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Execution of steel structures and aluminium structures

Part 5: Technical requirements for cold-formed structural aluminium elements and cold-formed structures for roof, ceiling, floor and wall applications

bsi.

National foreword

This British Standard is the UK implementation of EN 1090-5:2017.

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Exécution des structures en acier et des structures en aluminium - Partie 5 : Exigences techniques pour éléments en aluminium formés à froid et structures formées à froid pour applications en toiture, plafond, paroi verticale et plancher

Ausführung von Stahltragwerken und Aluminiumtragwerken - Teil 5: Technische Anforderungen an tragende, kaltgeformte Bauelemente aus Aluminium und tragende, kaltgeformte Bauteile für Dach-, Decken-, Boden- und Wandanwendungen

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

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European foreword

This document (EN 1090-5:2017) has been prepared by Technical Committee CEN/TC 135 “Execution of steel structures and aluminium structures”, the secretariat of which is held by SN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by September 2017, and conflicting national standards shall be withdrawn at the latest by September 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document is part of the EN 1090 series, which comprises the following parts:

— EN 1090-1, *Execution of steel structures and aluminium structures - Part 1: Assessment and verification of constancy of performance for structural components*

— EN 1090-2, *Execution of steel structures and aluminium structures - Part 2: Technical requirements for steel structures*

— EN 1090-3, *Execution of steel structures and aluminium structures - Part 3: Technical requirements for aluminium structures*

— EN 1090-4, *Execution of steel structures and aluminium structures - Part 4: Technical requirements for cold-formed structural steel elements and cold-formed structures for roof, ceiling, floor and wall applications*

— EN 1090-5, *Execution of steel structures and aluminium structures - Part 5: Technical requirements for cold-formed structural aluminium elements and cold-formed structures for roof, ceiling, floor and wall applications*

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies requirements for the execution i.e. the manufacture and the installation of cold-formed structural aluminium components made from profiled sheeting for roof, ceiling, floor and wall applications under predominately static loading conditions or seismic loading conditions and their documentation. It does cover products of structural class I and II according to EN 1999-1-4 used in structures.

Structural elements are understood here to mean profiled sheeting, such as trapezoidal, sinusoidal, liner trays or cassette profiles (Figure 1), that are produced by cold forming. Perforated and micro profiled sheeting are also covered by this part.

Welded sections are excluded from this part and are covered by EN 1090-3 except seal welding in low-stress areas.

This standard also covers spacer constructions between the outer and inner or upper and lower skins as well as supporting members for roofs, walls and ceilings made from cold-formed profiled sheeting and the connections and attachments of the afore mentioned elements as long as they are involved in load transfer, it also covers connections and attachments of these elements.

A combination of steel and aluminium structural elements are permitted, e.g. liner trays made of steel, stiffened by profiles made of aluminium. In this case, EN 1090-4 and this document apply.

Composite structural elements where the interaction between dissimilar materials are an integral part of the structural behaviour such as sandwich panels and composite floors are not covered by this standard.

NOTE The structures covered in this standard can be for example

- single- or multi-skin roofs, whereby the load-bearing structure (lower skin) as well as the actual roof covering (upper skin) or both consist of structural elements;
- single- or multi-skin walls whereby the load-bearing structure (inner skin) as well as the actual cladding (outer skin) or both consist of structural elements; or
- suspended ceilings for interior fitting.

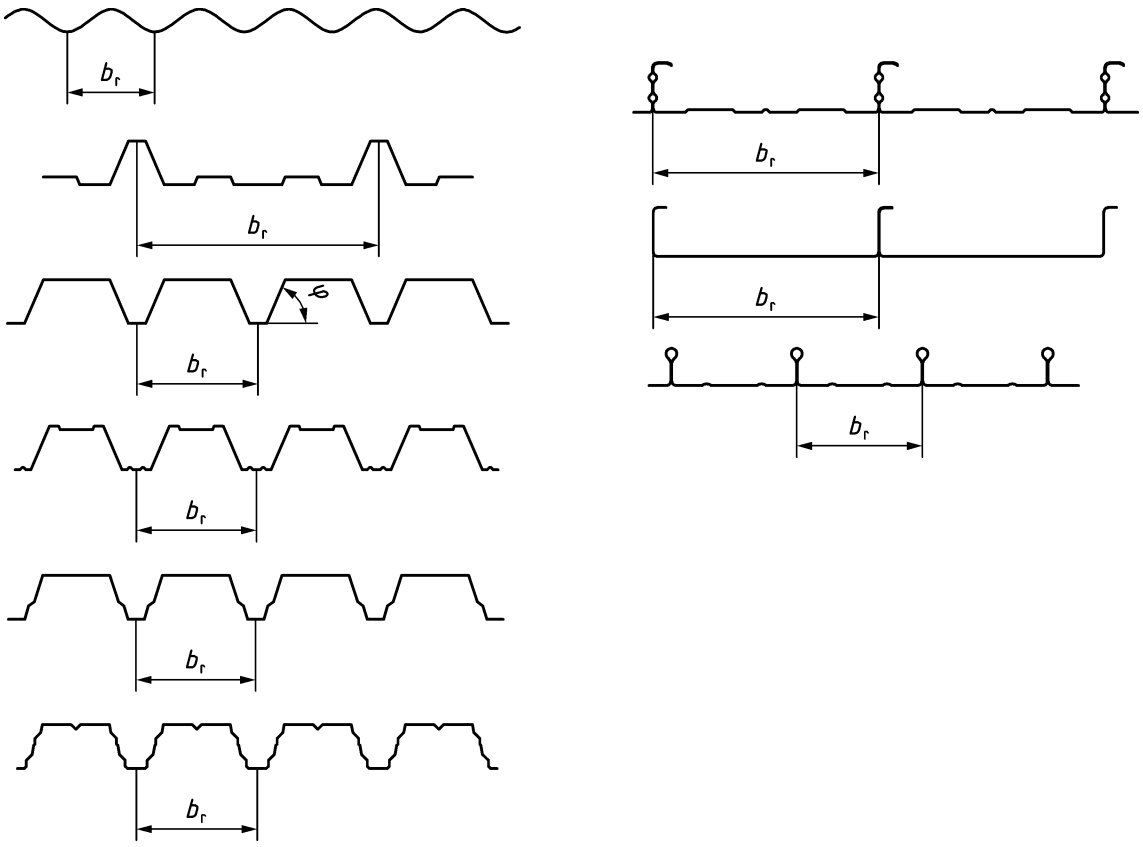


Figure 1 — Examples of profiled sheets

2 Normative references

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

EN 508-2, *Roofing products from metal sheet — Specification for self-supporting products of steel, aluminium or stainless steel sheet — Part 2: Aluminium*

EN 1090-1, *Execution of steel structures and aluminium structures — Part 1: Requirements for conformity assessment of structural elements*

EN 1090-3, *Execution of steel structures and aluminium structures — Part 3: Technical requirements for aluminium structures*

CEN/TS 1187, *Test methods for external fire exposure to roofs*

EN 1995-1 (all parts), *Eurocode 5: Design of timber structures — Part 1-1: General — Common rules and rules for buildings*

EN 1999-1-1, *Eurocode 9: Design of aluminium structures — Part 1-1: General structural rules*

EN 1999-1-4, *Eurocode 9 — Design of aluminium structures — Part 1-4: Cold-formed structural sheeting*

EN 10204, *Metallic products — Types of inspection documents*

EN 13501-5, *Fire classification of construction products and building elements — Part 5: Classification using data from external fire exposure to roofs tests*

EN 62305-3:2011, *Protection against lightning — Part 3: Physical damage to structures and life hazard (IEC 62305-3:2010)*

EN ISO 376, *Metallic materials — Calibration of force-proving instruments used for the verification of uniaxial testing machines (ISO 376)*

EN ISO 717-1, *Acoustics — Rating of sound insulation in buildings and of building elements — Part 1: Airborne sound insulation (ISO 717-1)*

EN ISO 11654, *Acoustics — Sound absorbers for use in buildings — Rating of sound absorption (ISO 11654)*

3 Terms, definitions, symbols and abbreviations

3.1 Terms, definitions

For the purposes of this document, the following terms and definitions apply.

3.1.1
ancillary
additional component e.g. as part of a purlin and rail system required to make the system function

3.1.2
cassette profile
roll formed, press-braked or folded structural elements with or without stiffeners used as substructures for walls and roofs with a bigger variety in cross sections than liner trays

3.1.3
cleat
connection bracket used to connect purlins and rails to the main steel frame such as a connector for attaching cold formed sections to each other – e.g. as in forming window or door openings

3.1.4
continuity sleeve
sleeve that connects two structural elements together and provide a continuous or semi continuous moment resistant joint

3.1.5
component I
component (usually the sheeting) that is facing the head of the fastener (the swage head in the case of blind rivets)

3.1.6
component II
second component of a connection (usually the supporting member)

3.1.7
decking
load bearing sheet to support e.g. insulation and outer skin

3.1.8
edge stiffener
supporting plate or profile at the longitudinal edge of a laying area to replace the missing neighboured sheeting and stiffen the free edge

3.1.9
fastening
fastener and, the process of fastening and the final connected components

3.1.10
flashing
non-load-bearing element, for example accessories and coverings in the areas of the skirting, eaves, gable end, ridge and corners

3.1.11
layout drawing
drawing showing the position of structural aluminium components and execution details

3.1.12
liner
inner sheet of a double skin system

3.1.13
penetration
opening in the decking executed on work-site to allow installation equipment to pass through

3.1.14
restraint
member transverse between two parallel runs of purlin or rail to provide structural restraint to the members – dependent on the system that can be positional or rotational restraint to the sections

3.1.15
saddle washer
oversized gasket that is adapted to the respective profile shape, which is made of aluminium, steel or stainless steel with an elastomeric or foamed sealant bonded to it

Note 1 to entry: The corrosion protection is adapted to that of the profiled sheeting.

Note 2 to entry: Saddle washer can be used when attaching profiled sheeting via its top flange.

Note 3 to entry: As an example, a figure of a saddle washer is given in EN 1993–1-3:2006, Table 10.3.

3.1.16
structural aluminium component
load-bearing element made from aluminium sheets

3.1.17
structural element
part of a structure e.g. profiled sheeting, such as trapezoidal, sinusoidal or cassette profile or linear profile cross section, e.g. with a Z, C, Ω or Π shape

3.1.18
trimmer
beam around an opening in a floor or roof or wall

3.2 Symbols and abbreviations

For the purposes of this document, the following symbols and abbreviations apply:

C corrosivity category

D edge waviness of the side lap

E modulus of elasticity

F force,

shear force of the fastener

I second moment of area

L span, distance

M bending moment

R end support reaction,

airborne sound insulation

T shear flow

V shear force of the structural aluminium component

a distance between a fastener and a web of a profiled sheet

b width,

width of spacing strip

d hole diameter,

nominal diameter of the fastener

e distance of hole from edge,

distance between fastener and centre line of flange of profiled sheet

distance between fasteners

f strength, yield stress

h depth of profile

l length of double layer

p distances between holes

r radius

t thickness of bare metal of the sheet, hole pitch

α sound absorption

Δ deviation, tolerance

δ deviation from straightness

φ inclination of the web of a profile

Indices

A end support,

centre-to-centre distance of the penetration from the end support or from the point of zero moment

B internal, intermediate support

I component 1, profiled sheet

II component 2, supporting member / Profiled sheet

L longitudinal edge, left side

N nominal sheet thickness $B_D + \Delta$

R rib edge, right side

S tensile force from constraints due to shear reinforcement

shear stiffness

cl clear span

f width of flange – theoretical requirement used for static calculations

i ideal distance between supports,

equal spacing of points of zero moment

k cantilever

lim limit

n nominal hole diameter

obs observed (e.g. result)

r required,

rib

s stiffener at the web

t tensile force

u bottom flange

w web,

weighted value

4 Specifications and documentation

4.1 Execution Specification

4.1.1 General

The necessary information and technical requirements for execution of each part of the works shall be agreed and complete before commencement of execution of that part of the works. There shall be procedures for making alterations to previously agreed execution specification. The execution specification consists of layout drawings and details, based on structural design and shall consider such of the following items as are relevant:

a) additional information, as listed in Annex F;

b) execution classes, see 4.1.2;

c) technical requirements regarding the safety of the works, see 4.2.3 and 9.7;

d) tolerance classes, see 4.1.4.

NOTE The responsibilities between the parties involved can be regulated by member states.

4.1.2 Execution classes

Four execution classes 1 to 4, denoted EXC1 to EXC4, are given, for which requirement strictness increases from EXC1 to EXC4.

The execution specification shall specify the relevant execution class or classes.

NOTE The requirements for the selection of execution classes are given in EN 1999–1-1.

The list of requirements related to execution classes is given in EN 1090-3.

Sheeting complying with this standard may be used for EXC 1 to 3. In this European Standard there is no differentiation in requirements between execution classes.

4.1.3 Layout drawings

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

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

— type and position of the structural elements;

— connection with the supporting member and arrangement of the fasteners;

— intended structural elements with profile designation and manufacturer's name, constituent product, nominal sheet thickness and manufactured length;

— direction of lay of sheeting and special installation sequences;

— statically effective overlapping (moment-resisting connections), if relevant;

— execution tolerances;

— intended fasteners with type designation, type of fastener (saddle, washer, etc.) and other fixing accessories, arrangement and separation distances, special assembly instructions depending on the type of connection, e.g. hole diameters, axial spacings and edge distances;

— type and details of the supporting member for the structural elements, such as material, centre to centre distances and dimensions, the inclination;

— details of the side and end overlappings and edges of the installed area;

— openings in the installed areas, including the necessary framing, e.g. for skylights, smoke and heat extractors and roof drainage, if relevant;

— superstructures or suspensions, e.g. for piping, bunched cables or suspended ceilings, if relevant;

— a label, stating that all structural elements shall be fixed immediately after laying;

— details about any special installation measures, if relevant;

— special devices for installation, if relevant;

— any specific hazards related to construction should be identified;

— details about corrosion protection, e.g. contact surfaces between different metals or between metals and timber, concrete, masonry or plaster, if relevant;

— details about the condition and location of sealant strips, fillers for profiled sheets and special elements, if relevant;

— details about setting-down places for bundles of structural elements on roof areas and floors according to the static calculation;

— details about walkability, if relevant;

— details about weather integrity, if relevant;

— details about fire protection, if relevant;

— details about thermal insulation, if relevant;

— details about acoustics, if relevant;

— details about air tightness, if relevant.

Laying areas and parts of laying areas that are intended to act as a diaphragm for the stabilization shall be specially marked in the layout drawings as “diaphragm”.

4.1.4 Geometrical tolerances

Two types of geometrical tolerances are defined in 11:

a) essential tolerances;

b) functional tolerances, with two classes for which requirement strictness increases from class 1 to class 2 (see 11.4).

4.2 Installer’s documentation

4.2.1 General

Annex C contains an example of documentation for the installation.

4.2.2 Quality documentation

The following points shall be documented:

a) organization chart and managerial staff responsible for each aspect of the execution;

b) the procedures, methods and work instructions to be applied;

c) an inspection plan specific to the works, see EN 1090-3:2008, 4.2.2, if applicable;

d) a procedure for handling changes and modifications;

e) a procedure for handling of nonconformities, requests for concessions and quality disputes;

f) specified hold-points or requirement to witness inspections or tests, and any consequent access requirements.

4.2.3 Safety of the erection works

Method statements giving detailed work instructions shall comply with the technical requirements relating to the safety of the erection works as given in 9.6.

4.3 Detailed traceability documentation

Constituent products for manufacturing cold-formed aluminium elements shall be traceable at all stages, from purchasing the sheet material to installation of the manufactured products. This traceability may be based on documentary records for batches of product allocated to a common production process.

4.4 Execution documentation

At completion, a statement of completion demonstrating that the works have been installed in accordance with the execution specifications and the provisions of this standard shall be signed by the company responsible for the installation.

NOTE Member states can define type and content of such a statement.

5 Constituent products

5.1 General

This section gives requirements with respect to the constituent products and the accompanying documents.

Constituent products to be used for the execution of cold-formed aluminium structures shall be according to 5.3.

5.2 Identification, inspection documents and traceability

The properties of supplied constituent products shall be documented in a way that enables them to be compared to the specified properties.

For aluminium products made of materials given in 5.3, the inspection document shall be 3.1 according to EN 10204.

Structural elements shall be delivered and identified as follows:

a) they shall be delivered in an appropriate packaging and labelled such that the content is readily identifiable;

b) labelling or accompanying documentation shall be in accordance with the requirements of the product standard and should contain the following information in a legible and durable form, attached to every packaged unit:

   — manufacturer’s works;

   — year of fabrication;

   — batch designation or documentation number for traceability;

   — designation of the structural element;

   — bundle weight;

   — length, if relevant for lifting or installing;

— number of products inside the package;

— sheet thickness;

— material properties or specific product reference;

— corrosion protection system (if relevant).

It is recommended that labels are retained. See also Annex C.

5.3 Materials

Structural elements shall have properties that conform to the required suitability for the cold-forming process. This concerns especially the bending radii. Suitable for cold formed sheeting, designed according the provisions of EN 1999-1-4, materials and tempers shall be used as listed in EN 1999-1-4, if national rules do not specify other material. The minimum 0,2 % proof strength ($R_{p0,2}$) for material to be processed to cold-formed structural sheeting and which is designed according to EN 1999-1-1 shall be 165 MPa.

Coating system shall be specified by the coating type and brand name, if relevant.

NOTE EN 485–2 includes for many materials/tempers information about minimum bending values.

The manufacturer shall only buy materials with characteristics declared by the base material supplier and with an inspection certificate 3.1 according to EN 10204. Therefore the finished product manufacturer's system requires only a document check to ensure that the characteristics meet the product manufacturer's specifications, provided that the production process for the finished product does not change in an unfavourable way these characteristics.

The inspection certificate 3.1 shall contain the following data:

— name or mark of the manufacturer’s works;

— identification number;

— indication of the type and grade of material, if relevant;

— nominal dimensions of the product ordered and nominal sheet thickness (t) (in mm respectively) and tolerance class according to EN 508-2;

— coating system; full designation, if relevant;

— thickness of the organic coating on the visible side/rear side in μm, if relevant;

— values of the mechanical material properties:

a) 0,2 %-proof strength ($R_{p0,2}$) in MPa;

b) tensile strength (R_m) in MPa;

c) elongation after fracture $A_{50\ mm}$ in %;

d) bend radius to thickness ratio;

e) adhesion of metallic coating, if relevant.

In case of not having a 3.1 inspection document or the 3.1 document is incomplete, the received base material shall be handled as nonconformity.

5.4 Thickness tolerances

The execution specification shall specify the tolerance limit value or type for the thickness for one or more projects. This shall be in accordance with the product standard for the aluminium sheet or strip concerned.

The class of thickness tolerance shall be specified in accordance with EN 508-2.

The thickness of the manufactured components shall be measured in those areas which are not influenced by the cold forming process.

5.5 Minimum nominal sheet thicknesses

5.5.1 Profiled sheets

The thicknesses shall be in accordance with the execution specification.

The minimum nominal sheet thicknesses shall not be less than shown below, if not otherwise specified:

— Decking: $t \geq 0{,}70$ mm

— Roof coverings: $t \geq 0{,}50$ mm

— Walls and wall claddings: $t \geq 0{,}50$ mm

NOTE 1 Static calculations according to the Eurocodes give a nominal thickness required for design. The values above are based on execution experiences on the work-site.

For aesthetic reasons, especially for wall applications, greater thicknesses may be necessary to prevent buckling. In every case the material thickness should be at least big enough to allow an aesthetic appearance.

NOTE 2 In some countries the above listed values additionally depend on the cross section and the span of profile and can be thinner than specified above.

5.5.2 Linear structural elements

The thicknesses shall be in accordance with the execution specification.

The minimum nominal sheet thicknesses for roof and wall structures shall be at least the nominal thickness of the attached profiled sheets, but not less than $t = 1{,}00$ mm, except:

— Spacer profiles: $t \geq 0{,}70$ mm

— Edge stiffening profiles: $t \geq 0{,}70$ mm

NOTE In some countries the above listed values additionally depend on the cross section and the span of profile and can be thinner than specified above.

5.6 Geometrical tolerances

Geometrical tolerances are given in Annex D.

5.7 Mechanical fasteners

5.7.1 General

This clause specifies the requirements for screws and blind rivets for structural aluminium elements. For other types of mechanical fasteners (e.g. bolts and nuts), EN 1090-3 shall apply.

5.7.2 Materials

Fasteners according to European Standards or European Technical Assessments (ETA) shall be used. The type of fastener with designation of the relevant European Standard or ETA shall be specified.

The fastener materials shall be made of austenitic stainless steel or aluminium.

5.7.3 Verification of suitability

Fastenings are subdivided into:

a) thread-forming screws, subdivided into:

— thread-forming self-tapping screws, which produce their female threads in a swarfless manner in predrilled holes;

— thread-forming self-tapping screws (pierce tip), which produce their female threads in a swarfless manner without predrilled holes.

b) blind rivets that comprise a rivet sleeve and a rivet mandrel with a predetermined breaking point.

EN 1090-3 shall apply for metric screws.

The parts of the fastening that are completely or partially exposed to weathering or similar moisture loading shall be made from austenitic stainless steel or aluminium. This does not apply to welded-on drill tips.

For a rainproof connection or mounting, washers made of aluminium or austenitic stainless steel with a cured-on elastomer seal at least 2,0 mm thick or saddle washers with seal shall be inserted under the head of the fastener.

NOTE Member states can require more severe requirements for a rainproof connection.

5.8 Accessories

Accessories are components that are absolutely necessary for the function of the construction but for which no analyses of the ultimate limit state or serviceability limit state shall be carried out, e.g. decking side trim, sealant strips, fillers for profiled sheets or flashings. They shall fulfil the same requirements for durability, corrosion protection and reaction to fire as the structural aluminium components, if not otherwise specified.

5.9 Surface protection

Verification of suitability of a corrosion protection system for a corrosivity category shall be carried out with reference to Clause 10 and Annex E of this standard.

5.10 External fire performance for roofing elements

5.10.1 Products deemed to satisfy the requirements for external fire performance

Products covered by this European Standard are considered “deemed to satisfy without the need for testing” in relation to the requirements for external fire performance provided that they meet the definitions given in Commission Decision 2000/553/EC, i.e. flat or profiled metal sheets of nominal thickness ≥ 0,4 mm with any external coating which is inorganic or has a gross calorific value, PCS ≤ 4,0 MJ/m^2 or a mass ≤ 200 g/m^2.

NOTE Individual Member States may have “deemed to satisfy” lists which go beyond the list given in the Commission Decision 2000/553/EC.

5.10.2 Products classified without the need for further testing (CWFT option)

The following products are considered to be classified in classes $B_{ROOF(t1)}$, $B_{ROOF(t2)}$, $B_{ROOF(t3)}$ and $B_{ROOF(t4)}$ without further testing in accordance with Commission Decision 2005/403/EC: profiled steel sheets, flat steel sheets or panels of coil coated galvanised or zinc-aluminium alloy coated steel of metal thickness ≥ 0,40 mm with an organic external (weather side) coating and, optionally, a reverse (internal) side organic coating. The external coating is of a liquid-applied Plastisol paint of maximum nominal dry film thickness 0,200 mm, a PCS of not greater than 8,0 MJ/m² and a maximum dry mass of 330 g/m². The reverse side organic coating (if any) shall have a PCS of not greater than 4,0 MJ/m² and a maximum dry mass of 200 g/m².

5.10.3 Other products

Products not meeting the definitions as given in 5.10.1 or 5.10.2 shall be tested in accordance with the relevant method(s) in CEN/TS 1187 and classified in accordance with EN 13501-5.

5.11 Reaction to fire

Reaction to fire shall be according to EN 1090-1.

5.12 Resistance to fire

Resistance to fire shall be according to EN 1090-1.

5.13 Release of dangerous substances

Release of dangerous substances shall be according to EN 1090-1.

5.14 Lightning protection

If structural elements made of metal are used as a natural part of the lightning protection then EN 62305-3 shall be respected.

6 Manufacturing

6.1 General

If the requirements of this European standard are not met, the manufacturing process shall not be used until corrected and checked again. It may be used on a restricted range of constituent products that do produce conforming results.

Structural aluminium components shall not have any cracks at the bended areas visible by the naked eye, if not otherwise specified. Holes may be punched full size without reaming.

6.2 Identification

At all stages of manufacturing each piece or package of similar pieces of structural aluminium components shall be identifiable by a suitable system.

6.3 Cold forming

Shaping by cold forming, produced either by roll forming or press breaking shall conform to the requirements for cold formability given in the relevant product standard and shall be manufactured considering the requirements in Clause 10 and within the tolerances specified in Clause 11.

6.4 Cutting

Cutting shall be carried out in such a way that the requirements for geometrical tolerances and smoothness of free edges as specified in this European Standard are met. Suitable tools for cutting shall be applied. Tools which have been used for other metals shall be cleaned.

NOTE Known and recognized cutting methods are shearing nibbling and water jet techniques. Other methods are possible if appropriate.

If coated materials are to be cut, the method of cutting shall be selected to minimize the damage on the coating.

Burrs that could cause injury or prevent the proper alignment or bedding of sections or sheeting shall be removed.

6.5 Punching

Holes may be punched.

7 Welding at the construction site

For the purpose of the connection of joints, overlaps, to attachments and penetrations, structural aluminium components may be welded where the welding method is suited to the material for the profile sheets used, e.g. TIG welding (tungsten inert gas welding) for AlMnMg alloys.

NOTE The weld seams only serve as seals ("sealing weld"). The weld seams are therefore made at points where no stress or only negligible stresses need to be transferred.

Before commencing welding work, necessary safety measures shall be met, e.g. inform the responsible fire services, ensure a fire extinguisher is close at hand, remove any ignitable materials from the workplace and its surroundings or at least put them in a safe place.

The welding work can be carried out either in a hall or on a construction site. Where welding is carried out on a construction site, the area shall be protected against wind and precipitation e.g. using a welding screen or tent.

The components to be welded shall have been cleaned, be free of grease and dry. For coated materials, the coating shall be mechanically removed before welding in a small area of 20 to 30 mm at the welding point.

To ensure the safe position of the joints, the joining parts shall be supported e.g. by a hardwearing thermal insulation. Sub-surfaces that are sensitive to temperature or fire shall be protected against ignition and damage e.g. using special welding underlays under the joining point. Butt welds shall be avoided. The sheet metal at the joining point shall overlap by approx. 10 to 20 mm. If this is not possible, a strip of sheet metal made of uncoated aluminium shall be placed underneath.

The weld seam tightness shall be checked by visual inspection.

8 Mechanical Fastening

8.1 General

This clause covers requirements for shop and site fastening of profiled sheeting and members by the use of screws and blind rivets. For other types of fastening EN 1090-3 shall apply

Fastenings shall be in accordance with the execution specification and used in accordance with the fastener manufacturer's recommendations.

The performance of fasteners will depend on the methodology that may be determined on basis of procedure testing. Procedure tests may be used to demonstrate that the required connections can be performed under site conditions. The following aspects should be considered:

a) ability to produce correct hole size for self-tapping screws and rivets;

b) ability to correctly adjust power screwdrivers with the correct tightening torque (e.g. depth location);

c) ability to drive a self-drilling screw perpendicular to the connected surface and set sealing washers to correct compression within the limits recommended by the fastener manufacturer;

d) ability to form an adequate structural connection and to recognize an inadequate one.

For thread-forming screws and blind rivets, the provisions of the European Standards or European Technical Assessment Documents (EAD) apply.

EN 1090-3 shall apply for metric screws.

When attaching profiled sheeting from its valley to supporting members, the fasteners shall be positioned such that there is no gap at the point of contact between component I and component II (Figure B.3) exceptions may be covered by ETAs.

Sealing strips for the reduction of heat transfer up to 3 mm thickness are permitted between component I and component II. A larger thickness may be used when it is permitted by an ETA.

During installation, the provisions given in the European Standards or European Technical Assessments (ETA) and the manufacturer's instructions regarding suitable sheet thicknesses, materials, clamping thicknesses and tools to be used shall be fulfilled.

After installation work any drilling swarfs or ejected broken mandrel stems shall be collected and removed from exterior work surfaces to prevent subsequent corrosion.

8.2 Use of self-tapping and self-drilling screws

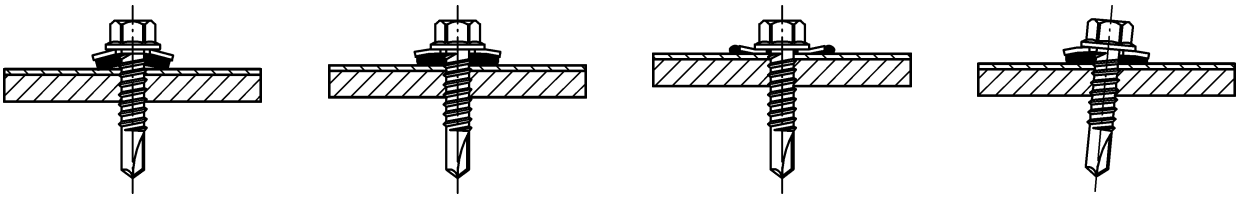
The length and thread form of screws shall be checked prior to the fastening to suit the specific application and shall be adapted to the thickness of the support to ensure the correct anchorage of the fastener in the support.

Screws for certain applications require an interrupted thread. If a sealing washer is used the thickness of the washer should be taken into account in selecting the thread length.

If screws are fastened in the crown of a roofing profile care shall be taken to avoid dents in the sheet at the penetration point, e.g. by using saddle washers.

Tools used for fixing screws shall be appropriate (e.g. screwdriver) and possess an adjustable depth and/or torque control that shall be set in accordance with the equipment manufacturer's recommendations. If power screwdrivers are used, the drilling and driving speeds (revolutions per minute) shall be in accordance with the fastener manufacturer's recommendations.

If sealing washers are used, the screws shall be set to achieve the correct compression of the elastomer as indicated by Figure 2.



a) too loose b) correct c) too tight d) too inclined

Figure 2 — Guide for compression of sealing washers

The depth control device, of a power screwdriver, shall be adjusted to compress the elastomeric washer within the limits set by the fastener manufacturer.

Screws without sealing washers shall be set using an appropriate torque or depth control device to avoid overtightening.

8.3 Use of blind rivets

Installation shall be performed according to the fastener manufacturer's recommendations.

The choice of the length of the blind rivet shall be according to the total thickness to be fastened. Component I and component II shall be in contact before riveting to avoid forming of the closing head between the components.

The rivet length recommended by the product manufacturer generally takes account of a certain drawing together of the plates to be fastened.

NOTE 1 Most manufacturers offer a range of manually and power operated setting tools to suit high or low volume usage. These are often readily adaptable by changing only the nosepiece and/or setting jaws to set a range of blind rivet types and sizes. Generally, interchangeable heads are available for setting where tool access is limited such as inside channels or cylindrical sections.

NOTE 2 Predetermined setting characteristics designed into the rivet body/mandrel relationship ensure consistent joints.

8.4 Attachment of cold formed structural elements to the supporting member

8.4.1 Types of connections and attachments

Differentiation is made between the following types of connections and attachments:

— attachments of profiled sheeting to the supporting member;

— attachments of load-bearing linear profile cross sections to the supporting member;

— connections between profiled sheets (e.g. side lap or end lap);

— connections between edge parts or linear profile cross sections and profiled sheeting.

8.4.2 Attachment of profiled sheets to the supporting member transverse to the direction of span

Attachment shall be carried out in accordance with the execution specification. However, at least every second profile rib of profiled sheets with a rib width $b_R > 100$ mm (b_R see Figure 1) and every third rib of profiled sheets with $b_R \leq 100$ mm shall be attached to the supporting member; at the edges of the laying area, every profile rib shall be attached where $b_R > 100$ mm and every second profile rib where $b_R \leq 100$ mm, if not otherwise specified.

In the case of diaphragms, every profile rib of the adjacent flange shall be attached to the diaphragm supports. In the case of intermediate supports that only serve to transfer loads at right angles to the laying area and do not have to participate whatsoever in the action of the diaphragm, attachment to every second profile rib suffices even within the area of the diaphragm.

At every support, liner trays and cassette profiles shall be attached to the supporting member in accordance with the execution specification but there shall be at least two fasteners near the web (Figure 3).

Dimensions in millimetres

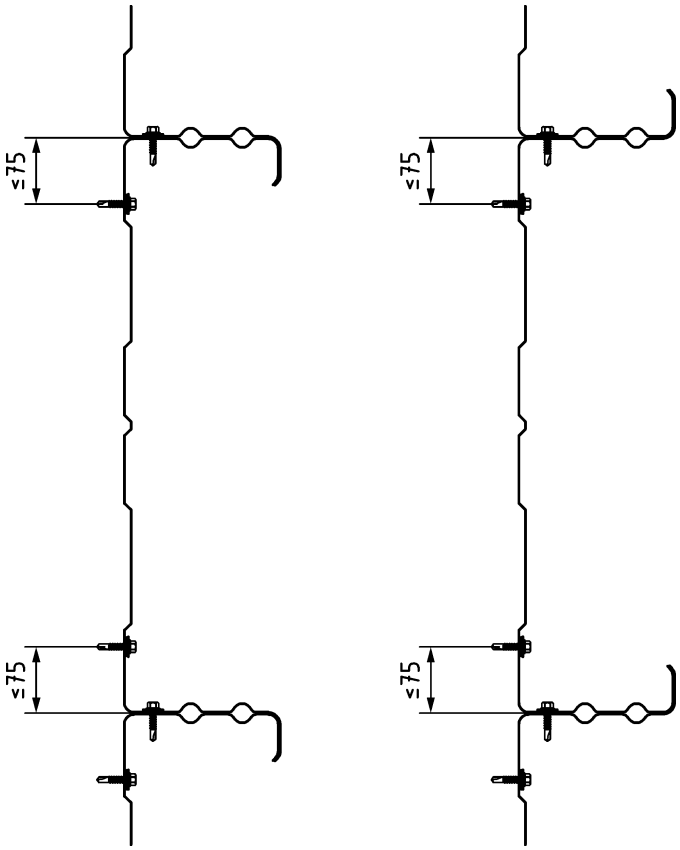
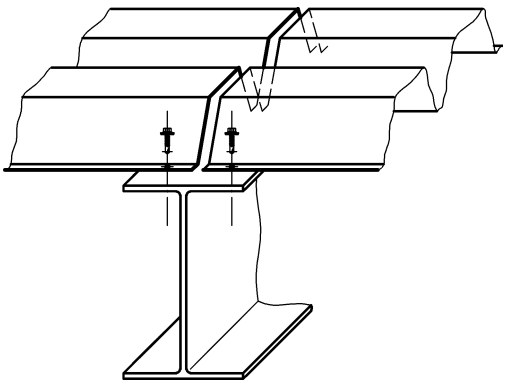
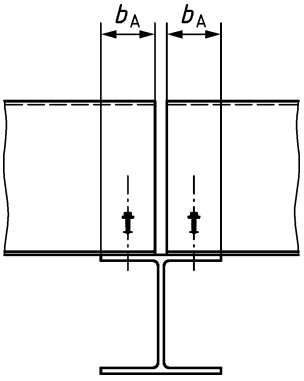


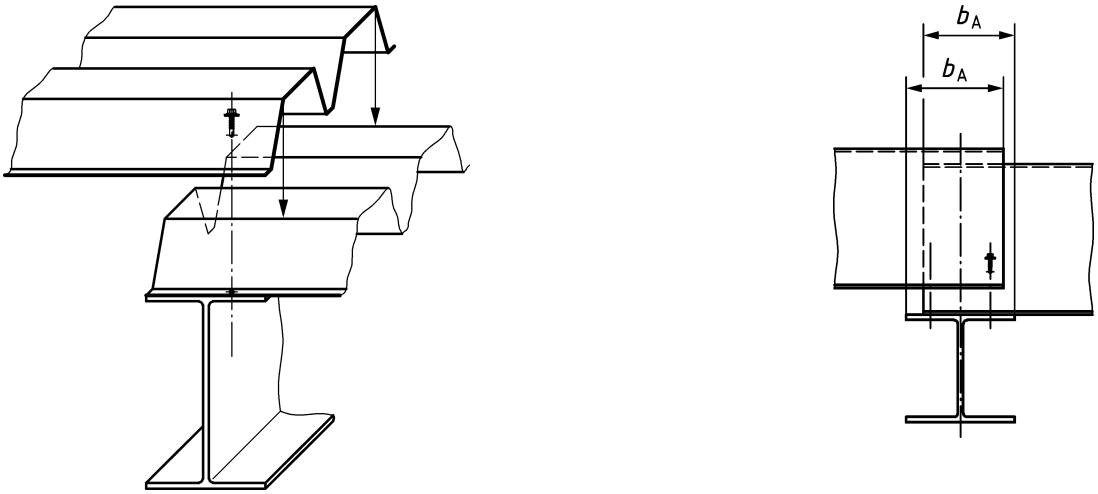
Figure 3 — Fastening of liner trays





Minimum support width: Annex B, Table B.1

a) without overlapping



Minimum support width: Annex B, Table B.1

b) with overlapping

Figure 4 — Example of Attachments of profiled sheets

8.4.3 Attachment of profiled sheets to the supporting member parallel to the direction of span

Trapezoidal or sinusoidal sheeting shall be attached to the supporting member along the longitudinal edges of the laid areas (Figure 4) in accordance with the execution specification at a spacing not exceeding the range of 50 mm ≤ e_R ≤ 500 mm (e_R see Figure A.1). In the case of a connection with an edge stiffening plate as per Annex A there shall be a spacing of 50 mm ≤ e_R ≤ 333 mm. In the case of diaphragms, attachment shall be carried out additionally in accordance with the execution specification. The same applies to the longitudinal edge of a profiled sheet adjacent to an opening in the laying area.

8.4.4 Supporting member made of metal

Provisions for the fixed length of the cylindrical part of the thread of thread-forming screws in supporting members made of metal are given in the relevant ETAs.

The tips for thread-forming or drilling may not be included in the recognized length. The tips of connectors may not be removed after installation in order to avoid damaging the connection.

8.4.5 Supporting member made of timber or other wood-based materials

The suitability of thread-forming screws, envisaged for the connection of profiled sheets or linear structural elements to supporting members made of timber or other wood-based materials, shall be according to European Standards or European Technical Assessments.

With regard to pilot drilling and screw-in depth, the execution specification shall follow the provisions according to EN 1995–1-1 provided the European Technical Assessments for the fasteners or the product standards for the screws do not contain other requirements.

Screws may not be hammered in – not even partially.

If aluminium profile sheets are used as exterior shells (weatherproof sheeting) and are connected to a timber sub-construction in the bottom flanges, the following conditions shall be observed:

— with trapezoidal profiles, the width of the connected bottom flange shall not be less than 23 mm;

— transverse joints of the profile sheets shall be arranged above the timber sub-construction;

The timber sub-construction may also be designed as coupled purlins.

— when determining the length L of the profile sheets, their colouring shall be observed;

  — light: $L \leq 10$ m
  — medium: $L \leq 9$ m
  — dark, natural tone: $L \leq 8$ m

— "Fixed points" according to Annex A shall be made on the sub-construction in the middle of the sheets, possibilities for displacement by 10 mm should be provided on both transverse edges;

— either wood screws, self-tapping screws or drilling screws made from aluminium or stainless steel with threads suitable for timber sub-constructions may be used as connecting elements;

— the diameter of the sealing washers shall be at least 16 mm, for cladding the diameter of the sealing washers shall be at least 10 mm. The vulcanised EPDM seal shall have a low Shore hardness and a thickness of minimum 3 mm;

— potential distortion of the timber sub-construction (for example, with coupled purlins) shall be taken into account via constructive measures.

8.4.6 Supporting member made of concrete or masonry

For attachment of the profiled sheets, continuous steel parts (e.g. flat steel of at least 8 mm thickness, fastening rails or cold-formed profiles) adequately anchored, shall be installed or post installed anchors, dowels or screws complying with European Standards or European Technical Assessments shall be used.

The steel parts including their anchoring shall be installed at least flush with the top edge of the concrete. The supporting surfaces for the profiled sheets shall have the same pitch as the profiled sheets and there shall not be any interference from screws, rivets, butt straps, top flange plates, push pads or butt plates.

The steel parts shall be adequately protected against corrosion.

8.5 Connecting profiled sheets

The longitudinal edges of the profiled sheets shall be joined together within the laying area or stiffened by means of an edge stiffener as specified in Annex A.

Connection type and spacing shall be adequate to draw together overlapping sheets.

Sidelaps of profiled sheets of the exposed surface of a roof should be fastened according to the recommendations of the manufacturer of the structural aluminium components.

Self-tapping or self-drilling screws, with sealing washers and elastomer seals, or blind rivets may be used to connect profiled sheets together according to the provisions of the relevant ETAs. If the profiled sheets are used as the supporting skin of multi-skin roofs not exposed to the weather, the sealing washers may be omitted or non-sealing blind rivets may be used.

Sidelapping fasteners shall comply with the following distances e_L:

— Supporting skins made of trapezoidal and sinusoidal sheeting: $50 \text{ mm} \leq e_L \leq 500 \text{ mm}$
— Supporting skin made of trapezoidal sheeting as a diaphragm: $50 \text{ mm} \leq e_L \leq 500 \text{ mm}$
  and at least 4 fasteners per span
— Weathered trapezoidal and sinusoidal sheeting as roof covering: $50 \text{ mm} \leq e_L \leq 500 \text{ mm}$
— Weathered trapezoidal and sinusoidal sheeting as wall cladding: $50 \text{ mm} \leq e_L \leq 500 \text{ mm}$

— Supporting skin made from liner tray profiles in the roof: $50 \text{ mm} \leq e_L \leq 500 \text{ mm}$

— Supporting skin made from liner tray profiles in the wall: $50 \text{ mm} \leq e_L \leq 1000 \text{ mm}$

— Supporting skin made from liner tray profiles as a diaphragm: $50 \text{ mm} \leq e_L \leq 333 \text{ mm}$

8.6 Edge and field spacings of fasteners for structural elements

8.6.1 General

Distances from the edge and field spacings shall be specified in the execution specification. Distances from edge and spacings of fasteners see EN 1999-1-4.

8.6.2 Edge spacings of webs of trapezoidal sheeting and liner tray profiles

Generally for flange widths of $b_U > 265$ mm a minimum of two fasteners per flange and support are required. Only the fasteners within 75 mm of the web should be considered in the design. Flanges width of $b_U \leq 265$ mm may be attached with a minimum of one fastener, or more if specified in the execution specification.

9 Erection

9.1 General

This clause gives requirements for erection and other work undertaken on site of profiled sheeting, if not otherwise specified. For the erection and other work undertaken on site of members EN 1090-3 shall apply.

Work carried out on site which includes preparation, welding, mechanical fastening and surface treatment shall comply with the Clauses 6, 7, 8 and 10 respectively.

Inspection and acceptance of the structure shall be performed in accordance with the requirements specified in Clause 12.

9.2 Site conditions

Erection shall not commence until the site for the construction works complies with the technical requirements with respect to the safety of the works, which shall consider such of the following items as are relevant:

a) provision and maintenance of hard standing for cranes and access equipment;

b) access routes to the site and within the site;

c) soil conditions affecting the safe operation of plant;

d) possible settlement of erection supports for the structure;

e) details of underground services, overhead cables or site obstructions;

f) limitations on dimensions or weights of components that can be delivered onto the site;

g) special environmental and climatic conditions on and around the site;

h) particulars of adjacent structures affecting or affected by the works.

Access routes to the site and within the site should be given on a site plan showing dimensions and level of access routes, level of the prepared working area for site traffic and plant, and areas available for storage.

If the works are inter-linked with other trades, technical requirements with respect to the safety of the works shall be checked for consistency with those for other parts of the construction works. This check shall consider such of the following items as are relevant:

i. prearranged procedures for co-operation with other contractors;

ii. availability of site services;

iii. maximum construction and storage loads permitted on the framework;

iv. control of concrete placement during composite construction.

9.3 Training / instruction of installation personnel

Installation may only be undertaken by companies that possess the necessary specialist knowledge and experience and can demonstrate they employ sufficient experienced personnel. The provisions of 4.2.2 shall apply.

9.4 Inspection of preceding works

Before starting the installation works, the preceding works shall be checked with respect to the prerequisites necessary for the installation. If there are defects in the preceding works that interfere with installation, those defects shall be reported in writing to the client and the client insures that appropriate corrective actions are made if necessary.

9.5 Layout drawing

Layout drawings (see 4.1.3) shall be available at the construction site and shall be followed during installation. Any changes shall be approved in writing by the responsible entity for the execution specification.

9.6 Tools required

Proper tools shall be used. The recommendations of the manufacturers shall be followed.

9.7 Safety on site

The necessary protective devices and fall protection shall be installed before starting the installation works. The technical requirements with respect to the safety of the works apply. Without load-dispersal measures, the profiled sheets may only be walked on up to the permitted spans given in the execution specification (see Annex B). For roofs access is strictly only for the purpose of maintaining and cleaning them.

The setting-down places for the stacks of profiled sheets shown on the layout drawings shall be adhered to.

Installation works shall cease if the weather conditions are not appropriate, e.g. wind is squally or strong.

Immediately after laying, each individual profiled sheet shall be attached to the substructure to prevent it from moving and joined to the adjacent profiled sheet or the edge construction via the overlaps at the sides. After laying, cantilever profiled sheets shall be secured against lifting without delay because of the risk of accidents (overturning). When producing cut-outs in roofs, fall protection shall be used and the cut-outs then secured to prevent anyone falling through them. Once bundles have been lifted up on sloping surfaces, all sheets shall be secured to prevent them sliding.

If the installation works are interrupted, all sheets shall be secured against storms and the occurrence of wind loads that are possibly higher than in the installed state, or against sliding. This shall also apply to partly used stacks.

9.8 Inspection of packaging and contents

After delivery to site the products shall be checked for completeness, packaging or transportation damage and to ensure the labelling is complete.

Defects and shortages shall be reported in writing immediately to the supplier and appropriate action taken.

9.9 Storage

The product shall be stored in accordance with the manufacturer's recommendations or the recommendations of manufacturer's associations if specified.

Storage of structural aluminium elements shall be carried out in such a way that condensation is avoided within the stack, e.g. by storing it in a covered storage area that may not be humid or hot, or subjected to frequent temperature changes.

Outdoor short-term storage is possible if suitable measures are taken to protect the profiled sheets against rainwater and splashes. The cover shall be air-permeable and firmly secured in case of wind. Contact with all substances that might influence the surfaces of the structural aluminium elements (e.g. soil, sand, gravel, mortar, concrete, or standing or flowing water) shall be avoided, even for short periods.

Storage areas shall be prepared and kept dry.

When storing stacks of metallic coated structural aluminium elements, transport packaging (e.g. stretch or shrink wrap) shall be removed immediately.

9.10 Damaged structural elements and connecting devices

Damaged structural elements and/or structural connecting devices (e.g. products with buckles, cracks, kinks, indentations or folds, damaged corrosion protection) shall only be installed or left in place (after installation) if it is verified that sufficient load-bearing capacity, serviceability and durability is still available.

9.11 Unloading, lifting gear / slings / straps

Suitable equipment for the safe unloading of products on site shall be utilized. Equipment shall be assessed for suitability of intended purpose. In all circumstances, protection specific gloves and safety helmet are necessary.

Structural elements shall be packed, handled and transported in a safe manner, so that permanent deformation does not occur and surface damage is minimized. Handling and storage preventive measures shall be applied as appropriate.

Special lifting equipment where available for structural elements that is adapted to shape of the profile should be used when using cranes during installation.

9.12 Laying

The product shall be installed following the execution specifications in accordance with the manufacturer's recommendations or the recommendations of manufacturer's associations if specified.

Trimmers at openings in profiled sheeting shall be installed immediately following the cutting out of every opening or before. The openings shall be secured to avoid the risk of falling.

9.13 Direction of lay of structural aluminium components

With roof and wall constructions that are visible after installation, the direction of lay of the individual profiled sheets to each other shall be the same because surfaces have different appearances when viewed from different angles. For curved systems, the specification of the manufacturer of the curved system shall be followed.

NOTE If member states define dominant directions of wind, these directions can be taken into account for the direction of lay.

9.14 Maintaining the cover width / adherence to tolerances

The geometry of the structural elements may not be altered as a result of the installation.

9.15 Condition after installation (swarf from drilling, fouling of surface, protective film wrap)

Loose-lying objects shall be cleared from the construction work; in particular, swarf from drilling operations shall be removed carefully.

Protective film wraps shall be removed in accordance with the producer's instructions. With profiled sheeting, the protective film wraps in the overlapping areas of the side and end laps and in the area of the attachments shall be removed before the start of the installation.

When installing profiled sheets using suction cross-beams, protective film wraps shall be removed before using the suckers.

9.16 Inspection after installation

An inspection should be undertaken directly after completion of the installation works, but particularly before the start of the subsequent works (e.g. roof sealing works, works on outdoor installations etc.), if necessary even on sections of the roof or wall area. If this conflicts with contractual agreements, a joint inspection shall be carried out by mutual agreement and an inspection report prepared.

Diaphragms and moment-resisting connections, especially the joints, shall be inspected to ensure proper and appropriate execution. This inspection shall be carried out jointly with the local building site manager and countersigned.

9.17 Diaphragms and moment-resisting connections in the envelope

It is necessary to mark the areas of the diaphragms (construction class I) in the envelope

— as "diaphragm" on the layout drawing and

— with clearly visible, permanent warning signs on the finished construction (Figure 5).

The text on the sign shall indicate that the stability of the whole building will be at risk if alterations are subsequently undertaken to the diaphragms without static analysis.

Figure 5 — Example for a sign "Warning – diaphragm in roof"

The owner of the building shall be informed about size, position and significance of the diaphragm.

9.18 Protection against lightning

The lightning protection expert shall receive confirmation in writing from the company that installed the roof regarding the suitability of the roof as a "natural element of the lightning protection system" (see 5.14). He can then attach the necessary leads to the metal terminals, – which shall also be tested to EN 62561-1, and thus connect the "natural lightning conductor metal roof" to earth. The same shall apply analogously to the cladding. See EN 62305-3:2011, 5.2.5 and 5.3.5.

10 Surface protection

10.1 Corrosion protection

Aluminium profile sheets are protected against corrosion under usual weather conditions in sea, country or industrial air by forming a natural oxide coating. In the case of applications where a particular corrosion stress occurs, e.g. in the immediate vicinity of operations that emit large quantities of aggressive substances (e.g. copper smelters, scrapyards for non-ferrous metals), the profile sheets shall also be protected by a suitable coating with a minimum nominal thickness of 25 µm. 10.2 provides criteria for the requirement of additional corrosion protection (see 5.2).

Precautions shall be taken so as to prevent galvanic corrosion produced by contact between different metallic materials, see Annex E. If insulation kits are to be used to avoid galvanic corrosion, full details of their use shall be specified.

10.2 Cleaning and maintenance

Cleaning and maintenance shall be performed in accordance with the product manufacturer's recommendations.

Organic coated products should not be subject to scratching or excessive rubbing and foot traffic. Masonry works, pargetting, concreting, plastering, stonework, tiling and similar works should have been completed in order to avoid the effect of splashes of lime, mortar, concrete or cement on the surfaces. Especially during setting, these building materials are alkaline and attack uncoated surfaces and, depending on the lacquer used, possibly coated surfaces. Alternatively, the surfaces shall be covered for protection.

Splashes of lime, mortar, concrete or cement shall be rinsed off immediately using lots of water. If exposure is more prolonged, slight etching of the uncoated or coated surface will result.

Reactions detrimental to the surface are no longer expected after careful rinsing. However, any visual defects will remain.

Visual defects and mechanical surface damage can be rectified, either by replacement or painting on site as part of a corrosion protection system. Where parts are replaced or repainted, there is the risk that the colour shade will differ from that of the parts that are not replaced or repainted. This shall be taken into account when considering replacement or repainting.

The adverse visual appearance shall be carefully evaluated on a case-by-case basis because although it does not affect the functionality it could have a marked detrimental effect on the decorative appearance of the façade or the roof as a result of the differences in colour shade that are to be expected.

Contact of coated elements with acids or alkalis shall be avoided. If there is contact, however, cleaning treatment shall be carried out immediately using lots of water.

The exterior surfaces of outer walls, exterior wall cladding, ceilings and roofs shall remain accessible for maintenance work. Depending on the local conditions and requirements, accessibility shall be possible e.g. by means of ladders, tower scaffolds, or permanently installed, free-hanging or mobile working platforms. Plans shall be made at the design stage for the constructional requirements for the chosen type of cleaning and maintenance, such as scaffold anchors.

11 Geometrical tolerances

11.1 General

The values of the tolerances of the profiled sheets are given in this standard in Annex D. These are manufacturing tolerances. It is not permitted to change the load bearing capacity of the product by deforming while erecting.

These values may be too large if greater demands are made on the construction works. Tighter tolerances might be possible, if agreed between manufacturer and customer.

11.2 Tolerance types

This clause defines the types of geometrical deviations and gives quantitative values for two types of permitted deviations:

a) those applicable for a range of criteria that are essential for the mechanical resistance and stability of parts or of the completed structure, called essential tolerances;

b) those required to fulfil other criteria such as fit-up and appearance, called functional tolerances.

Essential tolerances and functional tolerances are both normative.

NOTE The permitted deviations given do not include elastic deformations induced by the self-weight of the components.

In addition, special tolerances may be specified either for geometrical deviations already defined with quantitative values or for other types of geometrical deviations. If special tolerances are required the following information shall be given as appropriate:

— amended values for functional tolerances already defined;

— defined parameters and permitted values for the geometrical deviations to be controlled;

— whether these special tolerances apply to all relevant components or only to particular components that are specified.

In each case, the requirements are for final acceptance testing. If fabricated components are to form parts of a structure that is to be erected on site, the tolerances specified for the final checking of the erected structure (given in the design specifications) shall be met in addition to those for the fabricated components.

11.3 Essential tolerances

11.3.1 General

Essential tolerances shall be in accordance with Annex D. The values specified are permitted deviations. If the actual deviation exceeds the permitted value, the measured value shall be dealt with as a nonconformity according to Clause 12.

In some cases there is a possibility that the uncorrected deviation of an essential tolerance can be justified in accordance with the structural design when the excess deviation is included explicitly in a recalculation. If not, the nonconformity shall be corrected according to EN 1090-1.

11.3.2 Manufacturing tolerances

Cold formed profiled sheets shall conform to the permitted deviations in Table D.1.

11.3.3 Erection tolerances

The laying of the profiled sheeting shall not change the structural behaviour of the sheeting.

11.4 Functional tolerances

11.4.1 General

Functional tolerances are given in Annex D. The values specified are permitted deviations.

11.4.2 Tabulated values

Tabulated values for profiled sheeting for functional tolerances are given in D.2. Generally values for two classes are shown. The choice of tolerance class may be applied to individual components or selected parts of an erected structure.

NOTE How D.2 can be applied would be to invoke tolerance class 2 for part of a structure to which a glazed facade was to be fitted, in order to reduce the amount of clearance and adjustability required at the interface.

If D.2 is used, and the choice of class is not specified, tolerance class 1 applies.

12 Inspection, testing and correction

12.1 General

This clause specifies the requirements for inspection and testing with respect to the quality requirements included in quality documentation (see 4.2.2) as relevant.

Inspection, testing and corrections shall be undertaken on the works against the specification and within the quality requirements set out in this European Standard.

All inspection and testing shall be undertaken to a predetermined plan with documented procedures. Specific inspection testing and associated corrections shall be documented.

12.2 Structural elements

12.2.1 General

Checks shall be made to see whether the structural elements comply with the data given in the shipment documents and execution specifications.

NOTE This applies to profiles, profiled sheets, mechanical fasteners etc.

12.2.2 Non-conforming products

If the packaged unit containing structural elements does not have a label that complies with 5.2, the products shall be treated as non-conforming products until it can be shown that they fulfil the requirements for the intended application. A test report shall be issued if products are first treated as non-conforming but their conformity can subsequently be demonstrated, either by testing or repeating a test.

12.3 Manufacturing: geometrical dimensions of manufactured structural elements

12.3.1 General

The production control plan shall consider the requirements and the checks necessary on structural elements. Dimensional measurements of structural elements shall always be taken. Methods and instruments used shall be selected, as appropriate, from those listed in ISO 7976-1 and ISO 7976-2 and calibrated according to EN ISO 376. For special profile pre-shaped elements that respect the shape of the profile, shall be done to check the profile. Measuring accuracy shall be assessed in accordance with the relevant part of ISO 17123.

For holes, others than punched, of metric screws the provisions of EN 1090-3 shall apply.

The acceptance criteria shall be in accordance with 11.3. The deviations shall be measured with respect to any specified camber or preset. If acceptance inspection results in the identification of nonconformity, the action on such nonconformity shall be as follows:

a) if practicable, the nonconformity shall be corrected using methods that are in accordance with this European Standard and checked again;

b) if correction is not practicable, modifications to the structural aluminium component may be made to compensate for the nonconformity provided that this is in accordance with a procedure for handling nonconformities.

12.3.2 Profiled sheets

For profiled sheets the location and frequency of measurements shall be specified in the inspection plan and shall contain the following:

a) At every change of material (e.g. grade, coil) or new shift

   — the depth of the profile; on the middle rib on profiled sheets with three ribs, on the middle rib on profiled sheets with more ribs, and on an edge rib;

   — the cover width at both ends of the profiled sheet

b) at every change of profile

   — the sheet thickness (checking of documents);

   — the depth of the profile; on the middle rib on profiled sheets with three ribs, on the middle rib on profiled sheets with more ribs, and on an edge rib;

— the cover width at both ends of the profiled sheet

c) at every change of sheet thickness

— the sheet thickness;

— the cover width at both ends of the sheet;

d) twice per calendar year for every finished profile

— the internal radii;

— the stiffeners in the flanges and webs.

It is necessary to measure the sheet thickness of each coil after delivery. This should become part of the documentation.

12.4 Welding at the construction site

For welded joints at the construction site, see [7]. The weld seam tightness shall be checked by visual inspection.

12.5 Inspection of fastening

12.5.1 Self-tapping and self-drilling screws

If using self-tapping and self-drilling screws, checks on site shall be done as required in the relevant ETAs and the fastener manufacturer's recommendations.

The replacement of rivets or screws shall be in accordance with the manufacturer’s recommendation, and other relevant documents. These can need to be of a larger diameter to ensure a secure fixing in a pre-formed hole.

12.5.2 Blind rivets

If using blind rivets, checks on site shall be done as required in the relevant EADs and the fastener manufacturer's recommendations.

Holes with burred edges that would adversely affect the drawing together of the connected parts shall be treated as nonconforming until such time as they are rectified.

Connections with blind rivets shall be inspected to ensure that the upset at the blind end of the rivet is not formed between the overlapping sheets. Such connections shall be treated as nonconforming. The spoilt rivet shall be removed and replaced.

If the spoilt rivet is removed with a drill of larger diameter than used to form the original hole the replacement rivet shall be suitable for the hole size created.

Annex A
(normative)

Basic requirements for profiled sheeting

A.1 General

This annex contains basic requirements for profiled sheeting, if not otherwise specified. This annex does not cover composite metal decks.

A.2 Supporting members

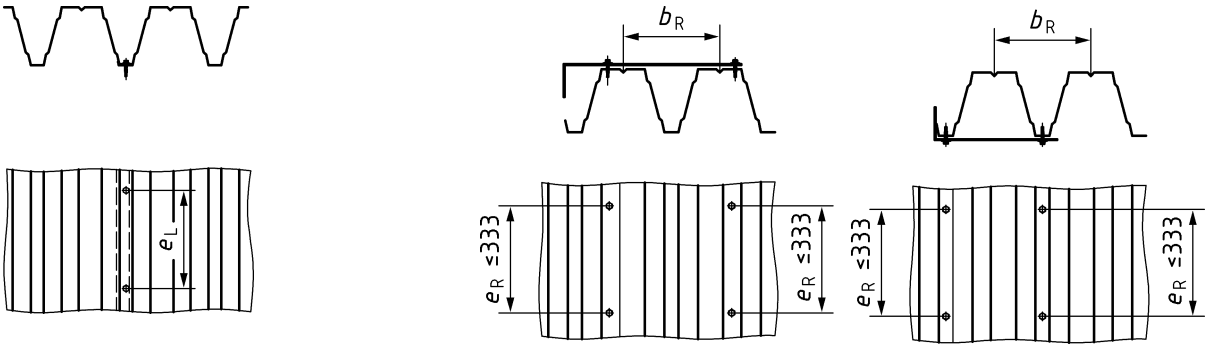
Supporting members shall be made of steel, corrosion protected steel, stainless steel, aluminium, timber, concrete or masonry.

A.3 Edges of laying area

A.3.1 Longitudinal edge stiffeners

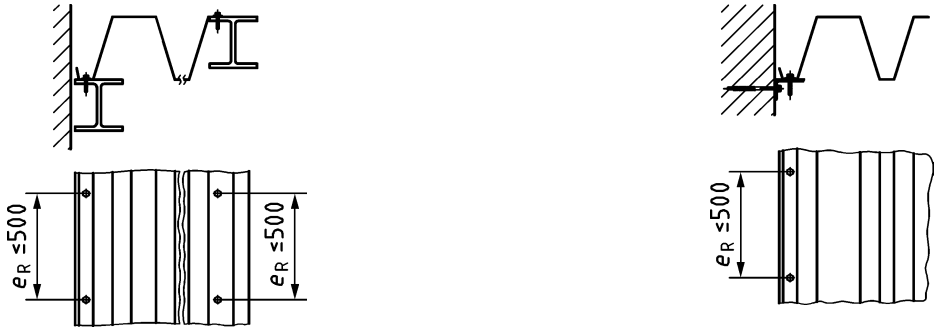
Edge stiffening plates can be implemented as one or two pieces as in Figure A.1. Sheet thickness of edge stiffening plates is given in 5.5.2.

Dimensions in millimetres



a) Attachment of profiled sheets at longitudinal overlap (e_L see 8.5)

b) Edge stiffening using edge stiffening plate



c) Edge stiffening support made from steel, concrete or timber

d) Attachment of longitudinal edge with a continuous steel or timber profile attached to the wall

Figure A.1 — Examples of edge stiffeners

A.3.2 Weakening of the cross section

Without verification, localized weakening of the cross section of the profiled sheets, e.g. due to mechanical attachment of thermal insulation or to suspensions for installations, shall only be permitted under the following conditions:

a) Hole diameter $d_n \leq 10$ mm

- — Spacing of individual holes or distance of edge holes from sets of holes: ≥ 200 mm
- — Number of holes per set: 4
- — Spacing of holes or edge holes: ≥ 4d ≥ 30 mm

b) Hole diameter $d_n \leq 4$ mm

- — Spacing of individual holes: ≥ 80 mm

A.3.3 Avoidance of ice damming

Ice damming can be avoided if suitable measures are taken at the planning stage, such as:

— avoid roof overhangs or at least insulate them;

— avoid shadows on roofs or use heating:

— equip areas that are at risk with roof heating;

— install a watertight roof supporting member up to 3 m inwards from the roof and connect this to the gutter;

— do not have the flow direction / roof pitch in the cold areas of the roof;

— heat the gutters, especially interior constructions;

— avoid bends in downpipes;

— keep drains free, maintain gutters and downpipes;

— run gutter heating into the downpipes and down as far as the area where the ground is frost-free;

— consider the risk of rupture with hanging gutters;

— keep snow distributed over the roof (lots of individual snow stoppers instead of fewer linear constructions);

— connect the vapour barrier to the gutter and use as an emergency drain;

— protect fall arrest systems, walkways and other obstacles against the accumulation of snow and ice by means of snow guards;

— minimize or completely avoid thermal bridges;

— avoid large differences in heat insulation factors.

The planner shall check whether individual measures suffice or whether several need to be combined to be adequately effective.

A.4 Building physics requirements

A.4.1 General

The necessary analyses and detailing for thermal insulation, moisture protection, noise control and fire protection shall be carried out taking the combined effect of all building materials and elements of the respective system into consideration as specified in the relevant provisions.

A.4.2 Water permeability

A complete assembly of all roof and wall systems shall be water impermeable (resistant to driving rain or drifting snow), i.e. the assembly that is to be installed in a building, including the product and its coatings, factory applied seals, standard joints, site applied seals, representative flashings, and a method of fixing.

When correctly manufactured and if satisfying an appropriate visual inspection the sheeting may be impermeable to water. The water permeability of the assembly is a function of its installation, the length of the roof (height of water), and the pitch of the roof and is only relevant to the joints and fixings.

A.4.3 Thermal insulation

Thermal bridges shall be minimized.

A.4.4 Avoidance of condensation

A.4.4.1 General

The heat-transmitting envelope of the building shall be permanently impermeable to air in accordance with the state of the art.

Under normal conditions a vapour barrier layer with a water vapour diffusion equivalent air layer thickness $s_d \geq 100$ m should be created to prevent water vapour from moist air diffusing into the roof construction or the wall construction.

When using profiled sheeting for thermally insulated roofs and walls, proof of adequate protection against condensation shall be provided in each individual case. In doing so, consideration shall be given to vapour diffusion and the movement of air. The movement of air in or through the roof or the walls and subsequent condensation as a result of the temperature falling below the dew point shall be prevented.

A vapour barrier layer with a water vapour diffusion equivalent air layer thickness $s_d \geq 100$ m shall be installed to prevent water vapour from moist air diffusing into the roof construction or the wall construction.

A.4.4.2 Measures against convection

If an airtight layer (“convection barrier”) is required, then it shall be installed to prevent the movement of warm air into the roof construction or the wall construction. It is important that this layer has a large resistance against convection, i.e. there are no holes or cracks, and that it is permanently and carefully connected to its overlap connections and joined to adjacent elements (e.g. by adhesive bonding, thermal or pressure welding, or flange-mounting).

As a rule, this condition is fulfilled for roofs or walls with a convection barrier made of:

— plastic membranes that are hot-air welded or bonded by thermosetting;

— bitumen membranes that are bitumen bonded or torched-on;

— foil that is bonded throughout with suitable age-resistant adhesive tape. A fold in the adhesive seam of the foil on laying is not allowed;

— profiled sheeting if the side and end laps are sealed throughout with suitable age-resistant sealant strips. Edge connections, openings and penetrations should be treated accordingly.

NOTE A double-skin non-ventilated roof will have adequate air impermeability if, on average, there are not more than five thread-forming screws, closed-end blind rivets or tri-fold blind rivets with gaskets or other verifiably tight connections per square metre that penetrate the layer on top of or adjacent to the inner skin.

A.4.5 Airborne sound insulation

Where required, the airborne sound insulation of a roof or wall construction can be taken from results of tested constructions or can be determined by testing according to the EN ISO 10140- series. The result shall be declared as a single value R_w rating to EN ISO 717-1.

A.4.6 Sound absorption

Where required, the sound absorption of a roof or wall construction can be taken from results of tested constructions or can be determined by testing according to EN ISO 354. The result shall be declared as α_w rating to EN ISO 11654.

A.4.7 Protection against lightning

Metal roof coverings are suitable for use as natural elements of a lightning protection system as specified in EN 62305-3.

According to EN 62305-3 a metal roof can be used as a “natural arrester” if certain prerequisites (see EN 62305-3:2011, 10, 5.2.5, Table 3) are fulfilled. It shall arrest the lightning and direct it to the connection points of the conductors, through which it is earthed. The individual roof elements shall be connected together in such a way that the lightning current can be directed to the connection points of the conductors and thus safely to the earthing system. The metal roof shall be electrically connected to earth in a safe manner. It shall be carried out professionally, i.e. as specified in the technical rules to be adopted, and connected to its supporting member in a structurally sound manner. It shall be inspected after every lightning strike and possibly repaired.

The following approach is possible when evaluating a metal roof as an arrester.

The verification of suitability of a metal roof as an arrester is given in the following cases:

a) The roof is made of bare metal or possibly other materials as specified in EN 62305-3.

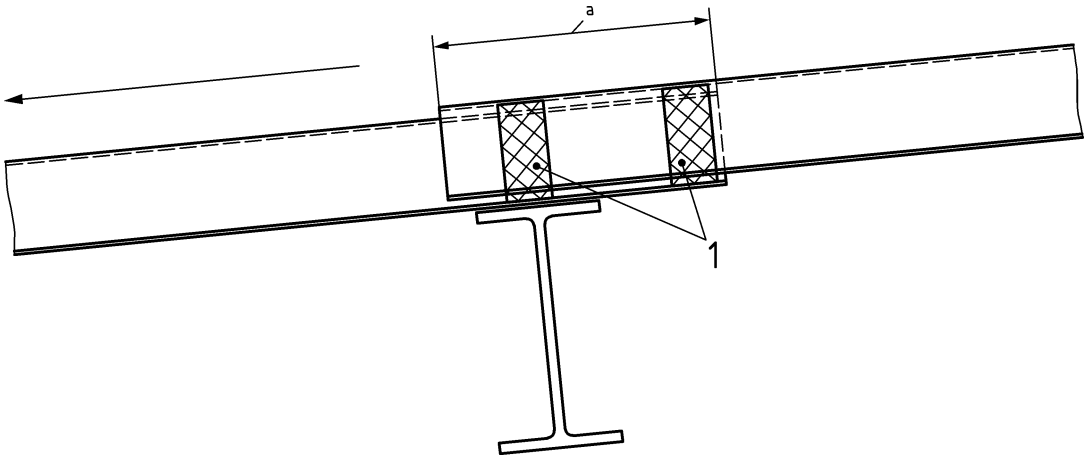
b) The roof is made of coated metal and the individual parts are joined together using screws or rivets, or by welding or brazing. If the connections are bare, a) applies.

c) The roof is made of coated metal and the individual parts are not screwed or riveted, welded or brazed, but folded, clamped, pressed, crimped, pushed into each other or laid on top of each other. Then the installer of the roof shall produce a test report based on EN 62305-3 which shows that the roof is suitable as a “natural arrester”.

A.5 Roof drainage

Roof areas should have a continuous downward pitch to the water drain. Local roof areas without any slope (pitch = 0°) necessitate special measures, e.g. arrangement of the drains at the points of maximum deflection. Where possible blockage of the drains can lead to flooding of the roof area, emergency drains (see EN 12056) should be envisaged at the side of the roof.

In accordance with Table A.1, the roof pitch can be as small as 3-5 degree if, in accordance with the state of the art, additional sealing measures are adopted.



Key

a = 100 to 200 mm

1 = Sealant

Figure A.2 — End lap – roof covering

For roof coverings with profiled sheeting, the minimum roof pitch shall not be less than 3°.

The overlapping of the end lap shall always be chosen as a function of the roof pitch (see Figure A.2). Recommendations are given in accordance with Table A.1.

Table A.1 — Recommended roof pitches and minimum overlapping lengths

Roof pitch, in degrees	Overlapping length, in mm	Comment
≥ 1,7 to 2,9		without transversal joint and without opening
2,9 to 10	200	with additional measures for sealing
10 to 17	200	
> 17	150	
≈90 (wall, vertical laying)	150	

The requirement limiting the minimum roof pitch is not applicable (locally) to the ridge area if, in the areas with pitches less than or equal to 3° (5 %) (e.g. curved roofs), the roof elements are not connected along the ridge between the eaves.

In addition, reference is made to EN 12056-1 and EN 12056-3.

Annex B
(normative)

Additional design requirements for profiled sheeting

B.1 General

This Annex concerns provisions which the designer shall take into account, if not otherwise specified, and which are not yet included in EN 1999-1-4.

This Annex does not cover composite metal decks.

Actions of the structural elements shall be taken into account when supporting members are designed. The effect of continuity on the support reaction can be ignored for continuous loads if the profiled sheeting spans more than two spans and the spans do not differ from each other by more than 20 %.

B.2 Serviceability

It is possible to have a connection in the top or bottom flange of the trapezoidal or sinusoidal sheeting.

When selecting the supporting member (e.g. material, thickness), consideration shall be given to the requirements of the fasteners.

If not otherwise specified the deflections of the profiled sheets shall be limited depending on the field of application:

for roofs subjected to gravity loading

—	with weather membrane on top (bonded roof construction)	$f_{max} \leq l/300$
—	with weather membrane on top and mechanical connection	$f_{max} \leq l/200$
—	with metal decking on top (double-skin roof, here supporting skin)	$f_{max} \leq l/150$
—	as metal decking (outer skin)	$f_{max} \leq l/150$
for walls		
—	cladding, under wind pressure	$f_{max} \leq l/150$

B.3 Dimensions, widths of supports

B.3.1 General

The required widths of the supports are obtained by determining the load-bearing capacity by calculation or testing. For correct execution during erection minimum support width are given in Table B.1.In case of installation on narrow supports, e.g. tubes, special execution provisions shall be taken into account to reduce the values in Table B.1.

During installation, if the profiled sheet is not attached to the supporting member immediately after laying, the width of the support including overlapping shall be at least 80 mm for safety reasons.

The minimum support width shall be calculated based on design rules or testing according to EN 1999-1-4.

Table B.1 — Minimum support widths

Type of supporting members	Steel, concrete [mm]	Masonry [mm]	Timber [mm]
Minimum end support width	40	100	60
Minimum intermediate support width	60	100	60

B.3.2 Supporting members made of metal (steel / aluminium)

In the case of asymmetrical linear profile cross section supporting members made of metal, consideration shall be given to reductions in the loading of the connection that may be necessary (see B.4 and the European Technical Assessments for the fasteners).

EN 1999-1-4 shall apply.

B.3.3 Supporting members made of timber

The EN 1995-1 series shall apply.

Trapezoidal and sinusoidal profiles can be fastened in crown and valley.

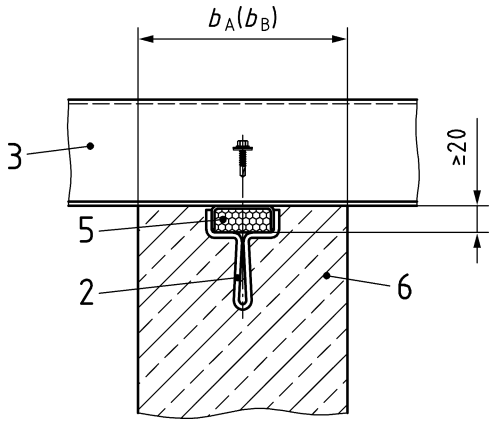
B.3.4 Supports made of concrete or masonry

In the case of these supports, adequately anchored, continuous elements to which the profiled sheeting can be connected, e.g. anchor bodies or fastening rails, preferably made of steel, shall be installed. Built-in parts made of flat steel shall have a thickness of at least 8 mm (see also 8.4.6 and Figure B.1).

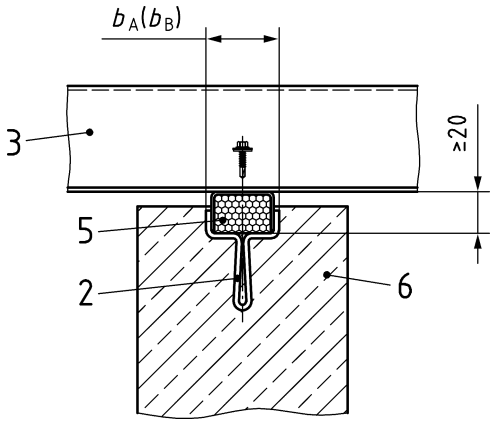
If the width of the supports is more than 10 % of the calculated span, the supports shall be installed so that they protrude above the concrete surface, in accordance with the deflection curve of the profiled sheeting.

In exceptional cases, e.g. for refurbishment of an old building, where there is no supporting component, the profiled sheeting may be attached directly to the supporting member. If the formation of condensation cannot be ruled out, direct contact with a support made of concrete shall be avoided.

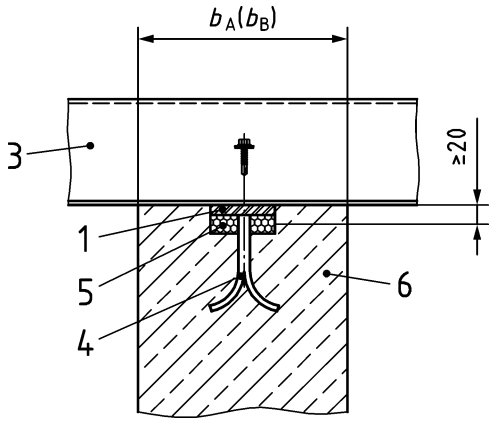
Dimensions in millimetres



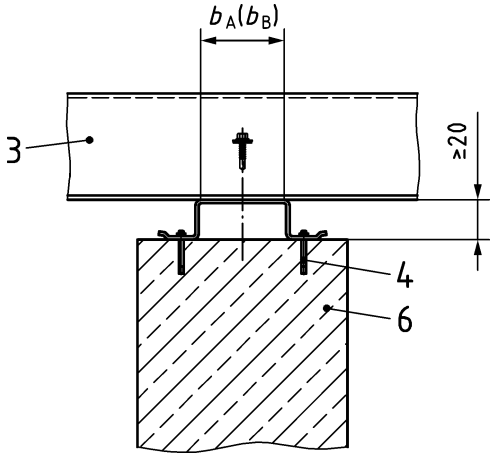
a) Connection with attachment rail embedded flush with top face of concrete support



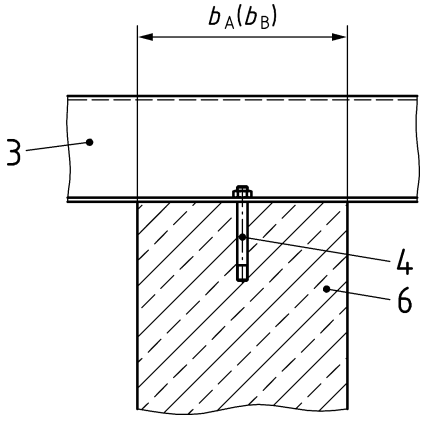
b) Connection with protruding attachment rail embedded in concrete support



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



d) Attachment with hat-shaped profile anchored in the support



e) Direct connection flush with top edge of concrete (refurbishment of an old building)

Key

1 steel plate, thickness not less than 8 mm
2 embedded steel attachment rail
3 trapezoidal sheeting
4 anchorage
5 rigid foam, timber, or similar material
6 concrete, reinforced concrete or pre-stressed concrete

Figure B.1 — Examples of support design

B.3.5 Shear forces / fixed points

When dimensioning the supporting member, consideration shall be given to the transfer of shear and normal forces acting in the roof plane by the profiled sheets. Forces designed to result from roof shear can only be transferred via the attachment in the valley of the profiled sheet. Where the attachment is via the top flange, the shear forces shall be absorbed e.g. by a special fixed point. When detailing fixed points, the structural elements and the supporting member concerned shall be designed and detailed for the respective shear forces.

Thermal elongation of the profiled sheets has to be taken into account by

— proof that the thermal elongation will not cause any damage; or

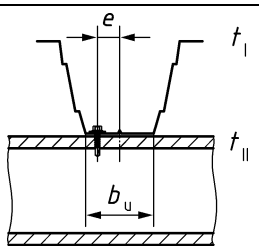
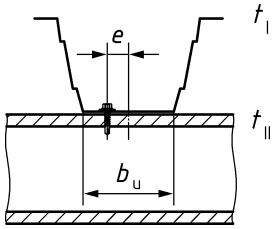
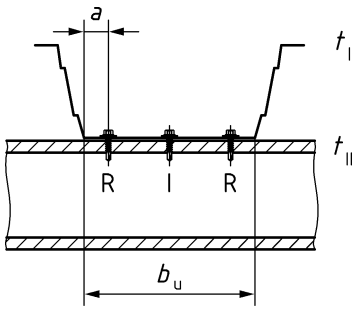
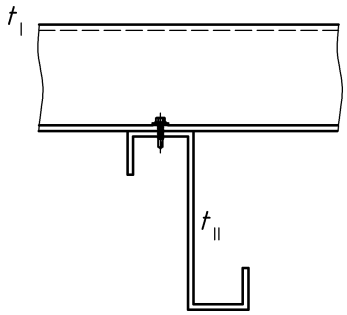
— the construction allows free movement of the profiled sheets and the definition of a fixed point.

B.4 Eccentric attachments

In the case of asymmetrical linear profile cross section supporting members made of metal, consideration shall be given to reductions in the loading of the connection that may be necessary (see Table B.2 and the European Technical Assessments for the fasteners).

Eccentric attachments shall be specified in accordance with Table B.2.

Table B.2 — Eccentric attachments – cases for the use of reduction factors according to EN 1999–1-4

Case	Requirement	Reduction factor For t_I < 1,25 mm
	$e > b_U/4$ $b_U \leq 150$ mm	0,9
	$0 < e \leq b_U/2$ 150 mm < $b_U \leq 265$ mm	0,5
	If $b_U > 265$ mm, at least two fasteners are necessary	for I 0,0 R a ≤ 75 mm 0,7 R a > 75 mm 0,35
	$t_{II} \leq 5$ mm Asymmetrical linear profile cross section Pull-through resistance shall be taken as 0,7 $F_{p,Rd}$	0,7

B.5 Stiffening of liner trays

For achieving full load-bearing capacity the narrow flanges of liner trays shall be stabilized:

— Stabilization of the narrow flanges of the liner trays is achieved by connecting them directly to the adjacent external skin or indirectly via the connection of individual profiles (intermediate profiles, spacer profiles).

— It is necessary to adequately dimension the connections and the external skin under conditions of wind suction loading, whereby only the fasteners shall be used as points of support in each case.

— Unless a more precise analysis has been carried out, the spacing of the connections between the outer or upper skin and the narrow flanges of the liner trays may not be greater than the spacing investigated in the tests carried out as specified in EN 1999-1-4. The external skin is deemed to be directly adjacent even when there is a continuous intermediate layer (e.g. rigid thermal separating

strips) with a maximum thickness, given by the relevant ETAs of the fasteners, positioned between the narrow flanges of the liner trays and the adjacent flanges of the external profiled sheeting.

If a greater thickness is necessary for the intermediate layer, the load-bearing capacity of the liner trays shall be verified.

In the case of an indirect connection of the external skin using spacer profiles, the stabilizing effect is transmitted via the individual spacer profiles. If the spacer profiles cannot be displaced in the longitudinal direction, thereby impeding the sideways movement of the narrow flanges of the liner trays, no demands shall be made on the external skin. Otherwise it is necessary to have a rigid external skin or the analysis of the load-bearing capacity of the liner trays shall be carried out using unstiffened flanges.

B.6 Walkability

B.6.1 Walkability during installation

During installation, i.e. not finally fixed, the profiled sheeting may only be walked on in order to install the roof.

The profiled sheets may only be walked on if load-dispersal measures are adopted (e.g. wooden planks in accordance with strength class C24 with a cross-section of 4 × 24 cm and a length greater than 3,0 m).

If appropriate tests have been carried out, the load-dispersal measures can be abdicated.

B.6.2 Walkability and access after installation

After installation, the profiled sheeting may only be walked on for maintenance and cleaning of the sheeting.

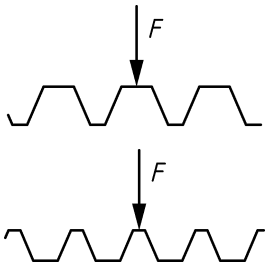
The profiled sheeting may only be walked on if load-dispersal measures are adopted (e.g. wooden planks in accordance with strength class C24 with a cross-section of 4 × 24 cm and a length greater than 3,0 m). If the existing span does not exceed the limiting value L_{lim} determined in tests according to B.6.3, one may forego load-dispersal measures. With profiled sheeting that is laid as multi-span supports, the existing limiting value L_{lim} may be up to 25 % larger than the limiting values determined in single span tests even without load-dispersal measures.

For access it is advisable to install walkways to units requiring regular maintenance or operational elements (e.g. continuous roof lights, chimneys, heating plants, photovoltaic).

B.6.3 Test “Walkability”

The profiled sheeting shall be deemed to be safe to bear a single person during installation or after installation for maintenance and cleaning of the sheeting if load-dispersal measures will not be used. Individuals can walk on a profiled sheet up to that span at which the assessment criteria in Table B.3 are fulfilled.

Table B.3 — Assessment criteria for walkability

	Loading pattern	Loading *F* in kN	Assessment criterion
Middle loading		1,2 2,0	significant permanent deformation failure load

A concentrated quasi-static loading shall be applied, in the direction of gravity, via a 100 mm x 150 mm area, with the longer side of the area parallel to the direction of span. In order to prevent any stress concentrations, loading shall be via a soft layer of about 10 mm in thickness, e.g. via a felt pad.

The test sheet shall be placed on flat rails not less than 40 mm wide.

The failure load here is the maximum load measured in the test without taking deformation into account. A significant permanent deformation is taken to be 3 mm. There is sudden failure without significant overall deformation if failure occurs before a deflection of 1/100 of the span. The minimum number of tests are defined in Table B.4.

Table B.4 — Minimum number of tests

Number of nominal sheet thicknesses to be tested	Number of tests
≥ 3	≥ 2
2	≥ 3
1	≥ 4

The span L_{lim}, which allows a single person to walk on the trapezoidal sheet is the smallest of the spans $L_{lim,test}$ resulting from loading at the edges or in the middle corrected with respect to 0,2 % proof stress and sheet thickness (a statistical treatment is not carried out).

$$L_{lim} = L_{lim,\ test}\left(\frac{f_{0,2}}{f_{0,2,\ obs}}\right)^{0,5}\left(\frac{t}{t_{obs}}\right)^{\beta} \text{ but } L_{lim} \le L_{lim,\ test} \tag{B.1}$$

where

$\beta = 1$ for $t \ge t_{obs}$

$\beta = 2$ for $t < t_{obs}$

If the failure load excesses the required load according to Table B.2, the adjustment may (partially) applied to the load:

$$L_{lim} = L_{lim,\ test}\left(\frac{f_{0,2}}{f_{0,2,obs}}\right)^{0,5}\left(\frac{t}{t_{obs}}\right)^{\beta}\frac{F_{obs}}{F_{required}} \text{ but } L_{lim} \le L_{lim,\ test} \tag{B.2}$$

For sheet thicknesses that are not tested, this span may be determined by interpolation or extrapolation:

— the smallest applied sheet thickness shall be tested

— linear interpolation between tested sheet thicknesses if the difference between the tested sheet thicknesses is not greater than 0,25 mm for $t \leq 1{,}0$ mm or 0,5 mm for $t > 1{,}00$ mm

— linear extrapolation for larger sheet thicknesses.

B.7 Rotational restraint

Trapezoidal and sinusoidal sheeting and liner trays can be used to stiffen the supporting member by means of a rotational restraint. In doing so, for aluminium trapezoidal profiles with superimposed loads, a characteristic value of the connection rigidity $c\vartheta_{,A,k}$ relating to a flange width b = 100 mm can be applied according to Table B.5 so long as no more accurate verification can be provided.

Table B.5 — Characteristic value of the connection rigidity $c_{\vartheta,A,k}$ of aluminium trapezoidal profiles with superimposed load relating to a flange width of b = 100 mm

Profile (narrow flange at the bottom)	Screw distance	
	b_r	2 b_r
29/124/0,7 25/100/0,7	7,0	4,0
35/200/0,7 50/167/0,7	3,2	2,0

B.8 Stressed skin design (diaphragms)

For the design of diaphragms made of structural profiled sheets, EN 1999-1-4 applies.

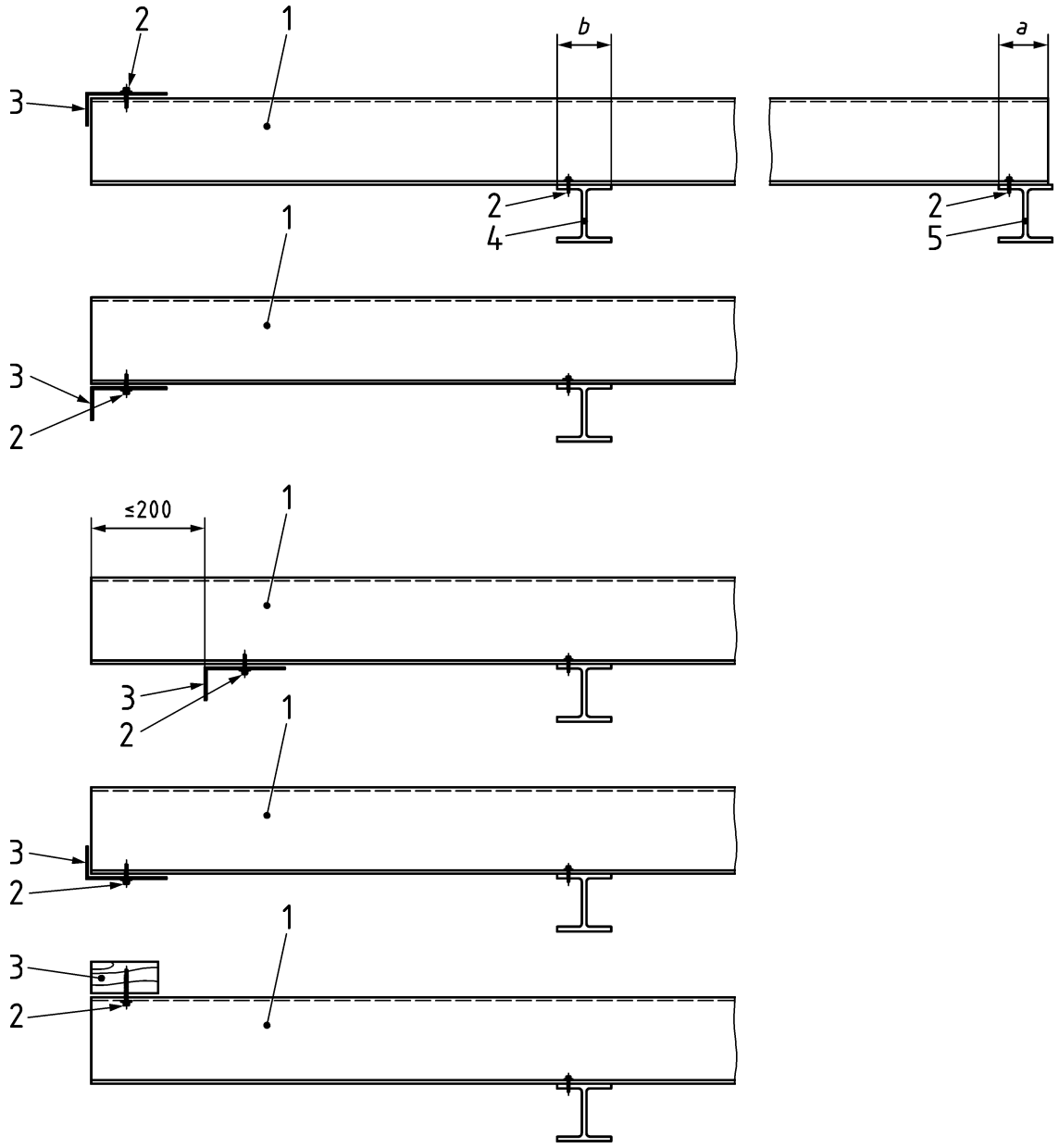
B.9 Cantilevers

Load dispersal can occur, for example, via angled sheet or timber planks (see Figure B.2).

The unsupported end of cantilever profiled sheets shall carry a load for access reasons and shall be specified, dispersed over a width of at least 1,0 m. If this load can only be carried by an additional transverse element, this element shall be connected to each profile rib to resist tension.

If the length of the cantilever is larger than L/10 and 300mm, a design according to EN 1999–1-4 is required.

Dimensions in millimetres



Key

1 profiled sheet
2 fastener
3 load dispersal at the unsupported end, each flange of the trapezoidal sheet to be fastened
4 front support for cantilever sheets
5 rear support; every profiled sheet to be secured against lifting immediately after laying

Figure B.2 — Examples of cantilevers

B.10 Openings in laying areas

Openings and penetrations in the surfaces of trapezoidal or corrugated profiles shall be considered in the verification of the structural safety and suitability for use and stipulated in the installation drawing.

For openings in roofs and walls (e.g. for roof lights, roof drainage systems), framing shall always be carried out and static verifications provided as long as the following points are not applicable

The following applies for openings in single-skin roofs:

a) For single openings per sheet and field with a diameter or a side length of up to 150 mm verification is not necessary.

b) With several openings per panel and field with a diameter or side length of up to 150 mm verification is not necessary if the penetrating component is welded all-round. This does not apply for flexible pipe sleeves.

Dimensions in millimetres

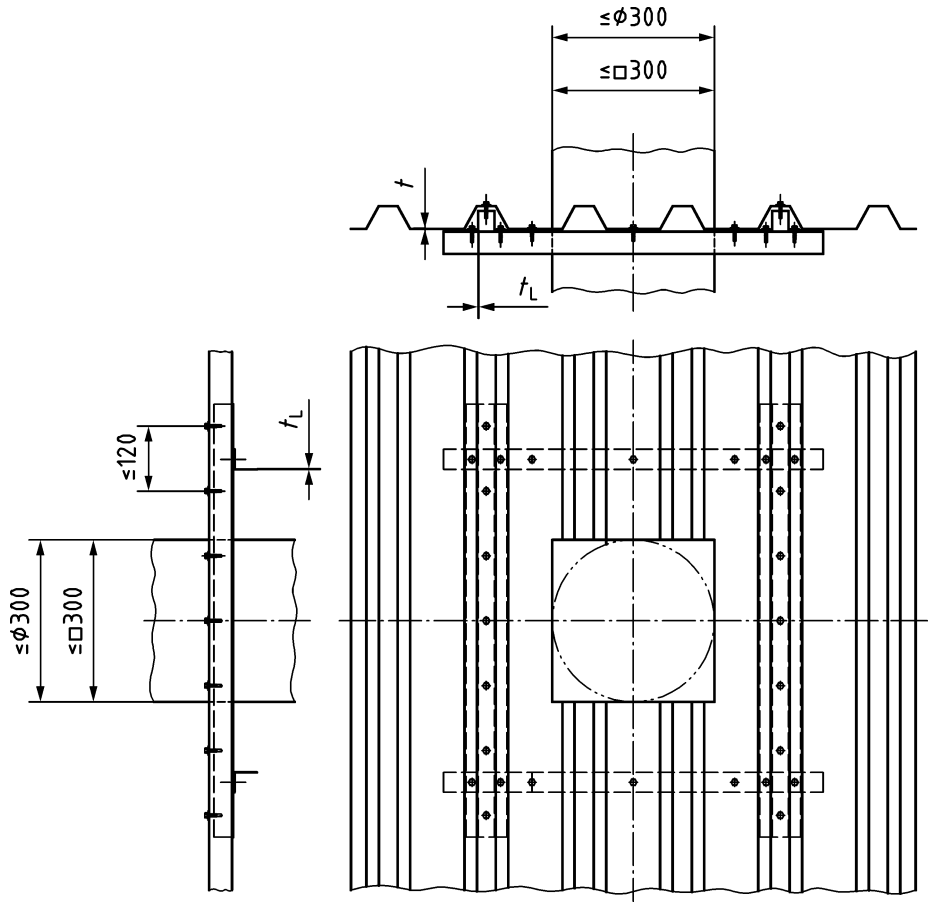


Figure B.3 — Openings from 150 mm to 300 mm diameter or side length in a single-skin roof

The following applies for openings in the outer skins of multi-skin roofs (see Figure B.3 and B.4):

a) For single openings per sheet and field with a diameter or a side length of up to 150 mm verification is not necessary.

b) With several openings per panel and field with a diameter or side length of up to 150 mm verification is not necessary if the penetrating component is welded all-round. This does not apply for flexible pipe sleeves.

c) For other openings with a diameter or a side length from 150 to 300 mm the following applies: At all four sides of the opening the profile sheets of the outer skin shall be supported, for example with Z profiles on the inner supporting skin. The Z profiles shall be connected to both skins according to

the static requirements. The inner supporting skin shall be statically verified or, where appropriate, constructively framed.

Dimensions in millimetres

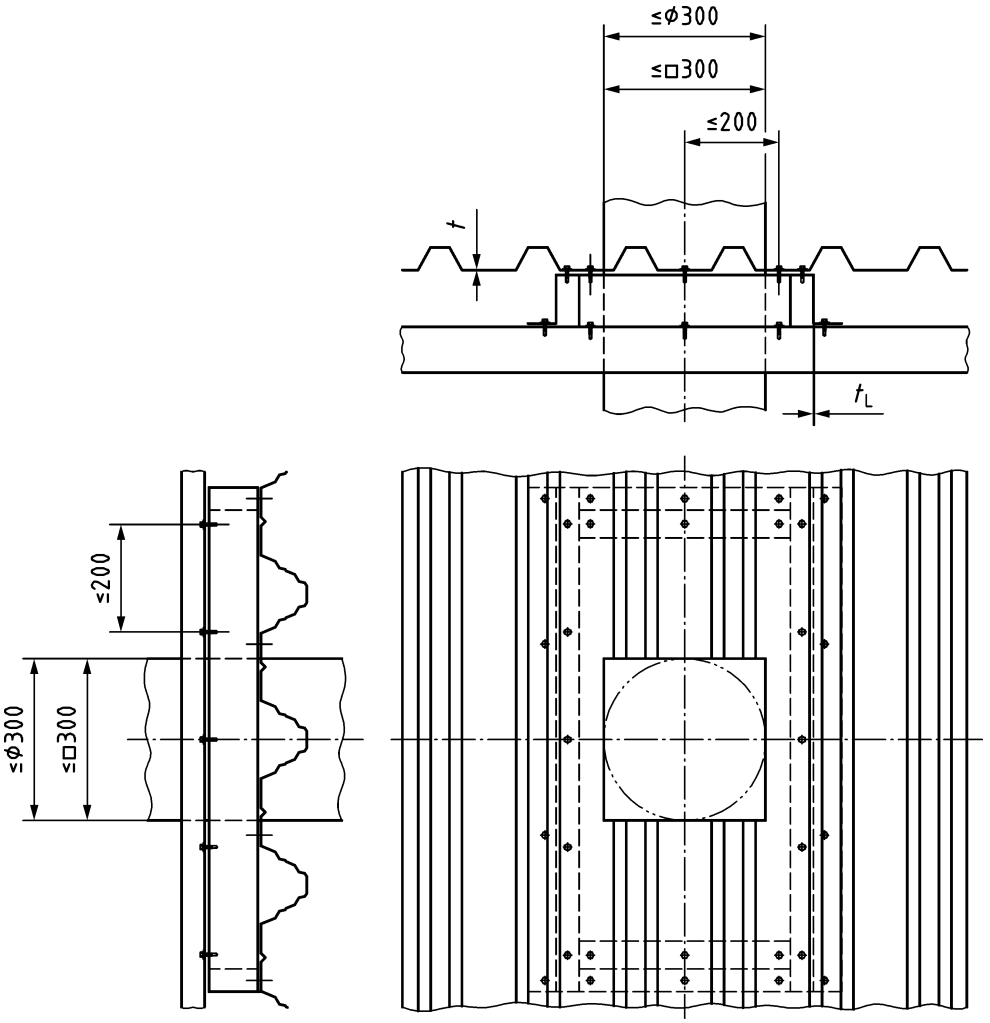


Figure B.4 — Openings from 150 mm to 300 mm diameter or side length in the outer skin of a multi-skin roof

Framing profiles shall be installed in such a manner that the existing profile geometry of the trapezoidal sheets and liner trays is not altered, even at the fixing points on the sub-construction. Ensure that the corrosion protection is sufficient.

Annex C
(informative)

Documentation

The construction records should document the state and progress of the construction works as well as all noteworthy incidents in the construction of the building. The construction records form an important part of the building files after completion of the works.

By agreement, the construction site management is obliged to keep daily construction records.

It is recommended to fill out the construction records daily by the operatives and signed by the construction manager.

The construction records should include, if not otherwise specified:

a) building project, interfaces between involved parties, start of work, deadlines;

b) if carried out in stages, also deadlines of stages;

c) building site manager and possible change of building site manager;

d) documentation of inspection of packaging and contents see 9.6;

e) date, weather;

f) number of craftsmen;

g) times of start and finish of the works / shifts;

h) interruptions and delays to the works and their cause;

i) machines and materials used;

j) meetings, with names / start and finish / signatures of participants;

k) topics covered at meetings as keywords with reference to minutes taken;

l) installation of elements that will no longer be accessible later and their acceptance;

m) actual or supposed defects and damage;

n) changes during the construction phases, the initiator and the reason for them;

o) receipt of drawings, amendments and corrections, and their approval;

p) exceptional incidents (such as heavy rain, storms or accidents).

Annex D
(normative)

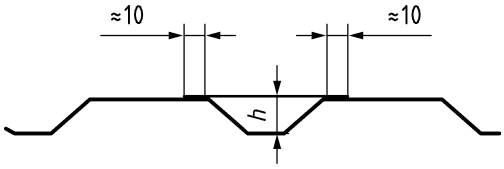
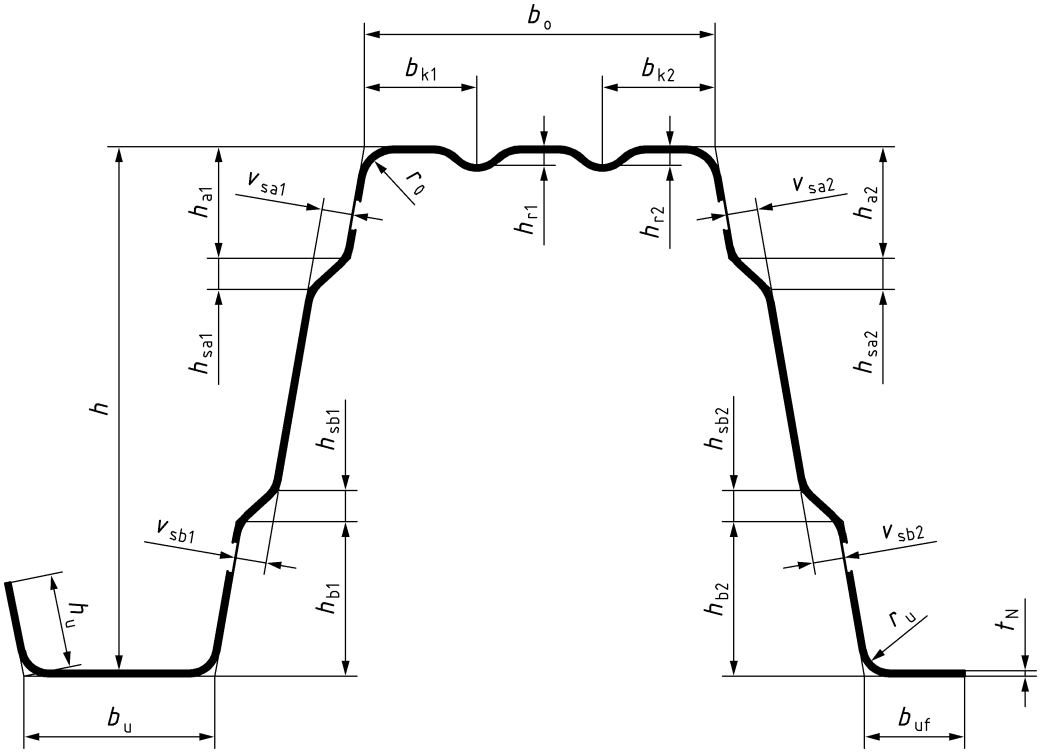
Geometrical tolerances

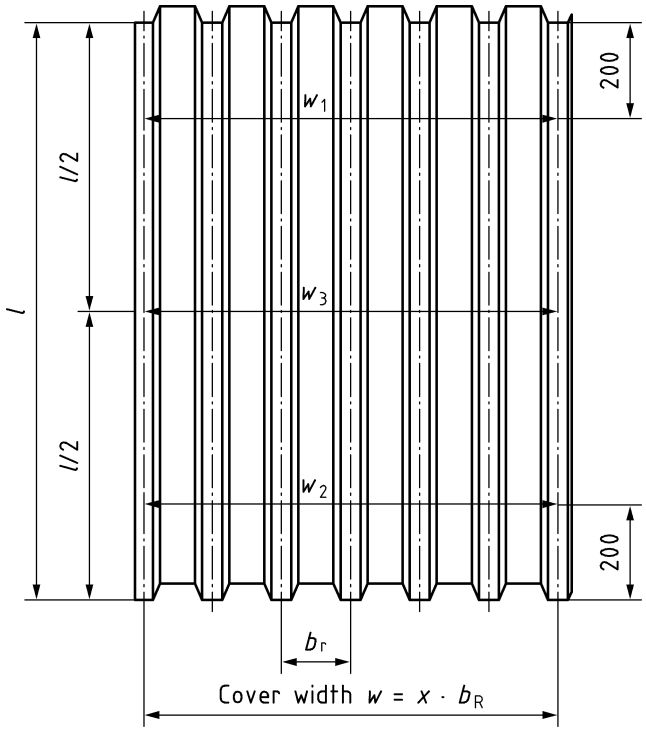
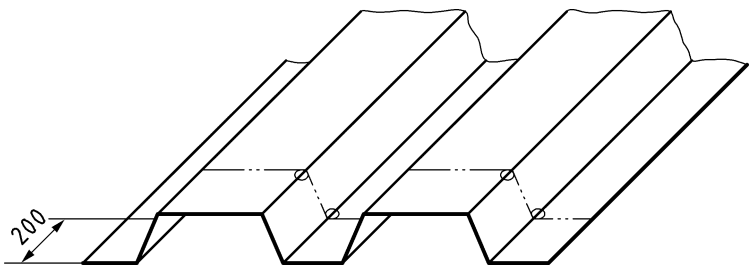
D.1 General

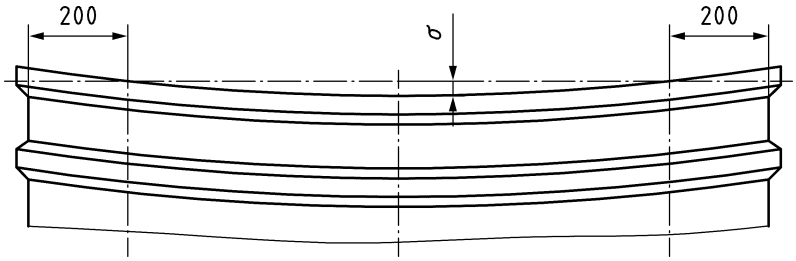
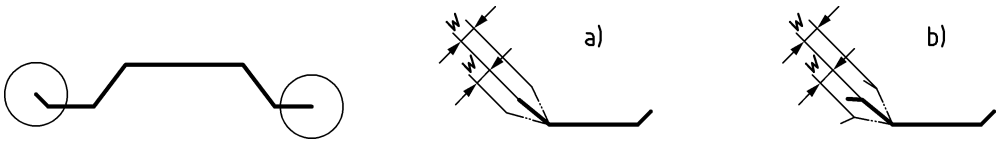
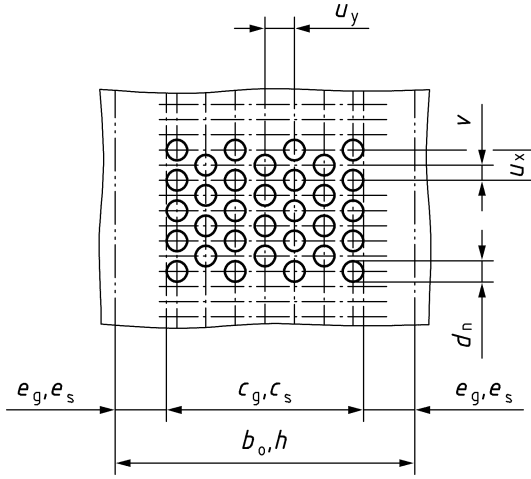
Permitted deviations for essential and functional tolerances are given in D.2 *Essential and functional manufacturing tolerances – Cold formed profiled sheets*, if not otherwise specified:

D.2 Essential and functional manufacturing tolerances – Cold formed profiled sheets

Table D.1 — Essential and functional manufacturing tolerances – Cold formed profiled sheets

No	Criterion	Parameter	Permitted deviation Δ	
			Essential	Functional
				
1	Depth of profile:	h	h ≤ 50 mm ± 1,0 mm 50 mm < h ≤ 100 mm ± 1,5 m m h > 100 mm ± 2,0 mm	-
				

No	Criterion	Parameter	Permitted deviation Δ	
			Essential	**Functional**
2	Depth of grooves / bends:	h_r v_s	+1 mm −1 mm	-
3	Width of the top and bottom flanges:	b	+2 mm / −1 mm	-
				
4	Cover width:	w	h ≤ 50 mm ± 5,0 mm h > 50 mm ± 0,1 × h ≤ 15 mm	-
5	Variation in cover width:	w_3	$(w_1 + w_2)/2$ - tolerance ≤ w_3 ≤ $(w_1 + w_2)/2$ + tolerance	-
				
6	Bend radius:	r	+2 mm, 0 mm	-

No	Criterion	Parameter	Permitted deviation Δ	
			Essential	**Functional**
				
7	Deviation from straightness:	δ	2,0 mm / m of sheet length, not more than 10 mm	-
8	Squareness	S		S ≤ 0,005 × w
9	Panel length:	l		L ≤ 3 000 mm +10 mm /-5 mm L > 3 000 mm +20 mm /-5 mm
				
10	Edge waviness of the side lap:	W		D ≤ ± 2,0 mm over a length of 500 mm
				
11	Hole diameter	d_n	d_n ≤ Ø 5 mm ± 0,2 mm d_n > Ø 5 mm + 0,2 mm / −0,4 mm In case of additional coating after profiling the measurement shall be done without additional coating	-

Annex E
(normative)

Galvanic corrosion

Coated structural elements can be installed together with other metals.

Consideration shall be given to material compatibility when installing structural elements, connections and fasteners made from different metals.

Areas of contact shall be separated permanently by means of additional coatings or barrier layers if there is a possibility of corrosion because of contact between structural elements, connections and fasteners made from different metals. Materials for fasteners shall always be the same or more noble than the material of the structural element that is fastened.

Table E.1 contains a compilation of the reliable material combinations with structural aluminium components.

If uncoated aluminium components make direct contact with components of other materials then there is no risk of contact corrosion in the following cases:

— with untreated or with compatible e.g. timber components treated with oily wood protection agent;

— with coated concrete or reinforced concrete components.

In all other cases, insulating intermediate layers shall be arranged as protective measures e.g. plastic films for steel or timber sub-constructions or intermediate layers containing bitumen for concrete or reinforced concrete sub-constructions. The measures may be omitted if the aluminium components are coated.

Table E.1 — Permissible material combinations

Material combination with aluminium	Environment		
	Rural area	City / Industry	Maritim
Zinc	+	+	+
Stainless steel	+	+	+
Lead	+	+	-
Non-protected steel	-	-	-
Copper	-	-	-
+ permitted - not permitted			

Annex F
(normative)

Additional information

F.1List of required additional information

This clause lists in Table F.1 the additional information that is required in the text of this European Standard as appropriate to fully define the requirements for execution of the work to be in accordance with this European Standard (i.e. where the wording "shall be specified" is used).

Table F.1 — Additional information

Clause	Additional information required
5 - Constituent products	
5.3	Aluminium alloy and temper, coating system; full designation,
5.4	Type of thickness tolerance
5.5.1	Minimum nominal sheet thickness
5.7.1	Mechanical fastener type with designation of the relevant European Standard or EAD
8 – Fastening	
8.6.1	Distances from the edge and field spacings
8.6.2	Eccentric attachments
10 – Surface protection	
10.1	If insulation kits are to be used to avoid galvanic corrosion, full details of their use
12 – Inspection, testing and correction	
12.3	The location and frequency of measurements
B - Basic requirements for profiled sheeting	
B.9	Access load on the free end of a cantilever

F.2List of additional information if not otherwise specified

This clause lists in Table F.2 requirements that shall be followed if not otherwise specified. (i.e. where the wording "if not otherwise specified" is used).

Table F.2 — Additional information, if not otherwise specified

Clause	Additional information required
5 - Constituent products	
5.5.1	Minimum nominal sheet thickness
5.8	Accessories
6 - Manufacturing	
6.1	Visibility of cracks
8 – Fastening	
8.4.2	Attachment of profiled sheets to the supporting member transverse to the direction of span
A - Basic requirements for profiled sheeting	
A.1	General
B - Additional design requirements for profiled sheeting	
B.1	General
B.2	Serviceability - Deflections of the profiled sheets
C - Documentation	
D – Geometrical tolerances	

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