BUILDING ENVELOPES

constructed from

SANDWICH PANELS

GUIDE TO THE INSTALLATION OF SANDWICH PANELS

BRUCHA®

BRUCHA Ges.m.b.H.
Tel.: +43 (0) 2275 5875
Fax: +43 (0) 2275 5875 1804

A-3451 Michelhausen
Rusterstraße 33
E-mail: office@brucha.com
web: www.brucha.com

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C O N T E N T S

1. BASIC PRINCIPLES

1.1 Purpose of this guide

The object is to hand over to the client a high quality building envelope. Ultimately, quality means the requirements of the customer have been fulfilled. The basic requirements of building envelopes are in order of increasing priority:

- Building Regulations (dependent on location of the building)
- EU-Building Directive EPBD 2002/91/EC (Energy Performance of Buildings Directive) together with the 6 mandatory technical directives:
    - Directive 1 on Mechanical Strength and Stability
    - Directive 2 on Fire Protection
    - Directive 3 on Hygiene, Health and Environmental Protection
    - Directive 4 on Safety in Use and Accessibility
    - Directive 5 on Sound Insulation
    - Directive 6 on Energy Conservation and Thermal Insulation
- European Standards (n.b. beware of possible national preambles and references to additional national regulations)
- National standards that apply exclusively in the European member state where the building is located (also cantonal regulations in Switzerland).
- Other agreements with the customer.

This guide is intended to provide designers, fabricators and end customers with a supporting document for dealing with sandwich panels. The details and specifications of solutions given here as examples can be used analogously for the detailed project planning of designers and fabricators. As a rule, manufacturers do not assume any liability for the planned and executed services and details of the fabricators.

1.2 Standards

The following references are essential for the application of this guide. Where references are dated, only the referred version is valid. Where references are undated, the latest edition of the document (including all revisions) is valid. In the case of legislative provisions the currently valid version must always be used.

ÖNORM EN 1990: Eurocode – Principles of structural design;

ÖNORM B 1990: Eurocode – Principles of structural design – Part 1: Building construction – National specifications and supplements;

ÖNORM EN 1991: Actions on structures / all parts;

ÖNORM B 1991-1-1: Actions on structures – national specifications;

ÖNORM B 1991-1-3: Eurocode 1 – Actions on structures – Part 1-3: General actions – Snow loads – National specifications concerning ÖNORM EN 1991-1-3, national comments and national supplements (13 pages + map);

ÖNORM B 1991-1-4: Eurocode 1: Actions on structures – Part 1-4: General actions – Wind loads – National specifications concerning ÖNORM EN 1991-1-4 and national supplements;

EN 1090-1: Execution of steel and aluminium structures – Part 1: Assessment and verification of constancy of performance for aluminium load-bearing members.

EN 1090-4: Execution of steel structures and aluminium structures – Part 4: Technical requirements for cold-formed steel structural elements and load-bearing components for roof, ceiling, floor and wall applications;

ÖNORM B 2110: General contract provisions for construction works – Standard for contracts for work and services;

ÖNORM B 2215: Timber construction works – Standard for contracts for work and services;

ÖNORM B 2221: Building plumbing work – Standard for contracts for work and services;

ÖNORM B 2225: Metal construction works, fabrication of steel and aluminium supporting structures and corrosion protection works – Standard for contracts for work and services;

ÖNORM B 2230-3: Painting – Contract standard – Part 3: Coating on metal;

ÖNORM B 2501: Drainage systems for buildings – Design, construction and testing – Supplementary guidelines to ÖNORM EN 12050 and ÖNORM EN 12056;

ÖNORM B 3417: Safety equipment and classification of roof surfaces for use, maintenance and repair;

ÖNORM B 3418: Planning and execution of snow protection systems on roofs;

ÖNORM B 3419: Planning and execution of roofing and wall cladding;

ÖNORM B 3521-1 Planning and execution of metal roofing and wall cladding – Part 1: Building plumbing work manufactured by hand;

Fachregel Spengler Planning and execution of metal roofing and wall cladding: Plumbing work – industrially manufactured roof and wall elements;

ÖNORM B 3691: Planning and execution of roof waterproofing;

ÖNORM DIN 18202: Tolerances in building construction – Structures;

ÖNORM EN 508, Parts 1-3: Metal sheet roofing products – Specification for self-supporting roofing elements made of steel sheet, aluminium sheet or stainless steel sheet;

ÖNORM EN 516: Prefabricated accessories for roof coverings – Equipment for access to the roof – Walkways, treads and single steps;

ÖNORM EN 517: Prefabricated accessories for roof coverings – Safety roof hooks;

ÖNORM EN 795: Protection against falls from a height – Anchor devices – Requirements and test methods;

ÖNORM EN 988: Zinc and zinc alloys – Requirements for rolled flat products for construction purposes;

ÖNORM EN 1873: Prefabricated accessories for roof coverings – Plastic skylight domes – Product specifications and test methods;

ÖNORM EN 1991-1-4: Eurocode 1: Actions on structures – Part 1-4: General actions – Wind loads (consolidated version);

ÖNORM EN 10027-2: Designation systems for steels – Numbering system;

ÖNORM EN 10169: Continuously organic coated (coil coated) flat steel products – Technical delivery conditions;

ÖNORM EN 10346: Continuously hot-dip coated flat steel products, technical delivery conditions;

ÖNORM EN 12056-3: Gravity drainage systems inside buildings – Part 3: Roof drainage, design and dimensioning;

ÖNORM EN 12951: Prefabricated accessories for roof coverings – Permanently installed roof ladders – Product requirements and test methods;

ÖNORM EN 14509: Self-supporting sandwich panels with metal facings on both sides – Factory made products – Specifications;

ÖNORM EN 14782: Self-supporting roofing and cladding elements for internal and external use made of metal sheet – Product specification and requirements;

ÖNORM EN 14783: Fully supported roofing and cladding elements for internal and external use made of metal sheet – Product specification and requirements;

ÖNORM EN ISO 14588: Blind rivets – Terms and definitions (ISO 14588:2000);

ÖNORM EN ISO 14589: Blind rivets – Mechanical testing (ISO 14589:2000);

ÖNORM M 7778: Installation planning and installation of thermal solar collectors and photovoltaic modules;

1.3 Warranty in accordance with Section 922 ABGB [Austrian Civil Code]

(1) Anyone who supplies others a good in return for payment guarantees that it complies with the agreement. He thus warrants that the item has the agreed or commonly expected properties, that it complies with its description, a test specimen or sample and that it can be used in accordance with the nature of the transaction or of the agreement entered into.

Standards: These are the accepted rules of engineering and good practice and represent the agreed or commonly expected properties.

1.4 Use of sandwich panels

Roof and wall cladding of industrial, commercial, agricultural and private buildings; general cladding; machine and switch room enclosures; ceilings; partitions; supervisor's cabins; cold stores and freezer stores and rooms etc. They are suitable both for interior and exterior applications.

1.5 Description of sandwich panels

Single-skin, insulated roof and wall claddings consisting of industrially manufactured composite elements (sandwich elements). The elements are fixed directly to the substructure, and when they are properly installed are capable fulfilling all the functions of the building envelope (structural, air-tightness, thermal insulation, sound insulation, fire protection and weather protection etc).

1.6 Production

Sandwich panels, whether they have an insulating core of polyurethane foam or mineral wool, are manufactured in continuous production lines.

2. TERMINOLOGY

2.1 CE Mark

Building products are those that fall within the scope of the Construction Products Regulation (BauPVo) EU 305/2011. The CE mark can be found on the packaging or accompanying documents. ÖNORM EN 14509 is the harmonised European standard for the production of "Self-supporting sandwich panels with metal facings on both sides – Factory made products – Specifications".

2.2 Product categorisation

Sandwich elements belong to the group of composite elements. A sandwich element is a building product that comprises two metal facings arranged on both sides of a core consisting of a thermal insulant, which is so frictionally bonded to both facings so that the three components act together under load.

2.3 Sandwich panel

Self-supporting composite element, consisting of two metal facings with a rigid core of polyurethane foam or mineral wool, which is capable of supporting both its self-weight and imposed loads (eg snow, wind, internal air pressure) and to transfer them into the supporting structure.

2.4 Sound insulation panels

Self-supporting composite panels consisting of two metal facings with a rigid core of mineral wool (usually rock wool), whereby the inner facing is manufactured from perforated sheet metal.

2.5 PU foam

Polyurethane foam is a petrochemical product consisting of polyol and isocyanate, propellant and accelerants offset with fire retardant elements.

2.6 Mineral wool

Rock wool with a high compaction grade and a maximum density up to 160 kg/m³. The flashpoint is > 1,000° C, which is why panels with this infill material are classified as incombustible.

2.7 Rainproof

The property of a roof finish or wall cladding, including all joints and flashings, that prevents the ingress of rainwater run-off, blown snow, driving rain and dust. The ingress of standing water, such as the watertight welding of the components of the roof substructure, must be prevented by additional measures.

In the case of wall cladding panels, the ingress of small quantities of water is insignificant provided it can be safely drained away on the back of the wall cladding.

NOTE: Watertight roofs can only be installed with waterproofing systems in accordance with ÖN B 3691.[Design and execution of roof waterproofing]

2.8 Airtightness and wind impermeability

For conditioned buildings without ventilation, the current regulations (ÖIB-Richtlinie 6, ENEV 2015) permit a maximum air change rate of $n50 \leq 3$. In rooms with a controlled ventilation system the maximum value is $n50 \leq 1.5$. Lower values are permissible, but must be specially agreed between the end user and the installing company.

Conditioned buildings require an energy certificate. Airtightness is measured by the blower door test.

2.9 Wall cladding, wall linings

Generic term for coverings of, and attached to, external walls.

2.10 Crown and trough

Refers to the top and bottom parts of the corrugations of profiled sheeting, decking and sandwich panels, (also known respectively as ‘crest’ and ‘trough’).

2.11 Sandwich panels for roof and wall elements

The provisions of the Austrian standards ÖNORM EN 14782, ÖNORM EN 14783 and ÖNORM EN 14509 apply to product specifications.

Regardless of the structural requirements, the normal minimum material thickness of the metal facings of sandwich elements is 0.5 mm.

NOTE: Where the material thickness is less than 0.50 mm, it is likely that the metal additional strengthening will be required in the form of additional profiling. Sandwich elements with metal sheets with a thickness of < 0.50 mm should therefore only be used for components where aesthetics is not an issue.

For materials such as flashings for roof and wall joints, roof drainage, separating layers and coatings, the provisions of ÖNORM B 3521-1 [Design and construction of roofing and wall coverings of metal] shall apply.

2.12 Eco-roof elements

Due to the continuous foaming process, creases can occur on the Erin foil during the production process. This phenomenon is purely optical and therefore has no effect on the technical functions of the elements.

These creases are system-related are therefore not grounds for complaint.

3. DESIGN

3.1 General design information

The provisions of ÖNORM B 3521-1 apply to the design of sheet metal roofing.

When designing wall and roof cladding, the expansion and contraction of the profiled sheeting and flashings must be taken into consideration.

Permitted manufacturing tolerances of sandwich panels (refer ÖNORM EN 14509) and temperature-related changes in length must be taken into account when designing the width of joints.

The roof construction above conditioned spaces must be determined with regard to the building physics requirements of ÖNORM B 8110.

In the design of roof and wall cladding from industrially manufactured products the following aspects must be given particular consideration:

- The intended service life and the type of building use with regard to possible consequences of damage (see Service Life Catalogue 2020, ISBN 978-3-200-07044-8);
- The bearing capacity and fitness for purpose of every roof, wall and ceiling construction must be verified through structural calculation, including connecting elements and fixings.

  NOTE: Unless otherwise agreed, the client is fundamentally responsible for providing the structural calculations. The panel manufacturer is not liable for the consequences of underpinned roof, wall and façade coverings.
- The standards ÖNORM EN 1991-1-4 and B 1991-1-4 contain all of the relevant parameters for the calculation of wind loads (basic values for the basic wind speed and pressure depending on location, division of the roof into the respective areas, and external and internal pressure coefficients);
- The physical requirements of the building such as thermal insulation, sound insulation, airtightness, wind impermeability in accordance with the applicable ÖNORM standards, especially the airtightness of the entire surface of the building envelope enclosing conditioned spaces, including all connection details;

- Wall and roof penetrations must be dimensioned and positioned by the designer;
- For Group 3 exterior colours and depending on the local conditions (in particular on south and west-facing elevations), heat accumulation may result in increased linear expansion of the outer cover tray and at internal angles of the outside panels. In this case, a sliding panel fixing must be allowed for, taking into account the wind pressure and suction loads.
- Type of coating, anti-corrosion protection and coating thickness (surface protection systems) must be specified in the light of the relevant environmental influences and any special exposure to chemicals, where applicable.

  The following specification criteria must be taken into account:
  - Resistance to mechanical loading;
  - Thermal resistance to high surface temperatures of construction elements;
  - Resistance to weathering;
  - Resistance UV radiation;
  - Gloss retention;
  - Anti-chalking properties;
  - Colour retention;
- The provisions of ÖNORM B 3417 [Safety equipment and classification of roof areas for use, maintenance and repair] for the classification of roofs with regard to safety equipment for subsequent works;
- The coating of the soffits of projecting profiled sheeting, sandwich elements etc must be selected with regard to their aesthetic and climatic requirements. Reverse side protective coatings are unsuitable for these areas;
- Snow guards in accordance with ÖNORM B 3418 [Design and construction of snow protection systems on roofs];
- The design and installation of solar panels in accordance with ÖNORM M 7778 [Assembly planning and assembly of thermal solar collectors and photovoltaic modules];

3.2 Resistance to driving rain

Sandwich panel roofs and wall claddings are classified as impervious to rain. All junctions and joints executed on the site must satisfy this requirement.

3.3 Chalking

The chalking of organic coatings when the panels are used outdoors is a natural, common process and does not constitute grounds for complaint.

3.4 Garden fences, free-standing walls outdoors

Such structures must be designed in such a way that, in the case of PU panels, the inner skin of the panel is always coated in a colour from colour group 1 and the core insulation thickness of the elements is at least 60 mm. The outer skin of this panel can be coated in a colour of groups 2 and 3. If, however, different RAL colours in colour groups 2 and 3 are desired on both sides, sandwich panels with an insulating core of mineral wool must be used. In this case all junction joints must be made rainproof.

3.5 Sandwich panels with cover shells made of stainless steel plate

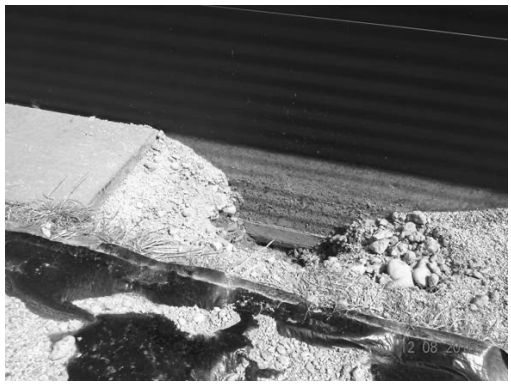
Production-related surface corrugations of the cover sheets are generally unavoidable, common and regulated in Table 4 of the product standard EN 14509. With polished stainless steel sheets, this leads to distortions of the mirror images and thus to increased conspicuousness.

3.6 Wall cladding installation system

3.6.1 General

Facades must be designed so that the sandwich panels do not extend below ground level irrespective of the direction in which they are installed. The embedding in earth, covering with gravel or similar, and setting in asphalt or concrete is prohibited.

The following sketch defines a minimum distance of 150 mm between the surrounding floor level and the lower edge of the drip profile:

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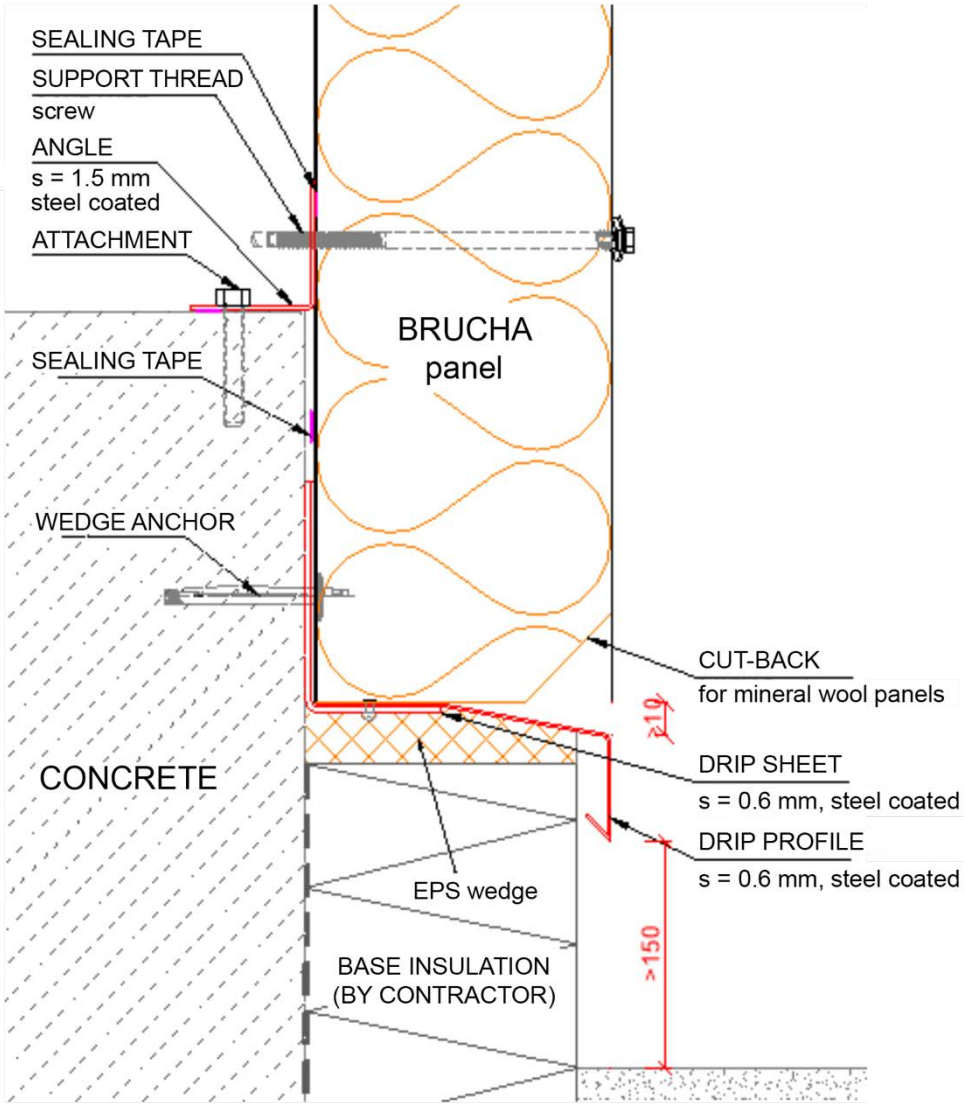

SEALING TAPE
SUPPORT THREAD
screw
ANGLE
s = 1.5 mm
steel coated
ATTACHMENT
SEALING TAPE
BRUCHA
panel
WEDGE ANCHOR
CUT-BACK
for mineral wool panels
≥10
DRIP SHEET
s = 0.6 mm, steel coated
DRIP PROFILE
s = 0.6 mm, steel coated
CONCRETE
EPS wedge
>150
BASE INSULATION
(BY CONTRACTOR)

3.6.2 Vertical Installation

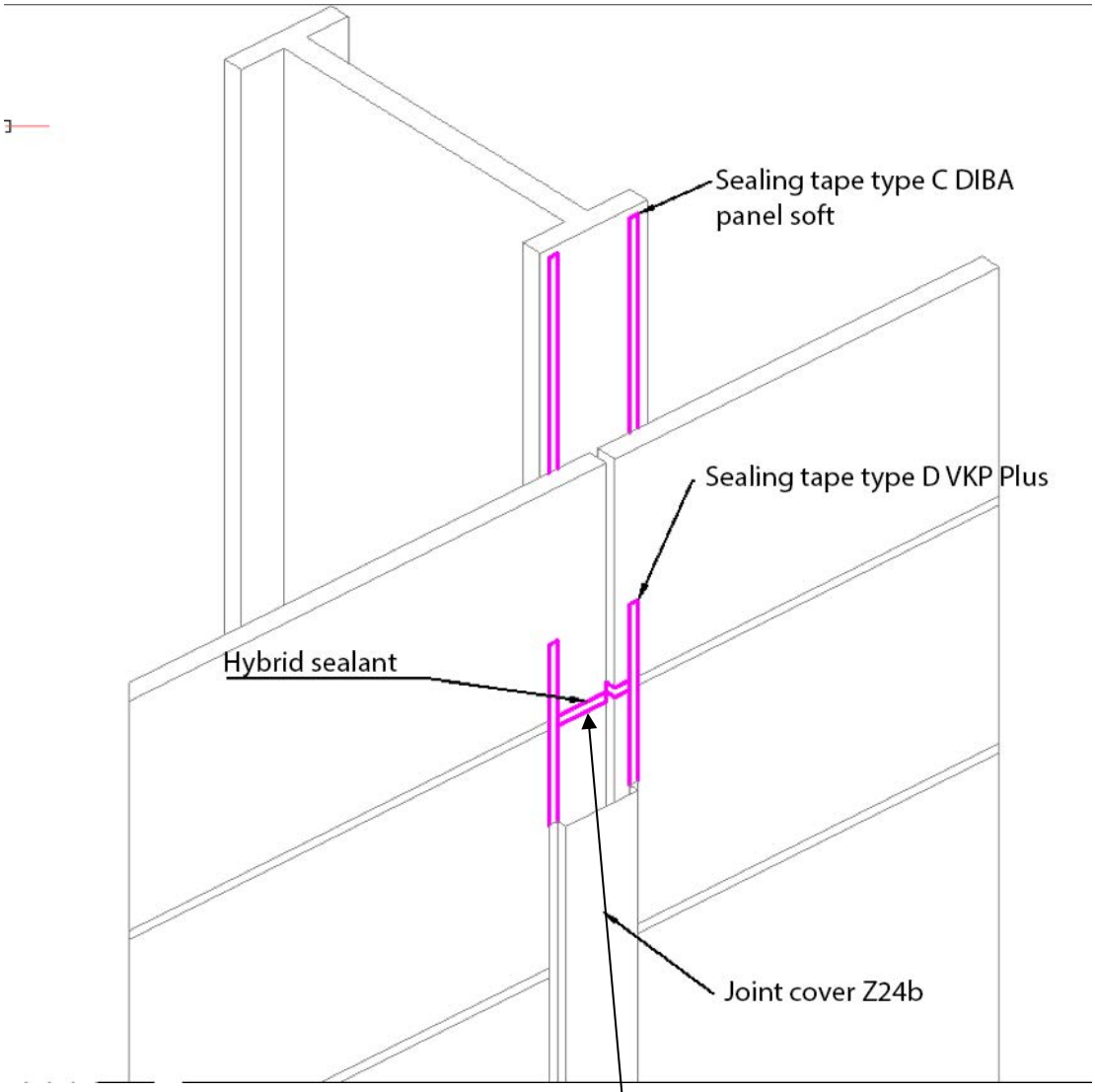
If the panels are installed vertically a suitable substructure of steel or timber sections must be provided. Care must be required bearing width and the span of the horizontal rails. The rails must be visually inspected to check that they are properly sized and fixed (duty to check and warn). A stable, thermally separated cill detail must be constructed. Care must be taken to ensure the panels fit together exactly. The thermal expansion of the outer skin occurs in the vertical direction. The expansion path for the sheet must be unobstructed and on no account be restricted. There bottom edge of the panel must be terminated neatly. Care must be taken to ensure water can drain freely through the gap between the panel and the cill (8–10 mm) and to allow for expansion of the outer skin. When panels are installed vertically it is unlikely that water can penetrate the vertical joints, provided any water leaking into the vertical seam is properly channelled to the outside. Where attachments or extensions are required to vertically installed sandwich PUR panels, a one-sided 45°upward cut must be made with a hand-held circular saw to allow for the insertion of a flashing. It should be noted that due the weakening of the panel, it may be necessary to insert an additional horizontal sheeting rail.

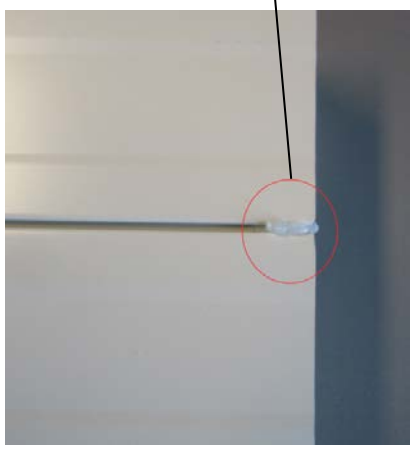
3.6.3 Horizontal installation

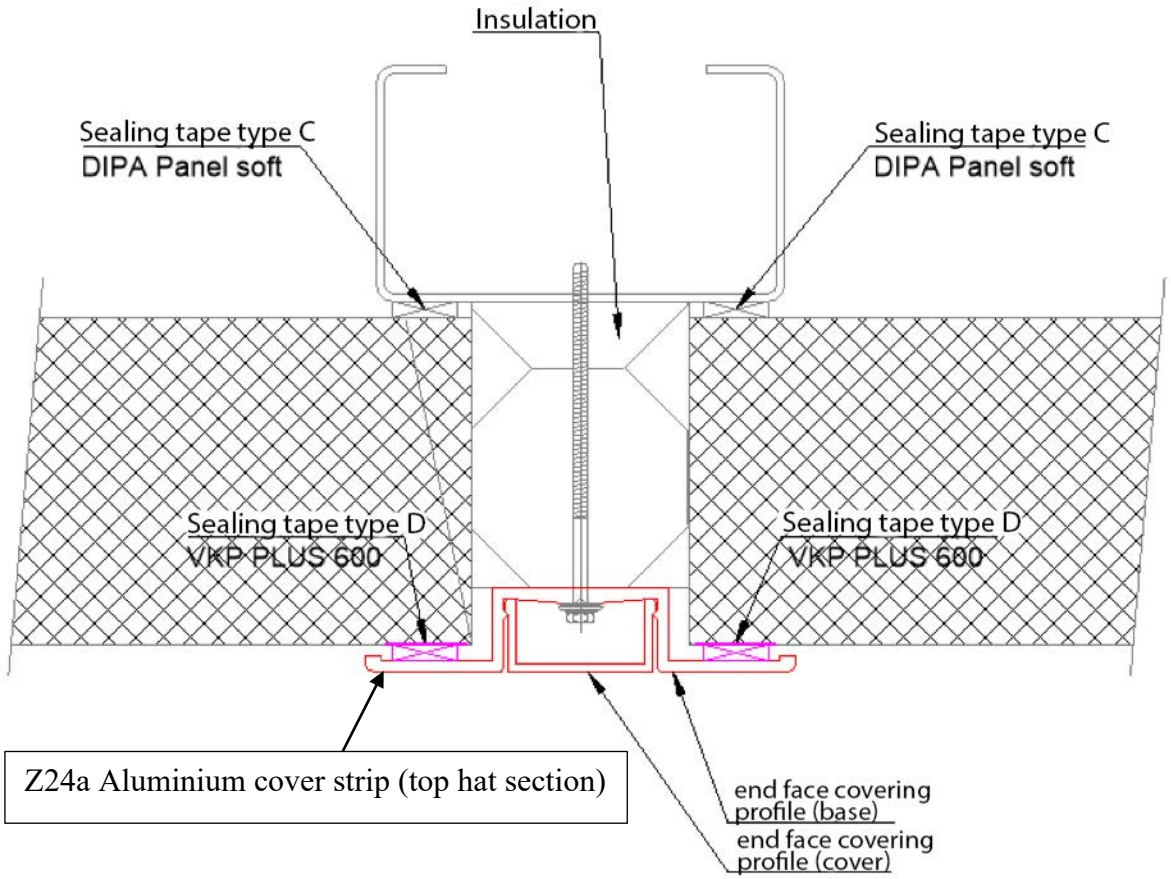
If properly organised, this type of installation is essentially quicker. Usually this involves having to bridge spans between supports of up to 6.00 m. Often the panels are installed as a continuously supported double-span system. With this type of installation, the full extent of the bimetallic effect or thermal bowing becomes apparent, depending on the colour group of the outer skin. There are constructional measures that must be taken to ensure the panels are properly fixed to the building structure and at the same time enabling free movement where necessary. Only narrow windows $\leq$ 1.20 m wide may be directly inserted in the wall cladding (i.e. without a trimming frame construction).

Regardless of the type of core insulation, care must be taken at the interfaces between the edge plates running vertically or at an angle to the panel joints to ensure that the horizontal panel joints are each sealed at these locations with a permanently elastic,

transparent hybrid sealant (e.g: Würth Bond + Seal). Particularly sandwich panels with a mineral core insulation can suffer irreparable damage due to water ingress.
The illustrations below show the proper method of execution regarding this subject.





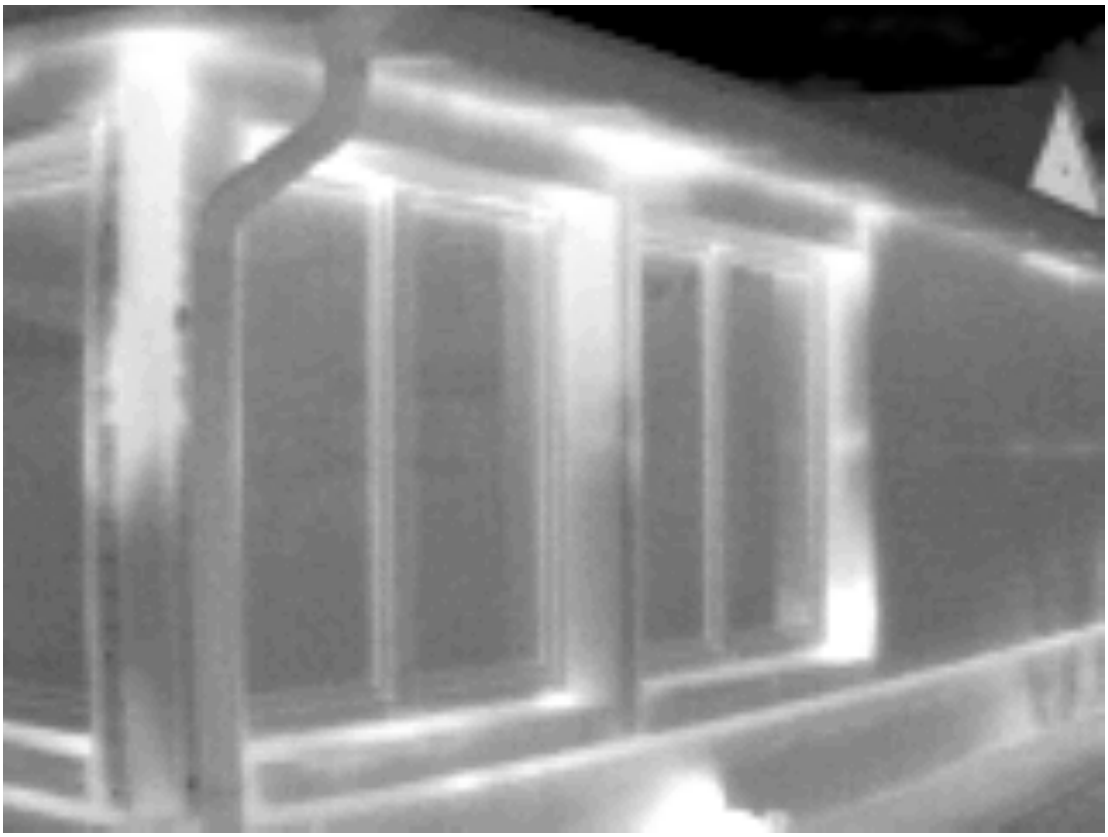


3.7 Heating and ventilation of the building

According to OIB Guideline 6, if the building has a controlled ventilation system, the maximum permitted air change rate of the building envelope is 1.5. If another heating system is installed without a ventilation system, the air change rate would then be 3. The client or their designer must inform the cladding contractor about the required n50 value (number of air changes per hour), otherwise the values from OIB Guideline 6 are valid. The air change rate of the building envelope is measured with the blow door system.

The additional costs for the proper sealing of the joints on site are moderate and bear no relation to the total price of the building envelope. The additional costs are soon written off due to the savings in heating costs.

Artificial fog generated on the inside can be used to assist in leak detection. Depending on the temperature difference between outside and inside, the use of thermographic cameras can be very helpful in detecting leaks in the building envelope in conjunction with the blower door.



The bright spots on this thermographic image indicate air leaks along the wall/roof panel junction, the plinth detail, the joints around the windows and also leaks along the horizontal panel joint, right in the image.

3.8 Statutory minimum insulation values of conditioned buildings (OIB Guideline 6)

OIB Guideline 6, which applies to the production of building envelopes made of lightweight metal construction elements, has been declared binding in the building technology ordinances of all nine Austrian provinces. The values given in the table below are binding for conditioned buildings. A building is considered to be conditioned if it is permanently heated to $\geq$ 5° Celsius in winter or cooled in summer.

	Component part	U-Wert [W/m²K]
1	WALLS exposed to outside air	0,35
2	WALLS adjacent to unheated or unconverted roof spaces	0,35
3	WALLS adjacent to unheated parts of a building that must be kept frost-free (except roof spaces) and garages	0,60
4	Basement WALLS	0,40
5	WALLS (partitions) between apartments or production premises	0,90
6	WALLS adjoining other buildings on plot or site boundaries	0,50
7	Small areas of outside WALL (e.g. dormers) that do not exceed 2% of the total wall area of a building, provided they are in conformance with Ö-Norm B 8110-2 (Preventing Condensation)	0,70
8	Internal WALLS within residential and business premises	-
9	EXTERNAL WINDOWS, FRENCH DOORS and GLAZED DOORS in residential buildings	1,40
10	EXTERNAL WINDOWS, FRENCH DOORS and GLAZED DOORS in non-residential buildings	1,70
11	Other TRANSPARENT vertical CONSTRUCTION ELEMENTS exposed to the outside air	1,70
12	Other TRANSPARENT horizontal or sloping CONSTRUCTION ELEMENTS exposed to the outside air	2,00
13	Other TRANSPARENT vertical CONSTRUCTION ELEMENTS exposed to unheated parts of buildings	2,50
14	ROOF WINDOWS exposed to outside air	1,70
15	Unglazed DOORS exposed to outside air	1,70
16	Unglazed DOORS exposed to unheated parts of buildings	2,50
17	Roller shutters, sectional doors etc. exposed to outside air	2,50
18	INTERNAL DOORS	-
19	CEILINGS AND SLOPING ROOFS exposed to outside air and roof spaces (ventilated or uninsulated)	0,20
20	CEILINGS adjacent to unheated building parts	0,40
21	CEILINGS adjacent to self-contained residential and business premises	0,90
22	CEILINGS within residential and business premises	-
23	FLOORS exposed to the outside air from below (e.g. over a passageway or car park)	0,20
24	CEILINGS adjacent to garages	0,30
25	FLOORS in contact with the ground	0,40

The minimum core insulation thickness of the sandwich panels is determined by the minimum U-value specified by law in the table above. Sandwich panels with an insulating core of mineral wool have a significantly greater panel thickness for the same U-value than comparable sandwich panels with a PU insulating core. It should be noted that mixing these two panel types in the area of fire compartments will result in depth jumps in a façade or height offsets on a roof covering. This is either to be accepted or to be taken into account by the building designer.

3.9 Use of sandwich panels in residential buildings

The climate in living spaces generally places increased demands on the building materials and materials used. The choice of material, therefore, requires critical consideration and assessment by the respective planner. If sandwich panels are used for building envelopes on living spaces or only parts of them, the planning of controlled living space ventilation is recommended. Otherwise, not only all building connections to other trades, but also all internal longitudinal and, if necessary, transverse butt joints must be sealed airtight.

3.10 Use of sandwich panels in livestock buildings

Depending on the use of the barn or hall for livestock and recreational animal husbandry, increased requirements may apply to the coatings of the galvanised sheet steel surfaces, especially on the room side, but also on the outside. The standard coating of 25µm polyester varnish may well be unsuitable for horse, cattle, pig, chicken sheds, etc. The building owner, respectively the planner, respectively the installation company is obliged to inform himself in chapter 5 of this installation guideline or the expert staff of the panel manufacturer about the coating that is suitable for the intended use and then to order it.

Recommendation: The chemically aggressive deposits in the vicinity of fan ridges in stable buildings must be regularly removed by cleaning by the stable operator, otherwise damage to the coating will occur.

3.11 Snow loads

The snow loads are to be determined according to the specifications of ÖNORM B 1991-1-3. In Austria, the local snow loads are to be determined directly on the snow map at www.hora.gv.at. For roofs with a roof pitch $\leq 30°$, a reduction factor of the characteristic value on the ground of 0.8 can be applied. In roof areas where drifting can be expected, higher values must be applied, see the relevant requirements of EN 1991-1-3. Along the edge of the eaves a linear loading of S_k x 0.5 must be applied.

3.12 Wind loads

Wind pressure and wind suction loads shall be determined in accordance with the requirements of ÖNORM B 1991-1-4. Panels must be calculated for their bearing capacity with respect to the wind loads acting on the site. Wind suction values must be determined to calculate the number of screws for panel fixing to the substructure.

3.13 Substructure

These load-bearing elements (purlins, cladding rails, trimmers for windows, personnel doors and industrial doors) transfer loads from snow, ice, wind pressure and wind suction into the structure. Particular reference should also be made here to any increased snow loads in the area of vertically rising elements more than 1m high. Substructures must be dimensioned on the basis of EUROCODES, taking into account the load conditions prevailing on the site. Substructures are load-bearing structures and must be CE marked in accordance with the Construction Products Directive EU 305/2011.

3.14 Panel lengths

Surcharges will be charged on panel lengths under 2.5 m, on small quantities. The surcharges are applied to the shorter lengths because in the factory the 'flying saw' cannot cut such short lengths, therefore the panels have to be finished manually. Minimum quantity surcharges are applied because when feeding in the material for the minimum required quantity or changing over to another profile or profile thickness, an unavoidable quantity of waste is produced.

Sandwich panels can be produced in excess length subject to consultation with the manufacturer. The transport, unloading and assembly of overlong panels require special arrangements by the fabricator.

3.15 Calculation of panel thickness

The wind pressure, wind suction and snow loads are the basis for the design of the span in addition to the panel thicknesses resulting from the required insulation value. The requirements can be found in the ÖNORM standards B 1991-1-3, B 1991-1-4 and the OIB Guideline 6.

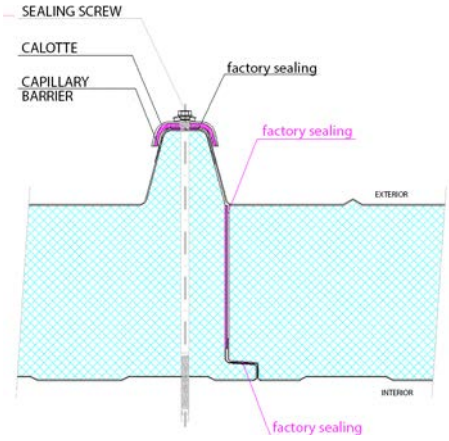
3.16 Calculating the number of fasteners for panels and flashings

Ideally, the gravitational forces (dead loads) of the panels should be transferred to the building structure or the foundation by placing them on a load-bearing substructure (e.g. support brackets), or panel fastening screws transfer the gravitational forces that occur via transverse forces through the screw into the sheet metal cover shell closest to the substructure. Panel fixing screws are fundamentally unsuitable for transmitting moments of force.

Wind suction loads also the basis for determining the number of fasteners (screws, bolts, self-tapping screws, rivets). The pull-out loads of the fasteners must be obtained from the manufacturer's technical approval certification. The partial safety factors γ_M 1.33 (screws) 1.5 (wind) and 1.25 (two-span beams) must be taken into account. The characteristic pull-out loads from the ETA approvals of the screw manufacturers must be taken into account for the fastening screws.

3.17 Factory-installed seals in panels

Joint sealing tapes must be of the closed cell foam and be compressed to 60 % of their initial thickness when assembling the panels on site.
When planning, it must be ensured that wall and façade panels, which are used against outside air have an internal joint sealing tape.
Roof panels must have a joint sealing tape, a sealing tape in the overlap joint on the high bead and an internal sealing strip in the fold. For roof panels, the inner joint tolerance is 2 mm +/-2 mm.



3.18 Sealing of site-formed joints

On envelopes of heated or cooled (conditioned) buildings, the inner level must be supplemented and closed in all connection areas by closed-cell sealing tapes (e.g. WÜRTH sealing tape Paneel Soft).

Plinth, door, gate and window lintel area: 20x10mm (Art.-No.: 0875200201), bind sheet in the middle to reduce the thermal bridge.

Side and top seals: 15 x 4.5mm (Art.-No.: 0875200201) normally glue in one row. Inner sheet metal panelling: 15 x 4.5 mm (Art.-No.: 0875200201).

These sealing tapes are only effective when they are compressed to 60 % of their original thickness. The spacing of the fasteners must be specified accordingly.

External joints must be made driving rain-proof using sealing tapes open to diffusion (e.g.: Würth VKP or equivalent) 300 Pascal up to 12m installation height and 600 Pascal from 12m installation height.

External joints of horizontally-mounted wall or façade panels are to be sealed locally at the intersections with vertically running elements using permanently elastic hybrid sealant in such a way that no precipitation water can get behind cladding sheets, see point 3.6.3.

Properties	Type A	Type B	Type C	Type D	Type E	Type K	Type G	Type L	Type I	Type M
Designation	Sealing tape Diba Paneel Soft 15/4,5	Partition wall tape B1	Sealing tape Diba Paneel Soft 20/10	Sealing tape VKP Plus 600	Butyl tape ALU	EPDM sealing tape interior	EPDM sealing tape	Sealing tape VKP Trio 750	Compression-resistant rubber underlay	EPDM sealing tape exterior VSK
e.g. Würth Art. No.	0875 200 154	0875 303…	0875 200 201	0875 021 …	0875 620..	0875 350 …	0875 850 330	0875 46. …	0681 018 062	0875 350 ..6
Application	Self-adhesive sealing tape for interior use between panel and cover angle	Acoustic decoupling, against creaking noise, thermal breaks	Self-adhesive sealing tape for interior use between panel and substructure	External joints, vapour permeable, impermeable to driving rain	Wall abutment seals, watertight connections	Vapour-tight and flexible sealing tape, window and element sealing, waterproof	High resilience and maximum protection against water ingress, optimal underlay for snow guards	Sealing of butt joints and window frames, airtight seal	Doubling at transverse joint, one-sided self-adhesive	conneciton joints, sealing of components; waterproof and breathable
Cellular structure	Closed cell	Closed cell	Closed cell	Open cell	-	-	Closed cell	Open cell	-	-
Material	PVC foam	PE foam	PVC foam	PUR foam	Butyl rubber with aluminium facing	EPDM rubber	EPDM cellular rubber	PUR foam	Rubber	EPDM- natural rubber
Annotation	-	-	-	-	-	-	-	airtight by polymer film	Hardness 65 shore	
Building material class DIN 4102-1	B1	B 1	B 1	B 1	B 2	B 2	-	B 1	-	E DIN 13501
Tensile strength	160 kPa	longitudinal 325 kPa transverse 220 kPa	160 kPa	-	-	>= 8MPa	-	-	40 kg/cm^2	>= 6MPa
Bulk density	110 kg/m³	29 kg/m³	110 kg/m³	110 kg/m³	1.5 g/cm³	-	-	-	-	-
Processing temperature	+10°C to +30°C	+5°C to +30°C	+10°C to +30°C	above +5°C dry	+5°C to +40°C	-5°C to +35°C	+5°C to +30°C	-5°C to +25°C	0°C to +40°C	5°C to +35°C
Temperature resistance	-30°C to +70°C	-50°C to +80°C	-30°C to +70°C	-30°C to +90°C	-40°C to +80°C	-30°C to +120°C	-30°C to +100°C	-30°C to +80°C	-30°C to +90°C	-30°C to +75°C
Vapour permeability	Sd =< 0,9 m	0,72 g/m2/d	Sd =< 0,9 m	Sd =< 0,1 m	Sd => 1500 m diffusion-resistant	sd = ca. 300 m diffusion-break	-	Sd =< 0,1 m	-	Sd = 12 m
Thermal conductivity	-	0.034 W/mK	-	0.05 W/mK	-	-	-	0.048 W/mK	-	-
Joint permeability	No	Yes	No	Yes	No	No	No	No	-	No
Impermeable to driving rain	No	No	No	Yes > 600 Pa	Yes	Yes	Yes	Yes > 750 Pa	-	Yes
UV resistance	Yes	Yes	Yes	Yes*	Yes	Yes	Yes	Yes*	No	Yes
Resistant to weathering	Yes	Yes	Yes	Yes*	Yes	Yes	Yes	Yes*	No	Yes
Compatibility with building materials	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Dimensions in mm	15 x 4.5 mm	30-95 x 3 mm	20 x 10 mm	Variable	40 - 100 mm	70 - 500 mm	30 x 3 mm	54 - 74 mm	50 x 5 mm	70 - 500 mm
Elongation at break	>190 %	>120 %	>190 %	-	-	>300 %	-	-	200%	>250 %
Colour	grey	anthracite	grey	grey	silver	black	black	anthracite	black	black
Shelf life	2 years	2 years	2 years	2 years	1 year	1 year	2 years	1 year	2 years	1 year

Vers.01.Nov.22

3.19 Stiffening of substructures by sandwich panels

Roof and wall cladding elements consisting of sandwich panels must not be used to stiffen a load-bearing construction. It is not possible to stabilise light gauge metal purlins or cladding rails against lateral torsional buckling..

3.20 Noise reduction inside buildings

Climatic effects can cause thermal elongation of sandwich panels with audible crackling and occasionally cracking sounds. These kinds of noises are systemic in metal cladding and do not constitute a defect. Timber substructures respond more easily here than steel substructures. Depending on the sound insulation requirements of the building, appropriate constructive measures must be designed (e.g. decoupling by means of fully bonded partition wall tape on the bearing surfaces between purlins / wall transoms and the inside of the panel). 'Symmetrical screwing' means that fastening screws are always positioned along an upper flange and not offset from each other in the rows of screws. This screw pattern reduces the noise level inside the building.

3.21 Operating temperatures

Temperature effects in excess of 80° C on the surface of the panels caused by the user are not permitted.

Sandwich panels must be installed so that their outer side always faces the warmer side (e.g. in partition walls). For façade sandwich panels, the marking of the outer side is on the long sides, for wall panels the marking is on the inner protective foil.

3.22 Protruding screws on substructures

Protruding or penetrating screws may be visible on the inside or damage the coating on the inner face of the supporting structure, depending on the supporting sections or timber substrate. Projecting fasteners must not be cut back due to CE. If the internal height is less than 2.5 m, the projecting drill ends on the inside must be covered to prevent injury.

NOTE: Fasteners, snow guards and other secondary components made from corrosion-resistant materials are generally not coated. If a colour coating is required it must be specially ordered. Plastic screw caps have not proved themselves when used outside and exposed to the weather.

3.23 Similarity of polyurethane and mineral wool panels

Due to the two different production processes an optically identical surface appearance cannot be expected.

3.24 Sound insulation panels

Due to the perforations of the panel inner shell, these panels do not have a vapour barrier and must not be used for cladding on roofs and walls against outside air in heated buildings. This also applies to indoor use in rooms with a humidity > 50%. In addition, a building physics report must be obtained from a relevant professional during the design phase.

3.25 Installation drawings

Installation layouts and working drawings must be produced to carry out the works. Depending on requirements, the following items must be determined:

- Metalwork schedules with section designation, and details of manufacturer, nominal sheet thicknesses, available stock lengths;
- Set-down points for deliveries;
- Structural systems for the profiled sheeting;
- Installation direction;
- Fasteners with type designation, layout and spacing;
- Special installation instructions depending on the type of connection (e.g.: drill hole diameter);
- Screw anchors, type designation, anchor characteristics, construction component dimensions (centre, edge and corner spacings), anchor base and construction component thickness;
- Details of supporting structure and materials including their strengths, spacing, spacing of fasteners, formation of supporting, falls, details of long and short edges of the installation area.
- Expansion joints;

- Openings in the installation area including necessary trimmers e.g. for rooflights, smoke extract vents, roof drainage, emergency overflows etc.;
- Mountings or hangers (e.g. for pipes cable bundles, suspended ceilings);
- Areas with shear diaphragm effect;
- Structurally effective decking / rigid joints;
- Cut-outs at the eaves;
- Restrictions regarding accessibility of the decking during the construction phase and if necessary also during the installation of insulation and waterproofing;
- Maximum permitted joint width of composite elements in order to ensure adequate seal tightness;
- Location and type of waterproofing using sealants and sealing tapes including dimensions;
- Ordering on the basis of complete elevations to avoid batch-related colour variations;

3.26 Permitted deflections

Unless otherwise specified, the calculated deflections must not exceed the following values:

- Roof sandwich panels: L/200 in Austria due to the national annex to ÖNORM EN 1990, otherwise L/150;
- Roof sandwich panels with external foil seals: L/200 in Austria (see ÖNORM EN 1990;
- Panels on walls: L/150;

The deflection must always be determined at the top flange, small local deflections of the bottom flanges may be neglected. The spacing between measuring points is fixed at 1.0 m.

3.27 Thermally induced panel bowing (bimetallic effect)

The unavoidable bowing of panels caused by differential thermal effects must be taken into account in the detailed design. Thermal bowing results from the differential expansion of the panel facings.

3.28 Temperature-induced movements of metal facings

Thermal movement must be taken into account in designing the panels.

For steel materials this is:

0.01 mm per m length and 1 °C temperature difference

For a 12.00 m long roofing panel with a dark exterior colour (RAL 7016) the calculation is as follows:

Temperature difference: Summer +76 °C + Winter -30 °C = 106 °C

0.01 mm x 12.00 m x 106 °ΔT = 12.72 mm.

For this reason, at transverse joints the outer facings of sandwich panels must never be mechanically connected to each other (screwed or riveted).

3.29 Tolerances of the finished works

Specification of the permitted tolerances and the applicable measuring methods for the finished surface, in particular dimensional accuracy, flatness and variations in colour and gloss level.

In specifying the permitted tolerances for the finished wall and roof areas the product, substrate and assembly tolerances must be taken into account.

Thermally induced elongation and distortions (deflections) are permitted in addition to these.

As a principle, the roof pitch must be determined on the crown of the profiled decking or sandwich elements.

For the visual evaluation of visible surfaces, the provisions of point 11.1 apply.

NOTE: The permitted tolerances for flatness are specified in ÖNORM DIN 18202 Table 3 (next page), line 6.

The design must take into account the material tolerance of the joint width. This is usually ± 2 mm. For the installation, the gap distance is less important than the contact pressure of the seal located in the rebate.

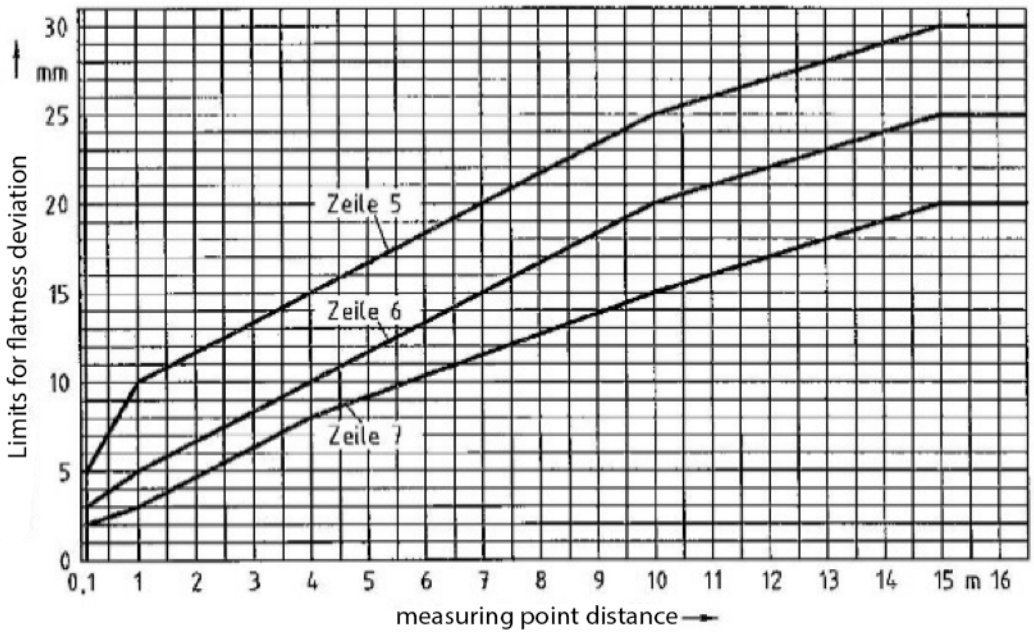
Test possibility: If a steel ruler (15mm/0.7mm) is inserted between the sealing tape and the edge protection paper of the adjacent panel in the butt joint of the panel, regardless of whether it is a roof, wall or façade panel, a firm resistance must appear after a maximum of 20 cm.

Tabelle 3 — Limits for flatness deviation

Spalte	1	2	3	4	5	6
Zeile	Regard	spot measurement limits [mm] for measuring point distances [m] up to				
		0,1	1 a)	4 a)	10 a)	15 a) b)
1	Non-finished upper surfaces of ceilings concrete substrutures and subsoils	10	15	20	25	30
2	Non-finished upper surfaces of ceilings, concrete substrutures and subsoils with higher requirements, e.g.: usage of floating floors, industrial floors, tile and slab floors, compound screeds. Finished surfaces for lower ranked purposes, e.g.: storage rooms, basements	5	8	12	15	20
3	Finished floors, e.g.: Exposed sreeds, screeds ready for floor coverings floor coverings, tilings, smoothed or glued coverings	2	4	10	12	15
4	As in line 3 but with higher require-ments	1	3	9	12	15
5	Non-finished walls and lower surface of raw ceilings	5	10	15	25	30
6	Finished walls and lower surfaces of ceilings, e.g.: plastered walls, wall coverings, suspended ceilings	3	5	10	20	25
7	As in line 6 but with higher require-ments	2	3	8	15	20

a Intermediate values can be found in figures 4 and 5

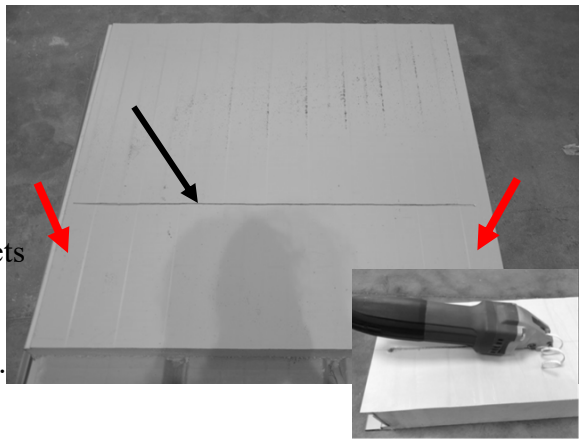
b limits for flatness deviation of row 6 also apply to measuring point distances above 15 m



3.30 Thermal break

Thermal breaks can be arranged in the inner skin to reduce thermal bridging of continuous composite elements around corners. These details must be issued to the cladding contractor; attention must be paid to possible changes to the loadbearing characteristics. The room air parameters of temperature and humidity are critical for whether thermal breaks must be designed. A consultant in building physics must assess the situation at the design stage and determine the relevant specifications.

The lateral seamed webs (red arrows) are not to be cut, they remain as static residual support elements. Here, attention must be paid to the reduction in load-bearing capacity for cantilevered panel parts, as in the case of projections from roof inlets or parapet overhangs. The maximum thermal break depth is 4–5 mm.



3.31 Prevention of cold bridges

Connection details should be formed so that cold bridges are reduced to an unavoidable minimum. At the corners of wall cladding formed of sandwich panels the connection should be made at 45° or the inner skin must be removed in the overlap between the panels. The OIB Guideline 6 states that harmful condensation on the inside surfaces of building components must be prevented. For new build projects and major building renovations the provisions of ÖNORM B 8110-2 must be observed. Any negative effects of cold bridges must be reduced as far as possible, taking into account technical and economic possibilities.

3.32 Airtightness

The joint between the wall and roof elements must be sealed against convection and vapour diffusion with connecting brackets and suitable sealing tapes. The remaining void should be filled with in situ foam or mineral wool.

The verge capping or bargeboard must cover two crowns. Where elements are cut, a Z-section with sealing tape must be installed as a substitute for the crown.

Transverse joints between verge cappings must be formed with adequate overlap but without a direct connection between them.

3.33 Colour consistency

According to EN ISO 11664-4 [Colorimetry. CIE 1976 L*a*b* Colour space] variations of < 2 ΔE degrees are permitted in the colour on a visible surface. The use of a new coil of sheet metal can cause colour variations in subsequent deliveries. Differences, for whatever reason, are not valid grounds for complaint. RAL does not specify any tolerances! We recommend including one or more spare panels in the initial order, otherwise the manufacturer must be provided with the precise order details and informed that it is a follow-up order. It is then possible to use a cover sheet from the original batch for the follow-up order.

NOTE: The visual impression of colours depends on the type of coating.

3.34 Snow guard

Snow rails must be seen and calculated as snow retention systems. The applicable standard ÖNORM B 3418 specifies the rules for this and is to be applied. The regional normative snow loads according to ÖNORM B 1991-1-3 are to be used in the calculation. The current regional characteristic snow loads can be obtained free of charge at www.hora.gv.at for the respective building location and taken into account in the calculation. Only approved snow guard systems with the same fastening materials made of stainless steel, aluminium, hot-dip galvanised or hot-dip galvanised and painted, or hot-dip galvanised and powder-coated steel may be used. If necessary, ice claws are to be planned and installed.

3.35 Solar and photovoltaic panels

Photovoltaic and/or solar systems can be mounted on sandwich panel roofs and façades. Sandwich panels with mineral wool insulation core are not suitable for the attachment of photovoltaic and solar modules. In its guideline 11/2020, the IFBS recommends a minimum coating thickness of ≥ 45µm for roofs with superstructures (PV or solar systems) that are regularly walked on for maintenance purposes.

Basically, the dead and live loads of these components, including their substructures, are to be transferred directly into the substructures of the building (purlins, wall beams). Regardless of this, planners, builders and fabricators are free to install other systems if they consider them suitable. The planner or installer of a photovoltaic and solar system is responsible for the storm-proof and rainproof mounting of the system.

3.36 Fire spread in the ceiling zone

If mineral wool wall or façade sandwich panels are installed as a building envelope on façades of multi-storey buildings to prevent the spread of fire from one storey to the next, highly expandable joint tapes made of fire-resistant polyurethane foam (e.g.: Würth joint system L or equivalent material) or expanded graphite tapes must be installed in the ceiling area prior to panel installation. Due to the complexity involved, you can find out more about this at www.wuerth.at/brandschutz. If necessary, ask an authorised specialist supplier. This measure is connected with the bimetallic effect because, depending on the column spacing, because solar radiation can cause an air gap of between 20 and 60 mm to form between the floors

3.37 Suitable substrates

3.37.1 General

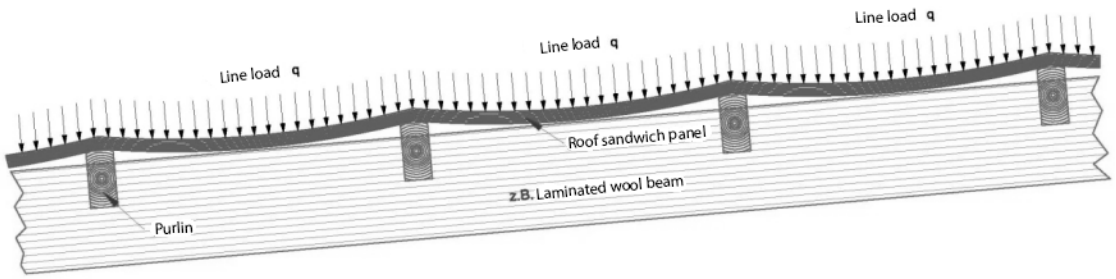
More stringent requirements regarding dimensions, shape and bearing tolerances for substrates must be specified and coordinated with the roof or wall construction where necessary.

The bearing surfaces must be continuously level, without interference from screws, rivets, straps, cover plates or butt plates.

Steel cladding rails and roof purlins must correspond to one of four execution classes (EXC 1 – EXC 4) in accordance with EN 1090-2, components made from sawn structural timber must conform to EN 14081-1.

Bearing surfaces of roof purlins must correspond to the roof pitch.

The supports of the composite roof elements must not block the free deflection of the composite elements, unless the support width is reduced to at least 50% of the max. permissible support width.



Purlins must be installed higher than the top of beam by a height equal to the anticipated deflection plus a safety margin of approximately 15 mm.

Substructures for fire walls made of composite elements must be made of non-combustible materials in the required fire protection qualification. The guidelines of the manufacturer of the composite elements must be taken into account, in particular, when planning the spans.

3.37.2 Tolerances of substrates

Where coverings fixed directly to the substrate, the specified precision of the finished roof and wall cladding is contingent on the permitted tolerances in the substrate. Manufacturing tolerances must also be taken into consideration. As a minimum, the tolerances for enhanced requirements in accordance with ÖNORM DIN 18202 must be observed.

If the nature of the substrate prevents compliance with these tolerances, suitable levelling constructions must be designed.

Constructions that compensate for the substrate tolerances must conform to ÖNORM DIN 18202. Tolerances for steel substructures must comply with ÖNORM EN 1090-2, while for aluminium substructures the tolerance specifications of ÖNORM EN 1090-3 must be observed.

3.37.3 Minimum pitches for insulated roofing panels

The minimum roof pitch must be designed in accordance with the following table subject the type of roofing, longitudinal and transverse joints, valley gutters and roof penetrations.

Other factors to be considered in deciding on the roof pitch include:

- The deflection of the substructure and the panel under the influence of continuous loads and long-acting variable loads. The minimum pitch of the substructure must be maintained under the maximum superimposed load.

- A beam must be selected such that the minimum roof pitch is maintained even with the anticipated deflection in the installed condition. The section must be sized accordingly;
- Transverse joints, where they cannot be welded, should be avoided as far as possible and be substituted by stepped falls;
- The minimum roof pitches apply to profiles with a depth of at least 32 mm on the longitudinal joint.
- In snowy areas (sk > 3.25 kN/m²) the minimum roof pitch given in Table 2 must be increased by at least 3° or a subroof must be designed in accordance with ÖN B 4119.
- Where there is a high risk of ice dams forming the roof must be ventilated with a subroof in accordance with ÖN B 4119 or the anticipated snow conditions must be taken into account in the building physics design.
- In other special climatic conditions such as extreme wind exposure and heavy rainfall intensity, the roof pitch should be increased accordingly as well as where there are especially long lengths of decking.
- Where possible, large roof fittings and penetrations such as rooflight domes, ventilation plant etc that interrupt the flow of water should be positioned on the ridge. Where necessary suitable measures must be designed (e.g. increasing the roof pitch, cross falls above the structures, recessed surrounds);

3.37.4 Bearing widths

Table 1:

Minimum bearing widths in mm			
Bearing type	Steel, concrete	Masonry	Timber
End bearing	40	40	40
Intermediate support transverse joint support	60 90	60 90	60 90

3.37.5 Masonry and concrete substrates

Masonry bearings for roof constructions must terminate on an adequately sized ring beam (concrete).

Where the supporting beams or purlins are of concrete, properly anchored cast-in steel channels must be provided. Suitable products are certified proprietary cast-in channels or steel sections and in exceptional cases steel flats with a minimum thickness of 8 mm.

Insert profiles must be installed flush, if the beam width is more than 1/10 of the span, the channels must be installed at a higher level corresponding to the anticipated deflection.

The installation of composite panels on to extensive areas of concrete and masonry substrate are special constructions and, in some circumstances, dimensional tolerances and fixing options must be checked due to exposure to moisture between the panel and the substrate.

Table 2:

<table>
<tr><th colspan="5">Minimum roof pitch</th></tr>
<tr><td>Pitch</td><td>Transverse joints</td><td>Valleys</td><td>Penetration</td><td>Longitudinal joints</td></tr>
<tr><td>3°–<5°</td><td>No transverse joints</td><td rowspan="4">Recessed to conform with ÖN B 3521-1</td><td rowspan="4">Flat tray to the ridge either as standing seam roofing to ON B 3521-1 or waterproof membrane to ON B 3691

or

Screwed-on sealing flange for penetrations up to 250 mm in diameter.</td><td>Longitudinal joints sealed</td></tr>
<tr><td>≥ 5° – < 7°</td><td rowspan="2">200 mm with seal</td><td rowspan="3">Overlap</td></tr>
<tr><td>≥ 7° to < 12°</td></tr>
<tr><td>≥ 12° to < 20°</td><td>150 mm with seal</td></tr>
<tr><td>≥ 20°</td><td>150 mm</td><td colspan="2">In accordance with ÖNORM B 3521-1:</td><td></td></tr>
</table>

3.37.6 Steel substrates

Regardless of the structural requirements, the material thicknesses must be designed to suit the specified connectors.

3.37.7 Timber substrates

Timber battens and timber decking must conform to ÖNORM B 2215. Battens must be at least 45 mm thick; timber boarding must be at least 22 mm thick.

Edge-glued timber panels must conform to ÖNORM EN 13986 and have a minimum thickness of 22 mm.

Wood-based boards must be at least Class OSB/3 in accordance with ÖNORM EN 300:2006 and have a minimum thickness of 25 mm.

NOTE Where decking and wood-based panels or edge-glued panels are less than 30 mm thick, screws will protrude through the underside.

Battens and boards installed as a double-layer unventilated construction must be impregnated with preservatives against rot. The compatibility with adjoining metallic components must be considered.

3.37.8 Creasing

Especially for sandwich panels on facades and walls, the colour shade of the outer panel skins must be taken into account in the calculation / determination. In the case of wall and facade panels with dark outer skins, the distance between the transoms can be reduced or a greater panel thickness is required. This also applies to darker appearing gloss levels of colours.

3.38 Asphalt works in confined spaces

Bituminous asphalt is usually laid at temperatures up to 160° C and mastic asphalt at 220 – 240° C. In confined spaces this trapped radiant heat is usually sufficient to cause irreparable wrinkling on the inner faces of sandwich panels within a very short period. Therefore, asphalt works in confined spaces may only be carried out if the radiant heat is removed by adequate conventional or mechanical ventilation.

4. INSTALLATION

4.1 General

All connectors and fasteners must be fit for purpose and be appropriately sized for the structural load. The site installation shall conform to the installation plan. The instructions of the relevant building control authority regarding connecting elements must be observed. The only fasteners that may be used are those that have either been officially tested in accordance with an official certification process, or have been tested in accordance with the manufacturers' construction certification for sandwich panels.

For a perfect installation of sandwich panels, the fastener must be screwed in until the seal under the screw head is slightly deformed. This also requires a slight compression of the outer panel face, which may be up to 1 mm deep, in the case of visible fixings. Only special screws with a secondary thread underneath the screw head may be used for visible fixings.

Only fasteners and connectors may be included that comply with the installation instructions specified in the approval document for fasteners and have the characteristic values listed therein and the partial safety factors specified in EN 1993.

NOTE: For screws without a drill tip the bearing capacity of the screw connections is crucially dependent on the diameter of the pilot hole, the nature of the materials and the thickness of the parts being assembled. It is, therefore, essential to observe the drill hole tables of the respective manufacturers from their approvals!

Fasteners in areas directly exposed to weathering must be of stainless steel but welded ferritic steel drill tips are permissible. In atmospheres containing chlorine or similar chemicals, suitable fasteners of a higher grade of stainless steel must be used.

Where fixings are concealed, fasteners must be at least galvanised steel, with a zinc coating of not less than 8 µm.

4.2 Fasteners and connectors for sandwich panels

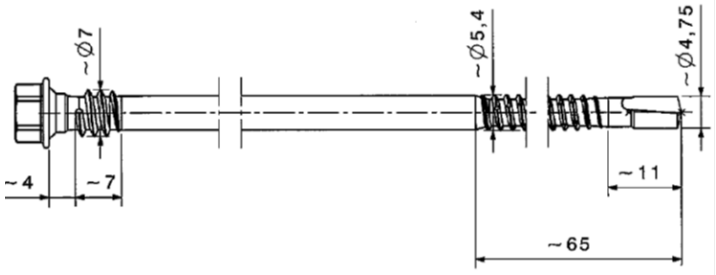
Screws for direct fastening of sandwich elements to walls and façades must have a technically mature underhead thread to prevent dents. The maximum denting depth when fixing wall cladding with visible screws must be limited to a of 1 mm.

When fixing roofing sandwich panels through the crowns suitable storm or saddle washers with a neoprene backing should be used. Especially in connection with timber purlins, screws with bottom head thread are recommended here. This keeps the connection between the sealing washer and the sheet metal outer shell, even if the screw is pushed out of the wood a little by moisture.

Fixing without the storm washers is permissible, provided the fasteners are fitted with a secondary (support) thread (minimum 1.5 kN working load for 0.5 mm sheet thickness).

e.g.: SFS... SXC ... for steel substrates,

e.g.: WÜRTH SANDWICH PIASTA® for steel



e.g.: WÜRTH SANDWICH PIASTA® for wood

Sealing grommets of sandwich panel screws must have a minimum diameter of 19 mm including the EPDM backing. The sealing grommet must be sized to prevent pull-over in relation to the thickness of the outer panel skin. If necessary, use 22 mm diameter sealing washers.

Where fasteners are used on the crown without storm washers, or in the trough the EPDM backing of the sealing grommets must be at least 3 mm thick and a Shore hardness of < 55.

NOTE For the fixing of sandwich panels in the troughs the thickness of the outer panel skin must be at least 0.5 mm with a steel grade of S 320.

For fixing sandwich panels direct to timber substrates only wood screws with fibre cutting drill points should be used.

Suitable pressure distribution plates must be used for fixing sandwich panels through the seams (concealed fixing). In this case, screws may also be used without sealing washers after direct weathering has not occurred.

For the direct fastening of sandwich panels in concrete substrates with concealed fastening, only fasteners with an ETA approval for sandwich panel construction may be used. Direct screw anchors made of galvanised or V4A stainless steel (e.g. SFS / www.de.sfs.com) are suitable for this purpose

Galvanised steel: MDC-S16-7,5x.....

Stainless steel: MXC-S16-7,5x.....

Both types are equipped with an underhead thread. Sealing washers with a larger diameter of 22 mm can be ordered separately.

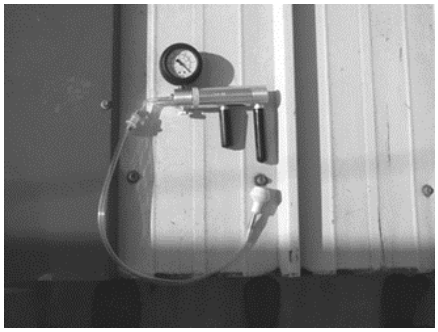
For these direct fixing screws, the company SFSintec has received an ETA approval with the number ETA-20/0115 dated 3 May 2021 with the title “Concrete screws for fixing sandwich panels”.

As a basis for calculating the required number of fasteners, the basic values from the above ETA approval in conjunction with the local wind loads EN 1991-1-4 are to be used. If the basic values of the ETA are not usable or insufficient for a structure, the screw manufacturer’s staff shall determine the failure values and design values by means of direct pull-out tests on the object in accordance with ÖNORM B 6124.

4.3 Longitudinal joint screws

In the longitudinal joint overlaps, non-cutting, material-displacing screws with a set spacing of ≤ 666 mm are to be used.

These stainless steel screws do not cause any drilling chips and are suitable for longitudinal joint and flashing fastening of sheets with max. 2 x 0.88 mm thickness (e.g.: SFS ... SLG-S-S14-4.8x20).



Vacuum leak tester

4.4 Misdrilled holes

Such holes can be repaired with “repair screws” made of stainless steel with sealing washer and EPDM seal (e.g. Würth FABA® type A, art. no.: 020107219, or SFS ... TDC-S-S19-7,1x25, art. no.: 1066788).

Screw diameter 7.1/7.2 mm

4.5 Blind rivets

The provisions of the Austrian standards ÖNORM EN 14588 and ÖNORM EN 14589 apply to product specifications.

Rivets for exterior use must either be of stainless steel or coated aluminium (prevention of contact corrosion) with a stainless-steel mandrel. Uncoated rivets with stainless steel mandrels are permissible with aluminium cladding and for interior use.

NOTE: Because the bearing capacity of riveted connections is also dependent on the diameter of the drill holes, the specified values given in the approval document must be observed.

4.6 Pressure distribution plates

Pressure distribution plates must be used when fixing wall and roofing composite panels through the seams; fasteners must as a minimum be galvanised or of a higher quality material. Sealing washers can be used obligatorily.

5. COATINGS

5.1 General

To prevent colour variations from different batches, orders for panels should be related to complete elevations or the whole building.

Apart from coatings referred to under 4.2 and 4.3, powder coatings in facade quality are permissible.

5.2 Colour groups

Panel colours are divided into three groups that are arranged in order of increasing heat absorption due to the darkness of the colour. The lighter the colour, the more heat energy is reflected and not absorbed by the metal (sheet material).

The temperatures listed in the table refer to measured surface temperatures at an ambient temperature of 27° C.

Colour Group I

RAL	Colour	°C
9010	Pure white	52
9001	Cream	53
1013	Oyster white	54
1015	Light ivory	54
9002	Grey white	54
1018	Zinc yellow	54
1016	Sulphur yellow	55
7035	Light grey	55
6019	Pastel green	55

Colour Group II

RAL	Colour	°C
1001	beige	57
1002	Sand yellow	57
7038	Agate grey	57
7032	Pebble grey	57
9006	White aluminium	57
1007	Daffodil yellow	59
1024	Ochre yellow	59
2003	Pastel orange	60
6021	Pale green	60
1020	Olive yellow	61
7001	Silver grey	61
2000	Yellow orange	61
6018	Yellow green	62
7002	Olive grey	64
6011	Reseda green	64
5012	Light blue	64
2004	Pure orange	64
8003	Clay brown	65
2001	Red orange	65
1000	Green beige	55
1006	Maize yellow	55
1024	Ochre yellow	59
2001	Red orange	64
2004	Pure orange	64
8023	Orange brown	64

Colour Group III

RAL	Colour	°C
2002	Vermilion	67
6010	Grass green	67
8025	Pale brown	68
8004	Copper brown	69
5007	Brilliant blue	69
6001	Emerald green	70
3000	Flame red	70
6002	Leaf green	71
3002	Carmine red	71
6003	Olive green	71
3009	Oxide red	71
5009	Azure blue	71
7015	Slate grey	71
8007	Fawn brown	72
7013	Brown grey	72
5010	Gentian blue	75
8011	Nut brown	75
6005	Moss green	76
7016	Anthracite grey	76
3004	Purple red	76
5002	Ultramarine blue	76
8014	Sepia brown	77
8016	Mahogany brown	78
6008	Brown green	79
5013	Cobalt blue	80
9007	Grey aluminium	80
6020	Chrome green	75
9005	Jet black	93

5.3 Coatings on galvanised sheet steel

Coatings on galvanised sheet steel must conform to ÖNORM B 10169 [Continuously organic coated (coil coated) steel flat products - Technical delivery conditions].

The usual coatings for sandwich panels are 25µm duplex polyester coatings. Other types of coating are available subject to additional charges.

Factory-applied coatings must have a UV resistance of at least RUV2. For applications above 900 m coatings must have a UV resistance of RUV4 in compliance with ÖNORM EN 10169.

Exterior coatings of steel sheets used for manufacturing panels have a minimum thickness of 25 µm.

The designer/processor of this material must specify the most suitable coating for the project and its design requirements

coating type	layer thickness	use case	property
polyester	25my	interior/exterior	RC3, RUV3
PVC film	150my	interior	not UV resistant
PVDF	25my	exterior	RC3, RUV4
PUR-PA	55my	interior/exterior	RC4-RC5 RUV4

Tabelle D.2 — location examples for different UV resistance categories

UV resistance categories	example
R_{uv1}	backside coating for exterior elements
R_{uv2}	regions north of the 45th northern latitude with a maximum elevation of 900m ASL
R_{uv3}	regions south of the 45th northern latitude and north of the 37th northern latitude with a maximum elevation of 900m ASL
R_{uv4}	regions south of the 37th northern latitude with an elevation higher than 900m ASL

Note 1: The given examples represent general benchmarks, because of the differences (even in small areas) in local conditions with regards to sunshine hours and UV radiation

Note 2: For buildings in proximity to marine environment, close to lakes or snow covered areas the UV radiation can be higher due to reflection of the respective surfaces

Table 6 - Relation of corrosion resistance categories, corrosive categories and atmosphere
Typical atmospheres in moderate climates
(see also EN ISO 12944-2)

corrosion resistance category	corrosive category	types of atmospheres					
		rural atmosphere	urban atmosphere	industrial atmosphere	marine atmosphere	air pollution and humidity	coastal atmosphere
RC1	C1 - very low (no conditions)						
RC2	C2 - low						
RC3	C3 - medium			low SO_2 content	low salt content		
RC4	C4 - high			medium SO_2 content	medium salt content		
RC5	C5-I - very high			high SO_2 content			
	C5-M - very hifgh				high salt content		high salt content

[a] based according to EN ISO 12944-2 on the behavior of low carbon steel

[b] see appendix C

Remark 1: The relationship between the corrosivity category and the types of atmospheres is characterized by the grey marked background of the corresponding fields.

Remark 2: It should be noted that the corrosivity under protective roofs and depending on the duration of exposure to moisture may be higher.

Remark 3: When detemining the corrosivity category, access forinspections, maintenance and/or repairs should be taken into account.

5.4 Colour consistency of adjacent building elements

It is quite usual for the colours of various building elements such as windows, doors cladding, sandwich panels etc. not to match each other exactly, even though they were ordered from suppliers with the same colour coding (RAL or NCS etc.).

If a particular colour match and a special gloss level are required, the customer/designer must provide the manufacturer of the sandwich panels with a reference sample in the

desired colour before ordering. If the best possible colour match is required for extensions to existing sandwich panel installations, a piece of reference sheet (approx. 30 cm x 30 cm) from the existing object must be handed over to the panel manufacturer unprompted.

6. ACCESSORIES

6.1 General

Accessories comprise:

- Product-specific prefabricated fittings and suitable roof-mounted components e.g:. fans, vent pipe terminals, rooflights,
- escape windows complete with mounting frame to suit the type of roof cladding.
- Solar and PV units complete with mounting frames and system components for fixing and penetrations, suitable for the type of cladding.
- The provisions of the following Austrian standards are applicable: ÖNORM EN 516, 517 and 795 for fall protection devices;
- ÖNORM B 3418 for snow guards;
- ÖNORM EN 12951 for permanently fixed roof ladders;
- ÖNORM EN 1873 for plastic rooflights.

6.2 Sealants (tapes, mastics foam fillers etc.)

The sealants used must be suitable and resistant for the corresponding application (e.g. air tightness, sealing against water ingress) and compatible with the materials to be joined.

When using tapes to seal construction joints in conditioned spaces the vapour resistance of the tape must be taken into consideration.

Where tapes are used to seal the interior and exterior sides of a joint, the tape on the inside (warm side) must have an Sd value of > 1. The Sd value of the sealing tape on the warm side must be higher than the Sd value of the tape on the cold side (ratio of inside to outside 3:1). The manufacturer's installation instructions must be observed.

6.3 Vapour checks / vapour barriers

The internal building envelope consisting of the internal panel faces also forms the vapour check. In order also to achieve this important condition along the panel joints, during the installation process the factory-applied joint sealing tapes must be

compressed by an amount specified by the manufacturer. Suitable tools must be used where necessary.

7. INSTALLATION

7.1 General

Composite roofing and walling panels must satisfy the requirements of the building envelope with respect to stability, air and wind tightness, thermal insulation, fire protection etc.

NOTE: Particular attention is drawn to the requirements of the OIB Guideline 6 (Austria) and the Energy Saving Ordinance (Germany) and to similar provisions in other countries in their current applicable versions.

NOTE: Rooms must be adequately ventilated, with mechanical systems if necessary.

The provisions of Austrian standard ÖNORM B 3521-1 shall apply.

In particular, the anticipated thermal expansion of the metal sheets must be taken into consideration.

In addition:

The industrially produced roof and wall cladding elements must be installed so that the elongation and contraction of the elements is unhindered or can be accommodated with detrimental effects.

Sandwich panels must not penetrate the surrounding ground level. They must neither be sunk into the earth, nor covered with gravel, nor be embedded in asphalt or concrete.

The panels must be installed in accordance with the project installation drawings.

Panels must be installed plumb and in alignment.

The cutting and processing of the coated outer and inner skins of the sandwich panels may only be carried out with cold cutting machines and tools. Cutting with an angle grinder burns zinc and coating, hot sparks burn into the coating surface, which can lead to rust damage.

Tolerance compensation is not possible with sandwich panels; therefore dimensional deviations are unavoidable. Unless otherwise agreed, the permissible limits of ÖNORM DIN 18202 [Tolerances in building construction - Buildings] shall apply.

Factory-applied protective films (including seals on sandwich panels) must be removed during the installation process they should not be exposed to sunlight for an extended period (see 7.8).

Each sandwich panel must be fixed on the supporting structure before the end of every work session.

Due to risk of falls, cantilevered roof and ceiling panels must be secured against uplift immediately after the installation of each profiled sheet. Panels may only be stored on load distributing boards. The total load must be no higher than can be supported by the purlins, decking and substructure.

For the horizontal installation of sandwich panels prefabricated cover strips or other galvanised multiple folded and coated sections must be installed. Cover strips are to be attached symmetrically on both sides of the outer panel faces.

Visible screw fixings must be arranged in an orderly geometrical pattern.

The ends of projecting fasteners (screws, cartridge-fired pins) must not be shortened.

At roof openings all layers of the roof construction (airtight membrane, insulation layers, bearings for decking etc.) must be connected to the penetrating in accordance with the 3:1 rule.

The ends of roof cladding and the cover tray of composite panels at eaves level must be tapered in the troughs to drain into the gutter (drip detail).

Cutting with angle grinders and similar spark-generating tools is only permitted in exceptional cases, e.g. nipplers, circular saws to be used. Hot metal chips burn into the paint surface and cause rust spots and can ignite the polyurethane foam. Swarf produced by sawing and drilling must be immediately removed from coated surfaces.

The prevailing wind direction should always be taken into account when installing roof cladding.

Sealing works for wall and roofing systems must executed with the specified sealing tapes and / or mastic sealants on the side and end laps and other joints.

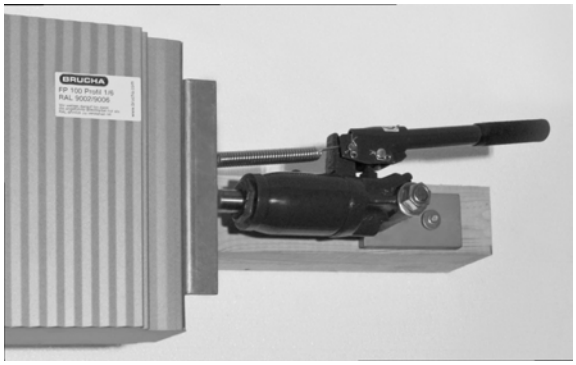
Sound insulation panels must not be integrated into the building envelope exposed to the outside air, because they do not have a vapour barrier!

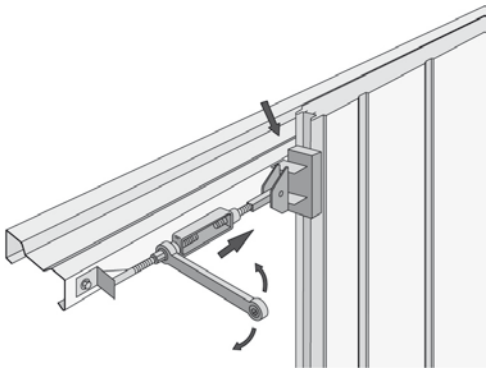
When **sandwich panels are used as a boundary fence** or an **external partition** without covering, the inner skins of these sandwich panels must always be coated white, otherwise bulges and sheet metal detachments may occur. The minimum core thickness is this case is 60 mm!

7.2 Correct panel assembly

In order to achieve the correct degree of compression of the factory-installed seam seals (60% of the original sealant thickness) it may be necessary to compress the panels before fixing them to the substructure.

This requires the use of professional tools:





7.3 Joints between construction elements

These must be insulated with the same material as the panel core in the same thickness. The use of PU foam is only permitted in joints exposed to water. Mineral wool packing must be compressed. Expanded polystyrene absorbs moisture and should be avoided as thermal insulation.

7.4 Thermally induced panel bowing (bimetallic effect)

Thermally induced variation in length can cause bowing of the panels during the assembly phase. This makes it more difficult to assemble the panels, thus requiring the use of mechanical compression aids where necessary. During assembly, the top panel in the package must be protected against direct sunlight.

7.5 Colour harmony across the facades

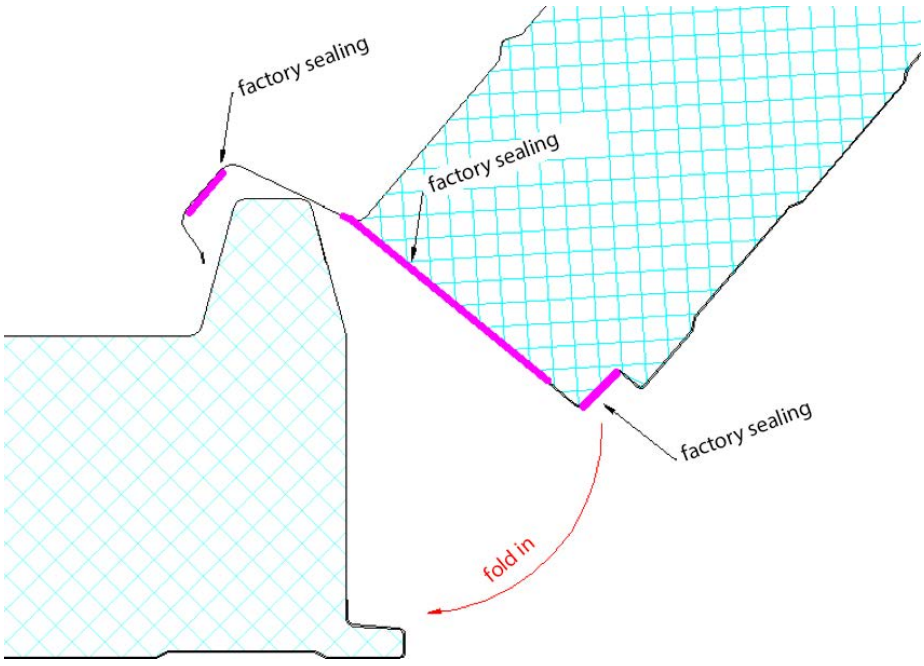
It is inevitable that the sheet metal coils used to make the panels will not be 100% identical in colour from start to finish. The panel packages are usually numbered. The

packages must be installed in numerical order. This is the only way to ensure colour harmony on the facades.

7.6 Assembly of roof sandwich panels

Lifting devices are available on the market that can be used with a crane including vacuum pump and suction plates and mechanical lifting tackle such as lifting clamps. Under no circumstances should the panels be lifted with straps at unprotected edges. This deforms and damages the folds. Attention must be paid to the centre of gravity of the panel and the correct choice of anchor points. It is also important that the lifting points are correctly spaced, otherwise the panel might buckle. Vacuum cups have rubber pads, which prevents damage to the painted surface of the sheet. Suitable protective measures must be taken with mechanical lifting devices. For each installed panel, the proper fit in the overlap area must be observed and checked. After the roof has been installed, corrections in this respect are no longer possible! Incorrect joint formation can lead to large gaps and thus vapour diffusion and condensation due to faulty compression of the factory-installed seals.

For this reason, it is advisable to have a specialist fitter in the hall during the roof panel installation so that he can immediately recognise any splitting errors and react to them!



Safety helmets must be worn when working with a risk of falling objects! No-one may remain in the danger zone! Do not stand under suspended loads! The operating instructions for vacuum suction devices and mechanical lifting clamps must always be observed. The equipment is considered as slinging equipment in the sense of the Work Equipment Ordinance BGBL II 164 / 2000 and must be inspected annually by an authorised person in accordance with Section 8 AM-VO – the inspection book must be kept available for the labour inspectorate at the place of use!

7.7 Assembly of wall and façade sandwich panels with vacuum suction units

When using vacuum suction systems for crane and forklift and telescopic forklift operation, ensure that the suction system is correctly assembled. The operating and instruction manual of the unit must always be reviewed in advance. The specifications contained therein are to be observed. The type, size and number of suction plates, their spacing, alignment and the type of rubber seals on the suction plates must be exactly matched to the type of sandwich panel to be lifted (PU or mineral wool). In the case of mineral wool panels, the sheet metal cover may detach from the insulation body. Failure to observe these instructions may result in irreversible plastic deformations in the shape of the suction pads that are clearly visible on the finished façade. The equipment required for the respective panel must be requested from the manufacturer or the equipment rental company. The panel manufacturer accepts no liability for any damage in this respect.

7.8 Protective films

Ideally, protective films (diffusion-open, perforated) applied at the factory should be removed completely from the sandwich panel surfaces immediately after installation, and must, in any case, be removed at the latest 10 weeks after the panel production date. Otherwise, adhesive residues and impurities will remain on the panel surfaces. Protective films must not be removed at temperatures below -25°Celsius and above +60°Celsius.

If sandwich panels with protective film are stored for a longer period of time, condensation may form between the protective film and the surface coating of the panel under suitable climatic conditions. Especially with metallic colours, this leads to irreversible staining and even incipient corrosion damage.

7.9 Occupational safety requirements

The occupational safety regulations must always be observed when working at height. The information leaflet M 222 can be downloaded free of charge from the AUVA (General Institute for the Prevention of Accidents) at: www.auva.at.

- Safety nets to be used for the installation of roof panels (above a fall height of 5.0 m).
- Edge protection with safety nets at eaves and verge.
- Stable scaffolding or mobile elevating work platform for the installation of wall panels.

7.10 Visual inspection of the substructure

No detailed investigations are required. They are not envisaged in the standards ÖNORM B 2110, B 2221. Line and level, which are critical interfaces for the installation of sandwich panels must be checked; a spirit level, chalk line and straight edge should be used to check the alignment of columns, purlins and cladding rails etc.

Because sandwich panels are generally fixed directly to the substructure, without the possibility of later adjustment, this inspection should include a check as to whether the tolerances of ÖNORM DIN 18202 for the finished facade can be maintained. If not, the client or his designer must be informed immediately (duty to inspect and warn in accordance with ÖNORM B 2110, ÖNORM B 2221 and SIA 118, Art. 25). It is necessary to check the squareness and perpendicularity of the working area. This can either be done with a laser, or conventionally with a chalk line and a surveyor's tape.

Before starting the installation of sandwich panels the purlin spacing should be checked against the drawings.

It is also important to check that all roof panels can deflect equally without obstruction. The permissible deflection of f = L/200 (length / 200 = permissible deflection under full load) must not be impeded. Beyond the maximum span, additional purlins are inserted to halve the span. In this case the sag is negligibly small. The first and last panels of the

roof area are special cases. If possible, prevent the roof panels from bearing on the wall panels; differential deformation must be allowed to take place free of constraints. The inside must be sealed with a windproof sealing tape 'loop' (see sealing tapes). The verge flashing must be installed so that it permits movement. With thinner panels the lateral distribution of forces is compensated by the elastic deformation in the panel; in this case the roof panel can also bear on the gable wall panel.

7.11 Drip flashing / plinth flashing detail

A gap of at least

6-8 mm must be left between the drip profile or coping so that rainwater can drain away and the cavity can dry out. Mineral wool must be cut free by a 45° upward cut and the mineral wool wedge must be removed; otherwise, water absorbed by capillary action will irreparably destroy the adhesive

.

7.12 Gutter details

Drip profiles or deflector plates should be installed, depending on the system requirements and height of the gutter.

For sustainability reasons we strongly recommend that the liner tray and insulation core are cut back at the eaves of sandwich panels. Suspended gutters should preferably be fixed to the underside of the cover tray. The exposed insulation core must be covered with a suitable flashing/profile, but there is no need to cover the small profile cross-sections below the cover tray.

The cuts can be omitted on minor buildings with an insulation thickness of ≤ 30 mm, provided that the panel has a foam insulation core. It is never permissible to allow water to flow over an exposed mineral wool insulation core (without eaves cut).

NOTE: Condensation and minor water leakage can occur underneath the gutter on cut-back eaves details.

Gutter brackets should be inserted below the crowns and fixed through the top of the crown with self-drilling screws and storm (saddle) washers.

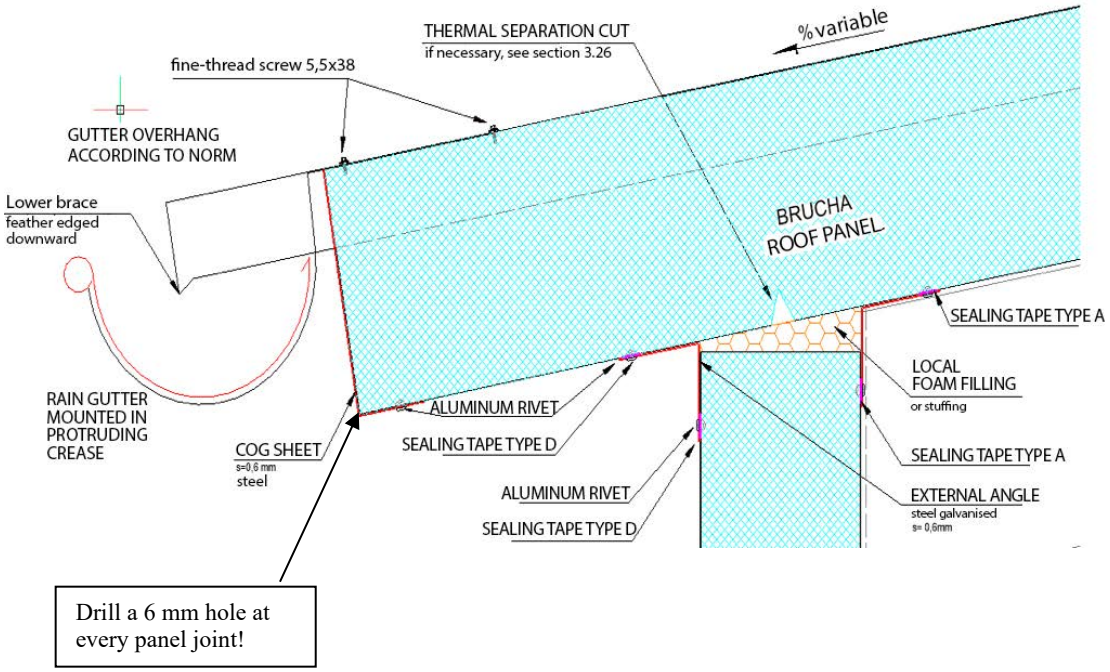
Expansion joints should formed in the gutter at a maximum spacing of 15 m. For roof sandwich panels with a mineral insulation core, the inner skin must protrude so far beyond the eaves beam that water can drip off unhindered.

7.13 Roof and wall cladding flashings

The provisions of ÖNORM B 3521-1 apply to the design of flashings for roof and wall cladding. Flashings must be designed to be rainproof with suitable sealants and fasteners.

In the case of flashings of directly fixed roof cladding (profiled sheeting, composite panels), the part of the flashing that extends into the roof area may be fixed directly to the roof. The part of the flashing that extends beyond the edge of the roof or to the wall surface or substructure (e.g. ridge, verge) must be supported by an eaves flashing that permits expansion

Flashings of directly fixed wall cladding elements may be attached with visible fasteners.



System-related requirements must be considered when designing roof openings and penetrations.

When designing connections, sufficient cover must be provided to deal with movements of the flashing caused by thermal expansion.

The permissible width of flashings (at right angles to the water flow) in the plane of the profiled sheeting is dependent on the quantity of water.

This is determined by its position on the roof, the area above the roof penetration, the width of the penetration and the roof pitch.

NOTE: The general rule is: the wider the penetration, the larger the roof area above the roof penetration and the shallower the roof pitch; the more important it is to recess the flashing or to extend the flashing from the crown to the ridge.

The following applies to flashings (trays) attached to the crown:

The voids of the profiles must be filled with insulation, the covering of the tray flashing must conform to the requirements for standing seam roofing (ÖNORM B 3521-1), whereby the seams should be designed sufficient falls in relation to the roof pitch. On roofs with shallow pitches the apron plate can also be formed in the waterproof membrane in accordance with ÖNORM B 3691.

7.14 Valley details

Depending on the roof pitch, the catchment area and the specified roof system, valleys must be either installed lower than the adjacent roof surface or be covered by standing seam roofing in accordance with ÖNORM B 3521-1 or as a flat roof waterproof membrane in accordance with ÖNORM B 3691.

Recessed valleys must conform to the requirements of ÖNORM B 3521-1 pertaining to roof pitch, dimensions and installation.

The use of sealants (permanently elastic materials) to form the joint between the roofing and the valley flashing is not permitted.

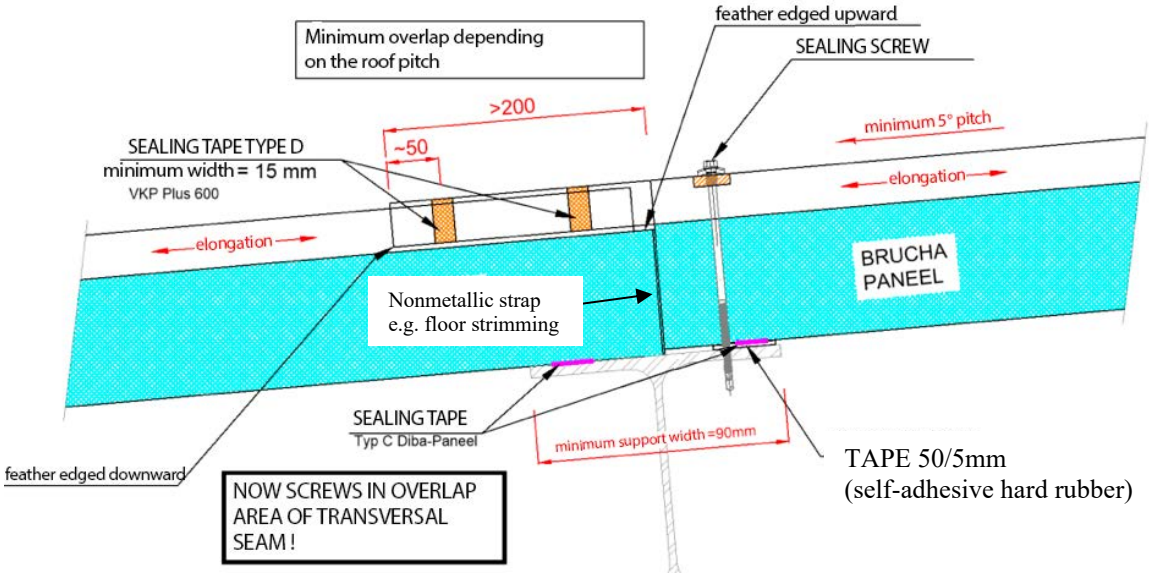
7.15 Transverse joints

It is not permitted to form transverse joints on roofs with a pitch of less than 5°. The joints must allow for expansion without rigid connections. A rubber underlay strip 5 mm thick (e.g. Würth 0681 018 062) must be inserted under the ridge-side composite element. From a panel core thickness of 160mm, two rows of this rubber must be glued next to each other to dissipate the transverse forces, thus increasing the support width! The external covering is based on the values in Table 2 and must be sealed in two rows with diffusion-open VKP tape (e.g.: Würth 15/4-8 Art. No.: 0875115008). More rows

must not be glued; otherwise, the outer shell will become too diffusion-tight and condensation will form on the room side!

For gaps of more or less than 5mm, a VKP sealing tape type adapted to the gap size must be used.
The sandwich element on the eaves side is to be attached upwards in the bottom chord. The upper element must be tapered down into the trough. A transverse joint may only be erected on a single purlin with **a common** surface of the eaves and ridge panel (never use parallel double purlins for transverse joints!). No snow guard devices may be installed directly below a transverse joint.

The overlap area is considered to be a movement zone. For this reason, the overlapping outer skins of the sandwich panels, together with the verge flashings attached to them, must not be connected to each other by screws, rivets, etc.

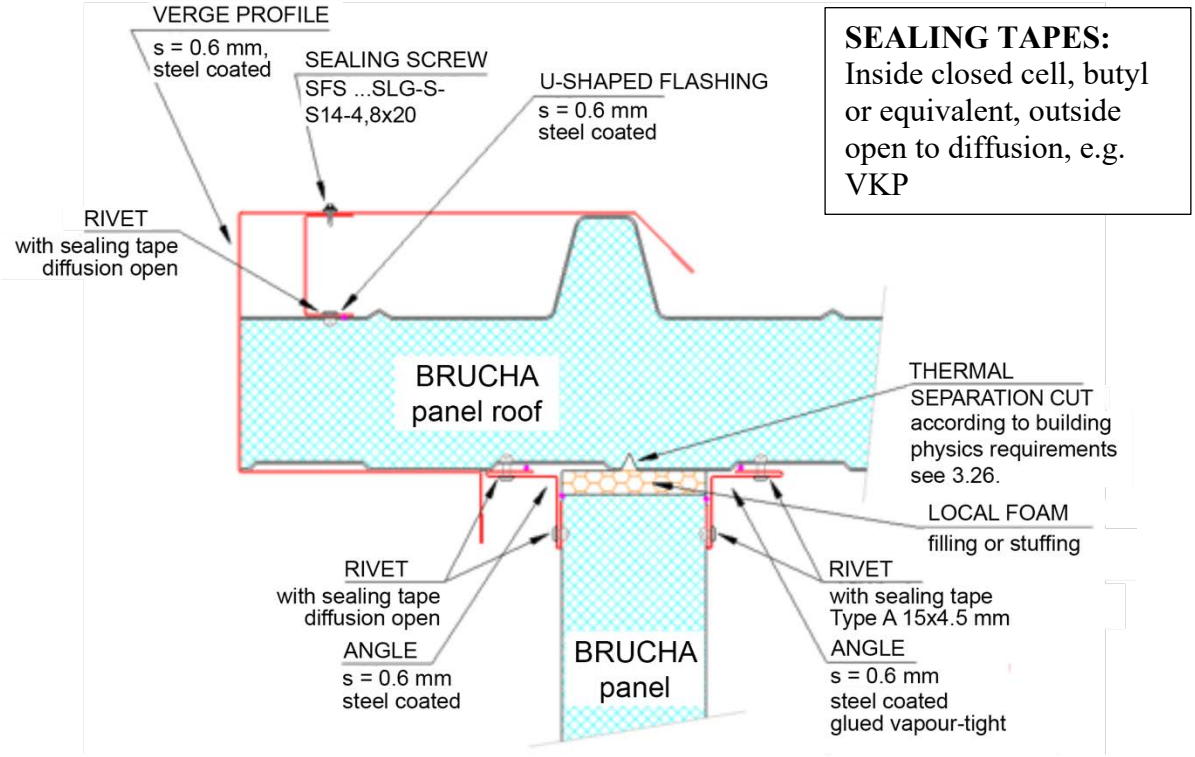


7.16 Verge, monopitch ridge and wall flashings for roof coverings

Verge, monopitch ridge and wall flashings must be dressed over the crowns of the cover tray. Where necessary suitable underlays must be installed beneath the flashings to bridge the corrugations of the decking.

Suitable fitted foam profile fillers, toothed plates or closure pieces must be installed to cover open profile cross-sections at ridge and monopitch ridge flashings.

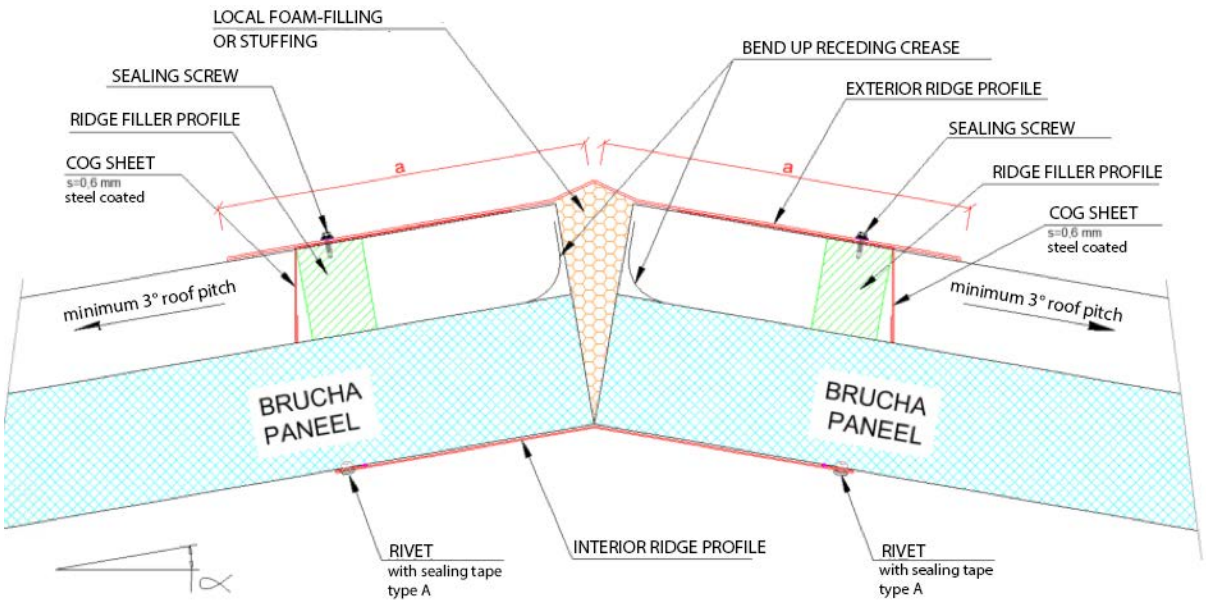
Example of a verge flashing:

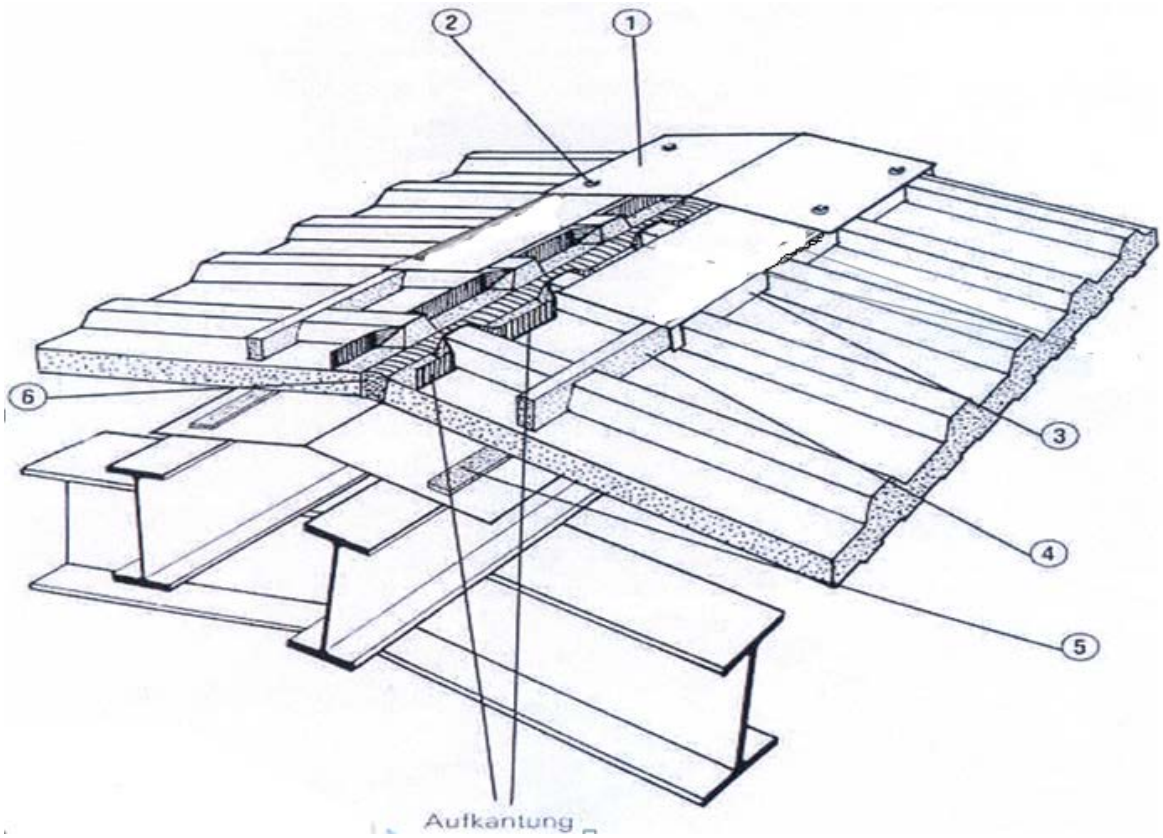


7.17 Ridge and monopitch ridge details

The troughs of the sandwich panels must be turned up approximately 30 mm at the ridge ends. The trapezoidal profile voids must be closed with suitable profile fillers and toothed plates. The ridge flashing must overlap the composite panel by at least 200 mm. The gap at the apex must be filled with insulation material of equivalent thermal characteristics and covered with a protective flashing.

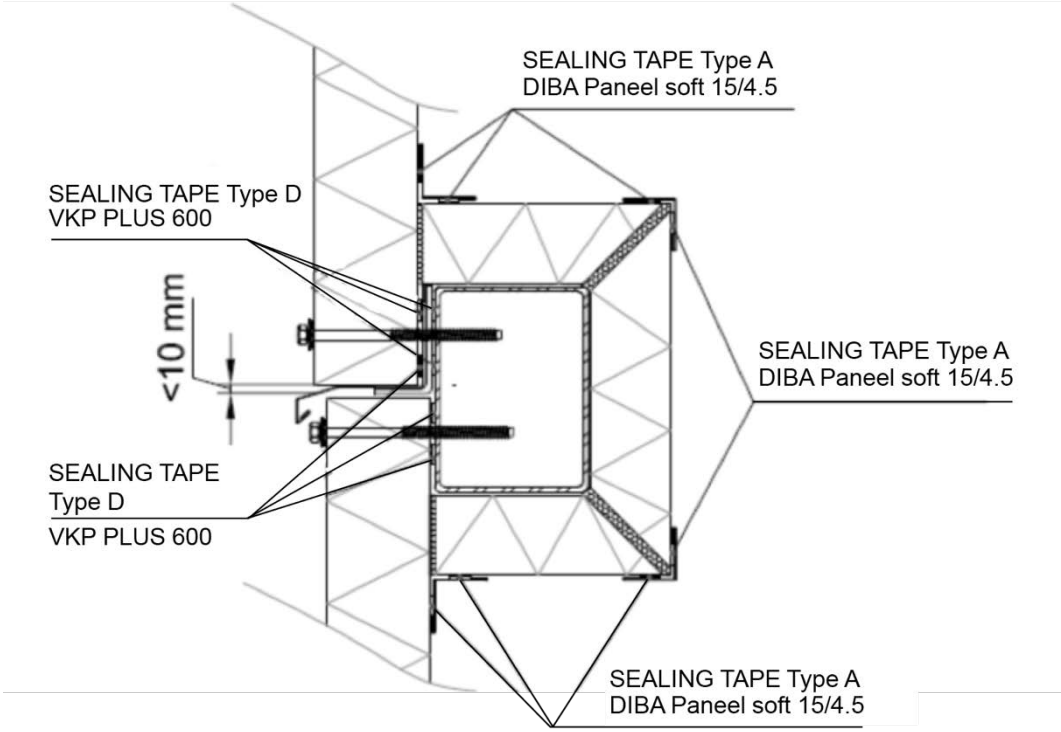
Example of the professional execution of the ridge





1 Ridge flashing (galv.)
2 S/steel self-drilling screws with seal
3 Toothed plate (galv.)
4 Profile filler (self-adhesive)
5 Sealing tape Type C (see Table)
6 local PUR foam, min. wool for min. wool panels

7.18 Transverse joint in wall panels

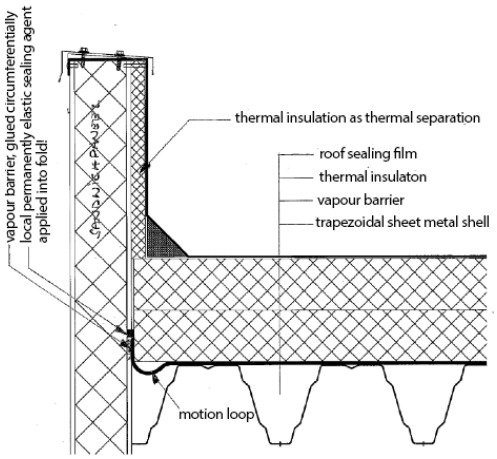


The continuous support angle is important for transferring the load of the upper panels into the structural frame and not on to the lower panels. In both cases space must be left for thermally induced movement of the outer skin.

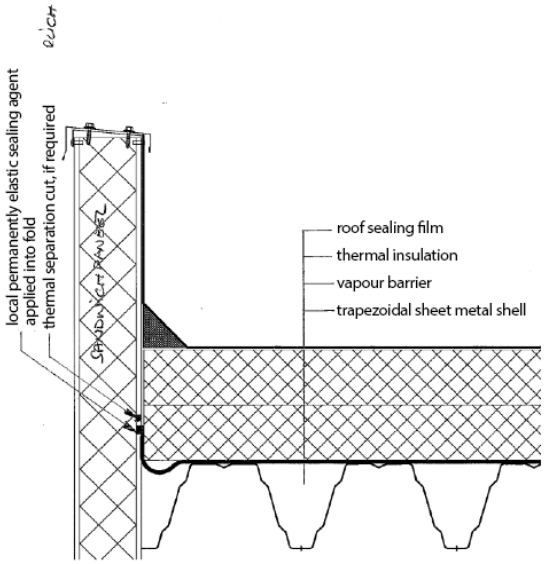
7.19 Warm roof – Junction of oversailing sandwich panel as parapet upstand

ÖNORM B 3691 is the applicable standard for the design and installation of roofing membranes. The vapour control layers made of suitable materials laid over the entire surface of the trapezoidal sheet metal roof decking shell must be joined together with vapour-tight seals. If the sandwich panels of the walls, whether laid horizontally or vertically, project above the level of the roof waterproofing membrane in the form of a parapet, the ends of the vapour barrier must be continuously bonded to the inner skins of the sandwich panels on all sides with suitable sealing tapes. In the case of vertically mounted wall or facade panels, the internal seams in the adhesive area must be filled locally with a permanently elastic sealant to prevent rising warm air from entering the roof structure. If the wall or facade panels are installed horizontally, the vertical butt joint in the intersection area of the sealing strip must be sealed against warm rising air. Depending on the climatic requirements, thermal separation measures should be considered.

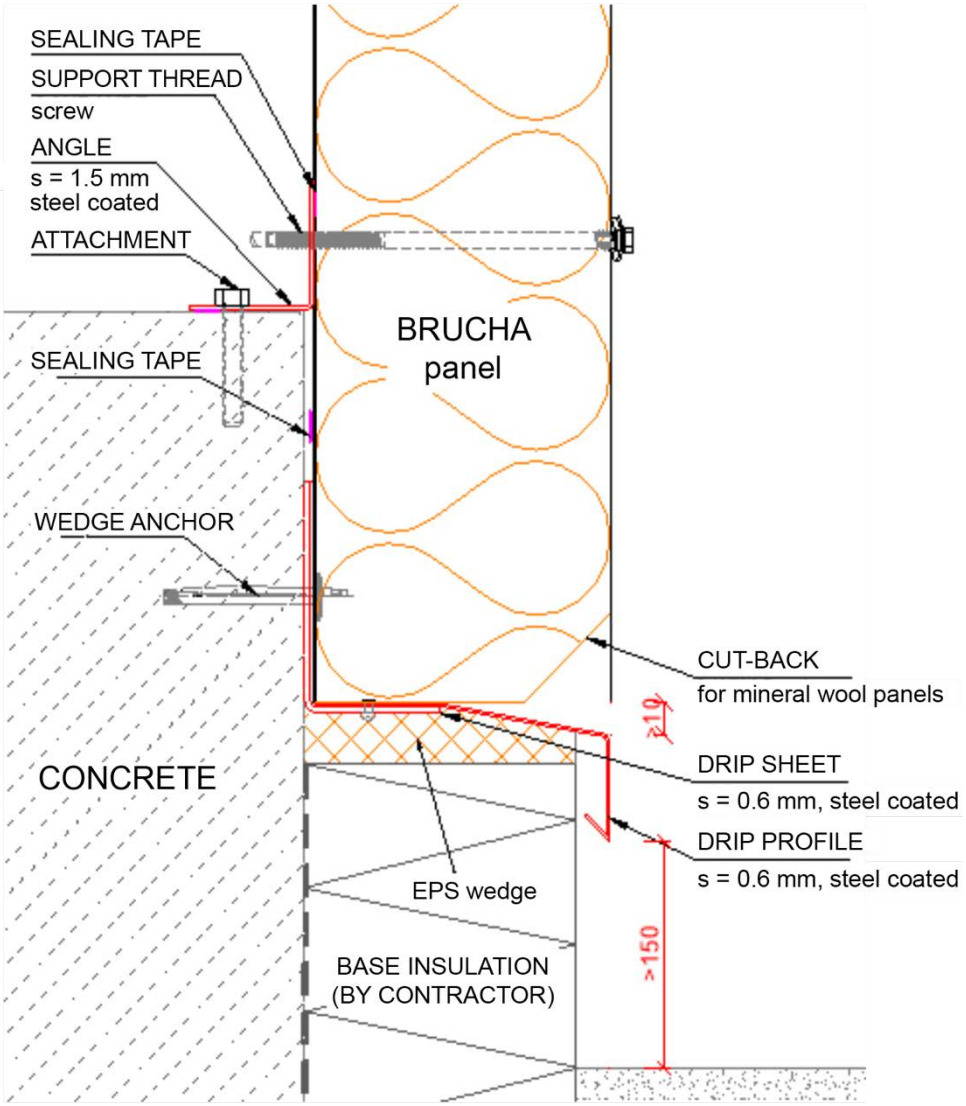
<u>Connection with parapet insulation:</u>



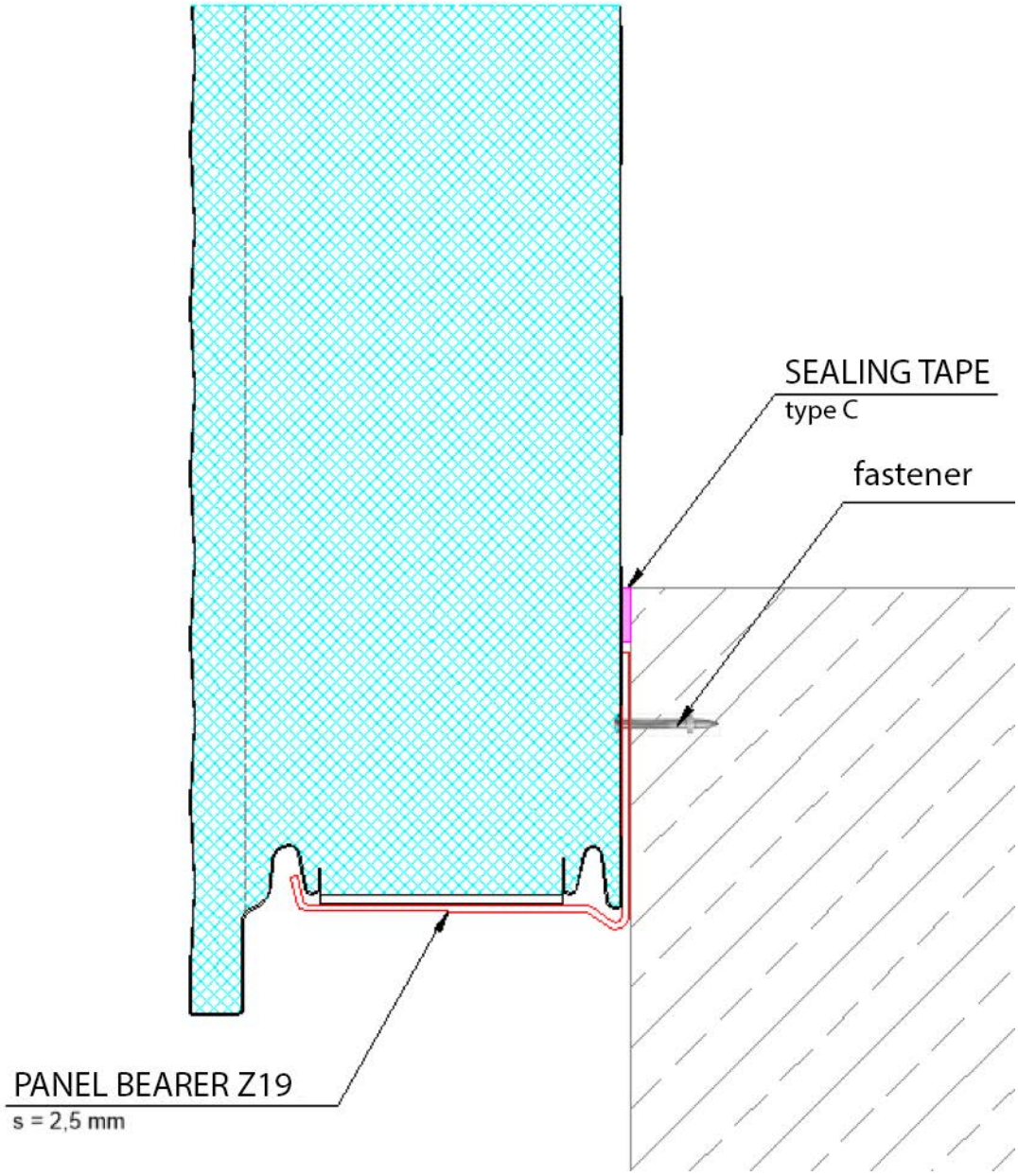
<u>Connection with thermal cut:</u>



7.20 Plinth detail - vertical assembly



7.21 Plinth detail - horizontal assembly



The supporting bracket must be continuous, in order to prevent thermal bulging and consequent damage to the bottom panel.

7.22 Parapet coping permitting bimetallic effect

With horizontally mounted panels of large spans, care must be taken with the parapet sheeting that the panel is not blocked in its movement. Especially with panels of colour group III and south side, tension problems may otherwise occur. Multiple fixings would cause creasing of the panel surface. It is therefore important to allow for the bimetallic effect in the detailing and execution of the connections. The thermally induced movements of the panel must not be constrained.

7.23 Industrial door reveals

Depending on the requirements reveals of industrial doors and shutters should be insulated, and this must be considered at the structural design stage because the trimmer frame (hollow steel sections or laminated timber) must be designed larger all round to allow for the thickness of the insulation. The prevention of thermal bridges must also be considered. A Type C sealing tape (20 x 10 mm) must be inserted between the vertical channels of the sectional doors and the reveal cladding.

7.24 Window installation

Windows must be installed and sealed in accordance with ÖNORM B 5320, provided that the windows are conventional and installed into prepared replacement frames. In the case of special windows or continuous window bands the requirements of the respective system manufacturer shall apply. Due to the bimetallic effect, it is not possible to install conventional windows directly into facades with long-span panels and south-facing elevations without a corresponding structural trimming of the window openings. A Type H sealing tape must be applied internally and externally. For sealing large areas on stick system facades, Type J bituminous membranes can also be used for the interior panel skins. Window tapes for inside/outside or multifunctional tapes (type L) can be used for sealing. In any case, pay attention to the second sealing level, especially with mineral wool sandwich panels!

Note the video https://www.youtube.com/watch?v=K0t5JYJ4-mg as a source of support / recommendation.

Recommendations for window installation with correct sealing:

Thermal breaks are necessary because during installation, the window has been in contact with the exposed foam insulation of the panel. The multifunctional sealing tape sticks on the inside and outside.

The best sealing is achieved through the correct use of sealing tapes combined with the craftsmanship of the sheet metalwork. Drip profile installed the panel.

The window must be fitted with a bottom cill profile. The outside is sealed with a Type H vapour permeable sealing tape. This is covered by the sheet metal cladding.

The window reveal plate is fitted behind the drip profile. From below, a headlining made of folded sheet metal is hooked in at the front and attached to the window at the rear.

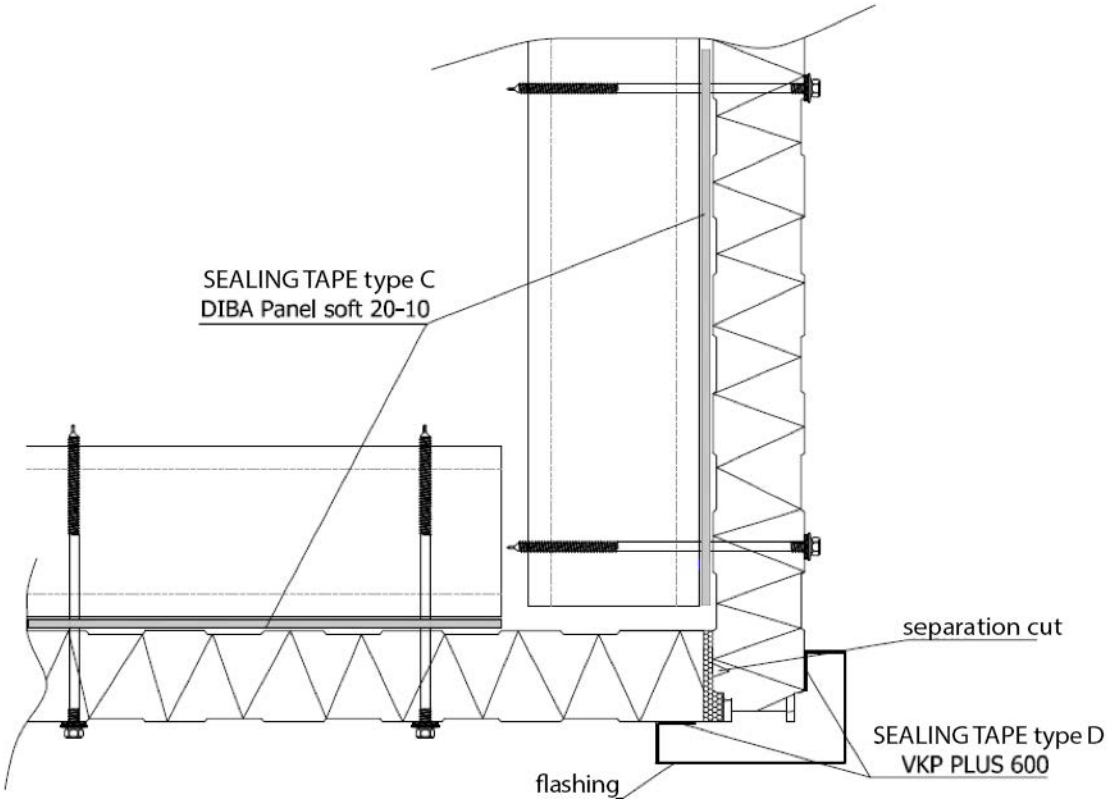
The foam on the lintel behind the outer seam is removed to form a slot for the later installation of the vertical seal. A recess must be made in the foam on both sides above the window reveals to provide space for raising the upstand profile.

The reveal cladding sheets are nested at high level. With this method it is important that a Type H window sealing tape is carefully applied under the cill profile and reveal linings without puncturing.

The window head cladding is now properly fitted. Both sides of the upper fillet joint should be sealed from the edges inward for approx. 100 mm, using a hybrid sealant. On no account should the sealant extend the full length of the lintel cladding, otherwise the water will be trapped inside!

The correct installation of the cill profile. The windows must be fitted with a suspended cill profile. The fall on the cill to the outside must be at least 3° with a projection of at least 25 mm. The vertical face dimension must be not less than 20 mm.

7.25 External corners



The more elegant corner detail using a concealed support angle. A Type D sealing tape must be installed between the panel surface and the support angle. The fastening brackets can be fitted using self-drilling screws. The corner cladding itself is fastened to the sides of the support angles using coated aluminium rivets with a stainless steel mandrel.

The industrial and thus more economical option with visible fixing lugs. Here again, Type D sealing tapes must be installed.

7.26 Edging on façades with stainless steel sheets

In addition to points 7.21. and 7.22., it is pointed out here that flashings made of polished stainless steel sheet require special design, alignment, fastening and good planning, as well as special craftsmanship. Fasteners, whether screws or rivets, always exert a pre-tensioning force on the sheet surface and deform it. With polished surfaces, this leads to completely distorted mirror images and in the end to a disastrous overall appearance of the façades. That is why rigid, multiple edged, raised and concealed fastened edging parts have to be planned and perfectly aligned. Polished stainless steel surfaces do not forgive any mistakes at all!

7.27 Flashings to flues, ducts, rooflights and pipe penetrations

Flashings can be designed in the following ways:

- Formed in sheet metalwork in accordance with ÖNORM B 3521-1.
- Use of prefabricated profiled components to suit the cladding, kerbs. The requirements of Table 2 are applicable for the joint with the roof cladding including minimum falls and jointing method (seals, overlap etc.). The kerb must be at least 150 mm high.
- The formation of a flat roof waterproof membrane in accordance with ÖN B 3691.
- Preformed flashings/ pipe collars with seal screwed on to the profiled decking
- The long side of the kerb should preferably be oriented parallel with the roof falls.
- Insulation must be of polyurethane material

7.28 Flashings of openings, corners and penetrations in wall cladding

Copings and flashings for wall cladding must be designed to be rainproof in accordance with system requirements.

Flashings may be directly fixed using suitable rivets and screws (preferably chipless screws); indirect, concealed fixing must be specified in the course of the detailed design phase.

NOTE: Indirect concealed fixing requires the use of coping support brackets etc and clip profiles etc. which must be designed accordingly.

7.29 Fixing of roof-mounted components

As a guiding principle, all roof-mounted components must be fixed to the structural frame. Support details must be weatherproof (through the use of welded-on collars and sleeves etc.). It is permissible to attach solar panels, snow guards, walkways, fall protection systems (anchor points) using clamps etc approved by the system manufacturer.

Any additional loads and the position of the roof cladding fasteners must be taken into consideration in the design of roof-mounted elements (solar panels etc).
The functionality of the cladding must not be compromised. Suitable clamps must be used to ensure that the expansion of the elements is not restricted, and that the expansion of the transverse members not transmit tension to the cladding fasteners.

The installation of solar panels must conform to Austrian standard: ÖNORM M 7778 or ÖNORM EN 1991-1-4 and B 1991-1-4.

7.30 Roof drainage

Roof drainage fittings must be designed in accordance with ÖN EN 12056-3.

Where the roof drains into internal downpipes, emergency overflows and gullies must be installed in accordance with the technical standards. The provisions of Austrian standard ÖNORM B 3521-1 shall also apply.

7.31 Snow guards

Snow guards must be designed in accordance with ÖNORM B 3418. As a principle, only snow guards approved for use with the particular roofing system should be installed. Snow guards must be installed in accordance with the roof cladding manufacturer's instructions; they must not be installed immediately below the transverse panel joints or ridges

Stirrups are manufactured in hot-dip galvanised design. These brackets are attached far to the rear, creating a relatively large contact area for applying forces and a favourable lever arm into the panel. The support brackets are installed at a spacing determined by the design calculations. The fixing is installed directly through the panel into the purlins using screws with EPDM seals. Hot-dip galvanised pipes available in the plumbing accessories are to be inserted through the holes in the brackets. This allows them to glide unimpeded. The pipes must be welded to the brackets at regular intervals to reduce noise. The pipes are connected using push-on sleeves. Commercially available ice claws can be used, but note the risk of ice blockage.

If the ice claws blocks access to the gutter, there is a high probability of water backing up and seeping into the building through the panel joints and causing damage. There is an obligation to warn and notify if the design poses that risk.

Cantilevered roof projections or canopies of heated halls, where a water baffle flashing has been installed in the gutter, are particularly at risk. In due course,

the water from the melting snow runs off the roof surface and accumulates in the area of the gutter on the cold, cantilevered roof part, becomes ice and blocks the entrance into the gutter. Subsequently the panels overflow and the water either seeps into the building or drips on to the ground from the lower panel joint. The lower ends of the panels must be open for any condensate seeping out of the seam on the long side of the

panel. On no account must these drainage paths be blocked by metal profiles or timber sections unless an alternative method of controlled drainage is provided.

7.32 Trimmers / rooflights

Trimmers for openings are possible in roofs with a minimum pitch of 5°. However, it must be ensured that an equivalent insulation value is achieved without forming thermal bridges. Flashings must be carefully formed with precision workmanship in accordance with ÖNORM B 3521-1. Upstands must be installed a minimum of 150 mm above the water-draining surface or 300 mm in areas prone to heavy snowfall.

It must be checked whether the roof panels are to be supported by means of a replacement frame made of wood or steel. With conventional top rings, guide the sheet metal to under the ridge cap. Pay close attention to the height of the top rings.

<u>In the case of mineral wool panels:</u>

The visible panel cut edges must be sealed with the diffusion-open Type H sealing tape before installation Of the sheet metal cladding. Otherwise, warm air flows into the wool core here and condensation occurs, which destroys the mineral wool panel.

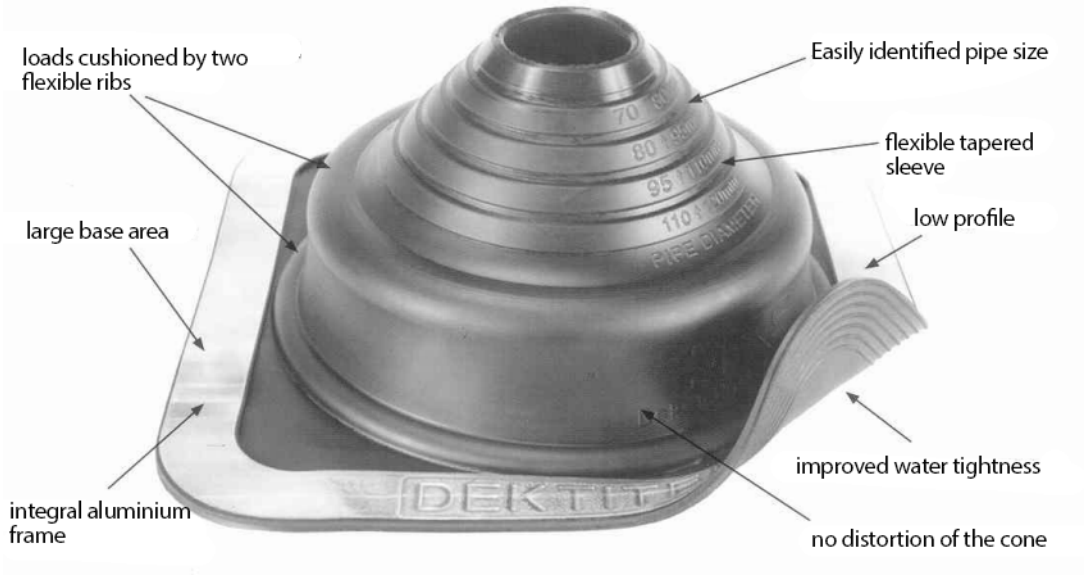
<u>Prefabricated kerbs:</u>

There are GRP laminated kerbs available on the market that can be bonded to the panels. Assembly details can be found in the manufacturers' product information (e.g. Eberspächer). Trimmer sections must be installed where these kerbs are installed over long spans.

Where openings are cut into mineral wool panels (including for rooflights), warm air must be prevented from penetrating the panel core by taping over the cut edges with a Type H self-adhesive sealing tape.

7.33 Roof penetrations

Prefabricated pipe collars are the ideal solution for roof penetrations. Beware that continuous metal pipes are thermal bridges that may also need to be insulated. This is particularly necessary with mineral wool panels in order to prevent the possibility of any condensation forming from the outset. It may be necessary to fulfil the general obligation to warn and notify.



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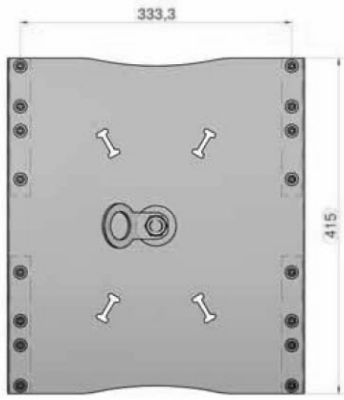
Assembly instructions:

1. Select a suitable pipe collar from the table. Cut open or cut off the pipe collar to suit the pipe diameter. For a press fit, the sleeve diameter should be 20 % smaller than the tube diameter.
2. Slide the sleeve over the tube from the top. The special lubricant Art. No. 0893126 simplifies the process.
3. Match the aluminium frame to the profile pattern of the roofing panels or wall cladding. A blunt tool is useful for fitting to small radii.
4. Apply Würth silicone sealant (Art. No. 0892 310x001) between the square flange and the profiled decking.
5. Now attach the aluminium frame with Zebra Piasta screws (Art. No. 0214 955x525). The maximum permitted screw spacing is 60 mm. For a better seal between the sleeve and the pipe we recommend the use of hose clamps or universal straps (Art. No. 0547).

7.34 Safety equipment

Fall protection devices must be installed in accordance with ÖNORM B 3417. Stable anchors are prescribed for attaching the fall arrest lanyards of safety harnesses for the safe working of roof maintenance staff. There are a wide variety of available systems. The manufacturers' assembly instructions must always be strictly observed. Due to the requirements of the Construction Products Regulation EU 305/2011, only CE-marked products can be employed for this purpose.

An example of such a plate, viewed from above.



7.35 Permanently elastic sealants

The use of hybrid sealants for permanently elastic joints must restricted to the minimum necessary extent. All fixings of cladding sheets must be installed in accordance with ÖNORM B 3521-1.

8. MINERAL WOOL PANELS – Special instructions

8.1 General

Sandwich panels with a mineral wool insulation core are mostly used as fire barriers, therefore they must be carefully installed in accordance with the accepted rules of engineering and good practice.

The sandwich panels have a mineral wool core (flashpoint > 1000° C) which is classified as incombustible. The panels are subject to fire resistance tests by the panel manufacturer. The cladding subcontractor must request the certification of the independent testing authority from the panel manufacturer. On the one hand this is to ensure that the panels are fit for the intended purpose, and on the other to establish the maximum span for the subsequent design process. The correct interfaces with adjoining works are the responsibility of the cladding subcontractor.

8.2 Roof panel

The longitudinal edge bond of the panels is closed with a PE film vapour barrier. Although warm air released from the building interior can enter the gap due to higher air pressure, it cannot the insulation core. The mineral wool must not be exposed to damage from condensation or ingress of rainwater. These PE film vapour barriers must not be damaged or removed. A Type C seal in the seam of the inner skin of the panel ensures that the least possible amount of warm air is able to penetrate the gap in the panel joint.

If the vapour control layer has been damaged, it must be repaired or replaced with an equivalent adhesive tape before installation.

The gutter detail must without exception incorporate a cut and a drip profile. The exposed panel face is open to the elements and must be closed by means of a metal flashing.

8.3 Thermal break

Particular attention must be paid to the sharp reduction of the bearing capacity of fire protection panels due to the thermal cut in the area of cantilevers.

The thermal break must also be sealed against air penetration with tape (e.g. Würth Eurasol).

8.4 Wall and facade panels

Exactly as with PUR panels, there is the choice between visible and concealed fixing. Due to the compression characteristics of mineral wool and for structural reasons, it is essential that pressure distribution plates are used on the fixing points. Using pressure distribution plates when fixing façade sandwich panels, the fixing screws can be installed with, but also without sealing washers.

8.5 Plinth detail

At least a wedge-shaped free cut is to be created, in order to prevent the soaking up of water through the rock wool. When planning the details, always pay attention to the fact that penetrating rainwater or leakage water can run out again unhindered, without ever coming into contact with the rock wool.

8.6 Transverse joints in the facade

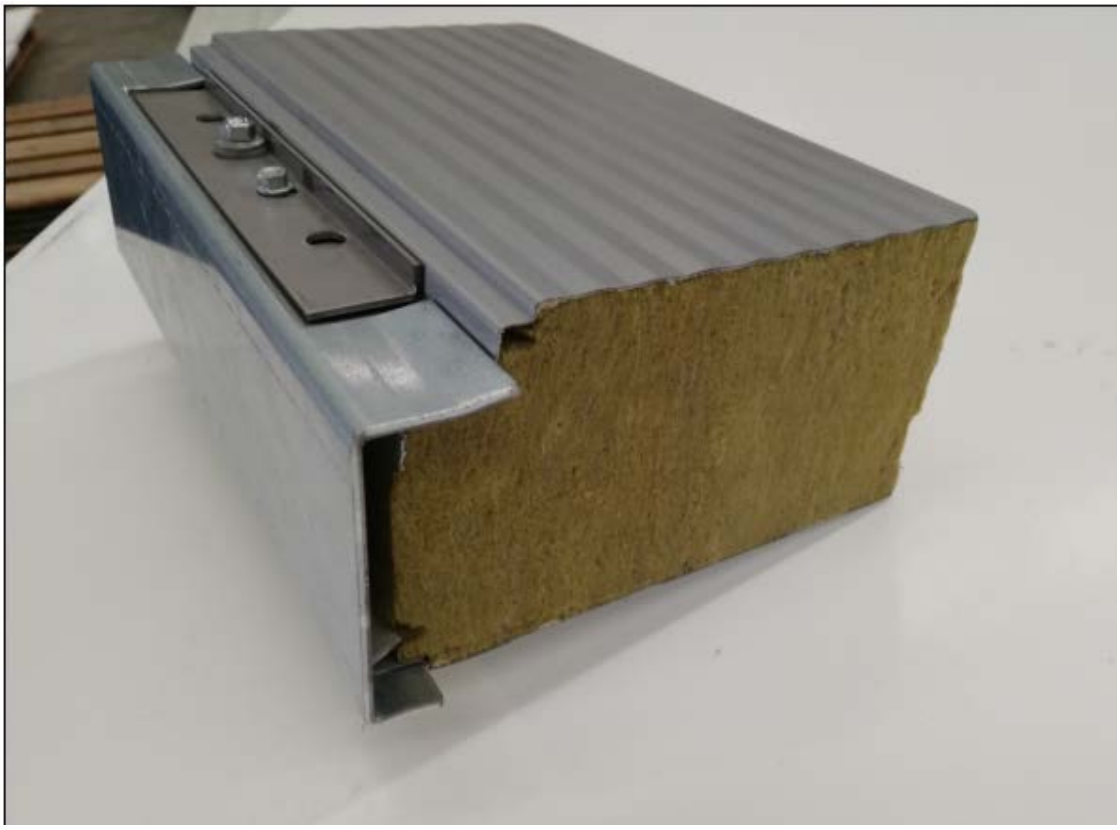
The mineral wool must also be undercut here at 45° to prevent water suction. The mineral wool must be completely removed At the same time a cold bridge is formed which must be insulated. The loads of the upper panels must not be directly transmitted to the panels below. It can lead to overloading and wrinkling in the facade. Furthermore, the outer skin of the panels must be able to expand freely. This occurs more with dark-coloured exterior cladding. A continuous support angle must be provided which only supports the inner panel facing.

8.7 Substructure

The substructure of a fire wall must be constructed in the same fire resistant or fireproof quality as the panel. The fire load represents an additional load case in structural terms. The cladding rails must be fitted at suitable intervals. Note that in case of fire, a firewall must be capable of remaining standing independently. Most manufacturers simply state the distributed loads (wind, snow) but not the fire load! Fire resistant panels screwed to an unprotected steel structure of a large-span shed building do not constitute a fire wall!

8.8 Template for mounting a mineral wool panel with concealed fixings

A sandwich panel with a mineral wool core cannot be compared with a polyurethane facade because of the soft insulation. Also, due to the sensitive nature of the insulation, incorrect mounting of the panels will have a negative effect on the overall appearance. In addition, incorrect mounting can hinder the smooth process of installation. To assist proper mounting, a template has been developed (see image) which can be requested from every sandwich panel manufacturer.



9. TRANSPORT and STORAGE

9.1 Safety instructions

The various materials, sections and flashings should be stored separately and preferably according to their installed locations.

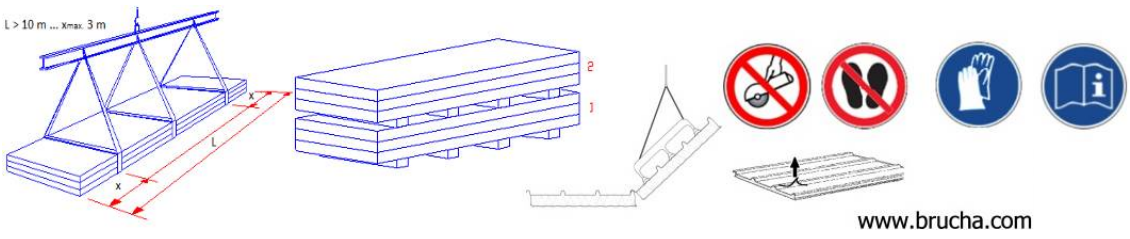
If it is necessary to set down packages on the roof structure it should be near to structural supports and be coordinated in advance with the steel erection contractor and the site management.

Packages or panels placed on the roof must be secured to prevent them sliding off.

During work stoppages opened packages must be secured against wind uplift.

9.2 Storage of panel packages

Panel packages must always be stored with a lengthwise fall so that rainwater can run off (place a length of timber under one end) If panel packages are to be stored outside for longer periods, they must be covered with vapour-permeable tarpaulins (to prevent condensation). These enable the packages to be quickly ventilated. It is essential to prevent standing water forming between the elements. Even where sheet metal has been surface-finished, these conditions can cause permanent damage (stains, corrosion, white rust)! Protective films applied at the factory are UV-resistant to a limited extent. The handling of protective foils is regulated in point 7.8.



To prevent pressure marks, packages must not be stacked on top of each other. When lifting by crane, packages must be protected with edge protection profiles under the lifting straps. For panel lengths over 10 m, a load traverse must be used. Panel packages may only be lifted individually. Unloading using two or more forklifts is not permissible.

10. ACCEPTANCE STANDARDS

10.1 Evaluation of sandwich panels from recommended viewing distances

The optical evaluation of sandwich panel facades and roof coverings is carried out in accordance with the rules laid down in the technical rule Part II, published by the Federal Guild of Sheet Metalworkers, dated 01.09.2016:

Roofs are assessed from a normal viewing distance.

Facades are judged from a standard viewing distance of approx. 10m, at right angles to the wall, which results in an assessment area of approximately 12 m x 12 m.

Repaired areas must not be visible to the naked eye under diffuse daylight at a distance of > 5 metres for exterior facades and > 3 metres for interior surfaces.

10.2 Repairing damage

Any remedial works or repairs of damage should always be carried out by specialist companies.

10.3 Cleaning panels with a polyester coating

Clean soiled areas on panel surfaces with copious amounts of water and a soft brush. A high-pressure washer may also be used, but only at a maximum pressure of 50 bar using cold water. Stubborn dirt may be removed with a diluted pH-neutral cleaner. In individual cases, extremely stubborn stains may be very carefully removed with ethanol; afterwards the affected areas must be immediately rinsed with water.

Acidic and alkaline cleaning agents are not suitable for polyester coated panel surfaces. Depending on the degree of soiling, the inner and, if necessary, outer skins of sandwich panels in buildings housing livestock must be cleaned at shorter intervals in order to avoid damage to the organic coating.

11. SERVICING and MAINTENANCE

Roofs are subject to natural ageing through temperature changes frost, snow loading and other environmental impacts. In addition, there is locally dependent soiling, particularly of the drainage system.

Periodic inspections and maintenance are advisable to maintain the long-term functionality of the cladding and flashings. Roof inspections are recommended, particularly after severe winters and other extreme weather conditions.

Inspections of the safety installations is compulsory at regular intervals or before use. Regular inspections, maintenance and repairs extend the service life of the flashings and in many cases can prevent more serious damage.

Working on roofs and repairing them can be dangerous and must only be carried out in conformance with the relevant safety regulations.

Dirt and leaves must be regularly cleared from gutters and downpipes. When cleaning or removing ice from roofs and gutters, care must be taken to prevent damage to the metalwork through the choice of suitable tools and working methods.

After cleaning or de-icing the flashings should be inspected for damage and repaired where necessary.

During the maintenance of mastic joints, any areas displaying signs of ageing of the sealant should be cut out and replaced. During the maintenance of pigeon control spikes the animal disease aspects (e.g. the law governing epidemics) and pollution control regulations must be observed.

If wood-displacing panel fastening screws (classic wood screws) are used in wooden purlins, the consequence is that, depending on the degree of moisture in the wood, they migrate out slightly, causing the sealing washers to lose their function, precipitation water to penetrate the holes and cause rotting of the wood all around the screw, drastically reducing the pull-out value of the screw and damaging the wooden purlin. If such screws are used, the screws must be professionally retightened at least after one year in the course of roof maintenance. The situation should be monitored for another two years.

If no more screws lift, the thing is stable and no further checks need to be made in this regard.

Roof surfaces of stables must be cleaned regularly in the vicinity of permanently effective ventilation systems.

No such effects have been observed in the case of fibre-cutting wood screws. These screws are thus easier to maintain.

12. DISCLAIMER

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