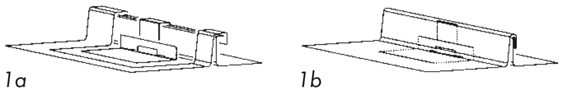
III. INTRODUCTION

III. 1 DOUBLE STANDING SEAM SYSTEM

RHEINZINK®



1a 1b

Fig. 1a to 1b: Forming a double standing seam by using roll formers – manufacturing process

III. Introduction

The following sections, which deal with covering systems, follow a standard format for ease of reference and comparison. In each case, the historical overview is followed by the specific characteristics of each system in the same order. To avoid duplication, cross-references are provided within the system descriptions, particularly within those pertaining to the Double Standing Seam and the Angled Standing Seam Systems.

For many details, especially those concerning the double standing seam system, geometric data is given in relation to the weather stress categories covered in more detail in Part II. 2.2.

Architectural examples of a variety of details are illustrated, to demonstrate the impact of a design effect when viewed from a distance. This means that the photographs must be taken from a distance at which individual details are no longer discernible.

In light of the vast range of potential applications, none of the sections claim to be exhaustive. Our Applications Engineering Department, whose extensive experience is available internationally, will gladly answer any further questions you may have.

III. 1.1 History of the System

Literature research shows that the double standing seam has been around since 1899, and can be regarded as a further development of the original batten seam or single standing seam.

For metal roofs at a pitch below 25°, this system is the clear favourite in most countries, particularly however in Scandinavia and in German-speaking countries, where it is sometimes used in combination with the batten system. The angled standing seam is also used for roof surfaces with a pitch steeper than 25° (see Part III. 2.1).

The widespread use of the double standing seam is down to the vast availability of the installation equipment, making it very efficient to install and turning it into the most economical seam system.

In terms of design, the double standing seam, in comparison to all other seam systems, is characterised by its sharply defined lines by its numerous detail variations.

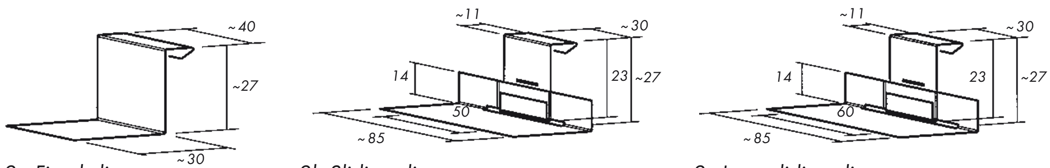
III. 1.2 Description of the System

The name "double standing seam" describes a type of lengthwise connection between adjacent sections above the water level. Double standing seams should be at least 23 mm high. This connection is rainproof without applying any additional measures, although it will not stop water from backing up.

The section edges can be formed using roll formers or by hand, while the seams can either be closed with a seaming machine or manually (see Part I. 3.6). Fig. 1 shows how the seams are formed.

Seam Height
Internationally, the 25 mm high double standing seam, formed with prefabricated sections, has become the norm. The machine-formed set for the profile shown in Fig. 1a and 1b is available internationally and is one of the most important advantages this system has to offer, particularly with regard to economical installation. This applies not only to simple roofs, but also to special roof designs such as convex and concave surfaces and conical sections, including all the fasteners the system requires. Additionally notching tools are available as standard to installers, which not only encourage the trend towards greater prefabrication in the shop, but also considerably improve the finished appearance.

In areas with heavy snowfall, considerably higher seams are used, which in the event of ice dam formations (refer to POHL "Belüftete Dächer mit Metalldeckung", RHEINZINK architecture series, Vol. 1) make it a lot more difficult for backed-up water to penetrate the construction through the seam. However, this can also be prevented by sealing the seams and implementing a sub-roof.



2a Fixed clip *2b Sliding clip* *2c Long sliding clip*

Fig. 2a to 2c: RHEINZINK clips for machine installation.

Machines for making higher seams are less practical and are steadily becoming more difficult to obtain.

Increasing the seam height in the area of rabbeted penetrations is not practical since the required folding can lead to backed-up water being absorbed by capillary action. Measures to seal the seams are also recommended in such cases.

Sealing Seams
This method can be implemented on the roof surface if the roof pitch is ≥ 3° and on details to provide an additional seal for the standing seam (see Fig. 3 and Part II. 4). In Sweden, sealed seams are installed as standard on double standing seams, regardless of the roof pitch.

Suitable sealing strips, such as RHEINZINK sealing strips for standing seam covers, are applied to the overcloak after the clips have been fastened (see Fig. 3). For mechanical reasons, it is recommended in such cases that the open seam is pressed against the angled standing seam at least every 50 cm using suitable pliers. The Piccolo or Flitzer seaming machine produced by Schlebach in Friedewald, Germany, has been used successfully in such applications. For the above-mentioned roof pitches, sealing strips are also placed in to the seam in areas containing roof penetrations to ensure the tightness of the horizontal seams in the water level.

The sealing strips are suitable for this application if a continuous heat stability of up to 90 °C is maintained, the sealing characteristics remain even when under continuous pressure, and a (non-destructive) compression can be achieved, which does not prevent the use of seaming machines.

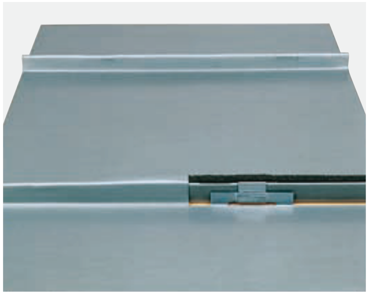


Fig. 3: Installation of a sealing strip to the undercloak that has been fastened with clips.

In Sweden, seam seals are produced with seam oil. Since seam oil contamination of metal surfaces leads to delayed patination, clean application is vital. Machines are now available that apply precise amounts of the seal to the underside of the overcloak. Application of the seal in that area is recommended to ensure easy handling and the subsequent use of seaming machines. If the external top surface becomes too oily, this will restrict or even prevent the use of seaming machines altogether.

Roof Pitch
The smallest roof pitch for double standing seams is ≥ 3°. For this roof pitch, seam sealing measures, structured underlays or sub-roofs (see Part II. 4.1) should be used. The above-mentioned statement, that double standing seams are rainproof but will not stop water from backing up, particularly applies to turned-over seams as well as notched pinched seams, etc. that are used on ridge connections, hips and the skilful embedment of roof penetrations.

Additional problems can arise from structural considerations caused by major deviations from a planned roof pitch. This includes customary building tolerances as well as the deflection of the construction due to loads.

The frequent failure to account for thermal linear deformation (in this case shortening) and other errors made in the eaves area often leads to the formation of "bowls", and sometimes even to a counter pitch which restricts or prevents water from running off.

In regions where there are extreme snow conditions, additional sealing strips are installed if the roof pitch is ≥ 3° (see Fig. 3 and Part II. 4). Frequently, these sealing strips are installed into the seams, starting at the eaves and going ≥ 2 m into the building geometry (or even further, depending on the roof pitch).

Roof constructions and underlays recommended for double standing seam covers are described in Part II. 1.3.6 and II. 4.3.

Fastening
The aim of fastening is to prevent slipping and resist wind suction loads. The mechanical peak load is determined by the wind suction forces (see Part II. 3.1.1), which pass into substructure through the roof surface, double standing seams and clips. Section width and metal thickness play a major role in this regard (see Table 1).

Fastening is always indirect: clips are attached in the seam area, or continuous cleats in the edges at section ends (although in some cases individual fasteners are used there as well). Three kinds of fasteners are used: fixed clips, sliding clips and long sliding clips (see Fig. 2a to 2c). Special clips are also available for manual installations.

The number of clips used per m² (refer to Table 1 and 2) is dependent on the wind suction load, the type of fastener used and the substructure, although this should not fall below the specified minimum. To determine the precise wind load for the project, please consult the architect, planner or structural engineer.

Extensive tests have been conducted by the Central Sanitary, Heating and Air Conditioning Association (ZVSHK) in conjunction with RHEINZINK to complete a static analysis of each clip system selected.

Tables 1 and 2 apply to RHEINZINK clips with a minimum tensile value of 300 N/clip, including the fastener. The relevant safety correction value is 1.5. The static requirements of the system's clips and fasteners are in accordance with DIN 1055, Part 4. Previous specifications of 500 N/clip had to be amended in accordance with European standards that specify a safety correction value of 1.5 must be maintained. RHEINZINK clips are manufactured with a metal thickness of 0.8 mm on the lower part and 0.7 mm on the upper part of the clip. The overall dimensions are in accordance with Fig. 2a to 2c. Even when fasteners with a significantly higher rating are chosen, this does not affect the required clip intervals, which predominantly depend on the strength of the seams and the material chosen for the clip itself and thus on the technological material properties of RHEINZINK. However, if fasteners with an extraction value of below 300 N/clip are used (refer to Table in Part II. 3.4.1) then a correspondingly increased number of clips must be used.

For applications in areas where wind loads are very high, clip rails are used for structural reasons. These clip rails are made manually and are faster to install compared to, say, using 13 clips (corner ≥ 20 m to ≤ 100 m). The definition of normal areas, corners and edges can be found in Part II. 3.1.1.

Coil width/mm	500	570	600	670	700	800
Section width/mm*	420	490	520	590	620	720
Section width/mm**	430	500	530	600	630	730
Metal thickn./mm	0.7	0.7	0.7	0.7	0.7	0.8
Wind loads in kN/m²						
- 0.3	4/500	4/500	4/500	4/500	4/500	4/400
- 0.6	4/500	4/500	4/500	4/500	4/400	4/400
- 0.9	4/500	4/500	4/500	4/500	4/400	4/400
- 1.2	4/500	4/500	4/500	4/500	4/400	4/400
- 1.5	6/350	6/350	6/350	6/300	6/250	6/250
- 1.8	7/300	7/300	7/300	7/300	7/250	7/250
- 2.1	8/250	8/250	8/250	9/250	9/200	9/200
- 2.4	8/250	8/250	8/250	9/250	9/200	
- 2.7	10/200	10/200	10/200	10/200	10/150	
- 3.0	11/200	11/200	11/200	11/150		
- 3.3	11/200	11/200	11/200	11/150		
- 3.6	13/150	13/150	13/150	13/150		
- 3.9	13/150	13/150	13/150			
- 4.2	15/150	15/100	15/100			
- 4.5	15/150	15/100	15/100			
- 4.8	17/100	17/100	17/100			
- 5.1	17/100	17/100	17/100			

Notes: The table can be adapted to all fasteners, provided that they ensure an extraction value of at least 300 N per clip (see Part II. 3.4.1). The dimension of the clip and the distance between the clips is based on an average section width of approx. 3 m.
* *Approx. section width when manufactured manually*
** *Approx. section width when manufactured by machine*

Table 1: Minimum number of RHEINZINK clips (per m²)/max. distance between clips (mm) dependent on the wind loads.

Sample calculation for fasteners < 300 N/clip:

$$\frac{\text{Wind suction load (N/m}^2\text{)}}{\text{Extraction rate (N/clip)}} = \text{Number of clips/m}^2$$

The calculated number of clips should be rounded up to the next full clip.

Sample calculation to determine the clip interval:

$$\frac{\text{1/section width (m)}}{\text{Determined number of clips (N/m}^2\text{)}} = \text{Distance between clips (m)}$$

The portion with the fixed fasteners prevents the sections from slipping. Sometimes it is desirable to increase its overall length, to reduce the area of movement. Positioning of the fixed fasteners depends more on the pitch of the roof (Fig. 5 and 7) than on the section length. Depending on the section length, the portion with the fixed fasteners can be between 1 m and 3 m long, but should be no more than a quarter of the section length (in France: ≤ 10 m and up to a third of section length). Directly fastened sections should not exceed 3 m in length, while on facade claddings they should not exceed approx. 1 m.

Notes pertaining to Monopitch Roofs
Based on practical experience, we recommend that the section width does not exceed 430 mm for monopitch roofs with a roof overhang. This measure will prevent noises, which occur when the sections bend naturally (max. 20 mm) during high winds. For free-standing buildings, a metal thickness of 0.8 mm should also be used.

Section Widths and Material Thickness
In sheet metal work, the terms coil width, section width and bay width are used in parallel (see Fig. 6). The coil width represents the width of the flat RHEINZINK coil before it is profiled into a section. Section width denotes the supported (net) width of the profiled section, i.e. without the lateral seams. If the profile is formed by machine, it is approx. 70 mm narrower than the coil width; if a profile is finished manually, it is approx. 80 mm narrower. On the other hand, the bay width also takes into account the expansion distance between section widths, which can vary by 3 mm to 5 mm at the construction site.

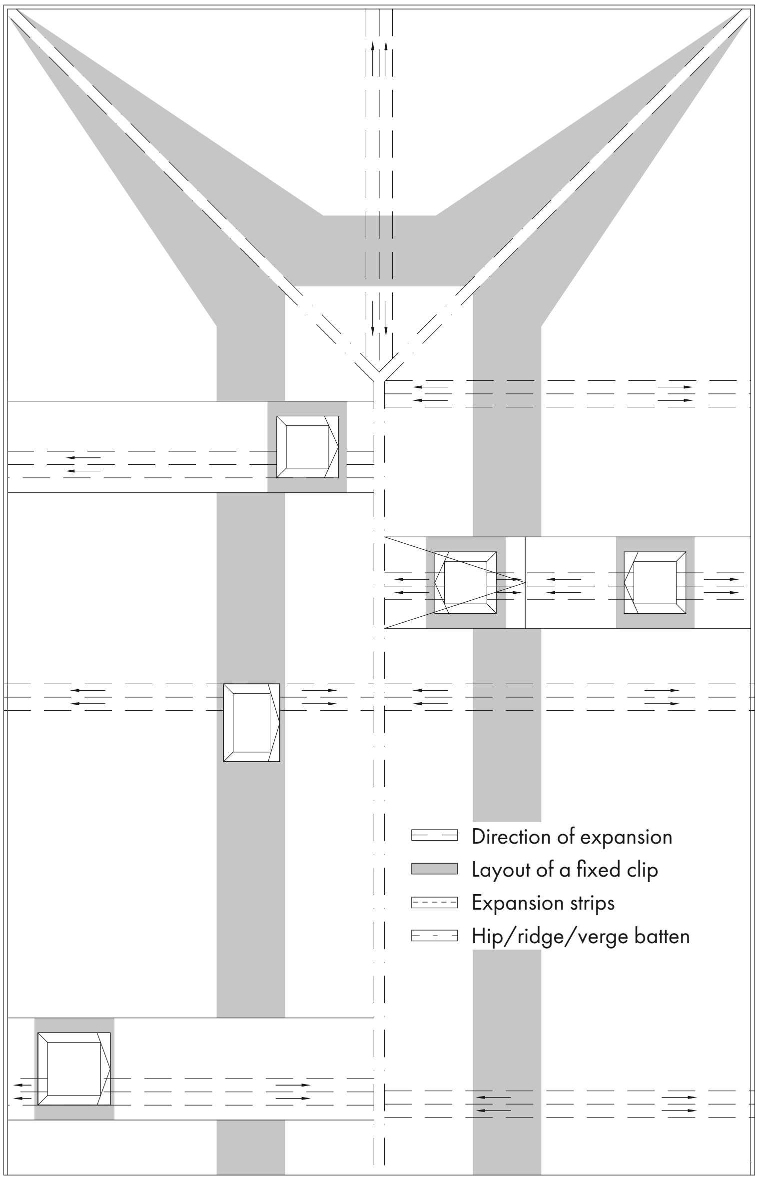


Fig. 5: Fixed clip area for a hip roof with a 9° pitch, section width of 16 m, with expansion strips and roof penetrations (example). For roof penetrations of ≥ 3.0 m, expansion strips should be installed on the sides and in the middle of the penetration, so that lateral and linear expansion at the assemblage points of the seam can be better accommodated.

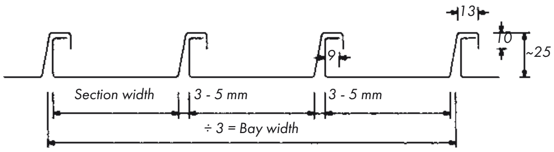


Fig. 6: Interrelationship between coil width, section width and bay width.

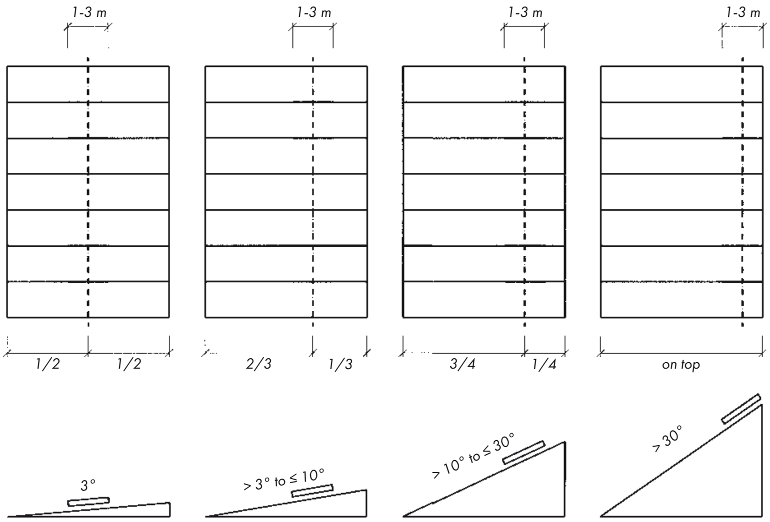


Fig. 7: Schematic overview of the position of the fixed clips in relation to the roof pitch.

Double and Angled Standing Seam
(seam loss approx. 70 mm, PROFIMAT SPM 30/80)

Section width	Strip width	Approximate addition	Approximate weight at 0.70 mm	Approximate weight at 0.80 mm
400 mm	470 mm	17.5%	5.9 kg/m²	6.8 kg/m²
430 mm	500 mm	16.0%	5.9 kg/m²	6.7 kg/m²
500 mm	570 mm	14.0%	5.7 kg/m²	6.5 kg/m²
530 mm	600 mm	13.0%	5.7 kg/m²	6.5 kg/m²
600 mm	670 mm	12.0%	5.6 kg/m²	6.4 kg/m²
630 mm	700 mm	11.0%	5.6 kg/m²	6.4 kg/m²
730 mm	800 mm	9.5%	5.5 kg/m²	6.3 kg/m²

Table 3: Seam loss and surface weights for seam systems.

The international standard dimension for roofs with Double Standing Seam Systems is a section width of 530 mm (coil width 600 mm) with a metal thickness of 0.70 mm. This can also be used for certain high-rise buildings.

The surface weights that can be expected, in relation to section width and metal thickness, are illustrated in Table 3).

Section Lengths

The generally accepted maximum section length is 10 m. Over time, this dimension has proven successful due to its ease of processing. It has been used in detailed drawings as the basis for expansion distances, which must be taken into account.

If this section length calculation is inadequate, details for the lateral connection of individual sections are available (see Part III. 1.1.3).

In special cases, sections of up to 16 m in length can be installed. However, due to their increased linear deformation they must be fastened with long sliding clips that are available from RHEINZINK. In addition, the connection details must be adapted to the changed requirements in accordance with the direction of the sections (i.e. lengthening the nose on eaves flashings to 4 cm).

The use of extra long sections (> 10 m) can sometimes be economically advantageous in the case of roofs without penetrations. However, there is an increased risk caused by the material tension, which may result in aesthetic defects. Both are often unavoidable in view of the practical situation on site, where wind or unfavourable transportation conditions can make it very difficult to move and handle extra long sections without damaging them.

If, in the case of extra-long sections, penetrations are required (ventilation pipes, chimneys, roof exits, etc.), particular attention must be paid to the increased linear deformation e.g. by inserting wooden strips (see Fig. 5). This can sometimes lead to higher construction costs.