European Association for
Panels and Profiles

RULES FOR GOOD PRACTICE

Wall cladding and roof coverings with double skin metal-faced insulating panels

Planning and installation

SEPTEMBER 2020

CONTENTS

1 INTRODUCTION

1.1 Purpose

The purpose of this document is to define minimum requirements for the planning and installation of conventional wall cladding and roof coverings using sandwich panels comprising two metal faces and a polyurethane (PU) or mineral wool (MW) insulating core that is bound to the faces in accordance with [17].

1.2 Content

These Rules for Good Practice refer to sandwich panels with through-fixing and hidden fixing systems. In the latter case, the fasteners are positioned in the joint; the heads of these fasteners hold the external face. A specific load distribution plate is recommended for some applications.

These Rules for Good Practice are only valid for sandwich panels having a CE marking and a Declaration of Performance in accordance with [23] and [17].

The rules of PPA-Europe do not replace any regulations or standards.

This document includes many references to specific national rules and recommendations, i.e. from France and Germany. These are marked with coloured bars:

- blue bars for France,
- yellow bars for Germany.

1.3 Scope of application

These Rules for Good Practice apply to cladding and roof covering work carried out in Europe using sandwich panels.

New sandwich panels can be installed on new or existing structures.

For installation on an existing structure, a survey of the structure to allow the verification of its compatibility with the new building envelope is not addressed in this document.

The scope of these Rules for Good Practice only covers sandwich panels installed on structures not exposed to the outside air.

Additional specific provisions must be considered when installing photovoltaic modules on the panels.

These Rules for Good Practice refer to wall cladding and roof covering work with sandwich panels that comply with [17] and are made of:

- two faces with a minimum thickness of 0.5 mm on the outside and 0.4 mm on the inside,
- an insulating core made of PU (PUR/PIR) or MW whose performance is established in accordance with [17], and
- a sealing system (one or more sealing arrangements) integrated in the longitudinal joint at the time of production or during installation.

These rules refer to roofs whose uninterrupted sloping length is:

- maximum 40 m if the rib height is ≥ 35 mm, or
- maximum 30 m if the rib height is between 25 and 35 mm.

Spans of roof sandwich panels are – within the scope of this document – restricted to 6 m.

The pitched roof areas are flat. The ribs of the sandwich panels shall be parallel to the line of maximum gradient.

Sandwich panel faces with zinc/aluminium/magnesium metallic coatings and/or any organic coatings shall have an appropriate corrosion resistance.

In mountain climates, the altitude at which roof covering sandwich panels can be used is limited to 2000 m. The technical provisions to be complied with are given in section 4.4.5.

By convention, a mountain climate occurs at an altitude above 900 m. The contract documents may consider that the specifications for mountain climates:

- shall not apply to the building site if it is at an altitude above 900 m, or
- apply to the building site even if it is at an altitude below 900 m.

This document refers to the installation of sandwich panels with an insulating core conforming to the minimum properties defined in Table 1.

Characteristics	Minimum values for internal inspections (MPa)
Tensile strength f_{Ct} – PU core panels	≥ 0.060
Tensile strength f_{Ct} – MW core panels	≥ 0.030
Compressive strength of core material f_{Cc} – PU	≥ 0.070

Table 1: Minimum properties of the insulating material

The Eurocodes shall apply.

When using sandwich panels in seismic zones, the installer must take into account the design and/or technical specifications for seismic behaviour referring to, for example, the type and number of fasteners, the distances between fasteners and panel edges or the weights of panels.

These Rules for Good Practice do not cover:

- sandwich panels bent on site,
- safety devices for individuals or groups of people,
- foams expanded with CO_2 only,
- elements suspended from the panel faces,
- outer cladding and attachment of decorative covers,
- locations with a very high humidity,
- the execution of rooftop structures or installation of equipment on the panels (photovoltaic glass modules, solar thermal collectors, etc.),
- any additional thermal insulation on the inner face of the panels,
- faces in the form of tiles,
- cold store applications.

2 NORMATIVE AND REGULATORY REFERENCES

2.1 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the document (including any amendments) applies.

[1] DIN 4102 Fire behaviour of building materials and building components
[2] DIN 4108-2 Thermal protection and energy economy in buildings – Part 2: Minimum requirements to thermal insulation
[3] DIN 4108-10 Thermal insulation and energy economy in buildings – Part 10: Application-related requirements for thermal insulation materials – Factory made products
[4] EN 1090-2 Execution of steel structures and aluminium structures – Part 2: Technical requirements for steel structures
[5] EN 1993 – Eurocode 3: Design of steel structures
[6] EN 1995-1-1 – Eurocode 5: Design of timber structures – Part 1-1: General – Common rules and rules for buildings
[7] EN 1999 – Eurocode 9: Design of aluminium structures
[8] EN 10025-2 Hot rolled products of structural steels – Part 2: Technical delivery conditions for non-alloy structural steels
[9] EN 10088 Stainless steels
[10] EN 10169+A1 Continuously organic coated (coil coated) steel flat products – Technical delivery conditions
[11] EN 10263-3 Steel rod, bars and wires for cold heading and cold extrusion – Part 3: Technical delivery conditions for case hardening steels
[12] EN 10346 Continuously hot-dip coated flat products of low carbon steels – Technical delivery conditions
[13] EN ISO 12944-1 Paints and varnishes – Corrosion protection of steel structures by protective paint systems – Part 1: General introduction
[14] EN 13501 Fire classification of construction products and building elements
[15] EN 13670 Execution of concrete structures
[16] EN ISO 14122-4 Safety of machinery – Permanent means of access to machinery – Part 4: Fixed ladders
[17] EN 14509 Self-supporting double skin metal faced insulating panels – Factory made products – Specifications
[18] EN 15804 Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products
[19] NF DTU 31.1 Building works – Timber frameworks
[20] NF P34-205-1 DTU 40.35 – Building works – Roofing with profiled sheeting made of coated steel sheet – Part 1: Technical clauses
[21] NF P34-310 Continuously hot-dip zinc coated structural steel sheet and strip for building purposes – Classification and tests
[22] NF P37-417 Roofing and cladding – Parts joined to a roof sheeting – Bases made of glass fibre reinforced polyester with upstand – Definition, specifications, test methods

2.2 Regulatory documents

[23] Regulation (EU) No. 305/2011 of the European Parliament and of the Council of 9 March 2011 laying down harmonised conditions for the marketing of construction products and repealing Council Directive 89/106/EEC (Construction Products Regulation)

2.3 Other reference works

[24] Professional Recommendations “Cladding with double steel faced insulated panels with polyurethane core – design and installation”, part of the programme “Code of Practice Grenelle Environnement (RAGE) 2012”
[25] Professional Recommendations “Roof covering with double steel faced insulated panels with polyurethane core – design and installation”, part of the programme “Code of Practice Grenelle Environnement (RAGE) 2012”
[26] IFBS Technical Rules in Metal Light Construction, “Planning and Installation”, edition 1/2020, IFBS, Krefeld, Germany, www.ifbs.eu
[27] IFBS “Catalogue for thermal bridges”, IFBS, Krefeld, Germany, www.ifbs.eu
[28] IFBS “Building Physics”, IFBS, Krefeld, Germany, www.ifbs.eu

3 TERMINOLOGY, DEFINITIONS

By convention, the term “installer” is used here to define the company in charge of installing sandwich panels.

3.1 Loadbearing structure

Structural members to which sandwich panels are attached. Those members can be made of steel, of concrete with embedded steel attachment rails, or of timber, and must be designed in accordance with the Eurocodes and their national annexes and corrigenda.

The loadbearing structure comprises a primary structure (e.g. portal frames, columns, beams) and any secondary structure (e.g. cladding rails, purlins).

3.2 Double skin metal-faced sandwich panels

3.2.1 Self-supporting sandwich panels

The sandwich panel is fixed to spaced structural supports and, by virtue of its materials and shape, is capable of supporting its self-weight and all the applied loads (e.g. snow, wind, internal air pressure and, if relevant, thermal gradient) and transmitting these loads to the supporting structure.

3.2.2 Structural sandwich panels

A structural sandwich panel may, in addition, be used to stabilise its supporting structure.

3.3 Joints between sandwich panels

The method for assembling sandwich panels for wall cladding, as specified in this document, makes use of tongue and groove joints, as shown in Figure 1a and Figure 1b.

There are two types of sandwich panel for wall cladding, depending on the method of assembly:

- sandwich panels with visible through-fixings (Figure 1a),
- sandwich panels with hidden fixings (Figure 1b).

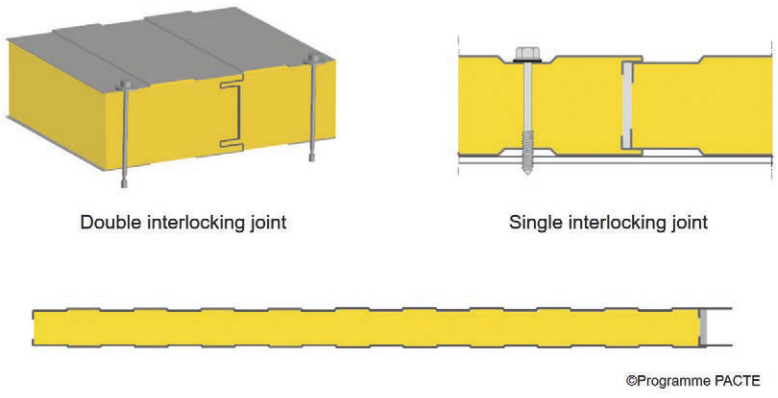


Figure 1a: Example of sandwich panels with visible through-fixings and single or double interlocking joints

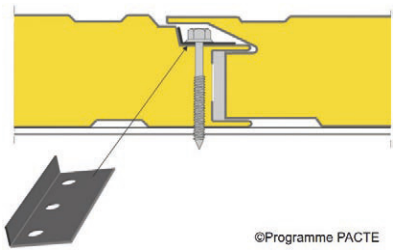


Figure 1b: Example of sandwich panel with hidden fixings and load distribution plate

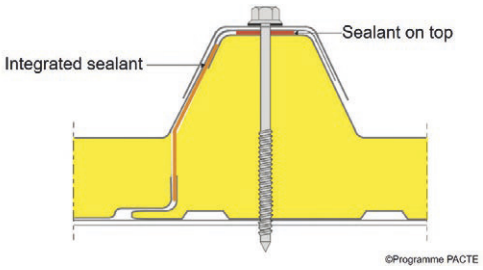


Figure 1c: Longitudinal overlapping joint between roof covering sandwich panels

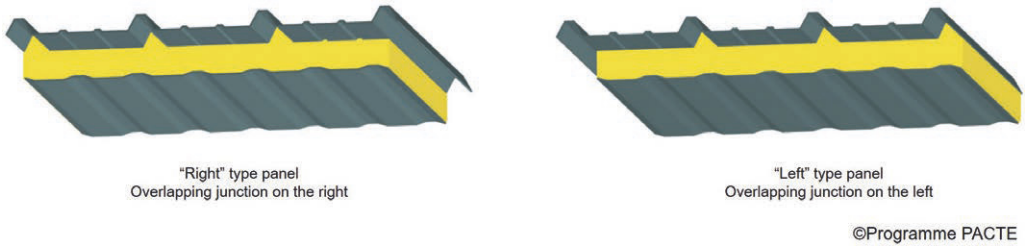


Figure 1d: Examples of roof covering sandwich panels

The roof panels have an overlapping joint type, typically on the longitudinal side (Figure 1c). The roof panels can be also jointed on their transverse sides. The overlapping joint type determines the installation direction of the roof panels. Therefore, panels are produced as "right" or "left" types, see Figure 1d.

3.4 Load distribution plate for panels with hidden fixings

A pre-drilled metal plate placed on the interlocking tongue of a sandwich panel with hidden fixings which is used to distribute the loads (Figure 1b and Figure 18).

3.5 Sealant

A joint sealer that ensures tightness.

3.6 Additional insulation

Site-applied insulation designed to ensure the continuity of the insulation provided by the sandwich panels. These additional components are placed in the building envelope's edge zones, at expansion joints, at façade/roof junctions, etc. if necessary.

3.7 Fixing system

A system that allows sandwich panels to be held in a specific position.

3.8 Fastener

A component of a system for fixing the sandwich panels to the supporting structure. The systems for fixing the sandwich panels to the supporting structure can consist of a screw with or without a saddle/storm washer.

3.9 Flashing

Flashings are non-loadbearing elements, e.g. accessories and coverings in the areas of the skirting, eaves, gable end, ridge and corners. See also Figure 14.

Flashings typically used are given below:

3.9.1 Apron or drip edge

Horizontal metal part that interrupts driving rain along the façade and thus allows rainwater run-off.

3.9.2 External or internal corner flashing

Metal part that flashes outside or inside a corner of a façade and thus ensures the integrity of the protection provided by the sandwich panel faces.

3.9.3 Parapet cladding

Cladding to provide waterproofing on the outer side of a high parapet.

3.9.4 Jamb

Vertical metal part to provide integrity of the wall sandwich panel cover flush with the frame to a window or a door.

3.9.5 Lintel

Horizontal metal part providing tightness at the upper side of an opening.

3.9.6 Expansion joint

Device to allow free movement of the façade and the roof aligned with an expansion joint in a structure (Figures 15 and 16).

3.9.7 Starting part

Flashing used to support the self-weight of panels during the horizontal erection of wall panels.

3.9.8 Upstand (base plate)

Member that projects above the plane of the roof covering to support a particular structure (rooflight, window frame, ventilation device, etc.) (Figure 2).

If base plates are made from polyester, they must be in accordance with [22].

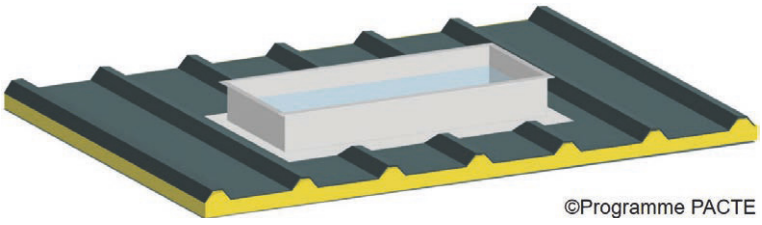


Figure 2: Example of an upstand

3.9.9 Monopitch roof ridge

Metal part that forms the external flashing across cladding and roof covering at a monopitch ridge (Figure 3).

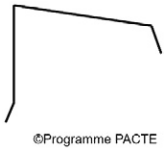


Figure 3: Monopitch roof ridge

3.9.10 Parapet coping

Metal part that forms the capping flashing to a parapet wall (Figure 4).

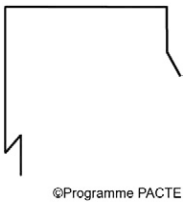


Figure 4: Parapet coping

3.9.11 Verge flashing

Metal part that forms the outer flashing across the cladding and the edge of the roof covering (Figure 5).

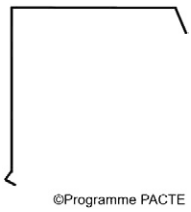


Figure 5: Verge flashing

3.9.12 Duopitch roof ridge with profile closers

Metal part that forms the external flashing between two pitched roof areas of the roof covering (Figure 6).

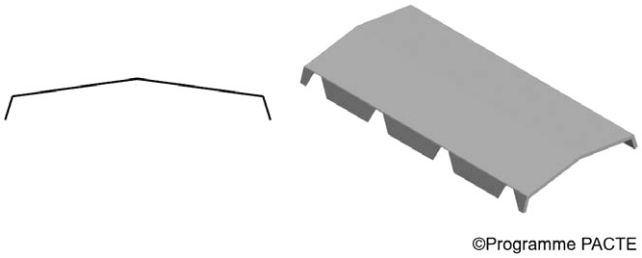


Figure 6: Duopitch roof ridge with profile closers

3.9.13 Apron flashing for wall abutment, with profile closer

Metal part that forms the flashing between a wall and the roof covering (Figure 7).

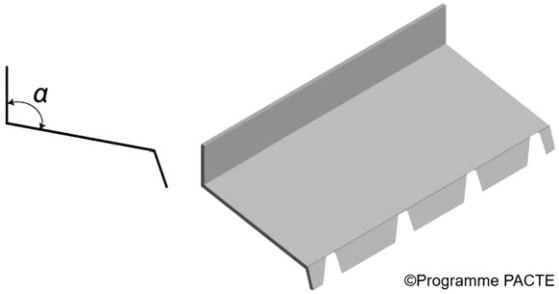


Figure 7: Apron flashing for wall abutment, with profile closer

3.9.14 Half roof ridge with flange and profile closer

Metal part that builds half of the external flashing between two pitched roof areas of the roof covering (Figure 8).

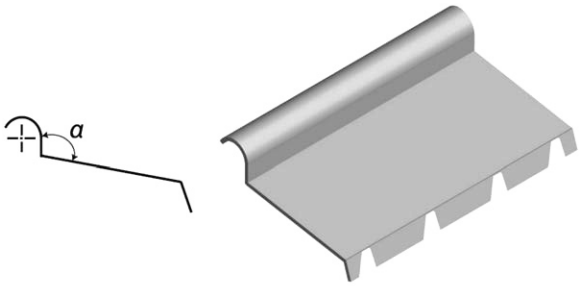


Figure 8: Half roof ridge with flange and profile closer

3.9.15 Profile closer flashing

Metal part to close off the foamed edge of the roof sandwich panel (Figure 9).

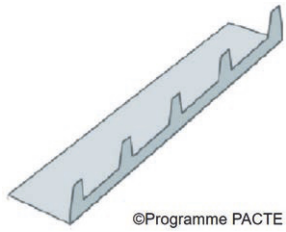


Figure 9: Profile closer flashing

3.9.16 Drain strip

Metal part to seal the line made by the inner face of the roof sandwich panel and an eaves gutter (Figure 10).

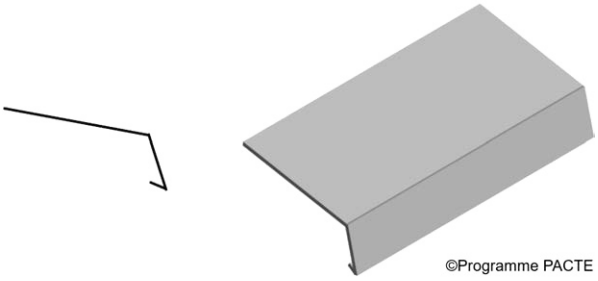


Figure 10: Drain strip

3.9.17 Penetration

Hole made in the waterproofing plane of the roof covering (Figure 11).

In the case of large penetrations, a design analysis shall be done on behalf of the client or their representative and submitted to the panel manufacturer in order to make sure that the design fully complies with the specific properties of that particular roof covering.

Upon request, the manufacturer shall provide technical assistance to companies to enable the execution of large penetrations affecting several panels.

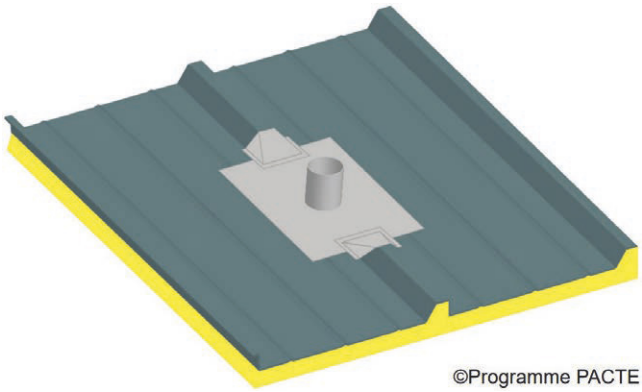


Figure 11: Example of a penetration with mounting plate

3.9.18 Edge plate abutted against wall

Metal part that covers the junction between a cladding edge and the edge of roof sandwich panels (Figure 12).

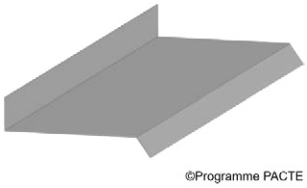


Figure 12: Edge plate

3.9.19 Ridge lining plate

Metal part used beneath the ridge of the roof to ensure the continuity of the inner face, to hold in place the additional insulation between the two adjacent panels and to compress the sealants (Figure 13).

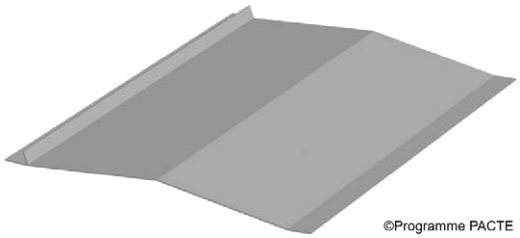


Figure 13: Ridge lining plate

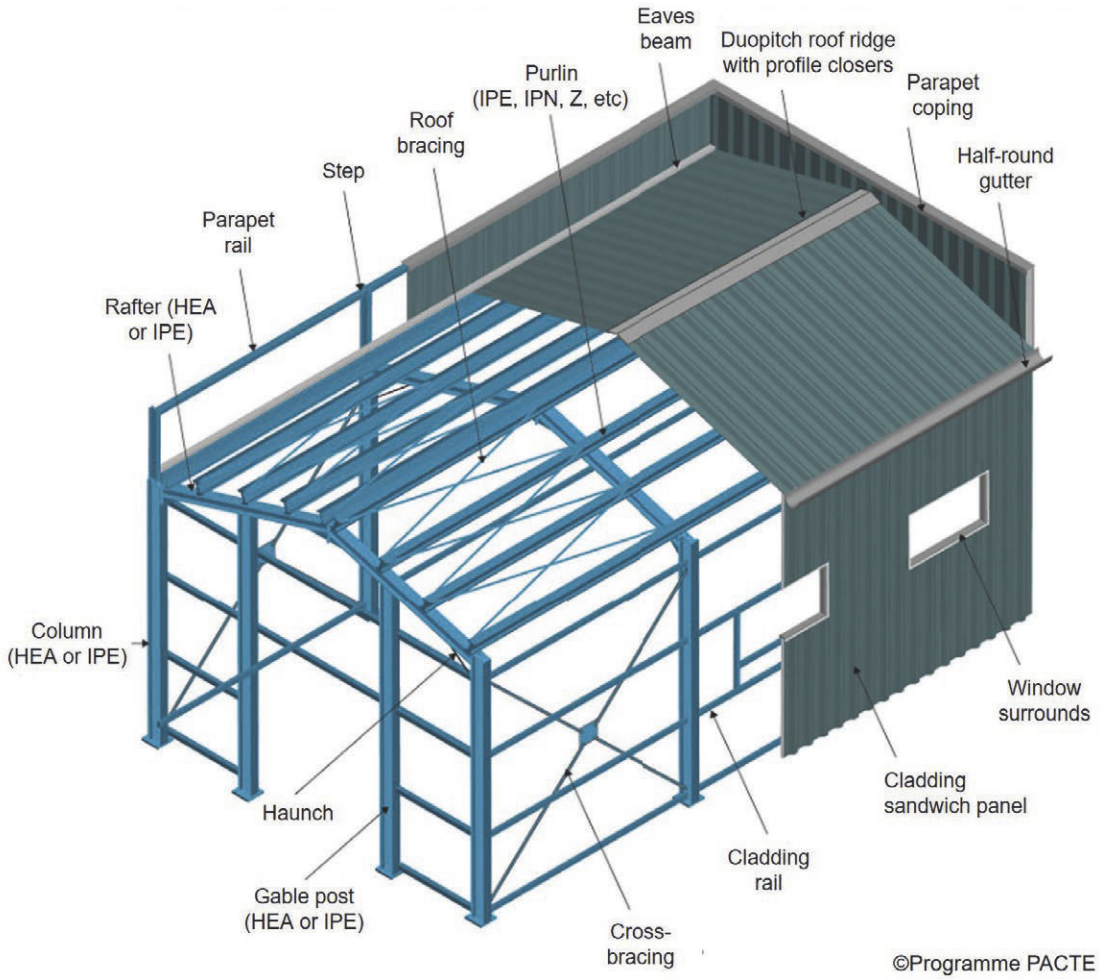


Figure 14: Terminology for metal building structure and envelope

4 DESIGN OF THE WORK

4.1 General

The necessary information and technical requirements for executing each part of the works shall be agreed and completed before commencing execution of that part of the works. Procedures shall be laid down for making alterations to a previously agreed execution specification. The execution specification consists of layout drawings and details based on the structural design.

The project manager/architect must provide the architectural drawings of the building envelope and specify the internal and external exposure of the building. The responsibilities of the parties involved must be defined.

The working drawings for the structure supporting the sandwich panels shall be communicated to the various parties involved.

4.2 Requirements for the cladding and roof covering work

4.2.1 List of requirements

The following requirements must be met for cladding and roof covering work using sandwich panels:

- Mechanical stability based on the actions to be considered
- Deformation limits (see [17])
- Safety in the event of fire
- Earthquake resistance (see 4.5)
- Thermal insulation (see 4.6)
- Moisture control (see 4.7 and Annex C)
- Environmental performance (see 4.8)
- Acoustic performance (see 4.9)
- Air permeability (see 4.10 and Annex C)
- Water permeability (see 4.11 and Annex C)
- Durability (see 4.12, Annex A and Annex B)
- Safety and accident prevention regulations relevant to the installation and maintenance of the cladding and roof covering (see 6.4.2)

4.2.2 List of minimum information required

In order to fulfil the requirements mentioned above, the following information must be provided:

- The type and use of the building:
  The purpose (especially buildings used for industry, commerce, sports, offices, non-residential purposes or agriculture and the relevant regulations such as fire protection):
  - the internal temperature of the building
  - the humidity inside the building
  - the vapour pressure inside the building, if relevant
  - the conditions and procedures for maintenance and use
  - the interior environment (clean or aggressive)

- The construction site:
  - the particular conditions of the outside atmosphere (e.g. in the vicinity of a factory emitting corrosive vapours, coastal location, etc.)
  - seismic data (areas, soil class)
  - possible connections to other buildings

***Note**: If a thermal gradient is to be considered, an indication of the indoor and outdoor temperatures is necessary.*

- Geometry of the building:
  - dimensions (width, length, height)
  - inclination of the building envelope
  - layout and dimensions of openings
  - positions of specific points: corners, base of cladding, top of cladding, flashings against walls, expansion joints, vents, rainwater downpipes, different penetrations (ventilation ducts, openings for electric cables, heavy-duty equipment supports, etc.)
  - number of floors

- Specifications for the structure:
  - the type and class of the structure that carries the sandwich panel (concrete, steel, timber); for timber structures, Eurocode 5 stipulates that the relevant requirements for common buildings must be considered
  - the distances between supports and their dimensions (width and thickness of support)
  - any additional structural elements provided by the installer (cross-beams, cladding rails for outer cladding, girders directly against the cladding)
  - positions and spacings of expansion joints or seismic (isolating) joints
  - execution tolerances

- Specifications for the building envelope:
  - the thermal, humidity and acoustic requirements
  - requirements regarding lightning protection and earthing
  - requirements regarding integrity of thermal insulation and vapour barrier at junction between wall cladding and roof covering (if applicable)
  - requirements to ensure airtightness of systems (if applicable)
  - design and kind of the particular works such as outer cladding, ridge capping (description or cross-section drawings)
  - requirement regarding airtightness testing (if applicable)
  - requirement regarding permanent fastening or anchoring systems for collective or personal safety equipment to prevent falls from heights (not attached to panels)
  - conditions for the dismantling of sandwich panels (if any)
  - particular precautions concerning storage and handling of loads (if any)
  - maintenance [Annex A]

Should the contract documents not specify all this information, the installer shall provide the necessary assumptions in their quotation.

***Note**: It is recommended that the installer obtain verification of these assumptions from the client or their representative prior to signing the contract.*

The national regulations or the contractual agreements on safety in the event of impacts on sandwich panels must be adhered to. Impact refers to soft or hard hits on the internal or external side of the panels.

4.3 Layout drawings

Layout drawings shall form part of the execution specification and are based on the structural design.

Layout drawings and assembly instructions shall include the following information and shall be prepared for the execution work:

- Type and position of structural members and sheeting.
- Connection to the supporting member and arrangement of the fasteners.

- Structural members and sheeting with profile designation and manufacturer's name, constituent product, nominal sheet thickness, manufactured length and corrosion protection.
- Direction of lay of sheeting and special installation sequences.
- Structurally effective overlapping (moment-resisting connections), if relevant.
- Execution tolerances.
- Fasteners, with type designation, name of manufacturer of the fasteners (not valid for bolts), type of washers and other fixing accessories, arrangement and spacings, special assembly instructions depending on the type of connection, e.g. hole diameters, axial spacing and edge distances.
- Type and details of the supporting member for the structural members and sheeting, such as material, centre-to-centre spacing and dimensions, inclination.
- Details of panel side and end overlaps and edges around the installed area.
- Openings in the installed areas, including the necessary framing, e.g. for rooflights, smoke and heat vents and roof drainage, if relevant.
- Superstructures or suspended items, e.g. for piping, bunched cables or suspended ceilings, if relevant.
- Statement that all structural members and sheeting shall be fixed immediately after laying.
- Details regarding any special installation measures, if relevant.
- Special devices for installation, if relevant.
- Any specific hazards related to construction should be identified.
- Details regarding corrosion protection, e.g. contact surfaces between different metals or between metals and timber, concrete, masonry or plaster, if relevant.
- Details regarding the condition and location of sealing strips, fillers for profiled sheets and special elements, if relevant.
- Details regarding places for setting down bundles of structural members and sheeting on roof areas and floors according to the structural calculations.
- Details regarding accessibility for foot traffic, if relevant.
- Details regarding weather integrity, if relevant.
- Details regarding fire protection, if relevant.
- Details regarding thermal insulation, if relevant.
- Details regarding acoustics, if relevant.
- -Details regarding airtightness, if relevant.

Areas or parts of areas with panels that are intended to act as a diaphragm to stabilise the structure or parts of the structure shall be indicated on the layout drawings with "diaphragm".

4.4 Special provisions

4.4.1 Cantilever overhangs

If a sandwich panel acts as a cantilever and the cantilever length is greater than L/10 or 300 mm, a design according to [17] is required. After laying in position, cantilever sandwich panels shall be secured against uplift without delay because of the risk of accidents (overturning).

4.4.2 Precautions for the use of sandwich panels

No items or other cladding panels other than those designed and specified shall be attached to the sandwich panels.

4.4.3 Openings and penetrations

Additional frame members (trimmers) are required for supporting and, in certain cases, for fastening the sandwich panels (discontinued main frame, bias cuts, etc.).

An additional frame element is required when the size of a penetration in a sandwich panel exceeds 200 x 200 mm (for a panel with cover width ≥ 1 m). Larger penetrations are permitted provided these are designed by the party responsible or if these are covered by a technical assessment.

Penetrations in the roof area should be avoided. If possible, penetrations, e.g. ventilation ducts, should be directed through the walls.

If roof penetrations cannot be avoided, smaller diameters up to 200 mm are sealed to make them rainproof using system pipe sleeves that match the profile geometry; the flow of rainwater must be diverted in a reliable manner.

It is not possible to transfer loads without additional structural measures.

4.4.4 Expansion joints

The elements of the building envelope must be installed in a way compatible with the systems as provided to ensure unhindered expansion of the supporting structure (expansion joints).

Figure 15 shows an example of an expansion joint for walls. Metal parts must overlap each other by at least 100 mm.

The elements of the expansion joint must fulfil all building physics requirements.

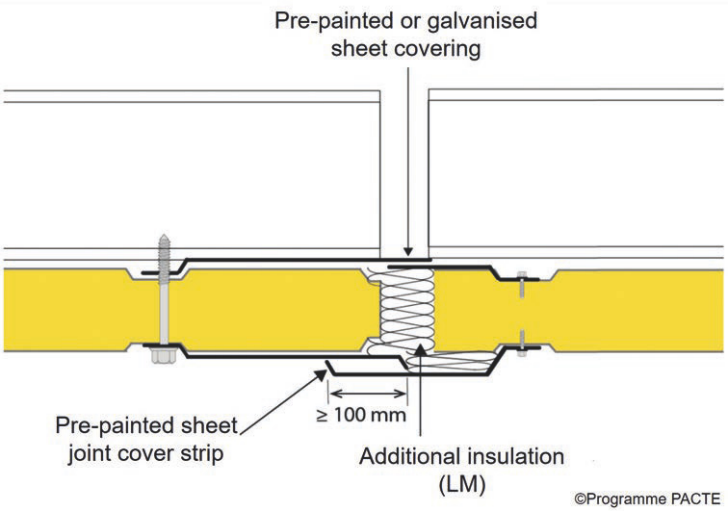


Figure 15: Example of an expansion joint

The roof covering elements must be installed in a way compatible with the systems as provided to ensure unhindered expansion of the supporting structure (expansion joints).

Figure 16 shows an example of an expansion joint for roofs for building heights not exceeding 15 m. Above this height, the design of such buildings must be defined in the contract documents.

Metal parts must overlap each other by 200 mm measured perpendicular to the roof pitch (“a” in Figure 16).

In Figure 16 the red line between the roof sandwich panels and the supporting structure represents a pre-painted or galvanised joint cover strip.

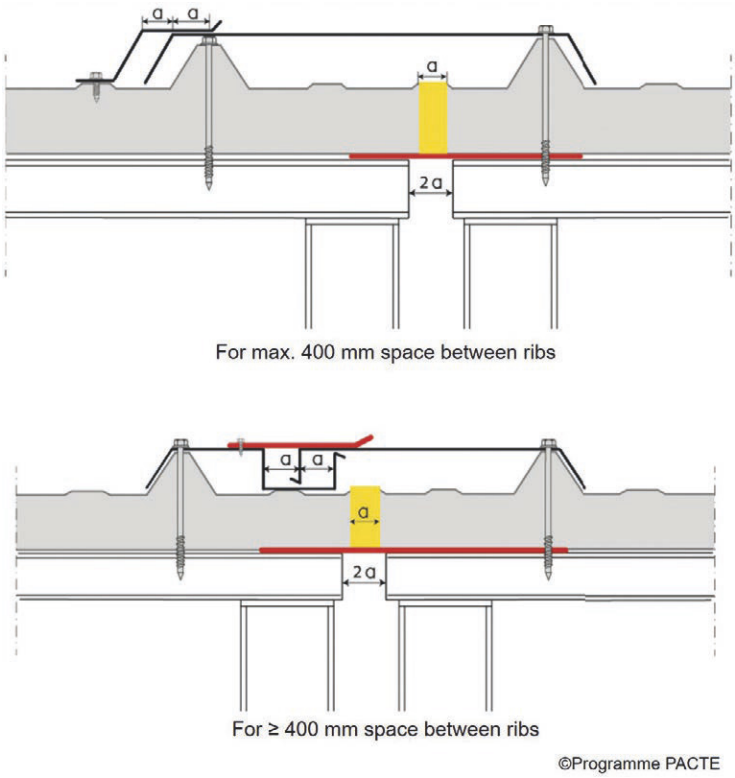


Figure 16: Expansion joint flush with the roof covering

4.4.5 Provisions for applications in mountain climates

The use of roof covering sandwich panels in an altitude zone between 900 and 2000 m (mountain climate), as defined in this document, requires exact compliance with the following two criteria:

- The sandwich panel manufacturer shall provide proof of their acknowledged and successful experience in the use of their sandwich panels in mountain climates over at least five years by means of:
  - a reference list of construction projects indicating the location of the building, the contact details of the client, the building type, the altitude, the panel types and thickness, details of technical inspector if needed, or
  - any other document or proof of that experience being acknowledged by an independent body.

- The sandwich panel manufacturer shall have access to technical support that is able to provide the verifications required in all the following matters, which shall be considered as soon as design begins:
  - Nominal thickness of the outer face steel sheet is at least 0.63 mm.
  - Nominal thickness of the inner face steel sheet is at least 0.50 mm.
  - The minimum thickness of a sandwich panel is 60 mm.
  - The “Technical Guide – Roof coverings in mountain climates” (CSTB brochure) shall apply, and especially the provisions regarding design and execution provisions for normal applications, which can apply to sandwich panels.
  - Roof coverings with one or two pitched roof areas overhanging the façades, excluding: parapet gutters, valley gutters, cantilever gutters.
  - Cross-beams are provided for any possible penetrations.
  - Sandwich panels are only attached with self-tapping/self-drilling screws or lag screws.
  - Panels shall be mounted continuously on at least three supports.
  - The minimum pitch of the roof covering is according to Table 10 (see 6.8.3.1.2).
  - The distance between supports shall take into account the snow accumulations in addition to the uniformly distributed loads.

- The bearing pressure at sandwich panel supports must be checked depending on the support width (see E.4.3.2 of [17], 2013 edition).
- Panel end overlaps shall be at least 200 mm and include obligatory additional sealing.
- The roof ridge shall be executed using ridge cappings with profile closers plus foam profile fillers; in addition, the lower flange of the external metal face of the panel shall be bent up with a pair of pliers. Alternatively, a custom ridge capping may be used.
- Snowguard systems must never transmit the loads through the sandwich panels or their fasteners.
- Lightning protection items shall be adapted for use in high mountainous areas.
- Possible local provisions shall be taken into account.
- Use of fully threaded screws.
- Device to prevent the penetration of powder snow.
- Crushing of supports shall be checked. The crushing calculated by means of the compression strength E_{Cc} shall not exceed 1 mm to ensure that the sealing washer stays properly compressed and retains its waterproofing function.
- Ensure that compressive stresses at ULS at each support do not exceed the f_{Cc}/γ_M stress of the CE marking, where $\gamma_M = 1.2$.

4.5 Safety in seismic regions

4.5.1 General

In the case of erection in an active seismic region, compliance with the relevant provisions is necessary in order to ensure that the building envelope remains safely in place.

After an exceptional hazard, repairs to the building envelope might be necessary. Such potential repair/re-construction work shall be taken into account by the building owner.

4.5.2 Seismic performance

A report of a seismic survey, which defines the seismic zones, the significance categories of the building and the soil classes, shall be issued by a competent body based on testing.

This report can recommend specific fasteners with minimum edge distances to be observed in accordance with the tests conducted.

4.6 Thermal insulation

Different national rules, e.g. [24] and [25] in France or [27] in Germany, shall be considered.

4.7 Moisture control

These Rules for Good Practice limit the use of sandwich panels for roof coverings to premises with low or moderate humidity (ventilation with outside air, natural or mechanical ventilation) or whose vapour pressure is between 5 and 10 mm Hg. Condensation is only to be expected at penetrations and single skin rooflight sheets and when $t < 12$ °C.

Furthermore, a condensation risk at through-fixings cannot be completely excluded.

At specific points (junction between roof covering and walls of building envelope), risks of superficial condensation are possible if junctions are not detailed properly, especially with additional insulation to ensure the thermal integrity (see Annex C).

4.8 Dangerous substances and environmental performance

Based on the data provided by the suppliers of the raw materials, sandwich panel manufacturers shall inform their clients of any hazardous substances and carcinogenic, mutagenic and reprotoxic (CMR) substances likely to be emitted.

The valid national requirements must be met regarding emissions of dangerous substances and environmental performance.

4.9 Acoustic performance

The contribution of sandwich panels to the acoustic performance of building envelopes is expressed in terms of acoustic insulation ($R_W(C;C_{tr})$), which is evaluated in a laboratory.

If such acoustic performance is specified in the tender, the panel manufacturer shall provide wall cladding and roof covering sandwich panels with properties that will contribute to improving the acoustics.

4.10 Air permeability

The air permeability values of sandwich panels stated on the CE marking only take into account the performance of longitudinal joints and fixings.

The airtightness performance of the building is ensured by all the elements of the building envelope and their connections. The airtightness of all these building elements (cladding, roof, roof coverings, openings, penetrations) must be ensured.

Annex C provides examples of constructional measures to deal with the air permeability at the junctions of the building elements.

To reduce the air permeability of a building envelope, sealants must be used, which are tested for their intended use.

4.11 Water permeability

The watertightness (resistance to driving rain) performance is deemed to be satisfied when the technical specifications given in Annex C are complied with.

4.12 Durability

The durability requirements of sandwich panels are usually met for normal conditions if the specifications of these Rules for Good Practice are complied with.

4.13 Protection of the cladding base

The design of the lower part of the cladding shall permit the cladding to start at a minimum height of 15 cm above the ground.

5 MATERIALS

5.1 Sandwich panels

Double skin metal-faced sandwich panels with a PU (PUR/PIR) or MW core are covered by [17].

Independent proof of constancy of performance of the product is recommended to contribute to the durability of the building.

Sandwich panels are identified by means of the technical documentation supplied by the manufacturer. The following information must be provided in addition to that given in the Declaration of Performance (DoP) on the basis of [17]:

- Information about hidden fixings, e.g. test reports, minimum edge distances, type of fasteners and load distribution plates, if required.
- Certification number under other schemes, if applicable.
- The possible need for a starting part.
- The seismic validation of the sandwich panel according to the test report and validation based on a study report, if relevant and required.
- Technical report issued by a fire engineering expert, if required.
- Thermal performance of the sandwich panel per panel thickness, if not covered by the DoP and if required.
- Environmental Product Declaration (EPD), if relevant.

5.2 Sealing materials and additional thermal insulation

Sealants and gaskets for air- and watertightness are applied on site:

- at supports at the ends of panels,
- at flashings,
- at transverse and/or longitudinal joints between panels for wall cladding,
- at the side laps and end overlaps of the panels for roof covering,
- for the execution of particular works.

These sealants can be, for example, sealing strips made from, for instance, impregnated foam.

Thermal insulation at joints may be provided by means of polyurethane foam spray, by mineral wool filling or with sealing strips.

Where horizontal and vertical joints intersect, the integrity of the sealing plane must be ensured.

In the case of a high humidity or air-conditioned rooms, the longitudinal joints between panels should be sealed with a mastic sealant suitable for coated steel.

5.3 Fasteners and their accessories

5.3.1 General

All fastening systems must be used in accordance with the recommendations for fasteners. They must comply with the relevant European standards or European Technical Assessments (ETAs) in the countries of use where those ETAs are mandatory.

Saddle washers can be used as part of the fastening system.

It is mandatory to use saddle washers for the fastening of roof panels.

5.3.2 Panel fastening systems

Panel fastening systems are qualified if:

- the fastener penetrating and clamping the core material is approved for head deflection in compliance with the European Assessment Document (EAD) covering fastening screws for sandwich panels, or
- optional fastening methods comply with the individual ETA of the panel manufacturer.

Screws must be inserted with a power tool equipped with a depth control.

The minimum embedment depth of the fixings in a supporting structure made of steel or timber must be adhered to, where the lengths of welded-on drill tips or hardened tips are excluded. The specifications of the fastener manufacturer concerning clamping thicknesses should be observed.

When screwing in self-tapping screws, it is recommended to use power screwdrivers with low rotational speeds which are intended for this application. Power screwdrivers with high rotational speeds are used for inserting self-drilling screws. The recommendations of the screw manufacturer should be observed.

Roof elements with aluminium faces should be fixed using stainless steel screws together with saddle or sealing washers.

To ensure trouble-free fixing of sandwich panels, the fastener must be screwed in such that the seal under the head of the screw is slightly deformed. This results in a slight indentation in the upper face of the sandwich panel. Thus, with sandwich panels, minor deformations in the upper face at the screwed connections is system-related and unavoidable. Dents in the faces of sandwich panels with a PU core should be less than 2 mm in the area of the screwed connections (can effectively only be checked with single-span supports and end supports). Small dents may also be visible in the outer face as a result of temperature-induced deformation. This is system-related and unavoidable.

These points comply with the acknowledged technical rules. They are therefore not irregularities in this respect.

Recommendations:

- *To reduce the susceptibility to denting, larger sealing washers should be used to improve load distribution. Instead of Ø16 mm sealing washers, Ø19 mm or Ø22 mm should be chosen.*
- *Denting of the faces can be reduced by using screws with double threads.*

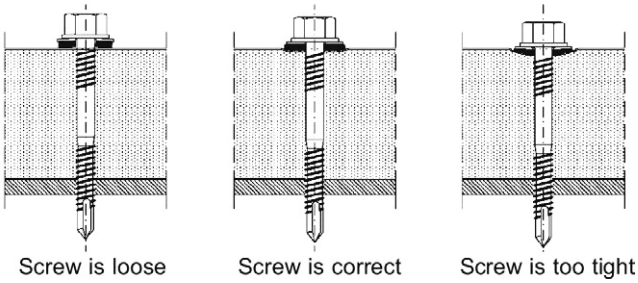


Figure 17: Seating of screws and sealing washers

5.3.2.1 Nature of the fastening systems

Table 2 shows the nature of fasteners for fixing sandwich panels to the structure which are compatible with the different types of support referred to within the scope of this document.

Thickness of support	Kind of fastener	
	Self-drilling or self-tapping screw	Self-drilling wood screw
Steel: thickness ≥ 1.5 mm	■	□
Concrete with embedded steel attachment rail of thickness ≥ 2.5 mm	■	□
Timber: thickness ≥ 80 mm with an embedment ≥ 50 mm	□	■
■ Use allowed □ Use prohibited		

Table 2: Nature of the fasteners

5.3.2.2 Properties of the fasteners

The properties of the fasteners for fixing sandwich panels to the structure are defined in Table 3.

Screws with double threads provided with a sealing washer or, alternatively, screws with a shank and no double thread, combined with a storm washer for a better loadbearing and sealing performance, are acceptable and common.

Type	Dimensions	Materials
Self-drilling or self-tapping screw (on steel)	Ø ≥ 5.5 mm for self-drilling, length such that the thread is visible under the mounted element Ø ≥ 6.3 mm for self-tapping, length such that the thread protrudes at least one diameter beyond the support (diameter considered at thread)	Case hardening steel wire complying with [11] or stainless steel wire according to [9][1]
Self-drilling wood screw	Ø ≥ 6.5 mm, length such that the embedment depth is ≥ 50 mm	Case hardening steel wire complying with [11] or stainless steel wire according to [9][1]

Table 3: Properties of the fasteners

[1] Stainless steel wire according to [9] is mandatory in Germany.

<table>
<tr><th>Screw type</th><th>Environment</th><th colspan="2">Requirements in France</th><th colspan="2">Requirements in other countries</th></tr>
<tr><td>Screws without washers
  </td><td>Dry</td><td colspan="2">• Coated carbon steel (≥ 12 cycles, Kesternich)</td><td colspan="2">According to the relevant ETAs or national approvals</td></tr>
<tr><td rowspan="2">Screws with washers
  </td><td rowspan="2">Exposed</td><td>Shank</td><td>• Coated carbon steel (≥ 12 cycles, Kesternich)
• Stainless steel grade A2 < 3 km distance to the sea</td><td rowspan="2">• Requirement in Germany: stainless steel</td><td rowspan="2">According to the relevant ETAs or national approvals</td></tr>
<tr><td>Head</td><td>• Coated carbon steel (≥ 12 cycles, Kesternich) with additional head protection:
– plastic moulded head
– zamak moulded head
– stainless cap
• Stainless steel grade A2 < 3 km distance to the sea</td></tr>
</table>

Table 4: Requirements for corrosion resistance of screws

5.3.3 Load distribution plate for panels with hidden fixings

Only systems that have been tested and documented by the manufacturer may be used.

The load distribution plate shall exhibit a minimum yield strength of S250 GD, have a metal coating of at least Z275 or be made of stainless steel grade A2 and shall be appropriate to the exterior atmosphere of the site.

The technical documentation of the sandwich panel manufacturer shall define the geometries, dimensions, materials, metal grades and corrosion protection of the fasteners.

Figure 18 shows an example of a load distribution plate.

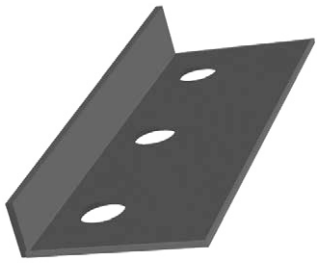


Figure 18: Example of a load distribution plate

5.4 Materials for secondary works – flashings

The flashings shall have a thickness at least equal to the nominal thickness of the panel face to which they are attached. However, the minimum thickness of the flashings shall be 0.5 mm in any case. For aesthetic reasons, especially for wall applications, greater thicknesses may be necessary to prevent loss of flatness.

A distinction is made between, for example:

- aprons,
- parapet copings,
- flashings for internal and external corners,
- verge flashings,
- duopitch roof ridges, etc.

If the appearance or colour has to be continuous, the flashings should be executed from the same material batch as that of the sheet used for the outer face of the panels.

6 INSTALLATION

6.1 Scope of the works

6.1.1 Works that are part of the contract

The necessary design studies and layout drawings form the basis of the installation works.
The contractual parties must define which of the following are covered by the installation work:

- Verification of the tolerances of the structure and its acceptance (see 6.6.1)
- Supply and installation of the sandwich panels
- Supply, shaping and installation of the flashings and, in particular:
  - flashing around point-like openings
  - flashings against other building parts and materials
  - expansion joints
  - verge flashings
  - flashings at corners
  - rainwater systems
  - sleeves for items penetrating the building envelope (ventilation items, structural items, etc.)
  - roof outlets, roof ridges, profile closers
  - parapet gutters, valley gutters, vents
  - supports for individual rooflights or other ancillary items

- Supply and installation of individual or long rooflights for ventilation, illumination, smoke extraction and access to the roof
- Sealing of joints
- Installation of the components for air- and watertightness
- Documentation of the work carried out
- Execution and adjustment of the supports, inserts
- Paint works and diverse possible protection works (fungicide, insecticide, anti-corrosion) for the structure
- Supply and installation of the cross-beams
- Supply and installation of the window frames
- Execution of the masonry works (walls, render, chimneys, fascia boards, spoilers, chases, etc.)
- Supply and installation of the technical devices and equipment on the façade
- Supply and installation of components to prevent the ingress of driving rain between penetrations and sandwich panels
- Removals necessary to allow access for other trades
- Possible testing for airtightness
- All maintenance works, especially those mentioned in Annex A

In the event of a contradiction between the contract documents, the thermal, acoustic and airtightness requirements and the inner wall specification, the contractor shall specify in their bid, for a given requirement, whether it is based on performance or on the specification.

The installer must check that the coating is compatible with the end use conditions.

6.1.2 Tasks of designers

The designers shall provide design studies (determination of wind actions in terms of pressure and suction, determination of the loads on the roof covering, verification of seismic actions, possible thermal gradients, verification of fasteners, spans and support widths), classifications, working drawings of the cladding and roof covering (sandwich panels, fasteners, seals and gaskets, additional insulation), in particular the connections to ancillary works and to the items for rainwater drainage.

6.2 Documentation required

The building site documentation needed to carry out building works and installation in a proper manner should be checked for completeness before starting the installation works. Particular attention should be given to those documents that the building authorities require to be held ready for inspection and which must be available at all times. These include:

- A global overview of all interactions between climate actions, seismic actions, thermal aspects, internal and external atmosphere of the building, etc.
- Structural calculations, load tables and plans, possibly with corresponding release notes (e.g. from test engineer)
- Layout drawings, detail drawings, parts lists
- Acceptance protocols for diaphragms and moment-resisting connections
- National building inspectorate notifications of approval for components, fasteners and anchoring elements, if required
- Installation instructions
- Health and safety plan
- Regulations governing scaffolding and its erection instructions
- Delivery notes and labels (CE marking)
- Site diary or meaningful time sheets
- Checklist/test report for working and protective scaffolding, stair towers, safety netting, roof edge protection

The following documents, which help the installer to perform the installation work smoothly, should be available:

- Accident prevention regulations
- PPA-Europe's Rules for Good Practice
- Installation and laying instructions
- Contract specification
- Acceptance forms (also for partial and interim acceptance)
- Forms for confirming completion of additional tasks
- Memos covering important incidents, changes etc. instigated by the building owner
- Time sheets
- Risk assessment

6.3 Preparation – coordination with other building companies

6.3.1 First phase

Upon notification of award of the contract, the installer shall receive architectural plans, layout drawings and indications from the project manager as well as all assumptions defined in section 4.2.2. The installer shall also receive complete information about access to ground, walls and roof.

Without those elements, or if they show large discrepancies from what was described in the tender file, the installer shall inform the project manager. The latter must state how to proceed. As a result, modifications to the contract can be made, including to the execution deadlines.

6.3.2 Second phase

Once in possession of the above elements and within the deadlines provided in the contract and agreed to by mutual agreement, the installer submits the information or drawings for executing general areas or specific points to the project manager and, if necessary, to the other building companies so that they may define the details of their works.

For this purpose, the project manager coordinates the different trades and approves the arrangements made. If this approval is lacking, the acceptance of the final execution drawings by the installer shall be deemed to be the project manager's consent.

6.3.3 Third phase

All final working drawings shall be delivered to the general contractor at least six weeks prior to the date specified in the contract as the start of the contractual time limit (or longer in the case of special supply).

6.3.4 Fourth phase

Before the works on the construction site begin, the slopes of the supporting surfaces of the structure and the alignment of the structure having been verified beforehand in an adversarial procedure (see 6.6.1) and accepted, the installer ensures that the structure, where it can be easily verified, complies with the plans and drawings required in the sections above and in the provisions of this document (dimensional properties and types of support, trimmer beams, etc.).

6.4 Preparation – organisation of the building site

6.4.1 Access

In order to allow the ordinary execution of the works, the project manager has to plan the following points:

6.4.1.1 Access to the ground

Access to the ground includes:

- Access to the building, the façades, the site facilities and to the storage areas for the site teams and the delivery trucks
- Storage areas in the immediate vicinity of the works
- Adequate clear spaces for construction and the equipment to be used

6.4.1.2 Access to the roof

Access to the roof includes access from inside or outside via a secured, fixed ladder (in compliance with [16] for maintenance) that has been installed at the same time as the loadbearing structure for workers' access.

6.4.2 Intervention of the contractor

The contractor shall ensure that the collective safety devices are set for the installation of the cladding and roof covering sandwich panels.

The provision of the temporary collective safety measures and the installation of the sandwich panels can only begin once the loadbearing structure has been accepted.

Furthermore, the stability of the elements being installed shall be ensured, also compliance with the precautions related to the handling of long elements.

6.4.3 Intervention of other contractors

The project manager shall be in charge of the coordination.

Materials and equipment belonging to trades other than the roof installers may not be stored on the roof. All the storage places must be indicated on the layout drawings. Other trades are not permitted to work on the roof during the execution of the roof covering works. After the execution of the roof covering works, access to the roof for other trades is only permitted in accordance with the specifications of the panel manufacturer regarding the resistance to point loads and repeated loads.

6.5 Tests for airtightness

Tests for airtightness can be carried out after completing the installation work. The installer must bear the costs of such tests only when they form part of the contract.

6.6 Requirements for preparation and execution of the works

6.6.1 Acceptable tolerances of the structure

6.6.1.1 Definition of the tolerances

The tolerances for structures given in standards are often too large for sandwich panels. Therefore, a secondary, adjustable frame, for which the steelwork contractor is responsible, may be erected in order to adjust those tolerances. These compensatory measures must be part of the contract. Deviations in the structure can neither be adjusted nor compensated for by a cladding or roof covering sandwich panel laid on the structure. Indeed, deviations in the actual dimensions of the loadbearing structure can only be assessed when the façade/roof is finished (and which must look good).

For timber structures, the limit values to be taken into account for deflections are those at the intersection of the column “Common buildings” and the line “Structural members” in Table 7.2 of section 7.2(2) of [6], 2013 edition.

Furthermore, the absolute deflection of loadbearing structures shall not exceed 2 cm for aesthetic reasons.

Therefore, the structure shall comply with the tolerances stated in Tables 5 and 6.

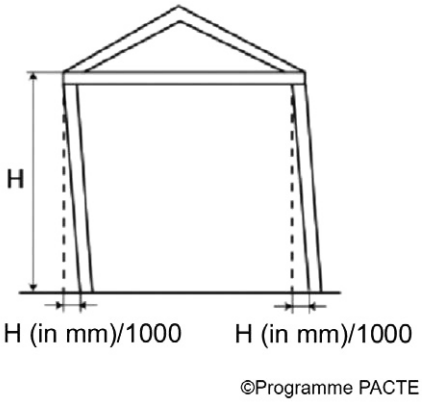
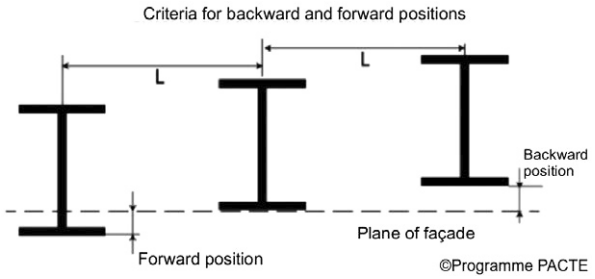
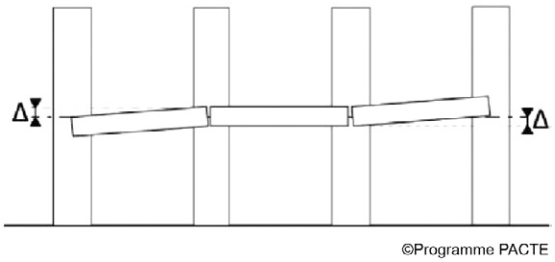
Direction considered	Value of alignment tolerance
Height Façade out of plumb.  	+/- 1 mm/m height, but max. 10 mm
Length Alignment of columns  	The reference plane is represented by the dotted line. Δ = tolerance range (backward + forward position) in mm $\Delta \leq L/750$ Δ_{max} = 8 mm L = centre-to-centre distance between columns (in mm) Maximum tolerances allowed over length of building: (-8 mm; 0) or (0; +8 mm) Beware of the rotation of each column about its vertical axis! Horizontal alignment: 10 mm per 10 m façade length
Alignment of cladding rails  Maximum possible tolerance over length of building: [-5 mm; +5 mm]	

Table 5: Usual alignment tolerances for façade structures

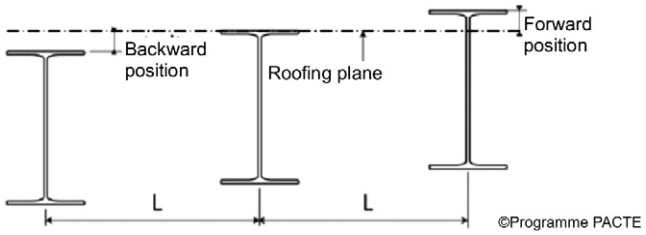
Direction considered	Value of alignment tolerance
Length Alignment of purlins or rafter of portal frame Criteria for backward and forward positions  	The reference plane is represented by the dotted line. Δ = tolerance range (backward + forward position) in mm $\Delta \leq L/500$ $\Delta_{max} = 8$ mm L = centre-to-centre distance between purlins (in mm) Horizontal alignment: 1 mm per 1 m length

Table 6: Usual alignment tolerances for roof structures

Tolerances for steel structures are given in [4].

Tolerances for concrete structures are given in [15].

It is possible that in their commercial literature, some manufacturers of sandwich panels request stricter alignment tolerances than those specified in [4] or [15].

Supporting structures must be continuously flat. The supporting surfaces for the sandwich panels must have the same slope as the panels and must not be interrupted by screws, rivets, straps, end plates or face plates.

Tolerances for timber supports in France are given in [19].

6.6.1.2 Final inspection of supporting structure

It is essential to verify those tolerances of the structure that will have an impact on the building envelope's final appearance, especially the general flatness and alignment of the edges, since those are particularly noticeable points.

The verification of the geometry of the supporting structure is incumbent upon the party in charge of the structure (verticality, unevenness, cladding rail spacing, support width, etc.). This party shall write a report on the final inspection of the loadbearing structure and submit it to the installer before the sandwich panel installation works begin.

Any possible non-compliance shall be corrected through a new adjustment or by means of a secondary structure.

6.6.2 Minimum support conditions

The minimum edge distance of the fasteners to the panel end is 20 mm based on the ETA for screws, or larger distances based on the recommendation of the panel manufacturer.

Type of supporting structure		Steel		Reinforced concrete		Timber	
		Germany	France	Germany	France	Germany	France
Walls	Width of end support [mm]	40	35	40[2]	35	40	20 + 4d d = fastener diameter
	Width of intermediate support [mm]	60	40	60[2]	60	60	
Roofs	Width of end support [mm]	40		40[2]	60	40	60
	Width of intermediate support [mm]	60	40	60[2]	60	60	

Table 7: Comparison of the minimum support widths for steel sandwich panels with PU core in Germany and France (walls and roofs)

When fixing sandwich panels on supporting structures, it is necessary to consider the provisions for a supporting structure made of steel according to [5], made of timber according to [6] and made of aluminium according to [7].

6.6.2.1 Support conditions in Germany

The actual widths of supports should be compared with the details given on the layout drawing. If the widths of supports are smaller than those specified in the execution specification, the author of the execution specification should be informed and their instructions awaited.

Support widths smaller than those shown in Table 8 must be verified separately.

Where a national approval applies, the respective provisions of that document must be complied with.

The necessary support width must be determined as part of the structural verification of the panels. In general, this verification leads to larger support widths than the minimum support widths given.

Type of supporting structure	Steel	Reinforced concrete	Timber
Width of end support [mm]	40	40[2]	40
Width of intermediate support [mm]	60	60[2]	60

Table 8: Minimum support widths for steel and aluminium sandwich panels (walls and roofs) in Germany

6.6.2.1.1 Supporting structure made of concrete or masonry

Sandwich panels shall be adequately anchored to concrete or masonry supporting members. Post-installed anchors, dowels, cartridge-fired pins or screws complying with European standards or ETAs should be used to attach the sandwich panels to the supporting structure.

[2] Taking into consideration the provisions in 6.6.2.1.1 and the requirements of the National Technical Approval for fasteners

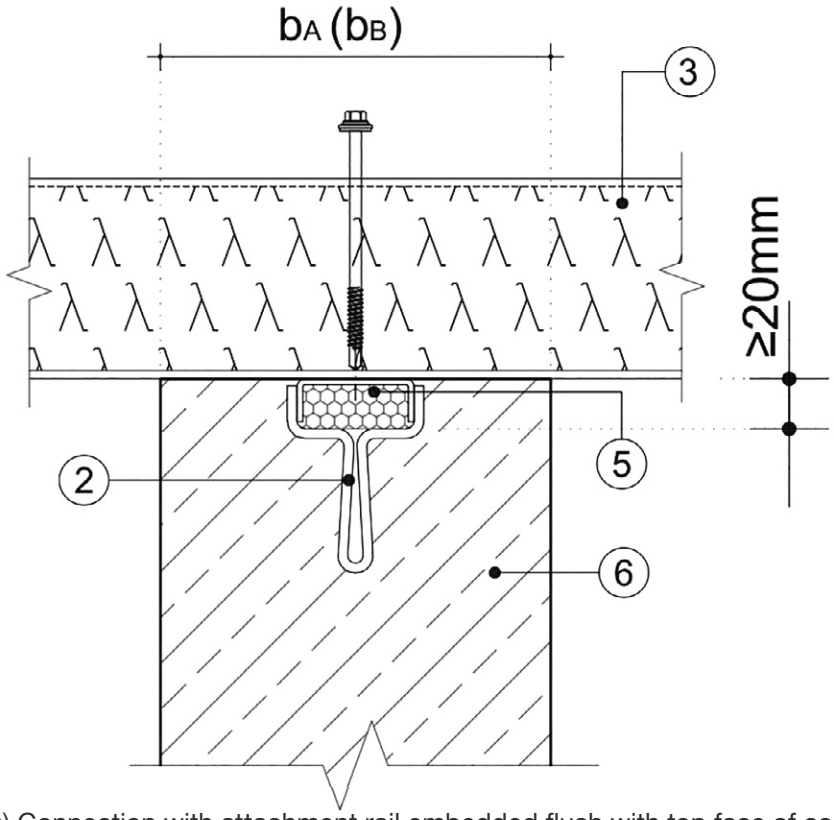
Continuous steel parts (e.g. flat steel with a minimum yield strength of 220 N/mm^2 and at least 8 mm thickness, fastening rails or cold-formed profiles) shall be used for attaching the sandwich panels. Figure 19 shows examples of support details for concrete or masonry.

The steel parts, including their anchorages, shall be installed flush with the surface of the concrete. The supporting surfaces for the sandwich panels shall have the same pitch as the sandwich panels and there shall not be any interference from screws, rivets, butt straps, top flange plates, end plates or splice plates.

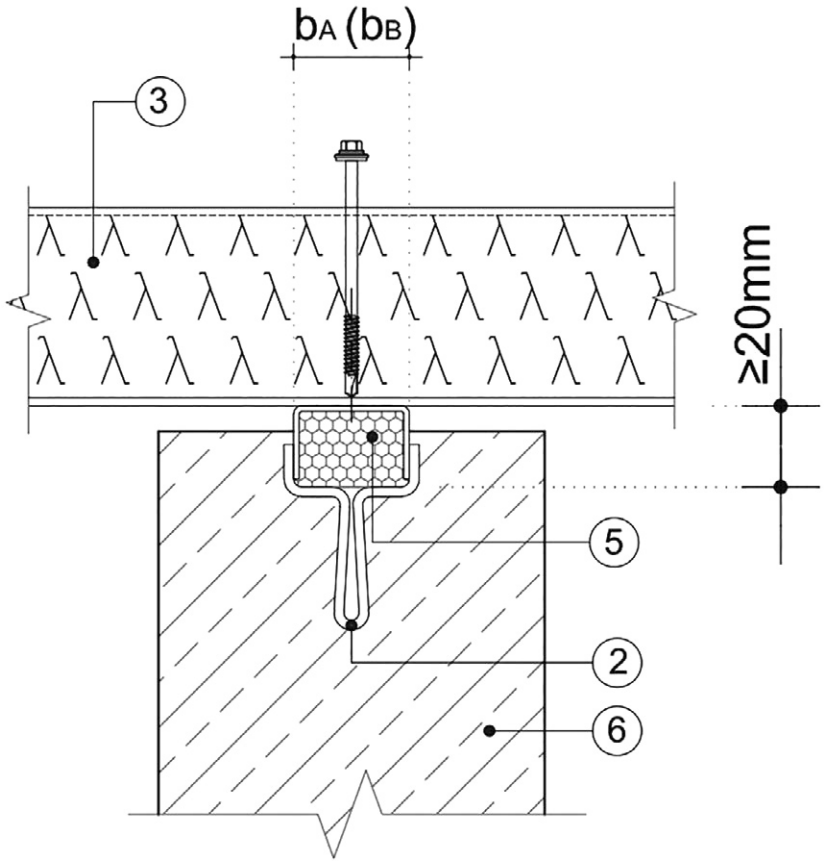
The steel parts shall be adequately protected against corrosion.

If the width of the supports is more than 10 % of the calculated span, then the supports shall be installed so that they protrude above the concrete surface, in accordance with the deflection curve of the sandwich panels.

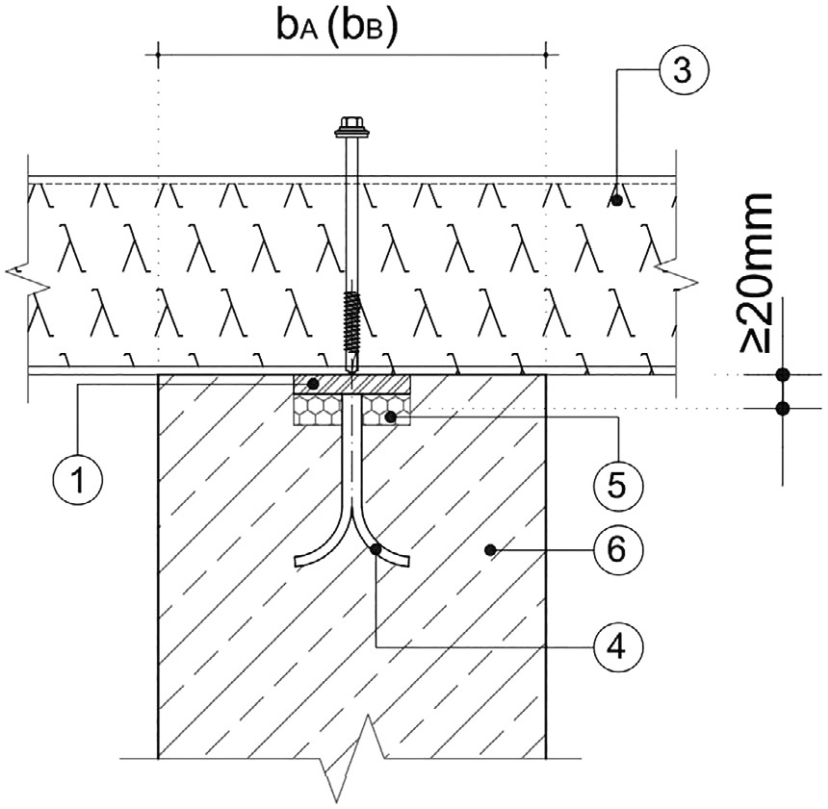
In exceptional cases where there is no supporting component, e.g. in building refurbishment projects, the sandwich panels may be attached directly to the supporting member. If condensation cannot be ruled out, direct contact with a support made of concrete shall be avoided. The screws or anchors for fixing sandwich panels directly to the concrete must be made of carbon steel and the instructions of the screw producer must be followed.



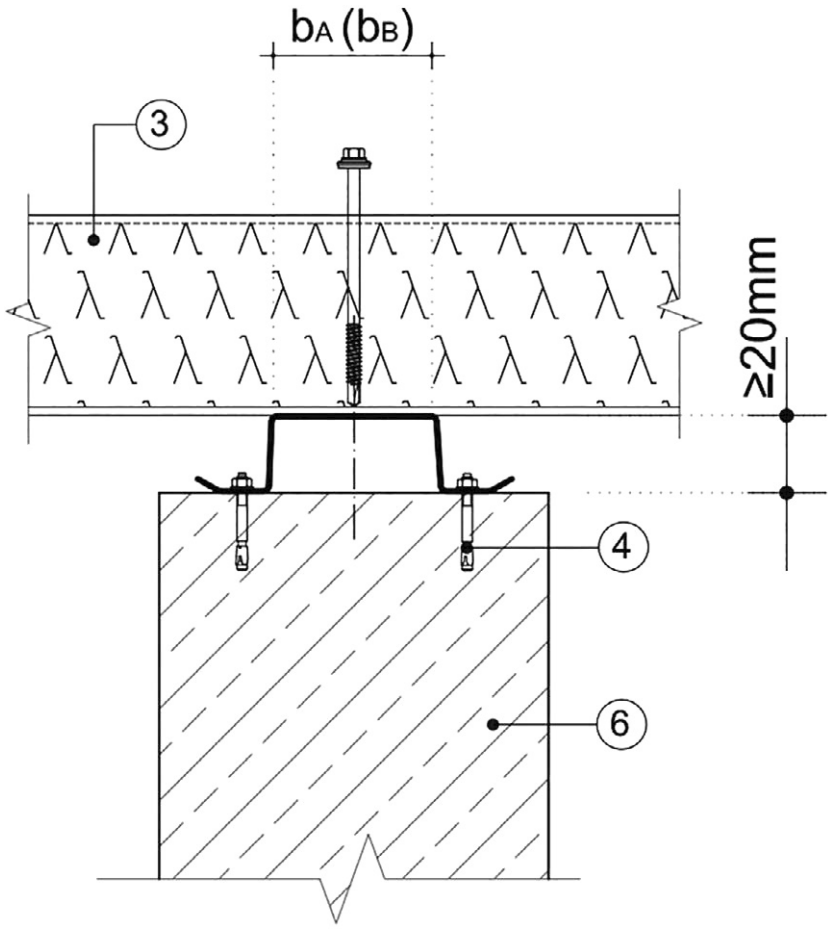
a) Connection with attachment rail embedded flush with top face of concrete support



b) Connection with protruding attachment rail embedded in concrete support



c) Connection with flat steel bar flush with top face of concrete



d) Attachment with hat-shaped profile anchored to support

Key

1 Steel plate, thickness not less than 8 mm
2 Embedded steel attachment rail
3 Sandwich panel
4 Anchor
5 Rigid foam, timber or similar material
6 Plain, reinforced or prestressed concrete, or masonry

Figure 19: Examples of support details for concrete or masonry

6.6.2.1.2 Steel supporting structure

Supporting structures made of steel must be continuously flat.

All screws and rivets regulated by the ETA are suitable for screwed connections in hot-rolled structural steel grade S235J according to [8] or in hot-dip coated structural steels grade S280GD or S320GD according to [12]. On supporting structures made of steel of a higher grade and strength, e.g. S275J or S355J according to [8] or S350GD according to [12], only fasteners suitable and approved for the material of the supporting structure (component II) may be used for installation.

Supporting structures made of stainless steel are normally not part of the ETA for fasteners and must be tested separately.

6.6.2.1.3 Timber supporting structure

Supporting structures made of timber must be continuously flat.

The only fastening systems that may be used for installation are those that conform to the ETA and for which the applicability for timber supporting structures has been expressly stated.

The parts to be connected should be pre-drilled in accordance with the approval. The minimum embedment depth without a reduction in the characteristic resistance is 50 mm; by contrast, other embedment depths can be given in the assessment for fasteners.

When fixing to a timber supporting structure, the timber supporting structure must be pre-drilled or self-drilling screws must be used.

It is only permitted to use screws that have been tested with a sufficiently large head displacement. These screws are regulated in ETAs.

6.6.2.2 Support conditions in France

6.6.2.2.1 Minimum conditions for the supports of wall cladding panels

The minimum edge distance between the fastener and the support edge (15 mm or 4d depending on the type of support) as well as the edge distance validated during the fatigue testing for assemblies with hidden fixing between the screw and the edge of the sandwich panel shall be complied with.

They are specified in Figures 20a, 20b and 20c below.

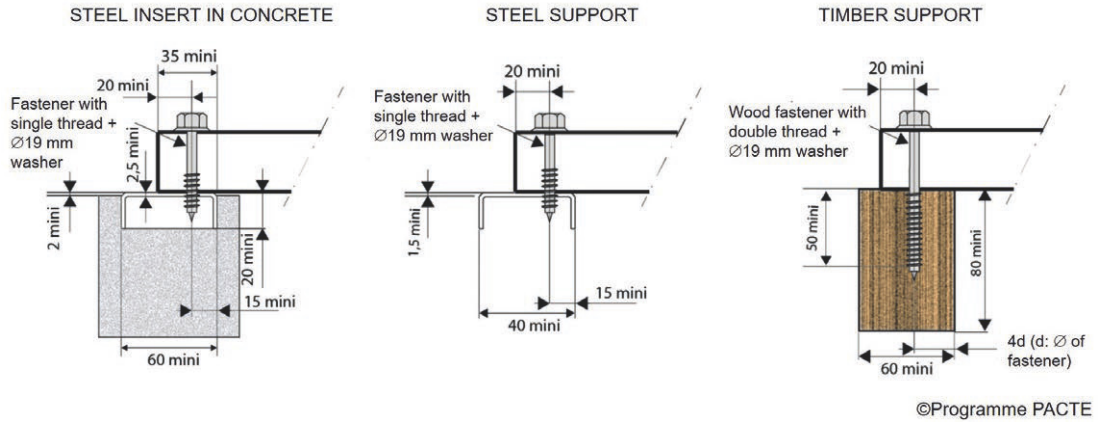


Figure 20a: End supports for sandwich panels

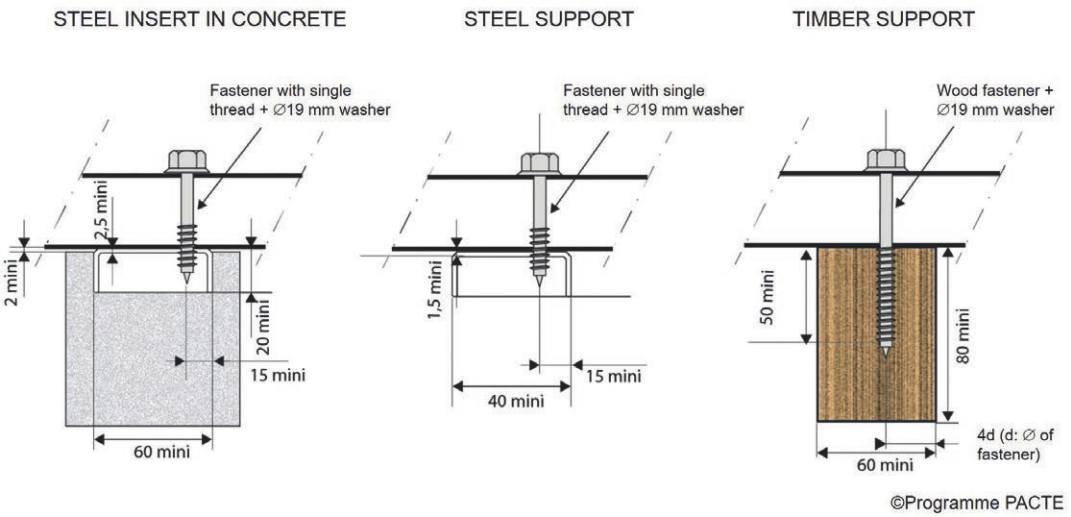


Figure 20b: Intermediate supports for sandwich panels

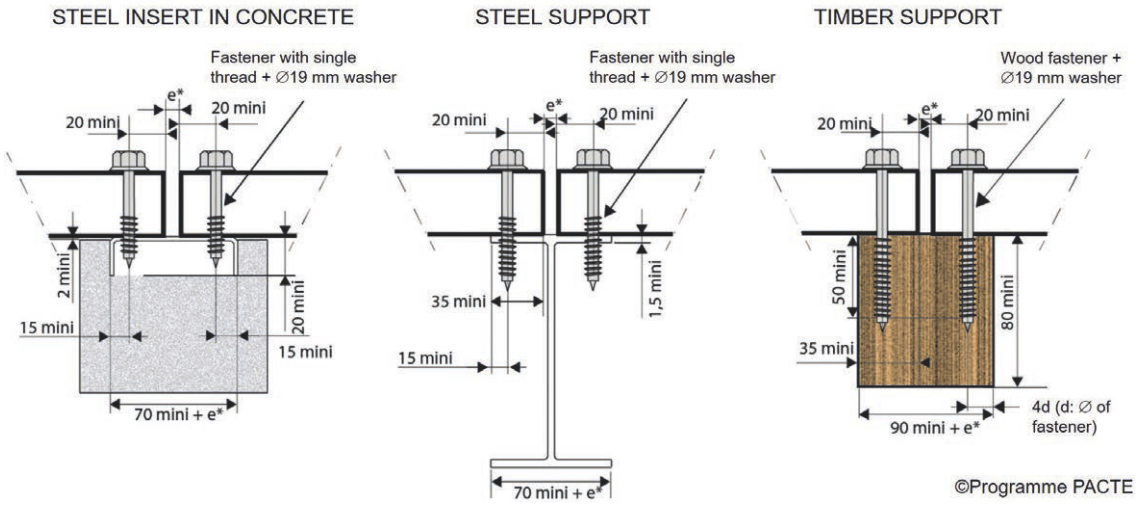


Figure 20c: End-to-end joints between sandwich panels

6.6.2.2.1.1 Installation on steel structure

With through-fixings:

The minimum width of the structural member is 40 mm per sandwich panel. The minimum thickness is 1.5 mm.
The minimum bearing width is 35 mm at sandwich panel ends and 40 mm at intermediate supports.
The minimum edge distance between fasteners and bare structure is 15 mm.

With hidden fixings:

The minimum width of the structural member is 40 mm per sandwich panel. The minimum thickness is 1.5 mm.
The minimum bearing width is 35 mm at sandwich panel ends and 40 mm at intermediate supports.
The minimum edge distance between fasteners and bare structure is 15 mm.
The distance between the fastener and the panel edge is determined via controlled fatigue tests.

6.6.2.2.1.2 Installation on timber structure

The minimum cross-section of the timber structural member must be 60 x 80 mm per sandwich panel at end and intermediate supports and 90 mm for panel end overlaps.

Screw embedment is min. 50 mm.

The minimum edge distance between fastener and bare structure is 4d, where d is the fastener diameter.

Concerning fasteners for timber supports, please note that the minimum spacing between two fasteners is 4d, where d is the fastener diameter.

6.6.2.2.1.3 Installation on concrete structure with embedded steel attachment rail

The concrete structure always comprises a metal insert, integrated and anchored during casting, with a minimum width of 60 mm per sandwich panel. The insert shall protrude from the concrete by about 2 mm.

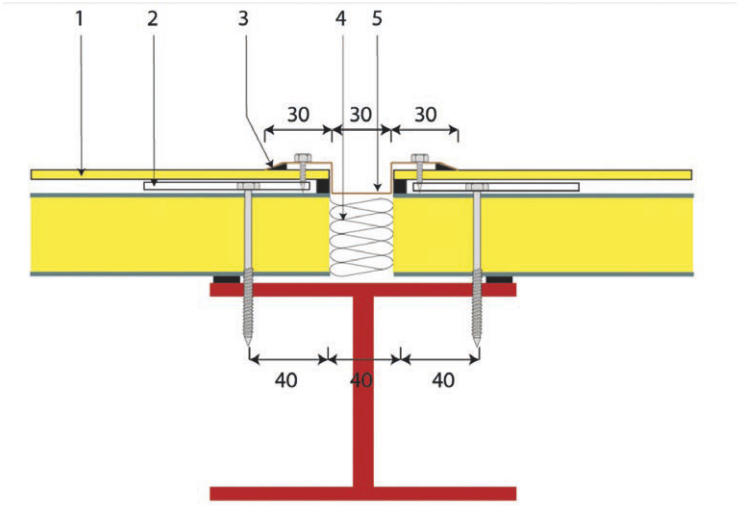
Inserts consist of a profile with a minimum thickness of 2.5 mm and minimum clear depth of 20 mm beneath the profile to allow space for the fastener.

6.6.2.2.1.4 Installation of panels with hidden fixings on a common support

In the case of rows of panels installed on a common support, the minimum support width of the structure is defined in Table 9 below. Other values are possible, depending on the fatigue testing conducted by a third party.

Support type	Indicative support width in the event of panel rows installed on a common support – to be validated by fatigue testing depending on the edge distance[3]
Steel	90 mm
Timber	110 mm
Concrete	90 mm

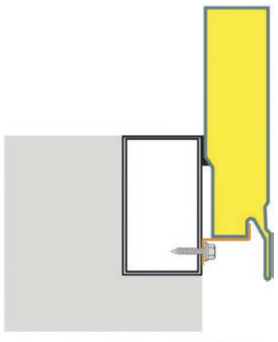
Table 9: Minimum support widths for panels installed on a common support



1. Panel with hidden fixings – 2. Load distribution plate
3. Sealant – 4. Additional insulation – 5. Cover profile

©Programme PACTE

Figure 21: Example of support detail and edge distances for wall panels with hidden fixings installed horizontally on a common steel support



©Programme PACTE

Figure 22: Example of support detail for wall panels with hidden fixings

[3] Minimum edge distance of 20 mm to be confirmed by fatigue test

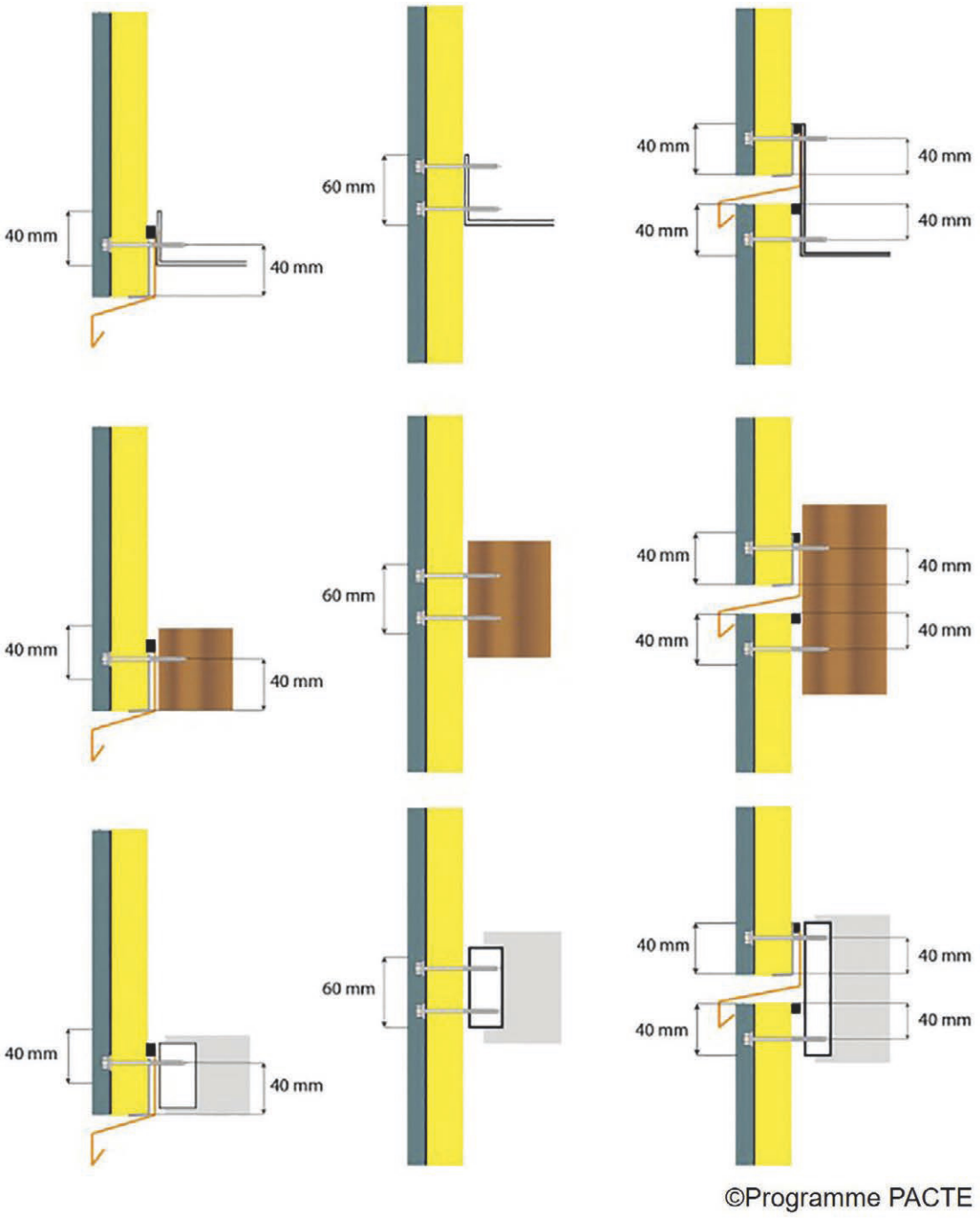


Figure 23: Examples of edge distances for wall panels with hidden fixings installed vertically on different types of support

6.6.2.2.2 Minimum conditions for roof panel support
These are defined in Figures 24, 25 and 26.

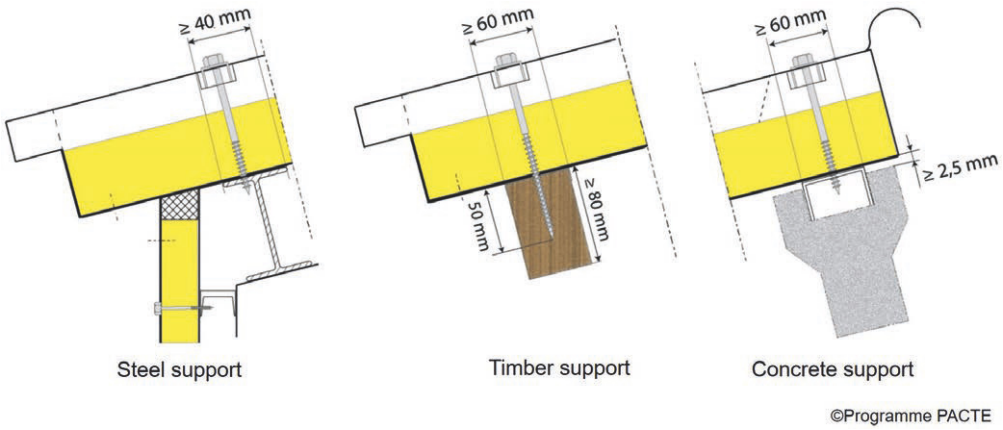


Figure 24: End support conditions

Figure 25: Intermediate support conditions

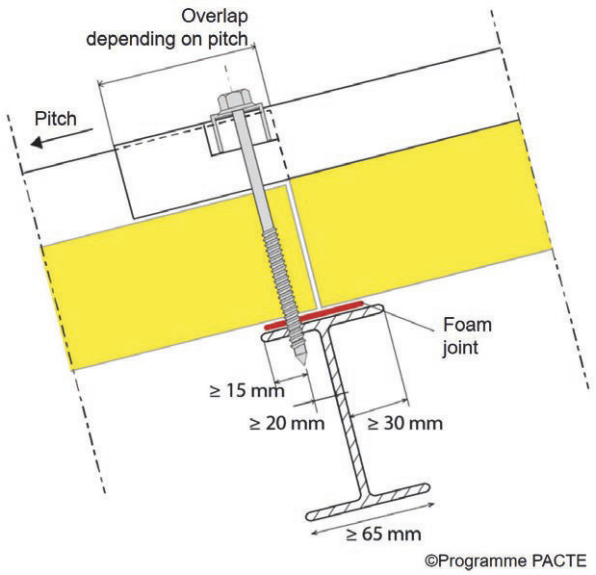


Figure 26: Special conditions flush with the overlapping panel ends (see table 10)

6.6.2.2.2.1 Installation on steel structure

The minimum width of the structural member is 40 mm per sandwich panel. Its minimum thickness is 1.5 mm.

The minimum width of structural members flush with the transverse joint is 65 mm.

The minimum bearing width is 30 mm at the sandwich panel end.

The minimum edge distance between fasteners and bare structure is 15 mm.

The minimum edge distance between fasteners and panel transverse end is 20 mm measured lengthwise (Figure 27).

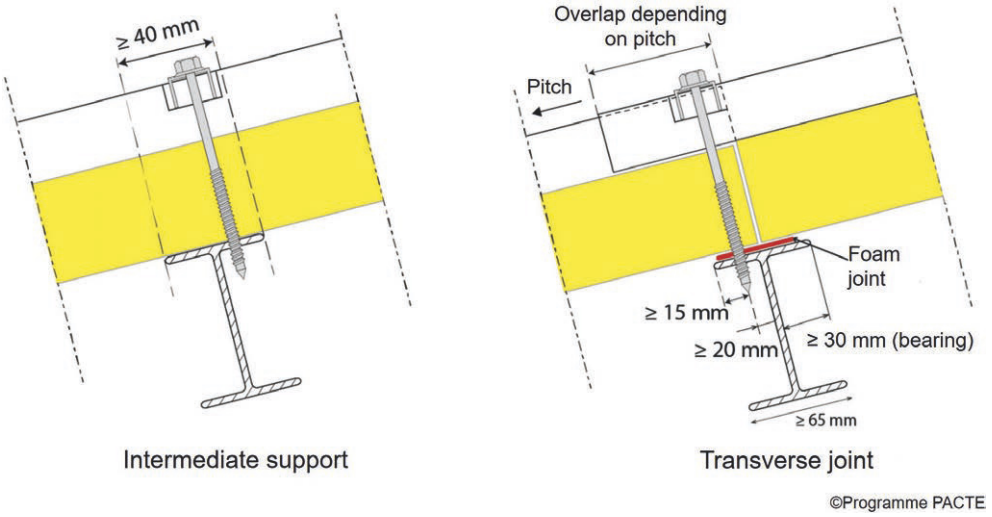


Figure 27: Conditions for steel supports

6.6.2.2.2.2 Installation on timber structure

The minimum width of the timber structure member is 60 mm per sandwich panel at end and intermediate supports and 90 mm at end overlaps between sandwich panels.

Embedment of self-drilling screw is min. 50 mm.

The minimum edge distance between fasteners and bare structure is 4d, where d is the fastener diameter (Figure 28).

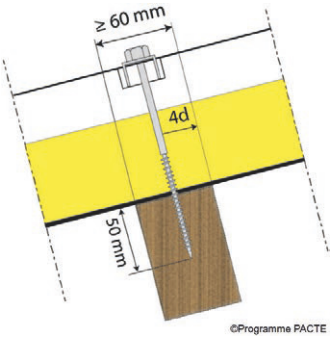


Figure 28: Conditions for timber supports

6.6.2.2.2.3 Installation on concrete structure with embedded steel attachment rail

The concrete structure always comprises a metal insert, integrated and anchored during casting, with a minimum width of 60 mm per sandwich panel (Figure 29).

The insert shall protrude from the concrete by at least 2 mm.

Inserts consist of a profile with a minimum thickness of 2.5 mm and minimum clear depth of 20 mm beneath the profile to allow space for the fastener.

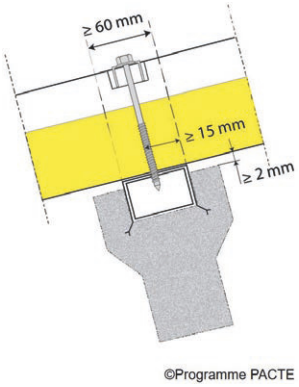


Figure 29: Conditions for concrete supports

6.6.3 Installation tolerances for sandwich panels – precautions

Before installing the sandwich panels, it is essential to check that the alignment of the edges and the overall evenness comply with the provisions of section 6.6.1, since a deviation in the alignment of the structure cannot be compensated for by the sandwich panels themselves. Deviations shall not exceed the values defined in Tables 5 and 6 for the tolerances of the support and must conform to the technical data of the panel manufacturer. In the case of any visual requirements, the deviations shall be measured with reference to the inspection document for the supporting structure.

In order to obtain a satisfactory installation, the first panels shall be positioned with an appropriate tool (e.g. laser).

Depending on the panel type, starting parts or suitable temporary assembly will allow this objective to be met. The starting parts are determined by the manufacturer of the panels.

Visual checks of the horizontality and alignment of the panels, starting from the building end, shall be carried out on a regular basis according to progress.

In general, the surface of a wall can only be as even and flat as the supporting structure.

Supporting structures should be checked for squareness, flatness, alignment, required support widths, etc.

Cladding rails that are not aligned using additional connectors should be permanently aligned prior to installation by way of suitable measures. This applies, in particular, to connections to continuous rooflights and window transoms.

6.7 Deliveries and storage

The packages shall be transported and stored in such a way that products are protected against moisture.

6.7.1 Method

Unloading and handling shall be carried out without causing:

- permanent deformations to the panels,
- damage that could affect the material corrosion resistance and the aesthetics of the panels.

6.7.2 Unloading

Forklift trucks may be used for unloading packages up to a length of 6 m.

Beyond 6 m, the use of a crane is recommended. In this case the lifting must always be carried out with a spreader bar with two or four beams and flat slings having a minimum width of 150 mm.

6.7.3 Handling

6.7.3.1 Handling of the packages

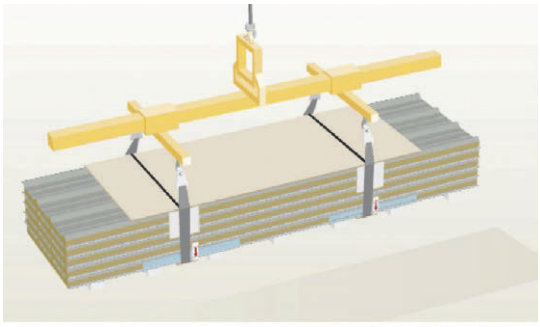
When handling packages with a forklift truck, it is necessary to:

- protect the edges and underside of each package,
- prevent the end of a package rubbing on the one underneath while lifting the packages.

When handling the packages with a spreader bar, it is recommended to use flat slings with a minimum width of 150 mm (Figure 30).

A rigid piece of wood shall be placed flush with the slings to prevent any damage to the product.

In no case may the cantilever overhang exceed the centre-to-centre distance of the sling points.



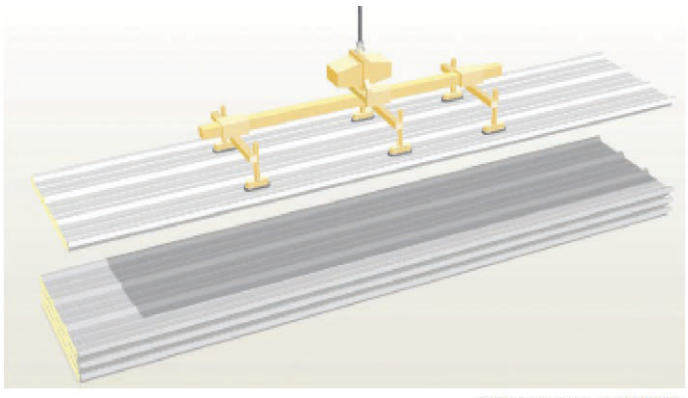
©Programme PACTE

Figure 30: Handling using spreader bar with two beams and flat slings

6.7.3.2 Handling the panels

It is necessary to take the following precautions when handling panels in order to prevent damaging them (handling on construction site):

- They shall not be subject to knocks or scratches, nor shall they undergo deformations that would make them unsuitable for the proper execution of the works.
- For all panels with a mass > 70 kg, the use of a spreader bar with vacuum cups is recommended (Figure 31).
- The spreader bar must be centred with respect to the centre of gravity of the panel.
- If the panel is covered by a protective film, the latter must be removed before using a spreader bar with vacuum cups.
- When handling panels, these shall not be picked up by the ends but instead on the sides, with the male side downwards, where applicable.
- Furthermore, for panels relatively long with respect to their thickness (L > 100 x thickness), they must be flipped upright on their long sides to prevent failure.



©Programme PACTE

Figure 31: Handling using spreader bar with vacuum cups

6.7.4 Storage on the construction site

This section provides basic recommendations for storage on construction sites. The requirements of the panel manufacturers must be followed. Storage places, dispatching stores and lifting facilities shall be given in the documentation and on the layout drawings.

The packages shall be stored in a ventilated shelter (covers, etc.). Furthermore, the selection of this place shall consider the fact that some of the materials used are incompatible with humidity, harmful vapours or other materials that could be present.

Packages may not be stacked more than two high.

The documentation stipulates the requirements applying to those storage methods (tarp or equivalent). Otherwise, those provisions shall be agreed on by mutual agreement between the project manager and the installer.

Modifications to and changing the storage places on the construction site shall be avoided, because of the risk of damage and degradation.

Packages shall be tilted relative to the horizontal in order to allow rainwater and condensation to run off (Figure 32).

Furthermore, they must be stored clear of the ground by placing a wedge beneath each vertical upright of the package, thus ensuring space for good ventilation and preventing the permanent deformation of the panels. This will protect the coating against superficial damage.

Suitable devices, either horizontal or vertical, shall be provided to prevent any permanent deformation over a short period and to prevent condensation inside the packages.

For sea packaging, supplementary precautions shall be met: ventilate the packages, protect the products against weathering and UV radiation.

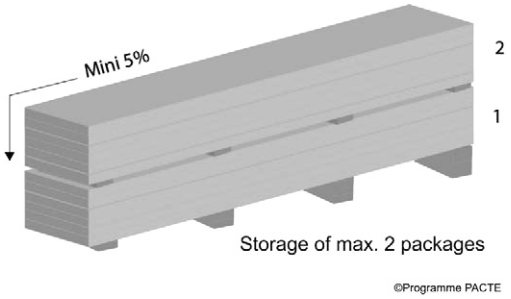


Figure 32: Storage of panels on construction sites

6.8 Erection of sandwich panels

Sandwich panels can only be installed if the following criteria are fulfilled:

The works on the relevant part of the building structure must be completed in order to avoid any risk of deterioration or disturbed alignment of the panels installed and to allow the contractor to work continuously. In the case of structures that are not completely erected before starting the panel installation, special precautions must be taken regarding the final alignment of the building envelope.

The installer shall ensure that the spans stated on the layout drawing with the latest revision index are complied with on the construction site (see 6.6.1.2). Installation without final inspection of the structure beforehand shall afterwards be deemed as accepted without complaints due to tolerance problems.

The building surroundings and the vertical line of the loadbearing structure must be accessible and present no disturbing level differences (cuttings, embankments, etc.) for the erection of scaffolding or hoists.

Deviations in the structural work shall be identified and clarified before starting the installation of the sandwich panels.

Sandwich panels should not be installed below an ambient temperature of 4 °C. Installation below this temperature is possible, but only when special measures are taken (e.g. by using heating devices to ensure a temperature higher than ambient).

6.8.1 Erection orientation of sandwich panels

Roof sandwich panels must always be installed in the direction of the pitch of the roof. Exceptions are possible, but they must be clearly defined in the accompanying documentation.

There are different erection orientations for wall sandwich panels:

- horizontally,
- vertically,
- diagonally.

Not all panel types can be installed in all orientations. The panel technical data sheet stipulates the suggested erection orientation.

The horizontal orientation requires:

- a panel design that prevents rain being retained in the panel when sealing is missing on the exterior side.

Furthermore, the installation shall prevent any water ingress at the transverse junctions of the panels (sealing flush with joint filler where they intersect) (Figure 33).

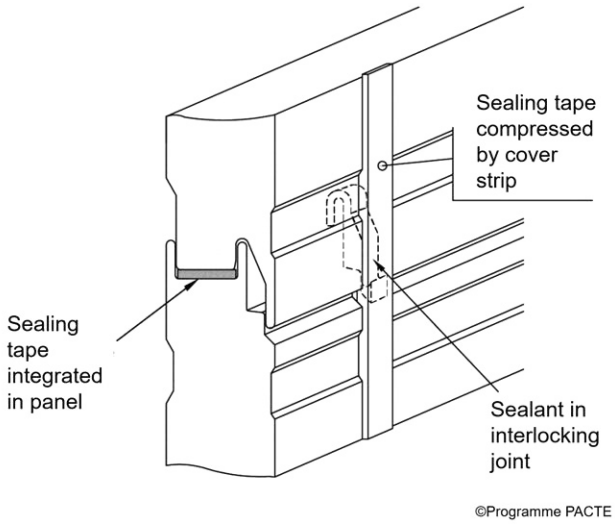


Figure 33: Panels with hidden fixings, horizontal erection: crossing joints

- provision of details for draining rainwater.

Figure 34 shows an example of a detail for draining rainwater.

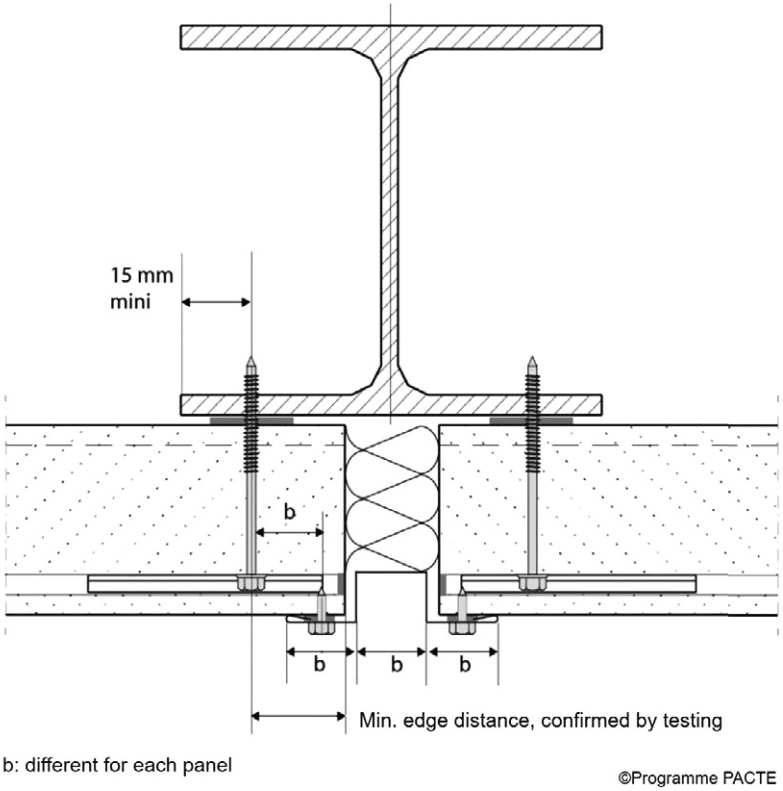


Figure 34: Example of detail for draining rainwater

Examples for the positioning of sealants and gaskets are given in Figures 35 to 39.

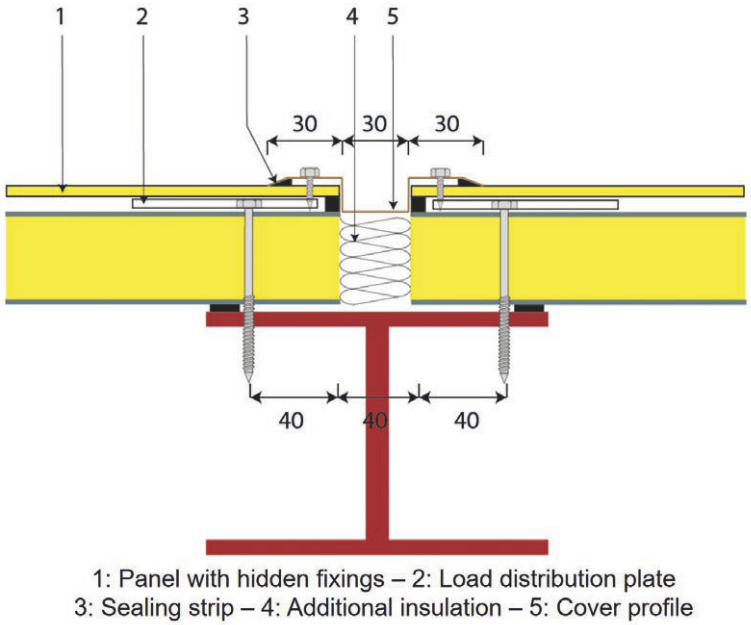
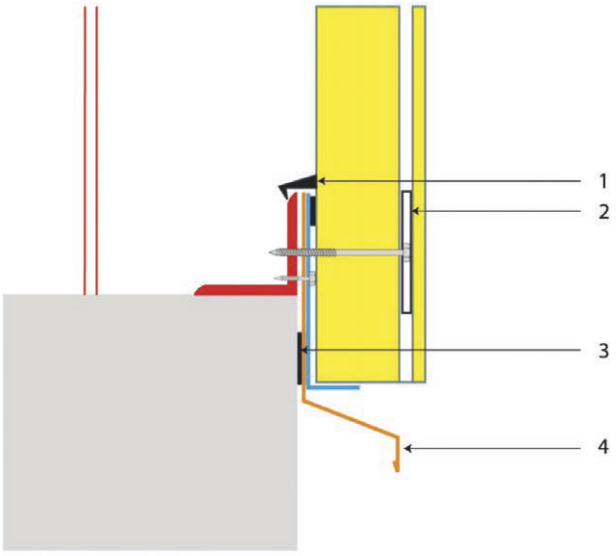


Figure 35: Position of joint at transverse junction between panels

Deviating from Figure 35, in Germany the sealing strip (No. 3 in Figure 35) has to be fitted between the upper flanges of the cover profile (No. 5 in Figure 35) and the external face of the sandwich panels.

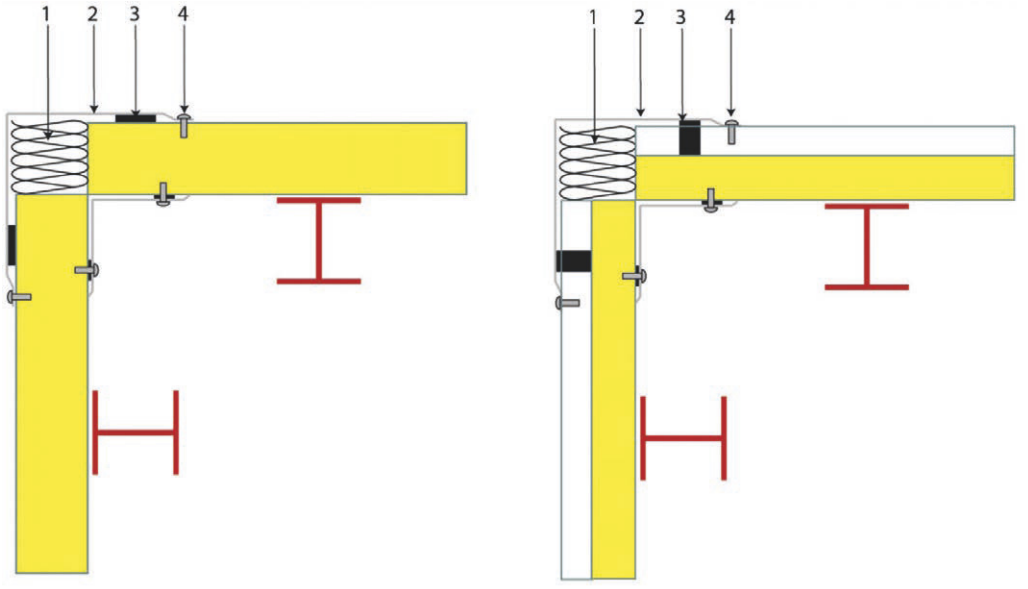


1: Silicone dab (for high humidity) – 2: Load distribution plate
3: Sealing strip – 4: Apron

Figure 36: Position of joint at base of cladding

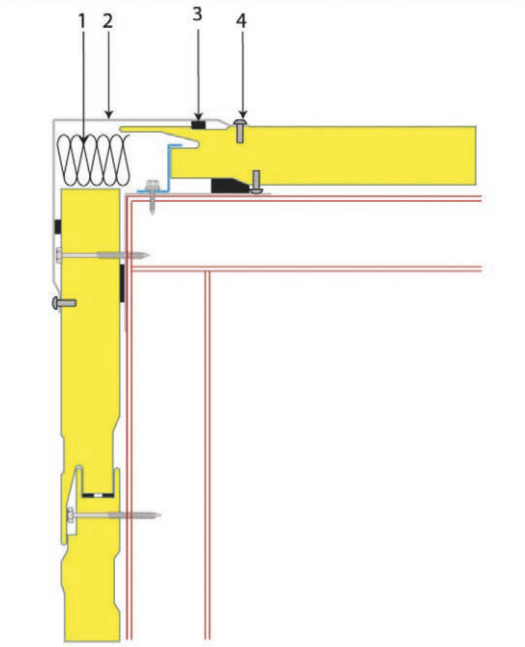
Deviating from Figure 36, in Germany the sealing strip (No. 3 in Figure 36) between base of cladding and apron (No. 4 in Figure 36) must be placed higher, directly below the angle (shown in red in Figure 36).

Figures 37 and 38 show construction details in France:



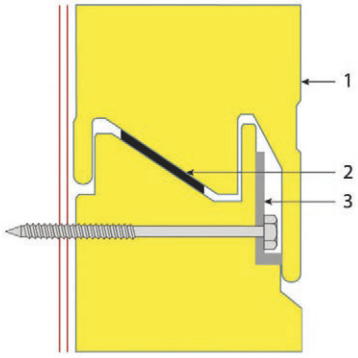
1: Additional insulation – 2: External corner flashing – 3: Sealing strip
4: Rivet or screw (sealing material must be inserted beneath the internal rivets or screws)

Figure 37: Horizontal erection – corner detail (internal and external sealing)



1: Additional insulation – 2: External corner flashing
3: Sealing strip – 4: Rivet or screw

Figure 38: Vertical erection – corner detail



1: Panel with hidden fixing – 2: Sealing strip – 3: Load distribution plate, if required by manufacturer

Figure 39: Interlocking joint position for panels with hidden fixings

6.8.2 Installation procedure

6.8.2.1 Panels for wall cladding

The typical sequence of installation phases is as follows (see Annex C for further details):

- Installation of the aprons (optional for horizontal orientation) and starting parts or temporary assembly at the base of the façade and the inner corner flashings.
- Positioning of the foam joints on the upper and lower supports, at corners, along the transverse junctions and around openings.
- Installation and fastening of the first panel after its upward straightness, alignment or level have been verified in accordance with the erection orientation.
- Positioning the sealants in the horizontal erection orientation, flush with the transverse junctions and the openings.
- Installation and fastening of the following panels in the same way.

- Placing of the additional insulation.
- Positioning of the waterproofing sealants flush with the transverse junctions, for horizontal erection flush with the jamb.
- Closing off the corners.
- Closing off the panel ends for horizontal erection orientation, closing off the jambs.

***Note**: Drilling and cutting: As installation work progresses, dispose of the metal filings carefully by cleaning with a nylon brush and clear water (without detergent).*

6.8.2.1.1 Distinctive feature of horizontal erection

Erection begins at the base of the façade and proceeds upwards. The panels are installed on starting parts that are positioned beforehand and defined in the technical data issued by the manufacturers or designers.

6.8.2.1.2 Distinctive feature of vertical erection

The vertical erection of panels is carried out starting from a corner of the building or from expansion joints, and is based on starting parts. Where several panels are used over the height of a building, their junctions are executed with a starting part and an apron.

6.8.2.2 Panels for roof covering

The sandwich panels are installed as work progresses.

The free rib of the panel to be installed overlaps the full rib of the last panel installed.

***Note**: On the basis of national requirements, the direction of installation of sandwich panels should be chosen to be opposite to that of the prevailing wind direction (Figure 40). This condition implies using sandwich panels of the "Left" or "Right" type (Figure 1d).*

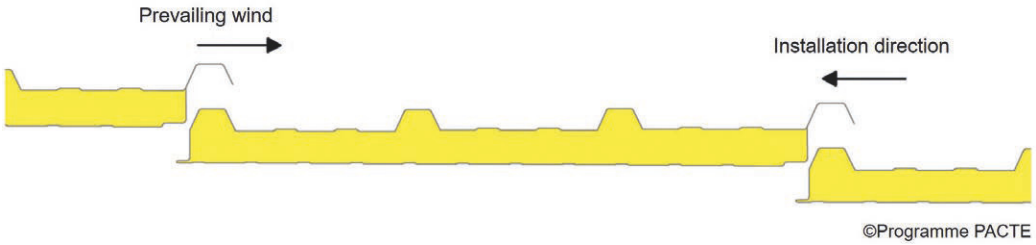


Figure 40: Installation direction

The typical sequence of installation phases is as follows:

- Installation of the parapet gutters / valley gutter / aprons in valley gutters (see C.8 and C.16).
- Installation of the ridge lining plate (see C.17).
- Application of sealants on purlins (see C.8 and C.16).
- Installation and fastening of the first panel at the bottom edge of the roof, starting from an edge after

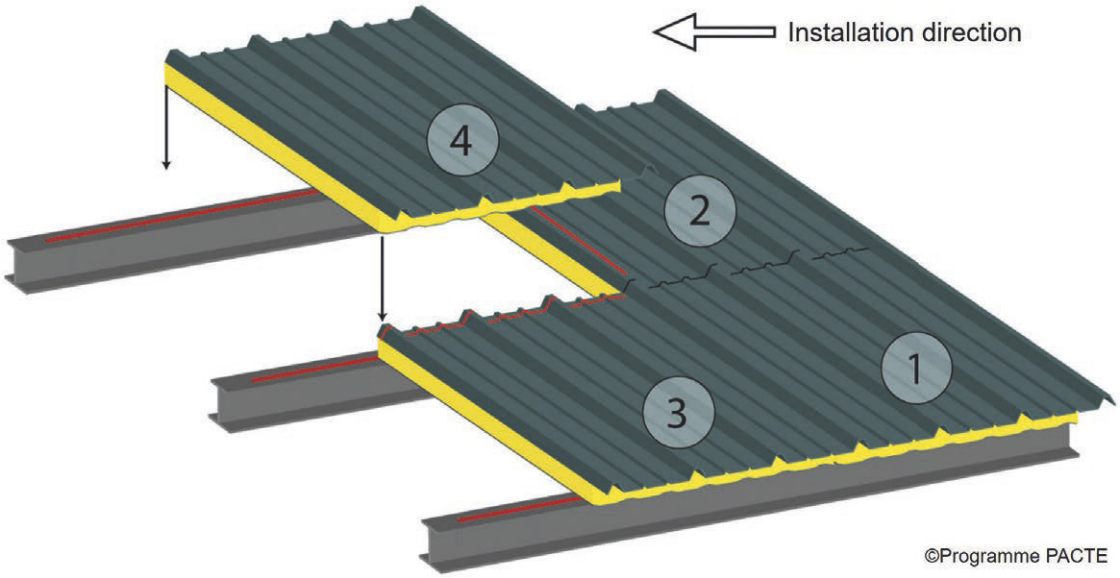


Figure 41: Installation order of roof covering sandwich panels

checking its alignment (see Figure 41).

- If needed (in the case of a low roof pitch), application of sealants lengthwise and transverse, in line with the panel junctions (on the outer face) and the openings (see Figure 42). Two sealing strips must be used lengthwise and transverse for roof pitches ≤ 7° and only one for roofs with pitches > 7°.

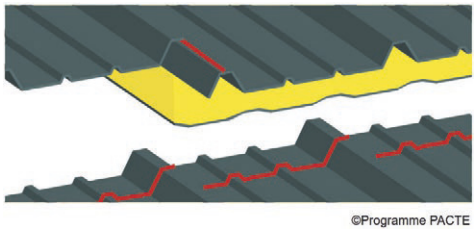


Figure 42: Sealants in line with panel junctions

***Note**: The panel ends of two overlapping roof panels must be supported and fixed.*

- Installation and fastening of the panels: complete fixing at the panel ends and complete or limited fixing on intermediate supports (see Figure 43).

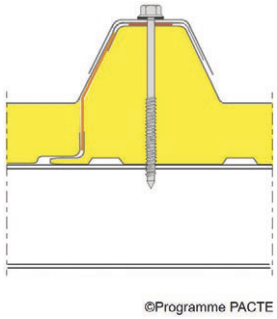


Figure 43: Panel fastening system

- Installation of the additional insulation (see C.8, C.16 and C.17).
- Closing off the roof ridge (installation of roof ridge flashing, see C.13 and C.17) and closing off the edges (see C.14 and C.15).

- Closing off the panel ends with profile closer flashings. Profile closer flashings can also be installed at the same time as down-slope panels.

***Note**: Drilling and cutting: As installation work progresses, dispose of the metal filings carefully by cleaning with a nylon brush and clear water (without detergent).*

6.8.3 Selection of the sealants

Examples of sealants are given in section 5.2 and in Figures 44 to 50. Different national requirements exist for sealants, as follows:

6.8.3.1 Requirements for sealants in France

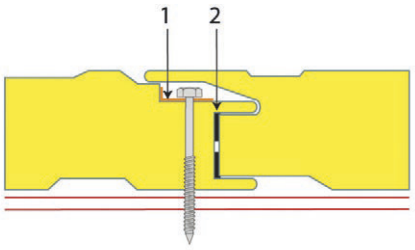
6.8.3.1.1 PU core panels for wall cladding

- An inner side sealant (extruded gasket, impregnated foam) compressed by the faces when installed horizontally.
- A sealant over the whole longitudinal joint or an inner side sealant (extruded gasket, impregnated foam) and an outer side sealant compressed by the faces when installed vertically.

6.8.3.1.1.1 Minimum layout

There are two possible types of sealing arrangement:

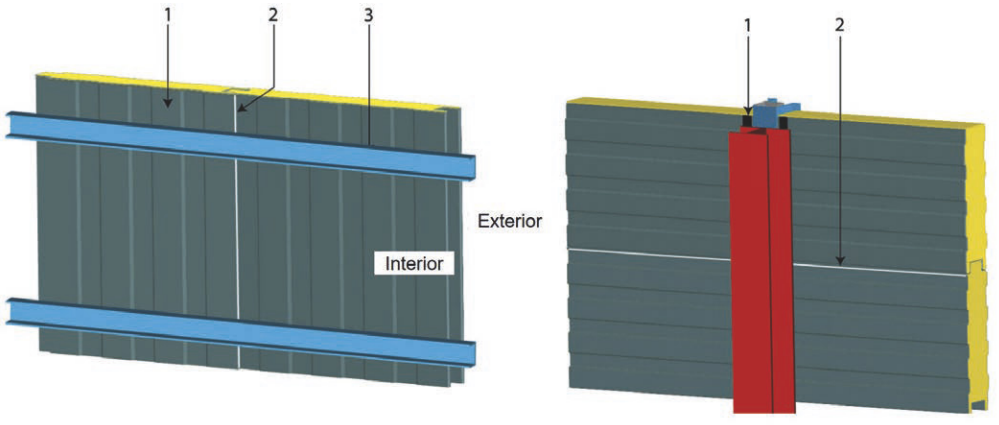
- A waterproofing sealant on the outer side, except for hidden fixing systems if the layout of the assembly creates an airtight, compression-resistant chamber (see Figure 44).



1: Load distribution plate – 2: Sealant

Figure 44: Airtight, compression-resistant chamber

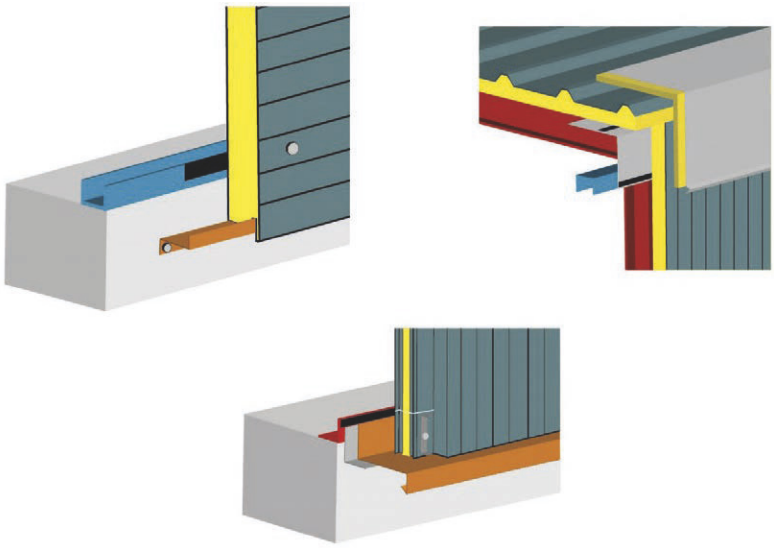
- A sealant for water vapour- and airtightness on the inner side.



1: Panel
2: Silicone gasket at longitudinal joints between panels
3. Cladding rail

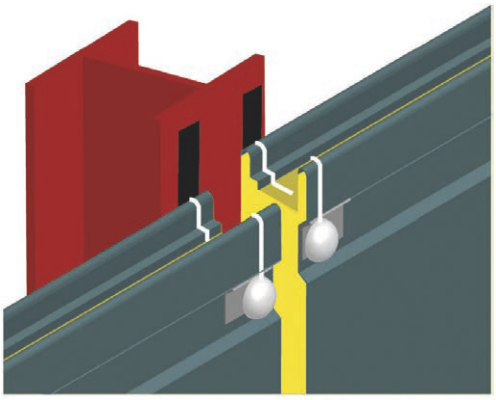
1: Silicone joint on support
2: Silicone gasket at longitudinal joints between panels

Figure 45: Positions of inside sealants in France



©Programme PACTE

Figure 46: Positions of sealants in France



©Programme PACTE

Figure 47: Detail of end-to-end joint between wall panels in France (application – before jointing – of a bead and dab of silicone, bonded with the sealing strip on the support)

6.8.3.1.2 PU core panels for roof covering
Sealants may be necessary:

- at the side overlaps (roof pitches between 5 and 7 %),
- to deal with particular details, e.g. roof penetrations.

Pitch p [%]	Pitch p [°]	End overlap		
		Zones I and II, all situations	**Zone III, all situations**	**Altitude > 900 m**
7 ≤ p < 10	6.3 ≤ p < 9	300 mm minimum or 150 to 200 mm + S	150 to 200 mm + S	Case not specified
10 ≤ p < 15	9 ≤ p < 13.5	200 mm minimum or 150 to 200 mm + S	300 mm minimum or 150 to 200 mm + S	200 mm + S
p ≥ 15	p ≥ 13.5	150 mm minimum	200 mm minimum or 150 to 200 mm + S	200 mm + S
S = sealant The zones and situations considered are those defined in [20], Annex E.				

Table 10: Requirements for roof panel end overlaps

The purpose of the additional joints is to reduce the vapour transfer and the condensation risk at the junctions between sandwich panels and at particular points of the roof covering.

Where foam joints are used, particular attention must be paid to their installation, so that they are properly compressed (min. 80 %).

6.8.3.2 Requirements for sealants in Germany

The German legislation covering energy-saving measures (*Energieeinsparverordnung*) calls for the joints to be permanently airtight.

Ref. [2] contains minimum requirements for thermal insulation and stipulates that the air permeability (a-value) of joints between building elements, deduced from measurements, must be < 0.1 $m^3/(m\ h\ (daPa))$.

In order to fulfil this air permeability requirement, the installer may use different types of material for sealing the joints between panels.

Sealing of side and end laps and connections in roof and wall systems must be carried out using the sealing strips and/or sealing compounds prescribed on the layout drawings (see [28]).

The layout drawings must show the arrangement of the sealing strips.

Sealing strips are applied to the loadbearing structure in accordance with the layout drawings.

6.8.3.2.1 Wall panels

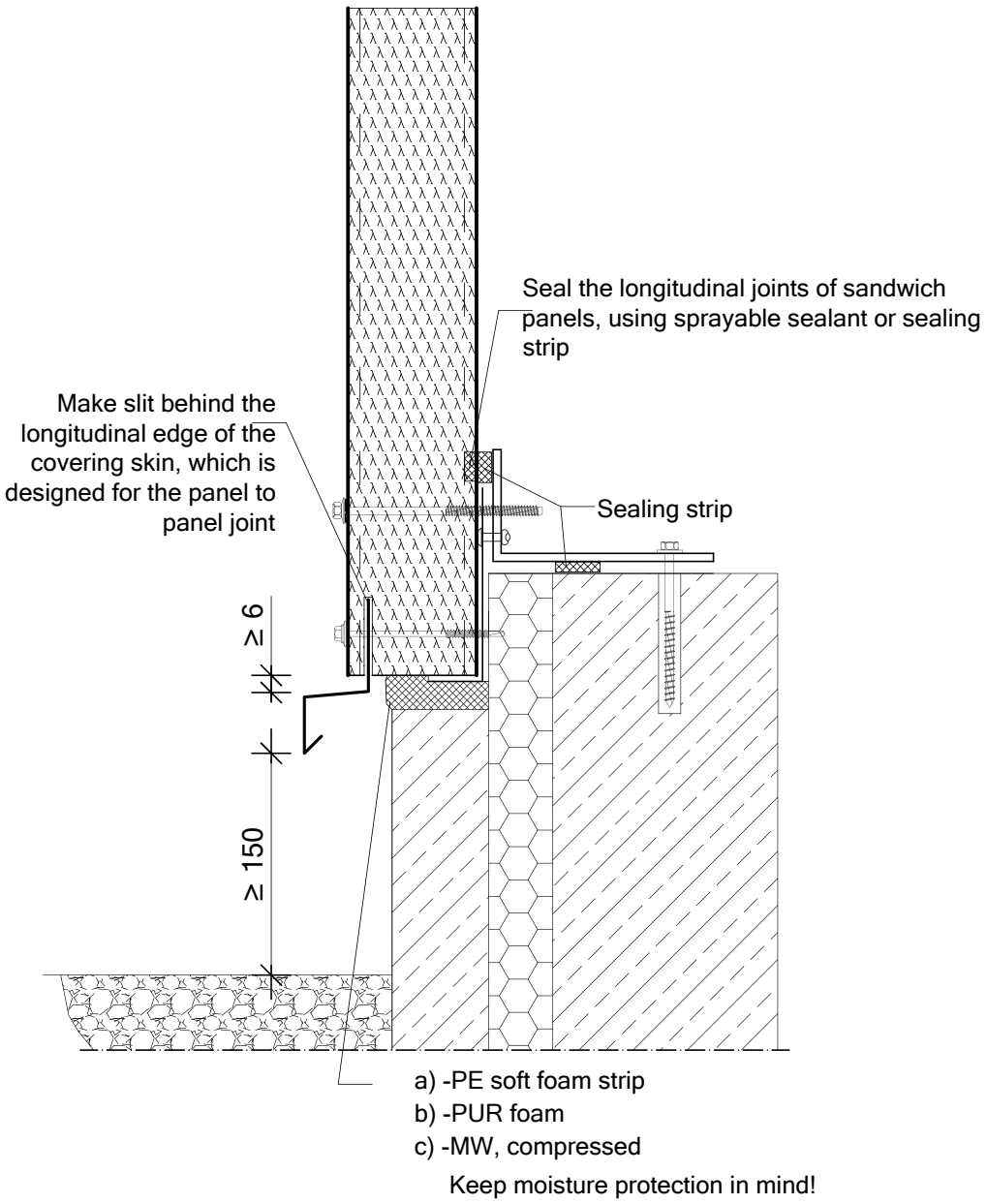


Figure 48: Positions of sealants at the cladding base in Germany

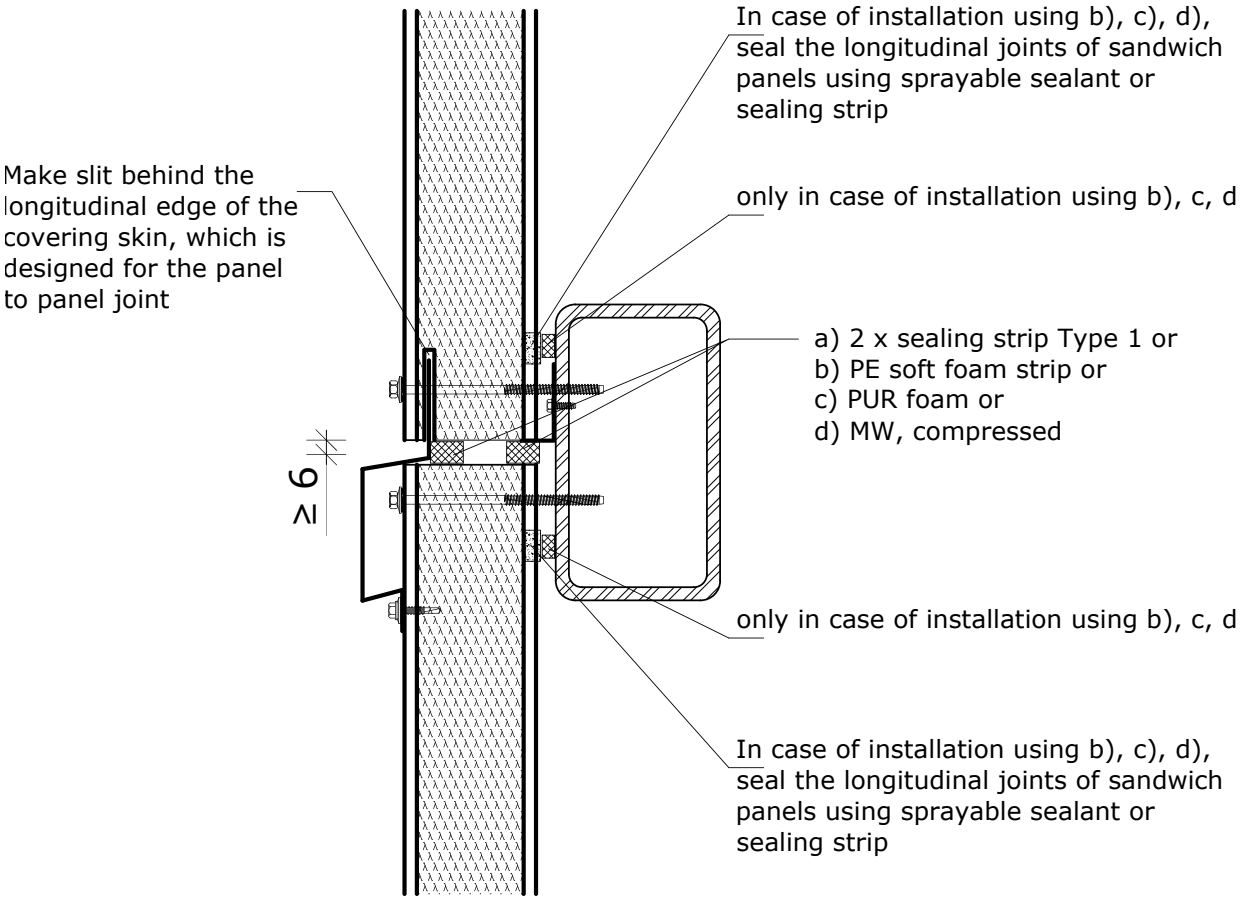


Figure 49: Detail of end-to-end wall panel joints in Germany

6.8.3.2.2 Roof panels

Roof pitch [°]	**Overlap length [mm]**
3 (minimum roof pitch) to 5	without transverse junction and without penetration
5 to 7	200 with additional measures
7 (standard roof pitch)	200
≥ 7	200
≥ 12	150
≥ 20	100

Table 11: Roof pitches and recommended overlap lengths

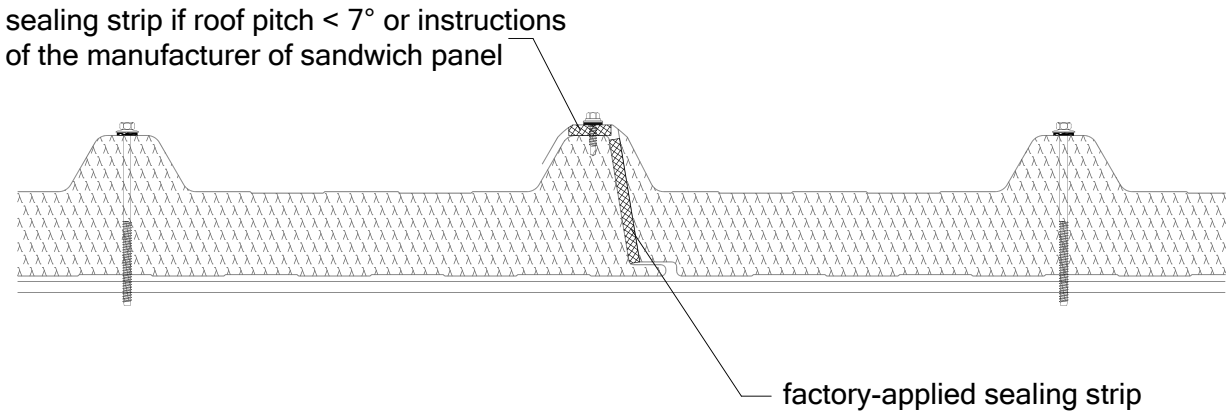


Figure 50: Sealing solution for roof panel side laps in Germany

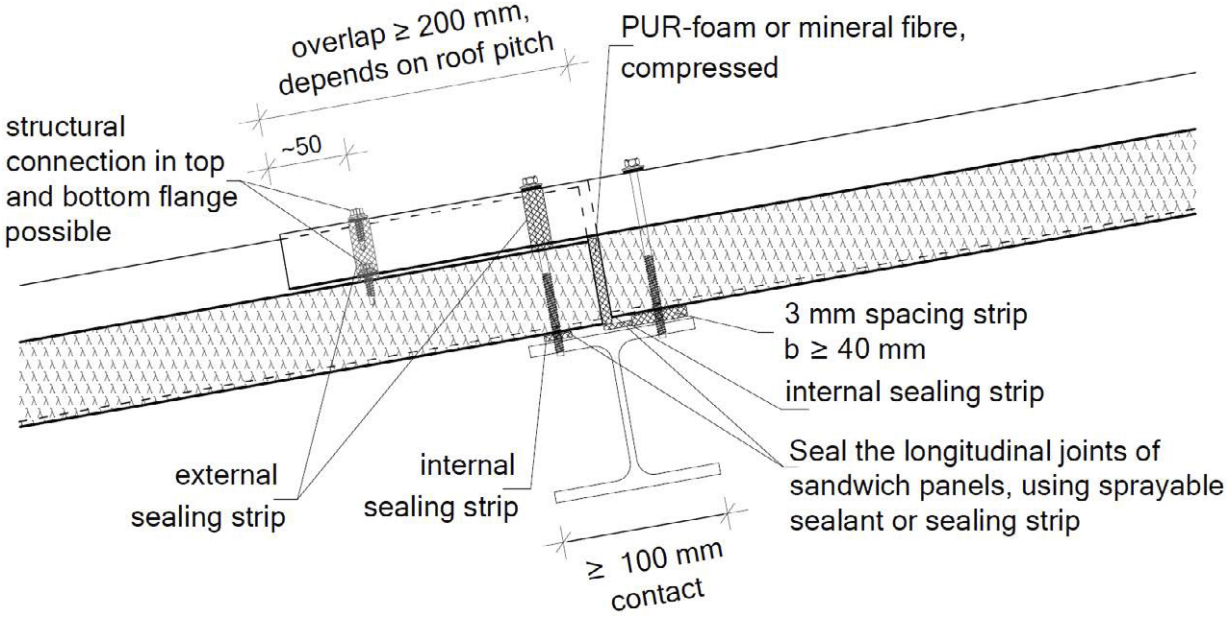


Figure 51: Sealing solution for roof panel end laps in Germany

6.8.4 Selection of the fasteners

The fasteners, load distribution plates and sealing washers shall comply with section 5.3.

6.8.4.1 Selection of panel fastening systems

Types of fastener shall be appropriate to the assembly work to be carried out.

Double-thread screws are recommended for MW core panels and for mountain climates.

The fastening systems are selected according to:

- the material and the geometry of the support,
- the atmosphere outside and the environment inside the building, and
- the total length to be assembled. The following factors must be taken into account:
  - In the case of steel or attachment rail embedded in concrete: nominal panel thickness + rib height (if applicable) + thickness of saddle washer (if applicable) + support thickness + diameter of self-tapping screw (bi-metal screws: stainless steel part must penetrate base material).

– Furthermore, the screw length shall be limited to prevent contact with the concrete surface underneath the embedded steel attachment rail.
– In the case of timber: nominal panel thickness + rib height (if necessary) + thickness of saddle washer (if necessary) + embedment depth.

6.8.4.2 Selection of fasteners for flashings
The minimum diameter must be 4.8 mm. Smaller diameters can be used if no national provisions exist.

The maximum spacing between two lap seam fasteners at corners or on edges of buildings is 500 mm.

The maximum spacing between two flashing fasteners is 1 m. Depending on the seismic zone, this spacing may be reduced to 500 mm in accordance with the seismic testing validation report.

The spacing of flashing fasteners can be reduced in order to reduce the permeability and for aesthetic reasons.

6.8.4.3 Selection and spacing of lap seam fasteners on roof panels
The recommended maximum spacing between two lap seam fasteners on roof panels is 300 mm.

6.8.4.3.1 Requirements for lap seam fasteners on roof panels in France
The minimum diameter is 4.8 mm. The maximum spacing between two lap seam fasteners is indicated in Table 12 below.

The sandwich panels are joined lengthwise where they overlap using self-drilling screws on the crest or side of the corrugation (see Figure 52).

Span [m]	Pitch ≥ 9°	Exposed situation according to [20] or pitch < 9°
L ≤ 2	L	L/2
2 < L ≤ 3.5	L/2	1 m
L > 3.5	1 m	1 m

Table 12: Spacing of lap seam fasteners

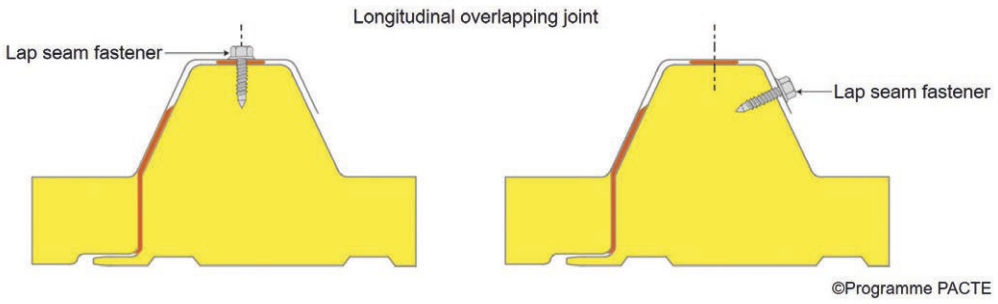


Figure 52: Positions of lap seam fasteners

The fixing of sandwich panels on purlins, on the crest of an overlap rib, is also deemed to be a lap seam fastening.

6.8.4.3.2 Requirements for lap seam fasteners on roof panels in Germany
A spacing of approximately 500 mm between the connections has proved to be appropriate for ensuring adequate contact pressure on the sealing strips in the longitudinal overlaps.

6.8.4.4 Anchoring of the fasteners

When using bi-metal stainless steel fasteners on steel supports, the carbon steel tip should completely penetrate the supporting construction. Therefore, always consult the manufacturer's data on the "effective clamping range" for these kinds of fastener.

On timber supporting structures, embedment must be at least 50 mm. The length of the embedment can be < 50 mm where calculations based on the Eurocode 5 are carried out.

On concrete supports with inserts, the compatibility of the fastener length with the space underneath the insert must be checked.

6.8.5 Cutting tools

The cutting tools used are:

- a fine-toothed saw (circular saw) or special panel saw,
- a nibbler-type metal cutter for flashings.

6.9 Specific points

6.9.1 General considerations

Specific points are:

- base of cladding
- corners
- edges
- wall cladding/roof covering junctions
- door and window frames
- abutments
- expansion joints
- longitudinal junctions for horizontal erection
- transverse junctions for vertical erection
- drains
- penetrations
- eaves drips
- eaves without drip
- parapet walls
- elements that extend beyond the roof plane (upstands, mounting plates)
- monopitch and duopitch ridges, wall abutments

Examples can be found in Annex C.

6.9.2 Requirements for flashings

Flashings and cladding shall overlap by at least 50 mm. Sealants have to be applied where required.

Parapet copings, aprons, etc. shall exhibit a pitch of at least 5°. If no sealant is applied, the overlap shall be min. 100 mm (see Annex C).

Roof ridge overlaps must be min. 100 mm long (see Annex C).

At verges, flashings must overlap at least one rib of the sandwich panel (see Annex C).

6.9.3 Execution of specific points

Execution of the specific points is defined in Annex C.

6.9.4 Cutting of panels on site

The cutting tools are defined in section 6.8.5.

Filings and/or swarf may result from cutting processes. They must be removed immediately from the coating to avoid incrustation.

6.9.5 Protective film for panels

This temporary protection shall be factory-applied by the manufacturer. It may have two aims:

- to preserve the good appearance of the surfaces,
- to distinguish between the inner and outer faces of a symmetrical panel with coatings of the same colour.

Protective films must be removed at the latest three months after applying them in the factory and one week after installation of the sandwich panels, because of the ageing properties of film exposed to ultraviolet radiation, which otherwise makes removal difficult.

The protective film that covers sandwich panels with pre-painted faces or made of stainless steel must be removed at the latest one month after dispatch from the manufacturing plant and delivery to the building site.

These films do not protect against impacts or scratches.

The protective film should be removed locally at joints between panels before installation.

6.10 Final inspection of the works

The condition of the finished façades and roofs shall be inspected for any indication that components have been distorted and to ensure that any temporary attachments have either been removed satisfactorily or are in accordance with the specified requirements (see chapter 8).

6.11 Environmental best practice

Construction companies have responsibilities with respect to any waste they generate on site. Companies must ensure that:

- their waste is stored, handled, recycled or disposed of safely and legally,
- their waste is stored, handled, recycled or disposed of only by companies that hold correct, current licences to do such work,
- they record all transfers of waste between their company and other companies using a waste transfer note (WTN) signed by both parties,
- they keep all WTNs for at least two years,
- they record any transfer of hazardous/special waste between their company and other companies using a consignment note signed by both parties, and
- they keep all consignment notes for at least three years.

These responsibilities have no time limit. Responsibility extends until the waste has either been finally disposed of or fully recovered.

If companies produce or deal with waste that has certain hazardous properties, they will also have to comply with the hazardous/special waste regulations.

The selection and procurement of construction materials makes a major contribution to the life cycle impacts of a building across the environmental, social and economic aspects of sustainability. The environmental impact of a product, which is measured by means of a life cycle assessment (LCA), is shown by the Environmental Product Declaration (EPD) in accordance with [18]. This is a set of numbers measuring an indicator such as impact on global warming or toxicity and can form an input for design tools to decide the best material and product option to deliver a required sustainability performance.

6.12 Requirements for installation on existing structures

Before sandwich panels are installed on existing structures, a survey must be conducted to establish the stability of the structure and the members that will carry the wall and roof panels.

The stability of the works shall be checked. Prior surveys of stability are incumbent upon the client. They are not incumbent upon the installer.

Those surveys shall verify – before the company installs the sandwich panels – whether the structure of the building and the members carrying the sandwich panels have the required stability considering their current state, the purpose of the building and the permanent, imposed and accidental loads.

Repair works may lead to changes to the permanent loads of the cladding and roof covering (increase or decrease).

Prior surveys must also include checking the evenness. Such surveys may require that works are necessary to improve the ground stability or change the structure or loadbearing members (e.g. additional thermal insulation systems, etc.).

The humidity of the location may have or have had some consequences for the construction works as a whole: stability, corrosion, condensation, thermal performance, etc.; prior surveys must consider such consequences.

It shall be verified that the supports fulfil the requirements of these Rules for Good Practice.

If the material or grade of the existing construction is unknown, a pull-out test must be carried out for the fasteners chosen.

Installing on given points is different from installing on new construction. Surveys of thermal bridges must be conducted on a case-by-case basis.

7 MAINTENANCE AND REPAIRS

7.1 Maintenance of the external side of the envelope

It is generally accepted that to preserve fully their fitness for purpose, metal façades and roofs must be maintained to a normal extent (see Annex A).

Maintaining the outside of metal façades and roofs is incumbent upon the building owner and must be carried out at least once a year. Rinsing must be carried out with clear water.

Annex A lists the work to be done.

The building owner must inspect the surfaces of the panels on a regular basis for any local damage or crushing caused by local impacts and for deterioration of the organic coating which impairs the integrity and durability of the sandwich panel.

The following work, if deemed necessary, forms part of maintenance:

- local repairs, in particular due to the onset of corrosion,
- application of paints, lacquers or various resins after washing or suitable preparation of the metal panels.

The panel manufacturer must be consulted in every case to ensure that the coating (metallic or organic) to be used in the repairs is compatible with the coating in situ.

In the case of local damage/crushing, these areas shall be repaired as soon as possible to prevent corrosion on the faces.

The replacement of an old element by a new one can lead to a discrepancy in colour.

Upon agreement with the manufacturer, damage to the organic coating caused during installation can be corrected with a paint applied by spray or brush. A fine brush can be used to apply paint to lightly scratched zones.

For deeper scratches, the metallic coating shall be renewed and a finishing sealant applied before applying the lacquer in agreement with the manufacturer, or the panel shall be replaced.

The paints must be suitable for external use.

Table 13 indicates the recommended processing depending on the type of incident.

7.1.1 Replacement of a damaged panel

The replacement of a panel is carried out by undoing its fastening screws and the screws of the two panels flanking it. By swivelling two panels, it is possible to remove and re-install the panel between them.

With through-fixings and horizontal erection, replacing a panel requires disassembly of the adjacent panel at the same time.

In the case of vertical erection, please refer to the manufacturer's technical data.

In the case of panels with hidden fixings, all the panels from the free edge up to the damaged panel must be disassembled.

Type of incident	Recommended processing
Impact	• Where there is no perforation of the face or destruction of the core on pre-painted sheets: – rub the area affected with pumice – degrease the area – apply an epoxy primer – fill with a common coach filler – apply a finish layer suitable for the nature of the coating (e.g. polyester lacquer on polyester coating) • Where there is perforation of the face and/or destruction of the core: – replace the panel
Scratch	As above apart from filling
Corrosion	As soon as it is identified, treat any corrosion caused by foreign bodies (fillings, etc.). The protection procedure is the same as for the repair procedure for impacts.

Table 13: Types of incident – recommended processing

7.2 Maintenance of the internal side of the envelope

Normally, the user is responsible for maintaining the inside at the location subjected to their usage.

The user shall ensure that the washing products are compatible with the coatings on the faces.

7.3 Paint repairs

7.3.1 On façade and roof areas made of zinc-coated steel sheet

Repairs to the damaged protective coating are carried out by washing the surfaces and then applying a zinc-rich paint that guarantees a similar protection.

7.3.2 On façade and roof areas with paint protection

Repairs are carried out as indicated above by using the same paint as that used for the initial protection or, by default, a paint that guarantees similar protection and appearance.

8 INSPECTIONS

The façades and roofs shall exhibit a regular appearance without any visible or unusual heterogeneity.

A proper straightness or curvature of the exterior lines is recommended.

All claddings, but especially flat panels for wall cladding, cause some distortion of reflected images. Metallic and organic coatings may amplify this effect.

Depending on distance, the viewing angle and the lighting level ratio between inside and outside, the appearance of panels may exhibit some changes inherent to the product.

8.1 General observation perspective for assessing the appearance of a façade

The general observation perspective for assessing the quality of appearance of façades made of sandwich panels is defined by the approach of a neutral observer and consists of the choice of observation point (observation distance), the field to be observed (observation angle), the lighting conditions (exposure to light) and the observation period (interval).

The general observation perspective, see Figure 53, applies when no other agreement has been reached and no special targets regarding the appearance have been agreed or defined.

In general, the following applies: Deviations must be identifiable by an impartial, neutral observer with no special knowledge (“untrained eye”) at a common observation distance, without reference to any particular places.

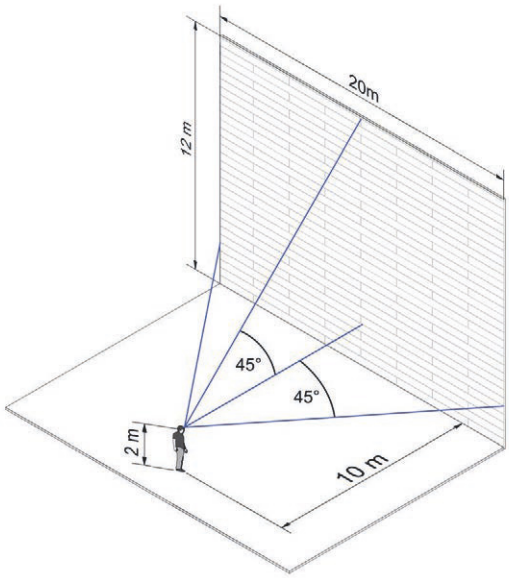


Figure 53: General observation perspective

8.1.1 Choice of observation point

The generally applicable common observation distance is 10 m from the surface (wall) to be observed and measured at a right-angle to that surface. Another observation distance can arise depending on the local conditions.

8.1.2 Field to be observed

A viewing angle of maximum 45° to both sides (approximately 10 m on both sides of the perpendicular) and 45° upwards (approximately 10 m) results in a field of observation measuring 20 x 12 m.

8.1.3 Exposure to light

Deviations shall be evaluated in diffuse light (without direct sun exposure). Grazing light is not appropriate for evaluating deviations.

8.1.4 Observation interval

The observation period shall correspond to the common interval adapted to the scope of application. Deviations must be identifiable at first glance and not after a search.

The existence of a deviation can be confirmed only when it is perceived as disturbing for more than one hour per day by a neutral observer with no special knowledge and without reference to any particular places.

8.2 Special observation perspective for assessing the appearance of a façade

Special observation perspectives must be considered when special agreements have been concluded beforehand and special requirements have been specified, e.g. for entrance areas or approaching a building in an exposed location. The special requirements must be defined in advance and must be determined with regard to the limits of validity, e.g. for what locations they are valid or what observation circumstances can occur and how they shall be considered.

Special requirements can make it necessary to execute the wall cladding in a special way for specific areas defined as such. This allows building areas that are more important from a visual point of view to be executed, for example, with sheets having thicknesses greater than those needed structurally. This must be defined by the building contractor or their architects within the scope of planning the work.

9 ANNEXES

[Annex A]: Conditions of use and maintenance

[Annex B]: Definition of interior environment and exterior atmosphere

[Annex C]: Details for the execution of specific points

10 BIBLIOGRAPHY

- Professional Recommendations “Cladding with double steel faced insulated panels with polyurethane core – design and installation”, part of the programme “Code of Practice Grenelle Environnement (RAGE) 2012”
- Professional Recommendations “Roof covering with double steel faced insulated panels with polyurethane core – design and installation”, part of the programme “Code of Practice Grenelle Environnement (RAGE) 2012”
- IFBS Technical Rules in Metal Light Construction, “Planning and Installation”, 1/2020 edition, IFBS, Krefeld, Germany, www.ifbs.eu
- IFBS Technical Rules in Metal Light Construction, “Basic Principles”, IFBS, Krefeld, Germany, www.ifbs.eu
- IFBS Technical Rules “Air tightness in metal light construction”, IFBS, Krefeld, Germany, www.ifbs.eu
- IFBS “Catalogue for thermal bridges”, IFBS, Krefeld, Germany, www.ifbs.eu
- IFBS “Building Physics”, IFBS, Krefeld, Germany, www.ifbs.eu

ANNEX A – CONDITIONS OF USE AND MAINTENANCE

A.1 General considerations

The purpose of this document is to execute works of good quality. Therefore, the condition of durability can be fully met only if those works are maintained and if they are used in conformity with their purpose.

A.2 Maintenance

After final inspection of the building, maintenance is incumbent upon the building owner or their successors in title. Maintenance involves regular inspections of the building works, at least once a year.

The building owner or their successors in title shall keep a record of the inspections in a logbook.

The works shall be incumbent upon the different building trades.

A.3 Works to be done during maintenance

Normal maintenance generally comprises:

- the periodic removal of moss and other sediments,
- maintenance of the rainwater outlets and downpipes,
- maintenance of the protective coatings:
  - in the event of accidental damage
  - in the event of the onset of corrosion

- maintenance of the elements that contribute to the sealing of the building envelope (boundaries to openings, transverse junctions, corners, etc.),
- for surfaces not naturally washed by the weather, regular cleaning followed by, if necessary, the systematic and immediate treatment of spots where corrosion is starting to build up,
- checking that the loadbearing structure is in good shape, otherwise excessive stresses can lead to damage to the cladding.

If only one inspection per year is specified, then it shall preferably take place at the end of the autumn for buildings standing next to trees.

***Note**: The attention of the building owner shall be drawn to the fact that if the environmental atmosphere becomes more aggressive (e.g. new pollution), the choice of the original coatings must be re-evaluated.*

ANNEX B – DEFINITION OF INTERIOR ENVIRONMENT AND EXTERIOR ATMOSPHERE

B.1 RANGE OF APPLICATION

The aim of this annex is to define the different humidity levels, existing interior environment and exterior atmosphere. If any national classification systems regarding humidity are available, they should be used instead of the systems detailed in this annex. Please also refer to [13].

B.2 HUMIDITY OF THE PREMISES

B.2.1 General considerations

Two properties W and n must be defined:

- W: the quantity of water vapour produced inside the premises per hour, expressed in grams per hour (g/h)
- n: the air exchange rate per hour, expressed in cubic metres per hour (m^3/h)

Four types of premises are defined here according to their humidity level in general use during periods of cold weather:

- low humidity premises $W/n \leq 2.5$ g/m^3
- medium humidity premises $2.5 < W/n \leq 5$ g/m^3
- high humidity premises $5 < W/n \leq 7.5$ g/m^3
- very high humidity premises $W/n > 7.5$ g/m^3 (outside the scope of this document)

A classification of premises according to their humidity levels is given below for information only.

***Note**: This classification only considers the humidity of premises with a clean environment and not those affected by a chemically aggressive environment.*

B.2.2 Descriptive classification of premises

The contract documents must specify the humidity classes of premises.

A classification of common premises according to their design, purpose and use is listed below for information purposes only.

Some of the premises classified below may comprise several areas with different humidity classes. The areas must all be considered separately.

B.2.2.1 Low humidity premises

- Non-air-conditioned office buildings, domestic premises provided with controlled mechanical ventilation and systems for extracting the water vapour production peaks as soon as they occur (exhaust hoods, etc.)
- Warehouses
- Sports halls without spectators, excluding their ancillary facilities (shower and changing rooms, etc.)

B.2.2.2 Premises with medium humidity

- School buildings with suitable mechanical ventilation
- Residential buildings, including kitchens and bathrooms, with proper heating and ventilation
- Industrial production buildings in which no water vapour is generated
- Shopping centres with suitable mechanical ventilation
- Sports halls with spectators
- Cultural centres, multi-purpose halls, places of worship

***Note**: In the case of occasional use only, the intensity of use may warrant consideration of a different humidity class. In that case the contract documents must state this.*

B.2.2.3 High humidity premises

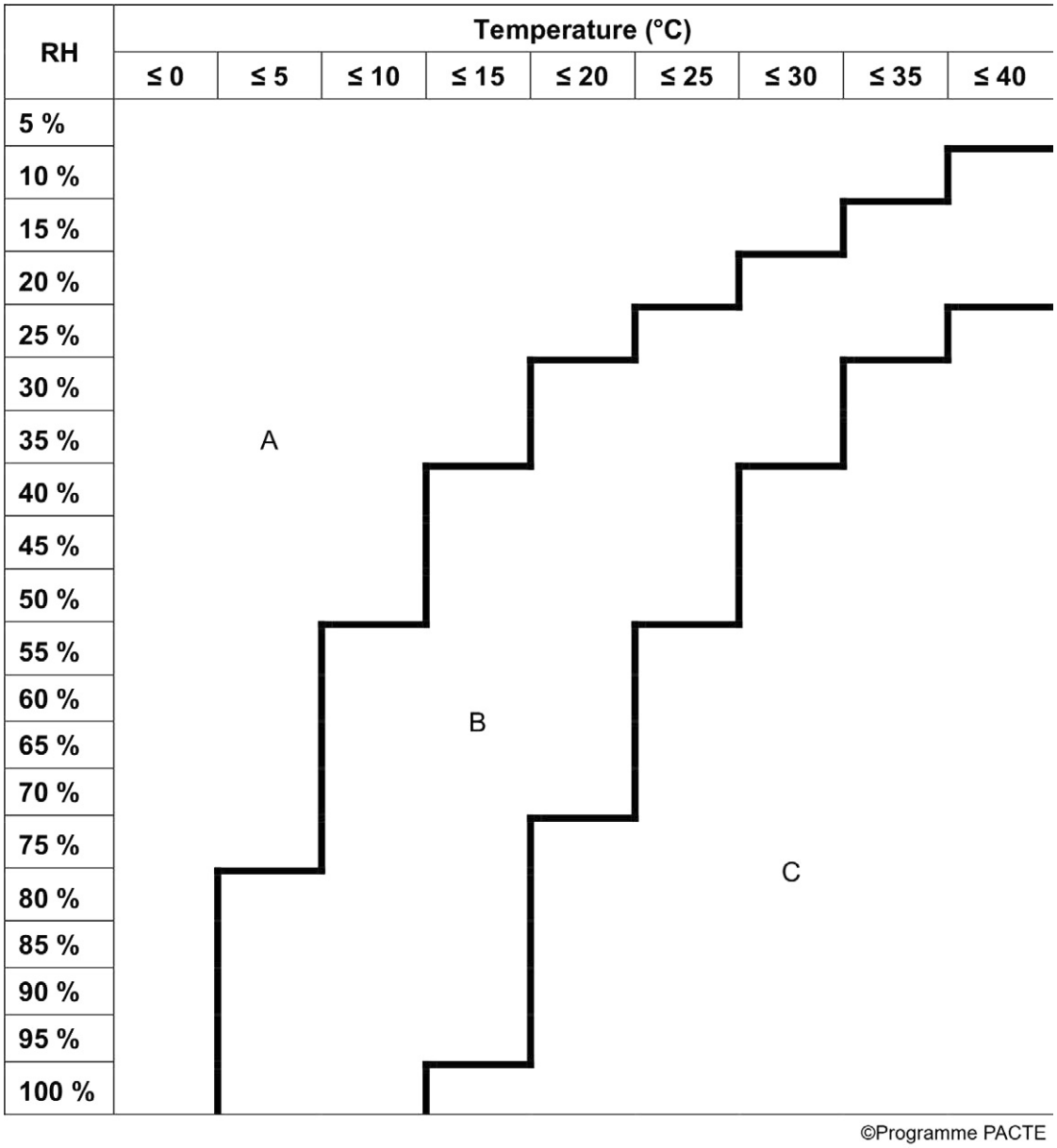
- Residential buildings with poor ventilation and excessive occupation rates
- Premises with high human concentration (collective changing rooms, certain workshops, etc.)

B.2.2.4 Very high humidity premises (outside the scope of this document)

- Special premises such industrial facilities that need to maintain a relatively high humidity, community health facilities with very high usage
- Industrial premises with a high production of water vapour (canning factories, dyeing factories, paper mills, milk processing plants, bottle washer rooms, breweries, polishing shops, community kitchens, industrial laundries, weaving plants, spinning mills, leather tanning works, etc.)
- Indoor swimming pools

B.2.3 Vapour pressure

Figure 54 indicates the vapour pressure to be considered according to the temperature and the relative humidity.



Water vapour pressure: A: $p \leq 5$ mm Hg | B: 5 mm Hg $\leq p \leq$ 12.5 mm Hg | C: 12.5 mm Hg $\leq p$

Figure 54: Vapour pressure according to temperature and relative humidity

B.3 Interior environments

A distinction is made between the following environments:

- Clean environment: environment showing no aggressivity due to corrosive chemical components
- Aggressive environment: environment showing aggressivity (chemical corrosion, corrosive sprays, etc.) even on an irregular basis, e.g. swimming pools with high chlorine compound exhaust, cattle sheds, riding arenas

Where necessary, a detailed classification of the aggressiveness of interior environments should be carried out according to [10].

B.4 Exterior atmospheres

B.4.1 Non-polluted, rural atmosphere

Environment corresponding to that outside buildings in the countryside, without particular pollution, e.g. fall-out from smoke containing sulphurous vapour (fuel oil heating).

B.4.2 Normal urban or industrial atmosphere

Environment corresponding to that outside buildings in built-up areas and/or in an industrial environment comprising one or more factories that produce gas and smoke that lead to a major increase in the atmospheric pollution without being a source of corrosion due to a high chemical compound content.

B.4.3 Severe urban or industrial atmosphere

Environment corresponding to that outside buildings in built-up areas or in an industrial environment with a high chemical compound content forming a source of corrosion (e.g. oil refinery, incineration plant, distillery, fertiliser works, cement works, paper mill, etc.) on a continuous or irregular basis.

B.4.4 Marine atmosphere

B.4.4.1 Atmosphere around buildings located between 10 and 20 km from the coast

This is defined in [21].

B.4.4.2 Atmosphere around buildings located between 3 and 10 km from the coast

This is defined in [21].

B.4.4.3 Seaside

Within 3 km of the coast, excluding direct seawater attack conditions (seafront).

B.4.4.4 Mixed atmosphere

Environment corresponding to the coexistence of a marine seaside atmosphere (see B.4.4.3) and the atmospheres defined in B.4.2 and B.4.3.

B.4.5 Special atmospheres

B.4.5.1 Atmosphere around buildings exposed to high UV radiation

For example, buildings situated in urban areas at an altitude above 900 m.

B.4.5.2 Particular atmospheres

Environments where the exposures described above are even more severe because of actions such as:

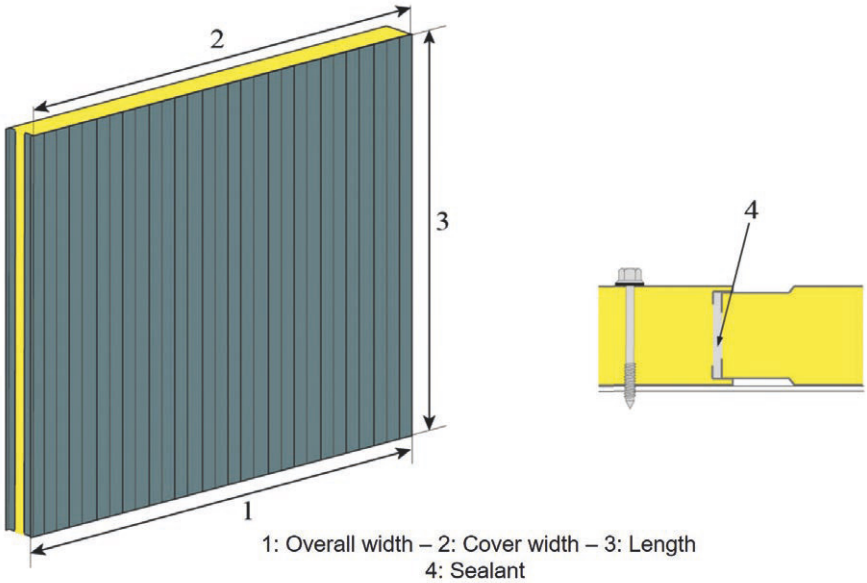
- abrasion,
- high temperatures,
- high humidity levels,
- large depositions of dust,
- spray along seafront, etc.

ANNEX C – DETAILS FOR THE EXECUTION OF SPECIFIC POINTS

This annex shows examples of good practice for the installation of sandwich panels and ancillary items at specific points of the building. Other solutions might also be possible. Some solutions might not be valid or permitted in certain countries.

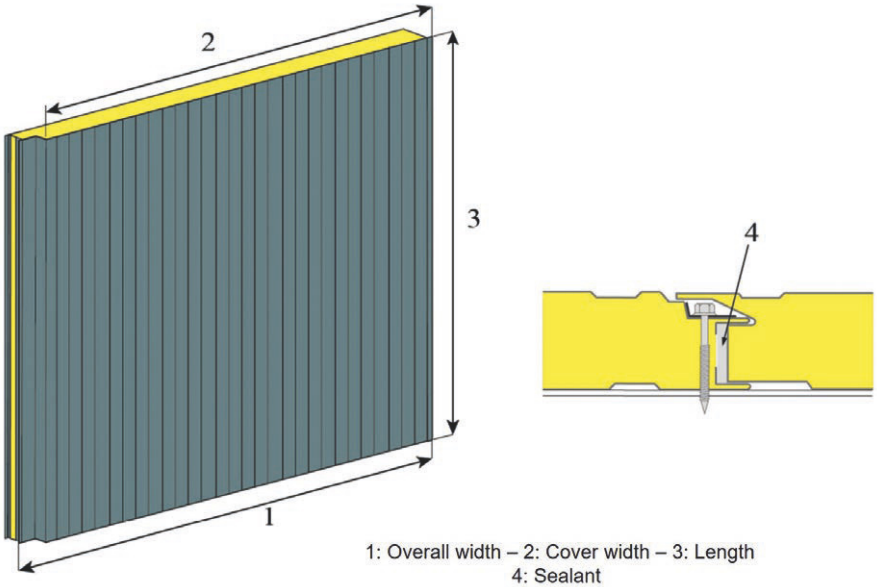
C.1 Panel installation modes

Detail 1: Vertically installed panels with through-fixings



1: Overall width – 2: Cover width – 3: Length
4: Sealant

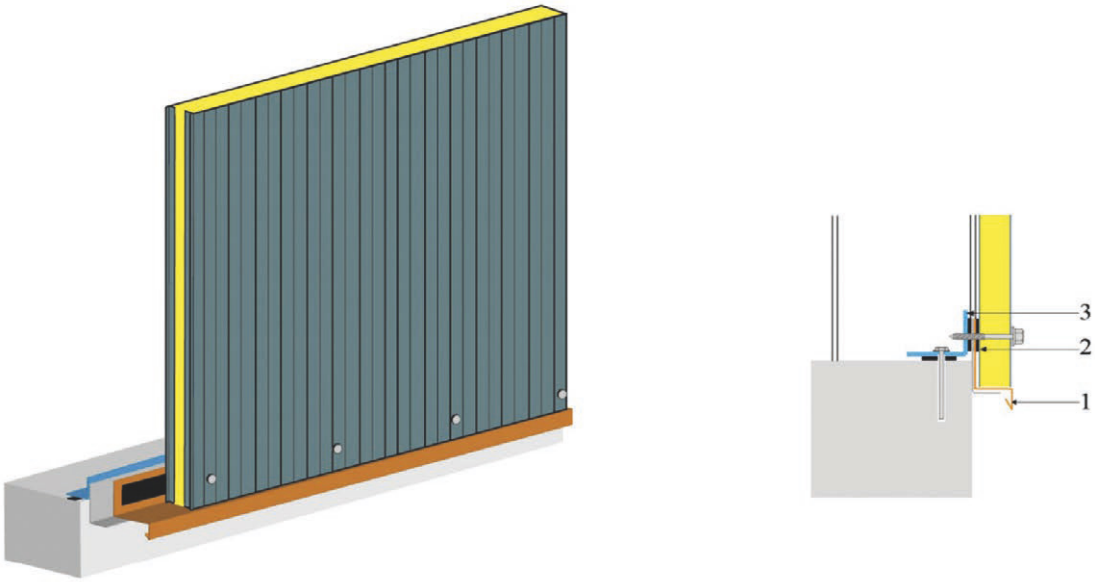
Detail 2: Vertically installed panels with hidden fixings



1: Overall width – 2: Cover width – 3: Length
4: Sealant

C.2 Cladding base details

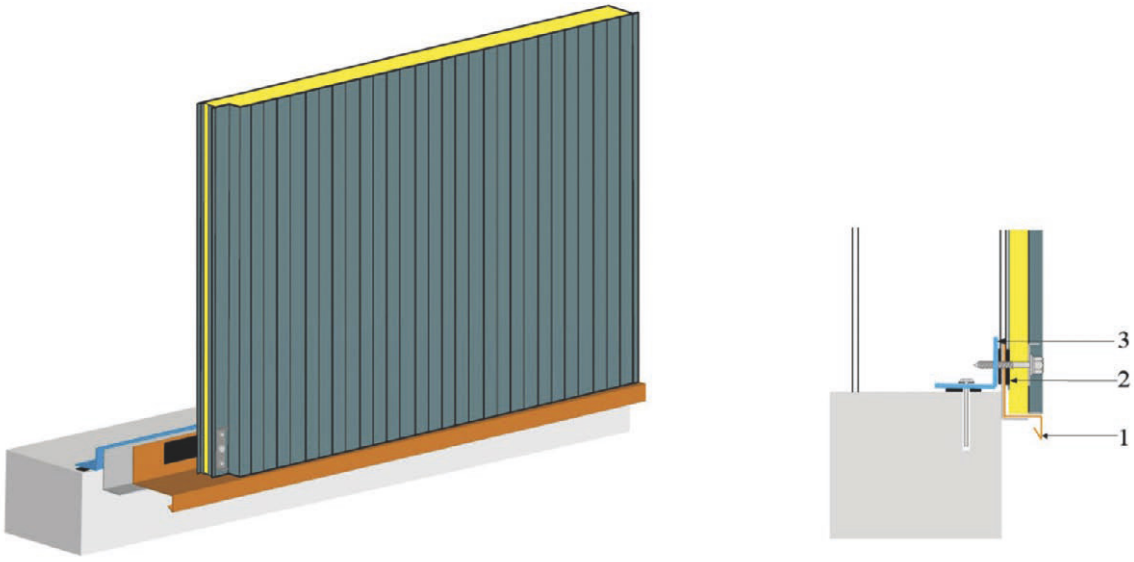
Detail 3: Cladding base
Vertically installed panels with through-fixings on steel support



1: Apron (optional) – 2: Sealant
3: Steel support

©Programme PACTE

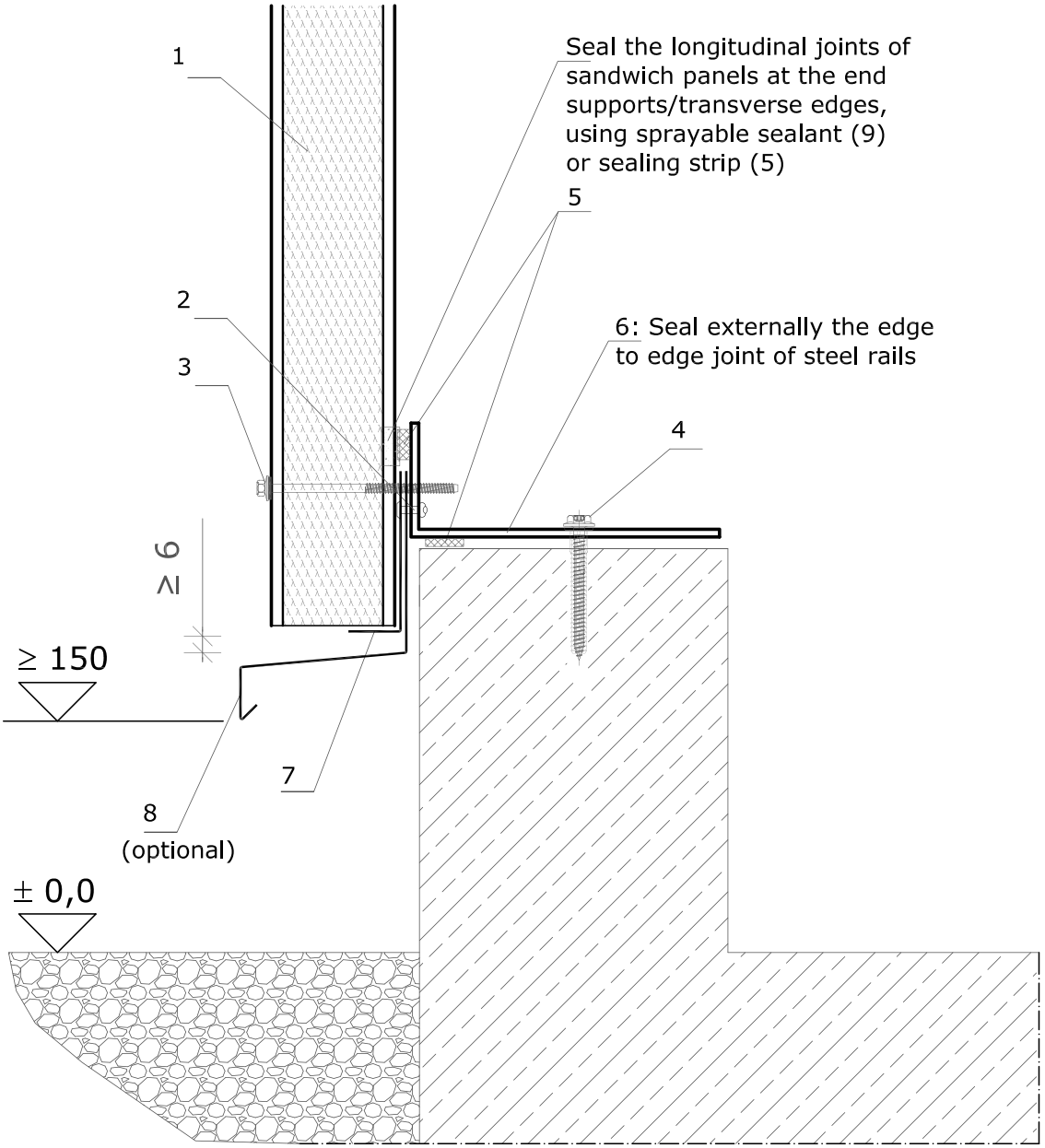
Detail 4: Cladding base
Vertically installed panels with hidden fixings on steel support



1: Apron (optional) – 2: Sealant
3: Steel support

©Programme PACTE

Detail 5: Cladding base – Construction detail recommended in Germany for vertically installed PU core panels[4] on steel support (valid for through and hidden fixings)



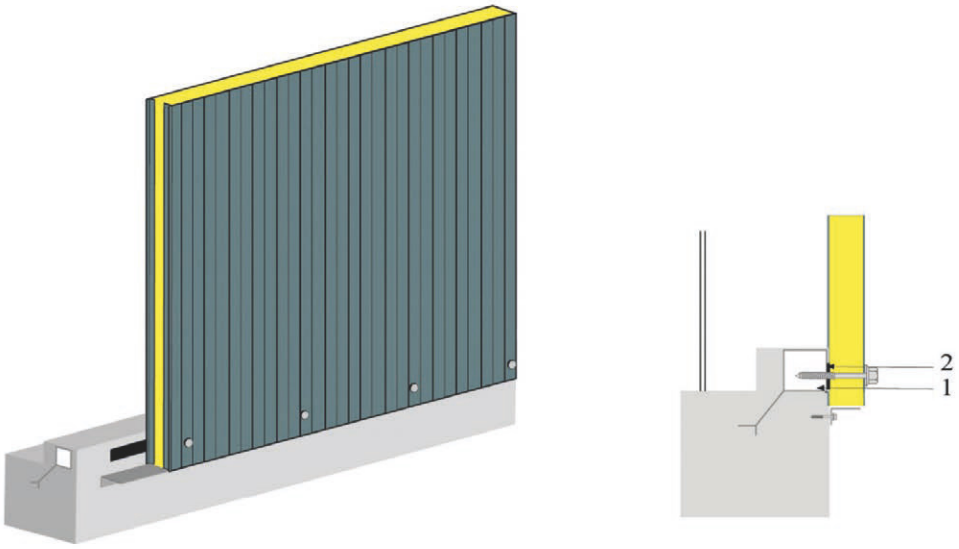
Key

1 PU core sandwich panel for wall applications
2 Pop rivet according to national technical approval (abZ) / general construction technique permit (aBG) Z-14.1-4 or ETA
3 Screw with sealing washer according to abZ / aBG Z-14.4-407 or ETA
4 Anchor
5 Sealing strip of type 1 or type 1a according to Table 2 in [26]
6 Bottom support, steel rail
7 Profile for positioning panels, $t_N \geq 1.00$ mm
8 Apron (optional)
9 Sprayable sealant of type 4 according to Table 2 in [26]

The bottom edge of the panel must be placed on the profile (7) and the apron (8) underneath the profile.

[4] For MW core panels, another construction solution is recommended in Germany. This can be found in section 6.2 in [26].

Detail 6: Cladding base
Vertically installed panels with through-fixings mounted on concrete support with steel attachment rail

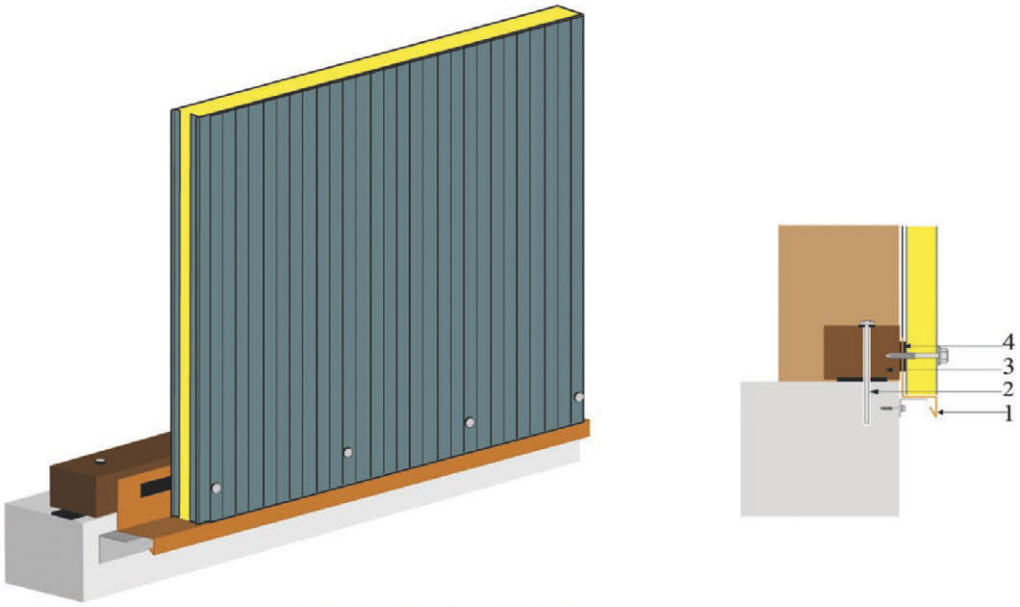


1: Steel attachment rail – 2: Sealant

©Programme PACTE

In the case of a concrete base, in Germany it is more usual to have a steel angle fixed with screws (see previous detail) than to use an embedded steel rail.

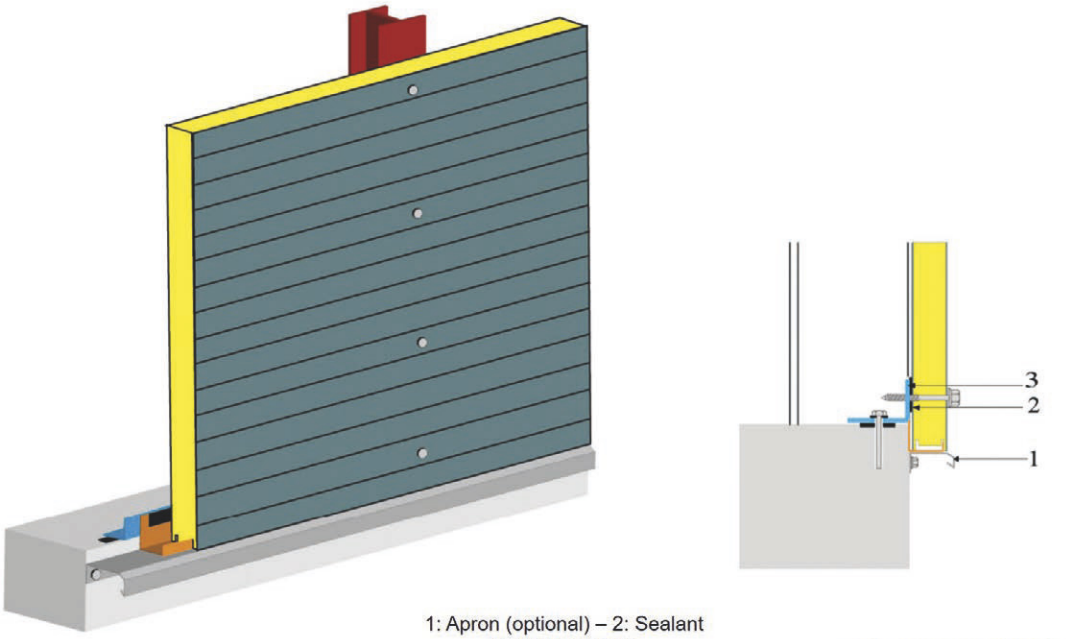
Detail 7: Cladding base
Vertically installed panels with through-fixings mounted on timber support



1: Apron (optional) – 2: Anchor
3: Timber support – 4: Sealant

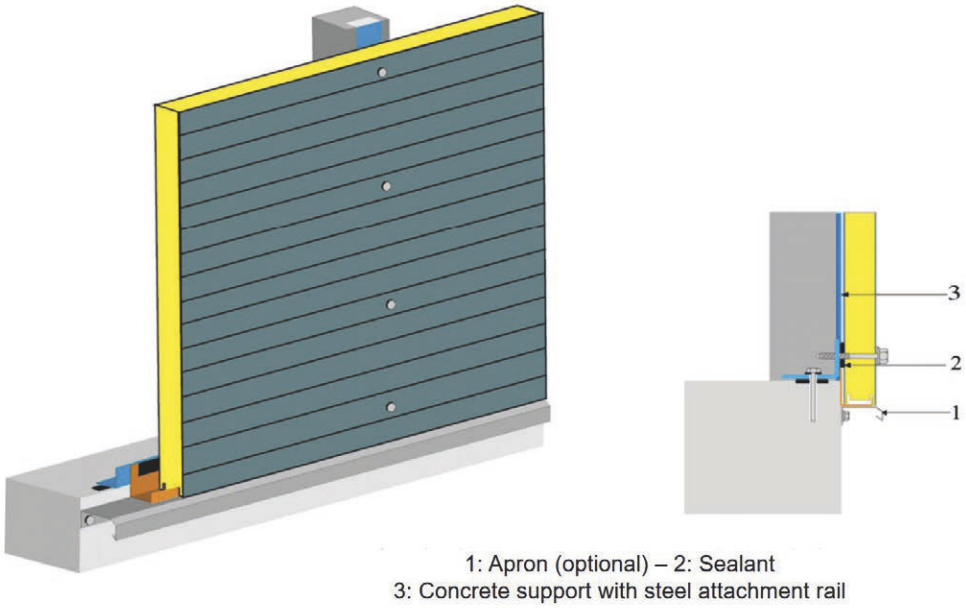
©Programme PACTE

Detail 8: Cladding base
Horizontally installed panels with through-fixings mounted on steel support



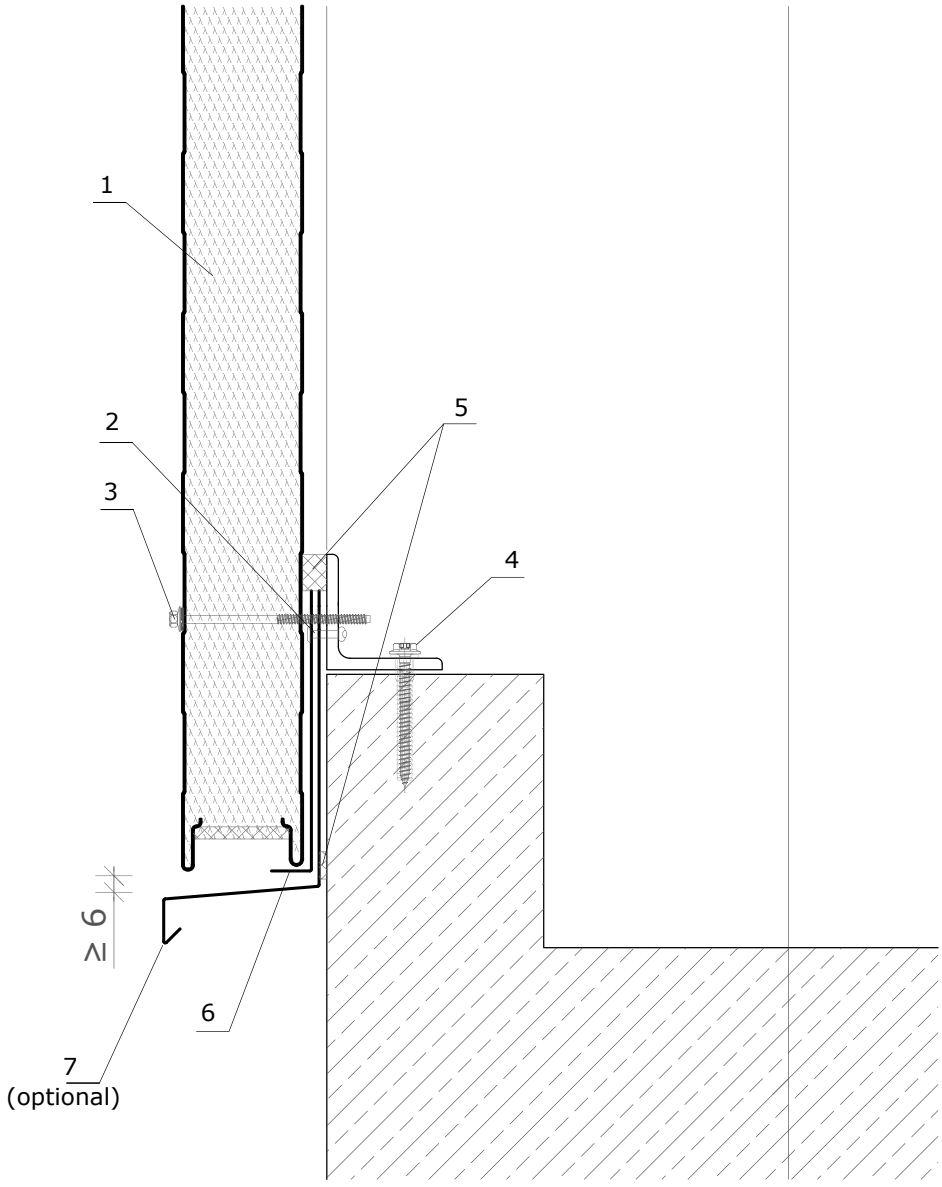
1: Apron (optional) – 2: Sealant
3. Steel support

Detail 9: Cladding base
Horizontally installed panels with through-fixings attached to steel angle on concrete support



1: Apron (optional) – 2: Sealant
3: Concrete support with steel attachment rail

Detail 10: Cladding base
Construction detail recommended in Germany for horizontally installed panels with through-fixings attached to steel angle fixed with screws to concrete support

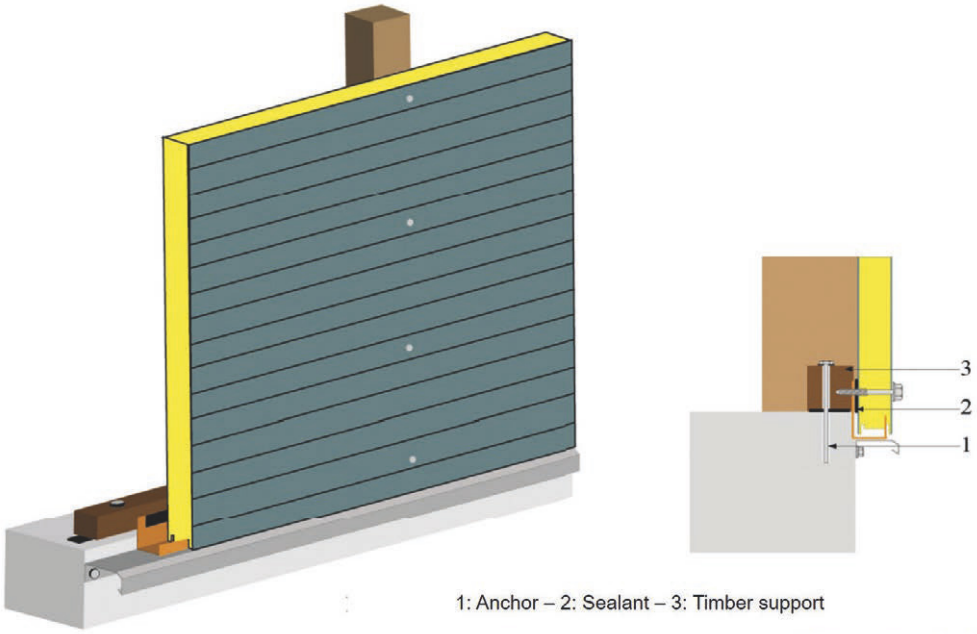


Key

1 PU or MW core sandwich panel for wall applications, with through-fixings
2 Pop rivet according to national technical approval (abZ) / general construction technique permit (aBG) Z-14.1-4 or ETA
3 Screw with sealing washer according to abZ / aBG Z-14.4-407 or ETA
4 Anchor
5 Sealing strip of type 1 or type 1a according to Table 2 in [26]
6 Profile for positioning panels, $t_N \geq 1.00$ mm
7 Apron (optional)

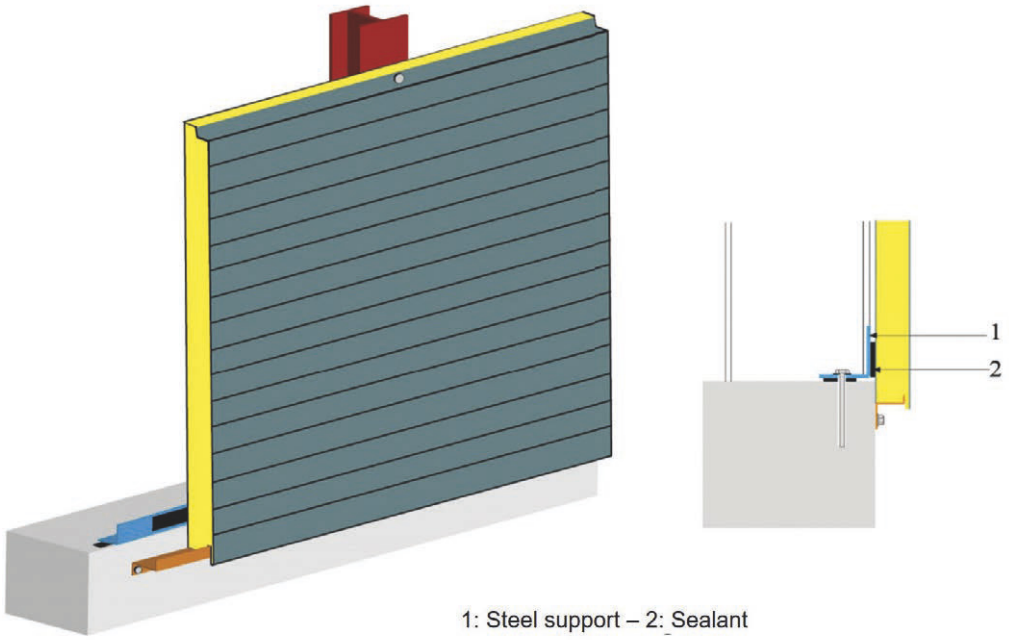
The apron must be fixed to the support with screws or rivets.

Detail 11: Cladding base
Horizontally installed panels with through-fixings, attached to timber support



1: Anchor – 2: Sealant – 3: Timber support

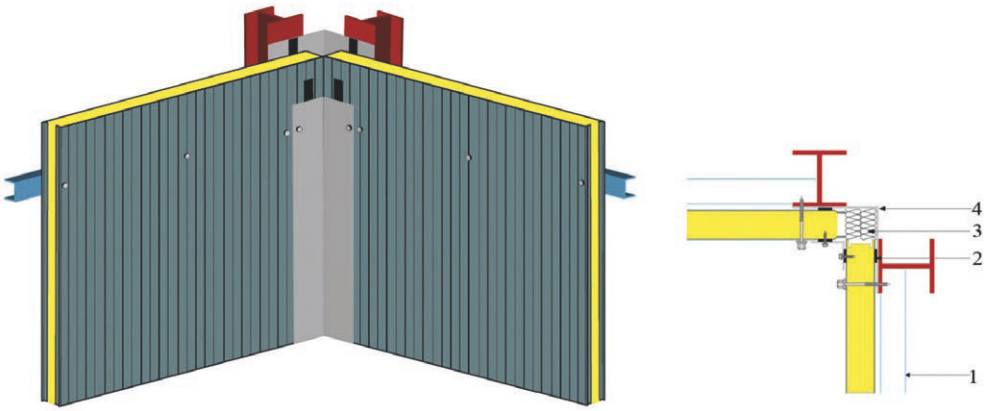
Detail 12: Cladding base
Horizontally installed panels with hidden fixings, attached to steel support



1: Steel support – 2: Sealant

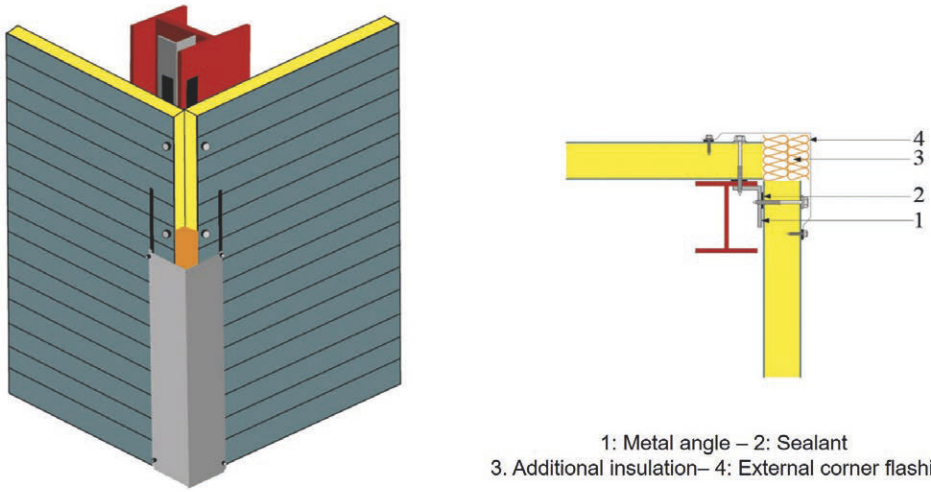
C.3 Internal and external corners

Detail 13: Internal corner – Vertically installed panels with through-fixings



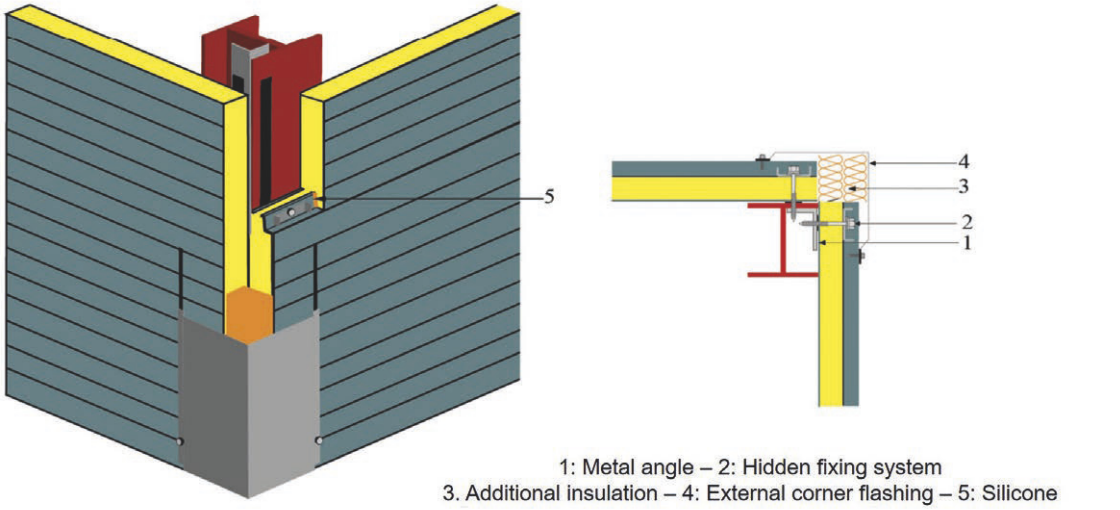
1: Cladding rail – 2: Sealant – 3: Additional insulation – 4: External corner flashing

Detail 14: External corner – Horizontally installed panels with through-fixings



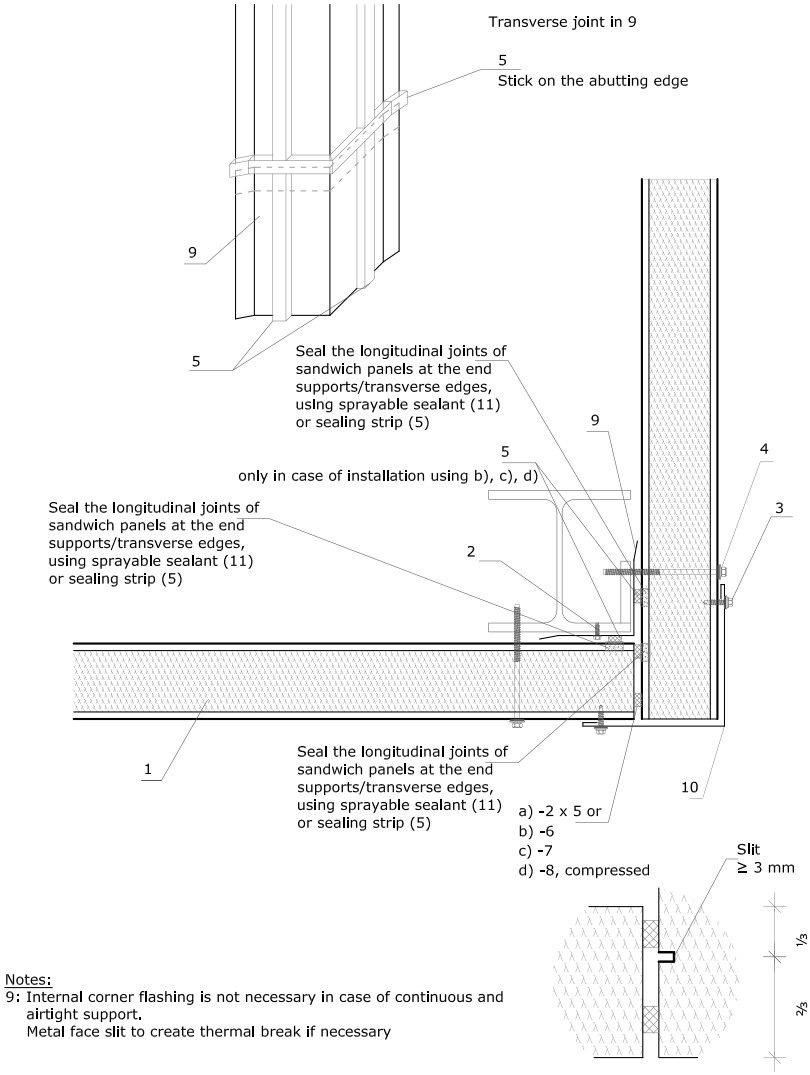
1: Metal angle – 2: Sealant
3. Additional insulation– 4: External corner flashing

Detail 15: External corner – Horizontally installed panels with hidden fixings



1: Metal angle – 2: Hidden fixing system
3. Additional insulation – 4: External corner flashing – 5: Silicone

Detail 16: External corner – Construction detail recommended in Germany for horizontally installed PU core panels[5]



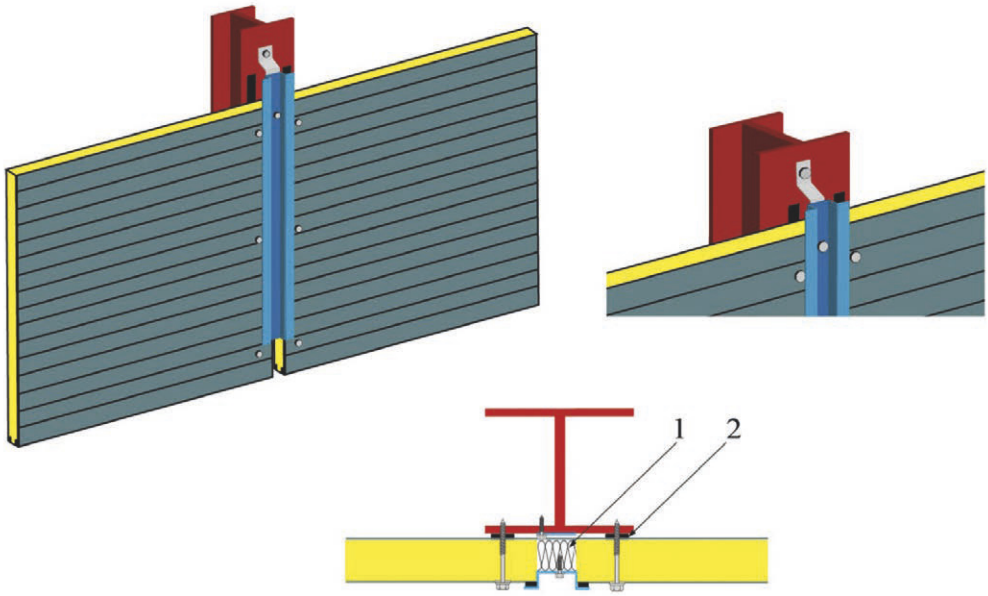
Key

1 PU core sandwich panel for wall applications
2 Pop rivet or screw without sealing washer according to national technical approval (abZ) / general construction technique permit (aBG) Z-14.1-4 or ETA
3 Pop rivet or screw with sealing washer according to abZ / aBG Z-14.1-4 or ETA
4 Screw with sealing washer according to abZ / aBG Z-14.4-407 or ETA
5 Sealing strip of type 1 according to Table 2 in [26]
6 PU (expandable) foam
7 Polyethylene (PE) soft foam strip
8 MW insulation material, application type DAD dk (according to [3]), non-combustible (according to [1] / [14])
9 Internal corner flashing
10 External corner flashing
11 Sprayable sealant of type 4 according to Table 2 in [26]

[5] For MW core panels, another construction solution is recommended in Germany. This can be found in section 6.2 in [26].

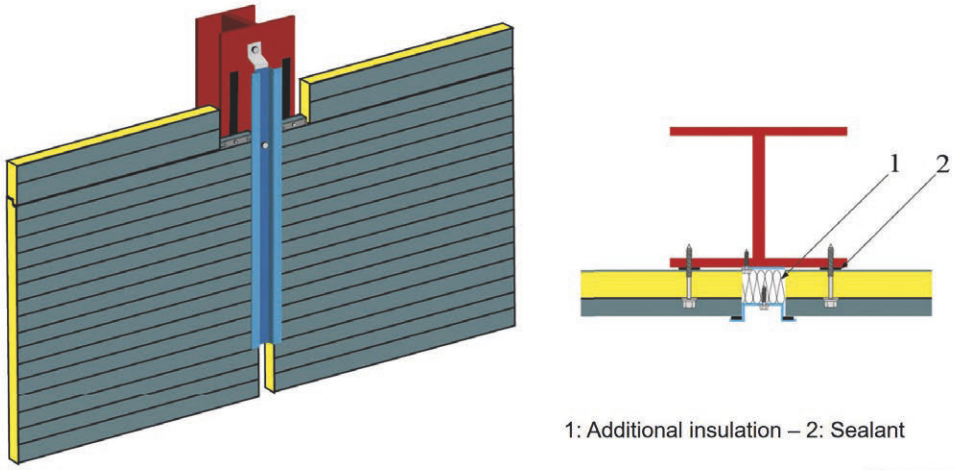
C.4 Transverse junction

Detail 17: Transverse junction – Horizontally installed panels with through-fixings



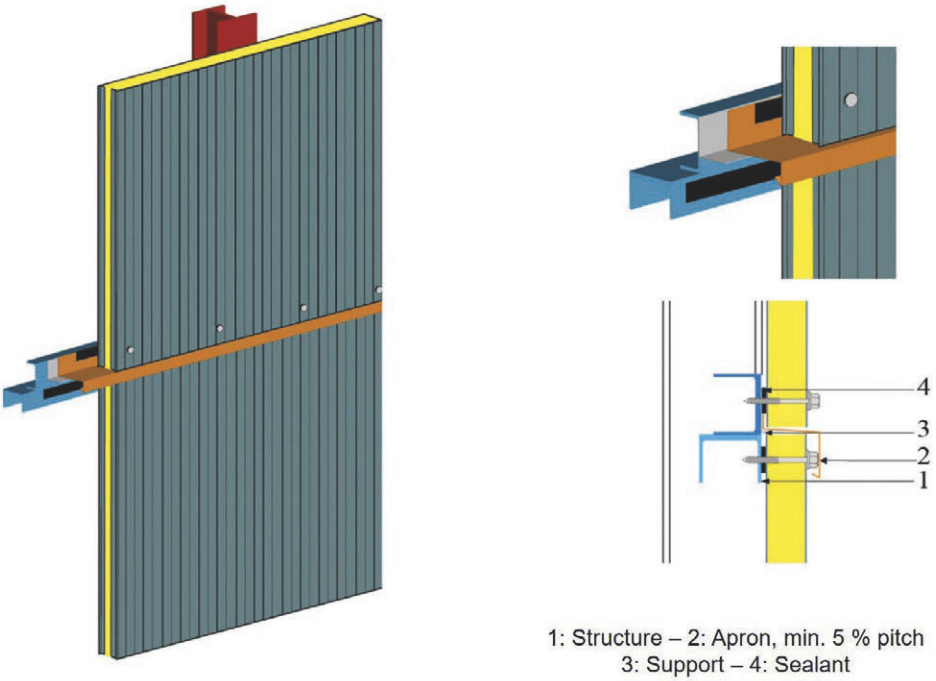
1: Additional insulation – 2: Sealant

Detail 18: Transverse junction – Horizontally installed panels with hidden fixings



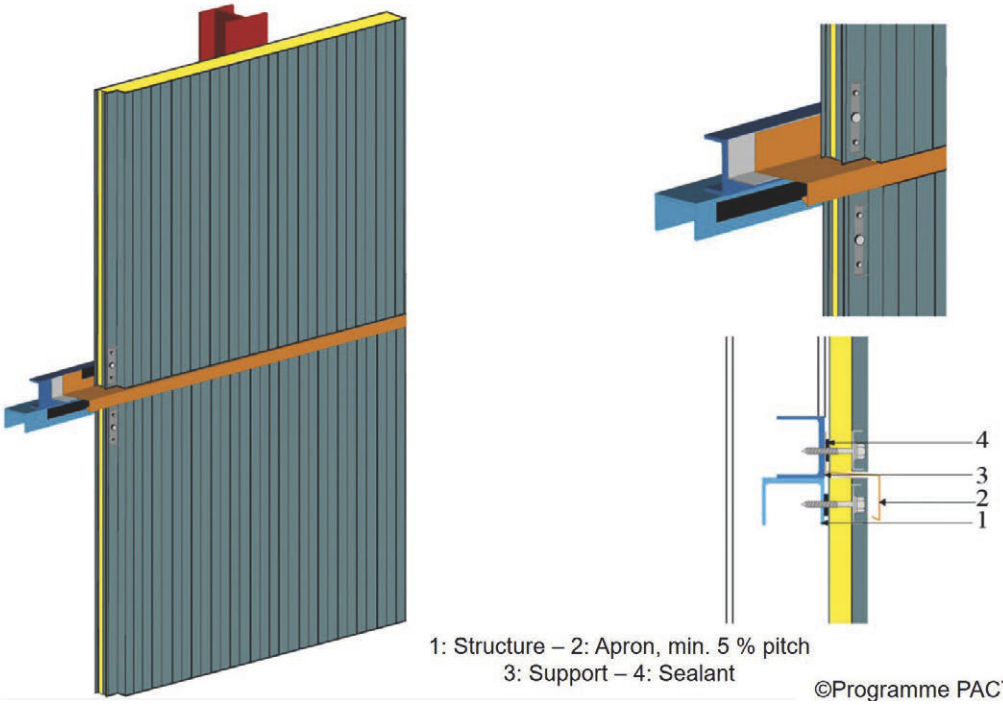
1: Additional insulation – 2: Sealant

Detail 19: Transverse junction – Vertically installed panels with through-fixings



1: Structure – 2: Apron, min. 5 % pitch
3: Support – 4: Sealant

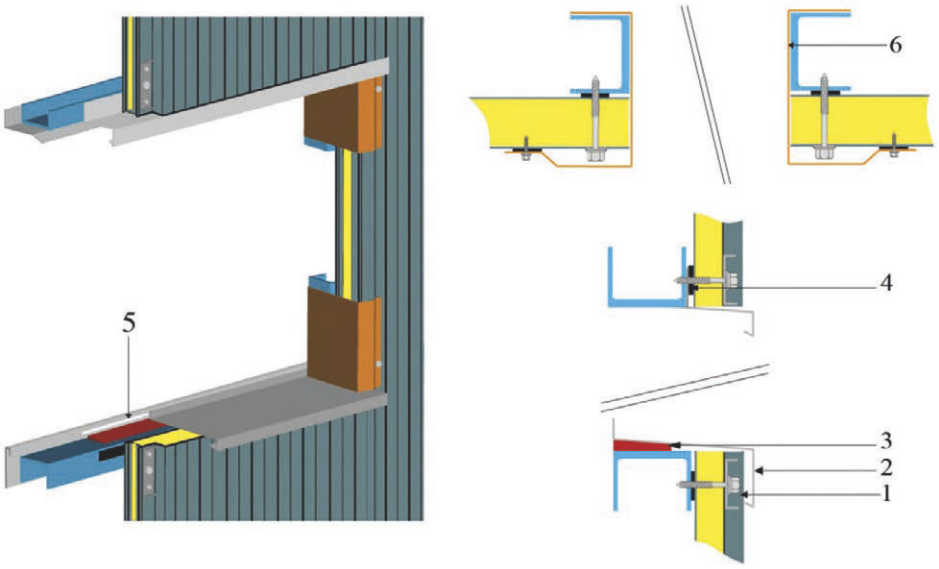
Detail 20: Transverse junction – Vertically installed panels with hidden fixings



1: Structure – 2: Apron, min. 5 % pitch
3: Support – 4: Sealant

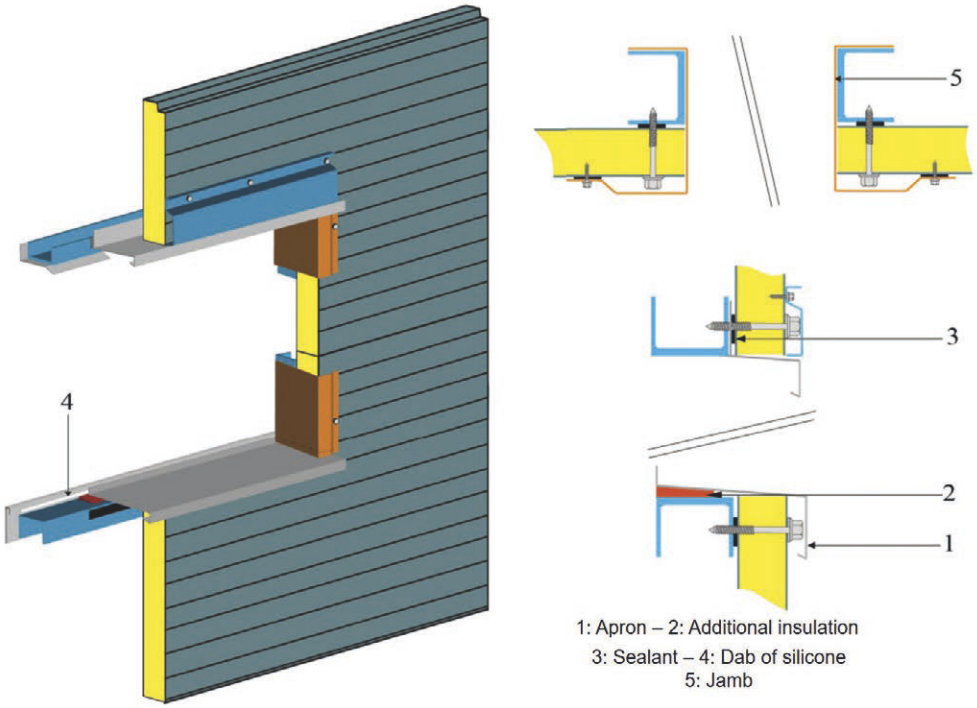
C.5 Openings (maximum height limited to 20 m)

Detail 21: Openings – Vertically installed panels with hidden fixings



1: Hidden fixing system – 2: Apron
3: Additional insulation – 4: Sealant
5: Dab of silicone – 6: Jamb

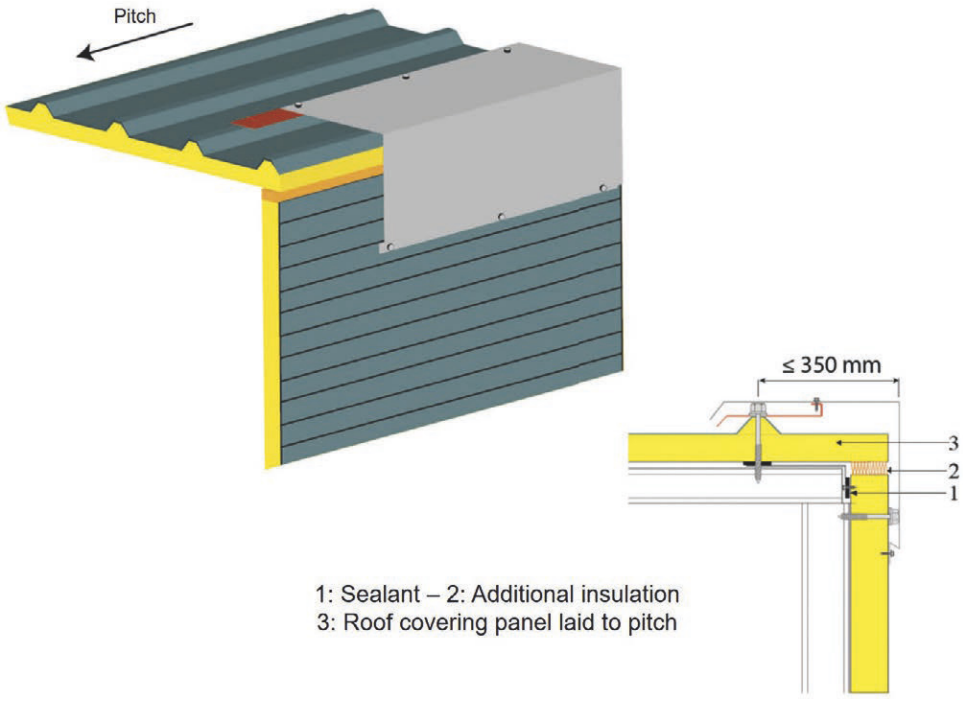
Detail 22: Openings – Horizontally installed panels with hidden fixings



1: Apron – 2: Additional insulation
3: Sealant – 4: Dab of silicone
5: Jamb

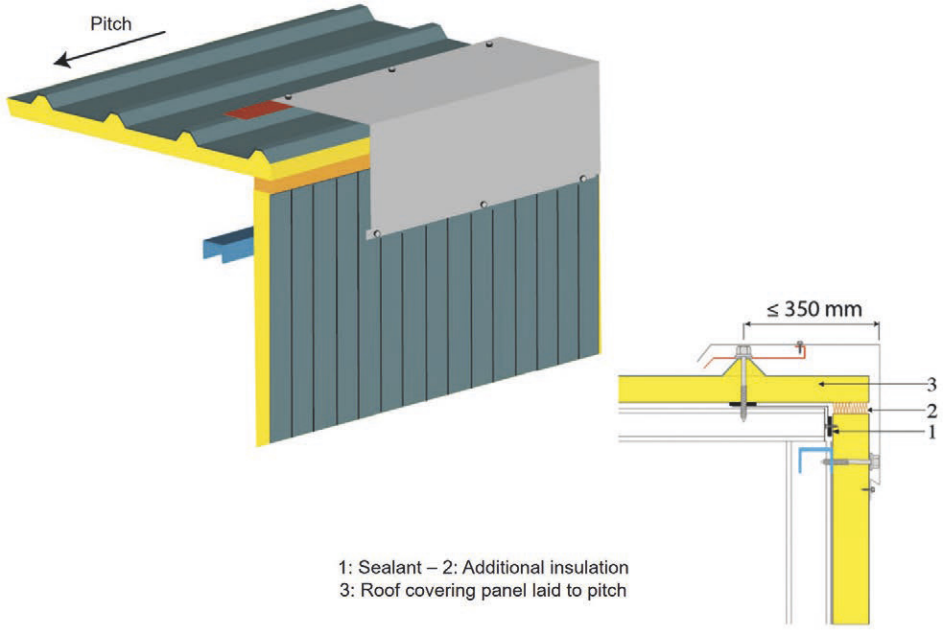
C.6 Top of cladding

Detail 23: Top of cladding – Horizontally installed panels



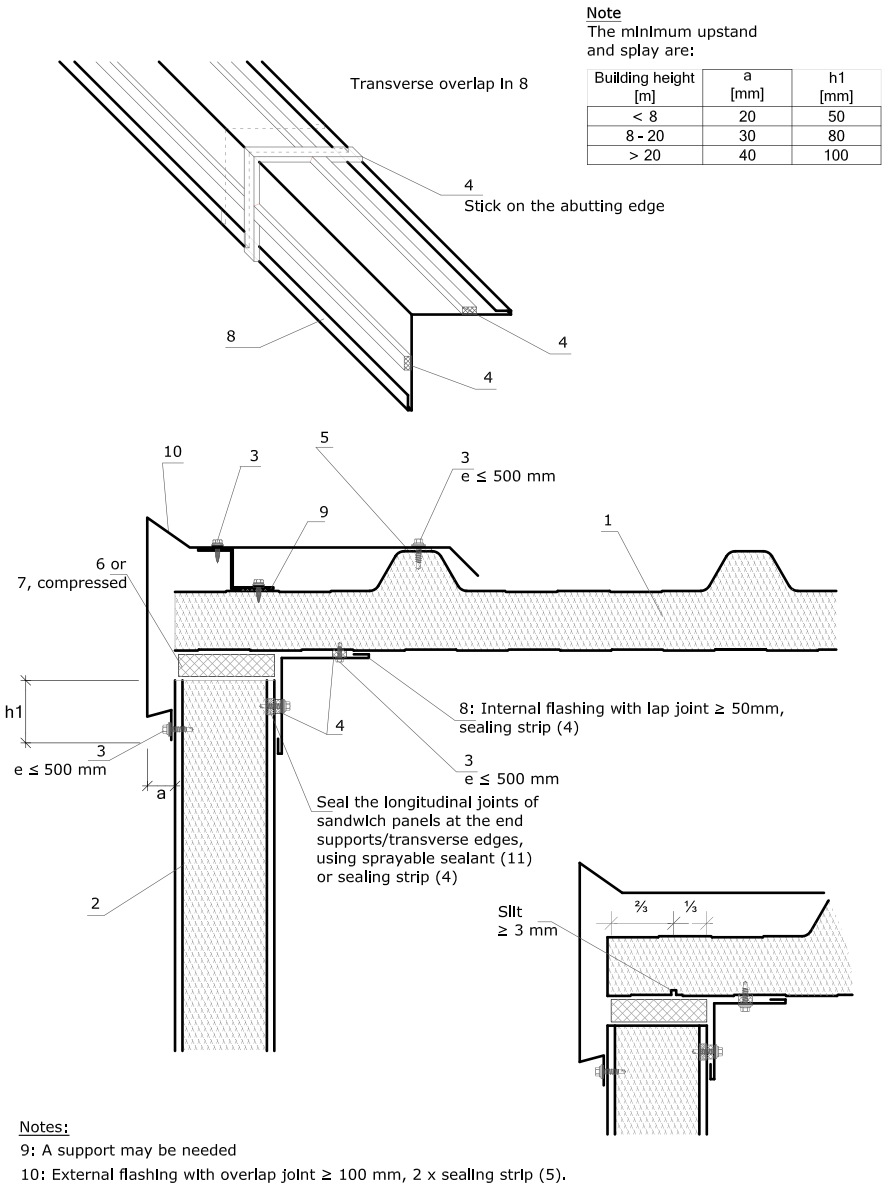
1: Sealant – 2: Additional insulation
3: Roof covering panel laid to pitch

Detail 24: Top of cladding – Vertically installed panels



1: Sealant – 2: Additional insulation
3: Roof covering panel laid to pitch

Detail 25: Top of cladding – Construction detail recommended in Germany



Notes:
9: A support may be needed
10: External flashing with overlap joint ≥ 100 mm, 2 x sealing strip (5).

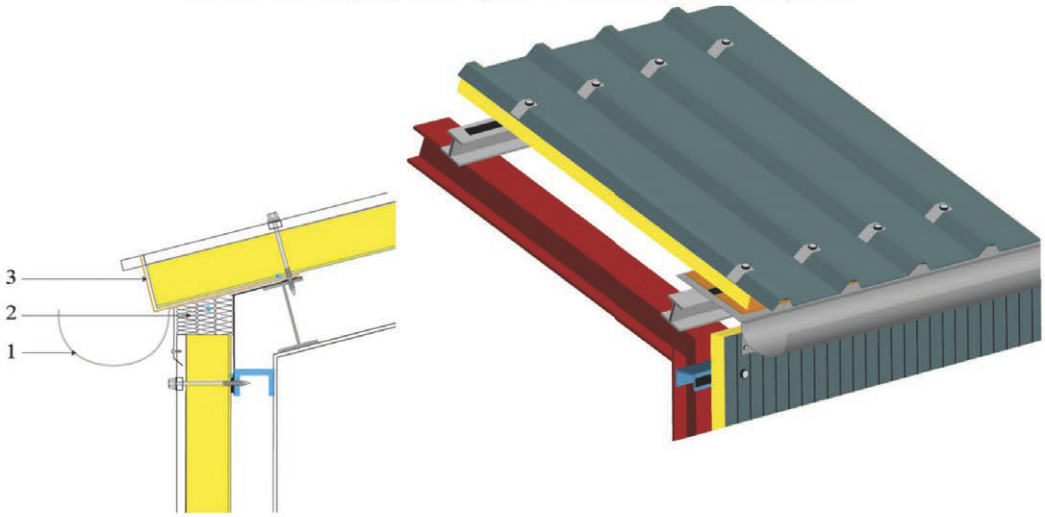
Outer metal face slit to create thermal break if necessary

Key

1 PU or MW core sandwich panel for roof applications
2 PU core sandwich panel for wall applications
3 Screw with sealing washer according to abZ / aBG Z-14.1-4 or ETA
4 Sealing strip of type 1 according to Table 2 in [26]
5 Sealing strip of type 2 according to Table 2 in [26]
6 PU (expandable) foam
7 MW insulation material, application type DAD dk (according to [3]), non-combustible (according to [1] / [14])
8 Internal corner flashing
9 Spacer (support) profile, $t_N \geq 1{,}00$ mm
10 Gable end flashing
11 Sprayable sealant of type 4 according to Table 2 in [26]

C.7 Hanging eaves gutter

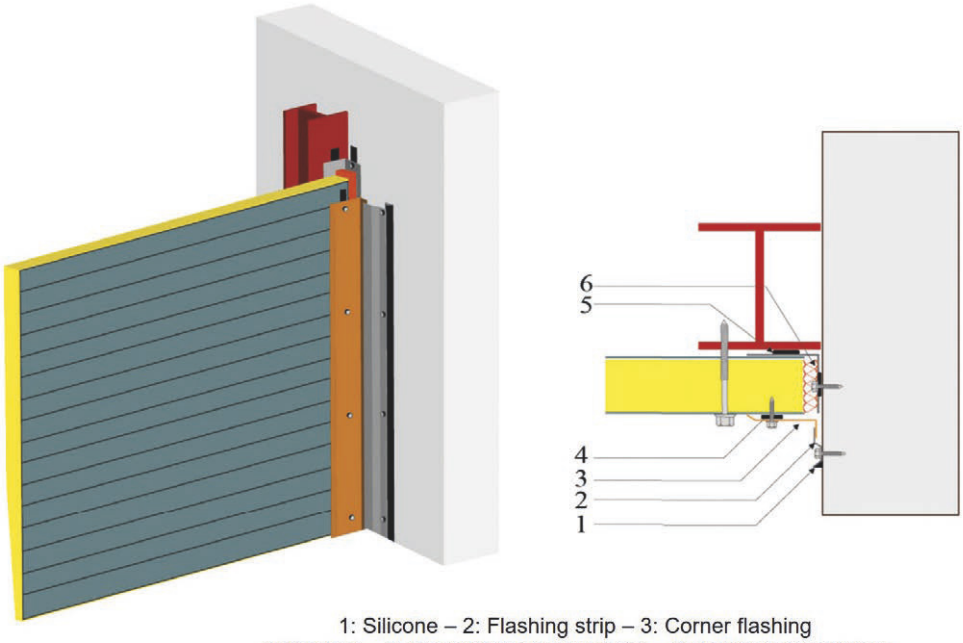
Detail 26: Hanging eaves gutter – Vertically installed panels



1: Gutter fixed to structure – 2: Additional insulation
3: Roof trim

C.8 Junction with masonry

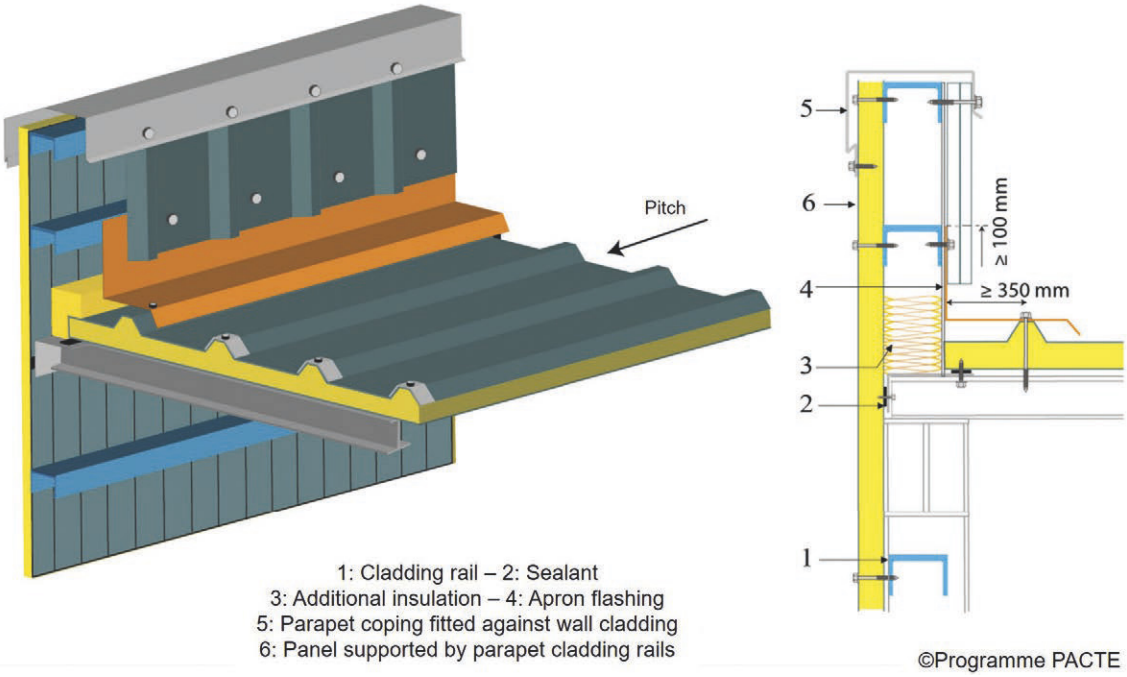
Detail 27: Junction with masonry – Horizontally installed panels



1: Silicone – 2: Flashing strip – 3: Corner flashing
4: Sealant – 5: Draughtproofing material – 6: Additional insulation

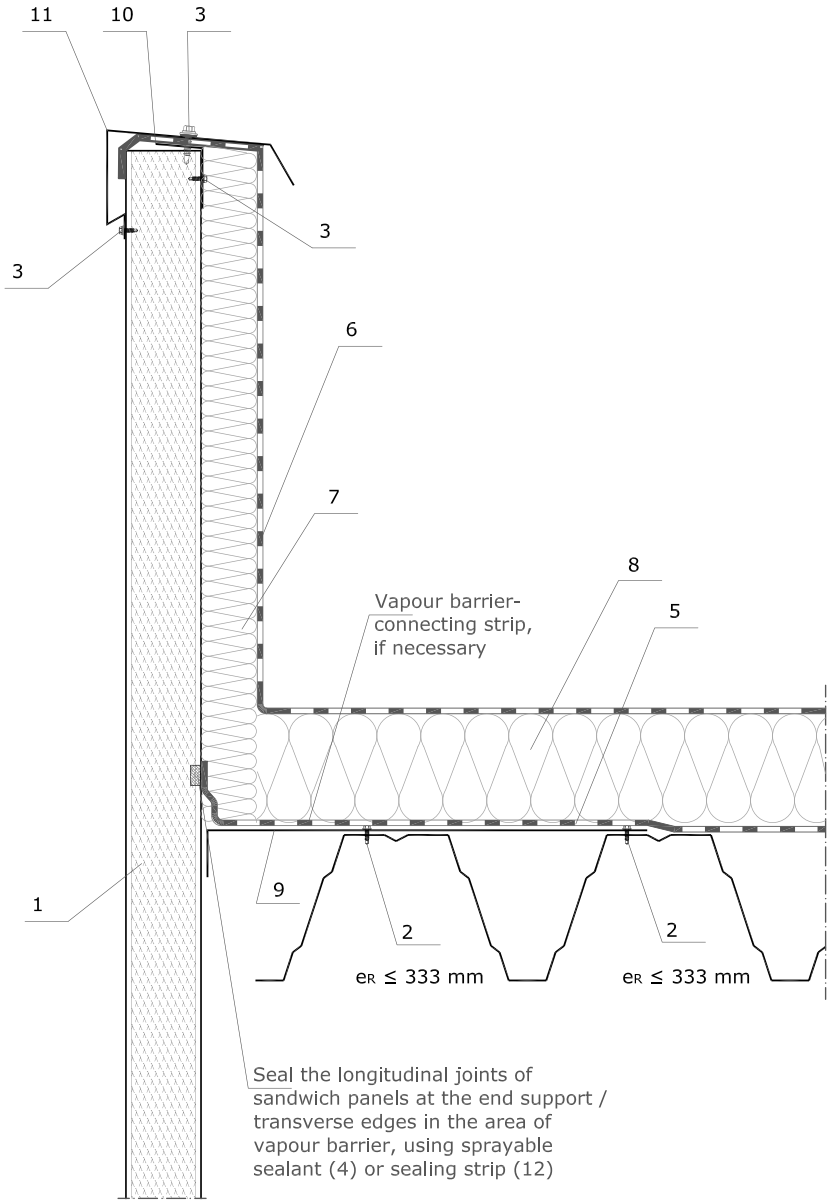
C.9 Parapet with vertical cladding

Detail 28: Parapet with vertical cladding



1: Cladding rail – 2: Sealant
3: Additional insulation – 4: Apron flashing
5: Parapet coping fitted against wall cladding
6: Panel supported by parapet cladding rails

Detail 29: Parapet with vertical cladding – Construction detail recommended in Germany



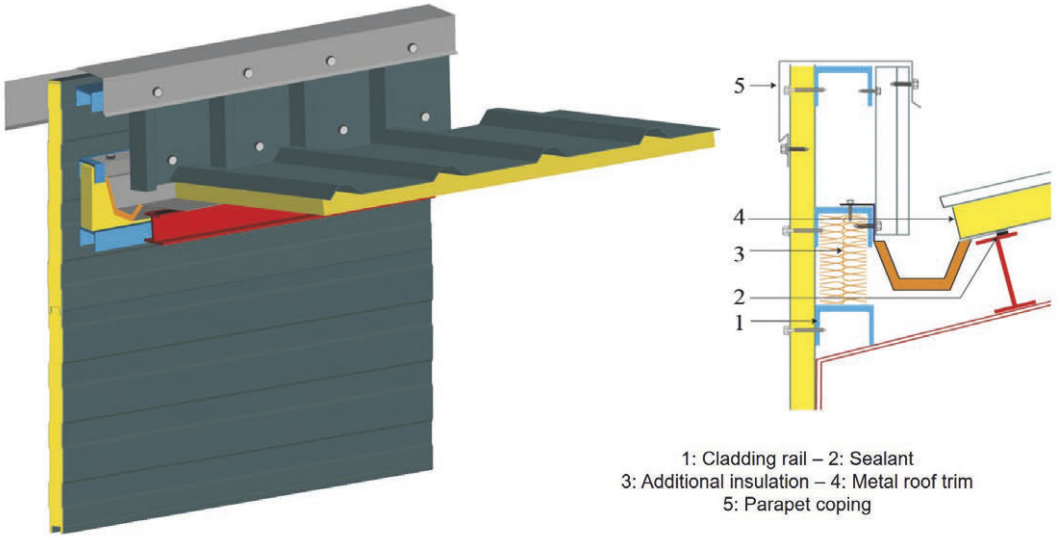
Key

1 PU or MW core sandwich panel for wall application
2 Pop rivet or screw without sealing washer according to national technical approval (abZ) / general construction technique permit (aBG) Z-14.1-4 or ETA
3 Screw with sealing washer according to abZ / aBG Z-14.1-4 or ETA
4 Sprayable sealant of type 4 according to Table 2 in [26]
5 Vapour barrier
6 Waterproofing membrane
7 MW insulation material, application type WAA (according to [3]), non-combustible (according to [1] / [14]), or PUR/PIR insulation board, at least type B2 according to [1], at least type E according to [14]
8 MW insulation material, application type DAA (according to [3]), non-combustible (according to [1] / [14]), or PUR/PIR insulation board, at least type B2 according to [1], at least type E according to [14]
9 Stiffening corner flashing
10 Parapet coping mounting bracket
11 Parapet coping
12 Sealing strip of type 1 according to Table 2 in [26]

In Germany construction details with parapet walls apply to flat roofs (rooftop terraces) only.

C.10 Parapet with horizontal cladding

Detail 30: Parapet with horizontal cladding

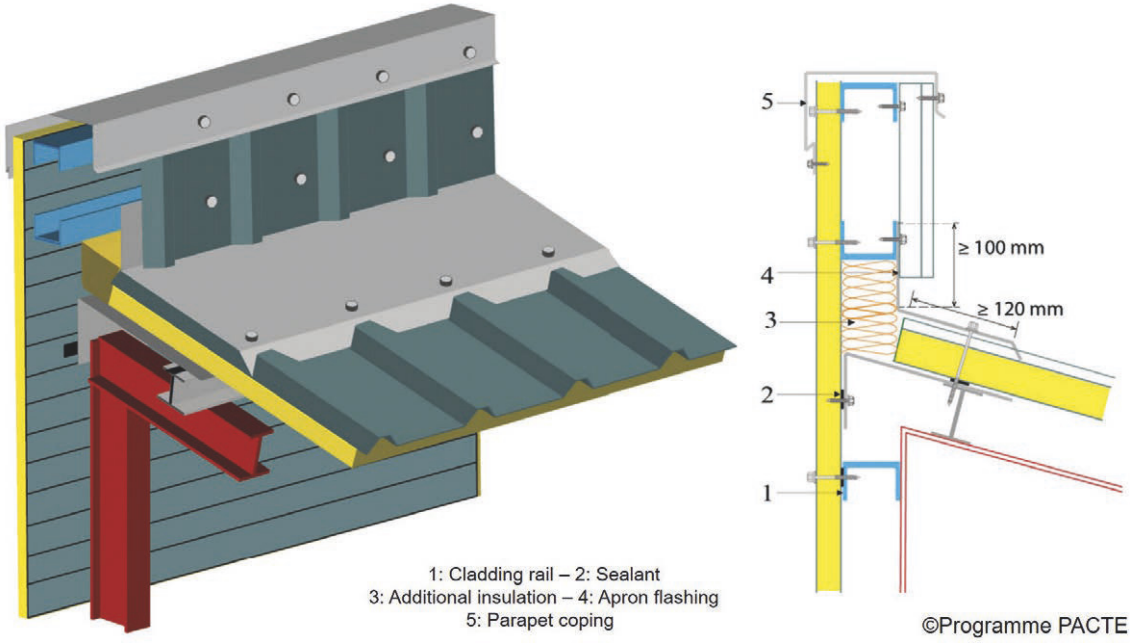


1: Cladding rail – 2: Sealant
3: Additional insulation – 4: Metal roof trim
5: Parapet coping

Sealant (2) must be applied between the purlin and the inside end of the sheet forming the parapet gutter.

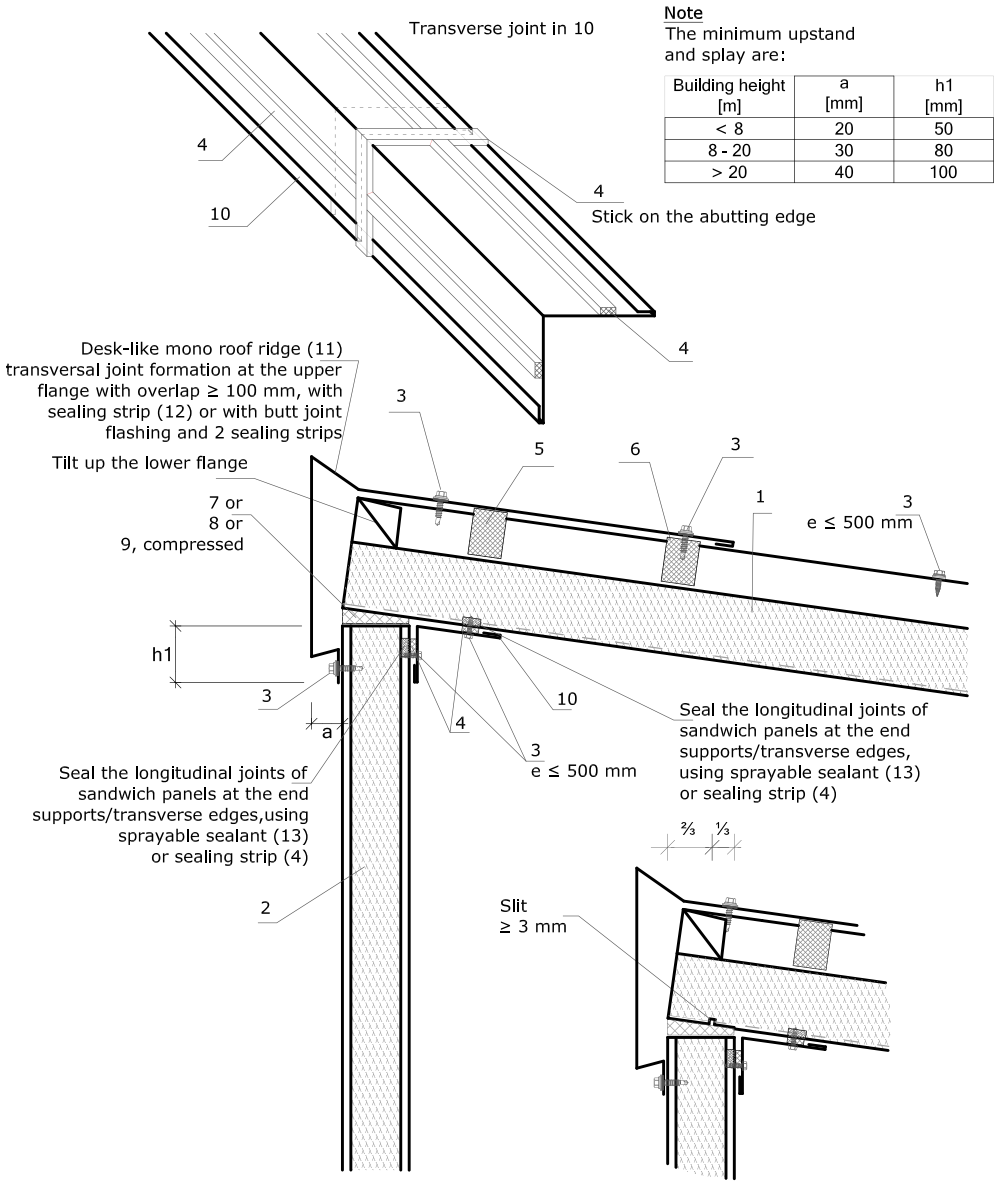
C.11 Wall abutment, with apron flashing

Detail 31: Wall abutment at top of slope – Case 1



1: Cladding rail – 2: Sealant
3: Additional insulation – 4: Apron flashing
5: Parapet coping

Detail 32: Roof ridge – Construction detail recommended in Germany



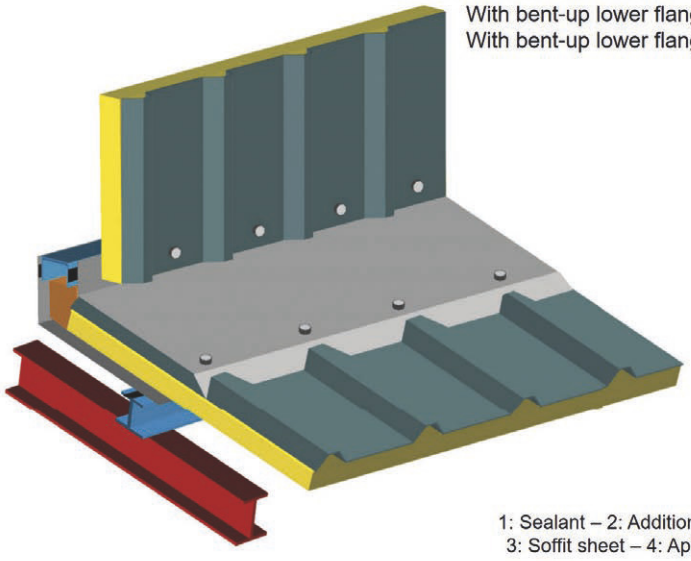
Note:

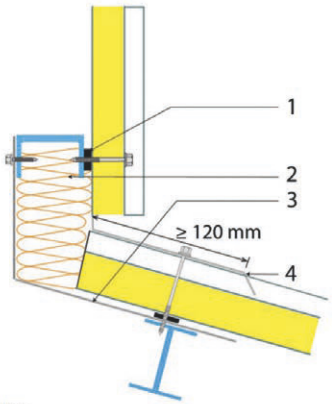
Key

1 PU or MW core sandwich panel for roof applications
2 PU or MW core sandwich panel for wall applications
3 Screw with sealing washer according to abZ / aBG Z-14.1-4 or ETA
4 Sealing strip of type 1 according to Table 2 in [26]
5 Profile filler of type 6 according to Table 2 in [26]
6 Profile filler of type 6a according to Table 2 in [26] (with UV-resistant lamination)
7 PU (expandable) foam
8 Polyethylene (PE) soft foam strip
9 MW insulation material, application type DAD dk (according to [3]), non-combustible (according to [1] / [14])
10 Internal corner profile
11 Roof ridge flashing
12 Sealing strip of type 2 according to Table 2 in [26]
13 Sprayable sealant of type 4 according to Table 2 in [26]

Detail 33: Wall abutment at top of slope – Case 2

With bent-up lower flange for pitches ≥ 7 % and < 10 %
With bent-up lower flange + profile filler for pitches ≥ 5 % and < 7 %



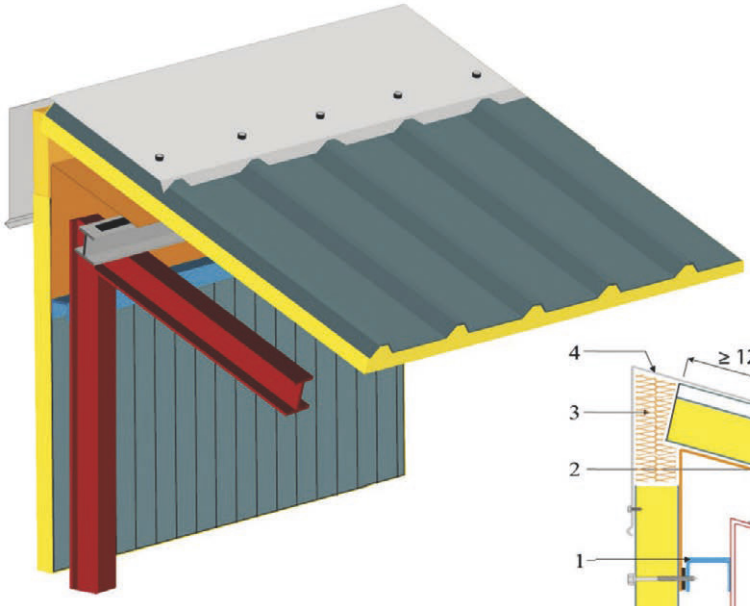


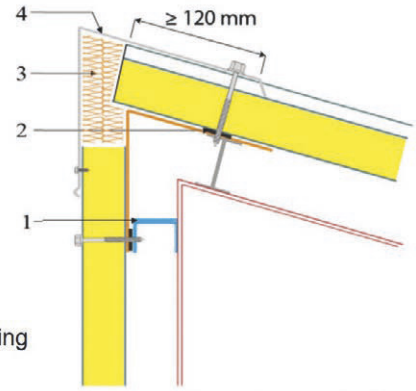
1: Sealant – 2: Additional insulation
3: Soffit sheet – 4: Apron flashing

©Programme PACTE

C.12 Monoroof ridge

Detail 34: Monoroof ridge

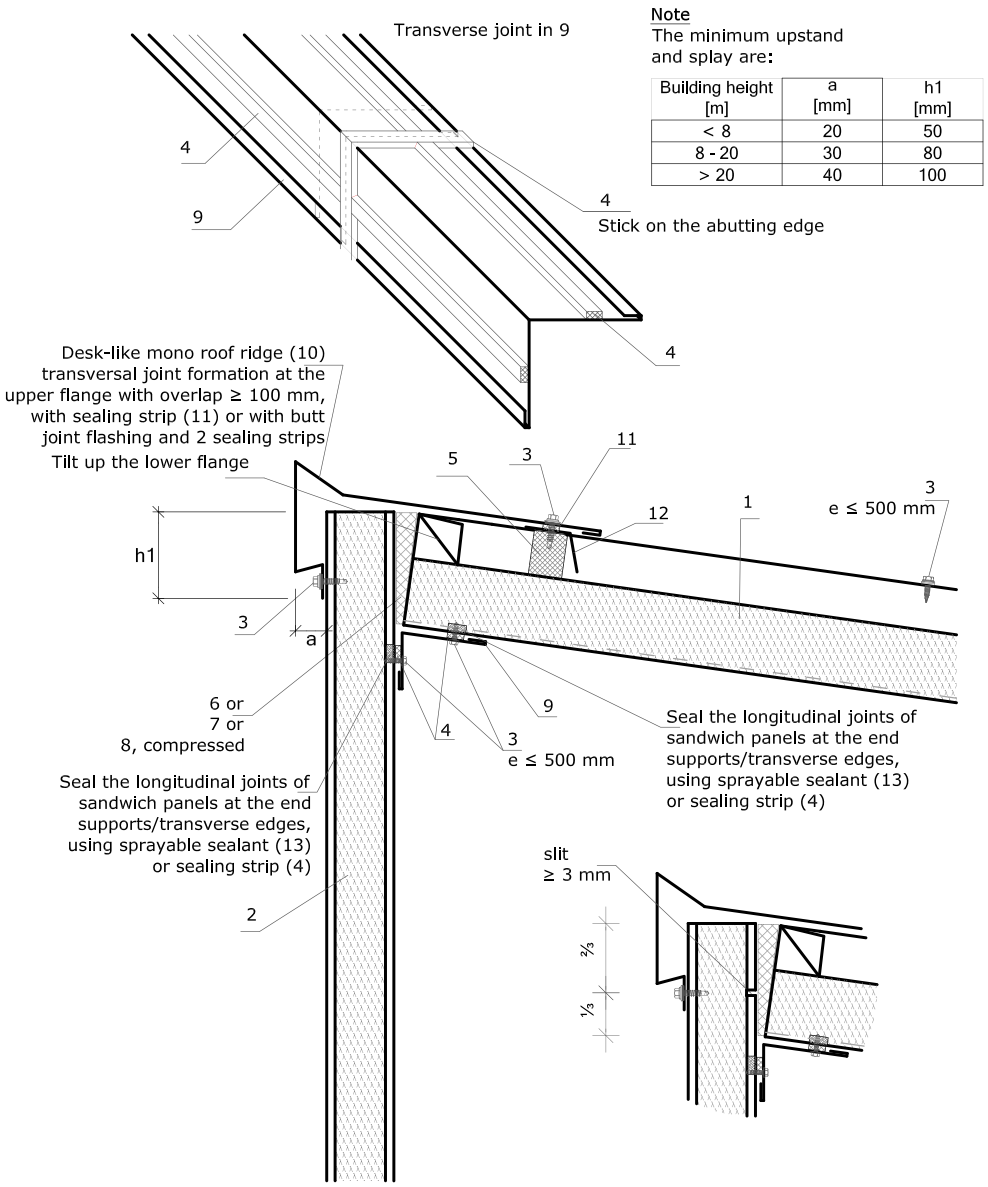




1: Cladding rail – 2: Sealant
3: Additional insulation – 4: Roof ridge flashing

©Programme PACTE

Detail 35: Monoroof ridge – Construction detail recommended in Germany

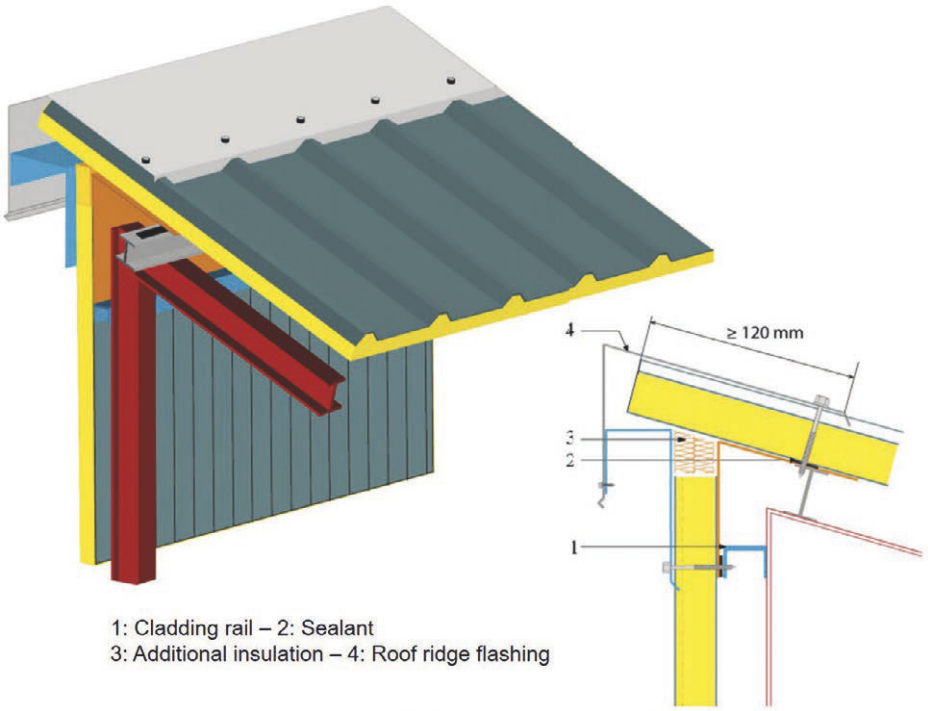


Note:

Key

1 PU or MW core sandwich panel for roof applications
2 PU or MW core sandwich panel for wall applications
3 Screw with sealing washer according to abZ / aBG Z-14.1-4 or ETA
4 Sealing strip of type 1 according to Table 2 in [26]
5 Profile filler of type 6 according to Table 2 in [26]
6 PU (expandable) foam
7 Polyethylene (PE) soft foam strip
8 MW insulation material, application type DAD dk (according to [3]), non-combustible (according to [1] / [14])
9 Internal corner profile
10 Roof ridge flashing
11 Sealing strip of type 2 according to Table 2 in [26]
12 Flashing with profile closer (optional)
13 Sprayable sealant of type 4 according to Table 2 in [26]

Detail 36: Monoroof ridge with overhang beyond wall

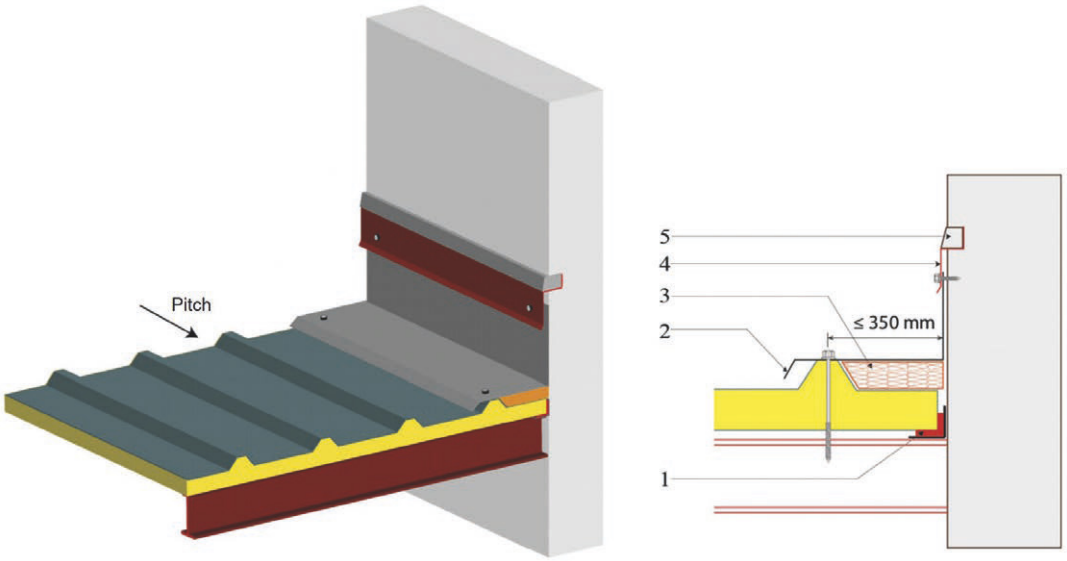


1: Cladding rail – 2: Sealant
3: Additional insulation – 4: Roof ridge flashing

With bent-up lower flange for pitches ≥ 7 % and < 10 %
With bent-up lower flange + profile filler for pitches ≥ 5 % and < 7 %

C.13 Wall abutment

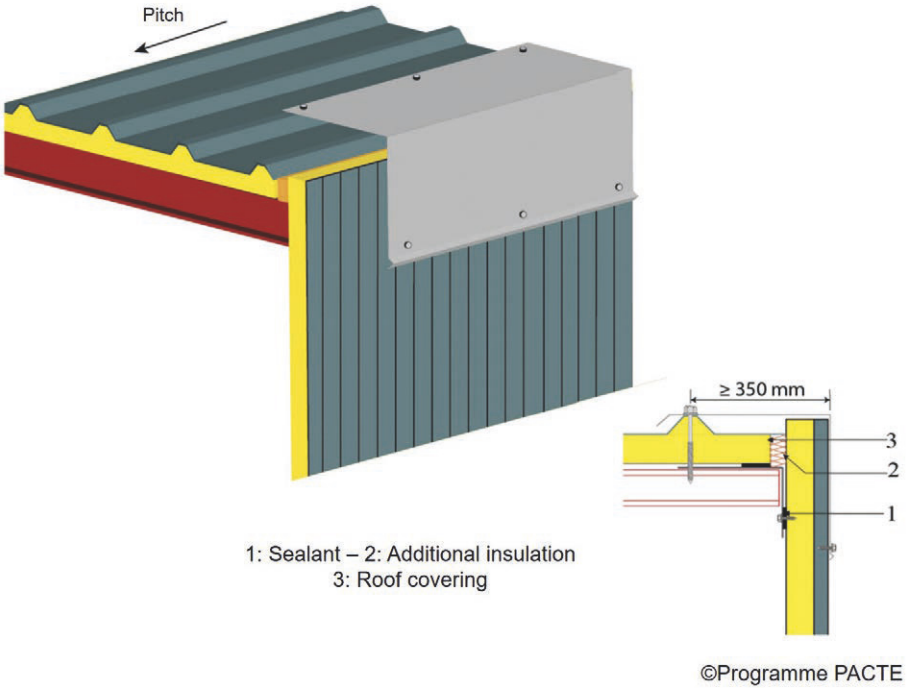
Detail 37: Wall abutment



1: Elements to ensure airtightness – 2: Apron flashing
3: Additional insulation – 4: Flashing – 5: Cement fill

C.14 Verge flashing

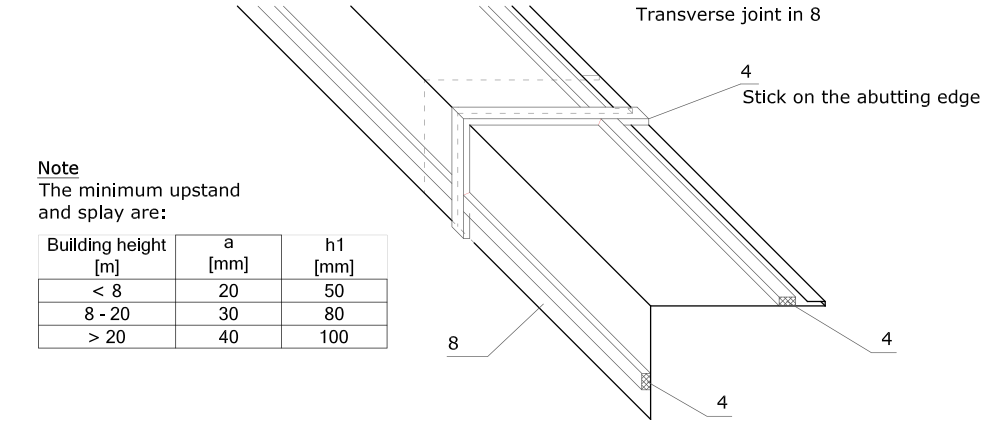
Detail 38: Verge flashing



1: Sealant – 2: Additional insulation
3: Roof covering

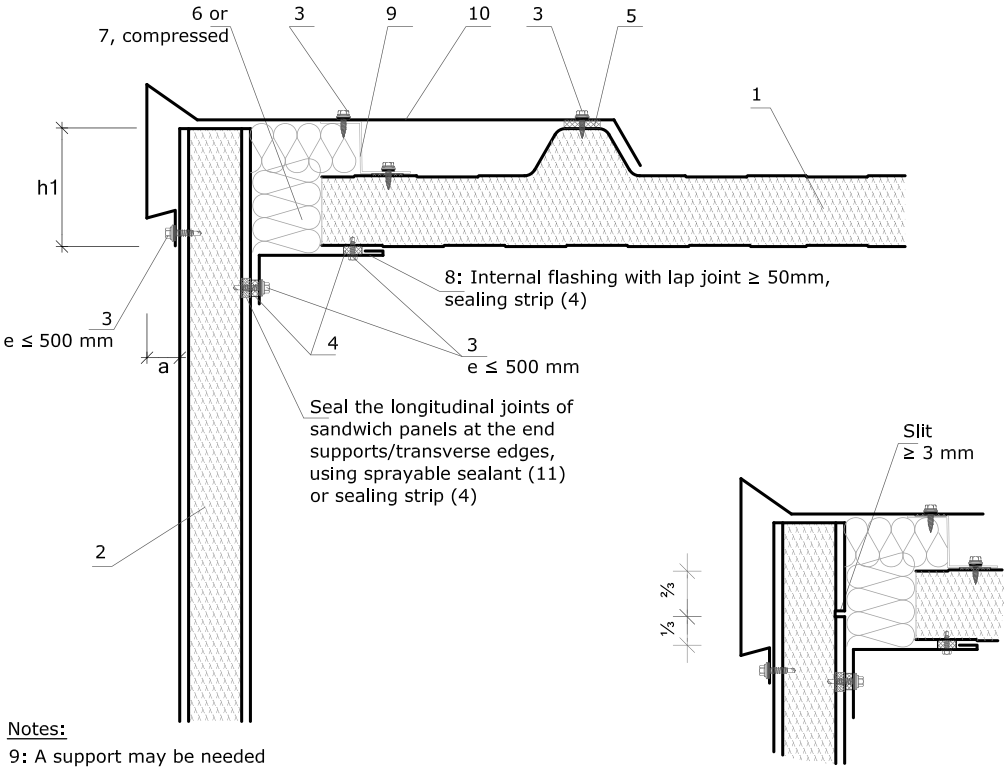
©Programme PACTE

Detail 39: Verge flashing – Construction detail recommended in Germany



Note
The minimum upstand and splay are:

Building height [m]	a [mm]	h1 [mm]
< 8	20	50
8 - 20	30	80
> 20	40	100

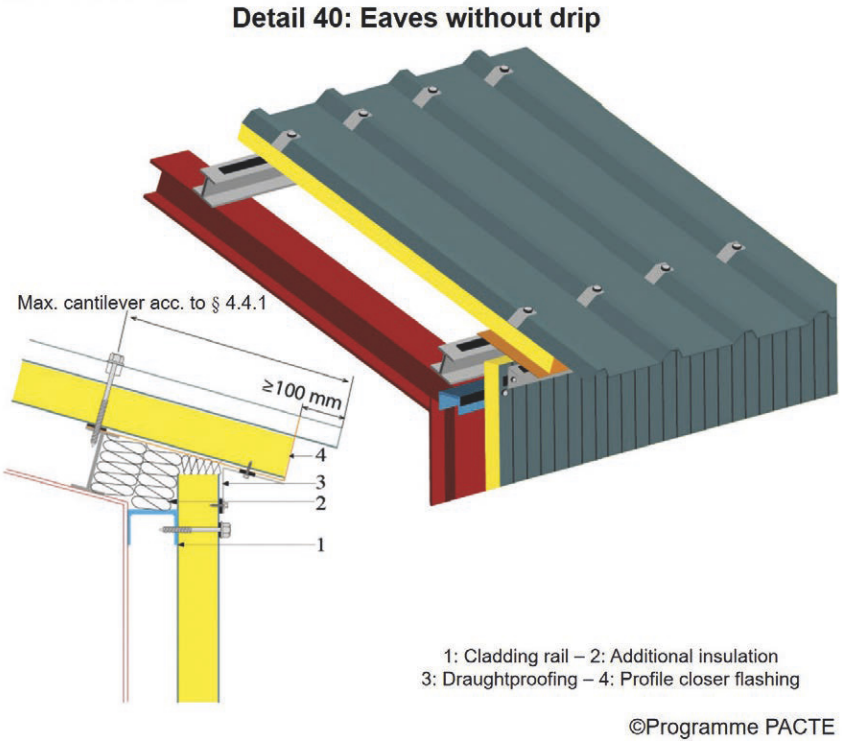


Notes:
9: A support may be needed
10: External flashing with overlap joint ≥ 100 mm, 2 x sealing strip (5).

Key

1 PU or MW core sandwich panel for roof applications
2 PU or MW core sandwich panel for wall applications
3 Screw with sealing washer according to abZ / aBG Z-14.1-4 or ETA
4 Sealing strip of type 1 according to Table 2 in [26]
5 Sealing strip of type 2 according to Table 2 in [26]
6 PU (expandable) foam
7 MW insulation material, application type DAD dk (according to [3]), non-combustible (according to [1] / [14])
8 Internal corner profile
9 Spacer (support) profile, $t_N \geq 1.00$ mm
10 Gable end flashing
11 Sprayable sealant of type 4 according to Table 2 in [26]

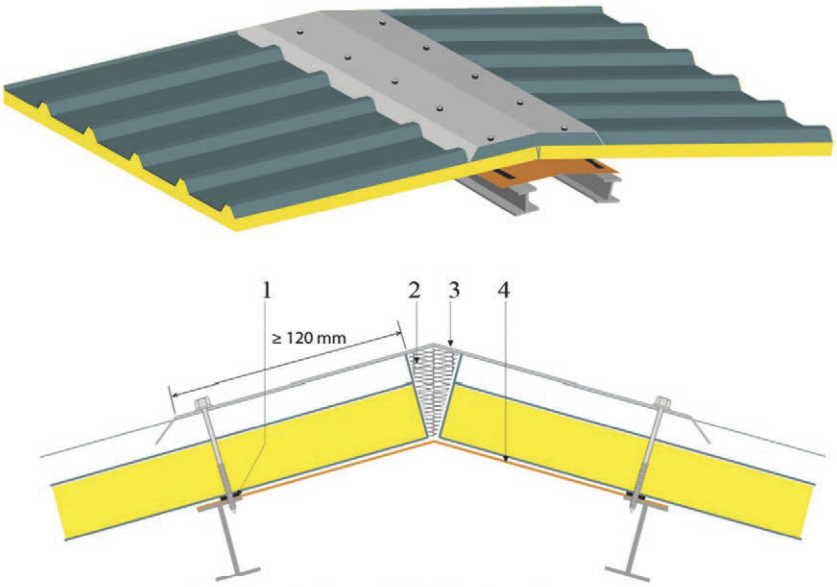
C.15 Eaves without drip



A profile closer flashing with sealing strips must be installed at the internal junction between the roof and the wall.

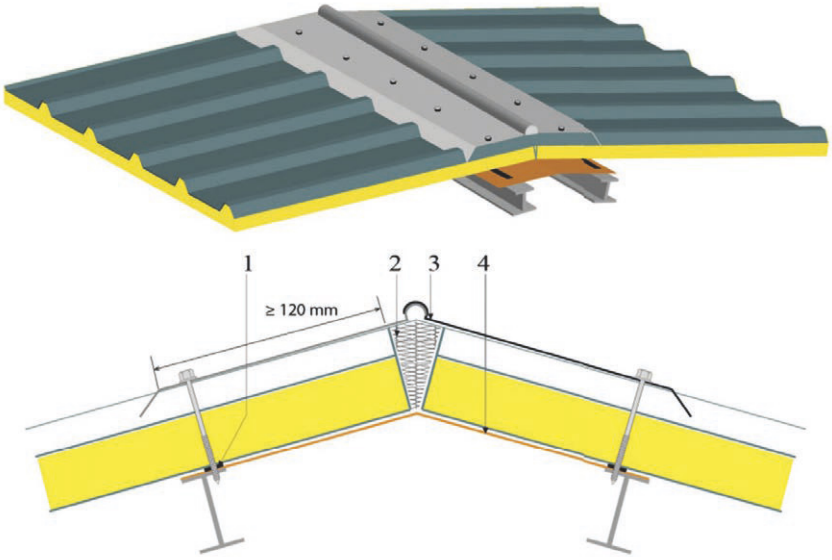
C.16 Duopitch roof ridge

Detail 41: Duopitch roof ridge flashing



1: Sealant – 2: Additional insulation
3: Duopitch roof ridge flashing – 4: Ridge lining plate

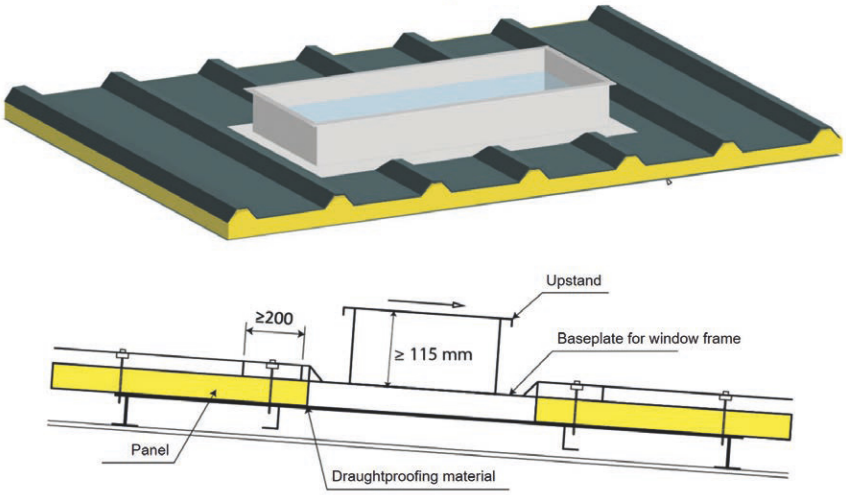
Detail 42: Roof ridge flashing with flange



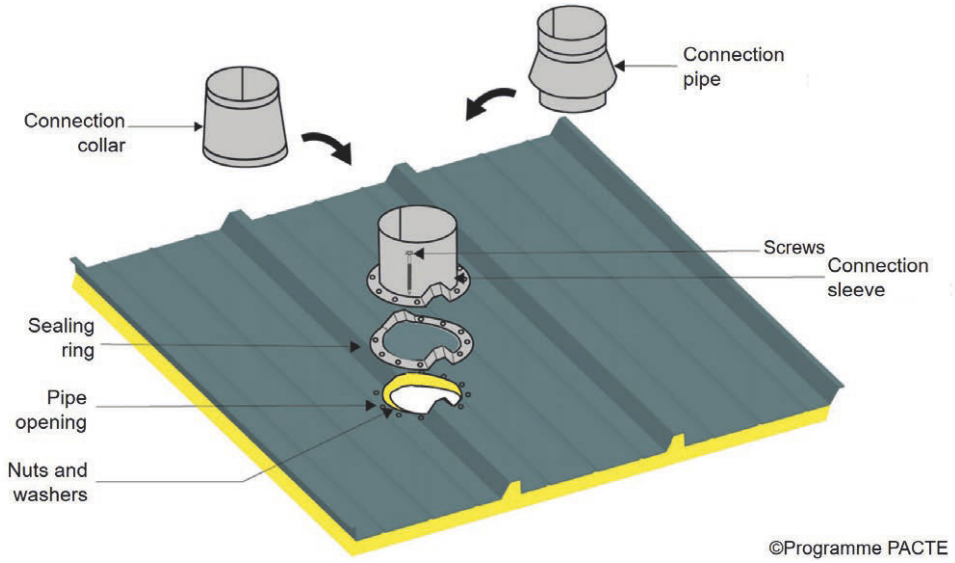
1: Sealant – 2: Additional insulation
3: Duopitch roof ridge flashing – 4: Ridge lining plate

C.17 Upstands

Detail 43: Upstand

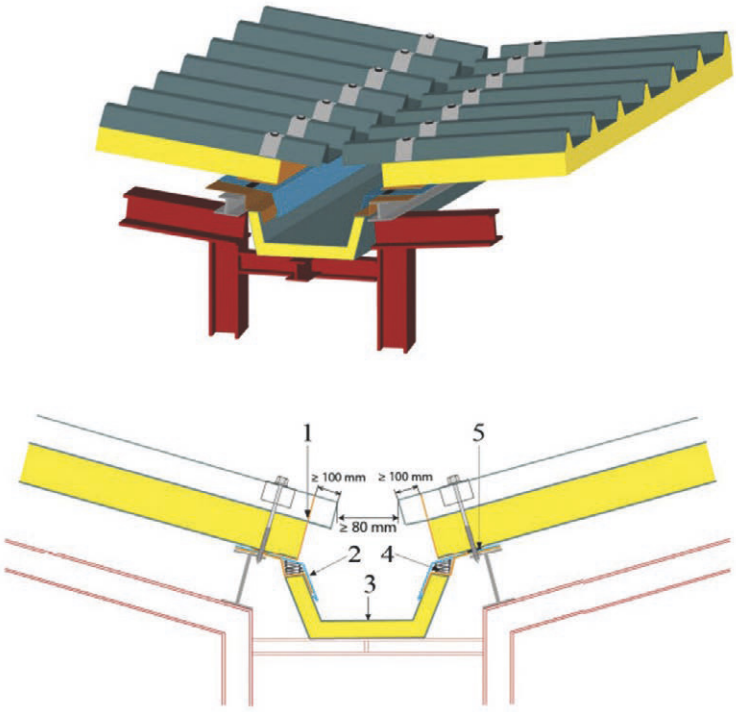


Detail 44: Mounting plate



C.18 Valley gutter

Detail 45: Valley gutter



1: Profile closer flashing – 2: Apron – 3: Insulated valley gutter
4: Additional insulation – 5: Sealant