EcoCocon

Passivhaus Manual

HOW TO PROJECT A PASSIVE HOUSE
FROM ECOCOCON STRAW PANELS

Version 0.5 - Februar 2014

(The manual is „work in progress" so check for a new version)

in cooperation with CREATERRA

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CONTENTS:

Introduction

Assembling sustainable and healthy buildings with EcoCocon straw panels is quick and easy. EcoCocon panels have a very low inbuilt (grey) primary energy and are a truly a cradle to cradle optimized product. The well insulated panels also save energy spent on heating and cooling during the entire lifetime of the building. Resulting lower CO_2 emissions do have a beneficial impact on global warming.

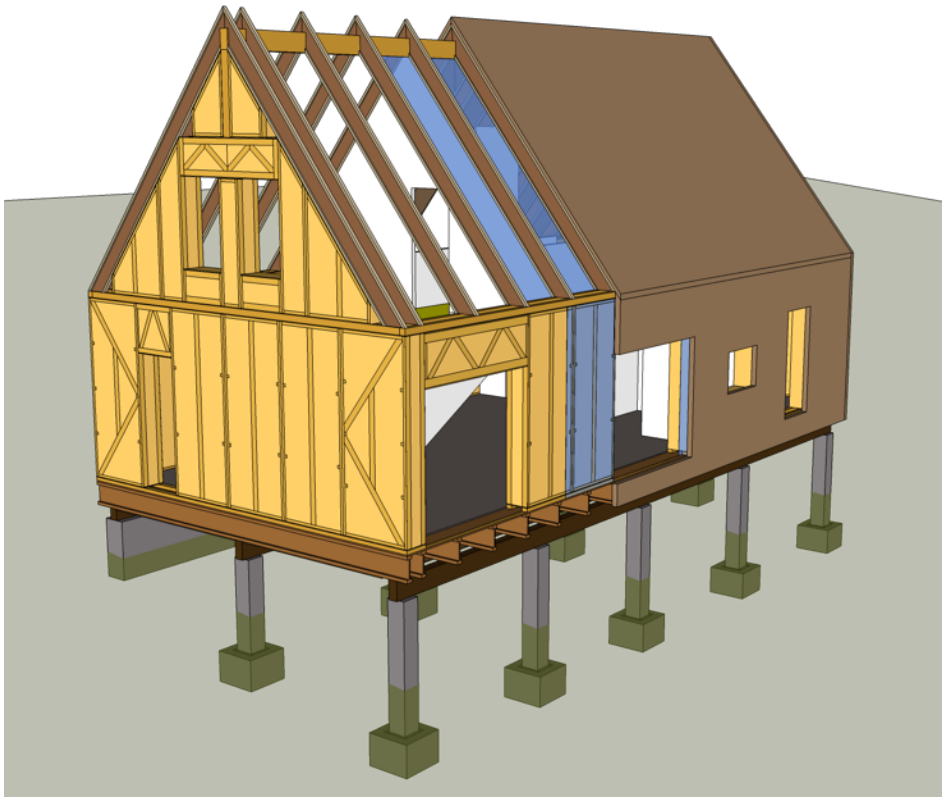
We think the EcoCocon panels are an ideal element if you want to achieve the passivhaus standard. We have developed details and calculated thermal bridges, ready for you to use. How to achieve an airtight building envelope is part of the overall concept. This manual should help you to get started on your passivhaus project.

Disclaimer: This is in no way a passivhaus course, just a tool. We advice you strongly to visit a passivhouse course organized by your local passivhaus organisation.

Example Project

In this manual we will present an example passivhaus project with some of the crucial details and calculations you need to do your own project.

3d model



The PH Concept:

[Simplyfied 3d model with different functional layers visible]

Rule 1: Continuous Super-Insulation

A passivhaus needs to have a continuous super insulated envelope. The thermal insulation is here shown in yellow (EcoCocon straw panels for walls, blown in cellulose in the roof, XPS for foundations) and orange (woodfibre boards). Standard U-value for the wall of 0,113 W/m²K is achieved. Uninterrupted insulation in connections, corners and to the foundation are possible.

Rule 2: Continuous Airtight Layer

The red dotted line is the airtight layer (membrane with an sd value <0,2 and taped connections). Notice that the airtight layer for the walls is placed between the straw panels and woodfibre boards. Everywhere else the airtight membrane (sd>2,3) is on the inside. We will show later under what conditions it is possible to place the airtight layer on the outside of the straw.

Rule 3: Eliminating Heat Bridges

Some details of the construction are especially important. These are marked with D1 to D6. Each of these details is discussed separately in the details section. Variations of these details are possible and enable different solutions. New thermal bridge calculations and details will in future be available for download on the website.

Rule 4: Correct Solar Orientation

A passivhaus needs passive solar gains. Your project needs to have most of your glazing area (usually 60% or more) on the south side, with not more than 30° deviation from south. This ensures also that you will pleasantly experience the sun deep into your house in winter months. If this is not achievable (shading on the site, view to the north etc.), you should still apply all the other rules.

Rule 5: Excellent Windows and Shading

Use if possible certified passivhaus windows (See: www.passiv.de/komponentendatenbank) Good passivhaus windows have a slim frame to accomodate more glazing, glazings with a high g-value (solar gains up to 62%) and highly efficient distances holders of the glass. It is recommended to use shading devices on these windows to ensure high summer comfort.

Rule 6: Include Mechanical Ventilation

In a comfortable house fresh air needs to be provided in a controlled manner. Ventilation units with heat recovery achieving an air exchange of 30% of the interior volume per hour also keep the humidity in the house balanced. Use an entalpy (humidity) heat exchanger in cold climates. Always use certified ventilation units with heat recovery above 75% efficiency.

EcoCocon Specifics:

Airtightness on the Outside of Straw Panels

Usually, the airtight layer should always be on the inside. This is also our recommendation, except for the EcoCocon walls. Because we want to plaster the straw directly with clay, we know that achieving airtightness inside is very difficult. Not because of the clay plaster, but all small gaps around light switches, sockets, wooden beams and more…

Leakage of air through a gap can lead to condensation in the construction. Through an opening 1mm wide and 1m long as much as 360g of humidity might pass in 24h. No construction is able to deal with this large amount, even if it is vapour diffusion open on the outside. If we want any house to last, it is necessary to achieve an airtight solution.

We have verified a solution that is airtight but completely open to vapour. The membrane used needs to have a sd-value of <0,2m, and will let moisture pass from inside to outside without slowing it down. This moisture transfer is only about 2g per square meter of construction per day, a lot lower than if you would have movement of air passing trough. The wood fibre board on the outside is necessary, because it effectively moves the moisture away from the membrane to the outside. Natural materials such as wood fibre or cellulose do transport moisture very well, always from warmer to colder side.

The membrane also protects the panels from driving rain during the building period. The membrane should be applied to the top and outside of the panels as soon as the walls are put up.

Requirements for Use:

- Membrane must have a sd-value < 0,2m.
- Membrane must be taped airtight at all overlaps and connections to other surfaces.
- A blower door test must achieve a result below 0,6 1/h @50p.
- The membrane must be covered on the outside by a wood fibre board at least 60mm thick.
- A ventilation unit should be installed to keep moisture levels in the house below 50 rel. humidity.

Construction Details With Thermal Bridge Calculation

Several details have been designed and thermal bridges calculated. You can use the resulting psi-values for your passivhaus calculation.

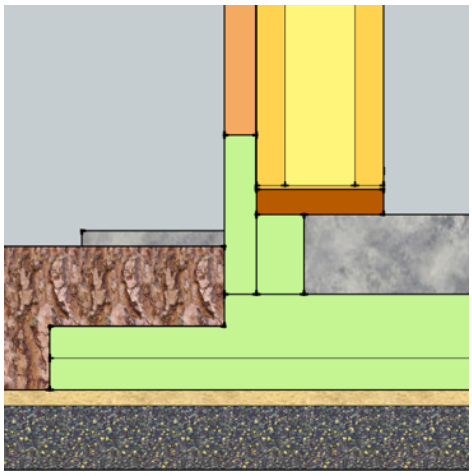
All details do also have an the airtight layer indicated. It is important that the layer is continuous and all connections taped. If tape is used on concrete, a primer should be used to impregnate the surface first.

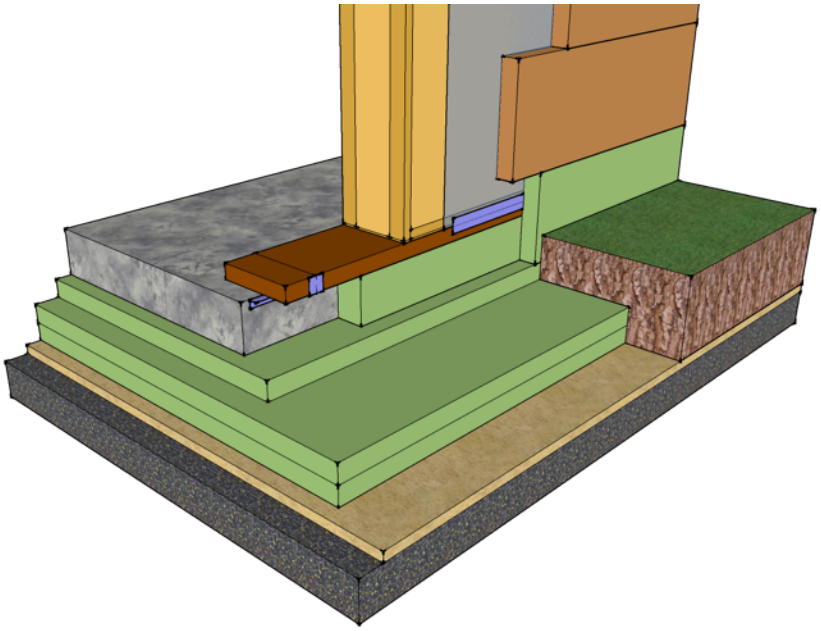
All details are calculated with a 100mm wood fibre board (standard):

- Outside corner (wall to wall)
- Inside corner (wall to wall)
- Perimeter (wall to foundation – variations: on slab (2 versions), in air (length and cross))
- Eaves (wall to roof – variation: rafter extension and roof with no extension, flat roof)

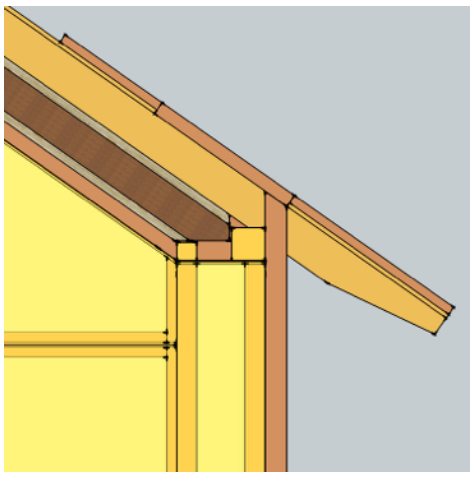
- Gable (wall to roof – variation: rafter extension and roof with no extension)
- Top of roof
- Ceiling (ceiling to wall – variation: hanged and lying on top

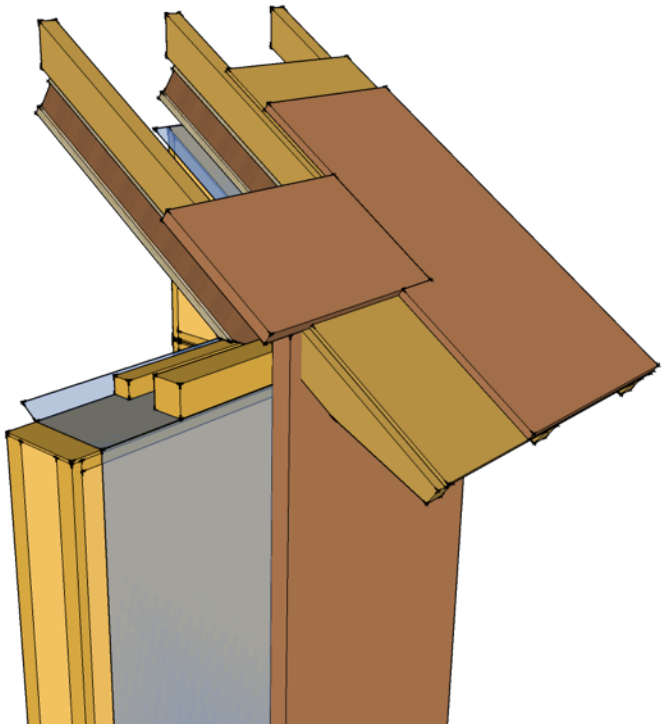
Foundation on XPS
Psi= -0,056 W/mK



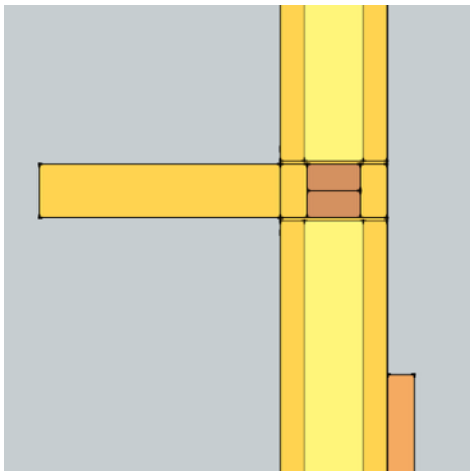


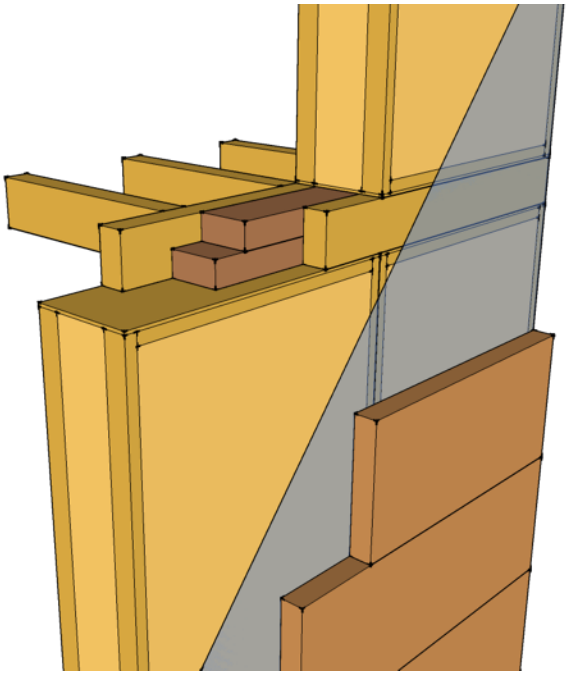
Eave
Psi= -0,034 W/mK



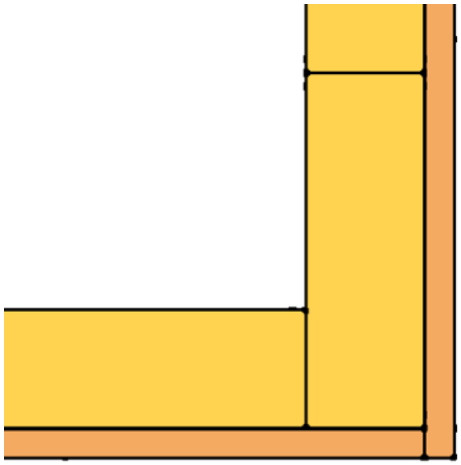


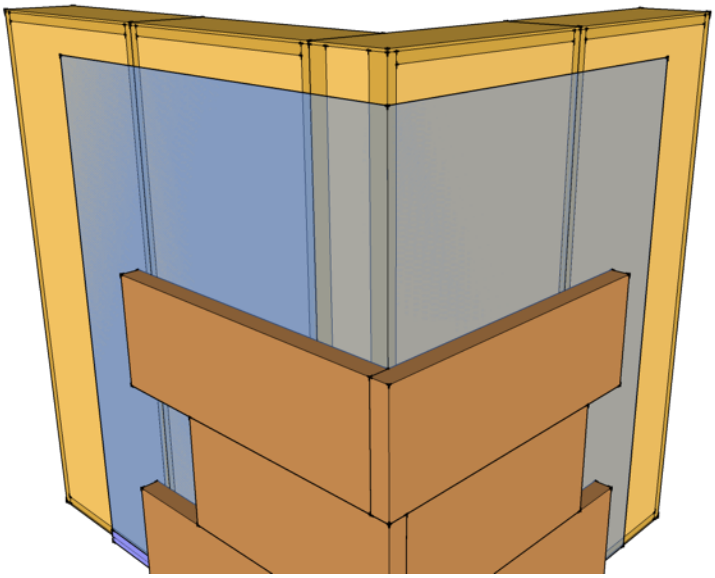
Ceiling
Psi= 0,002 W/mK





Wall outside corner
Psi= -0,074 W/mK





Basic EcoCocon Elements

EcoCocon panels are modular. We can adapt our panels to your dimensions. We recommend, however, if you start a new project, to use as many standard elements (3000×1200×400mm) as possible and keep the dimensions to 100mm segments. (within steps of 100mm).

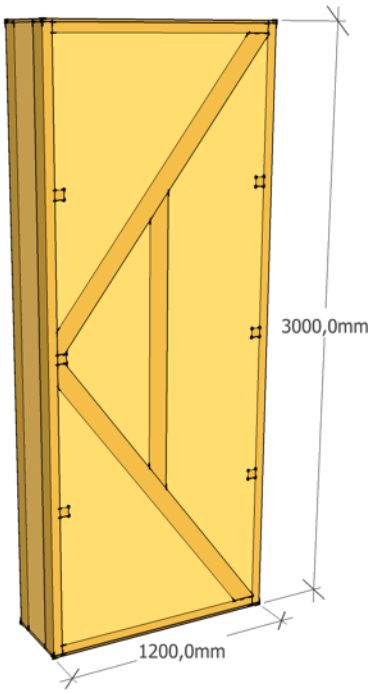
There are some limits as well:

- All EcoCocon panels (without wood fibre board) are always 400mm thick
- The minimal width and height are 400mm
- The maximum width and height is 3000mm
- The max angle of the top is max. 45°

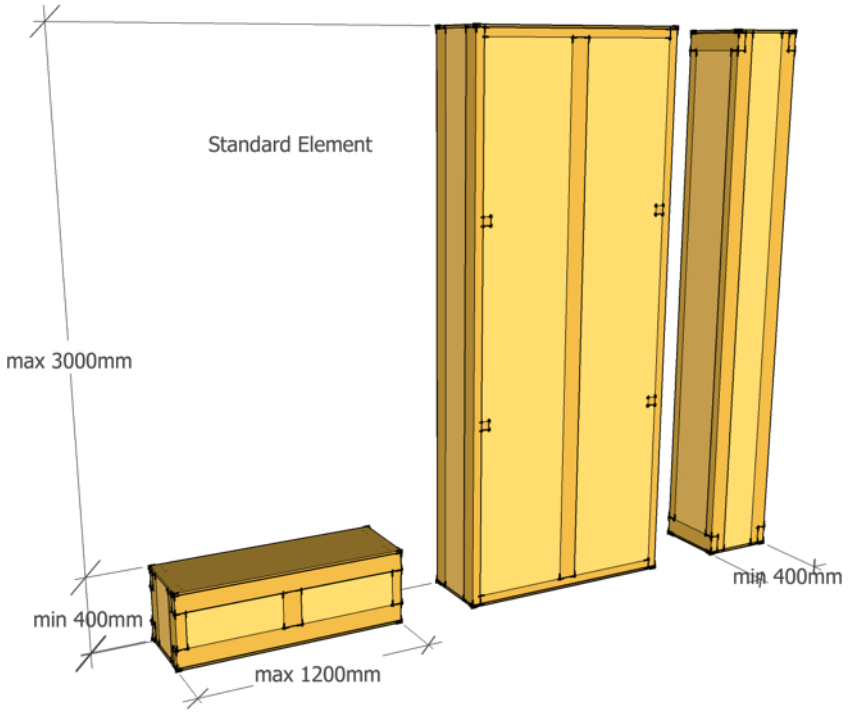
Five different types of panels are produced:

- Standard panels (1200×3000mm, possible width 400–1200mm and height 400–3000mm)
- Standard corner panel (1200×3000)
- Lintels (height 400–1200mm, width 400–3000mm)
- Sills (height 400–1200mm, width 400–3000mm)
- Sloped elements (width 400–1200mm and max. height 400–3000mm, angle max. 45°)

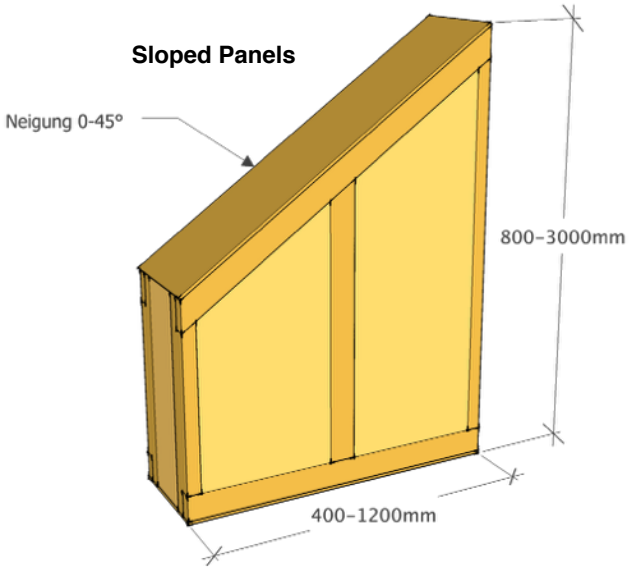
Reinforced Panels



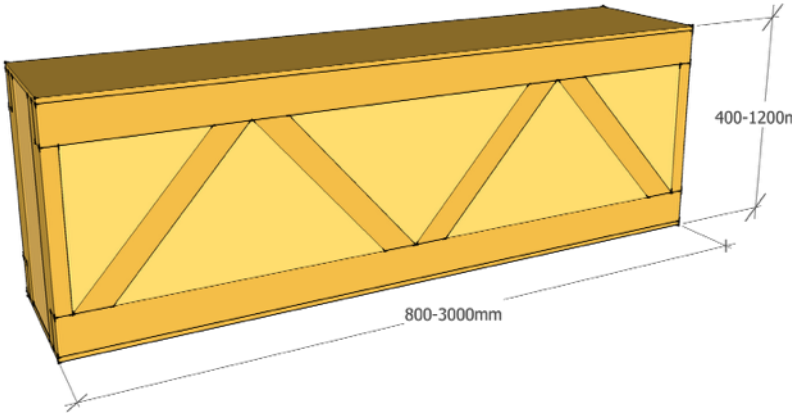
Panel Size



Sloped Panels



Lintels Panels



Project

Preparing for Calculation

To be able to calculate and prepare materials for delivery, we need from you the following information:

- Project name
- Plan of the building
- List of panels (including height, width and type description)
- List of Steico joist elements (verified by a structural engineer)
- Surface (wall and roof) covered with wood fibre board
- Building site adress (for transport costs)
- Invoice adress and VAT number
- Please add name and contact of the architect and builder

How We Calculate Billed Wall Surface:

We include also openings in the wall, except if there is a gap in the wall from top to bottom. The calculated extra surface compensates for the more complex elements.

If sloped elements are used, the circumscribed rectangular size is calculated.

Tools to Use

We recommend to prepare drawings with Sketchup, a free software that can be downloaded here: http://www.sketchup.com You can download sample files from our website with elements that can be used for modeling your house. Most houses can be assembled virtually in Sketchup in a few hours and the 3d model is good for verifying that everything fits together the way you'd expect.

If you do not have the capability or time to do it yourself, we can help create the necessary model based upon your architectural drawings for a standard fee. Please ask for an offer.

Contact for Verifying Your Plans

Please send your files to: projects@ecococon.lt

Ventilation Planning

In a Passivhaus you need ventilation. We recommend to use a local planner to design the ventilation system with a medium air exchange of 0,3 h^{-1} (30% of the inside volume per hour).

If you need openings in the straw panel for ventilation ducts, we are able to preproduce openings in the panel based upon your drawings. Please remember to insulate all ducts with airtight insulation (Armaflex) to ensure there is no condensation on the surface.

Chimney and Other Special Requirements

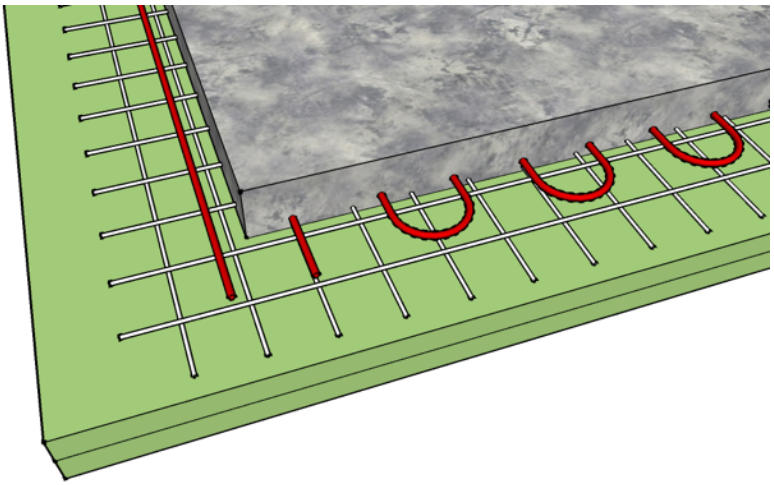
If you need o cross the wall with a stainless steel chimney, we advice to leave at least 30cm space on all sides so that this gap can be insulated with non combustible mineral insulation. A hot chimney duct must never heat the straw, excessive heat might lead to self-ignition of the straw.

Heating/Cooling Planning

If you want to use floor heating, it is possible to include it in the loadbearing floor slab, if this is insulated from below. The heating register should be placed in the bottom of the slab, so that screws for fixing walls in the concrete slab cannot penetrate the tubes.

In a house built according to EcoCocon advice, the heat load will be somewhere between 12 and 18W/m². 18W/m² for a small building, 12W/m² or less for bigger or more compact buildings. The heating can be dimensioned accordingly. We recommend to do a complete PHPP calculation to ensure exact dimensioning of the heating system.

Slab with heating tubes



Building

Preparation

The foundation and/or slab has to be prepared before delivery, including all installations. We recommend to do all earth moving works in advance and provide a corse gravel surface to all areas that will later be covered by a hard surface.

Be sure to install the airtight membrane at the right time of the building process. Check the details and verify the steps necessary to take in adavance.

The elements need to be placed on a level surface. There should be no more than 1mm difference in height for every 1m length.

If a wooden slab is constructed with an airgap below, the same level has to apply. The airgap has to be well ventilated, otherwise condensation from dew might create mold on the surface.

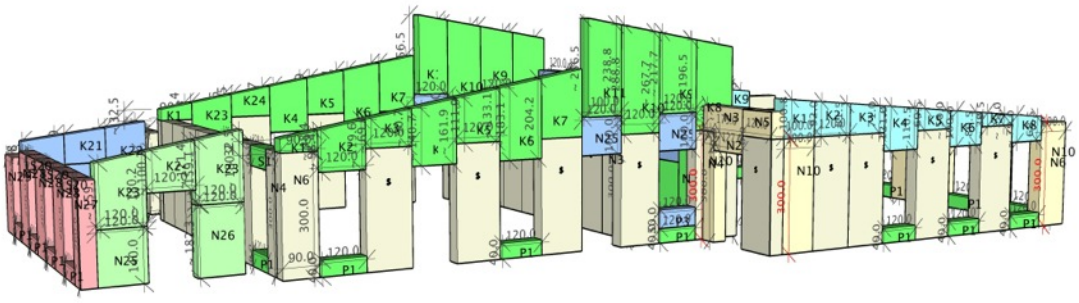
Delivery and Unloading

The panels are brought by lorry directly to the building site. The largest standard panels weigh 180kg, and need at least 4 persons to unload or a forklift. The panels have to be unloaded to the side of the lorry.

All panels are marked with number and a separate color for each of the four sides of the house (or see plan), which makes it easy to place the panels close to where they will be assembled.

Heavier elements can be moved on the slab by two persons on a metal roll or by moving it side to side over a corner.

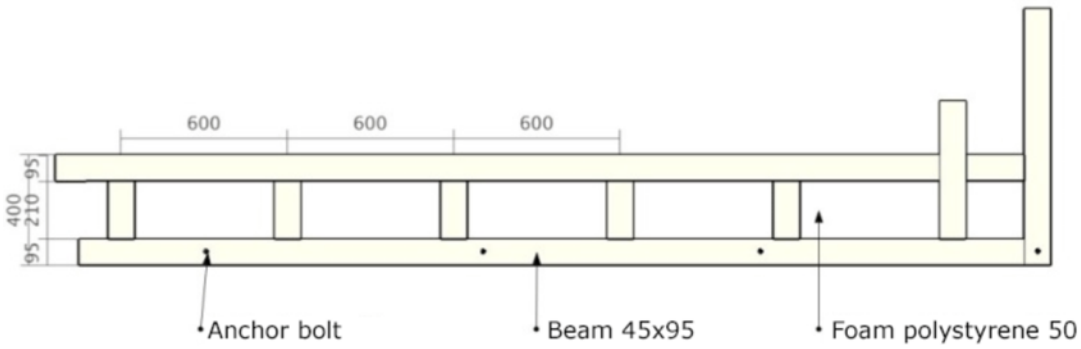
The panels should always be stored in a vertical position because of rain. Do ensure the panels are secured against tipping over.



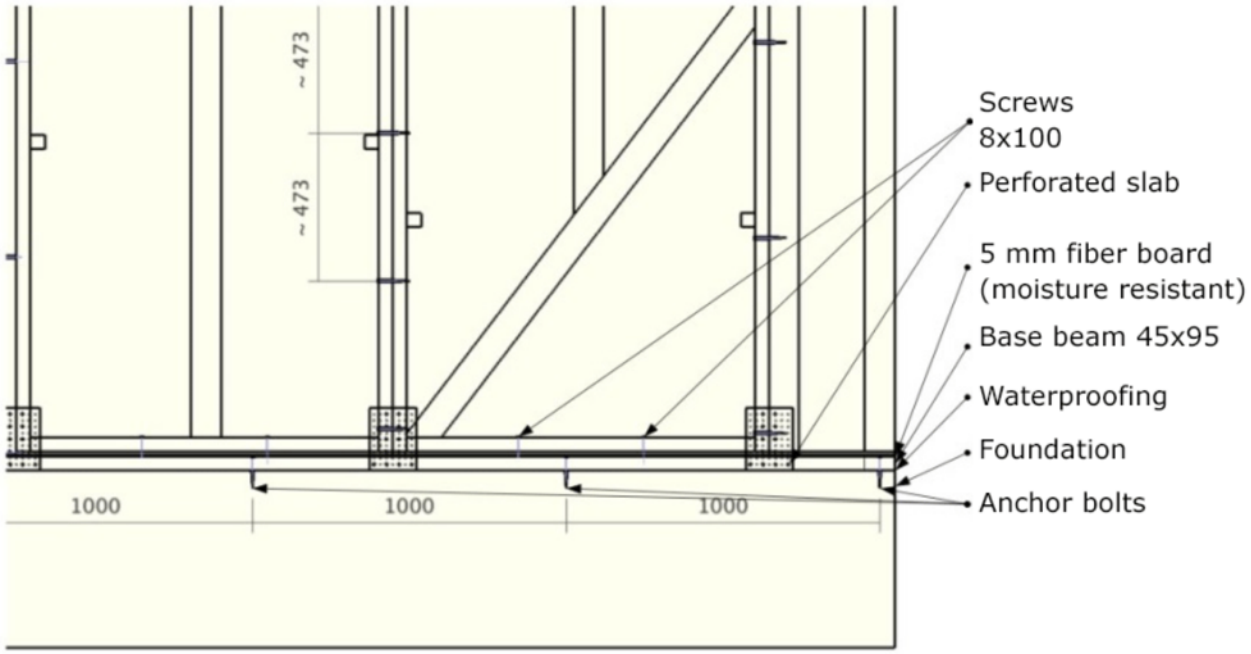
Example of a element plan

Assembly

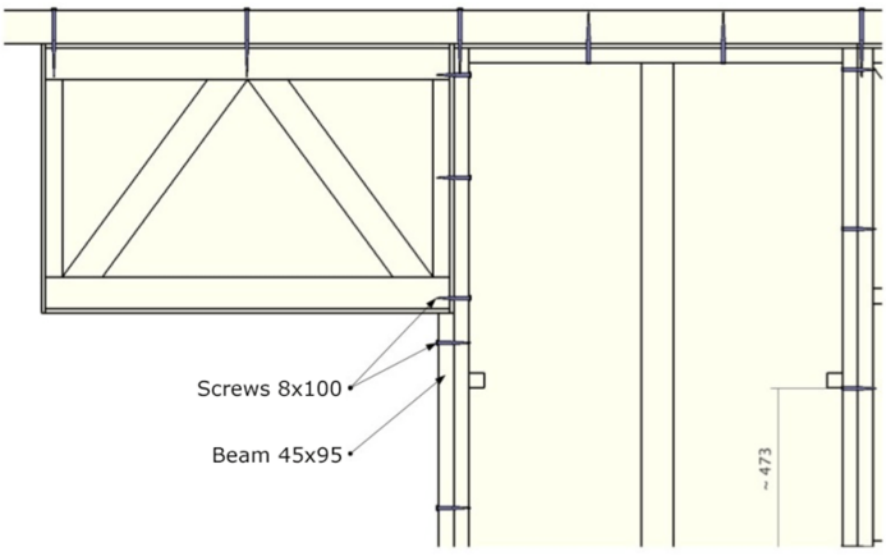
Panel base



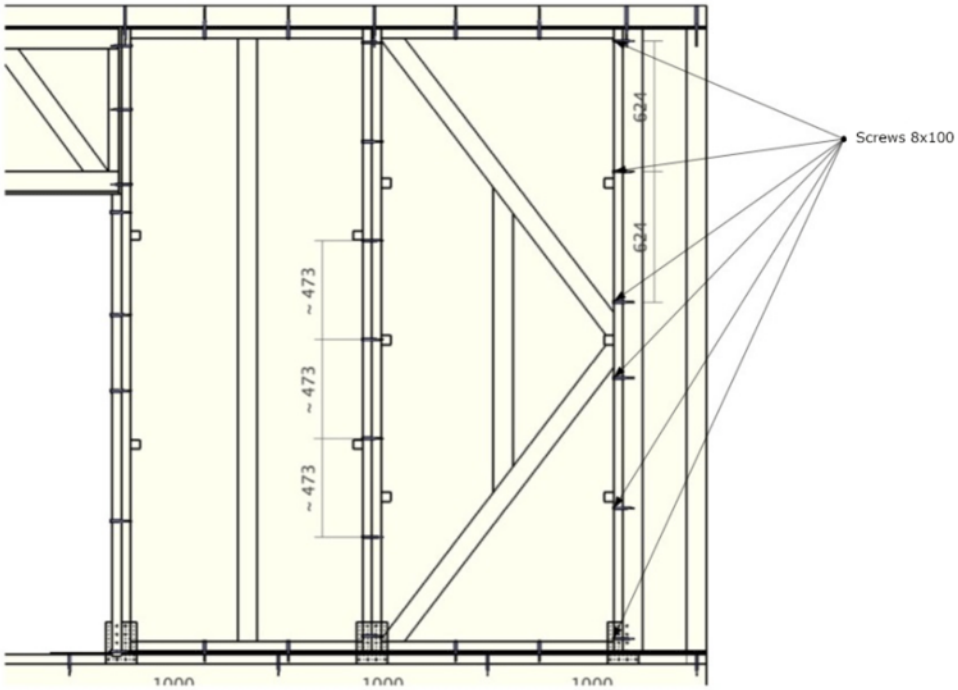
Attachment to foundation



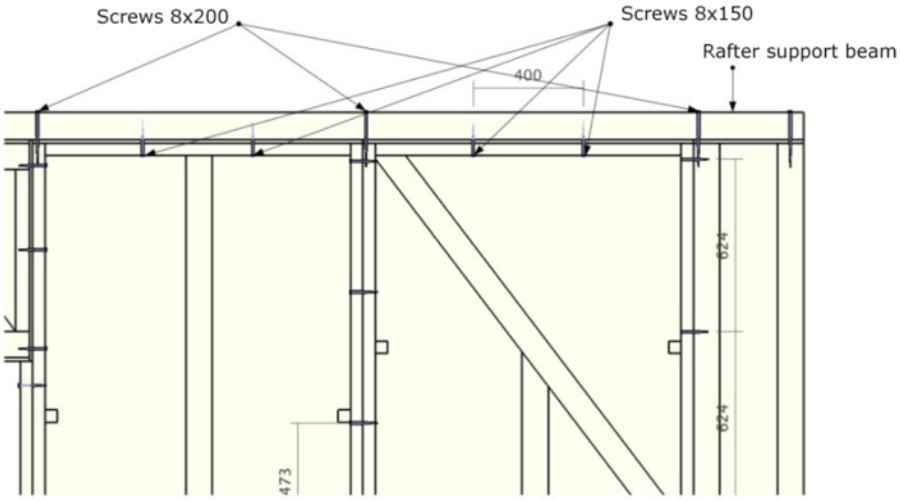
Mounting the lintel



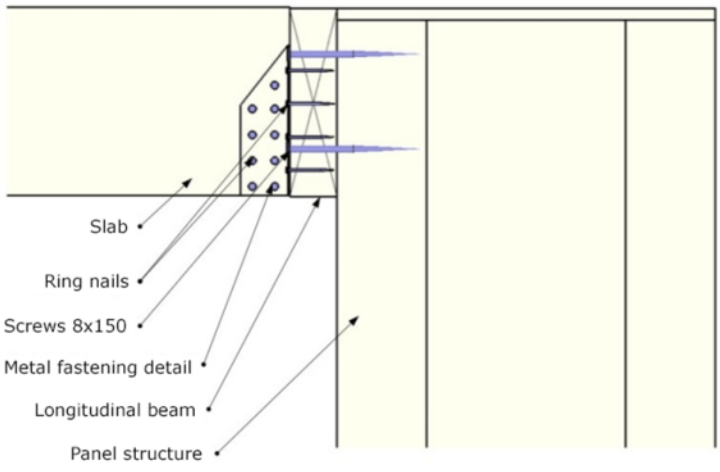
Eckverbindung



Ring beam



Floor connection



Assembly

Assemble the wall elements according to drawings. The elements are very precise (1–2mm tolerance), but you need to ensure the elements have no gap between themselves, otherwise the last panel will not fit. It is possible you will need to use a special jack to pull the elements together before screwing. The straw between the panels tend to keep the elements apart.

We advice to fix the panels together at the bottom first, then work yourself upwards from the ring beam.

Use the type and amount of screws as specified in the general drawings or follow the specifications of the structural engineer.

Install the sill before installing the lintel. Fix smooth pieces of wood at the exact height to the side panels and slide the lintel into place. Then fix the lintel with screws to the panels on its sides. If specified by the structural engineer, reinforce the load bearing column with another tight fitting board.

Wrap the built wall with the airtight membrane. Take care to cover the top of the panels in one go, so that the membrane sticks to the inside. Fix the membrane with thin strips of plywood to the vertical wooden construction. The plywood should be 90mm wide and 8–10mm thick, the surface level with the surface of the straw. Fix the plywood with staples. If you need to remove the staples for some reason in the future, you have to tape the punctured holes, otherwise the membrane doesn't remain airtight. The same applies for screws penetrating the membrane.Mit der Luftdichtigkeits-Schicht auf der Außenseite lässt sich problemlos Passivhaus-Standard erzielen.

The membrane also protects the panels from driving rain. Be sure to achieve an airtight connection to the foundation.

Window Installation

The installation of windows is critical to achieve good airtighness. Cut the membrane diagonally from one corner to the other and bend the membrane inside. Tape the corners. The membrane or tape should go 5cm further to the interior than the window.

The window installer should use air and **diffusion closed** tape to ensure airtightness between the frame and membrane. This has to be ensured with great care also in the corners. Any air leakage can produce damage by moisture over time.

We advice to use wool as insulation in the gaps between window frames and panels. On the outside the gaps should be covered with a **diffusion open** tape (to let excess moisture dissipate to the outside).

If possible, cover the window frames with as much as possible of the wood fibre boards. This improves the installation.

Connections of Ceilings and Roofs

A top ring beam is usually fixed to the panels. Be sure the airtight layer goes below the ring beam, if a roof is mounted on top. If the ring beam is used for a ceiling, uncover the top and let the membrane continue straight up to the next floor.

Installations

Electrical installations can be made directly on the straw. Fix the cables with short pieces of bendable wire to the straw. Fix the electrical boxes directly in the straw with a piece of wood. Wherever some sturdier construction is needed, fix a strong piece of plywood from one wooden element to the next.

Finishes

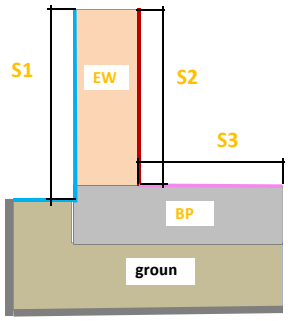
Before plastering attach thin wood fibre boards and mesh to the wooden elements. This ensures that the clay plaster will stick well to the surface and that no cracks will apear over time. Model round corners with the clay plaster, as these are less prone to damage and look nice. At the connections of clay plaster to visible wooden construction, create a small shadow gap. This will cover any resulting crack after drying.

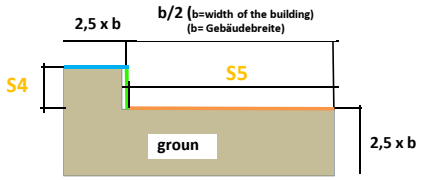
When applying clay plaster, a lot of moisture is produced inside. It is very important to ventilate properly. Moisture build-up can lead to condensation on windows and in the construction and result in damages. If you do plastering works in winter, heat air coming in through one hole and suck at least 10x the volume of the building out per hour. The dry, warm air will help dry the clay plaster.

Appendix:

Bottom plate against exterior wall (PHI)

for CW s1=0
für KW s1=0





Model complete:

U_{1D} EW	0,105	W/m²K
Length S1	2,837	m
Length S2	2,717	m
Length S3	3,675	m
	6,392	m
$U_{2Dcomplete}$	0,104	W/m²K

custom length S2+S3

Model ground only:

Length S4	0,450	m
Length S5	4,207	m
	4,657	m
$U_{2Dground}$	0,090	W/m²K

custom length S4+S5

L_{1D}	0,298	W/mK
$L_{2Dground}$	0,420	W/mK
$L_{2Dcomlete}$	0,662	W/mK
Ψ_e	-0,056	W/mK

PHI				
Boundary Conditions	R_s	θ	R_s	θ
	0,13	20,00	0,25	20,00
	0,17	20,00	0,25	20,00
	0,04	-10,00	0,04	-10,00
	-	20,00	-	-
	-	20,00	-	-
ground	adiabatic	adiabatic	0,00	10,00
	Psi-value		fR_{si}	

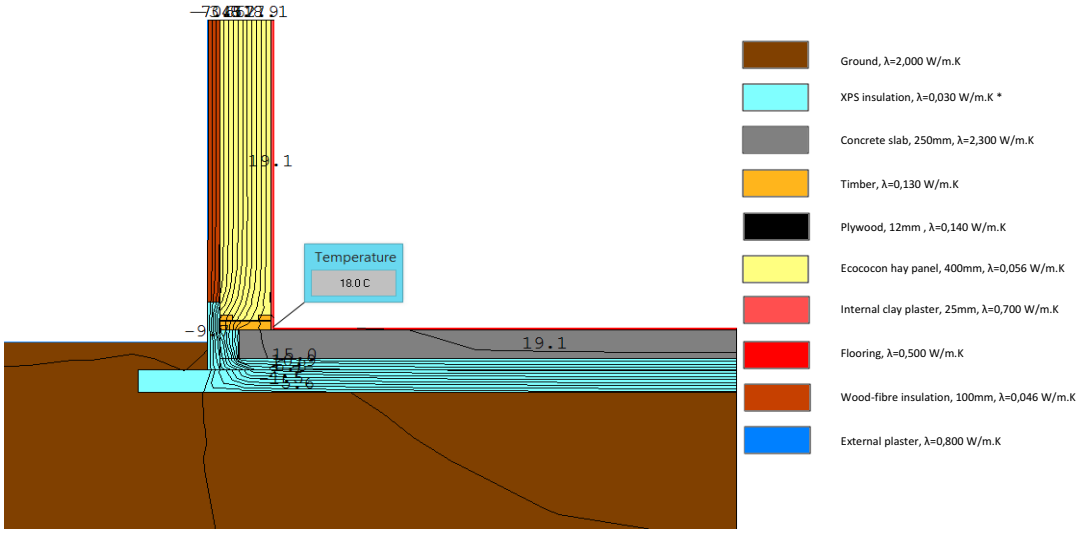
lowest interior temperature: 18,0°C

f_{RSI} at 20 °C / -10 °C: 0,93 > 0,7 requirement fulfilled

parameter		
ground material	unknown	
heat conductivity ground: λ_g	2,00	W/(m*K)
U_{1D_EW}	0,10	W/(m²*K)
R_{s_EW}	9,36	m²*K/W
U_{1D_BP}	0,10	W/(m²*K)
R_{s_BP}	10,15	m²*K/W

Isotherms:

*** XPS thicknesses: 300mm under the concrete slab, 250mm in front of the concrete slab**

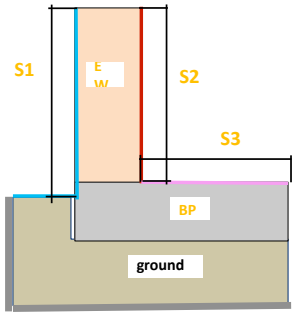


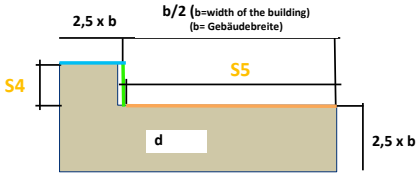
Calculated by: Ing.Richard Hauskrecht

Project	Ecococon
Date	01-2014

Bottom plate against exterior wall (PHI)

for CW s1=0
für KW s1=0





Model complete:

U_{1D} EW	0,105	W/m²K
Length S1	2,685	m
Length S2	2,540	m
Length S3	3,875	m
	6,415	m
$U_{2Dcomplete}$	0,117	W/m²K

custom length S2+S3

Model ground only:

Length S4	0,265	m
Length S5	4,407	m
	4,672	m
$U_{2Dground}$	0,111	W/m²K

custom length S4+S5

L_{1D}	0,282	W/mK
$L_{2Dground}$	0,516	W/mK
$L_{2Dcomlete}$	0,749	W/mK
Ψ_e	-0,049	W/mK

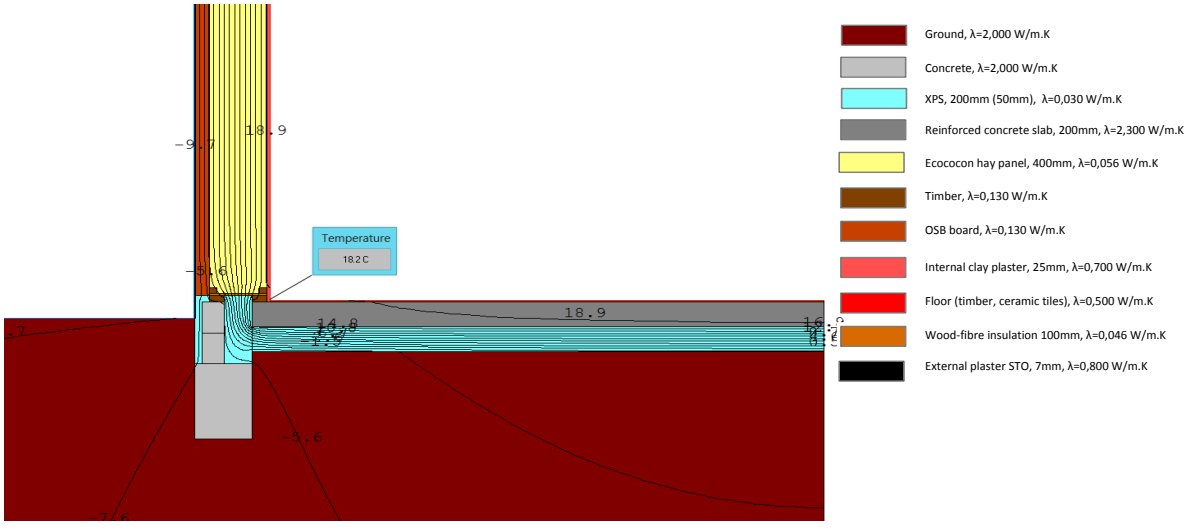
PHI				
Boundary Conditions	R_s	θ	R_s	θ
	0,13	20,00	0,25	20,00
	0,17	20,00	0,25	20,00
	0,04	-10,00	0,04	-10,00
	-	20,00	-	-
	-	20,00	-	-
ground	adiabatic	adiabatic	0,00	10,00
	Psi-value		fR_{si}	

lowest interior temperature: 18,2°C

f_{RSI} at 20 °C / -10 °C: 0,94 > 0,7 requirement fulfilled

parameter		
ground material	unknown	
heat conductivity ground: λ_g	2,00	W/(m*K)
U_{1D_EW}	0,10	W/(m²*K)
R_{s_EW}	9,36	m²*K/W
U_{1D_BP}	0,14	W/(m²*K)
R_{s_BP}	6,77	m²*K/W

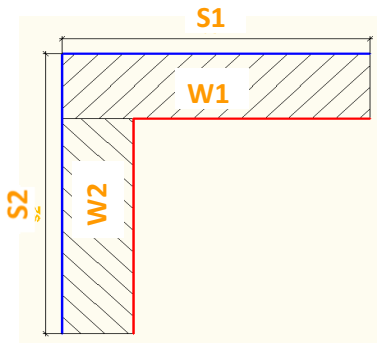
Isotherms:



Calculated by: Ing.Richard Hauskrecht

Project	Ecococon
Date	09-2013

Corner external



U_{1D} W1	0,104	W/m²K
U_{1D} W2	0,109	W/m²K
U_{2D}	0,100	W/m²K

Custom length

Length S1	4,075	m
Length S2	3,123	m
Total length	7,198	m

L_{1D}	0,762	W/mK
L_{2D}	0,721	W/mK

Ψ_e	-0,041	W/mK

PHI				
Boundary Conditions	R_s	θ	R_s	θ
	0,13	20,00	0,25	20,00
	0,04	-10,00	0,04	-10,00
	Psi-value		fR_{si}	

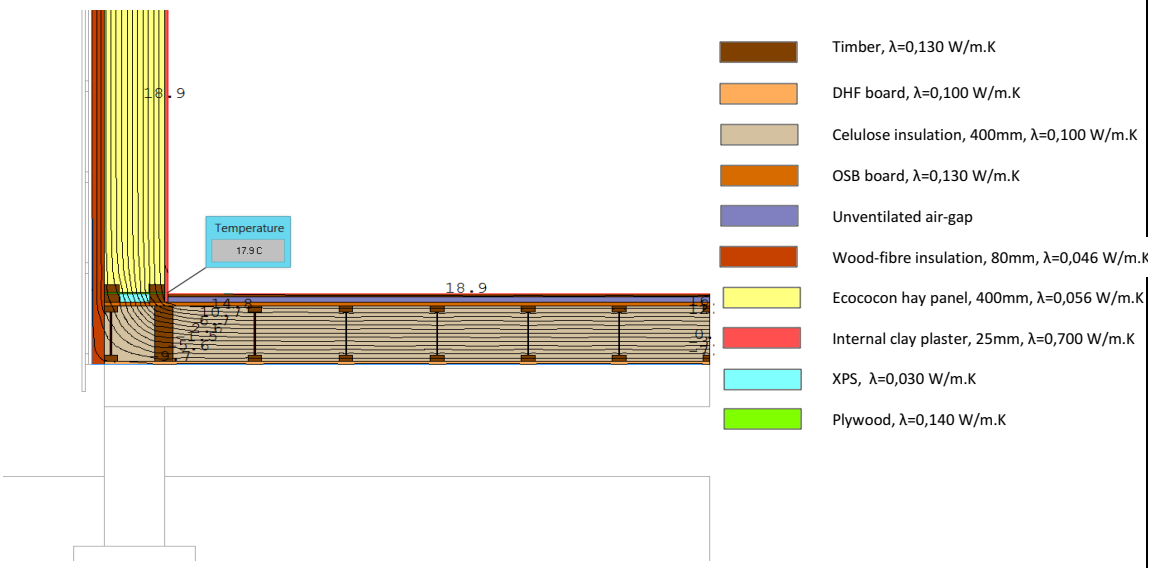
lowest interior temperature: 17,9°C

f_{RSI} at 20 °C / -10 °C: 0,93 > 0,7 requirement fulfilled

Isotherms:

Floor slab on timber beams (in the air)

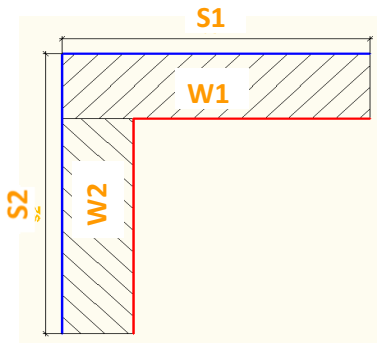
* fasade with ventilated cladding



Calculated by: Ing.Richard Hauskrecht

Project	Ecococon
Date	09-2013

Corner external



U_{1D} W1	0,093	W/m²K
U_{1D} W2	0,109	W/m²K
U_{2D}	0,092	W/m²K

Custom length

Length S1	4,125	m
Length S2	3,123	m
Total length	7,248	m

L_{1D}	0,724	W/mK
L_{2D}	0,667	W/mK

Ψ_e	**-0,057**	W/mK

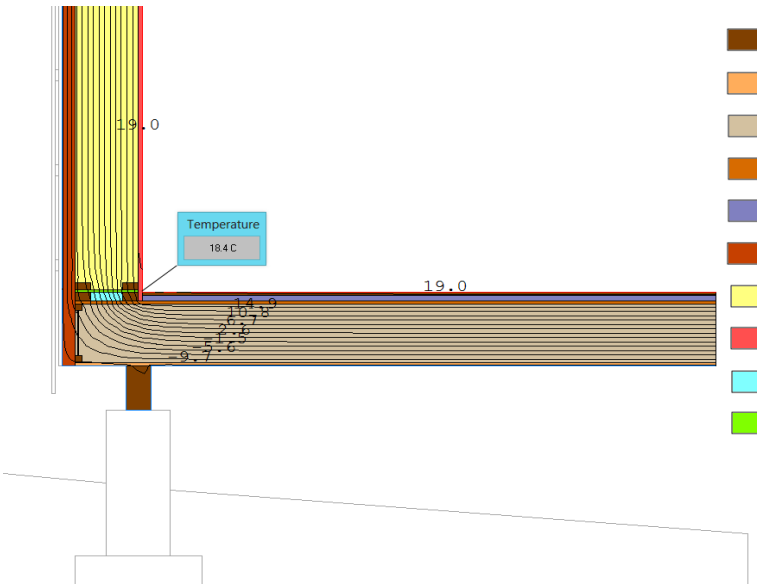
PHI				
Boundary Conditions	R_s	θ	R_s	θ
	0,13	20,00	0,25	20,00
	0,04	-10,00	0,04	-10,00
	Psi-value		fR_{si}	

lowest interior temperature:	18,4°C	
f_{RSI} at 20 °C / -10 °C	0,95	> 0,7 requirement fulfilled

Isotherms:

Floor slab on timber beams (in the air)

* fasade with ventilated cladding

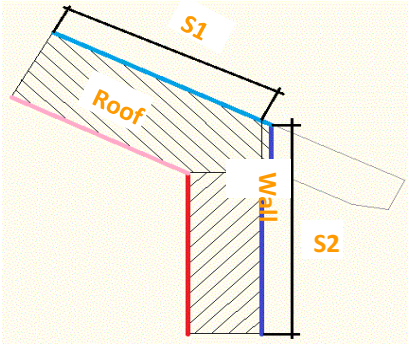


- Timber, λ=0,130 W/m.K
- DHF board, λ=0,100 W/m.K
- Celulose insulation, 400mm, λ=0,100 W/m.K
- OSB board, λ=0,130 W/m.K
- Unventilated air-gap
- Wood-fibre insulation, 80mm, λ=0,046 W/m.K
- Ecococon hay panel, 400mm, λ=0,056 W/m.K
- Internal clay plaster, 25mm, λ=0,700 W/m.K
- XPS, λ=0,030 W/m.K
- Plywood, λ=0,140 W/m.K

Calculated by: Ing.Richard Hauskrecht

Project	Ecococon
Date	09-2013

Eave



U_{1D} Roof	0,095	W/m²K
U_{1D} Wall	0,104	W/m²K
U_{2D}	0,092	W/m²K

Custom length

Length S1	1,992	m
Length S2	1,966	m
Total length	3,958	m

Please choose:

room temperature: heated

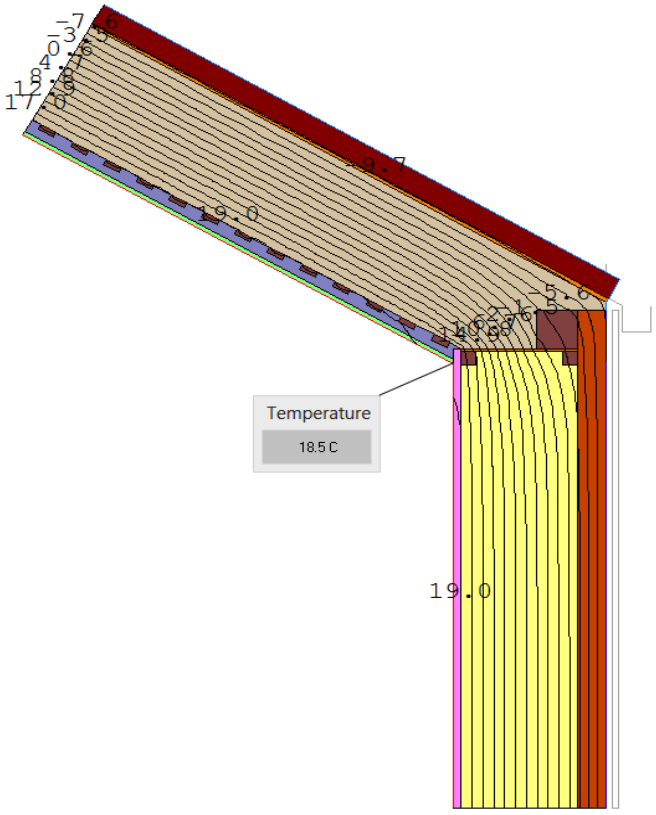
PHI				
Boundary Conditions	R_s	θ	R_s	θ
	0,13	20,00	0,25	20,00
	0,04	-10,00	0,04	-10,00
	0,10	20,00	0,25	20,00
	0,10	-10,00	0,04	-10,00
	Psi-value		fR_{si}	

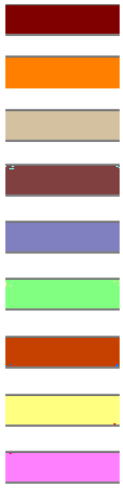
L_{1D}	0,393	W/mK
L_{2D}	0,364	W/mK
Y_e	**-0,030**	W/mK

lowest interior temperature: 18,5°C

f_{RSI} at 20 °C / -10 °C: 0,95 > 0,7 requirement fulfilled

Isotherms:





Ground, λ=2,000 W/m.K

OSB board, λ=0,130 W/m.K

Celulose insulation, 400mm, λ=0,040 W/m.K

Timber, λ=0,130 W/m.K

Airgap - not ventilated

Gypsum fibre board, λ=0,900 W/m.K

Wood-fibre insulation, 100mm, λ=0,046 W/m.K

Ecococon haystacks, 400mm, λ=0,056 W/m.K

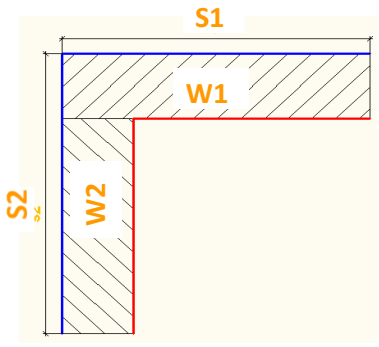
Clay plaster, 25mm, λ=0,700 W/m.K

Calculated by: Ing.Richard Hauskrecht

Project	EPD Ecococon

PSI base

Corner external



U_{1D} W1	0,107	W/m²K
U_{1D} W2	0,107	W/m²K
U_{2D}	0,089	W/m²K

Custom length

Length S1	2,188	m
Length S2	2,013	m
Total length	4,201	m

L_{1D}	0,449	W/mK
L_{2D}	0,375	W/mK

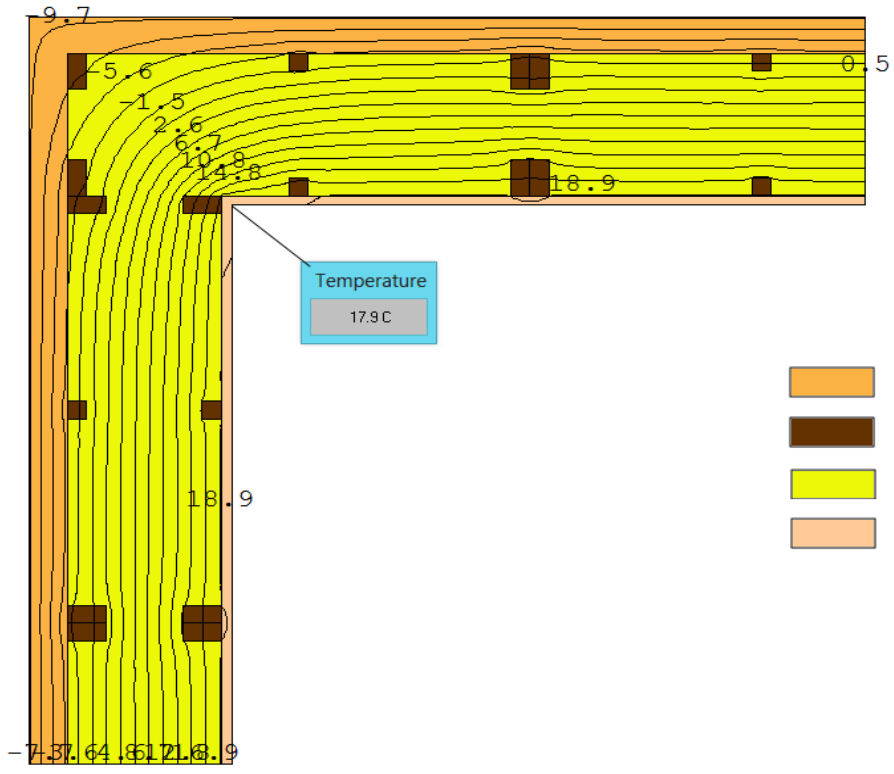
Ψ_e	-0,074	W/mK

PHI				
Boundary Conditions	R_s	θ	R_s	θ
	0,13	20,00	0,25	20,00
	0,04	-10,00	0,04	-10,00
	Psi-value		fR_{si}	

lowest interior temperature: 17,9°C

f_{RSI} at 20 °C / -10 °C: 0,93 > 0,7 requirement fulfilled

Isotherms:



Wood fibre insulation, 100mm, λ=0,046 W/m.

Timber, λ=0,130 W/m.K

Haystacks, 400mm, λ=0,056 W/m.K

Clay plaster, 25mm, λ=0,700 W/m.K

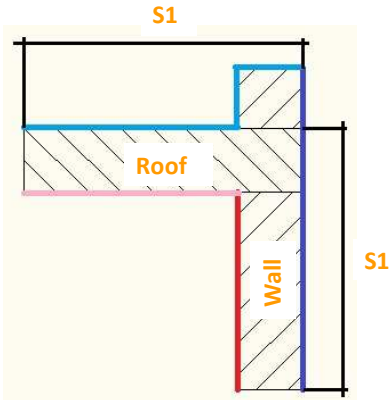
***fasade with ventilated gap**

Spracoval: Ing.Richard Hauskrecht

Project	Ecococon dom
Date	5.7.2013

PSI base

Flat roof



U_{1D} Roof	0,099	W/m²K
U_{1D} Wall	0,105	W/m²K
U_{2D}	0,085	W/m²K

Custom length

Length S1	2,313	m
Length S2	2,092	m
Total length	4,405	m

Please choose:

room temperature: **heated**

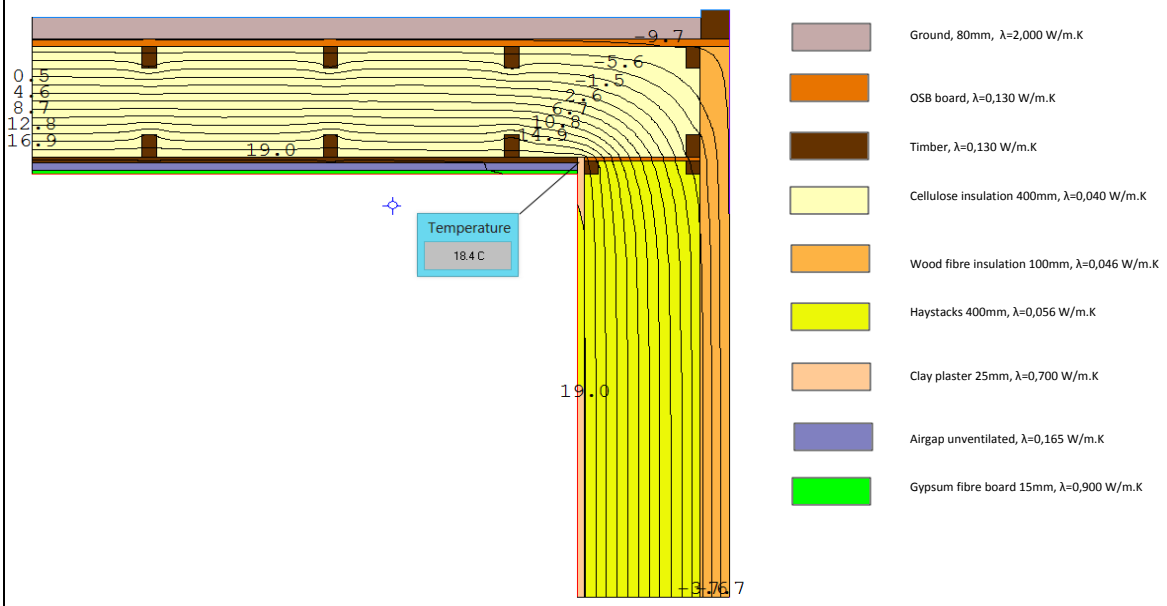
PHI				
Boundary Conditions	R_s	θ	R_s	θ
	0,13	20,00	0,25	20,00
	0,04	-10,00	0,04	-10,00
	0,10	20,00	0,25	20,00
	0,10	-10,00	0,04	-10,00
	Psi-value		fR_{si}	

L_{1D}	0,448	W/mK
L_{2D}	0,372	W/mK
Ψ_e	**-0,076**	W/mK

lowest interior temperature: 18,4°C

f_{RSI} at 20 °C / -10 °C: 0,95 > 0,7 requirement fulfilled

Isotherms:



Spracoval: Ing.Richard Hauskrecht

Project	ECOCOCON dom
Date	05.07.2013

STATE ENTERPRISE CONSTRUCTION PRODUCTS CERTIFICATION CENTRE

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Website: www.spsc.lt

National technical approval

NTĮ-01-061:2013

(original Lithuanian language version)

Trade name:	**Wooden frame external panels with insulation straw core**
National technical evaluation owner:	**UAB Ecococon, Dievogalos g. 69 Dievogalos km. LT-53425, Kaunas district**
Generic type and use of the construction product:	**Timber frame external insulation board with a thermal-insulation layer of straw**
Manufacturing plant:	**UAB Ecococon, Dievogalos g. 69 Dievogalos village LT -53425, Kaunas district**
Valid from:	**26-08-2013**
Valid till:	**26-08-2018**
This national technical approval contains:	**28 pages including 3 Annexes**

I LEGAL BASIS AND GENERAL CONDITIONS

1. This national technical approval was issued by the State Enterprise Construction Products Certification Centre (*VĮ Statybos produkcijos sertifikavimo centras*) in accordance with:
1.1. The Law on Construction of the Republic of Lithuania;
1.2. Regulation of the European Parliament and of the Council 305/2011/EC;
1.3. technical regulations on construction:
1.3.1. STR 1.01.04:2013 “Assessment, verification and declaration of Construction products not harmonized technical specifications for the constancy of performance”. Testing laboratories and certification bodies allocation;
1.3.2. STR 1.03.03:2013 “Appointment, publication (notification) of technical approval institutions, their performance and competence monitoring. National technical approvals”;
1.3.3. STR 2.01.03:2009 “Design values of thermal technical values of construction materials and products”;
1.3.4. STR 2.05.01:2005 “Thermal technique of buildings’ partitions”;
1.3.5. STR 2.05.04:2003. “Stresses and loads”;
1.3.6. STR 2.05.07:2005 “Design of wooden structures”;
1.4. Requirements and provisions the technical specifications listed below were taken into consideration when preparing this national technical approval:
1.4.1. Guideline for European Technical Approval ETAG 007 (edition April 2001) “Timber frame building kits”;
1.4.2. Common Understanding of Assessment Procedure CUAP 12.01/02cl1 (edition June 2003, revision 1 June 2005, revision 2 October 2009) “Factory-made thermal insulation material and/or acoustic insulation material made of vegetable or animal fibres”.

2. State Enterprise Construction Product Certification Centre is authorized to check the compliance with the requirements of this national technical approval. Checking may take place in places of manufacture. UAB Ecococon is responsible for the building product conformity to the operational properties verified according to the requirements of this national technical approval.

3. This national technical approval may not apply to producers not indicated in the title page of this national technical approval, as well as to the manufacturing facilities not reported to the State enterprise Construction Product Certification Centre.

4. In accordance with the specified procedure, the State Enterprise Construction Product Certification Centre may repeal this national technical approval.

5. Only the full text of this national technical approval may be copied and distributed (including electronic dissemination). Reproduction and distribution of parts is allowed only with the consent of the State Enterprise Construction Product Certification Centre. In this case, the reproduced and distributed part must be clearly marked with the national technical approval number and the trade name of the product. Text and drawings presented in promotional publications must not contravene the guidelines for this national technical approval.

6. The original national technical approval is issued by the technical approval body in the Lithuanian language. Translations into other languages have to be designated as such.

II SPECIFIC CONDITIONS CONCERNING THE NATIONAL TECHNICAL APPROVAL

1. Definition of product and intended use

1.1. Product definition

The technical approval is intended for timber frame external panels with a thermal insulation layer of straw manufactured by UAB Ecococon.

The panel is made up of a supporting wooden frame filled with a pressed straw bale layer. The panels are manufactured in a factory without the inner and outer layers of finish. These layers are installed after installation on site. At the customer's request, the mixture of dry clay plaster for the interior wall surface decoration produced by the manufacturer may be supplied along with the panels.

Specification of materials and components used for the panel manufacturer is provided in Annex 1. The general view of the wooden frame of the panel is provided in Annex 2.

Panels are made separately for each individual building. In general, the wooden panel frame is designed so that only small incisions or shaping have to be made on-site, which does not affect the structural and mechanical durability of the entire enclosure design.

1.2. Intended uses

Panels are designed for the construction of exterior walls of residential and non-residential buildings.

A separate type of panel is a lintel which is used for the openings for doors and windows.

Panels are recommended for the construction of buildings in 0. I, II, III and IV category areas as defined by LST EN 1991-1-4. The use of panels must always be considered in each case individually depending on the marginal climatic conditions.

Application of panels depends on the construction technical regulations and other legal acts, and in individual cases on specific customer requirements, specific climatic conditions, and should be described in the design documentation in each case.

The base and load-bearing element of the walls is the timber frame, which, according to the required building mechanical strength and durability, in each particular case, may be enhanced by additional bearing elements (e.g., columns, beams, girders, etc.).

Provisions of this technical approval are determined from the condition that the economically reasonable useful life of these panels is 50 years for load-bearing structures, inaccessible components and materials, and 25 years for replaceable and interchangeable components and materials provided that the building will be operated and maintained properly, and will be heated during the winter season.

2. References

Dated and undated reference provisions from other publications are included in this technical approval. These normative references are written in the appropriate places in the text and the list of publications is given in this section.

In case of dated references, all subsequent amendments or corrections of these publications apply to this technical approval only when they are included in it as amendments or corrections. In case of undated references, the latest edition applies (including any amendments).

LST 1413.5 “Building mortar. Test methods. Density determination method”;
LST 1413.6 “Building mortar. Test methods. Determination of compressive strength of mortar”;
LST 1413.9 “Building mortar. Test methods. Determination of mortar contraction – expansion deformation”;

LST EN 335-3 “Durability of wood and wood-based products. Definition of hazard classes of biological attack. Part 3. Application to wood-based panels”;
LST EN 336 “Structural timber. Sizes, permissible deviations”;
LST EN 338 “Structural timber. Strength classes”;
LST EN 350-2 “Durability of wood and wood-based products. Natural durability of solid wood. Part 2. Guide to natural durability and treatability of selected wood species of importance in Europe”;
LST EN 351-1 “Durability of wood and wood-based products. Preservative-treated solid wood. Part 1. Classification of preservative penetration and retention”;
LST EN 380 “Timber structures. Test methods. General principles for static load testing”;
LST EN 460 “Durability of wood and wood-based products. Natural durability of solid wood. Guide to the durability requirements for wood to be used in hazard classes”;
LST EN 594 “Timber structures. Test methods. Racking strength and stiffness of timber frame wall panels”;
LST EN 595 “Timber structures. Test methods. Test of trusses for the determination of strength and deformation behaviour”:
LST EN 596 “Timber structures. Test methods. Soft body impact test of timber framed walls”;
LST EN 717-1 “Wood-based panels. Determination of formaldehyde release. Part 1. Formaldehyde emission by the chamber method”;
LST EN 717-2 “Wood-based panels. Determination of formaldehyde release. Part 2. Formaldehyde release by the gas analysis method”;
LST EN 823 “Building thermal-insulating products. Determination of thickness”:
LST EN 1027 “Windows and doors. Imperviousness to water. Test method”;
LST EN 1309-1 “Round and sawn timber. Method of measurement of dimensions. Part 1. Sawn timber”;
LST EN 1310 “Round and sawn timber. Method of measurement of features”;
LST EN 1602 “Building thermal-insulating products. Determination of apparent density”;
LST EN 1607 “Building thermal-insulating products. Determination of tensile strength perpendicular to faces”;
LST EN 1609 “Building thermal-insulating products. Determination of short term water absorption by partial immersion”;
LST EN 1934 “Thermal performance of buildings. Determination of thermal resistance by hot box method using heat flow meter. Masonry”;
LST EN 1990:2004 ”Eurocode. Bases for design of structures”;
LST EN 1990:2004/A1:2006/NA:2012 ”Eurocode. Bases for design of structures”;
LST EN 01-01-1991:2004 ”Eurocode 1. Actions on structures. Part 1-1. General actions. Densities, self-weight, imposed loads for buildings”;
LST EN 04-01-1991:2005 ”Eurocode 1. Actions on structures. Part 1-4. General actions. Wind actions”;
LST EN 04-01-1991:2005/NA:2012 ”Eurocode 1. Actions on structures. Part 1-4. General actions. Wind actions”;
LST EN 01-01-1995:2005 ”Eurocode 5. Design of wooden structures. Part 1-1. General provisions. General and building rules”;
LST EN 1995-1-1:2005/NA:2012 ”Eurocode 5. Design of wooden structures. Part 1-1. General provisions. General and building rules”;
LST EN 12086 “Building thermal-insulating products. Determination of water vapour permeability properties”;
LST EN 12152 “Curtain walling. Air permeability. Performance requirements and classification";
LST EN 12153 “Curtain walling. Air permeability. Test method”;
LST EN 12154 “Curtain walling. Imperviousness to water. Performance requirements and classification";

LST EN 12155 “Curtain walling. Leakproofness. Laboratory test under static pressure”;
LST EN 12667 “Thermal performance of building materials and products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance”;
LST EN 12865 “Hygrothermal performance of building components and building elements. Determination of the resistance of external wall systems to driving rain under pulsating air pressure”;
LST EN 13171 “Building thermal-insulating products. Factory made products of wood fibre (WF). Specification”;
LST EN 13183-2 “Moisture content of a piece of sawn timber. Part 1. Determination by oven dry method“:
LST EN 13497 “Building thermal-insulating products. Determination of the resistance to impact of external thermal insulation composite systems (ETICS)”;
LST EN 13501-1 “Fire classification of construction products and building elements. Part 1. Classification using data from external fire exposure to roofs tests”;
LST EN 13501-2 “Fire classification of construction products and building elements. Part 2. Classification using data from fire resistance tests, excluding ventilation services”;
LST EN 13823 “Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item”;
LST EN 13986 “Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking”;
LST EN 15048-1 “Non-preloaded structural bolting assemblies. Part 1. General requirements”;
LST EN ISO 717-1 “Acoustics. Rating of sound insulation in buildings and of building elements. Part 1. Airborne sound insulation”;
LST EN ISO 846 “Plastics. Evaluation of the action of microorganisms”;
LST EN ISO 898-1 “Mechanical properties of fasteners made of carbon steel and alloy steel. Part 1. Bolts, screws and studs with specified property classes. Coarse thread and fine pitch thread”;
LST EN ISO 6946 “Building components and building elements. Thermal resistance and thermal transmittance. Calculation method”;
LST EN ISO 8990 “Thermal insulation. Determination of steady-state thermal transmission properties. Calibrated and guarded hot box”;
LST EN ISO 10140-1 “Acoustics. Laboratory measurement of sound insulation of building elements. Part 1. Application rules for specific products. Version 1. Guidelines for the determination of the sound reduction index of joints filled with fillers and/or seals”;
LST EN ISO 10140-2 “Acoustics. Laboratory measurement of sound insulation of building elements. Part 2. Measurement of airborne sound insulation”;
LST EN ISO 10140-4 “Acoustics. Laboratory measurement of sound insulation of building elements. Part 4. Requirements for measurement procedures”;
LST EN ISO 10140-5 “Acoustics. Laboratory measurement of sound insulation of building elements. Part 5. Requirements for test facilities and equipment”;
LST EN ISO 10456 “Building materials and products. Hygrothermal properties. Tabulated design values and procedures for determining declared and design thermal values”;
LST EN ISO 11925 “Reaction-to-fire tests. Ignitability of building products subjected to direct impingement of flame. Part 2. Single-flame source test”;
LST EN ISO 12567-1 “Thermal performance of windows and doors. Determination of thermal transmittance by the hot-box method. Part 1. Complete windows and doors”;

LST EN ISO 13788 “Hygrothermal performance of building components and building elements. Internal surface temperature to avoid critical surface humidity and interstitial condensation. Calculation methods”;

ISO 7892:1988 “Vertical building elements. Impact resistance tests. Impact bodies and general test procedures”;

ONORM B 6010 “Materials for thermal and/or acoustic insulation in building construction. Test methods”.

3. Terms and definitions

Terms and definitions used in this technical evaluation:

3.1. wooden external frame panel with thermal insulation straw layer – a panel with the timber frame as the main load-bearing element, filled with a compressed straw layer.

4. Symbols and Abbreviations

Markings used in this technical approval:

- $\mathbf{d_N}$ – nominal product thickness. mm;
- $\mathbf{\lambda_D}$ – declared value of thermal transmittance coefficient, W/(m·K);
- $\mathbf{\lambda_{90/90}}$ – 90% quintile of the limit level of the thermal conductivity coefficient at the confidence level 90%, W/(m·K);
- $\mathbf{\lambda_{ds}}$ – design value of thermal transmittance coefficient, W/(m·K);
- $\mathbf{R_D}$ – the cleared thermal resistance of the thermal insulation layer, (m^2·K)/W;
- $\mathbf{R_{90/90}}$ – 90% quintile of the thermal resistance threshold at the confidence level 90%, (m^2·K)/W;
- $\mathbf{R_{pl}}$ – - panel thermal resistance, (m^2·K)/W;
- $\mathbf{U_{pl}}$ – heat transfer coefficient value of the panel, W/(m^2·K);
- ρ – density, kg/m^3.

The following abbreviations used in this technical approval:

- NTĮ – national technical approval;
- PTB – initial type testing.

5. Essential performance characteristics of the product and methods of their verification

This national technical approval sets out the requirements and test methods for the essential performance characteristics of products that are necessary to confirm their suitability for use.

5.1. Mechanical resistance and stability

Calculations of mechanical strength of the wall panel were performed according to the requirements of LST EN 1990. LST EN 1991-1-1, LST EN 1995-1-1 and the ETAG 007 guidelines.

The estimated mechanical strength characteristics are given in Annex 1.

Partitioning of the described wall panels can be installed on all types of foundations: for example, concrete slab on the soil, strip concrete or masonry foundation, concrete basement walls. This technical approval does not include the foundation design, which must be designed based on individual requirements.

5.2. Safety in case of fire

5.2.1. Combustibility

Flammability classification of the wall panel and its individual components LST EN 13501-1 are presented in Annex 1.

5.2.2. Fire resistance

The property not determined.

If necessary, the panel fire resistance can be determined in accordance with the requirements of LST EN 13501-2.

5.3. Hygiene, health, and environment protection

5.3.1. Water vapour permeability, and resistance to moisture effects

Having performed calculations in accordance with LST EN ISO 13788, STR 2.05.01:2005 under normal climatic conditions, the panels were rated as ensuring sufficient support of moisture depending on the scope of application specified in section 1.2, provided that the building is heated during the winter season.

5.3.2. Water impermeability

The panel structure and its interconnection units and connection units with other structures ensure their tightness to rain and snow.

In order to protect the panel structure from moisture penetration through the foundation, the waterproof layer must be equipped between the panel and the foundation.

The use of these panels in higher humidity areas such as bathrooms, are possible by equipping the additional layer impervious to water and water vapour on the inner surface of the panel, to ensure the moisture resistance of the structure. This technical approval does not include the panels of his design.

5.3.3. Dangerous substances

According to the manufacturer's declaration, the wall panels do not contain any harmful and hazardous materials, other than:
- potential presence of formaldehyde in wood fibre panels and plywood;
- potential presence of pesticides and fungicides in the thermal insulating straw layer.

Formaldehyde emission class E1 according to LST EN 13986.

Straw used in the manufacture of panels may be processed during growth. In this case, the manufacturer must declare:
- the name of the pesticide (s), name and concentration of the active ingredient;
- processing stage and the amount applied.

The manufacturer must ensure that the products used in the processing of straw during growth meet the requirements of Directive 98/8/EC for biocidal products.

5.4. Safety in use

5.4.1. Impact resistance

The impact resistance of the outer surface of the panel is ensured by the materials used, and is determined and declared in accordance with the corresponding technical specification.

The surface impact resistance of the internal plastered clay panel is a validated by performing the impact resistance test to a solid body according to LST EN 13497 or ISO 7892 under the following test conditions:
- 2 J, 500 g, 408 mm;
- 10 J, 1000 g, 1020 mm.

Resistance to impact is considered to be satisfactory if no mechanical damage (cracks, detached layers) is visible with any I after the test.

5.5. Protection against noise

5.5.1. Airborne sound insulation

Airborne sound insulation index of wall panels was determined according to the requirements of LST EN ISO 10140-2:2010. LST EN ISO 10140-1:2010. LST EN ISO 10140-4:2010. LST EN ISO 10140-5:2010 and LST EN ISO 717-1:1999. The value of airborne sound insulation is determined during the test and is presented in Annex 1.

5.6. Energy economy and heat retention

5.6.1. Thermal resistance

Wall panel thermal resistance R_{pl} and its corresponding heat transfer coefficient U_{pl} are set to meet LST EN ISO 6946 and STR 2.01.03:2009.

The thermal properties of the corresponding materials are taken from LST EN ISO 10456, from the manufacturers' declarations of conformity or from direct test results.

Values of thermal properties, thermal conductivity and heat transfer coefficients are given in Annex 1.

5.6.2. Air permeability

The analysis of the panel design and its interconnection units and connection points with other structures showed that the panels are sufficiently impermeable to air according to the intended use, provided they are properly interconnected to each other and to the adjacent structures.

5.7. Durability

5.7.1. Durability

The rules for the design of timber frame building ensure that the wear of materials and components within the economically reasonable service life will be negligible and will not affect the essential performance characteristics if the building is used for the intended purpose indicated in section 1.2.

5.7.2. Wood product resistance to biological effects

Depending on the durability class and the use of wood components, wood components can be treated for wood beetles, insects, fungi, and the blue mould.

This technical approval does not include exterior decoration of the panels. These products must meet the durability requirements of corresponding technical specifications.

5.7.3. Corrosion resistance of metal fasteners

Metal fasteners and structural connections (bolts, screws, etc.) must be corrosion resistant or protected against corrosion in accordance with the requirements of LST EN 01-01-1995.

5.7.4. Thermal insulating straw layer resistance to biological effects

Straw layer durability was rated according to its resistance to mould fungi under increased humidity conditions. The test was conducted in accordance with the requirements of ONORM B 6010. evaluating the fungi mould overgrowth of samples according to the methods of LST EN ISO 846.

Description of the test procedure and result of approval are presented in Annex 1.

5.8. Geometric shape and dimensional accuracy

Requirements for the geometric dimensions and shape accuracy of the products are presented in Table 5.8.1.

5.8.1. Requirements for geometric dimensions and shape accuracy of panels

Indicator	Permitted tolerance	Test method
Height:	± 2 mm	Measurement accuracy – 1 mm. Measured in three places on both sides of the panel – at the panel edges and in the middle. Assessment – by the arithmetic mean of all measurements.
Width	± 2 mm	Measurement accuracy – 1 mm. Measured in three places on both sides of the panel – on top, bottom and middle of the panel. Assessment – by the arithmetic mean of all measurements.
Thickness	± 2 mm	Measurement accuracy – 1 mm. Measured in three places on both sides of the panel – on top,

		bottom and middle of the panel. Assessment – by the arithmetic mean of all measurements.
Perpendicularity	± 5 mm	Measurement accuracy – 1 mm. Measured diagonals. Evaluation – difference in diagonals.
Edge straightness	± 2 mm/2 mm	Measurement accuracy – 1 mm. Measured on all edges. Measurement length – 2 m.

5.9. Requirements for materials

5.9.1. Timber

C24 and higher strength class timber is used for the manufacture of panels in accordance with LST EN 338.

Wood moisture content ≤ 20%.

The timber must be suitable for use for the performance class 2 under LST EN 01-01-1995.

Requirements for geometric dimensions and shape of the wood beam are given in Table 5.9.1.1.

5.9.1.1. Requirements for geometric dimensions and shape of the wood beam

Characteristic	Permitted tolerances	Method of measurement
Cross-sectional dimensions	Class 2 according to LST EN 336	LST EN 1309-1
Shape accuracy: - spring* - bow** - twist*** - cup****	 ≤ 4 mm in 2 m length ≤ 6 mm in 2 m length ≤ 6 mm in 25 mm width and in 2 m length; ≤ 2 mm 100 mm of the side	LST EN 1310

* – spring – longitudinal shift of the lumber workpiece, perpendicular to the edge;
** – bow – lengthwise shift of the lumber workpiece perpendicular to the sides;
*** – twist – helical lengthwise twisting of the lumber workpiece sides;
**** – cup – curvature of the lumber workpiece perpendicular to the width of the side.

5.9.2. Straw

Straw requirements are given in Table 5.9.2.1.

5.9.2.1. Straw requirements

Characteristic	Requirement	Method of measurement
Humidity	≤ 20%	Manufacturer's method
Biocide (pesticide) quantity	Must meet the requirements of Directive 98/8/EC for biocidal products	straw supplier's declaration
Straw structure	Technical specification of the manufacturer	visual inspection

5.9.3. Fibreboard

Essential wood fibre board characteristics are specified in Table 5.9.3.1.

5.9.3.1. Essential wood fibre board characteristics

Characteristic	Value	Method of measurement/assessment
Nominal density	270 kg/m^3	LST EN 1602
Nominal thickness d_N	60 mm	LST EN 823
Thickness accuracy class	T4	LST EN 13171
Declared value of thermal transmittance coefficient λ_D	0.048 W/(m·K)	LST EN 12667 LST EN 13171
Design value of thermal transmittance coefficient λ_{ds}	0.049 W/(m·K)	STR 2.05.01:2005
Class of reaction-to-fire performance	E	LST EN ISO 11925-2 LST EN 13501-1
Water vapour diffusion resistance factor μ	5	LST EN 13171
Tensile strength perpendicular to the surface	≥ 20 kPa	LST EN 1607
Short-term water absorption by partial submission in water	≤ 1.0 kg/m^2	LST EN 1609

5.9.4. Plywood

Essential requirements for plywood are specified in Table 5.9.4.1.

5.9.4.1. Essential requirements for plywood

Characteristic	Value	Method of measurement/assessment
Formaldehyde emission class	E1	LST EN 717-1 LST EN 717-2
Performance class	2	LST EN 01-01-1995
Resistance class to biological organisms	2	LST EN 335-3

5.9.5. Fasteners

Fasteners must be the resistant to corrosion or be protected from it. The minimum corrosion protection requirements under LST EN 1995-1-1:2005+AC:2006 are given in Table 4.1.

Attachment elements must be easily replaceable.

If the controlled strength (selected from the condition of strength) bolts to be used for the panel connection, their class according to LST EN ISO 898-1 must not be less than 4.6. In this case, screw sets must be chosen according to the requirements of LST EN 15048-1.

5.9.6. Clay plaster

Essential characteristics of clay plaster used and included in the delivery are specified in Table 5.9.6.1.

5.9.6.1. Essential characteristics of clay plaster included in the delivery

Characteristic	Value	Method of measurement/assessment
Density	1600÷1800 kg/m^3	LST 1413.5
Plaster adhesion to the straw insulation layer: - bond strength - method of disintegration	40 kPa in the straw layer	ETAG 004 5.1.4.1.1

Shrinkage deformations	1.5 mm/m	LST 1413.9
Compressions strength	1.7 MPa.	LST 1413.6
Design value of thermal transmittance coefficient λ_{ds}	0.521 W/(m·K)	LST EN 12667 STR 2.05.01:2005
Water vapour diffusion resistance factor μ	8.2÷9.9	LST EN 12086

6. Evaluation of the constancy of performance, testing and marking

6.1. System of the evaluation of the constancy of performance, testing and marking

The evaluation and approval system of the constancy of performance of panels is presented in Table 6.1.1. The manufacturer must demonstrate the compliance of its product with the following national technical approval requirements:

- by initial type testing;
- production control.

6.1.1. System of evaluation and approval of the constancy of performance, testing and marking

Product(s)	Intended use	Evaluation and approval scheme
Timber frame external panels with thermal insulation layer of straw	For exterior petitioning of residential and non-residential buildings, as provided in section 1.2	2+ [a]
[a] (see European Parliament and Council Regulation (EC) 305/2011V, Annex (1.3)		

Scope of the constancy evaluation process of performance and distribution of tasks is specified in Table 6.1.2.

6.1.2. Scope of the constancy evaluation of performance and distribution of tasks

Tasks		Scope of the task
Tasks of the manufacturer	- initial type testing	see 6.2.1.1
	- production control (PC)	see 6.2.1.2
	- testing of samples taken from the manufacturer according to the Control plan (Annex No 4)	see Control plan (Annex No 4)
Tasks for the technical approval body	- initial type testing	see 6.2.2.1: - mechanical durability and stability (p. 5.1); - class of reaction-to-fire performance (p. 5.2.1); - fire resistance (p. 5.2.2); - thermal characteristics (p. 5.6.1); - durability (p. 5.7.4)
Tasks for certification body	- manufacturing control system certification: – initial production and production control system approval; – ongoing production control system supervision and approval	see 6.2.2.2 see 6.2.2.3

6.2. Responsibilities

6.2.1. Tasks of the manufacturer

6.2.1.1. Initial type testing

Results of tests and approvals carried out for this type of technical evaluation are used as the initial type testing. In case of changes in the manufacturing process, components and manufacturing control system which may affect the declared essential performance characteristics, the initial type testing must be repeated

Initial type testing performed by manufacturer is specified in Table 6.2.1.1. Other initial type testing may be carried out only by the technical approval institution – State Enterprise Construction Product Certification Centre.

6.2.1.1. Scope of the initial type testing performed by the manufacturer

Characteristic	Test/assessment method
Water vapour permeability, and resistance to moisture effects (p. 5.3.1)	Calculation according to LST EN ISO 13788, STR 2.05.01
Water impermeability	Evaluation according to the provided element and component drawings in accordance with known engineering practice. Test acc. to the methods of LST EN 12155, LST EN 12154, LST EN 1027, LST EN 12865.
Dangerous substances (p. 5.3.3)	The declaration according to the supplier compliance documents
Impact resistance (p. 5.4.1)	LST EN 13497 or ISO 7892 under the conditions: - 2 J, 500 g, 408 mm; - 10 J, 1000 g, 1020 mm.
Airborne sound insulation indicator (p. 5.5.1)	LST EN ISO 10140-1, LST EN ISO 10140-2, LST EN ISO 10140-4, LST EN ISO 10140-5, LST EN ISO 717-1
Air permeability (p. 5.6.2)	Evaluation according to the provided element and component drawings in accordance with known engineering practice. Testing in accordance with the methods of LST EN 12153, LST EN 12152.

Initial type testing results must be recorded, submitted for inspection and stored for at least 10 years after the date of the last manufactured batch for which it was intended.

Tests must be carried out using testing methods described in this technical approval.

6.2.1.2. Production control (PC)

The internal production control system must be established, validated and documented. The internal production control system must cover the manufacturing process and production control activities to ensure that products placed on the market complies with the requirements of this technical approval and declarative values. These internal controls must include:

- incoming materials control in accordance with the Control plan (see Annex 4), with the determination of their admission criteria for quick evaluation whether the materials are appropriate. This control must also ensure that the panel components not manufactured by the NTE owner are in accordance with this technical approval requirements;
- control of manufacturing processes in accordance with the Control plan, identifying the controlled parameters and their acceptance criteria. Processing and measuring equipment suitability

must be ensured. Actions must be in place to ensure that the tested characteristics or criteria do not meet those specified;

- finished product testing in accordance with the Control plan, by determining the sampling method of the finished product and the test frequency, ensuring the conformity of production, according to the criteria and declarative values of this NTE. Suitability of test equipment must be ensured;
- finished product storage management and control to ensure that nonconforming products are clearly identified. The recall procedure of nonconforming products must be documented.

All manufacturer's installed elements, requirements and means must be formalized in writing in the procedures and policies.

The manufacturer's control results are recorded and evaluated. The records must include at least the following information:

- test subject identification;
- date of test/control;
- test and control results and, if appropriate, comparison with requirements;
- signature of the responsible person.

The records must be presented to the inspection body during the continuous surveillance. They must be delivered to the Construction Product Certification and Testing Centre upon request.

6.2.2. Tasks for the bodies carrying out third party assignments in the assessment and verification of the constancy of performance of the construction product

6.2.2.1. Initial type testing

Results of tests and assessments carried out for this type of technical evaluation are used as the initial type testing. In case of changes in the manufacturing process, components and manufacturing control system which may affect the declared essential performance characteristics, the initial type testing must be repeated

Scope of the initial type testing performed by the state enterprise Construction Products Certification Centre is specified in Table 6.2.2.1. Other initial type testing may be performed by the manufacturer.

6.2.2.1. Scope of the initial type testing performed by the technical approval body

Characteristic	Test/assessment method
Mechanical durability and stability (p. 5.1)	Calculation according to requirements LST EN 1990. LST EN 1991-1-1, LST EN 1995-1-1 and ETAG 007. Tests according to LST EN 380. LST EN 594, LST EN 595, LST EN 596.
Class of reaction-to-fire performance (p. 5.2.1)	LST EN 13501-1
Fire resistance (p. 5.2.2)	LST EN 13501-2
Thermal characteristics (p. 5.6.1): - of the straw layer λ_D; - thermal resistance of panel R_{pl}	Tests according to LST EN 12667, according to LST EN 12939. Calculations according to LST EN ISO 6946 and STR 2.01.03.
Durability (straw layer resistance to biological effects)	Tests according to ONORM B 6010. Evaluation according to the methods LST EN ISO 846.

6.2.2.2. Initial factory and production control

Based on this technical approval and the Control plan, the certification body must make sure that the factory (personnel and equipment) and the factory internal production control are adequate to ensure they continuous manufacture of production in accordance with the requirements of this NTE.

The initial approval must evaluate the scope and the result of the original type testing.

6.2.2.3. Continuous supervision, manufacturing control assessment and approval

The frequency of audits performed by the certification body in the factory should be at least once a year.

These audits should include checking for the compliance of the internal factory production control and the specified manufacturing process with the Control plan requirements.

Ongoing monitoring and evaluation of the internal factory production control must be conducted in accordance with the Control plan.

During each audit the certification body must verify:
- incoming material control records;
- manufacturing process control records in the course of production;
- finished production control records;
- technological equipment control records;
- control and calibration records of testing equipment and measurement.

In cases where the provisions of the technical approval and the Control plan are no longer complied with, the production control certificate must be suspended.

6.2.2.4. Production control certificate and declaration of performance characteristics

Once the conditions specified in this technical approval are met, the certification body must issue a certificate of conformity of production control. The certificate must contain the following information:
- name and address of the certification body;
- manufacturer's name, address, place of manufacture;
- general product description (type, corresponding identification details, use);
- provisions met by the product (marking of this technical approval);
- certificate number;
- validity of the certificate and conditions, if any;
- full name and position title of the person authorised to sign the certificate.

The manufacturer must draw up a declaration of performance characteristics (see STR 1.01.04:2013, Annex I), which must include:
- manufacturer's name, address, place of manufacture;
- product description (type, identification details, use);
- essential performance characteristics in accordance with p. 5.1, 5.2.1, 5.2.2 (if declared), 5.3.3, 5.5.1 (if declared), 5.6.1;
- provisions to which the product complies (marking of this technical approval) and a preference to the reports of initial type testing and assessment, production control certificate;
- name and address of the certification body;
- special conditions for the product use;
- full name and position title of the person authorised to sign the manufacturer's declaration.

In addition, if necessary, legislation relating to dangerous substances, which should be fulfilled by a product and all information necessary according to this legislation, must be indicated in an appropriate manner.

6.3. Marking and labelling

6.3.1. Marking

6.1.1. The nominal marking must include:
- wall element name (panel, lintel or sill);
- panel type;
- measurements (height, width, thickness), cm.

6.3.2. Labelling

Every product has to be labelled. The labelling must be durable.

The product must contain the following information:
- manufacturer's name or trademark and address;
- product labelling (p. 6.3.1);
- production date;
- marking of this technical approval.

Information on all essential performance characteristics indicated in this technical evaluation must be indicated in the declaration of performance.

Figure 1 provides the example of the labelling information to be used on the product.

UAB Ecococon, Dievogalos g. 69 Dievogala village. Kaunas district;	Manufacturer’s name, address
NTĮ-01-0XX:2013	National Technical Evaluation Reference
Wall panel T1 – 300.120.40	Product type and nominal designation
SP/8	Product identification mark in accordance with working drawings (if necessary)
Date of manufacture: 03-05-2013	Date of product manufacture

Fig. 1. Output labelling sample to be used on the product

Figure 2 provides an example of the labelling information to be used for packaging, and in documentation.

UAB Ecococon, Dievogalos g. 69 Dievogala village. Kaunas district;	Manufacturer’s name, address
NTĮ-01-0XX:2013	National technical evaluation marking
Wall panel T1 – 300.120.40	Product type and nominal designation
Performance characteristics:	

Load-bearing capacity:	
- affected vertically by the load of medium duration	36.9 kN/m
- affected vertically by the load of short-term duration	41.45 kN/m
- affected vertically by the load of short-term duration with the horizontal load:	
–1.8 kN/m^2	29.5 kN/m
– 2.1 kN/m^2	25.8 kN/m
– 2,.4 kN/m^2	22.2 kN/m
- affected by horizontal instantaneous load	5.05 kN/m^2
- affected by shearing short-term and instantaneous loads	0
Class of reaction-to-fire performance:	B-s1,d0
Thermal resistance R_D	8,1 (m^2·K)/W
Airborne sound insulation indicator R_W ($C;C_{tr};C_{100-5000}$)	54 (-1;-3;0) dB
Dangerous substances	See the Annex

Information about the key performance characteristics of the product

Fig. 2. Example of the presentation of information to be used for packaging, documentation

7. Assumptions for the assessment of the fitness of the construction product for the intended performance characteristics

7.1. Manufacturing

The production process is carried out in dry, heated industrial premises. All necessary materials and components are stored indoors ensuring favourable conditions for the quality of these materials and components.

The products are manufactured in accordance with the provisions of this national technical evaluation, using the method of production which has been identified during the manufacturing audit, and as specified in the technical documentation.

This national technical approval is issued on the basis of the data provided by the manufacturer for the product identification, evaluation and validation which are stored in the state enterprise Construction Product Certification Centre. Changes that may have an impact on the output characteristics of the production process must be notified before the Construction Product Testing Centre before these changes are implemented. The Construction Product Testing Centre shall decide whether these changes have an impact on the validity of the national technical approval and whether it will require additional evaluation and/or the NTE replacement.

Product suitability for use according to the purpose indicated in this technical approval has been approved after the assessment of:

- mechanical durability and stability of the product design during transportation, installation and operation;
- product safety requirements;
- essential performance characteristics of products;
- production control system used by the manufacturer to ensure the performance stability.

7.2. Design and legal regulation

The products are manufactured according to the design of the individual building, where they will be used. The design must take into account the following:

- requirements for load bearing capacity;
- fire protection garments;
- special requirements for health and the environment;

- safety of use;
- protection from noise,
- energy savings.

7.3. requirements for the base

This national technical approval is not intended for building foundations.

The foundations must be individually designed according to the national technical specifications in force on the construction site.

Before beginning the installation of products, the installer must check the products and assess the existing base according to the tolerances indicated below (this is necessary for the correct mounting of the panels):

- length, width: ± 0.01 m;
- perpendicularity: ± 0.01 m;
- planes: surface smoothness ± 0.01 m;
- edge straightness: ± 5 mm.

Waterproof membrane must be installed between the base and the product according to the working drawings.

7.4. Installation

Products must be installed in accordance to the installation manual provided by the manufacturer.

Installation instructions must contain the following:

- method of installation and necessary means;
- temporary fastening of products during installation;
- final product attachment to the base;
- description of all materials and components;
- standard and special connector and an assembly drawings.

8. Instructions for the manufacturer

8.1. Packaging, transport and storage

The manufacturer must draw up the transport and storage instructions for the product.

The products must be protected from harmful effects of atmosphere during transport, storage and installation.

Products and their components must not be subject to and stored in a manner that might damage them, for example, due to local stress or own weight, or due to excessive bending deformation.

8.2. Use, maintenance, repair

The manufacturer is responsible for ensuring the proper information about the use of the products with each shipment, including general information and specific installation drawings and structural details.

Prior to the installation it must be ascertained that the products and components are not damaged during transportation and storage. Damaged items and components need to be replaced.

Where it is necessary to replace or repair the structure, it can be done only in accordance with the installation instructions. In other cases, changes may be made only with a written consent of the manufacturer.

In order to preserve the properties of products and ensure the stability of these properties through the reasonable time of use, they may require regular maintenance. In such case, the maintenance actions and frequency must be specified in the manufacturer's maintenance instructions.

Annex 1
(normative)

Overall appearance of panels, their configuration, basic geometry, and main performance characteristics

This annex contains information on the product configuration, components, basic dimensions and essential performance.

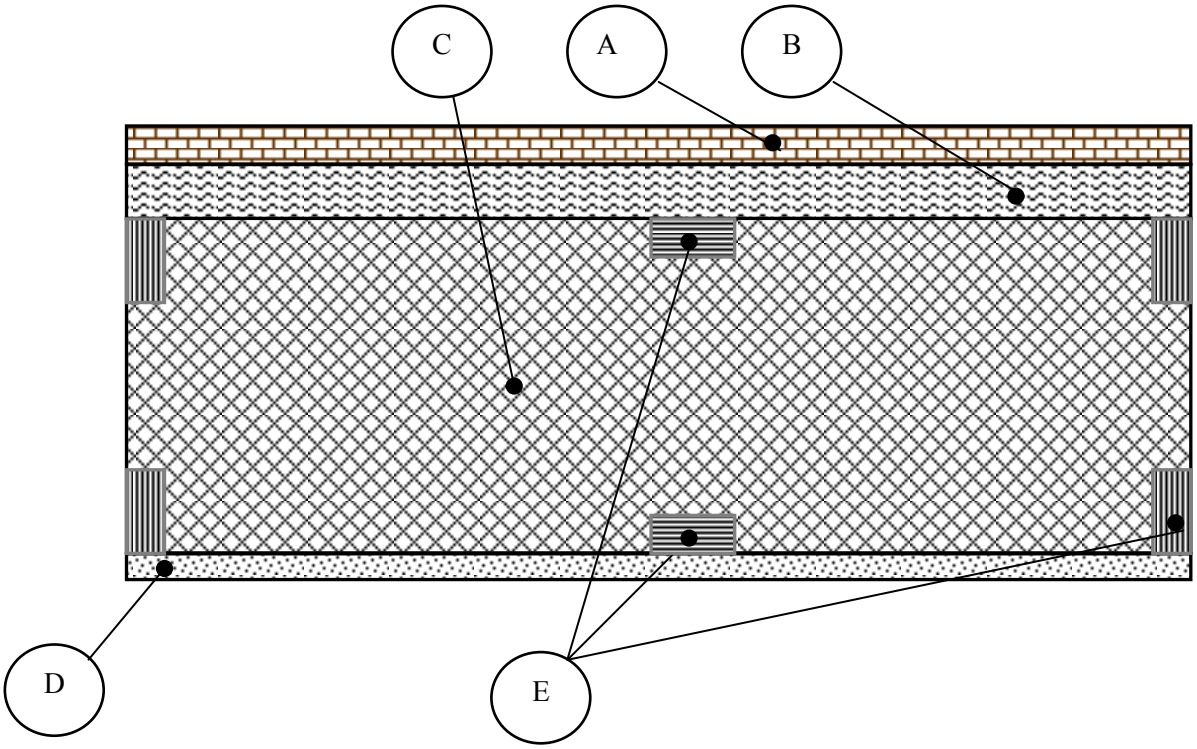
The panels are manufactured in the factory without the inner and outer layers of finish.
A mixture of clay plaster may be supplied for the inner layer together with the product. The inner layer of clay plaster is installed after the installation of the panels and protecting the internal structures of the building against precipitation.

Standard panel dimensions: height – 3000 mm, width – 1200 mm. If necessary, smaller dimension panels can be manufactured.

Depending on the panel timber frame structure, UAB Ecococon company produces two types of panels:

- Type T1 – no struts (see Fig. P.2.1);
- Type T2 – with struts (see Fig. P.2.2).

P.1.1. Panel description



Marking	Description of the constituent
A	External finishing layer. Used according to customer's request. This technical approval does not include this layer and does not provide its requirements.
B	Fibreboard, density 270 kg/m^3, thickness 60 mm, flammability class E, λ_D = 0.048 W/(m·K). For other properties, see. in Table 5.9.3.1
C	Thermal insulating layer of compressed straw, density 98 ÷ 127 kg/m^3, humidity 12%, thickness 400 mm, λ_D 0.060 W/(m·K)
D	internal clay plaster layer: clay plaster "brown clay", thickness 30 mm, density 1600÷1800 kg/m^3, quantity 48 kg/m^2, reinforced with hay fibre
E	Timber frame: - vertical C24 strength class timber beams, 95×45 mm; - struts from the C24 strength class of timber beams, 95×45 mm

Fasteners:

Connecting elements	Fastener type	Essential requirements
Timber frame load-bearing elements	Paneltwistec screws according to ETA-11/0024	Diameter: ∅4 mm, ∅6 mm; ∅8 mm. Steel limit strength: ≥ 600 N/mm^2

P.1.2. Mechanical resistance and stability

Wall bearing capacity calculations were performed according to the requirements of LST EN 1990, LST EN 1991-1-1, LST EN 1995-1-1 and ETAG 007 guidelines. The calculations were carried out according to the ultimate safety state by applying the partial factor method.

Assumed in calculations:

- timber strength class C24 (characteristic timber density ρ_k = 350 kg/m^3);
- timber frame elements are connected with the screws Paneltwistec (∅4 mm; ∅6 mm, ∅8 mm, ETA-11/0024, steel strength limit R_m = 600 N/mm^2);
- effects of timber fibreboard used for wall panelling is not evaluated.

Calculations were made using the operating conditions class 2 according to LST EN 01-01-1995.

In case of different classes of the timber strength and operating conditions, and other types of joints, the load-bearing values indicated in the table is should be adjusted accordingly.

P.1.2.1. Design vertical bearing power under the medium and short-term load

The load of roofing and floor elements asked be transferred to the walls through additional elements (beams, joists). The bearing capacity of those elements must be verified in separate calculations.

The design vertical load-bearing capacity of external timber frame walls under the medium and short-term loads is presented in Table P.1.2.1.

P.1.2.1. Design vertical load-bearing capacity (kN/m) under medium and short-term loads

Design scheme of the panel	Design vertical load-bearing capacity (kN/m), when the load duration	
	average	short-term
Without struts (Annex 2, Fig. P.2.1)	36.9	41.45
With struts (Annex 2, Fig. P.2.2)	56.2	63.2

P.1.2.2. Design vertical load-bearing capacity under short-term load acting along with the horizontal load (perpendicular to the plane of the wall)

Horizontal loads are approximately taken according to the possible maximum wind load pressures in Lithuania areas.

The design vertical load-bearing capacity of external timber frame walls acting along with the horizontal load (perpendicular to the plane of the wall) is presented in Table P.1.2.2.

P.1.2.2. Design vertical load-bearing capacity (kN/m) at a short-term load along the horizontal (perpendicular to the plane of the wall) load

Design scheme of the panel	The design vertical load-bearing capacity (kN/m), the horizontal load q (kN/m2)		
	1.8	2.1	2.4
Without struts (Annex 2, Fig. P.2.1)	29.5	25.8	22.2
With struts (Annex 2, Fig. P.2.2)	18.8	11.1	3.5

P.1.2.3. Design horizontal (perpendicular to the plane of the wall) carrying power in the instantaneous load time

Wall batten exterior load-bearing capacity must be verified in separate calculations.

External timber frame walls The design horizontal (perpendicular to the plane of the wall) carrying power in the instantaneous load time is presented in Table P.1.2.3.

P.1.2.3. Design horizontal load-bearing capacity (perpendicular to the plane of the wall) under instant-term load

Design scheme of the panel	$q_{H.d}$ (kN/m^2)
Without struts (Annex 2, Fig. P.2.1)	5.05
With struts (Annex 2, Fig. P.2.2)	2.4

P.1.2.4. Design shear load-bearing capacity (in the wall plane) under short-term and instantaneous load

The shear load-bearing capacity calculations assume that the frame wall is anchored to the base.

The design shear load-bearing capacity (in the wall plane) of external framed walls under short-term and instantaneous load is presented in Table P.1.2.4.

P.1.2.4. Design shear load-bearing capacity (in the wall plane) (kN/m) under short-term and instantaneous loads

Design scheme of the panel	Design shear load-bearing capacity (kN/m), when the load duration	
	short-term	instantaneous
Without struts (Annex 2, Fig. P.2.1)	0	0
With struts (Annex 2, Fig. P.2.2)	2.56	3.12

P.1.2.5. Design vertical bearing power under the medium and short-term load

Only the load bearing wooden elements of one side were evaluated in the calculations of the design vertical bearing power of the truss lintel. The load of roofing and floor elements asked be transferred to the walls through additional elements (beams, joists). The bearing capacity of those

elements must be verified in separate calculations. The required length of support must be calculated in the lintel support area.

The design vertical bearing power under the medium and short-term load is presented in Table P.1.2.4.

P.1.2.5. Design vertical load-bearing capacity (kN/m) under medium and short-term loads

Load duration	**Design vertical load-bearing capacity (kN/m), when the load duration**
Medium	3.95
Short-term	4.45

P.1.3. Thermal characteristics

P.3.1. Thermal insulation layer of straw

The main thermal insulation material these panels – pressed layer of straw. Thermal resistance of this layer and the thermal conductivity are determined by measuring samples according to LST EN 12667 and thick samples – according to LST EN 12939.

The declared values of the thermal conductivity and thermal diffusivity coefficients are determined under the following conditions:
- average temperature – 100 ºC;
- samples are conditioned by keeping them at least for 6 h in the temperature of (23±2) ^{0}C, and in (50±5)% relative humidity of air;
- the measured values are expressed in three significant digits;
- thermal resistance R_D and the declared thermal conductivity coefficient λ_D is the limit values which represent at least 90% of production at 90% confidence level;
- value of the thermal conductivity coefficient $\lambda_{90/90}$ is rounded with the accuracy of 0.001 W/(m·K) to the higher side and is shown as λ_D every 0.001 W/(m·K);
- the declared value of thermal resistance R_D is calculated by the nominal thickness d_N and the corresponding heat transfer coefficient value $\lambda_{90/90}$;
- thermal resistance value of $R_{90/90.}$ where it is calculated from the nominal thickness d_N and the corresponding heat transfer coefficient value $\lambda_{90/90.}$ is rounded with the accuracy of 0.05 (m^2·K)/W to the smaller side, and presented as R_D every 0.05 (m^2·K)/W.

The declared values are calculated from at least ten test results of the thermal resistance or thermal conductivity.

Thermal properties of the straw insulating layer are presented in Table P.1.2.1.

P.1.3.1. Thermal properties of the straw insulating layer

Technical parameters of the thermal insulation layer of straw	**λ_D [W/(m·K)]**	**d_N [mm]**	**R_D [(m^2·K)/W]**
Density: 98 ÷ 127 kg/m^3 Humidity: 12% Water vapour diffusion resistance factor μ: 1,4	0.060	400	6.65

P.1.3.2. Thermal characteristics of the panel

thermal properties of the panel are determined in the test in accordance with LST EN ISO 12567-1:2010. LST EN ISO 8990. LST EN 1934:2000 and calculations in accordance with LST EN ISO 6946:2008.

Tests and calculations were performed under the following conditions:
- fibre boards λ_{ds}=0.049 W/(m·K);
- clay plaster λ_{ds}=0.0521 W/(m·K);

Thermal characteristics of the panel is presented in Table P.1.2.3.

P.1.3.2. Thermal characteristics of the panel

Technical parameters of the panel	U_{pl} [W/(m^2·K)]	R_{pl} [(m^2·K)/W]
Layers: - 30 mm clay plaster layer, ρ=1600 kg/m^3, λ_{ds}=0.521 W/m^2·K; - 400 mm layer of straw, ρ=98 ÷ 127 kg/m^3, λ_D=0.060 W/m^2·K; - 60 mm wood fibreboard, ρ=270 kg/m^3, λ_D=0.049 W/m^2·K	0.123	8.1

P.1.4. Class of reaction-to-fire performance

Flammability class was found by testing the panel test pieces in accordance with LST EN ISO 11925-2, LST EN 13823 and the classification in accordance with LST EN 13501-1. Tests were carried out on the external finishing layer.

Panel flammability classification results are shown in Table P.1.6.1.

P.1.4.1. Panel flammability classification results

Panel configuration	Class of reaction-to-fire performance	Extended application range
Configuration 1: – wood frame (timber without protective coating, moisture content 8%); – thermal insulation compressed straw layer (density ≈100 kg/m^3, thickness 160 mm, humidity 12%); – fibreboard (density 270 kg/m^3, thickness 60 mm); – external layer (exposed to flame): – reinforcement lattice (165 g/m^2) – Baumit open KlebeSpachtel White reinforcement – adhesive mixture (thickness 4.5÷5.0 mm, area mass 5.8÷6.5 kg/m^2) – Baumit UniPrimer primer (area weight 0.3 kg/m^2) – Baumit NanoporTop decorative plaster (thickness 2 mm, area weight 3.2 kg/m^2)	B-s1,d0	This classification is applied for the specified configuration and can be extended to these product parameters: - compressed straw thickness ≥ 160 mm; - any unpainted mineral decorative plasters, with the thickness of ≥ 2 mm
Configuration 2: - wood frame (timber without protective coating, moisture content 8%); - hardpanel strips every 20 cm (density 250 kg/m^3, thickness 5 mm);	B-s1,d0	This classification is applied for the specified configuration and can be extended to these product parameters: - compressed straw

- thermal insulation compressed straw layer (density ≈100 kg/m^3, thickness 170 mm, humidity 12%); - external (layer 0 exposed to flame: – clay plaster "Brown clay", 3 layers (thickness 30 mm, density 1600 kg/m^3, area mass 48 kg/m^2, reed fluff 0.05 %reinforcing mesh of 165 g/m^2 is placed between the second and third layer) – decorative clay plaster "White clay" (thickness 2 mm, density 1600 kg/m^3, area mass 3.2 kg/m^2, cellulose 0.025%)		thickness ≥ 170 mm

P.1.5. Airborne sound insulation indicator

Airborne sound insulation indicator was determined according to LST EN ISO 10140-1, LST EN ISO 10140-2, LST EN ISO 10140-4, LST EN ISO 10140-5 and LST EN ISO 717-1.

Airborne sound insulation value of the panel is presented in Table P.1.2.4.

P.1.5.1. Airborne sound insulation value of the panel

Panel configuration	Airborne sound insulation indicator
Configuration: - fibreboard (density 270 kg/m^3, thickness 60 mm); - timber frame; - thermal insulation layer of compressed straw (density 98 ÷ 127 kg/m^3, thickness 400 mm); - inner layer – clay plaster, thickness 30 mm, density 1600 kg/m^3	R_W (C;C_{tr};$C_{100-5000}$) = 54 (-1;-3;0)

P.1.6. Resistance of the thermal insulating straw layer to biological effects

Test of mould fungi resistance of the straw insulating layer was conducted in accordance with ONORM B 6010 methodology applied to the straw samples. The test determines the mould fungi resistance of the samples by storing them for 28 days at a temperature of (23±2) ^{0}C, under 95% relative humidity. At the end of the test the samples were evaluated according to the intensity of the fungi growth on them, using a 5 point scale according to LST EN ISO 846.

Assessment results of the resistance of thermal insulating straw layer to biological effects are shown in Table P.1.6.1.

P.1.6.1. Resistance of the thermal insulating straw layer to biological effects

Sample storage conditions	Resistance to biological impacts (points according to LST EN ISO 846)
28 days at ambient temperature of (23±2) ^{0}C and relative air humidity of 50 %	0 (no visible fungal growth through a microscope)
28 days at ambient temperature of (23±2) ^{0}C and relative air humidity of 95 %	2 (fungal growth visible with the naked eye covers the up to 25% of the sample surface)

Annex 2
(normative)

General view of the wooden frames of the product

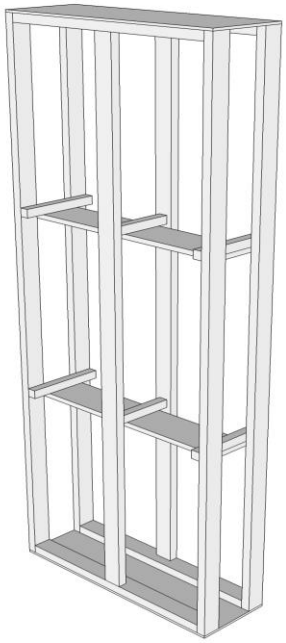


Fig. P.2.1 Wooden frame of panel T1 (no struts)

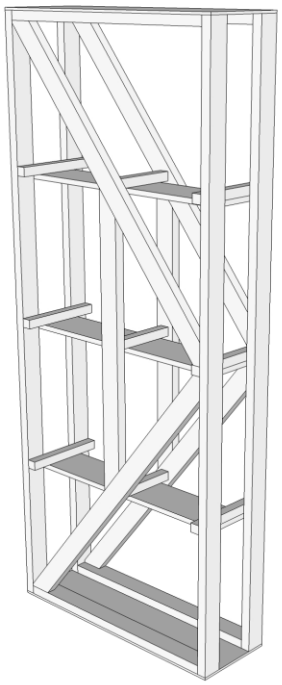


Fig. P.2.2 Wooden frame of panel T2 (with struts)

Fig. P.2.3 Wooden frame of truss lintel

Annex 3
(normative)

Control plan

Products must be accepted after the evaluation of the results of materials, production process, finished goods testing, periodic testing, and the requirements of this technical approval.

P3.1. Control of incoming materials

The incoming materials control plan is presented in Table P3.1.

P3.1. Incoming materials control plan

No	Name of the raw material, characteristic	Test/control method	Requirement	Control/testing frequency
1	**Timber**			
1.1	Wood strength class	According to the conformity documents of the supplier	C24	Each batch before unloading
1.2	Wood moisture content	Measurements according to LST EN 13183-2	Not exceeding 20%	Each batch before unloading
1.3	Wood sectional dimensional accuracy	Measurement	Dimensions (95×45) mm. Accuracy – class 2 according to LST EN 336	1) each batch prior to unloading. 2) before using in the production
1.4	Wood shape accuracy	Measurements according to LST EN 1310	- spring ≤ 4 mm in 2 m length; - bow ≤ 6 mm in 2 m length; - twist ≤ 6 mm in 25 mm width and in 2 m length; - cup ≤ 2 mm in 100 m of the side;	1) each batch prior to unloading. 2) before using in the production
1.6	Resistance of wood to the biological effects of environment	According to the conformity documents of the supplier	LST EN 350-2, LST EN 351-1, LST EN 460	Each batch before unloading.
2	**Straw**			
2.1	Humidity	Measuring according to the manufacturer's method	Not exceeding 20%	1) each roll before unloading 2) before using in the production
2.2	Biocide (pesticide) quantity	According to the supplier’s declaration	Requirements of Directive 98/8/EC for biocidal products	Each batch according to the supplier and place before unloading.
2.3	Straw structure	Manufacturer's method	technical specification of the manufacturer	Each batch according to the supplier and place before unloading.
3	**Metal fasteners**			
3.1	Type	According to the conformity documents of the supplier	Type according to working drawings	Each batch before unloading
3.2	Durability (corrosion resistance)	According to the conformity documents of the supplier	According to the working drawings	Each batch before unloading
4	**Fibreboard**			
4.1	Type	According to the	According to the working drawings	Each batch before

		conformity documents of the supplier		unloading
4.2	Appearance	Visual inspection	According to the reference sample	Each batch before unloading
4.3	Accuracy of measurements	Measurement	According to the working drawings	Each batch before unloading
5	**Plywood**			
5.1	Type	According to the conformity documents of the supplier	According to the working drawings	Each batch before unloading
5.2	Appearance	Visual inspection	According to the reference sample	Each batch before unloading
5.3	Accuracy of measurements	Measurement	According to the working drawings	Each batch before unloading

Notes:
- spring – longitudinal shift of the lumber workpiece, perpendicular to the edge;
- bow – lengthwise shift of the lumber workpiece perpendicular to the sides;
- twist – helical lengthwise twisting of the lumber workpiece sides;
- cup – curvature of the lumber workpiece perpendicular to the width of the side;

P3.2. Manufacturing process control

The manufacturing process control plan is presented in Table P3.2.

P3.2. Manufacturing process control plan

No	Name of the raw material, characteristic	Test/control method	Requirement	Control/testing frequency
1	**Wood blanks preparation**			
1.1	Cross-sectional dimensions of timber (if the timber is cut)	Measurement	Class 2 according to LST EN 336	Prior to the use of production
1.2	Wood shape accuracy	Measurements according to LST EN 1310	- spring* ≤ 4 mm in 2 m length; - bow** ≤ 6 mm in 2 m length; - twist*** ≤ 6 mm in 25 mm width and in 2 m length; - cup**** ≤ 2 mm in 100 m of the side	Prior to the use of production
1.3	Wane	Visual	Impermissible	Prior to the use of production
1.4	Wood impregnation (if necessary)	Measurement	According to the technological documentation: - material quantity; - coverage thickness; - impregnation depth	Each batch
2	**Wood frame assembly**			
2.1	Selection of fasteners	Visually, measurement	According to the working drawings requirements	Each fastener type
2.2	Accuracy of assembly	Measurement	According to the working drawings requirements	Each frame
3	**Pressing of the thermal insulation layer of straw**			
3.1	Density	Weighing	100 ÷ 130 kg/m^3	In case of doubt
3.2	Planes	Measurement	± 2 mm in 2 m length	In case of doubt
4	**Clay plaster (prescription) manufacturing**			
4.1	Dispensing accuracy	Weighing	± 2%	Each mixture

P3.3. Finished product control

The finished production control records are presented in Table P3.3.

P3.3. Finished production control records

No	Control name	Test/control method	Control frequency
1	Control of shape and dimensions	Measurement	Each panel
2	Panel weight	Weighing	Each panel
3	Moisture content of the thermal insulation layer of straw	Measurement	Each panel
4	Marking	Visual control	Each product

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Sachverständiger
DIN EN ISO/IEC 17024:2012
Zertifizierungs-Nr.:
ZN - 20120928 - 0262
Gültig bis 10/2017
Personen-zertifizierter Sachverständiger

Bjorn Kierulf
Createrra s.r.o.
Hruby Sur 15

90301 Senec
Slovak Republic

Zertifizierter Sachverständiger
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Bauphysik, Fenstermontagen,
energetische Bewertung von
Gebäuden und Energieeffizienz

Bonn, den 28.08.2013

Straw Bale House

Dear Mr. Bjorn Kierulf,

the calculations with WUFI have been done under the following conditions:

- **climate data: Wien, Hohe Warte**
- humidity of the materials: straw < 17%
- indoor climate: high humidity loads (bathrooms or similar as maximal humidity)
- exterior wall: west (main wheater side)

1) Wall construction with 4mm plaster

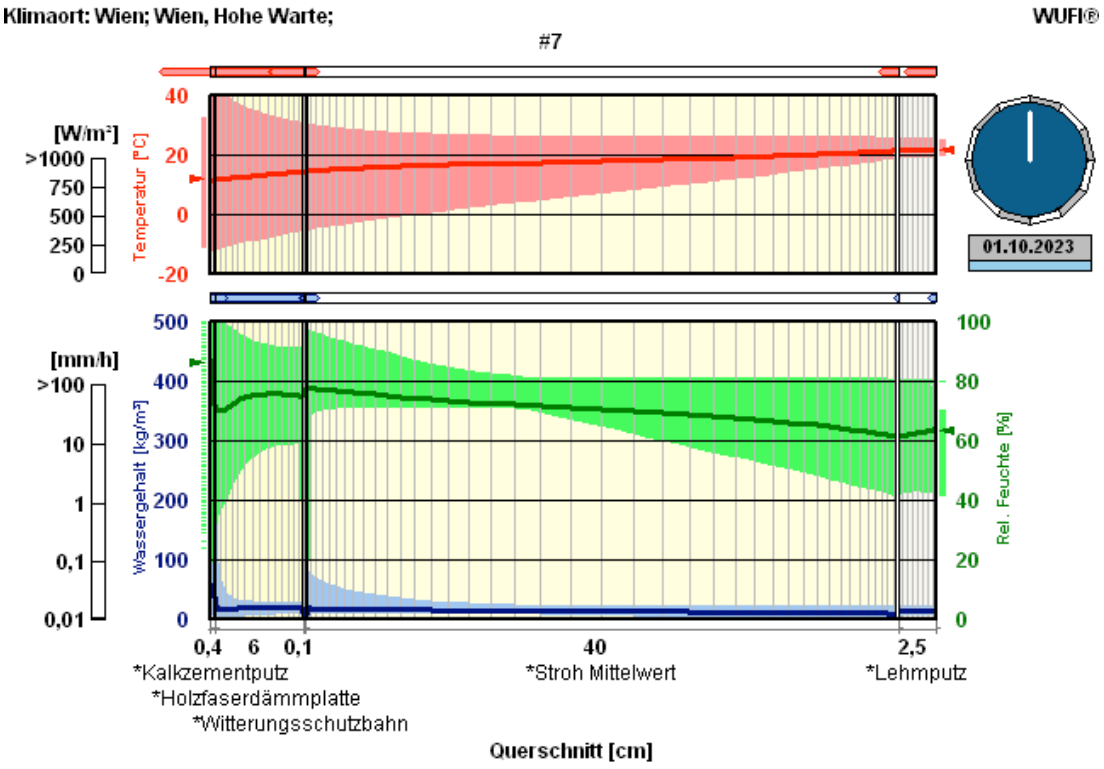
Construction from inside to outside:

clay plaster 25mm
straw 400mm
roofing membrane SD: 0.2 m
wood fibre insulation board 040 60mm
exterior plaster 4mm

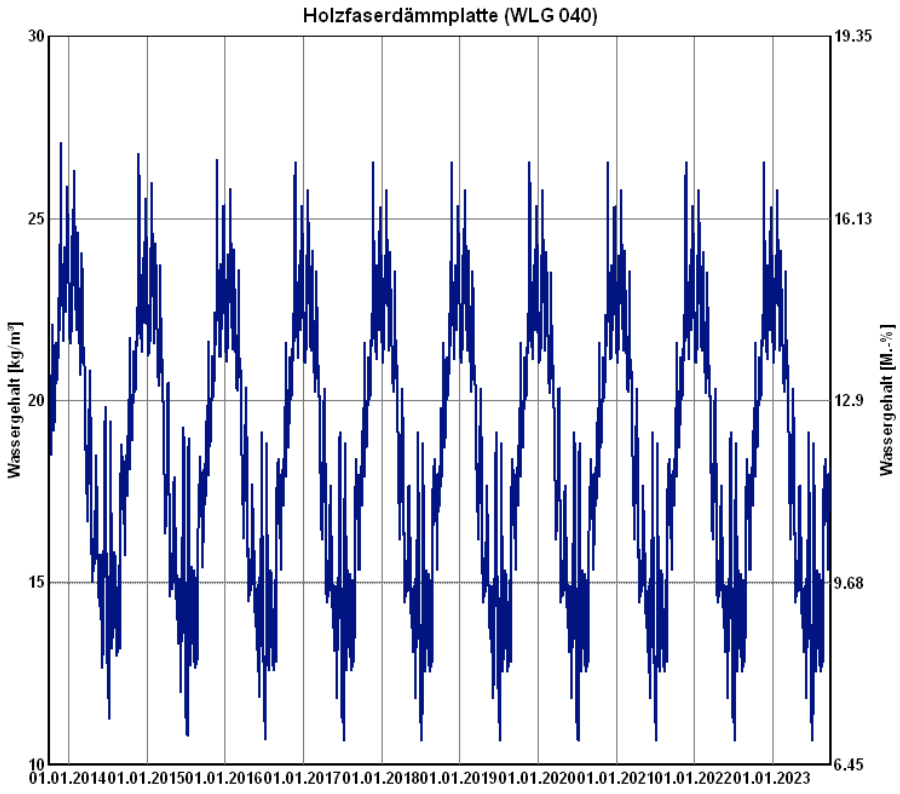
The exterior plaster with a w-value (coefficient of water absorption) of <0.1 kg/m2 * h.

Under these conditions, the calculations for the relevant components have revealed the following:

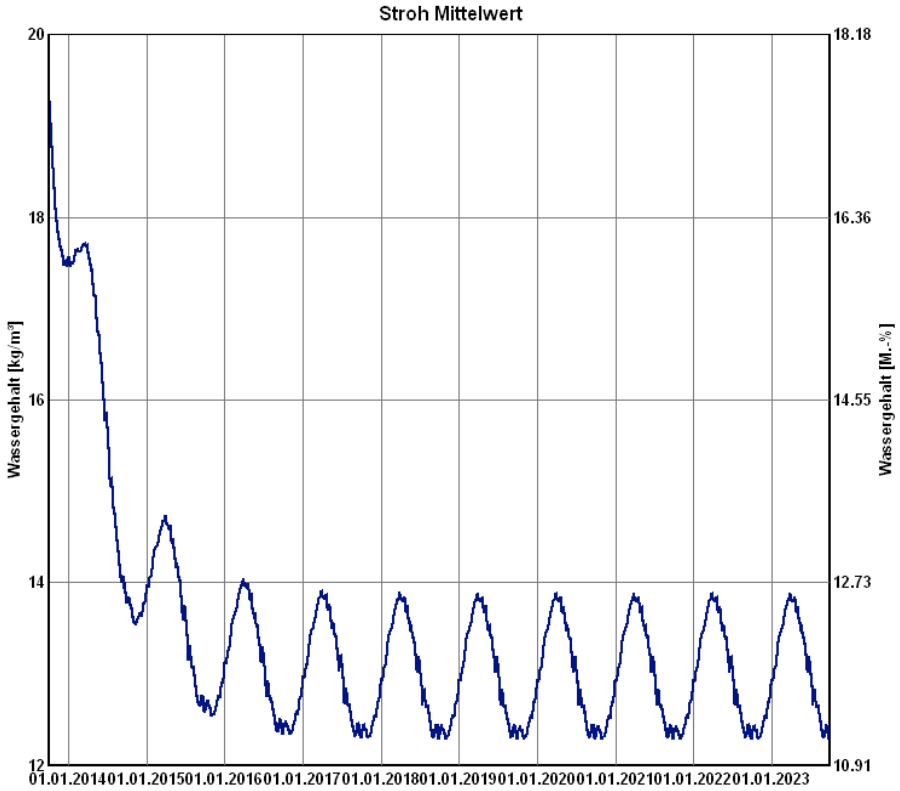
Whole construction:



Wood fibre insulation board:



Straw bale:



This construction can be realised under the following conditions:

- The exterior plaster must have permanently a w-value of <0.1 kg/m2 * h.
- The w-value must be frequently controlled. If the value increases over 0.3 kg/m2 * h the construction is not longer realisable

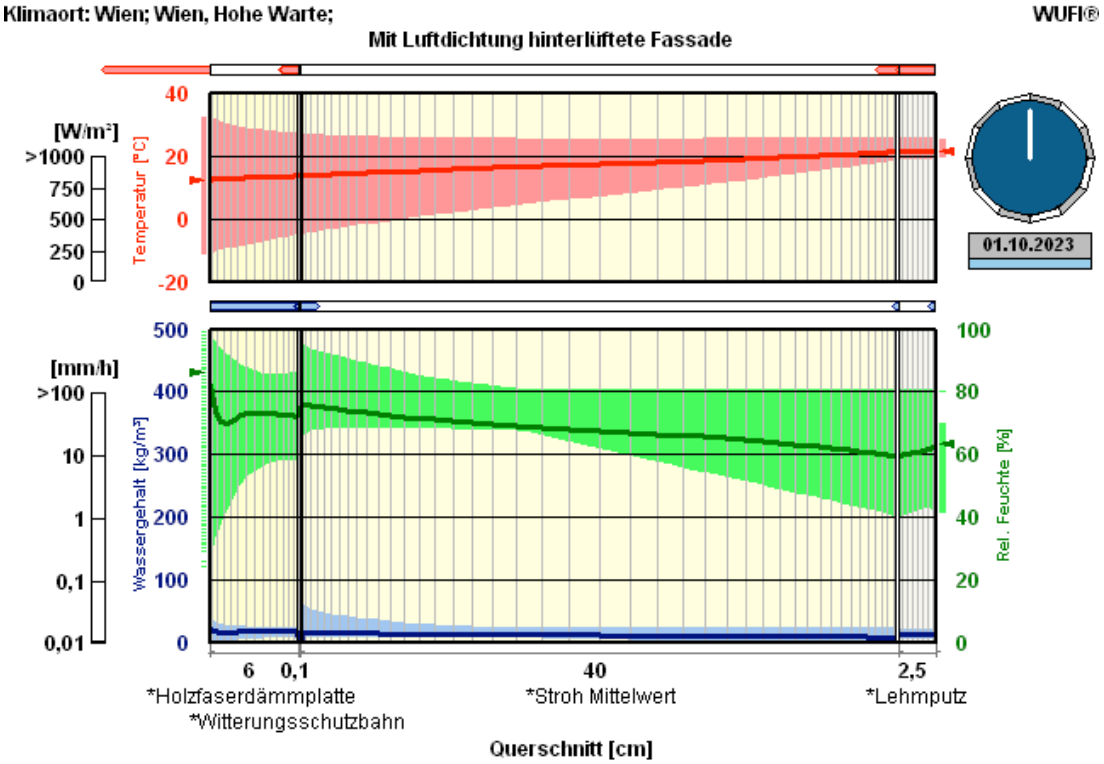
2) Construction with ventilated facade:

The construction with the ventilated facade, without rainfall on the wood fibre insulation board, has the following results:

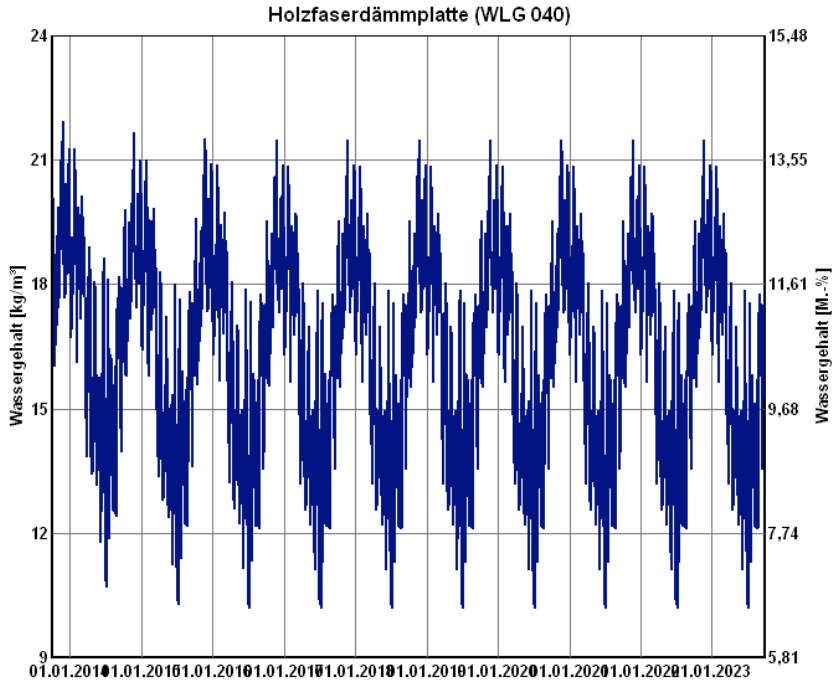
Construction from inside to outside:

clay plaster 25mm
straw 400mm
roofing membrane SD: 0.2 m
wood fibre insulation board 040 60mm
ventilated facade

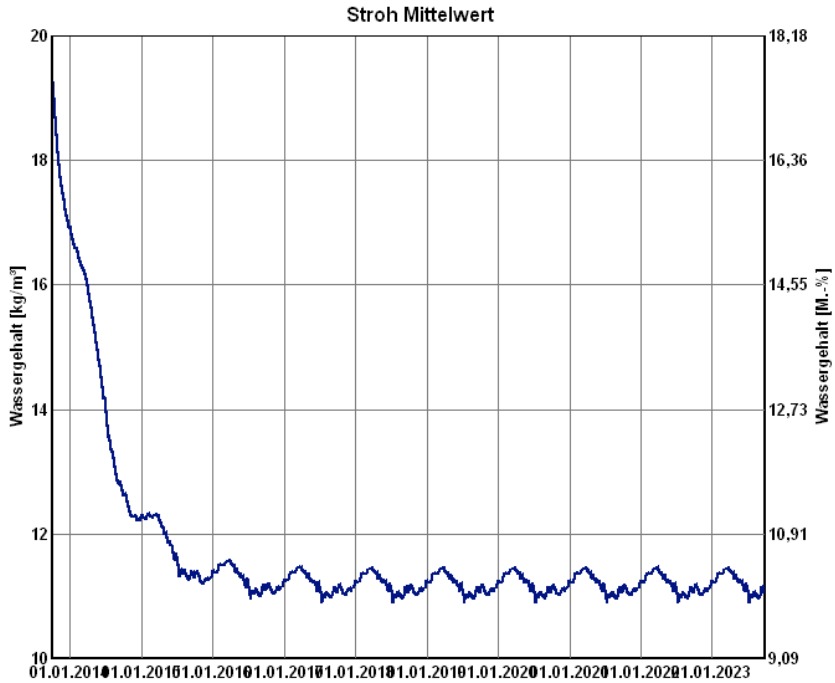
Whole construction:



Wood fibre insulation board:



Straw bale:



The construction can be realised.

The same construction could also be realised without the roofing membrane, if the vapor tightness is ensured on the inside.

Kind regards

Michael Brandhorst

Annotation:

The values for the Straw bale are average values, of all existent analysis. The following values has been used for the calculations:

raw density	100,0	kg/m^3
porosity	0,9	m^3/m^3
thermal capacity	2000	J/kgK
thermal conductivity	0,045	W/mK
diffusion resistance coefficent	1,3	-

Due to their inhomogeneity exact values for straw bales are not definable. The above-mentioned calculations present only refenrence values.

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Bonn, den 28.08.2013

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90301 Senec
Slovak Republic

Straw Bale House

Dear Mr. Bjorn Kierulf,

The calculations with WUFI have been done under the following conditions:

- **climate data: Miami, cold year**
- humidity of the materials: straw < 17%
- indoor climate: high humidity loads (bathrooms or similar as maximal humidity)
- exterior wall: southeast (main wheater side)

1) Wall construction with 4mm plaster

Construction from inside to outside:

clay plaster 25mm
straw 400mm
roofing membrane SD: 0.2 m
wood fibre insulation board 040 60mm
exterior plaster 4mm

The exterior plaster with a w-value (coefficient of water absorption) of <0.1 kg/m2 * h.

Under these conditions, the calculations for the relevant components have revealed the following:

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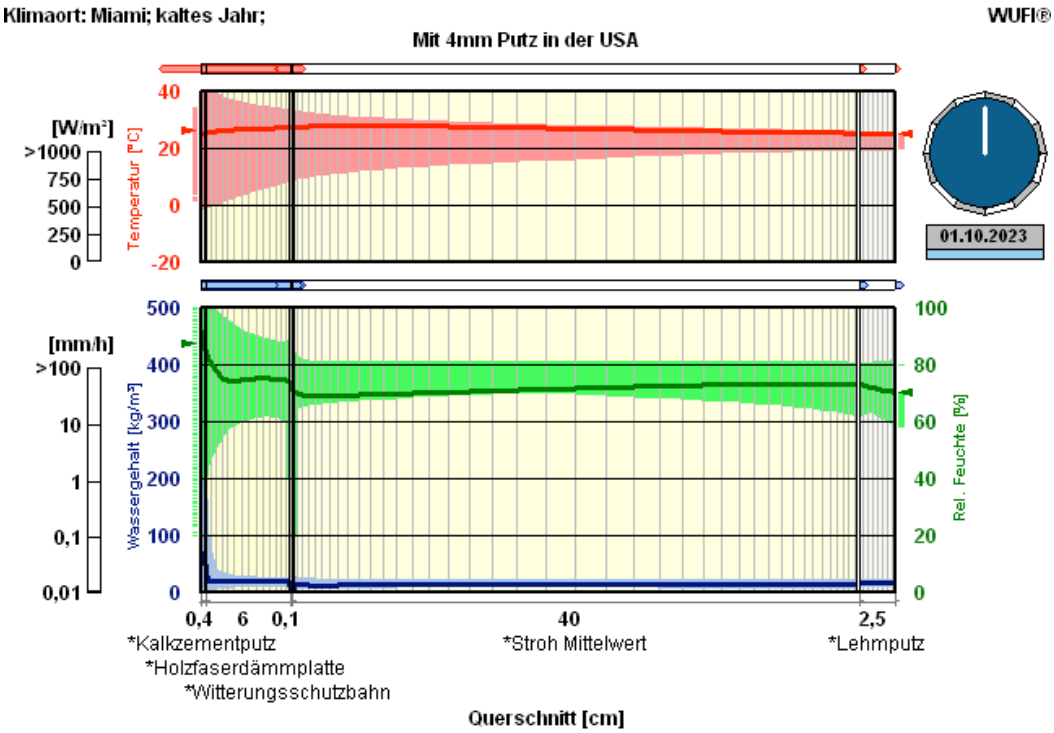
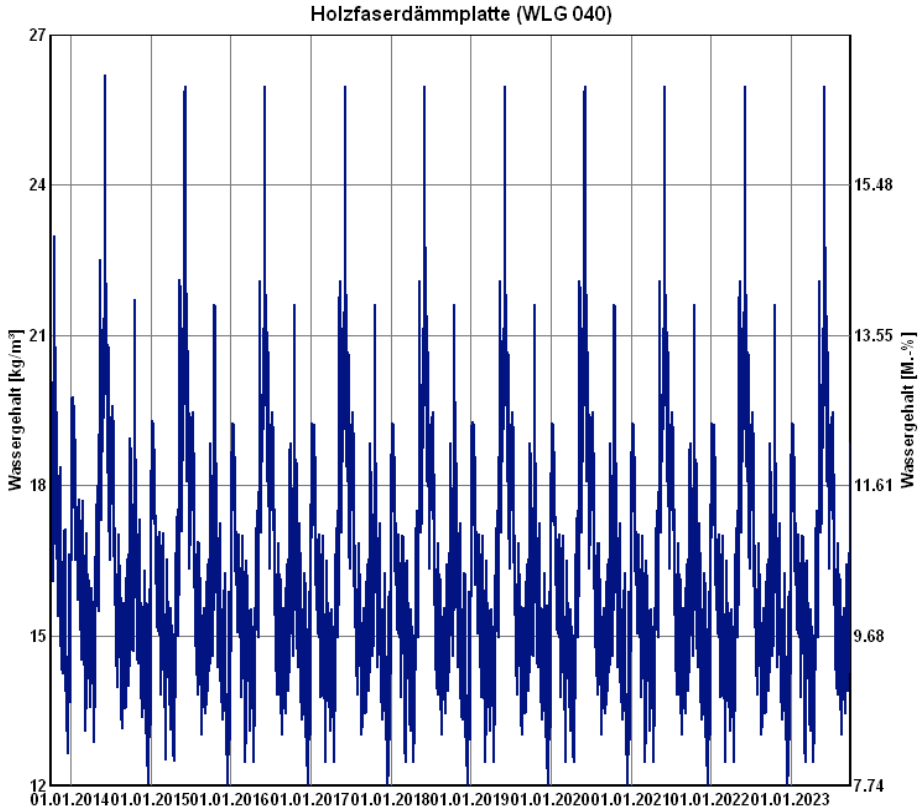


Wood fibre insulation board:



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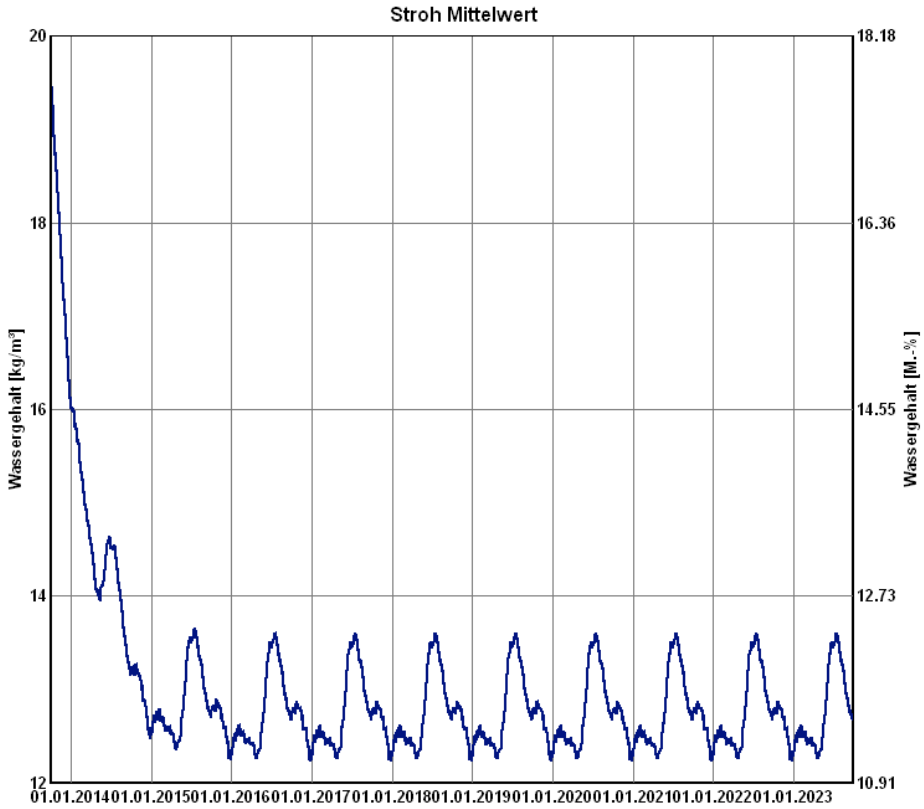

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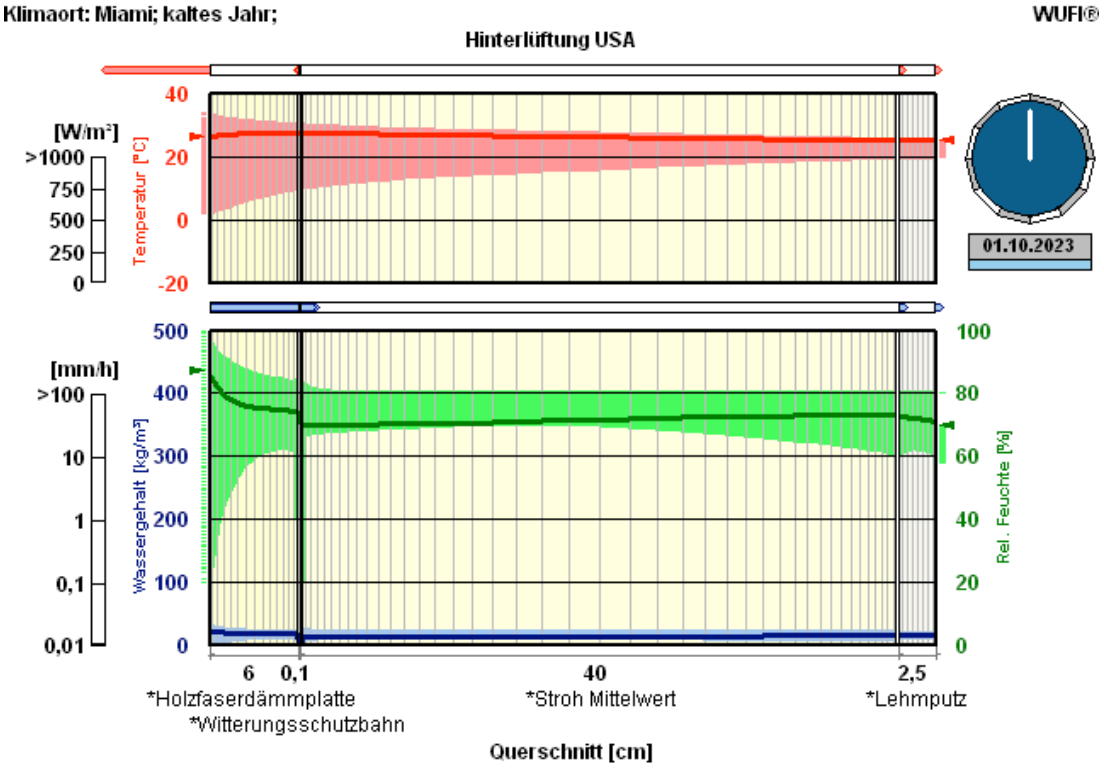
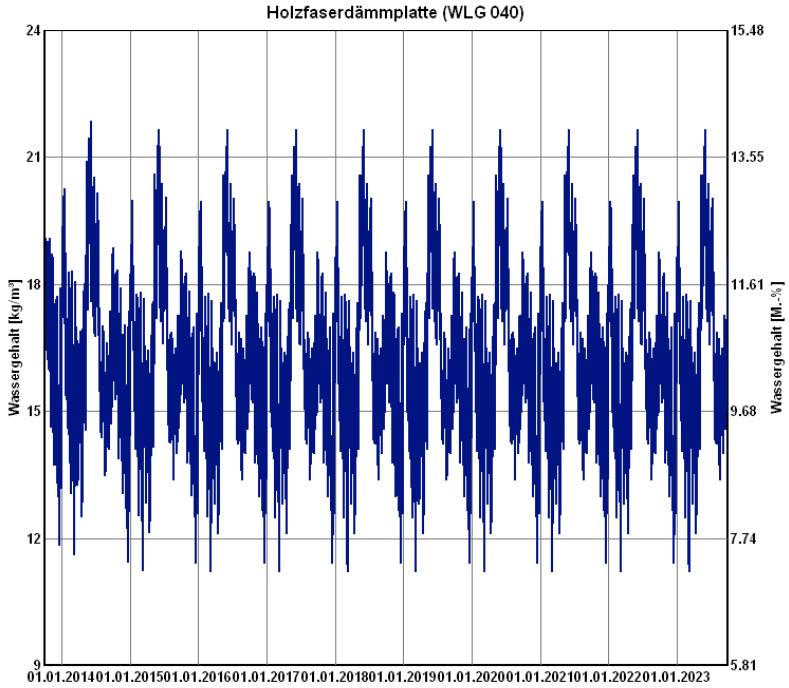
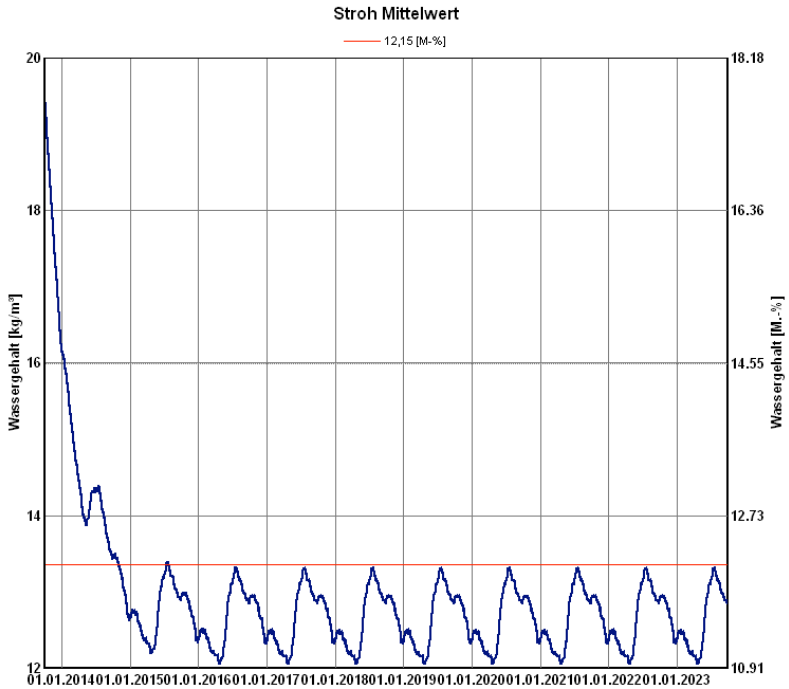


Wood fibre insulation board:



Straw bale:



The construction can be realised.

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