

# TITANIUM ZINC SHEETS

## User manual





## Titanium zinc sheets are a classic and timeless material immune to vogues and fashion whims

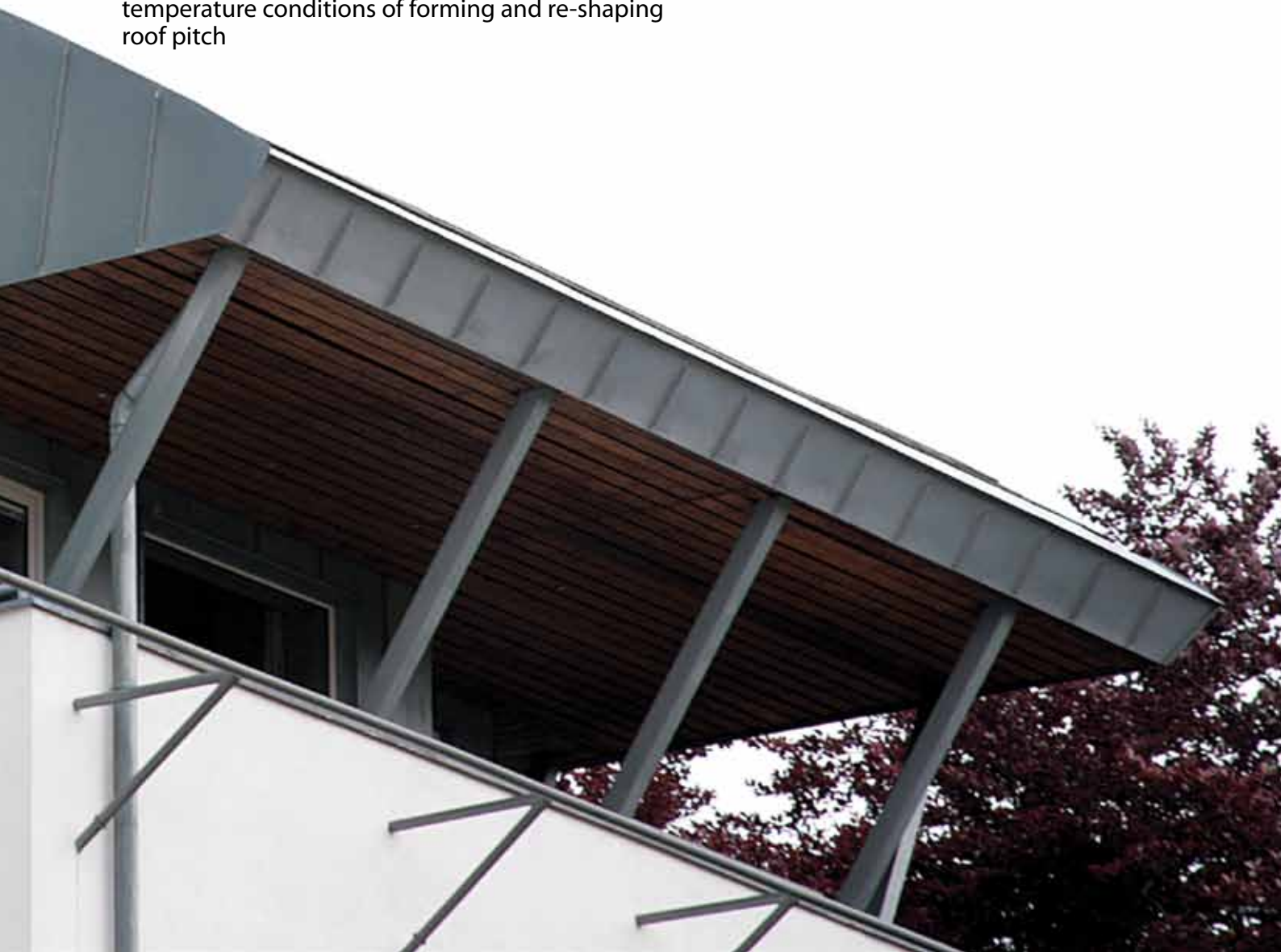
- long useful life
- no need for additional maintenance
- as durable as copper sheet, yet considerably less expensive
- excellent plasticity (folding, drawing)
- simple soldering
- environmentally friendly
- fully recyclable

## Titanium zinc sheets have a wide range of possible application

- roofing
- façades
- rain gutters, pipes, fittings
- wind and other linings
- window sills
- roof decoration

## Use of titanium zinc sheets requires expert knowledge and experience

- Appropriate roofing construction
- drainage wrap
- dilatation characteristics of sheets
- contact of sheets with other materials
- temperature conditions of forming and re-shaping
- roof pitch





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## Titanium zinc sheet properties

Since the titanium zinc sheets are a construction material intended primarily for constructing roofs and façades of buildings, they have to comply with all standards, norms, and regulations effective in the construction industry. As the manufacturer of this construction material, we adopted a commitment with the technical harmonization of the EU standards, to offer the construction industry a high-quality and functional product.

Below are some highlights from these standards and regulations that bear a direct impact on the quality of the construction service using the titanium zinc sheets.

### STANDARDS

Quality requirements for the titanium zinc sheets are laid down by the following two standards:

DIN EN 1179 - purity (chemical composition) of the basic raw material (zinc)

DIN EN 988 - chemical composition of the alloy and properties of the sheets

Both standards are effective as of 1996. Predecessors to these two standards are DIN 1706 (pure zinc) and DIN 1777 (sheet properties).

Titanium zinc sheets are based on the purest type of zinc (99.995% Zn or Z1 according to DIN EN 1179), alloyed with copper (Cu) and titanium (Ti). Addition of these two metals improves the toughness and flexibility/formability of the sheets.



## Mechanical and physical properties of the titanium zinc sheets

Properties:	Value according to DIN EN 988
Sheet thickness	0.60 - 1.00 mm
Useful thickness of sheets in construction	0.60 - 1.50 mm
Yield point ( $R_p = 0.2$ )	min 100 N/mm <sup>2</sup>
Tensile strength ( $R_m$ )	min 150 N/mm <sup>2</sup>
Extensibility (elongation before breakage) (A50)	min 35%
Hourly elongation (A0.1 /1h, 50 N / mm <sup>2</sup> )	max 0.1 %
Thermal expansion coefficient	0.022 mm / m , 0 K
Recrystallization temperature (change of properties)	$\geq 300$ 0 C
Specific weight ( $\gamma$ )	7.2 g / cm <sup>3</sup>

The specified mechanical properties are a warranty for durability of the installed roof cladding. Therefore, continuous lab testing of chemical composition, durable strength, tensile strength and elongation, bending, and thickness, is an important control stage in the production of titanium zinc sheets.

The quality of the roof and useful life of the titanium zinc roofing depends on the quality of the entire roof structure, rather than merely the cladding. The use, or installation, of this material requires an experienced roof construction expert and a skilled and meticulous handicraft worker - roofer.



## Production program, formats, packaging

In the construction industry, titanium zinc is predominantly used in the form of plates, coils, and strips. The basic format is plates and coils of maximum width of 1,000 mm. Upon customer's request, the basic formats can also be cut to desired sub-dimensions (see table below). Pursuant to relevant regulations, the thickness of titanium zinc sheets used in construction should be 0.60 to 1.5 mm, depending on the purpose of use.

Tolerance regarding sheet metal thickness is  $\pm 0.03$  mm.

	Size			Weight in kg/ linear meter					
	Unit	Min.	Max.	Sheet width	0.60mm	0.65mm	0.70mm	0.80mm	1.00mm
<b>PLATES</b>	Length	500 mm	6000 mm	1000 mm	4.3	4.7	5.0	5.7	7.2
	Width	500 mm	1000 mm	800 mm	3.4	3.7	4.0	4.6	5.7
	Thickness	0.30 mm	2.00 mm	670 mm	2.9	3.1	3.3	3.8	4.8
<b>STRIPS</b>	Length	500 mm	6000 mm	600 mm	2.6	2.8	3.0	3.4	4.3
	Width	100 mm	500 mm	500 mm	2.1	2.3	2.5	2.8	3.6
	Thickness	0.30 mm	2.00 mm	400 mm	1.7	1.9	2.0	2.3	2.8
<b>COILS</b>	Length	6 m	approx 200 m	333 mm	1.4	1.5	1.7	1.9	2.4
	Width	100 mm	1000 mm	285 mm	1.2	1.3	1.4	1.6	2.0
	Thickness	0.30 mm	2.00 mm	250 mm	1.0	1.2	1.3	1.4	1.8
	Ø interior	300 mm	400 mm	508 mm	200 mm	0,8	0,9	1,0	1,1



The product is packaged in moisture-resistant paper on wooden pallets, up to 1,000 kg per pallet.

To improve distinction of the packed sheets by thickness, colour-coding of the packed units (pallets) is used:

Yellow = 0.60 mm	Blue = 0.65 mm	Red = 0.70 mm	Green = 0.80 mm	White = other dimensions
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The following is also offered for order within our special construction material program:

- oval titan zinc gutters type 333
- round titanium zinc pipes  $\varnothing$  100 m
- titanium zinc wind and other linings

## TRANSPORT AND WAREHOUSING

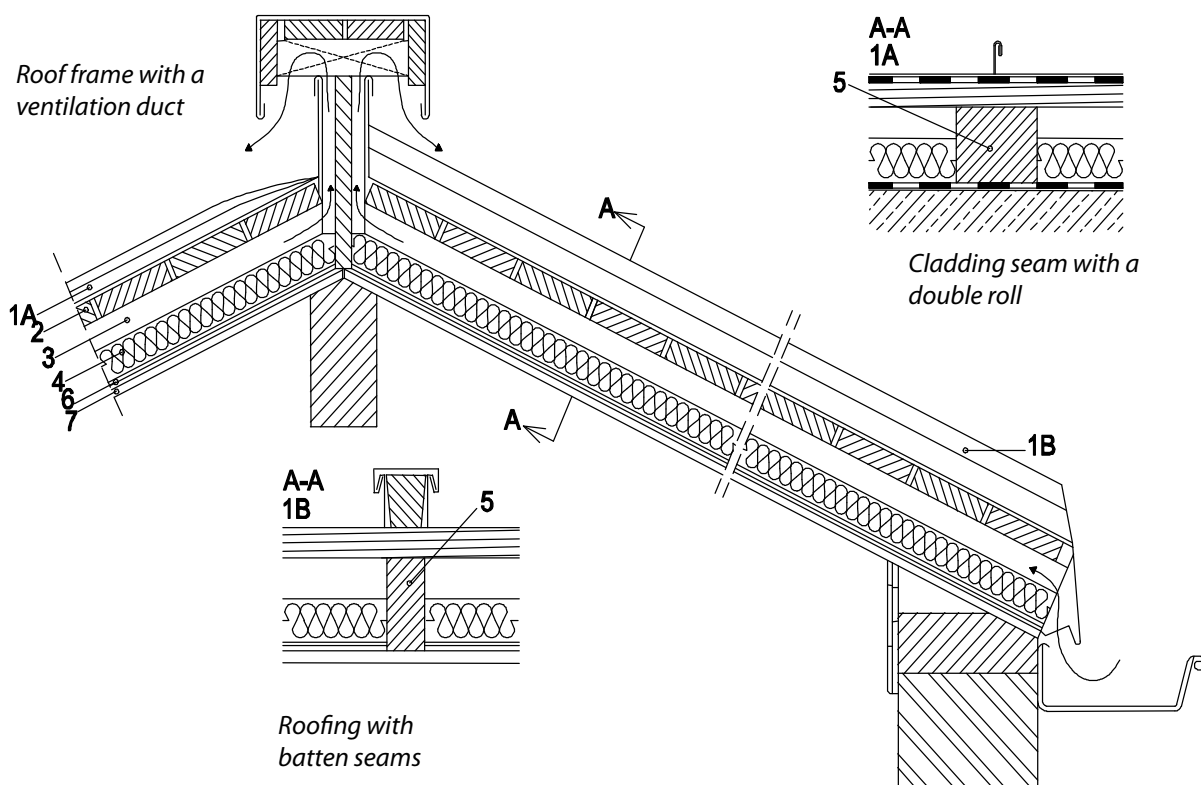
To transport titanium zinc sheets on pallets, transport vehicles with an enclosed cargo compartment (tarpaulin) are recommended. Titanium zinc sheets should be stored in a dry and well ventilated area.



## Titanium zinc roof construction – roof frame plan

Climate conditions in Slovenia and indeed entire Europe are highly challenging in terms of construction physics. Such conditions impose responsibility on the architects of roof frames to take into account extensive temperature swings (-25 to +40 °C), various climate zones (continental, Alpine, seaside), and various atmospheric factors (urban, industrial, countryside atmosphere). In addition to factoring in all these conditions, the architects should also consider the economy criterion.

Roof type most highly recommended by the manufacturer of the titanium zinc sheets is a thermally insulated and ventilated roof.



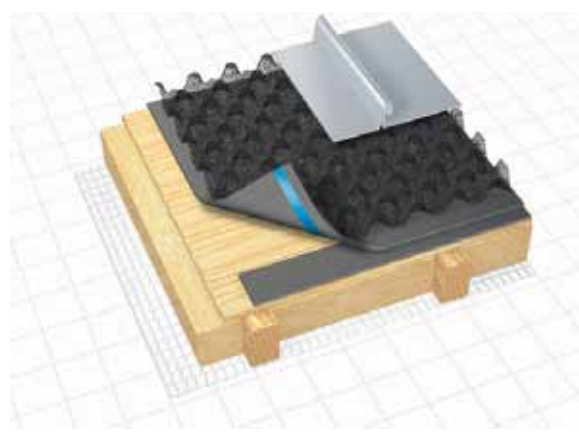
### 1 ~ A AND B TITANIUM ZINC CLADDING

Titanium zinc strips of appropriate thickness are used (0.70 to 0.80 mm), width 400 to 700 mm, joined with longitudinal seams (see page 18). Lengthwise, cladding strips can be up to 10 meters long. If a greater length is required, several strips are used, joined by traversal seams.

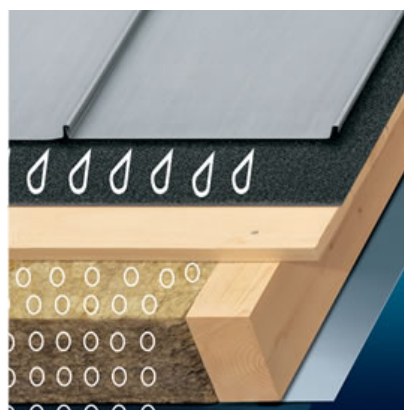
### 2 ~ WOODEN BASE AND SEPARATING LAYER

Normally, non-planed (raw) sheathing boards are used with minimum thickness of 23 mm. Gaps of 5 - 10 mm shall be left between the sheathing boards. Zinc coated nails (contact corrosion) shall be used to fasten the sheathing boards. They should be driven deeply into the boards. Sometimes, as a result of misinformation, bitumen felt (asphalted cardboard) is used as a separating layer between the cladding and the supporting deck/sheathing. It has been

found that such material is not acceptable for the titanium zinc cladding (bitumen corrosion, warm water corrosion). As a separating layer, a special structured film/underlay shall be used, produced especially for this purpose. Structured films/underlays by manufacturers Dörken and Klöber are the most renowned. Use of such underlay is recommended regardless of the roof pitch; it should always be used for roofs with a pitch lesser than 20°. Structured underlay will allow draining of the water accumulated as a result of a leak in the roof finish or condensation. In roofs with a steeper pitch, the cladding may be mounted directly onto the sheathing, without a separating layer. When wooden panels are used for sheathing instead of boards, structured film must be used regardless of the roof pitch.



**DOERKEN** DELTA-TRELA/DELTA-TRELA PLUS



**KLOEBER** Permo sec

### 3 ~ VENTILATION DUCT

The size of the ventilation duct (height, cross-section) depends on the roof pitch (air buoyancy effect); it should be between 5 and 20 centimetres.

### 4 ~ INSULATION

Depending on the desired effect of heat insulation, various insulation materials are available (glass wool, rock wool, polystyrene).

### 5 ~ ROOF SUPPORT FRAME

Only wooden materials of various dimensions shall be used.

### 6 ~ VAPOUR BARRIER

Water- and vapour-proof vapour barrier (plastic, metal film) shall be used.

### 7 ~ INTERIOR WALL FINISH

The choice of interior finish material is subject to requirements in terms of aesthetics and insulation (wood, plasterboard/drywall, plastics).

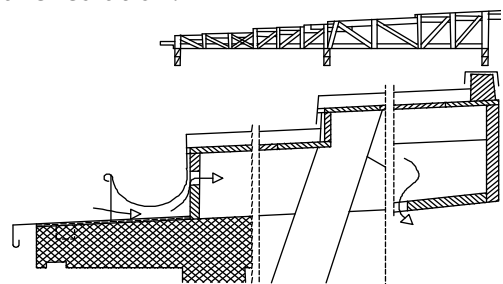
## Roof ventilation, vapour barrier

Moisture (condensate) accumulated under the metal cladding (construction moisture, air humidity) must be provided a free passage in order to be evacuated from the roof frame construction. The best solution is one that allows natural air circulation in the attic (air buoyancy current).

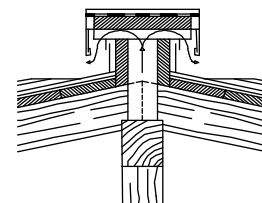
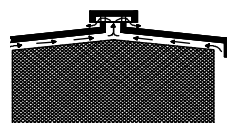
In addition, the following effects should be taken into account:

- the purpose of the building;
- amount and frequency of condensate accumulation (climate);
- roof shape, pitch, length, and height of ventilation ducts;
- building position relative to wind direction;
- forced circulation if there are no conditions for natural circulation.

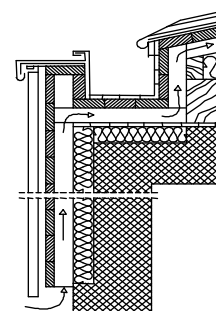
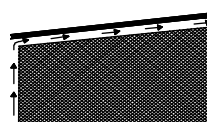
*Ventilation of a 'cold' mono-pitched roof*



*Ventilation of a 'double-pitched' roof with a ridge*



*Ventilation of the wall (façade) in connection with the roof frame construction*



Functional ventilation requires a certain minimum cross-section of ventilation ducts (see table) and the selection of the lowest point (rain gutter area) and the highest point (ridge) of the roof.

Roof pitch	Minimum opening height	Minimum opening cross-section per sqm of roof
Less than 3° (5 %)	20 cm	25 cm <sup>2</sup>
From 3° (5%) to 20° (36 %)	10 cm	20 cm <sup>2</sup>
20° (36%) and more	5 cm	10 cm <sup>2</sup>

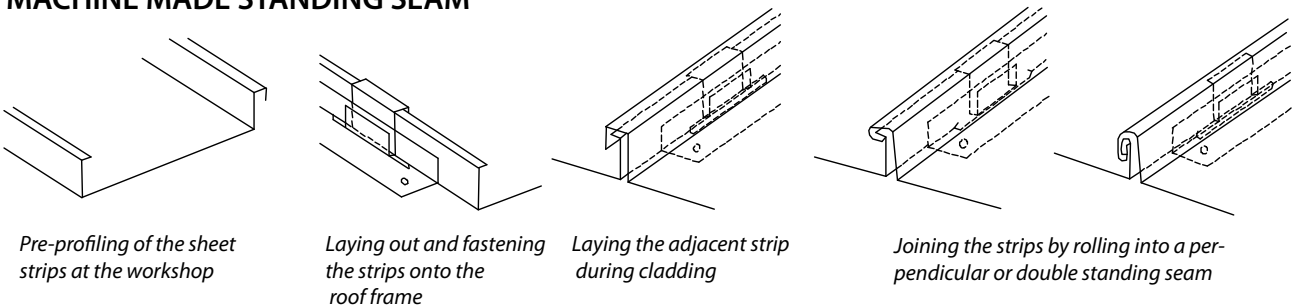
Vapour barrier on the roof frame is a vital part of the roof construction. Its key function is to prevent the permeation of moisture (condensate) from a humid area into the area of roof insulation. Failure to install a vapour barrier (plastic film) may cause saturation of the roof insulation with moisture which impairs the insulation performance and causes local discharge of water back into the living area.



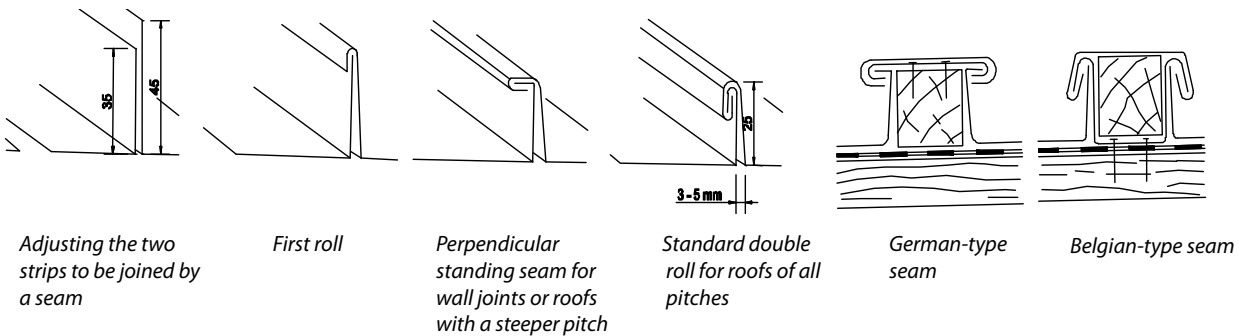
## Systems of longitudinal and traversal seams

Covering a roof with titanium zinc sheets is normally carried out by employing the standing seam; more rarely, the batten seam is employed. Strips with thickness of 0.70 mm and width of 400 - 700 mm are used. Approximately 75 mm of the strip width is used for the seam (45 mm + 35 mm); hence, in case of the most commonly used strip width of 670 mm, approximately 600 mm of roof is covered with each strip. Maximum length of a single strip is 10 meters. For longer surfaces, dilatation joint pads/gaskets should be integrated, or a special traversal seam technique should be employed.

### MACHINE MADE STANDING SEAM



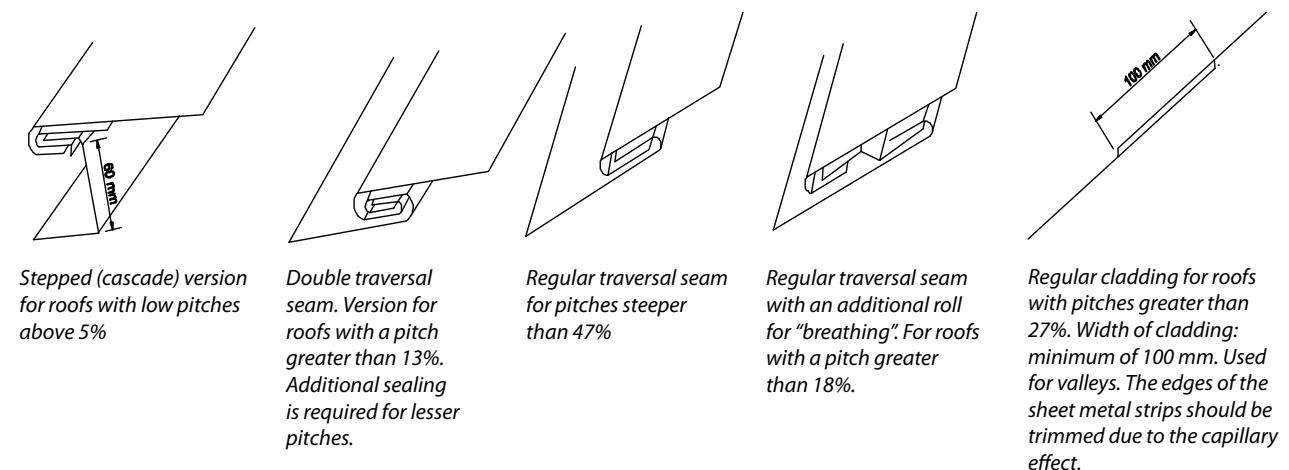
### STAGES OF MAKING A DOUBLE STANDING SEAM



**WARNING:** At temperatures lower than 12°C, the sheets have to be warmed to 35-40°C prior to rolling.

### TRAVERSAL SEAMS BETWEEN STRIPS ON A ROOF

The choice and fabrication of the traversal seam joining two strips depends on the roof pitch and the particular type of roof frame construction. Traversal seam should also "breathe" while being waterproof..





## Roof pitch and methods of fixing the roofing material (outer layer)

### ROOF PITCH

The pitch used in construction is between 0° (flat roof top) and 90° (wall or façade). Within this interval, roofs are classified into four categories:

1. *Roof pitch lesser than 3° (5%)*

This includes special roof shapes such as roof extensions, jutting roofs, trims, domes etc.

**Caution:** For flat or nearly flat roofs with a pitch of less than 3° (5%), use of titanium zinc sheets is not recommended, except for smaller areas (up to 15 sqm).

2. *Roof pitch from 3° (5%) to 7° (12%)*

This category includes various types of roofs with low pitch

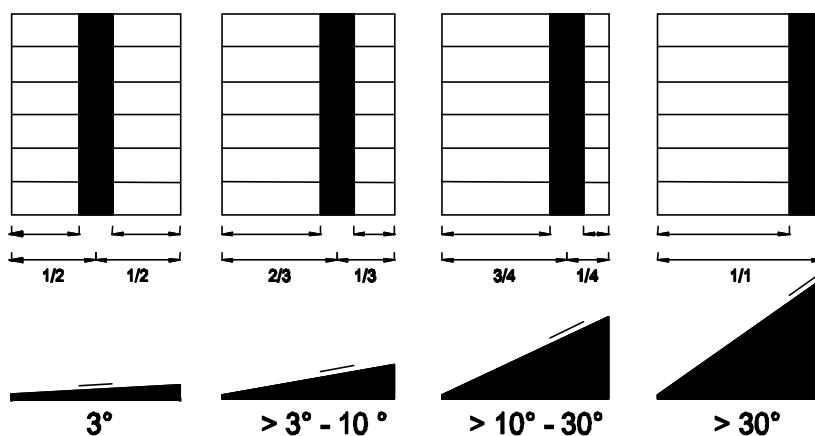
**Caution:** For roofs with a pitch lesser than 7° (12%), structured underlay (drainage, or sheathing wrap) should be installed as a separation layer (also recommended for steeper pitches). It should be made sure that the roof construction/sheathing is watertight.

3. *Roof pitch from 7° (12 %) to 20° (36%)*

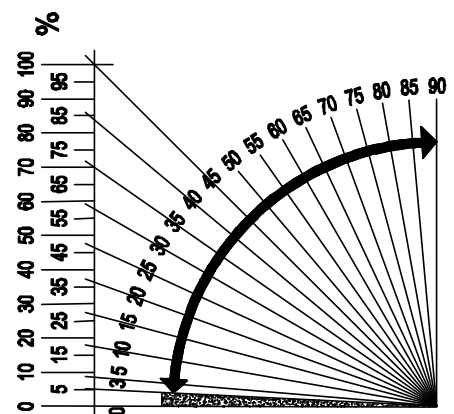
This category includes most roofs, including butterfly roofs or roofs with a valley (and a rain gutter at the bottom of the valley). With this pitch, use of structured underlay is also mandatory.

4. *Roof pitch more than 20° (36%)*

This category includes steeply pitched roofs and wall (façade) cladding with a pitch of 90°. For these, the same construction and physical laws apply as for conventional roof frame constructions.



Position of fixed anchors depending on the roof pitch



Graphic presentation of pitch unit conversion from degrees to percentage

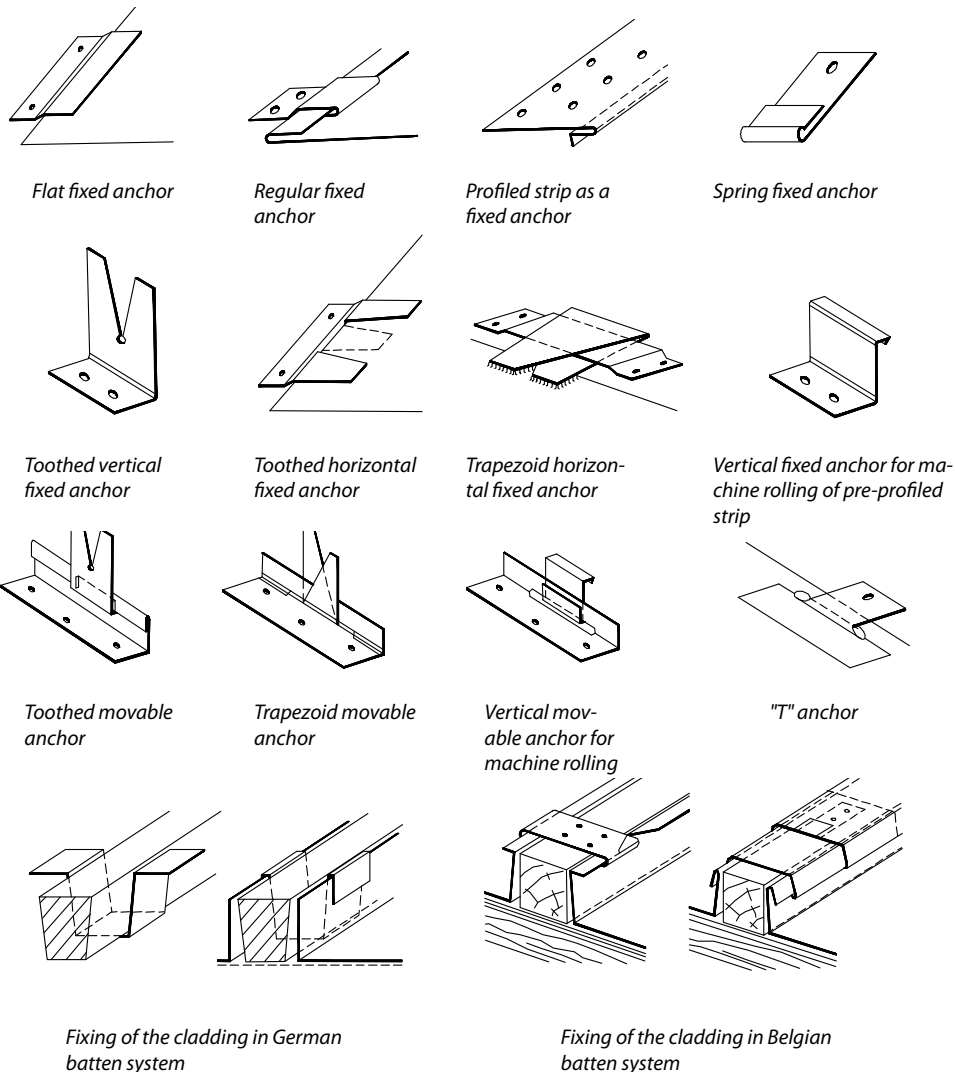


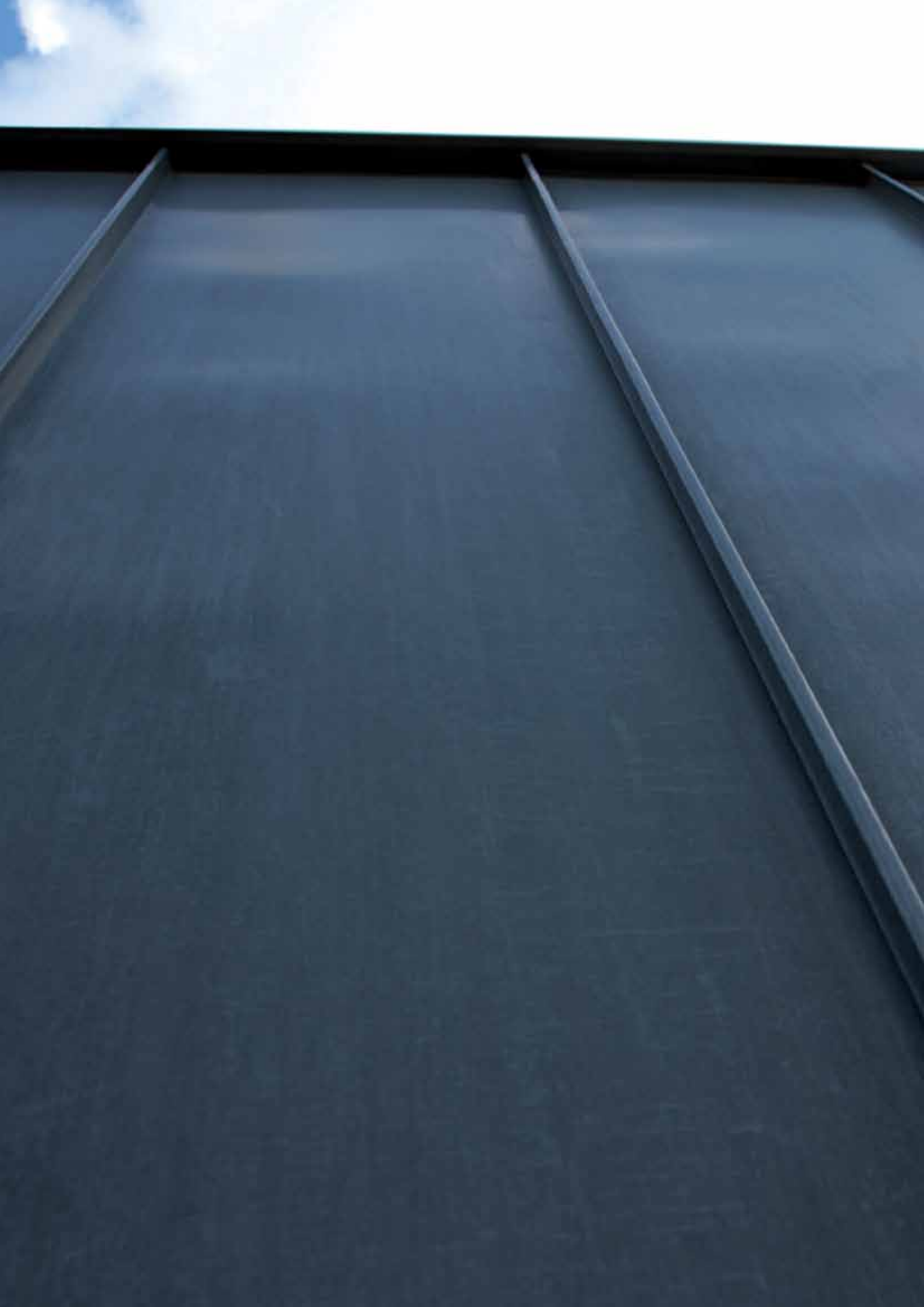
### FIXING (ANCHORING) THE CLADDING ONTO THE ROOF FRAME/SHEATHING

To anchor the titanium zinc sheets onto the wooden roof frame construction, **fixed** and **movable** anchors are used. Since the anchors are in direct contact with the cladding, the choice of anchors and fixing hardware (nails, screws) should be made very carefully, considering the contact compatibility of materials. The table below indicates the correct combination of material for anchors and fixing hardware. For movable anchors made of aluminium sheets, the thickness of the sheet used for the lower part of the anchor should be at least 1.00 mm.

Type of material for the anchors	Material thickness for the anchors	Fixing hardware	
		Spiral nails	Screws with flat countersunk (flat) head
Titanium zinc sheets Zinc-coated sheets	0.70 mm 0.60 mm	Zinc-coated nails 2.8 x 25 mm	Zinc-coated screws 4 x 25 mm
Stainless steel sheets Aluminium sheets	0.40 mm 0.80 mm	Stainless steel nails 2.8 x 25 mm	Stainless steel screws 4 x 25 mm
		Aluminium nails 2.8 x 25 mm	

### INDIRECT ATTACHMENT OF THE CLADDING ONTO THE ROOF FRAME (FIXED AND MOVABLE ANCHORS)





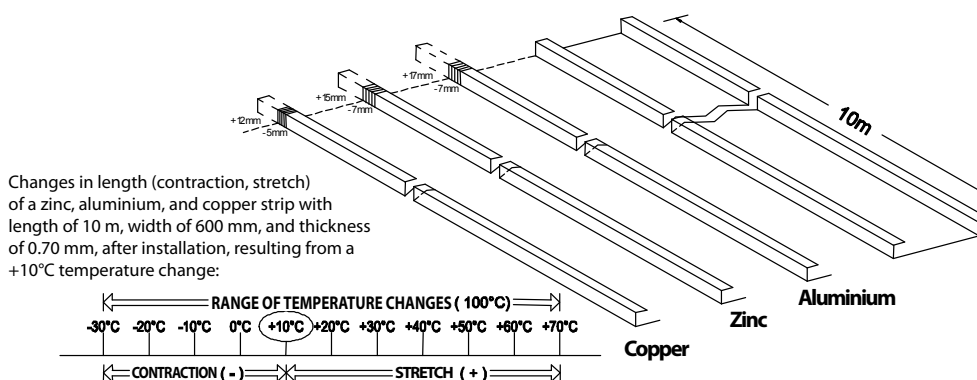




## Stretching of the titanium zinc sheets as a result of temperature changes

It is a commonly known property of any metal that they stretch (expand) and contract as the temperature changes. In our climate conditions (temperate climate), temperature changes in the span of 100°C can be expected (ranging from -30°C to +70°C). This physical property of metal should be seriously considered when constructing the roof, and when laying the titanium zinc cladding on the roof or on the façade, and when mounting the rain gutter and drain system. Otherwise, the roof cladding may be damaged to such extent that the roof may begin to leak (cracks in the material, loosening of soldering points).

Titanium zinc sheets have a temperature stretch coefficient of 0.022 mm/m °C, which means that on a 10 m strip, material can move by as much as 22 mm. If the issue of material "breathing" is not resolved and accounted for in an adequate manner, the material can be subjected to considerable tension (up to 5 tons) and as a result, the material may break.



In practice, regulations are in force regarding the movement of material (expansion gaps) used for roof cladding. Solutions are sought in correct selection and installation of fixed and movable anchors, appropriate traversal seams of strips, as well as levelling (compensation) joints at certain critical points.

The choice of standard compensation joints depends on the particular case at hand on the roof. Most frequently, the movable system of traversal strip joint overlapping is used. In addition, so-called neoprene compensation joint pads are practical and more and more in use. They consist of a metal part (titanium zinc sheets) to which a special type of rubber (neoprene) is glued (vulcanized). The joint pads are of different shapes and sizes, depending on the role and the point of installation.

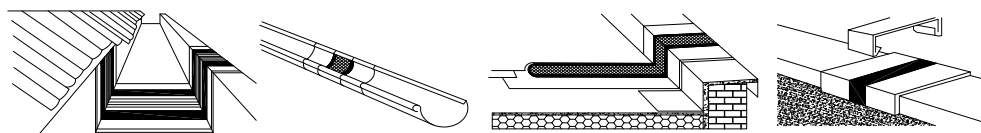


Table: Maximum distances without compensation joint pads for different types:

Length of element	Cladding element on the roof
6m	Glued lining/trimmings, corner joints
8m	Wall cladding, freely mounted roof valley rain gutters with cross section > 500 mm
10m	Freely mounted roof valley rain gutters with cross section > 500 mm
15m	Hung rain gutters with cross section < 500 mm

Table: Possible extension (movements) and internal tension for various materials at temperature-induced changes in the material

Material	SUMMER (+10 °C do +70° C)		WINTER (+10 °C do -30°C)	
	Stretch (elongation)	Tension	Contraction	Tension
Zinc	+ 15 mm	+5.1 tons	- 7 mm	-2.2 tons
Aluminium	+ 17 mm	+4.9 tons	- 7 mm	-2.1 tons
Copper	+ 12 mm	+6.3 tons	- 5 mm	-2.7 tons

# Roof drainage system

Roof drainage system comprises the following:

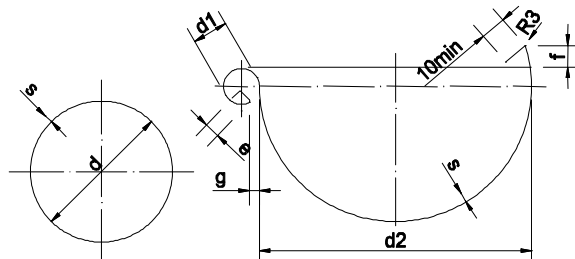
- rain gutters (hanging or integrated) and gutter attachments
- pipes (bent or welded), pipe connections
- hooks (brackets) and rings

Hanging gutters (hung on hooks) and drain pipes (attached with rings) are subject to standard DIN EN 912 (previously DIN 18461). The standard includes instructions for gutters (dimensions and shape of bends), pipes (dimensions and methods of metal joints), hooks (dimensions and material) and rings (dimensions and material).

Integrated gutters are considered a part of the roof; therefore, they shall be installed according to instructions for roofing with emphasis on border areas of the roofs.

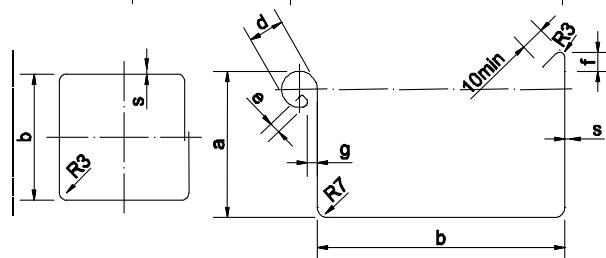
### ROUND GUTTER AND ROUND PIPE

GUTTER LABEL		PIPE LABEL		Round pipe dimensions				
Strip width (mm)	Sheet thickness (mm) S	Pipe diameter (mm) d	Sheet thickness (mm) S	d <sub>1</sub> mm	d <sub>2</sub> mm	e mm	f mm	g mm
250	0.65	80	0.65	18	105	7	10	5
280	0.70	80	0.65	18	127	7	11	6
333	0.70	100	0.65	20	153	9	11	6
400	0.70	120	0.70	22	192	9	11	6



### SQUARE GUTTER AND SQUARE PIPE

GUTTER LABEL		PIPE LABEL		Square pipe dimensions					
Strip width (mm)	Sheet thickness (mm) S	Cross section b x b (mm x mm)	Sheet thickness (mm) S	a mm	b mm	d mm	e mm	f mm	g mm
250	0.65	80 x 80	0.65	55	85	19	7	10	5
333	0.70	100 x 100	0.70	75	120	20	9	10	6
400	0.70	120 x 120	0.80	90	150	22	9	10	6



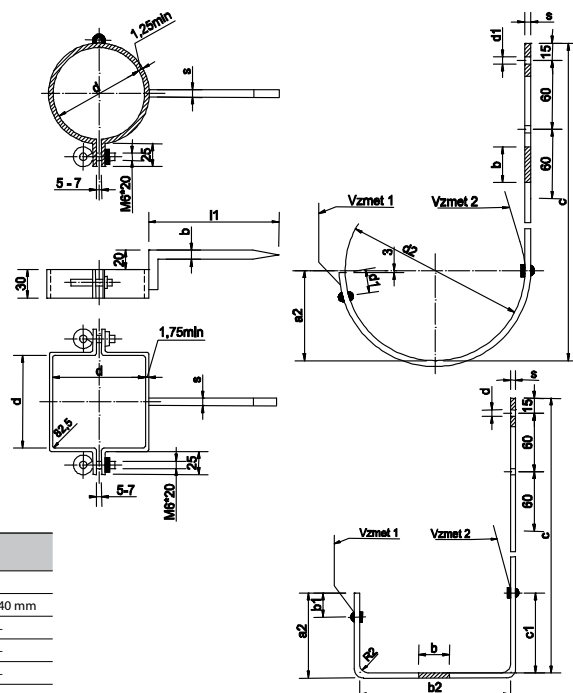
ROUND HOOKS/BRACKETS						ROUND RINGS			
Code / Symbol (type):	c mm	d <sub>1</sub> mm	d <sub>2</sub> mm	a <sub>1</sub> mm	a <sub>2</sub> mm	Code / Symbol (type):	d mm	e mm	b x s
250	280/330	6	105	18	50	80	80	140/200	10 x 6
280	280/350	6	127	20	61	80	80	140/200	10 x 6
333	300/370	6	153	20	74	100	100	140/200	10 x 6
400	340/430	6	142	20	93	120	120	140/200	10 x 6

Spring 1 (mm): 24 x 1.25 x 100      Spring 2 (mm): 20 x 1 x 80

SQUARE HOOKS/BRACKETS							SQUARE RINGS			
Code / Symbol (type):	c mm	d mm	b <sub>1</sub> mm	a <sub>1</sub> mm	a <sub>2</sub> mm	c <sub>1</sub> mm	Code / Symbol (type):	d mm	e mm	b x s
250	280/330	6	85	20	44	45	80	82	140	10 x 6
333	300/370	6	120	20	62	65	100	102	140	10 x 6
400	370/420	6	150	20	77	79	120	122	140	10 x 6

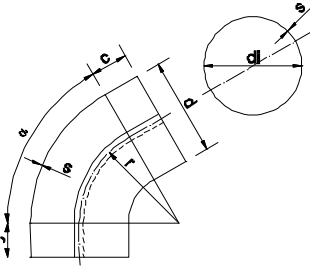
Table: Choice of dimensions of zinc-coated strips for hooks/brackets according to expected load of the gutters and distance between two adjacent hooks/brackets

Hook label	Normal load per gutter			Increased load per gutter (snowy regions)		
	Distance between adjacent hooks			Distance between adjacent hooks		
	700 x 40 mm	800 x 40 mm	900 x 40 mm	700 x 40 mm	800 x 40 mm	900 x 40 mm
250	25 x 4	30 x 4	25 x 6	25 x 6	-	-
280	30 x 4	30 x 5	25 x 6	25 x 6	25 x 6	-
333	30 x 5	25 x 6	40 x 5	30 x 6	20 x 6	-
400	30 x 5	40 x 5	25 x 8	30 x 6	30 x 6	-

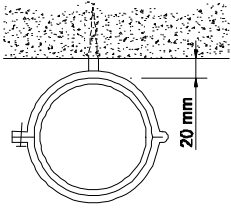
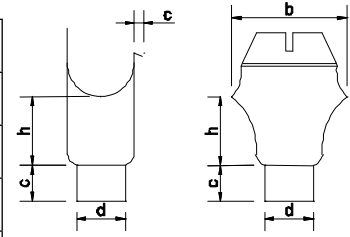




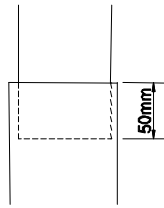
Diameter	d mm	80	100	120
Overlap	c mm	35	35	40
Sheet metal thickness	s mm	0.70	0.70	0.70
Elbow angle	α°	40°, 60°, 72°		
Solder seam radius	r mm	d x 1.75 d x 1.35		



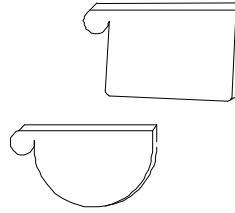
Attachment label	-	260 60	333 100	400 120
Insertion diameter	d mm	78	98	118
Connection width	b mm	min 165	min 185	min 210
Connection height	h mm	min 80	min 95	min 105
Insertion length	c mm	40	45	50



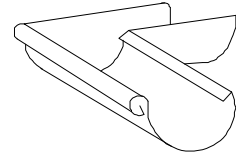
Distance between the pipe and the wall



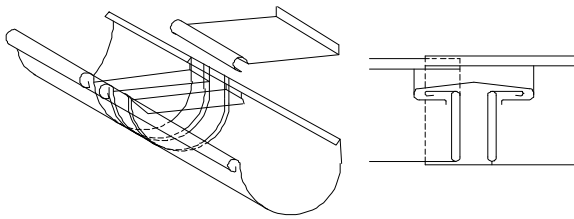
Pipe overlapping



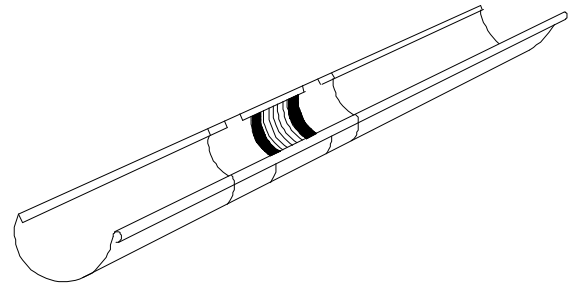
Gutter end piece



Gutter corner piece



Classic make of the dilatation/expansion joint pad on the gutter



Rubber (neoprene) dilatation/expansion joint pad

**GUTTER/DRAINAGE SYSTEM DIMENSIONS**

The following information is required to define the dimensions of the gutter system

- maximum precipitation in a certain period of time (V),
- roof area (S),
- roof pitch (> 15°),
- roof inclination (pitch) coefficient (ψ),
- water flow on the roof surface (Q).

Example: Defining the dimensions for the gutter/drainage system of the following roof:

Calculation:

$$V = 300 \text{ l/s. ha}$$

$$S = 12,5 \text{ m} \times 17,5 \text{ m} = 220 \text{ m}^2$$

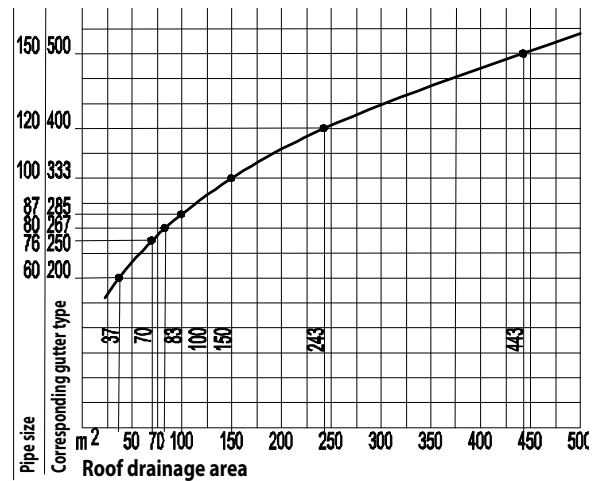
$$Q = \frac{V \times S \times \psi}{10000} \times 300 \times 1,0$$

$$\psi = 1,0 \text{ (for pitch } \geq 15^\circ)$$

$$\psi = 0,8 \text{ (for pitch } < 15^\circ)$$

$$Q = 6,6 \text{ l/s}$$

The result, found in a relevant manual or a schedule, will be that in such case, one pipe φ = 120 mm or two pipes φ = 100 mm should be used.

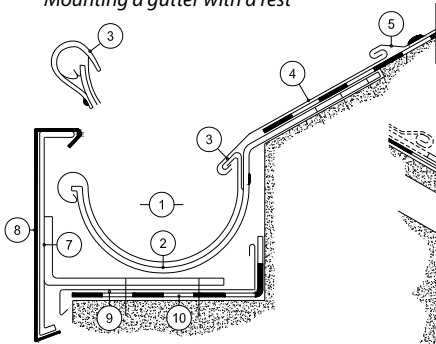


Graph of a simplified calculation of the dimensions of gutter/drainage system depending on the roof drainage area.

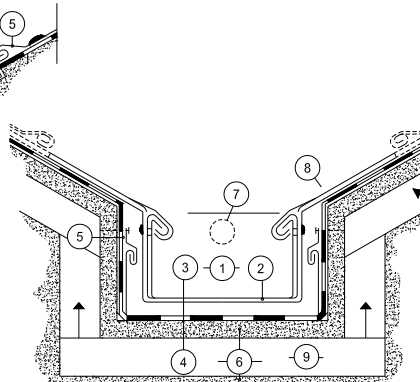


# Characteristic roof, gutter, and window cover strips/end caps

Mounting a gutter with a rest

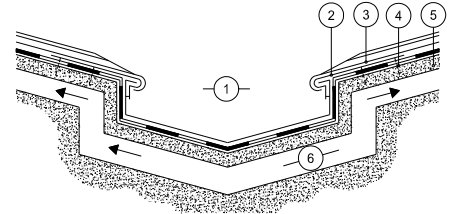


- 1. gutter
- 2. hook
- 3. anchor spring
- 4. cover batten
- 5. anchor
- 6. support construction/frame
- 7. parapet anchor
- 8. sheet parapet
- 9. support construction/ frame lining
- 10. separation layer



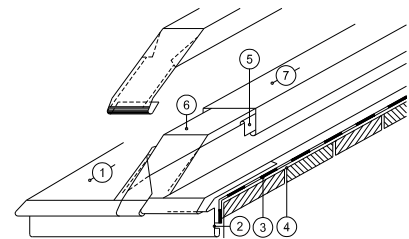
- 1. gutter
- 2. hook
- 3. protection gutter
- 4. separation layer
- 5. anchor
- 6. support construction/frame
- 7. overflow protection
- 8. gutter overlapping
- 9. ventilation

Mounting a roof valley rain gutter



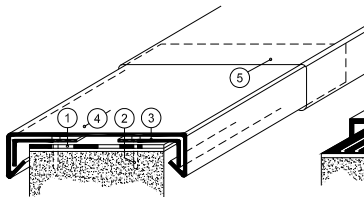
- 1. gutter
- 2. base batten
- 3. cladding with a double seam
- 4. separation layer
- 5. wooden base
- 6. ventilation

Batten cladding system  
Batten end detail



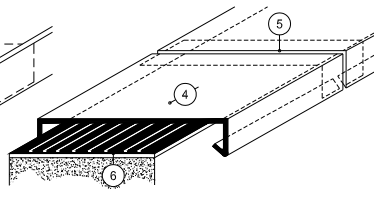
- 1. cladding with the batten system
- 2. end batten
- 3. separation layer
- 4. wooden base
- 5. anchor batten
- 6. wooden batten
- 7. cladding cap

Sheet wall cladding - affixed

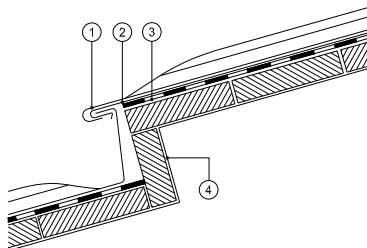


- 1. separation layer
- 2. fixing pin
- 3. base batten
- 4. cladding sheets
- 5. expansion/dilatation overlap
- 6. glue

Sheet wall cladding - glued

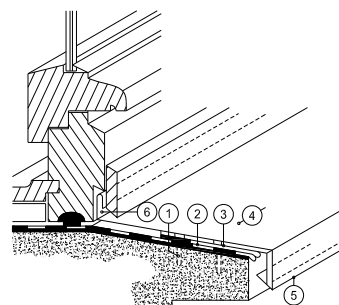


Double seam (cascade) cladding



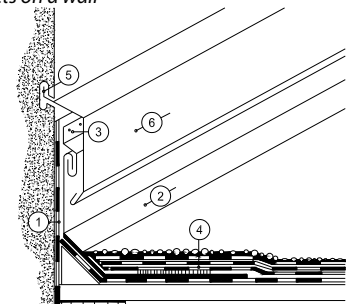
- 1. cladding with a double seam
- 2. end batten
- 3. separation layer
- 4. wooden base

Window sill installation

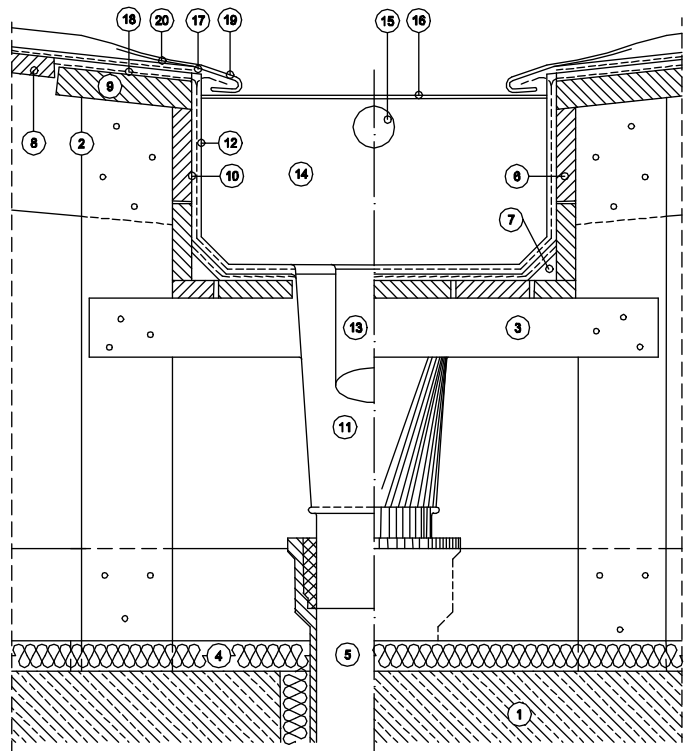
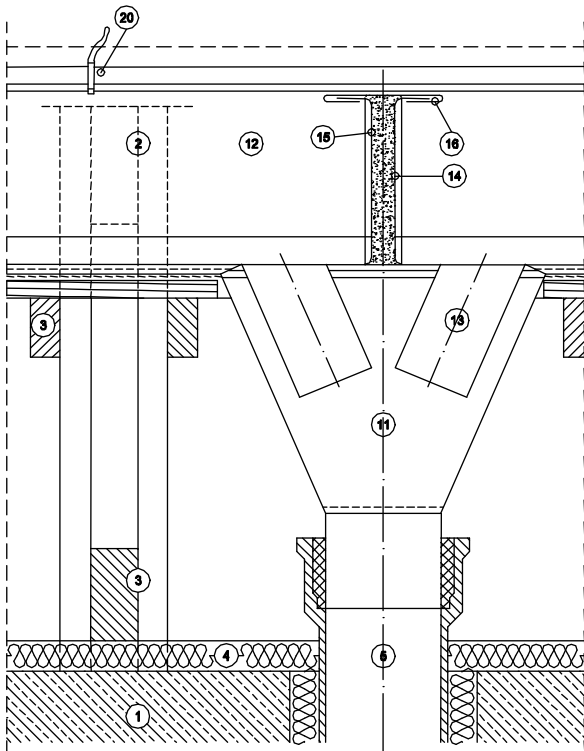


- 1. fixing pin
- 2. separation layer
- 3. base batten
- 4. sheet window sill
- 5. groove preventing water penetration
- 6. bend with water retention flap

Installation of final (end) cladding sheets on a wall



- 1. separation layer
- 2. sheet end piece
- 3. anchor
- 4. protection layer
- 5. wall groove
- 6. protection cladding



Internal gutter with a pipe and a flexible connection

1. Support concrete shelf
2. Wooden support construction/frame
3. Wooden support sheathing
4. Insulation layer
5. Pipe
6. and 7. Wooden gutter lining
8. and 9. Wooden roof sheathing
10. Protection layer (sheets, tar paper)
11. Gutter connection
12. Gutter
13. Pipe attachment
14. Gutter end piece
15. Overflow opening
16. Flexible connection cap
17. Bracket anchor
18. Separation layer (structured film)
19. Cladding end piece
20. Double standing seam cladding



## Façade systems

Façade defines the final appearance of a building. It expresses its appeal, importance, and interest, as well as the architect's sense of art and creativity.

It should be kept in mind that façade is one of the most delicate parts of a building. Any mistake or failure to meet expert standards can prove very costly. Therefore, correct approach to planning the façade is highly important.

1. Defining the façade system (plan) and static calculation
2. Choice of façade material (metal, colour)
3. Selecting the type of support frame/construction
4. Method of fastening the façade cladding

Defining the façade system is subject to architect's decision. In addition to aesthetics and functionality, the environmental load should also be considered (blizzards, snow, ice) and the choice of support frame should be made accordingly.

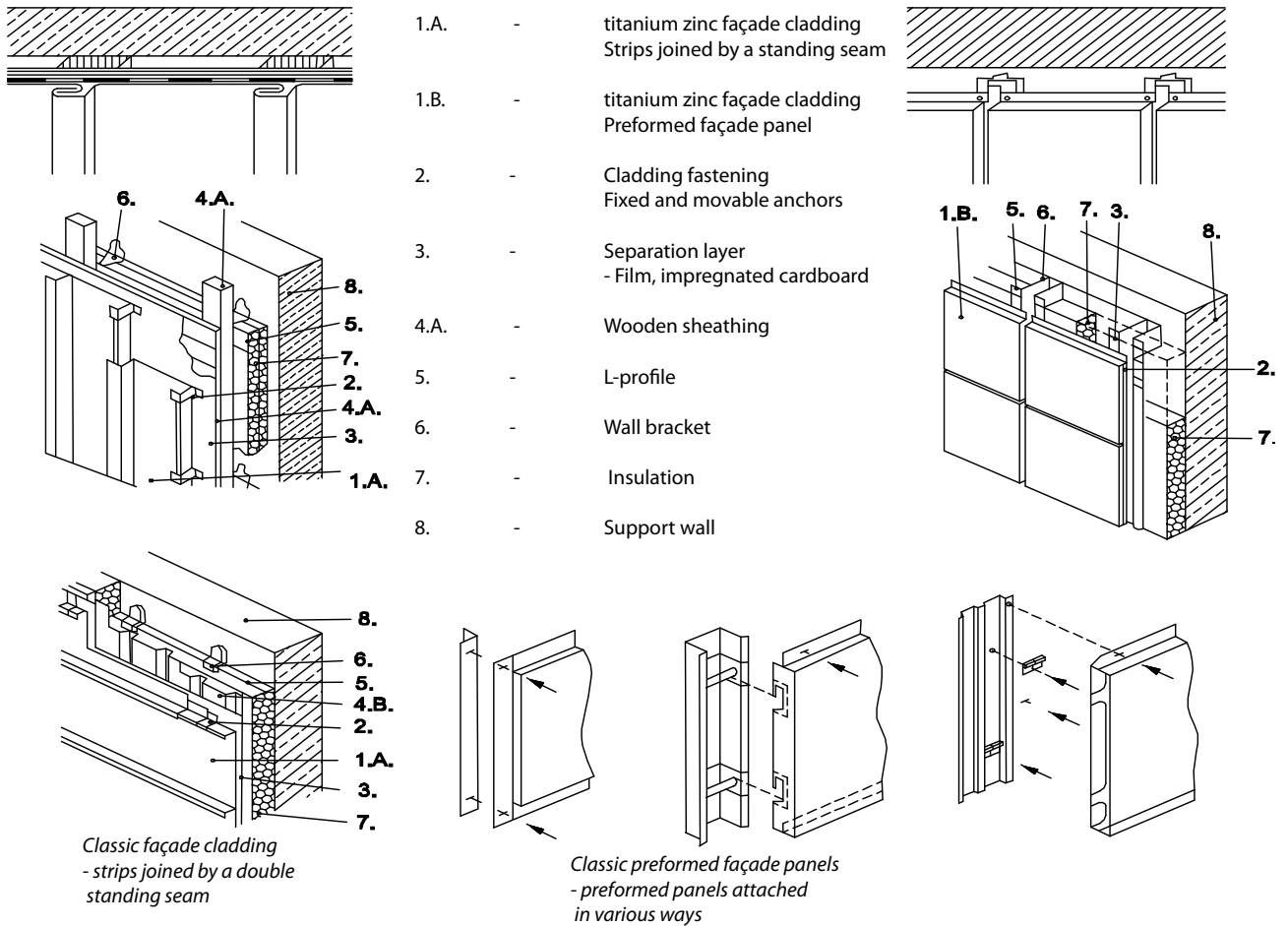
For the façade, the same construction and physical laws apply as for roofing. The following two types are most commonly used for metal façades:

- strip version façade with angled standing double seam;
- preformed panel façade.

For façades with angled standing double seam, pre-profiled strips are used with width of up to 700 mm and thickness of 0.70 mm - 1.00 mm. The strips should not be too long (3 m - 6 m). Longer strips (10 m - 15 m) should only be used exceptionally. Strips can be laid horizontally, vertically, or diagonally.

Preformed façade panels are prepared entirely at the workshop. They are made of sheet metal with thickness of up to 2 mm, in a format from 1:1 to 1:4 (width : length).





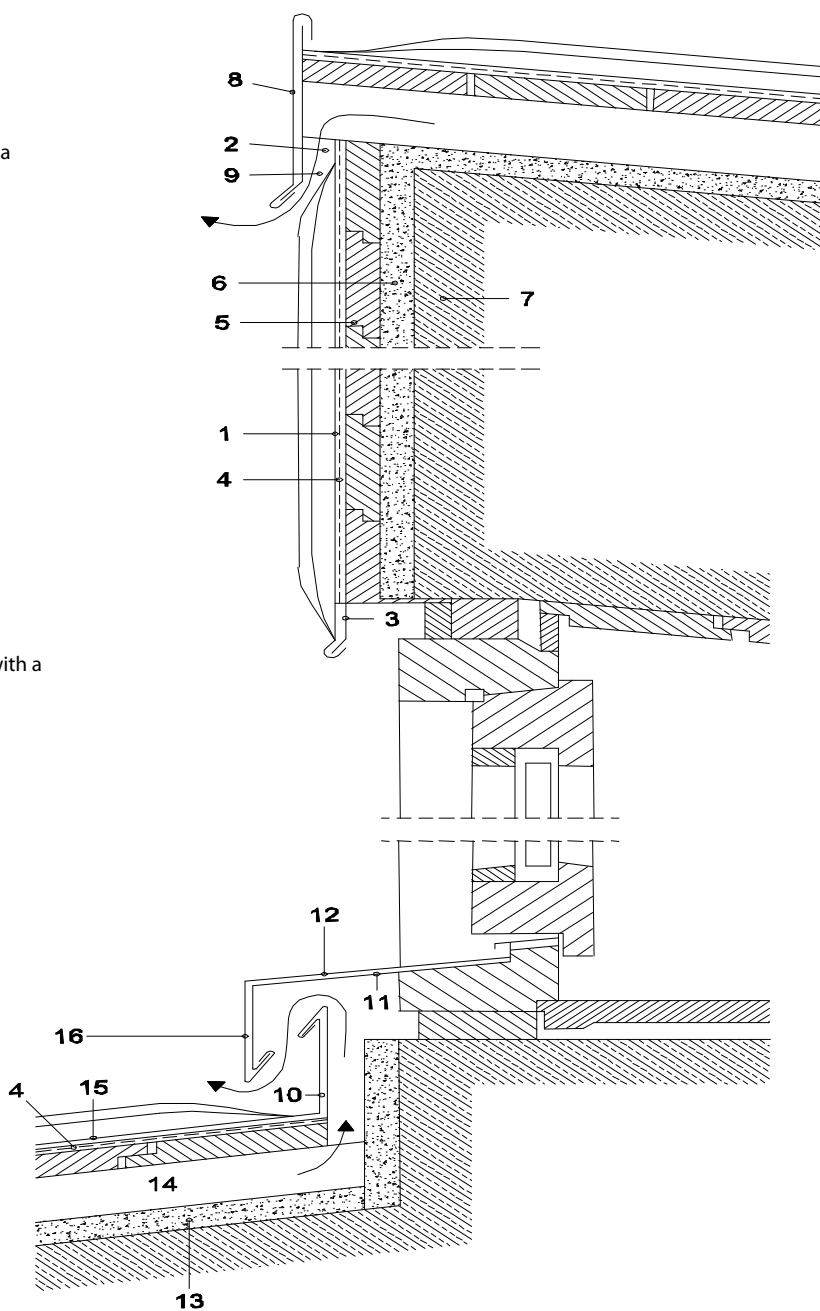
Material for façade cladding (strips, panels) should only be purchased from proven high-quality suppliers. Material surface should be flat (without internal corrugation) and free from any faults or imperfections.

Façade cladding can be self-supporting. Alternatively, a support frame is constructed first to provide lasting support for the façade.

Classic support frame version is a combination of profiled metal and impregnated wood. Newer approaches tend to avoid wood (fire safety, durability) in favour of a fully metal support frame (trapezoid profiled metal as a joining layer).

In affixing the façade cladding to a wall, the same rules and laws apply as for roofs with a steep pitch. The following must be provided: ventilation of the support frame (natural draught), expansion "breathing" of the cladding (fixed and movable anchors, flexible joints), prevention of contact corrosion (appropriate choice of material for anchors, nails, screws, rivets etc.).

1. Titanium zinc façade cladding  
Strips, width 1.00 mm, joined with a standing seam
2. Cladding fixing - top
3. Cladding fixing - bottom  
Fixed end anchor  
Fixed end bracket
4. Separation layer  
- Film, impregnated cardboard
5. Wooden sheathing  
Planks, width 25 mm
6. Insulation layer
7. Concrete support wall
8. Roof fascia
9. Ventilation opening - top
10. Roof base layer end
11. Interior base for window sill
12. Window sill
13. Insulation layer
14. Wooden sheathing
15. Titanium zinc roof cladding  
Strips, thickness 0.70 mm, joined with a standing double seam
16. Ventilation opening



Example of a combined building outer layer (covering)  
(roof - façade - window opening)

## Occurrence and prevention of contact corrosion on titanium zinc sheets

One of the key properties of titanium zinc sheets is the ability to self-protect from aggressive media affecting the surface of the sheets. In the presence of oxygen, carbon dioxide, and atmospheric humidity, a thick and non water soluble film (patina) will gradually form on the surface of the material, which provides exceptional corrosion resistance of the sheets in the atmosphere.

However, failure to consistently observe the rules of the installation of sheets in practice may lead to situations that will allow deterioration of the sheets due to corrosion. The main cause of such deterioration is accumulation of water or moisture between the sheets and the base, which prevents the occurrence of the self-protection chemical process, i.e. the forming of patina. Hence, instead of patina, zinc hydroxide is formed, which cases the material to decompose.

Particular attention should be paid to the following chemical processes which may lead to corrosion of the cladding:

### **CORROSION DUE TO WARM WATER**

Corrosion due to water trapped between the sheets and the base (in most cases tar paper) is a result of atmospheric heating of the sheets, and, indirectly, heating of the water present below the sheets, to a temperature of 40°C. Presence of water under the sheets is a result of poor seal on the junctions or seams, particularly in case of lower pitches, or condensed moisture from the building interior. Tar paper that does not allow draining or drying of the water may also provide a base for such process. In this case, a chemical reaction occurs between the warm water and the sheets, resulting in zinc hydroxide. Corrosion can be so intense that it causes a "hole" in the cladding, and in the extreme case, complete disappearance of the cladding.

Such corrosion can only be prevented by installing a ventilation and draining base between the sheets and the wooden sheathing.

### **ELECTROCHEMICAL CORROSION**

Metals can develop different mutual electrochemical potential (galvanic/voltaic cell). In the presence of moisture (a conductor), this may lead to deterioration of one of the present materials.

The contact of the installed titanium zinc cladding (base material) with copper, unprotected iron, or other contact metals in a humid or wet environment or medium (steam, condensate, drained rainwater) will lead to rapid deterioration of the titanium zinc sheets. This is referred to as contact corrosion.

The table below lists the permitted (+) and non-permitted (–) contacts between different base metals with fixing hardware for roofing, façade, or drain system.



contact metal base metal	Zinc	Zinc-coated material	Aluminium	Copper	Lead	Stainless steel	Construction grade iron
Zinc	+	+	+	2)	+	1)	1)
Zinc-coated material	+	+	+	2)	1)	1)	1)
Aluminium	+	+	+	-	-	-	+
Copper	+	+	+	+	+	+	+
Lead	+	+	+	+	+	+	+
Stainless steel	+	+	+	+	+	+	+
Construction grade iron	+	+	+	3)	3)	+	+

- 1) In case of sufficient surfaces of base material and use of anchors and screws as contact metal. Critical in case of smaller surfaces of base material
- 2) Generally critical, but possible in case of smaller area of base material
- 3) Critical in case of smaller areas of base material, otherwise allowed

## BITUMEN CORROSION

Bitumen lining (hydro insulation, gluing) underneath titanium zinc sheets is subject to deterioration resulting from the effect of UV rays, temperature fluctuations, and aggressive environment. In the process of ageing (deterioration), acids are released which may cause corrosion of the titanium zinc sheets. Corrosion normally develops slowly, unless humidity is also present. In order to avoid this effect, use of appropriate bitumen-based glues (Enkolit) is recommended, which blocks the ageing effects and provides good adhesion properties.

## CORROSION EFFECT OF MORTAR AND CONCRETE

Mortar and concrete contain aggressive, basic/alkaline components which, in the presence of humidity, cause corrosion of the titanium zinc sheets. Thoroughly dried mortar and concrete will have virtually no effect on the sheets.

## CORROSION EFFECT OF SULPHUR DIOXIDE (SO<sub>2</sub>)

In areas with high industrial pollution, increased concentration of sulphur dioxide (SO<sub>2</sub>) may be present (chimneys). In the presence of moisture, aggressive acids (acid rain) will occur, which can cause corrosion of the titanium zinc sheets. Care for the environment, emphasizing the reduction of SO<sub>2</sub> emissions in recent years has virtually eliminated this problem.

## Titanium zinc sheet soldering

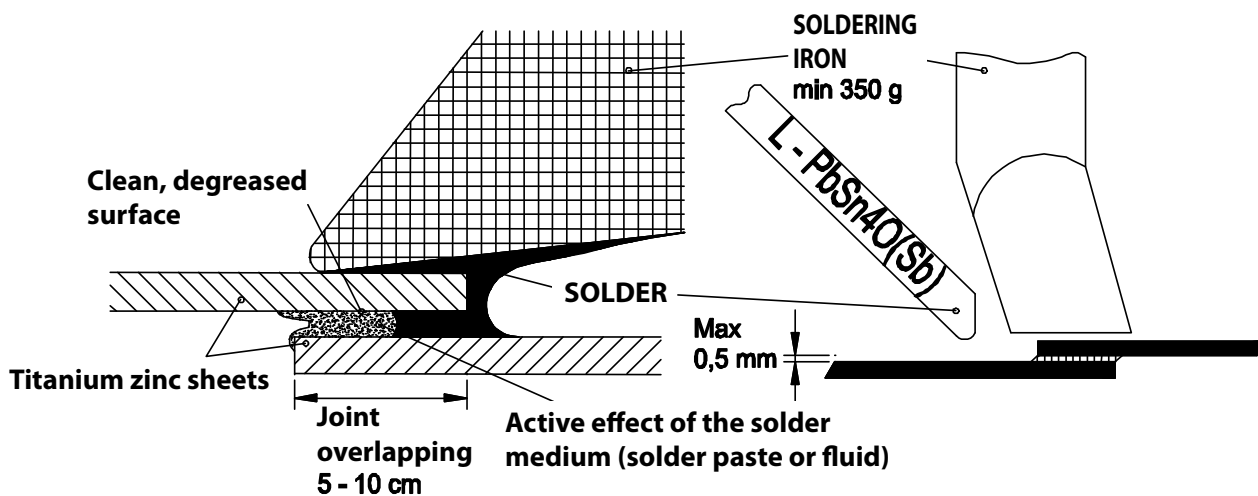
Simple soldering is one of the key advantages of the titanium zinc sheets compared to cladding made of other metals.

The following soldering alloy is recommended: lead (Pb 60%), tin (Sn 40%), with addition of antimony (Sb). The code for soldering alloy in the standards is LPbSn (Sb).

The alloy has a melting interval from 183 to 235°C. The thickness of soldering alloy application should not exceed 0.5 mm. Overlapping of soldered surfaces should be from 5 mm (for vertical roofs) to 10 mm (for flat roofs). The choice of soldering iron depends on the heat capacity (weight of the soldering head) and the contact surface (soldering head tip). The weight of the soldering iron is between 350 g and 500 g. The wider the contact area, the more even and aesthetic the soldering joint.

Soldering is carried out using a special soldering fluid or solder paste applied with a paintbrush onto a clean non-oxidized joint area. Excessively oxidized surface should first be cleaned with a scraper until a metal sheen is seen. For thicker joints, soldering of both contact areas is recommended.

### Drawing of a soldered joint







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