KATALOG

Kulturarv, Transformation & Restaurering
af Anders Holmgrün Carlsen & Astrid Frischknecht Ansbjerg

INDHOLD

Keldur (eget foto)

Tørvehus ved Isafjordur

Pakhus, Hofsós (eget foto)

Pakhus, Hofsós (eget foto)

Pakhus, Hofsós (eget foto)

Pakhus, Hofsós (eget foto)

Badstofa i Glaumbær tørvegård, Island

Djupavik, Westfjords (eget foto)

Djupavik, Westfjords (eget foto)

Djupavik, Westfjords (eget foto)

Høst af tørv, Olaf Ott Becker

Tørvegræs, Fra bogen *From Earth*

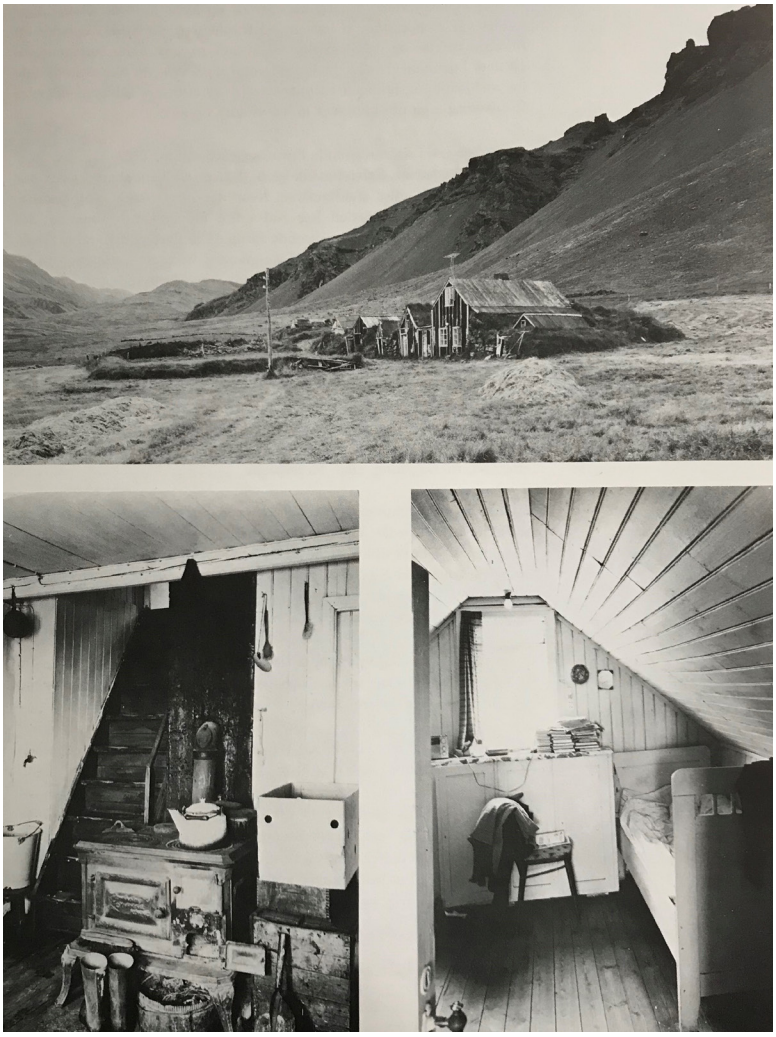
Sky lagoon, Island

Ise Shrine, Japan

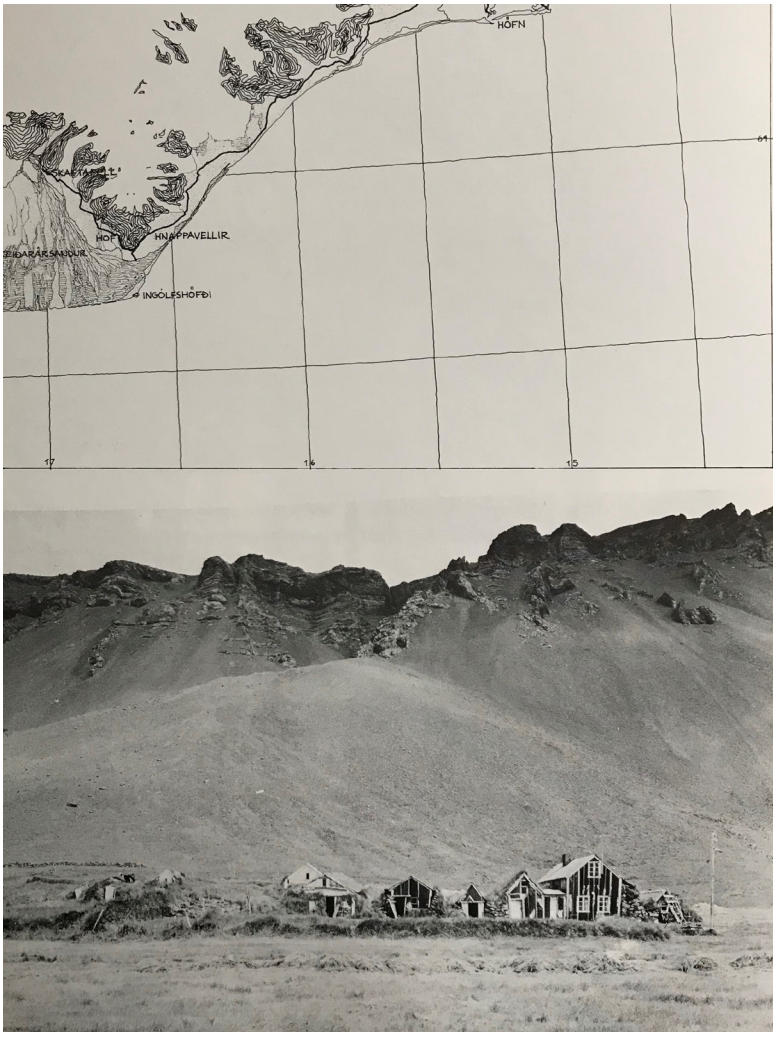
Trækanker

Trækanker

Hedmark Museum, Sverre Fehn



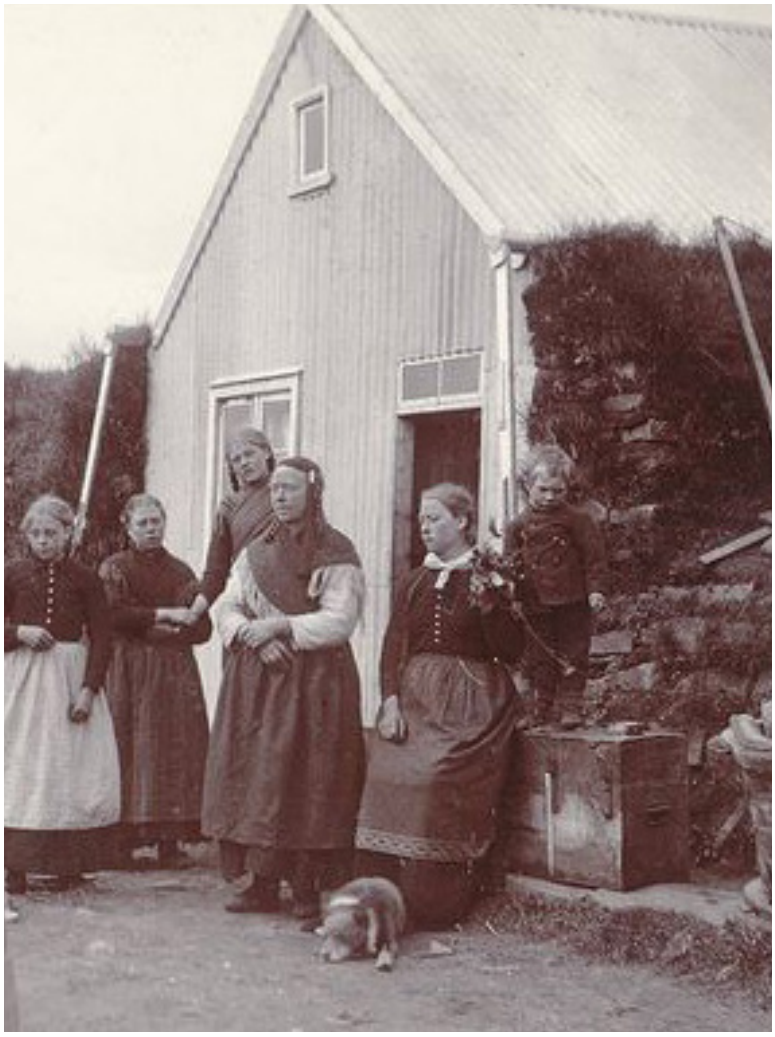
HISTORISKE FOTOS



Breidargerdi, Skagafjordur

Tørvegård

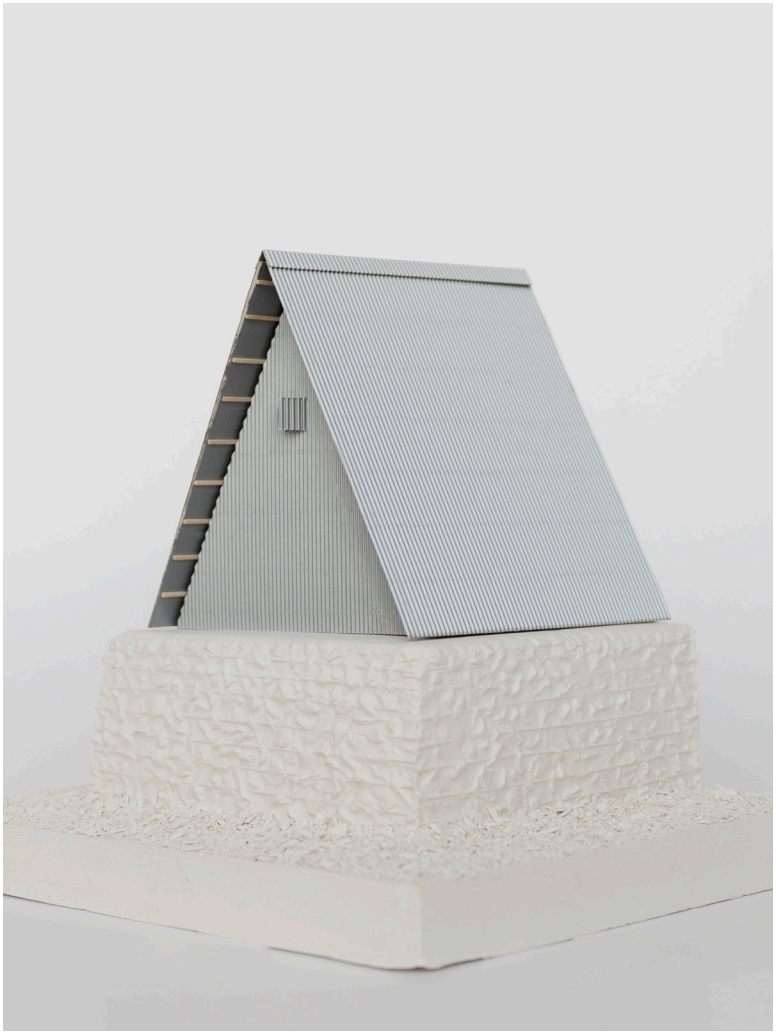
Tørvegård



Tørvegård

Tørvegård

MODELSTUDIER



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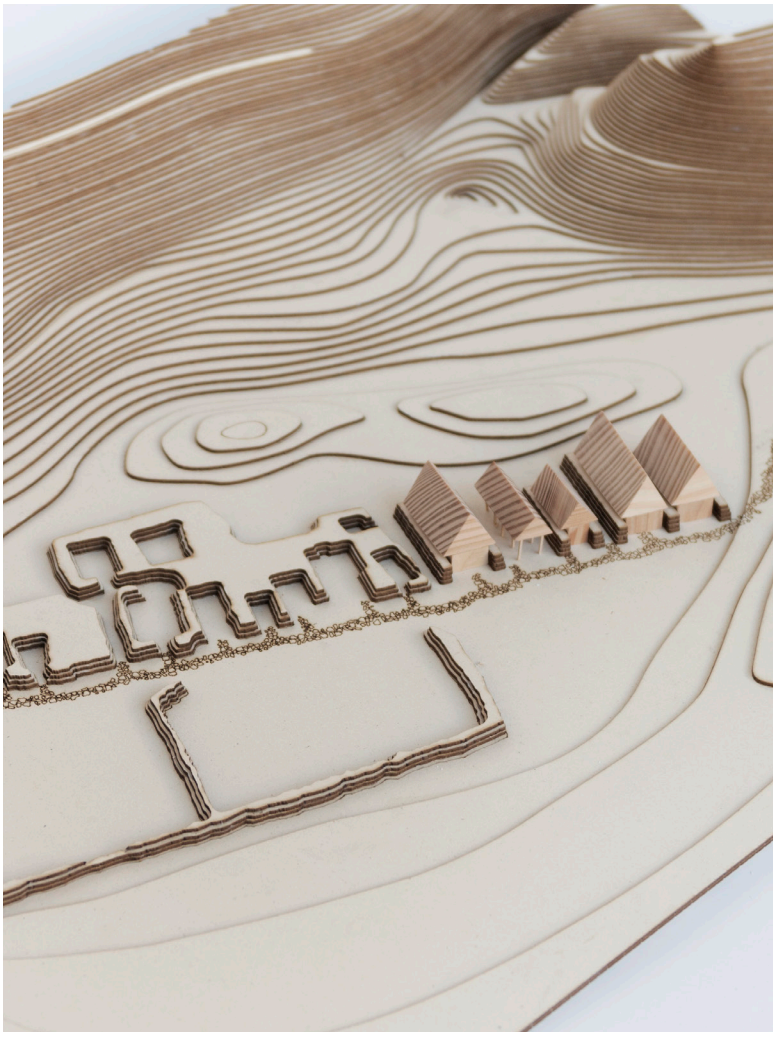

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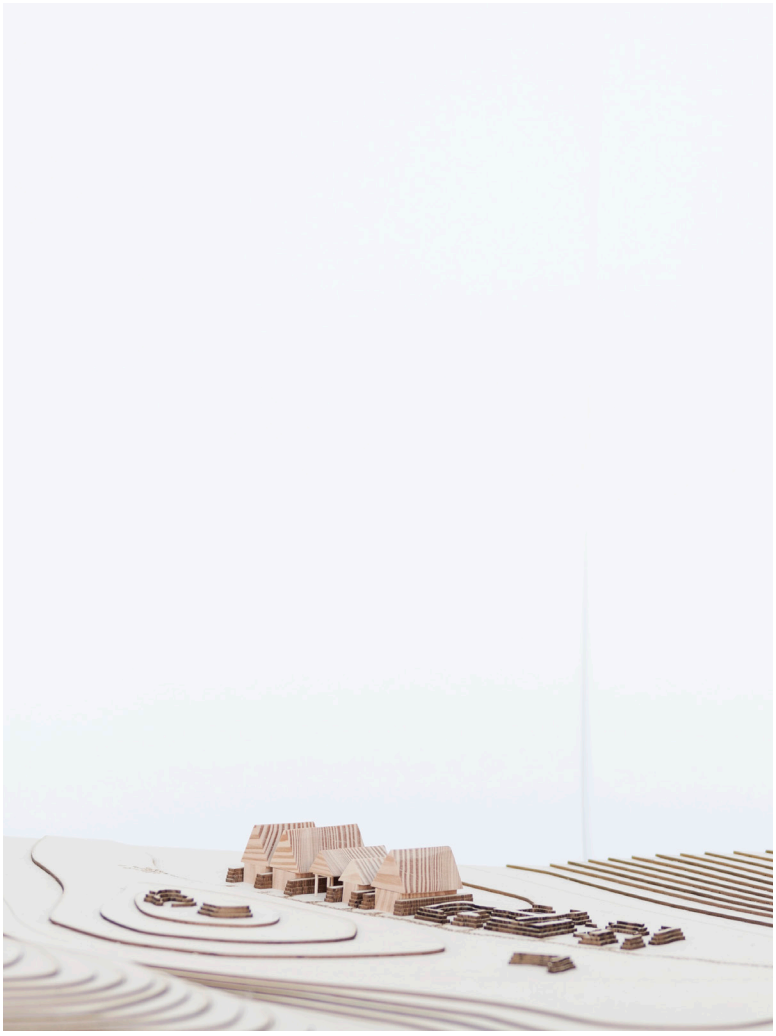


MODELSTUDIER

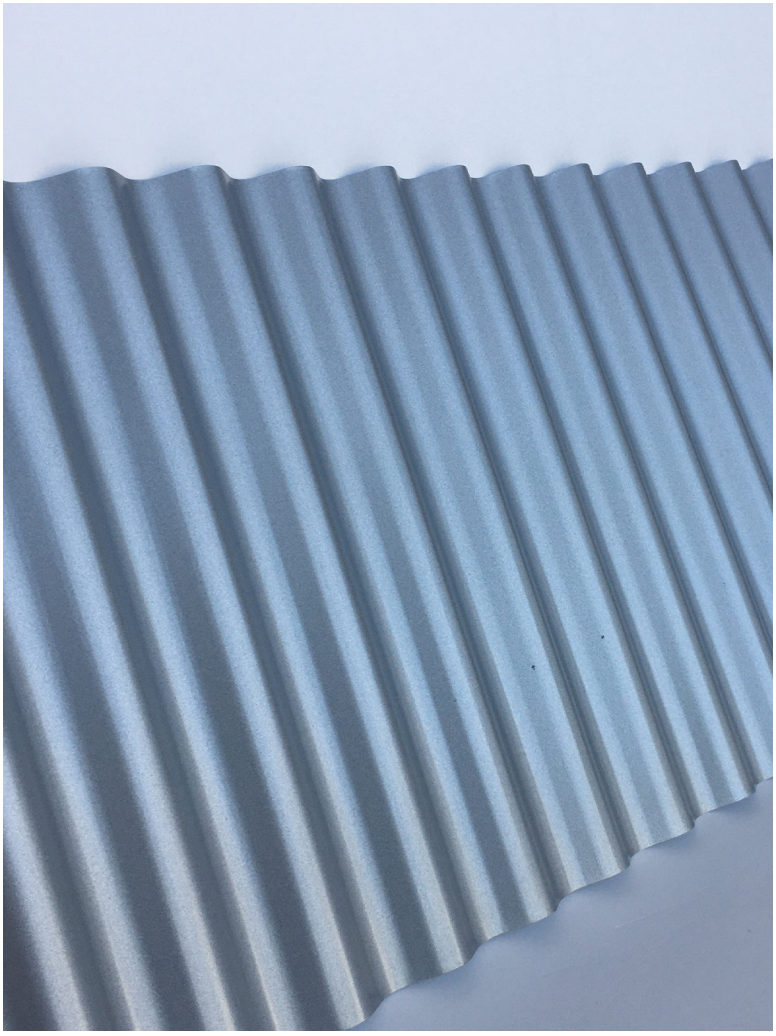
MODELSTUDIER

MODELSTUDIER

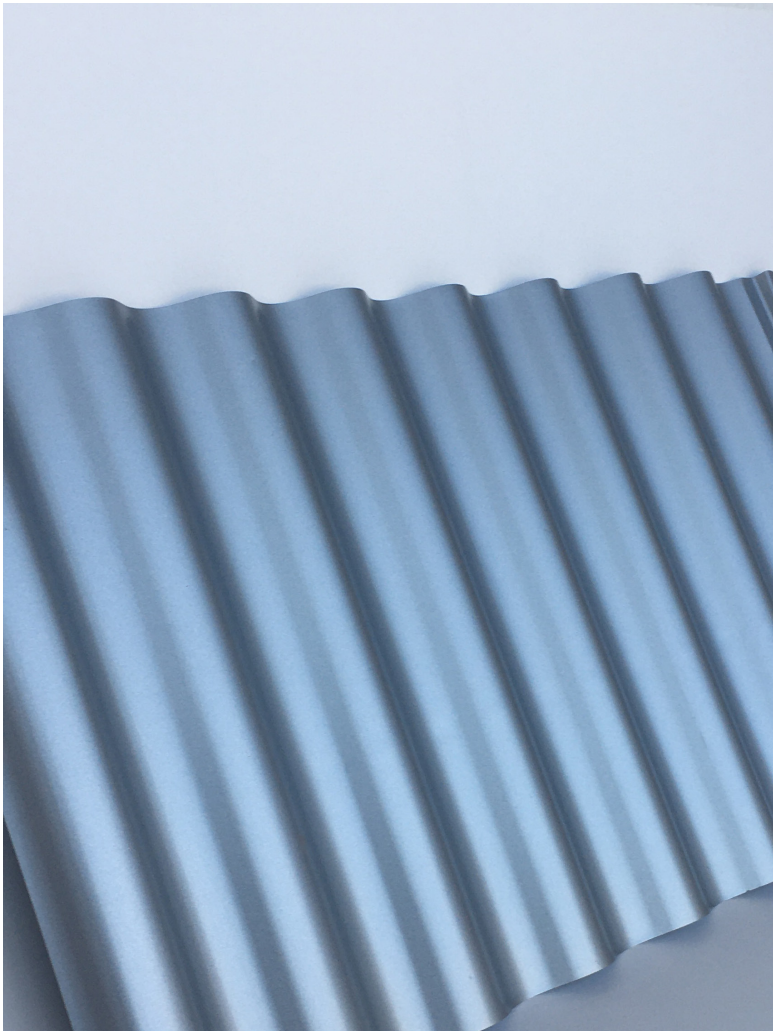
Jord model, marts 2022

Jord model, maj 2022

Sten



Sinus 18

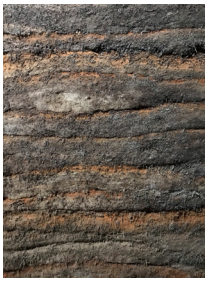
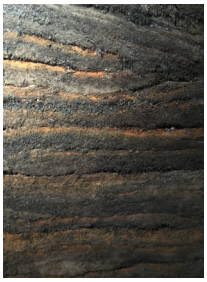
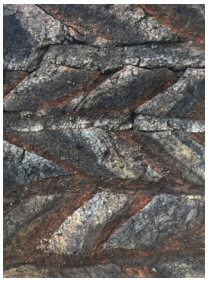


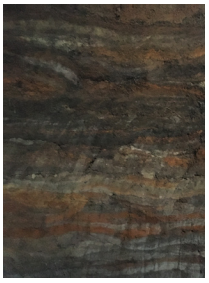
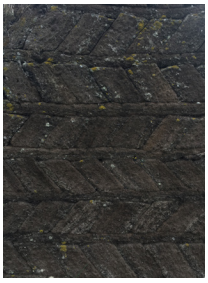
Sinus 26

Fyrretræ

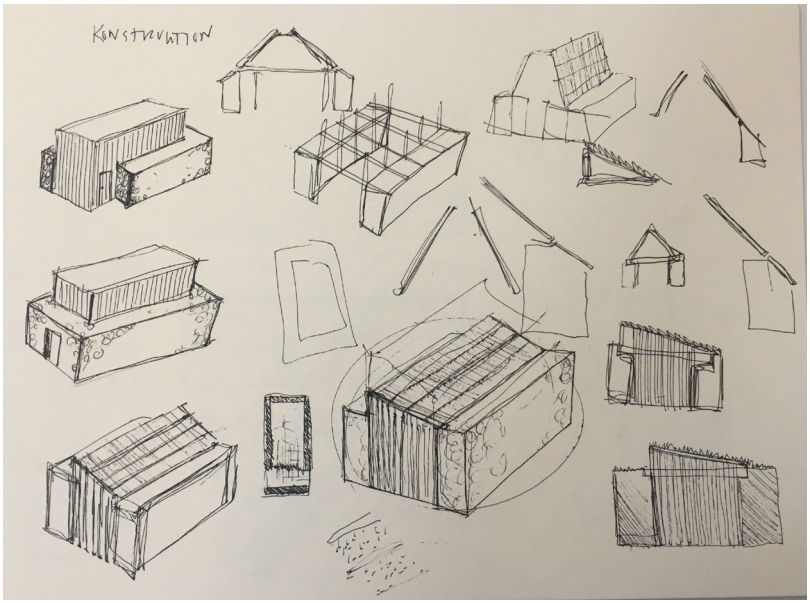
MATERIALER

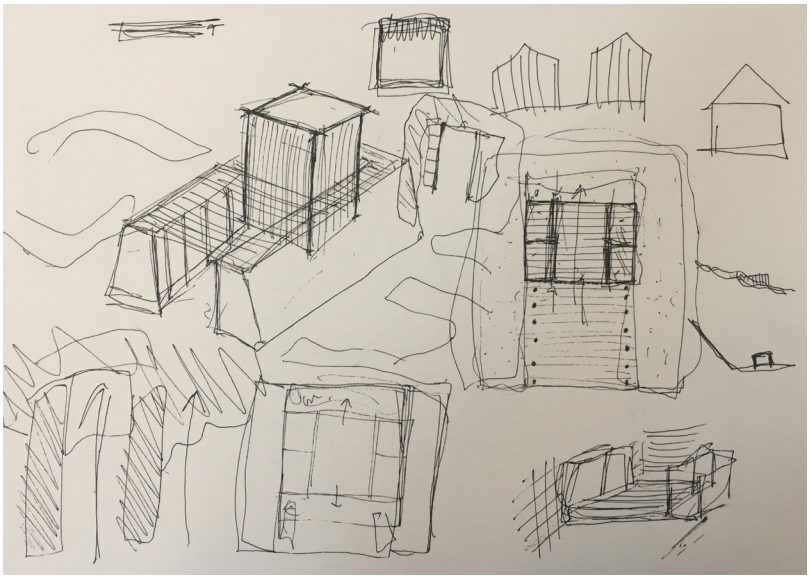


SKITSER





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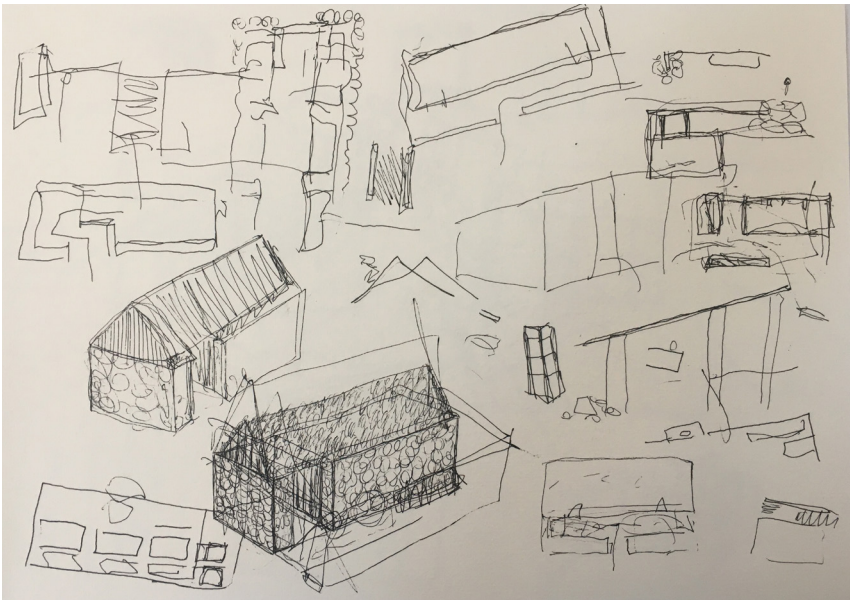

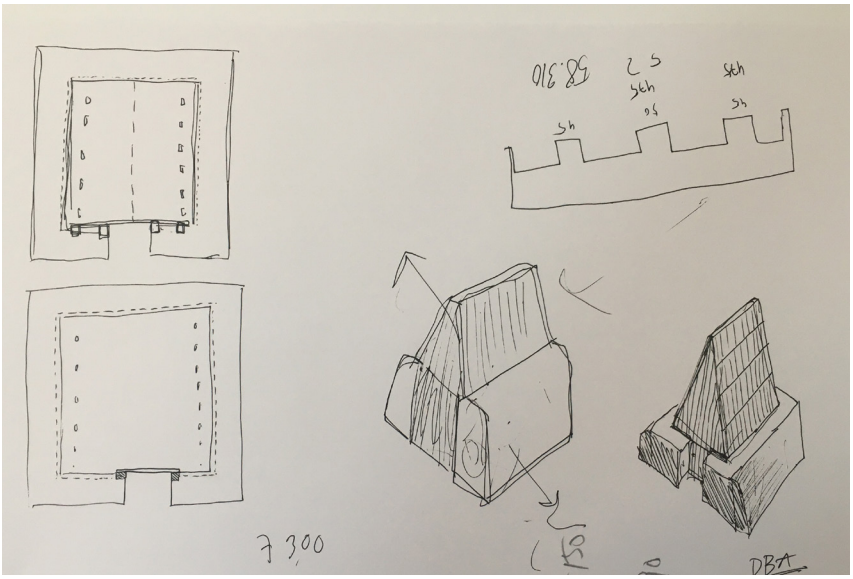

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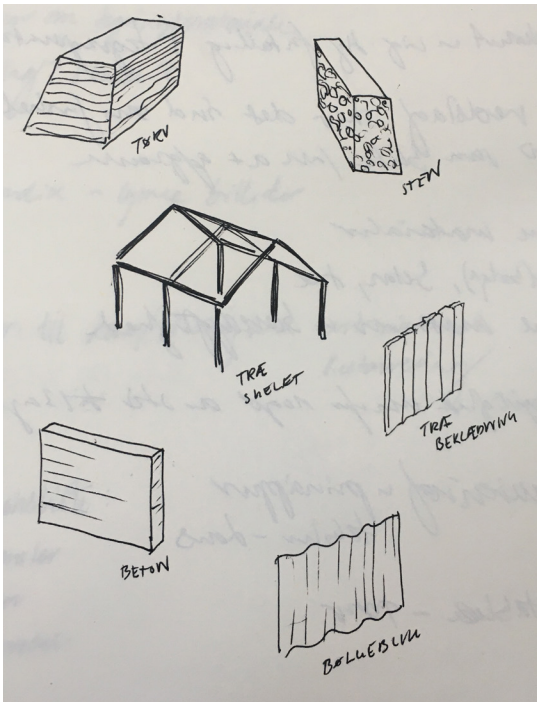
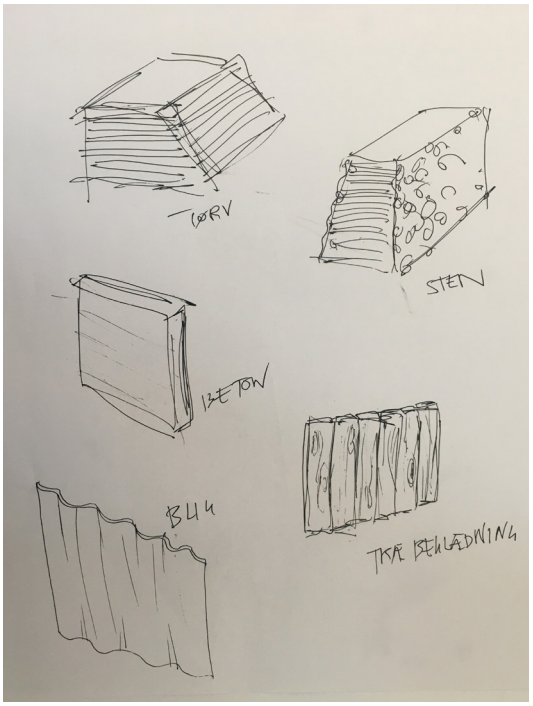
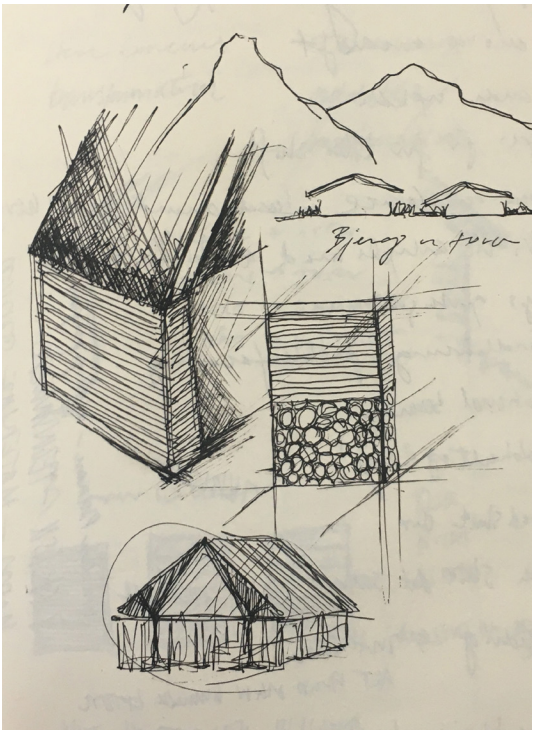
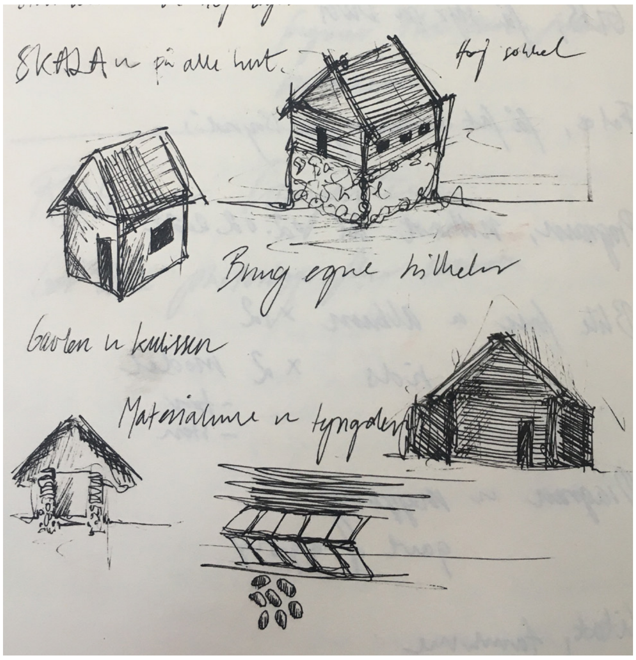
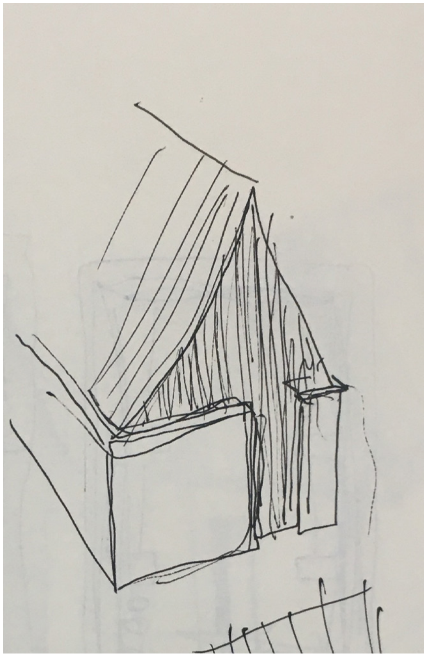

TØRV
STEN
TRÆ SKELET
TRÆ BEKLÆDNING
BETON
BØLGEBLIK


TØRV
STEN
BETON
BLIK
TRÆ BEKLÆDNING

SKITSER




Høj sokkel
Gavlen er kulissen
Materialerne er tyngden



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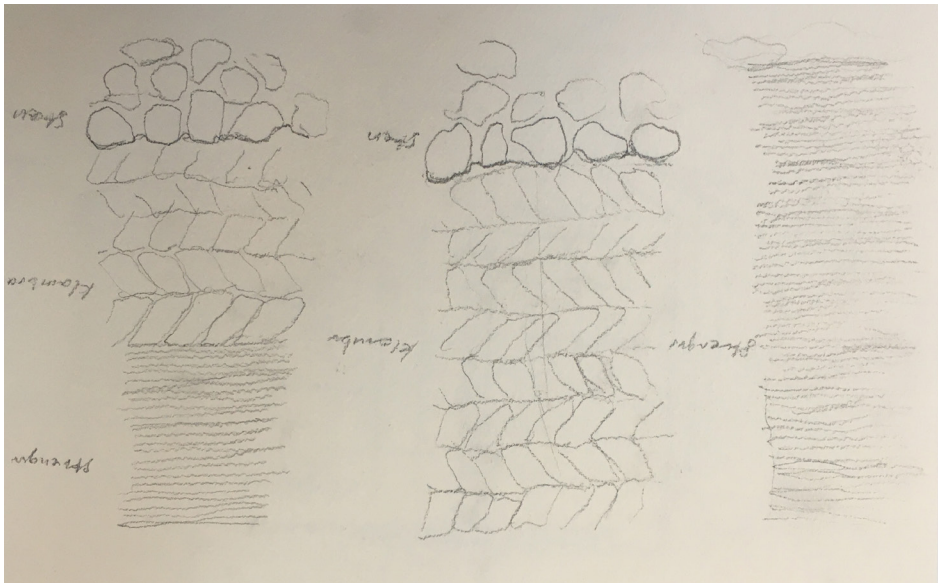

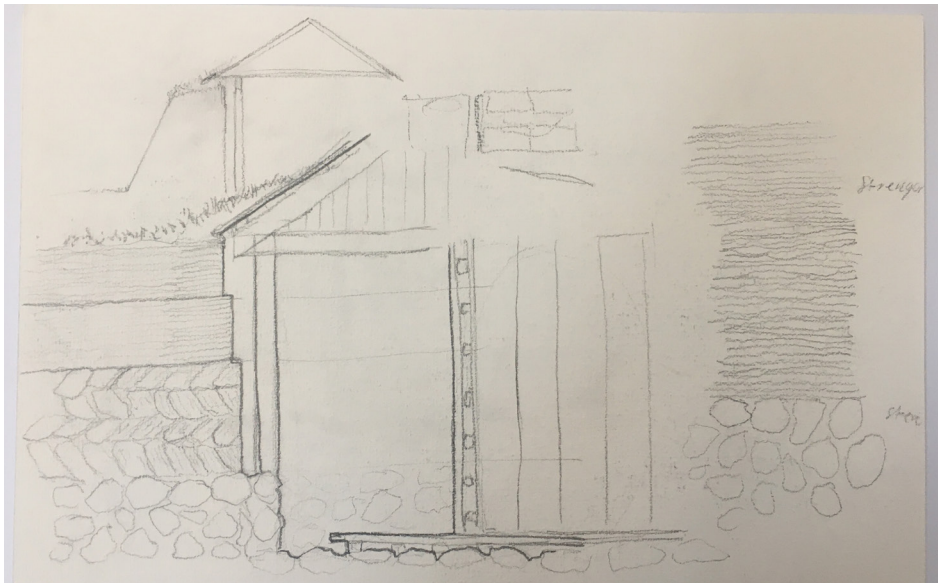

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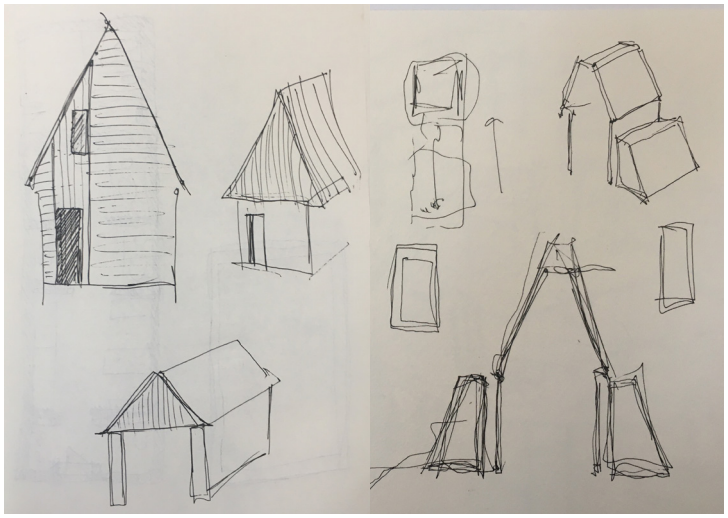
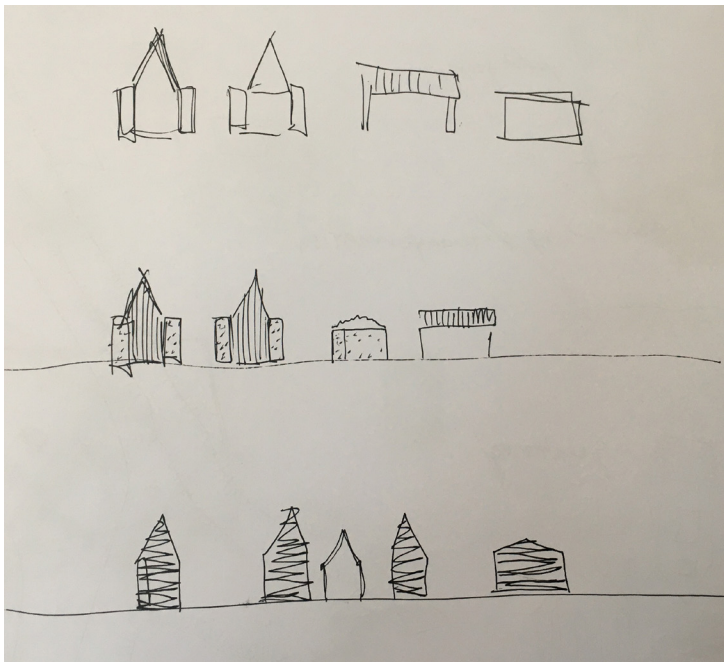
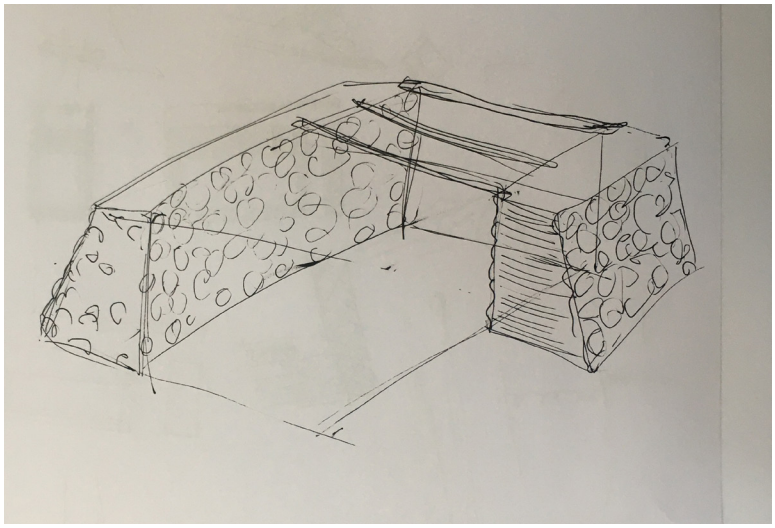
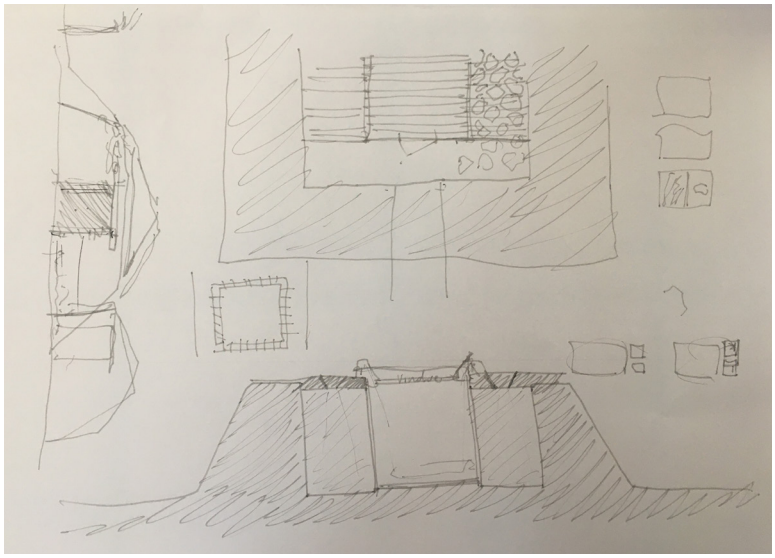
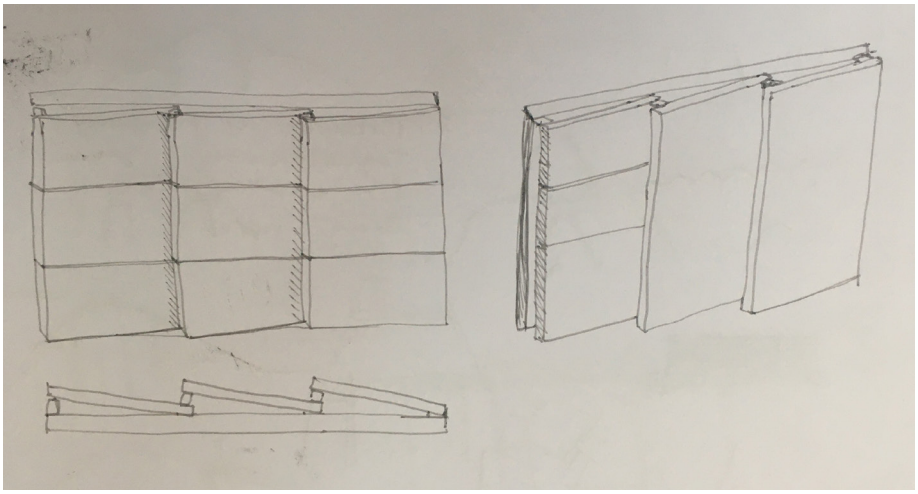
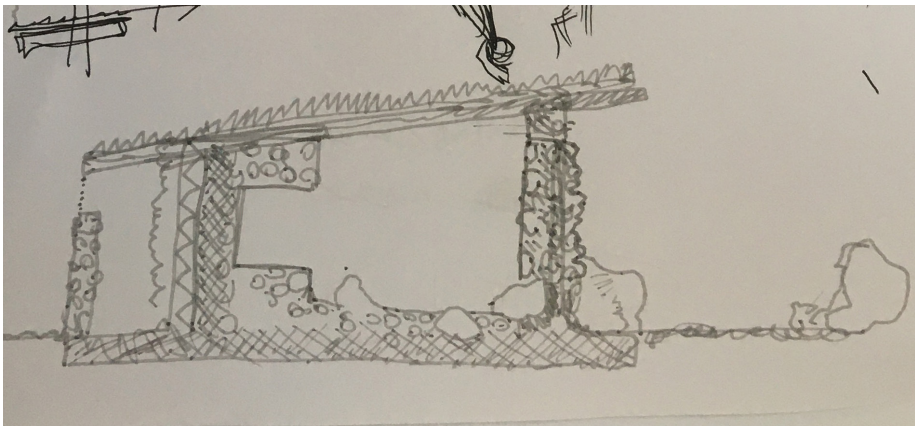




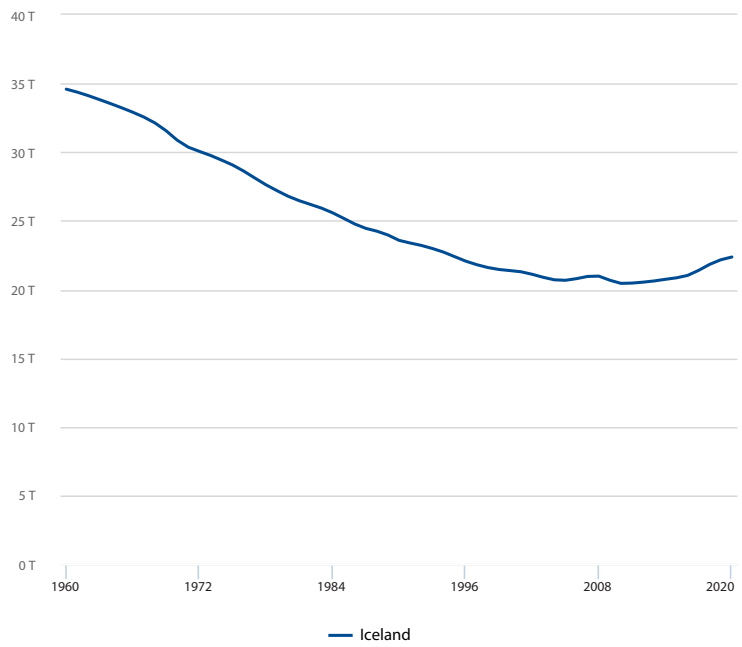






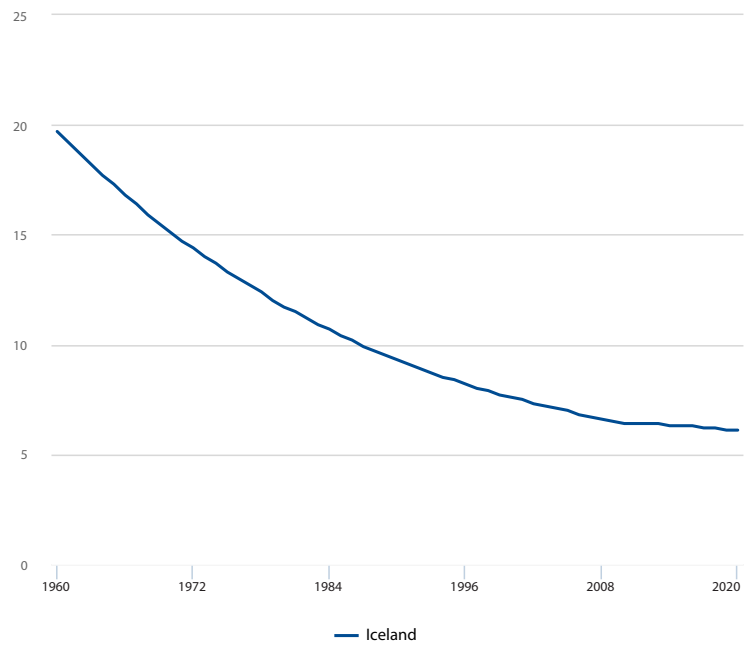


DIAGRAMMER



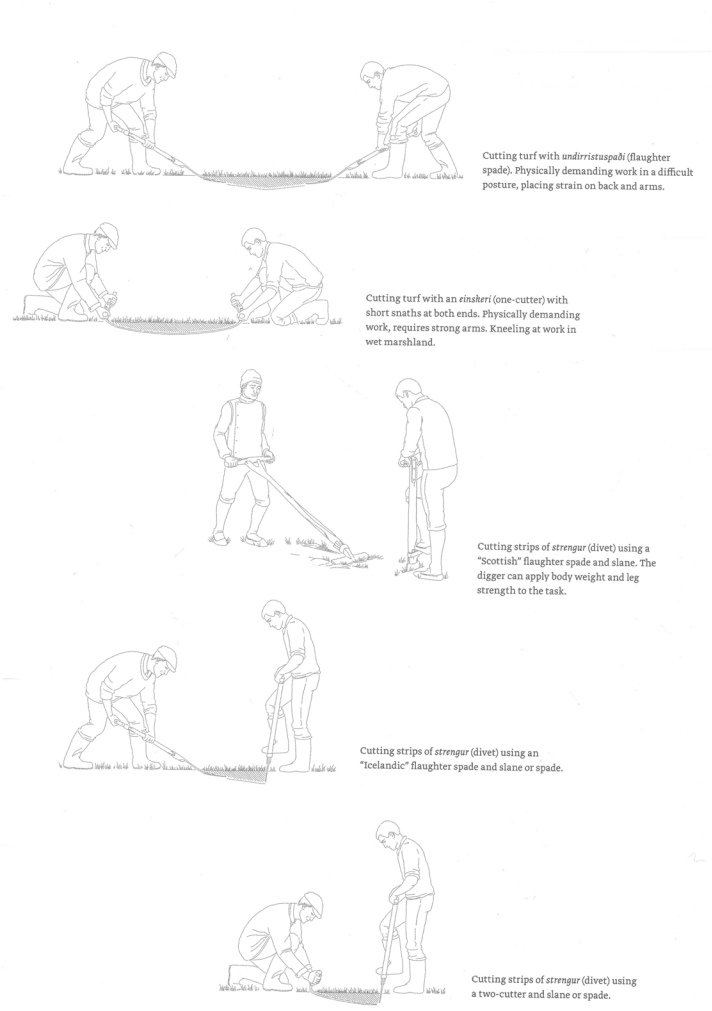
Source: World Development Indicators
Series : Rural population
Created on: 01/30/2022

DIAGRAMMER



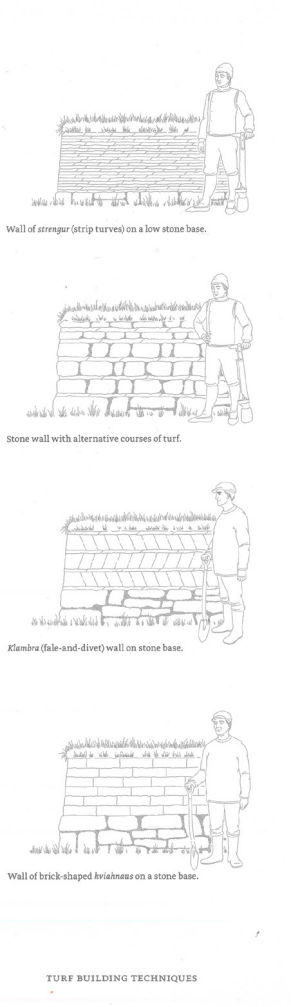
Source: World Development Indicators
Series : Rural population (% of total population)
Created on: 01/30/2022

DIAGRAMMER



Uskæring af tørv, Fra bogen *From Earth*

DIAGRAMMER



Wall of *strengur* (strip turves) on a low stone base.

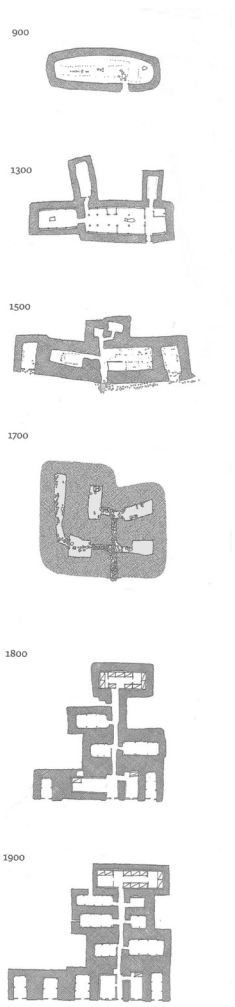
Stone wall with alternative courses of turf.

Klambra (fale-and-divet) wall on stone base.

Wall of brick-shaped *kviahnaus* on a stone base.

TURF BUILDING TECHNIQUES

Tørvevægge, Fra bogen *From Earth*

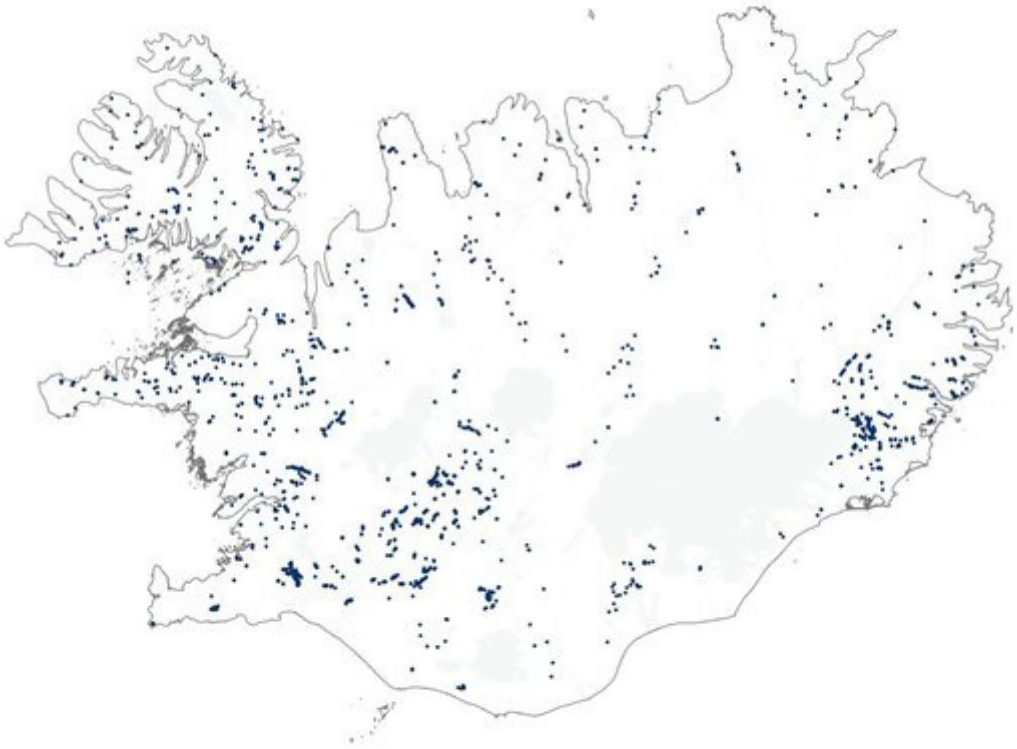


Tørvehus udviklingsdiagram, Fra bogen *From Earth*

Tegning af tørvegård, Fra bogen *From Earth*

technical specifications

Thermal conductivity	λ 0,034-0,038 W/m,K.
Heat transfer coefficient U	0,226 W/m2,K (Layer Thickness 15 cm)
Soundproofing	High sound absorption over a wide frequency range
Binder fibers	synthetic or derived from starch
Specific heat capacity c	1.6 – 2.1 kJ/kg,K.
Vapor diffusion resistance μ	1-2 (open to diffusion)
Moisture behavior	Absorbs and desorbs moisture
Dimensional stability	(EU-Norm 1604) Dimensional variance max. +/-1%
Resistance against fungal attack (DIN IEC 68-2-10)	No growth
Fire behaviour (EN 13501-1)	Category E



Oversigt over varme kilder (eget kort)

ubakus

Exterior wall

Exterior wall
created on 22.5.2022

Thermal protection

U = 0,03 W/(m²K)

GEG 2020 Bestand*: U<0,24 W/(m²K)

excellent insufficient

Moisture proofing

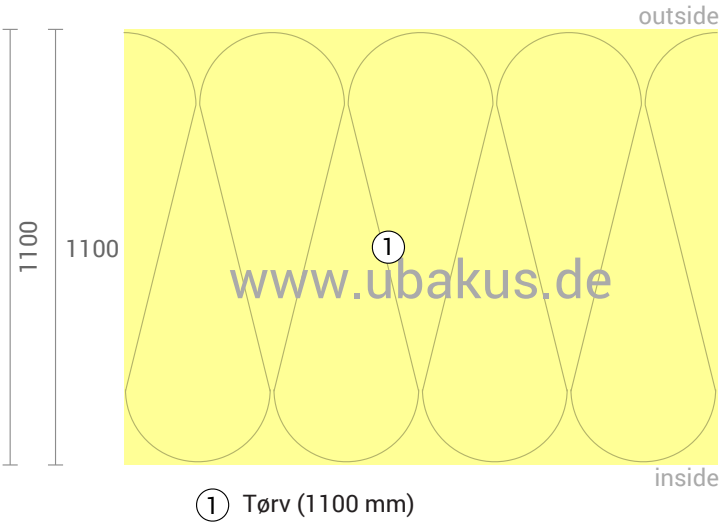
No condensate

excellent insufficient

Heat protection

Temperature amplitude damping:
phase shift: non relevant
Thermal capacity inside: 1559 kJ/m²K

excellent insufficient



WärmeschutzVO 95
EnEV Bestand niedrige Ti

① Tørv (1100 mm)

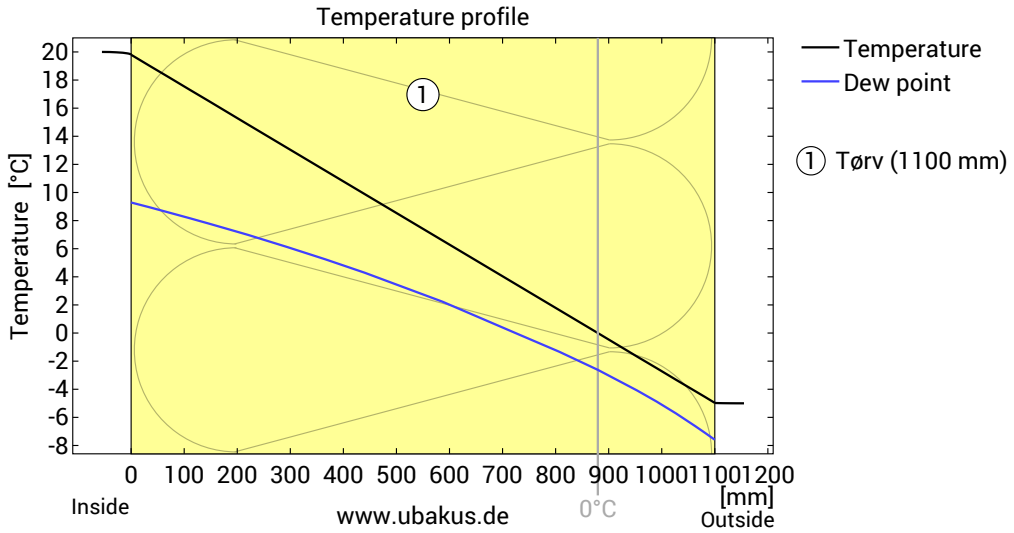
Impact of each layer and comparison to reference values

Inside air :	20,0°C / 50%			Thickness:	110,0 cm
Outside air:	-5,0°C / 80%		sd-value: 2,2 m	Weight:	1540 kg/m²
Surface temperature.:	19,8°C / -5,0°C			Heat capacity:	2926 kJ/m²K

*Vergleich mit dem Höchstwert gemäß GEG 2020 für erstmaligen Einbau, Ersatz oder Erneuerung von Außenwänden (Anlage 7, Zeile 1a,1b).

Exterior wall, U=0,03 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*		0,130	19,8	20,0	
1	110 cm	Tørv	0,036	30,556	-5,0	19,8	1.540,0
		Thermal contact resistance*		0,040	-5,0	-5,0	
	110 cm	Whole component		30,726			1.540,0

*Thermal contact resistances according to DIN 6946 for the U-value calculation. Rsi=0,25 and Rse=0,04 according to DIN 4108-3 were used for moisture proofing and temperature profile.

Surface temperature inside (min / average / max):	19,8°C	19,8°C	19,8°C
Surface temperature outside (min / average / max):	-5,0°C	-5,0°C	-5,0°C

Exterior wall, U=0,03 W/(m²K)

Moisture proofing

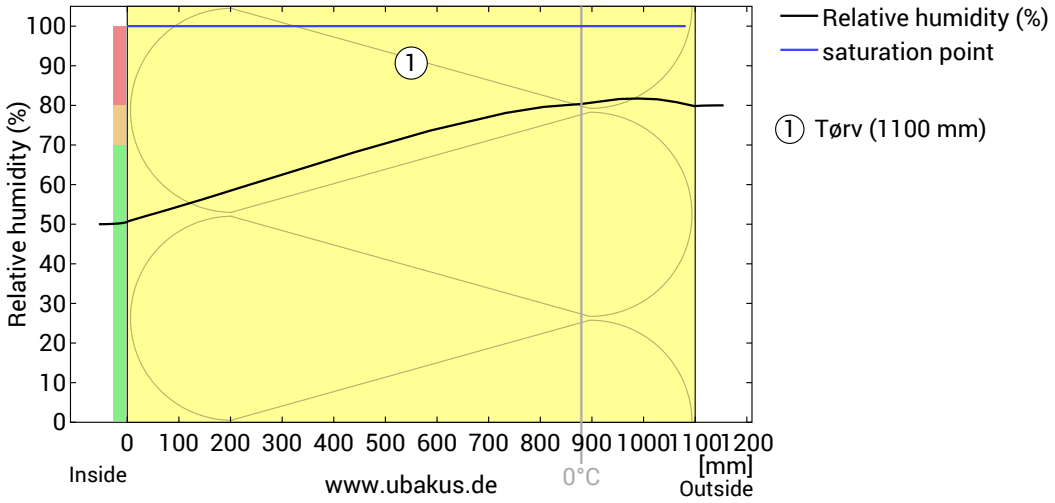
For the calculation of the amount of condensation water, the component was exposed to the following constant climate for 90 days: inside: 20°C und 50% Humidity; outside: -5°C und 80% Humidity. This climate complies with DIN 4108-3.

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

#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	110 cm	Tørv	2,20	-		1.540,0
	110 cm	Whole component	2,20			1.540,0

Humidity

The temperature of the inside surface is 19,8 °C leading to a relative humidity on the surface of 51%.Mould formation is not expected under these conditions.
The following figure shows the relative humidity inside the component.

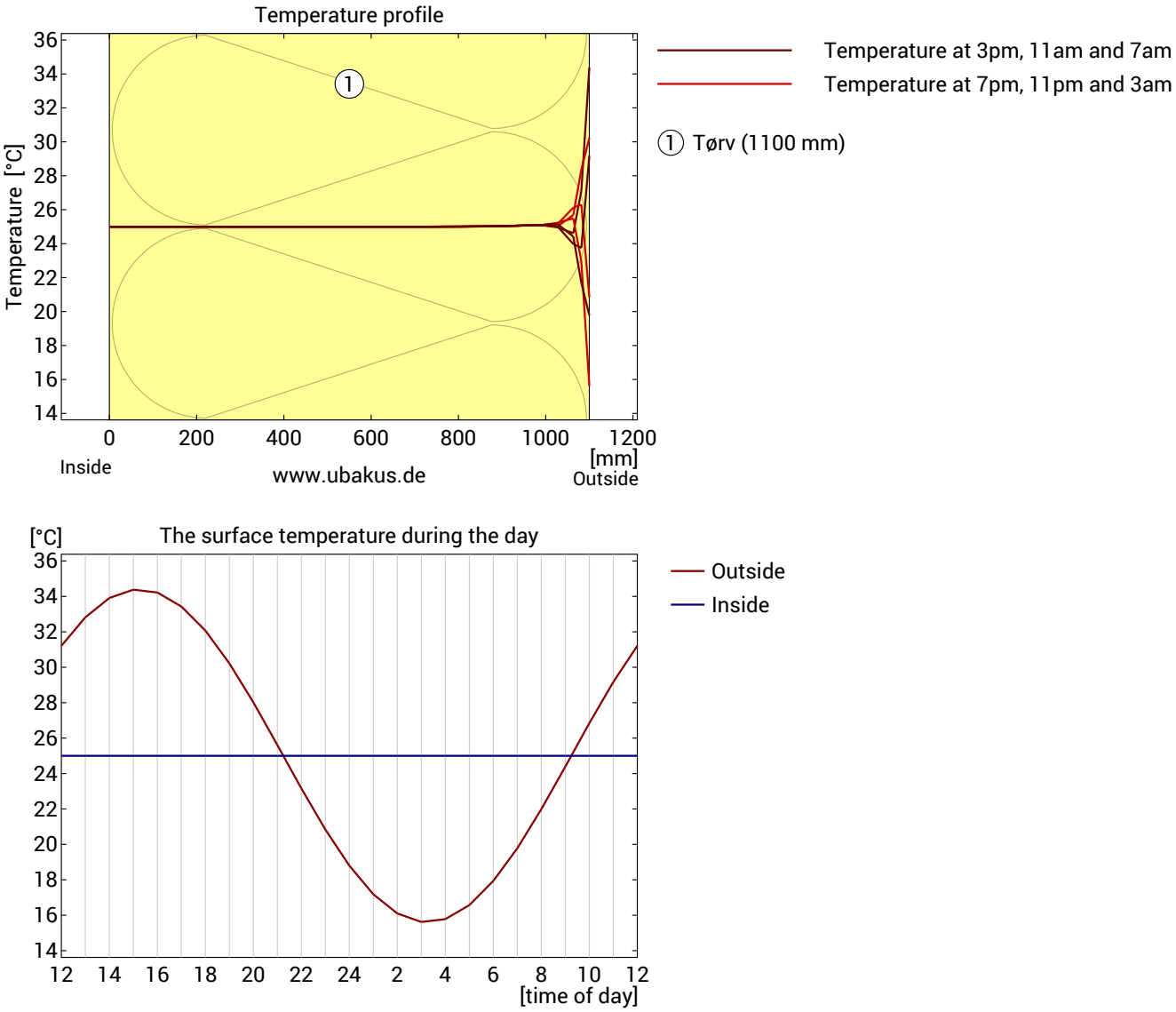


Notes: Calculation using the Ubakus 2D-FE method. Convection and the capillarity of the building materials were not considered. The drying time may take longer under unfavorable conditions (shading, damp / cool summers) than calculated here.

Exterior wall, U=0,03 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):	2926 kJ/m²K
Amplitude attenuation **	>100	Thermal capacity of inner layers:	1559 kJ/m²K
TAV ***	0,000		

* 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.

ubakus

All statements without guarantee

Exterior wall

Exterior wall
created on 22.5.2022

Thermal protection

U = 0,16 W/(m²K)

GEG 2020 Bestand*: U<0,24 W/(m²K)

excellent insufficient

Moisture proofing

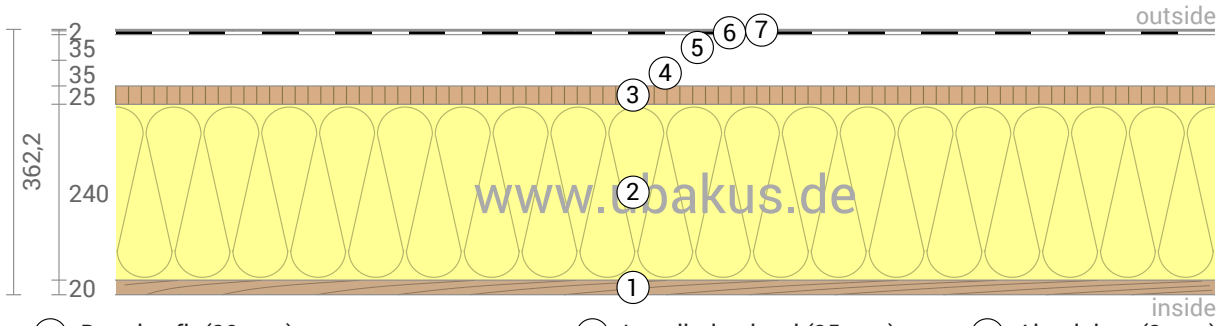
Dries 42 days
Condensate: 243 g/m²
Wood moisture: +1,0%

excellent insufficient

Heat protection

Temperature amplitude damping: >100
phase shift: non relevant
Thermal capacity inside: 64 kJ/m²K

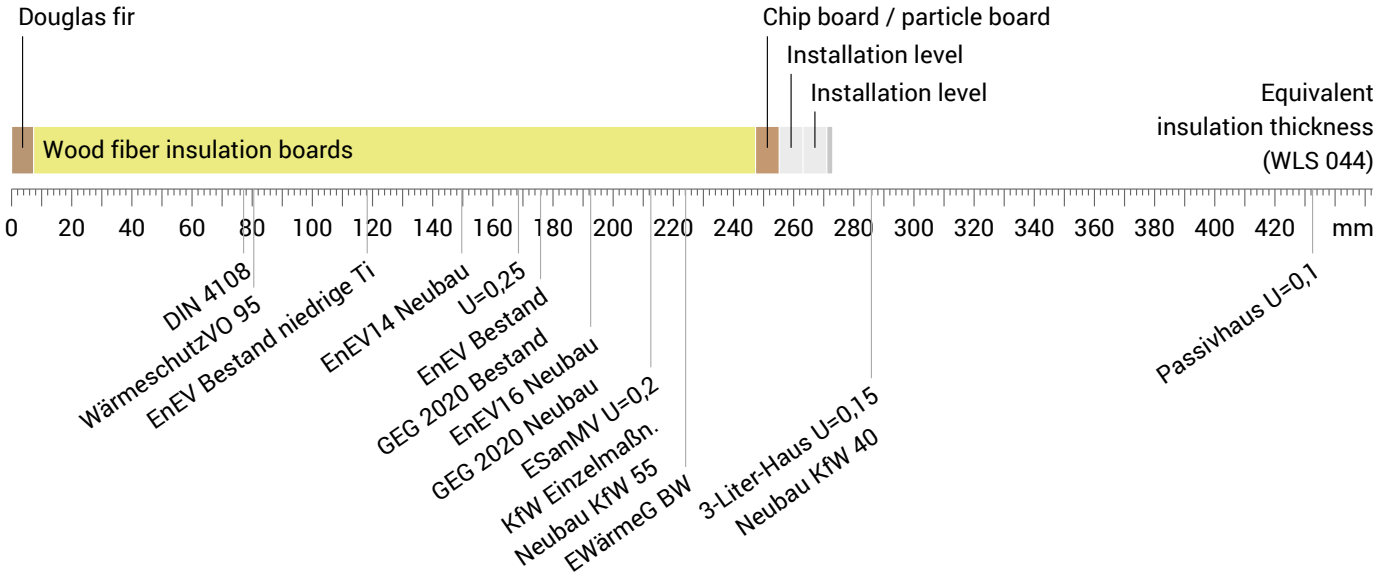
excellent insufficient



1. Douglas fir (20 mm)
2. Wood fiber insulation boards (240 mm)
3. Chip board / particle board (25 mm)
4. Installation level (35 mm)
5. Installation level (35 mm)
6. Vedaflor WS-X
7. Aluminium (2 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 0,044 W/mK.

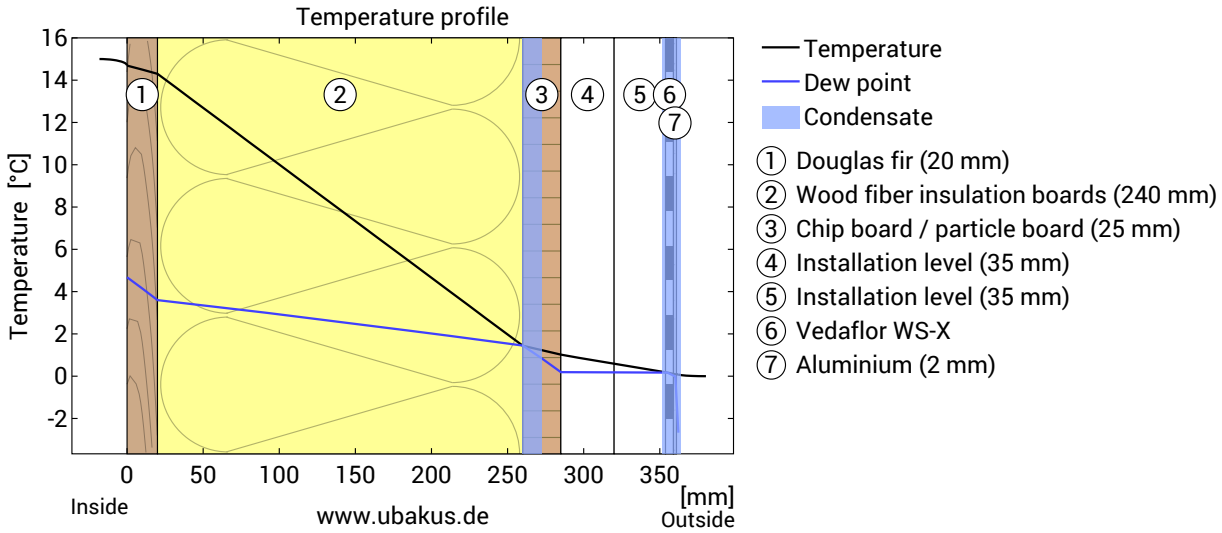


Inside air :	15,0°C / 50%		Thickness: 36,2 cm
Outside air:	0,0°C / 80%	sd-value: 1606,4 m	Weight: 76 kg/m²
Surface temperature.:	14,7°C / 0,1°C		Heat capacity: 137 kJ/m²K

*Vergleich mit dem Höchstwert gemäß GEG 2020 für erstmaligen Einbau, Ersatz oder Erneuerung von Außenwänden (Anlage 7, Zeile 1a,1b).

Exterior wall, U=0,16 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*		0,130	14,7	15,0	
1	2 cm	Douglas fir	0,120	0,167	14,3	14,7	10,6
2	24 cm	Wood fiber insulation boards	0,044	5,455	1,4	14,3	38,4
3	2,5 cm	Chip board / particle board	0,140	0,179	1,0	1,4	16,3
4	3,5 cm	Installation level	0,194	0,180	0,6	1,0	0,0
5	3,5 cm	Installation level	0,194	0,180	0,2	0,6	0,0
6	0,52 cm	Vedaflor WS-X	0,170	0,031	0,1	0,2	4,7
7	0,2 cm	Aluminium	160,000	0,000	0,1	0,1	5,6
		Thermal contact resistance*		0,040	0,0	0,1	
	36,22 cm	Whole component		6,360			75,6

*Assuming free circulating air at the inside surface.

Surface temperature inside (min / average / max):	14,7°C	14,7°C	14,7°C
Surface temperature outside (min / average / max):	0,1°C	0,1°C	0,1°C

Exterior wall, U=0,16 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: 15°C und 50% Humidity; outside: 0°C und 80% Humidity (Climate according to user input).

Under these conditions, a total of 0,24 kg of condensation water per square meter is accumulated.This quantity dries in summer in 42 days (Drying season according to DIN 4108-3:2018-10).

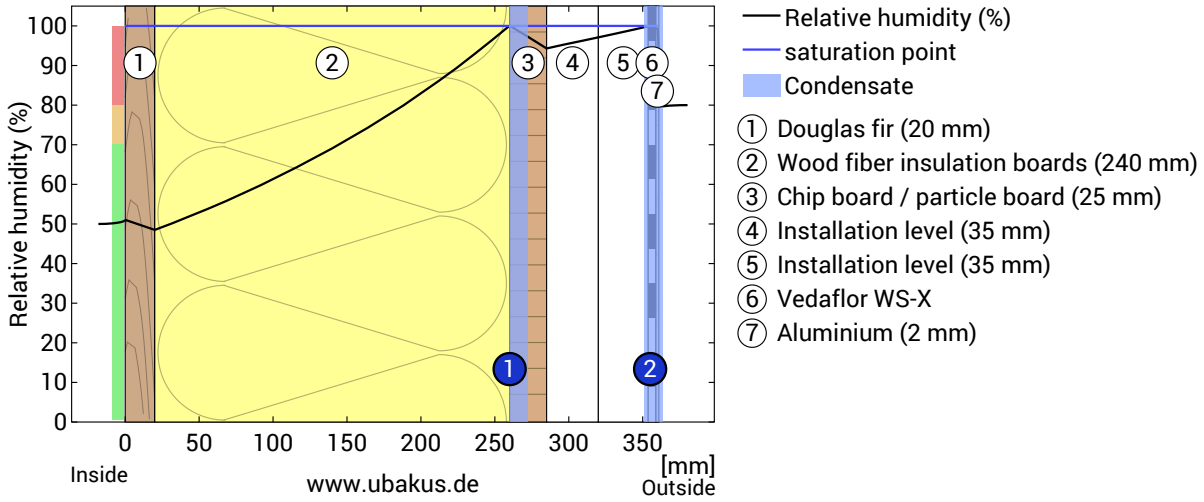
#		Material	sd-value [m]	Condensate [kg/m²]	[Gew.-%]	Weight [kg/m²]
1	2 cm	Douglas fir	0,40	-	-	10,6
2	24 cm	Wood fiber insulation boards	0,72	0,17		38,4
3	2,5 cm	Chip board / particle board	1,25	0,17	1,0	16,3
4	3,5 cm	Installation level	0,01	-		0,0
5	3,5 cm	Installation level	0,01	0,072		0,0
6	0,52 cm	Vedaflor WS-X	104,00	0,072		4,7
7	0,2 cm	Aluminium	1500	-		5,6
	36,22 cm	Whole component	1.606,40	0,24		75,6

Condensation areas

1. Condensate: 0,17 kg/m² Affected layers: Chip board / particle board, Wood fiber insulation boards
2. Condensate: 0,073 kg/m² Affected layers: Vedaflor WS-X, Installation level

Humidity

The temperature of the inside surface is 14,7 °C leading to a relative humidity on the surface of 51%.Mould formation is not expected under these conditions.
The following figure shows the relative humidity inside the component.

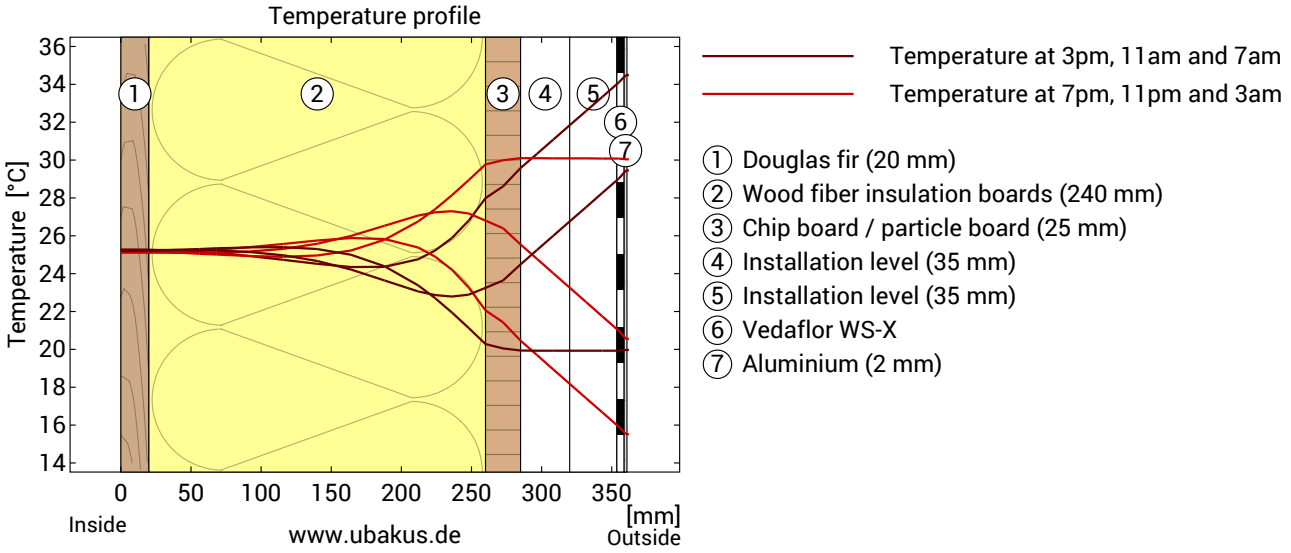


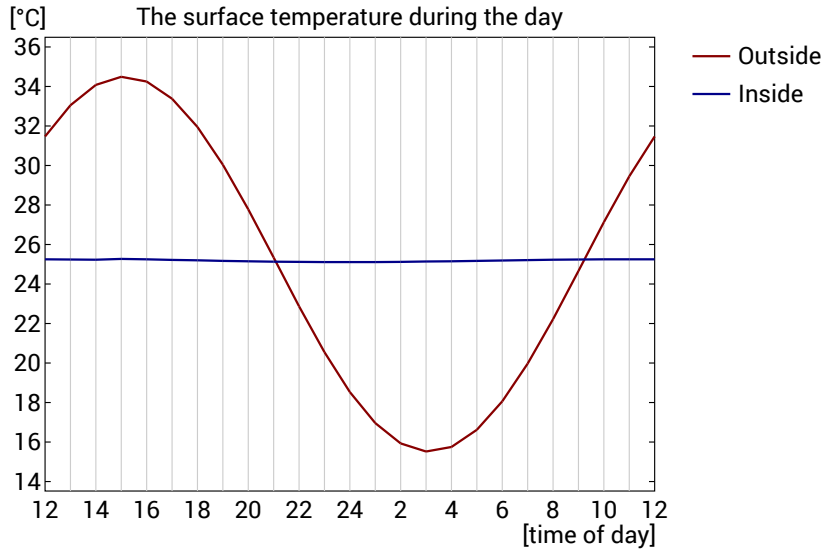
Notes: Calculation using the Ubakus 2D-FE method. Convection and the capillarity of the building materials were not considered. The drying time may take longer under unfavorable conditions (shading, damp / cool summers) than calculated here.

Exterior wall, U=0,16 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):	137 kJ/m²K
Amplitude attenuation **	>100	Thermal capacity of inner layers:	64 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.