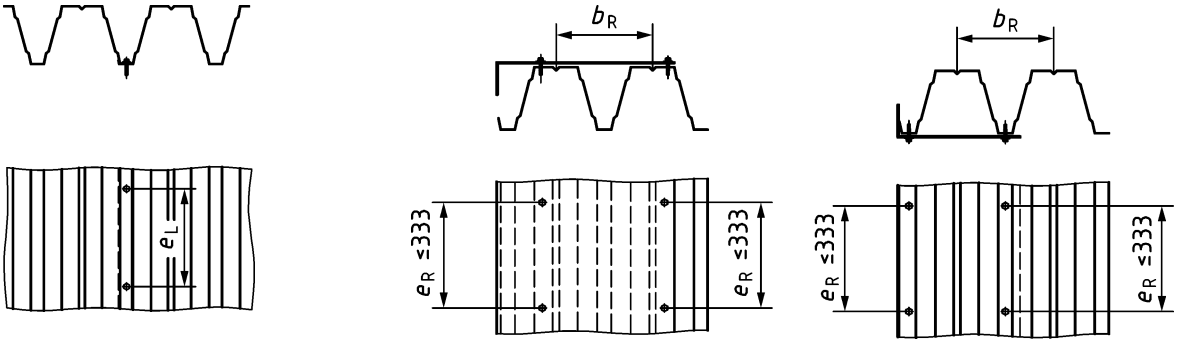
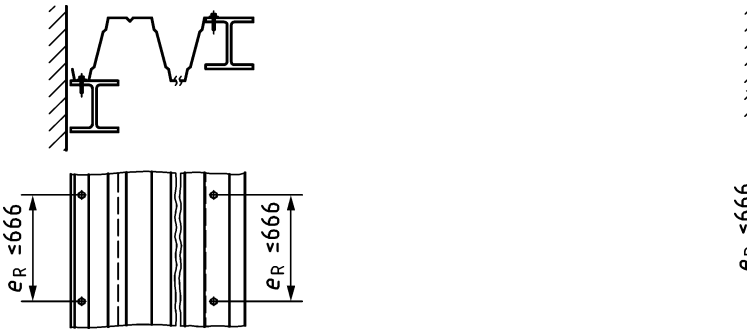
Dimensions in millimetres



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 decking edge trims

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

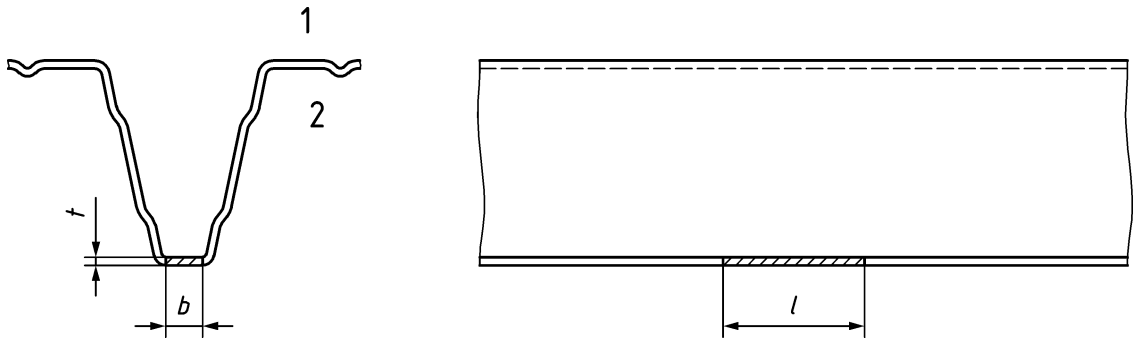
—	Spacing of individual holes:	≥ 80 mm

A.3.3 Reinforcements and double layers

The load-bearing capacity of trapezoidal and sinusoidal sheet or liner trays may be increased by use of reinforcing profiles e.g. by means of additional structural members and sheeting or overlap of side laps and ribs. Trapezoidal and sinusoidal sheet can also be reinforced by means of double layers. Double layer means the longitudinal complete overlap of two sheets,

Reinforcing profiles shall be installed in such a way that the existing profile geometry of the profiled sheeting is not altered — not even at the points where it is attached to the supporting member.

In the case of double layers, the cross-sectional and design values for each layer may be fully utilized if provision is made to support the bottom flange of the upper layer. If profiles sheets' geometry causes a gap between the sheets, the gap can be filled by inserting metal strips in the bottom flange of the lower layer (Figure A.2). The metal strips shall be arranged above the support and at least once in the field and fixed in place (e.g. by adhesive bonding). The position and number of metal strips shall be taken into account when determining the internal forces for the whole system. A composite diaphragm shall not be used. The length of the spacing strip shall be used as the width of the support of the upper layer in the structural analysis.



Key

1 upper layer

2 lower layer

Figure A.2 — Double layers

The side laps of the lower layer shall be connected by rivets or screws in accordance with 8.3 and 8.5.

Cartridge-fired pins shall not be used for fastening of double layers.

A.3.4 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 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 / moisture protection

A.4.4.1 General

The heat-transmitting envelope of the building shall be permanently impermeable to air and humidity 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 (convection). 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 created 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 (R_w)

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 (αw)

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

a) The roof is made of bare metal (aluminium, alloy galvanized steel) 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.

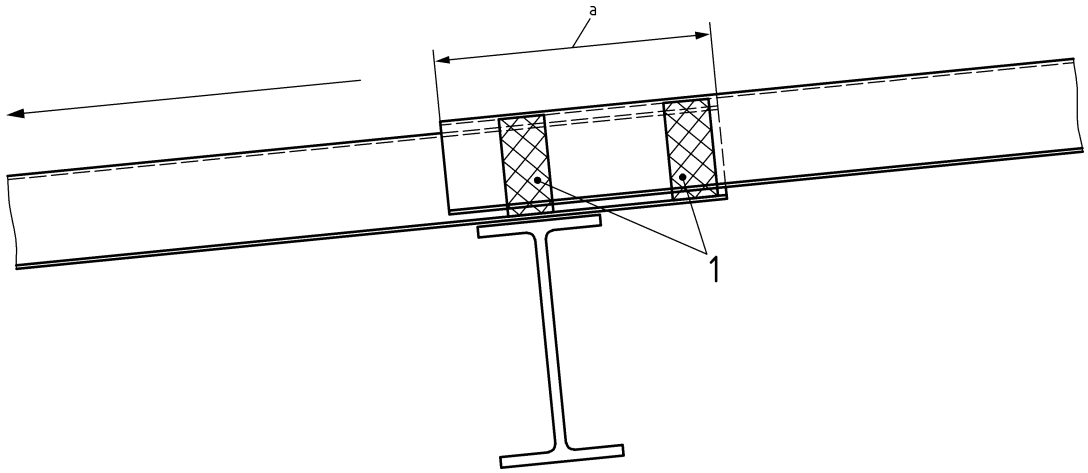
c) The roof is made of coated metal and the individual parts are not screwed or riveted, welded or brazed, but folded, clamped, pressed, crimped, pushed into each other or laid on top of each other. Then the fabricator of the roof shall produce a test report based on EN 62305-3 which shows that the roof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

A.5 Roof drainage

Roof areas should have a continuous downward pitch to the water drain. Non-sloping roof areas (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.

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.

Dimensions in millimetres



Key

1 sealant strips

Figure A.3 — 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.3). Recommendations are given in Table A.1.

Table A.1 — Recommended overlapping lengths

Roof pitch, in degrees	Overlapping length, in mm	Comment
3 (minimum roof pitch) to 5	0	without end lap and without opening
≥ 5	200	with additional measures for sealing
≥ 7	200	
≥ 12	150	
≥ 20	100	

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 1993-1-3.

This annex does not cover composite metal decks.

Actions of the structural members and sheeting 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 %.

Water ponding should be avoided (see also A.5). If water ponding is possible (e.g. roof pitches smaller 2 % and a unfavourable drainage arrangement), the action "water ponding" should be considered as follows: Permanent load and in addition the load in the water pond as a result of the deflection of the sheeting due to this action combination.

NOTE For liner trays the self-weight of outer shells up to g_d = 0,23 kN/m^2 could be neglected.

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 fasteners, the requirements of the supporting member (e.g. material, thickness), shall be considered.

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 actions $f_{max} \leq l/150$

for floors without composite action with spans > 3000 mm, under imposed loads

- in the span examined (all other spans are without loading) $f_{max} \leq l/500$

B.3 Widths of supports

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 large enough for safety reasons.

Table B.1 — Minimum support widths

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

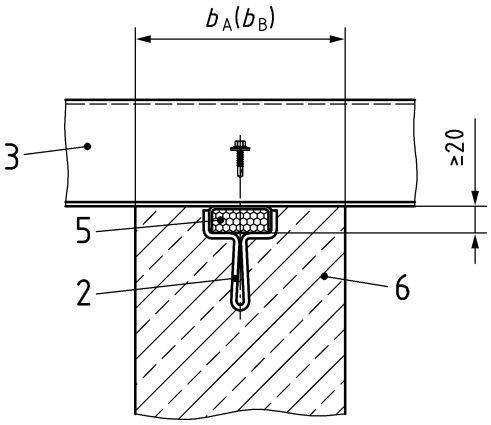
B.4 Supports made of concrete or masonry

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 (see Figure B.1). Built-in parts made of flat steel shall have a thickness of at least 8 mm (see also 8.5.6).

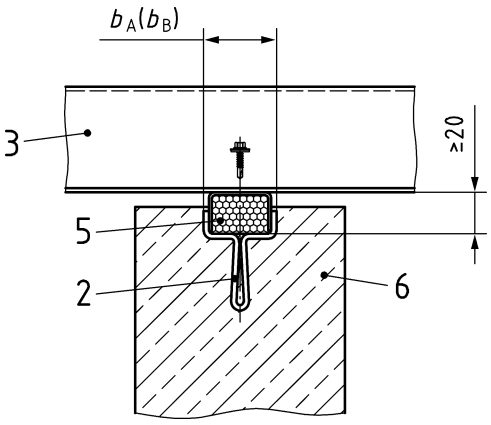
If the width of the supports is more than 10 % of the calculated span, the supports shall be installed so that they protrude above the concrete surface, in accordance with the deflection curve of the profiled sheeting.

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.

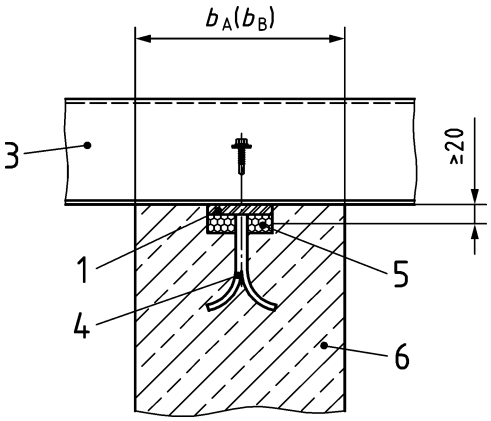
Dimensions in millimetres



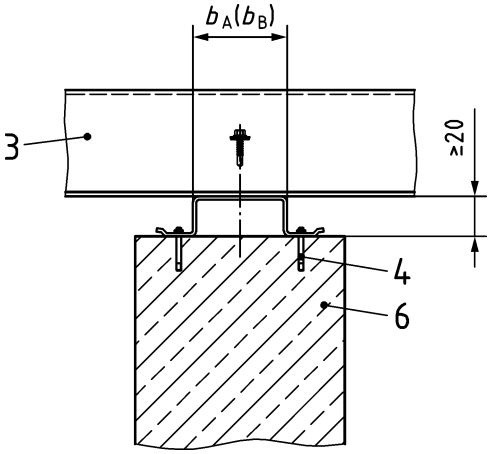
a) Connection with attachment rail embedded flush with top face of concrete support



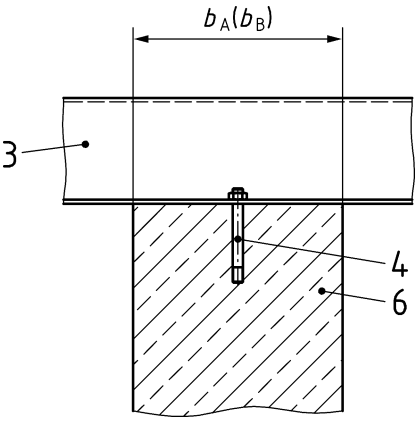
b) Connection with protruding attachment rail embedded in concrete support



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 (mainly refurbishment of an old building or reparation)

Key

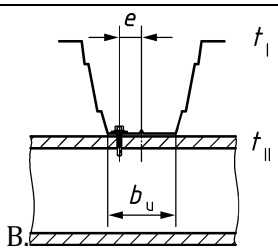
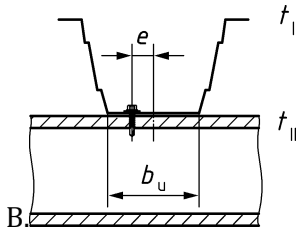
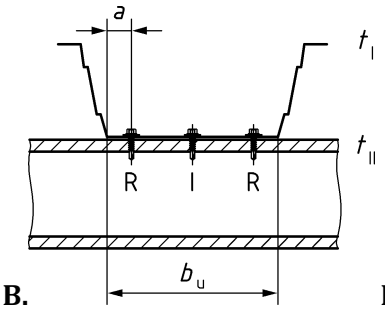
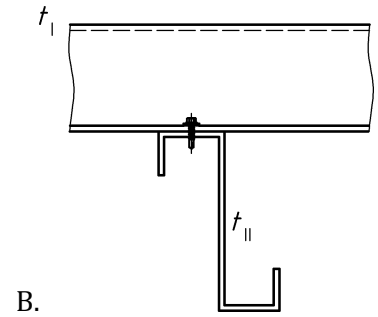
1 Steel plate, thickness not less than 8 mm
2 Embedded steel attachment rail
3 Trapezoidal sheeting
4 Anchorage
5 Rigid foam, timber, or similar material
6 Concrete, reinforced concrete or pre-stressed concrete

Figure B.1 — Examples of support design for concrete or masonry

B.5 Eccentric attachments

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

Table B.2 — Eccentric attachments — cases for the use of reduction factors according to EN 1993–1–3

Case	Requirement	Reduction factor For t_I < 1,25 mm
	$e \le b_U/4$ $b_U \le 150$ mm	1,0
	$e > b_U/4$ $b_U \le 150$ mm	0,9
	$0 < e \le b_U/4$ 150 mm < $b_U \le 265$ mm	0,7
	$0 < e \le b_U/2$ 150 mm < $b_U \le 265$ 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
	$t_{II} < 5$ mm Asymmetrical linear profile cross section	0,7

B.6 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 1993-1-3. If trapezoidal or sinusoidal sheeting is used for the