KLH®

MADE FOR BUILDING
BUILT FOR LIVING

ASSEMBLY & INSTALLATION

IMPRINT

Version: Assembly & Installation, 07/2024

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ASSEMBLY & INSTALLA-TION

The large KLH® solid wood panels can usually be installed easily and using very few tools. The fully packaged assembly set is delivered directly to the construction site by lorry or container. The relevant installation company (usually a wood construction firm) will check and accept the delivery. The individual components are assembled and screwed together by using appropriate lifting gear. Compared to other construction materials, such as bricks, concrete or steel, KLH® building shells take much less time to be assembled. Follow-up work can start immediately after the components have been assembled, since this is a dry form of construction that does not require any drying time that would otherwise need to be taken into consideration.

The individual components are cut exactly to fit. As a result, almost no field measurements need to be taken into account (e.g. for ordering windows and doors), which in turn has a positive impact on the overall construction time. In our experience, installation work can be completed approx. 20 – 40% quicker than with conventional, traditional solid structures. Dry construction work, the application of insulation material and the façade as well as the installation of doors and windows will also take about 10 – 30% less time. In summary, this provides an innovative and long-lasting construction that meets both economic demands as well as the criteria for ecological sustainability.

01 GENERAL INFORMATION

ASSEMBLY WORK COMPLETES THE PROJECT DEVELOPMENT CYCLE

The clients submit their planning documentation including any additional information that we need in order to prepare a quotation. After consultation and after the order is placed, the actual preparation work with the client starts, submitted to us in the form of work planning documentation. Based on this work planning, which is approved by the client, production and CNC cutting of the relevant panels as well as delivery to the construction site will be carried out. At the construction site the components will be accepted, checked and put into position.

Assembly work completes the project development cycle as described in the previous chapter on “Project Management”.
For successful assembly as well as a smooth work procedure at the construction site it is of paramount importance to carefully prepare all work and to meticulously organise the assembly.

On the day of the assembly, 4 – 6 assemblers, at least 1 lifting gear (crane) and a lorry with the delivered KLH® solid wood panels ready for assembly will be at the construction site. It goes without saying that this day is cost-intensive and is therefore of major importance.

The following organisational procedure is recommended for assembly

- Preparation of auxiliary tools required for assembly
- Assembly of the components and appropriate protection of construction parts
- Organisation of follow-up work and installation work on the building

02 PREPARATION FOR ASSEMBLY

2.1 CLARIFYING THE OPERATING POSITION OF THE LIFTING GEAR AND THE LORRY DELIVERING THE PANELS

The means of transport delivering the components to the construction site as well as the loading and unloading order were already determined in the course of work planning and project submission. In order to identify the required type of lifting gear and any necessary measures, it is important to determine the exact position for the lifting gear and the delivery lorry.

Usually, positioning takes at least one day, maybe longer. All resulting consequences have to be reviewed by the client and have to be duly organised, such as road blocks or various official permits that may be required. The parking space for the lorry delivering the KLH® components should be even and horizontal, if possible.

2.2 SELECTING THE APPROPRIATE LIFTING GEAR

In order to select the appropriate lifting gear, the following parameters are decisive

- Distance from the lifting gear to the furthest assembly position
- Maximum lifting weight (see list of components)
- Required lifting height from lorry to assembly position
- Review of special situations (e.g. in case of installation in already existing buildings)
- Special situations that might apply to the unloading procedure

From a logistics point of view we distinguish between 3 assembly situations

- Assembly directly from the means of transport
- Assembly of components already stored at the construction site
- Assembly or unloading of components transported by container

Assembly directly from the vehicle

This type of assembly is the best in terms of costs. Unloading from the lorry and assembly work is performed step by step.

Assembly of components already stored at the construction site

If, for logistics or technical reasons or any special situation, assembling directly from the lorry is not possible, the KLH® components must be temporarily stored at the construction site. In this case the lifting gear must be able to cope with the unloading requirements. The lifting gear for assembly may be different from the lifting gear used for unloading. We do not recommend this course of action for visible surfaces.

Assembly after unloading from containers

In this case it must be determined in what way the containers can be unloaded at the construction site (also applies to unloading in ports, in case of reloading onto a lorry).

Unloading containers

Containers are accessible for unloading as follows:

Standard 40´ container	– only from behind (door)
40´ open top container	– from top or from behind
40´ flat container	– from top, from behind or from side

The type of lifting gear must be selected according to the unloading situation.

2.3 CHECKING EMPLOYEE SAFETY REGULATIONS AND PERSONAL PROTECTIVE EQUIPMENT AT THE CONSTRUCTION SITE

Depending on where the assembly takes place, country-specific and local employee protection regulations as well as requirements regarding personal protective equipment will apply. The assembly of KLH® components corresponds to the assembly of large, pre-fabricated wooden construction components by wood construction companies/construction firms.

2.4 ASSEMBLY TOOLS

Assembly tools are auxiliary tools that assemblers need to complete an assembly or installation (fixing) of a component.

We distinguish between the following auxiliary tools

- Auxiliary tools for positioning and fixing of components in their positions
- Auxiliary tools required to achieve the installation situation and/or fixing of components required

Auxiliary tools for positioning and fixing components in their positions

Fig. 1 – Assembly support, positioning bracket

Fig. 2 – Ceiling support

Auxiliary tools required to achieve installation and/or the fixing of components

Fig. 3 – Ladder

Fig. 4 – Assembly scaffolding

If possible, part of the scaffolding should already be complete prior to the assembly of components. This way, elements can already be screwed tightly from the scaffolding.

If the installation situation keeps changing, and if the construction site is accessible via aerial platforms, then hoisting platforms and aerial platforms are suitable for the assembly of the components – even for larger buildings with high installation positions such as shed constructions.

Fig. 5 – Aerial platforms and hoisting platforms

2.5 DETERMINING THE REQUIRED FASTENERS AND ADDITIONAL MATERIALS

Fasteners are materials which connect or fix panels. Types and numbers of fasteners will result from the detailed construction plans as well as static calculations. Standard fasteners include e.g. screws, brackets, stud anchors (transition into concrete).

Fig. 6 – Partially threaded screw

Fig. 7 – Flat head screw

Fig. 8 – Fully threaded screw

Fig. 9 – Stud anchor

Fig. 10 – Assembly bracket

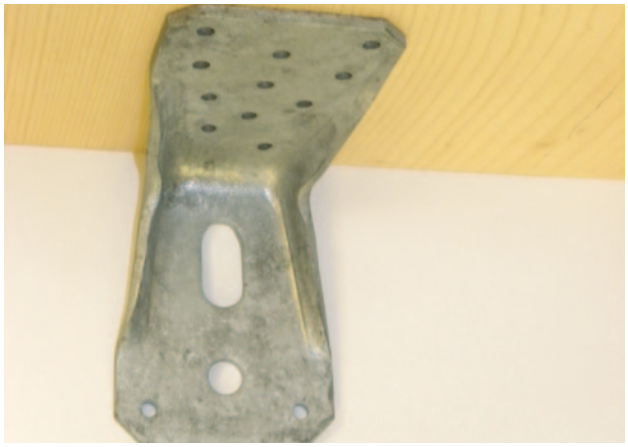


Fig. 11 – Assembly bracket

Depending on the architectural layout and the assembly situation, standard fasteners may sometimes not suffice. In this case special steel components, dimensioned by a structural engineer and organised in time by the assembly firm, will be required.

Determining additionally required material

The appropriate detailed construction work requires additional material to be available already during assembly. This includes e.g. sealing tapes to form airtight KLH® constructions or elastomer supports to improve sound insulation.

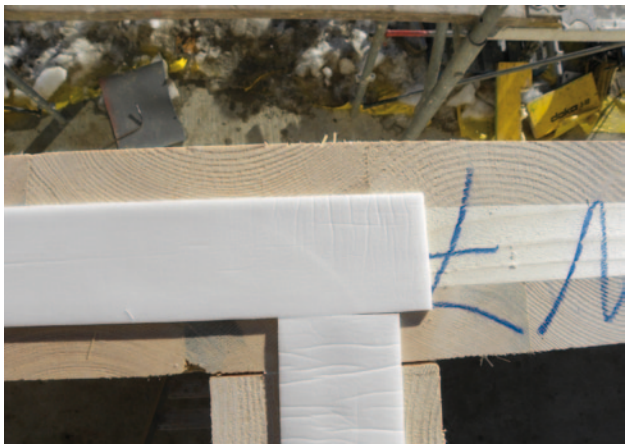


Fig. 12 – Wide elastic adhesive tape

Fig. 13 – Narrow elastic adhesive tape

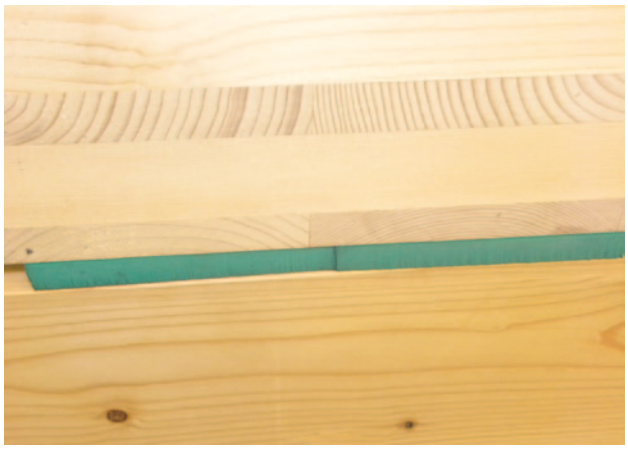


Fig. 14 – Elastomer support, soundproofing layer

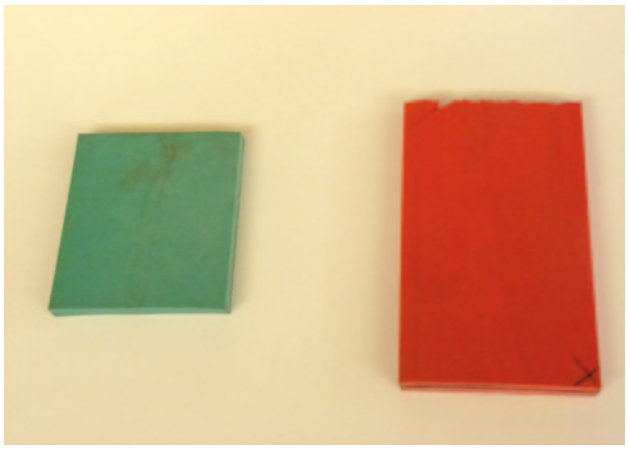


Fig. 15 – Elastomer support, soundproofing layer

2.6 DETERMINING THE TOOLS REQUIRED FOR ASSEMBLY

The assembly work of KLH® components requires nothing more than conventional tools used in wood construction, such as e.g. chalk line, hammer drill and drill with bits, aluminium levelling rod, hammer, sledgehammer, rafter clamps and the like. Figures 16 – 34 will give you an overview of the most common tools used for assembly.

Fig. 16 – Hammer drill

Fig. 17 – Drill

Fig. 18 – Cordless drill

Fig. 19 – Chainsaw

Fig. 20 – Circular hand saw

Fig. 21 – Groove cutter

Fig. 22 – Planer

Fig. 23 – Grinder

Fig. 24 – Sledgehammer

Fig. 25 – Hammer

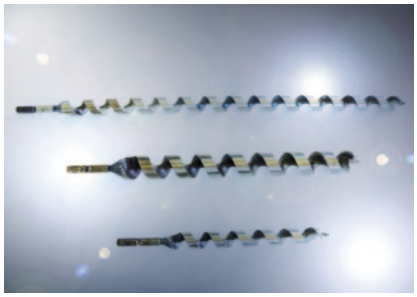


Fig. 26 – Auger bits

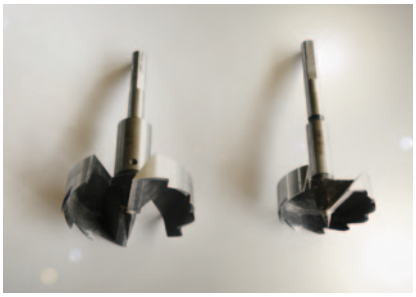


Fig. 27 – Hole cutters

Fig. 28 – Forstner bits

Fig. 29 – Bits

Fig. 30 – Chalk line

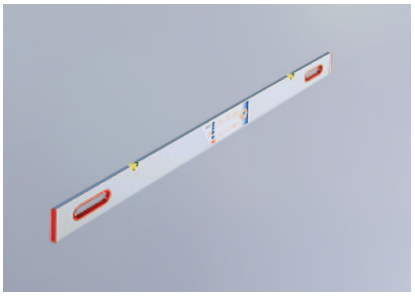


Fig. 31 – Levelling rod

Fig. 32 – Angle

Fig. 33 – Rachet beam tensioner

Fig. 34 – Lifting gear from the firm WÜRTH (transportation anchor plus combined Assy-II-screw)

2.7 DETERMINING THE REQUIRED NUMBER OF ASSEMBLERS

The number of assembly staff required depends on the detailed planning as well as the unloading situation. Assuming that expert staff will be used at the construction site, we suggest the following number of staff be required:

- Fastening the KLH® solid wood panels to the lorry — 1 person
- Placement of construction components and securing of position — 2 persons
- Screwing components tightly, reworking at construction site — 2 persons

2.8 PREPARATION WORK FOR PANEL ASSEMBLY AT THE CONSTRUCTION SITE

Depending on the detailed planning, this work usually consists of 4 activities. Depending on the detailed planning, the order of these activities may vary:

1. Applying wall positions on the substructure (concrete structure)
2. Placing assembly brackets
3. Applying horizontal moisture sealant
4. Height levelling

The above-mentioned work should be completed prior to panel assembly.

Ad 1. Applying wall positions on the substructure (concrete structure)

The working drawing results in a ground plan projection showing the positions of the individual walls. In coordination with the detailed planning (transition details from concrete to wood), the planned measurements are transferred to the concrete construction. This must be made accurately to the nearest millimetre. Angles should be checked several times by measuring the diagonal lines. Setting the fastening brackets requires each wall to be sketched with the panel thickness. Marking on the concrete slab is carried out by using a chalk line.

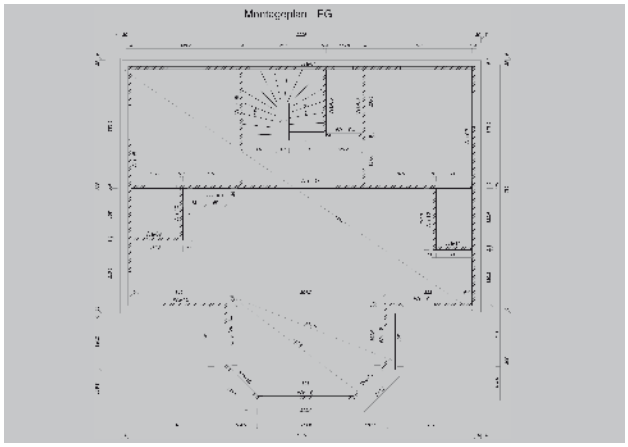


Fig. 35 – Working drawing – ground plan

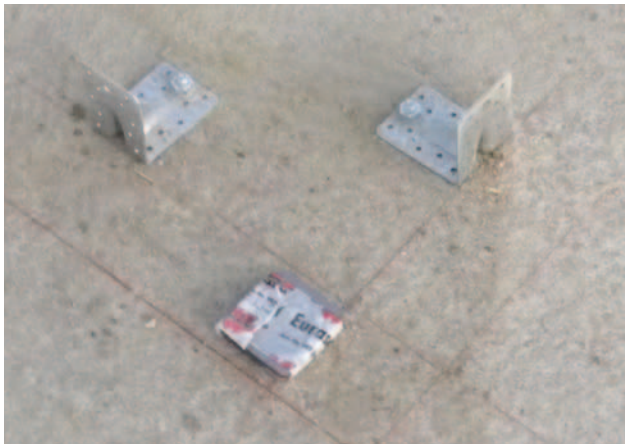


Fig. 36 – Drawing the walls

Ad 2. Placing assembly brackets

On the chalk-line mark, e.g. BMF brackets are doweled on one side in order to fix the positions of the walls. The distances between brackets will be according to static calculations. Usually, the bracket distance will be between 100 and 150 cm. Please remember not to set any brackets in areas where doors will be inserted. During assembly, these brackets will be useful as positioning tools for the wall components.

Fig. 37 – Fastening an assembly bracket

Ad 3. Applying horizontal moisture sealant

In buildings with cellars, this will only be carried out in wall areas and after setting brackets. In case of a full-surface, flame-scarfed, horizontal sealing, this will already be done prior to outlining the wall positions on the substructure.

Fig. 38 – Moisture sealing

Ad 4. Height levelling

At each fixing bracket the exact height will be determined by using a levelling instrument. Inaccuracies will be compensated with appropriate support material. Please take into account the maximum possible compression at these support points. The open joints between the KLH® wall components and the bottom slab must be filled with mortar in order for the supporting wall to fully rest on the substructure once the installation is completed. To this end, the KLH® panel will either be placed in a moist mortar bed or the joint will be filled with swelling mortar afterwards.

03 ASSEMBLY OF COMPONENTS

3.1 ASSEMBLY OF KLH® CONSTRUCTION COMPONENTS

The aforementioned preparation work should be completed prior to starting the assembly work. Due to the high number of staff and tools used, the assembly day is very cost-intensive. It is therefore particularly important that all work and organisational preparation completed up to this point have been carried out with due care.

The KLH® components are fastened to the crane hook with their lifting gear already installed at the factory, unloaded in the correct order of assembly and put in their appro-priate positions.

Figs. 39 to 42 – Assembly of KLH® components

The assembly team (2 persons) bring the components into the right positions and fix them, so the crane can get the next component. The assembly of the components is performed according to the construction plan and/or detailed planning. The 2 persons from the screwing team connect and/or fasten the components according to the detailed plan and/or according to the information provided by the structural engineer.

In case of conventional assembly work with KLH® components, it is safe to assume 4 – 6 lifting operations per hour as a general rule of thumb. One delivery consists of 25 to 40 components on average. Assuming 40 components per delivery and 5 lifting operations per hour we get an assembly time of approx. 8 hours. For larger buildings this will result in an approximate orientation value of one lorry load per day.

In case of a larger number of deliveries, allow for a time buffer between deliveries for bad weather and reworking at the construction site.

The aforementioned values refer to regular assembly that meets the Central-European standard in terms of technical knowledge, auxiliary assembly tools and employee protection regulations at the construction site.

Figs. 43 to 46 – Assembly of KLH® components

3.2 PROTECTION FROM WEATHER DURING ASSEMBLY

KLH® components are designed for applications of the service classes 1 and 2 and must therefore receive effective protection from direct weather exposure in constructions. Based on our experience we know that KLH® components will survive short-time weather exposure during assembly without any damage. It is important to allow increased moisture to evaporate later.

In case of visible surfaces, direct weather exposure will usually result in the soiling of these surfaces. We recommend organising follow-up work to commence immediately after the assembly of the KLH® components, especially for companies contracted for roofing, window installations and façade work.

3.3 PROTECTION OF VISIBLE SURFACES

Visible KLH® surfaces are planed and sanded surfaces. We recommend removing any soiling caused by assembly work directly after assembly, and applying a primer on the surfaces.

04 FOLLOW-UP WORK AND INSTALLATION WORK

4.1 ORGANISATION OF FOLLOW-UP WORK

As already mentioned, the assembly times for the building shell of KLH® buildings are much shorter than for conventional solid constructions. Follow-up work will also be significantly more time-saving. In order to benefit from this advantage and to maintain it until completion of the building, follow-up contractors must be instructed appropriately and made familiar with the KLH® construction method.

In some cases the performances provided by follow-up contractors will also influence the installation process of KLH® components. For example: if prefabricated chimneys are installed during building shell assembly work, or if prefabricated flights of stairs are installed. The same applies to any storage of dry construction materials. Very often they are already lifted inside during assembly work in order to use the crane that is available at this point. These aspects must be taken into consideration for the organisation of the assembly work.

Fig. 47 – Assembly of a prefabricated chimney

Fig. 48 – Assembly of a prefabricated flight of stairs

4.2 BASIC INSTALLATION POINTERS TO BE CONSIDERED

For most construction projects, installations are made in the conventional construction form. The foundations as well as the suspended ceilings are used for cable routing. Vertical grooves are milled in supporting interior and exterior walls. As regards milling at the construction site, it must be ensured that they will only be performed in the direction of the cover lamination. If milling at an angle to the cover lamination becomes necessary, static examination of this area will be required because such milling will result in static weakening of the KLH® solid wood panels. As regards wall ends (for example next to doors), it must be taken into account that static bearing capacity may be reduced by up to 30% if a large number of cables are laid together. Structural analysis may be required in individual cases. Generally, in case of a very large number of cables as well as water and sanitary installations, front wall installations should be undertaken. In case of water pipes, sufficient sound insulation must be ensured.

If installation pipes or cables are run through sealing layers – e.g. electric cables for outdoor lighting or water pipes for garden water taps – these penetrations must be appropriately sealed. If the sealing layer is formed by a convection barrier, penetrations must be sealed with a film. If the sealing layer is formed by the KLH® construction, appropriate sealing towards the wooden construction will be necessary. The same principle applies to chimney or ventilation penetrations and the like.

4.3 ELECTRIC INSTALLATIONS

It must be determined where and how installations will run. In case of wall components in non-visible quality, it is possible to run installations in facing formwork or to mill lines into KLH® walls and to plank them afterwards (e.g. with type X gypsum boards). If possible, we recommend milling in lines (milling in fibre direction of the covering layer) and to plank walls directly. 4/5ths of the panel thickness should be used as the maximum milling depth. If a building is to be made airtight with the KLH® building shell (i.e. film-free), we regard it as necessary to maintain at least a glue joint. We also recommend the installation of airtight sockets and, if necessary, masking of these areas.

Example: socket installation in a non-visible wall

Depending on the type of socket installation, drill holes are either made with a diameter of 68 or 92 mm. This requires the use of a drill with appropriate output. Ensure that the shaft of the hole cutter is entirely compatible with the drill.

Fig. 49 – Socket drilling in a KLH® non-visible wall

Fig. 50 – Milling grooves for cables

Fig. 51 – Installation of empty tubing, e.g. with a 25 mm FX hose (electrician)

Fig. 52 – Installation of type X gypsum boards by a dry construction worker and socket drilling in the course of that process

Fig. 53 – Placing and fixing of the socket (electrician)

Grooves are usually made with a groove cutter. Approx. 20 cm distance will remain to the floor and ceiling. They are inaccessible due to the front and back supporting table. In these areas the grooves will be completed by using a Forstner drill bit; ceiling penetrations will be made from the bottom by way of an auger drill.

In case of visible surfaces, lines are milled on the back, e.g. on the upper side of ceiling and roof elements, on the outside of exterior walls (mind the sealing layer – mask these areas or apply a convection barrier, as appropriate).

Fig. 54 – Installation of a switch/wall socket combination for walls with visible surfaces. The drill hole on the visible side must be sized according to the socket diameter and the covering frame (usually 68 mm diameter)

4.4 HEATING INSTALLATION, WATER AND SEWER PIPING

These pipes are mostly run on the ground or in facing formwork. On the ground, pipes are usually not milled in but laid in the floor structure. Risers with a maximum thickness of 4/5ths of the panel thickness may be milled selectively. Larger pipes must be covered by facing formwork, such as downpipes for water drainage piping. When fastening pipework, ensure sufficient sound insulation. As regards pipe penetrations (e.g. ceiling penetrations) and installation shafts, ensure sufficient sound insulation or fire and sound stoppers. Penetrations of sealing layers must be sealed appropriately. For bathrooms we recommend a horizontal surface sealant below the floor structure.

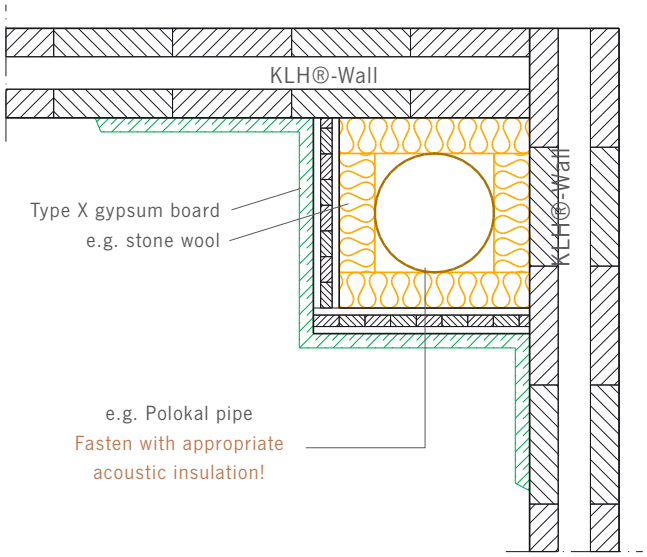
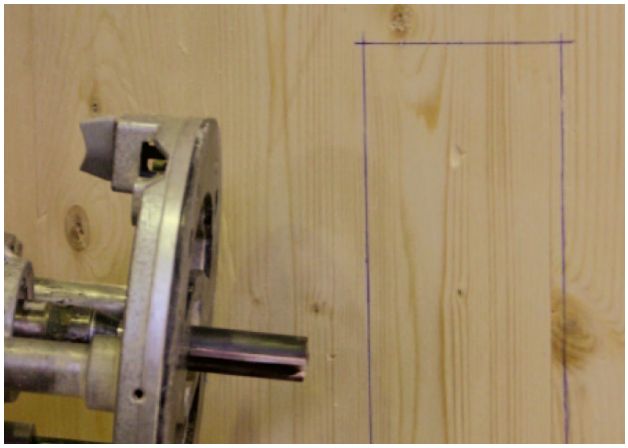


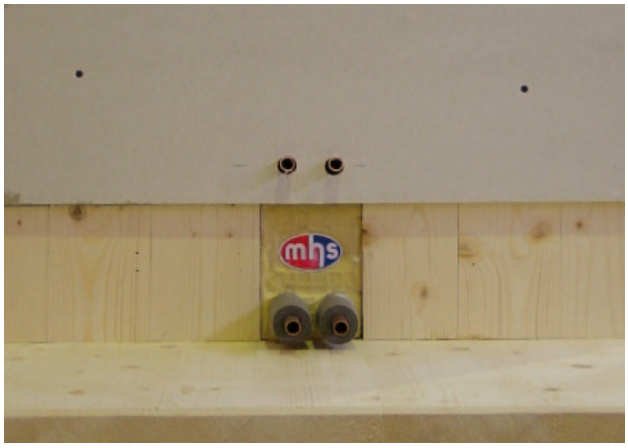
Fig. 55 – Schematic diagram – downpipe in installation shaft – ground plan

Example of installation of an mhs radiator box



The KLH® solid wood panel is milled with a router. We recommend milling in several stages. It is important not to take away too much wood at a time.

Installation of an Instabox for a valve radiator.



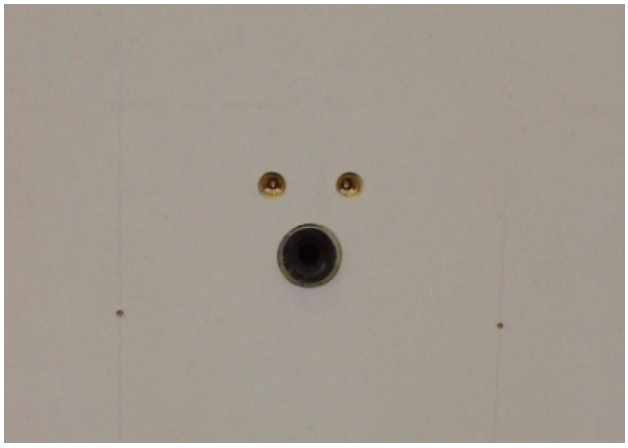
Facing of KLH® solid wood panel and Instabox – in this case with a type X gypsum board.
Prior to that, however, make sure to cut both water connections for the radiator to size.

Figs. 56 to 59 – Use of an mhs radiator box

Example of installation of a dry construction box for a washbasin

Application of two 5 x 8 cm thick laths that will be used later to install the dry construction box and to fasten the type X gypsum board

Once the correct height for the water connection and the drain pipe has been determined, the installation box can be fastened on the 5 x 8 cm laths with countersunk bolts



After fastening the installation box, it should be faced with a type X gypsum board and also fastened onto the 5 x 8 cm laths

Tiling the type X gypsum board.
Wet rooms should always be tiled. We recommend using moisture-resistant type X gypsum boards. In splash water exposed areas (bathtub and shower area) as well as on the floor, an additional sealing layer should be included between tiles and gypsum boards.

Figs. 60 to 63 – Application of a dry construction box for a washbasin

Additional examples of installation shafts. In wet rooms, the wooden structure must be protected by a second sealing layer.

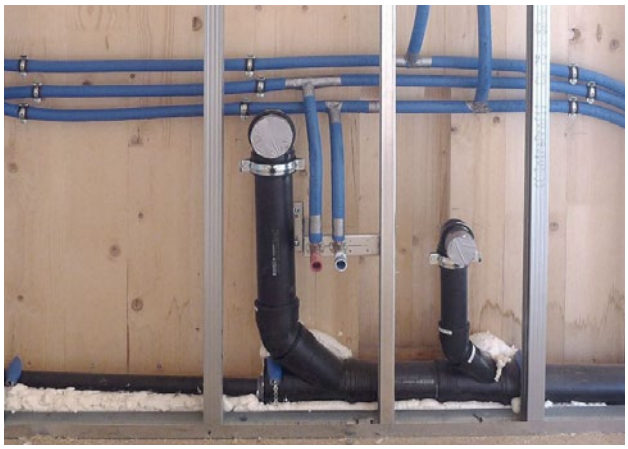


Fig. 64 – Installation of pipes in the facing formwork

Fig. 65 – Installation of pipes in the facing formwork

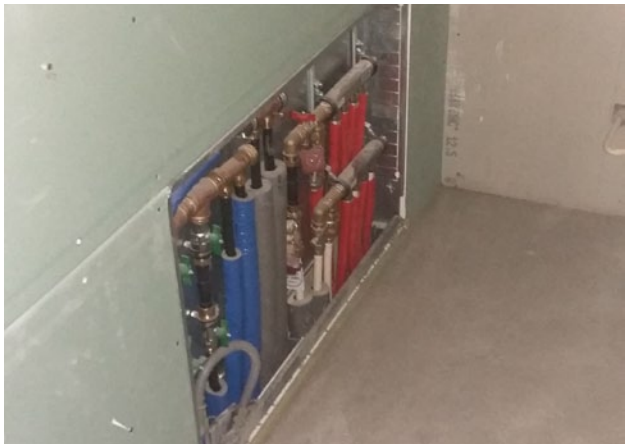


Fig. 66 – Floor distributor

Fig. 67 – Mock-up of a system solution with sealing tray

Fig. 68 – Installation of pipes in the suspended ceiling

Fig. 69 – Installation of pipes in the suspended ceiling

Figs. 64, 65, 66, 68, 69 Reference: Master's thesis, G. Schmid, TUG, 2014
Fig. 67 Reference: Research project, CLT Plumbing Design, 2023

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NOTES

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