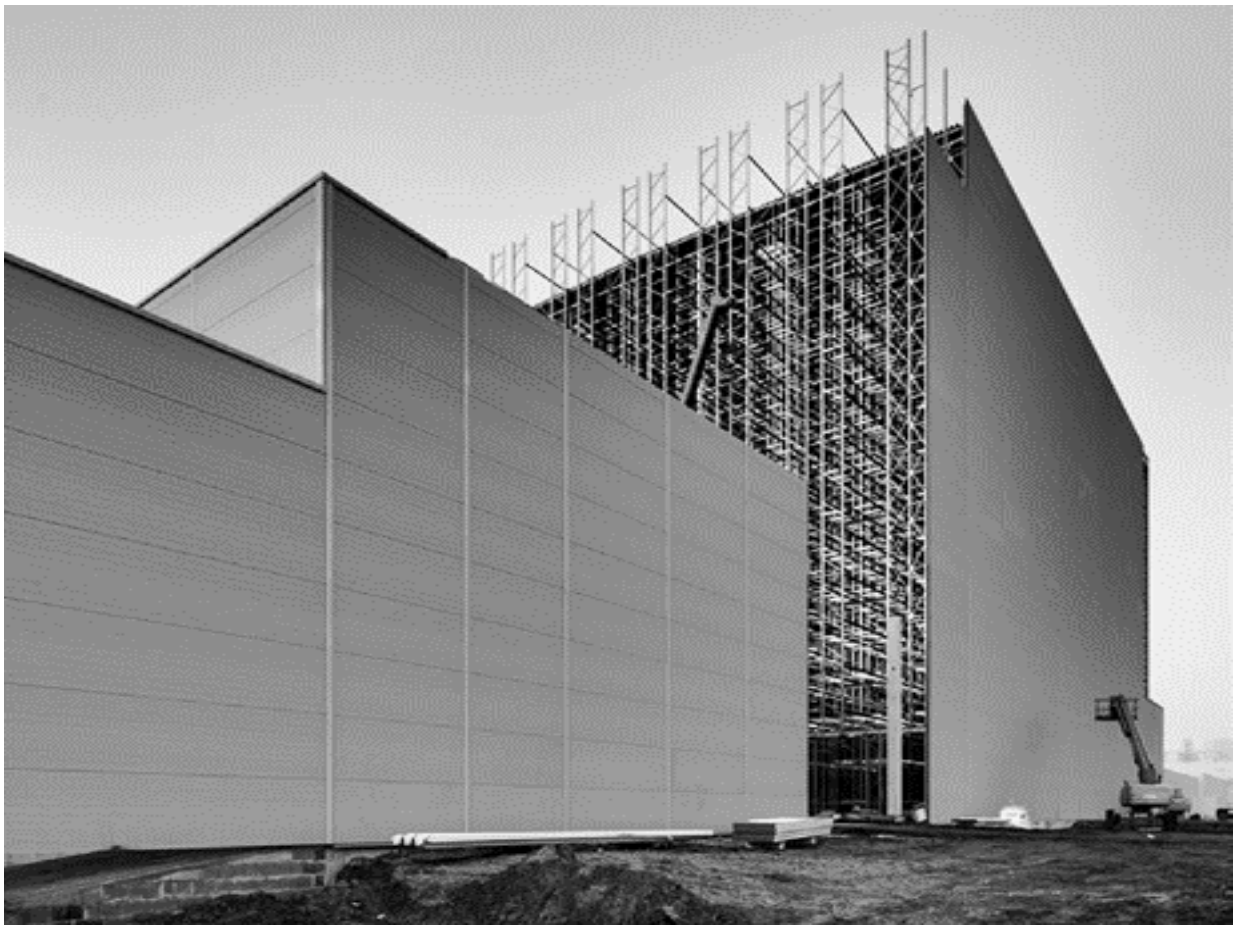
KAMARIDIS
GLOBALWIRE

SANDWICH PANELS

INSTALLATION GUIDE



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

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 – Basis of Structural Design;
ÖNORM B 1990:	Eurocode – Basis of Structural Design – Part 1: Buildings – National Regulations and Supplements;
ÖNORM EN 1991:	Actions on Structures / all sections;
ÖNORM B 1991-1-1:	Actions on structures – National Regulations;

ÖNORM B 03/01/1991:	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 04/01/1991:	Eurocode 1: Actions on Structures – Part 1-4 General Actions - Wind Loads - National specifications concerning ÖNORM EN 1991-1-4 and national supplements;
ÖNORM B 2110:	General conditions of contract for works of building and civil engineering construction - Contract to provide services
ÖNORM B 2215:	Wood working – Works contract
ÖNORM B 2221:	Plumbing works – Works contract
ÖNORM B 2225:	Metal construction works, execution of steel structures and aluminium structures and corrosion protection work - Works contract
ÖNORM B 2230-3:	Painting work – Works contract – Part 3 Coatings on metal:
ÖNORM B 2501:	Drainage systems for buildings - Design, construction and testing - Supplementary guidelines to ÖNORM EN 12056 and ÖNORM EN 752
ÖNORM B 3417:	Safety equipment and classification of roof areas for use, maintenance and repair
ÖNORM B 3418:	Design and construction of snow protection systems on roofs
ÖNORM B 3419:	Design and construction of roof finishes and wall cladding
ÖNORM B 3521-1	Design and construction of metal roof finishes and wall cladding – Part 1 Sheet metalwork - hand crafted

ÖNORM B 3521-2	Design and construction of metal roof finishes and wall cladding – Part 2 Sheet metalwork - industrially produced roof and wall elements (will probably come into force in 2014);
ÖNORM DIN 18202:	Tolerances in building construction - Buildings;
ÖNORM EN 508, Part 1-3:	Sheet metal roofing and cladding products - Specification for self-supporting of steel, aluminium or stainless steel sheet roofing elements
ÖNORM EN 516:	Prefabricated roofing accessories - Installations for roof access - Walkways, treads and steps
ÖNORM EN 517:	Prefabricated roofing accessories – Roof safety hooks
ÖNORM EN 795:	Fall protection – anchor devices – Performance requirements and test methods
ÖNORM EN 988:	Zinc and zinc alloys - Specifications for rolled flat products for building
ÖNORM EN 1873:	Prefabricated accessories for roofing - Individual rooflights of plastics - Product specification and test methods
ÖNORM EN 1991-1-4:	Eurocode 1: Actions on Structures – Part 1-4 General Actions - Wind Loads (consolidated version);
ÖNORM B 10027-2:	Designation systems for steels - Numerical system
ÖNORM EN 10169:	Continuously organic coated (coil coated) steel flat products - Technical delivery conditions
ÖNORM EN 10346:	Continuously hot-dip coated steel flat products - Technical delivery conditions
ÖNORM B 12056-3:	Gravity drainage systems inside buildings - Part 3: Roof drainage, layout and calculation;
ÖNORM EN 12951:	Prefabricated accessories for roofing - Permanently fixed roof ladders - Product specification and test methods
ÖNORM EN 14509:	Self-supporting double facing metal faced insulating panels - Factory made products - Specifications;

ÖNORM EN 14782:	Self-supporting metal sheet for roofing, external cladding and internal lining - Product specification and requirements;
ÖNORM EN 14783:	Fully supported metal sheet and strip for roofing, external cladding and internal lining - Product specification and requirements;
ÖNORM B 1002714588:	Blind rivets - Terminology and definitions (ISO 14588:2000);
ÖNORM B 1002714589:	Blind rivets - Mechanical testing (ISO 14589:2000);
ÖNORM DIN 7778:	Assembly planning and assembly 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

Sandwich panels are suitable for: the 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 harmonized European standard for the manufacture of: Self-supporting double-skin metal-faced insulating panels - Factory made products - Specifications

2.2 Product Categorization

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 (e.g. snow, wind, internal air pressure) and to transfer them into the supporting structure.

2.4 Polyurethane Foam

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

2.5 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.

2.6 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 must be prevented by additional measures such as the watertight welding of the components of the roof substructure.

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]

2.7 Air Tightness and Wind Impermeability

For conditioned buildings without ventilation, current regulations (ÖIB-Richtlinie 6, ENEV 2010) permit a maximum air change rate of n50≤3. In rooms with a controlled ventilation system the maximum value is 50≤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. Air tightness is measured by the blower door test.

2.8 Wall Cladding

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

2.9 Crown and Valley

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

2.10 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. 5 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.

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 and (refer ÖNORM EN 14509) and thermal expansion 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 ÖN B 8110.

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

- The planned service life and the kind of building use in relation to possible consequential loss.
- 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: The client is basically responsible for providing the structural calculations.
- The standards ÖNORM EN 1991-1-4 and B 1991-1-4 contain all of the relevant parameters for the calculation of wind loads including 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, air tightness, wind impermeability in accordance with the applicable ÖNORM standards, especially the air tightness 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;
- 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;
- Color 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];
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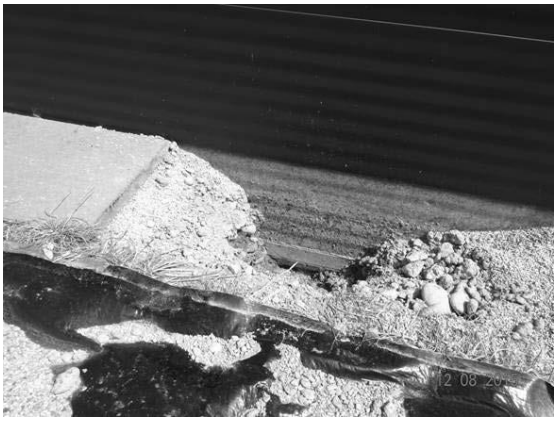
3.2 Resistance to Driving Rain

Sandwich panel roofs and wall claddings are classified as impervious to rain.

3.3 Wall Cladding Installation System

3.3.1 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 (refer to photos overleaf).



3.3.2 Vertical Installation

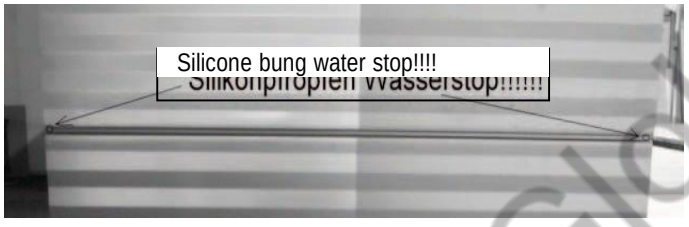
If the panels are installed vertically a suitable substructure of steel or timber sections must be provided. Care must be required bearing width and the span of the horizontal rails. The rails must be visually inspected to check that they are properly sized and fixed (duty to check and warn). A stable, thermally separated cill detail must be constructed. Care must be taken to ensure the panels fit together exactly The thermal expansion of the outer facing 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. Attention must be given to ensure water can drain freely through the space between the panel and that the outer facing can expand. 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.

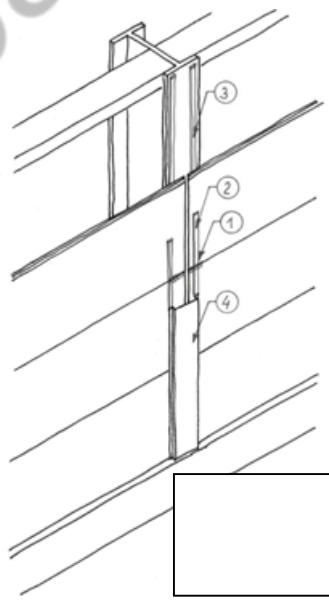
3.3.3 Horizontal Installation

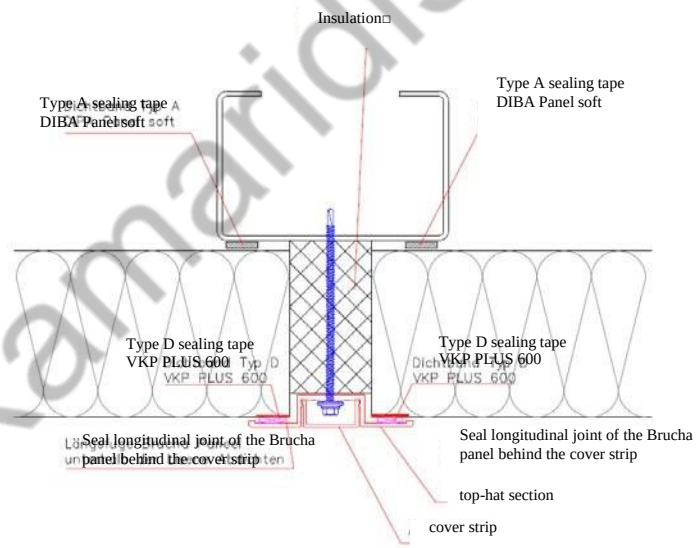
If properly organized, this type of installation is essentially quicker. Often this involves spans up to 6.00 m wide, with the panels installed as a continuously supported double-span system. With this type of installation, the full extent of the bimetallic effect or thermal bowing becomes apparent, depending on the colour group of the outer facing. 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 ≤ 1.20 m wide may be directly inserted in the wall cladding (i.e. without a trimming frame construction).

Furthermore, care must be taken to ensure that at the ends of the panels, behind the cover strips, the horizontal joints are sealed with a transparent hybrid sealant up to the end of the edge of the top hat section cover strip (e.g. "Klebt + Dichtet" made by Würth). Experience shows that run-off rainwater and driving rain is sucked into the vertical butt joint behind the cover strip by capillary action. There it either drains away or is absorbed by the mineral wool. This can cause irreparable damage to mineral wool panels. Water then often runs down the inside of the masonry plinth wall and forms puddles.







Z24a Aluminium cover strip (top hat section)

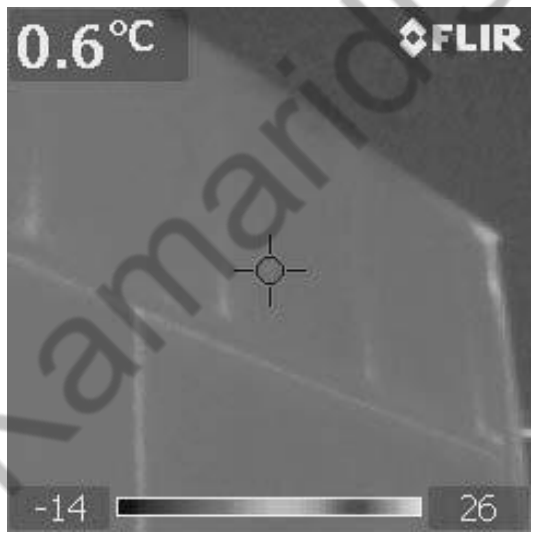
Z31 Sealant (for overview see Annex)

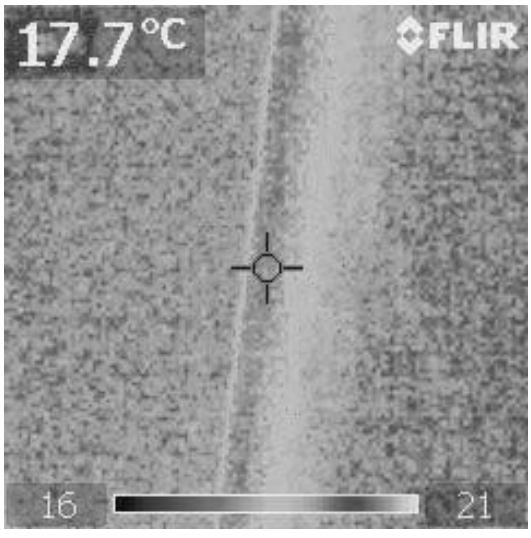
3.4 Heating and Ventilation

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).

The air change rate of the building envelope is measured with the blow door system.

Artificial fog generated inside the building can be used to support leak detection. Depending on the difference between the external and internal temperature, the use of thermographic cameras combined with the blower door method can be very useful for locating leaks in the building envelope.





3.5 Minimum Insulation Values of Conditioned Buildings (OIB Guideline 6)

	Building element	U-value [W/m²K]
1	WALLS external walls adjoining outside air	0.35
2	WALLS adjoining unheated roof spaces	0.35
3	WALLS adjoining unheated but frost-protected parts of a building (except roof spaces)	0.60
4	WALLS below ground	0.40
5	WALLS party walls separating dwellings or commercial units	0.90
6	WALLS adjoining other structures on the site or plot boundary	0.50
7	WALLS small areas of external wall (e.g. on dormers) not exceeding 2% of the total external wall area, providing the provisions of Ö-Norm B 810-2 (preventing condensation) are complied with.	0.70
8	WALLS partition walls within dwellings or commercial units	-
9	WINDOWS, FRENCH DOORS, GLAZED DOORS in dwellings adjoining outside air	1.40
10	WINDOWS, FRENCH DOORS, GLAZED DOORS in non-dwellings adjoining outside air	1.70
11	Other vertical TRANSPARENT BUILDING ELEMENTS adjoining outside air	1.70
12	Other horizontal or sloping TRANSPARENT BUILDING ELEMENTS adjoining outside air	2.00
13	Other vertical TRANSPARENT BUILDING ELEMENTS adjoining unheated building elements	2.50
14	ROOF LIGHTS adjoining outside air	1.70
15	DOORS unglazed, adjoining outside air	1.70
16	DOORS unglazed, adjoining unheated building elements	2.50
17	INDUSTRIAL DOORS external roller shutters, sectional doors etc.	2.50
18	INTERNAL DOORS	-
19	CEILINGS and SLOPING CEILINGS adjoining outside air and roof spaces (ventilated or uninsulated)	0.20
20	CEILINGS adjoining unheated building elements	0.40
21	CEILINGS adjoining separated dwellings and commercial units	0.90
22	CEILINGS within dwellings and commercial units	-
23	CEILINGS/SOFFITS adjoining outside air (e.g. above passageways under buildings, parking decks)	0.20
24	CEILINGS adjoining garages	0.30
25	FLOORS in contact with the ground	0.40

3.6 Snow Loads

Snow loads must be calculated on the basis of EN 1991-1-3. For roofs with a pitch of $\leq 30°$ a reduction factor of 0.8 of the characteristic ground value can be applied. In

roof areas where drifting can be expected, higher values must be applied (refer EN 1991-1-3).

3.7 Wind Loads

Wind pressure and suction loads must be calculated on the basis of EN 04/01/1991.

Panels must be designed for their capacity to withstand the local wind loads acting on them. The wind suction values used to calculate the number of bolts for fixing the panels to the substructure.

3.8 Substructures

These supporting elements (purlins, sheeting rails, trimmers for windows, doors and industrial doors) transmit the loads from snow, ice, wind pressure and wind suction. They must be designed to take into consideration the prevalent load conditions based on the relevant Eurocodes. Substructures are load-bearing structures and must be marked in compliance with the Construction Products Regulation EU 305/2011 CE.

3.9 Panel Lengths

Surcharges will be charged on panel lengths under 2.5 m and 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 up to 18 m in length. However, it is difficult to transport and install panels of this length, which is why shorter panels should be designed (up to 13 m).

3.10 Calculation of Panel Thickness

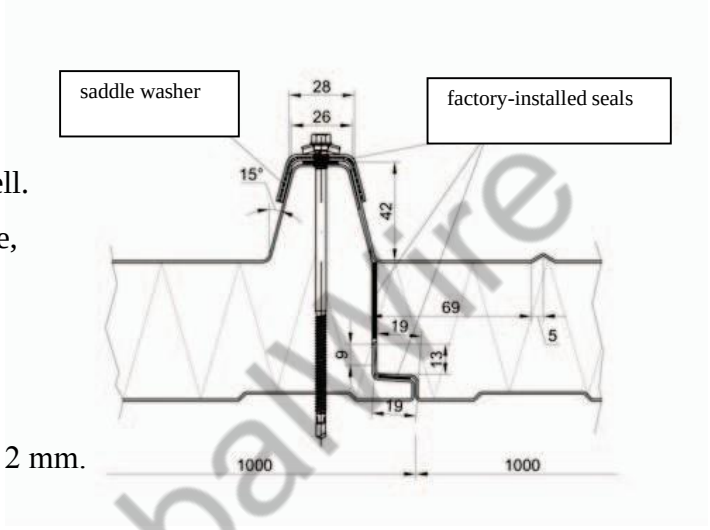
Panel thickness is also based on wind pressure and suction loads, as well as the required insulation value.

3.11 Calculation of the Number of Fasteners

Wind suction loads also determine the number of fasteners. The pull-out loads of the fasteners must be obtained from the manufacturer's technical approval certification. The partial safety factors specified in EN 1993 [Eurocode 3: Design of steel structures] must also be taken into consideration.

3.12 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. During the design process care must be taken to ensure that wall and facade panels are sealed against outside air with joint sealing tape on the inside as well. Roof panels must have a joint sealing tape, a sealing tape in the overlapping joint on the crown and an internal sealing tape in the seal. The internal joint tolerance in roof panels is ± 2 mm.



3.13 Seals for Joints Formed on Site

All joints in the envelope of buildings that are heated or cooled (conditioned) must be sealed on the inside surface using suitable sealing tapes (e.g. 'DIBA Paneel' system by Würth).

At plinth level, personnel and industrial doors, heads of windows: 2 x 50 x 4 mm, with centre flashing to reduce thermal bridging.

Side and top seals: 8 x 20 mm normally bonded as a single strip.

Interior cladding: 15 x 3 mm.

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 formed with vapour permeable sealing tapes and resistant to driving rain (e.g. Würth VKP 300 or VKP 600 where installed above 12 m, or similar approved). The external joints of horizontally installed panels must be sealed at their ends so that no rainwater can penetrate behind the cover flashings.

A table of sealing tapes is given on the following page.

Properties	Type A	Type B	Type C	Type D	Type E	Type F	Type G	Type H
Designation	Sealing tape Diba Paneel Soft 15/4,5	Partition wall tape	Sealing tape Diba Paneel Soft 20/10	Sealing tape VKP Plus 600	Aluminium butyl	EPDM sealing tape	Flexband Aktiv Easy sealing tape	Compression-resistant rubber underlay
e.g. Würth Art. No.	0875 200 154	0875 303...	0875 200 201	0875 021 ...	0875 620..	0875 850 330	0875 181 ...	0681 018 062
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	High resilience and maximum protection against water ingress, optimal underlay for snow guards	Sealing of butt joints and window frames	Doubling at transverse joint, one-sided self-adhesive
Cellular structure	Closed cell	Closed cell	Closed cell	Open cell	Vapour and gas-tight	Closed cell	Closed cell	-
Material	PVC foam	PE foam	PVC foam	PU foam	Butyl rubber with aluminium facing	EPDM cellular rubber	Polyester membrane, coated on both sides with polyester fleece	-
Impregnation	-	-	-	Acrylate polymer dispersion	-	-	-	-
Building material class	-	B 1	-	-	B 2	B 2	B 2	-
Tensile strength	160 kPa	longitudinal 325 kPa transverse 220 kPa	160 kPa	-	-	-	-	40 kg/cm^2
Fire performance	B 1	B 1	B 1	B 1	-	-	B 2	-
Bulk density	110 +/- 20 kg/m³	29 kg/m³	110 +/- 20 kg/m³	-	1.58 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 +50°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 +100°C	-40°C to +80°C	-30°C to +90°C
Vapour vapour diffusion	Vapour check	-	Vapour check	-	Vapour barrier	-	Humidity variable	-
Vapour permeability			μ = 76 (sd 1.5 m)	$\mu \leq$ 100 DIN 18542	sd 1500 M diffusion-resistant	-	sd 0.10-6.6 M	-
Thermal conductivity	None	None	None	0.05 W/mK	None	Negligible	-	-
Joint permeability	No	Yes	No	Yes	No	No	No	No
Impermeable to driving rain	No	No	No	Yes	Yes	Yes	Yes > 600 Pa	No
Resistant to weathering	Yes	Yes	Yes	Yes	Yes	Yes	3 months	No
Compatibility with building materials	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	50 - 100 mm	30 x 3 mm	70 - 200 mm	50 x 5 mm
Elongation at break	>190 %	-	>190 %	-	-	-	-	200%
Colour	grey	anthracite	grey	grey	silver	black	beige	black
Shelf life	2 years	2 years	2 years	2 years	1 year	2 years	2 years	2 years

3.14 Stiffening of Supporting Structure with Sandwich Panels

Roof and wall cladding panels must not be used to stiffen the supporting structure. It is not possible to stabilize light gauge metal purlins or cladding rails against lateral torsional buckling.

3.15 Noise Reduction Inside Buildings

Climatic effects can cause thermal elongation of composite elements with audible crackling or occasionally cracking sounds. These kinds of noises are systemic in metal cladding and do not constitute a defect. Depending on the sound insulation requirements constructional measures must be designed (e.g. resilient acoustic sealing tape for decoupling).

3.16 Operating Temperatures

Temperature effects in excess of 90° C on the surface of the panels caused by the user are not permitted.

3.17 Protruding Screws on Supporting Structure

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. The projecting drill ends on the inside must be covered below 2.5 m.

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 to be successful in practice.

3.18 Similarity of Polyurethane and Mineral Wool Panels

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

3.19 Installation Plans

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 profiled sheeting;
- Installation direction;
- Fasteners with type designation, layout and spacing;
- Special installation instructions for specific types of fasteners (e.g. diameters of drilled holes);
- 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. forroof lights, 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;

3.20 Permitted Deflections

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

- Structural decking for roofs with metal cladding: L/200 in Austria due to the national annex to EN 1990, otherwise L/150
- Single-layer roofs, top sheets of multilayer roofs: L/200
- Structural decking under roofs with waterproof membranes L/300
- Walls: L/150

As a basic rule deflection must be measured at the crown. Small areas of local deflection of the troughs may be disregarded. The spacing between measuring points is fixed at 1.0 m.

3.21 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.

3.22 Temperature-induced Movements of Metal Facings

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

For steel materials this is:

=.01 mm per m length and 1 C temperature difference

For a 12 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).

3.23 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.

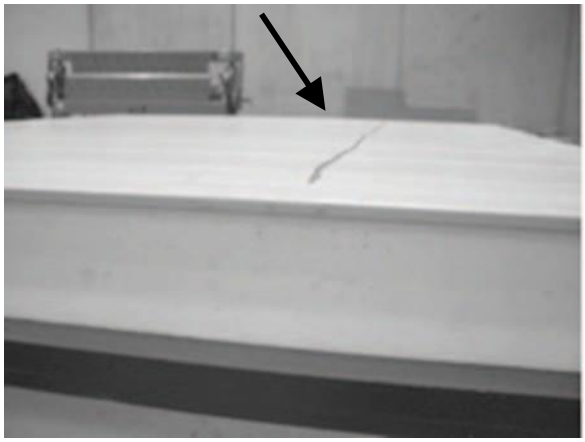
The visual assessment of surfaces must be undertaken at a conventional viewing distance in diffuse lighting conditions.

NOTE: The permitted tolerances for flatness are specified in ÖNORM DIN 18202 [Tolerances in building construction - Buildings].

The design must take into account the material tolerance of the joint width. This is usually ± 2 mm.

3.24 Thermal Break

Thermal breaks can be arranged in the inner facing 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 lateral seamed webs must not be cut, they remain as residual structural elements. The reduction in bearing capacity must be taken into account with projecting parts of panels, for example overhanging roof cladding or parapet upstands. The maximum depth of cut is 4-5 mm, the web remains as the residual structural element.



3.25 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 facing must be removed in the overlap between the panels.

3.26 Air Tightness

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 flashings must be formed with adequate overlap but without a direct connection between them.

3.27 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 appearance of colours depends on the type of coating.

3.28 Solar and Photovoltaic Panels

Unintentional anchor points must be taken into account in the planning of the fixings for the anchors and their supporting structure. Where there are subsequent roof attachments, the fixings must be checked for possible additional loads.

3.29 Fire Spread in the Ceiling Zone

Where mineral wool panels installed in multistorey buildings to prevent fire spreading between floors, high tensile joint tapes made of fire resistant polyurethane foam (e.g. Würth Fugensystem L or similar) must be fitted in the ceiling zone prior before the installation of the panels. You can find out more about the complexities of this subject at: www.wuerth.de/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.

3.30 Suitable Substrates

3.30.1 General

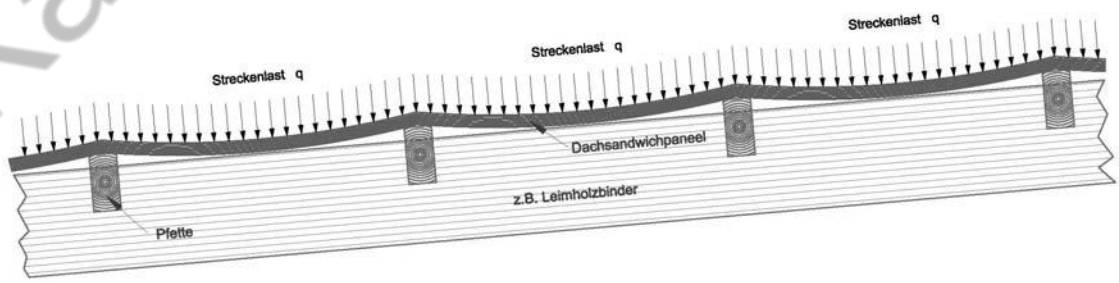
More stringent requirements regarding dimensions, shape and bearing tolerances for substrates must be specified and coordinated with the roof or wall construction where necessary.

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 support of composite roofing panels must <u>not</u> obstruct the free deflection of the composite elements, unless the span is reduced to 50% of the permitted value.



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 firewalls constructed from composite elements must be manufactured from incombustible materials of the required fire rating. The panel manufacturer's recommendations must be complied with regard to spans.

3.30.2 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 ÖN 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 ÖN 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.

3.30.3 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 areas prone to heavy snow fall (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 roof light 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.

3.30.4 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

3.30.5 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. The cast-in channels 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 mounting 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 Ø250 mm.</td><td>Longitudinal joints sealed</td></tr>
<tr><td>≥ 5° – < 7°</td><td rowspan="2">200mm with seal</td><td rowspan="2">Overlap</td></tr>
<tr><td>≥ 7° – < 12°</td></tr>
<tr><td>≥ 12° – < 20°</td><td>150mm with seal</td></tr>
<tr><td>≥ 20°</td><td>150mm</td><td colspan="2">In accordance with ÖNORM B 3521-1:</td><td></td></tr>
</table>

3.30.6 Steel Substrates

The material thickness must be suited to the connecting element, if using cartridge-fired pins the minimum thickness is 6 mm.

3.30.7 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.

3.31 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. Asphalt works in confined spaces may only be carried out if the radiant heat is removed by 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 those 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 sandwich panel screws 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 screwed connections is crucially dependent on the diameter of the pilot hole, the nature of the materials and the thickness of the parts being assembled.

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.

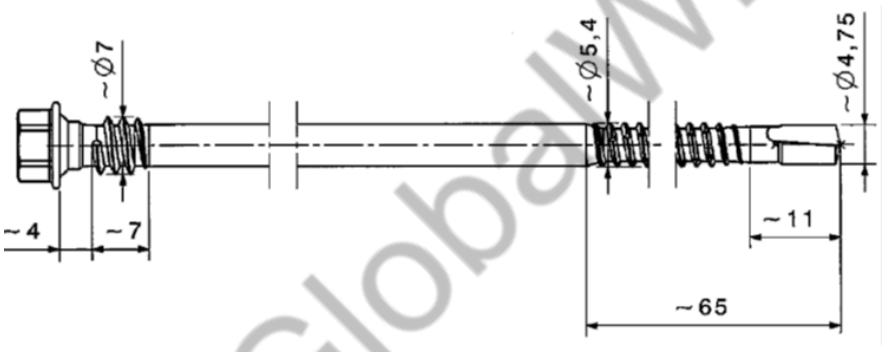
Where fixings are concealed, fasteners must be at least galvanized steel, with a zinc coating of not less than 8 μm.

4.2 Fasteners and Connectors for Sandwich Panels

Screws for the direct fixing of sandwich panels must have a support thread to prevent the formation of dents. The maximum denting depth when fixing wall cladding with visible screws must be limited to 1 mm.

When fixing roofing sandwich panels through the crowns suitable storm or saddle washers with a neoprene backing should be used.

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



e.g.: SFS intec SXC……., SXCW ……/www.sfsintec.biz/at, or similar.

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 facing.

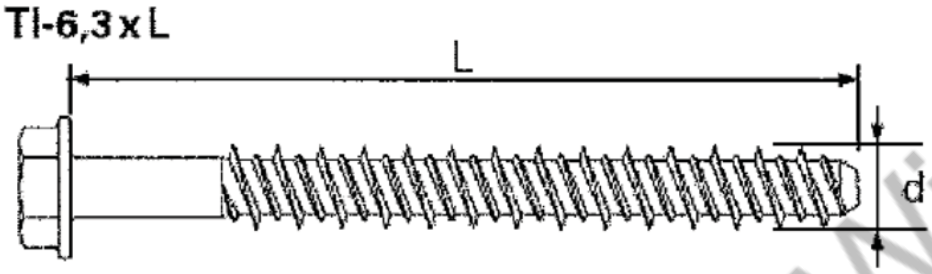
Where fasteners are used on the crown without storm washers, or in the trough the EPDM backing of the sealing grommets must be at least 3 mm thick and a Shore hardness of < 55.

NOTE The fixing of sandwich panels in the troughs the thickness of the outer panel facing 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 should be used for fixing sandwich panels through the seams (concealed fixing). In this case screws without sealing grommets may be used, provided the facade is installed vertically or is externally suspended.

Where sandwich panels are directly installed with concealed fixings only fasteners approved by the local building control authorities may be used. The most suitable direct fasteners are made from galvanised steel (e.g. SFS intec TI / www.sfsintec.biz/at)



To determine the precise number of required fasteners, the pull-out strength must be calculated in accordance with the requirements of ÖNORM B 6124 [Mechanical attachments for external thermal insulating composite systems (ETICS)] or the EOTA guidelines. The pull-out tests are usually carried out by the screw manufacturers.

4.3 Side Lap Screws

Screws for side lap stitching must be officially approved stainless steel screws with undercut and a sealing grommet with EPDM seal and minimum Ø 14 mm at a maximum spacing of 666 mm. Screws should be preferably of the material-displacing and swarf-free type. These stainless steel screws are suitable for side lap and edge fixings of sheets with a maximum thickness of 2 x 0.88 mm (e.g.: SFS intec SLG-S). The tightness of these types of screws can be verified through vacuum testing.

4.4 Mis drilled Holes

These holes can be rectified with stainless steel 'repair screws' with sealing grommets and EPDM seals.

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 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 be of galvanised or similar materials

5. COATINGS

5.1 General

To prevent color 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 Color Groups

Panel colors are divided into three groups that are arranged in order of increasing heat absorption due to the darkness of the color. The lighter the color, 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.

Color 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	Sulfur yellow	55
7035	Light grey	55
6019	Pastel green	55

Color 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	Clay brown	64

Color 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	78
6008	brown Brown green	79
5013	Cobalt blue	80
6020	Chrome green	75

5.3 Coatings on Galvanized Sheet Steel

Coatings on galvanized 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	Thickness	Application	Characteristic	Price
Polyester	25 µm	Exterior/interior	Good UV resistance	Standard
Thin polyester	15 µm	Interior	Less UV-resistant	Standard
PVC film	150 µm	Inside coating	Not UV-resistant	Surcharge
PVDF	25 µm	Exterior	Does not fade quickly	Surcharge
TTHD	60 µm	Exterior	Harsh environments	Extra
Plastisol	100,150,200 µm	Exterior	UV-resistant	Surcharge

6. ACCESSORIES

6.1 General

Accessories comprise:

- Product-specific prefabricated fittings and suitable roof-mounted components e.g.: fans, vent pipe terminals, roof lights,
- 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 roof lights.

6.2 Sealants (Tapes, Mastics Foam Fillers etc.)

The sealant must be suitable for the intended purpose (e.g. air tightness, watertight seals) and be resistant to, and compatible with the bonding substrates.

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.

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.

Each sandwich panel must be fixed on the supporting structure before the end of every work session. For safety reasons it is recommended that side lap connections should be formed as soon as possible, particularly on roofs and ceilings.

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 galvanized 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 or similar tools capable of producing sparks are only permissible in exceptional cases; use sheet metal nibblers and hand-held circular saws instead. 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.

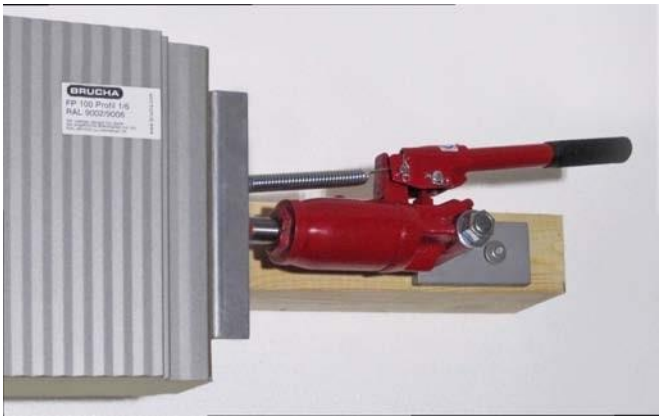
The prevailing wind direction should always be taken into account when installing roof cladding.

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

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 specialist tools



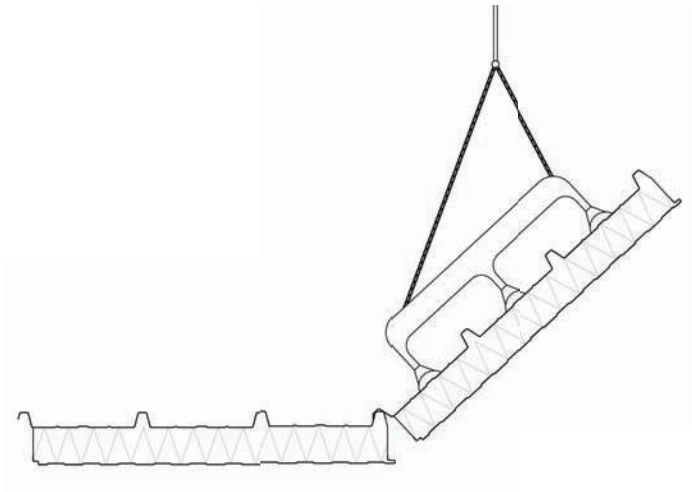
7.3 Thermally Induced Panel Bowing (Bimetallic Effect)

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.

7.4 Installation of Roof 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. On no account should the panels be lifted with slings on the unprotected corners; the seams will be deformed and damaged. Make sure the attachment points and centre of gravity are correctly selected to ensure safe lifting. It is also important that the lifting points are correctly spaced, otherwise the panel might buckle. Suction cups have rubber plates that protect the paint surface; suitable protection measures must be adopted when using mechanical devices. Make sure each panel fits precisely in the joint area. It is not possible to adjust the panels after the roof installation has been completed. Incorrect joint formation can lead to large gaps and thus vapour diffusion and condensation due to faulty compression of the factory-installed seals.

During the roof installation it is therefore important to post a specialist installer inside the space to spot any gaps and take action immediately.



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! Suction devices and mechanical lifting clamps are lifting tackle within the meaning of the Working Appliance Ordinance BGBL II 164 / 2000 and are subject to an annual testing obligation by an authorised person in accordance with Section 8. The test logbook must be held in readiness for the occupational safety inspectorate!

7.5 Occupational Safety Requirements

The occupational safety regulations must always be observed when working at height. The information leaflet M 222 (Working on Roofs) and other information can be downloaded free of charge from the AUVA 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.

7.6 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 length/200 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.

7.7 Drip Profiles

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 bond.

7.8 Eaves Details

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

For sustainability reasons it is recommended 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 (crowns). 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.

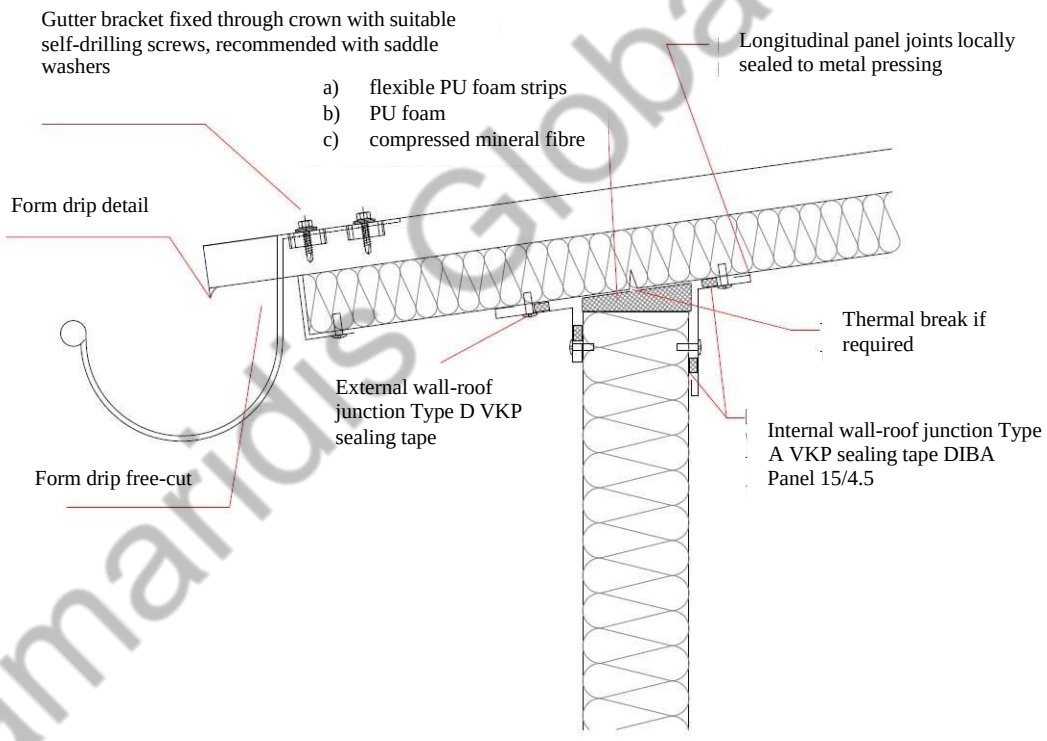
The cuts can be omitted on minor buildings with an insulation thickness of ≤ 30 mm, provided that the panel has a foam insulation core. It is never permissible to allow water to flow over an exposed mineral wool insulation core (without eaves cut).

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 be formed in the gutter at a maximum spacing of 15 m.

Example of a preferred eaves detail with a round or rectangular suspended gutter



7.9 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.

7.10 Valleys

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.

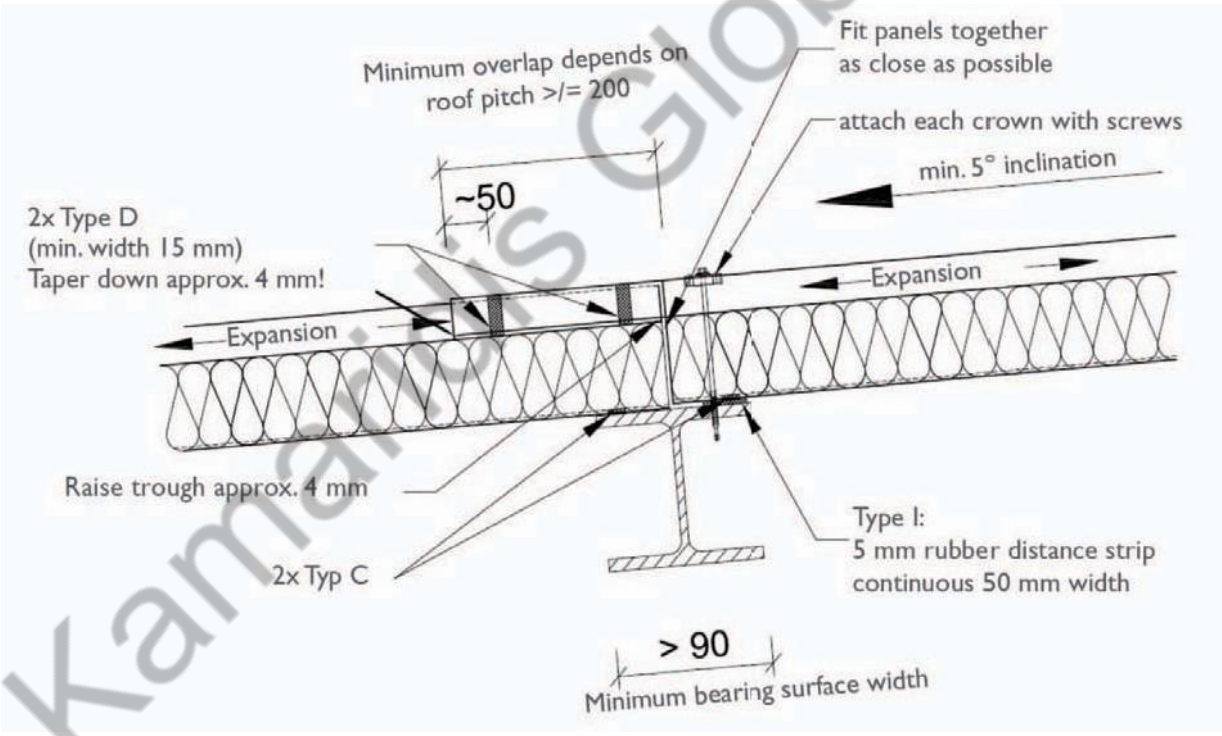
Recessed valleys must conform to the requirements of ÖNORM B 3521-1 pertaining to roof pitch, dimensions and installation.

The use of silicone sealants to form the joint between the roofing and the valley flashing is not permitted.

7.11 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 5 mm rubber underlay strip (e.g. Würth 0681 018 062) must be inserted underneath the ridge-side panel; the required overlap is given in Table 2 and must be sealed with two strips of vapour permeable compressible sealing tape. The lower element must be tapered upwards into the trough. The upper element must be tapered down into the trough. Transverse joints must only be formed over a purlin.

No fixings in the overlap area!



7.12 Verge, Monopitch Ridge and Wall Flashings

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.

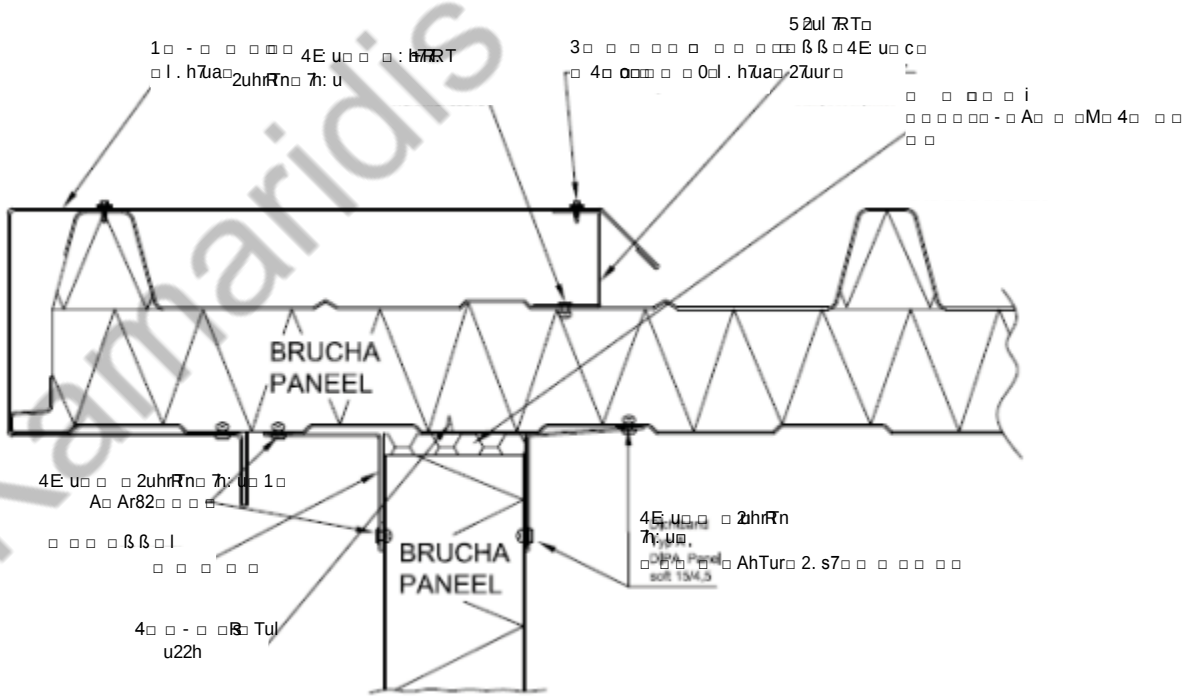
Suitable fitted foam profile fillers, toothed plates or closure pieces must be installed to cover open profile cross-sections at ridge and monopitch ridge flashings.

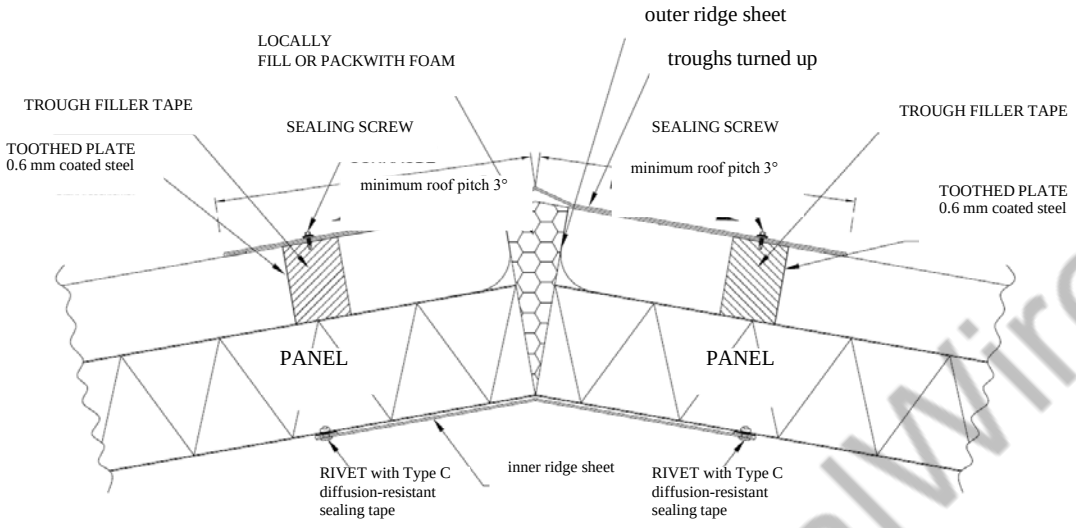
Example of a verge flashing:

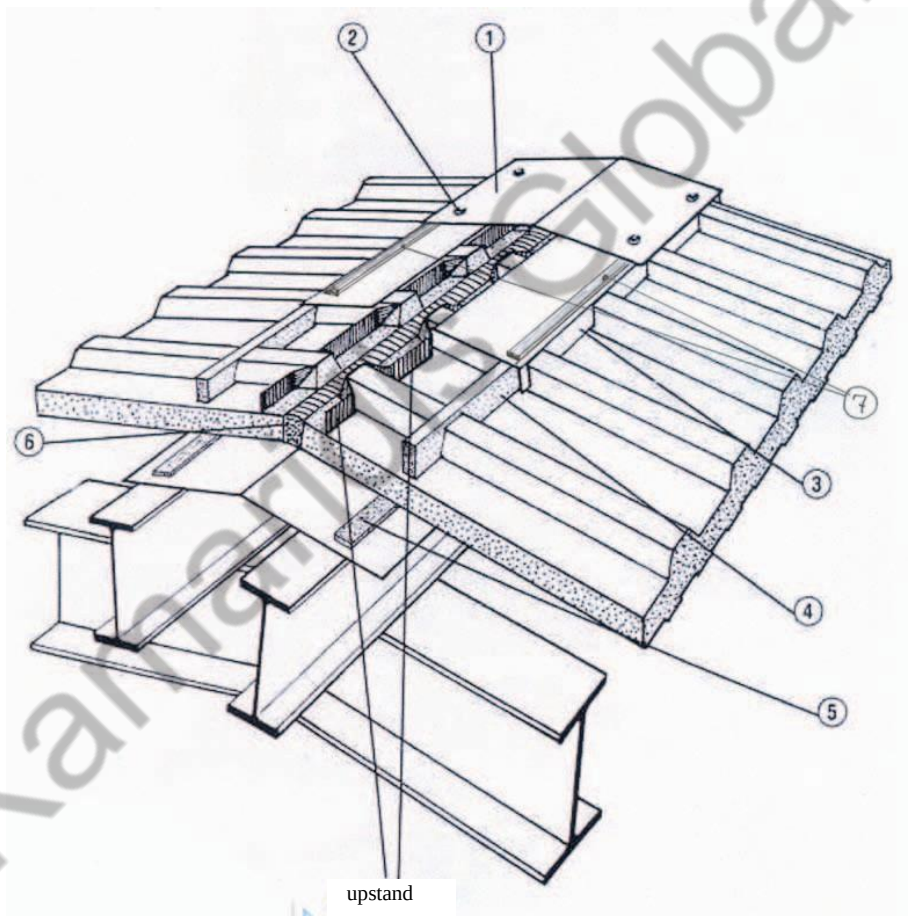
7.13 Duopitch and Monopitch Ridge Details

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







1 Ridge flashing (galv.)

2 S/steel self-drilling screws with seal

3 Toothed plate (galv.)

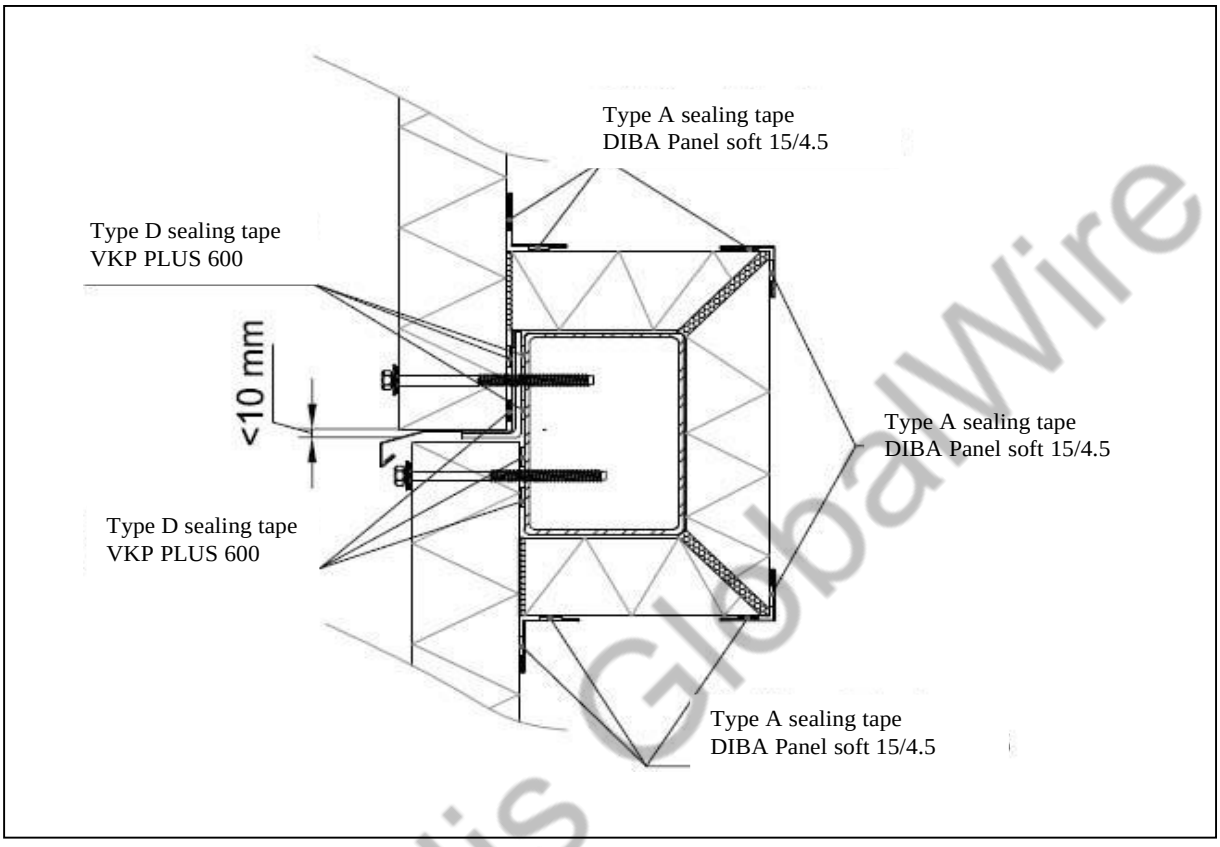
4 Profile filler (self-adhesive)

5 Sealing tape Type 3 (see Table)

6 in situ PUR foam, min. wool for min. wool panels

7 Sealing tape Type 4 (see Table)

7.14 Transverse Joints in Wall Panels

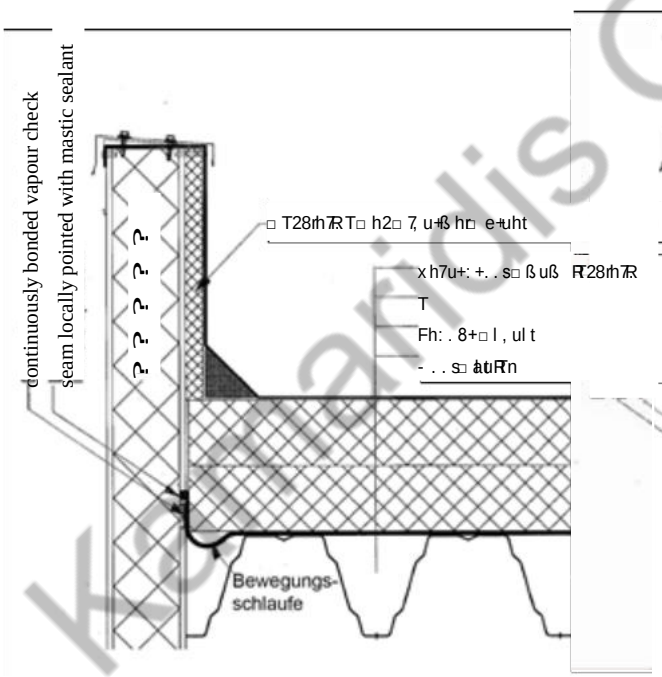


The continuous support angle is important for transferring the load of the upper panels into the structural frame and not on to the lower panels. In both cases space must be left for thermally induced movement the outer facing.

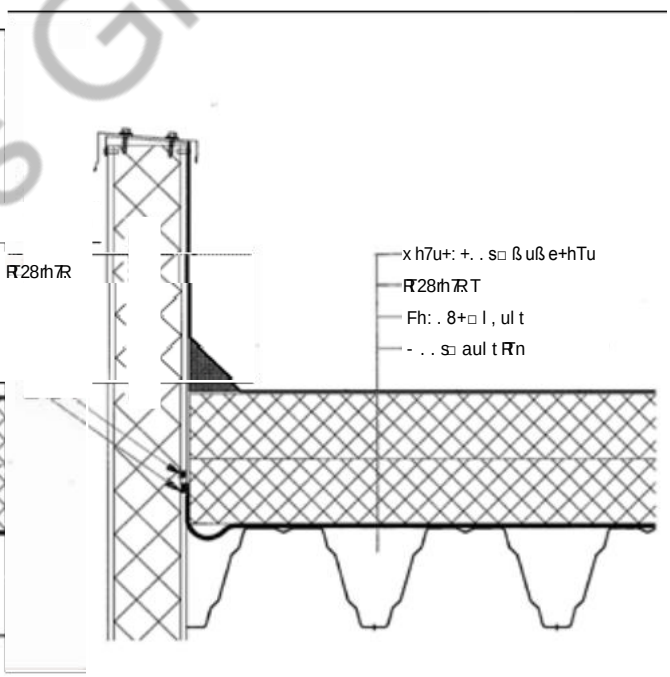
7.15 Warm roof – Junction with oversailing sandwich panels as coping detail

ÖNORM B 3691 must be used for the design and installation of roof waterproofing systems. Vapour checks that are fully bonded to trapezoidal roof decking must be vapour sealed to each other with suitable materials. Regardless of whether they are laid vertically or horizontally, if wall cladding sandwich panels over sail the level ofthe roof waterproof membrane in the form of a coping, then the ends of the vapour check must be continuously bonded to the inner skin of the sandwich panels withsuitable sealing tapes. Where wall or cladding panels are installed vertically, theinternal seams must be filled with a permanently elastic sealant to prevent rising warmair from entering the roof structure. Where wall or cladding panels are installedhorizontally, the vertical butt joints must be sealed against rising warm air in the areaof the intersection of the sealing tapes. Depending on climatic requirements, thermalbreaks should be considered.

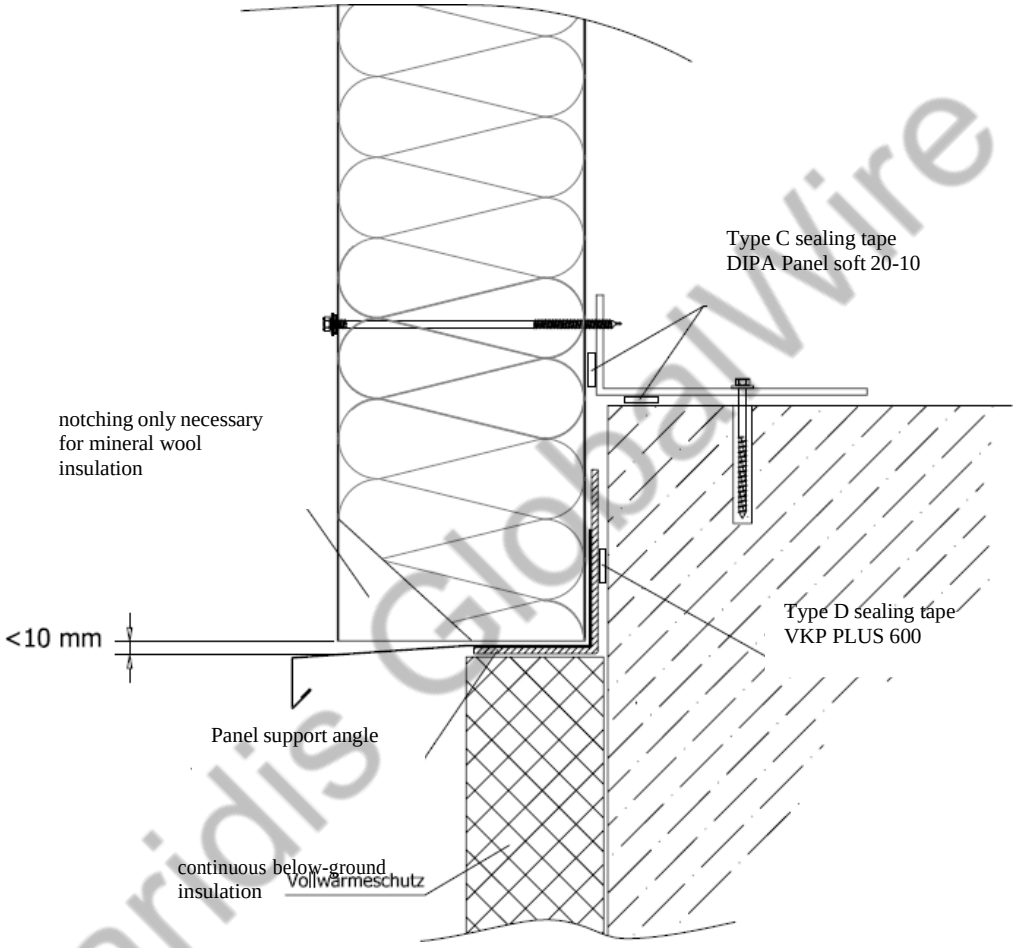
Junction with coping insulation:



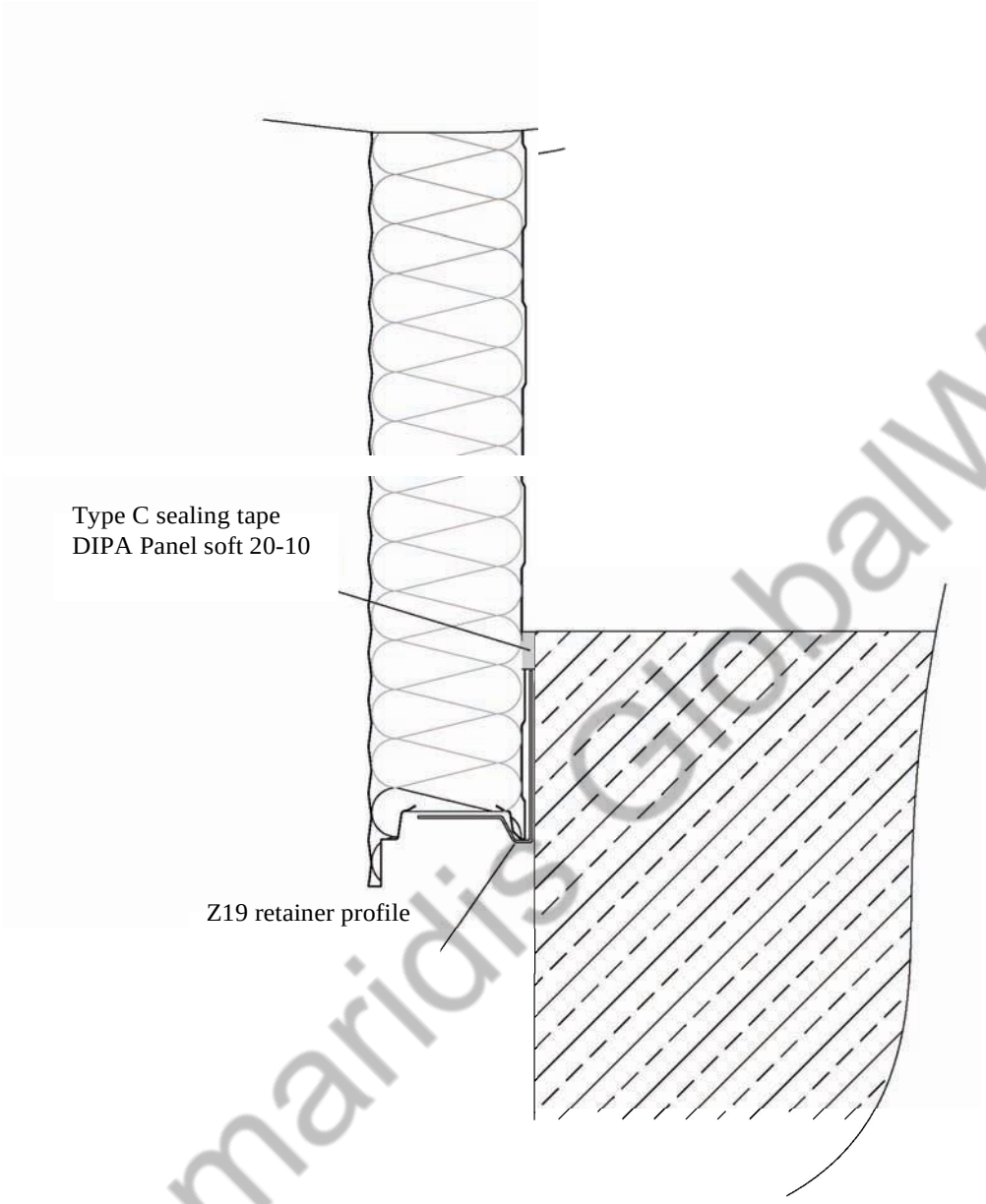
Junction with thermal break:



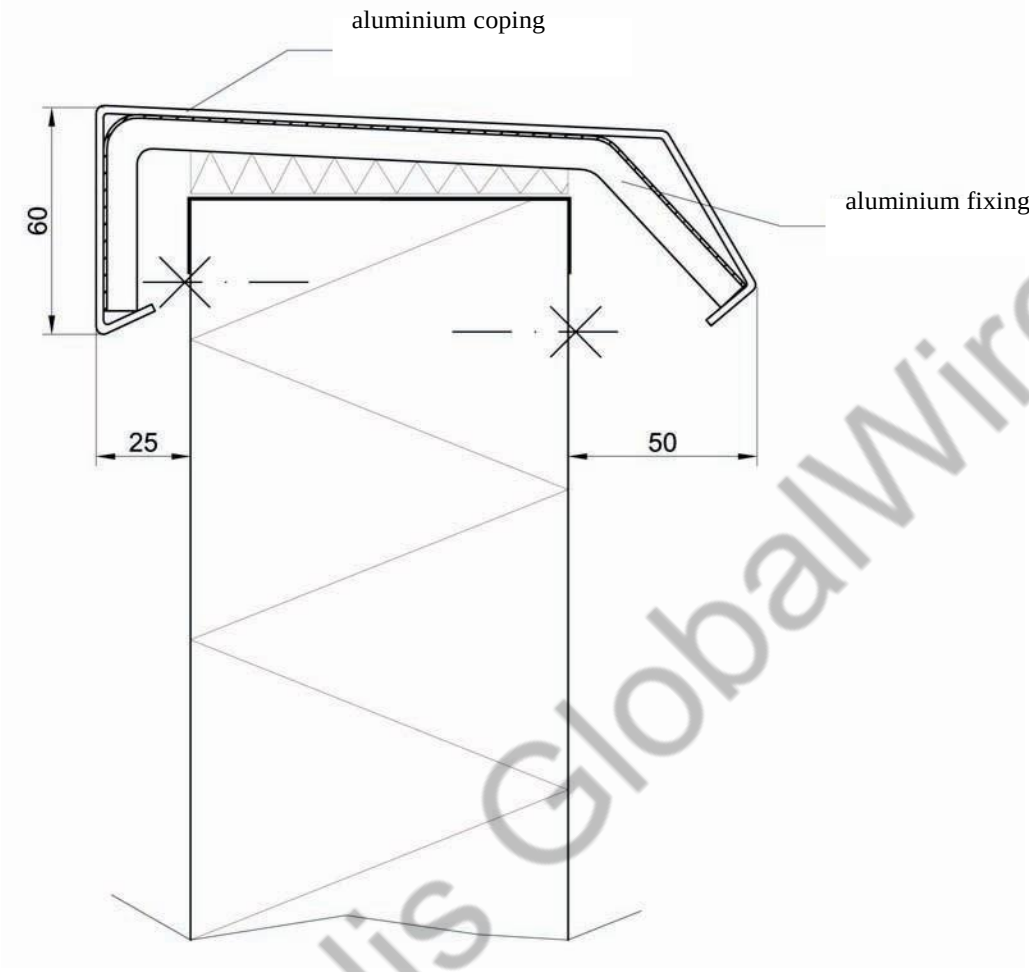
7.16 Plinth Detail - Vertical Assembly



7.17 Plinth Detail - Horizontal Assembly



7.18 Parapet Coping Permitting Bimetallic Effect

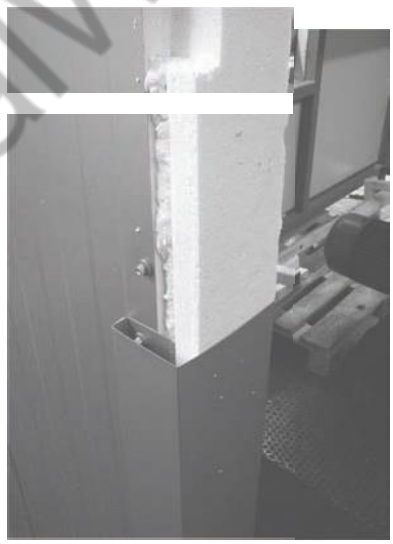


When installing long-span panels it must be ensured that their movement is not constrained, otherwise it can cause stress problems, particularly in panels coated with a Group III RAL colour. Multiple fixings would cause creasing of the panel surface. It is therefore important to allow for the bimetallic effect in the detailing and execution of the connections. The thermally induced movements of the panel must not be constrained.

7.19 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 3 sealing tape (50 x 4 mm) must be inserted between the vertical channels of the sectional doors and the reveal cladding.

The photo on the right shows an example of a properly constructed reveal. The cladding panel is folded inwards for the subsequent installation of the guide rails of the sectional doors. On the outside you can see a cladding support bracket on to which the reveal cladding has been riveted. In this case the insulation was polystyrene.



Here is another example of a reveal cladding detail. The pocket-shaped edge bending allows the outer part to be easily replaced in case of damage without having to remove the guide rails.

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Thermally insulated lintel cladding, including sealing tapes in accordance with OIB 6:

7.20 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.

Type 7 sealing tapes are to be used inside and Type 8 on the outside. For sealing large areas on stick system facades, Type 10 bituminous membranes can also be used for the interior panel facings.

Thermal breaks are necessary because during installation, the window was in contact with the exposed foam insulation of the panel. A Type 7 vapour impermeable sealing tape is bonded on the inside.

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 8 vapour permeable sealing tape. This is covered by the sheet metal cladding.

The window reveal plate is fitted behind the drip profile. Behind that is the Type 8 vapour permeable sealing tape. A soffit lining made from an edge-folded plate is suspended from the front edge and attached to the window at the back.

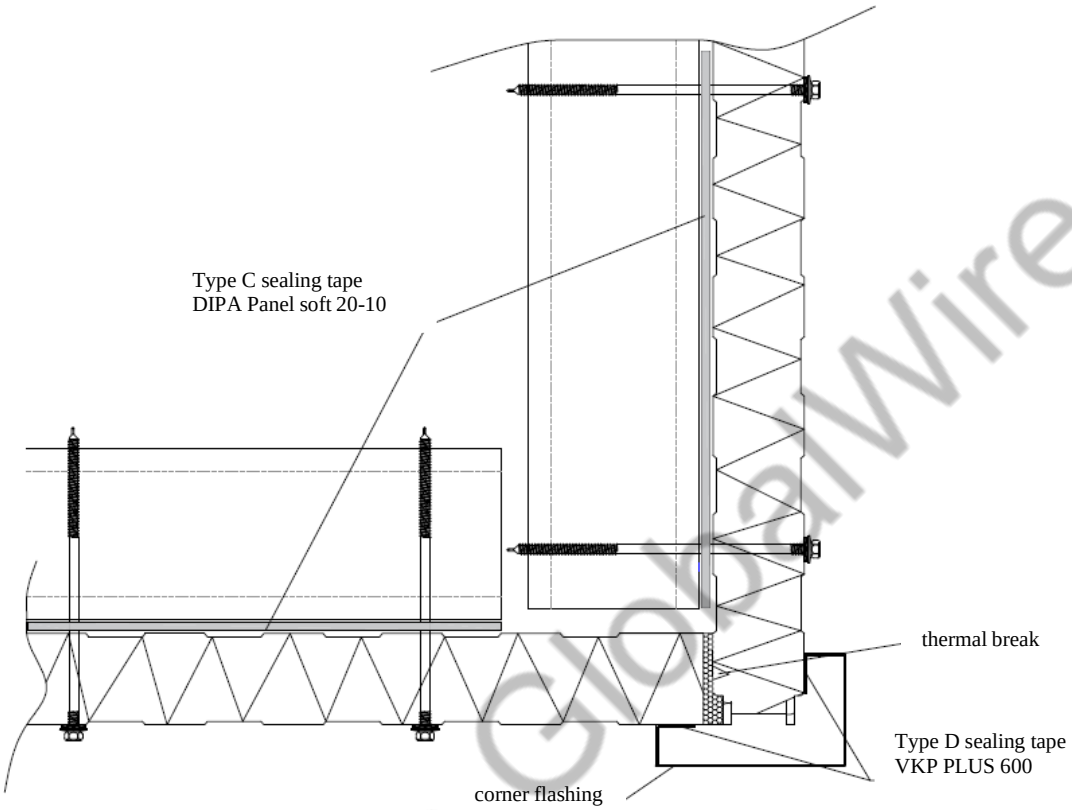
The foam on the lintel behind the outer seam is removed to form a slot for the later installation of the vertical seal. A recess must be made in the foam on both sides above the window reveals to provide space for raising the upstand profile.

The reveal cladding sheets are nested at high level. With this method it is important that Type 8 window sealing tape is carefully applied under the cill profile and reveal cladding sheets without puncturing.

The lintel cladding has now been 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.

7.21 External Corners



The more elegant corner detail using a concealed support angle. A Type 4 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. Again, Type 4 sealing tapes must be installed.

7.22 Flashings to Flues, Ducts Roof lights and Pipe Penetrations

Flashings can be formed in accordance 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.

7.23 Flashings of Wall Openings Corners and Penetrations

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

7.24 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 anchors using clamps 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.

7.25 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.

7.26 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□

Double snow guard fastened to the purlin by means of two screws.

Single snow guard with ice claws fastened to the purlin using a single screw.

Galvanised support brackets are available that are fixed further back to create a relatively large bearing surface and an effective lever arm for transmitting the forces into the panel. The design calculation determines the spacing of the supports. The fasteners (with EPDM seals) are screwed directly into the purlin. Galvanised pipes are available as sheet metal roofing accessories; they are fed through the holes in the brackets where they can slide freely. 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 block 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.

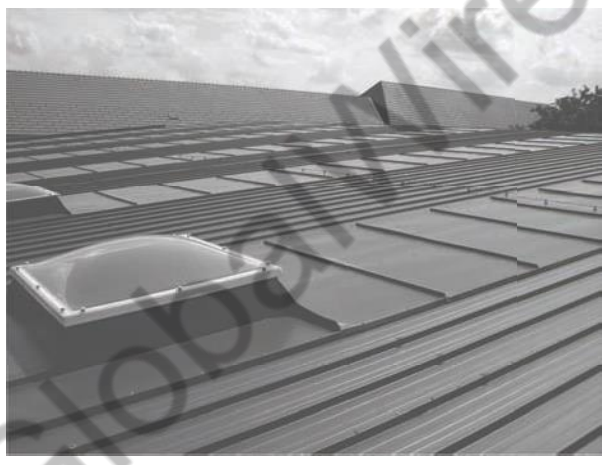
The projecting eaves and canopies of heated shed buildings are particularly vulnerable where a water baffle plate has been installed in the gutter. In time the water from the melting snow backs up in the eaves area and freezes on the cold projecting part of the roof, blocking

the entrance to 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.

7.27 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. Checks must be made to determine whether the roof panels can be supported with timber or steel trimmers. With conventional prefabricated kerbs, the uphill apron flashing should be taken up and under the ridge flashing.

Make sure the upstand kerbs are set at the correct level.



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

The exposed panel edges must be sealed with a Type H vapour permeable sealing tape before installation of the sheet metal cladding, otherwise warm air will diffuse into the mineral wool core, leading to condensation that will destroy the panel.

Prefabricated kerbs:

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 insulation by taping over the cut edges with a Type 8 self-adhesive sealing tape.

7.28 Roof Openings

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.

Z 23

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).

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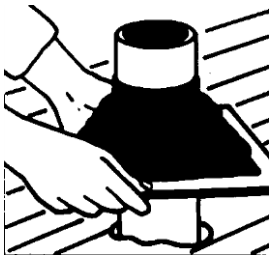
2. 

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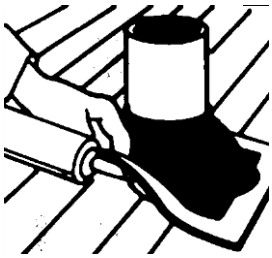
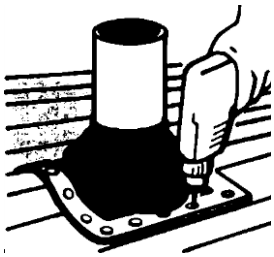
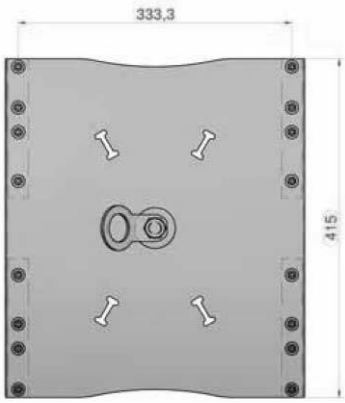
4. 

5. 

7.29 Fall Protection

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.



7.30 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 are 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 is 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 3 seal in the seam of the inner facing 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 barrier is damaged or if the installation gap between the panels is too big, the affected internal longitudinal joints must be taped with a 50 mm wide opal matt adhesive tape and high-strength adhesive tape (Würth Eurasol without markings). The specialist supplier can provide advice on this. The tape must be opal matt because on a surface coated with RAL 9002, this tape is hardly visible from a reasonable distance, whereas gloss tapes are very conspicuous.

The installation of a transverse joint on the roof should be avoided where possible. However, if this proves unavoidable observance of these rules is extremely important. The gutter detail must without exception incorporate a thermal 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 be sealed against air penetration with tape (e.g. Würth Eurasol).

8.4 Wall and Facade Panels

Exactly as PUR panels there is the choice between visible and concealed fixing. Due to the compression characteristics of mineral wool pressure distribution plates must be used on the attachment points.

8.5 Plinth Detail

At least one fillet-shaped cut must be formed to prevent the absorption of water by the mineral wool. In designing the detail always ensure that penetrating rainwater or leakage water can freely drain away without coming into contact with the mineral wool.

8.6 Transverse Joint in the Facade

The mineral wool must also be undercut here at 45° C to prevent water suction. The mineral wool must be removed completely. 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 because it can lead to overloading and wrinkling in the facade. Furthermore, the outer facing 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!

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.

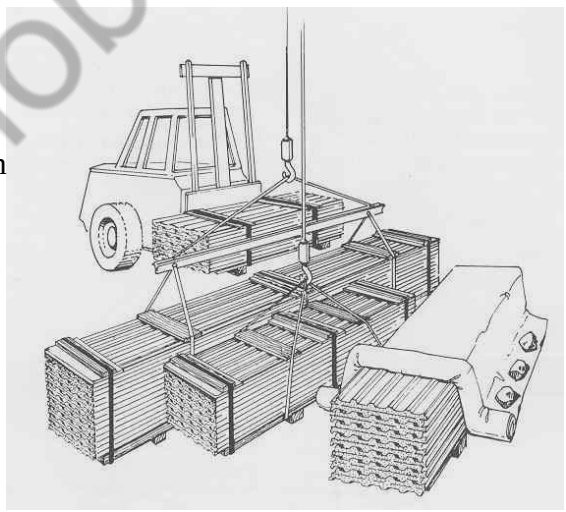
If it is necessary to set down packages on the roof structure it should be near to structural supports and be coordinated in advance with the steel erection contractor and the site management.

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) Storing panel packages outside for longer periods requires a canvas cover (not plastic sheeting) due to the risk of condensation forming on the underside of the plastic cover! It enables a rapid ventilation of the packages. Standing water between the panels must be prevented at all costs. Even surface-treated panels can be damaged under these conditions (stains, corrosion white rust).



To prevent pressure marks packages must not be stacked on top each other. When lifting by crane, packages must be protected with edge protection profiles under the lifting straps. If the panels are over 8 m long a spreader bar must be used. Only lift one package at a time. When loading and unloading with a forklift ensure the forks are spaced as widely as possible. Very long panels may require the use of two forklifts.

10. ACCEPTANCE STANDARDS

10.1 Repairing Damage

Repairs must be carried out using synthetic enamel paint. The total area of repairs must not exceed 300 mm² per m². Repairs must be invisible when the relevant facades are viewed under diffuse lighting conditions at a distance of > 5.0 m outside, and internal surfaces are viewed at a distance of > 3.0 m (analogous to ÖN EN 13438).

10.2 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. For practical tips please also refer to www.brucha.com.

10.3 Replacing Damaged Panels

If in the service life of the building, an accident or storm causes mechanical damage to one or more panels, it is possible, with sufficient labour, to replace the panels (with visible fasteners) by unscrewing and levering the panels out. New panels can be installed and the wall can be reassembled. With concealed fixing this is more problematic. After the inner panel seam has been cut, at least the last panel of the repaired wall to be installed can only be attached with visible fasteners. If this is not acceptable, the wall must be taken down as far as the damaged area, and reconstructed after the installation of the new panels. If the new panels are only secured by screws through the inner panel facing, the number of screws must be increased due to the lower pull-out loads.

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.

Depending on the moisture level of the timber, panel fasteners screwed into timber purlins have a slight tendency to work loose, which causes the sealing washer to lose its function, allowing rain to penetrate the drill hole thus causing rotting of the timber around the screw, which drastically reduces the pull-out strength of the screw. If this type of screw is used, after 18 months the screws must be re-tightened in the course of a roof inspection. The situation usually remains stable thereafter.

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