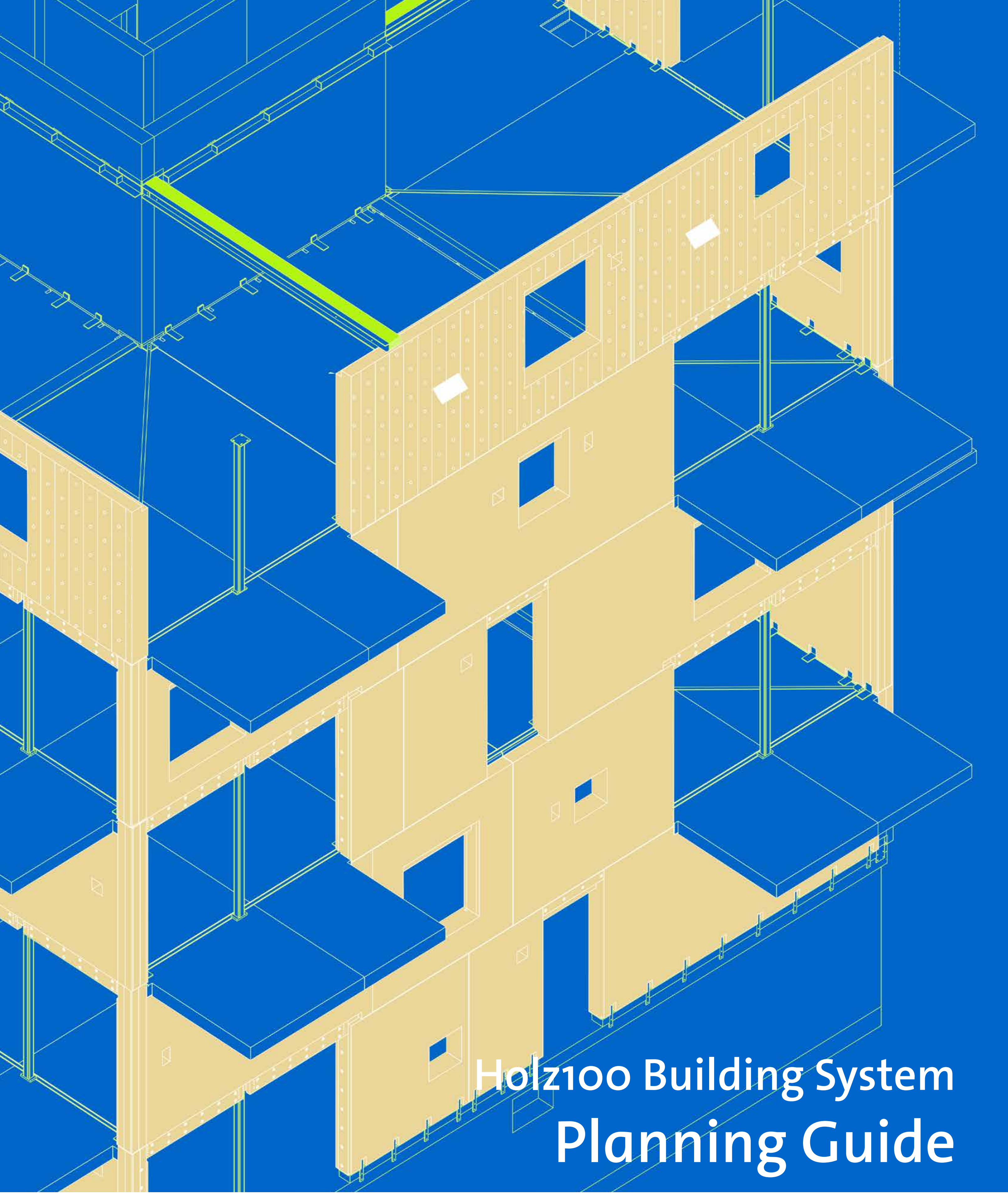


Holz100 Building System
Planning Guide

Thoma

Contents

Preface

With this parts catalogue, we aim to provide technically interested readers with essential information, details and ideas for working and planning with Holz100.

Research and development are a top priority in our company. As a result, our possibilities are constantly expanding as we forge new paths. The pages below are only snapshots that reflect a small part of our expertise. Please do not hesitate to contact us directly if you have any questions.

We wish you pleasure and inspiration,
Florian & Erwin Thoma

Florian and Erwin Thoma

Our credo

Thoma builds the healthiest homes – this is scientifically proven and verifiable.

This is achieved primarily by moonwood that is mechanically fastened with dowels and does not contain the usual poisonous bonding agents and wood preservatives.

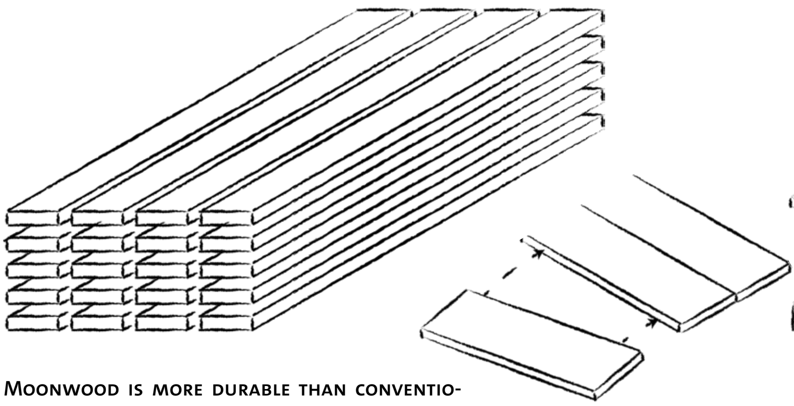
Thoma houses are a prime example of waste-free construction based on the ecocycle principle of forests. At present, the construction industry is the largest waste producer in the world.

Through innovation and patents, we build energy self-sufficient wooden houses or buildings with minimal energy requirements – without any stressful insulating materials and without complicated technology.

Thoma houses that heat and cool themselves make nuclear power plants superfluous. They end wars over oil. Thoma houses are like trees - creating cities like forests.

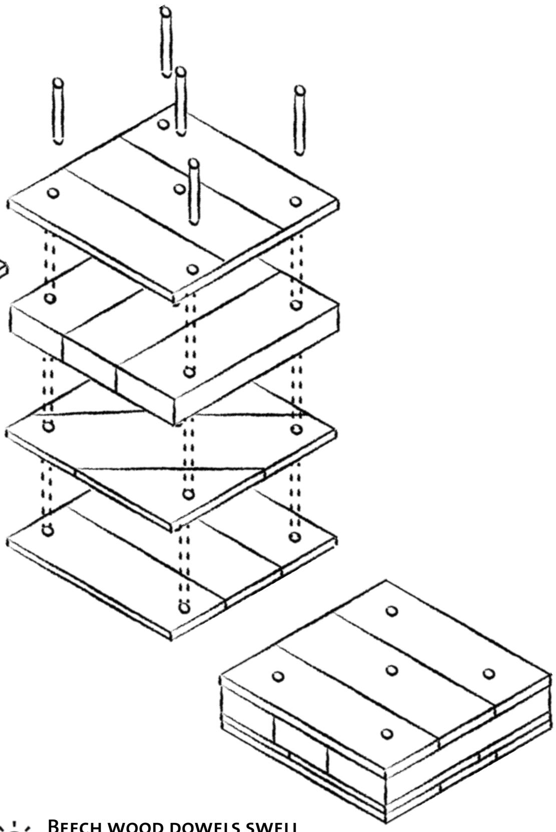
Functional principle of Holz100

In modern timber construction, the dowel with its swelling force is the perfect alternative to the usual glued joints.
Dowellings can already be found in the oldest timber buildings of mankind. Thousand-year-old wooden temples of Asia are held together by wooden dowels and sophisticated plug connections alone.
Together with the two technical universities of Vienna and Karlsruhe, we carried out scientific research into this natural phenomenon at the Thoma Research Centre and developed the Holz100 dowelled solid wood construction system in the 1990s as a pioneering company.
Thoma Holz100 elements are flat wooden components up to 364 mm thick, consisting of parallel, crosswise (right-angled) and 45° layers of boards and squared timber connected to each other by hardwood dowels made of beech. Solid wood panels are used as load-bearing, stiffening or non-load-bearing wall, ceiling, roof or special components for wooden structures.



Moonwood is more durable than conventional wood – it replaces wood preservatives in a natural way.

View into the workshop: A wall element is laid by hand before it is dowelled in the next step.



Beech wood dowels swell in the wood and mechanically create an insoluble bond, which replaces any kind of glue.

Technical data

PROPERTY	VALUE	PROOF
Type of wood	Spruce, fir, PEFC certified wood	Other wood types on request
Board and core layers	2.4-8 cm	Technically dried and quality sorted
Strength and grading class	C24 (=S10) and max. 30 % C16 (=S7)	ETA - 13/0785
Wood moisture	12 % (+/- 2 %)	on delivery
Maximum format	L = 8.5 m, B = 3.10 m, D = 0.364 m	Custom-made products possible
Gross density	450 kg/m³ and 5.0 KN/m³	Density for transport weight Weight: according to EN 1991-1-1 for structural calculations
Thermal conductivity	λ= 0.079 - 0.12 W/(m*K)	Values according to test reports and standards
Heat capacity	cp = 1.6 kJ/(kg*K)	EN ISO 10456
Diffusion resistance	μ = 37	Values acc. to test report
Air permeability	Class 4	Values according to test report, according to EN 12207, connections, front surfaces etc. must be sealed accordingly
Reaction to fire	Class D-s2 d0	Table value acc. to EN 13501-1
Fire resistance H-100 W17	REI 60	Acc. to test report, in conformity with EN 13501 -2
Fire resistance H-100 W36 (not thermal)	REI 120	Acc. to test report, in conformity with EN 13501 -2
Burn rate	0.7 mm/min	Table value acc. to EN 13501-1

Wall types

36.4cm outer wall

Our thick exterior wall with its 36 cm solid wood offers best living climate and highest comfort. It allows building without insulation.

Product name: H100 - W36
Function: Thermal outer wall, load-bearing
Element thickness: 36.4 cm
Core layer: 80 mm
Top layer: horizontal or vertical
Structure: 11 layers
v – h – v – h – d – k – d – h – v – h – v

30.6cm outer wall

With its almost 140 kg per square metre, this wall manages to compensate for heating and cooling load peaks over a period of one month thanks to its high storage capacity.

Product Name: H100 - W30
Function: Thermal outer wall, load-bearing
Element thickness: 30.6 cm
Core layer: 80 mm
Top layer: horizontal or vertical
Structure: 9 layers
v – h– v – h– d – k – d – h– v

25cm outer wall

Our 25 cm wall is the first to be designed in "Holz100-Thermo" and thus offers higher insulation properties than normal solid wood. The 80 mm thick core also increases the vertical load-bearing capacity of the wall.

Product name: H100 - W25
Function: Thermal outer wall, load-bearing
Element thickness: 25.0 cm
Core layer: 80 mm
Top layer: horizontal or vertical
Structure: 7 layers
v – h– d – k – d – h – v

20cm outer wall

The 20 cm wall offers a high level of fire protection and all advantages of a solid wood wall thanks to the thick wall structure.

Product Name: H100 - W20
Function: External wall, load-bearing
Element thickness: 20.0 cm
Core layer: 60 mm
Top layer: horizontal or vertical
Structure: 6 layers
v – h – d – k – d – v

17cm outer wall

The 17 cm Holz100 wall is the entry-level model for the exterior wall. It combines a cost-effective budget with a high standard of living health and comfort.

Product Name: H100 - W17
Function: External wall, load-bearing
Element thickness: 17.0 cm
Core layer: 60 mm
Top layer: horizontal or vertical
Structure: 5 layers
v – h – k – d – v

14cm inner wall

The 14 cm Holz100 wall is used as a load-bearing inner wall and increases the heat storage capacity of your house.

Product Name: H100 - W14
Function: load-bearing inner wall
Element thickness: 14.0 cm
Core layer: 60 mm
Top layer: horizontal
Structure: 4 layers
h– k – d – h

12cm inner wall

The 12 cm Holz100 wall is used as a non-load-bearing inner wall. It combines minimum wall thickness with the advantages of solid wood and good sound insulation.

Product Name: H100 - W12
Function: Non-load-bearing inner wall
Element thickness: 12.0 cm
Core layer: 40 mm
Top layer: horizontal
Structure: 4 layers
h– k – d – h

The position of the core layer is not always the same. It often depends on the structural specifications. The core layer is usually designed centrally under the wall plate to ensure optimum centric load transfer. With thick walls, the wall construction can be adapted accordingly.

Roof and ceiling types

21.2cm ceiling

Our 21 cm ceiling enables spans of over 5 metres in the roof area thanks to the upper and lower belts. It also has a structurally stiffening effect due to the two inner layers.

Product Name: H100 - D21
Function: Roof/ceiling element
Element thickness: 21.2 cm
Upper and lower belt: 7.7 cm
Structure: 4 layers

17.6cm ceiling

Our 17.6 cm ceiling has similar structural spans as its big sister with 21.2 cm. According to ETA, this board cannot be used as a bracing element in structural system. It is a cost-optimised solution for uncompromising solid timber construction.

Product Name: H100 - D17
Function: Roof/ceiling element
Element thickness: 17.6 cm
Upper and lower belt: 7.7 cm
Structure: 3 layers

Surfaces

The face of wood

The more you let wood show its true character, the more you learn to love its map-like unevenness, grain and knotholes, and the more your eyes will enjoy the sense of stability, orientation and security it provides.

Wood without knotholes is always worth less to me, always seems a bit poorer than wood that looks at me through its "eyes". It is precisely the small, resin-soaked openings, the so-called resin pockets, that bear witness to the uniqueness of the material. It is the irregularities, the cracks and joints that give wood its unique character and its aura. Wood creates environments that offer shelter and bold vantage points.

The courage to show the true character of wood is life affirming. This affirmation of life sustains us, gives us confidence and freedom.

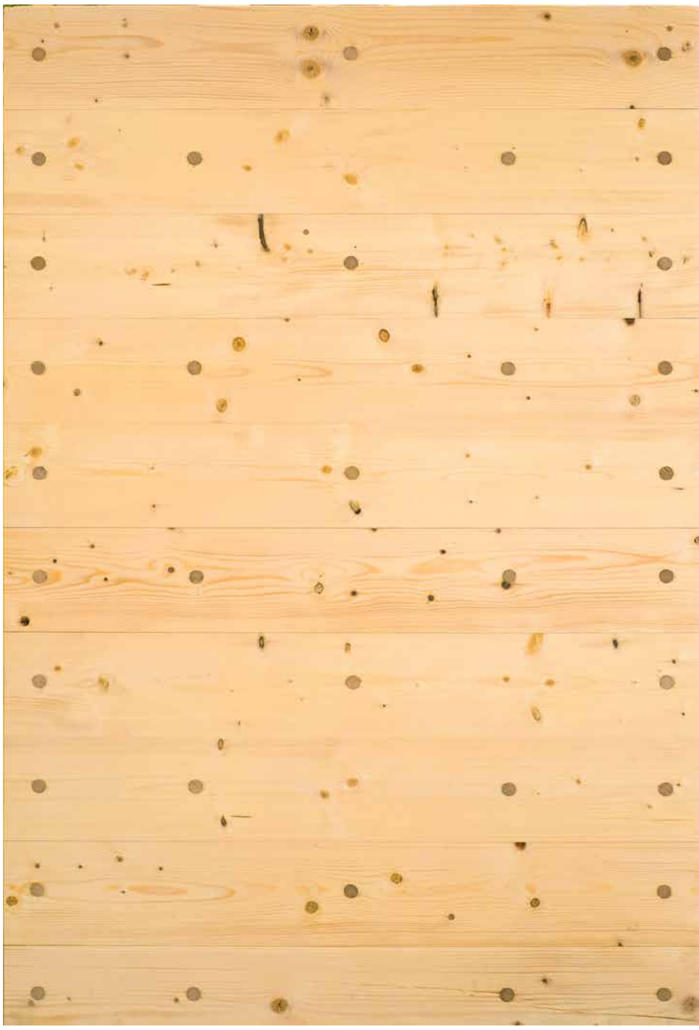
What joy it is to be accompanied by trees, their woods and their features.

Text excerpt
Erwin Thoma (Holzwunder, 2016)

Description

Holz100 elements consist of 100% natural, locally harvested moonwood, combined with rod dowels of local hardwood and are free of chemicals and synthetic glues. Our standard surface "natur" is designed in visible quality and no longer needs to be machined. The characteristics are described as follows:

Milled surface: The Holz100 surface is milled over the entire surface using a disc milling head and is not planed or sanded.
Forest edges: Only sharp-edged boards are used as cover boards, intermediate layers can have tree edges.
Colour defects: Blue stains, red streaks etc. are excluded – this applies to the Holz100 surface, but not to interlayer woods, natural wood discolourations such as browning in firs are permissible. No standard sorting of different wood colours is carried out for planed goods.
Worm infestation: is excluded.
Knotholes: are permitted in any number and size.
Torn-out knots and dowels: During milling, knots are always torn out. Such tears can be eliminated with little effort by inserting a knothole plug on site. Small tears may also occur around the dowel due to the high pressure of insertion.
Pitch pockets: We make every effort not to install highly resinous boards. Individual pitch pockets cannot always be prevented. If they disturb the visual appearance, it is technically possible to mill out the pitch pockets at the construction site and patch them with so-called "little ships" made of wood.
Traces of manipulation and transport: Basically, Holz100 elements are treated carefully. Minor traces of manipulation and transport, however, cannot be completely excluded. A removal of such traces on site by means of steel wool, grinding machine etc. is a small effort that poses no problem.
Holz100 hardwood dowels: Due to material-related swelling and shrinkage processes, the end-grain surfaces of the dowels may not seal evenly with the Holz100 surface. This does not imply any



Thoma standard surface "Natur" (spruce/fir)

restriction with regard to technical performance and cannot be completely excluded. Colour differences between hardwood dowels and the remaining Holz100 material or different colour shades of the individual dowels are standard and are to be understood as a trademark and sign of quality.
Individual knothole patches (plugs) and so-called "little ships" to repair natural wood defects (e.g. "sorted" surfaces) are possible. The patches are applied with small amounts of casein glue. Casein glue consists of: casein + water + lime, casein is a protein that is contained in large quantities in low-fat curd.
Joints: The top layers are butted in length and not laid 100% joint free in width. Depending on the heating and season, the seasonal formation of gaps will also occur in a natural process that accords with the wood.

Additional surfaces

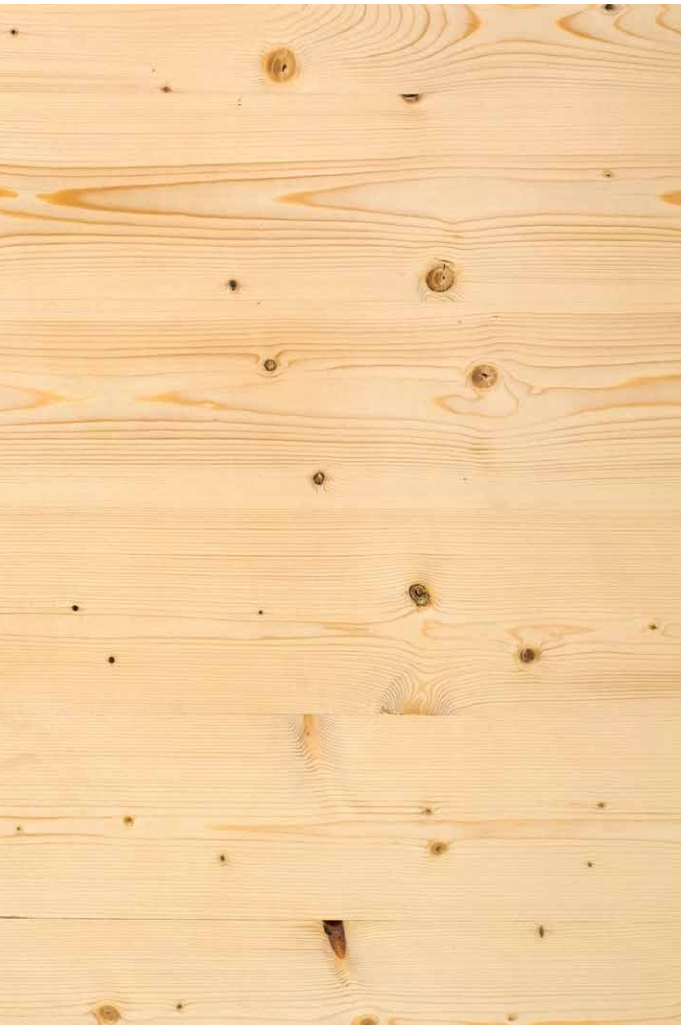
Dowel-free surface: Thanks to a special process, Holz100 walls and ceilings can be manufactured with invisible dowels on one side. Due to the thicker top layer required for this, dowel-free walls are 1.2 cm thicker. Smaller fixing dowels may be found sporadically in the surface.
The"sorted" surface is characterised by the fact that the top layer boards are sorted again. Knotholes and torn-out knots are only allowed up to a size of 1 cm. Pitch pockets are largely excluded. Other distinctive wood features are repaired as described above with knothole fixes (plugs) and patches.

In the planning phase, you can decide together with our engineers whether you prefer horizontal or vertical boards for the top layers. The surfaces can vary wall by wall.

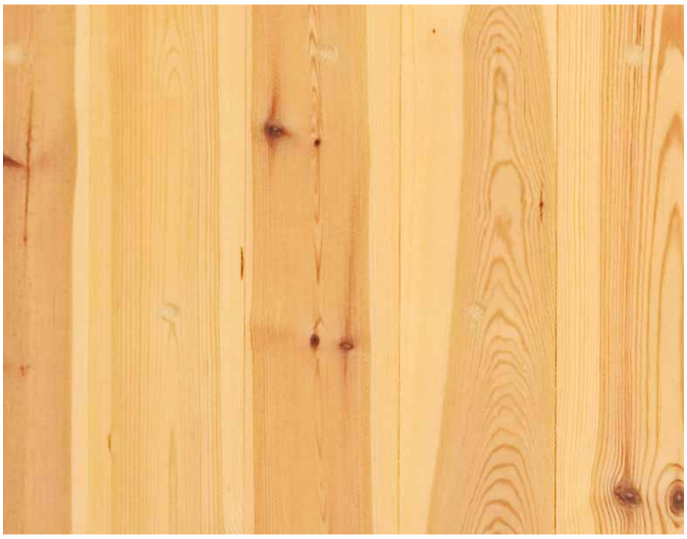
"Sorted" (spruce/fir) surface

Sanded surface: As standard, the surfaces of the Holz100 walls are produced with a disc milling head, slight traces in the sense of round milling edges can be visible. In addition, it is possible to have the walls sanded at the factory using a disc sander.
Other wood species such as pine, larch or stone pine, as well as special wood selections can be produced after consultation.

Walls built from pine are not only particularly beautiful, but are nice to your budget thanks to the cheaper wood price!



"Dowel-free" (spruce/fir) surface



"Pine" surface

"Swiss Stone Pine" surface

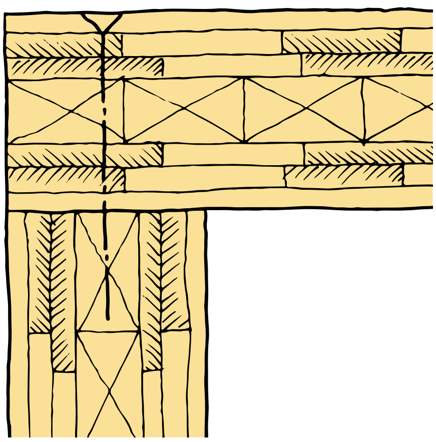

4

Each element is unique and creates a feeling of joy.

Detailed catalogue

Element connections

The following details are construction suggestions and a tool for planners and executors for the appropriate detail development. They do not replace the applicable national and regional laws and standards and make no claim to completeness!

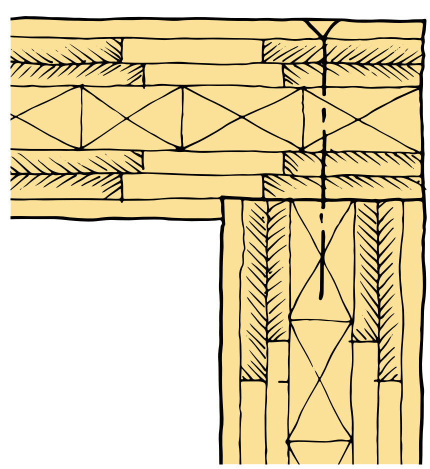


Corner joint - Blunt

Thoma elements are connected to each other with wood screws according to the structural design. Partially threaded screws (TGS) are used for the walls. For a quick assembly, we pre-drill the exact positions of the screws.

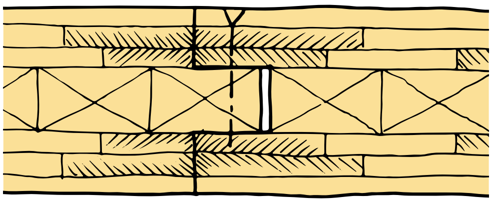
Corner joint - Rebated

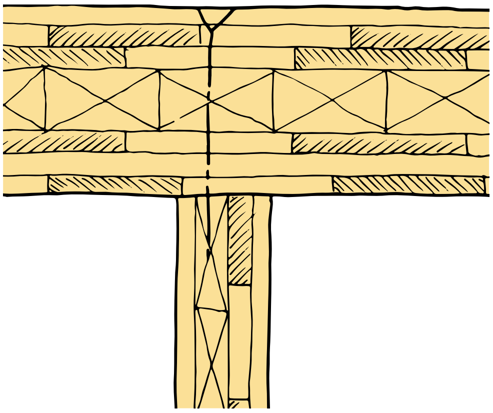
The advantage of rebated corner joints is that the wall can be better connected during assembly. After assembly, the joint alignment is more even due to the rebate. For deeper rebates, special connection details can be used to improve the air tightness.



Wall joint - Longitudinal

If walls become too long or too heavy, they can be joined using a tongue-and-groove joint. If possible, these joints are placed behind inner walls. In the case of vertically arranged top layer boards, the impacts are almost invisible.



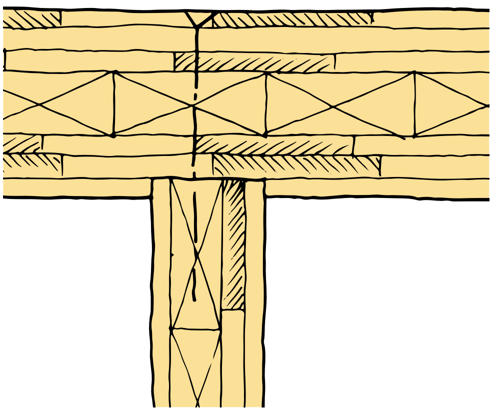


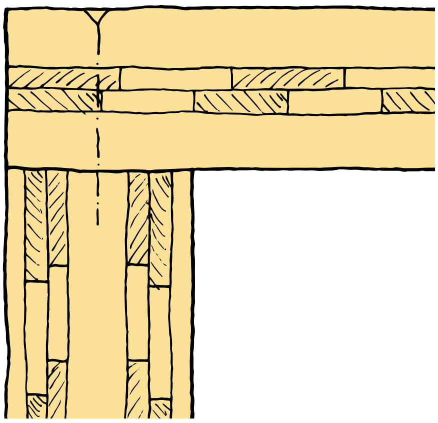
Wall joint - Transverse, blunt

After assembly of the outer walls, the inner walls are screwed to the outer walls. The screws must be in the core position. The inner walls are fixed to the floor with steel brackets.

Wall joint - Transverse, rebated

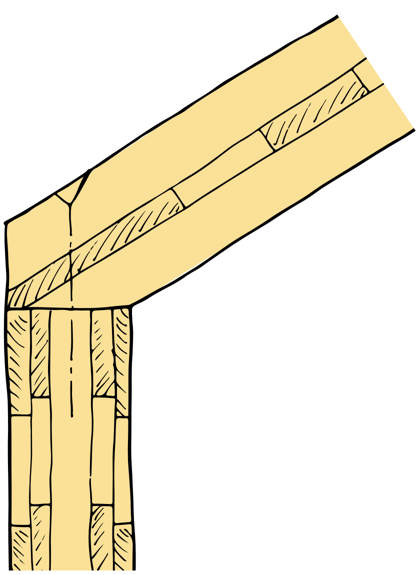
Similar to the rebated corner joints, the advantages of this design are faster assembly and a slightly improved appearance of the joint on the inner walls.





Wall - Ceiling

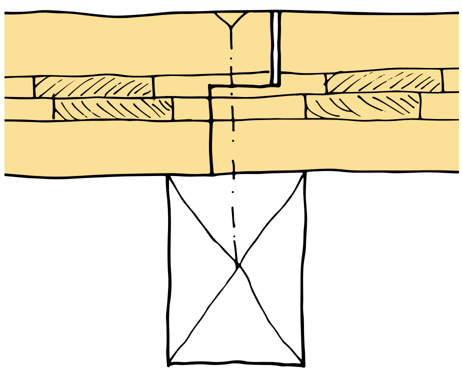
Thoma ceilings are bluntly laid up to the outer edge of the wall. The ceiling and roof elements are screwed to the Thoma walls with fully threaded screws. The fully threaded screws are inserted in pairs at an angle of 45° to ensure standard-compliant screw connections to the end grain of the walls.



Wall - Roof

Like ceilings, roof panels are mounted and screwed flush on the outside. The canopy is usually constructed using rafters. On the fronts of ceilings and roof elements, attention must be paid to an airtight and windproof connection on the outside.

Ceiling and roof supports

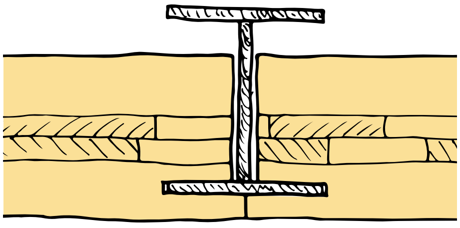


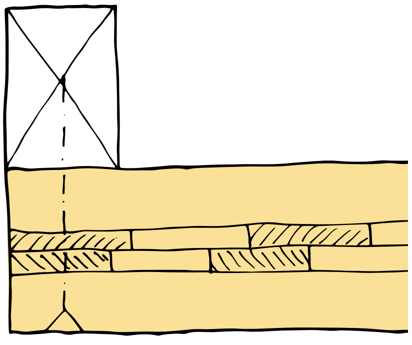
Joist

Depending on the structural requirements and span widths, structural elements may be needed to support the Thoma ceilings and roofs. Thoma elements are generally used as single-span beams which rest on linear bearings. Alongside load-bearing walls, beams are the traditional support.

Steel beams - Hidden

Steel beams are often used when beams can no longer be produced without gluing, due to excessive dimensions. Steel beams can be integrated "invisibly" into the ceiling elements. When the outer shell is penetrated by the beams, care must be taken to avoid thermal bridges.

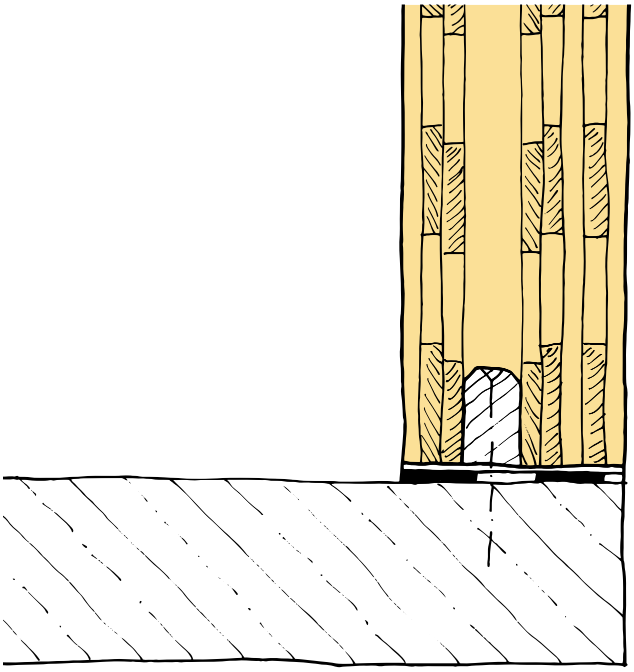




Inverted beams

An alternative to steel and beams on the underside of the ceilings is the inverted beam. The elements are suspended from the inverted beams. The inverted beams are integrated into the seam grooves of the walls above or into the roof and ceiling structures.

Connection to solid structure

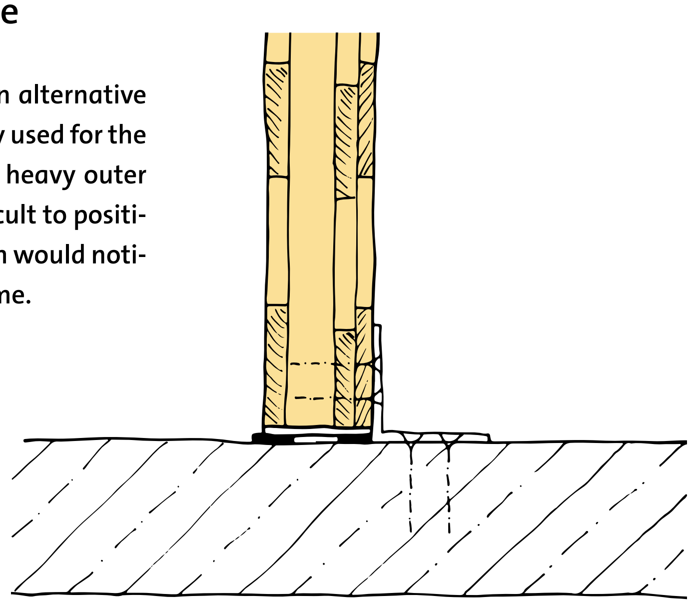


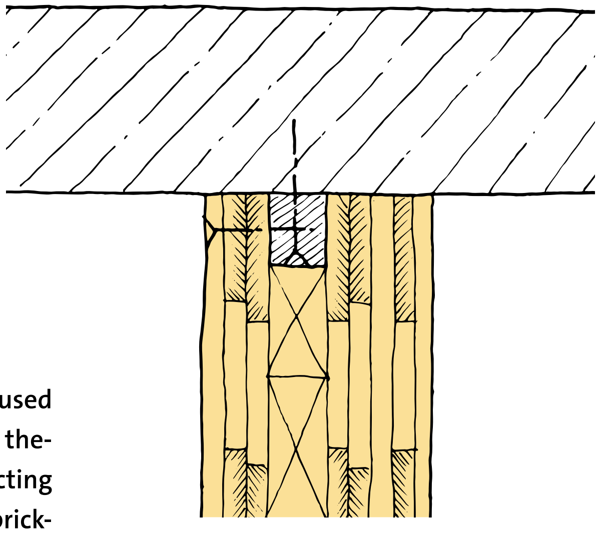
Exterior wall
Floor slab

Thoma outer walls are usually connected to the foundation with an mounting joist made of larch wood. The mounting joists are levelled, placed in a mortar bed for air tightness and protected against rising damp from the foundation with a moisture separating layer.

Inner wall on base plate

Steel brackets can be used as an alternative to mounting joists. This is mainly used for the lighter, thinner inner walls. The heavy outer walls would be much more difficult to position with steel components, which would noticeably increase the assembly time.



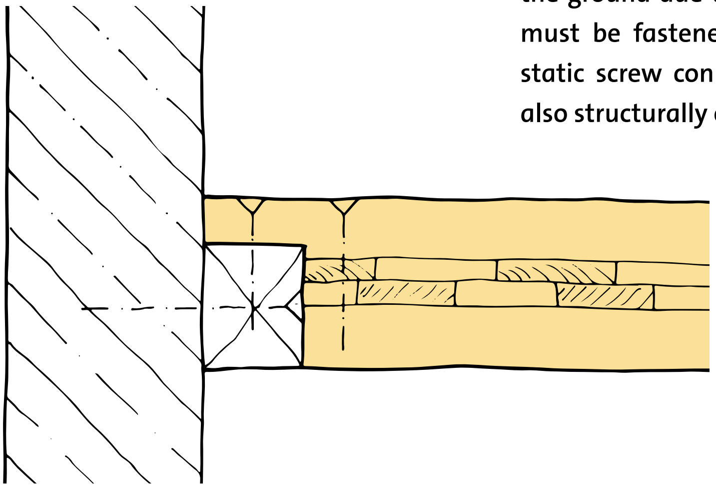


Wall to masonry

Since Thoma components are not only used in new buildings, but also in extensions, these details show the possibility of connecting the components to existing massive brickwork. Mounting joists are also used to install the walls.

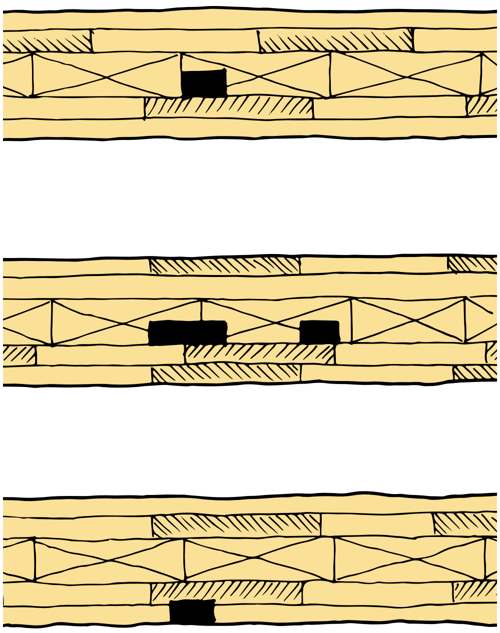
Ceiling/roof on brickwork

The linear bearings for the ceiling components can again be made with steel angles or uninjured squared timber. If the lower belts of the Thoma elements do not lie on the ground due to the detailed design, they must be fastened to the top belts with a static screw connection to ensure they are also structurally effective.



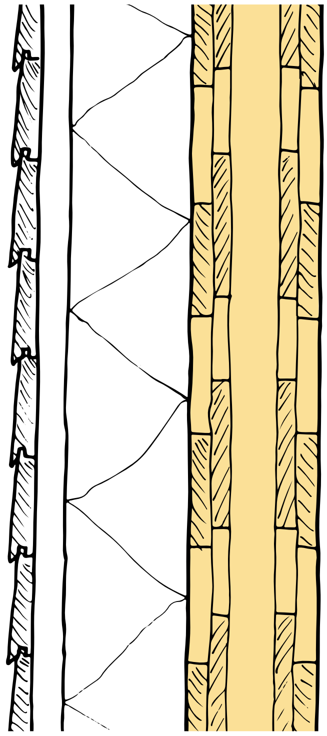
Electrical and sanitary lines

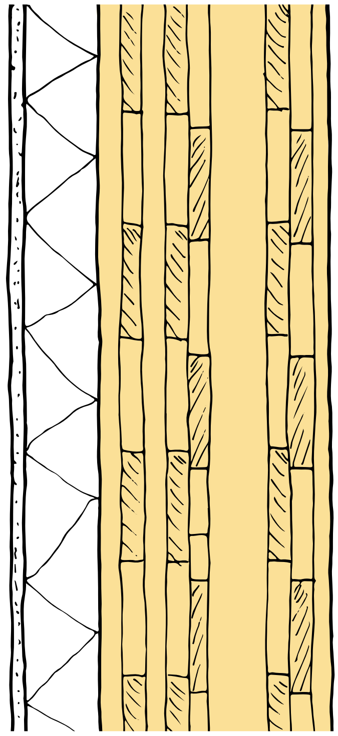
Thoma components arrive at the construction site with finished surfaces. There is no longer any need for mortising or milling work to lay the electrical cables, as 3 x 5 cm shafts are already prefabricated in the walls for this purpose. In case of increased cable requirements, several shafts are simply placed next to each other. These cable slots are provided via the floor and a factory milled opening in the joist area of the walls. At the desired height, the electrician only has to drill the socket so that everything is ready for laying the cables. This procedure saves a lot of time and nerves on the construction site, but requires precise electrical planning in advance. If, for example, the walls are still covered with clay plaster, the cable slots can also be milled on-site into the top layer. Water pipes are not integrated into the walls. These are veneered with a facing layer and routed out via fall shafts.



All ducts, cables and sockets are installed in the cable slots of the Thoma walls at the construction site.

Exterior wall structures





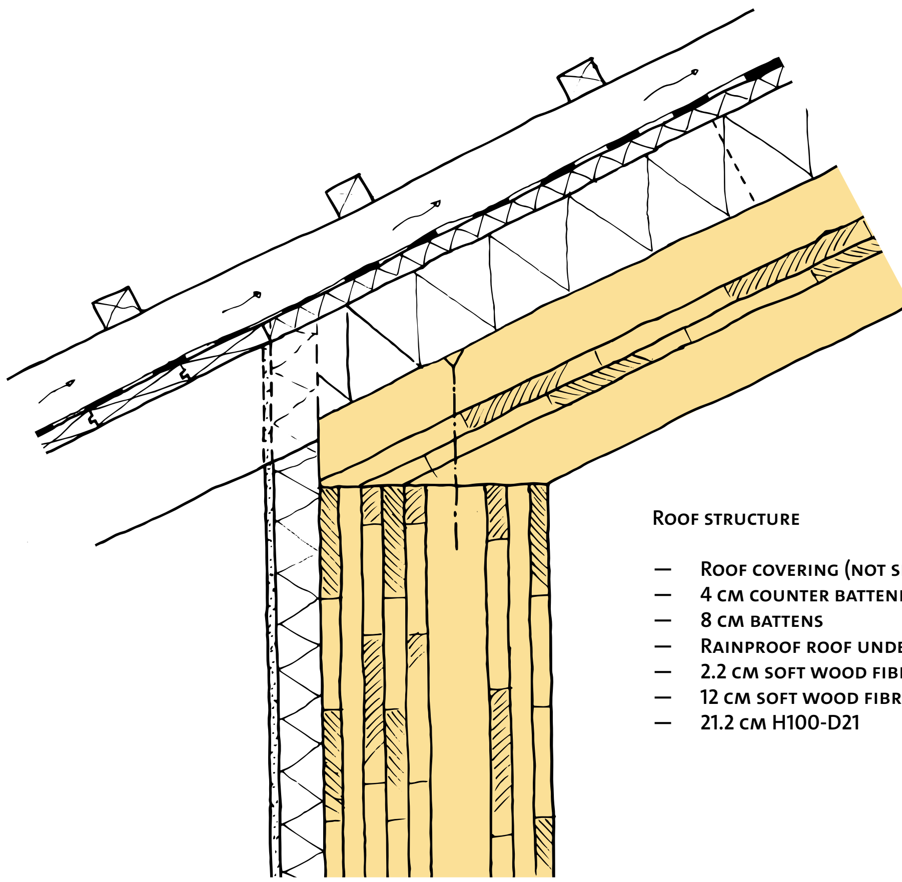
H100-W17

Wood combines the advantages of good thermal insulation and a high heat storage mass better than any other building material. Because we know about the positive effects of a large storage mass in the thermal outer shell, our thinnest outer wall starts at 17 cm wall thickness. The insulation is made of heavy and high quality wood fibre insulation boards. With a U-value of approx. 0.17 W/m²K, the wall structure with 16 cm insulation shown in the figure already meets the highest demands on housing quality. The façade is a ventilated wooden façade with a total wall structure of approx. 40 cm.

H100-W30

The 30.6 cm thick wall has almost twice as much mass as the 17 cm wall. It also reacts twice as inertly as the 17 cm wall. The inner layers are provided with additional thermal milling. The layers of air inside improve the U-value of the wall by 13 %. These wooden walls are the key components for a building without insulation. Wood fibre boards are primarily used here as plaster base boards or as an airtight layer. With 10 cm wood fibre boards, the wall has a U-value of approx. 0.18 W/m²K and with the plaster façade a wall thickness of 43 cm.

Eaves with canopy



Roof structure

- Roof covering (not shown)
- 4 cm counter battening
- 8 cm battens
- Rainproof roof underlay
- 2.2 cm soft wood fibre/canopy boarding
- 12 cm soft wood fibre/canopy rafter
- 21.2 cm H100-D21

Exterior wall construction

- 1 cm plaster system, open to diffusion
- 6 cm soft wood fibre board
- 30.6 cm H100-W30

Description

The canopy roof is not produced with a solid wooden plate in the eaves area, but using rafters. This "furring" is dimensioned according to the roof structure and the snow load and screwed onto the H100 roof panels. It does not have to run along the entire length of the roof if the solid roof slabs are load-bearing. The design allows a slim and modern appearance of the canopy. The continuous thermal insulation ensures an optimum connection in the eaves area with regard to building physics.

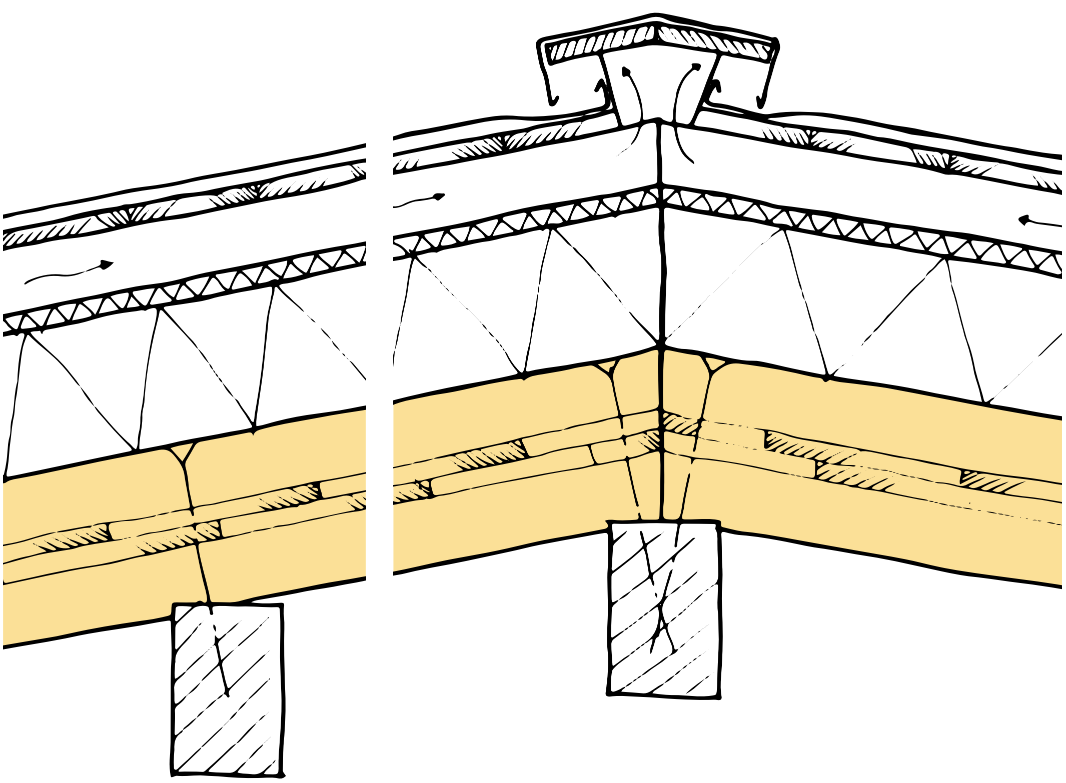
Middle and ridge purlins

Description

Thoma roof elements are usually supported by purlins or load-bearing inner walls. For a practical connection, we cut the roof slabs at the factory with the birdsmouths along the support area. These are screwed on the purlins at a distance of 40 cm with partial thread screws, and crosswise and in pairs into the end grain of load-bearing walls with fully threaded screws. Wood fibre boards are used for the insulation. There are also plates available from current manufacturers which can be used as a rainproof underlay.

Roof structure

- Roof covering
- 2.4 cm rough formwork
- 8 cm battens
- 2.2 cm rainproof underroof
- 18 cm soft wood fibre
- 21.2 cm H100-D21



Verge detail

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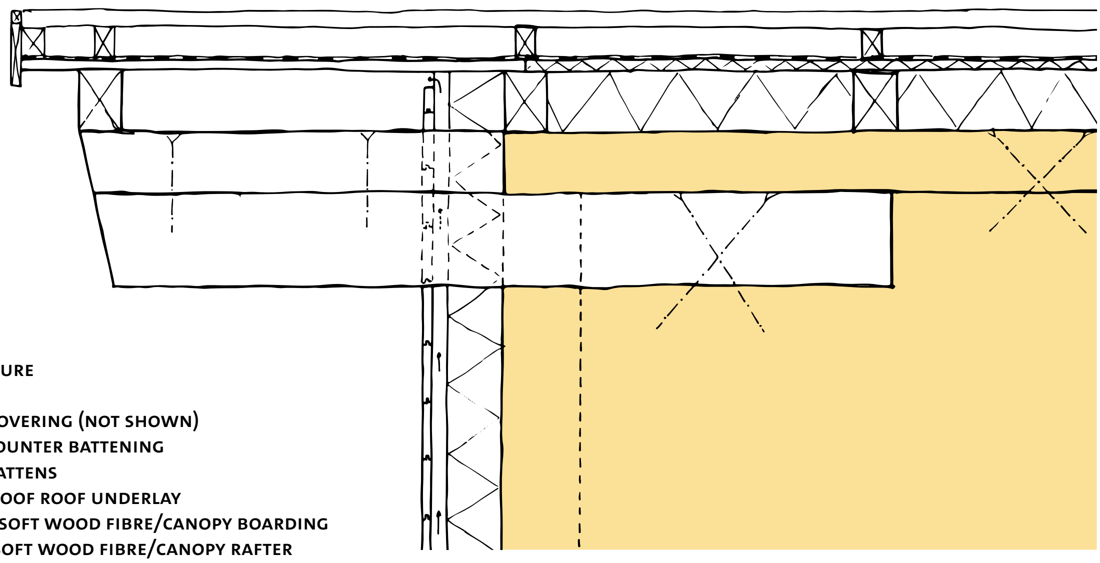


Roof structure

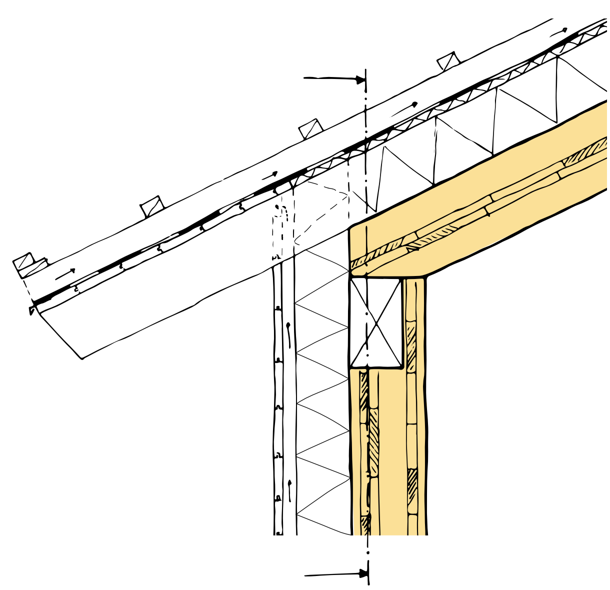
- Roof covering (not shown)
- 4 cm counter battening
- 8 cm battens
- Rainproof roof underlay
- 2.2 cm soft wood fibre/canopy boarding
- 16 cm soft wood fibre/canopy rafter
- 21.2 cm H100-D21

Exterior wall construction

- 2.3 cm wooden formwork
- 4 cm battens
- 14 cm softwood fibreboard
- 20 cm H100-W20 - purlin 14/24

Description

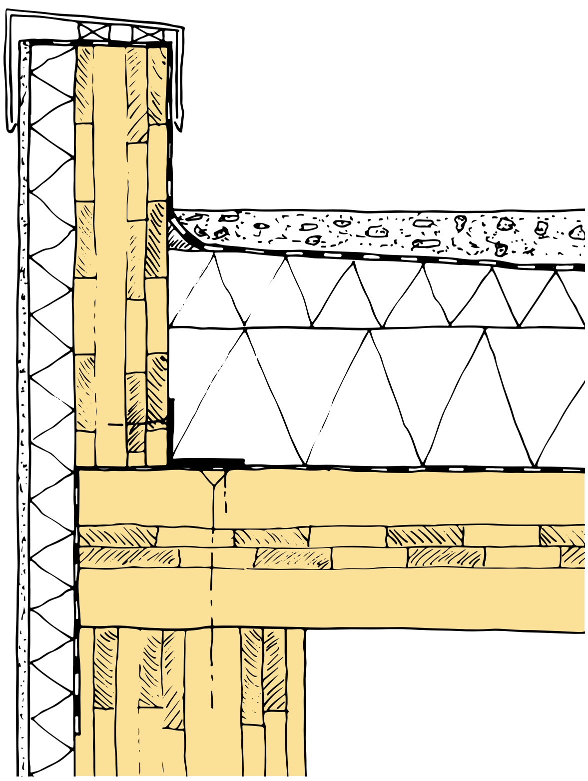
This detail shows the inferior purlin in the eaves area. Like the cantilever rafters in the previous detail, they are designed as "furrings" and integrated invisibly into the Holz100 outer wall inside. This improves the air and wind tightness of the connection. The dimension of the purlin depends on the structural dimensions of the canopy. The purlin is doubled in order to adjust the height level of the roof formwork to the Holz100 roofing slab. The wind brace* is mounted on the protruding rear ventilation batten for a slim appearance. In the case of rear-ventilated wooden façades, a ventilation grille must be installed in the upper area so that damp air can be removed.



*Boards on the gable-side roof edge. They are intended to prevent the wind from entering the roof covering from the side.

Flat roof - Warm roof

The planning brochure "Flachgeneigte Dächer aus Holz" [Flat-pitched Roofs Made of Wood] (Holzforschung Austria, 2010) offers a good opportunity to delve further into the planning and design of warm roofs.



Roof structure

- Gravel fill
- Roof sealing
- approx. 20 cm flat roof insulation on a slope (3%)
- Vapour barrier
- 21.2 cm H100-D21

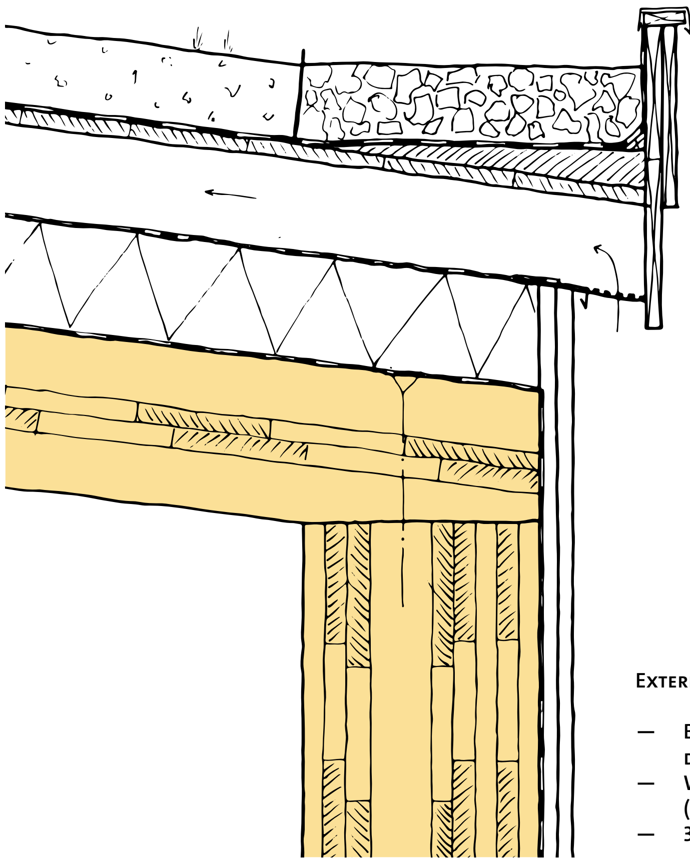
Exterior wall construction

- 1 cm plaster system, open to diffusion
- 6 cm soft wood fibre board
- 30.6 cm H100-W30

Description

Basically, we recommend cold roof constructions. Here, the air exchange in the ventilation cross-section must be ensured. If, for any reason, this cannot be done in a flat roof, then a warm roof construction is an often-used alternative. Here the boundary conditions (shading situation, roof covering and climatic conditions) can be designed in such a way that detailed, dynamic moisture protection calculations can be dispensed with. This is referred to as verification-free design. Flat roofs on Thoma roof elements are designed as on-roof insulation. Because there is no danger of condensation water damage to the statically relevant supporting structure, this is the safest variant of a warm roof. The roof gradient should not be less than 3%. The vapour control layer should be as diffusion-tight as necessary (to prevent condensation in winter), but as open to diffusion as possible (to allow re-drying in summer). This is dimensioned by means of condensation proofs.

Flat roof - Cold roof



Roof structure

- Extensive roof greening
- Bitumen waterproofing
- 24 mm rough formwork
- 12 cm rear ventilation with battens
- Ventilation grilles
- Roof underlay Omega Udos 330 (sd value: approx. 0.18 m)
- 14 cm soft wood fibre boards
- Vapour barrier, Omega SD10 (sd value: approx. 10 m)
- 21.2 cm H100-D21

Exterior wall construction

- Base-top formwork, larch, sawdust
- Wind seal, Omega WD wind seal (sd value: approx. 0.02 m)
- 30.6 cm H100-W30

Description

This detailed description is based on our tree house. The Thoma roofing slabs were designed with a gradient of 7° and we were able to lay wood fibre boards easily for the insulation. If the insulation layer itself is designed with a gradient (with straight roof slabs), an insulating material made of polystyrene is generally used. Alternatively, you can used mounted rafters executed in a gradient, as well as an intermediate insulation made of renewable raw materials. We used Isocell products for the roof underlay, for the vapour barrier and for the façade membrane. The final step is the rough formwork with bitumen waterproofing and extensive green roofing. Drainage is ensured by a partial seepage pipe in the eaves area, a fascia is not visually necessary. We did not use insulating materials for the exterior walls of our tree house, thereby eliminating the need for a rear ventilation layer behind the façade boards.

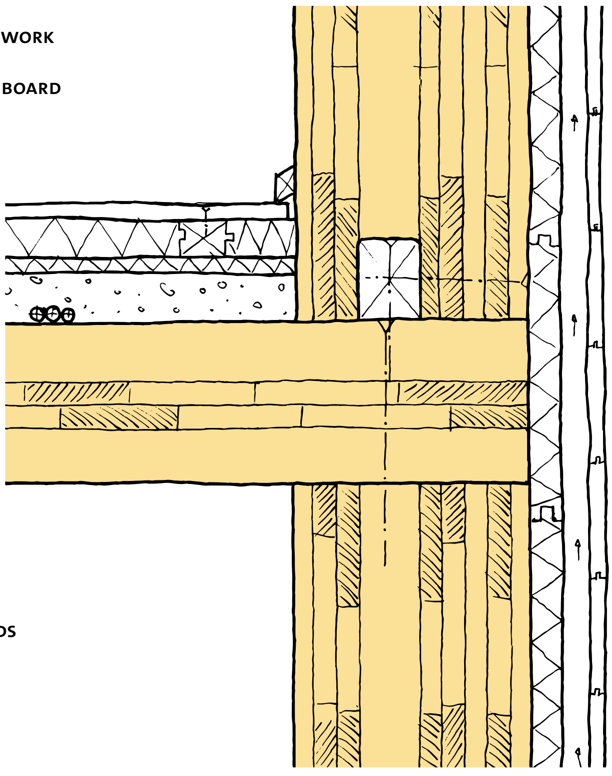
Storey transition

Description

The processing of Thoma ceiling elements enables very fast assembly times. The cover plates can be screwed precisely as large-area units (width > 2 m) in a short time to the outer walls and load-bearing inner walls of the basement. The outer walls of the storey above are installed with mounting joists, the inner walls by using iron angles. The H100-D21 elements have a bracing effect and the bottom view is delivered to the construction site as a finished surface.

Exterior wall construction

- 2.3 cm wooden formwork
- 4 cm battens
- 4 cm softwood fibreboard
- 30.6 cm H100-W30

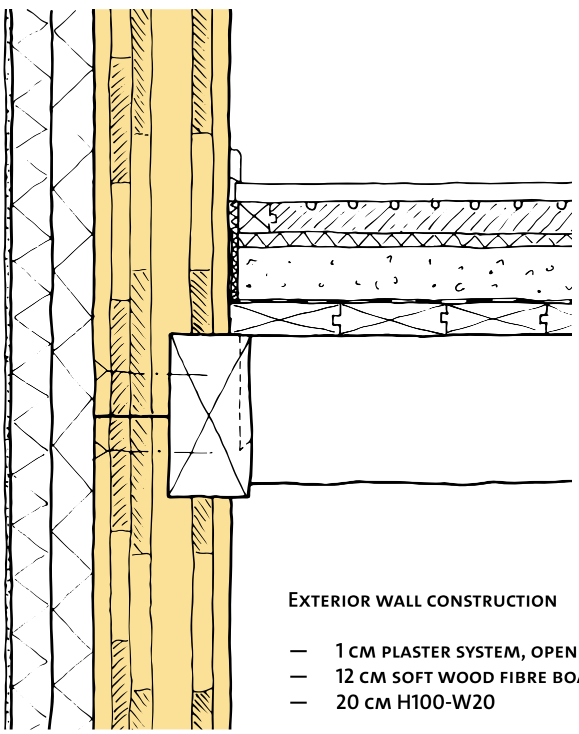


Ceiling structure

- 2 cm floor board, screwed
- 4 cm substructure floor boards
- 3 cm impact sound insulation
- 6-10 cm fill
- Trickle paper
- 21.2 cm H100-D21

Floor transition - Beam ceiling

For galleries, it is also possible to completely dispense with a floor structure and use the fire resistant casing in the desired type of wood as a floor.



Ceiling structure

- 23 mm solid wood floor
- 4 cm Lithotherm dry screed
- 3 cm impact sound insulation, wood fibre boards
- 7 cm fill, cement-bonded wood fibres - Cemwood
- Trickle paper
- 4 cm fire resistant casing, spruce
- 22 cm beam layer

Exterior wall construction

- 1 cm plaster system, open to diffusion
- 12 cm soft wood fibre board
- 20 cm H100-W20

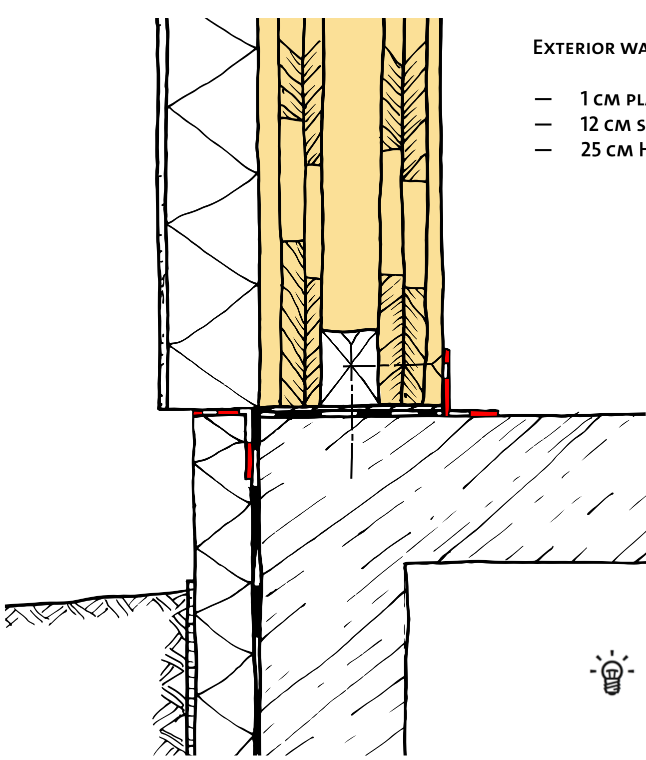
Description

Beam ceilings have a different visual appeal, are more affordable, have poorer sound insulation than solid wooden ceilings and are more time-consuming to install. In this description, the individual beams are pronged into the edge beams with a dovetail connection. For structural reasons, this must rest at least 2 cm on the core layer of the wall. To support the beams, you can also mill individual pockets into the walls or work with a seam milling, cavity insulation and a cover board. A 4 cm thick fire resistant casing (REI 30) and the floor structure are placed on the beam ceiling. The weight that can be applied to beam ceilings to improve sound insulation is severely limited due to the vibration of the ceiling. Here a dry screed made of lava stone slabs with integrated underfloor heating was used. The Cemwood fill is a good compromise between weight and sound insulation.

Base connection, standard version

Description

Some of the oldest wooden buildings in the world, the temples of Japan, have been built strictly according to the principles of constructive wood preservation. In order to also build our houses for centuries, special attention must be paid in the detailed planning to the pedestal, the transition between concrete and wood near the ground. In order to protect the wooden construction from water and moisture, or in Japan also from termites, it must not be installed below the outside level, filled in or subsequently built over. The gradient from the adjacent floor level must always be planned away from the plinth with a slope of at least 2%. Many standards and guidelines recommend a threshold level of at least 30 cm. This ensures that the wooden walls and associated façade are outside the splash water area. The base underneath can be recessed for improved water drainage and executed in a different colour to offset faster soiling in the splash water area.

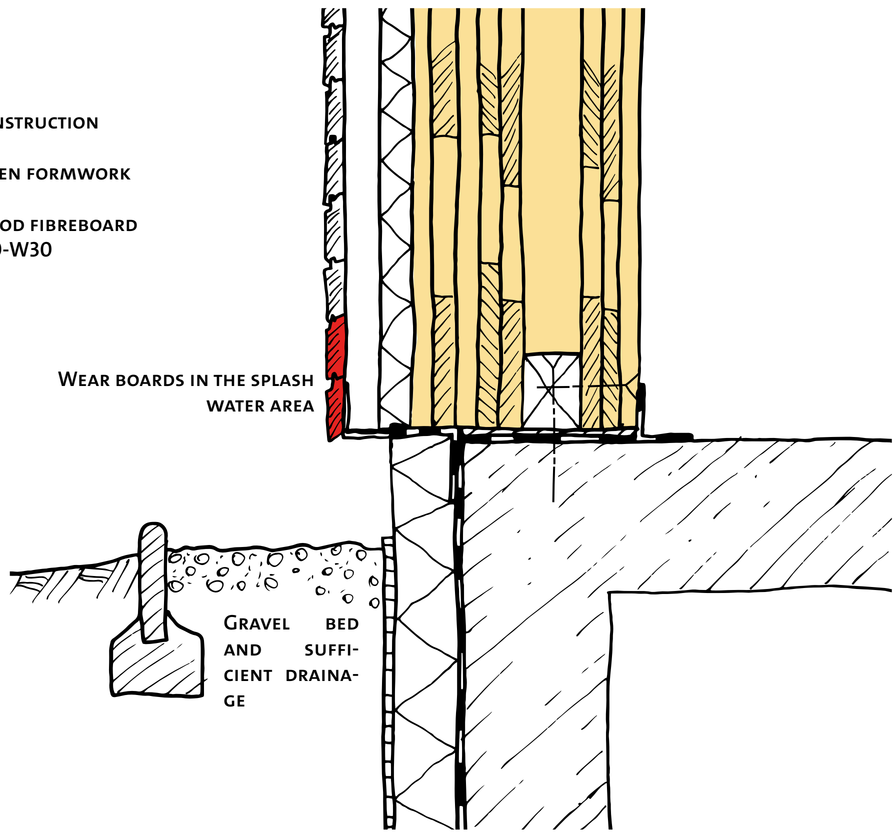


Exterior wall construction

- 1 cm plaster system, open to diffusion
- 12 cm soft wood fibre board
- 25 cm H100-W25

The joint in the base area must be sealed on the outside with a joint sealing tape which is wind and rain proof and air proof on the inside.

Base connection with rear-ventilated façade



Description

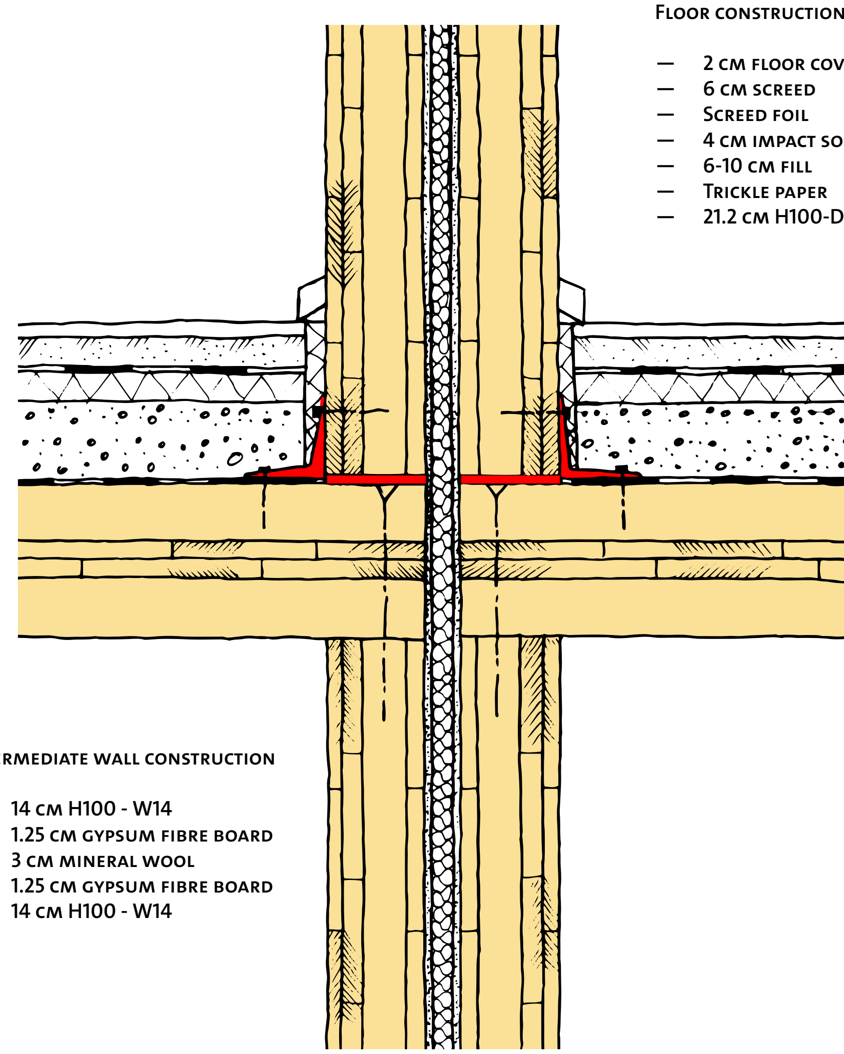
If you you want to build below the threshold level of 30 cm, additional constructional measures such as drainage, sheeting, sealing inclines and drainage channels are necessary. A threshold level of > 15 cm is recommended. Here it is still possible to dispense with lifting the cellar waterproofing and the Thoma wall structure remains open to diffusion. With wooden façades, the boards have a shorter service life in the splash water area. Therefore a horizontal formwork is recommended, as this facilitates the exchange of individual "wear boards" in the lower area.

We recommend the guideline "Sockelanschluss im Holzbau" [Base Connection in Timber Construction] (Holzforschung Austria, 2015) for many other relevant details and for practical application.

Connections for increased sound insulation

Description

This detail focuses on sound insulation, in particular for commercial buildings. No facing layers are used to ensure a visible wood surface. Soundproofing bearings and sound-optimised connections are used to prevent flanking transmission. To reduce impact sound, we recommend a heavy floor structure with loose chippings fill and sound insulation made of mineral wool. In order to avoid sound transmission between the rooms, the construction is completely decoupled and designed with two shells. Gypsum fibreboards are used to improve fire protection. The construction normally fulfils the REI 60 requirement, which is often required in building construction.



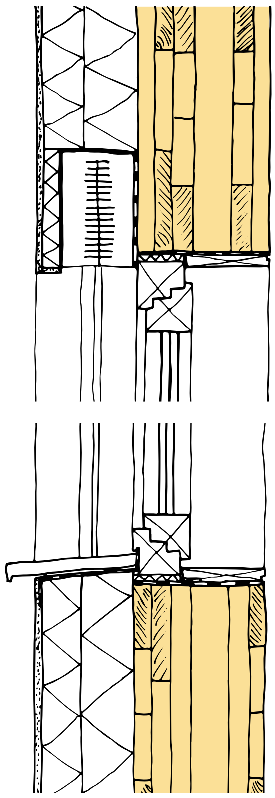
Floor construction

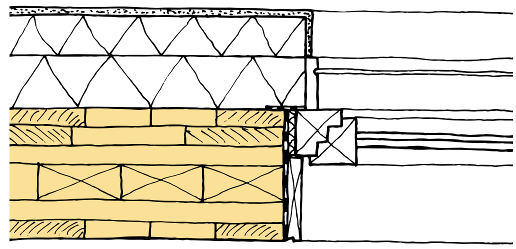
- 2 cm floor covering
- 6 cm screed
- Screed foil
- 4 cm impact sound insulation
- 6-10 cm fill
- Trickle paper
- 21.2 cm H100-D21

Intermediate wall construction

- 14 cm H100 - W14
- 1.25 cm gypsum fibre board
- 3 cm mineral wool
- 1.25 cm gypsum fibre board
- 14 cm H100 - W14

Window installation - Flush with façade





Exterior wall construction

- 1.5 cm plaster system, open to diffusion
- 6 cm soft wood fibre board
- 8 cm softwood fibreboard
- 20 cm H100-W20

Description

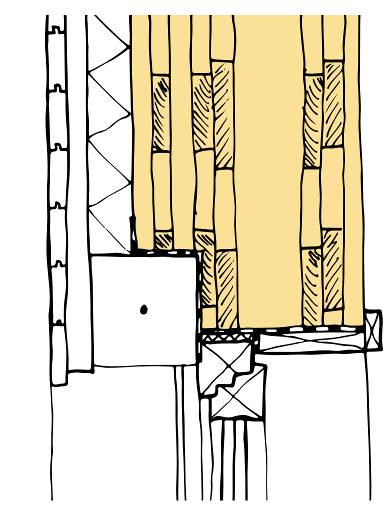
With the thinner outer walls, the window frame is flush with the Thoma wall on the outside. For thermal optimisation, the window frame can be insulated in the lintel and reveals. The two sealing levels of the window sill (sheet metal and sealing membrane) are arranged in the insulation layer and are raised on the frame. In contrast to roller shutters, Venetian blinds have the advantage that the incidence of light can be controlled by tilting the slats. It is integrated into the insulation layer and not visible from the outside. To improve wind and air tightness, the reveals of the Thoma walls can also be sealed with a tape before the window is installed.

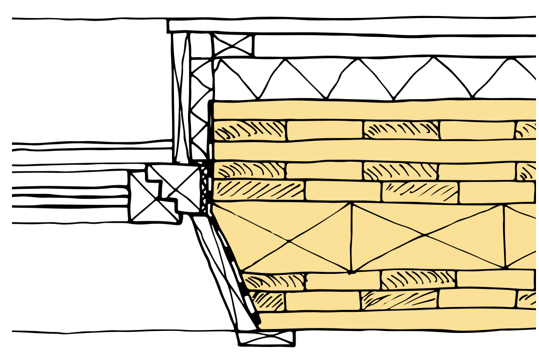
Sealing of the reveals with Ralmont's "Flexband inside, grey". The sealing starts inside from the middle of the second top layer and continues to the outer edge of the wall. The width of the tapes can be ordered to measure.

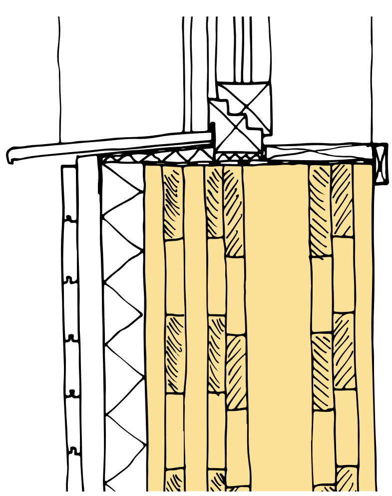
Window installation - Offset

Description

Less insulation is used in thicker walls. The window can also be placed flush with the outside wall. This gives a modern façade appearance, with the windows almost identical to the outer façade (see picture of the tree house). If you do not want "deep" window reveals on the inside, arrange the window in the middle of the wall. This also improves the constructive wood protection of the window, which is less weathered in the middle section of the wall. Should you require an opening design for deep window reveals, we can produce laterally sloping window frames, which also increase the incidence of light through the windows. For Venetian blinds and roller shutter boxes, we provide mill cut-outs at the factory for thick outer walls so that they can also be set flush on the outside.







Exterior wall construction

— 2.3 cm wooden formwork
— 4 cm battens
— 6 cm soft wood fibre board
— 30.6 cm H100-W30

The first tree houses and big dreams of our childhood, built without chemical agents © Stephan Wiesinger

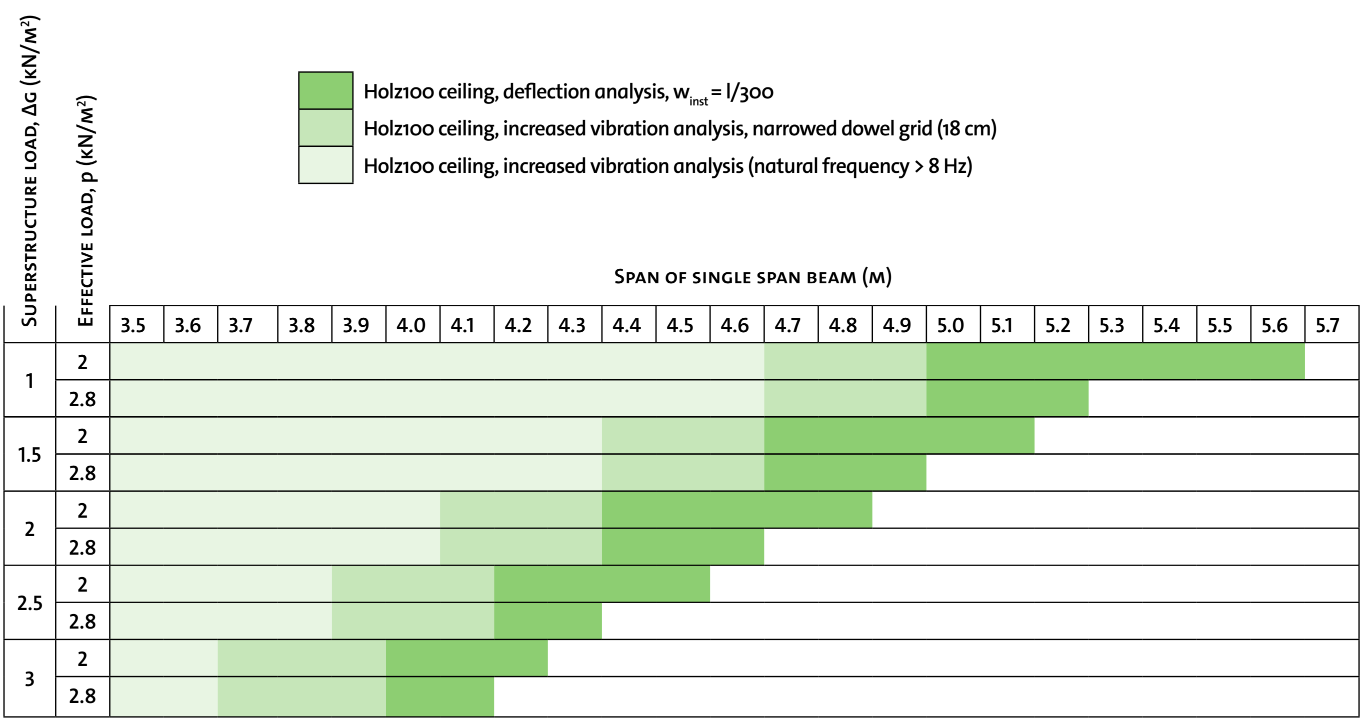
Dreaming on... Tree house in the research centre Goldeggg, structure completely in unglued solid wood

Structural analysis

Ceilings - Preliminary structural measurement table

All information provided in the chapters on structural analysis below are only for preliminary dimensioning and do not replace a detailed structural analysis. The company Thoma gives no guarantee for the indicated values! Verification according to EN 1995-1-1:2010-12 and ETA-13/0785.

The ceilings consist of horizontal timbers with a thickness of between 70-80 mm, which absorb the tensile and compressive forces in a ceiling. Due to the two diagonal board layers in the middle, the ceiling can also be used as a stiffening plate. The following table shows the possible span widths for Holz100-DE21 as a function of superstructure load and weight capacity. A distinction is also made between the type of requirement and dowel density.



Superstructure load, Δg (kN/m²)

kN	Example
1	Dry construction with dry filling
1.5	Wet screed
2	
2.5	Wet screed with split fill
3	

Effective load, p (kN/m²)

kN	Example
2	Living spaces
2.8	Living spaces with light partition walls

In the case of roof elements, the loads and requirements are applied differently. For example, spans of up to 6.2m are possible with light superstructures and low snow loads.

Thoma walls - Vertical load capacity

Vertical building loads are caused by the dead weight, effective load and snow loads. Up to five storeys, the vertical load-bearing capacity of the wall usually plays a subordinate role in the structural analysis, as this is sufficiently high. The following table gives preliminary measurement values of the load-bearing capacity of individual wall types as a function of the buckling length (normally corresponds to the wall height) and the cover layer direction (vertical and horizontal).

Concentrated load introduction into the walls (e.g. by ceiling beams) must be considered separately according to ETA. The pressing of supports (transverse pressure) also plays a role in the detail verification and is not taken into account here. The calculations are based on a k_{mod} factor of 0.8 and a transverse wind load of 0.4 kN/m^2.

The more vertical layers are placed in the outer areas of the walls, the more they increase the load-bearing capacity (lever principle). However, for fire safety assessment, it must be borne in mind that these layers also burn faster. That is why we arrange our most important vertically supporting layer (the thick core layer) in the middle.

Wall thickness (cm)	V=vertical H=horizontal	Buckling length (m)					
		2.5	3.0	3.5	4.0	4.5	5.0
		Maximum load capacity Rd (kN/m)					
14	H	118.3	83.4	61.9	47.7	37.9	30.8
17	V	195.0	153.4	127.5	110.2	97.8	88.6
	H	118.3	83.4	61.9	47.7	37.9	30.8
20	V	207.7	166.0	140.0	122.6	110.1	100.8
	H	151.4	111.9	87.5	71.3	59.9	51.6
25	V	384.4	298.0	244.2	208.3	183.0	164.3
	H	376.0	287.5	232.3	195.4	169.4	150.2
30.6	V	386.3	299.5	245.4	209.4	184.0	165.2
	H	376.0	287.5	232.3	195.4	169.4	150.2
36.4	V	391.5	303.6	248.8	212.4	186.7	167.8
	H	376.0	287.5	232.3	195.4	169.4	150.2

The 17 cm wall almost doubles the vertical load-bearing capacity compared to the 14 cm wall. Therefore, this wall can also be used indoors for heavily loaded walls. Starting from the 25 cm wall, no more large increases are to be expected, because according to ETA only a maximum of 3 vertical layers may be used for the verification.

Wood-concrete composite solutions specially matched to Holz100 can open up interesting possibilities in multi-storey building construction, in order to simultaneously increase sound insulation and the span width of the ceilings.

Thoma Walls - Slab stress

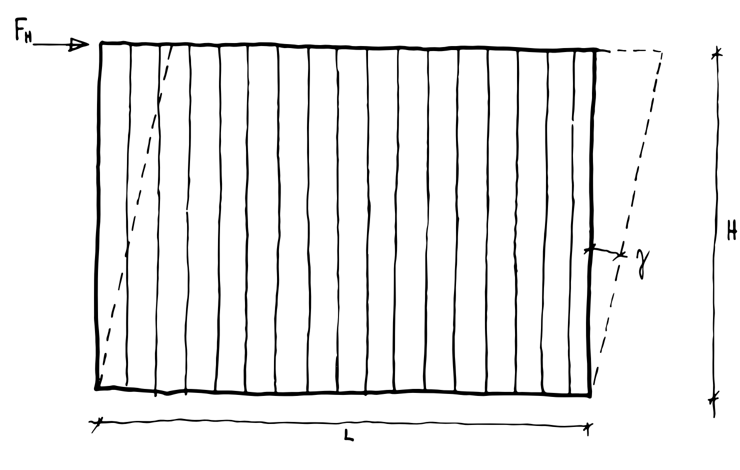
In addition to vertical loads, buildings are also exposed to horizontal forces. Horizontal loads can be caused by wind, earthquakes and other impact loads. Due to the typical processing of the board layers of a Holz100 wall in 3 different directions (horizontal - vertical - diagonal), Holz100 walls can also absorb and dissipate such forces.

The required wall thickness or the required combination of 3 board layers is calculated from the characteristic, horizontal load$_{FH,k}$. A distinction is made between different requirements:

- On the one hand, the serviceability (e.g. wind bracing) must be demonstrated, for which the maximum horizontal deformation is limited to H/500.
- For the verification in case of fire or earthquake (extraordinary impact) it is sufficient to exclusively verify the bearing capacity. The limit state here is H/100.

Requirement	One triple layer*	Two triple layers*
Serviceability H/500	$f_{V,Rk}$ = 8 kN/m	$f_{V,Rk}$ = 16 kN/m
Carrying capacity H/100	$f_{V,Rk}$ = 50 kN/m	$f_{V,Rk}$ = 100 kN/m

In these specified maximum shear flows, deformations in the horizontal plane, related to the height, have already been taken into account. It follows from this that components which can be used as slabs must be at least half the wall height long. When carrying out the structural analysis for fire scenarios, it must be considered that some board layers are eliminated as fire resistance due to the fire protection design. If a component has been used as a slab, it must be designed in such a way that at least one triple layer remains after the fire exposure.



$_{FH,k}$ / L < $f_{V,Rk}$

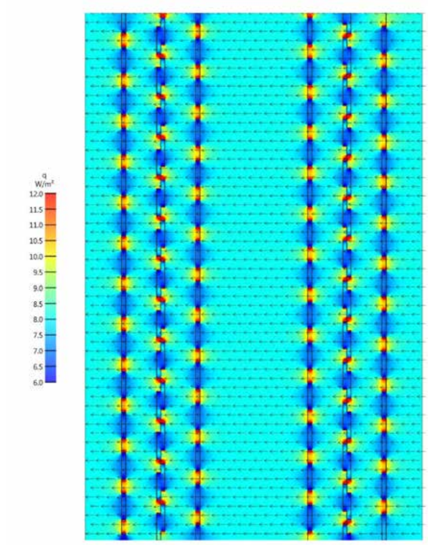
Building physics

Energy

In order to heat and cool a building with minimal effort, many factors have to be taken into account. In addition to location, user behaviour, architecture and correct building technology, the properties of the building materials also play an important role. In the following, the most important aspects of Holz100 will be considered.

Thermal conductivity (λ) and heat transfer coefficient (U-value)

The thermal transmittance (W/m²K) of a component is calculated from the thermal conductivity (W/mK) of the individual materials used. Our dowelled layers result in air cushions between the boards, which reduce the λvalue. In addition, we mill slots in our boards once again to enhance this effect. These improved board layers are used from the 25 mm wall upwards (Holz100 thermal walls). The following λ values can be used for Holz100.



Heat flow view of a H100-W25 with thermal milling (TU Graz: Calculation of the Equivalent Thermal Conductivity of Holz100, 2015)

PROOF	USE	THOMA-BUILDING COMPONENT
EN ISO 10456, λ = 0,12 W/mK	Timber with a density of < 450 kg/m³	For all H100 buidling components
Hotbox measurement according to EN ISO 8990 - FH Oberösterreich, λ= 0.079 W/mK	Measured value with protocol, no rated value according to EN ISO 10456	For all thermal walls: W25, W30, W36
Numerical calculation Fraunhofer Institute for Building Physics, λ= 0.105 W/mK	Mathematical proof of improvement by thermal milling (13 %)	For thermal wall: W30
Building Technology Ordinance of the Salzburg State Government λ= 0.10 W/mK	For technically dried spruce and fir timber	In the federal state Salzburg (Austria) for all H100 components.

Lambda Insulation thickness

Element thickness

	0.042	2	4	6	8	10	12	14	16	18	20
17	0.120	0.457	0.370	0.311	0.268	0.236	0.210	0.190	0.173	0.159	0.147
20	0.120	0.410	0.339	0.289	0.251	0.223	0.220	0.181	0.166	0.153	0.142
25	0.105	0.326	0.279	0.244	0.217	0.195	0.178	0.163	0.150	0.139	0.130
30.6	0.105	0.279	0.244	0.217	0.195	0.178	0.163	0.150	0.139	0.130	0.122
36.4	0.105	0.243	0.216	0.195	0.177	0.162	0.150	0.139	0.130	0.122	0.115
17.6	0.120	0.447	0.363	0.306	0.265	0.233	0.208	0.188	0.172	0.158	0.146
21.2	0.120	0.394	0.328	0.280	0.245	0.218	0.196	0.178	0.163	0.151	0.140

U-value table based on lambda values according to EN ISO 10456 and numerical calculation methods (see second column)
A wood fibre board with a lambda value of 0.042 W/mK was assumed as insulation.

Lambda Insulation thickness

Element thickness

	0.042	2	4	6	8	10	12	14	16	18	20
17	0.081	0.348	0.295	0.257	0.227	0.203	0.184	0.168	0.155	0.143	0.133
20	0.081	0.308	0.266	0.234	0.209	0.189	0.172	0.158	0.146	0.136	0.127
25	0.079	0.254	0.225	0.201	0.183	0.167	0.154	0.143	0.133	0.124	0.117
30.6	0.079	0.215	0.194	0.176	0.162	0.149	0.139	0.129	0.121	0.114	0.108
36.4	0.079	0.186	0.170	0.156	0.145	0.135	0.126	0.118	0.111	0.105	0.100
17.6	0.081	0.339	0.289	0.252	0.223	0.200	0.181	0.166	0.153	0.142	0.132
21.2	0.081	0.295	0.256	0.226	0.203	0.184	0.168	0.155	0.143	0.133	0.125

U-value table based on the lambda values after the hotbox measurements of FH OÖ (see second column)
A wood fibre board with a lambda value of 0.042 W/mK was assumed as insulation.

In the Austrian film archive in Laxenburg, 60,000 old nitrate film treasures are stored on an area of 250 m². Thanks to the 36.4 cm thick Thoma walls, the cooling requirements of the entire building can be covered with a 2.5 KW cooling completely self-sufficient with a photovoltaic system.

A 30 cm thick wooden wall offers maximum heat protection because the temperature peaks in summer can no longer penetrate the construction (amplitude damping).

The insulating properties of wood depend very much on the moisture content. In a study by Proholz Salzburg, it was proven that the wood moisture content of solid wood walls decreases in winter and that the Lambda value improves by approx. 30 % according to standard. Wood adapts to the seasons! This insight has also been implemented in the Salzburg Building Order (BauVO) since the summer of 2016.

The house without heating (www.n11.ch) in Zweisimmen in Switzerland (947 m ASL). The 5-storey residential building is completely heated using passive solar energy production. There is no heating system in the whole building. Regula and Sascha call their building and planning method the "Solar Direct Profit House".

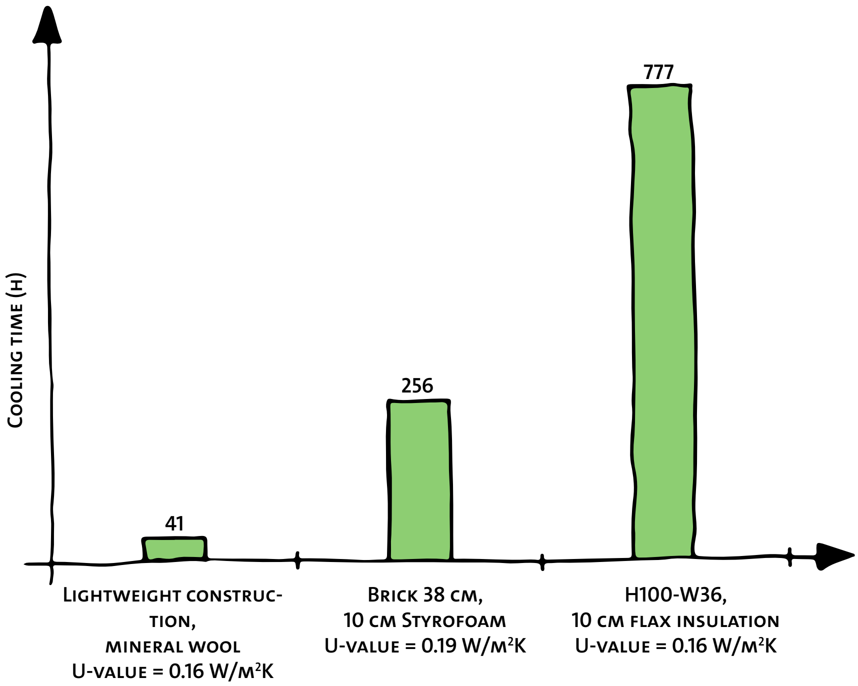
Specific heat storage capacity (cp) and gross density (ρ)

Wood is the only building material that combines the properties of poor heat conductance and at the same time good heat storage. A thick, solid wooden wall is both an insulating material and a heat storage medium. The U-value alone does not provide enough basis to build houses that can air-condition themselves without depending on technical systems.

To feel thermally comfortable in a house, we want warm surfaces, rooms that warm up quickly when lighting up a fireplace and do not overheat in summer. We want a balanced room climate without temperature and humidity fluctuations. Insulation barracks without thermal storage mass or stone castles, which absorb all heat, do not offer this. In addition to the material, crucial groundwork is also laid by the architecture through the careful arrangement of glass surfaces. The heat input through glass can be 1000 times greater than through the walls.

PARAMETER	VALUE	PROOF
Gross density (ρ)	450 kg/m³	Literature, own measurements
Heat storage capacity (cp)	1.6 kJ/(kg*K)	according to EN ISO 10456

Due to the storage mass of Holz100, many Thoma houses require 30-50 % less energy in operation than the simplified heat demand calculations according to the current standards. Solid wooden walls are the building's key element, enabling us to dispense with complex building technology such as ventilation or air conditioning systems.



Comparison of the cooling time of 3-series constructions with a similar U-value (TU Graz, Thermische Simulation zum Holz100 Bausystem, 2001)

For Holz100 there are only two further values apart from the thermal conductivity, which form the basis for a complete, transient, structural-physical consideration. With the gross density (kg/m³) and specific heat storage capacity (kJ/kgK), all other necessary key figures and calculations can be determined for a realistic consideration and for the design of sustainable house engineering concepts. Together with the Graz University of Technology, we have carried out dynamic building simulations and obtained remarkable results. One question was the different cooling time of three constructions (lightweight construction, brick, wood100) when the heating is switched off in winter. The following graph shows the time until the surfaces on the inside reached 0°C. A month for a thick wooden wall! It should be noted that all designs have a comparable U-value.

Wind and air tightness

In new buildings, permanent wind and airtight building envelopes must be produced. These are two different requirements that are often confused.

Air tightness is about so-called convection, or the loss of warm interior air to the outside. Wind tightness refers to the reverse direction, where cold air is prevented from moving into the building from outside.

Wind tightness describes the construction of the outermost layer exposed to the weather. If a construction were not windtight, air currents from the outside could penetrate into the insulation layer and reduce the insulation properties. A moisture-resistant wind seal on the outer façade must be installed on site after assembly of the Holz100 elements, and connected windtight to all fixtures such as windows and doors. This is the only way to ensure optimum thermal insulation and wind tightness in all details.

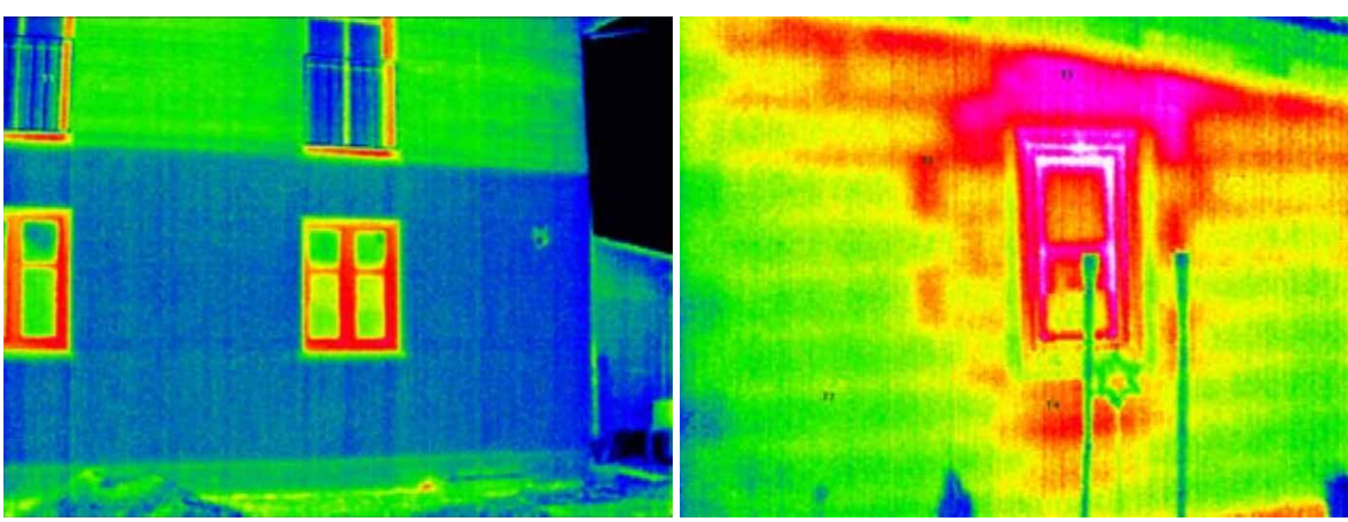
Air tightness describes the tightness of the building envelope on the inside. This is important to avoid heat loss and condensation from convective warm air. Holz100 external walls are airtight in the surface. To determine the air tightness of buildings, the air exchange rate at 50 Pascal pressure difference is measured from inside to outside (n50). Holz100 buildings are designed up to the particularly airtight passive house standard (n50 < 0.6). Where appropriate, we recommend not to use complicated building technology such as mechanical ventilation. Hourly air exchange rates of n50 = 1-1.5 are sufficient in this case. According to the usual building regulations, a value of 3 per hour must not be exceeded. The air tightness depends on the design and detailed planning provided by the customer.

We built Sarah Wiener's house with H100-W36. n50=1.6 without any external façade or airtight layer - the canopy replaces the external façade.

Moisture protection

This is an important prerequisite for a healthy living climate and a damage-free construction. Thick and monolithic wooden walls achieve incredible results in all areas. On the one hand, wood is open to diffusion and can drain off and compensate moisture itself. On the other hand, wood can also absorb moisture and thus acts as a moisture regulator and reservoir in living areas. Specifically, it is about protecting the construction. Here are three examples:

- In the plinth area with suitable seals against rising damp and standard-compliant formation of the plinths (see plinth detail).
- With many lightweight constructions it is common to work with vapour barriers on the inside so that no warm air can condense in the insulation layer. With Holz100 we do without it and build in materials that are more and more open to diffusion from the inside, starting with wood to the outside. Holz100 acts like a natural vapour barrier that is open to diffusion. This means that highly sensitive vapour control layers or glued panel materials can be dispensed with.
- At external corners or window lintels, the insulation properties are usually greatly reduced and thermal bridges are created. If the walls on the inside become cold, there will be condensation. This problem is particularly present in concrete structures. Thermal bridge free construction is possible with solid wooden walls!



Heat radiation on a winter day. Left: Thoma house, right: brick building with a thermal bridge in the lintel area. Thermographic images can be used to identify thermal bridges and thermal weak points.

The thicker the wooden wall, the less sensitive the construction is to moisture. We know about this wonderful property of our solid walls and therefore offer a 50-year guarantee on the condensate- and mildew-free construction of our buildings.

The exterior walls of the eleven greened floors of the town hall in Venlo (NL) were made with Thoma H100 elements. Among other things, the decisive factors for this decision were the insensitivity of the construction to moisture and the Cradle to Cradle certification of the building material (waste-free construction).

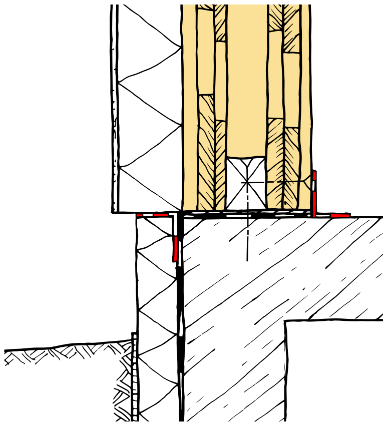
In the case of diffusion-open exterior wall structures with Thoma walls, the airtight layer does not have to be arranged on the room side, but can also be implemented on the outside. For an airtight layer, for example, airtight softwood fibre boards with tongue-and-groove joints and diffusion-open formwork membranes can be used. The airtightness of connections to other components, such as windows and doors, can be improved by proper masking. If the building is expertly designed, the moisture output is limited by convection into the component and the solid wood in combination with the diffusion-open structure can easily compensate for these moisture quantities. A good standard of workmanship regarding the air exchange rate also helps to ensure thermal comfort and save energy.

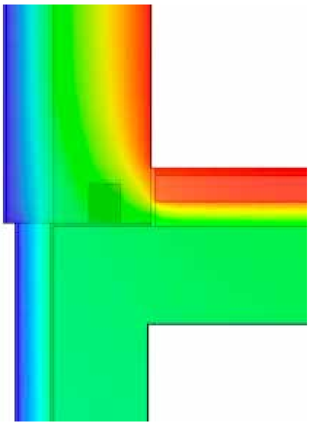
Thermal bridge calculations

In verification methods commonly used for calculating heat losses via the building envelope, you can take advantage of thermal bridge-reduced construction. With a thermal simulation of individual details, the heat loss of the respective thermal bridges is obtained in the form of a "correction factor" (Psi value, Ψ). With this value, it is easy to reduce the lump sum surcharge for the transmission heat loss by thermal bridges in the requirement calculations. This can account for up to 20 % improvement in our massive wooden houses. Below you will find a few of the most important details with the associated Ψvalues. These serve as orientation, but do not replace proofs in individual cases. The lambda values of the hotbox measurement served as the basis for the calculation.

Plinth

Cellar unheated, with floor construction, H100 -W25



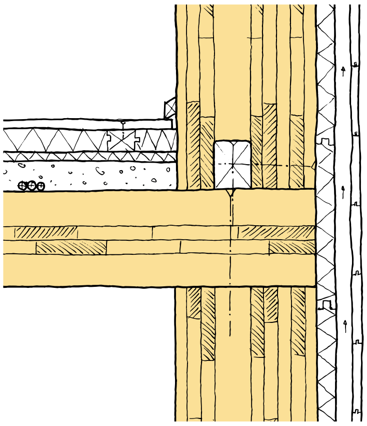


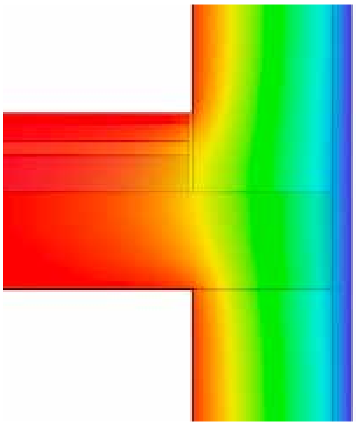
Thermal bridge loss coefficient (Ψ) = -0.044 W/(mK)

The smaller the Ψvalues are, the better. In the case of particularly good constructions in solid timber construction, these even become negative.

Storey ceiling

H100 -W30 and H100-D21

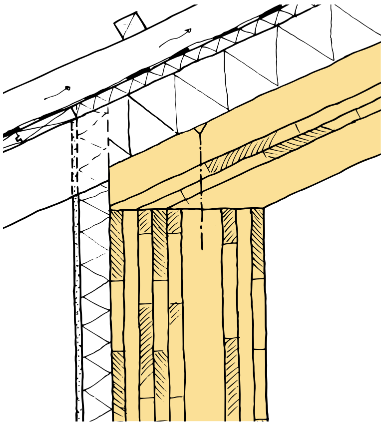


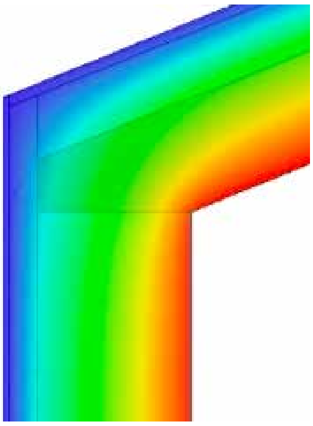


Thermal bridge loss coefficient (Ψ) = -0.012 W/(mK)

Eaves

H100 -W30 and H100-D21

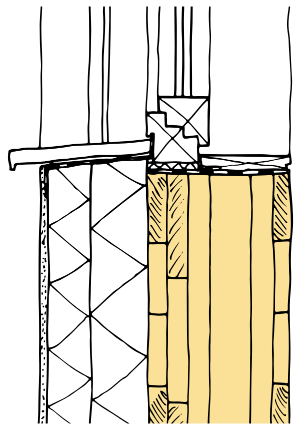


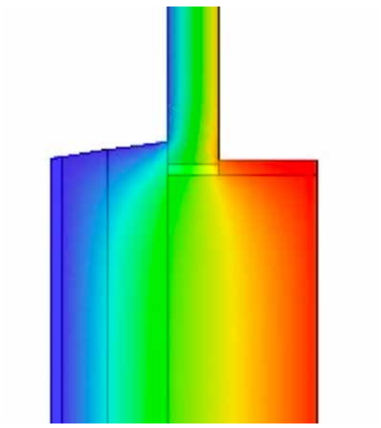


Thermal bridge loss coefficient (Ψ) = -0.051 W/(mK)

Window parapet

H100 -W20

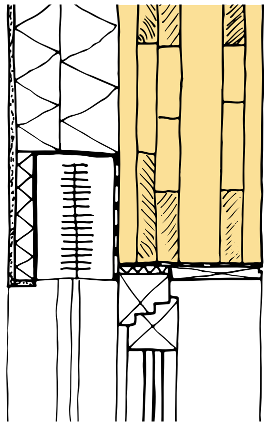


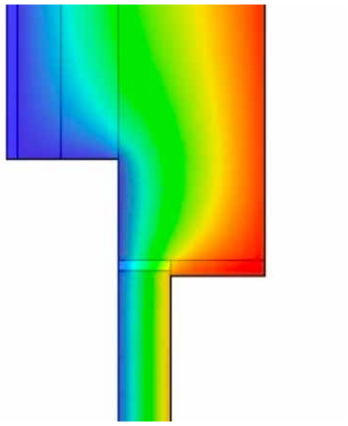


Thermal bridge loss coefficient (Ψ) = -0.013 W/(mK)

Window lintel

H100 -W20, with uninsulated roller blind box

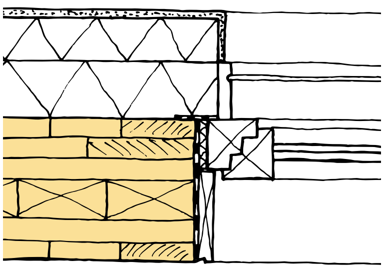


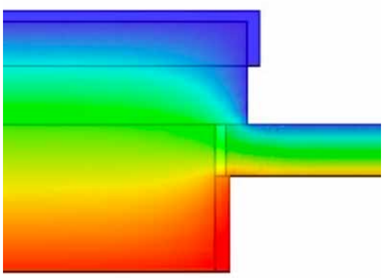


Thermal bridge loss coefficient (Ψ) = +0.054 W/(mK)

Window reveal

H100 -W20





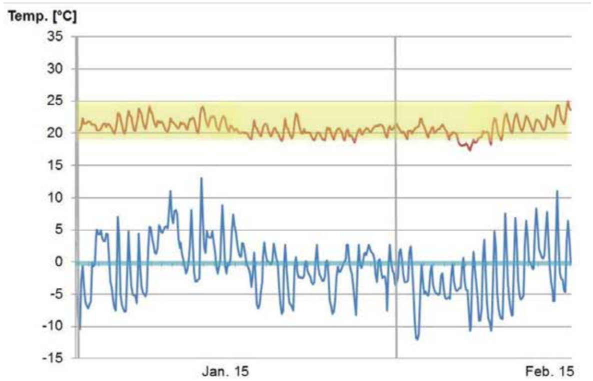
Thermal bridge loss coefficient (Ψ) = -0.014 W/(mK)

In summary, the following ingredients are the basis for creating buildings that do not rely on heating or cooling systems and yet offer the highest level of living comfort.

- Poor heat conduction of wood
- High heat storage capacity of wood
- Breathable wall and roof constructions
- Wind- and airtight design
- Reduced thermal bridge details

For sustainable buildings, we need buildings that remain free of damage for centuries and at the same time cause minimal operating costs.

Comparison of outside temperatures and inside temperatures in the house without heating in the coldest winter months.



There are many ways to heat. Wooden living spaces create warmth and security.

The Schagerl family heats their house with a single tiled stove. Other heat sources are not necessary.

Fire

In the event of a fire, a building must be able to protect both its occupants and the furnishings for a certain period of time. Thoma houses ensure excellent fire protection thanks to their massive, solid wood design. How does that work? The burning of wood is a slow, constant process, which is easy to estimate. Fire creates a layer of carbon on the surface of the wood (pyrolysis), protecting it from high temperatures. This reduces the burning speed.

The fire resistance called REI consists of 3 functions.

1. R - Resistance - Load capacity
2. E - Emission- Room closure (smoke and flame tightness)
3. I - Insulation - Thermal insulation

Proof of fire protection can be provided on the one hand by testing the respective components or on the other hand by a structural fire protection assessment from an engineering office. Both are possible with Holz100. The following components have been tested by an institute.

- Wood100 W17 = REI 60
- Wood100 W36.4 thermo = REI 60
- Wood100 W36.4 = REI 120

In practice, however, the load-bearing capacity (R) is calculated by the structural engineer by means of a fire protection assessment. This enables an individual and more efficient view. According to the structural approval (ETA) for Holz100, a combustion rate of 0.7 mm/min is permitted. The smoke tightness (E) can be ensured by a paper inside the component. The thermal insulation (I) is always given and can be calculated using the U-value.

In addition to fire resistance, the various building laws also place demands on the fire behaviour of the various load-bearing components. Holz100 is classified as D-s2-d0 according to EN1305-1. This means that Holz100 is flame-retardant (D), smoke-emitting (s2) and non-drip (d0).

In Austria, fire protection regulations are mostly regulated regionally in the building laws of the provinces. That is why a lot of different things are possible in the different regions. Basically, most current building laws in Central Europe allow buildings with up to 3 storeys to be erected in Holz100 without any problems. If an additional fire protection concept is provided, significantly larger buildings can be built. Currently we have already erected 7-floor buildings (and 11 in hybrid construction) in Holz100, but we believe that much more is possible here.

Qualitative self-investigation, fire pattern after 150 min of direct flame treatment (Bunsen burner, with approx. 900 °C).

Fire protection tests in the laboratory showed that after 134 minutes of firing, the maximum temperature increase on the cold side was 2 °C maximum.

Sound

Introductory remarks

The desired soundproofing of buildings is generally very dependent on the subjective perception of the users. For example, a family in a single-family house will not expect the same sound insulation between rooms as two parties in a multi-family house between their individual apartment partitions. You can place very high demands on sound insulation, which you then try to implement with complicated detailed solutions. On the one hand this can become very expensive, on the other hand a faultless execution on the construction site is not always guaranteed due to the very complex connections.
If you now want to determine a desired sound insulation in your project, you should discuss the cost-benefit question together with an expert to find an appropriate planning solution. As a rule, the applicable standards only contain recommendations for single-family houses (EFH) and requirements for multi-family houses (MFH).

Airborne sound

The airborne sound insulation of exterior walls or partition walls is often largely determined by the openings. Windows or doors are usually the weak points of these components. With Thoma components, airborne sound insulation can be easily implemented in all areas. In this chapter we show some important parameters of superstructures and walls. Most measurements were made under laboratory conditions. Due to the flanking transmissions and possible execution errors, sufficient buffer must be taken into account for the actual values to be expected.

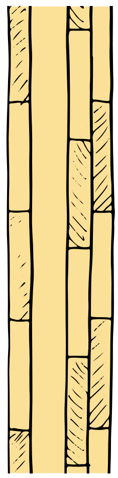
Impact sound

In the case of impact sound (as well as airborne sound), the importance of edge transmission also increases with increasing sound insulation requirements. If increased soundproofing is desired, at least as much attention must be paid to the flanking passages in planning and execution as to the building components themselves. You will find a proposal for the design of the intersection in our detailed catalogue.

Application area	R'_w	$L'_{n,w}$
EFH recommendation	≥ 50 dB	≤ 56 dB
MFH requirement	≥ 54 dB	≤ 53 dB
Increased sound insulation	≥ 55 dB	≤ 46 dB

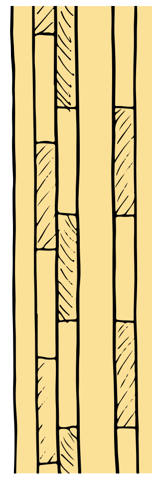
Sound insulation, standard values according to DIN 4109 (1989)

H100 - W14



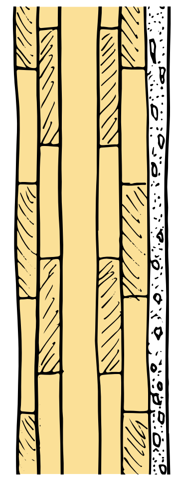
$R_W(C;C_{TR})$ = 39 (-1;-4) DB
TESTING INSTITUTE: TU - GRAZ

H100 - W20



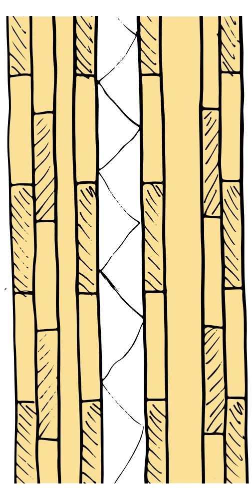
$R_W(C;C_{TR})$ = 41 (-1;-4) DB
TESTING INSTITUTE: TU - GRAZ

- H100 - W17
- 3 CM WEM CLAY PLATE



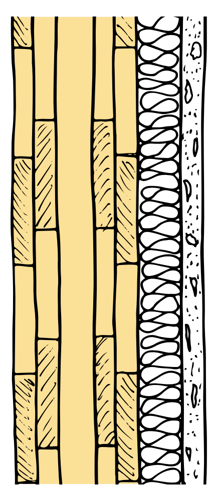
$R_W(C;C_{TR})$ = 48 (-2;-6) DB
SERVES AS A GUIDE ONLY
TESTING INSTITUTE: SELF-MEASUREMENT

- H100-W12
- 6 CM HWF
- H100-W14



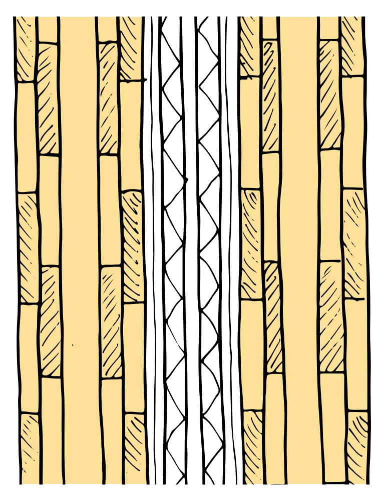
$R_W(C;C_{TR})$ = 54 (-2;-8) DB
NOT SCREWED!
TESTING INSTITUTE: TU GRAZ

- H100 - W17
- 6 X 4 CM BATTENS
- 6 CM STEICO-FLEX
- 3 CM WEM CLAY PLATE



$R_W(C;C_{TR})$ = 60 (-4;-11) DB
SERVES AS A GUIDE ONLY
TESTING INSTITUTE: SELF-MEASUREMENT

- H100 - W17
- 2 X 1,25 CM PLASTER
- 3 CM MINERAL WOOL
- 2 CM AIR
- 3 CM MINERAL WOOL
- 2 X 1,25 CM PLASTER
- H100 - W17



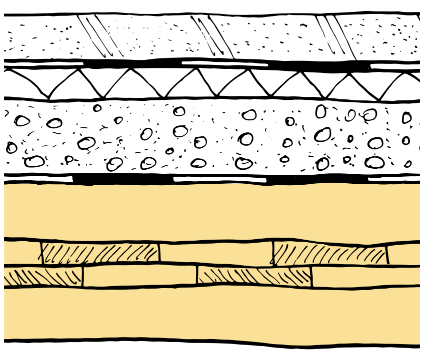
$R_W(C_{100\text{-}3150};C_{TR,100\text{-}3150})$ = 76 (-2;-6) DB
NOT SCREWED!
TESTING INSTITUTE: IFT ROSENHEIM

Recommendations for good sound insulation:

1. Avoid sound bridges: edge insulation, broken screed foil, crossing pipes, clean separation of screed in door area
2. Optimize superstructures: heavy, unbound fill (approx. 1400 kg/m³), impact sound insulation with low, dynamic stiffness (s'< 10 MN/m³)
3. Decouple connections: to avoid longitudinal sound conduction, use a double-shell design, bearings and optimised fasteners

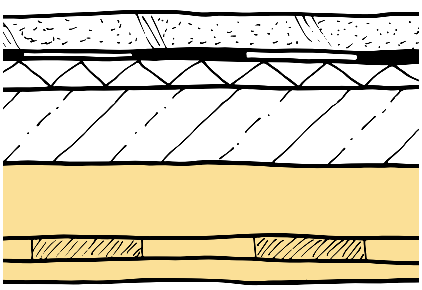
The tested ceiling structures show a minimum spectrum matching value ($_{CI,50\text{-}2500}$) when viewed from the low frequency range. Since sound transmissions in timber construction are usually perceived as disturbing at low frequencies, these ceilings offer optimum protection against walking noises or muffled pounding noises.

- 5 cm screed (120 kg/m²)
- 4 cm TSD (s' ≤ 7 MN/m3³)
- 10 cm double-crushed chippings 8/11 (144 kg/m²)
- H100-D21 (85 kg/m²)



$R_W(C_{100\text{-}3150};C_{TR,100\text{-}3150})$ = 76 (-4;-11) DB
$L_{N,W}$ $(C_{I,50\text{-}2500})$ = 40 (2) dB
TESTING INSTITUTE: IFT Rosenheim

- 5 cm screed (120 kg/m²)
- 4 cm TSD (s' ≤ 7 MN/m3³)
- 25.5 cm wood-concrete composite (258 kg/m²)



$R_W(C_{100\text{-}3150};C_{TR,100\text{-}3150})$ = 72 (-2;-8) DB
$L_{N,W}$ $(C_{I,50\text{-}2500})$ = 43 (0) dB
TESTING INSTITUTE: IFT Rosenheim

ALTERNATIVE
- 5 cm screed (120 kg/m²)
- 4 cm TSD (s' ≤ 7 MN/m3³)
- 6 cm light fill (Cemwood, 30 kg/m²)
- H100-D21 (85 kg/m²)

$R_W(C_{100\text{-}3150};C_{TR,100\text{-}3150})$ = 71 (-2;-8) DB
$L_{N,W}$ $(C_{I,50\text{-}2500})$ = 48 (1) dB
TESTING INSTITUTE: IFT Rosenheim

ALTERNATIVE
- 4.5 cm LITHOTHERM, DRY SCREED (73 kg/m²)
- 3 cm FIBREBOARDS
- 6 cm light fill (Cemwood, 30 kg/m²)
- H100-D21 (85 kg/m²)

$R_W(C_{100\text{-}3150};C_{TR,100\text{-}3150})$ = 64 (-2;-8) DB
$L_{N,W}$ $(C_{I,50\text{-}2500})$ = 51 (6) dB
TESTING INSTITUTE: IFT Rosenheim

Life cycle assessment

Environmental declaration according to EN 15804
Environmental Product Declaration (EPD)

The declared unit is one square meter H100-W17. It is a "Cradle-to-gate with options" declaration. The systems therefore include the following stages according to EN 15804: Product stage (modules A1-A3)

- A1 Provision of raw materials and processing of secondary materials serving as inputs
- A2 Transport to manufacturer
- A3 Manufacturing

After the product has reached end-of-waste status as chopped waste wood, it is assumed that it will be fed to a biomass combustion plant that produces thermal energy and electricity. The resulting effects and credits are declared in module D. In principle, EPD data can only be compared or evaluated if all data sets have been compiled in accordance with EN 15804 and the product-specific performance characteristics have been considered.

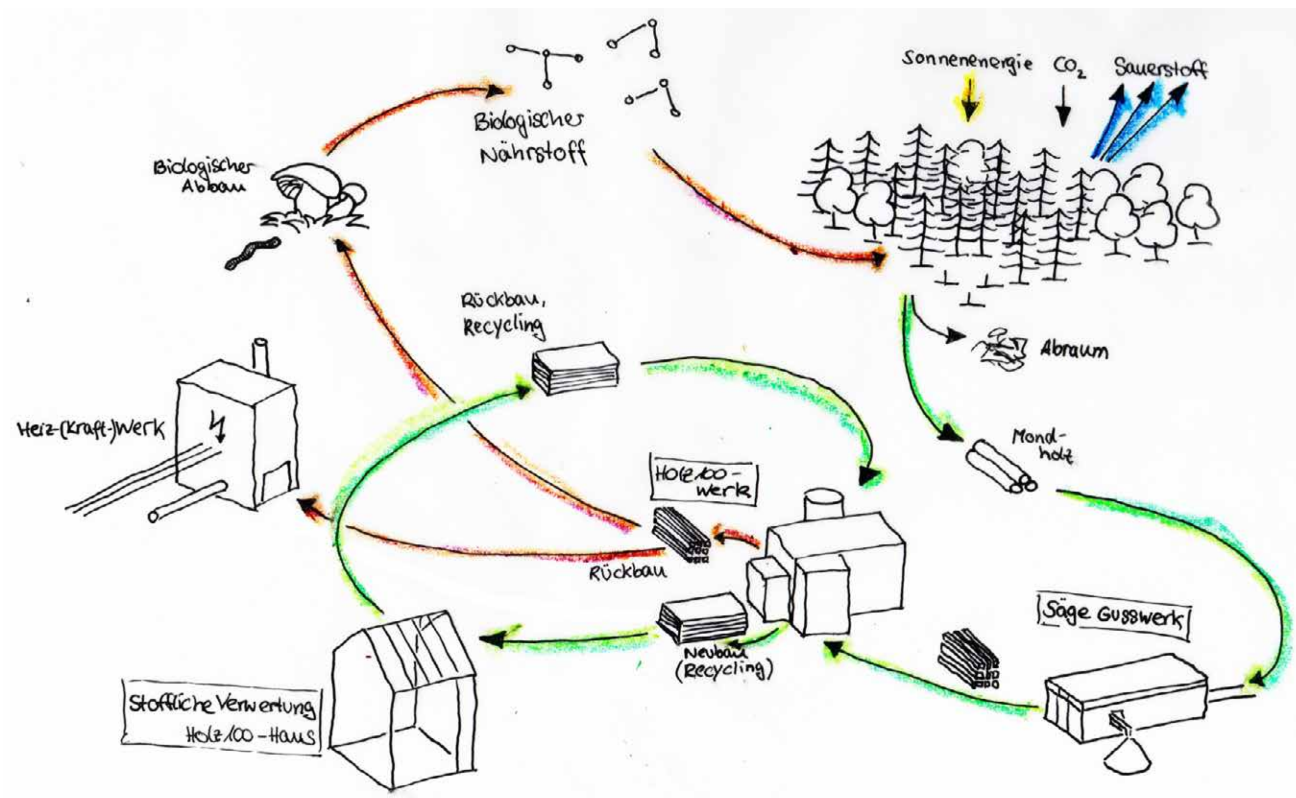
Parameter	Unit	A1-A3	D
Global warming potential	kg CO_2-eq.	-1.35E+02	4.40E+01
Acidification potential of soil and water	kg SO_2-eq.	1.03E-01	-5.28E-02
Total non-renewable primary energy sources	MJ	2.70E+02	1.39E+03

This is only an extract containing the most important cornerstones of the declaration.
The complete declaration and associated assumptions are available on request.

The photovoltaic system at our factory in Lahr uses pure sunlight to produce an average of 690 MWh per year. On average, the plant consumes 410 MWh. Thoma is an Energy PLUS manufacturer of building materials!

Cradle to Cradle

Another very important aspect is the importance of cycles in the material flow of our building masses. The mistaken belief that thermal recycling is the solution to all problems hinders the development potential of functional recycling concepts. In order to optimize disposal processes, homogeneous properties of the demolition material are advantageous. In contrast to "demolition with the wrecking ball", this can be achieved by a systematic dismantling of the construction (selective dismantling).
For example, these considerations are also applied at Cradle to Cradle. "Products should function in material cycles, so that there is no useless waste, but only useful raw materials." Old building structures can therefore be an important source of raw materials for new buildings. With Holz100, this is enabled by the dowel connection. The dowels are drilled out again in a "reverse" production chain by means of optical recognition and the loose boards are reused in new wall elements after sorting.



THOMA - Holz100 is the only solid wood system with C2C Gold certification.

Wood construction planning

We have in-house carpenters who take care of the wood construction planning. This means that one of the following prerequisites must be fulfilled at the start of the cooperation, which our specialist planning team can build on.

Stage 1: Approval plans

- Planning status for submission of building application
- Scale 1:100 (floor plans, views, sections)

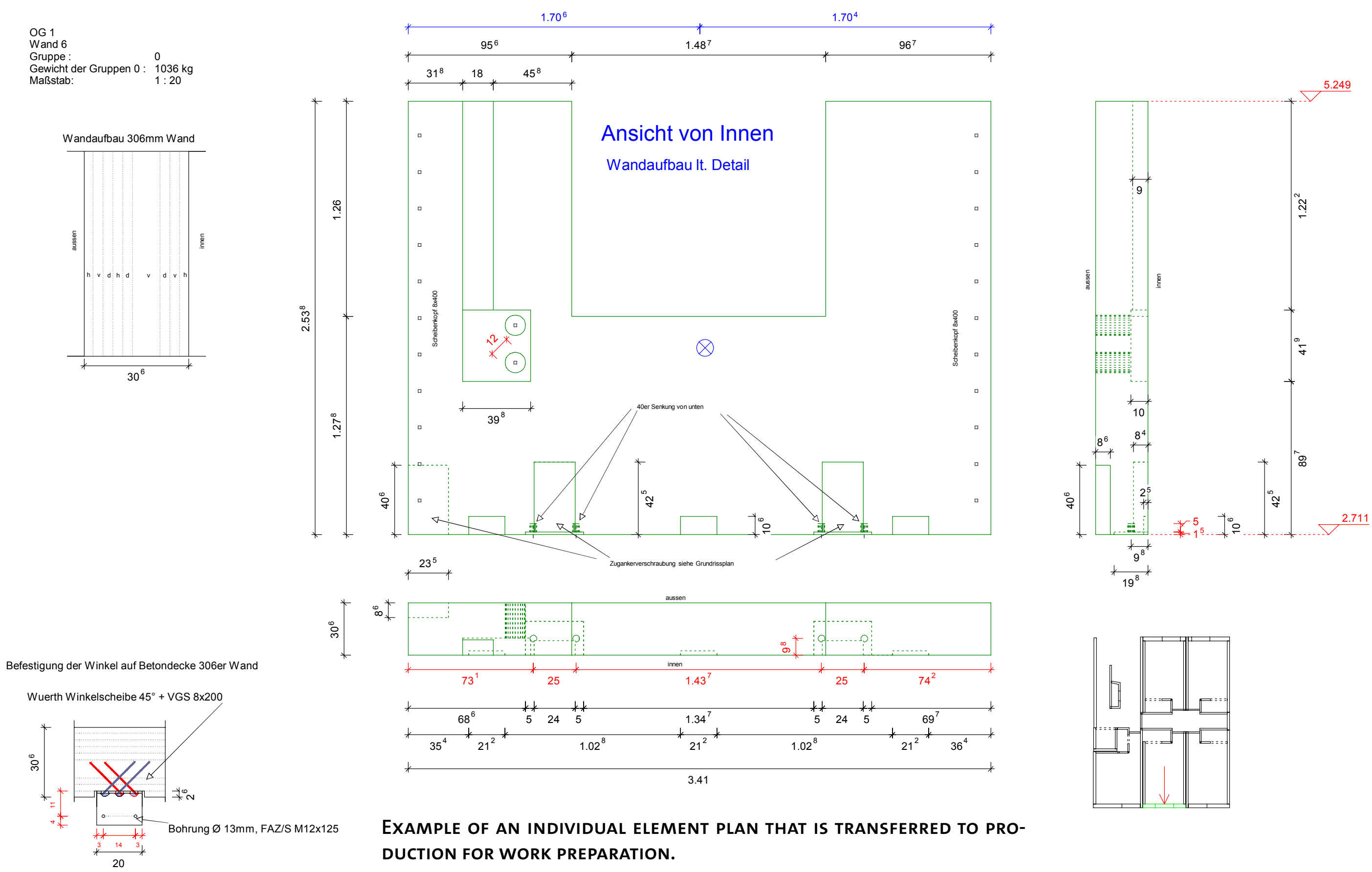
Level 2: Work plans

- Finished execution plans and those approved by the client
- Scale 1:50 (floor plans, views, sections)
- Wall constructions, HVACSE (heating, air conditioning, ventilation, sanitary, electrical), as well as shell dimensions must be completely incorporated.

Level 3: 3D data

- Functioning and readable 3D model with complete and approved wall envelopes
- Dietrichs, Cadwork and IFC files are possible
- Squared lumber, wall structures, HVACSE planning and shell dimensions must be fully incorporated

The statics are enclosed with all plans or are provided by us.



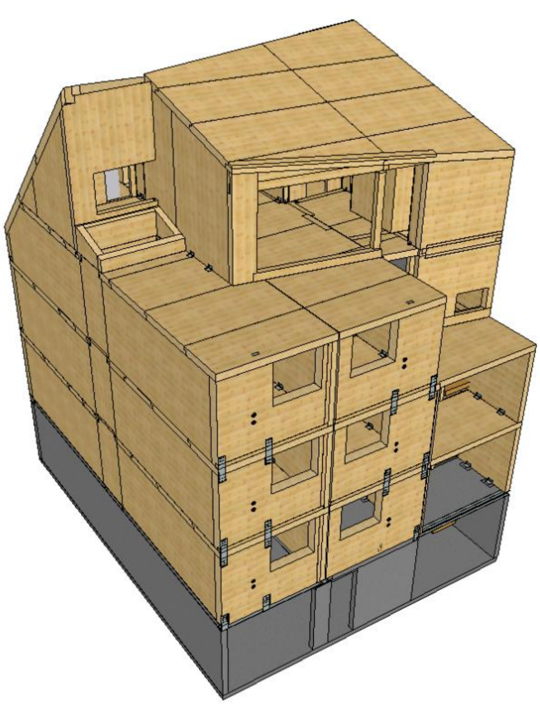
Example of an individual element plan that is transferred to production for work preparation.

Should you have any questions regarding technical feasibility or other details during the design phase, we will be happy to advise you!

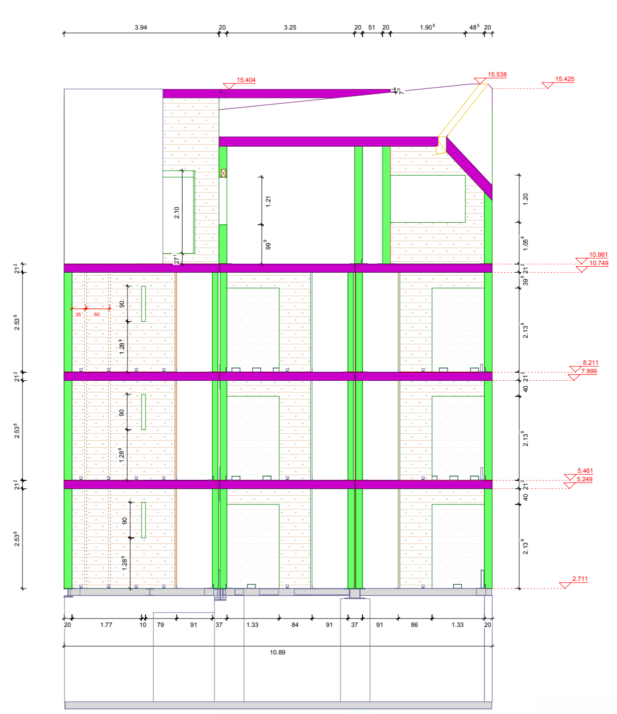
The planning process therefore begins after the basics have been provided to us. In the next step, our engineers create a 3D model. Floor plans, sections and views are created from the model, which are sent to the contact person responsible on site for approval or for the possibility of last changes. From the time of release, no further changes are possible because the plans for the individual components are then drawn up. After the planning of the individual plans has been completed, they are sent to the work preparation department to generate the necessary machine data and production can begin.

The release of the plan takes place 8 weeks before the desired delivery date.

In the planning phase, all integrated electrical cables are incorporated into the walls. The 3D model can also be used to create a complete squared timber plan, such as a roof truss plan. We also prepare assembly plans for the joists and prepare screw lists. Finally, loading plans are created which determine the exact position of the elements on the low-loaders in accordance with the assembly sequence. The complete documentation serves the on-site carpenters to assemble the building.



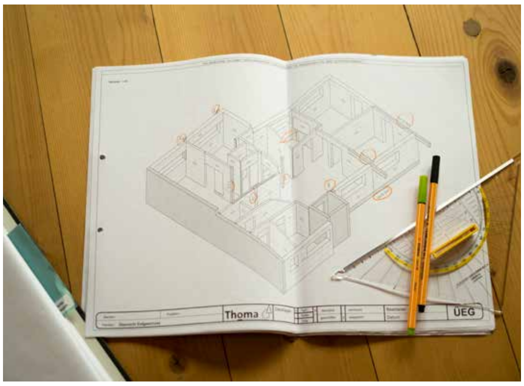
All projects are processed in 3D models



Technical section through the project

Our planning leaves nothing to chance! Quality assurance in the factory is always safer than improvisation on the construction site

Construction process



The work plan is on the table

You have designed your dream house together with your Thoma partner or architect, the plan has been approved and prepared as a construction plan. Now our engineers get to work and transform the whole house into individual Holz100 components in a wood construction design process.

The components are manufactured.

The Holz100 components are now individually manufactured in our workshops and according to the specifications of the Holz100 production plan. In the first step, individual layers of moonwood boards are stacked on top of each other by hand or robot.

All parts are connected with wooden dowels.

The entire element is held together by purely mechanical wood joints. Beech dowels swell up in the board layers and connect them insolubly with each other. Toxic glues or wood preservatives are not used in the production of Holz100. Thousands of Thoma houses built so far have saved man and environment thousands of times.

The components of a detached house

In the Holz100 workshops, the dowelled components of a detached house are stored until, in the next step, they are joined with millimetre precision using the CNC-controlled milling machine. All necessary machining operations are completed so that the elements do not have to be worked on later.

The finished component is inspected

Now the component is completely tied. But before release and loading takes place, all dimensions are checked again, the surface inspected for blemishes and manually reworked. This final inspection ensures that Thoma elements are hand-picked components of the highest quality.

Everything is ready for transport.

The individual parts of the house are loaded onto platforms in the factory hall and covered with tarpaulins. Thus prepared for transport, the platforms can be loaded with the low-loader and set off on time for the construction site.

The house is transported to the construction site.

Thanks to our two locations, we can keep delivery routes short throughout Europe and minimize CO_2 emissions. In the run-up to delivery to the construction site, the access route is clarified on site so that the lorry can easily get to and from the construction site on arrival.

The delivery is accepted at the construction site.

At the construction site, the carpenters are ready with the crane and now lift one component after the other onto the floor slab of the future Thoma House. The platforms can stay with the elements on the construction site. This means that the truck does not have to stay and rain can also be waited for before assembly begins.

A wall floats over the construction site

All components are safely lifted with special mounting hangers. Already in the planning stage, the assembly sequence of the individual elements is taken into consideration in a loading plan prepared by us and the elements can be lifted off the platform one after the other.

and is placed on the mounting joist

The larch joists determine the position of the timber structure on the floor slab and are installed and levelled with millimetre precision. The walls are fitted with a groove on the underside to fit precisely onto the mounting joists and can be assembled in no time at all thanks to the enormously high and precise degree of prefabrication.

The ceiling elements are mounted

Due to the multi-layered structure of the roof and ceiling elements, the panels, which have a bracing effect, can be installed in large widths of approximately 2.50 m. This enables very fast assembly times and the most complicated elements, such as dormers or complex roof trims, retain their shape to the millimetre.

The building shell stands in the evening already

A Holz100 construction kit for a detached house can be erected in the record time of one day. We and our local partners see it as our mission to amaze you through perfect planning, production, construction management and an uncompromising focus on quality.

Related topics

Moonwood

How can we improve the properties of wood without using chemicals? This question has been on our mind since our company's inception. Avoiding the use of chemicals is at the very heart of our actions. When processing our trees we improve the quality by many factors. The wood, harvested at high altitudes, is slowly and gently dried in the air for up to 3 years in our storage sites before it is further processed. For timber harvest, we have always observed the rule of cutting the wood only during the so-called juice-rest (or hibernation period in the winter months) and the waning moon – without exception. We operate our own sawmill to be able to provide complete proof of this quality commitment. We let ourselves be guided by the ancient knowledge that we have received from our ancestors. The right harvest makes the wood more resistant to fungi and insects.

View of a part of the log storage of our unique moonwood saw (Gusswerk, Steiermark, Austria)

After many years of work guided by this knowledge, we finally received backing from science. Prof. Ernst Zürcher speaks of an influenced cluster formation of water by the moon-earth constellations. These clusters influence the binding of water to the wood cell wall. With waning moon more water is bound in the cell walls. Wood that is harvested under a waning moon can retain more water in their cell structure during the drying process. This wood thus shrinks more and is "denser" and heavier after drying. We recommend the exciting book by Prof. Ernst Zürcher "Die Bäume und das Unsichtbare" (Trees and the Invisible) (2016) for those who want to delve deeper into the subject.

Perfection in detail starts at the very beginning. In winter, in the woods. © Rachele Z. Cecchini

Respectful interaction with each other and with the gifts of nature is important to us. The most valuable reward for this is the joy of our work!

Planed products

Lumber store, moonwood for formwork, joinery and floors (Neukirchen am Grossvenediger, Salzburg, Austria)

The planing mill

Neukirchen am Großvenediger. Here we started 1990 with the first moonwood production in a small planing and sawmill. Even today, we process local "wood specialities" into joinery, solid wooden floors and formwork.

Floors

In the following detailed suggestions we show different floor constructions for solid floorboards. Floors made of solid wood cannot be laid floating on a "traditional" wet screed and of course we do not want to use adhesives. These floors are screwed onto insulating boards so that they lie tightly and firmly on the floor. Should wet screed nevertheless be used, we recommend covering it during the drying process so that air humidity in the room does not become too high and the formation of gaps on the Holz100 surfaces is minimized.

Formwork

The interior formwork is very similar to our floors in terms of the planed profile and the available types of wood. The main types of wood used for external formwork are spruce, fir and larch. The slightly more expensive larch is more durable than spruce and fir if exposed to constant weathering. However, this durability rarely plays a decisive role on the façade with good structural wood protection (canopy, planed profile, building height, etc.). The following three examples illustrate the treatment of external formwork:

- COATING: Longer-lasting, even surface with characteristic wood colouring or other colours, no noticeable increase in the durability of the façade. Once painted means you need to paint over and over again. Maintenance intervals approx. 5-8 years, for a better environment use natural paints (e.g. Auro).

- UNTREATED: Natural weathering process, discolouration analogous to old wooden buildings from grey to golden brown. After weathering, the wood species larch, spruce and fir can hardly be distinguished. Maintenance-free façade, with complete renunciation of paints.
- PRE-GREYING: Controlled and accelerated natural pre-greying. Greying depends on primary factors such as the sun and water (weather exposure, climate and location of the building). Regular grey on the entire façade, maintenance-free and without paints.

Four façades at a glance (from left to right): pre-greyed, painted, untreated, lime plaster

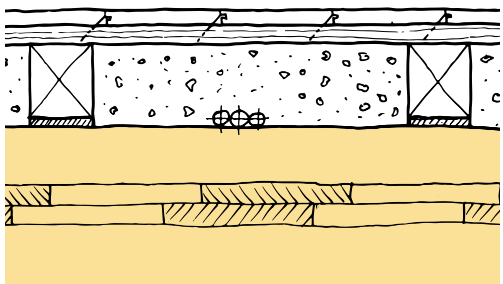
Joinery

Furniture made of solid wood can be created from individual trunks with a special character, giving pleasure to many generations. We store this wood in the form of unedged earth trunks in various dimensions. Because these treasures are so individual, we do not deliver them to order. We will gladly take the time to search for suitable pieces in our warehouse together with you.

Our plant manager for sanding solid wood floors

There are various methods for pre-greying wood. We have used iron(II) sulphate/iron vitriol in our experiments. This solution was applied to the façade boards with a fruit syringe. Sawed spruce works best. The larch is less suitable. Depending on the location and situation of the building or façade boards, the mixtures can achieve different effects. A certain experience or willingness to experiment is therefore assumed.

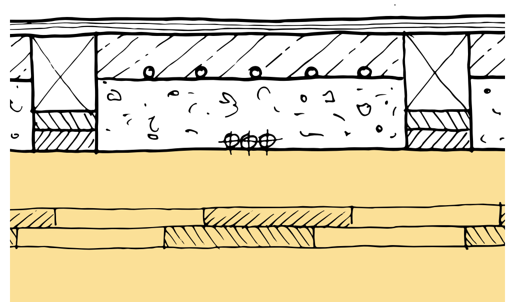
Traditional structure



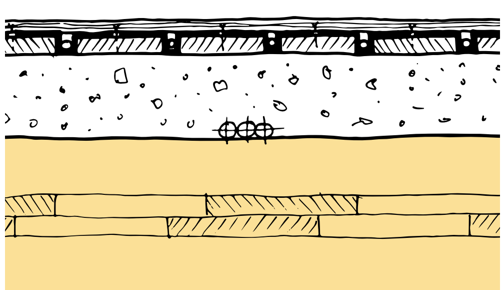
The longstrip planks (23 mm) are screwed to a false floor (25 mm), which in turn is mounted on insulating boards (approx. 8/10 cm). These are mounted on impact sound bearings and can also be mounted on the ceiling without screwing if a well-bonding fill is used (impact sound insulation).

Screed and underfloor heating

The heating screed is inserted between the insulating boards in order to screw the longstrip planks together. The insulating boards are held by supporting timbers and a footfall sound insulation. Examples for fillings: Geocell©, Cemwood©, Liapor© or washed chippings.



Heat conduction sheets



An alternative for ambitious do-it-yourselfers to heating screeds are heat-conducting sheets, which are placed between spaced dummy floor boards. With this system you do not have a sound bridge through the insulating boards and you are a little more free in the choice of the filling (e.g. clay fillings or clay bricks from your own excavation pit).

Further possibilities without insulating boards, which penetrate the filling:

- Lithotherm©: prefabricated dry screed slabs made of clay or Eifellava for underfloor heating systems. Insulating boards which match the system will be supplied.
- Wood fibre boards: substructures of different manufacturers, tongue and groove systems with included substructure insulation, e.g. Gutex Thermosafe-nf©

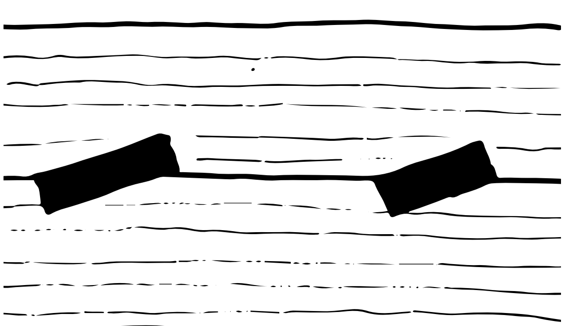
Square timber

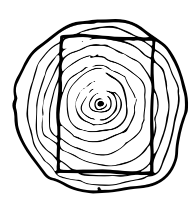
Square timber

Today, load-bearing supports or beams are mostly used in the form of finger-jointed beams in straight lengths or glued laminated timber. This wood can be quickly and easily supplied to the construction site. In order to be able to consistently think through glue-free timber construction to the end and to be able to dispense with these glued industrial products, it is important to pay attention to this early in the project planning stage. Steel beams are an alternative, but not for everyone. When using solid squared timber, which is cut in one piece from a log, the following points must be taken into account.

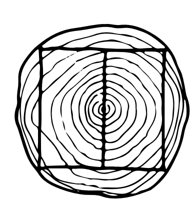
- LONGER WAITING PERIODS: The wood is cut to the required dimensions for each project and must also be dried. In order to optimize the transport effort, we try to load the material with the Holz100 transports and therefore need a little buffer time. The joinery plans for the squared timber must therefore be approved by the customer at least 9 weeks before delivery.
- RESTRICTED DIMENSIONS: If you want to cut a cross section from a trunk that tapers upwards, the maximum possible dimensions decrease with the length of the squared lumber. Cross sections that are too thick can also no longer be dried well. A good guideline for maximum dimensions of a solid squared lumber is approx. 14 cm x 25 cm.
- SWELLING AND SHRINKAGE: Working the wood more or less always leads to the formation of cracks, which are aligned to the core. To be able to influence this, we cut the wood in two stems (core separated) by default. In the case of large dimensions with a single stem (with core) and upon request and agreement, we can also cut the square timber with three stems (without core).

With dowelled beams, the load-bearing cross-sections of beams can be increased by means of a mechanical connection instead of a glued joint. This can be solved traditionally with a hardwood inlay or also with a screw connection.

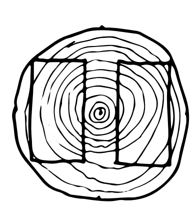




Single stem



Double stem



Triple stem

Tenders with Thoma

Solid wood walls - Glue and metal free

Delivery and installation of a glue- and metal-free solid wood wall (solid wood wall), spruce/ fir wood species, from PEFC-certified forestry, chemically untreated and harvested in winter during the waning moon phase. The origin, time of harvest and processing route of the wood used must be verifiable in writing.

Wall thickness XXXmm
Bulk density: 450kg/m³

Layer structure: X layers, layered crosswise (lengthwise, crosswise and diagonally) to form a massive, solid wooden element. The longitudinal fibre of the wood, as a bracing element, thus runs at least once in one of the three directions and thus guarantees the dimensional accuracy of the element. The individual layers must be joined mechanically/constructively by wood exclusively, without metal parts or other foreign materials.

The following certificates must be submitted:

- Valid ETA Certificate
- Certificate of moonwood with confirmation of origin and processing chain
- Valid certificate of eco-effectiveness, which evaluates the recycling management and the sustainable manufacturing process of the product. Example Cradle to Cradle http://www.c2ccertified.org/ or comparable. Only gold or platinum certified products are permitted.

Design according to drawing: includes connecting and fastening elements according to structural requirements, mounting joist in larch (according to drawing), separating layers between concrete ceiling and wooden wall as protection against rising damp (bitumen sheeting), cuttings, all incidental and additional services, further performance specifications (e.g. surfaces or optional types of wood).

Calculated according to the actual areas (tongues and coverings are deducted), openings up to 2.50m² are calculated over the entire area, openings over 2.50m² are 100% deducted. In the case of gable walls/slant cuts, the omitted surfaces are deducted.

Unit price XXX €/m²

Solid wood ceilings - Glue and metal free

Delivery and installation of a glue- and metal-free solid wood wall (solid wood wall), spruce/fir wood species, from PEFC-certified forestry, chemically untreated and harvested in winter during the waning moon phase. The origin, time of harvest and processing route of the wood used must be verifiable in writing.

Wall thickness:212mm
Bulk density: 450kg/m³

Layer structure: 4 layers, layered crosswise (upper and lower belt in longitudinal direction, 2 intermediate layers) to a massive, solid wood element. Due to the arrangement of the layers, the element can be used as a stiffening plate. The individual layers must be joined mechanically/constructively by wood exclusively, without metal parts or other foreign materials.

The following certificates must be submitted:

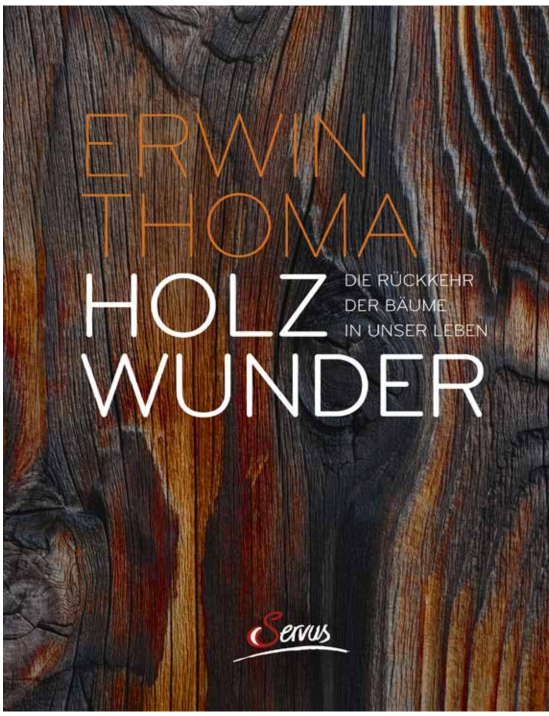
- Valid ETA Certificate
- Certificate of moonwood with confirmation of origin and processing chain
- Valid certificate of eco-effectiveness, which evaluates the recycling management and the sustainable manufacturing process of the product. Example Cradle to Cradle http://www.c2ccertified.org/ or comparable. Only gold or platinum certified products are permitted.

Execution according to drawing: Includes connecting and fastening elements according to structural requirements, cuttings, all incidental and additional services, additional performance specifications.

Calculated according to the actual areas (tongues and coverings are deducted), openings up to 2.50m² are calculated over the entire area, openings over 2.50m² are 100% deducted. In the case of angle cuts, the omitted surfaces are deducted.

Unit price: XXX €/m²

Books by Erwin Thoma



Learn all about the new findings and possibilities of wood construction in the exhaustive books by Erwin Thoma.

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