KLH®

MADE FOR BUILDING
BUILT FOR LIVING

COMPONENT CATALOGUE FOR
CROSS LAMINATED TIMBER STRUCTURES

IMPRINT

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KLH®

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CON-STRUCTION

The suggested constructional designs with KLH® solid wood panels show application details in a systematic and self-explanatory form.

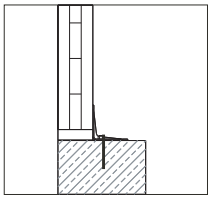
Users and planners will be able to easily derive project-specific details with reference to the basic depictions. The suggested detailed solutions merely represent recommendations given by the manufacturer.

In principle, KLH® constructions may be combined with all construction materials available on the market. For example: you may use various different insulating materials such as soft wooden fibres, mineral fibres, cellulose, etc. as well as different façade materials on back-ventilated façades or rendered façades. The structural and physical aspects such as sound insulation, heat insulation, air tightness of the building or fire protection must be assessed on the basis of the relevant project.

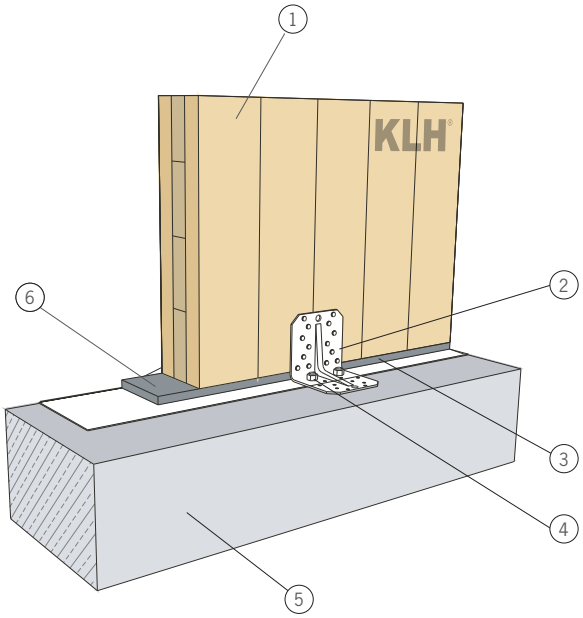
The KLH® construction as such, as well as the required connections, must be dimensioned appropriately in terms of statics. It may happen that the suggested standard connection types are not sufficient, e.g. if high earthquake loads require tension anchorage of KLH® wall elements.

Architect Dipl. Ing. Hubert Rieß, KLH®

01 WALL-CONCRETE CONNECTION

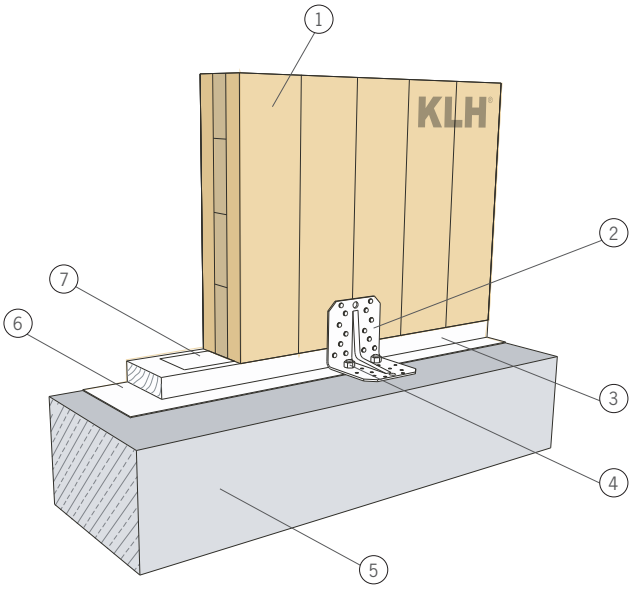


1.1 WITHOUT ADDITIONAL SILL PLATE



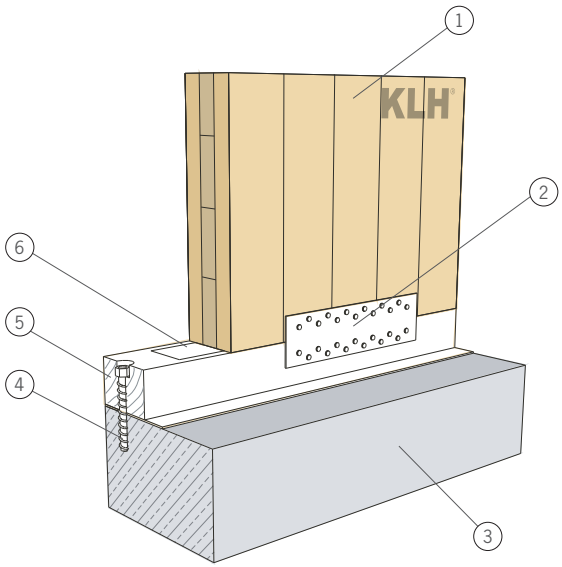
1. KLH® wall panel according to static requirements
2. E.g. BMF angle bracket
   Shear transmission and tension anchorage for the walls according to static requirements
3. The walls must rest on the base over their entire length – if the walls only rest on the base in some places, static verification is required
4. Caution: At least 2 dowels must be installed for each BMF angle bracket; otherwise the effect of the angle bracket is highly reduced (preferably use the two holes directly next to the wall or the sill plate)
5. Concrete component (wall, ceiling, concrete slab)
6. Low-shrink mortar bed

1.2 WITH THIN SILL PLATE



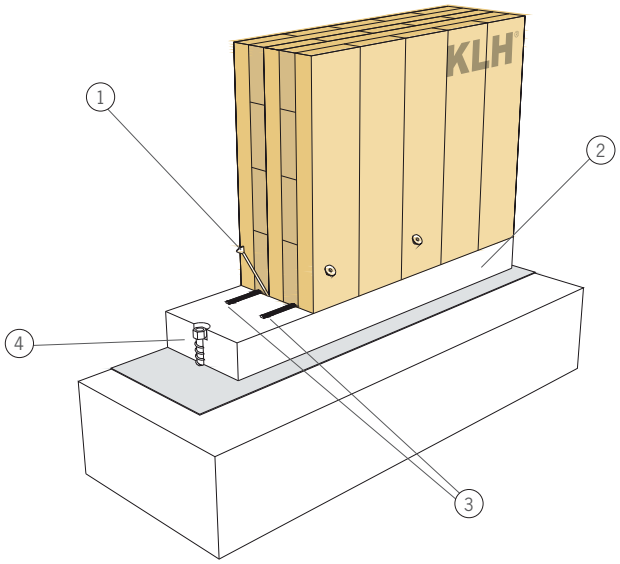
1. KLH® wall panel according to static requirements
2. E.g. BMF angle bracket for shear and tensile forces – special solutions are required for high tensile forces
3. Oak or larch sill laid in mortar bed – with the entire surface resting on the base
4. Caution: At least 2 dowels must be installed for each BMF angle bracket; otherwise the effect of the angle bracket is highly reduced (preferably use the two holes directly next to the wall or the sill plate)
5. Concrete component (wall, ceiling, concrete slab)
6. Protection against rising moisture
7. Install joint tape, if necessary

1.3 WITH HIGH SILL PLATE



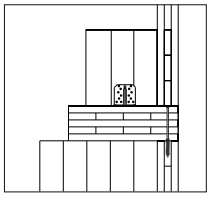
1. KLH® wall panel according to static requirements
2. E.g. BMF perforated plate for shear connection between KLH® wall and sill
3. Concrete component (wall, ceiling, concrete slab)
4. Concrete screws for shear force transmission between sill and concrete
5. Oak or larch sill laid in mortar bed – with the entire surface resting on the base
6. Install joint tape, if necessary

1.4 CONNECTION OF THICKER EXTERIOR WALLS

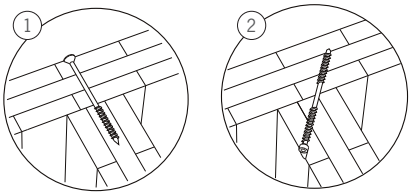


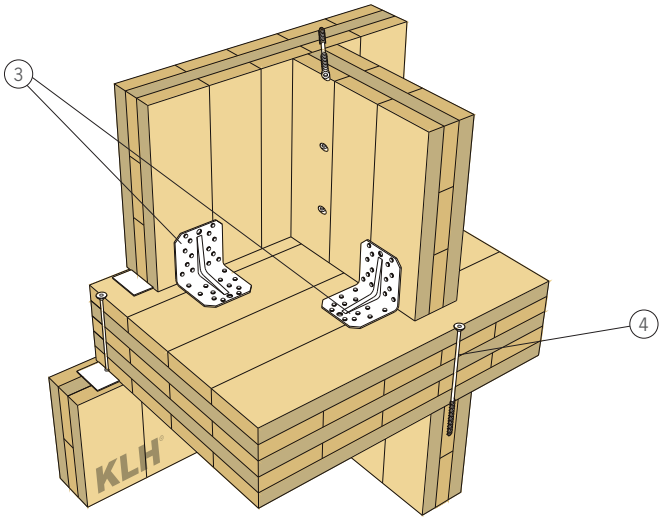
1. Diagonal fully threaded screws to absorb higher horizontal forces
2. Sill plate laid in mortar bed and dowelled to concrete
3. 2 x sealing tape along longitudinal panel lengths
4. Dowel connection between sill and concrete

02 WALL-WALL CONNECTION, CEILING-WALL CONNECTION



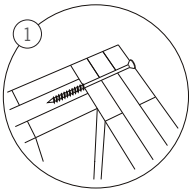
2.1 EXTERIOR WALL – INTERIOR WALL - CEILING

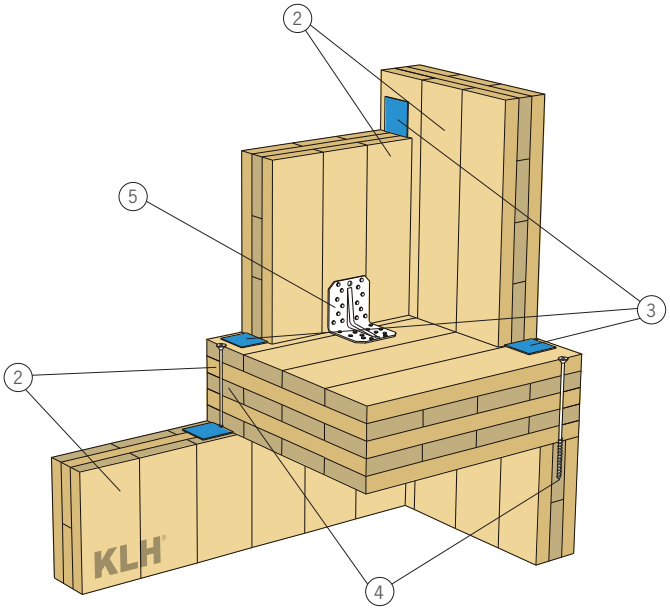




1. Cross wall connection – screw connection from the outside
2. Cross wall connection – screw connection from the inside
3. Shear force transmission along the joint and tension anchorage of walls – e.g. BMF angle bracket – type, distance according to static requirements
4. Screw connection of ceiling with walls according to static requirements

2.2 EXTERIOR WALL – EXTERIOR WALL - CEILING

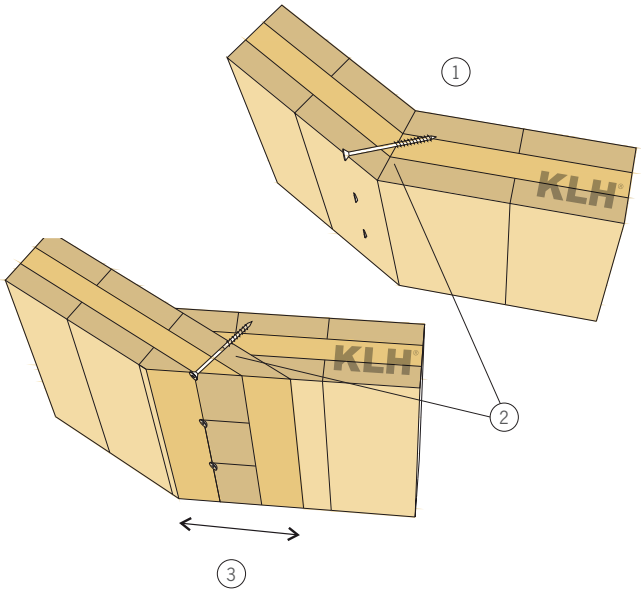


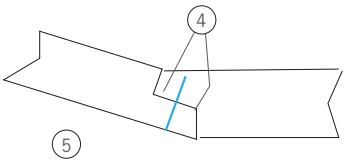


1. Corner joint – screw connection of wall corners according to static requirements or for the compression of joint tapes
2. KLH® panel according to static requirements
3. Install joint tape for all panel joints, unless a vapour barrier or windproof layer is installed on the outside
4. Ceiling/walls screw connection with self-drilling wood screws – type, diameter and distance according to static requirements
5. E.g. BMF angle bracket for the statically effective connection between wall and ceiling. Shear forces in the direction of the wall, tension and pressure normal to the wall (wind forces)

03 WALL-WALL CONNECTION, ROOF-WALL CONNECTION

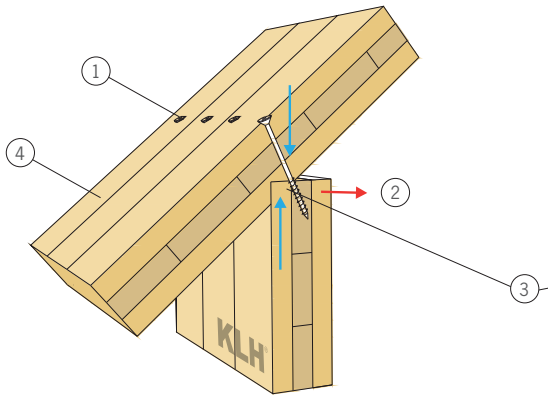
3.1 CONNECTIONS OF WALLS AT AN ANGLE TOWARDS EACH OTHER





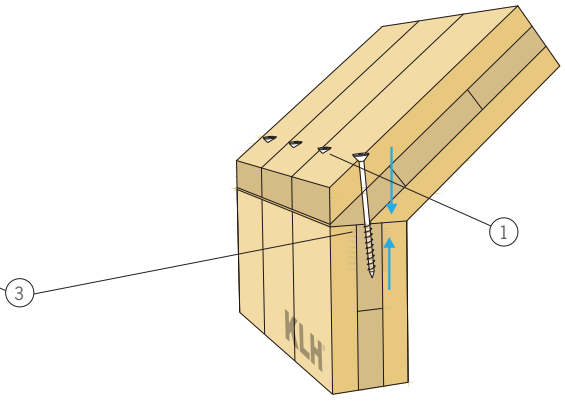
1. For very shallow angles, the effectiveness of screw connections is quite limited; special measures might become necessary
2. The screws only transfer shear forces in the direction of the joints; mind the reduced bedding lengths
3. Bevelled panel edges can only be easily produced up to approx. 20 cm of bevelled length
4. Required edge distances for the screws
5. Shiplap design if high shear forces must be transferred

3.2 EAVES DESIGN WITH CANOPY OR INTERMEDIATE BEARING (MIDDLE WALL)



1. Screws absorb shear forces parallel to bearing or wind suction forces
2. Use fully threaded screws for high forces towards the inside
3. The bearing surface must be set at a normal angle in the direction of the main loads

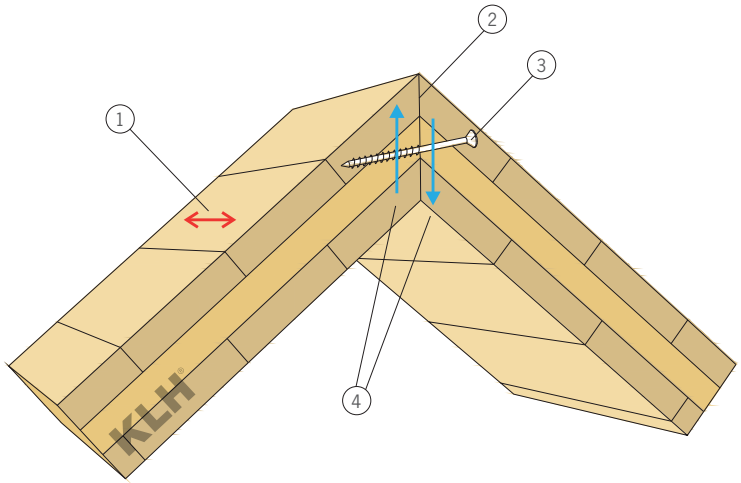
3.3 EAVES DESIGN WITHOUT CANOPY (INDEPENDENT OF PANEL BEARING DIRECTION)



4. If the main bearing direction of the panel is parallel to the bearing, any lateral projections are only possible subject to cross-bearing capacities (middle layers) – static verification required

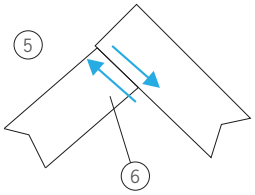
04 ROOF-ROOF CONNECTION

4.1 RIDGE DESIGN, IF MAIN BEARING DIRECTION IS PARALLEL TO RIDGE

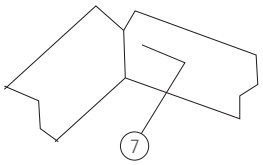


1. Main bearing direction of the panel
2. Caution: Bevel cut for panel edges can only be easily produced up to 20 cm of bevelled length; greater lengths require considerably more work on beams (higher costs)
3. Screw connection mainly transfers shear forces in a longitudinal direction, only minor transverse forces
4. Transverse forces
5. The transverse forces of this joint design are higher than for bevelled panel edges
6. If panels are thinner, it may not be possible to transfer forces with screws (cross tension)
7. Keep bevelled cutting width < 20 cm

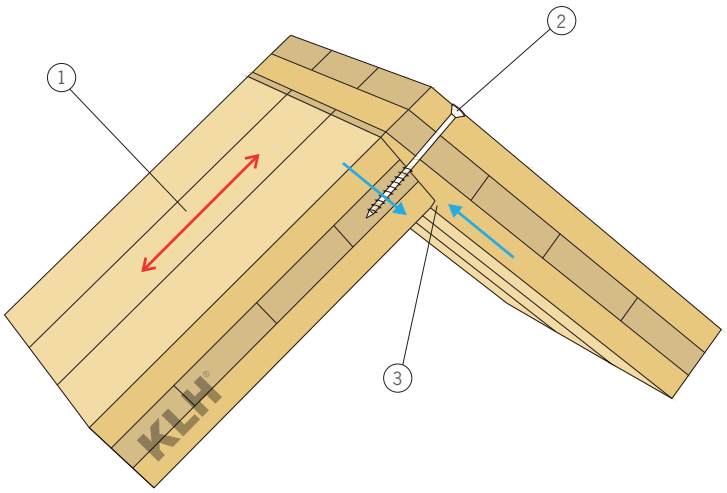
Variant with thinner panels:



Variant with thicker panels:

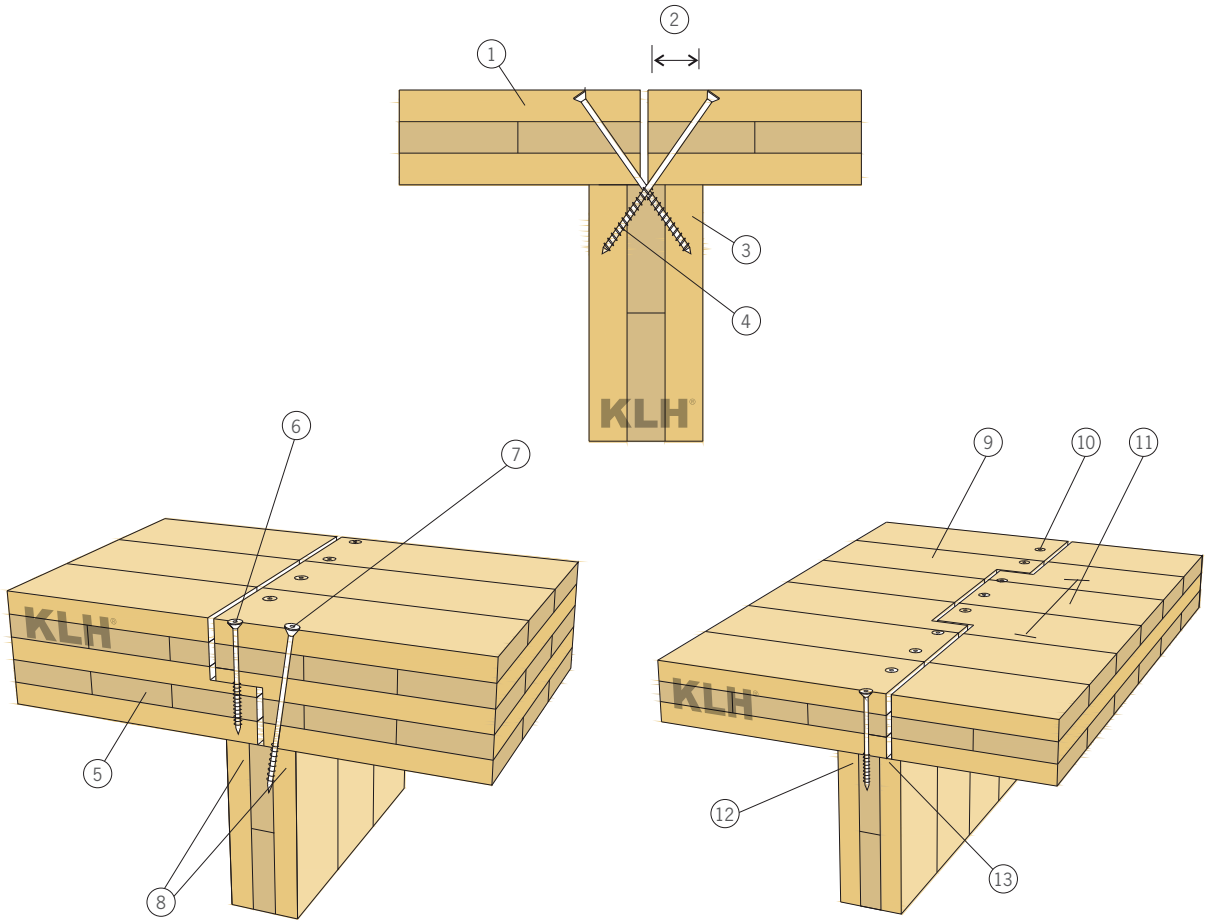


4.2 RIDGE DESIGN, IF MAIN BEARING DIRECTION IS NORMAL TO RIDGE



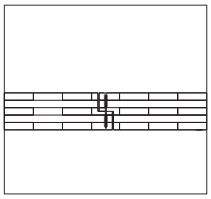
1. Main bearing direction of the panel
2. In this case, screws mainly transfer shear forces in a cross direction. If panels are thicker, screw connections at an angle may be a reasonable solution (see hinge design – longitudinal joints). The lower bearing area is still practical, as it makes installation easier.
3. Form “bearing area” for counter panel; this allows a clear transmission of transverse forces

05 CEILING JOINT ON THE WALL



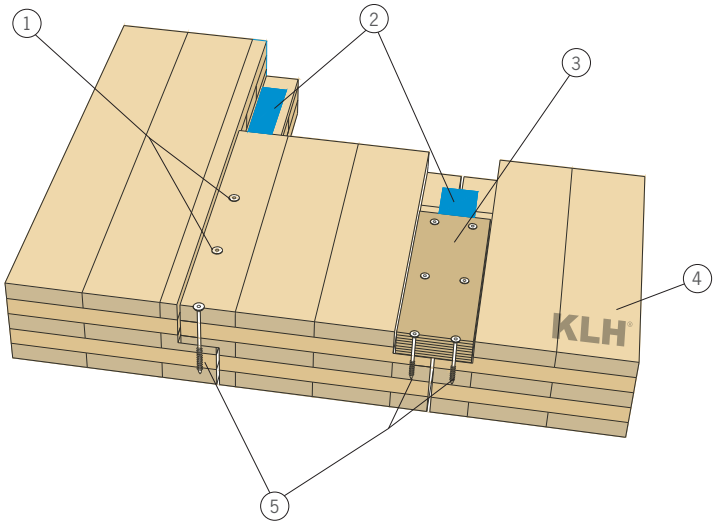
1. Ceiling joint over a thin wall (may be necessary for sound-technical decoupling of roof panels)
2. Take construction tolerances into consideration for bearing width
3. Bearing width at least 4 cm; keep compression normal in relation to fibre. Keep in mind fire stress: approx. 3 cm; bearings must still be in place even after wall has burnt down
4. Panel joint at one wall only possible in case of minor horizontal forces in the panel-wall joint; cross screw connection calculations only possible with restrictions – only recommended for minor stress levels
5. Disengage panels for clear load transmission; this usually allows for side distance requirements for screws to be met
6. Shear force transmission from panel to panel
7. Shear force transmission from panel to wall
8. Adjust bearing widths for fire, horizontal forces, etc.
9. For clear load transmission for bearing of thin panels on thin walls
10. Alternating niches in panel ends
11. Width of niche depends on panel type – thin cross layers require shorter distances
12. Bearing in niche, fully effective for the panel and the screw connection
13. Bearing effective in “used state”; in load-bearing case only the bearing in the area of the niche will be effective

06 TRANSVERSE CEILING JOINTS, FLEXIBLE AND BEND-RESISTANT



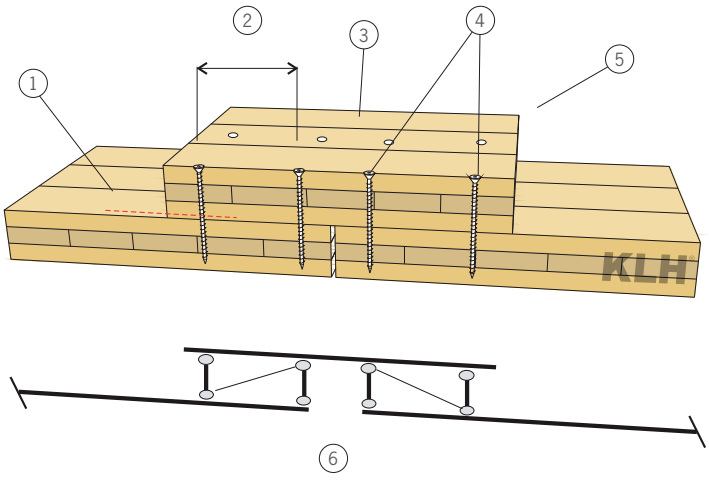
6.1 FLEXIBLE TRANSVERSE CEILING JOINTS – STANDARD WIDTH CONNECTION

1. Connection for shear transmission in the direction of the joint
2. Install joint tape, if air tightness is required (e.g. fire, smoke)
3. Plywood strip
4. E.g. KLH® ceiling panel
5. Type, diameter and distance of screw connection according to static requirements

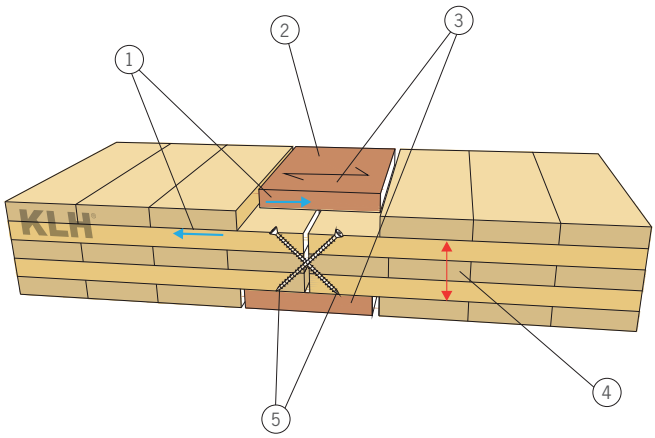


6.2 BEND-RESISTANT LONGITUDINAL JOINT FOR THIN PANELS

1. In case of roof panels, vapour barriers should be installed below the coupling piece
2. Optimal screw distance: approx. 3 x panel thickness
3. A fairly cost-effective type of bend-resistant joint; high load-bearing capacities can also be achieved without gluing. The joint is able to transfer bending moments, transverse forces as well as tension and pressure forces
4. Connections with fully threaded screws
5. Coupling piece according to static requirements; normally same panel type as panel below
6. Static system for identification of screw forces

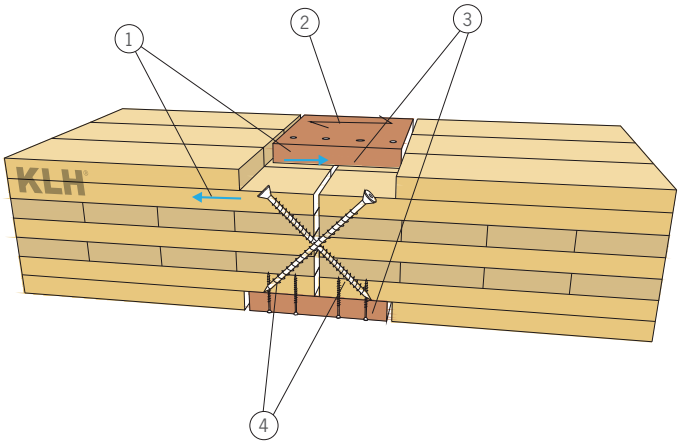


6.3 BEND-RESISTANT CROSS JOINT (TRANSVERSE TO MAIN BEARING DIRECTION)



1. Forces transferable by way of the connection
2. Use is only practical where transverse rigidity is absolutely necessary; gluing should only be performed under controlled conditions (climate, surfaces, staff) – and is therefore rather expensive
3. Glue on connection straps (screw-pressure gluing) or only mechanical connection (nails, screws); materials: veneer laminated timber or 3s panels or according to static requirements; relatively high transmission forces are possible
4. Effective cross-section height in cross direction
5. Transverse force and tensile force transmission with fully threaded screws; with thin panels only minor transverse forces are transferable (screw depiction is only symbolic; crossed screws must be set at a certain distance to each other)

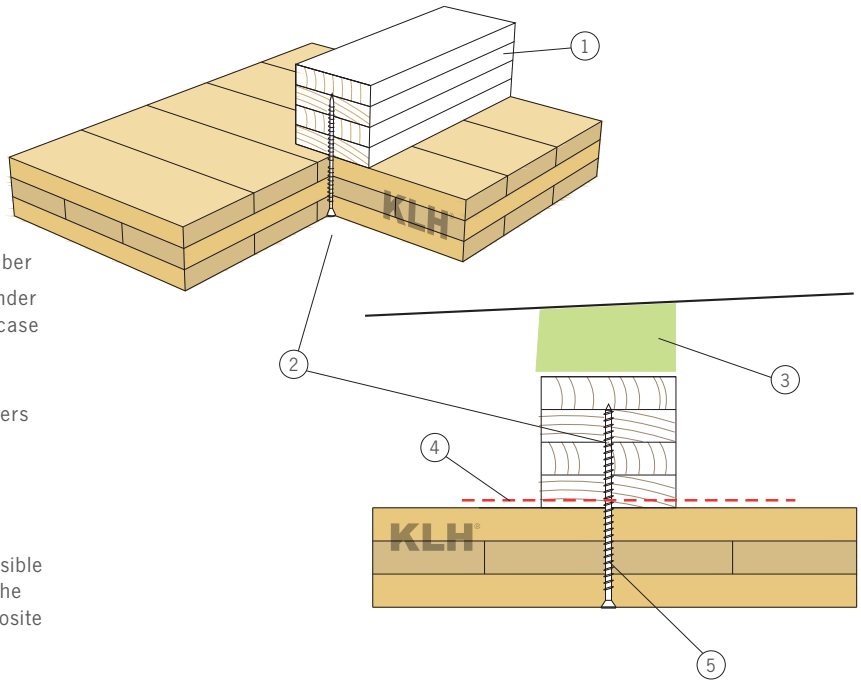
6.4 BEND-RESISTANT LONGITUDINAL JOINT FOR THICKER PANELS WITH DOUBLE LONGITUDINAL LAYERS ON THE EDGE



1. Forces transferable by way of the connection
2. Caution: Full 100% transmission force not possible – rather 30 to 50%, depending on panel type. Therefore, its use is only recommended where absolutely necessary. In addition, this design is comparatively expensive, the gluing must be done in a controlled environment (climate, surfaces, etc.).
3. Glue on connection straps (screw-pressure bonding) or only mechanical connection (nails, screws); materials: veneer laminated timber or 3s panels or according to static requirements
4. Transverse force and tensile force transmission with fully threaded screws (screw depiction only symbolic; crossed screws must be set at a certain distance to each other)

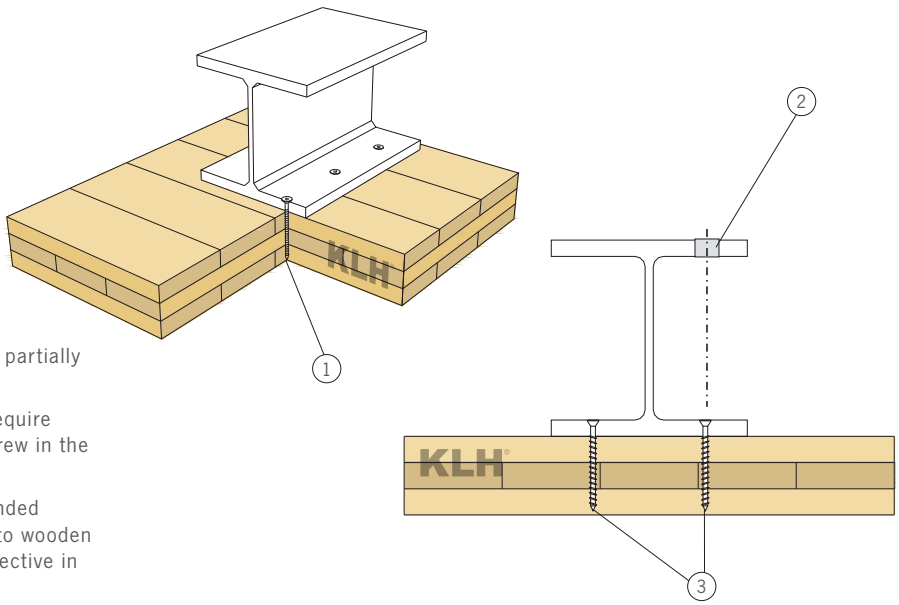
07 CEILING/ROOF CONNECTION TO SUSPENDER BEAM

7.1 WOODEN GIRDER CONNECTION – PANEL SUSPENDED ON WOODEN GIRDER



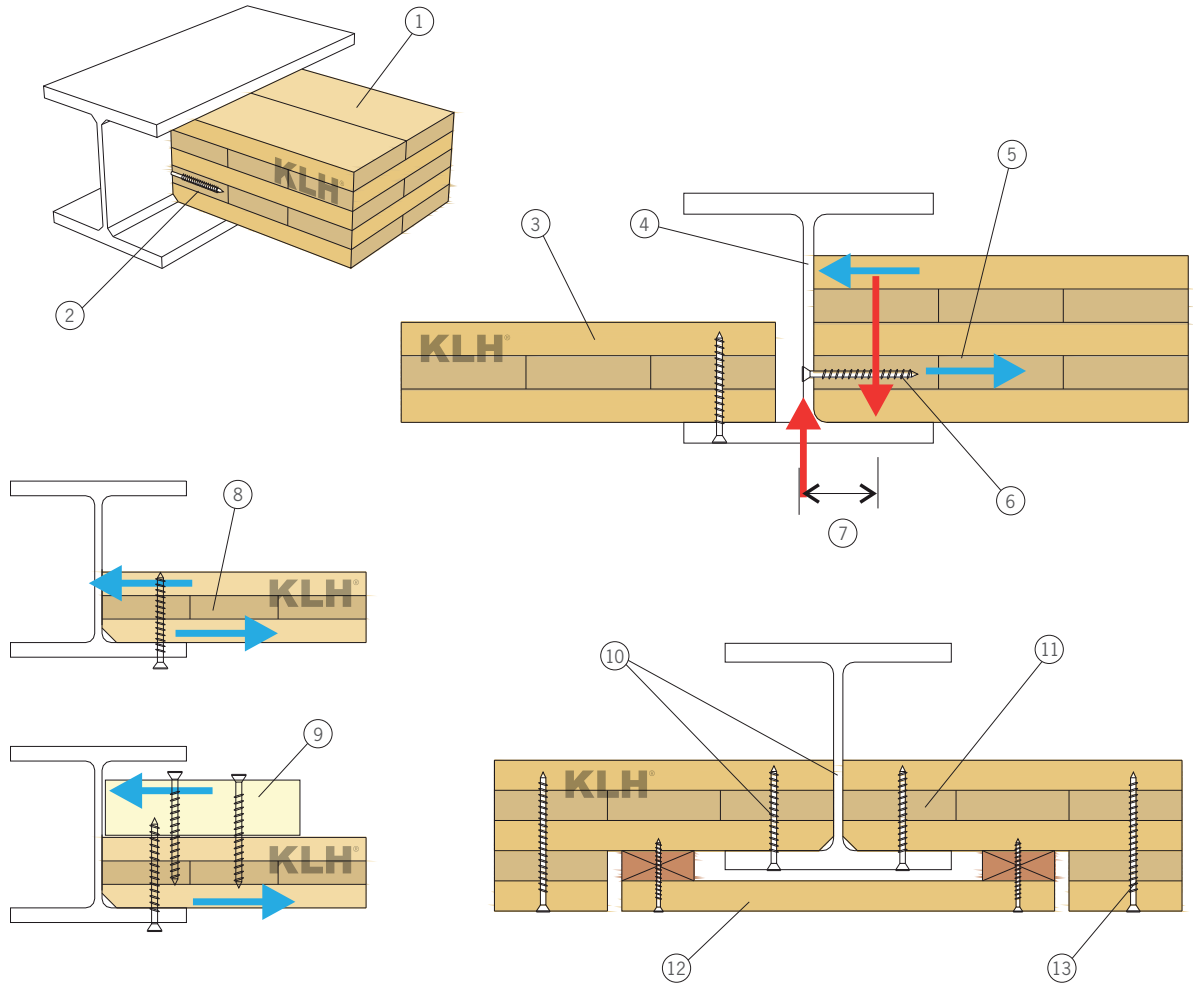
1. Suspender beam, e.g. of laminated timber
2. Elevated suspension of panel in suspender beam with fully threaded screws or in case of minor forces with partially threaded screws with flat head or washers
3. Top insulation of laminated timber girders in case of roof superstructures
4. In case of roof superstructures, install vapour barrier below suspender beam (bitumen layer with aluminium inlay)
5. Interactions of panel and girder are possible – in this case connections must have the appropriate dimensions – flexible composite structure

7.2 STEEL GIRDER CONNECTION – PANEL SUSPENDED ON LOWER FLANGE



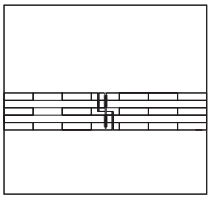
1. Connections with fully threaded or partially threaded screws are possible
2. Steel girders with a lower height require one borehole on top in order to screw in the wood screws
3. 2-row connection; panel is “suspended high”; steel girder is “clamped” into wooden panel – therefore, no torsion is effective in the steel girder

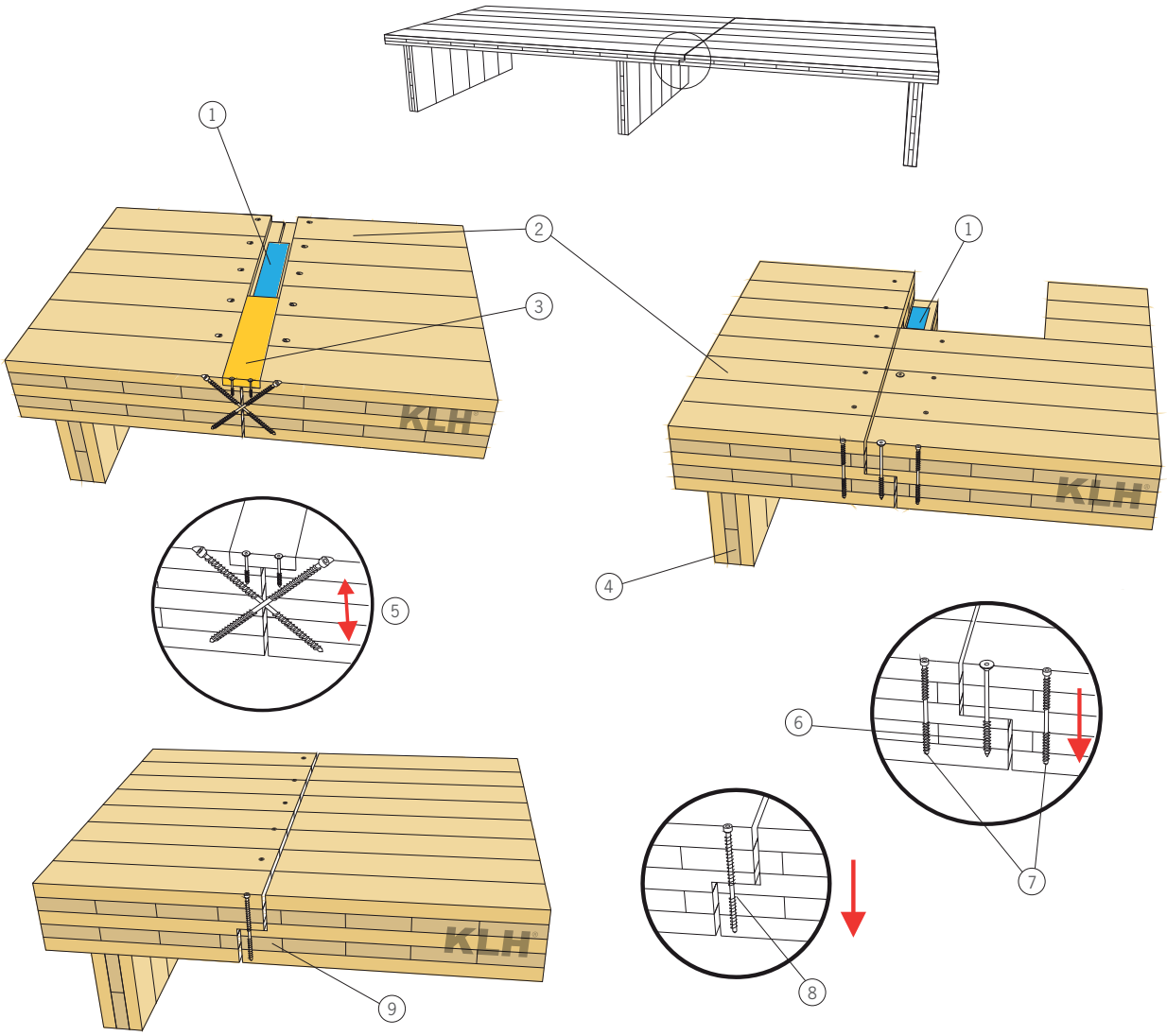
08 CEILING/ROOF CONNECTION TO STEEL GIRDER



1. Steel girder connection – panel placed on lower flange
2. Connections with fully threaded or partially threaded screws are possible
3. Simplified connection, if load eccentricity is borne differently (e.g. adjacent panel, torsion in steel girder)
4. Pressure force with pressure contact
5. Tensile force with screw
6. Screw must be screwed in transversal layer
7. Load eccentricity must be taken into account
8. Lever arm of thin panels is very small, i.e. only very low load eccentricities are possible
9. In case of higher load eccentricities, special measures are required – panel parts or wooden components screwed on
10. Connections for load eccentricities calculated or steel girder torsion calculated
11. Disengaged bearing of panels
12. Caution: In case of higher fire protection requirements, such a design will deliver R30 max.
13. Transverse tension securing, if necessary

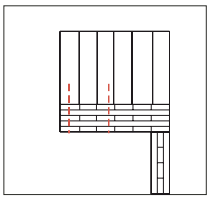
09 LONGITUDINAL PANEL JOINTS – TRANSVERSE FORCE CONNECTIONS

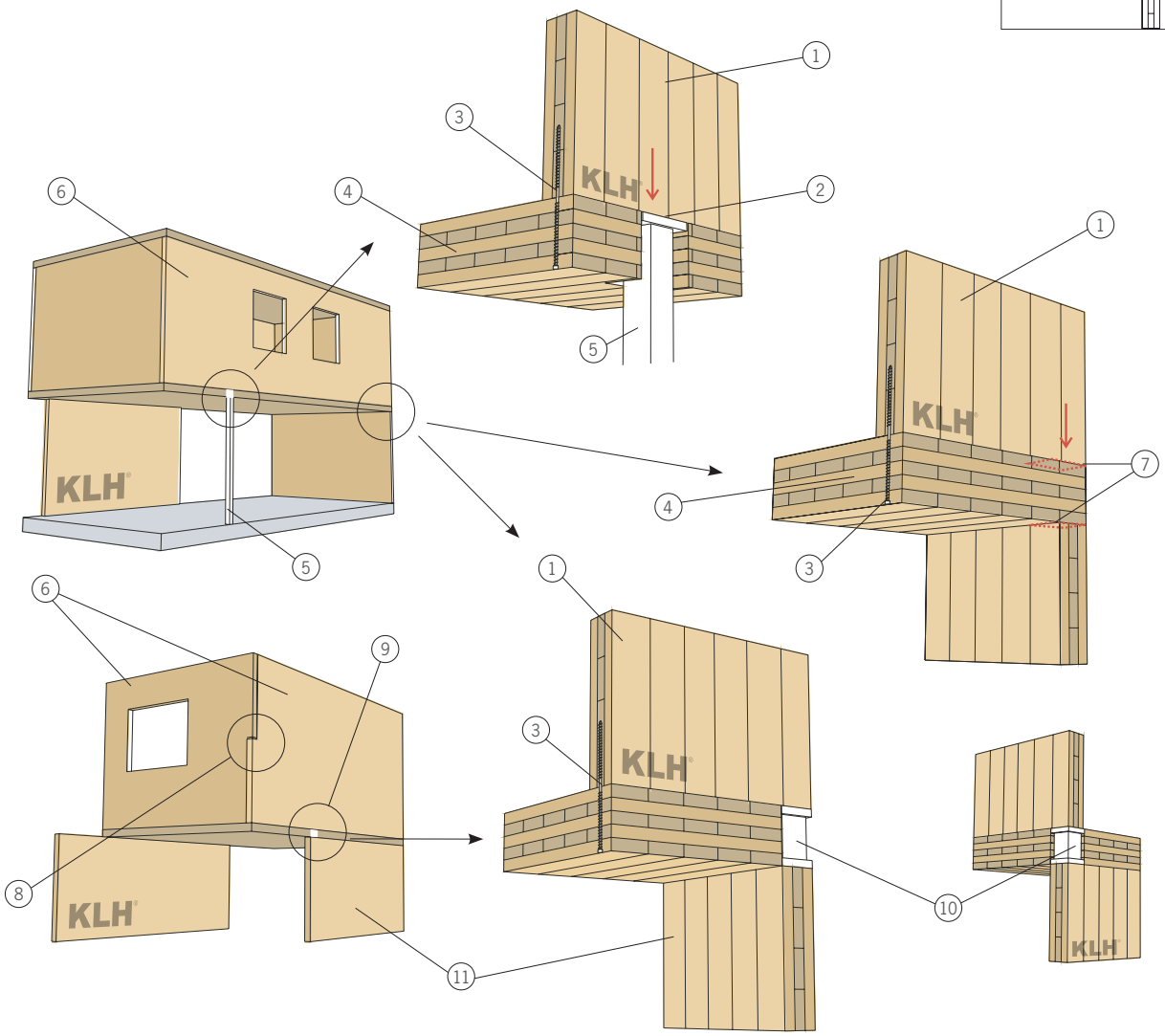




1. Install joint tape (air tightness)
2. KLH® ceiling panel 5s or according to static requirements
3. Plywood strip nailed with KLH® panels – shear force transmission
4. KLH® wall panel according to static requirements
5. Transverse force connection with SFS or fully threaded screws
6. Transmission of shear forces in the joint
7. Transverse tension securing – screw distance max. 10 to 15 cm
8. Transmission of forces with fully threaded screws, max. distance of 10 to 15 cm
9. In case of correct positioning of the shiplap, no transverse tension securing is required; slightly more complex to install

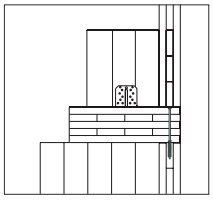
10 SUPPORT OF SHEAR WALLS – SUSPENSION OF CEILINGS



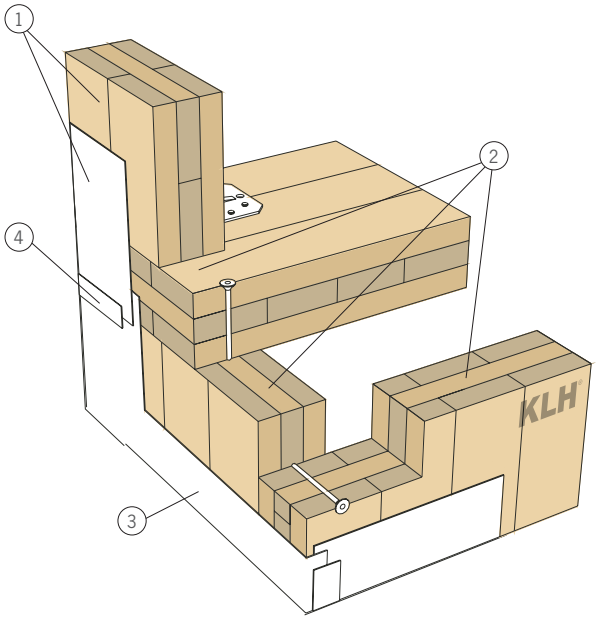


1. KLH® wall panel as shear wall
2. Deflection of high bearing forces: load transmission directly from the vertical layers of the shear wall into the steel plate – this reduces the bearing area
3. Screw connection with SFS or fully threaded screws – screw distance max. 10 to 15 cm
4. KLH® ceiling panel according to static requirements
5. E.g. steel support or wooden support
6. Wall panel as shear wall (wall-high support), orientation and thickness of board layers according to static requirements
7. Support of shear wall, if the pressure area is sufficient, with load of wood being normal in relation to fibre
8. Metal plate for transfer of forces from cross grain to cross grain
9. Design with steel, if there are high local forces
10. Steel component for the deflection of high bearing forces from the shear wall – transfer forces directly from cross grain to cross grain
11. KLH® wall panel according to static requirements

11 AIR TIGHTNESS – SEALING LAYER THROUGH CONVECTION BARRIER

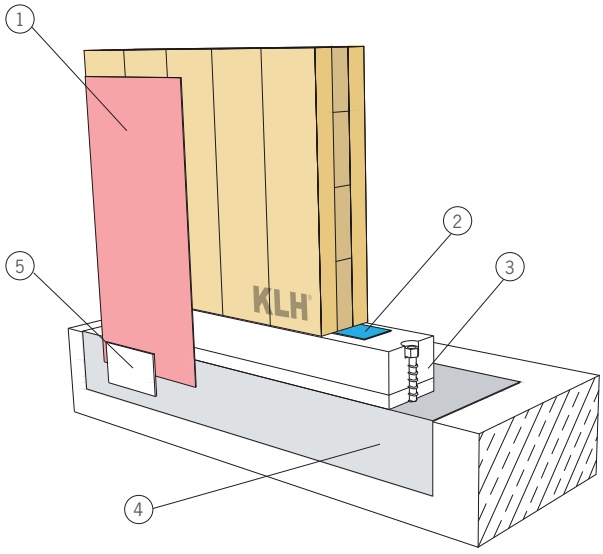


11.1 CEILING JOINT

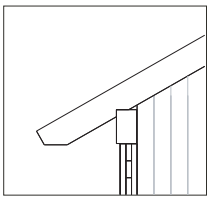


1. Flow-tight exterior walls with membrane applied outside (vapour tightness of membrane adjusted to further wall structure)
2. With this construction, the joints may be made without sealing tapes
3. Convection barrier, e.g. made of diffusion-permeable material, adjusted to further wall structure (e.g. flow-tight layer)
4. Joint gluing

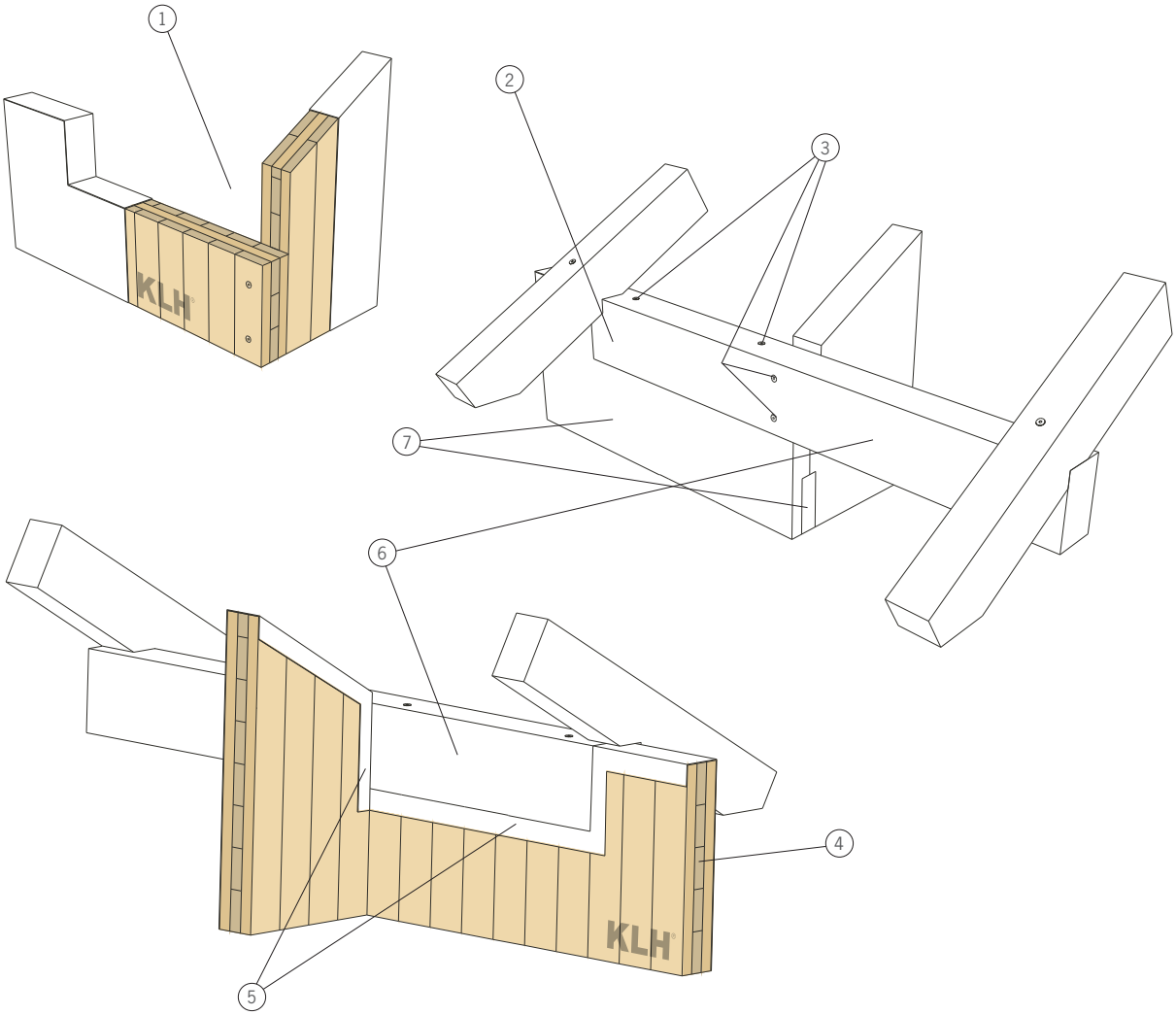
11.2 BASE CONNECTION



1. Façade construction with convection barrier – a windproof, diffusion-permeable membrane is applied to the outside of the panel across the entire surface
2. If a separate sealing layer is applied outside, a sealing tape is not absolutely required
3. Sill plate laid in mortar (tolerance compensation)
4. Sealing of the floor slab
5. Connection of sealing layers with approved products – adjustment of materials

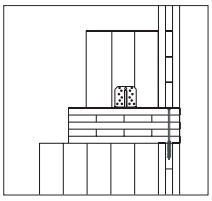


11.3 ROOF CONSTRUCTION CONNECTION – SEALING LAYER THROUGH CONVECTION BARRIER

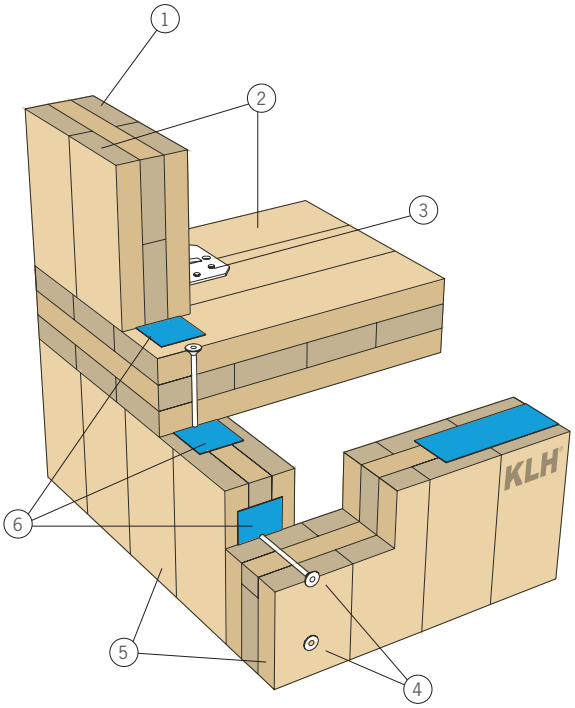


1. Recess for canopy purlin
2. Place canopy purlin at least up to the first interior rafter
3. Screw connections according to static requirements
4. KLH® wall as jamb wall
5. Bring vapour retarder of wall to the inside and glue with canopy rafter or vapour barrier of the roof surface
6. Canopy purlin – dimension and anchorage according to static requirements
7. Vapour retarder

12 AIR TIGHTNESS – FLOW-TIGHT CONSTRUCTIONAL DESIGN

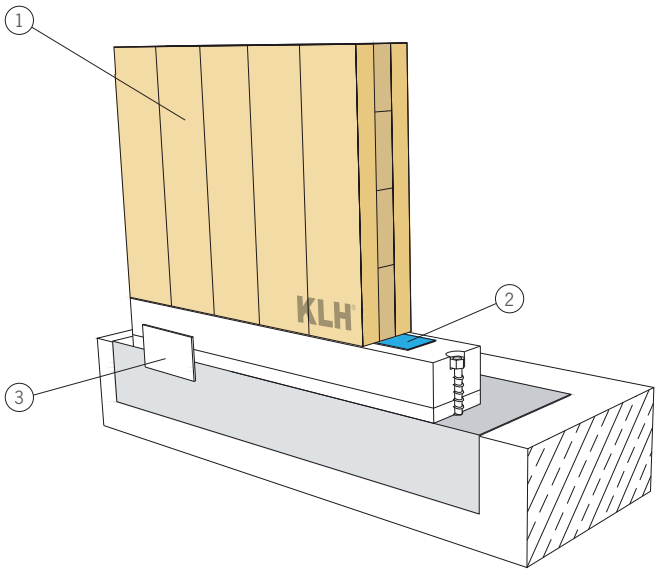


12.1 FLOW-TIGHT EXTERIOR WALLS WITHOUT ADDITIONAL MEMBRANES – CEILING JOINT



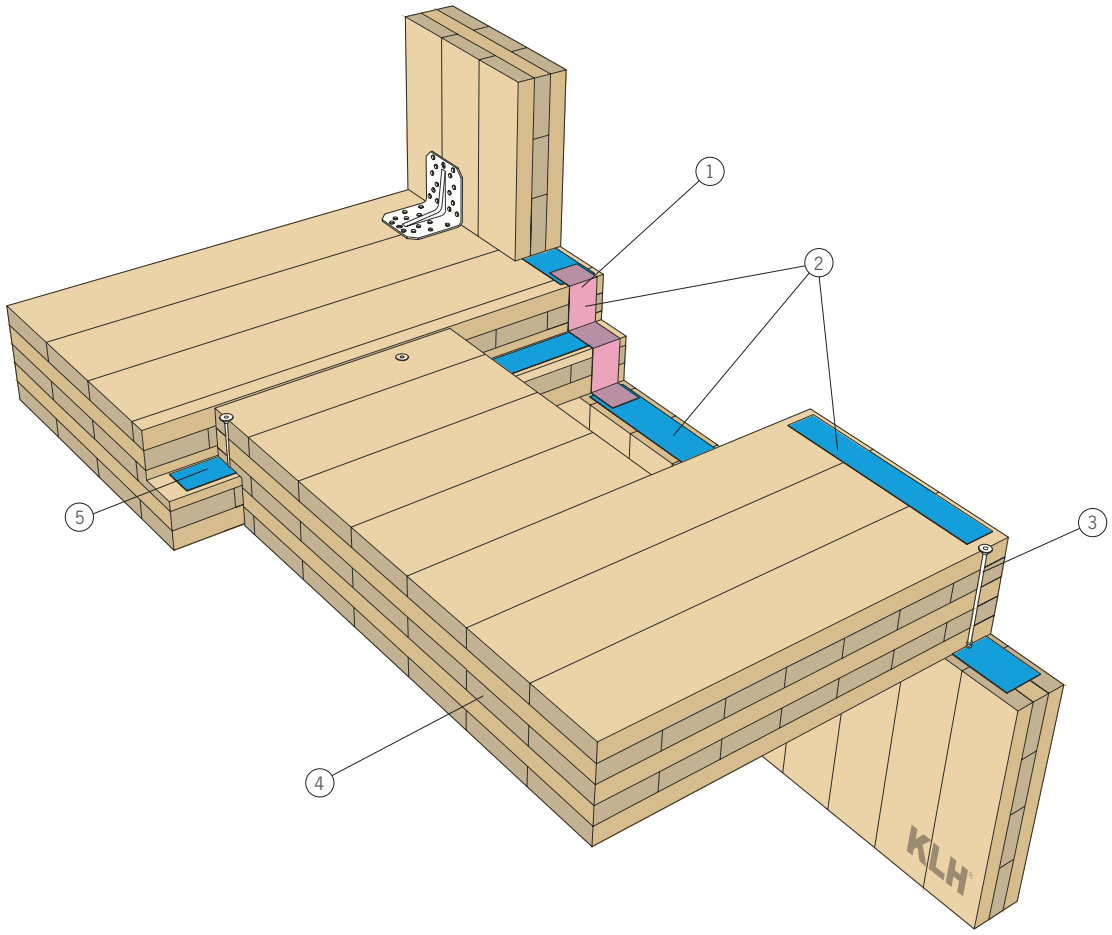
1. Wall in non-visible quality made of 5-layer panels (KLH 5s NSI) or walls in visible industrial quality made of 3-layer panels (KLH 3s ISI)
2. KLH® wall and ceiling panel according to static requirements
3. E.g. BMF angle bracket for statically effective connection between wall and ceiling
4. Corner connections of KLH® panels with wood screws in order to obtain an adequate compression of the joint tapes – also statically effective, if required
5. KLH® panels according to static requirements
6. Install joint tape for all panel joints – for construction in the area of ceiling joint, see also 3.3 Sealing of transverse ceiling joints

12.2 BASE CONNECTION



1. Façade construction without vapour retarder – the KLH® panel is regarded as an inner air-tight layer. Provided that the glue lines are not penetrated and joints are sealed accordingly.
2. Joint tape absolutely necessary; connects sill with wall
3. Connecting sealing layers with approved products (adjusted to various materials)

12.3 SEALING OF TRANSVERSE CEILING JOINTS

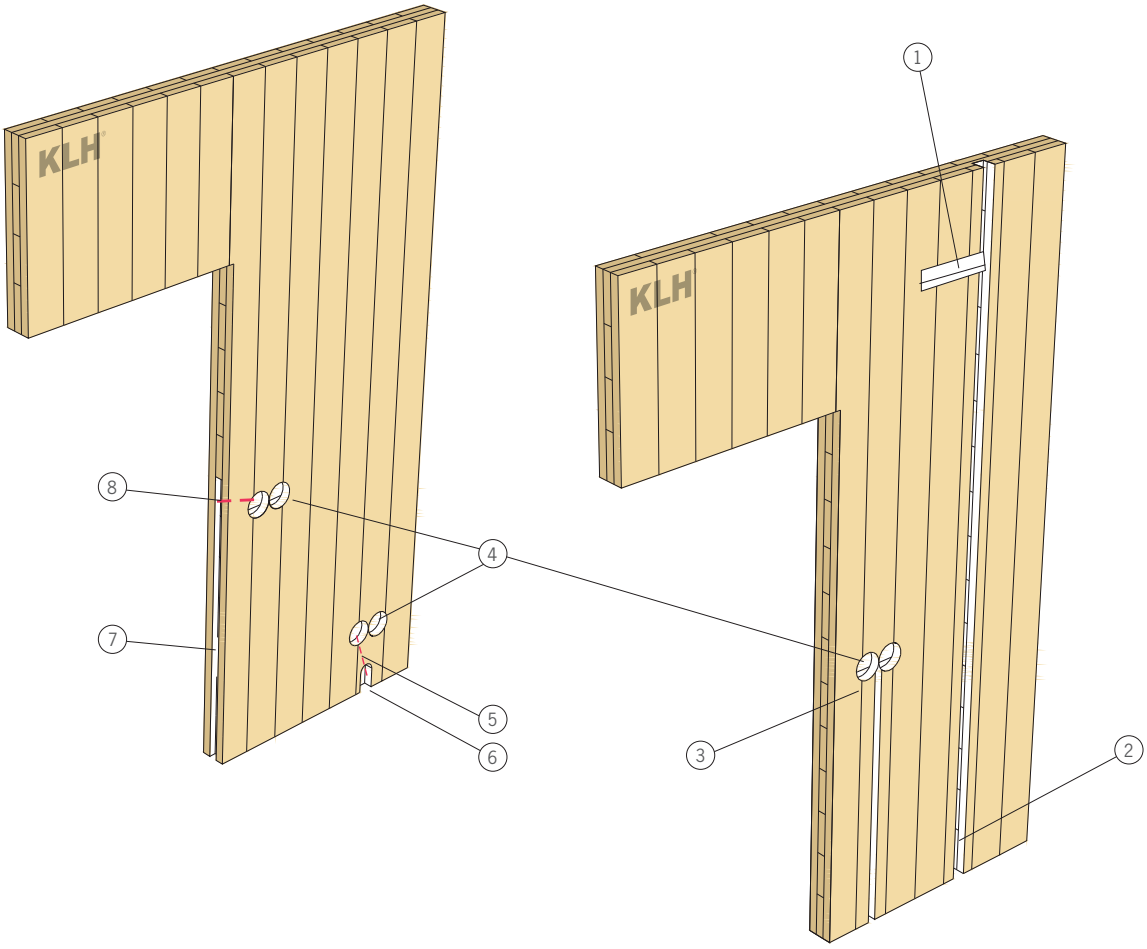


1. Apply sealing tapes transversely to the shiplap edge
2. Flow-tight KLH® building shell – installation of sealing tapes, if no vapour retarder or convection barrier is installed on the exterior
3. Screw connection according to statics
4. KLH® ceiling panel according to static requirements
5. Joint tapes, if air-tight joint is required

13 ELECTRICAL INSTALLATIONS

13.1 SLOTS AND BOREHOLES IN VISIBLE WOOD SURFACES

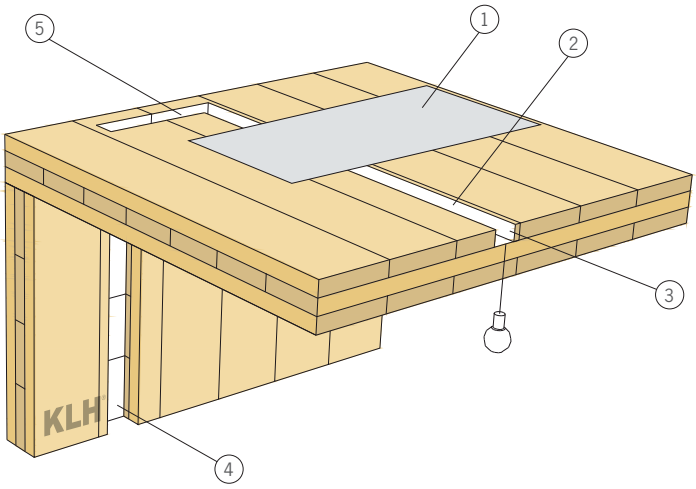
13.2 SLOTS AND BOREHOLES IN NON-VISIBLE WOOD SURFACES



1. Transverse slots – only possible with certain limitations and with mandatory analysis of statics
2. Vertical slots – only in direction of covering layer
3. Minimum distance to edge 10 cm
4. Boreholes for sockets and switches – distance to edge of socket borehole depends on load borne by wall element
5. Boreholes in front parts of the walls (from bottom)
6. Small niche/hole in surface for cable routing (in floor structure)
7. Slot in door jamb
8. Borehole from door jamb to switch boreholes

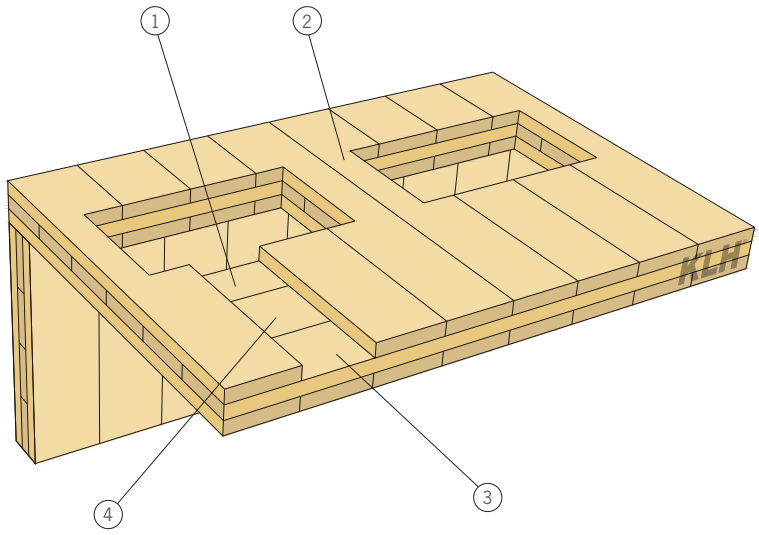
14 INSTALLATION SLOTS AND OPENINGS

14.1 SLOTS IN ROOF PANELS WITH VISIBLE WOODEN SOFFITS



1. Application of vapour barrier over slot and cable routes is possible – avoid penetration
2. Slot in surface area only possible in the direction of covering boards
3. As regards roof elements in visible surfaces, cut cable routes on upper side – usually only required for lighting current (also suitable for exterior walls with visible surface inside)
4. Vertical slots only in covering layer and only in the direction of the fibres of the covering boards – make static analysis in the areas of windows and doors
5. In bearing areas, short transverse slots are usually possible

14.2 SLOTS AND OPENINGS IN CEILINGS



1. Slots on upper side (if required – e.g. for drain pipes, if more longitudinal inclination is required)
2. If openings for cable routes are placed at an angle to the ceiling span direction, they should be repeatedly divided with bars; wide continuous slots without additional measures are only possible with thicker panels
3. Slots on the upper side in the area of the opening only until the first cross layer – otherwise the transverse bearing effect of the element will be disturbed in the area of the opening
4. Slot – carry out static analysis

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KLH MASSIVHOLZ GMBH

Gewerbestraße 4 | 8842 Teufenbach-Katsch | Austria

Tel +43 (0)3588 8835 | Fax +43 (0)3588 8835 415

office@klh.at | www.klh.at