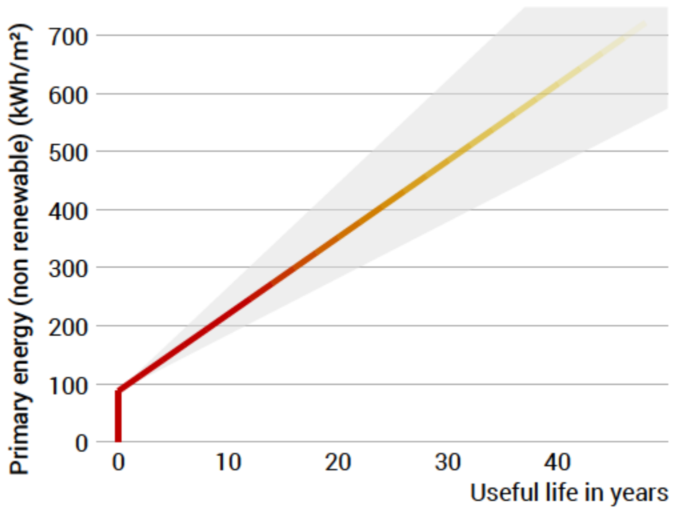
Composition of the greenhouse potential of production:



Tremblay Crawlspace Wall (Exposed), 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 1.2 kWh per kWh of heat and a global warming potential of 0.21 kg CO_2 eqv/m² per kWh of heat was used. Heat source: Natural gas H.

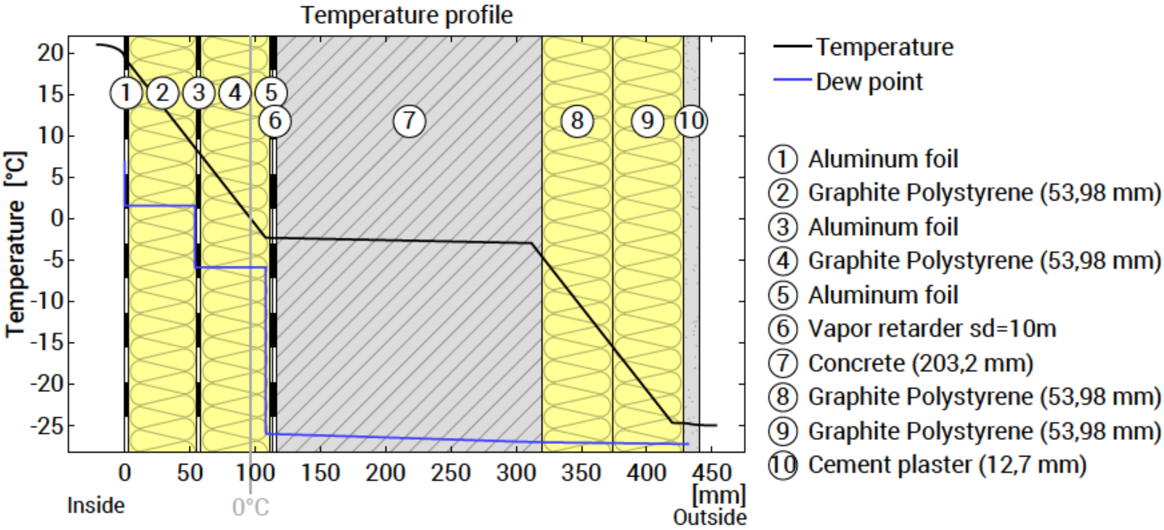
Hints

Calculated for the location AB:CALGARY INTL A, heating period from Mid of October to End of April. The calculation is based on monthly average temperatures. Source: Canadian Weather Year for Energy Calculation (2016)

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.

Keine Berechnung möglich.

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]	RSI [m²K/W]	Temperatur [°C] min	max	Weight [kg/m²]
		Thermal contact resistance*		0,250	19,4	21,0	
1	0,001 cm	Aluminum foil (coated)	160,000	0,000	19,4	19,4	0,0
2	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	8,5	19,4	0,8
3	0,002 cm	Aluminum foil (coated)	160,000	0,000	8,5	8,5	0,1
4	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	-2,3	8,5	0,8
5	0,001 cm	Aluminum foil (coated)	160,000	0,000	-2,3	-2,3	0,0
6	0,05 cm	Vapor retarder sd=10m	0,220	0,002	-2,3	-2,3	0,1
7	20,32 cm	Concrete	2,000	0,102	-3,0	-2,3	487,7
8	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	-13,8	-3,0	0,8
9	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	-24,7	-13,8	0,8
10	1,27 cm	Cement plaster	1,400	0,009	-24,7	-24,7	25,4
		Thermal contact resistance*		0,040	-25,0	-24,7	
	43.234 cm	Whole component		7,030			516,6

*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):	19,4°C	19,4°C	19,4°C
Surface temperature outside (min / average / max):	-24,7°C	-24,7°C	-24,7°C

Tremblay Crawlspace Wall (Exposed), U=0,14 W/(m²K)

Moisture proofing

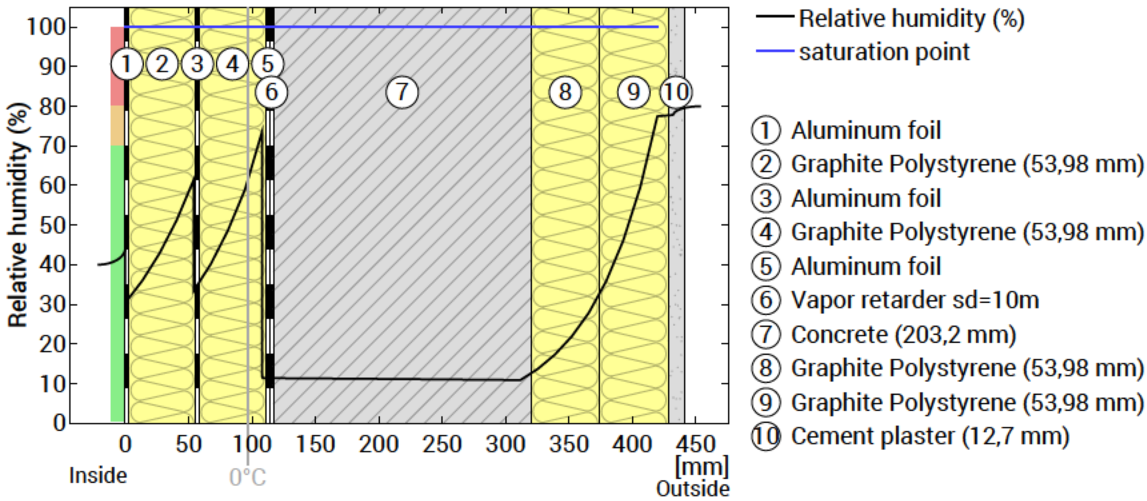
For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 21°C und 40% Humidity; outside: -25°C und 80% Humidity (Climate according to user input).

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

#		Material	sd-value [m]	Condensate [kg/m²]	Condensate [Gew.-%]	Weight [kg/m²]
1	0,001 cm	Aluminum foil (coated)	1500	-		0,0
2	5,398 cm	Graphite Polystyrene (GPS)	1,08	-		0,8
3	0,002 cm	Aluminum foil (coated)	1500	-		0,1
4	5,398 cm	Graphite Polystyrene (GPS)	1,08	-		0,8
5	0,001 cm	Aluminum foil (coated)	1500	-		0,0
6	0,05 cm	Vapor retarder sd=10m	10,00	-		0,1
7	20,32 cm	Concrete	26,42	-		487,7
8	5,398 cm	Graphite Polystyrene (GPS)	2,70	-		0,8
9	5,398 cm	Graphite Polystyrene (GPS)	2,70	-		0,8
10	1,27 cm	Cement plaster	0,44	-		25,4
	43.234 cm	Whole component	4.544,91	0		516,6

Humidity

The temperature of the inside surface is 19,4 °C leading to a relative humidity on the surface of 44%.Mould formation is not expected under these conditions.
The following figure shows the relative humidity inside the component.

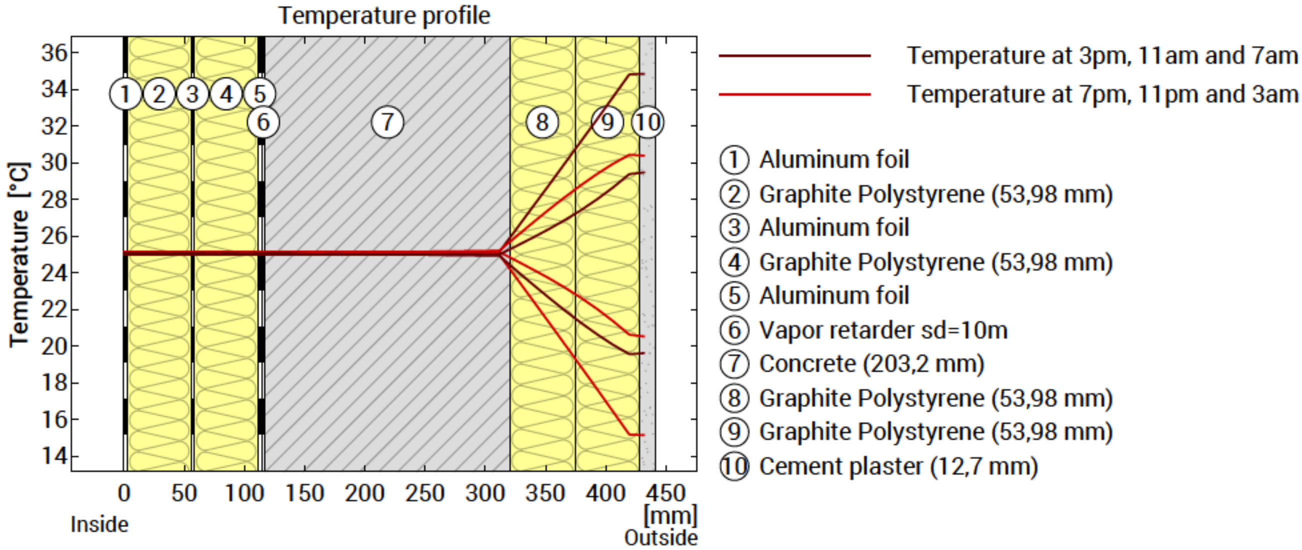


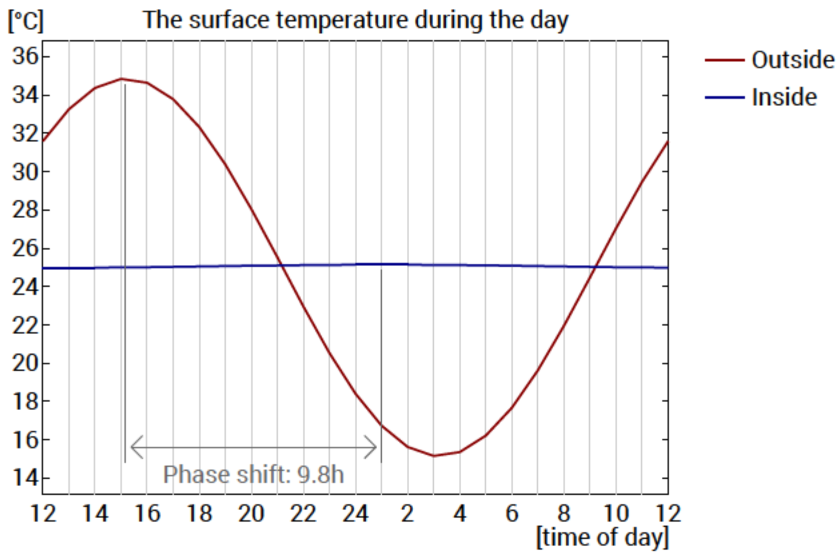
Notes: Calculation using the Ubakus 2D-FE method. Convection and the capillarity of the building materials were not considered. The drying time may take longer under unfavorable conditions (shading, damp / cool summers) than calculated here.

Tremblay Crawlspace Wall (Exposed), U=0,14 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*	non relevant	Heat storage capacity (whole component):	494 kJ/m²K
Amplitude attenuation **	>100	Thermal capacity of inner layers:	228 kJ/m²K
TAV ***	0,008		

* 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.

Tremblay Crawlspace Floor

Floor
created on 20.1.2025

Thermal protection

U = 0,21 W/(m²K)

DIN 4108*: R>1,75 m²K/W + R_{si} + R_{se}

excellent insufficient

Moisture proofing

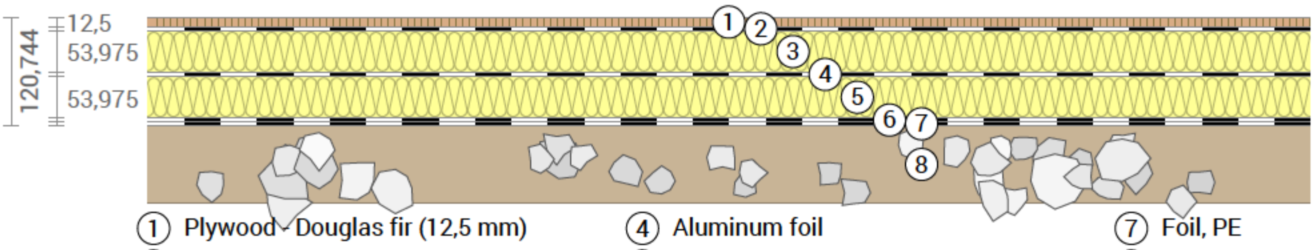
No condensate

excellent insufficient

Heat protection

Component is adjacent to earth:
TAV and phase non relevant
Thermal capacity inside: 6.7 kJ/m²K

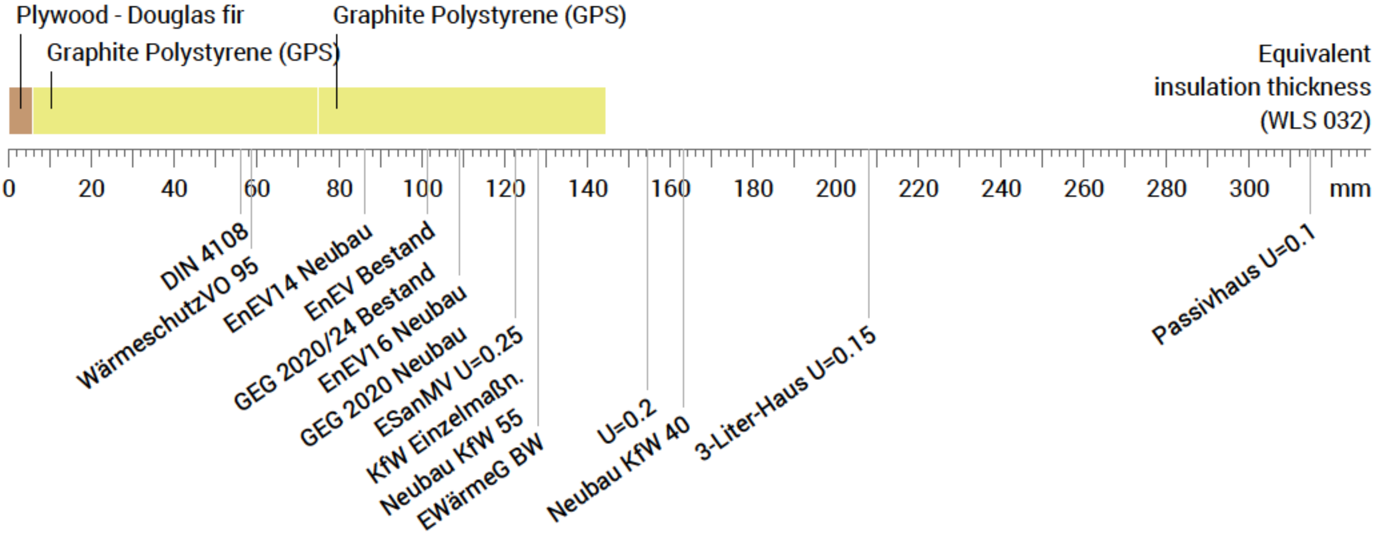
excellent insufficient



1. Plywood - Douglas fir (12,5 mm)
2. Aluminum foil
3. Graphite Polystyrene (53,975 mm)
4. Aluminum foil
5. Graphite Polystyrene (53,975 mm)
6. Aluminum foil
7. Foil, PE
8. Soil

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 0,032 W/mK.



Inside air :	21.0°C / 40%			Thickness:	12,1 cm
Ground:	0.0°C / 100%	sd-value:	4528,8 m	Weight:	6 kg/m²
Surface temperature.:	19,6°C / 0,2°C			Heat capacity:	8.9 kJ/m²K

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

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

Tremblay Crawlspace Floor, U=0,21 W/(m²K)

U-Value calculation according to DIN V 4108-6

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,170
1	Plywood - Douglas fir	1,25	0,090	0,139
2	Aluminum foil (coated)	0,00	160,000	0,000
3	Graphite Polystyrene (GPS)	5,40	0,032	1,687
4	Aluminum foil (coated)	0,00	160,000	0,000
5	Graphite Polystyrene (GPS)	5,40	0,032	1,687
6	Aluminum foil (coated)	0,00	160,000	0,000
7	Foil, PE	0,03	0,400	0,001
	Thermal contact resistance outside (Rse)			0,000

Calculation of the constructive U-value

Thermal contact resistances have been taken from DIN 6946 Table 7.
Rsi: heat flow direction downward
Rse: heat flow direction downward, outside: Ground

Thermal resistance R_{tot} = 3.684 m²K/W

Constructive heat transfer coefficient U = 1/R_{tot} = 0.271 W/(m²K)

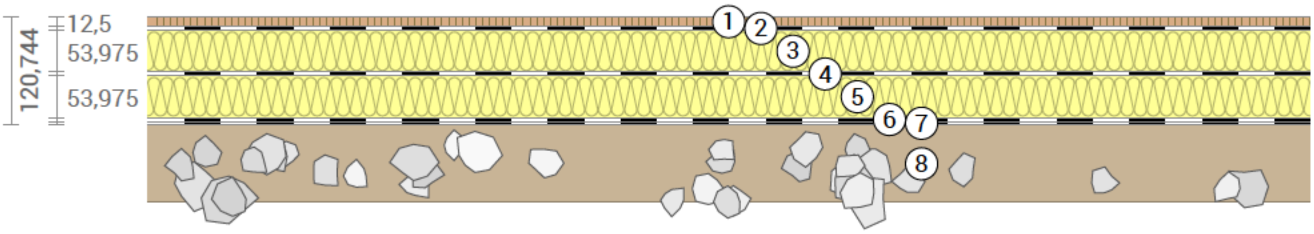
Consideration of heat losses across the soil

Calculation according to DIN 4108-6 Appendix E with the following parameters:

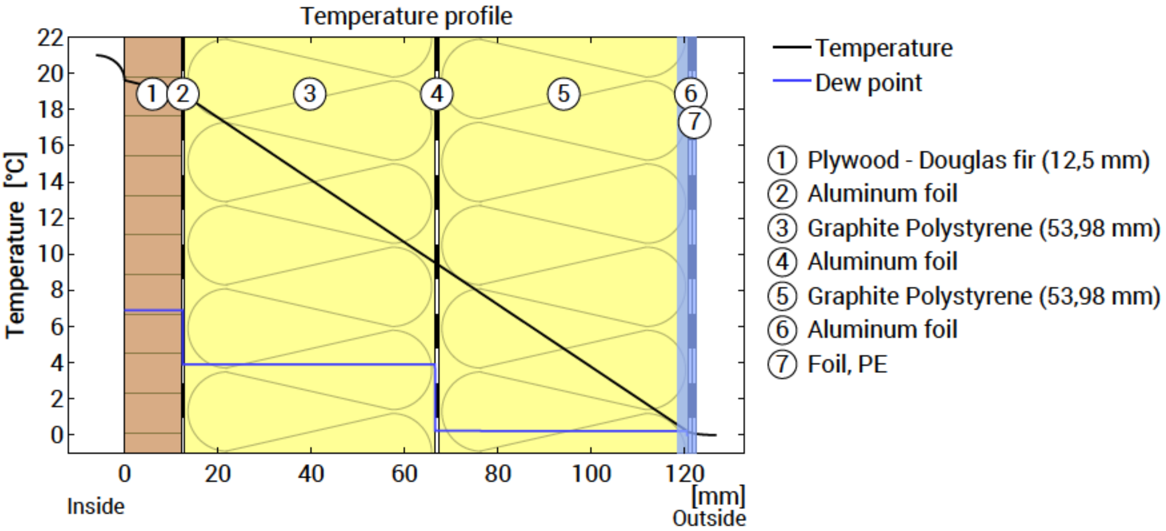
Floor space, A_G:	28,89 m²	Heat conductivity of soil, λ:	2 W/mK
Perimeter of floor space, P:	21,7 m	Height of basement wall with earth-contact, z:	0,75 m
Thickness of rising wall, w:	0,3 m		

Characteristic measure of base slab B' = A_G / (0.5 · P) = 2.66 m
Effective thickness d_t = w + λ · (Rsi + Rf + Rse) = 7.75 m; mit Rsi + Rf = 1/U; U = 0.271 W/m²K und Rse = 0.04
Verwende Formel E.24 weil d_t + 0.5 * z ≥ B':
U_{bf} = λ/(0.457 B' + d_t + 0.5z) = 0.214 W/m²K

Effective heat transfer coefficient **U_0 = 0,214 W/m²K**
Attention Beta version: Please report errors and problems with the calculation according to DIN 4108-6.



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]	RSI [m²K/W]	Temperatur [°C] min	max	Weight [kg/m²]
		Thermal contact resistance*		0,250	19,6	21,0	
1	1,25 cm	Plywood - Douglas fir	0,090	0,139	18,9	19,6	3,8
2	0,001 cm	Aluminum foil (coated)	160,000	0,000	18,9	18,9	0,0
3	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	9,5	18,9	0,8
4	0,002 cm	Aluminum foil (coated)	160,000	0,000	9,5	9,5	0,1
5	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	0,2	9,5	0,8
6	0,001 cm	Aluminum foil (coated)	160,000	0,000	0,2	0,2	0,0
7	0,025 cm	Foil, PE	0,400	0,001	0,2	0,2	0,2
		Thermal contact resistance*		0,040	0,0	0,2	
8		Soil			0,0	0,0	20,5
	12.0744 cm	Whole component		3,684			5,7

*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):	19,6°C	19,6°C	19,6°C
Surface temperature outside (min / average / max):	0,2°C	0,2°C	0,2°C

Tremblay Crawlspace Floor, U=0,21 W/(m²K)

Moisture proofing

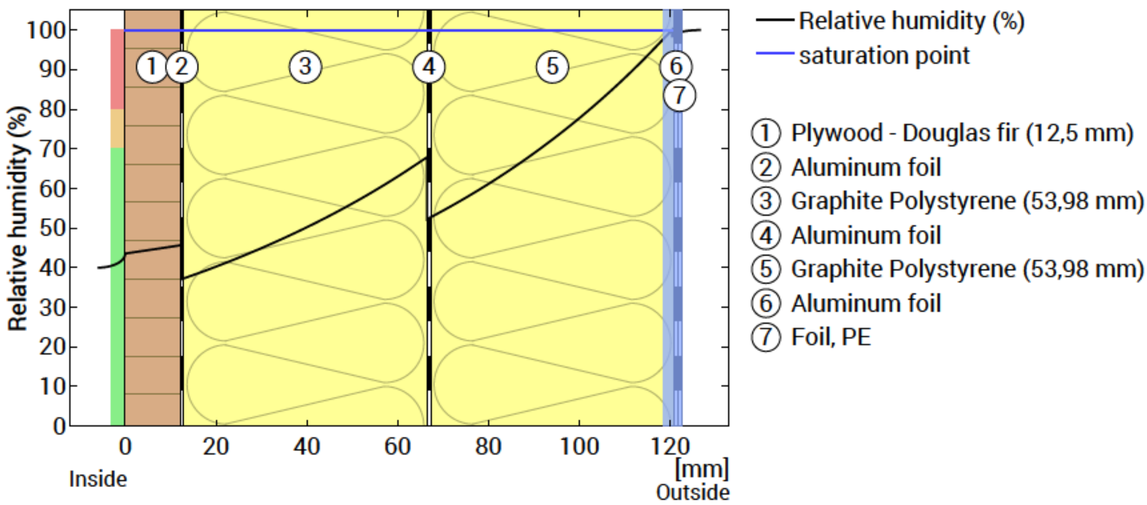
For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 21°C und 40% Humidity; outside: 0°C und 100% Humidity (Climate according to user input).

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	Plywood - Douglas fir	0,63	-	-	3,8
2	0,001 cm	Aluminum foil (coated)	1500	-		0,0
3	5,398 cm	Graphite Polystyrene (GPS)	1,08	-		0,8
4	0,002 cm	Aluminum foil (coated)	1500	-		0,1
5	5,398 cm	Graphite Polystyrene (GPS)	1,08	~0		0,8
6	0,001 cm	Aluminum foil (coated)	1500	-		0,0
7	0,025 cm	Foil, PE	25,40	-		0,2
	12.0744 cm	Whole component	4.528,75	~0		5,7

Humidity

The temperature of the inside surface is 19,6 °C leading to a relative humidity on the surface of 44%.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.

Tremblay Basement Wall (Remaining Ground)

Exterior wall
created on 20.1.2025

Thermal protection

U = 4,30 W/(m²K)

DIN 4108*: R>1,2 m²K/W + R_{si} + R_{se}

excellent insufficient

Moisture proofing

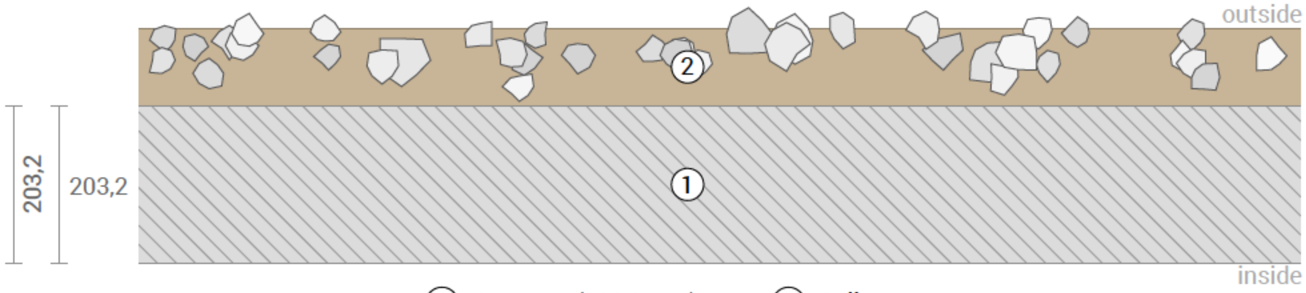
No condensate

excellent insufficient

Heat protection

Component is adjacent to earth:
TAV and phase non relevant
Thermal capacity inside: 112 kJ/m²K

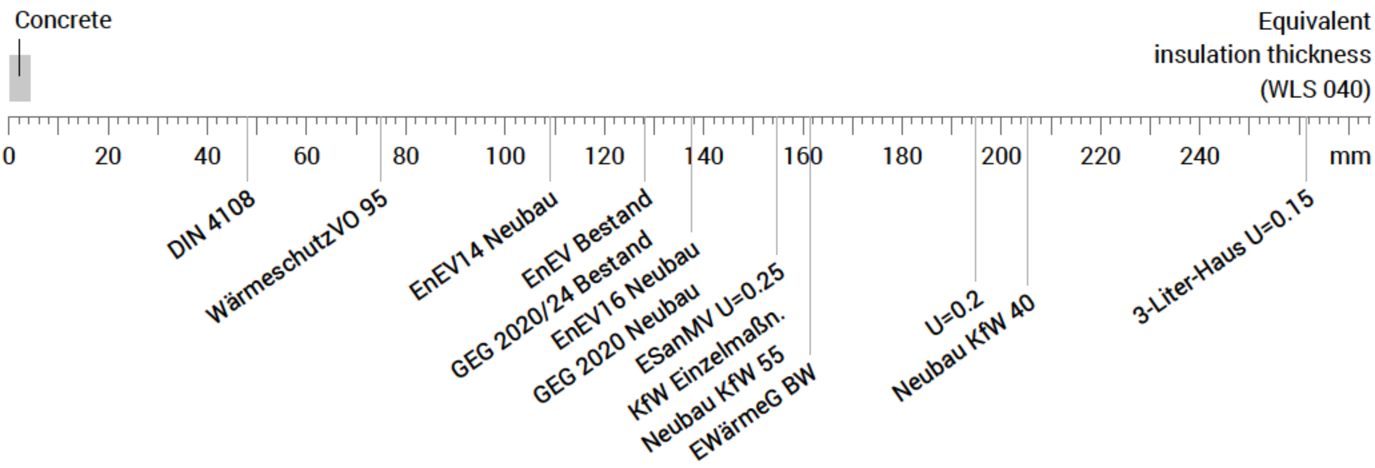
excellent insufficient



① Concrete (203,2 mm) ② Soil

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 :	21.0°C / 40%		Thickness:	20,3 cm
Ground:	0.0°C / 100%	sd-value: 26,4 m	Weight:	488 kg/m²
Surface temperature.:	7,6°C / 2,1°C		Heat capacity:	463 kJ/m²K

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

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

Tremblay Basement Wall (Remaining Ground), U=4,30 W/(m²K)

U-value calculation

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,130
1	Concrete	20,32	2,000	0,102
	Thermal contact resistance outside (Rse)			0,000

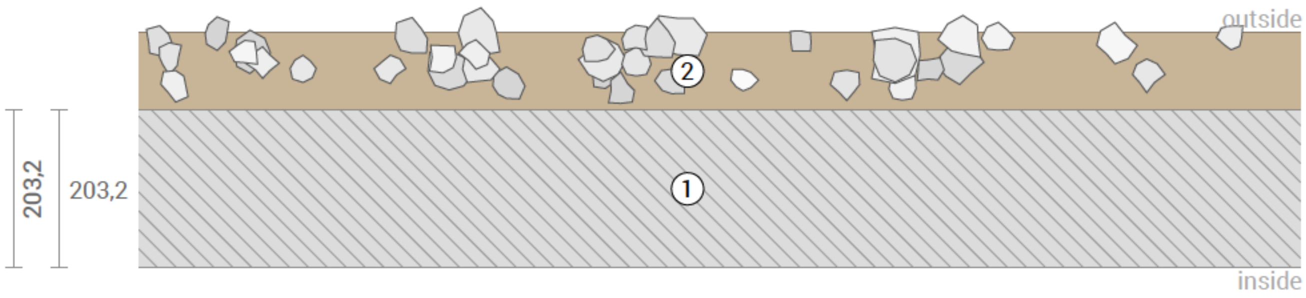
Thermal contact resistances have been taken from DIN 6946 Table 7.
Rsi: heat flow direction horizontally
Rse: heat flow direction horizontally, outside: Ground

Thermal resistance R_{tot} = 0.2326 m²K/W

DIN 6946 may not be used for earth-contacting components. However, for the alternative method from DIN V 4108-6 Annex E, the required data on the size and position of this component are missing.

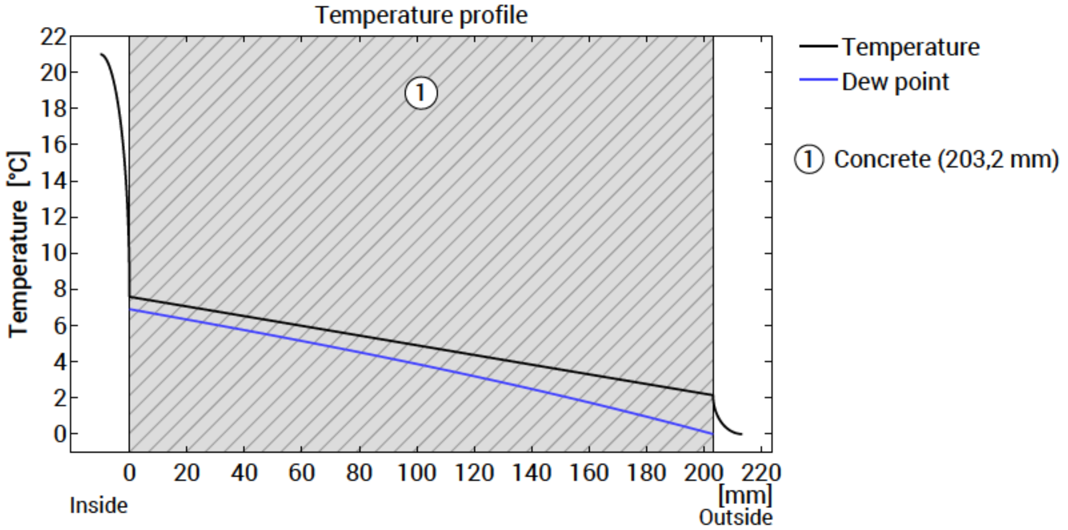
Heat transfer coefficient U = $1/R_{tot}$ = **4,30 W/(m²K)**

The constructive U-value was calculated. Heat losses across the ground or basement were not considered because the necessary data are missing.



Tremblay Basement Wall (Remaining Ground), U=4,30 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]	RSI [m²K/W]	Temperatur [°C] min	Temperatur [°C] max	Weight [kg/m²]
		Thermal contact resistance*		0,250	7,6	21,0	
1	20,32 cm	Concrete	2,000	0,102	2,1	7,6	487,7
		Thermal contact resistance*		0,040	0,0	2,1	
2		Soil			0,0	0,0	34,5
	20.32 cm	Whole component		0,233			487,7

*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):	7,6°C	7,6°C	7,6°C
Surface temperature outside (min / average / max):	2,1°C	2,1°C	2,1°C

Tremblay Basement Wall (Remaining Ground), U=4,30 W/(m²K)

Moisture proofing

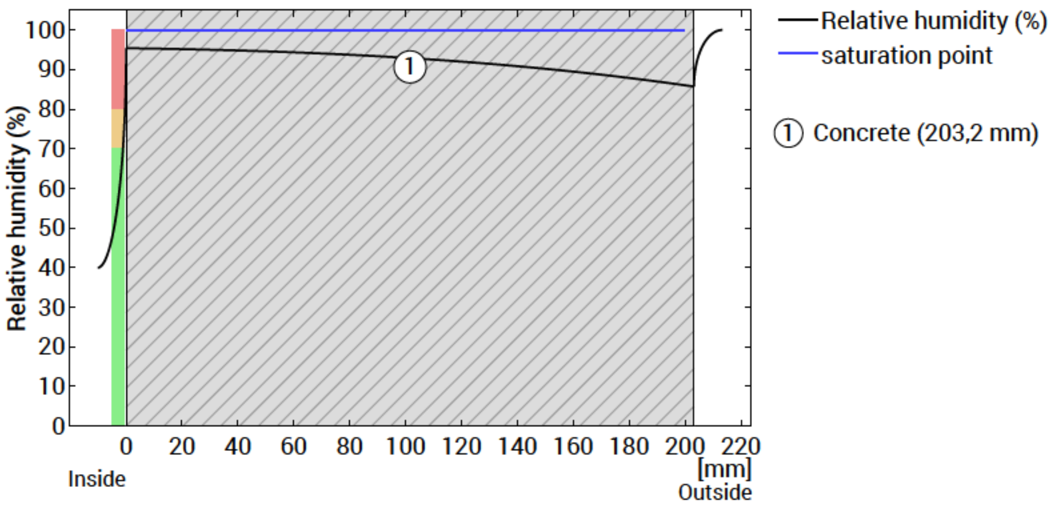
For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 21°C und 40% Humidity; outside: 0°C und 100% Humidity (Climate according to user input).

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

#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	20,32 cm	Concrete	26,42	-		487,7
	20.32 cm	Whole component	26,42	0		487,7

Humidity

The temperature of the inside surface is 7,6 °C leading to a relative humidity on the surface of 95%.Most kinds of moulds start to grow at relative air humidities of 80% or more. Mould grow is expected! To avoid mould formation, the surface temperature should be increased by (additional) insulation.
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.

Tremblay Basement Wall (Ground)

Exterior wall
created on 20.1.2025

Thermal protection

U = 0,28 W/(m²K)

DIN 4108*: R>1,2 m²K/W + R_{si} + R_{se}

excellent — insufficient

Moisture proofing

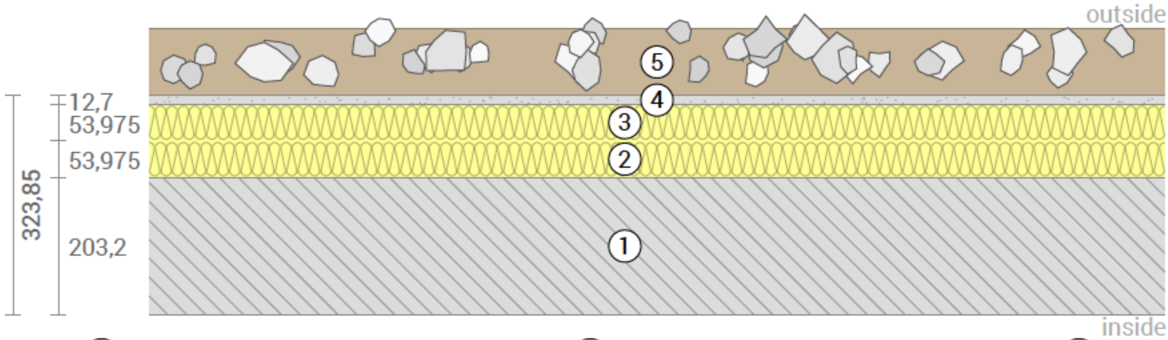
No condensate

excellent — insufficient

Heat protection

Component is adjacent to earth:
TAV and phase non relevant
Thermal capacity inside: 428 kJ/m²K

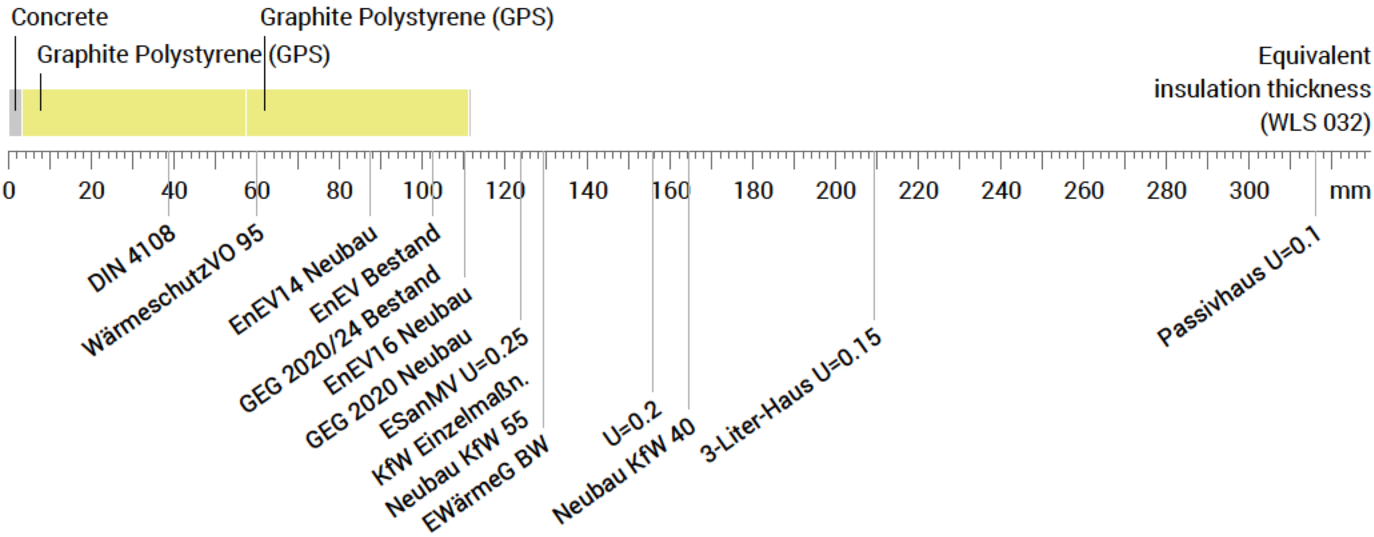
excellent — insufficient



1. Concrete (203,2 mm)
2. Graphite Polystyrene (53,975 mm)
3. Graphite Polystyrene (53,975 mm)
4. Cement plaster (12,7 mm)
5. Soil

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 0,032 W/mK.



Inside air :	21.0°C / 40%		Thickness:	32,4 cm
Ground:	0.0°C / 100%	sd-value: 18,9 m	Weight:	515 kg/m²
Surface temperature.:	19,6°C / 0,2°C		Heat capacity:	491 kJ/m²K

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

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

Tremblay Basement Wall (Ground), U=0,28 W/(m²K)

U-value calculation

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,130
1	Concrete	20,32	2,000	0,102
2	Graphite Polystyrene (GPS)	5,40	0,032	1,687
3	Graphite Polystyrene (GPS)	5,40	0,032	1,687
4	Cement plaster	1,27	1,400	0,009
	Thermal contact resistance outside (Rse)			0,000

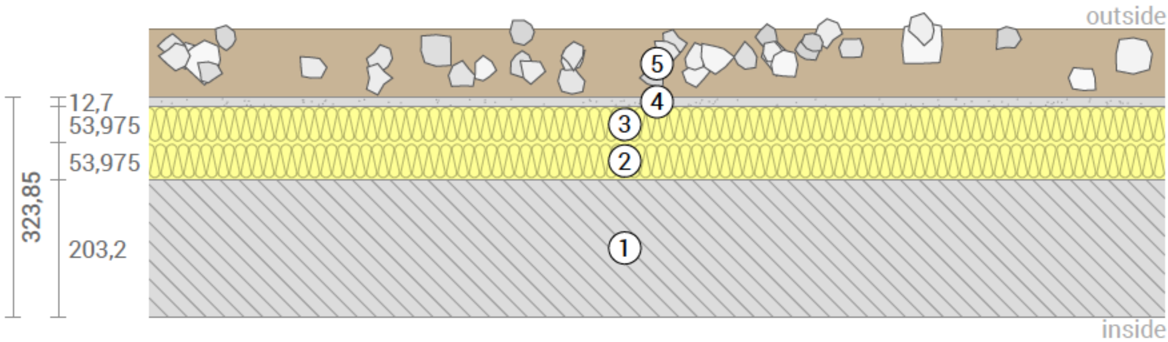
Thermal contact resistances have been taken from DIN 6946 Table 7.
Rsi: heat flow direction horizontally
Rse: heat flow direction horizontally, outside: Ground

Thermal resistance R_{tot} = 3.615 m²K/W

DIN 6946 may not be used for earth-contacting components. However, for the alternative method from DIN V 4108-6 Annex E, the required data on the size and position of this component are missing.

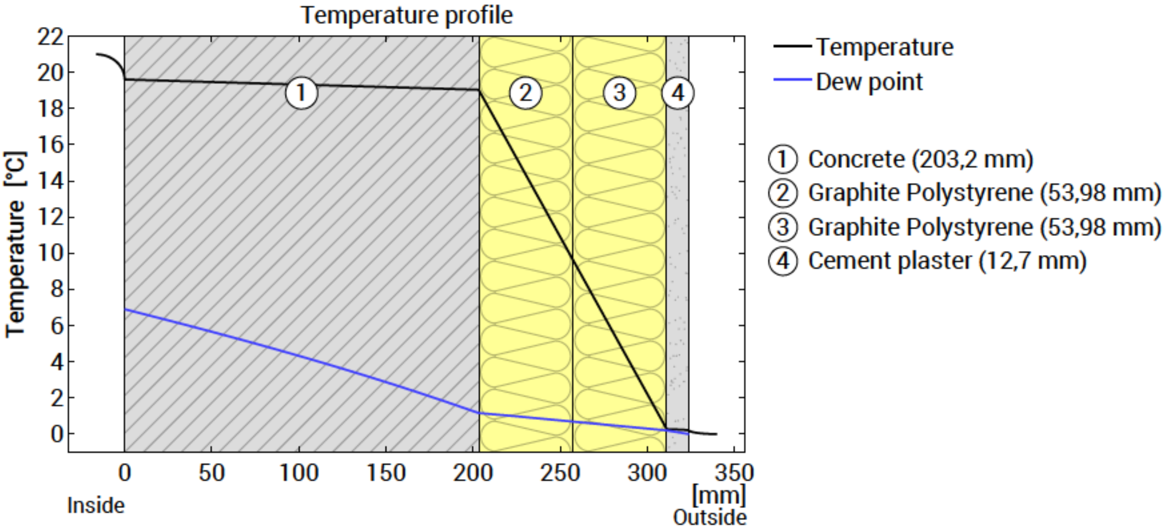
Heat transfer coefficient U = 1/R_{tot} = **0,28 W/(m²K)**

The constructive U-value was calculated. Heat losses across the ground or basement were not considered because the necessary data are missing.



Tremblay Basement Wall (Ground), U=0,28 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]	RSI [m²K/W]	Temperatur [°C] min	max	Weight [kg/m²]
		Thermal contact resistance*		0,250	19,6	21,0	
1	20,32 cm	Concrete	2,000	0,102	19,0	19,6	487,7
2	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	9,7	19,0	0,8
3	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	0,3	9,7	0,8
4	1,27 cm	Cement plaster	1,400	0,009	0,2	0,3	25,4
		Thermal contact resistance*		0,040	0,0	0,2	
5		Soil			0,0	0,0	55,1
	32.385 cm	Whole component		3,615			514,7

*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):	19,6°C	19,6°C	19,6°C
Surface temperature outside (min / average / max):	0,2°C	0,2°C	0,2°C

Moisture proofing

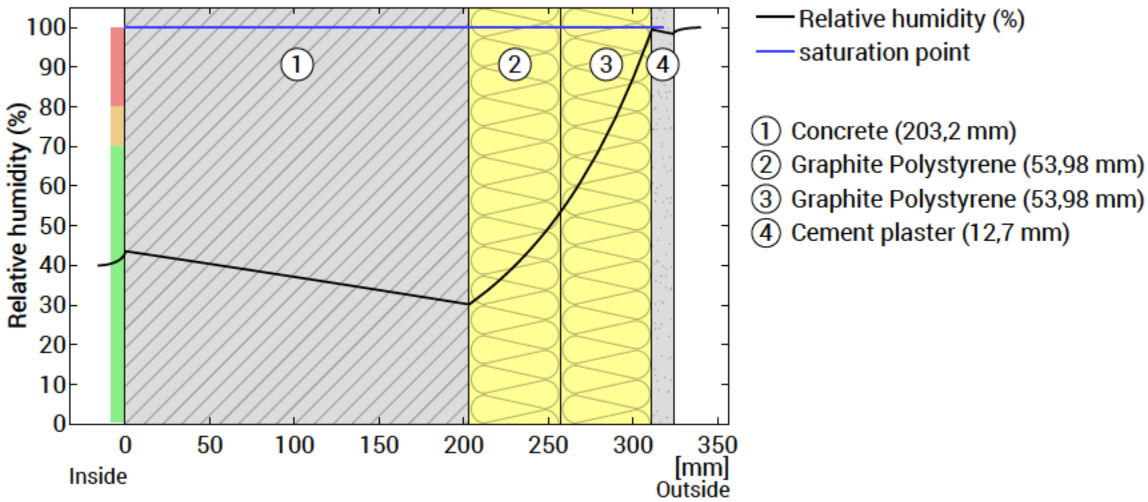
For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 21°C und 40% Humidity; outside: 0°C und 100% Humidity (Climate according to user input).

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

#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	20,32 cm	Concrete	16,26	-		487,7
2	5,398 cm	Graphite Polystyrene (GPS)	1,08	-		0,8
3	5,398 cm	Graphite Polystyrene (GPS)	1,08	-		0,8
4	1,27 cm	Cement plaster	0,44	-		25,4
	32.385 cm	Whole component	18,86	0		514,7

Humidity

The temperature of the inside surface is 19,6 °C leading to a relative humidity on the surface of 44%.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.

Tremblay Basement Wall (Exposed)

Exterior wall
created on 20.1.2025

Thermal protection

U = 0,27 W/(m²K)

DIN 4108*: R>1,2 m²K/W + R_{si} + R_{se}

excellent insufficient

Moisture proofing

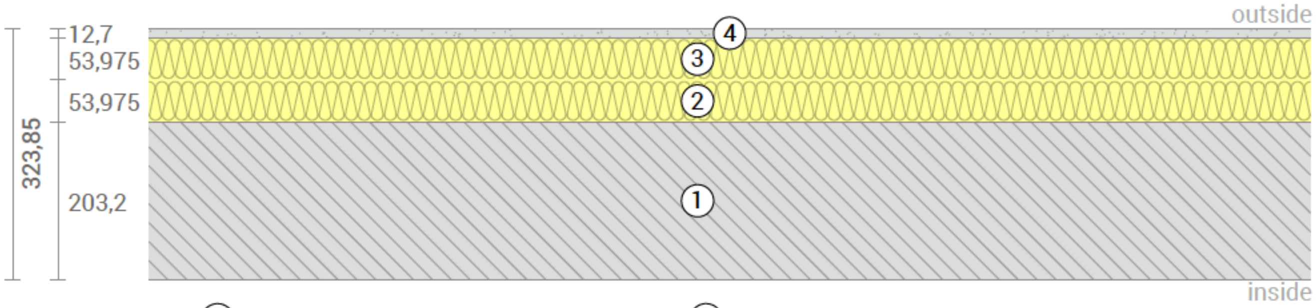
Dries 2 days
Condensate: 21 g/m²

excellent insufficient

Heat protection

Temperature amplitude damping: >100
phase shift: non relevant
Thermal capacity inside: 428 kJ/m²K

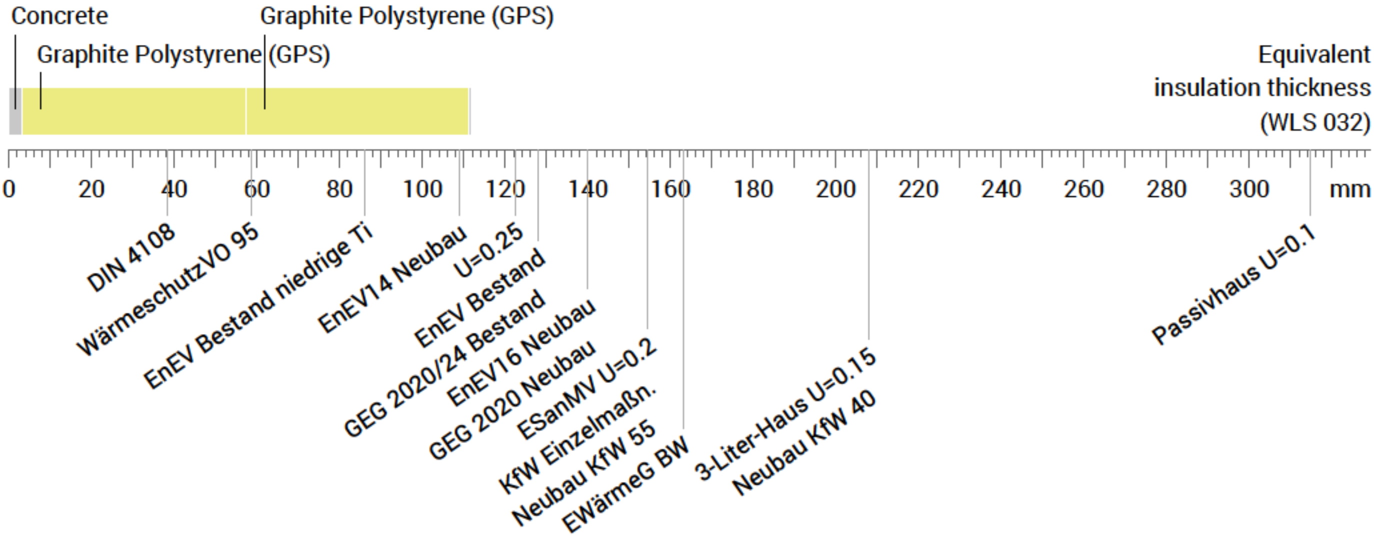
excellent insufficient



1. Concrete (203,2 mm)
2. Graphite Polystyrene (53,975 mm)
3. Graphite Polystyrene (53,975 mm)
4. Cement plaster (12,7 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 0,032 W/mK.



Inside air :	21.0°C / 40%		Thickness:	32,4 cm
Outside air:	-25.0°C / 80%	sd-value: 18,9 m	Weight:	515 kg/m²
Surface temperature.:	18,0°C / -24,5°C		Heat capacity:	491 kJ/m²K

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

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

Tremblay Basement Wall (Exposed), U=0,27 W/(m²K)

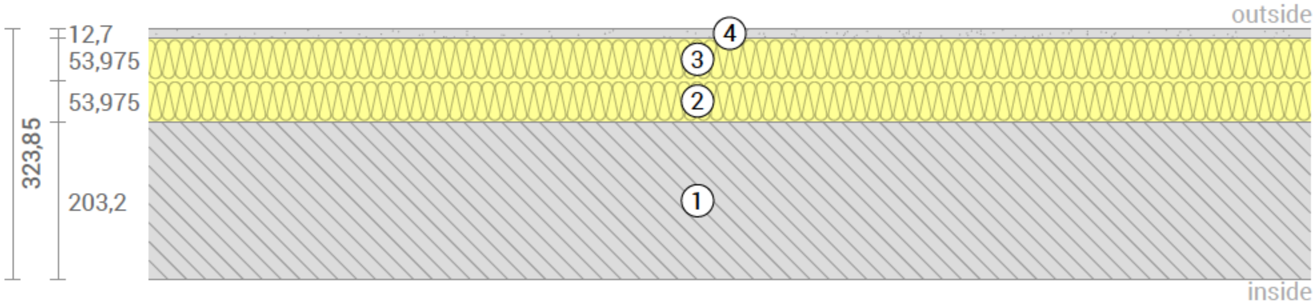
U-Value calculation according to DIN EN ISO 6946

#	Material	Dicke [cm]	λ [W/mK]	R [m²K/W]
	Thermal contact resistance inside (Rsi)			0,130
1	Concrete	20,32	2,000	0,102
2	Graphite Polystyrene (GPS)	5,40	0,032	1,687
3	Graphite Polystyrene (GPS)	5,40	0,032	1,687
4	Cement plaster	1,27	1,400	0,009
	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 resistance R_{tot} = 3.654 m²K/W

Heat transfer coefficient U = 1/R_{tot} = **0,27 W/(m²K)**



Tremblay Basement Wall (Exposed), U=0,27 W/(m²K)

LCA

Heat loss: 30 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.

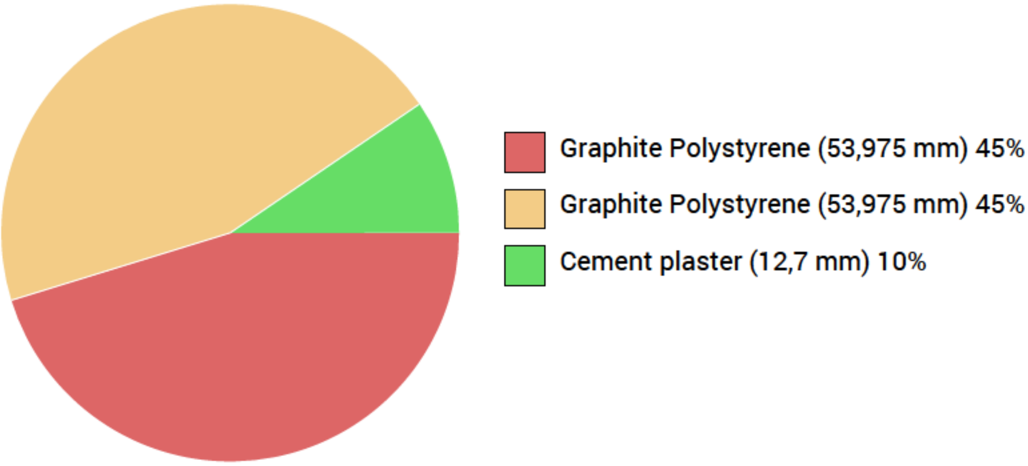
Primary energy (non renewable): 42 kWh/m²

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

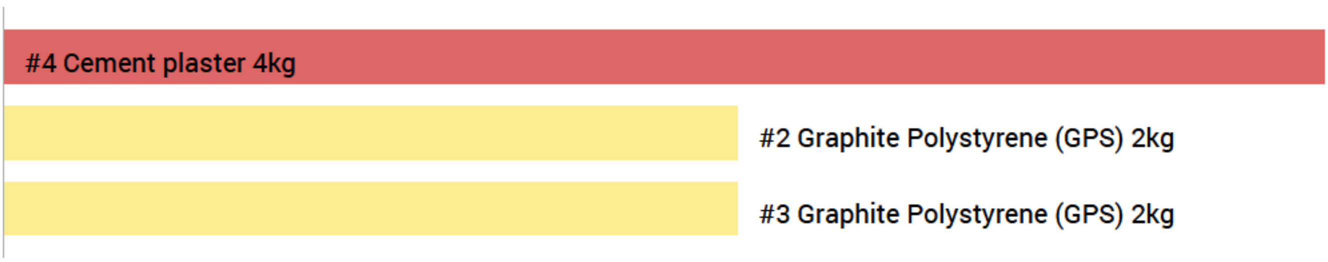
Green house gas potential: 9.2 kg CO2 Äqv./m²

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

Composition of non-renewable primary energy of production:

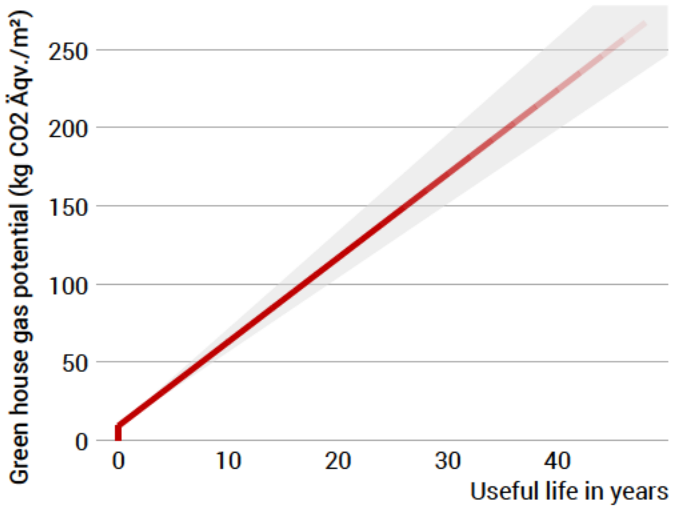


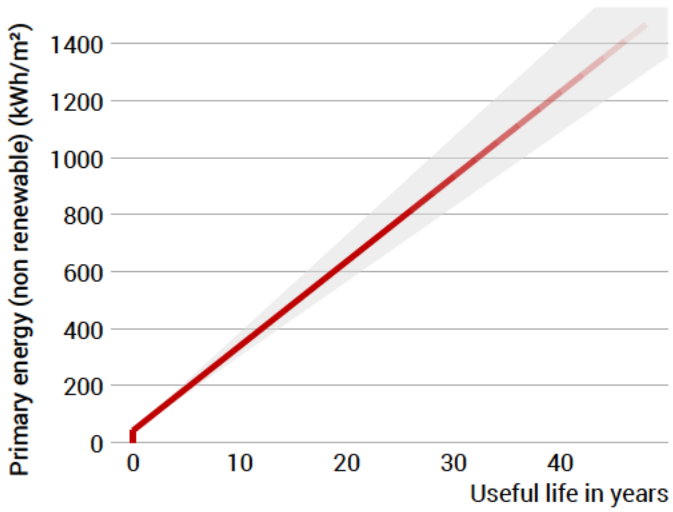
Composition of the greenhouse potential of production:



Tremblay Basement Wall (Exposed), U=0,27 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 1.2 kWh per kWh of heat and a global warming potential of 0.21 kg CO_2 eqv/m² per kWh of heat was used. Heat source: Natural gas H.

Hints

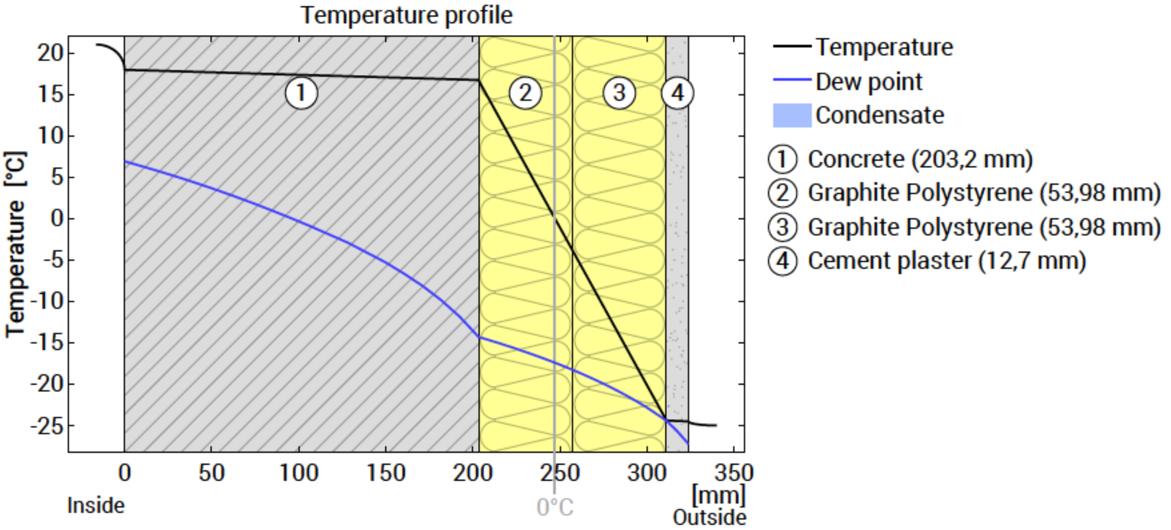
Calculated for the location AB:CALGARY INTL A, heating period from Mid of October to End of April. The calculation is based on monthly average temperatures. Source: Canadian Weather Year for Energy Calculation (2016)

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.

Keine Berechnung möglich.

Tremblay Basement Wall (Exposed), U=0,27 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]	RSI [m²K/W]	Temperatur [°C] min	max	Weight [kg/m²]
		Thermal contact resistance*		0,250	18,0	21,0	
1	20,32 cm	Concrete	2,000	0,102	16,7	18,0	487,7
2	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	-3,8	16,7	0,8
3	5,398 cm	Graphite Polystyrene (GPS)	0,032	1,687	-24,4	-3,8	0,8
4	1,27 cm	Cement plaster	1,400	0,009	-24,5	-24,4	25,4
		Thermal contact resistance*		0,040	-25,0	-24,5	
	32.385 cm	Whole component		3,654			514,7

*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):	18,0°C	18,0°C	18,0°C
Surface temperature outside (min / average / max):	-24,5°C	-24,5°C	-24,5°C

Tremblay Basement Wall (Exposed), U=0,27 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: 21°C und 40% Humidity; outside: -25°C und 80% Humidity (Climate according to user input).

Under these conditions, a total of 0.021 kg of condensation water per square meter is accumulated.This quantity dries in summer in 2 days (Drying season according to DIN 4108-3:2018-10).

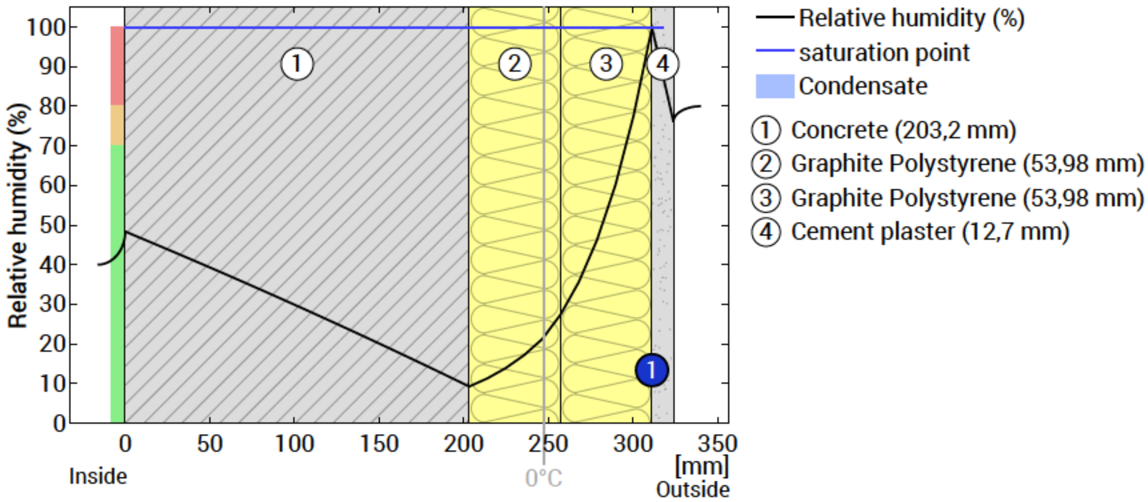
#		Material	sd-value [m]	Condensate [kg/m²]	Condensate [Gew.-%]	Weight [kg/m²]
1	20,32 cm	Concrete	16,26	-		487,7
2	5,398 cm	Graphite Polystyrene (GPS)	1,08	-		0,8
3	5,398 cm	Graphite Polystyrene (GPS)	1,08	0.021		0,8
4	1,27 cm	Cement plaster	0,44	0.021		25,4
	32.385 cm	Whole component	18,86	0.021		514,7

Condensation areas

(1) Condensate: 0,021 kg/m² Affected layers: Cement plaster, Graphite Polystyrene (GPS)

Humidity

The temperature of the inside surface is 18,0 °C leading to a relative humidity on the surface of 48%.Mould formation is not expected under these conditions.
The following figure shows the relative humidity inside the component.

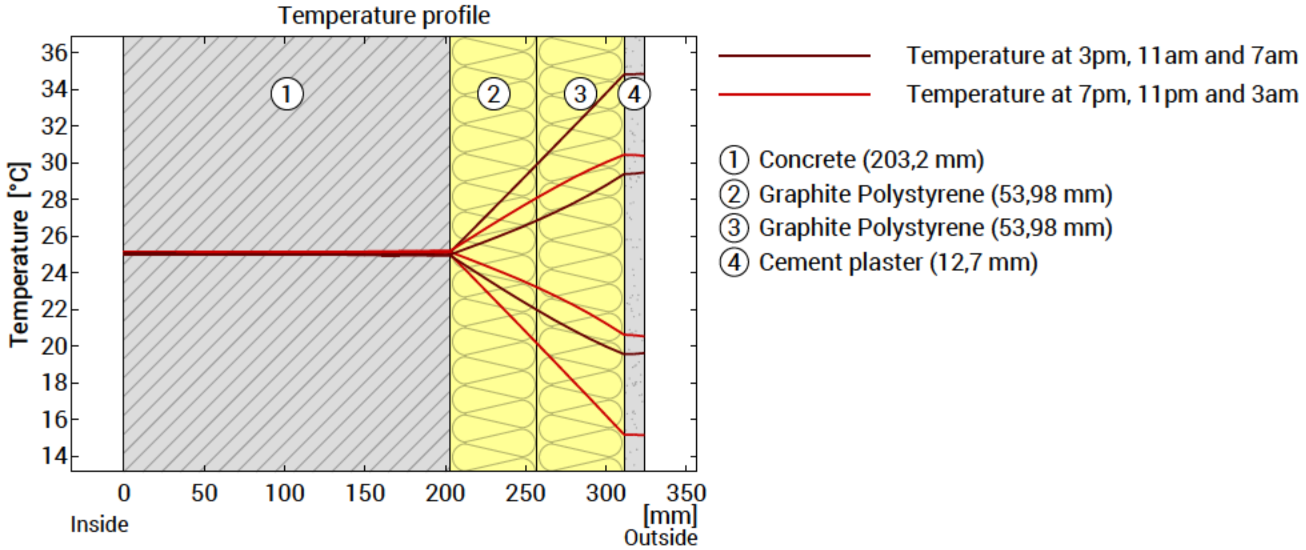


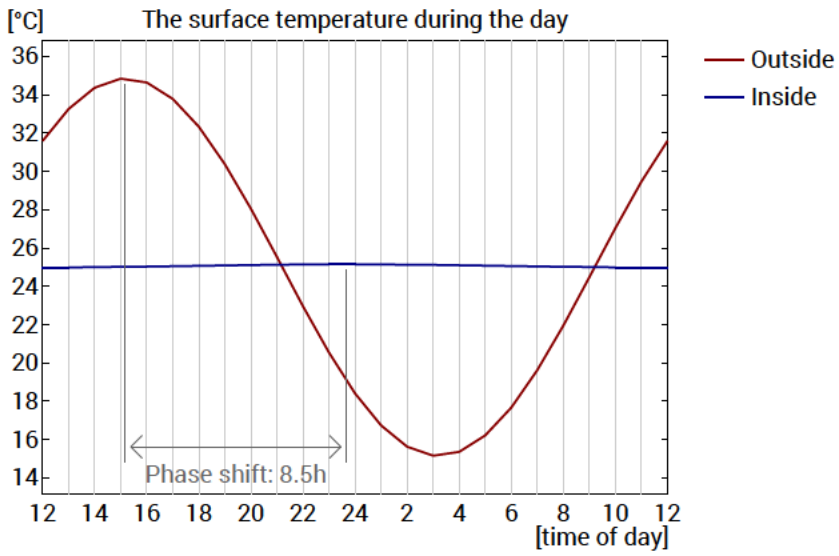
Notes: Calculation using the Ubakus 2D-FE method. Convection and the capillarity of the building materials were not considered. The drying time may take longer under unfavorable conditions (shading, damp / cool summers) than calculated here.

Tremblay Basement Wall (Exposed), U=0,27 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*	non relevant	Heat storage capacity (whole component):	491 kJ/m²K
Amplitude attenuation **	>100	Thermal capacity of inner layers:	428 kJ/m²K
TAV ***	0,008		

* 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.