MUNCHOLM

FALZONAL®
Pre-Painted Aluminium in Lock-Welt Quality
Construction Examples - Planning and Application

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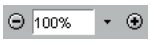

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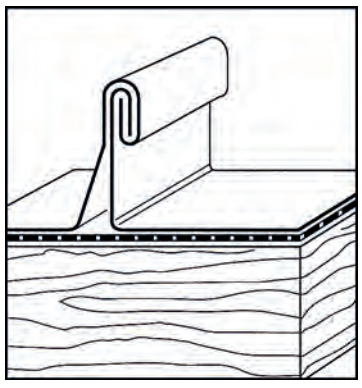
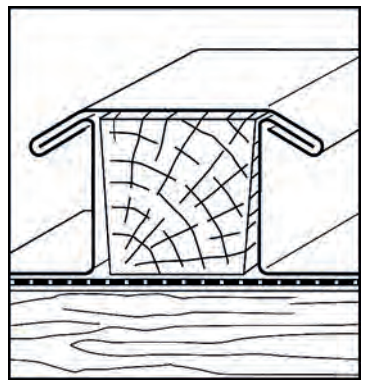
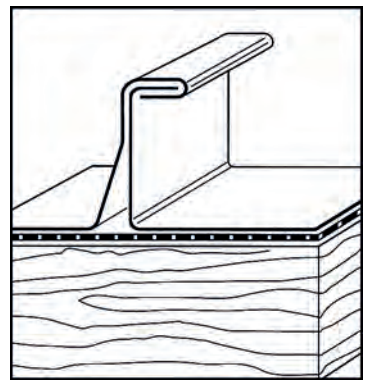
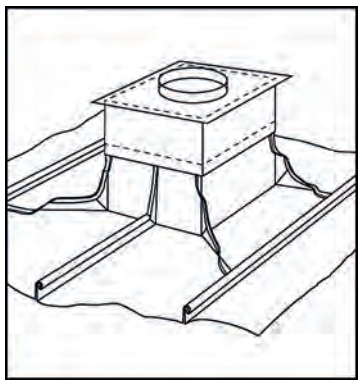
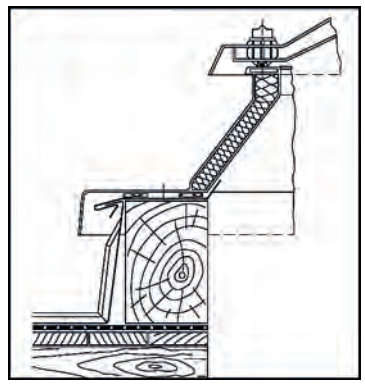
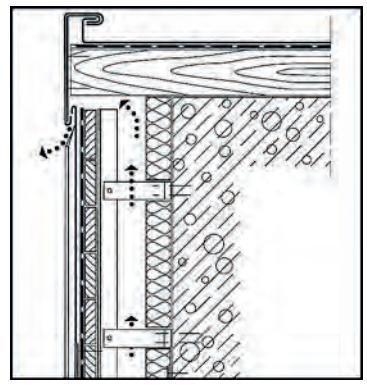
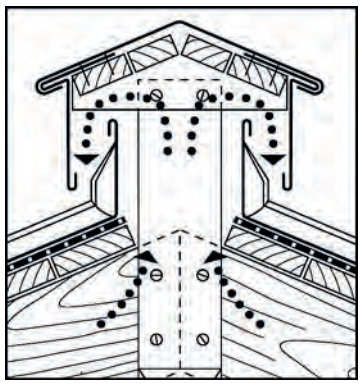
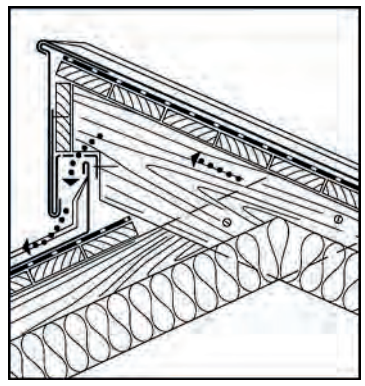
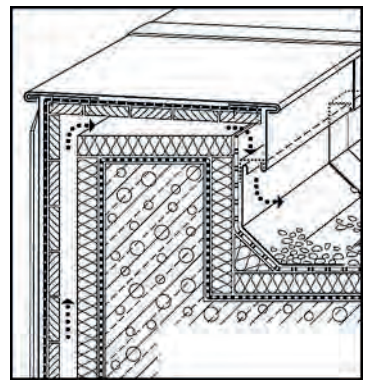
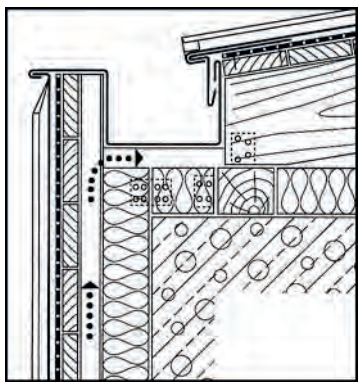
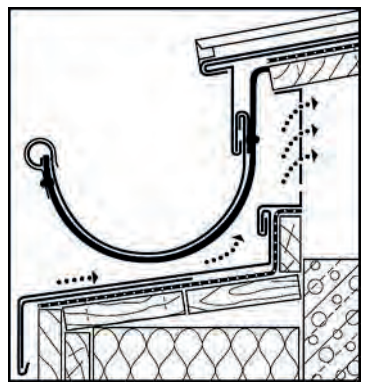
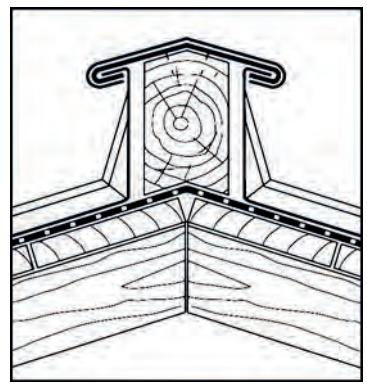
FALZONAL® - Construction Examples

Construction examples

01.00 Introduction

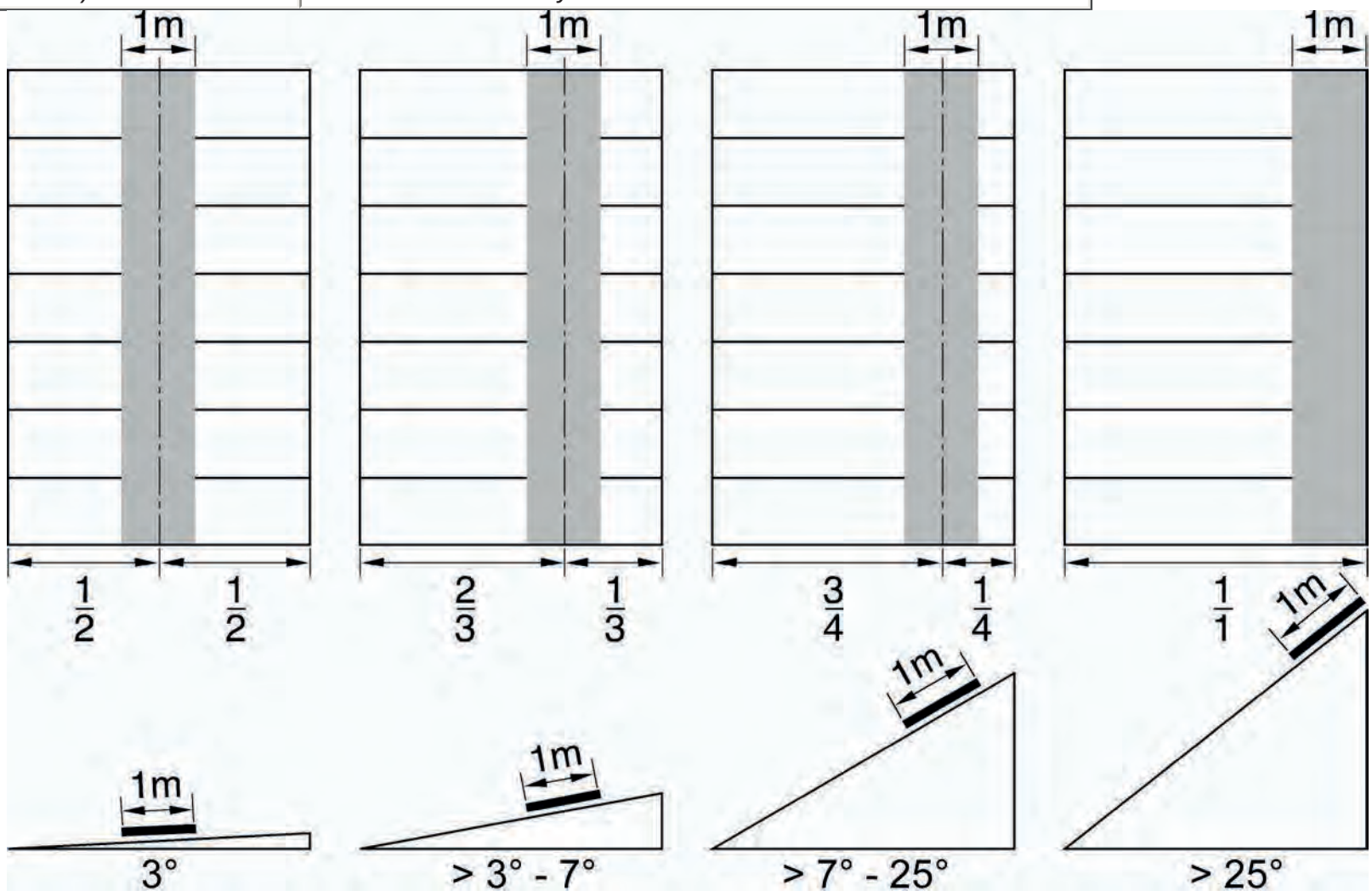
This aid applies to the construction of non-bearing cladding systems for roofs and facades with sheets and coils made of FALZONAL® prepainted Novelis aluminium in lock-welt quality. It is to serve as a guideline and work aid for the architect, planner and installer.

The drawings presented are examples of the normal case. They do not relieve the planner and installer from their obligation of critical examination. All currently known relevant specifications, regulations and guidelines must be observed. These installation instructions will not discuss in detail other regulations from the construction supervisory authority, the trade association, etc., since it is presumed that they are known. The diagrams shown are not true-to-scale representations but are instead pure examples that are intended to illustrate the descriptions in the text. They reflect the current level of knowledge. All examples, diagrams, etc. pose constructive solutions that basically presume that individual construction will be adapted to the local aspects of the individual construction projects. No special cases are included and they shall be subject to more extensive or limited measures than in the normal instance.

No aspects of contract law are dealt with in these construction examples. Therefore, they cannot serve as the basis for any actionable claims of deficiencies, errors or incompleteness.

Schematic representation of the area of the fix clip as a function of the roof slope

Layout of the fix clip in case of trays over 3 m long	
Roof slope	**Location of the fixed-point area**
5% (3°)	in the centre of the tray
5% - 13% (3° - 7°)	In the upper tertiary point of the tray
13% - 47% (7° - 25°)	In the upper quarter point of the tray
(over 25°)	At the end of the tray



02.00 Relationship to other regulatory works

For installation, comply with the following (the latest edition in each case):

- **Guidelines for the installation of metal roofs, exterior wall cladding and metal roofers' work.***
- Technical rules of the roofers' craft, from the ZVSHK (German Metal Roofers' Association).
- VOB, Part C - ATV (German General Technical Contract Procedures for Building Works).
- Metal roofing - DIN 18 339

* Outside of the Federal Republic of Germany, observe the relevant national regulations.

The VOB is a bylaw that is to be agreed upon. It was enacted by the German legislature specifically for the building trade. It is divided into three parts. Part A is an administrative regulation. Part B is a procedural regulation. Part C consists of general technical contractual conditions.
DIN 18 339 - VOB, Part C - is not an implementation standard; it is a contractual standard. It is frequently cited in the general preliminary remarks of performance specifications. Therefore it is important to provide a precise description of the performance, which is then binding for the invitation to tender. As a fundamental rule, defective building works are to be remedied. Only by way of exception can a reduction of payment be considered, namely if the remedy

- is impossible
- cannot reasonably be accepted by the client
- would cause the client a disproportionately high expense.

03.00 Planning

The planner must observe the relevant regulations of the construction supervisory authority, bylaws, standards and guidelines. Building physics parameters for the construction of two-skin heat-insulated roof structures with roof slopes are > 10°. The requirements are minimum requirements (based on DIN 4108, Part 3, edition of August 1981 and the WSV (German Thermal Protection Code)

04.00 Fire Protection

Construction codes of individual German states and the associated bylaws place requirements on the protection of constructional materials against fire. These requirements and the terminology used to refer to them are defined in DIN 4102, "Behaviour of construction material and constructional elements", which was initiated by the construction supervisory authority.
According to DIN 4102, Part 4, aluminium alloys are Class A1 construction materials (**non-combustible construction materials**). According to the same standard (Section 8.7), aluminium roofing is resistant to flying sparks and radiated heat even if it has organic coating on both sides and insulating layers of Class B2 construction materials underneath it. This resistance is also referred to as "hard" roofing. According to DIN 4102, FALZONAL® belongs to construction material class A2 (**non-combustible construction materials**).

05.00 Noise Protection

Sound is the result of mechanical vibrations and waves that are noticed due to fluctuations in air pressure against the ear drum. If these vibrations continue in the air, this is referred to as "airborne sound or noise". In solids, it is called "structure-borne sound or noise". DIN 4109, "Protection against noise in building construction", contains the requirements regarding airborne noise. The German Technical Instructions for Protection against Noise and the German Federal Emission Protection Code must be observed for protection against noise in and around industrial systems. The requirements in terms of protection against noise depend on the prevailing circumstances. For example, different conditions apply for hospitals and or a university reading room than for manufacturing facilities or offices. The location of the structure also affects the measures required (city centre, industrial area, forest area).

Hearing of noise is always subjective. Each individual experiences noise differently. Here, too, the surroundings and existing accompanying noises are also decisive factors in experiencing noise.

A frequent question posed in connection with metal roofs is about drumming noises during hail or heavy rain. A measurement taken in a soundproof room would certainly produce results, however they would be of very little practical significance. Hail or heavy rain seldom occurs and even then are brief. The noises that rain generates when it falls on leaves, strikes the ground or even in the air is relatively loud. Dense rain swallows up noises; the sound is absorbed. The noises that you hear from the roof come less through the roof than they do through the windows. A distinction is drawn between noise insulation and noise absorption.

05.01 Noise insulation

Noise insulation is the reduction of the sound that passes through a building component. It is irrelevant if this sound is coming in from the outside or vice versa. A distinction is the "airborne sound insulation index" Rw in dB (A). The hearing ability of the individual is factored in here. Airborne noise is essentially reduced by the mass of a structure or its multiple sheaths. Part of the noise is reflected on the surface of a structure; the remainder penetrates into the structure, causing it to vibrate (structure-borne noise). Leaky joints can greatly reduce the noise insulation because the nose can pass through unhindered. A large percentage of the sound energy is lost on the boundary layers between different materials. Constructive measures can be taken to reduce the transmission of structure-borne noise, e.g. by avoiding continuous constructional elements or by combining constructional elements of different rigidity.

06.00 Lightning protection

Lightning Protection is a necessary means of protection to avoid damages of buildings or other installations. In case of lightning hitting a building without lightning protection, the lightning passes all insulating materials, until it hits conductive parts being linked with the earth.
By this means the lightning flows into the earth, where it spreads. Often a fire is started, possibly even doing damage to people.
In case lightning is hitting a building with lightning protection this - when properly designed - is caught and disposed into the earth.

In case a part of the building with a conductive facade (conductive sub-construction or cladding) without lightning protection, the tension between the conductive facades and the earthed parts increases until there is an overspill. This usual is the case between the lower edge of the conductive facades and the earth.
Therefore, in principal connected facades should be equipped with an earthing in distances of not more than 10 m.
Contrary to general opinion metal roofs and facades do not attract lightning.

06.01 Special lightning protection measurements for electrical and electronic interior systems

Also in buildings with lightning protection, according to the norm lightning can do damage by electromagnetic effects on the electronic installations.
The most efficient and economic protection measurement is to reduce the electromagnetic fields caused by the lightning by shielding measurements.
The electromagnetic field inside the building and by that the inherent tensions can be reduced, if the lightning stream is being spread into as many conductive ways on the surface of the building.
Modern building have a large number of conductive parts, e.g. the steels skeletons, the fortification of columns and ceilings, roofing or claddings and their support constructions or other extended conductive parts. If these are properly connected (metal cladding, roof) they form an excellent shielding. The cost for disconnection usually is low, if necessary additions will be included right during the planning stage.

06.02 The application of the roofs and walls for shielding against lightning.

We have to distinguish between

- Lightning protection of buildings and installations
- Lightning Protection of the electronics inside of buildings (shielding)

A consequently connected large area wall planning, which is linked to the catching equipment on the roof and the earthing forms a good lightning protection. It can also result in an effective shielding in case of the individual parts of the cladding a reconnected by conduction.

The requirements for the installation of the consequently conducting connection are different:
For the lightning protection of buildings according to DIN V ENV 61024-1 an overlapping without screwing at the connections is allowed, if the overlapping area is greater than 100 cm² and the distance is not greater than 1 mm. When hit by lightning distances will be bridged.
With overlapping, the sheet meet at points not to be determined in advance, where the lightning can bridge. Pre-painted sheet up to a paint thickness ≤ 50µm behave similar to plain sheet as the lightning current is bridging the painting.

At this bridging area meltings may derive. Due to that at points with higher partial lightning concentrations, flashing have proven to be effective which are fixed by screws or rivets or connections which reduce the risk of melting.

For the shielding of buildings the safe separation of the lightning to many parallel outlets is decisive.

- In case roof and wall claddings should be utilised for shielding, clearly defined connections by rivets or screws have to be provided. At the vertical over-lapping distances of connections the distance points should be 500 - 600 mm. At the horizontal overlapping approximately the same distances have to applied. The smaller the distance of screws the greater is the number of connections and the better the shielding effect.

- If the joints of the vertical and horizontal overlapping have sealant the distances of the connection elements have to be half in order to obtain the same shielding effect without sealant.

- With roofs and walls in double-seamed plain aluminium there is contact over the entire area.

06.03 Implementation of shielding (use of roof and wall claddings for lightning protection)

The lightning which derives from a cloud has to be absorbed by a catching device. Most likely strong lightning hits the edges and the areas of a roof with its accessories.

Weak lightning on high-rise buildings (more than 20 m height) can also hit the walls.

- Roof claddings made of aluminium sheet can be used as a catching device.
  In case of not allowed malting, DIN V ENV 62014-4 requires a minimum thickness of the building elements of 4 mm of steel and 7 mm with aluminium. This cannot be practically realised with large areas. Thin sheet can be damaged by strong lightning, so that the sheet have to be exchanged.
  Melting can be avoided when catching devices are installed above the roof area to avoid hitting the roof.

- At the roof edges usually flashings are used as catching devices.

- The flashings have to be connected to the facade and it's substructure and to it's catching devices on the roofs.

- The aluminium cladding can be used to derive the lightning into the earth, if they are connected sufficiently. A damage is not to be expected.

- With high-rise buildings also lightning at the sides is possible with buildings up to 50m. The lightning strength is, however, low. A damage to the facade is unlikely.

- If the cladding and the sub-structure is not connected will discharge over the cladding and bridge at missing links or plastic parts. Depending on the transmission intensity of the air distances or the plastic parts the energy will focus on a few areas only. The more parallel ways will be found the higher the intensity may be on every path leading to possible damages on the facade.

- If all elements of the cladding are connected on their edges with the eespective neighbouring element, the lightning energy will flow via the facade without damage.

- At the lower edge of the facade, connections to the earthing are necessary. If the lower edge of the facade is close to an armed wall it is advantages to connect directly on them. By that exterior visible connections can be avoided. The use of the armouring improves the lightning protection and the shielding in this area.

Lightning protection and shielding should be considered in the planning phase of a building in order to have a technical optimum of the building found in line with the architectural aspects.

Lightning protection devices installed in retrospect or during the building phase tend to be not technically optimised and looking not attractive.

07.00 Thermic protection

Thermic protection comprises structural measures which, in accordance with the stipulations of DIN 4108, "Thermic protection in building construction", are differentiated into thermic protection for the winter and thermic protection for the summer.

08.00 Moisture protection

Constructional elements to enclose rooms are subject to stress due to precipitation outside and utilisation moisture inside. This can cause condensation on the room-side surface. In general, the amount of moisture condensing in a roof or wall structure must be smaller than the amount of moisture diffusing out during the winter/summer period, i.e. must be within the range of the moisture content equilibrium. In the event of a negative balance in the movement of moisture, the amount of condensation must be adequately reduced or eliminated by means of a suitable vapour barrier. Even if the annual balance is positive, however, an additional vapour barrier is frequently necessary to achieve the specified limit of 1 kg/m3 on the amount of condensate. In particular, care must be exercised to ensure that flashing and leadouts are so constructed as to be adequately vapour proof and carefully processed to eliminate diffusion and/or convection. In the case of roofs and walls with an unventilated structure, the inner layer which functions as a vapour barrier furnishes good protection against water vapour diffusion because vapour only passes through the joints at a rate proportional to the percentage of the total surface that the joints constitute.

09.00 Corrosion protection requirements

The fasteners and connecting devices used for FALZONAL® must be able to fulfil their function throughout the period the building is scheduled to be in use. Therefore, they must

- be dimensioned such that the loads that develop can be reliably absorbed
- be made of a material that prevents failure due to corrosion.

Furthermore, it is absolutely necessary to take into account the climatic conditions that prevail at the building. Make certain that the fasteners and connecting devices utilized are compatible due to the possibility of contact corrosion. Contact corrosion always occurs where two different metals or metal alloys come into contact or are connected and electrically conductive and an electrically conductive liquid (electrolyte) is added. Due to the difference in the electric potential of the different metals, surface material is eroded at the anode, i.e. the less noble metal. In actual practice, this means for example that cleats made of high-quality steel are to be preferred over ones that are plated.

Assembly of FALZONAL® with accessories made of other metals

Mating of materials	Atmosphere		
	Country	City/industry	Near the ocean
Zinc	+	+	+
Stainless steel	+	+	+[1)]
Lead	+	+	-
Unprotected steel	-	-	-
Copper	-	-	-

1) This only applies for thread-forming screws and blind rivets made of stainless steel if formation of electrolyte is to be prevented.

09.01 Wood

The wood preservative to be used to impregnate wooden substructures should not belong to the chlorinated naphthalene preparations and should not contain salts such as copper or mercury salts nor fluorine compounds.

09.02. Concrete

Avoid direct contact of the aluminium trays with fresh concrete. We recommend an intermediate layer containing bitumen on the contact surface.

10.00. Cleaning and protective maintenance

Every product that is supposed to remain decorative over the long term requires appropriate care. This not only ensures that it retains its appearance; it also maintains the value of the roof or the façade. Both are readily achieved with FALZONAL®.

10.01. Cleaning in general

In general, washing with warm water is sufficient. Detergent and special cleaners are helpful. Use as specified by the manufacturer.

Possible tools are sponges and soft brushes such as those used in car care. Where relatively large surfaces are involved, a pressurized spray unit should be used. Rinsing with warm, clear water is imperative.
Note: Always clean from the top down.

10.02. Cleaning prepainted aluminium roofs and facades

Acidic or neutral cleaners are to be preferred over alkalic cleaners to clean prepainted aluminium roofs or facades of the PVD C (polyvinylidene chloride). Avoid: organic solvent, strong acids, alkalis and agents containing chlorine. In addition, hard abrasives, wiping when dry, hard brushes and the like are damaging.

Note: Under no circumstances should cleaners containing solvents be used.

The following cleaners are recommended, e.g.:

P3-T768
Henkel KGaA
Henkelstr. 67
D-40589 Düsseldorf
Tel. (+49) 211/7971

TG-22
Tegee-Chemie
Bergedorfer Str. 6-8
D-28219 Bremen
Tel. (+49) 421/38997-0

Beckers C 03 00000
Beckers GmbH
Roseller Str. 13
D-41539 Dormagen
Tel. (+49) 2133/501-0

10.03.Graffiti / Fungus

Anti-Graffiti
Graffiti can be removed by using special cleaners. After application with spray can, brush or rags, let the cleaner work for more than a few minutes. Then wipe off and flush with water.

Recommended cleaners:
Antivan Cleaner
Antivan Chemicals
P.O. Box 24
Leatherhead
Surrey
KT233LX, UK

P3-Scribex
Fa. Henkel KGaA
40191 Düsseldorf

Anti-Fungus
According to information from the PVDF manufacturer, coatings of PVDF resist fungus growth where other surfaces already reveal fungus attack. Tests confirm that no yeast growth ca be detected after 14 days if yeast spores in a water solution are spayed on coated panels and the panels are subjected to high humidity (90 to 95%) and high temperature (30°C).

10.04. Repairs

Air-drying touch-up paint is available from accessories dealers to repair damaged surfaces. This requires that you furnish special data regarding the property.

11.00 Surfaces and colour configuration

The use of coils and sheets coated via the coil coating process is recommended in the roof and façade areas in the case of structures that are to be architecturally and aesthetically attractive for a long time. Due to the coils that are coated in this manner it is possible to achieve a uniform surface structure with a high level of colourfastness over the entire surface of the strips and sheets. In the case of paints with a metallic effect, care must be taken to ensure that the trays are laid in the same direction (mark on the back). To ensure that colours are the same, avoid mixing different shipments or batches of strips and sheets coated using the coil coating process if possible.

12.00 Material

FALZONAL® has the following mechanical properties:
Alloy: Novelis WG-C4S (AlMn1MgO.5 as
per EN 573/EN 1396)
Condition: H41 (standing seam quality)

Approximate values as
per DIN 50 114:
Tensile strength: R_m 130-170 MPa
Yield point: $R_{p0,2}$ > 100 MPa
Elongation at break: A50 > 6%.
Module of elasticity: approx. 70.000 MPa
Thermal expansion: Coefficient of thermal expansion 0,024 mm/m/K°

13.00 Substructure

13.01 Wooden shell

As a rule, a wooden framework that enables trouble free fastening of the trays is utilised as the substructure for roofs and facades with FALZONAL®. Lock-welt and ledge roofs are fastened in accordance with DIN 18334, "Carpentry and woodwork":
FALZONAL®. Lock-welt and ledge roofs are fastened in accordance with DIN 18334, "Carpentry and woodwork":

- Rough tight sheathing as per DIN 4072 at least 24 mm thic
- Shell made of air-dried pine as per DIN 68365, quality class 1, parallel square-edged and planed. The minimum thickness is 24 mm; the width should be 80 to 160 mm. Substructures made of wood should be permanently dimensionally stable. When wood preservatives are used, the compatibility of the fasteners and/or connecting devices must be verified in advance.
- Chipboard sheets should not be used as an underlay because, when they become moist, there is no assurance that the fasteners and/or connecting devices will not be torn out.
- Laminated boards made of other sheets of wood are to be regarded as a special construction and must be planed accordingly. In particular, the expansion behaviour (temperature and moisture) of the wooden materials utilised must be taken into account.

13.02 Aluminium profiled sheets

As the result of special requirements in terms of protection against fire for materials and constructional elements under the individual building codes of the various (German) states, profiled sheet systems can be used as a substructure in light of their non-combustible properties. Aluminium profiled sheets and the required fasteners and/or connecting devices are designed in accordance with DIN 1880, Part 9, "Aluminium trapezoidal profiled sheets in building construction" and the pertinent test

reports of the system manufacturers. The trays are fastened to the profiled sheet as a substructure by means of rivets approved by the German Board of Works. Systems with or without heat insulation are possible when a combination of profiled sheets serves as the substructure.

In the case of substructures of concrete, concrete slabs and autoclaved aerated concrete slabs the trays are fastened by means of officially approved dowels with corrosion-protected screws.

14.00 Membrane layers

Separating or parting layers in the form of intermediate membranes are used to protect the metal on the bottom against

- alkalic influences
- damaging effects of wood preservatives containing salt and copper.

Aside from this, separating layers enhance the dilatation in the case of changes in length due to the temperature and they also enhance the sound insulation. If the wooden shell is not impregnated with wood preservatives containing salt or copper, a separating layer isn't necessary with FALZONAL®. Possible separating or parting layers are, e.g.

- bitumen roof sheeting with layer of glass fibre fleece as per DIN 52143, V13
- glass fibre reinforced plastic sheets
- suitable PE sheets approx. 0.2 mm thick. Special separating layers and/or drainage sheets which function as a second water-conducting level are not necessary for FALZONAL® because the material is corrosion resistant.

15.00 Vapour barrier

The blocking value of a vapour barrier is the product of the coefficient of its vapour barrier diffusion resistance µ multiplied by the thickness of the material (s). The result is the diffusion-equivalent air layer thickness Sd. Applied layers of adhesive are not taken into consideration during the measurement. The following vapour barriers or vapour barrier layers, depending on the application:

- vapour blocking of supporting frameworks
- vapour barriers made of bituminous materials (e.g. bituminous waterproofing sheeting at least 4 mm thick, with glass fibre fleece and aluminium coil inserts, 0.1 mm thick, type designation V60 S4 + Al 0,1)
- vapour barriers made of plas
- vapour barriers made of metallic materials
- vapour barriers made of composite material

It is a basic rule that the diffusion resistance of a vapour barrier must be coordinated with the construction and the relevant project-related load due to moisture. The moisture content of the installed materials must be factored in when dimensioning the vapour barrier.

If a vapour barrier assumes the function of providing an airtight seal, the associated requirements must be met.

16.00 Convection barrier

Sheets with a diffusion layer that are installed between the heat insulation and the metal roofing are referred to as a top convection barrier with a diffusion layer. Such sheets function like separating or parting sheets and they enable diffusion, but do not permit any convection into the structure from the outside. It is characteristic of convection barriers with a diffusion layer that their Sd-

Where relatively large roof surfaces are involved, it is advisable to use machines because hand tools may leave visible depressions and dents. Moreover, machines ensure a more consistent quality of workmanship.

19.00 General specifications for processing

Only companies possessing the necessary specialized know-how are permitted to install FALZONAL® products. At the start of the assembly work, install the necessary safety equipment and protection against falls. Use of profiled trays that are damaged (e.g. by cracks, bends, dents and wrinkles) is not permitted. Once the roof is finished, rid the trays of items lying around loose. Carefully remove chips created during drilling and grinding.

20.00 Processing FALZONAL®

FALZONAL® is made of an aluminium alloy developed especially to meet the demands of tinsmiths. Therefore it can be readily folded, roll-bent, rounded, flanged, upset, stretched, driven, compressed and deep drawn without damaging the material or the layer of paint that was applied using the coil coating process. Other processing techniques include pressing and folding as well as parting by means of cutting or stamping. Right-angle forming is performed with pressing presses or folding machines. Parts to be shaped should be marked with a soft pencil or a felt tip pen. If sharp-edged equipment is used, a notch effect may be produced which could subsequently result in a fracture due to an elevated concentration of stress.

During execution, in actual practice, the forming temperature should not exceed 0°C. Important: the protective sheet placed on the viewing side must always be removed prior to folding. For this step, the Novelis protective film was equipped with a perforation that separates the sheet from the main protection surface (cf. 6.00, "Protection against lightning").

Due to the colour coating it is not advisable to weld or solder FALZONAL® because the heat would destroy the coating.

Parts to be connected must be either folded or riveted. As an alternative, they could also be glued (cf. 21.00, "Bonding").

Width and length of the trays, material thickness, number and distance between the trays

Building height		up to 8 m	8 - 20 m	20 - 100 m
Tray width [mm] 1)		520	520	520
Material	Tray length [m]	Minimum material thickness mm		
FALZONAL®	≤ 10	0,7	0,7	0,7
Roof area		trays, number and distance between 2) 3)		
Centre	mm	500	500	500
	St/m²	3,9	3,9	3,9
Edge	mm	500	350	250
	St/m²	3,9	5,5	7,7
Corner	mm	300	200	150
	St/m²	6,4	9,6	12,8

1. The tray widths are calculated from the widths of the coils or sheets of 600 mm minus approximately 80 mm in the case of lock-welt roofs. For ledge roofs a small tray width is calculated as a function of the cross-section of the ledges.
2. Requirement for the trays: see table "Cleats and fasteners"
3. The specified cleat distance in mm is to be met as the average over a range of 3 m.

Requirements for cleats and fasteners							
Bands material	Shell thickness	Cleat		Connecting devices			
				Roughened nails		Countersunk screws	
		Material	Thickness	Material	Dimensions	Material	Dimensions
Aluminium WG-C4S	24 mm	Stainless Steel	0,4 mm	Stainless Steel	2,8 x 25	Stainless Steel	4 x 25

21.00 Bonding

21.01 Adhesives containing bitumen

If bonding should prove necessary for design reasons, you may use plastic sealing and cold-bonding agents with a bitumen base (e.g. "Enkolit"). The sealing and cold-bonding agents can be applied with a spatula in accordance with factory specifications and this can be used to glue the trays. Tests with FALZONAL® have shown that bonding with "Enkolit", e.g. on a compressed mineral heat insulating material (such as "Hardrock") provides a good elastic connection.

21.02 Adhesives containing polyurethane

One of the advantages of bonding a metal is that it requires no high temperatures which could alter the structural condition of the prepainted aluminium and therefore its hardness and strength as would be the case, for example, with welding or soldering.

The strength of a glued connection depends not only on the size of the bonding area, the type of adhesive, the pretreatment of the adhesive surface and the thickness of the bonding layer but also on the type of the glued connection. The following work rules must be followed when gluing with polyurethane adhesives:

- the joining surfaces must be clean and free of grease
- the glue should be applied immediately after the surface is pre-treated
- the bonding layer should be 1 to 3 mm thick
- during the curing, the parts must be secured to prevent slippage

The adhesives "Sikaflex 11 FC", "Sikabond-T1" and "Sikabond-T2" have proven themselves in actual practice. With these moisture hardening polyurethane adhesives work on joints, e.g. gluing gutters and installation of air vents, can be carried out simply and reliably. If the components to be connected will be subjected to relatively high loads, however, it is advisable to rivet them as well.

22.00 Accessories

Gutters, downspouts, snow guard systems, cleats, screws and nails are available commercially for FALZONAL®. High-grade steel 0.4 mm thick is specified as the material to be used for the cleats because tests in the wind tunnel have demonstrated that when used in conjunction with FALZONAL® these exhibited the best characteristics in terms of sturdiness under high wind loads. Half-round gutters, rectangular eaves and even eaves on the inside and outside can be manufactured from FALZONAL® without difficulty. The eaves are processed by roll forming or crimping.

Planning should include an emergency flow-off channel so that the middle gutter will not overflow.

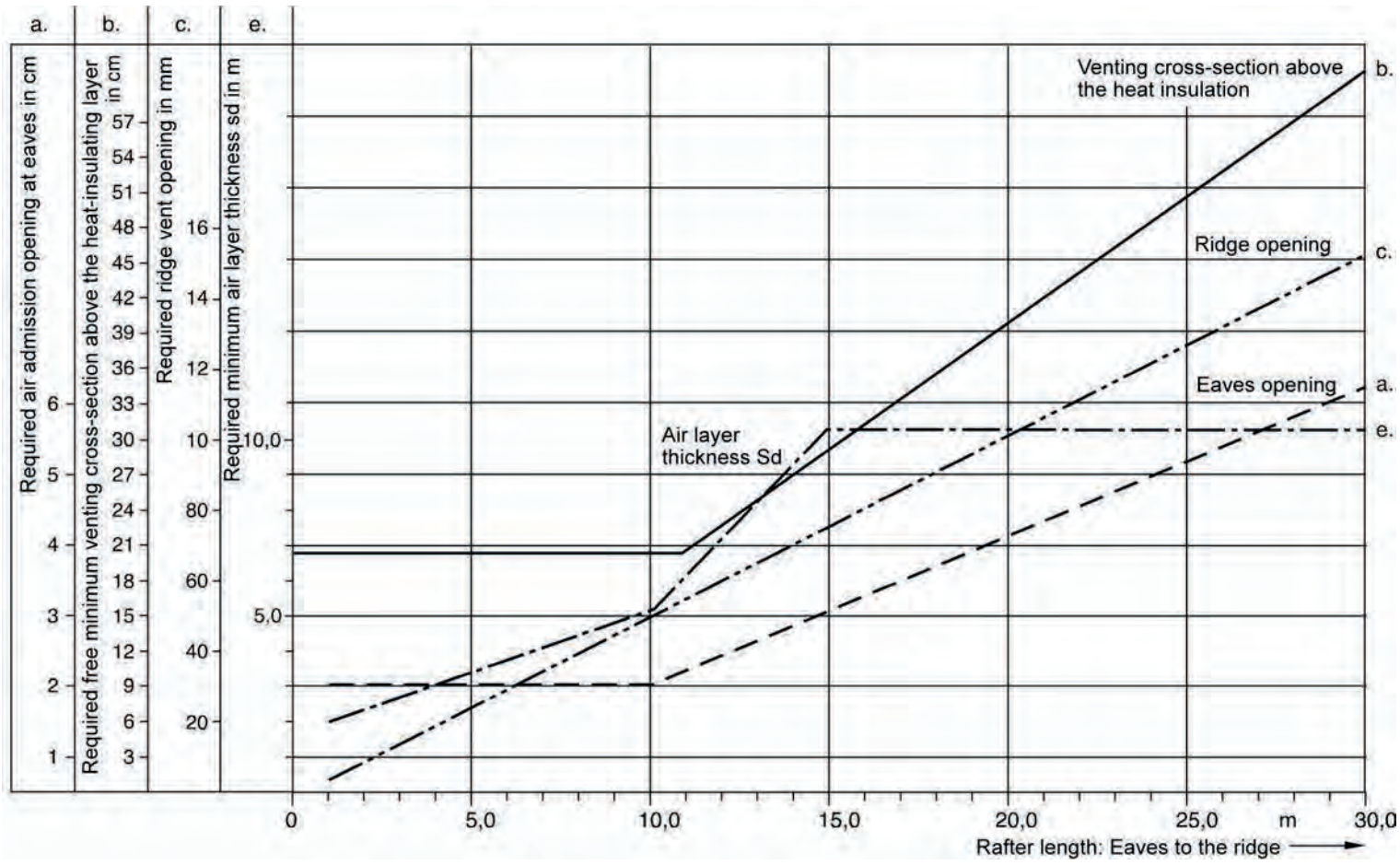
23.00 Ventilated structures

23.01 General

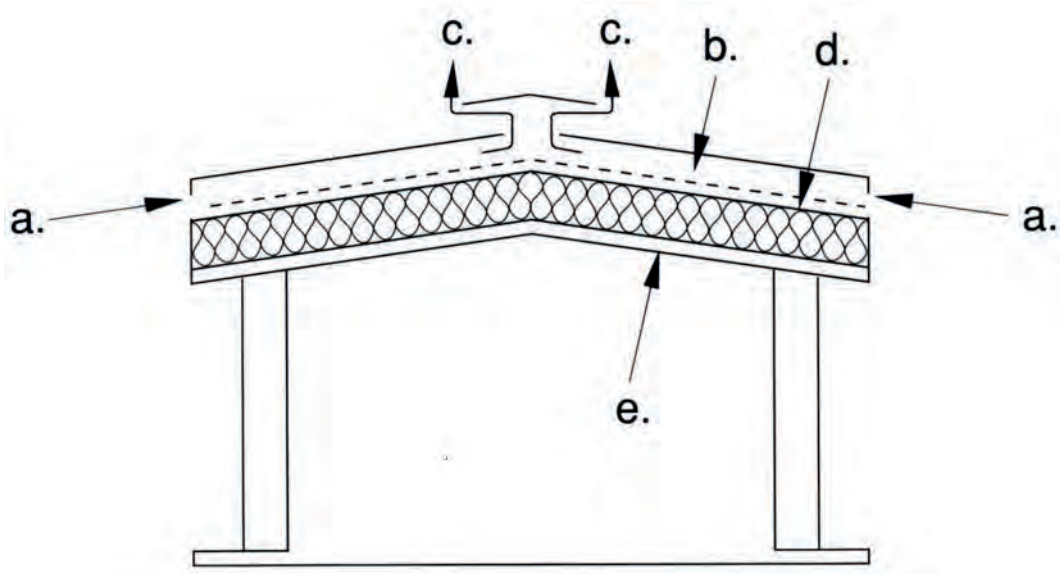
Adequate ventilation between thermal insulation, shell and roof wall structure must be available with the customary substructures. As a basic rule, there must be ventilation openings (intake air) at the lowest points and vent openings (exhaust air) at the highest point of the structures in question. The intake and exhaust openings have to be evenly distributed along the entire length of the roof and wall structures. Continuous ventilation slots are to be preferred over openings. The unobstructed ventilation cross-section should be at least 200 cm²/m; in actual practice 300 cm²/m is customary. The values given do not apply for constricted ventilation openings.
Some of these ventilation openings have to be secured against vermin by means of perforated plates with a hole diameter of 4 - 8 mm. Make certain that the holes in the perforated plates provide the required unobst-ructed cross-section. It should be possible to remove the perforated plates so that they can be removed regularly for cleaning because dust and death insects can accumulate and reduce the available ventilation cross-section too much.
It is the planner's duty to specify the layout and the size of the intake and exhaust vents in accordance with the building physics of the structure.

Ventilation of roofs (intake and exhaust)

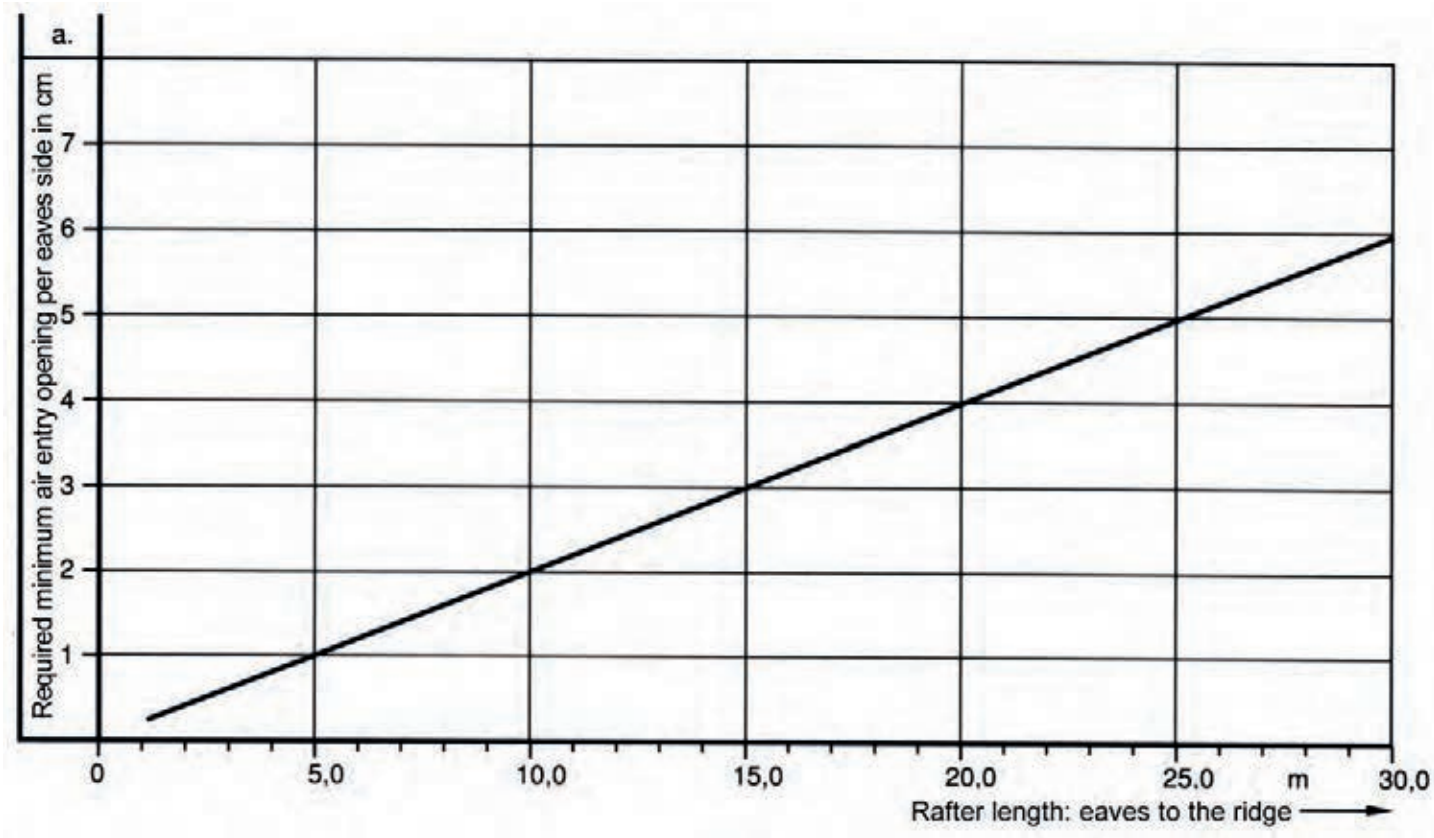
Building physics parameters for the construction of two-skin heat-insulated roof structures with roof slopes are ≥ 10°.
The requirements are minimum requirements based on DIN 4108, Part 3 07/2001)



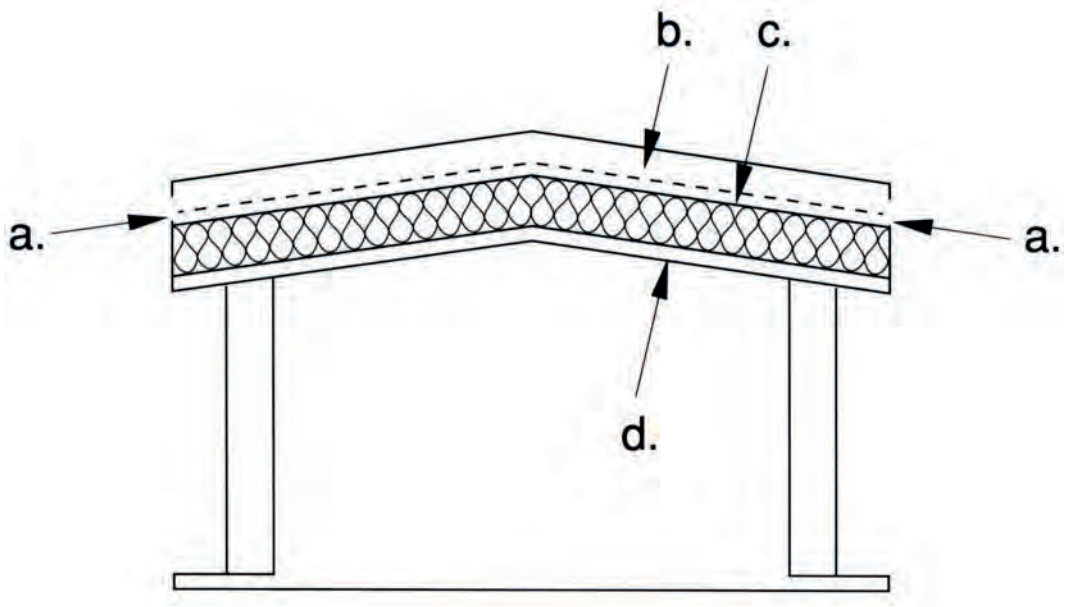
a. the free ventilation cross-section at the eaves must be at least 2 ‰ of the roof surface, but at least 200 cm² per metre of eaves
b. the ventilation cross-section over the heat-insulated layer at least 200 cm² per metre vertical to the direction of flow. Free space above at least 2 cm
c. free ventilation open at ridge at least 0.5 ‰ of the total roof surface
d. one-way diffusion layer
Convection barrier - optional
e. Convection barrier with diffusion-equivalent air layer thickness Sd of construction element layers situated under ventilated space b.
Minimum: see graphics. Better Sd ≥ 100 m



Building physics parameters for the construction of two-skin heat-insulated roof structures with roof slopes are ≤ 10°.The requirements are minimum requirements based on DIN 4108, Part 3 07/2001)



a. the free ventilation cross-section of the openings made on at least two opposing eaves per 2 ‰ of the roof area
b. the height of the free ventilation cross-section above the heat insulation layer at least 5 cm.
c. 1-way diffusion layer convection barrier - optional
d. convection barrier with diffusion-equivalent air layer thickness Sd of the constructional element layers required under ventilated space b. Minimum 10 m, better Sd ≥ 100 m



23.02 Intake and exhaust ventilation of special structures

The Sd-value (µ x s) at all points of the constructional elements under a ventilated space must be at least 10 m. Special structures such as domes or paraboloids are designed as ventilated roof structures with different slopes. The building parts and substructures are parallel to each other. The minimum height of the air space through which air flows can be ascertained using the rule of thumb: 1 m of rafter length = 1 cm of space through which air flows, measured perpendicular to the slope of the room must be at least 6 cm. In the case of roof and wall structures for air-conditioned rooms and damp rooms such as swimming pools and hazy rooms, the size, layout and execution of openings for ventilation and venting must be calculated by the planner in accordance with DIN 4108, Part 3.

23.03 Intake and exhaust openings of wall cladding

Like roof structures, wall structures can be designed as ventilated structures. The effect in terms of building physics and the definition are the same as those for roofs.

24.00 Unventilated roof structures

24.01 General

Using FALZONAL® for unventilated roof structures

- permits simpler design solutions, particularly in the case of roof areas that are complicated in configuration.
- offers higher thermal insulation together with low structure heights because the space for roof ventilation can be omitted.

24.02 Fundamentals of building physics

Building physics dictates that an overpressure exists in the inside of a building (exception: cold storage buildings). Due to this overpressure, moist room air flows out into the structure from the inside. Warm air always has a higher percentage of water than cold air. When the warm, moist room air flows into the roof structure and no adequate vapour barrier is present, it penetrates the individual layers of the structure. En route the air cools and is therefore no longer able to hold the higher percentage of water and condensation water is released. The condensation that forms on the bottom of the standing cladding is released through the double standing seam over the course of the warm/cold temperature periods (even during the winter). This means that it is not only necessary that the vapour barrier be installed such that it seals out water vapour; all bottom junctions and terminations of the roof structure, e.g. roof edging, eaves sheets, verges and all components that penetrate the roof must be absolutely water-vapour-tight. A logical consequence of this is that the structure must be 100% steam-vapour-tight from below. Consequently, care must be exercised to ensure that thermal bridges are precluded. Accordingly, we recommend a decoupling strip, e.g. one made of a polymer material, between cleat and vapour barrier.

24.03. Moisture in unventilated structures

For unventilated structures, it is not the absolute maximum moisture that it is decisive; it is the annual average, because periods can alternate between elevated moisture and absolute dryness. Laboratory tests and calculations based on building physics have demonstrated, for example, that an unventilated roof structure can dry out in the winter and that the moisture can increase in the summer. The decisive factor in this instance is that the structure can again become absolutely dry.

Moisture that forms between the metal skin and the convection barrier with a one-way diffusion layer, can escape through the standing seam . The tightness of an unventilated roof structure in terms of water vapour must decrease from the bottom up.

The convection barrier with a diffusion layer mustn't be a vapour barrier because only a convection barrier with a diffusion layer enables diffusion to the outside. This fact is particularly important in light of the development or avoidance of standing water in the structure.

Designs that result in standing water or promote the formation of water pockets must be avoided. A double standing seam roof created using tinsmith technology is not a watertight roof; it is a rain-tight roof.

The slope of the roof depends on the individual building type and the roof shape. Under some circumstances, roofs with complicated curves which are special designs in some areas as per ZVSHK (slope of roof 3° - 7°) should be equipped with higher double standing seam designs, depending on the annual rainfall.

24.04. Basic rules for the construction of unventilated roofs

As a basic rule, care must be exercised to ensure that the overall construction is carried out satisfactorily and properly. In other words, the thermal insulation as such must be protected from moisture from the inside and the outside as well. The roof structure must be protected to the outside against driving rain or snow and to the inside against diffusion or convection moisture. If moisture enters the thermal insulation, it is rendered useless. The barrier under the thermal insulation of an unventilated roof structure must serve as a vapour barrier and it must have an Sd- value ≥ 100 m. (Note that, e.g. profiled sheets are regarded as a special case, even with a material 0.6 mm thick and riveted and sealed joints. Extreme care must be exercised in this instance because trapezoidal profiled substructures are not convection- and wind-tight.) Insofar as the construction of unventilated roof structures with FALZONAL® is concerned, there are no misgivings regarding the selection of aluminium. This material is long lasting and resistant to weathering and to moisture diffusing through it.

24.05. Roof of an unventilated roof structure with FALZONAL®

In its alloy, the mechanical characteristic values and the coating on both sides, FALZONAL® is especially prepared for use in the tinsmith's trade. The high resistance of FALZONAL® to corrosion makes it possible to construct a roof that does not require rear ventilation.

The roof of an unventilated roof structure (starting at the bottom) with FALZONAL® is usually as follows:

- Aluminium profiled sheet or solid sheathing or concrete as the static element
- Vapour barrier with an Sd-value of 100 to 150 m
- Non-crush thermal insulation
- one-way diffusion layer convection barrier (optional)
- FALZONAL® in standing seam technology

25.00 Façade structures

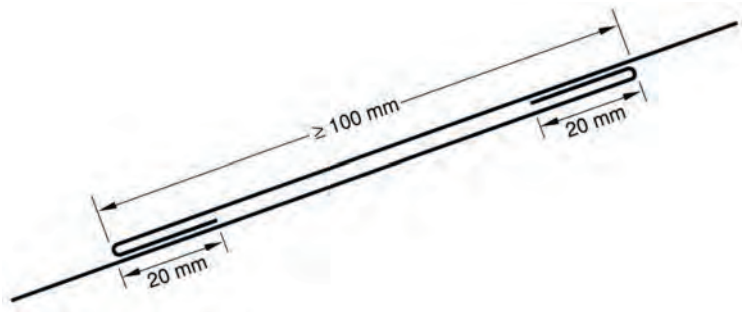
FALZONAL® is processed using the traditional tinsmith technology - i.e. a handicraft technology. Due to this handicraft technology, some warping and slight humps may occur. This phenomenon is not unusual and frequently cannot be avoided with this type of processing of metal facades. In trade literature this effect in the case of facades of thin sheets is referred to "characteristic light waves". In light of this fact, the substructure should be checked in advance for unevenness. Where wooden sheathing functions as the substructure, this sheathing should have a slight moisture content because fresh wood dries and shrinks over the course of time. Consequently, it exhibits a shift in position relative to the metal surface, causing a slight waviness of the trays.

Crosswelt in Trays

Expansion within the tray length is taken up by sliding cleats. The trays may not be longer than 10 m and are to be laid continuously. Longer tray lengths are to be broken by means of steps or beaks in the incline. In the case of roof pitches greater than 18% (10°) a supplementary clip may be built in as an alternative to a sliding clip. The upstand height in the case of breaks in the incline or steps must be at least 60 mm and is to be performed in the substrate.

Overlap 100 mm

pitch ≥ 58 % (30°)

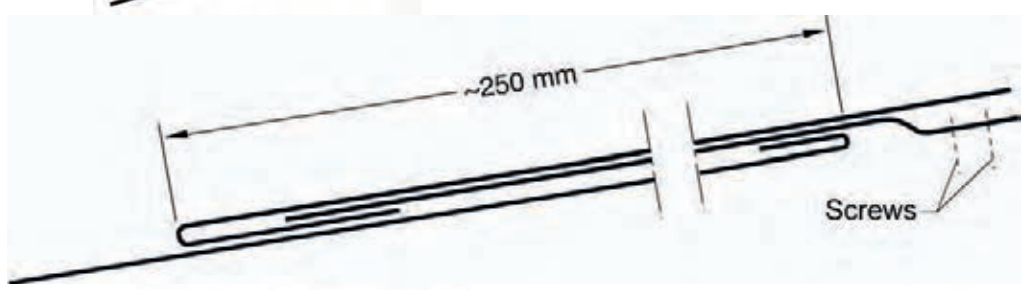


Single cross-seam

pitch ≥ 47 % (25°)

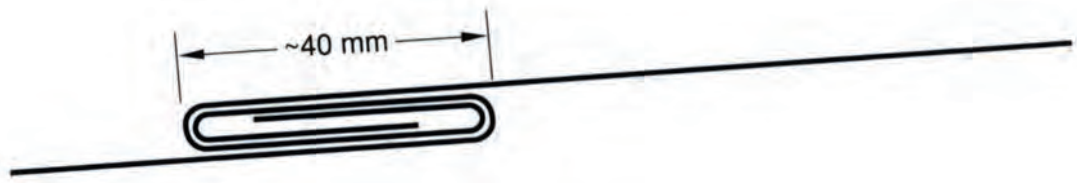
Single cross-seam with additional seam

pitch ≥ 18 % (10°)



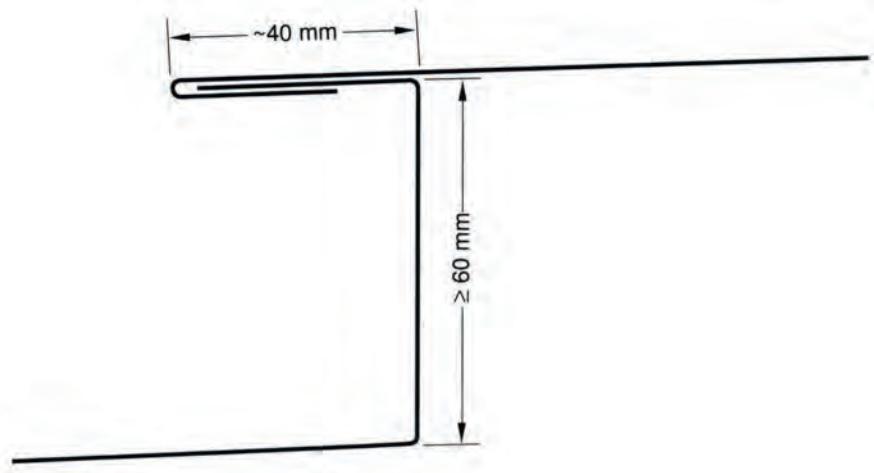
Double cross-seam

pitch ≥ 13 % (7°)

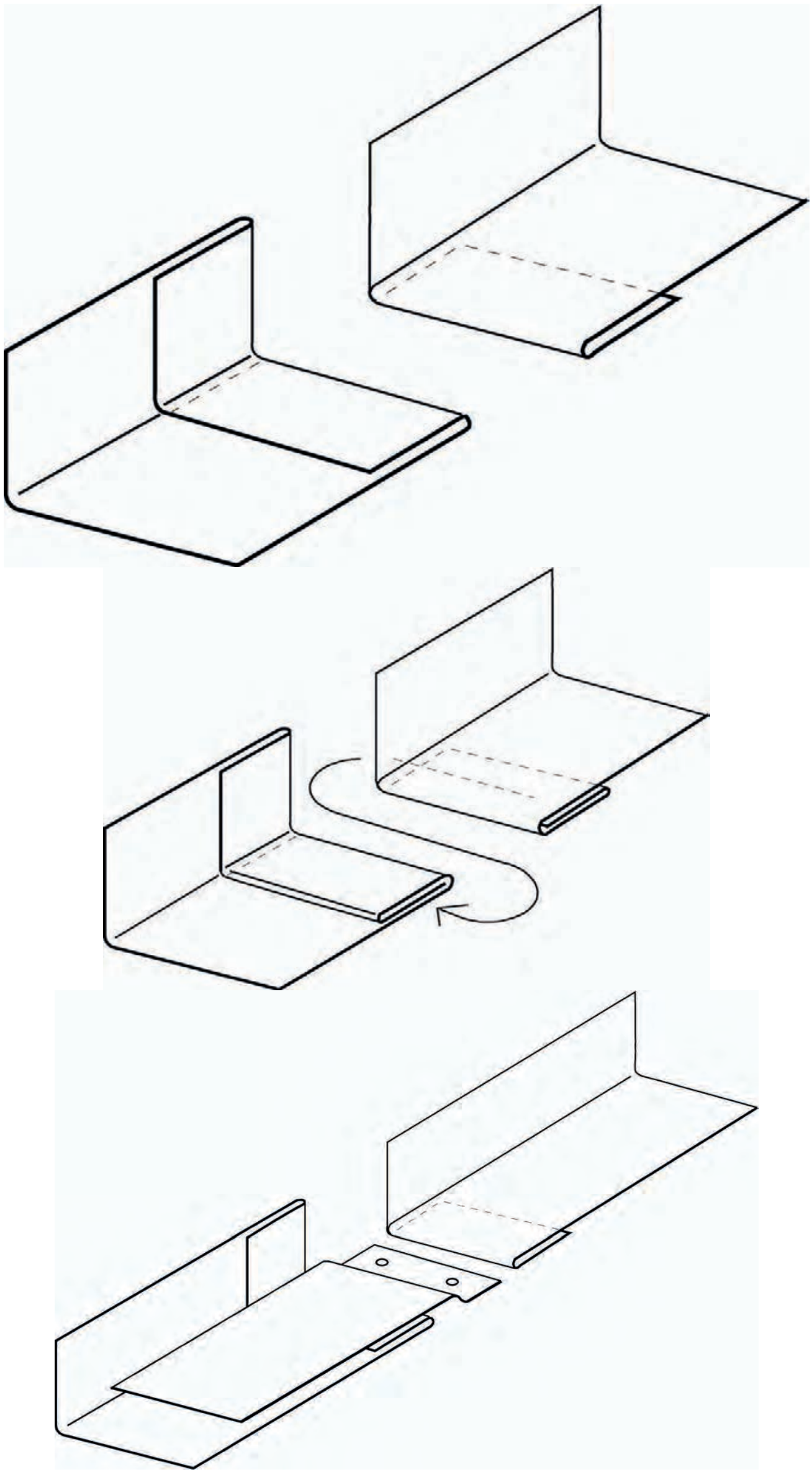


Crosswelt-step

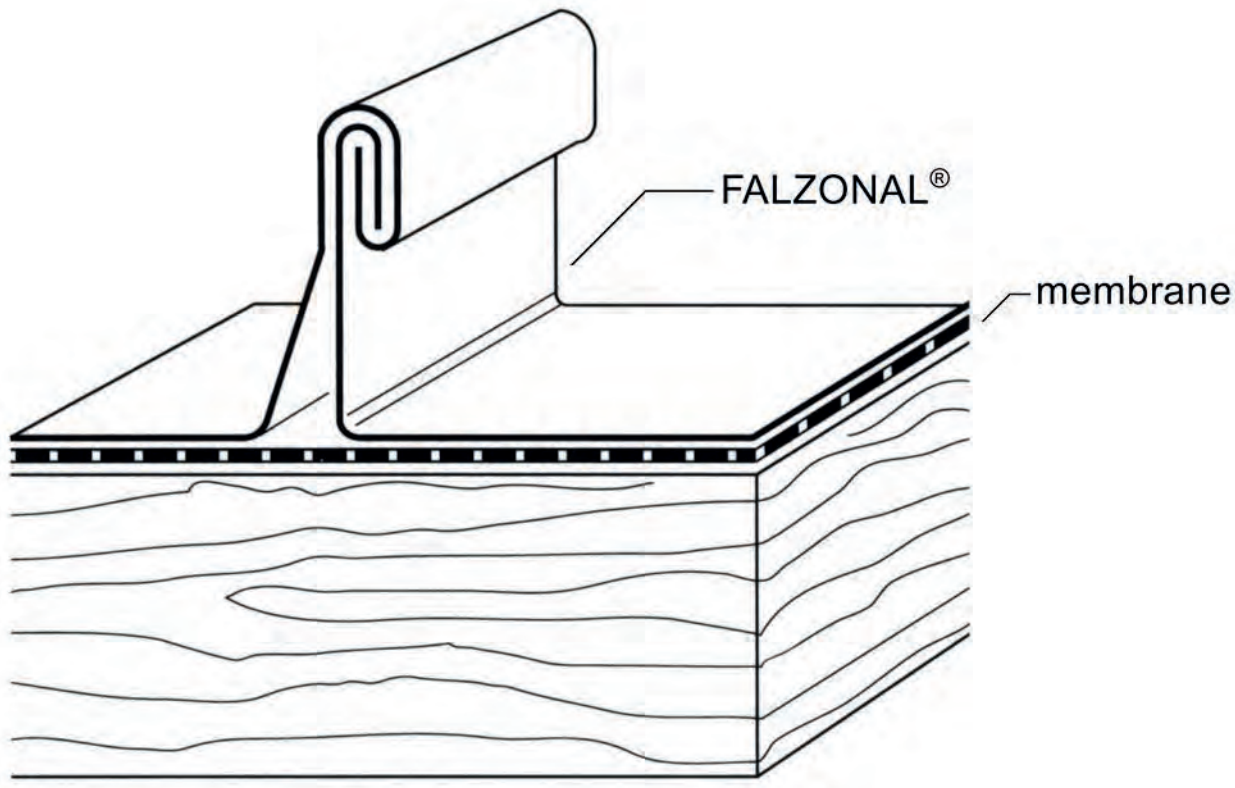
pitch ≥ 5 % (3°)



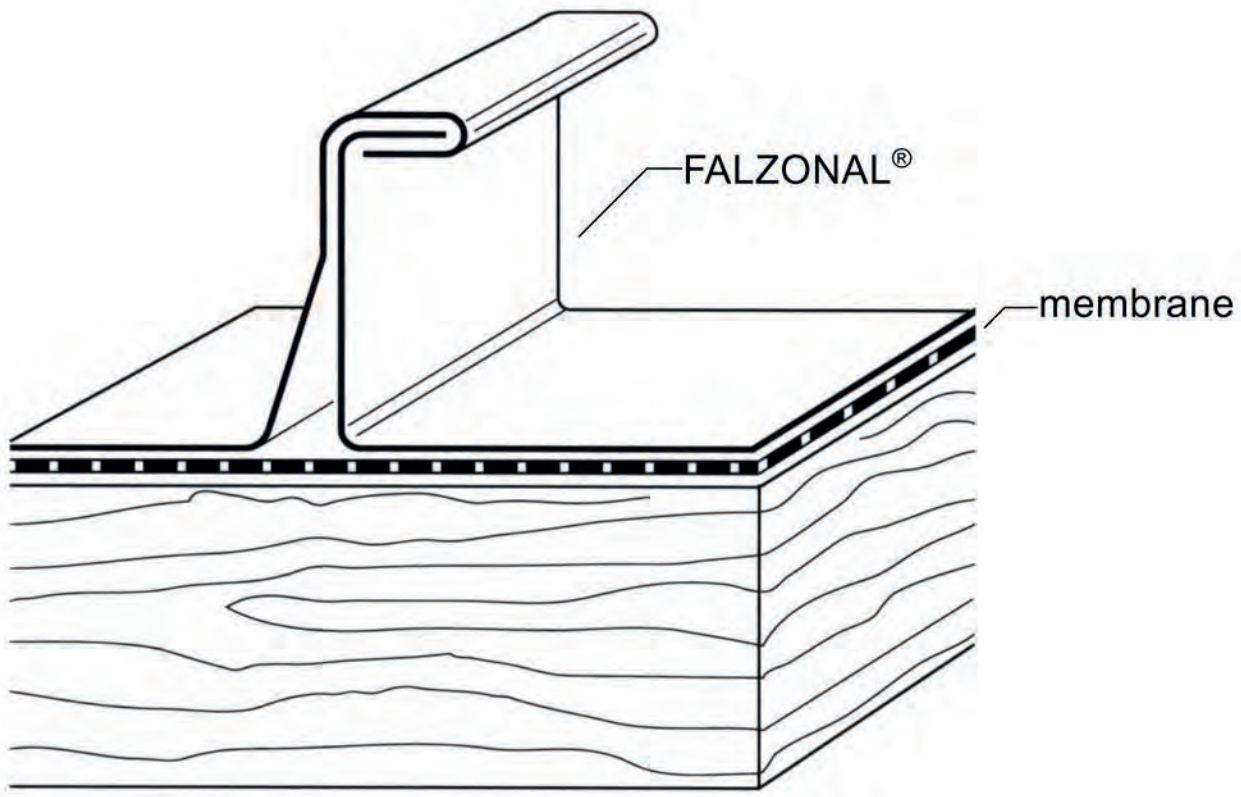
Cross connection



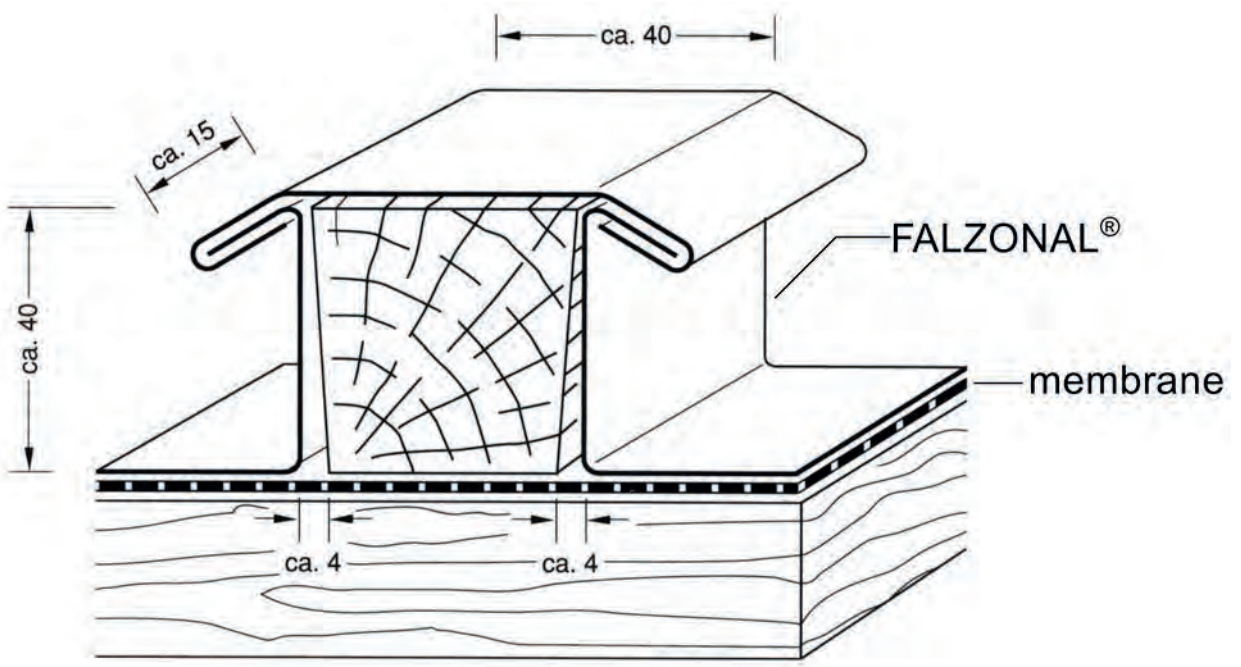
Double seam



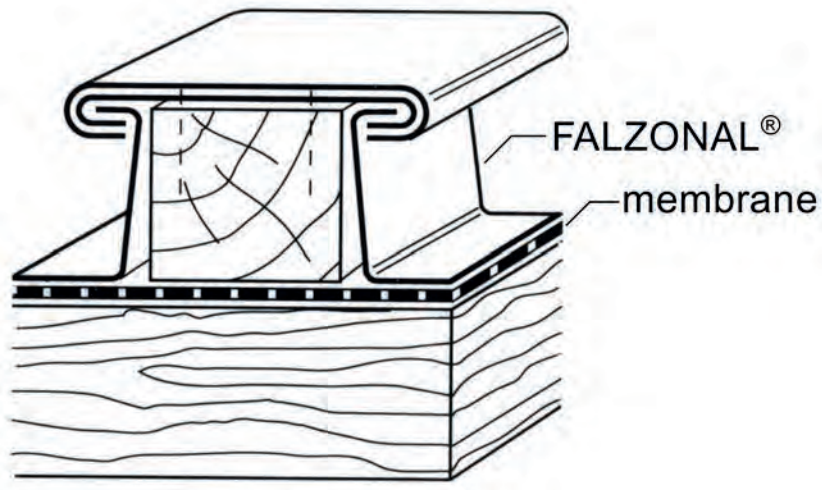
Angled seam



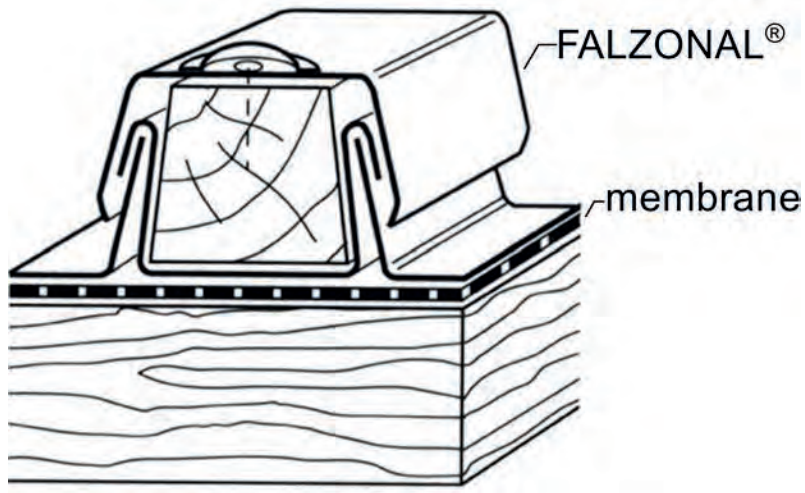
Batten roll



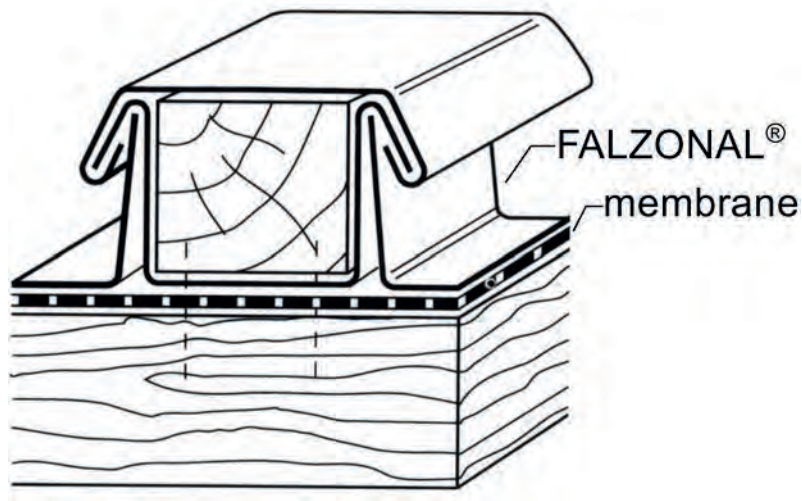
Batten roll
German system



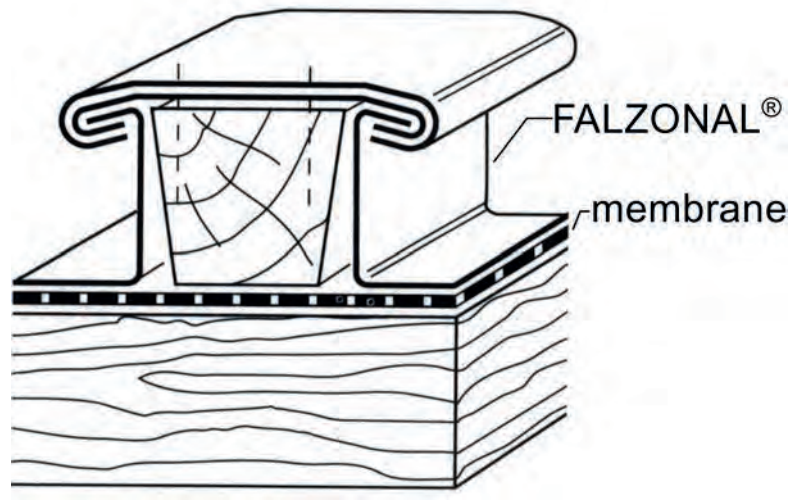
Batten roll
Swiss system



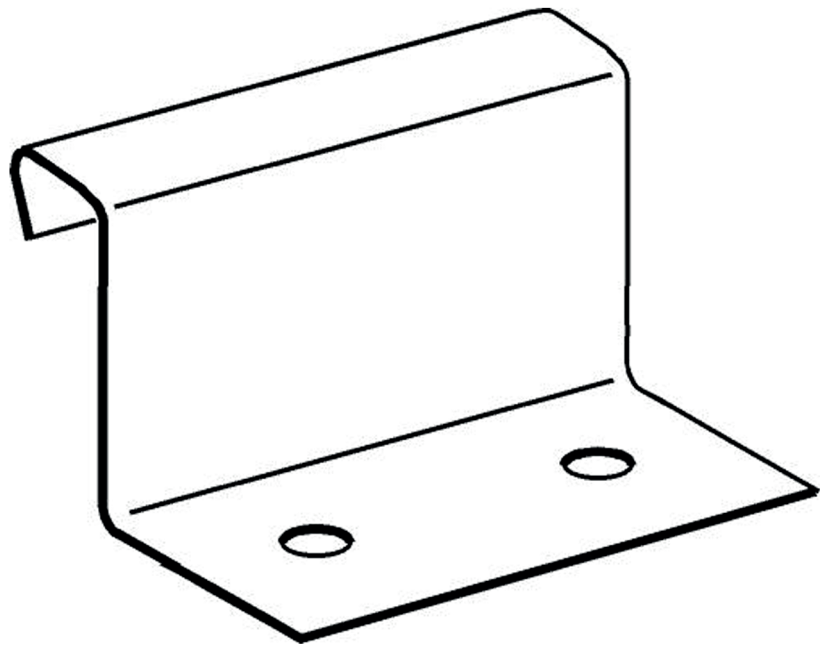
Batten roll
Belgian system



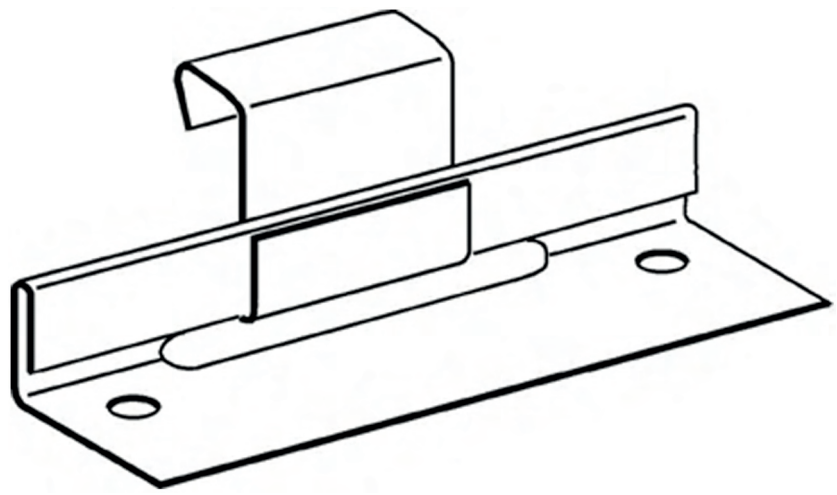
Batten roll
French system



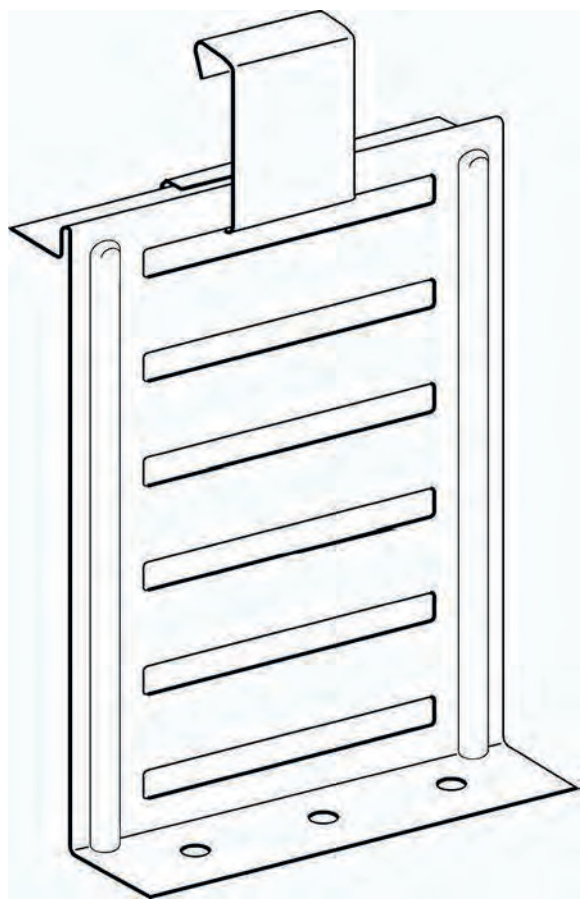
Fixed clip



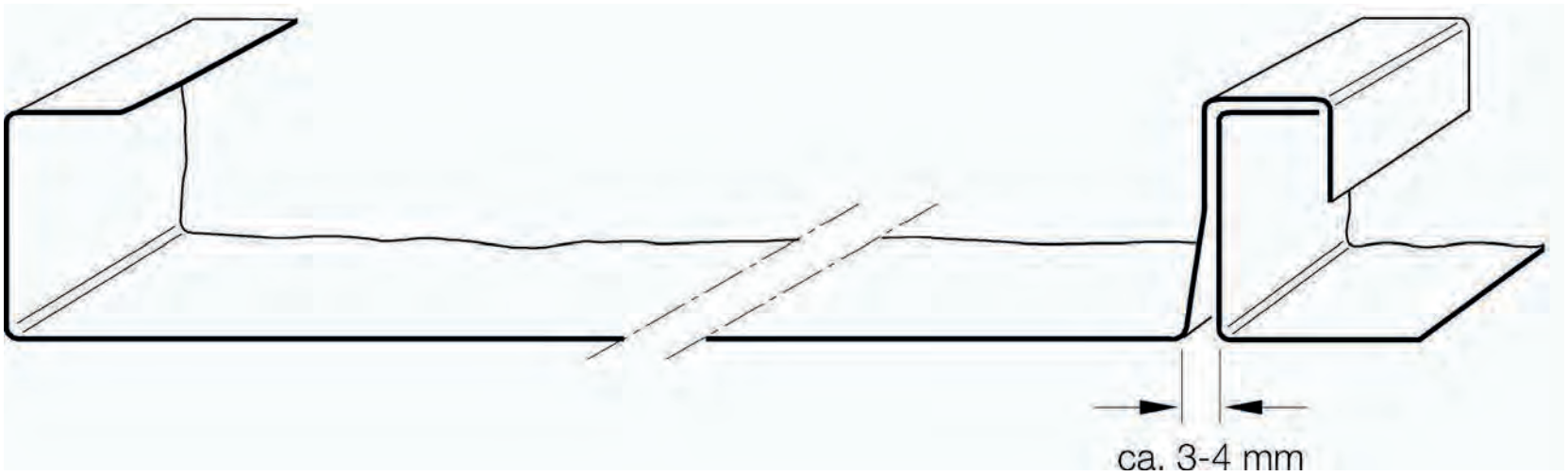
Sliding clip



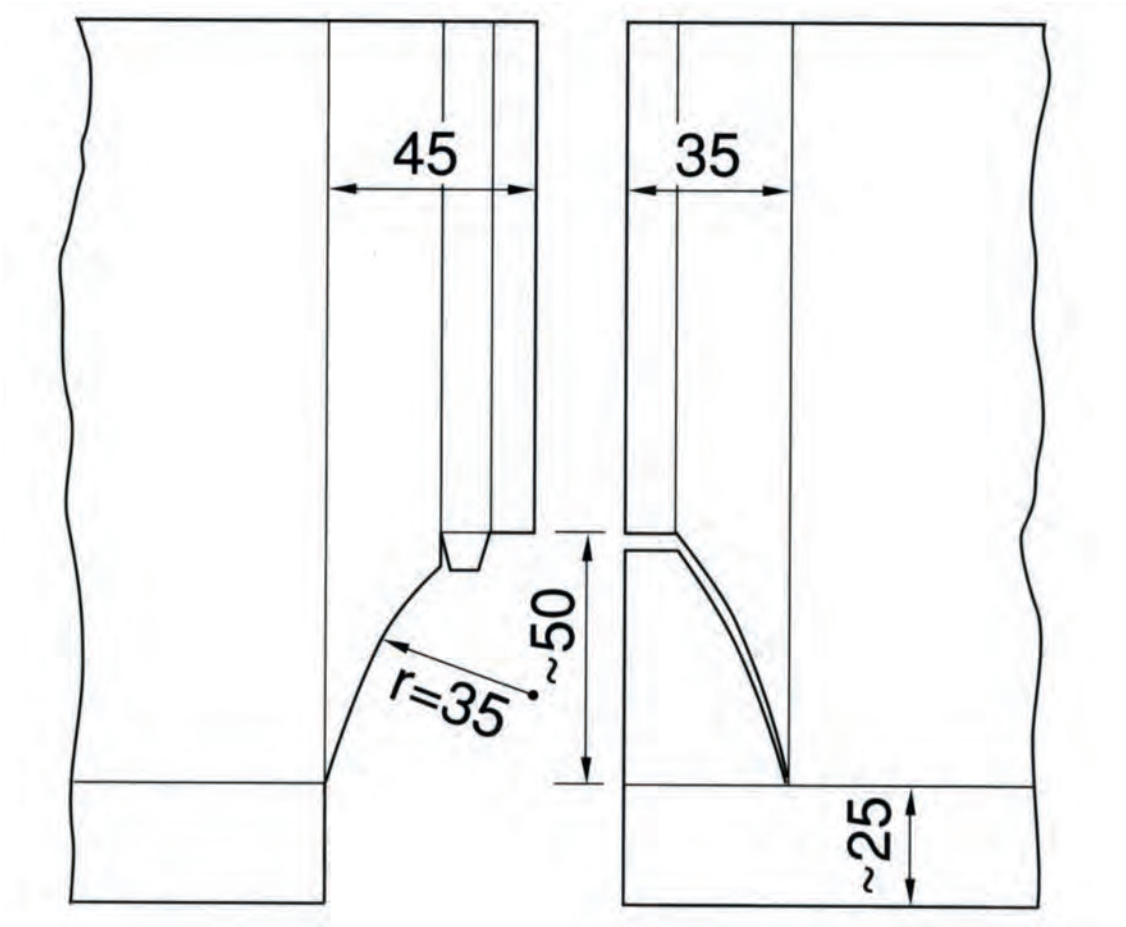
Sliding clip for warm roof construction (with walkability rockwool-construction)

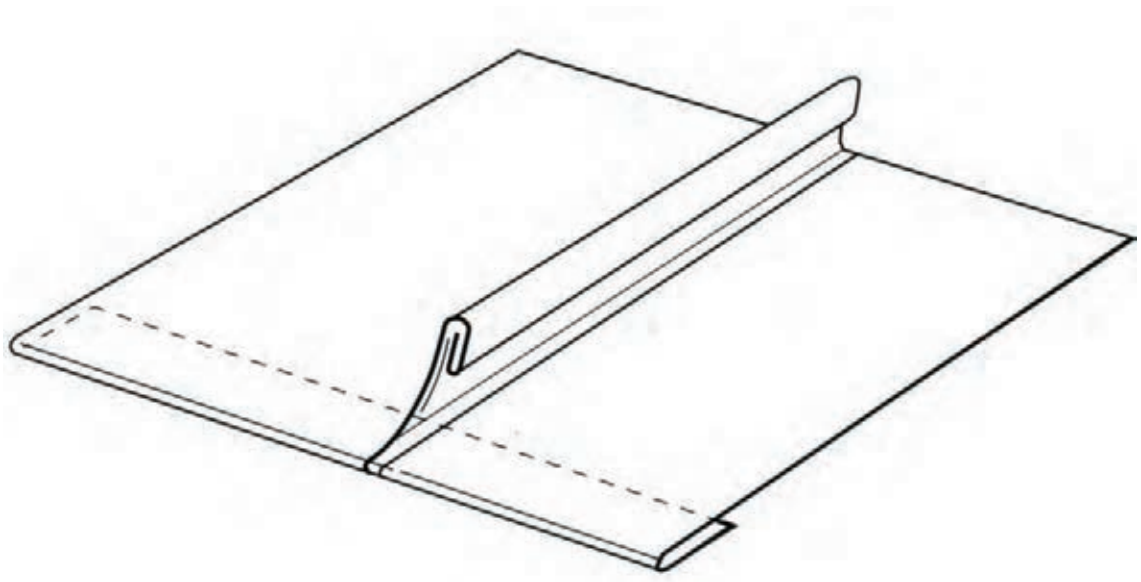


Preprofiled trays

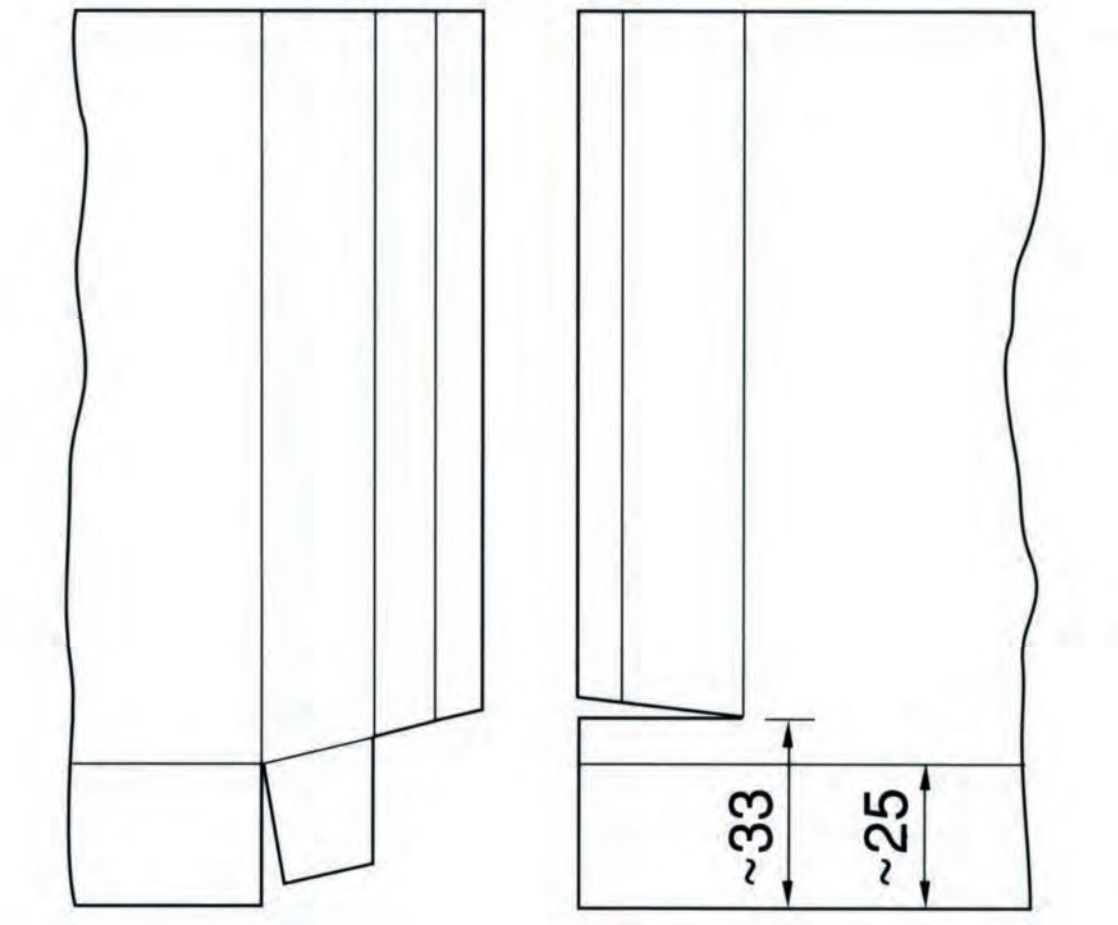


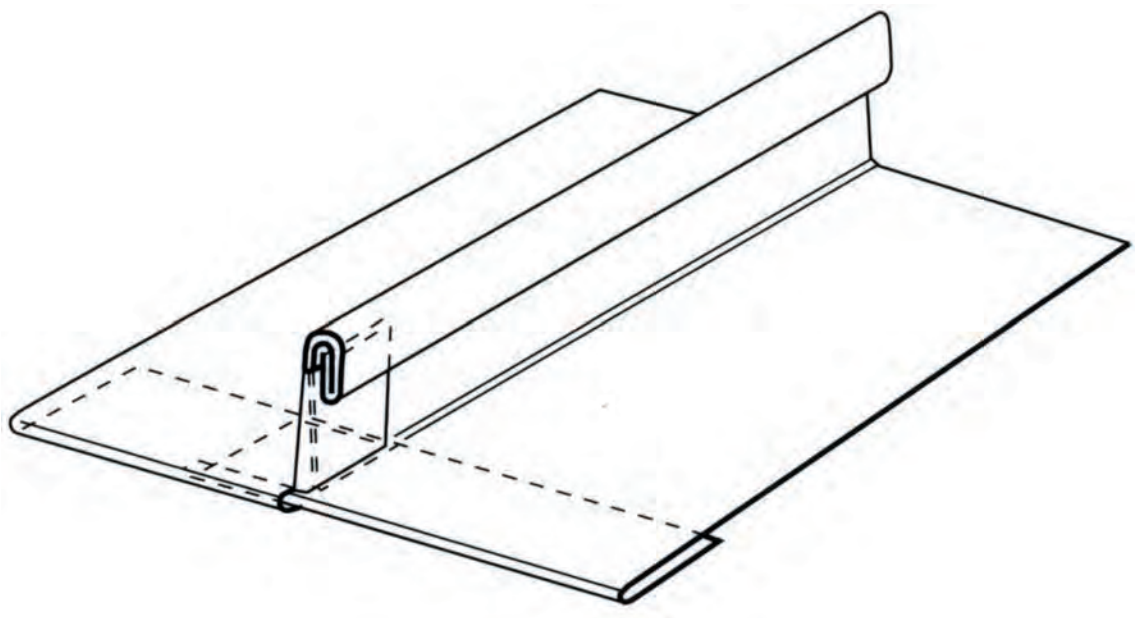
Eaves interface - standing seam with inclined finish



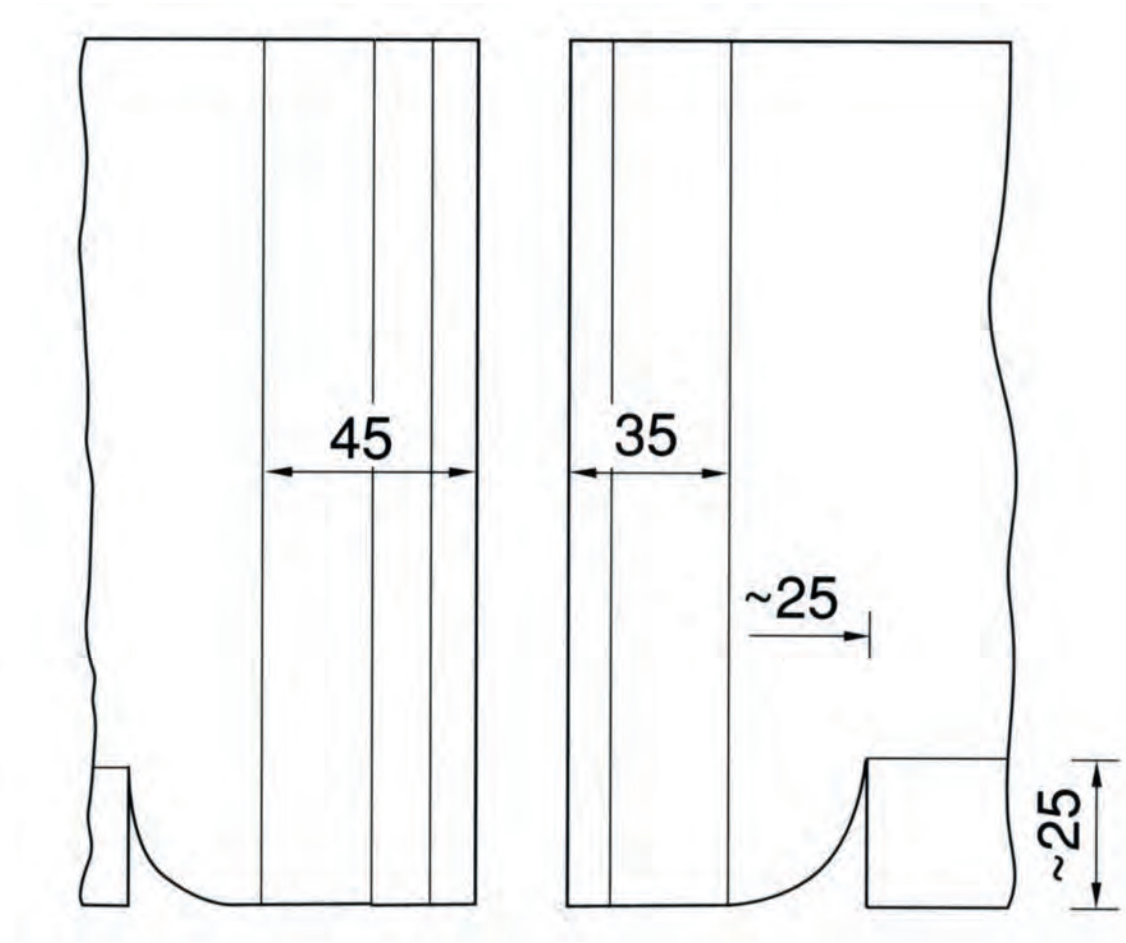


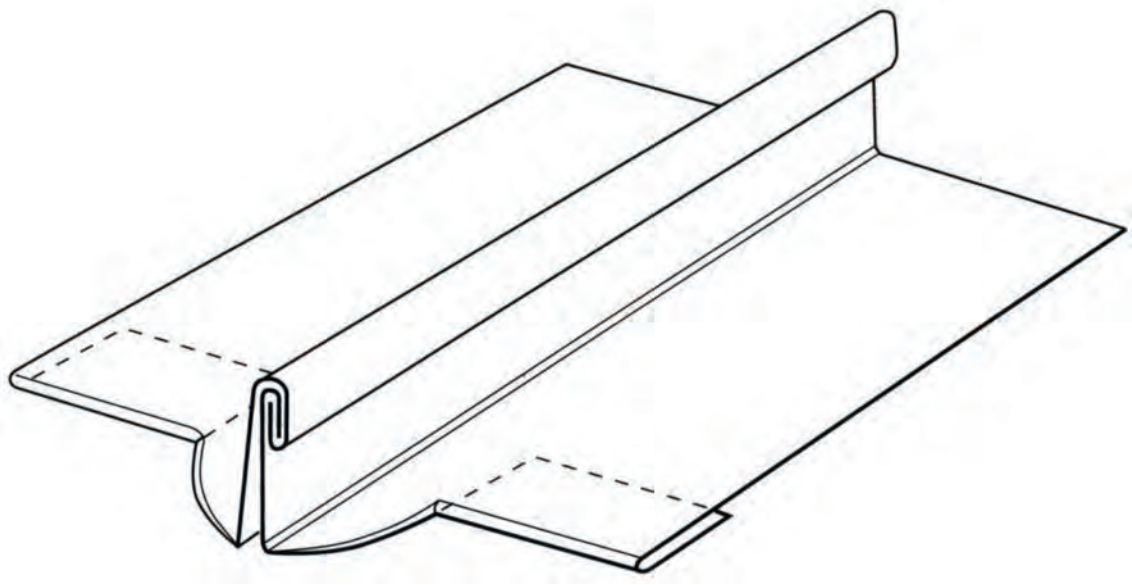
Double lock standing seam - vertical finish



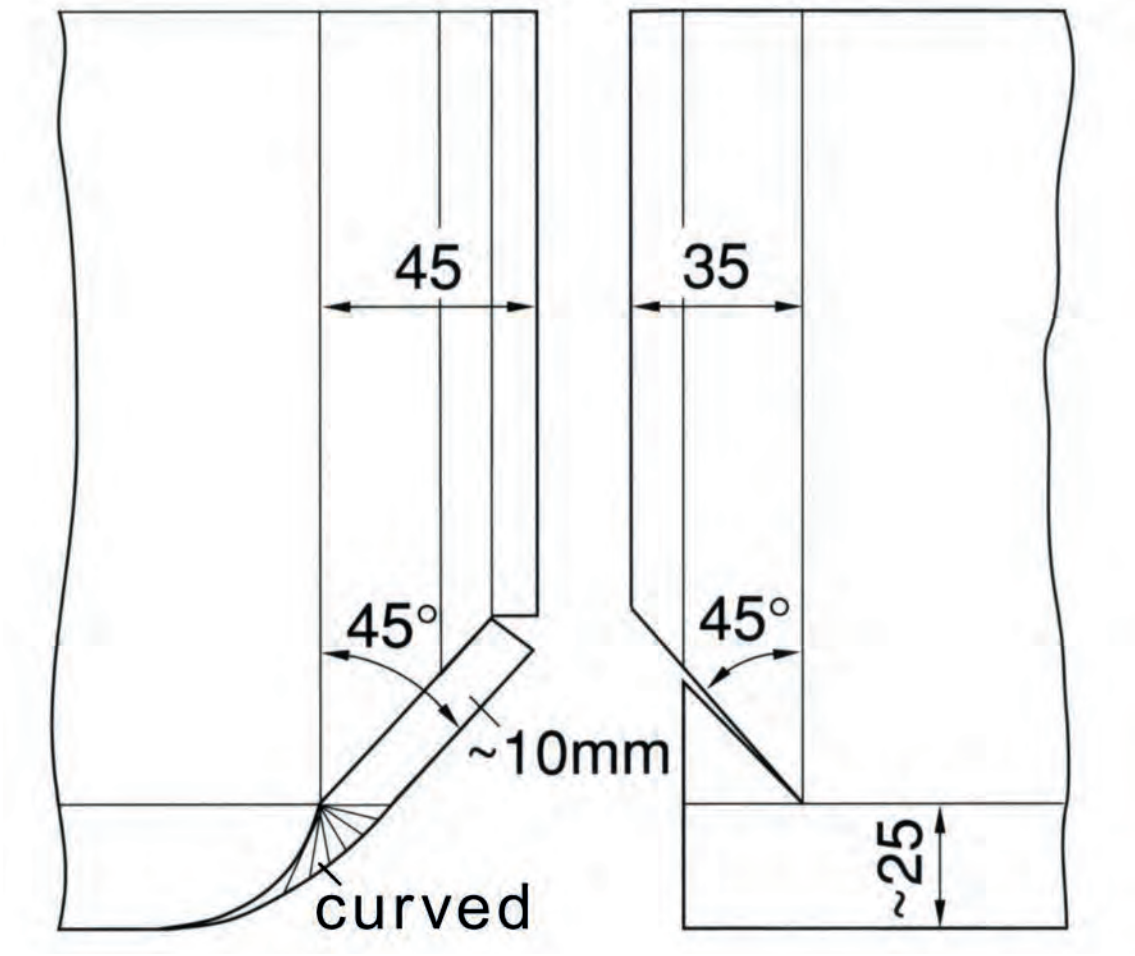


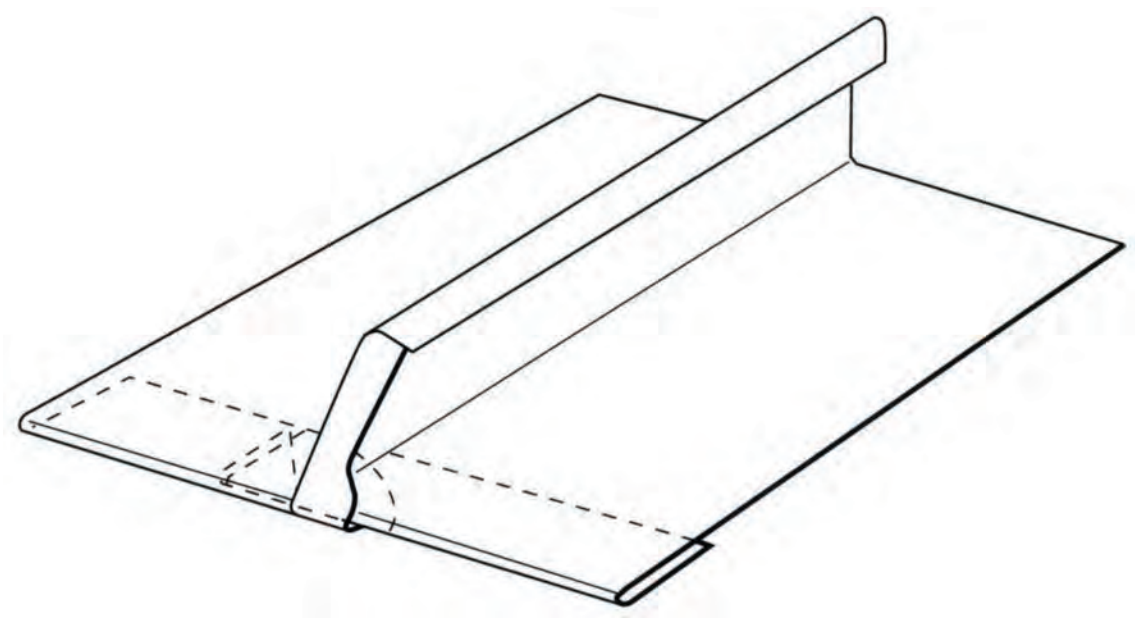
Eaves interface - standing seam with rounded finish



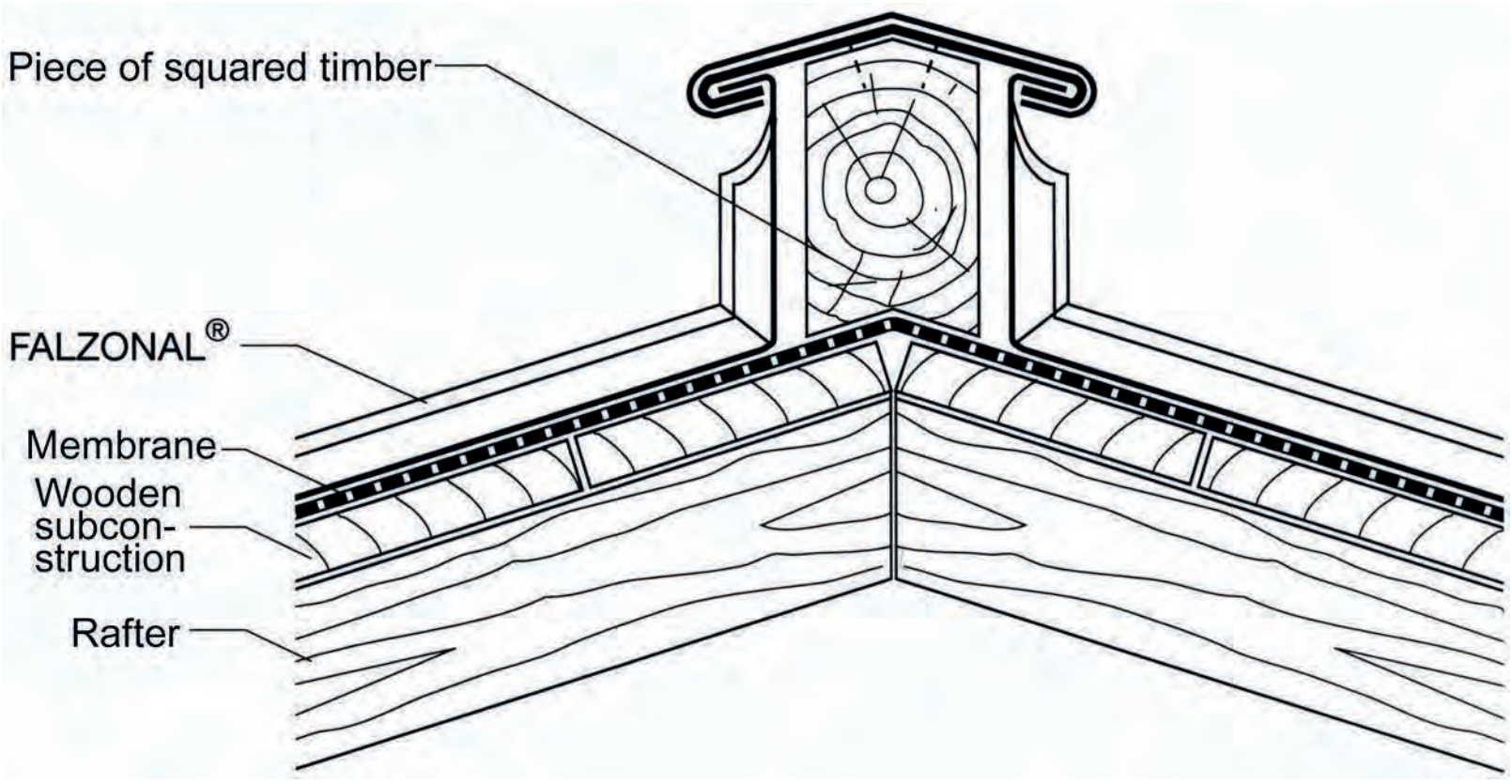


Eaves interface - double standing seam curved

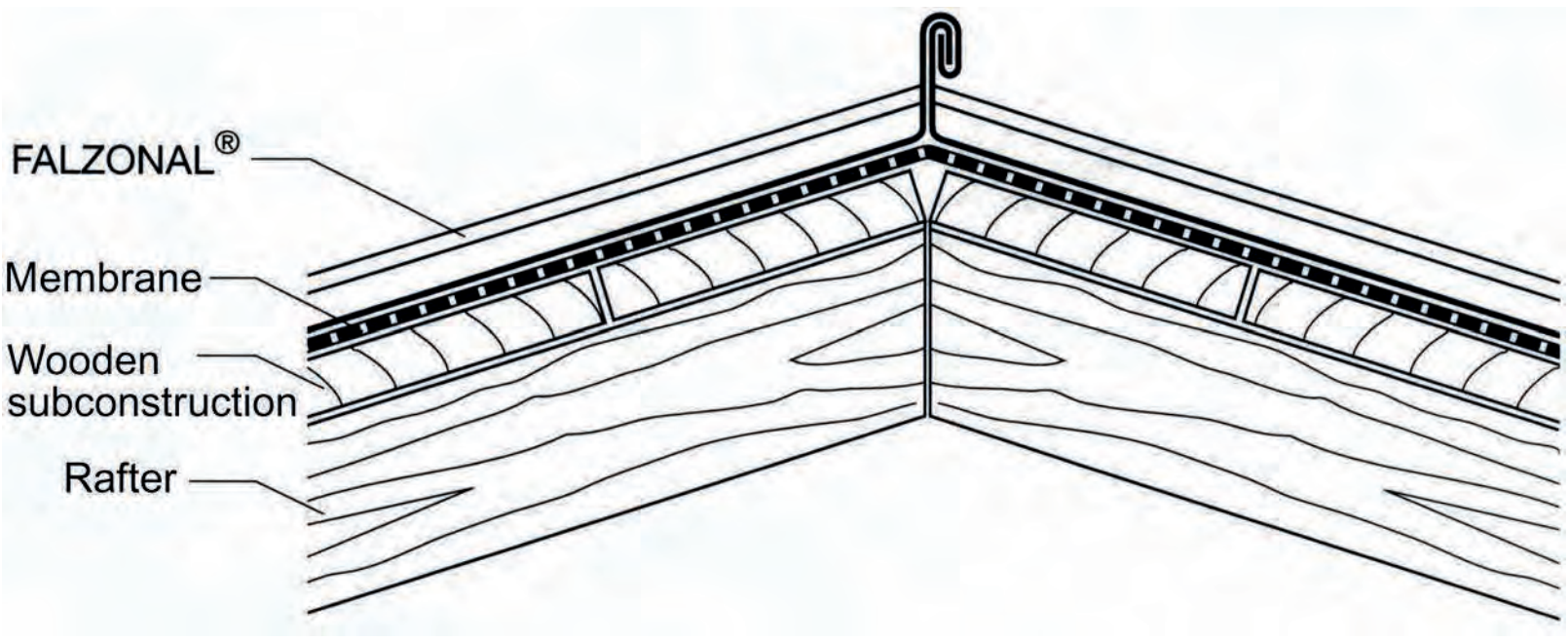




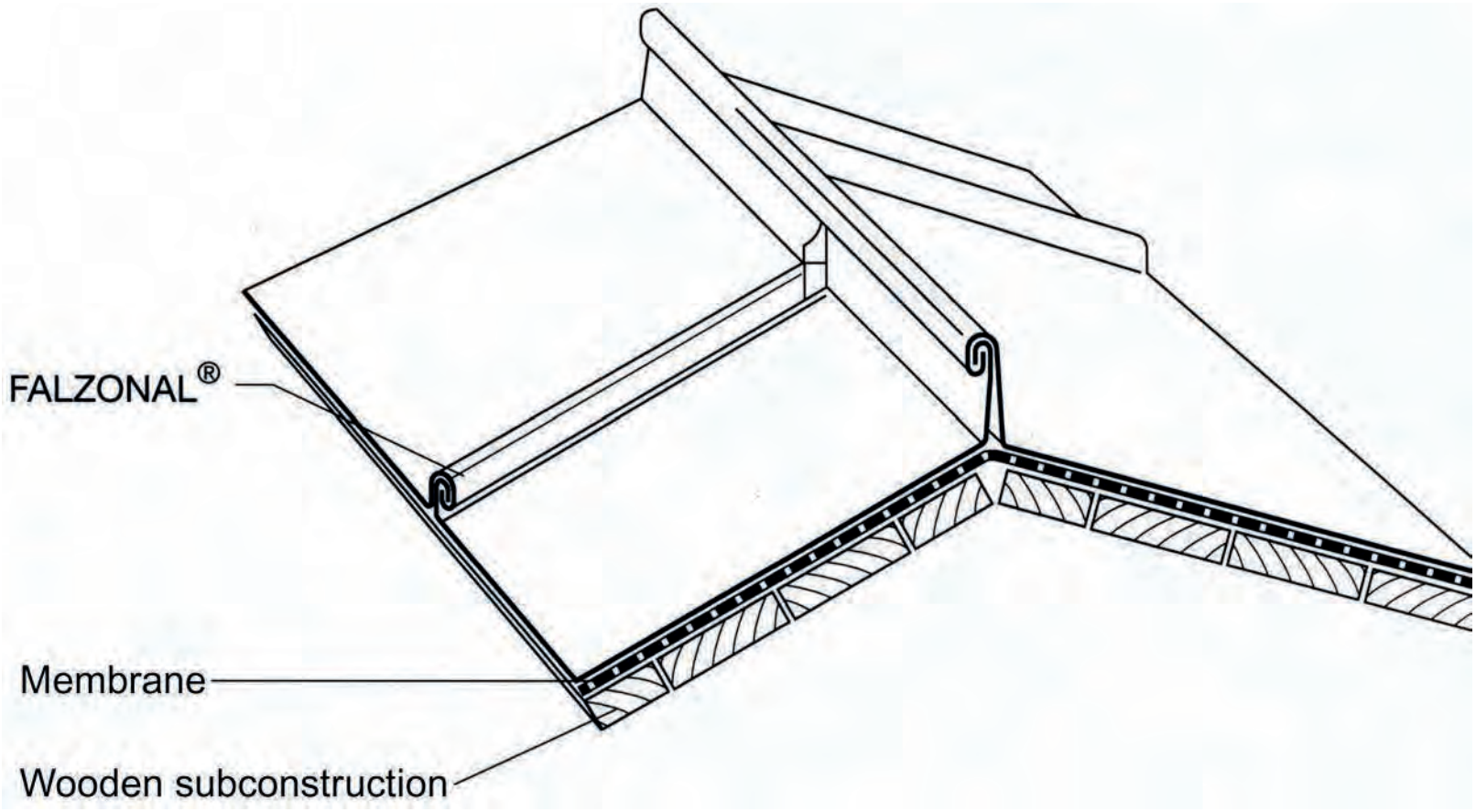
Ridge construction - unventilated



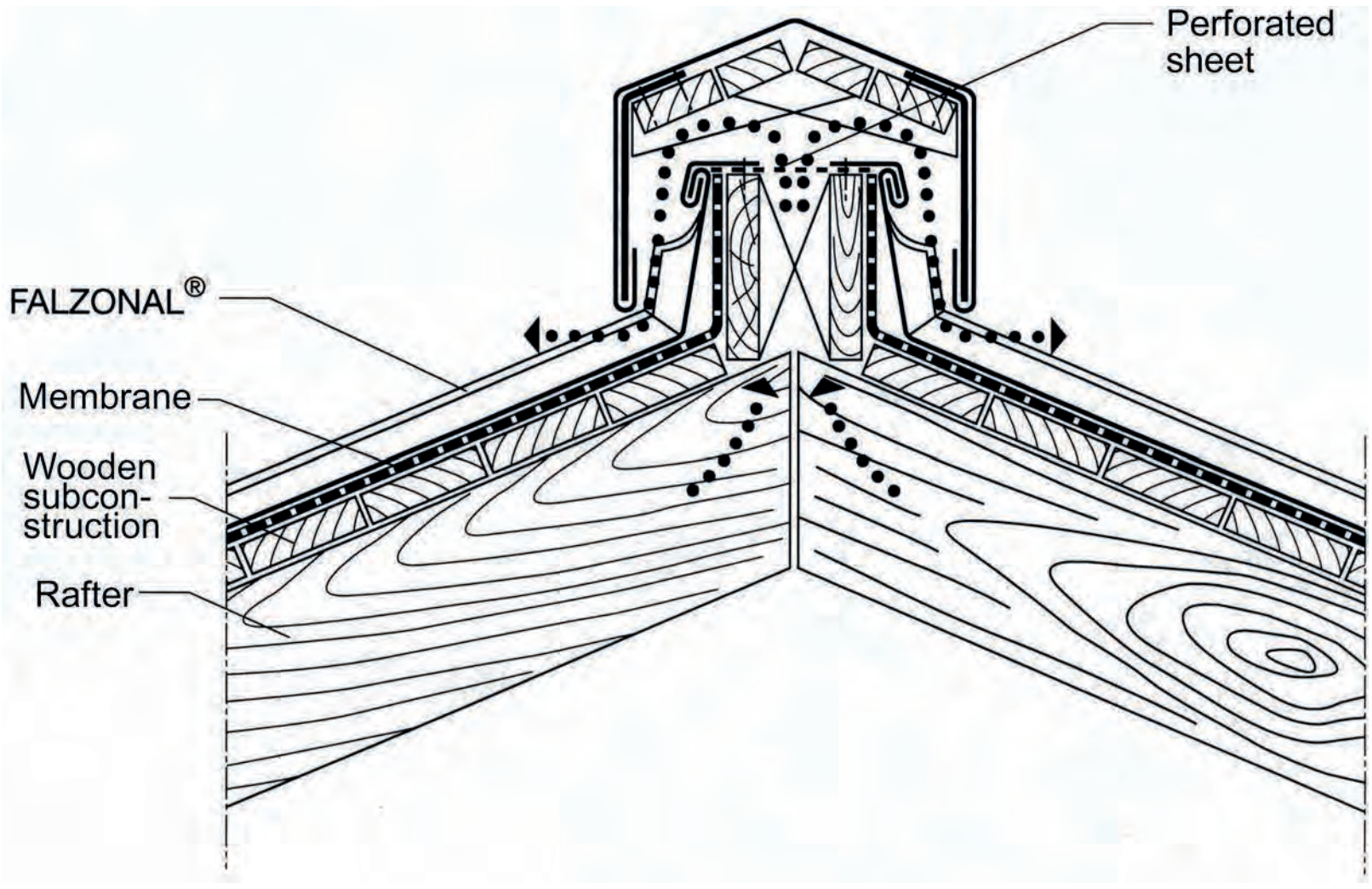
Ridge construction - unventilated



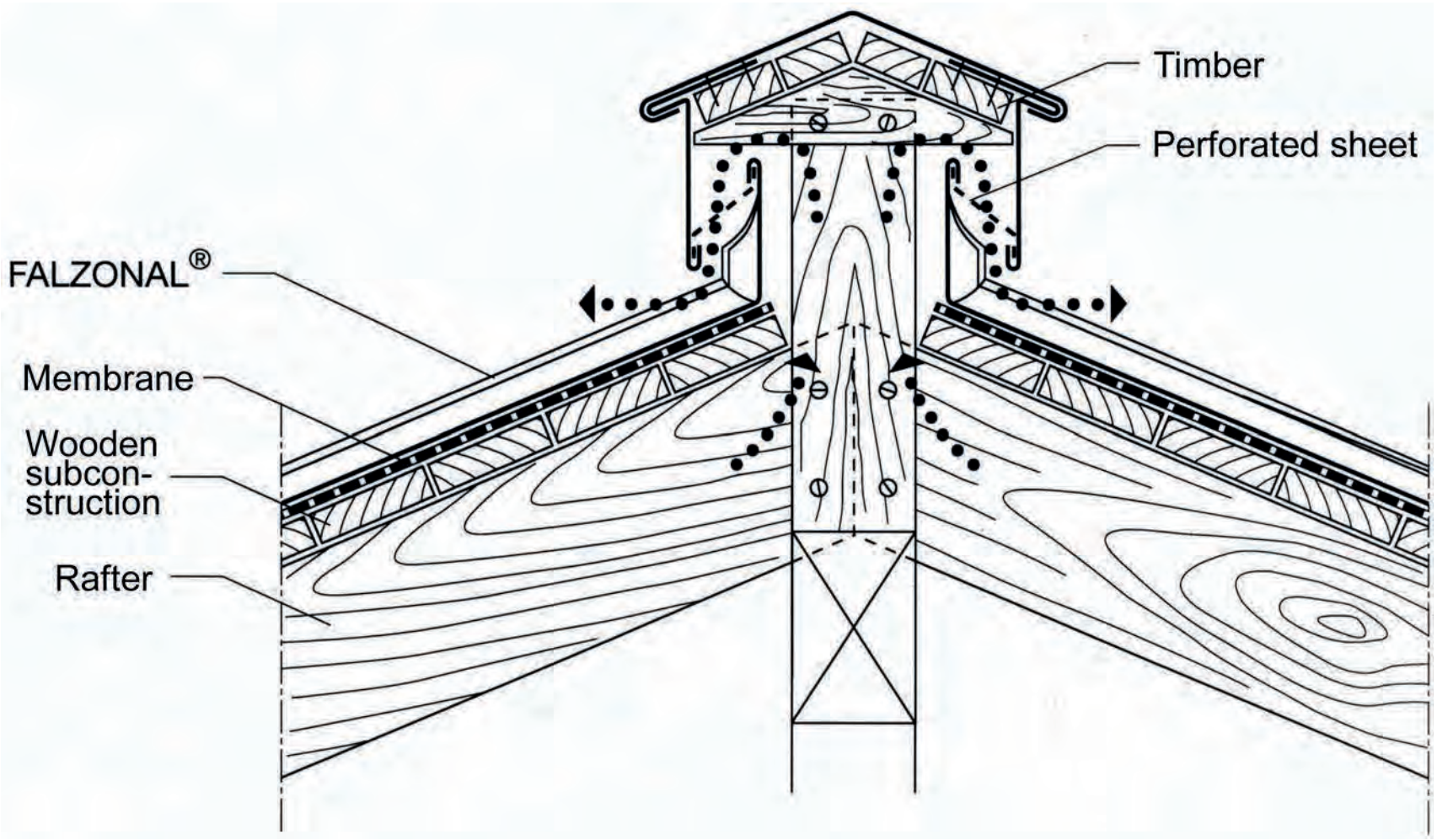
Seamed ridge



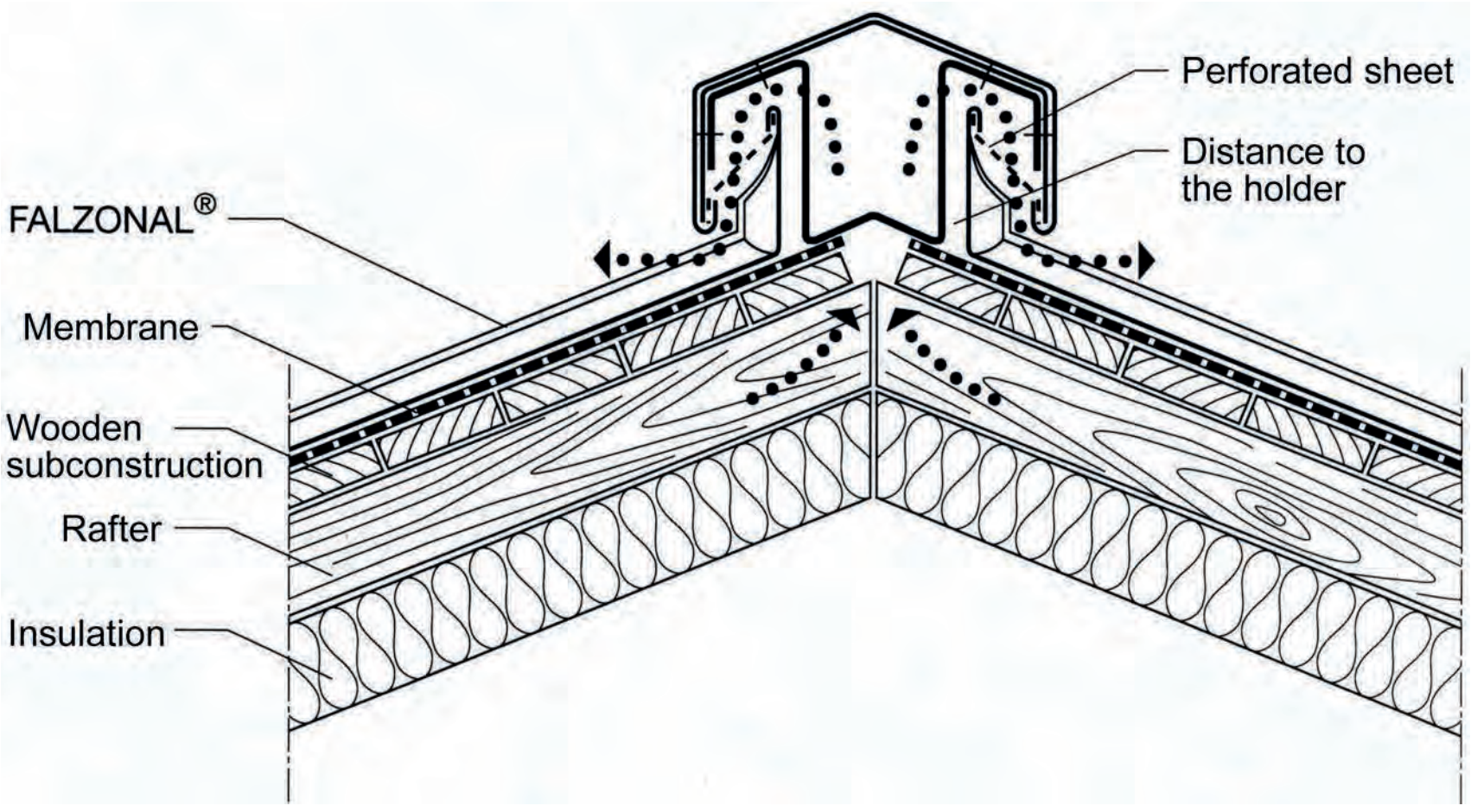
Ridge construction - ventilated



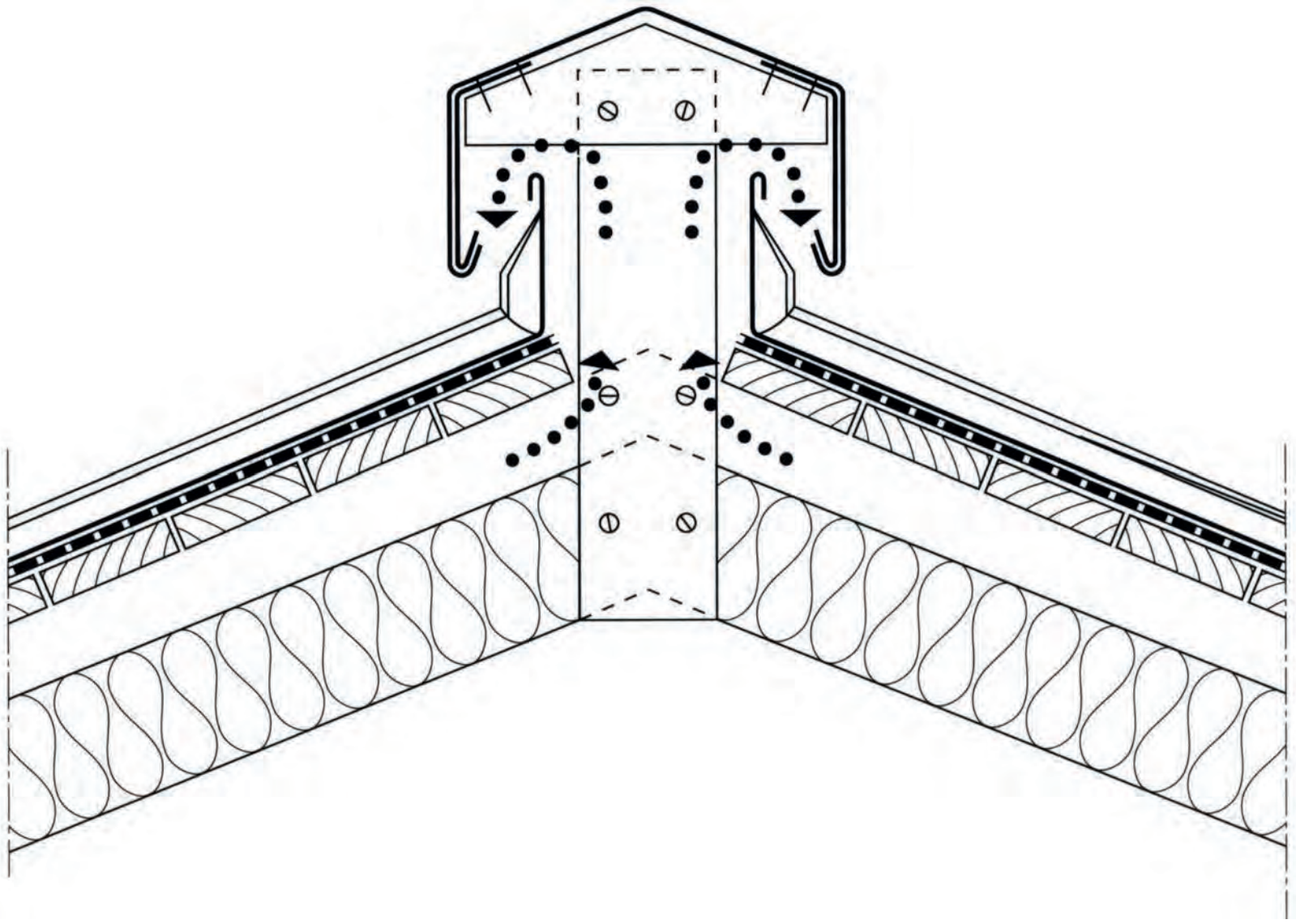
Ridge construction - ventilated



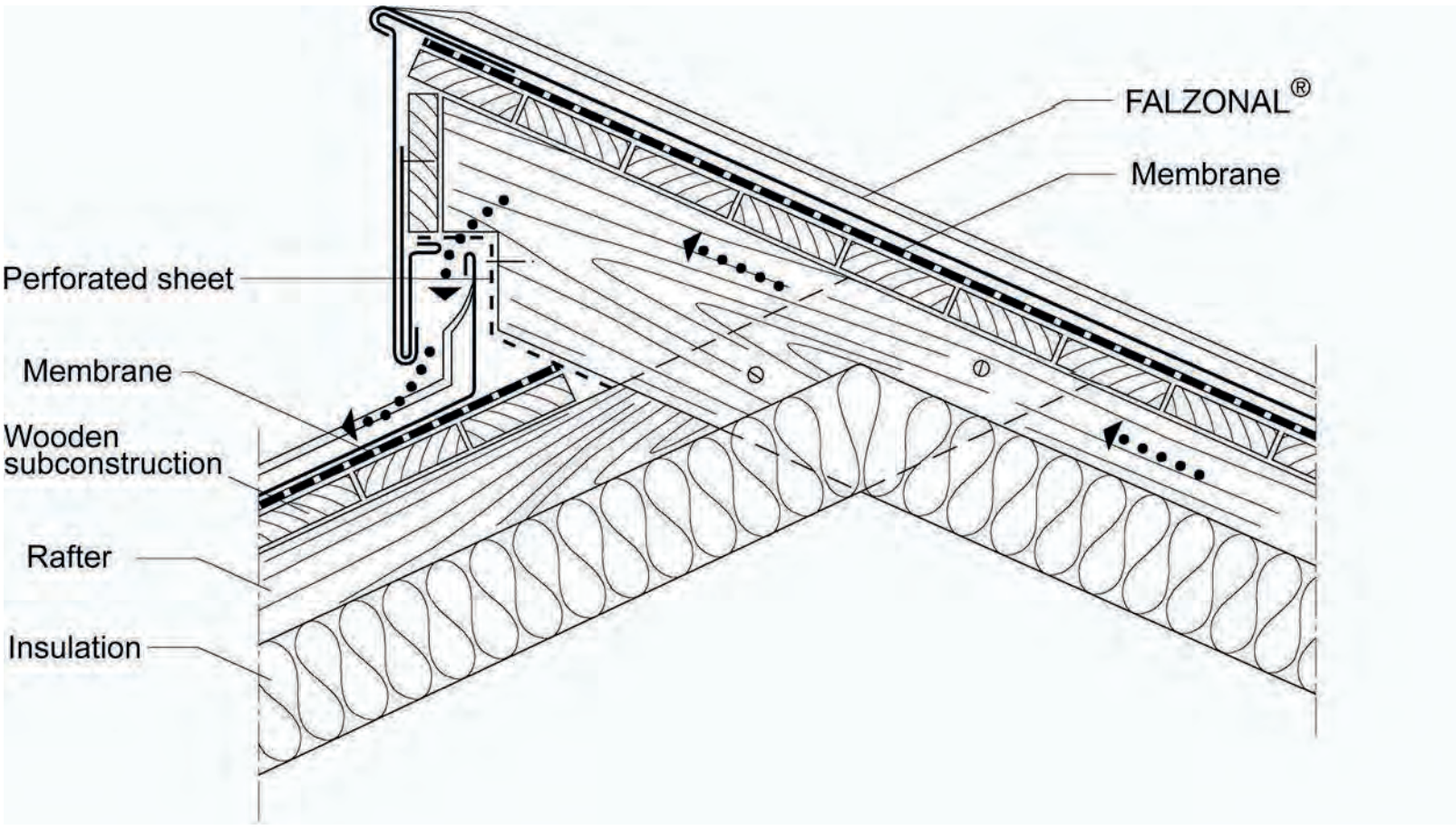
Ridge construction - ventilated



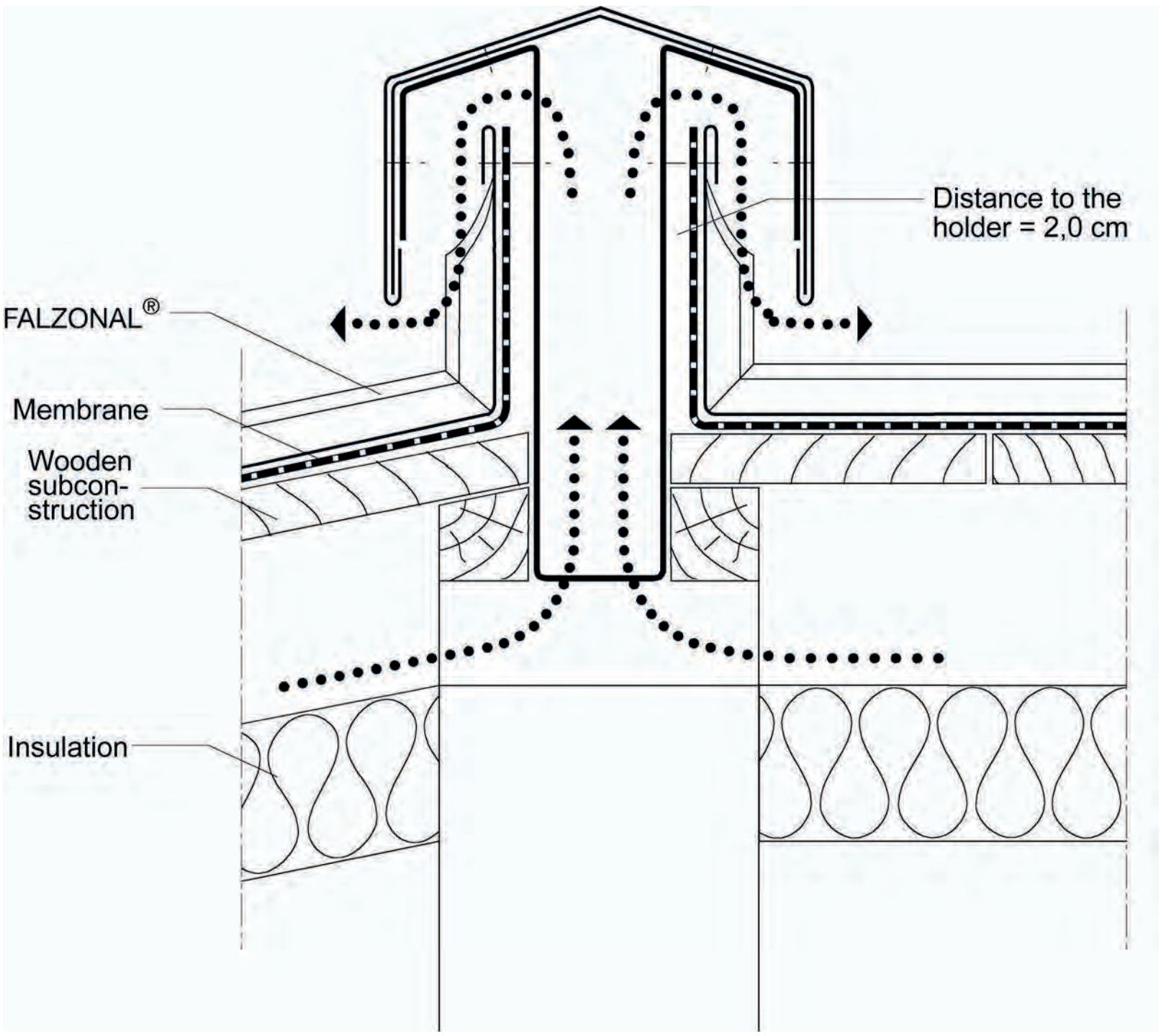
Ridge construction - ventilated



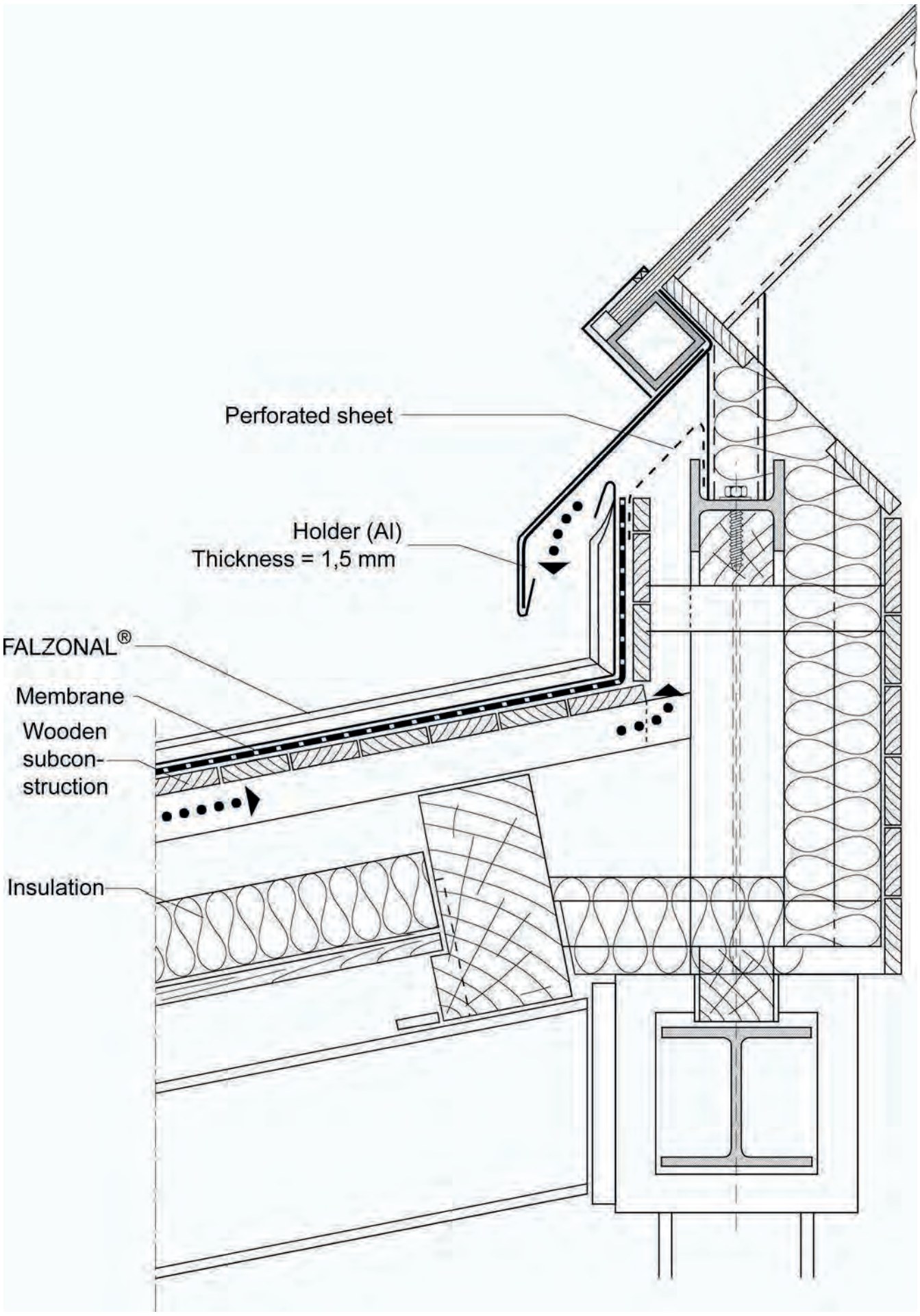
Ridge construction - ventilated



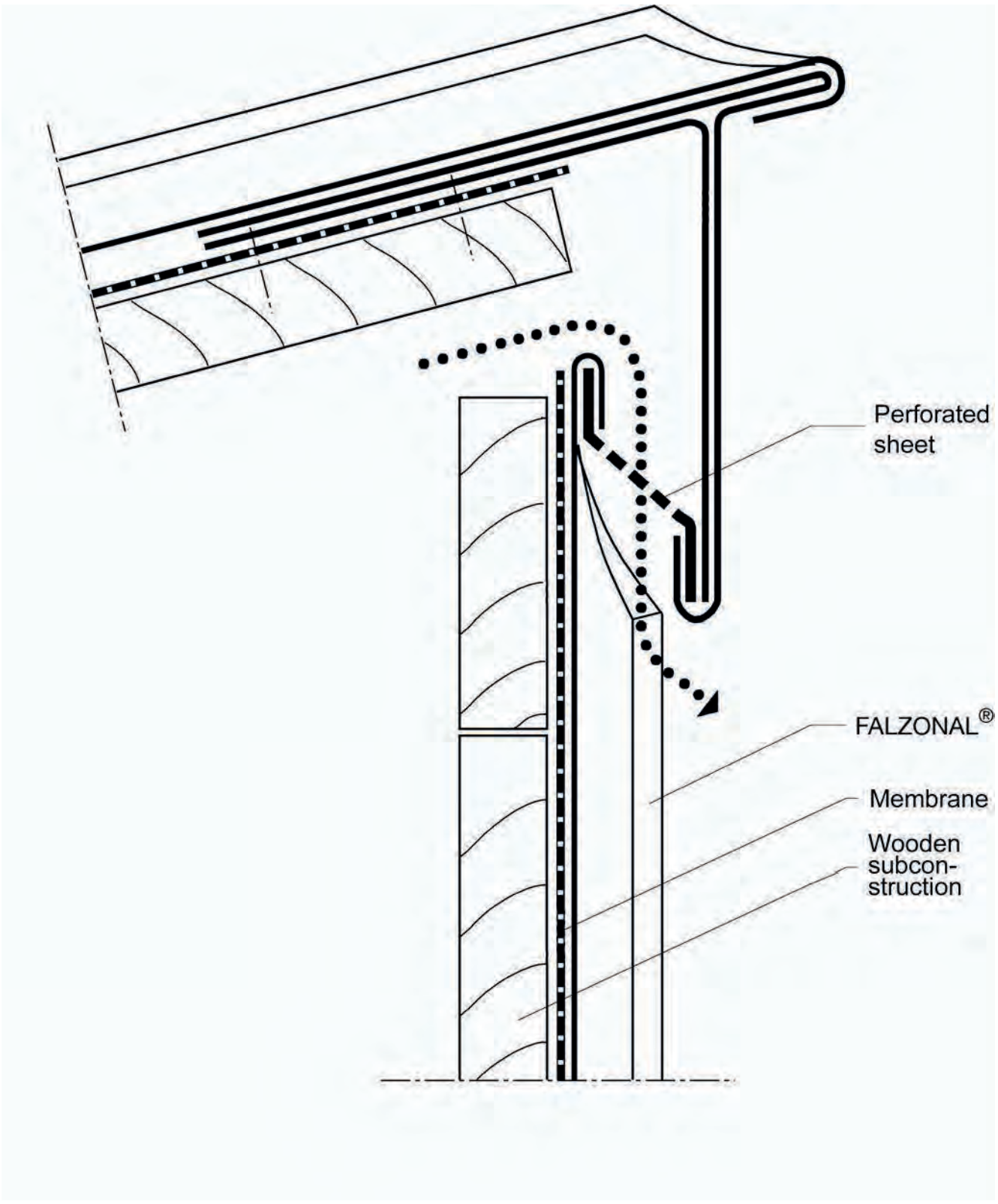
Ridge cap - ventilated



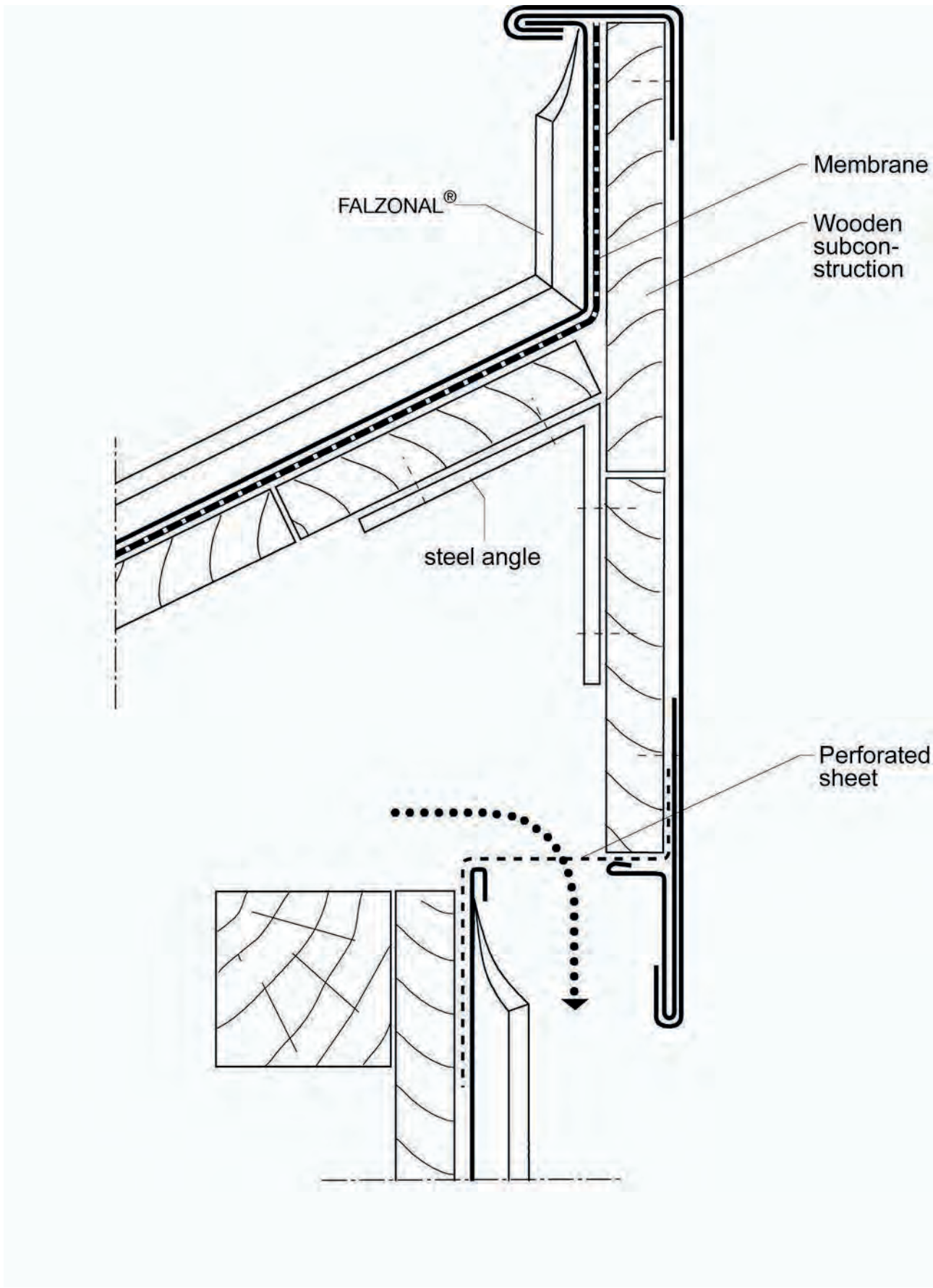
Ridgepoint - glazed



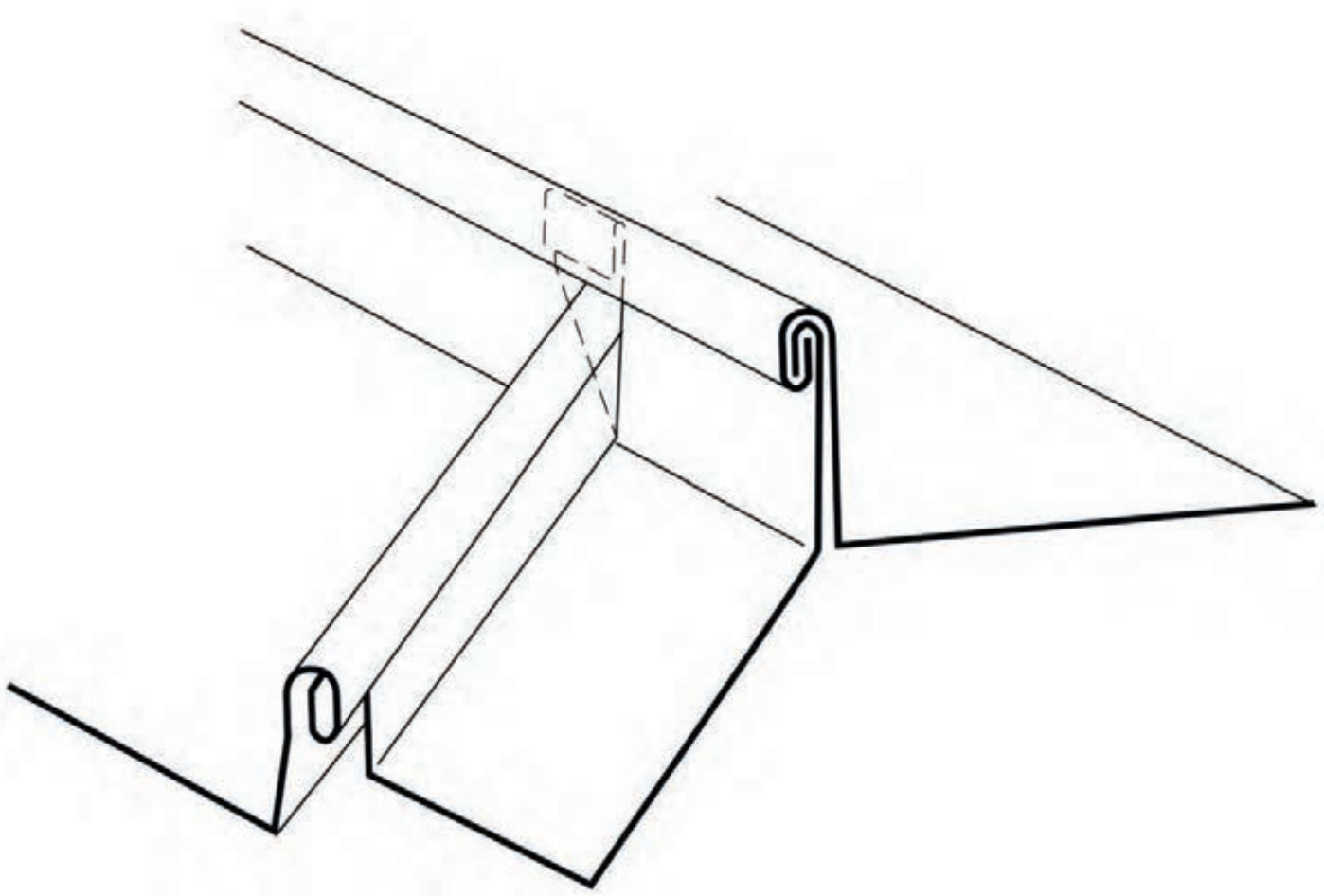
Monopitch roof-ventilated ridge interface

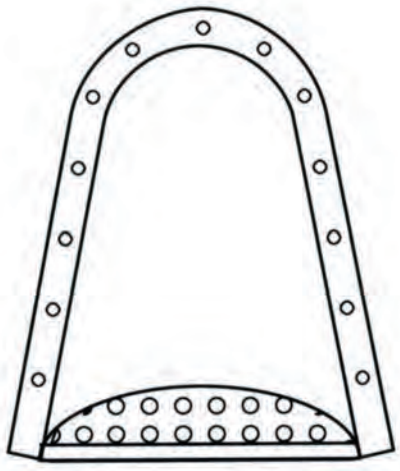


Monopitch roof - ventilated ridge

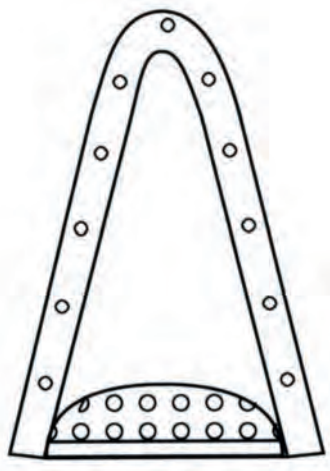


Hip construction - standing seam

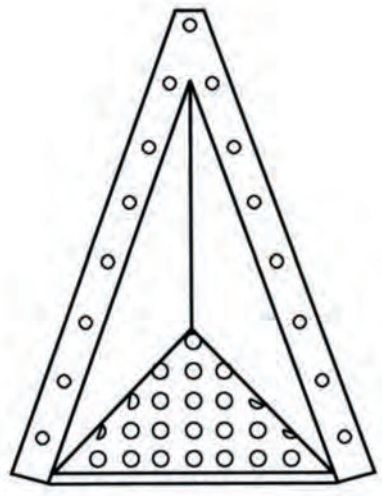




Vent hoods, halfround

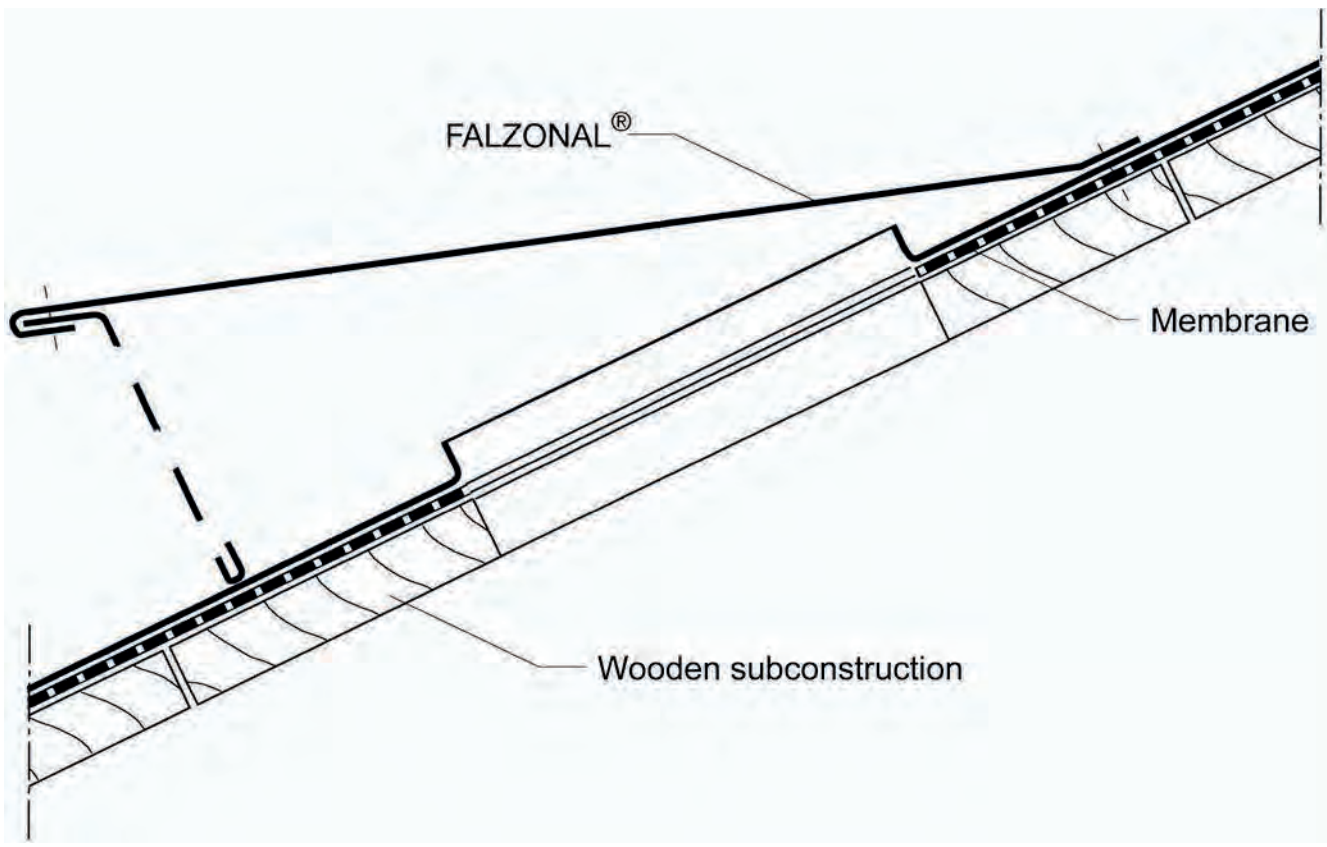


Vent hoods, trapezoidal

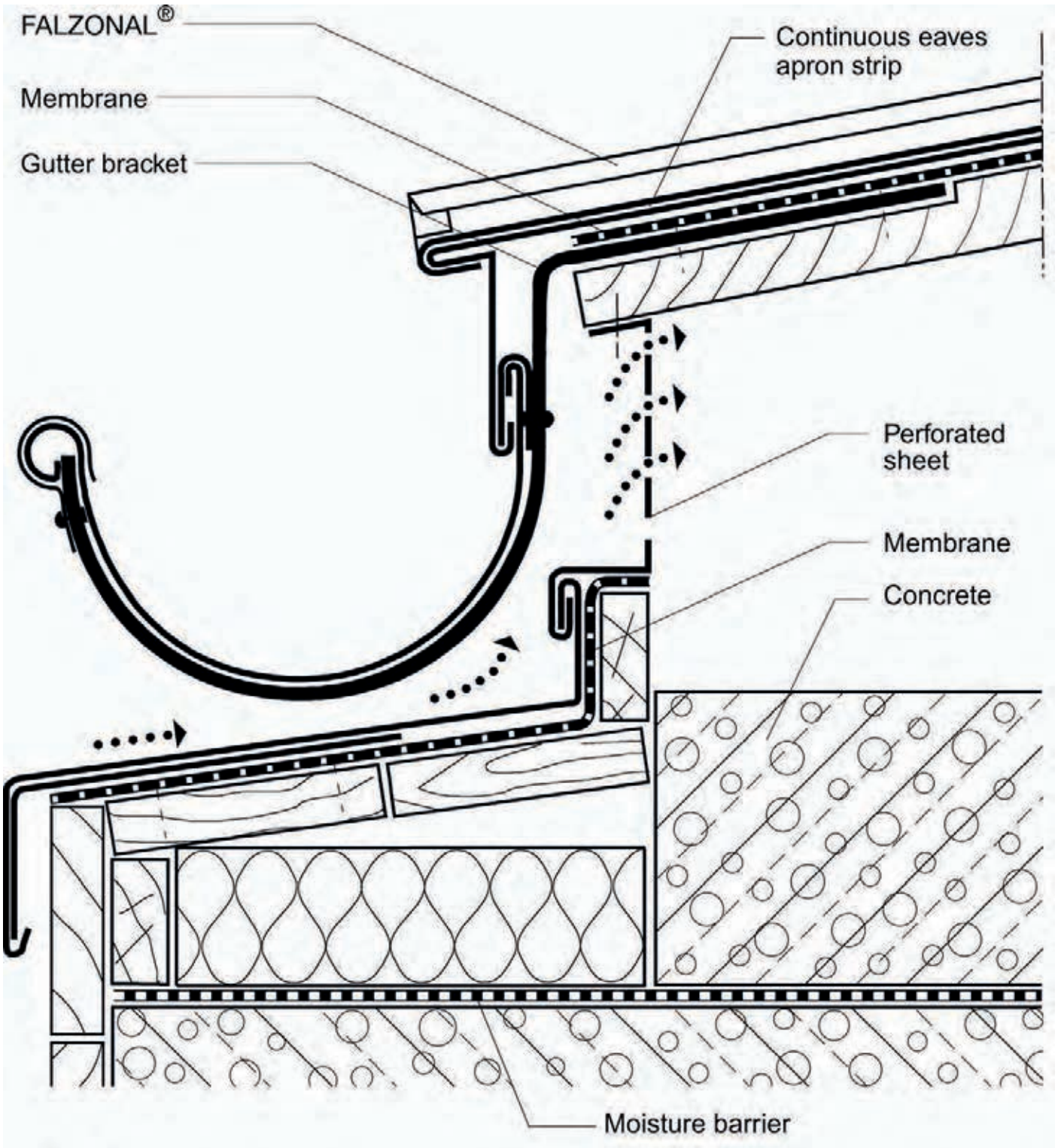


Vent hoods, triangular

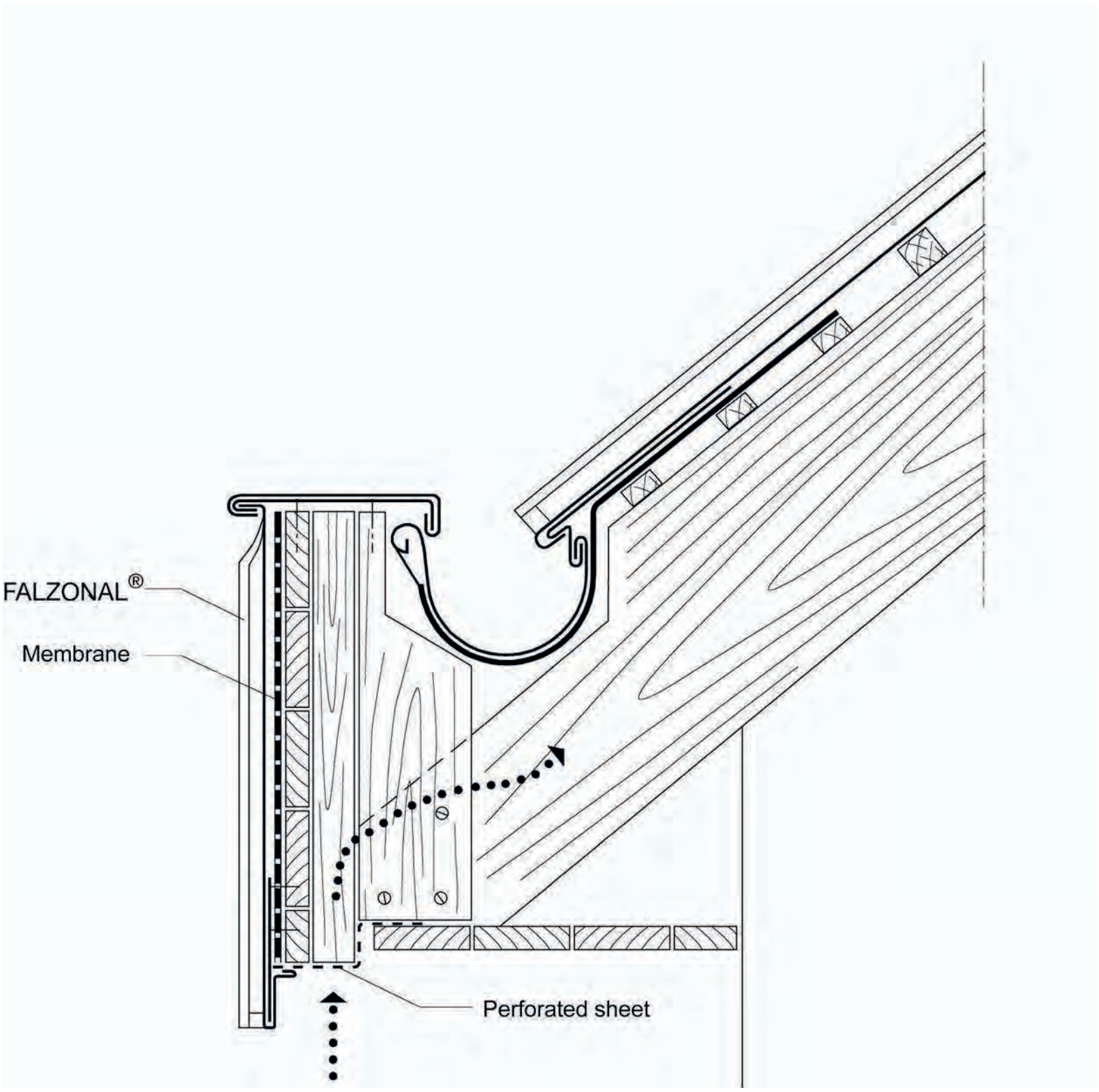
Vent hoods cross-section



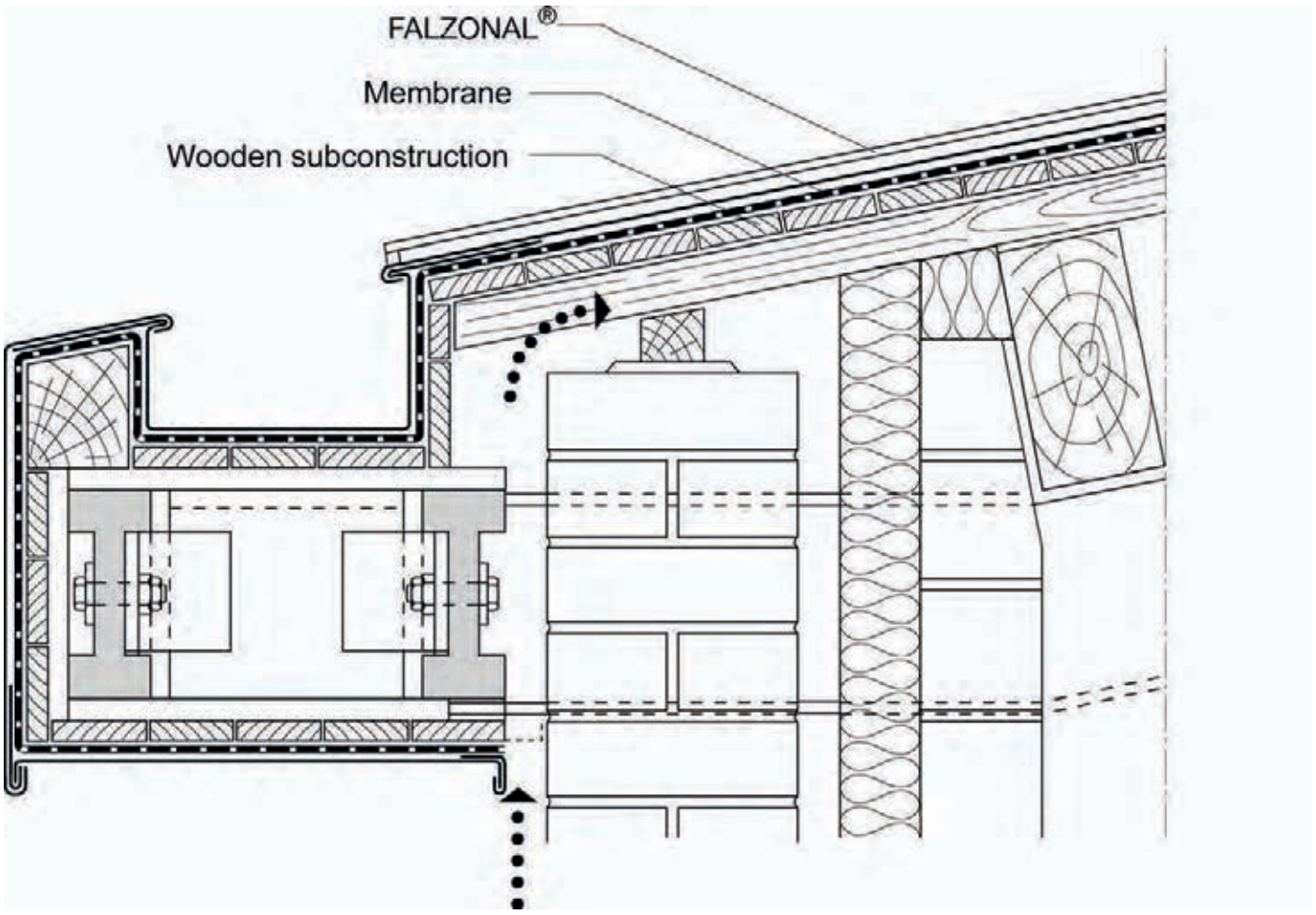
Eaves area


FALZONAL®
Membrane
Gutter bracket
Continuous eaves apron strip
Perforated sheet
Membrane
Concrete
Moisture barrier

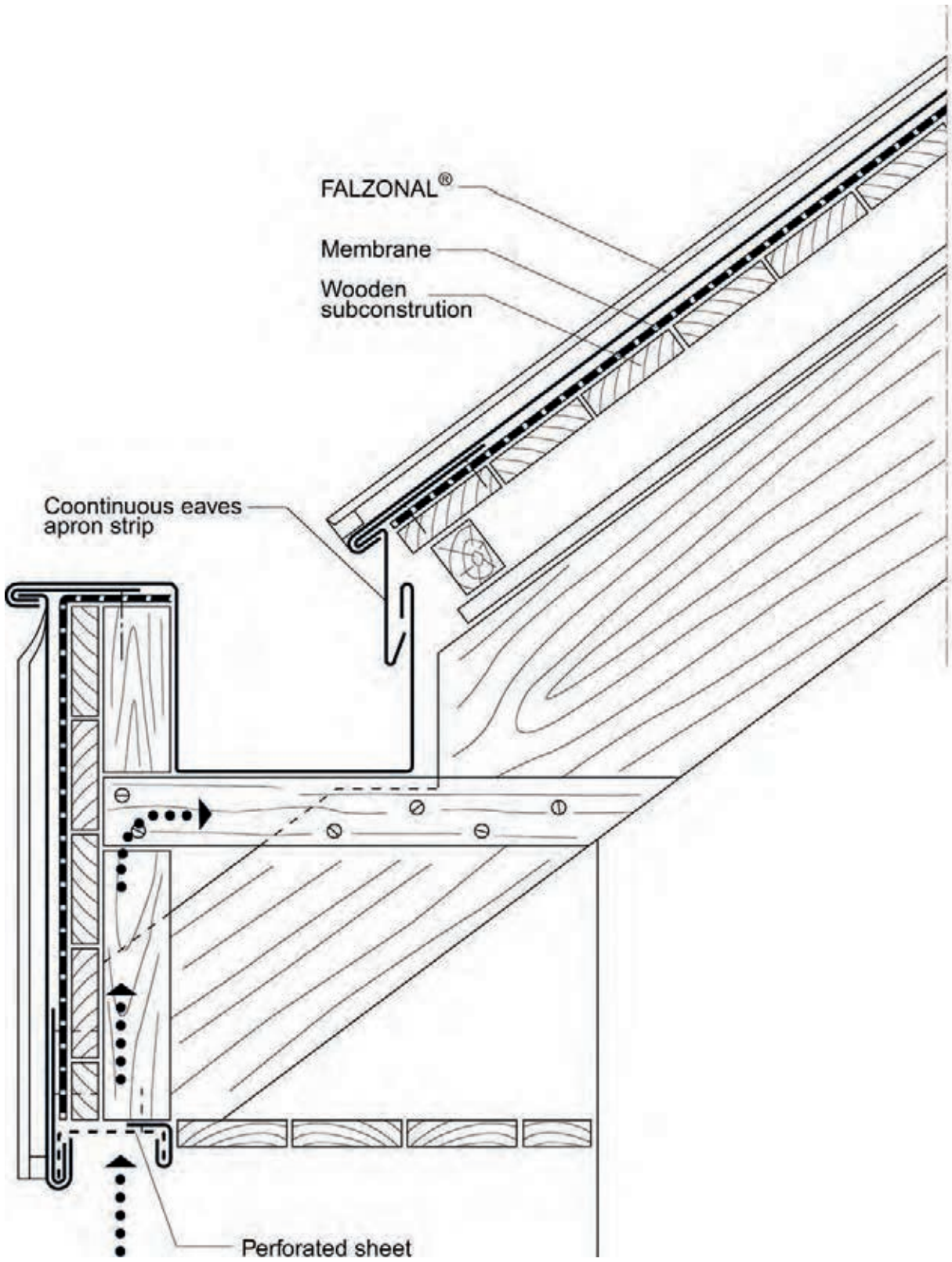
Eaves cladding



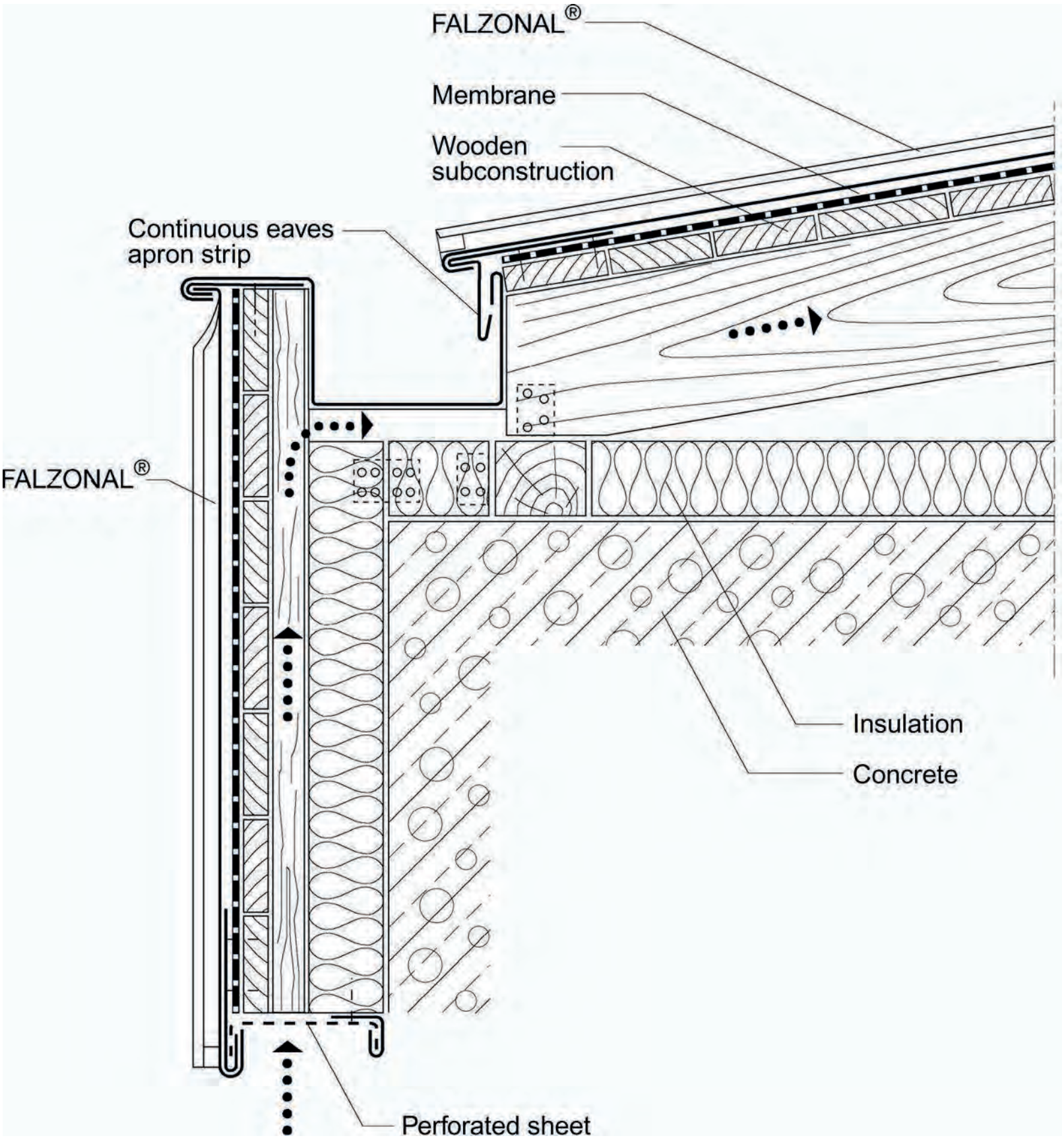
Eaves area



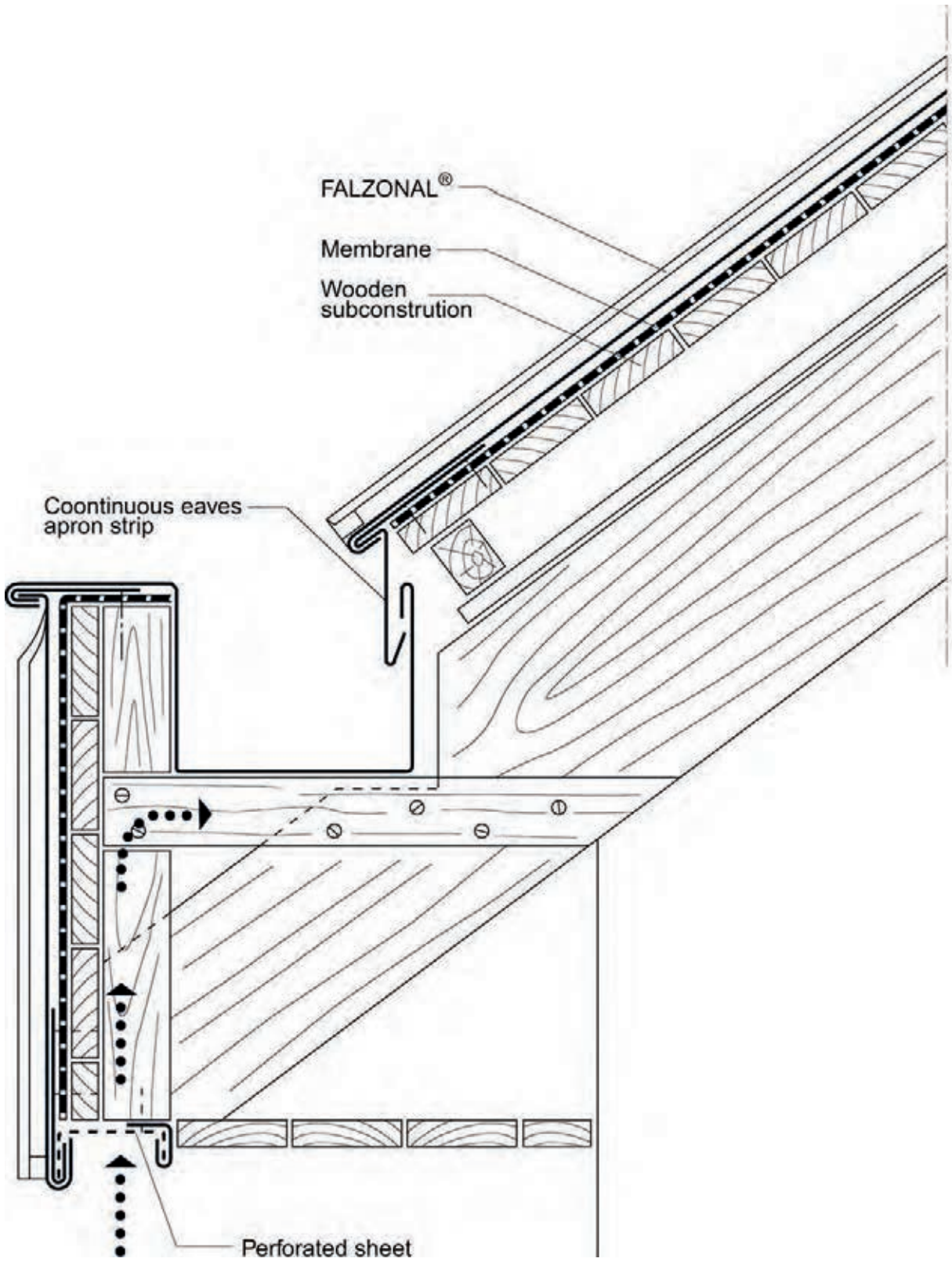
Eaves area


FALZONAL®
Membrane
Wooden subconstrution
Coontinuous eaves apron strip
Perforated sheet

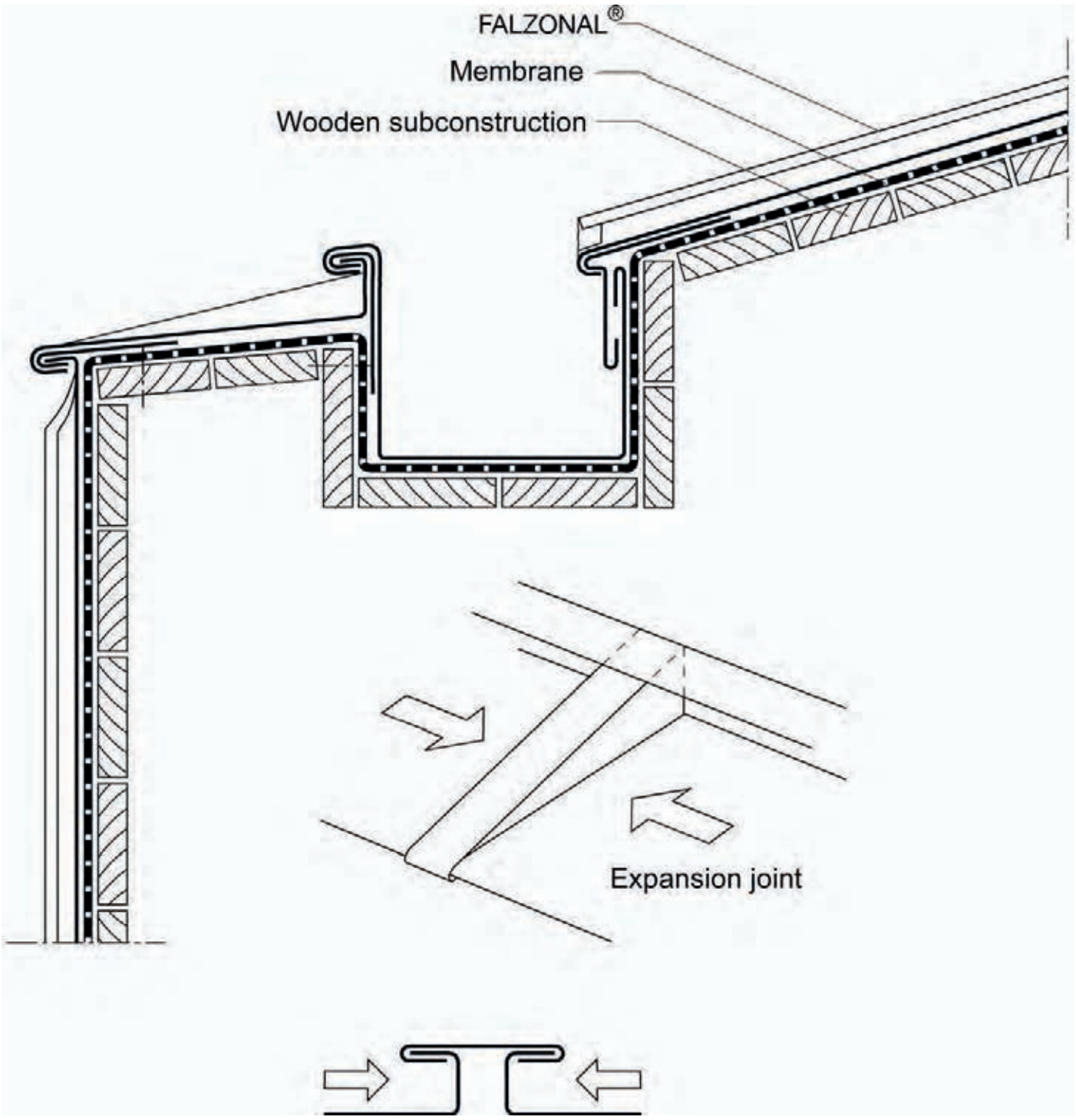
Eaves area


FALZONAL®
Membrane
Wooden subconstruction
Continuous eaves apron strip
FALZONAL®
Insulation
Concrete
Perforated sheet

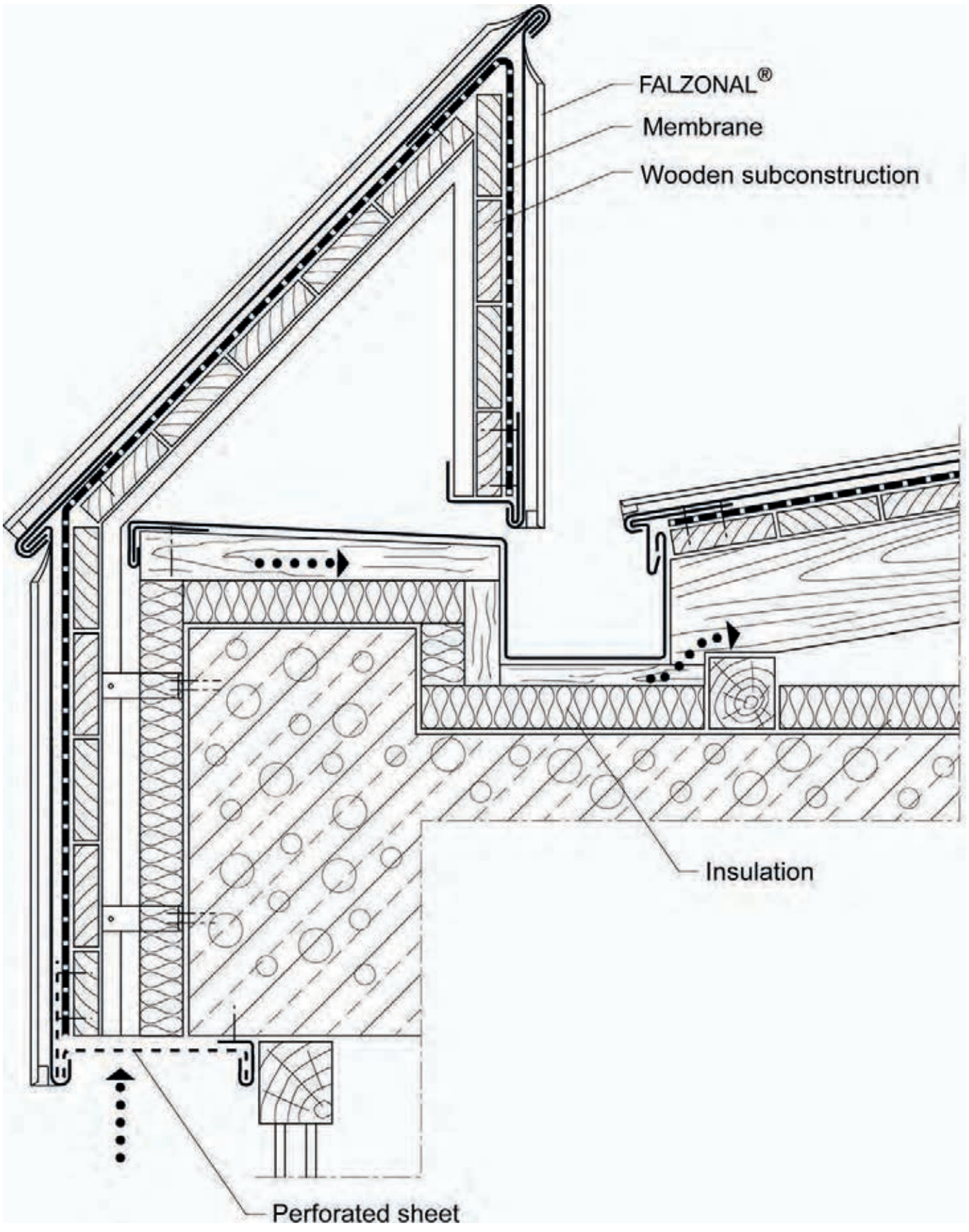
Eaves area


FALZONAL®
Membrane
Wooden subconstrution
Coontinuous eaves apron strip
Perforated sheet

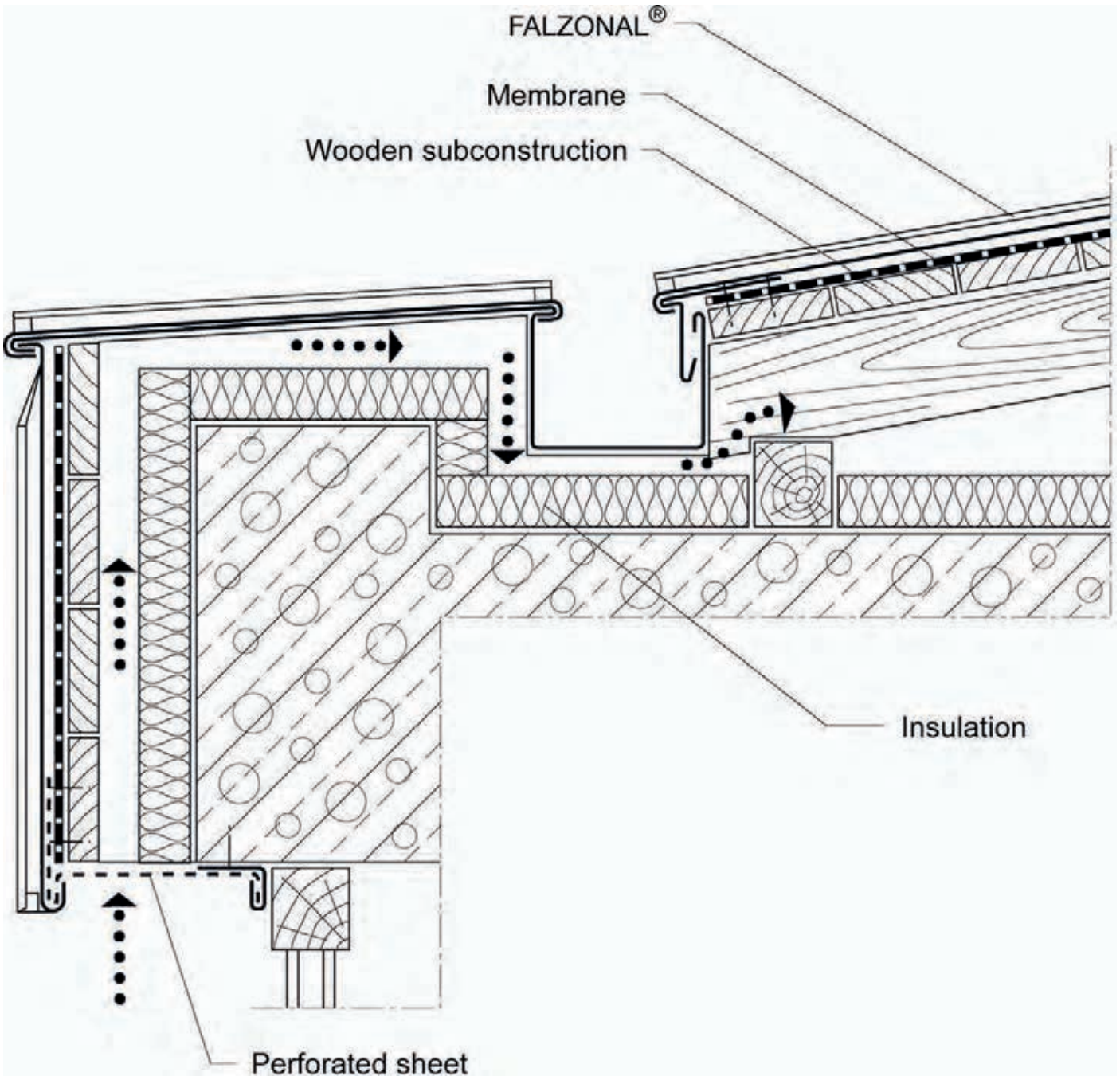
Eaves cladding



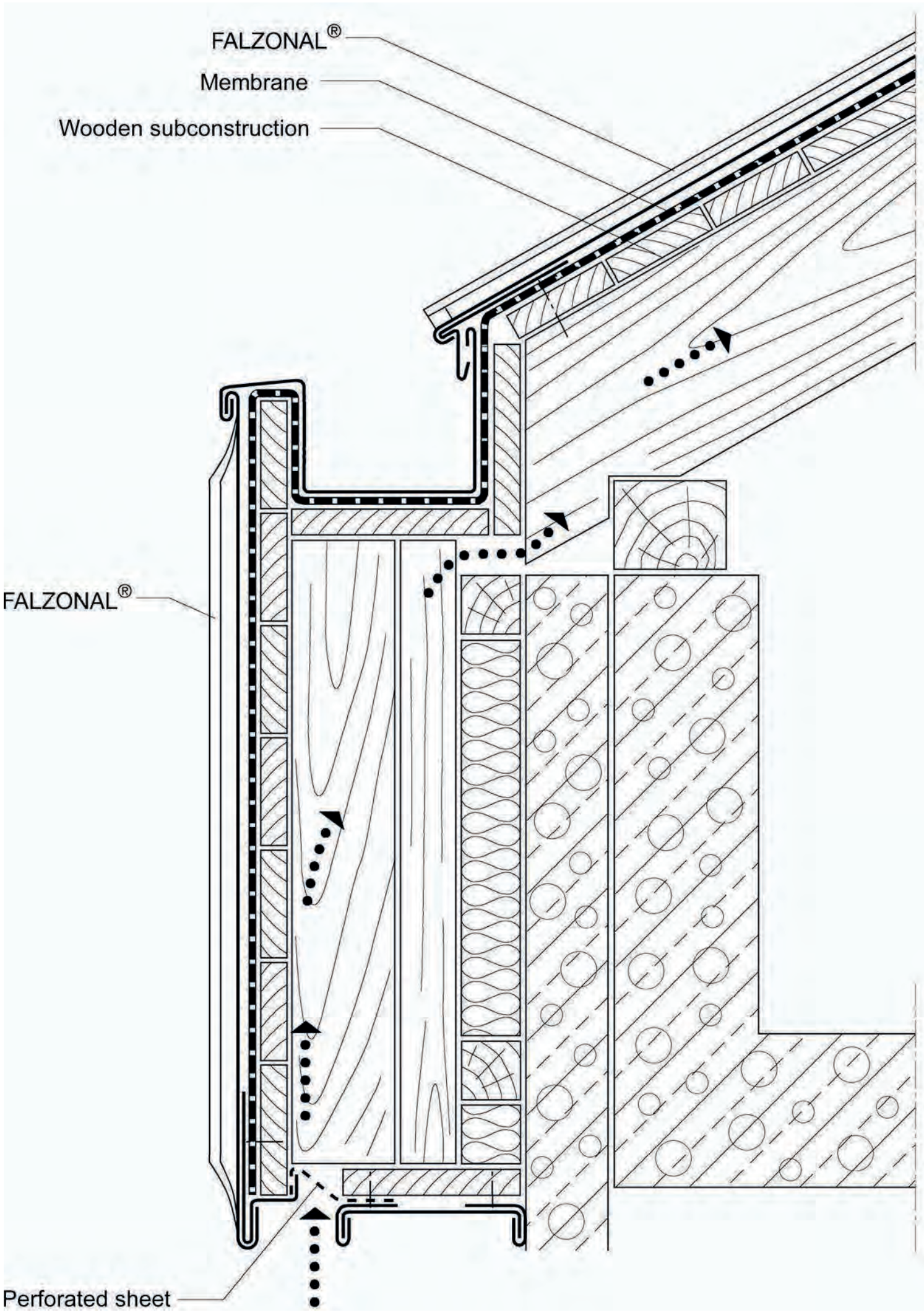
Eaves cladding



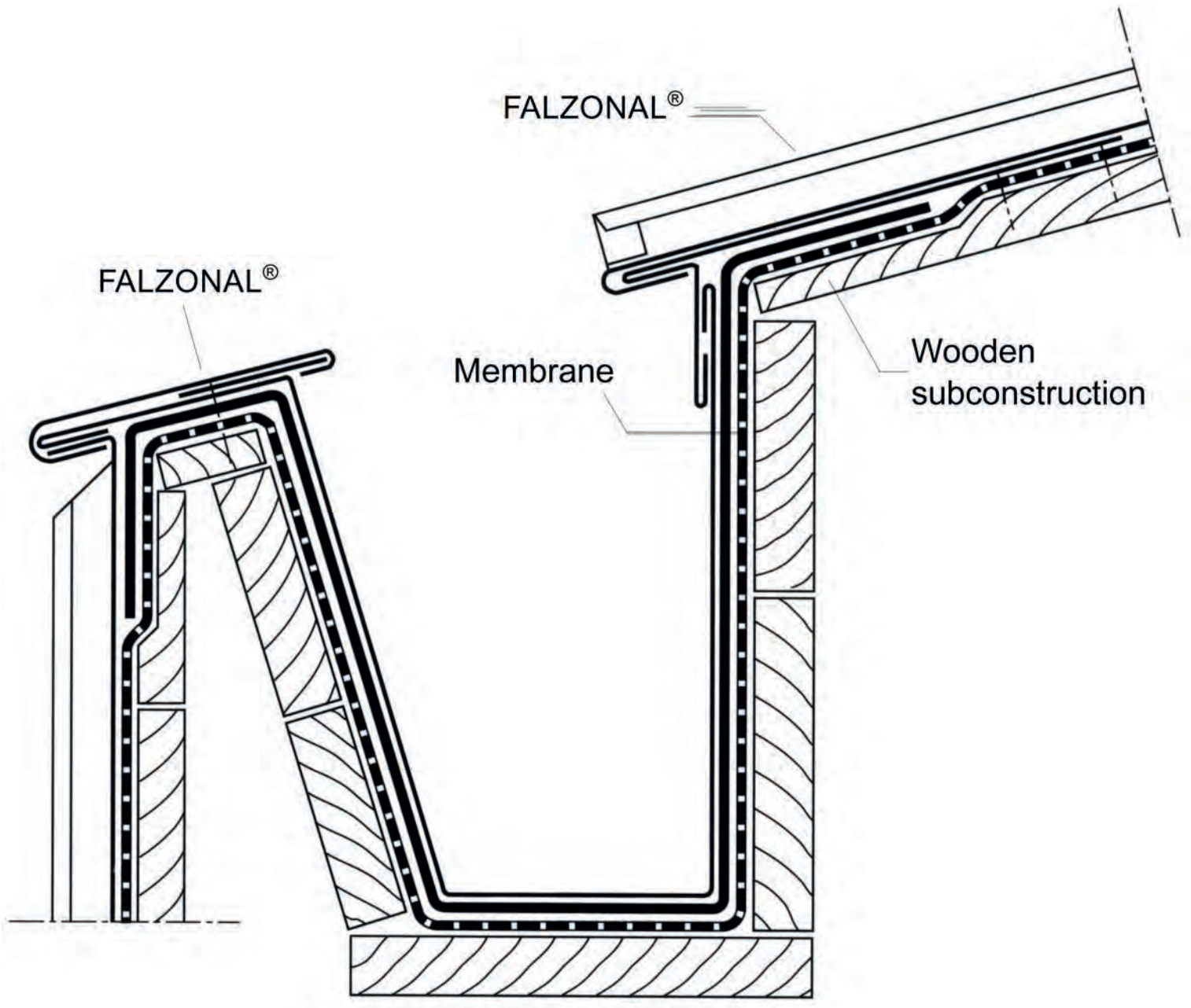
Eaves cladding



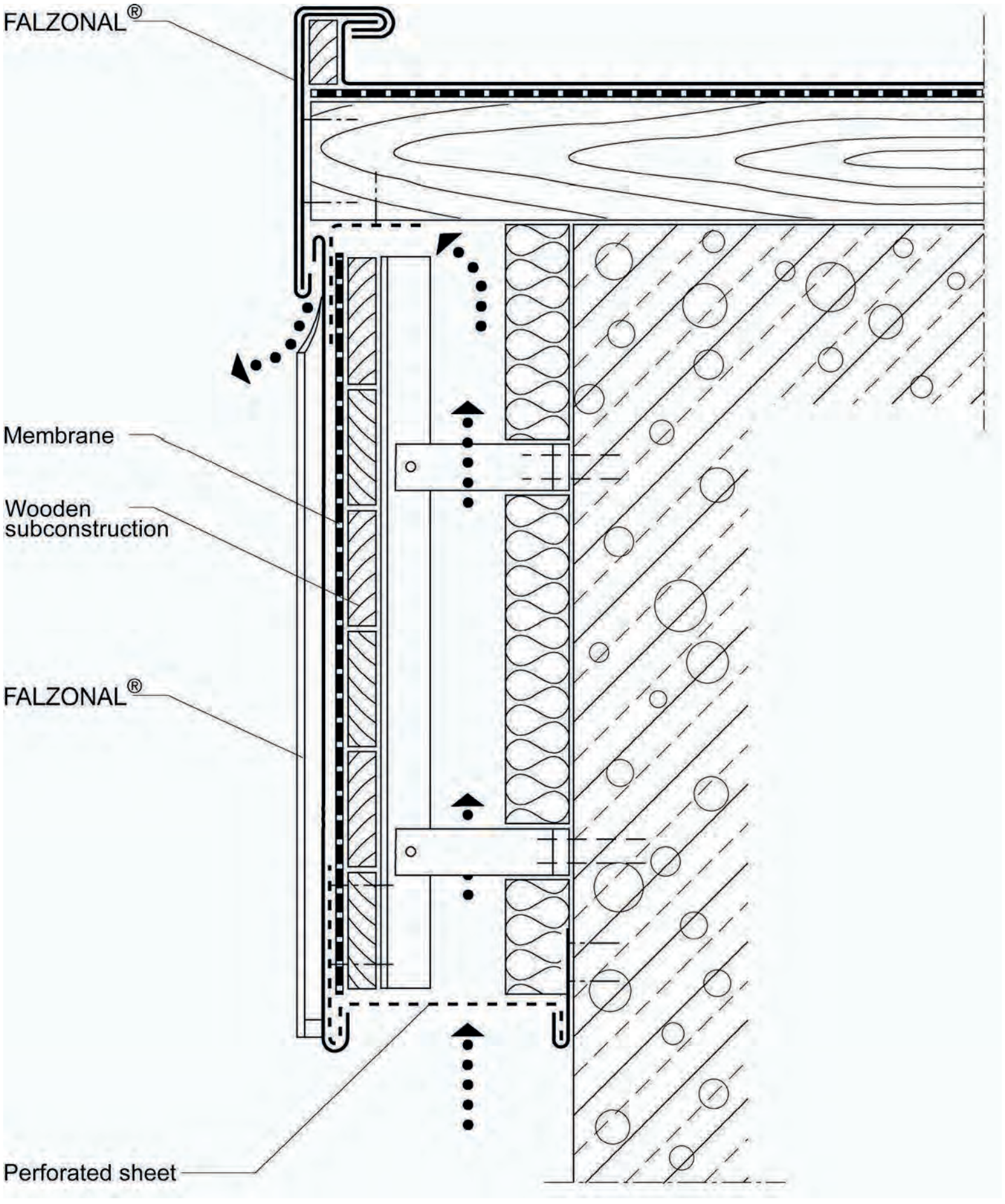
Eaves cladding



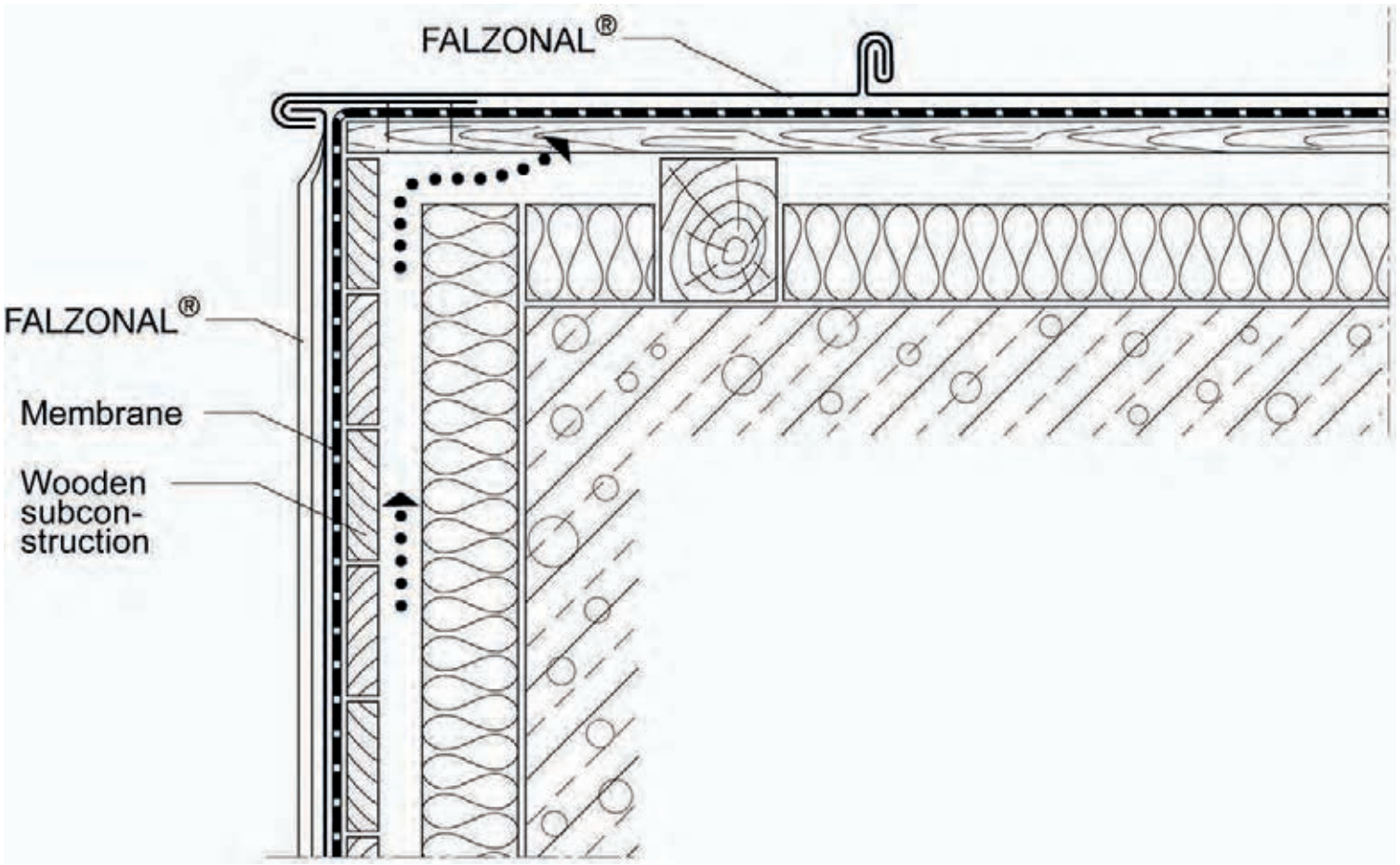
Internal gutter



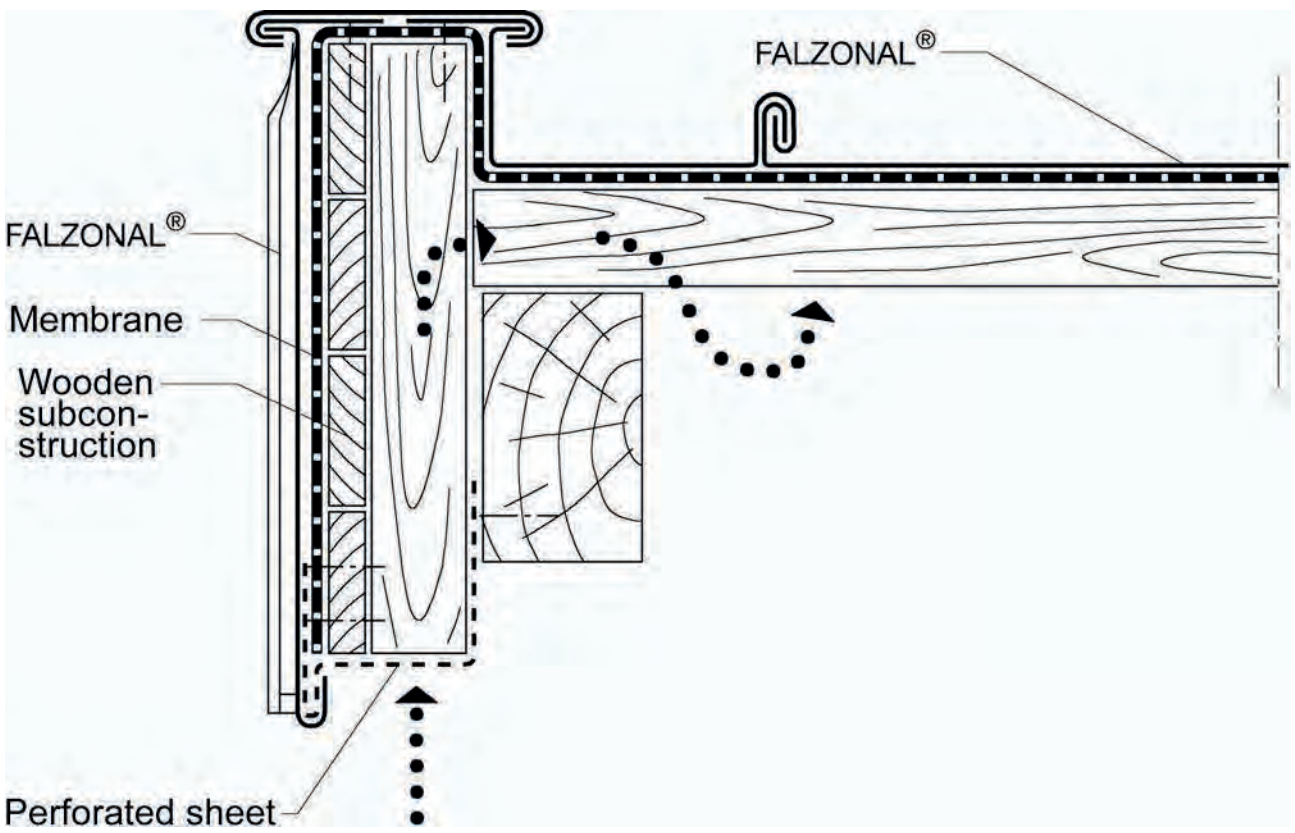
Verge with wall flashing



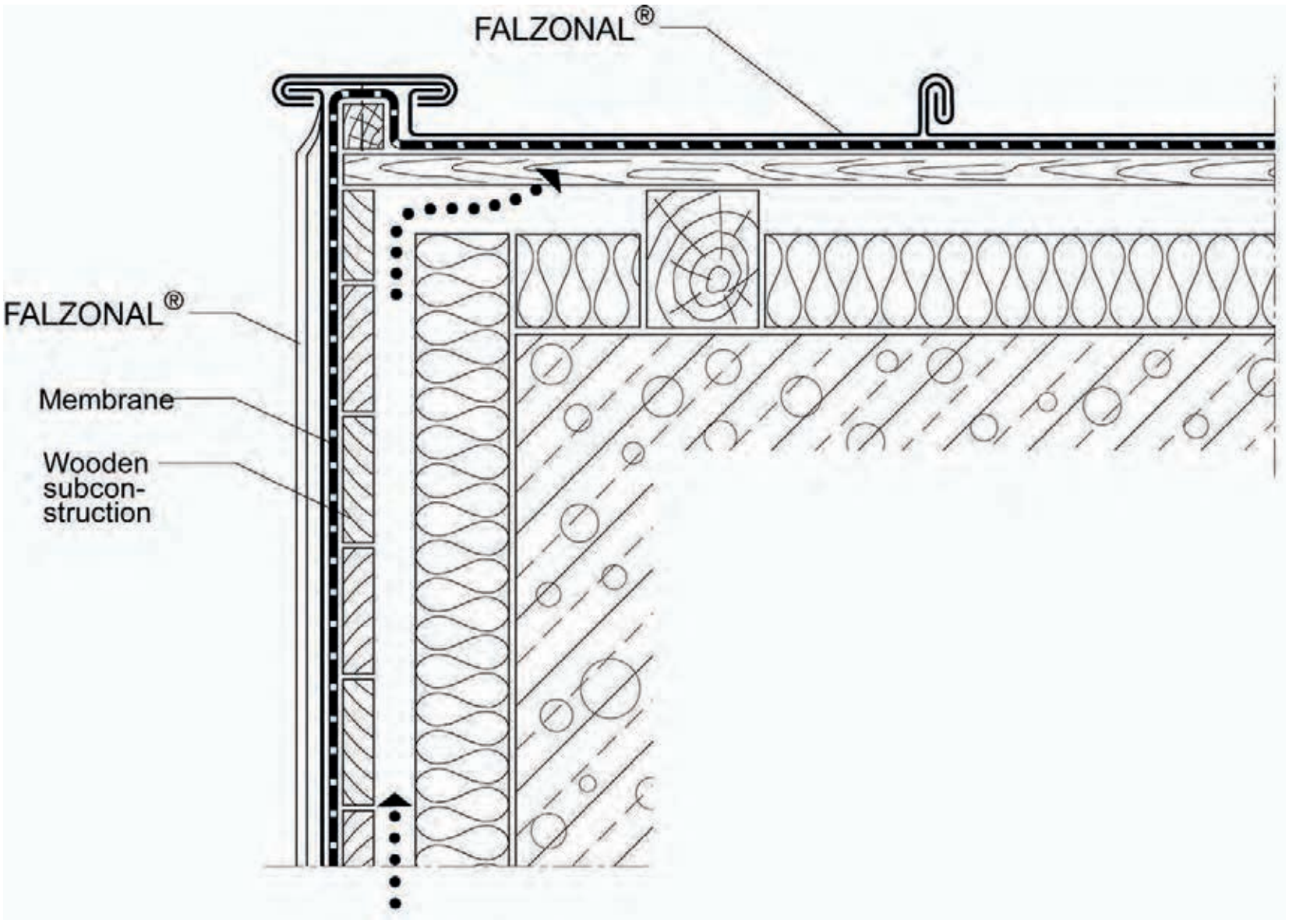
Verge with wall flashing



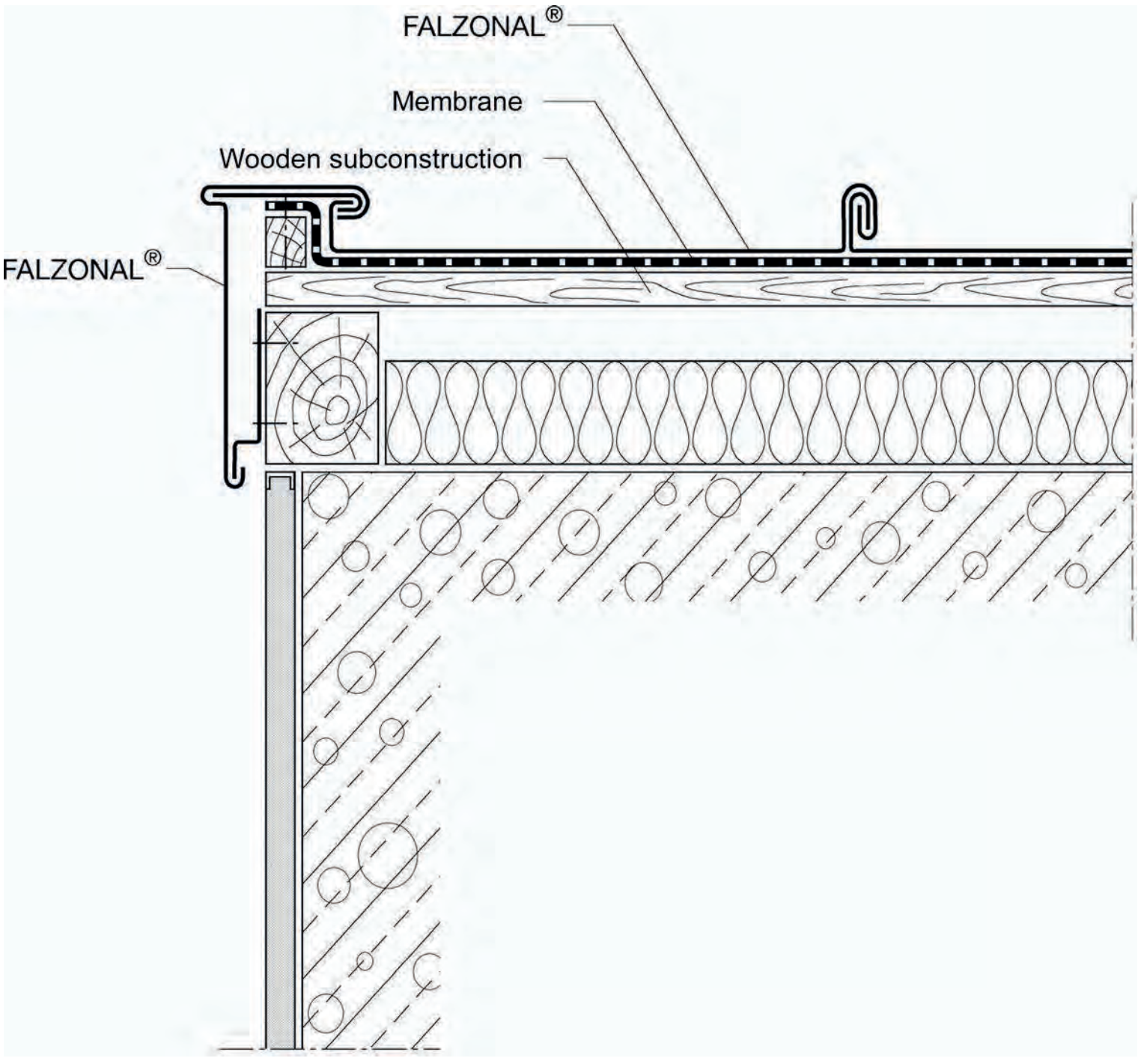
Verge with wall flashing



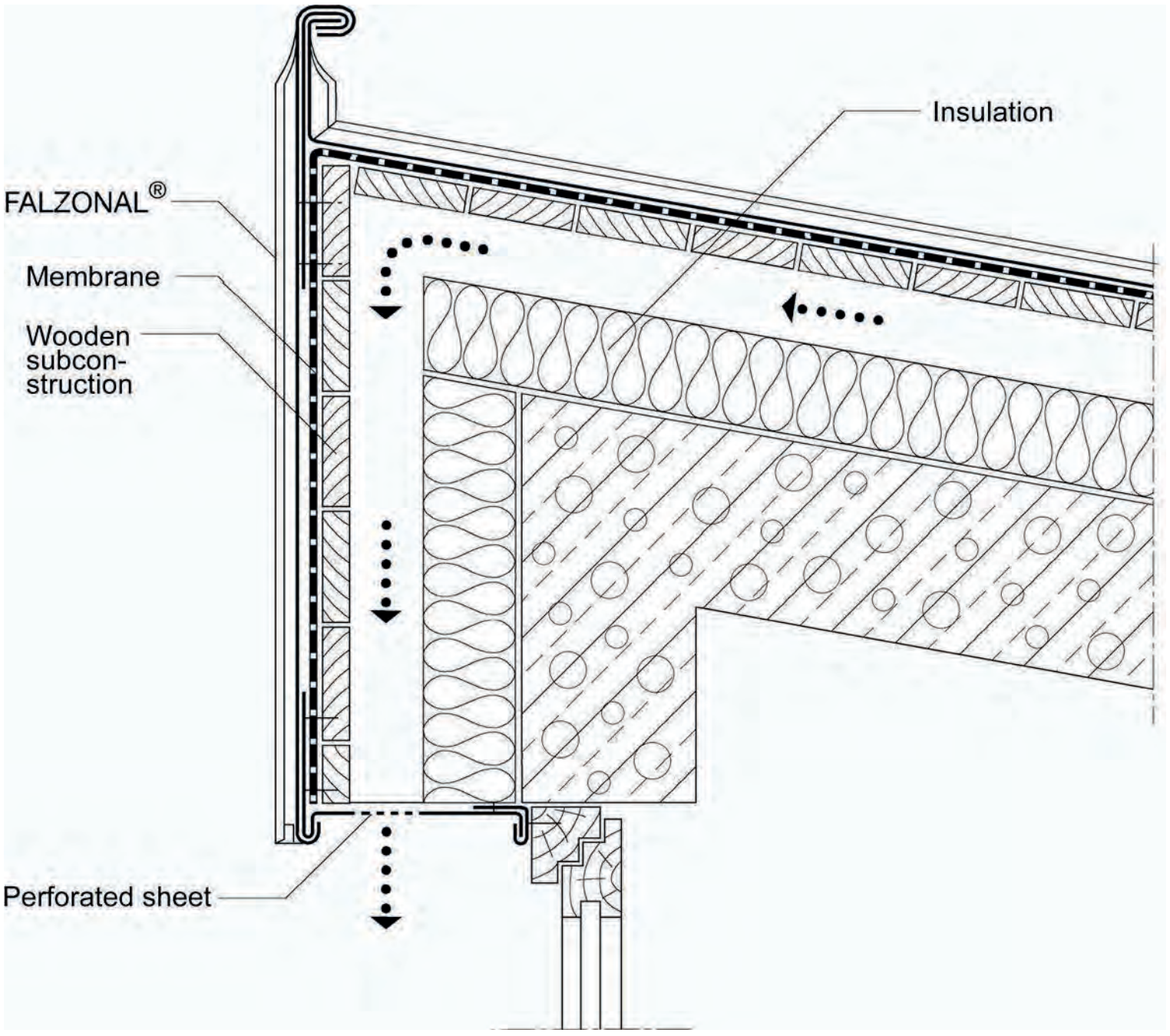
Verge with wall flashing



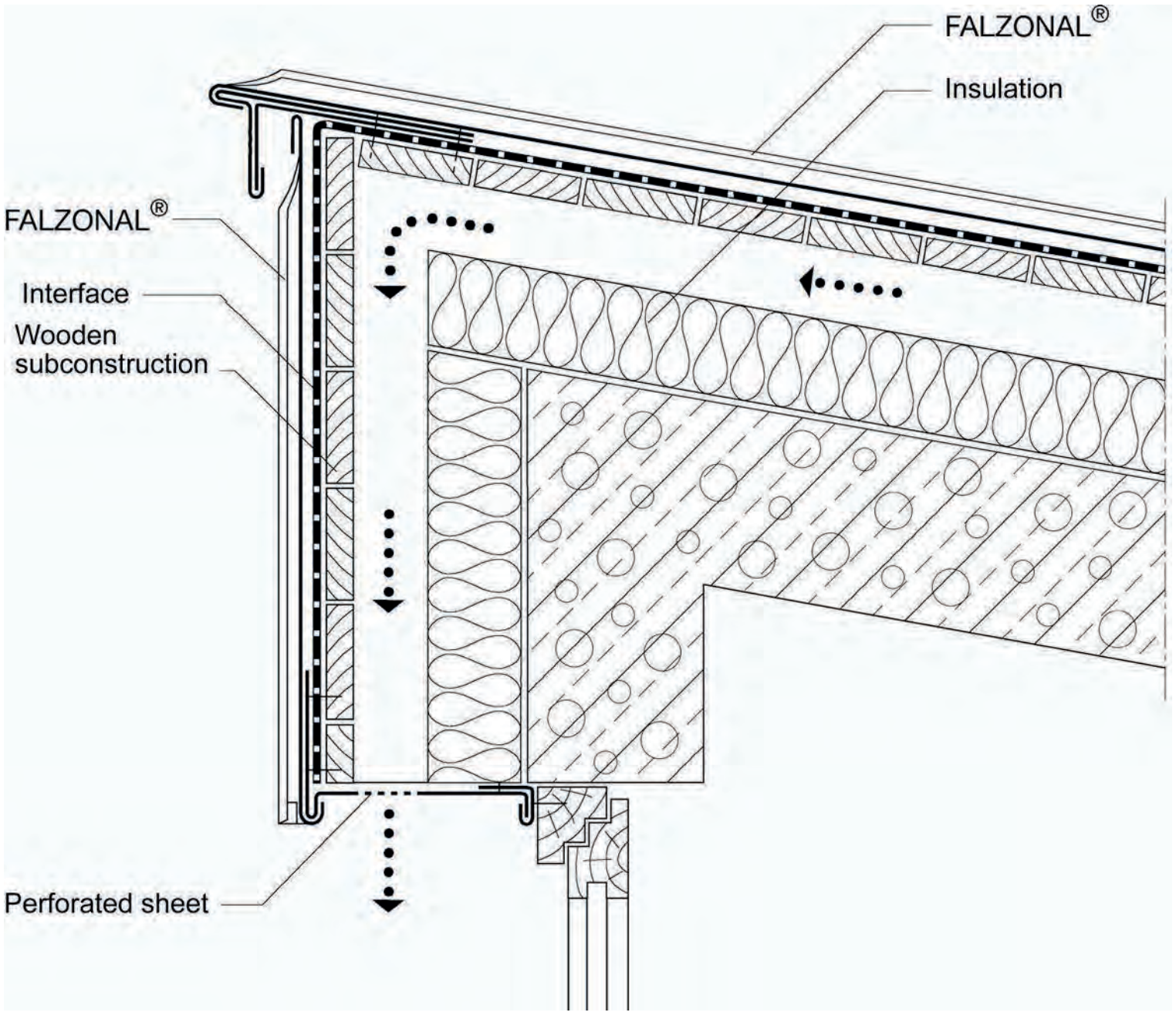
Verge termination



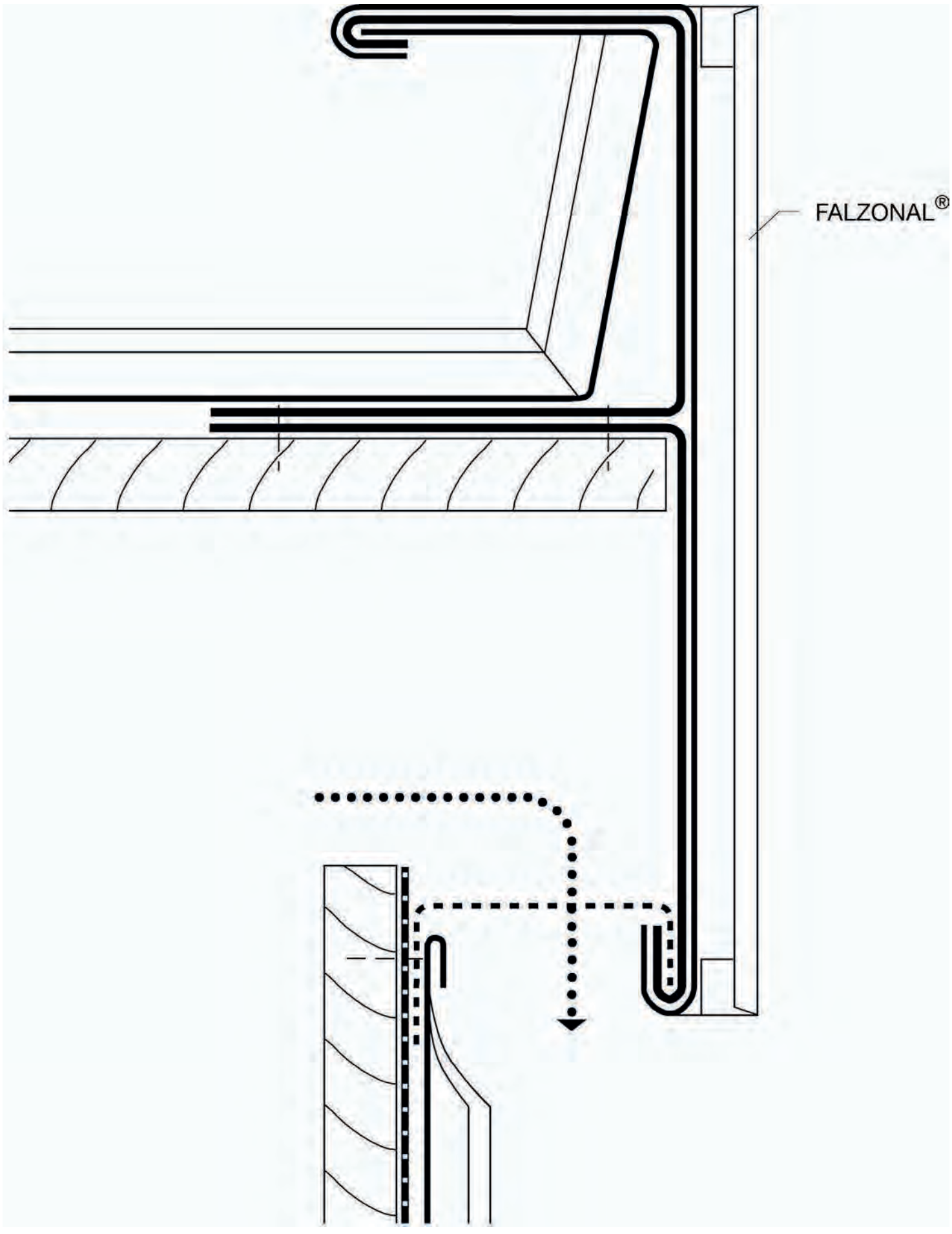
Monopitch roof edge construction with wall flashing



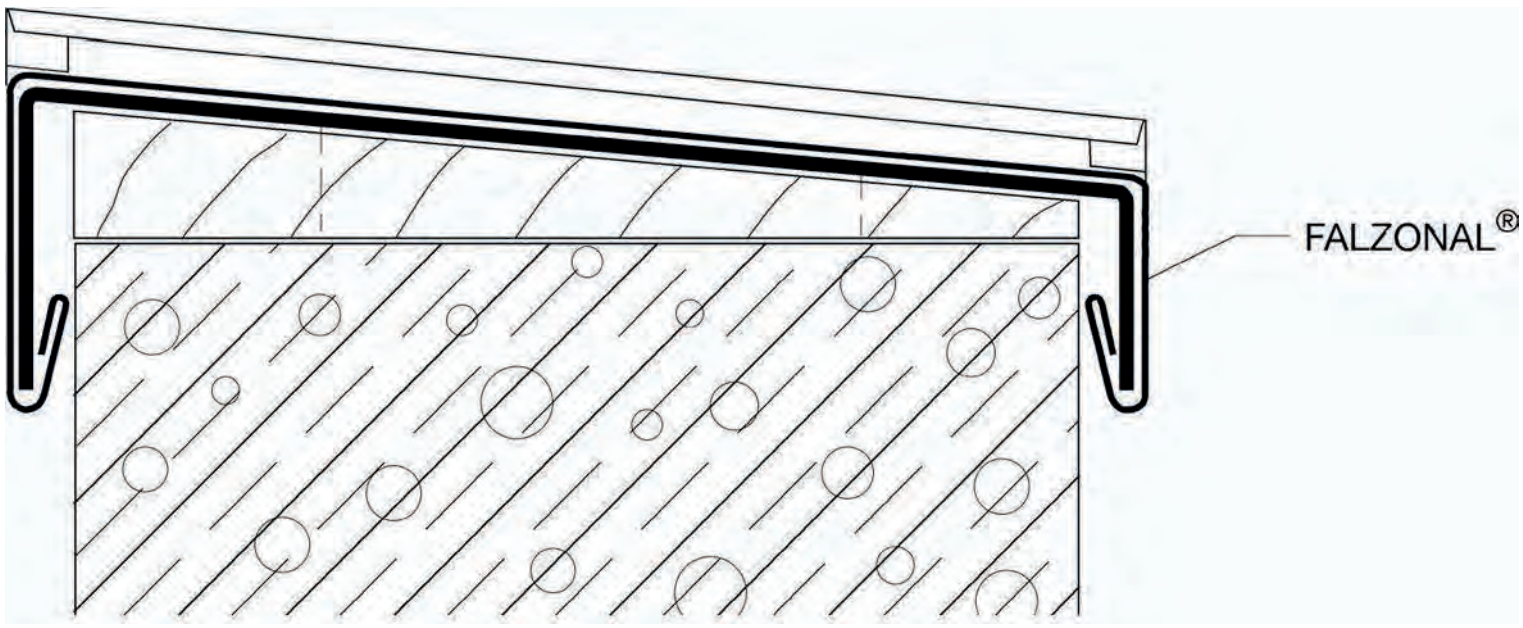
Monopitch roof edge construction with interfacing fascia



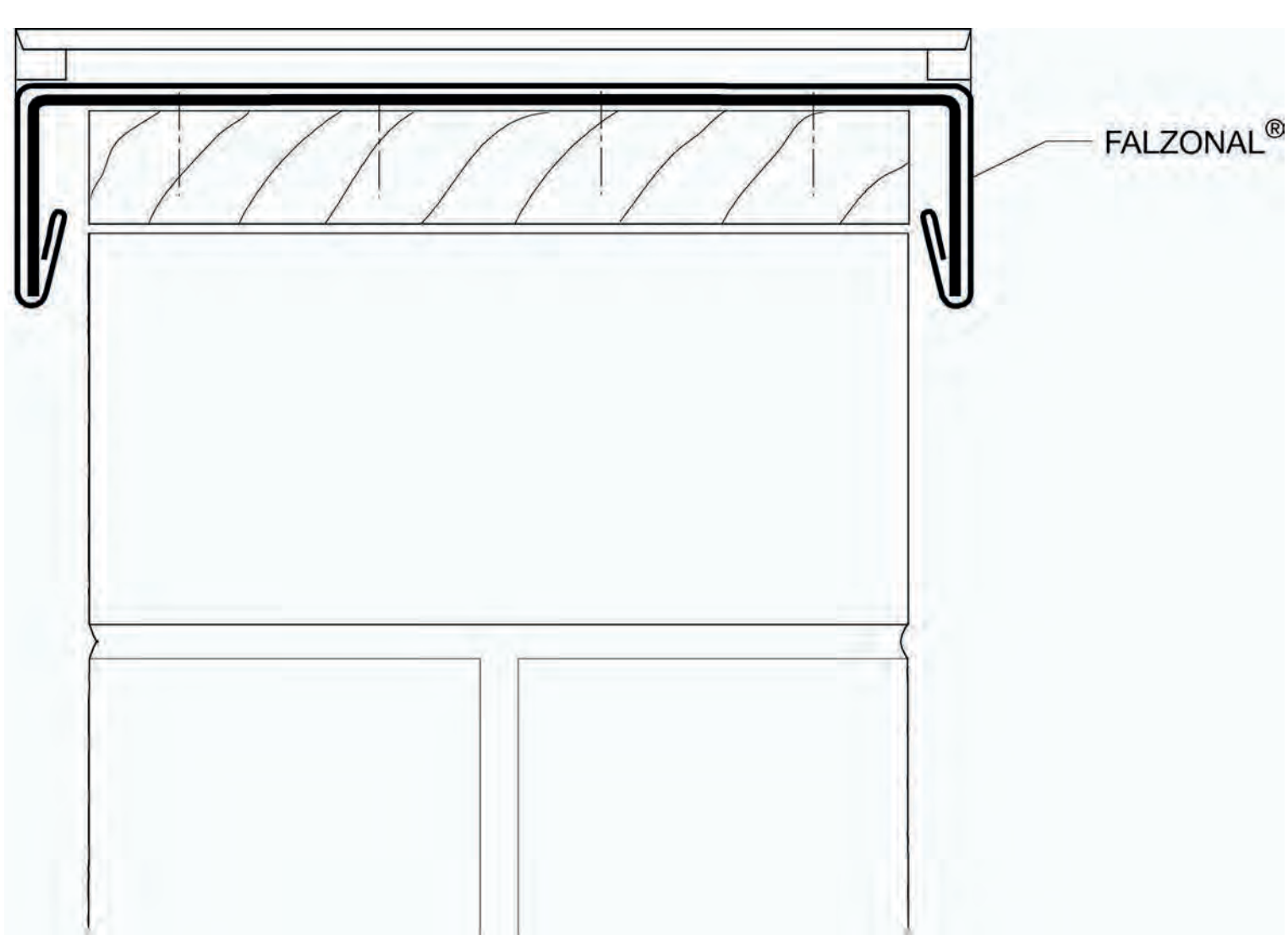
Edge construction



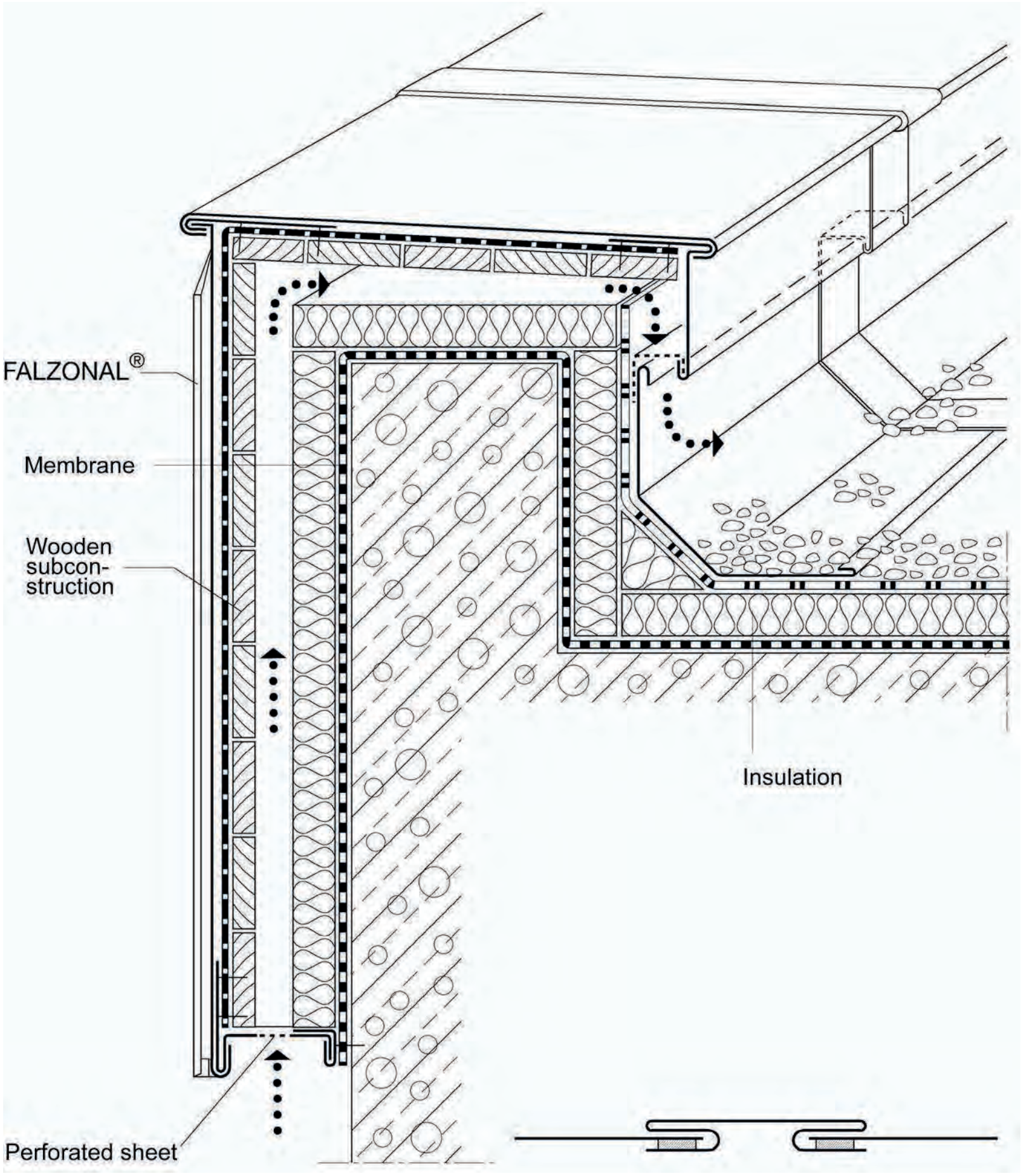
Wall capping/Canopy



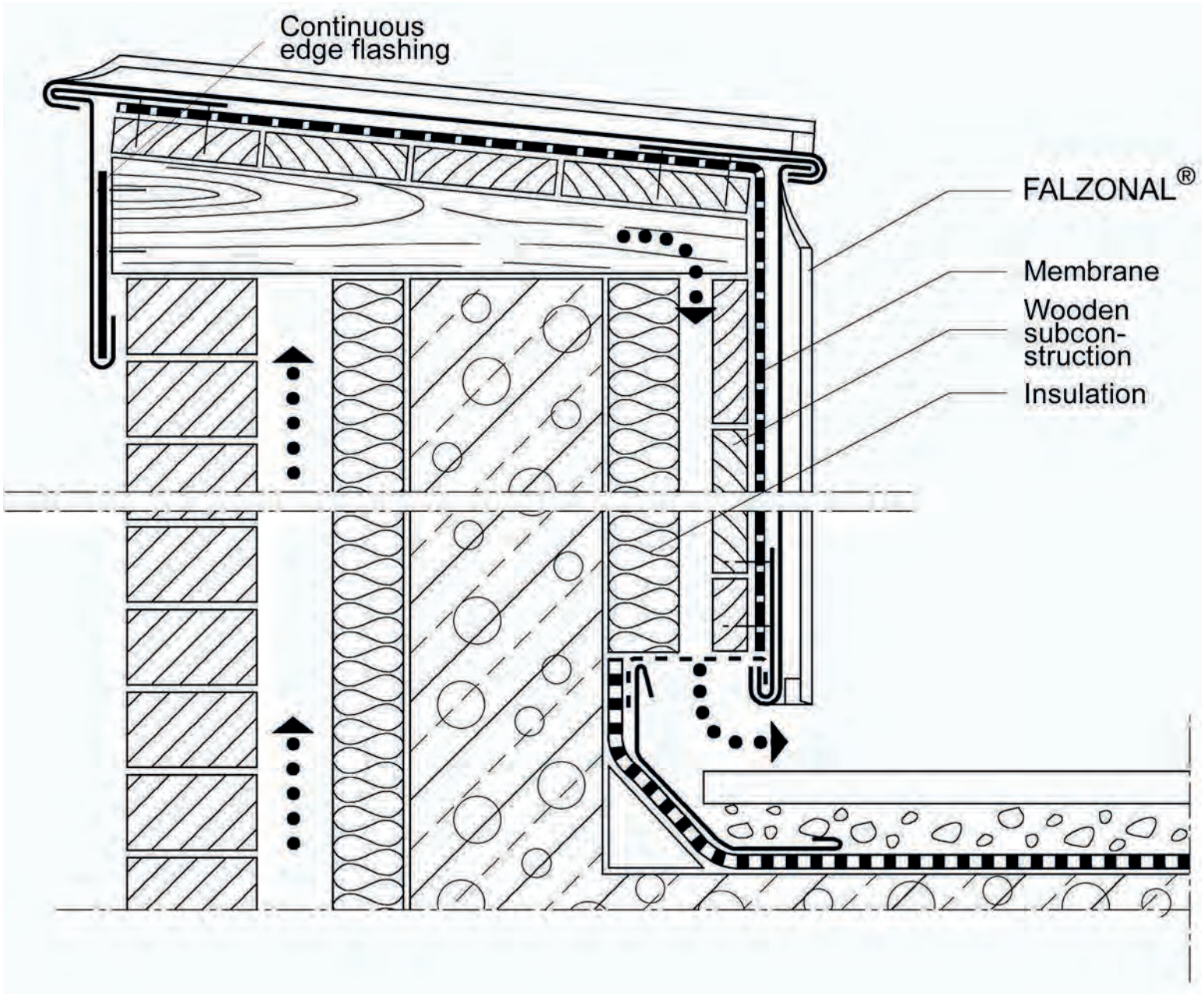
Wall capping/Canopy



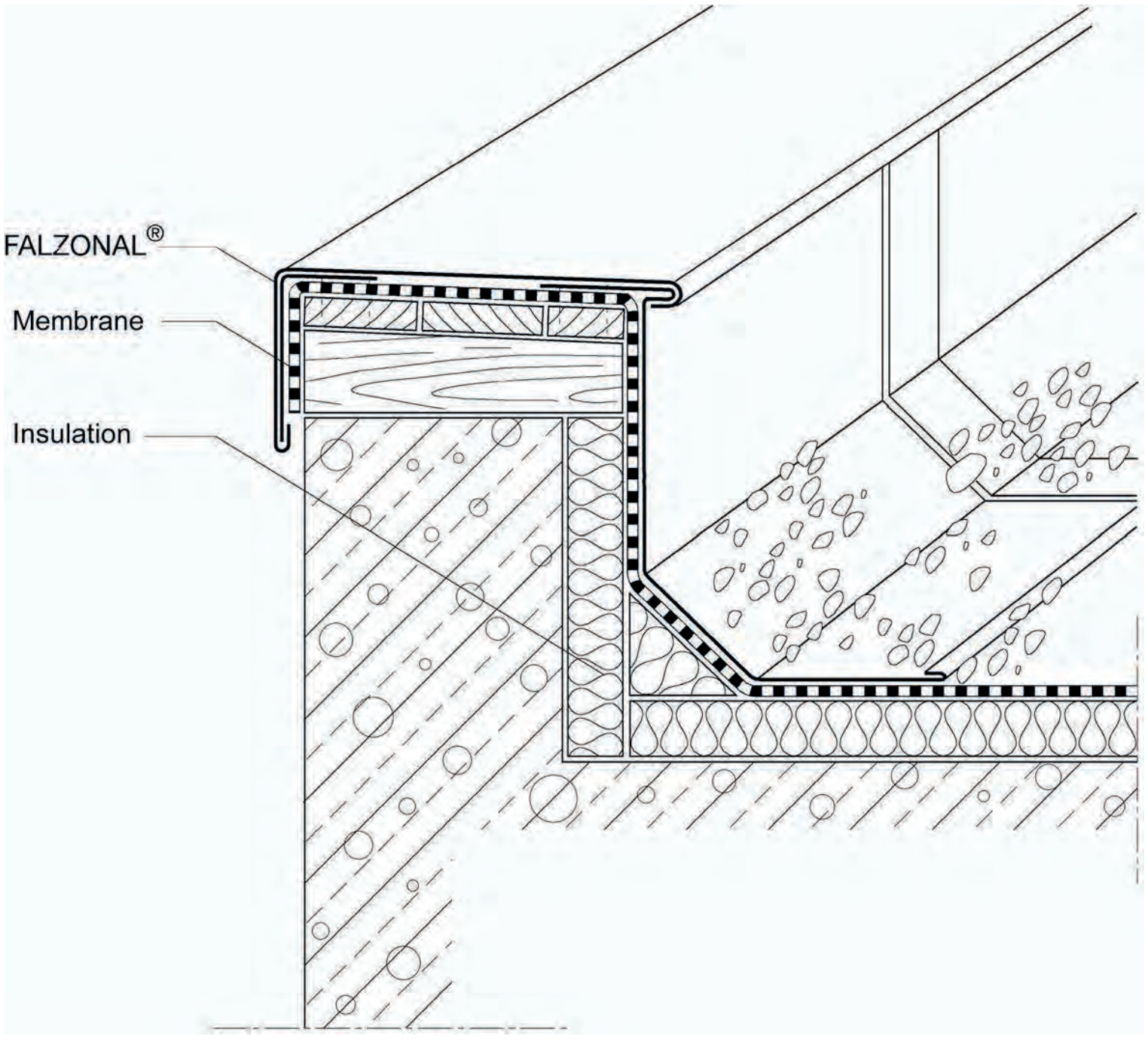
Wall capping with fascia and roof interface



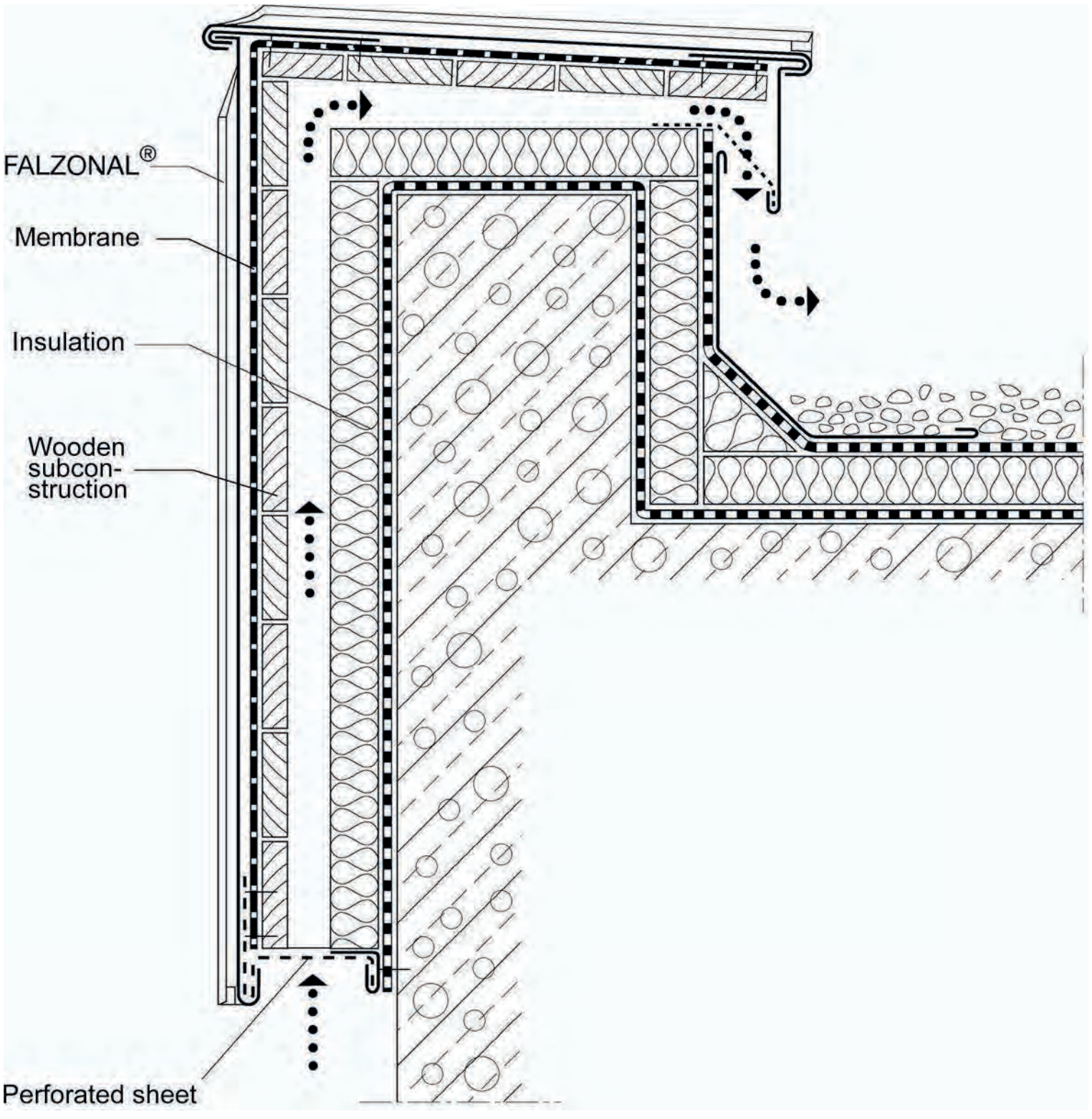
Wall capping



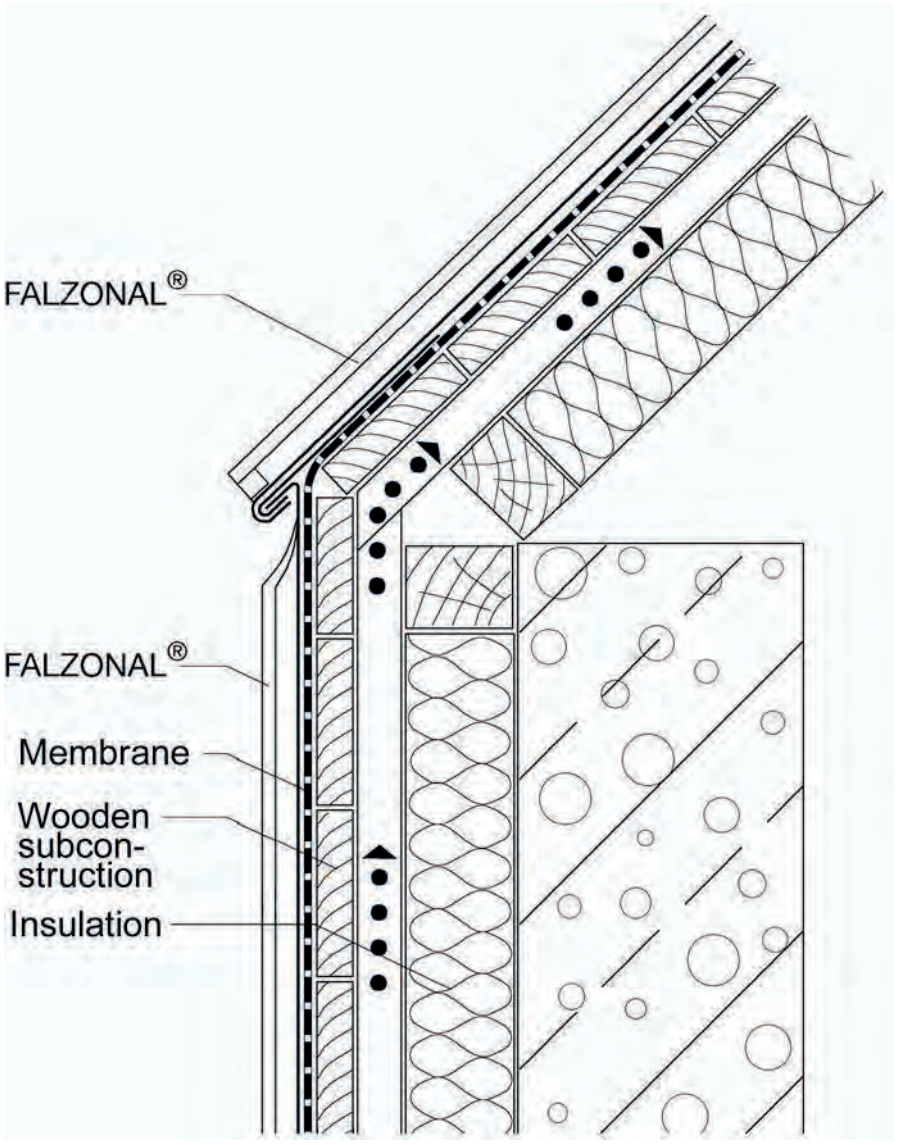
Wall capping and flat roof interface

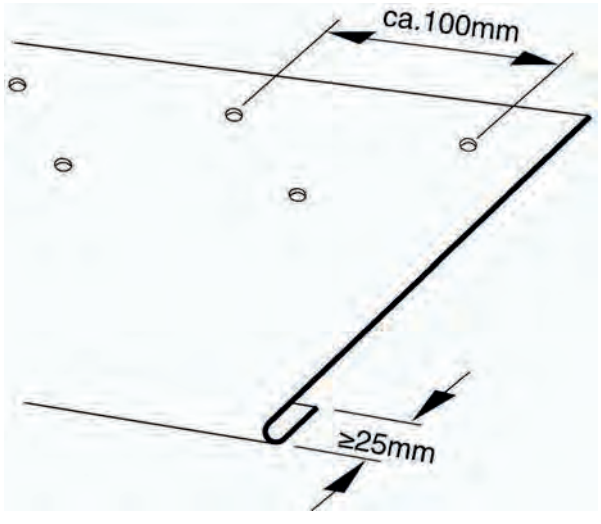


Wall capping - flat roof and wall interface

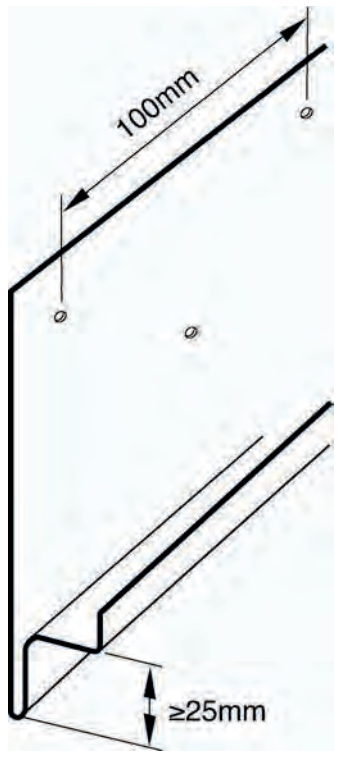


Fascia/Roof slope interface

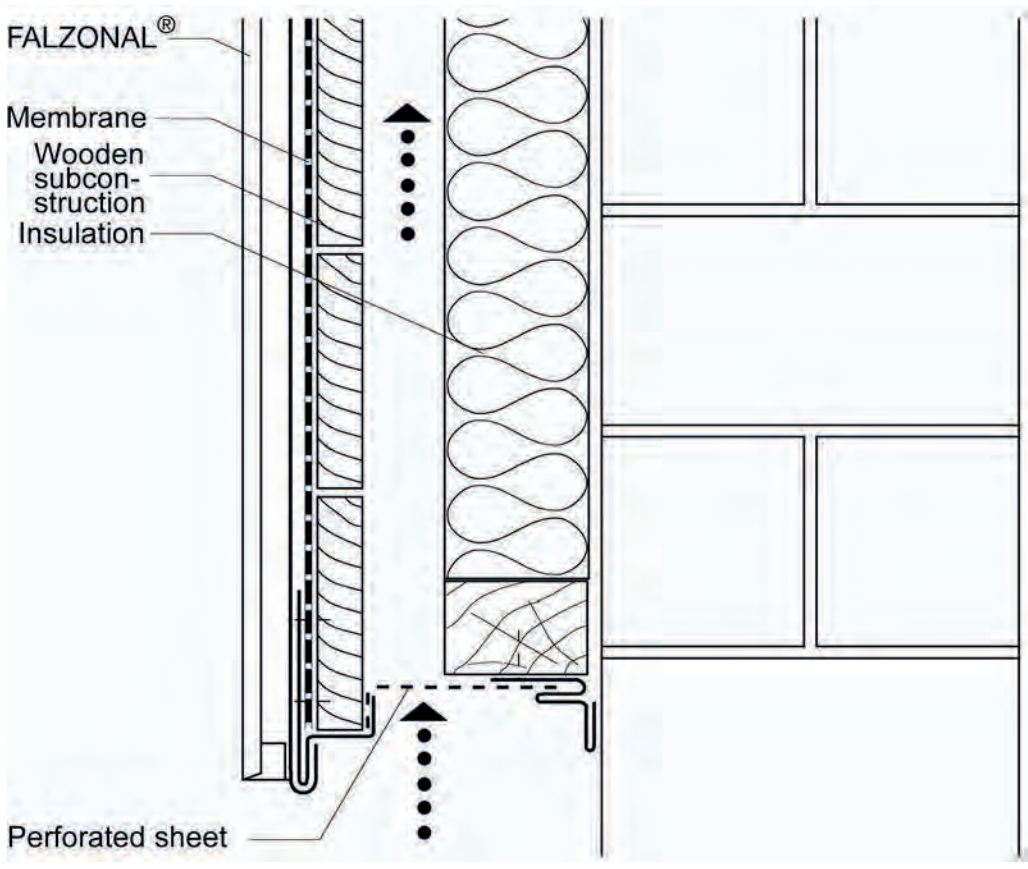




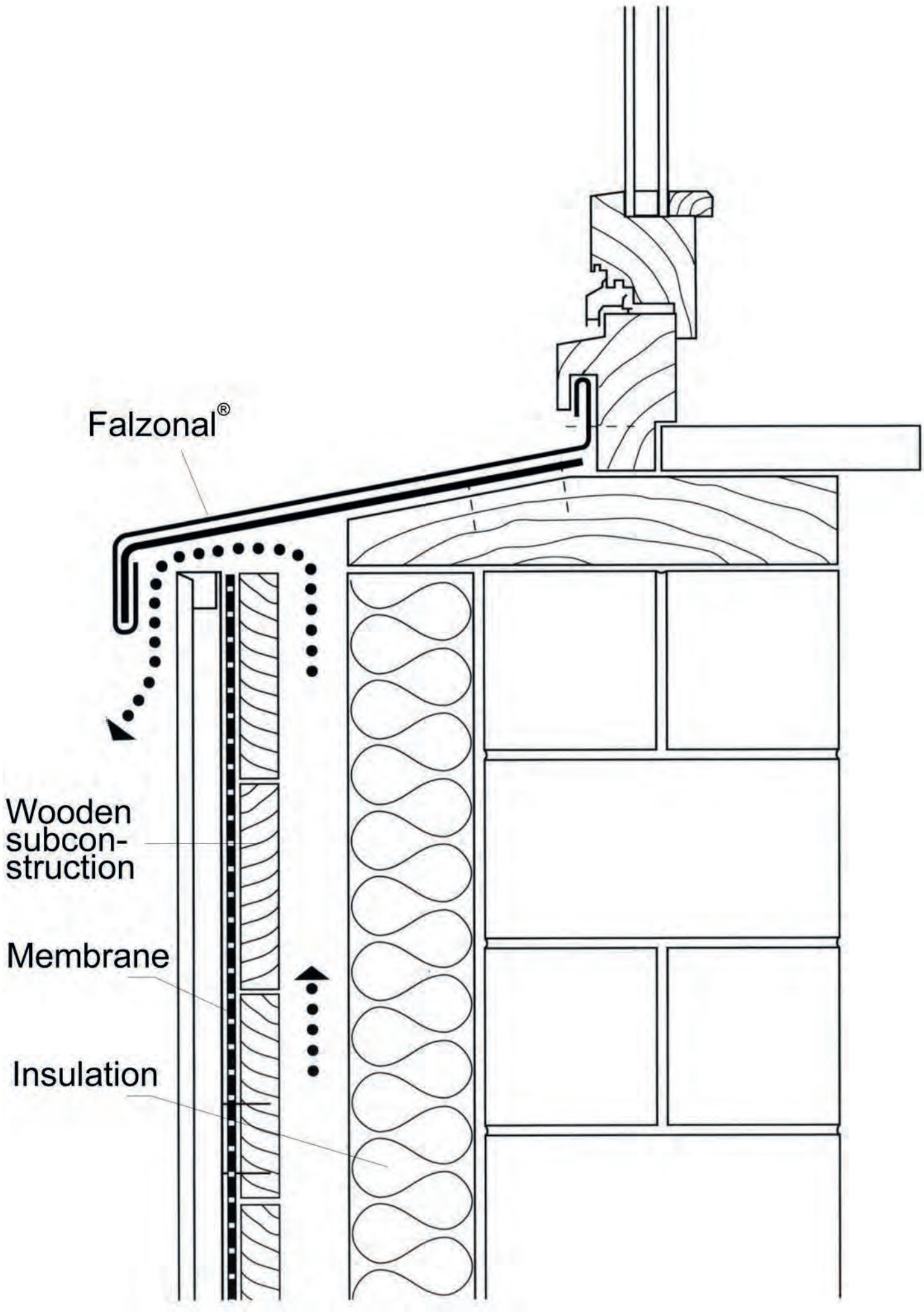
Fascia-drip edge



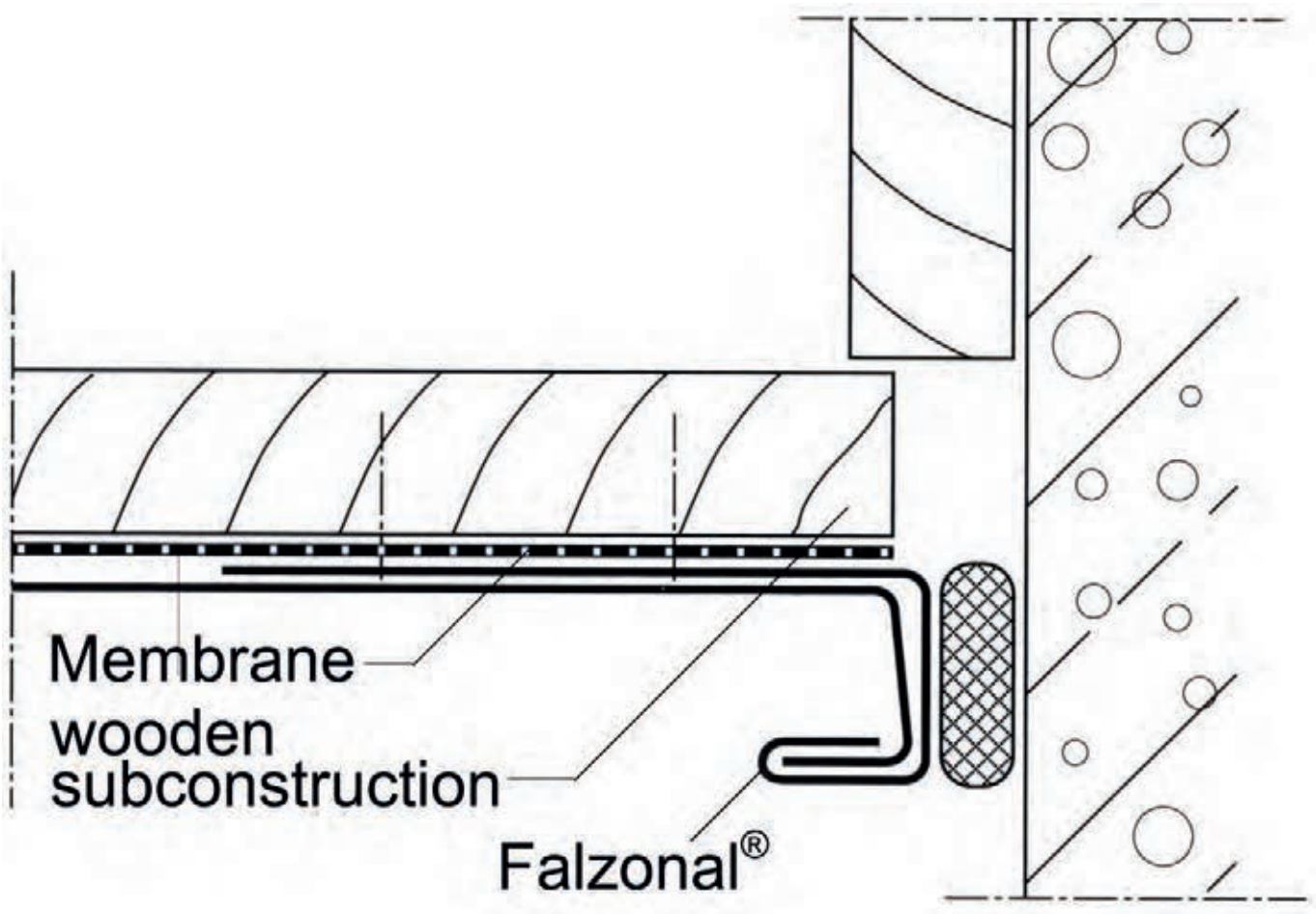
Continuous edge flashing



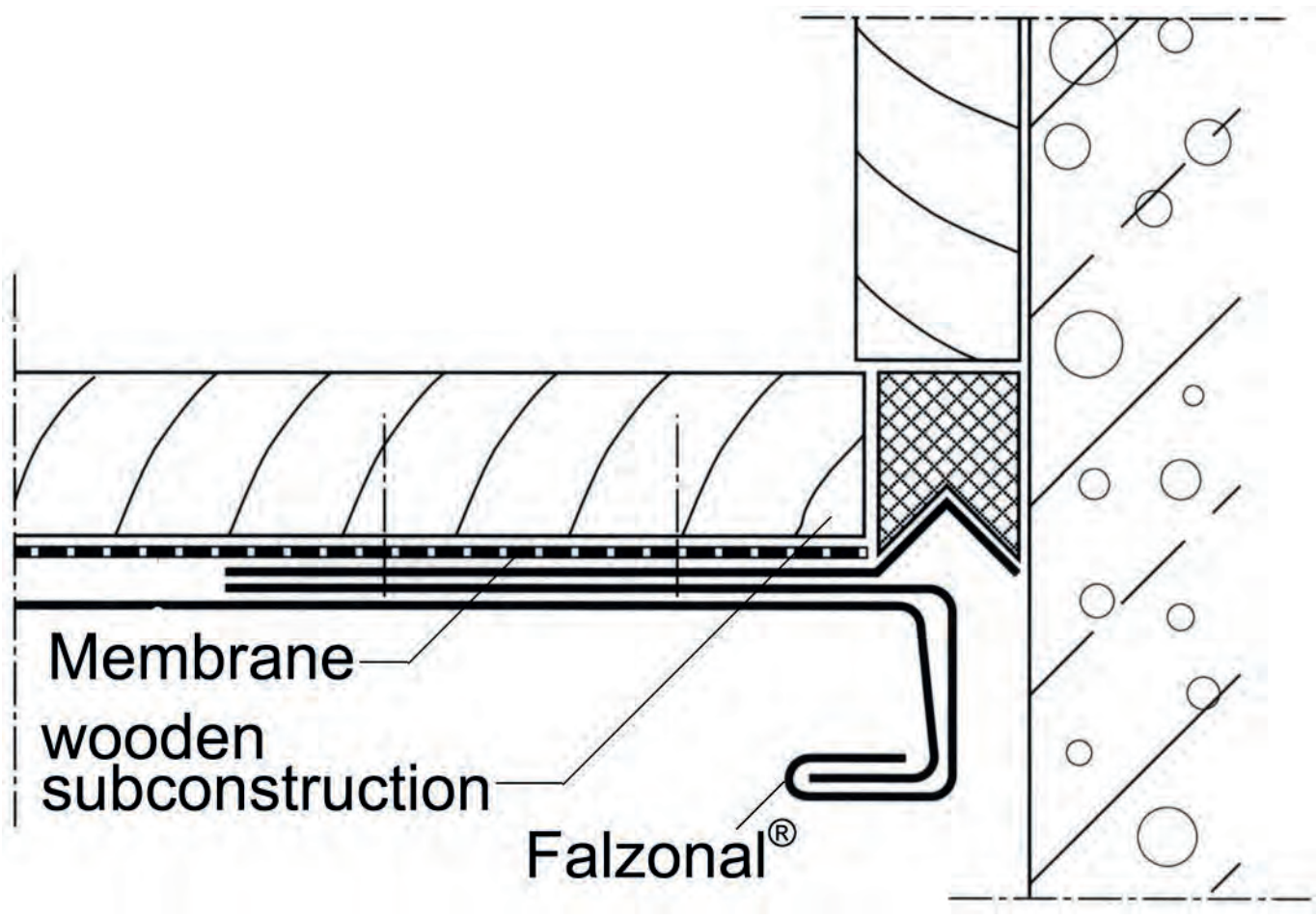
Window Sill



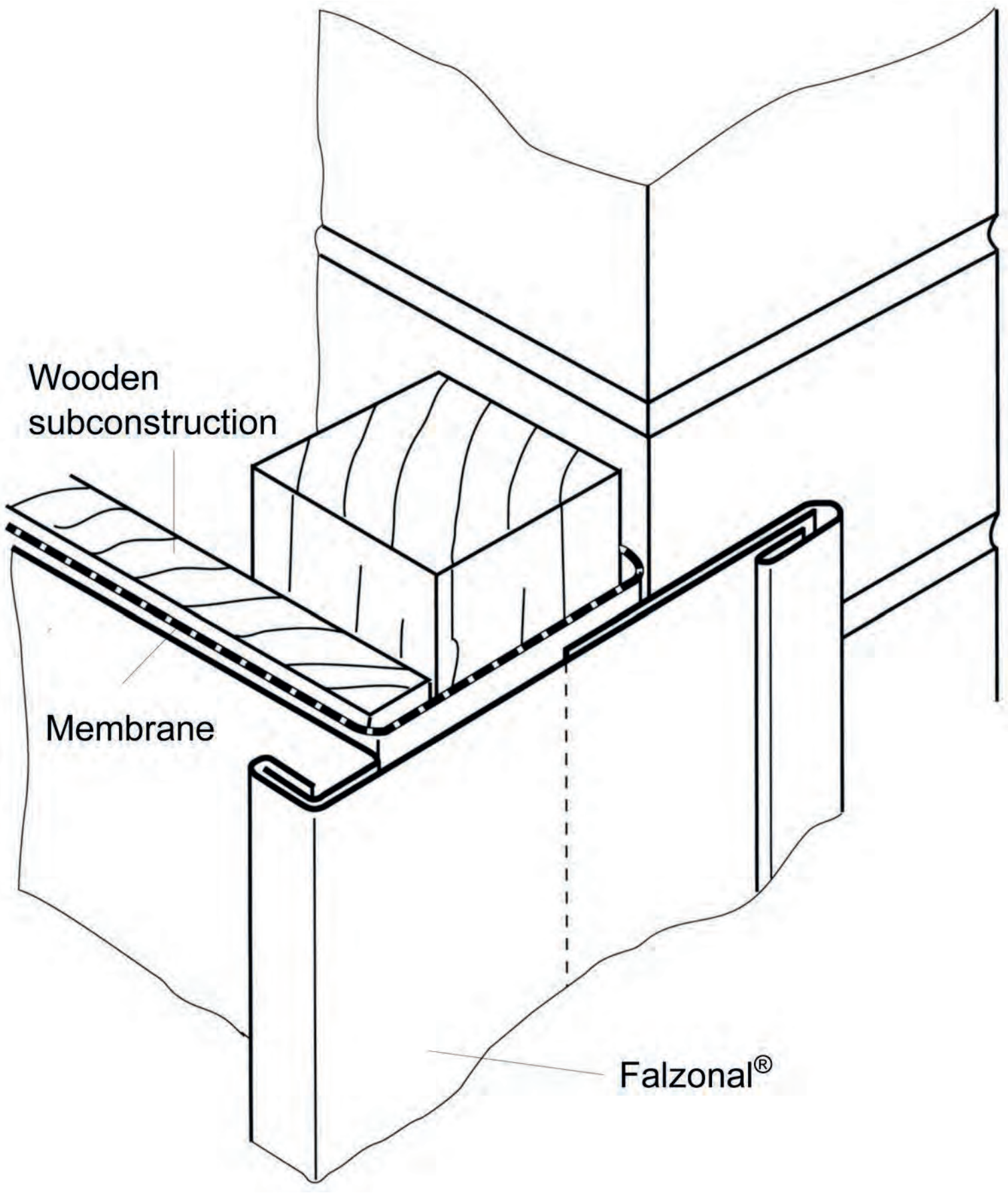
Wall flashing, lateral, vertical section (Parapet)



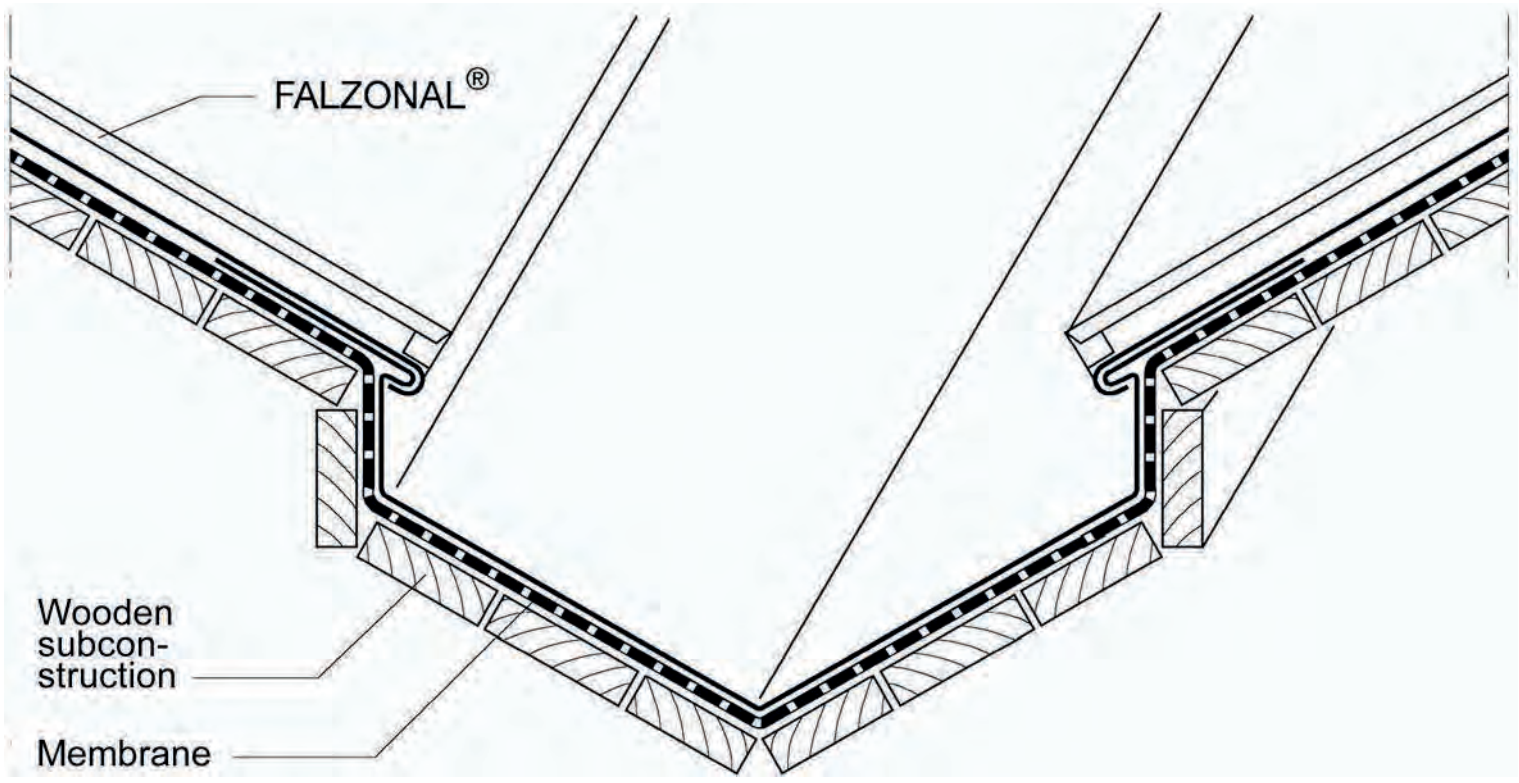
Wall flashing, lateral, with closure flashing



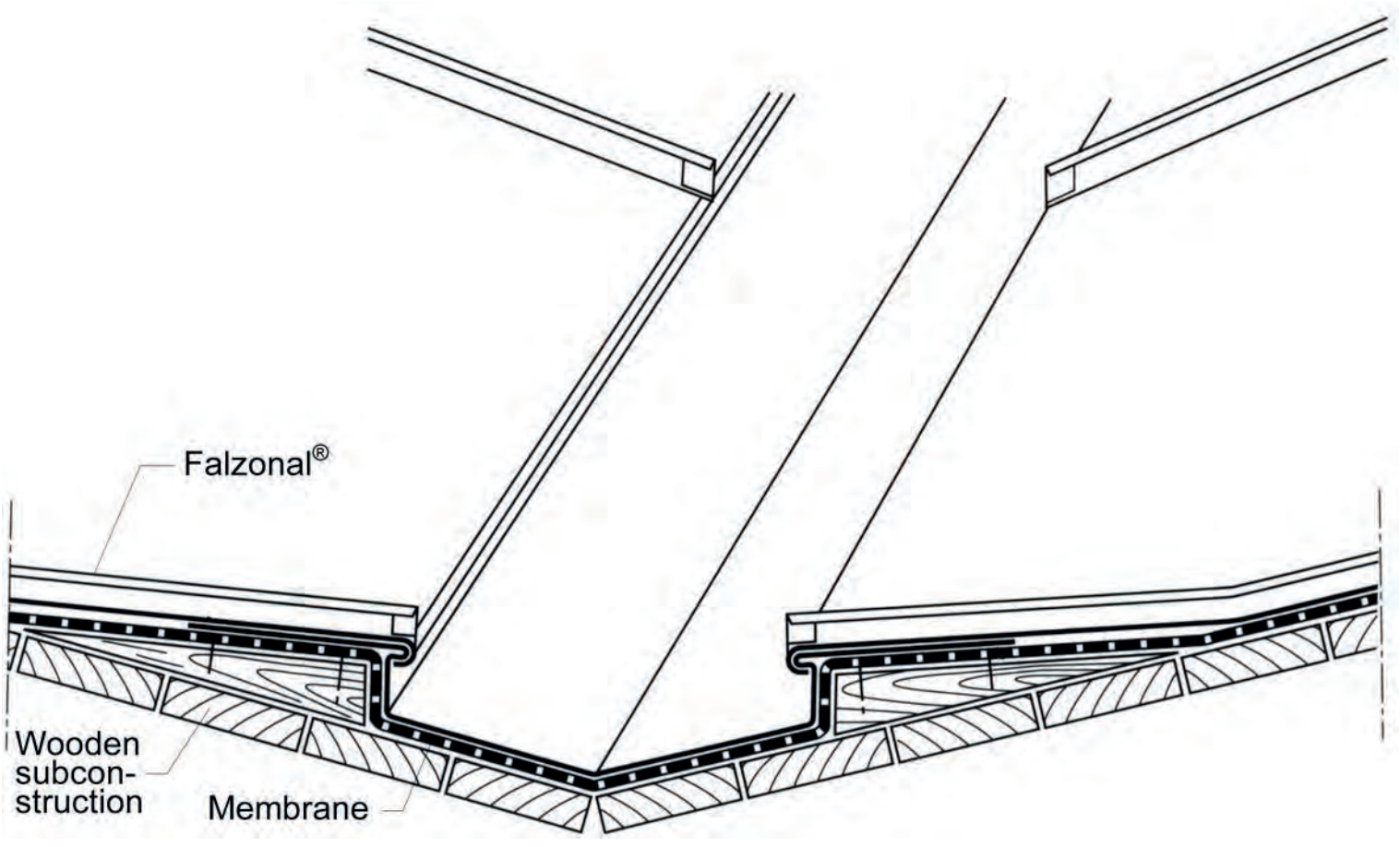
Window flashing, lateral



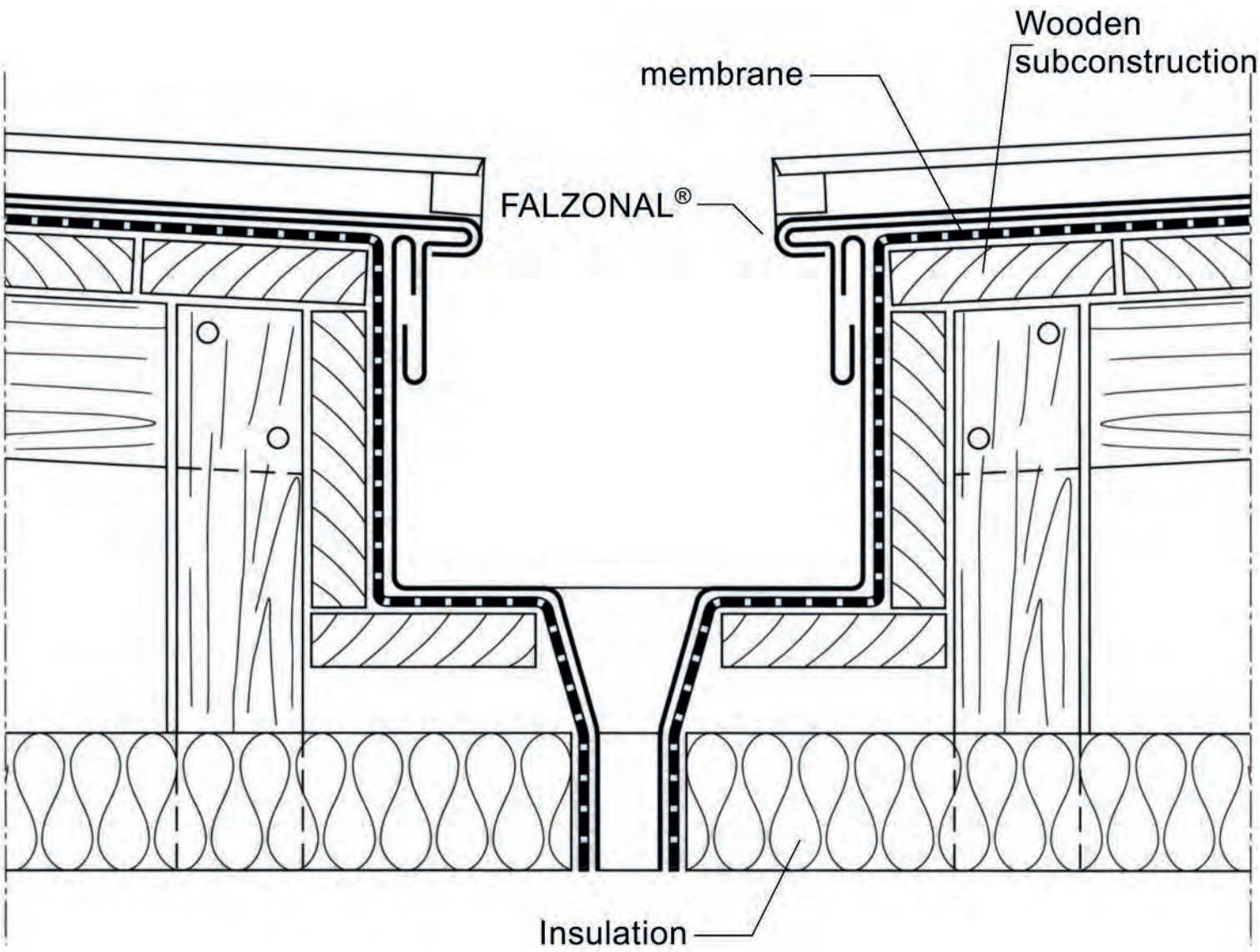
Valley gutter



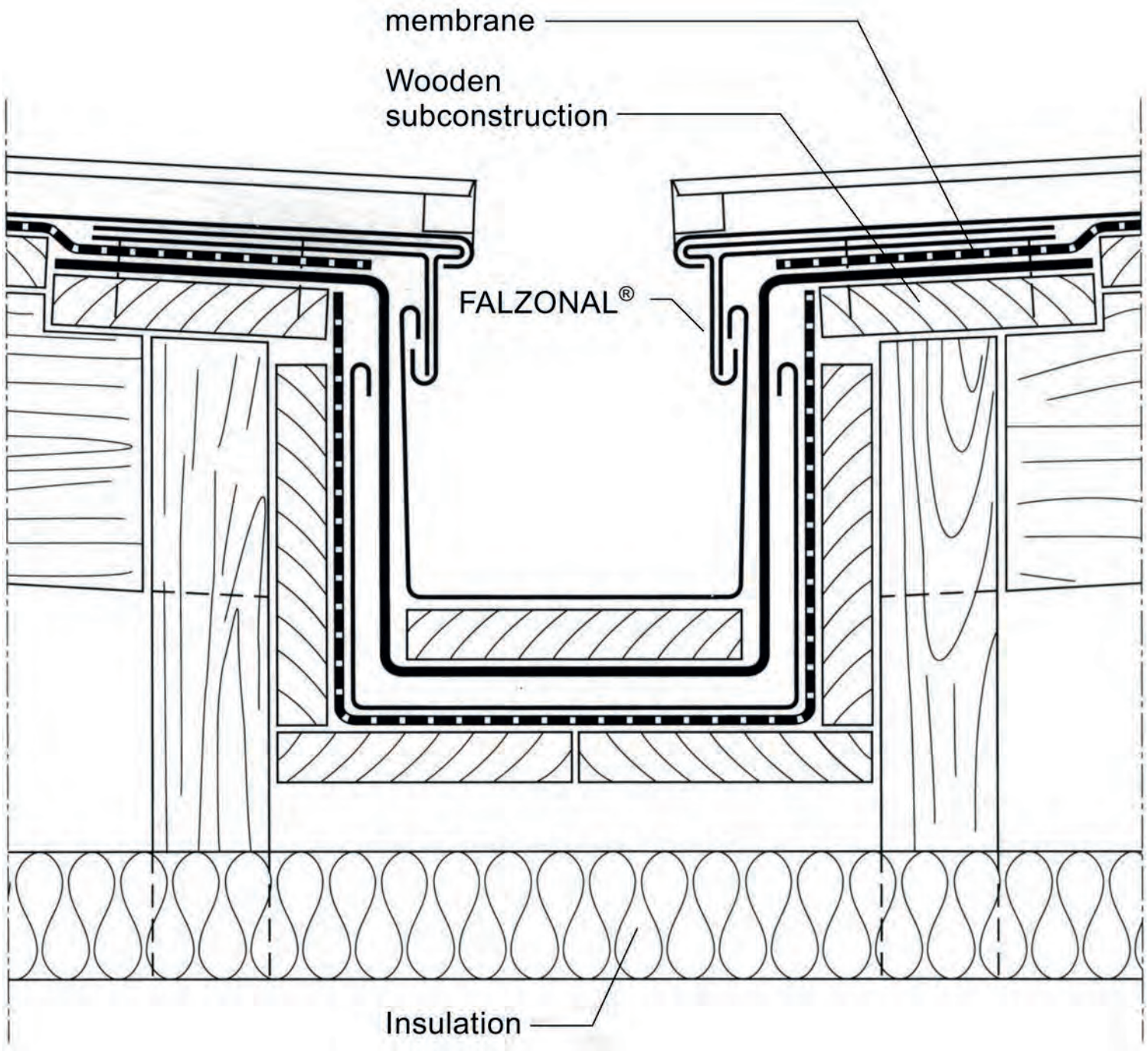
Valley gutter



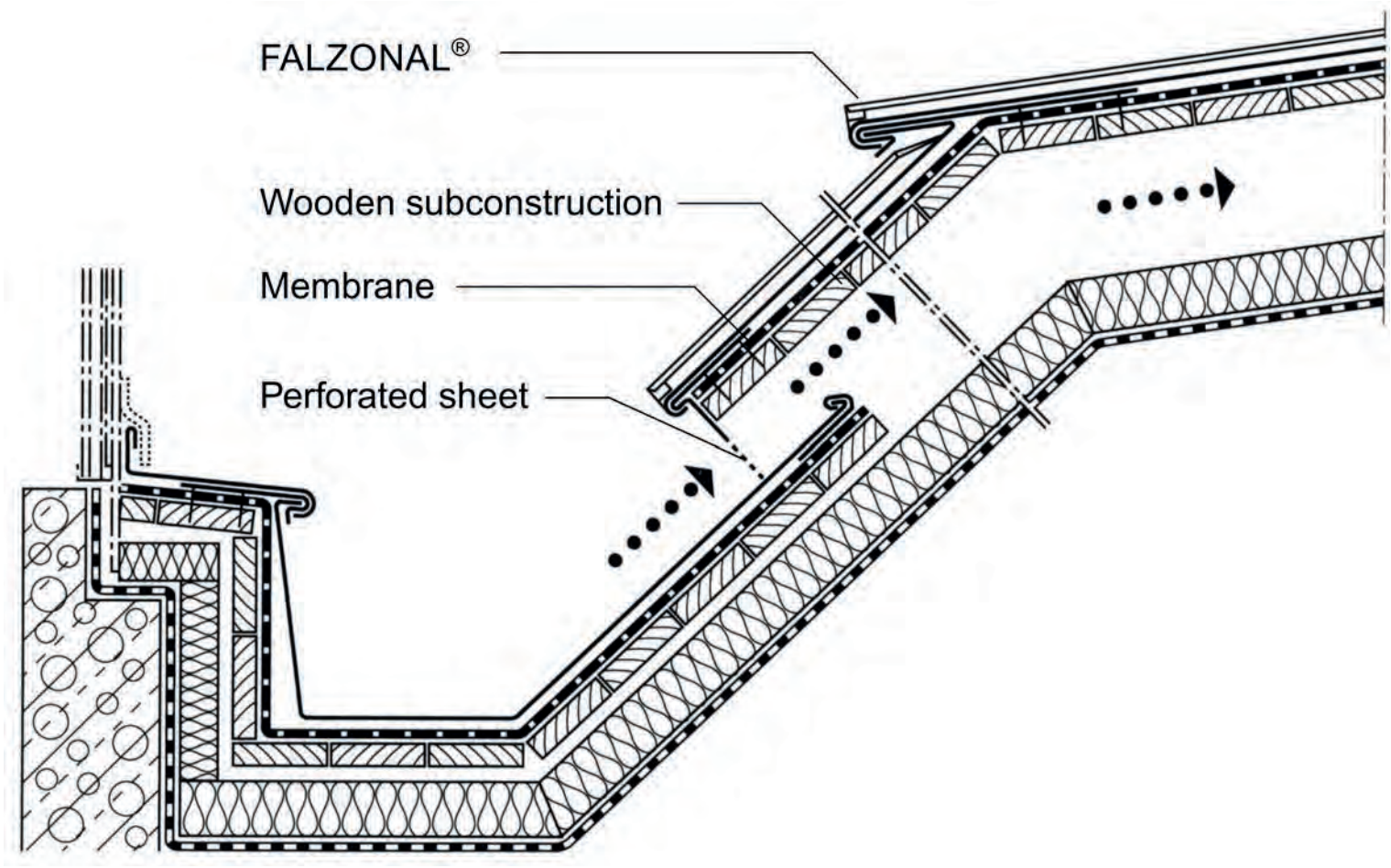
Internal gutter without secondary lining



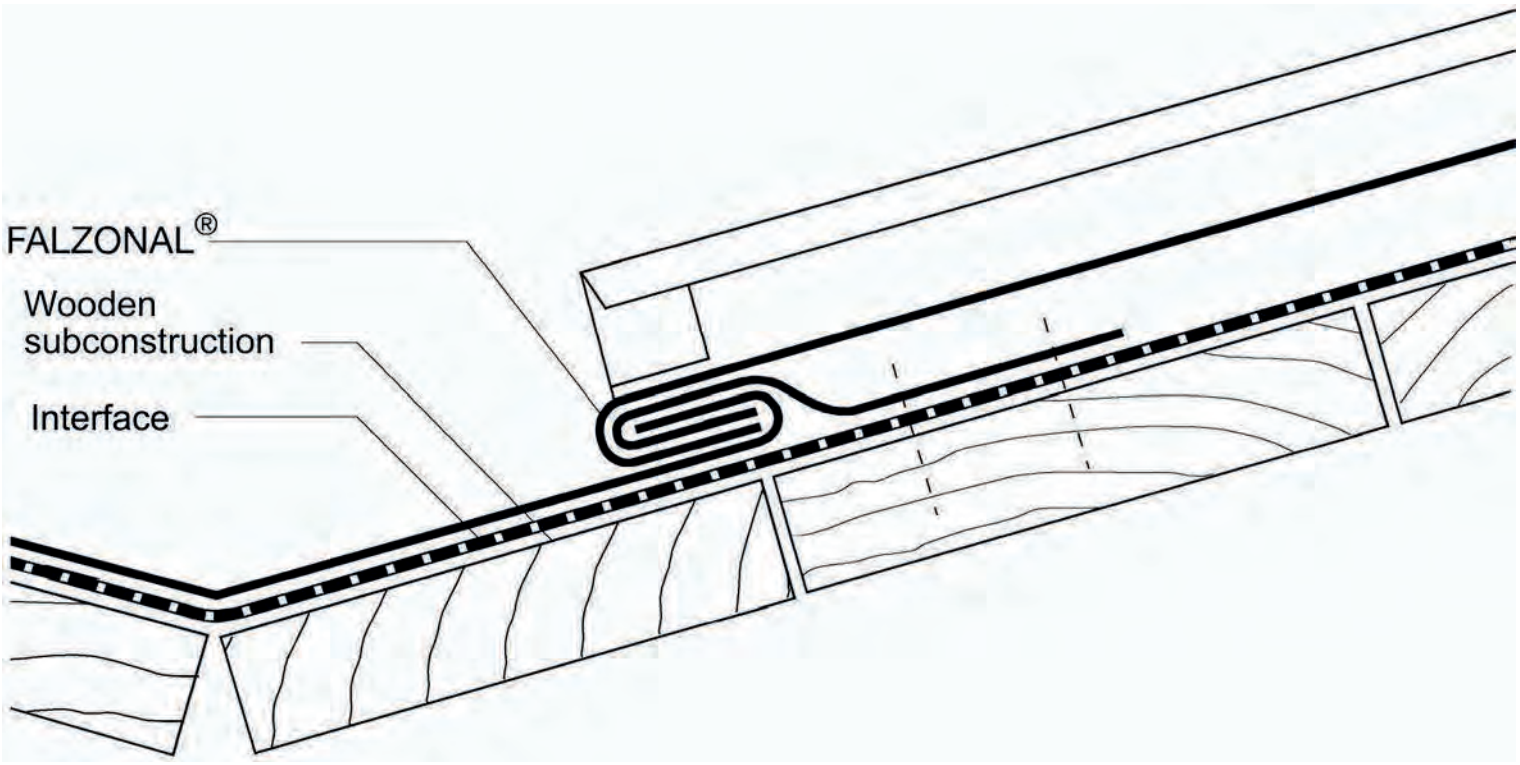
Internal gutter with secondary lining

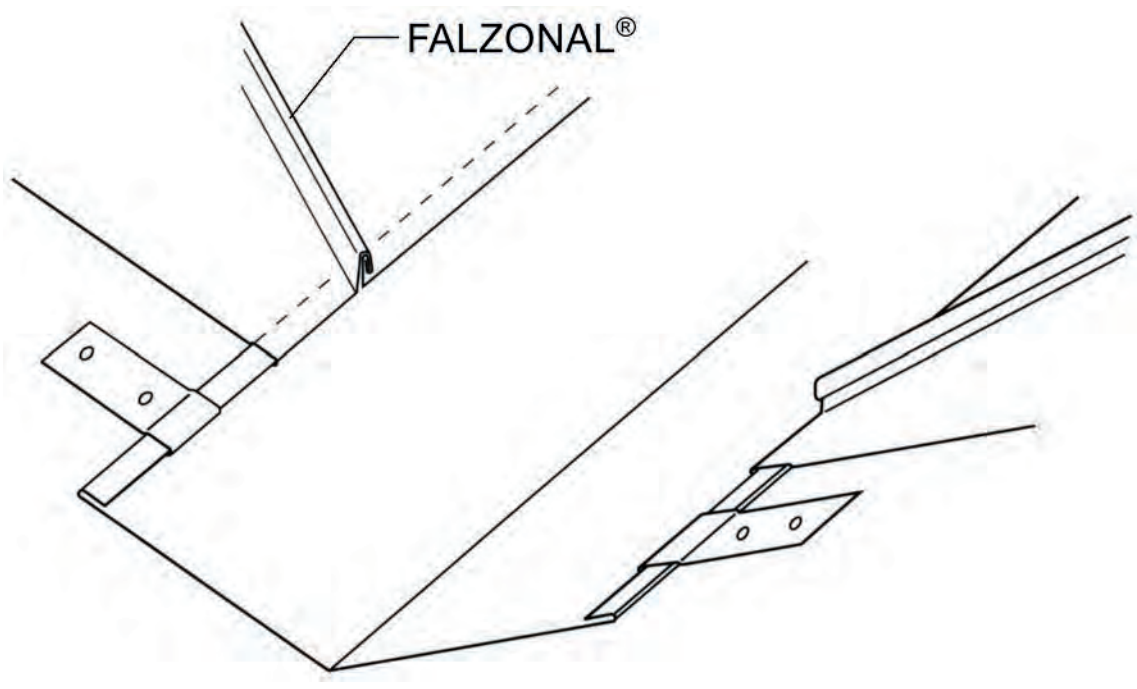


North light gutter

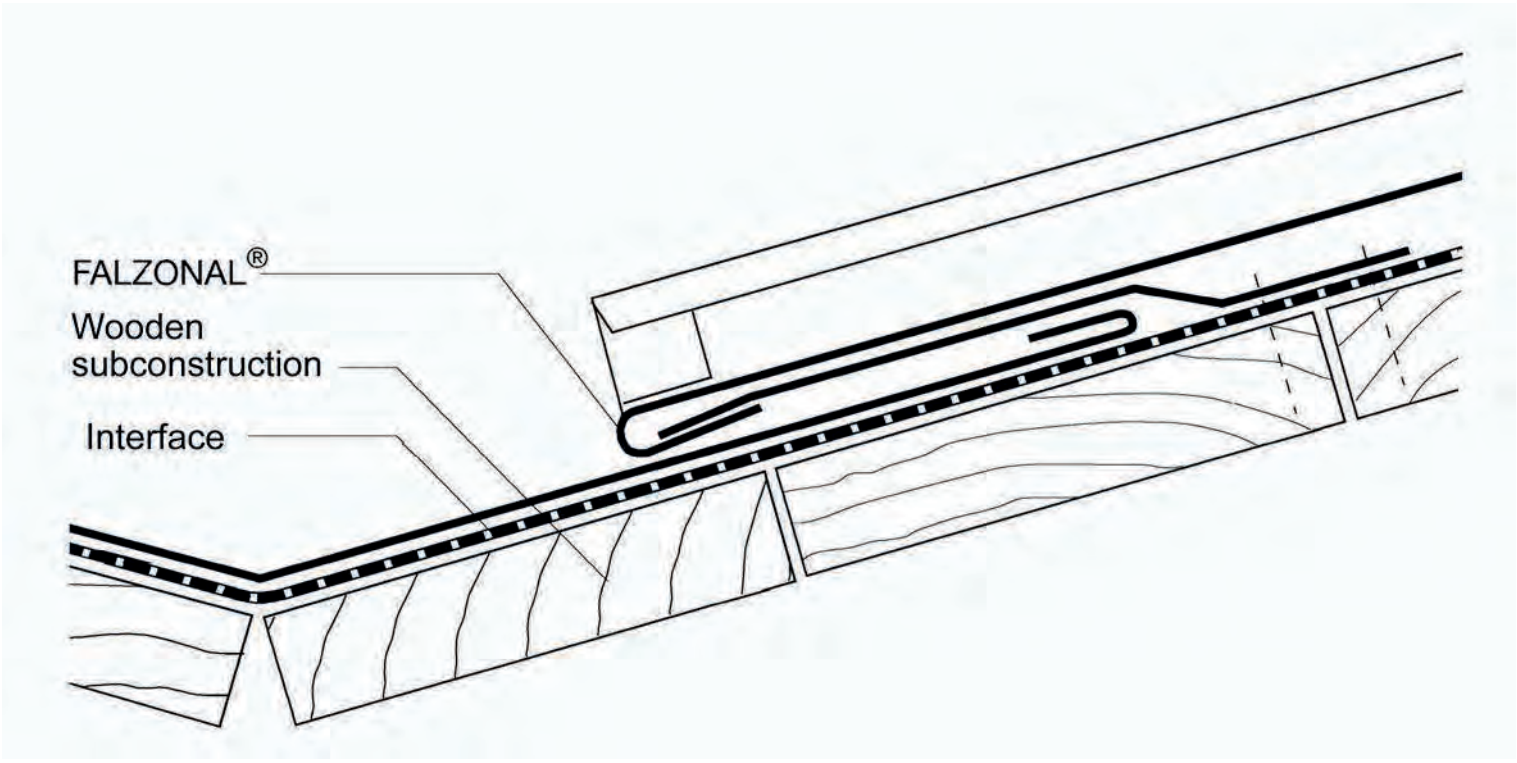


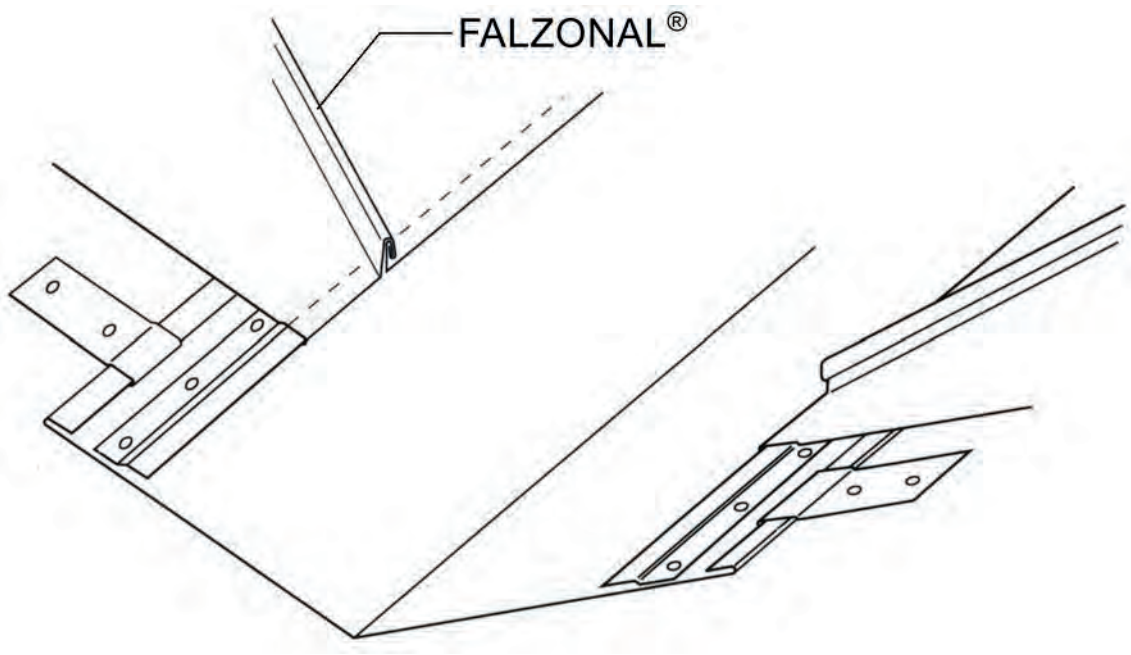
Valley with single-seam





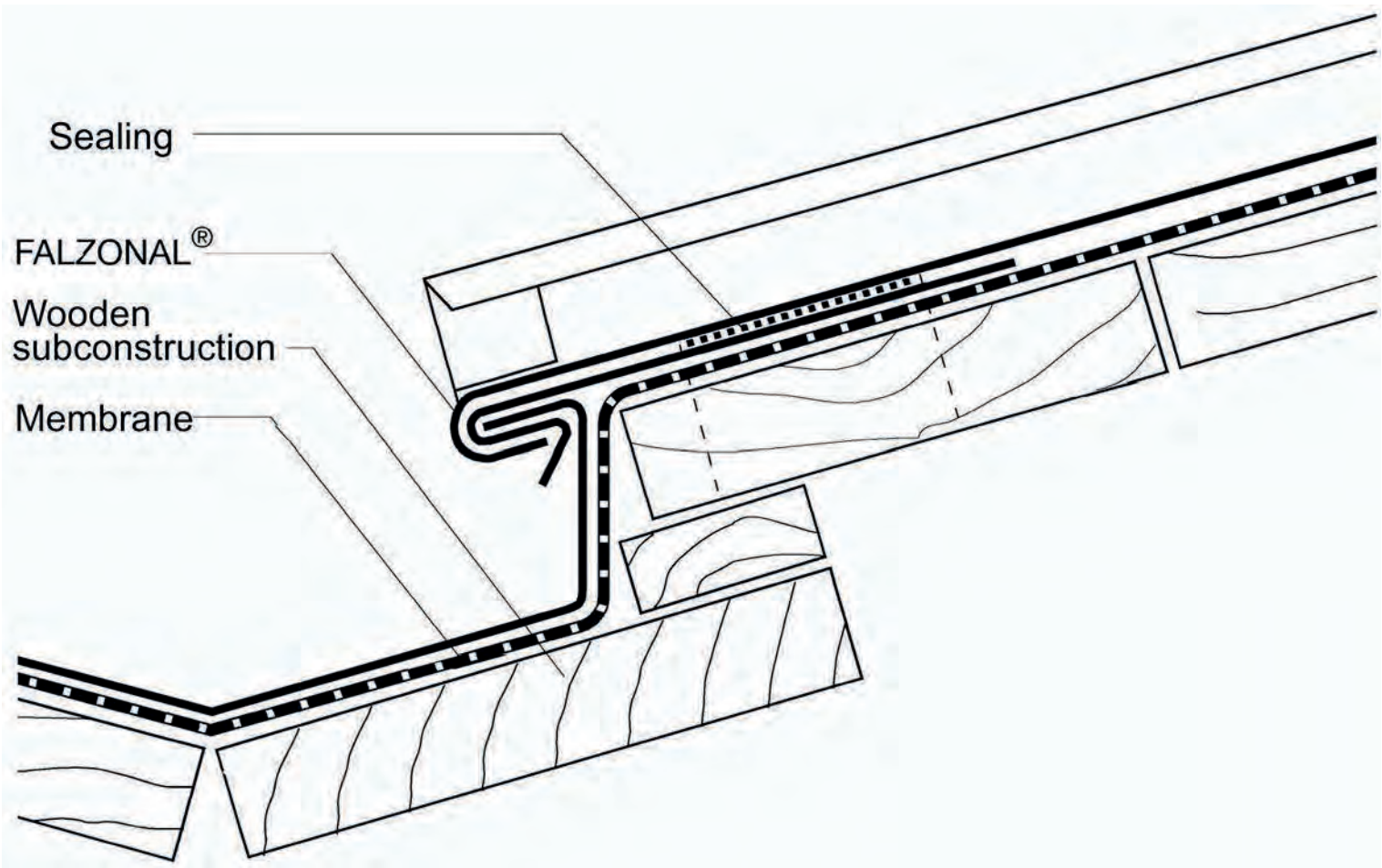
Valley

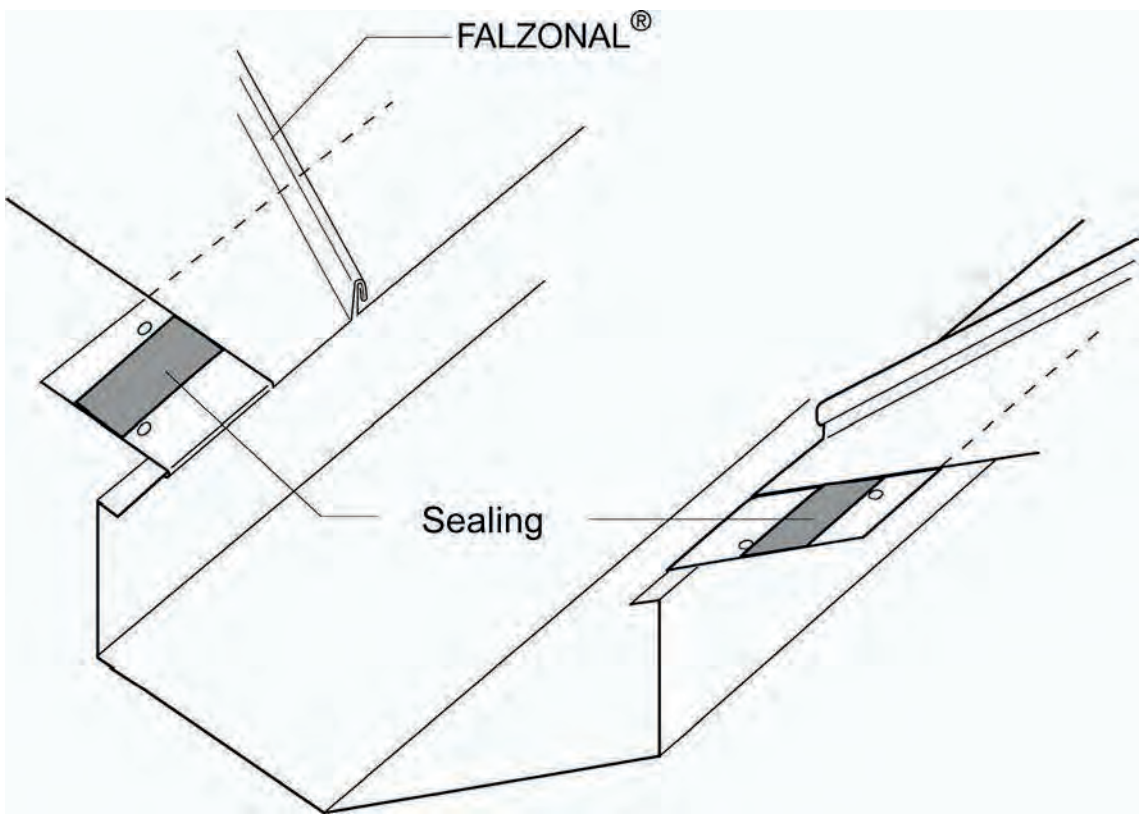




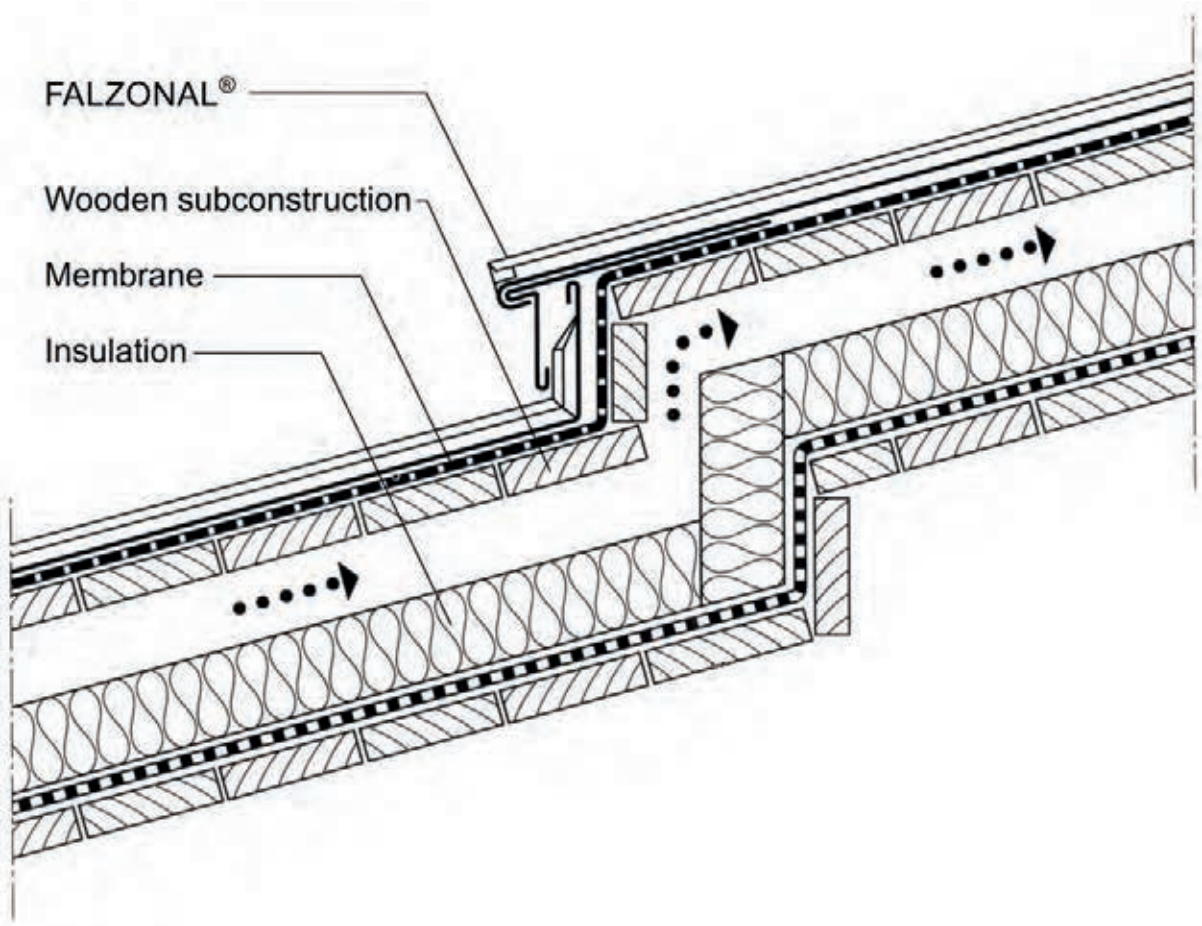
Valley construction

Boxed valley
> 3° (5, 2%)

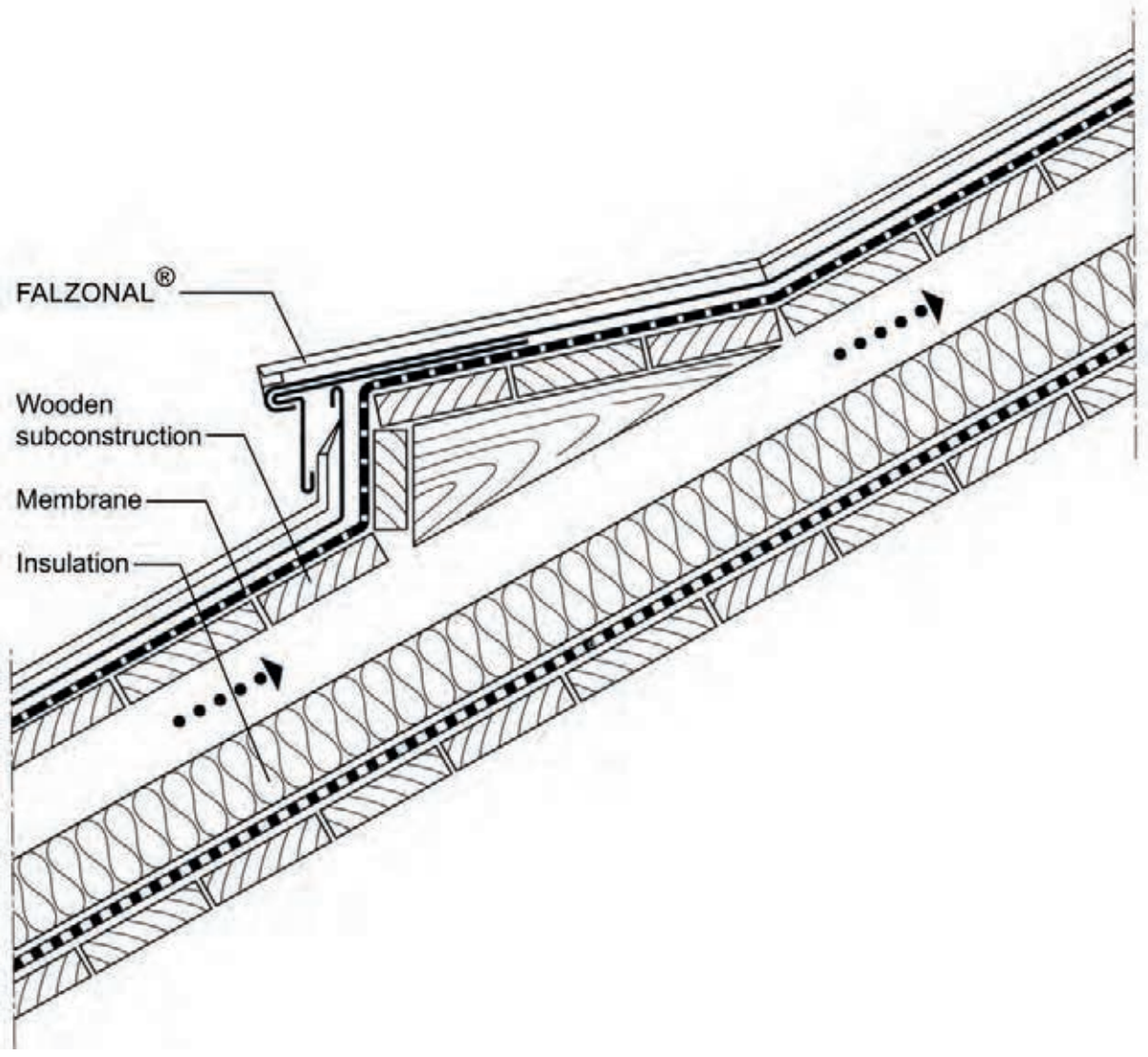




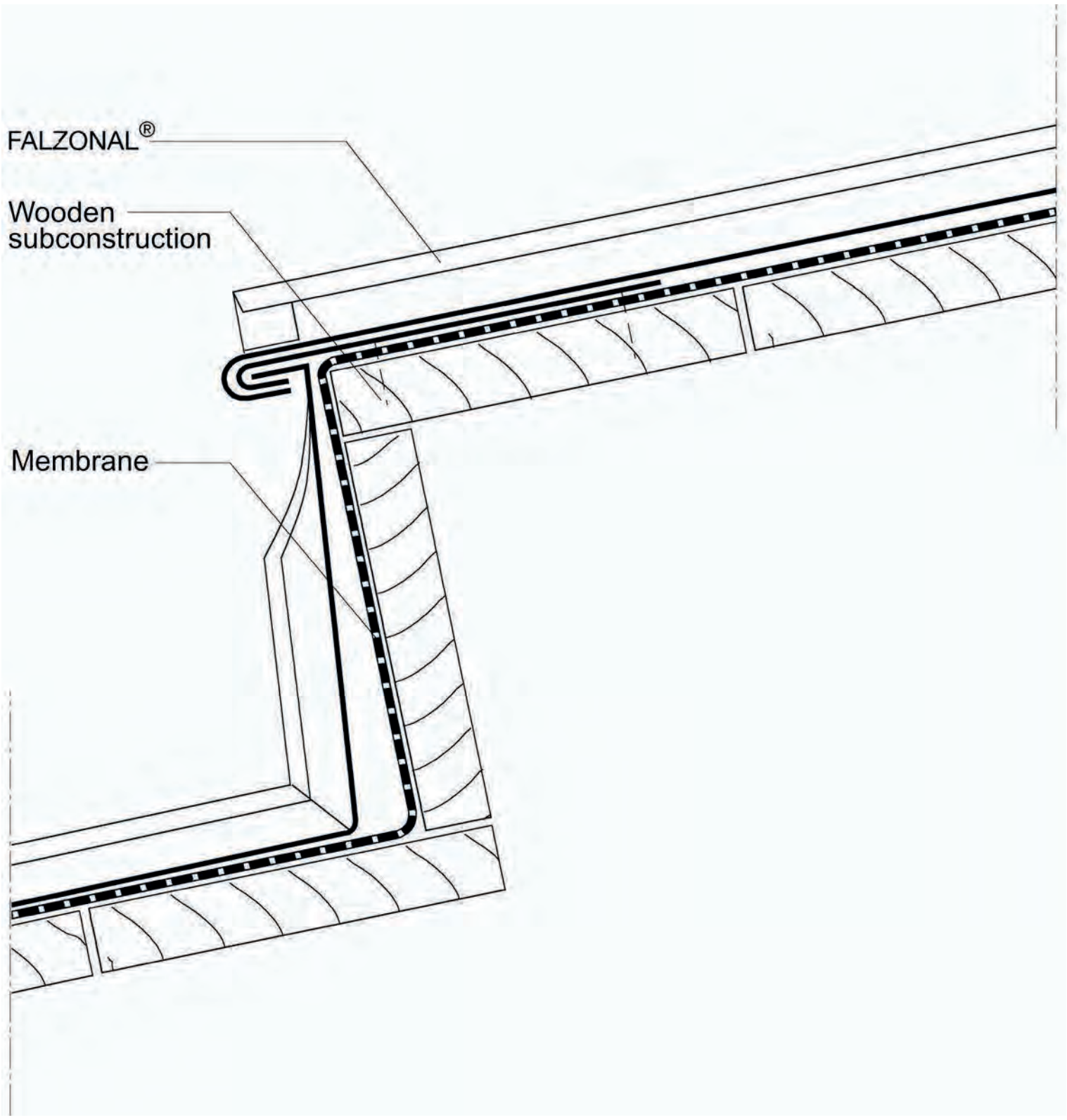
Parallel step



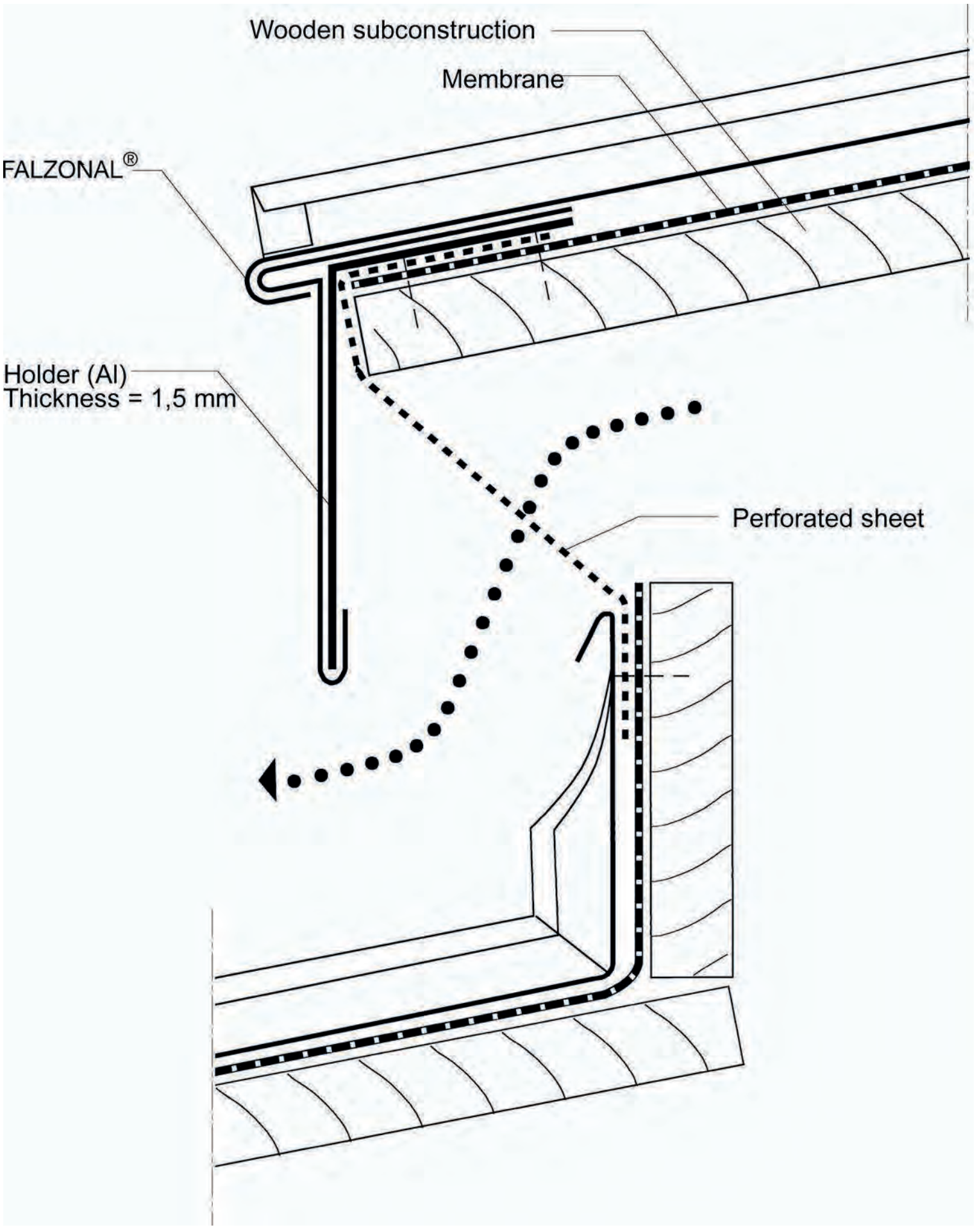
Parallel step



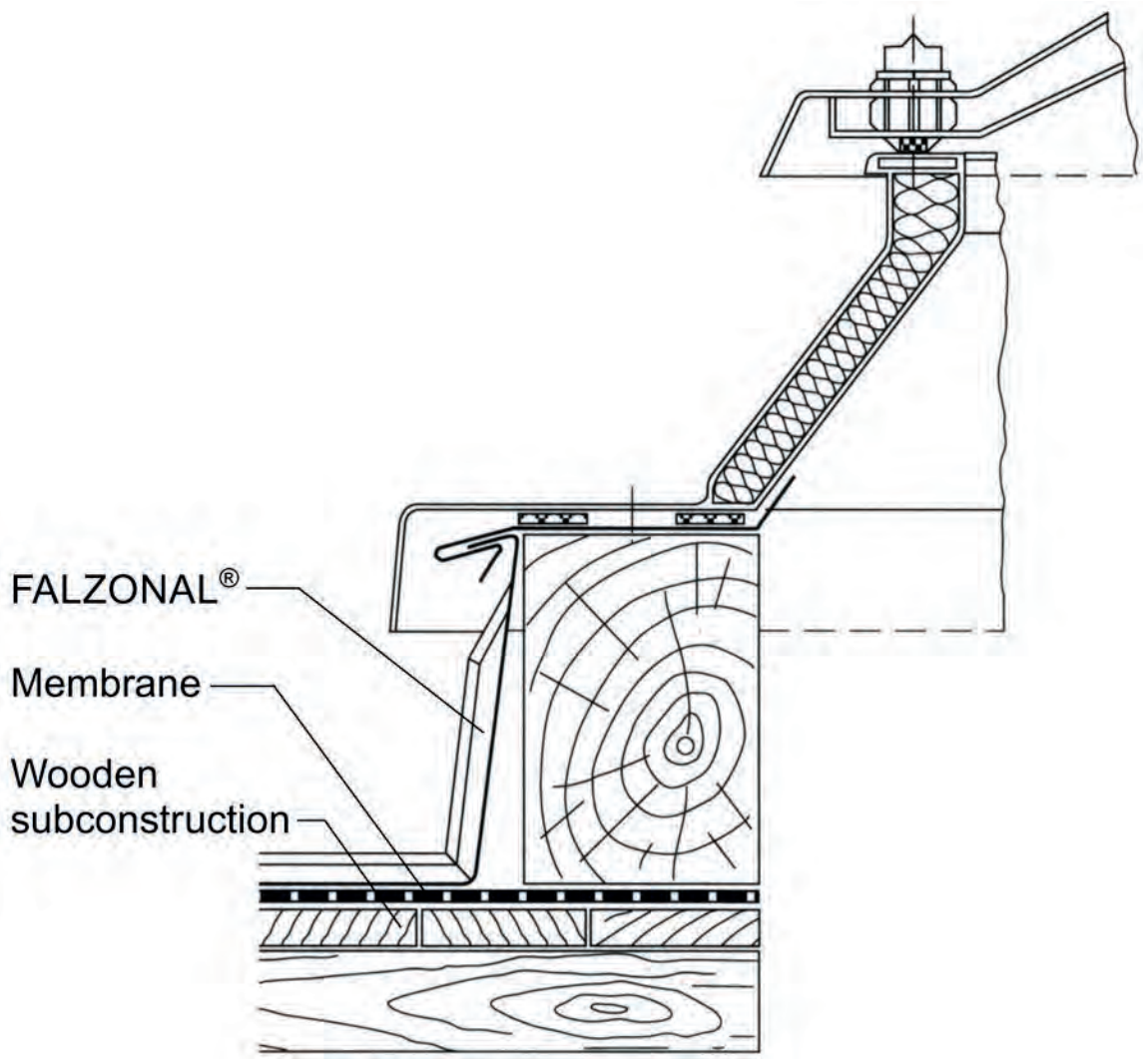
Step-roof slope



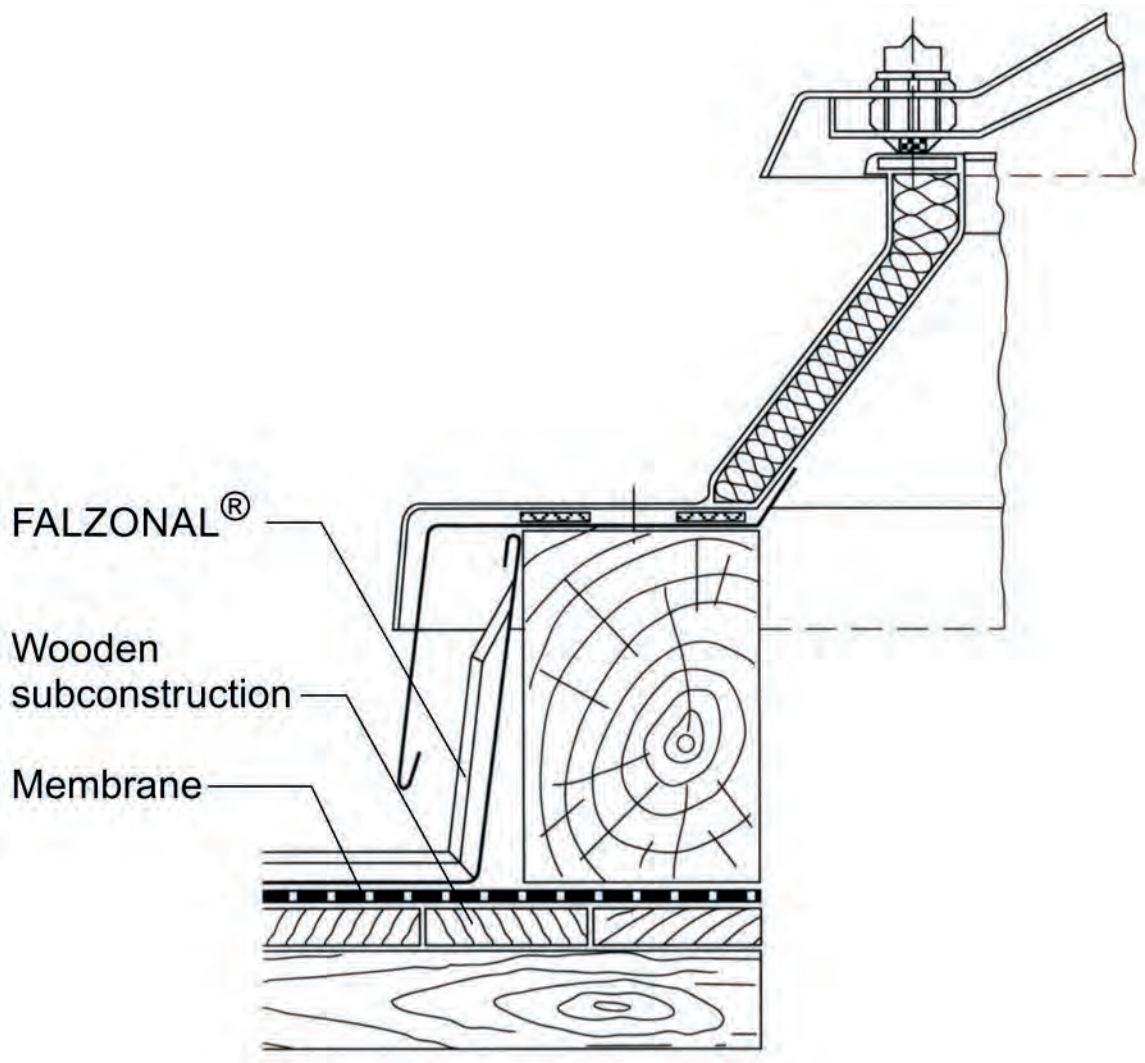
Platform step (with ventilation)



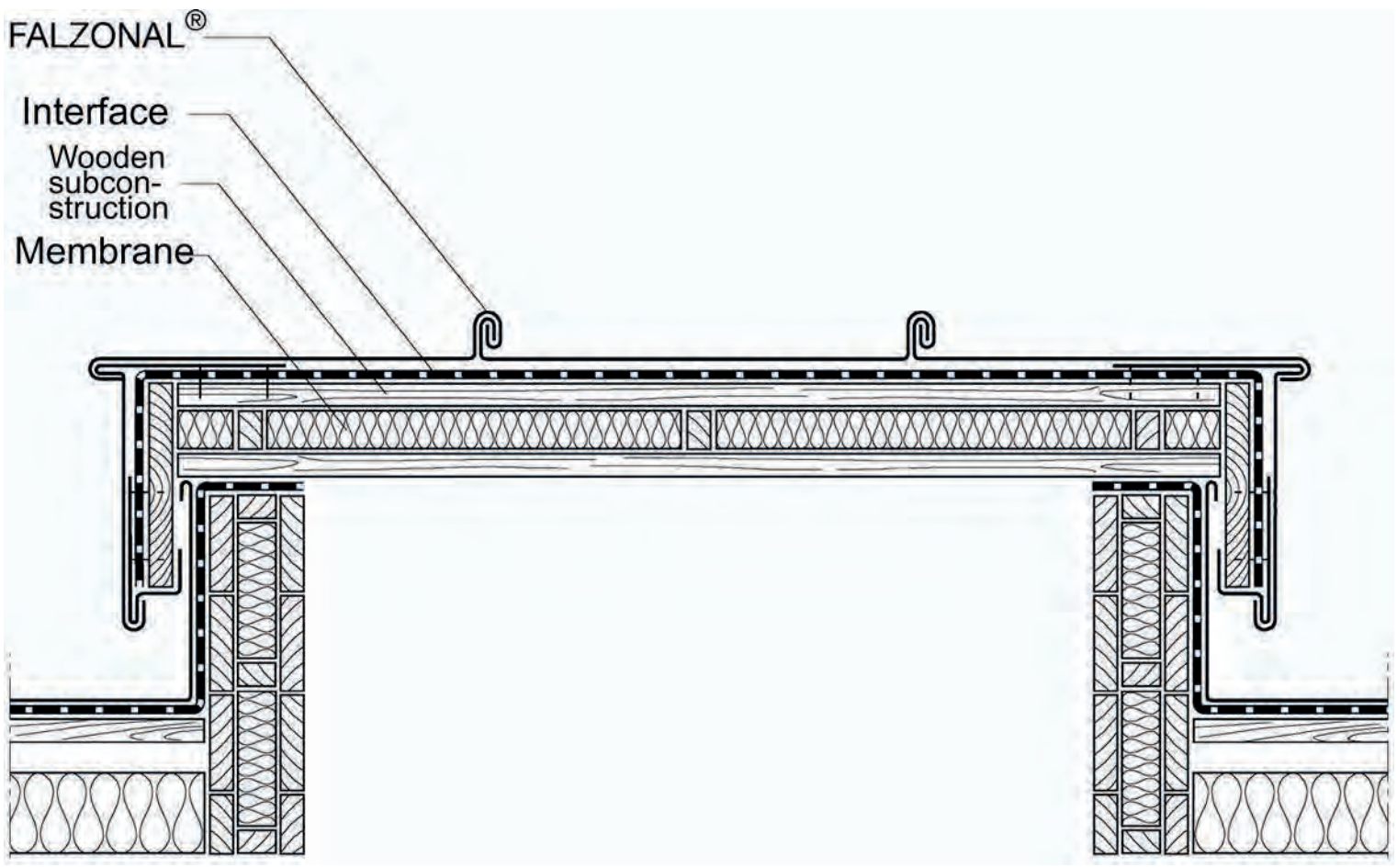
Rooflight abutment



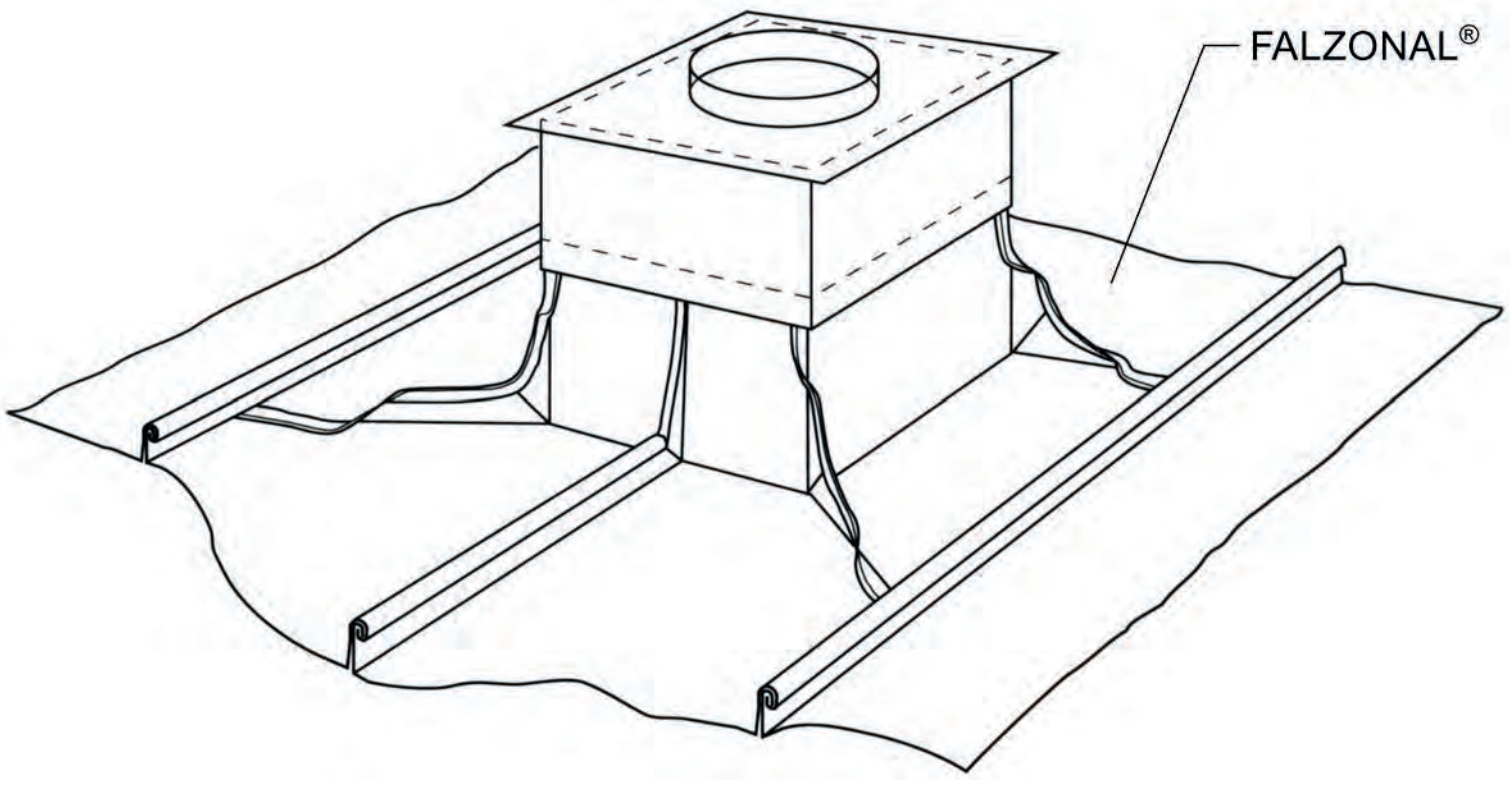
Rooflight abutment



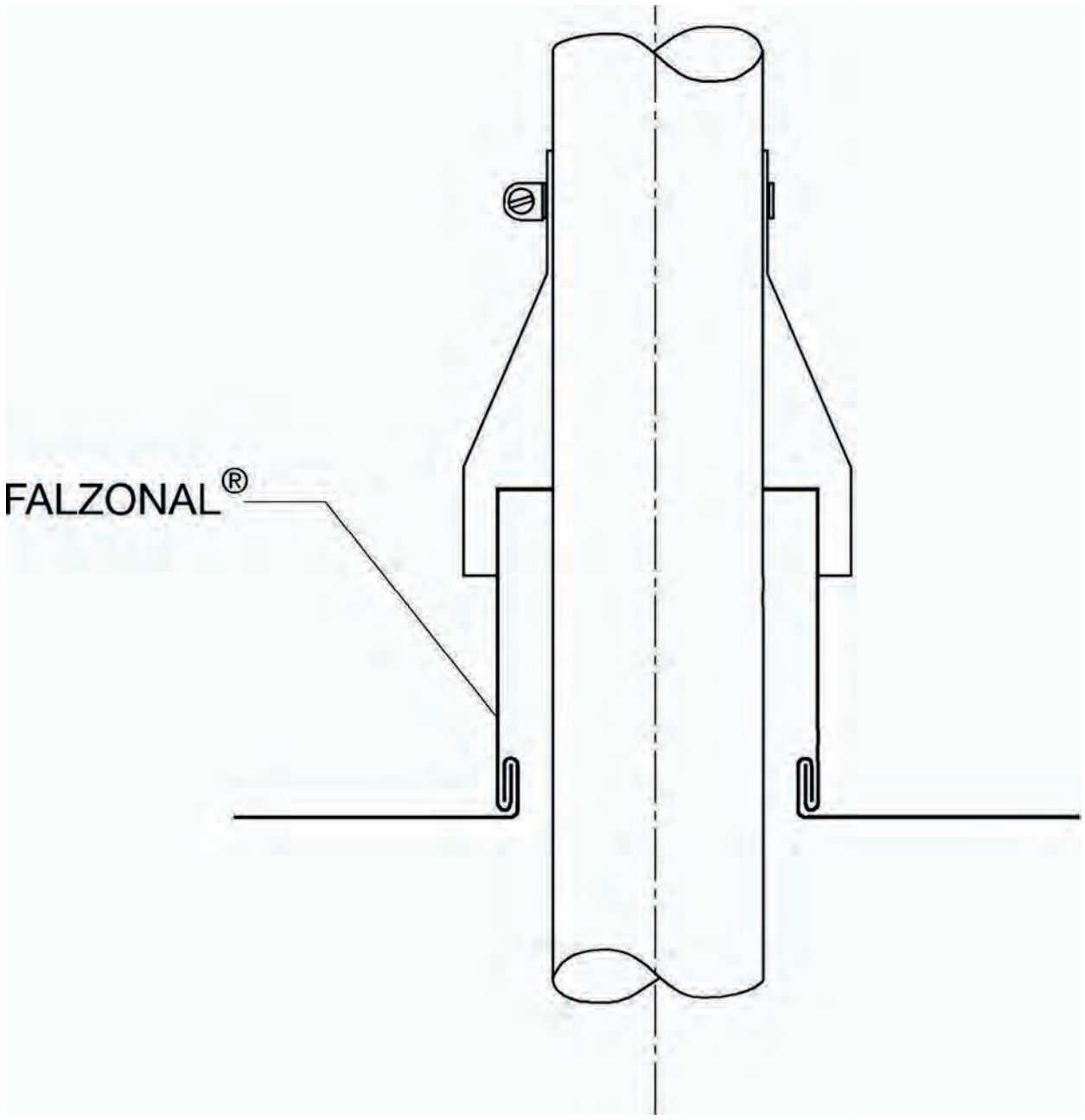
Roof hatch

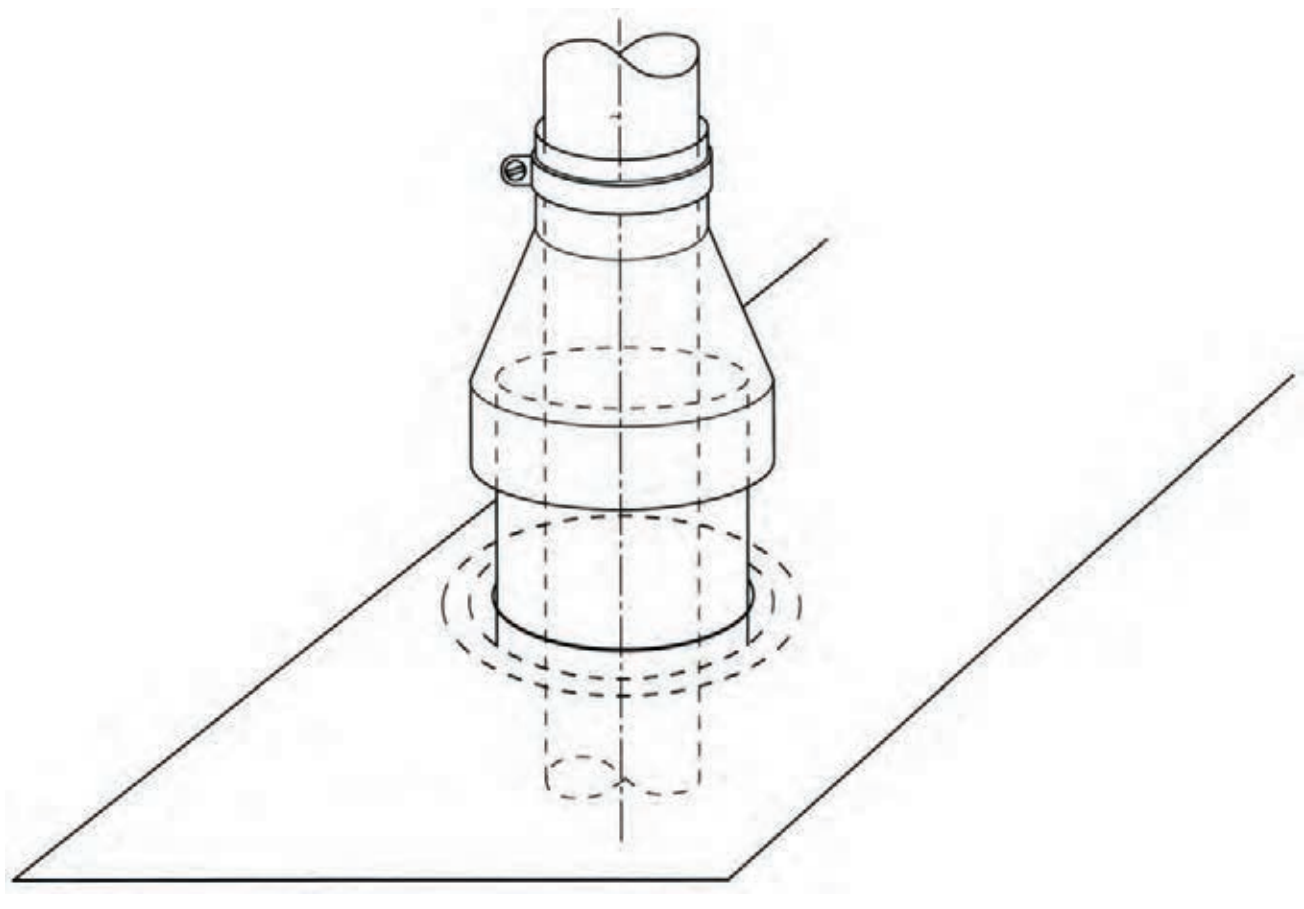


Roof penetration

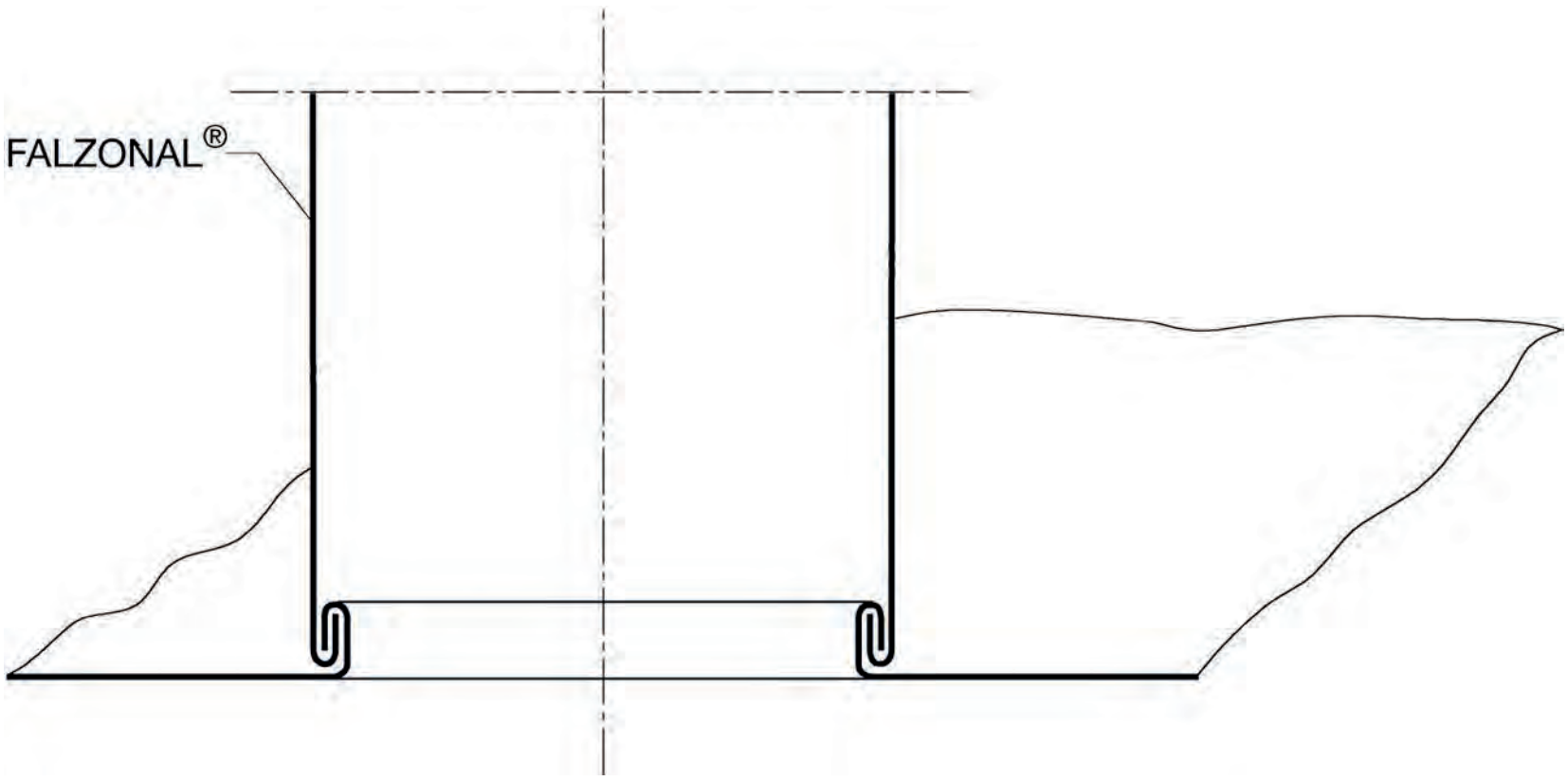


Flashing penetrations-antenna, pipes etc.

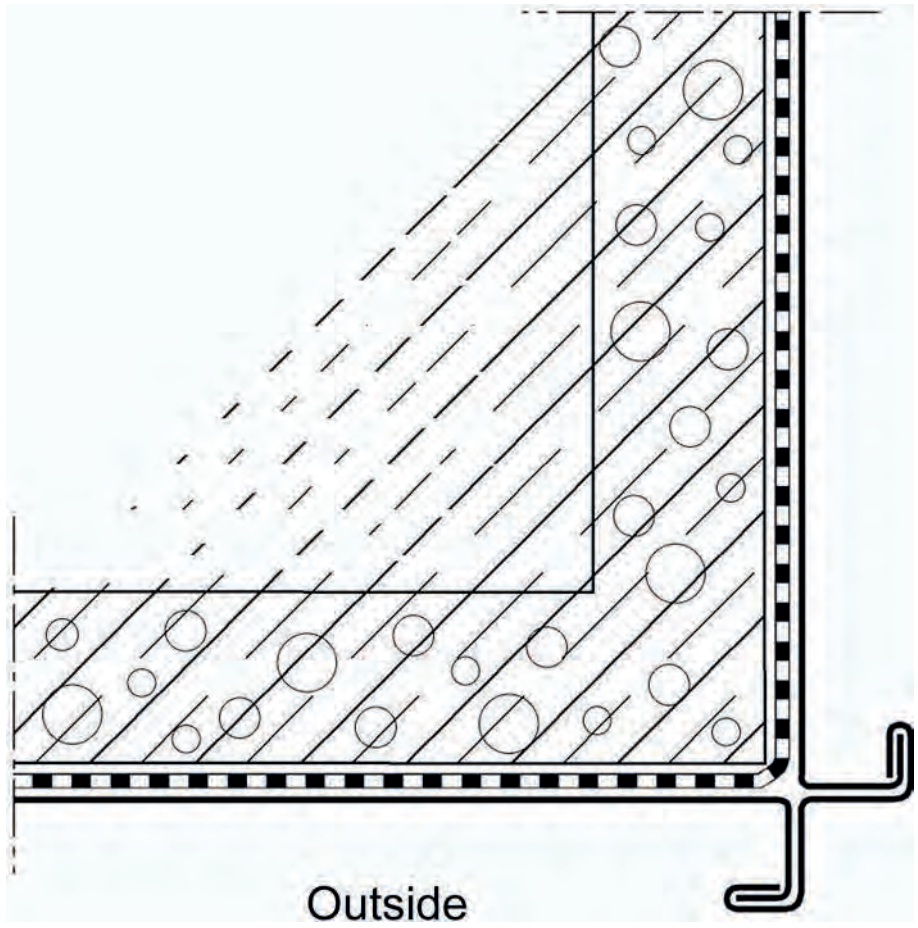


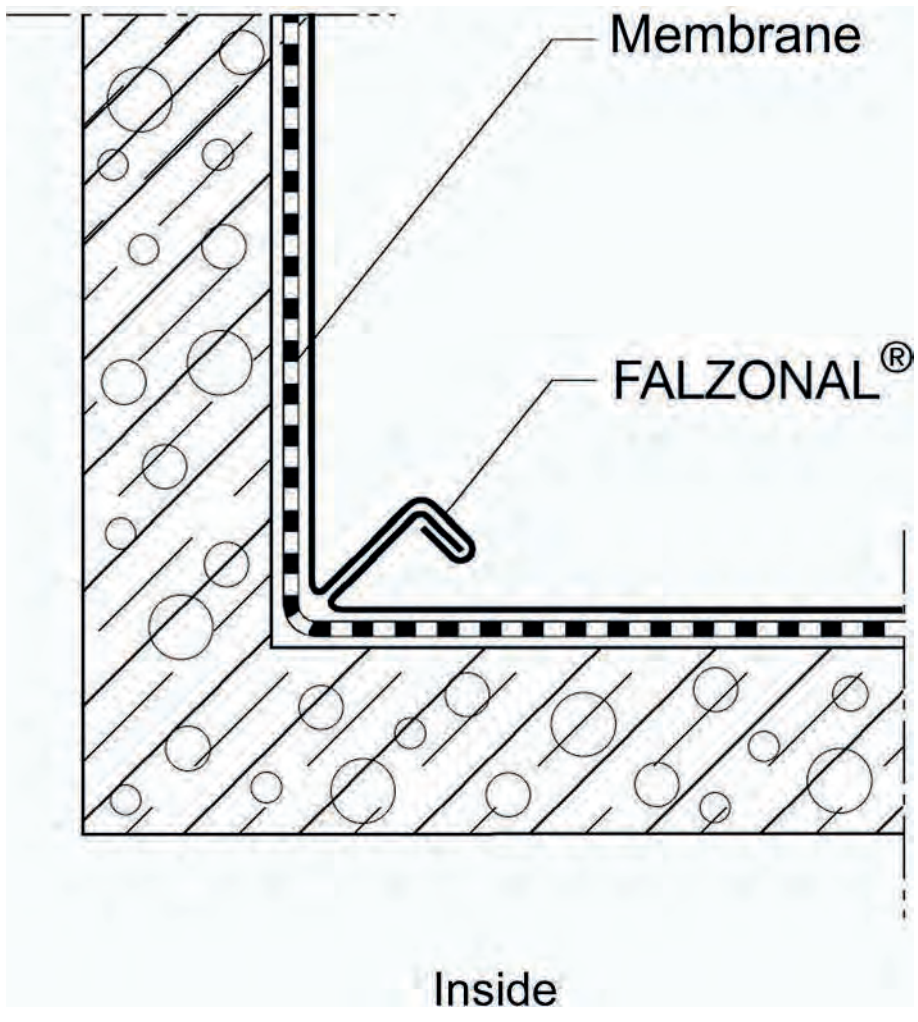


Flashing seamed

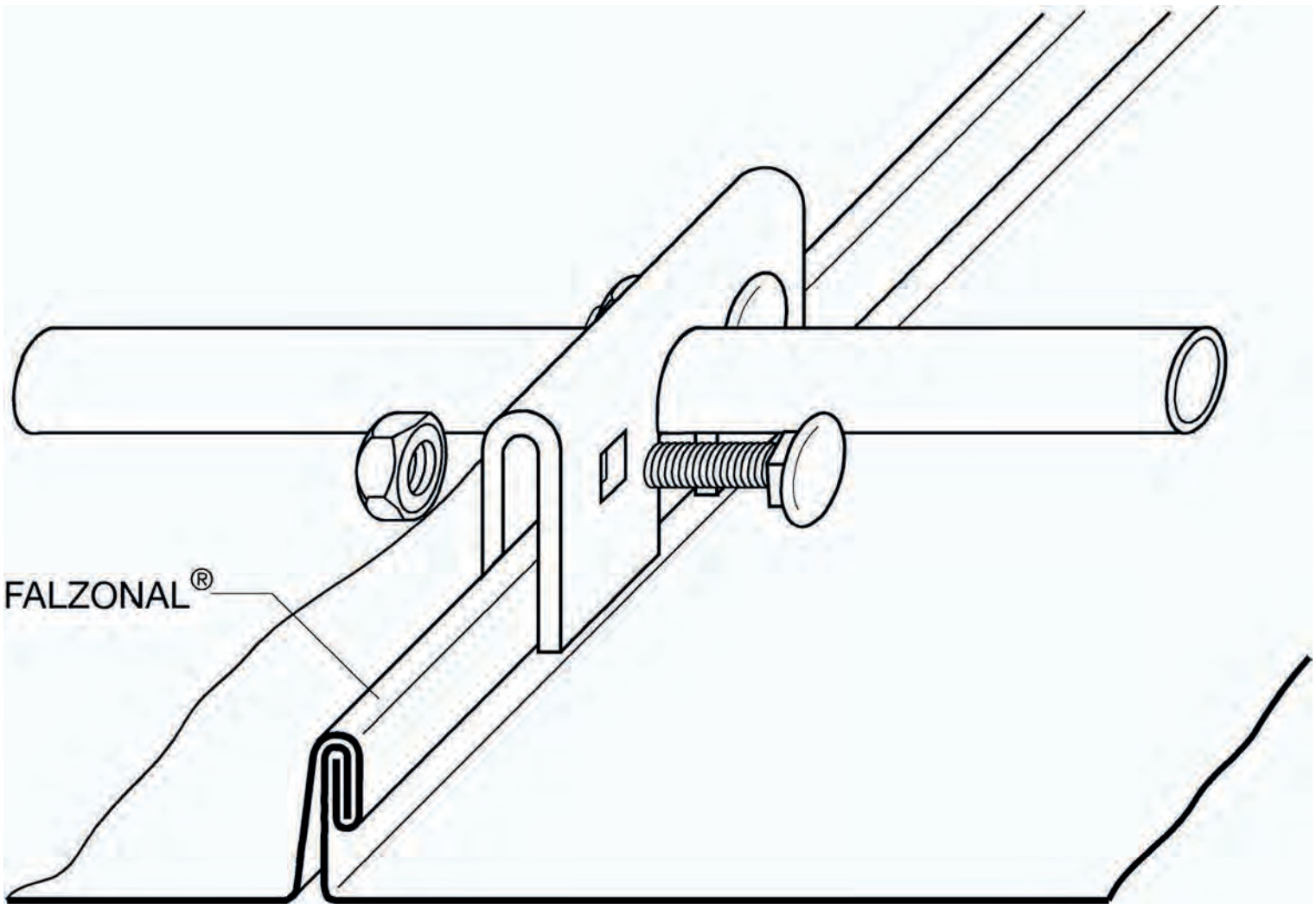


Corner- with corner piece

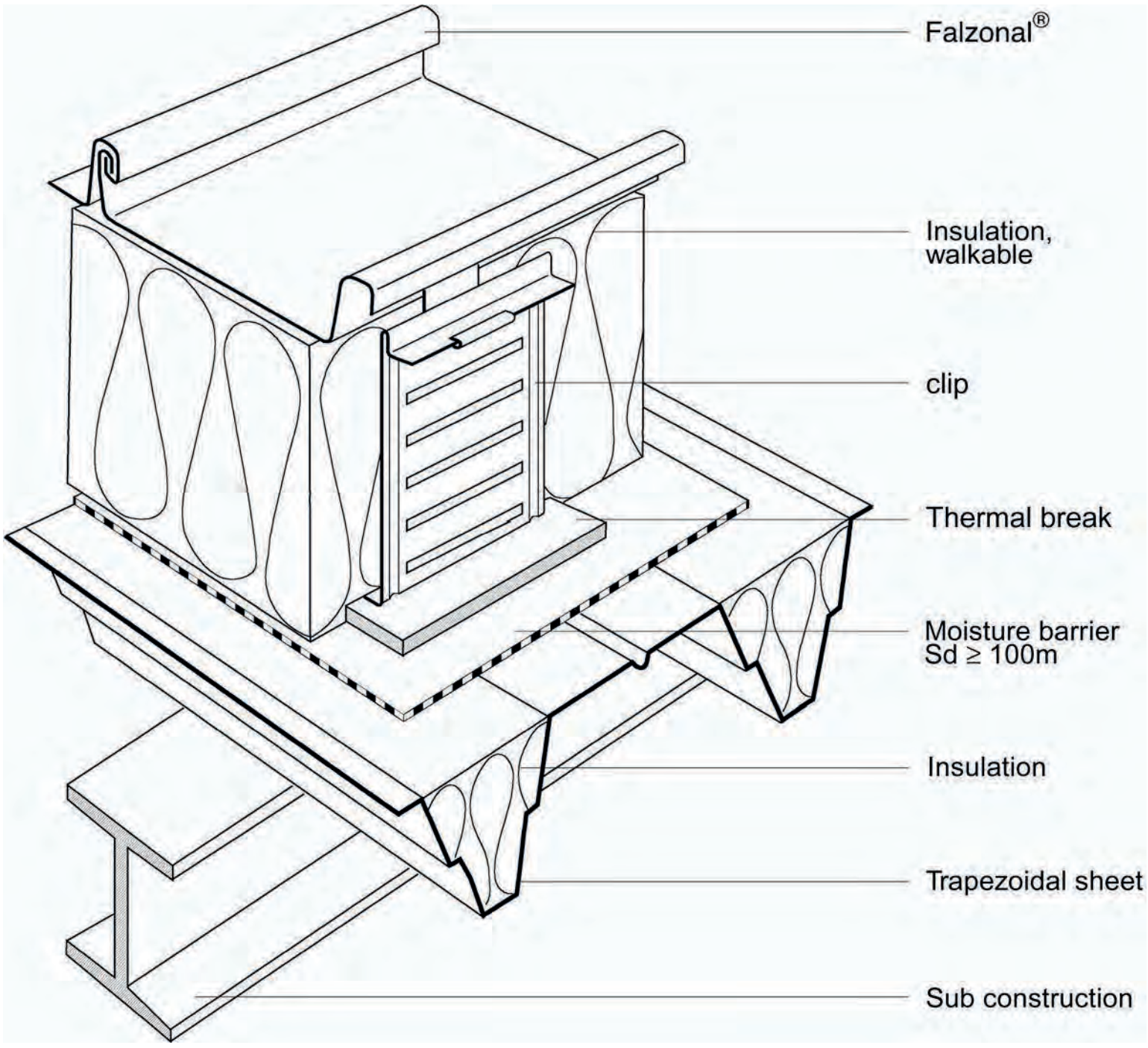




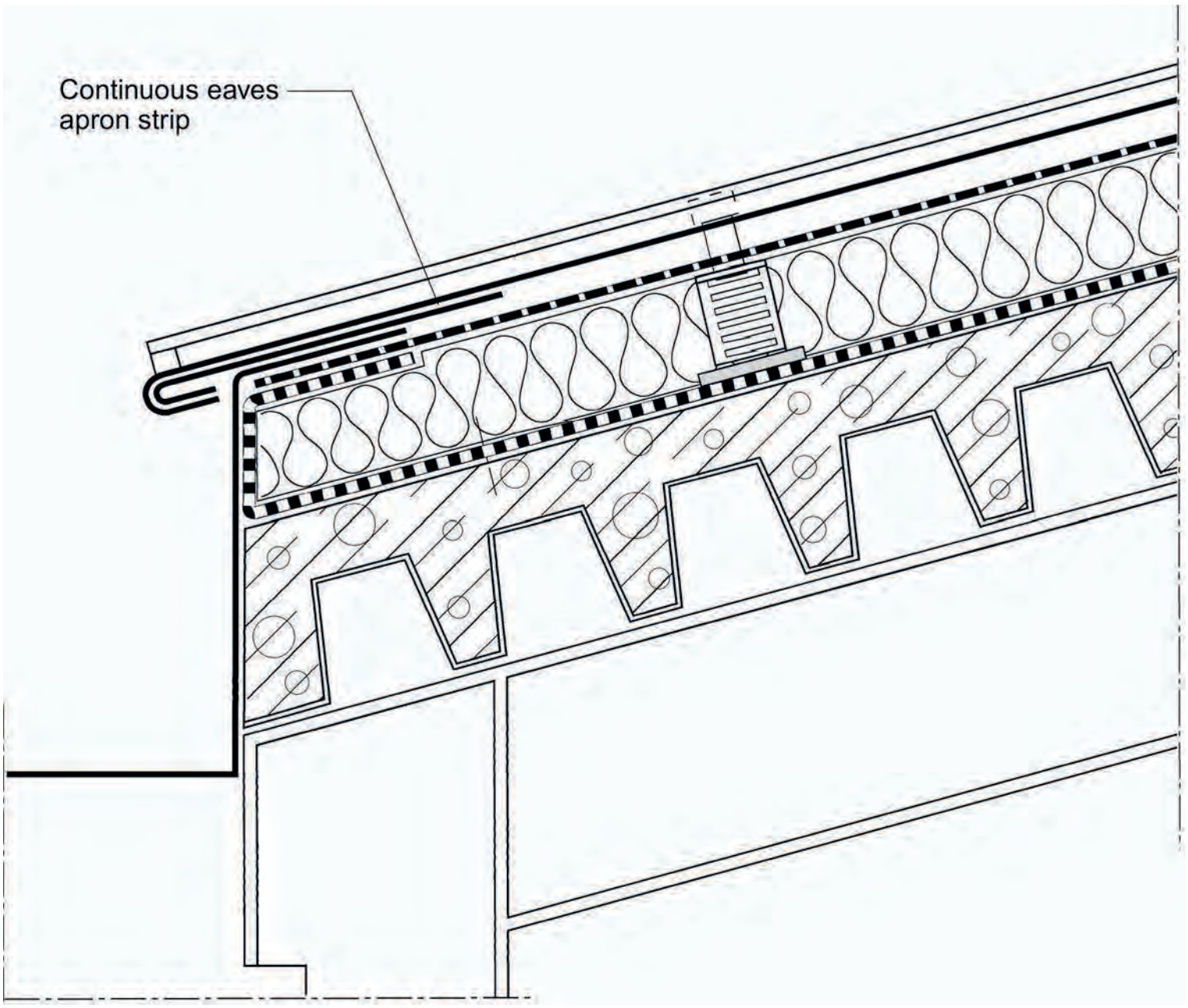
Snowguard carrier



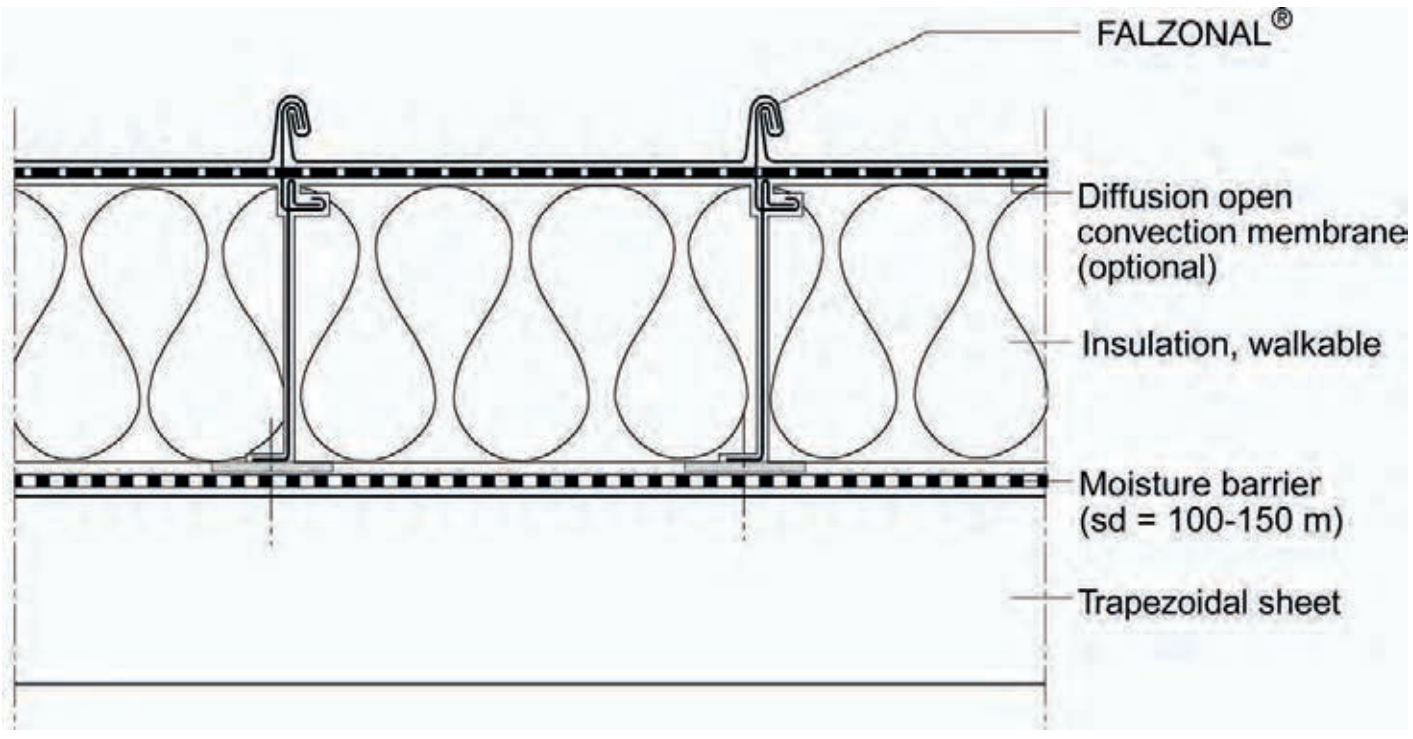
Warm roof construction



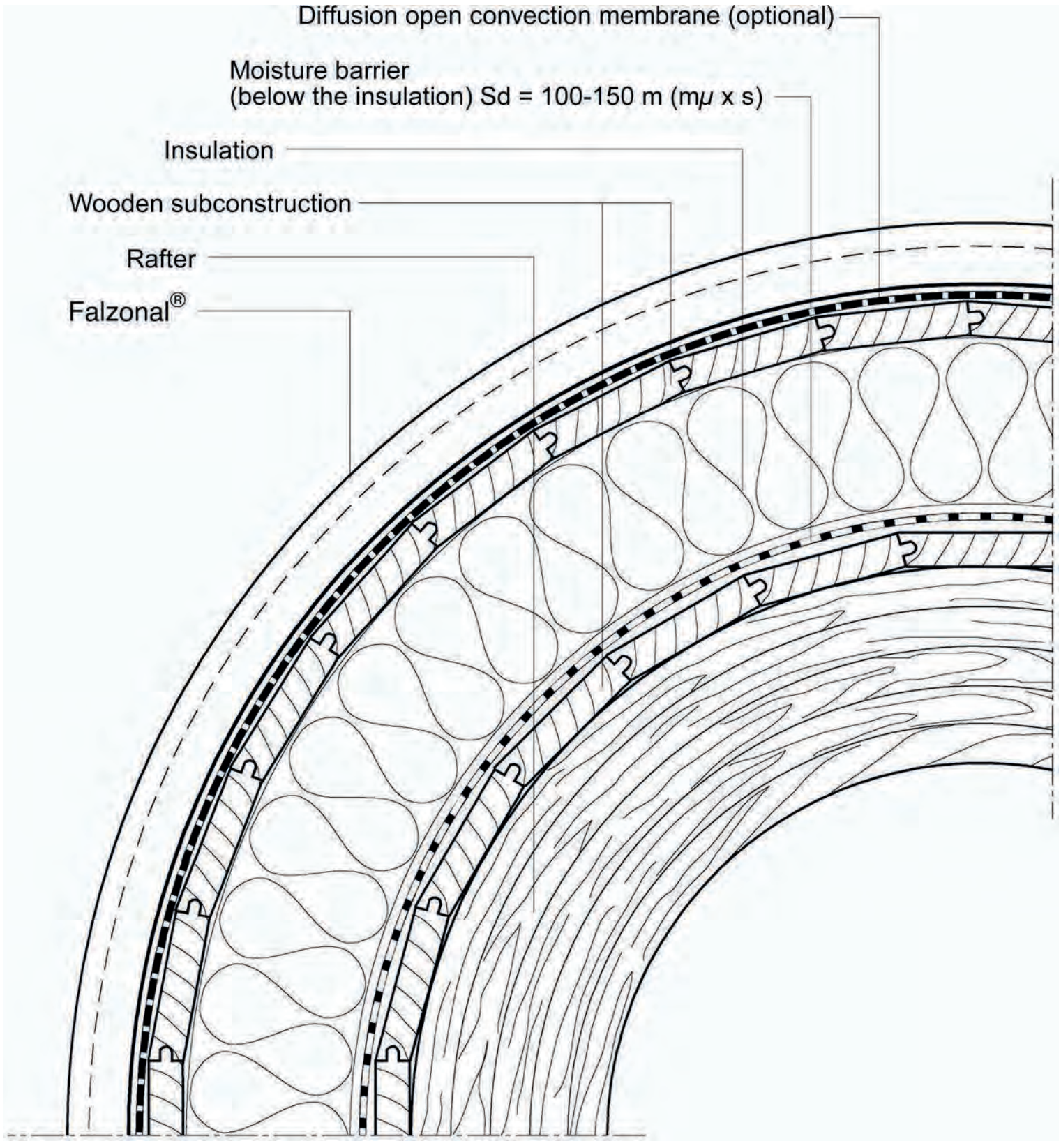
Warm roof construction on concrete



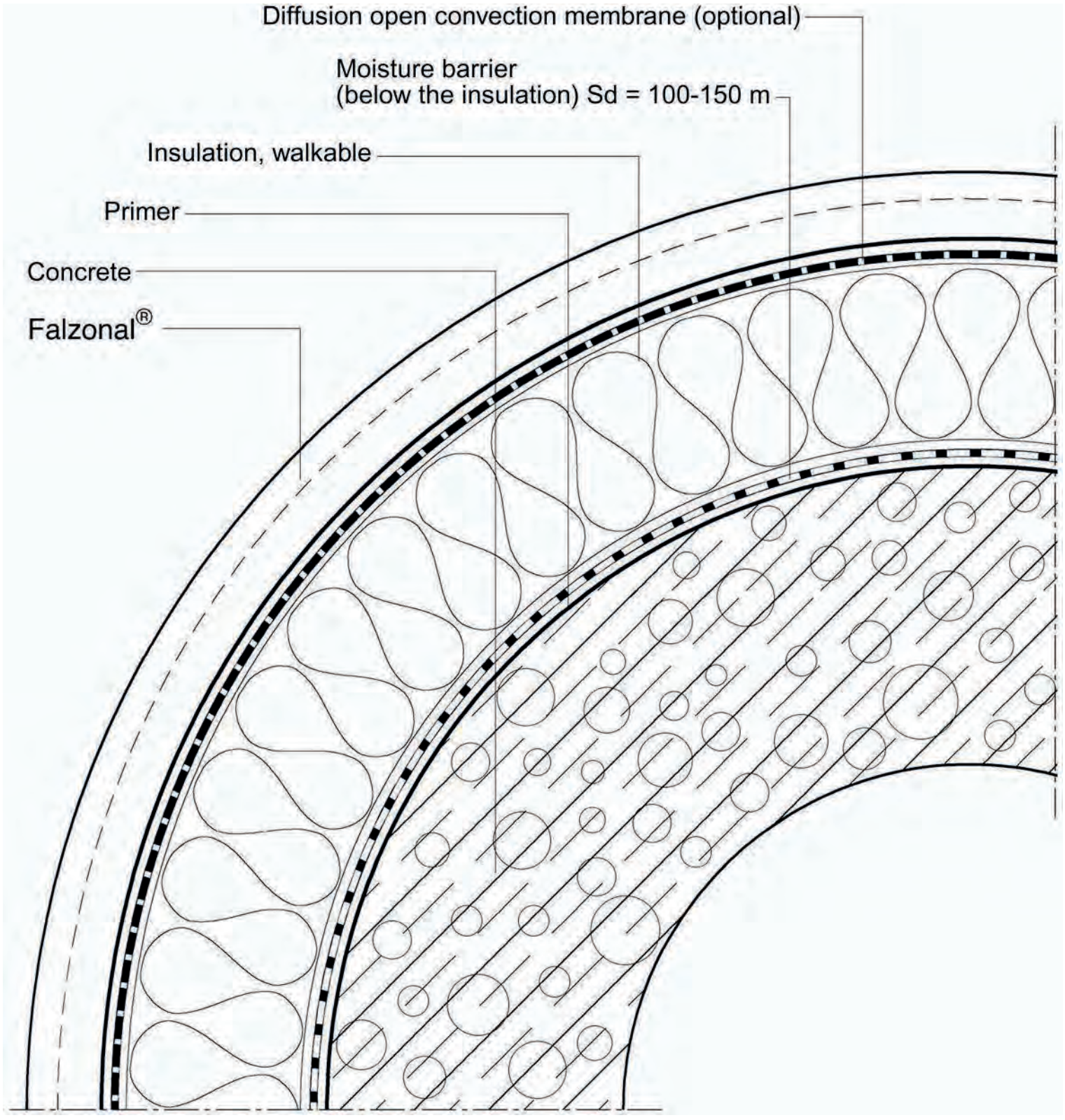
Warm roof construction on profiled sheets



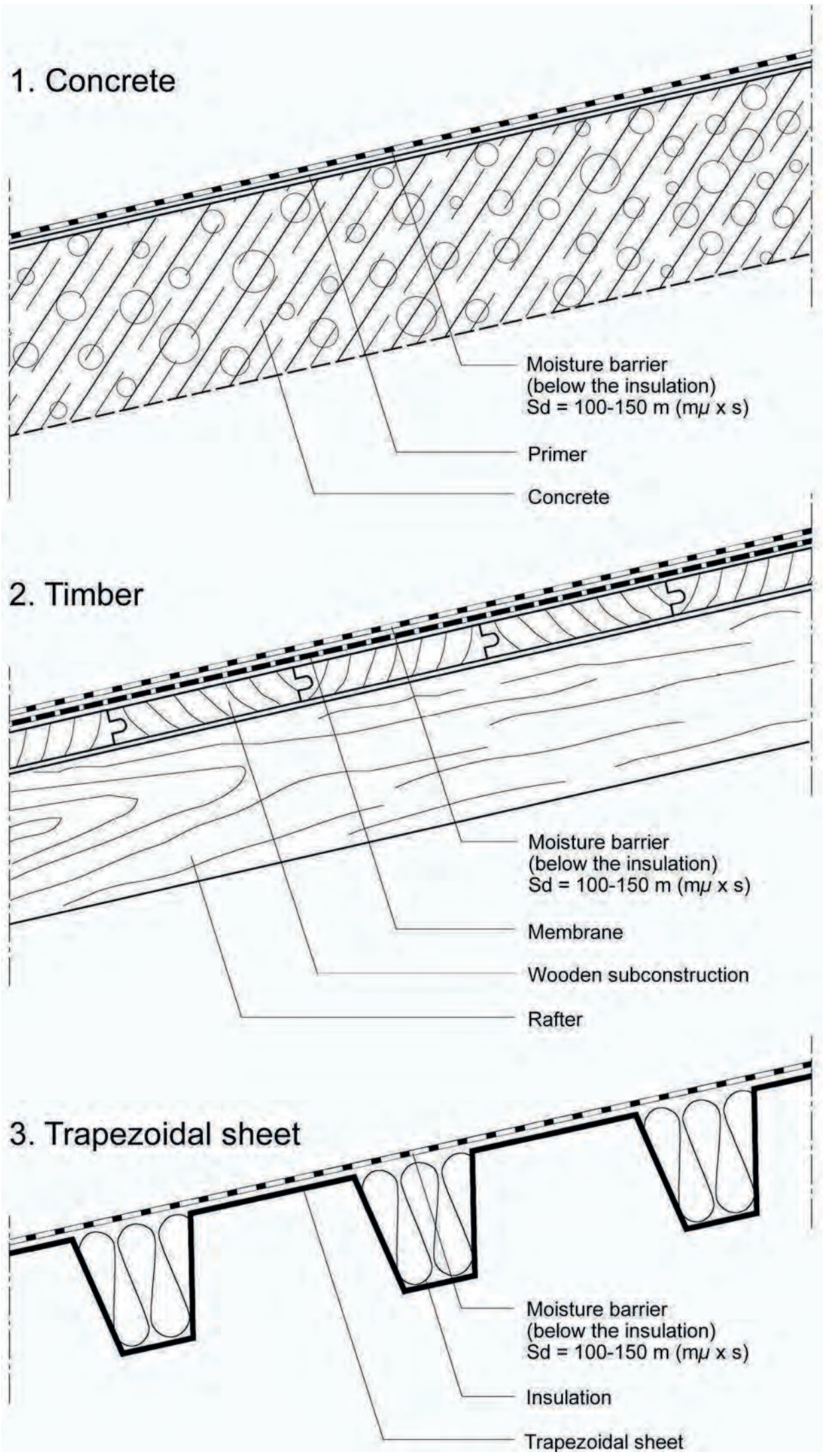
Warm roof - barrel shaped with wooden subconstruction



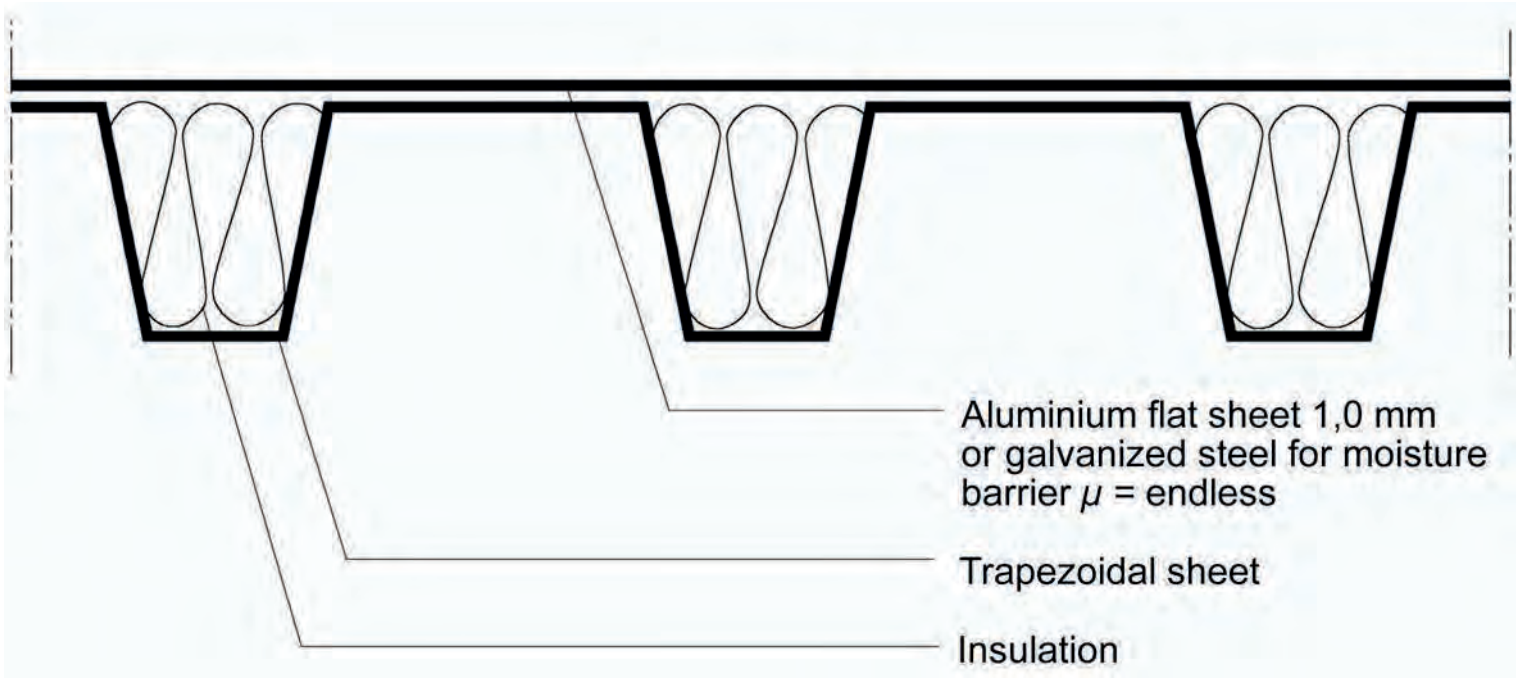
Warm roof - barrel shaped with concrete subconstruction

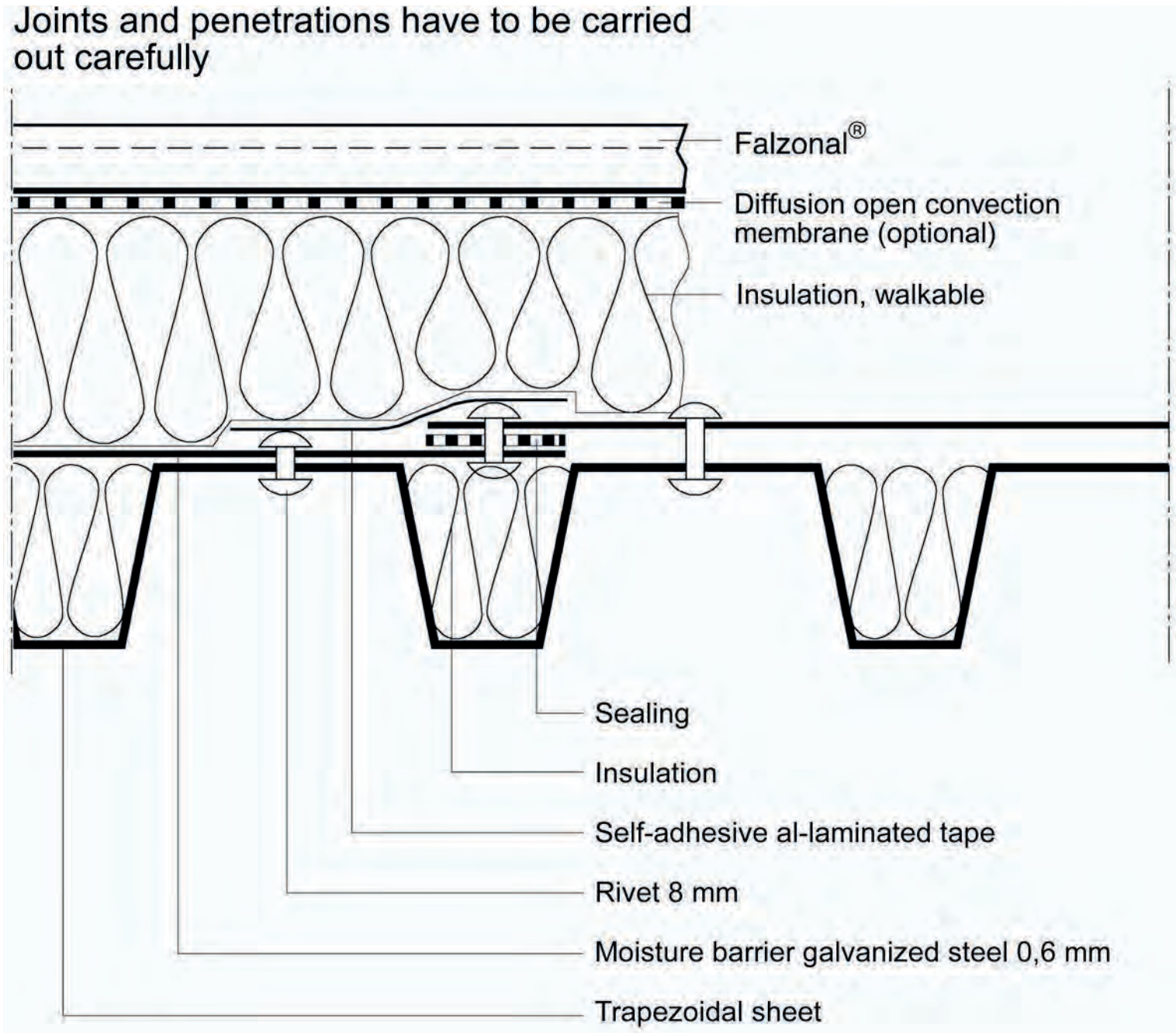


Supporting structure

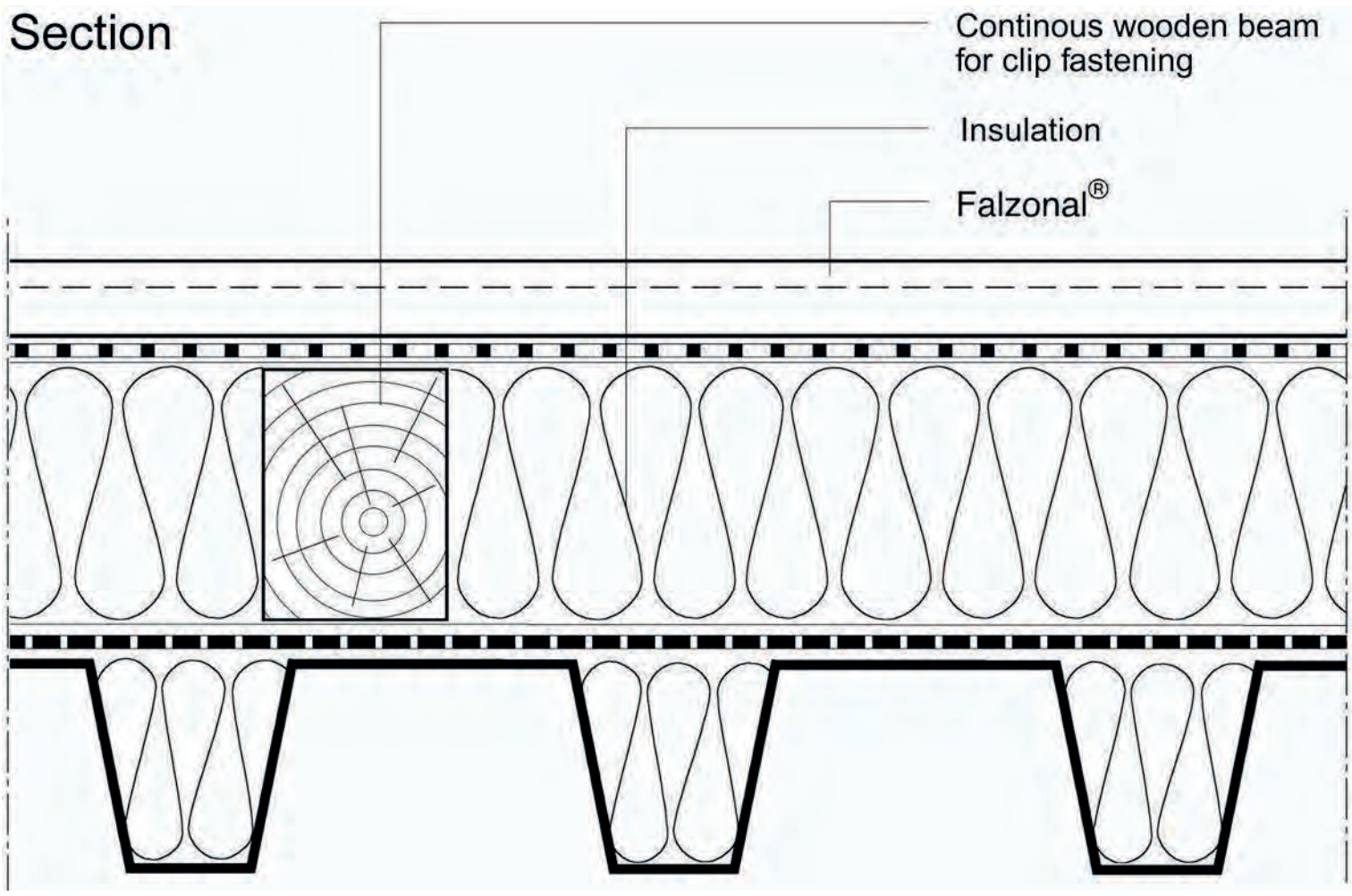


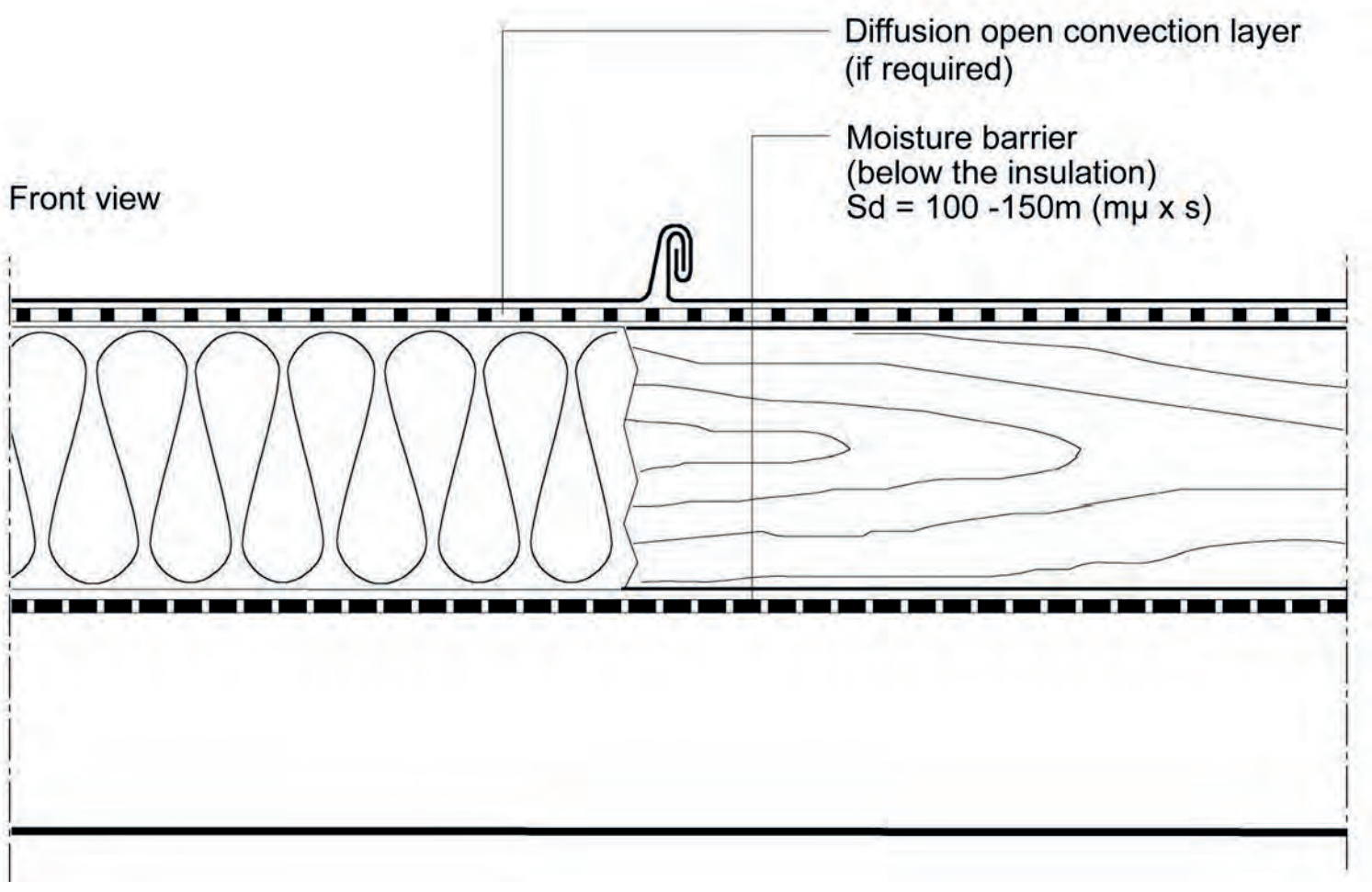
Connections penetrations - subconstruction corrugated sheet



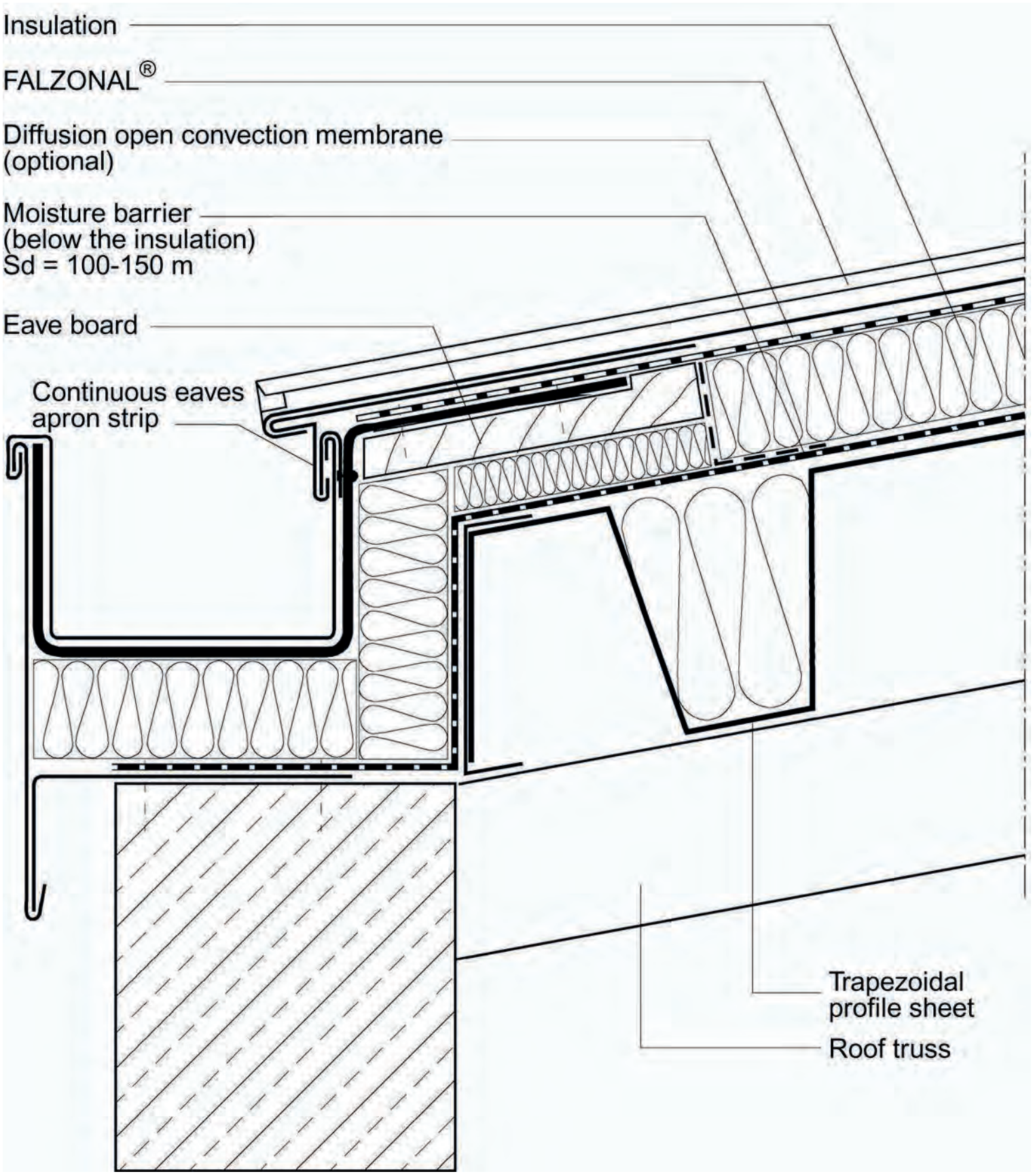


Fastening on timberwood subconstruction

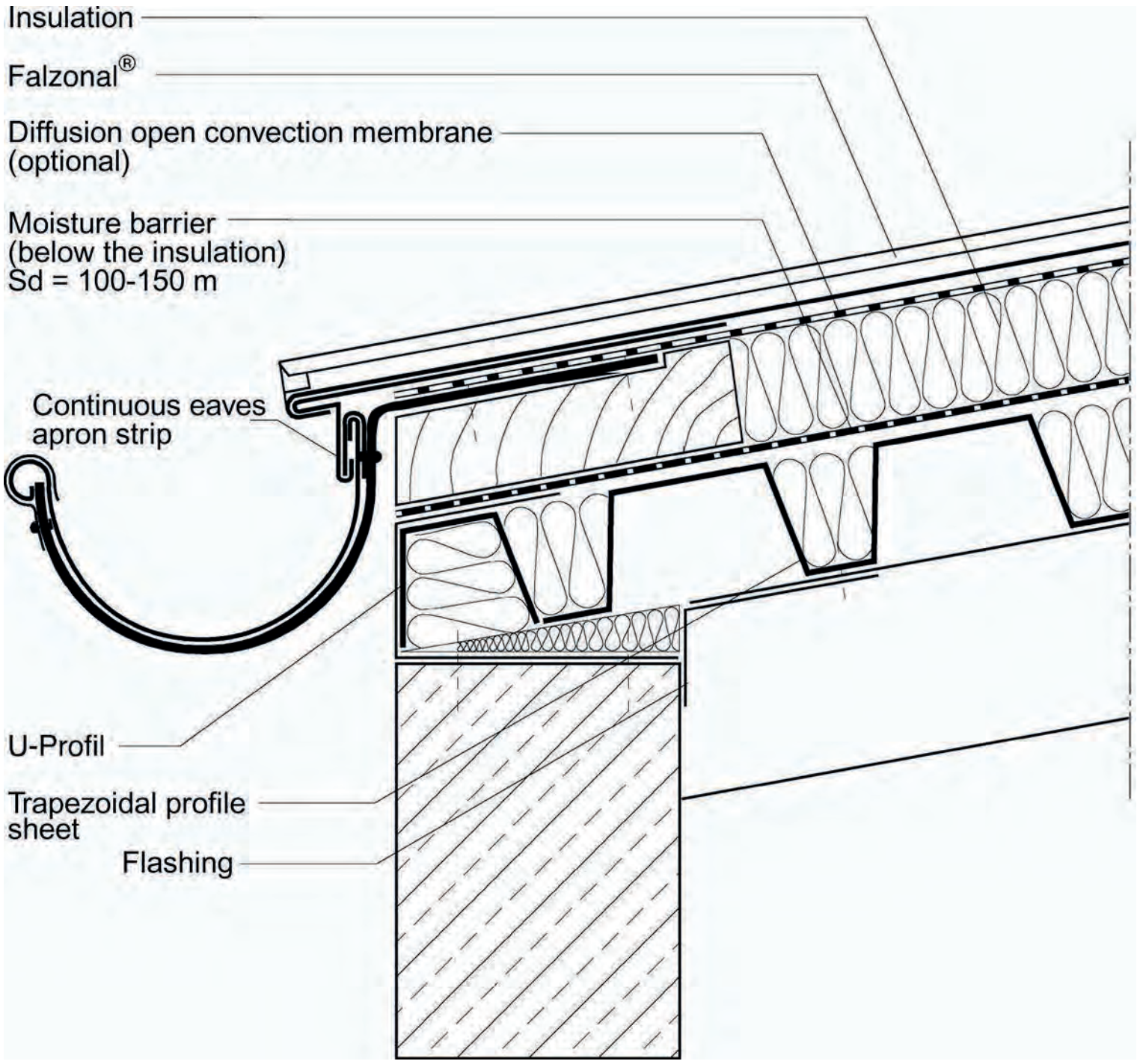




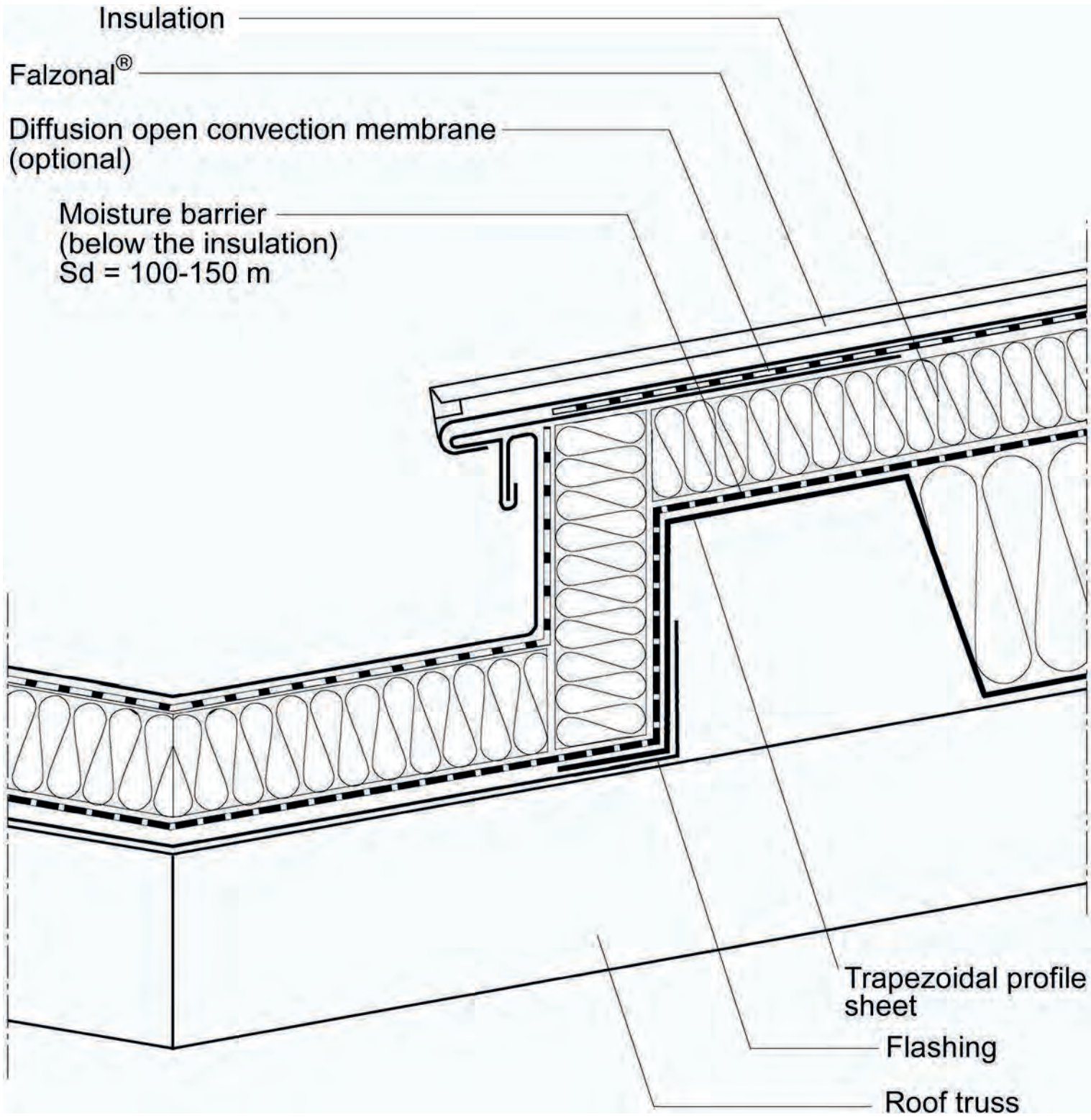
Box gutters


Insulation
FALZONAL®
Diffusion open convection membrane (optional)
Moisture barrier (below the insulation) Sd = 100-150 m
Eave board
Continuous eaves apron strip
Trapezoidal profile sheet
Roof truss

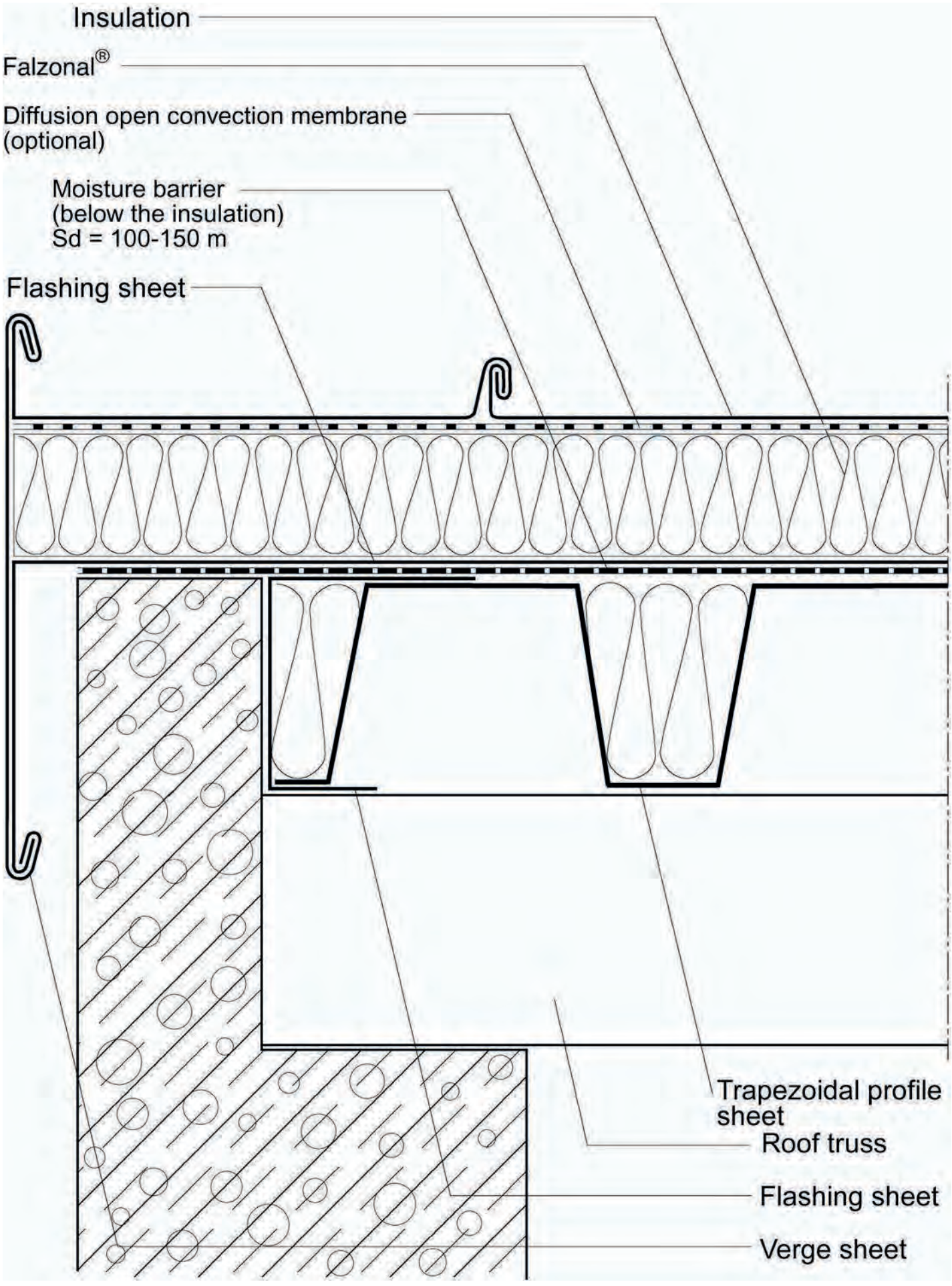
Halfround gutter



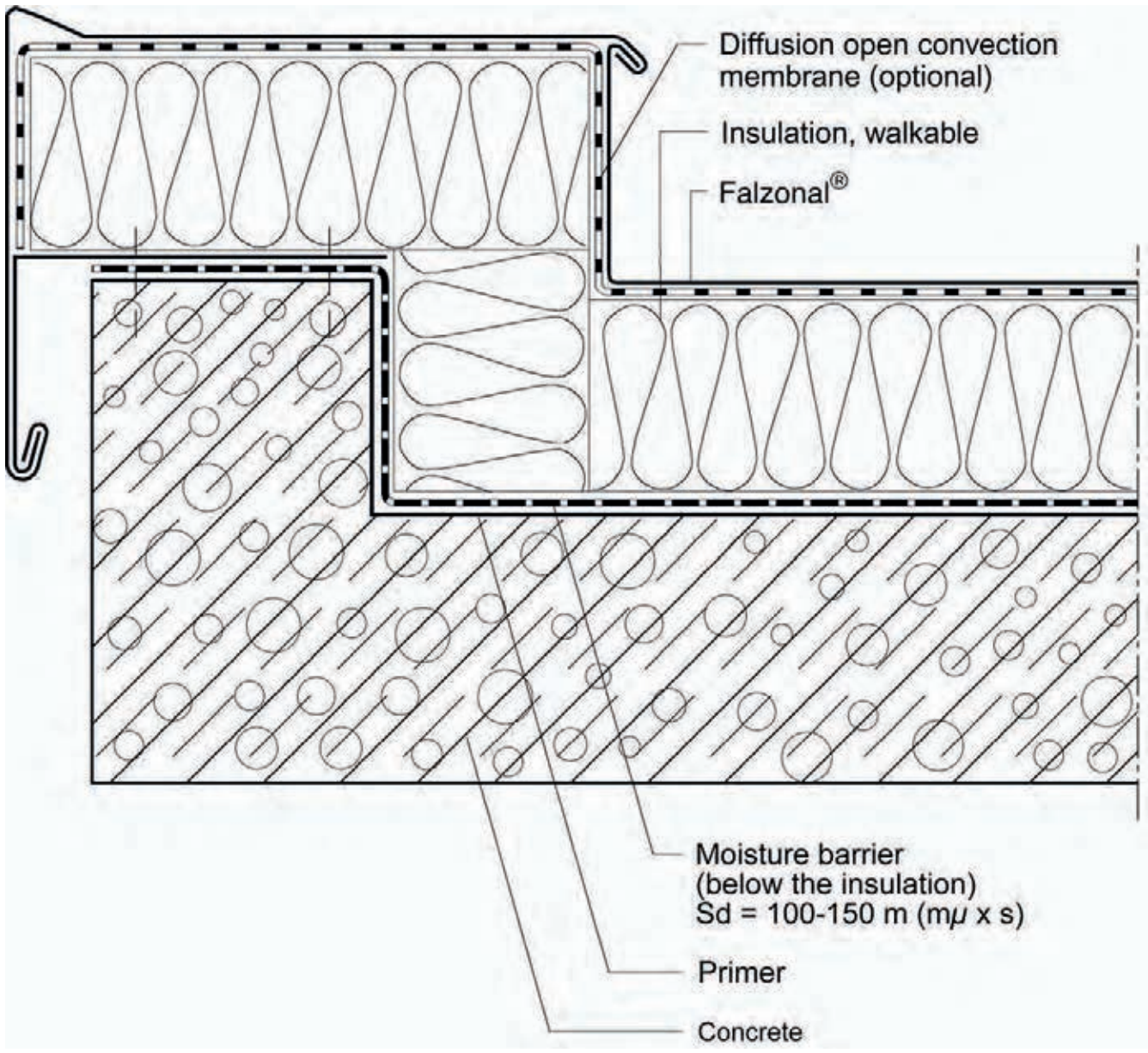
Valley gutter

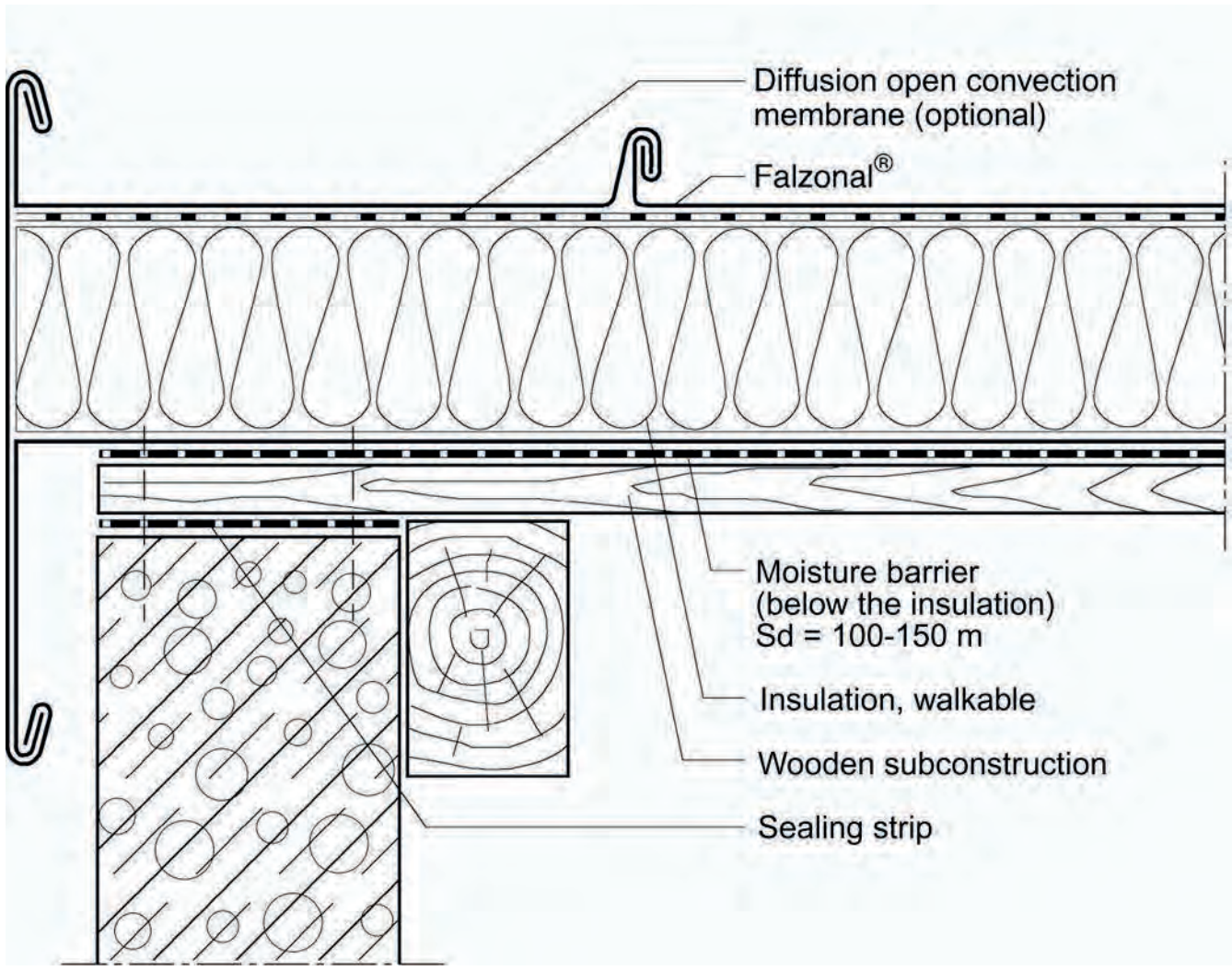


Verge

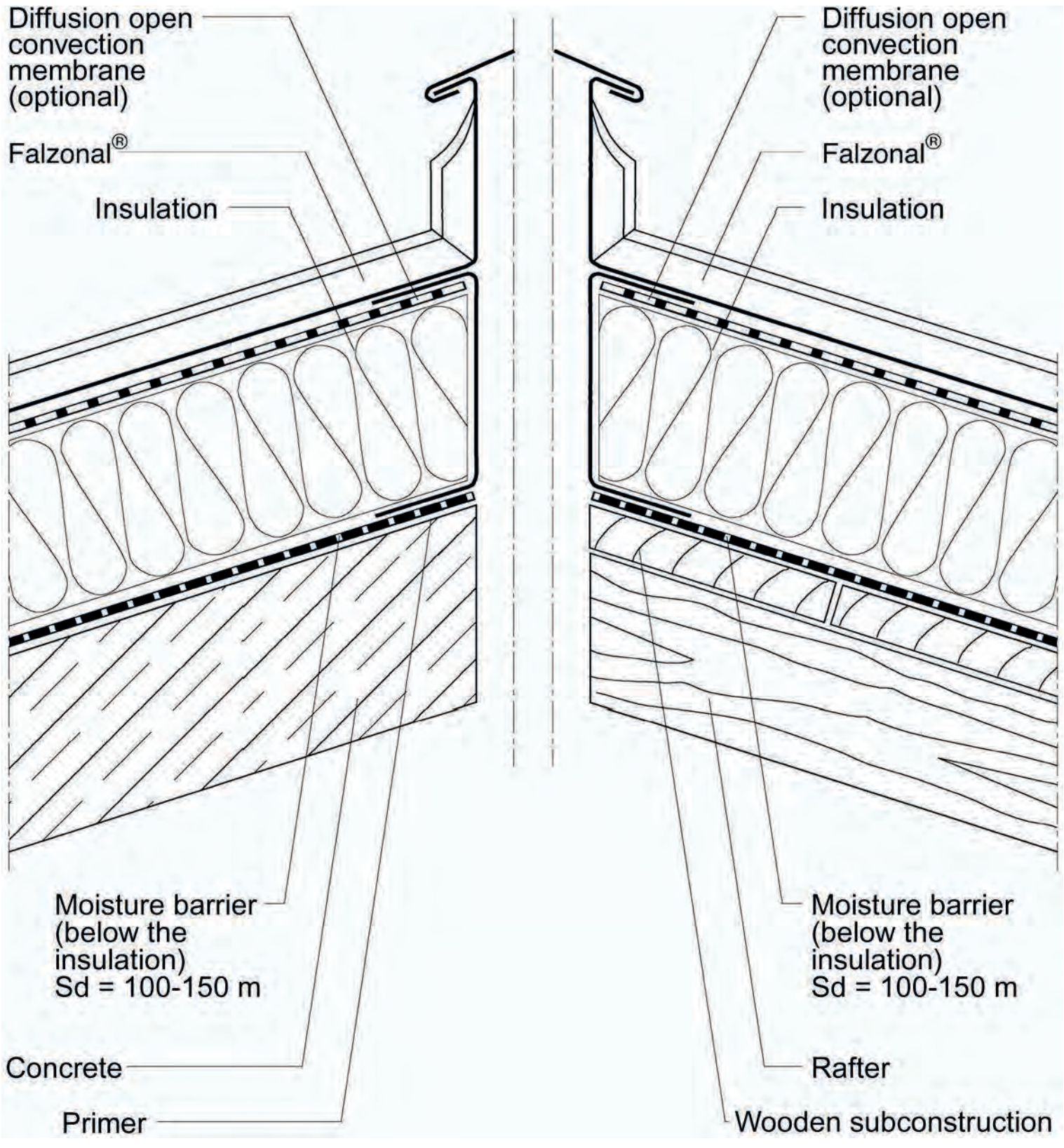

Insulation
Falzonal®
Diffusion open convection membrane
(optional)
Moisture barrier
(below the insulation)
Sd = 100-150 m
Flashing sheet
Trapezoidal profile
sheet
Roof truss
Flashing sheet
Verge sheet

Verge

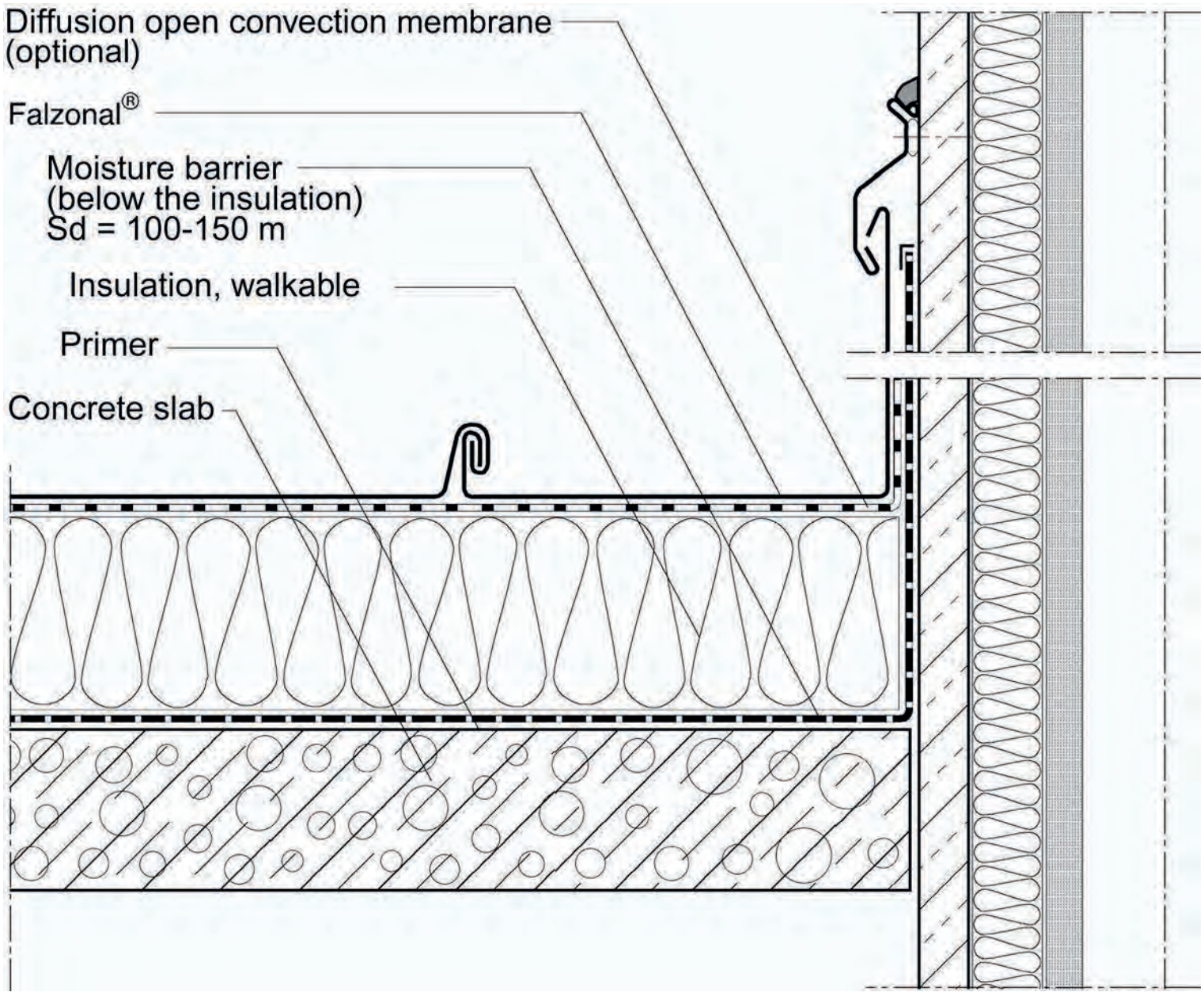

Diffusion open convection membrane (optional)
Insulation, walkable
Falzonal®
Moisture barrier (below the insulation) Sd = 100-150 m (mμ x s)
Primer
Concrete


Diffusion open convection membrane (optional)
Falzonal®
Moisture barrier (below the insulation) Sd = 100-150 m
Insulation, walkable
Wooden subconstruction
Sealing strip

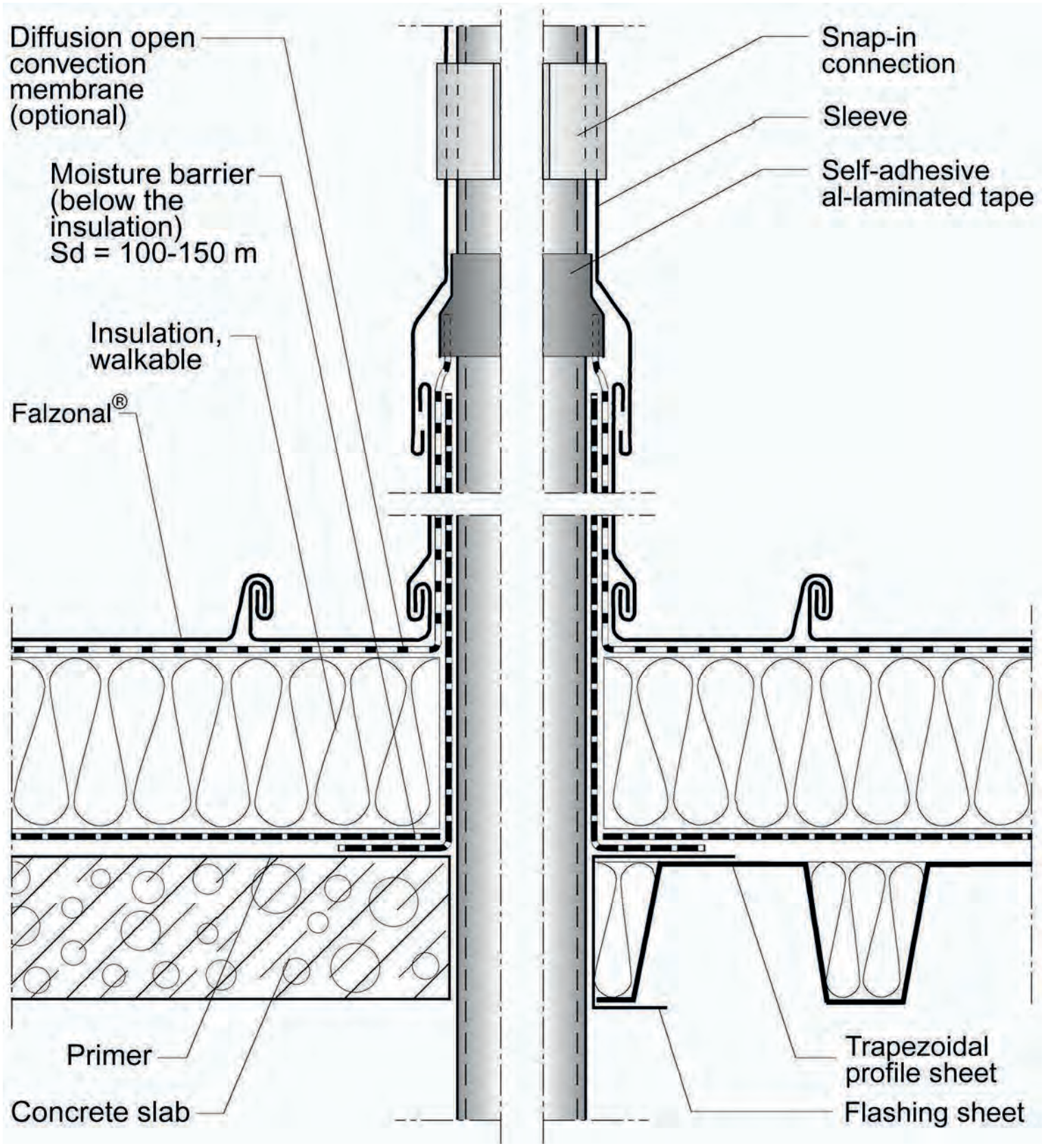
Ridge without ventilation



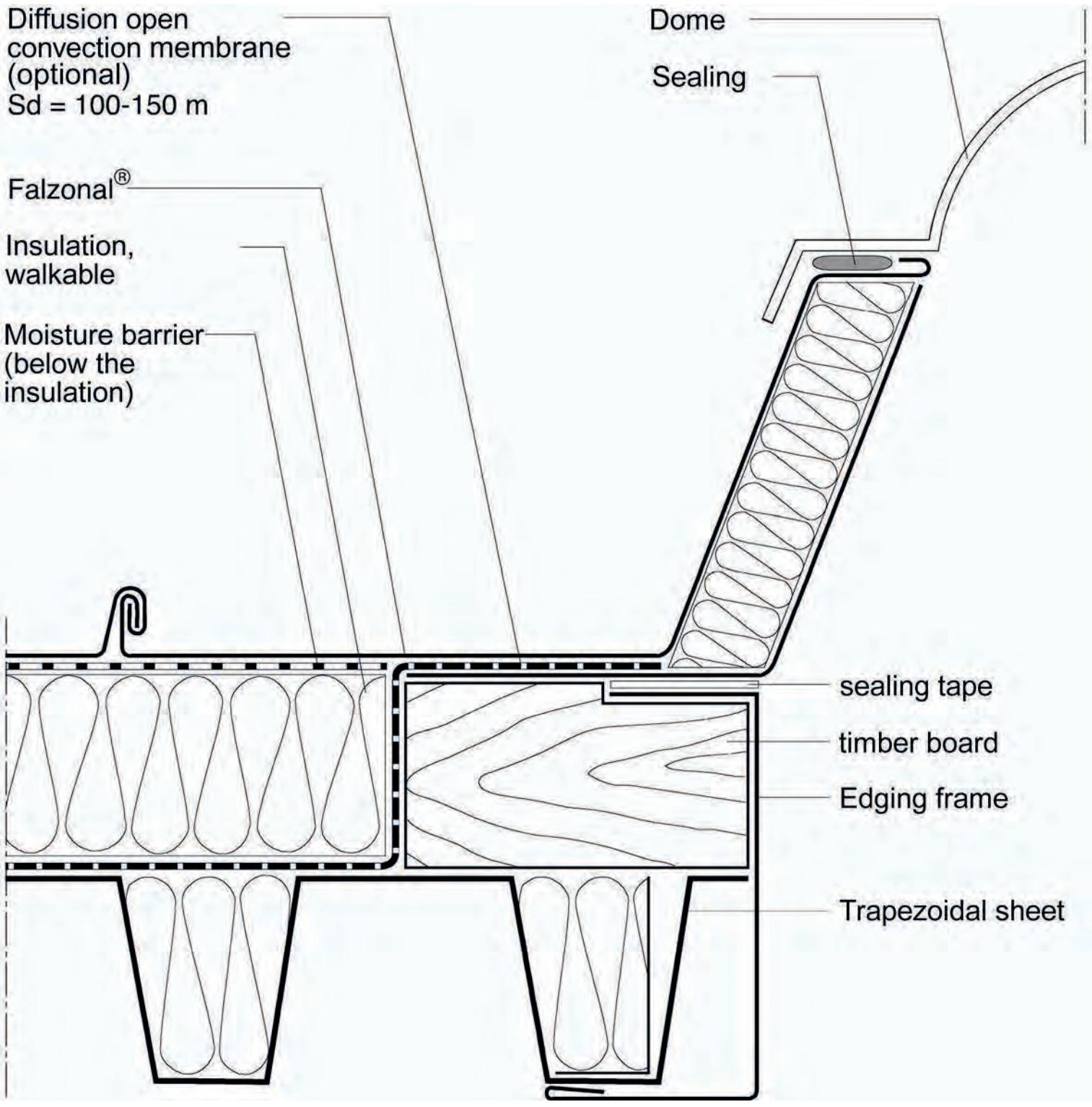
Chimney and wall flashing



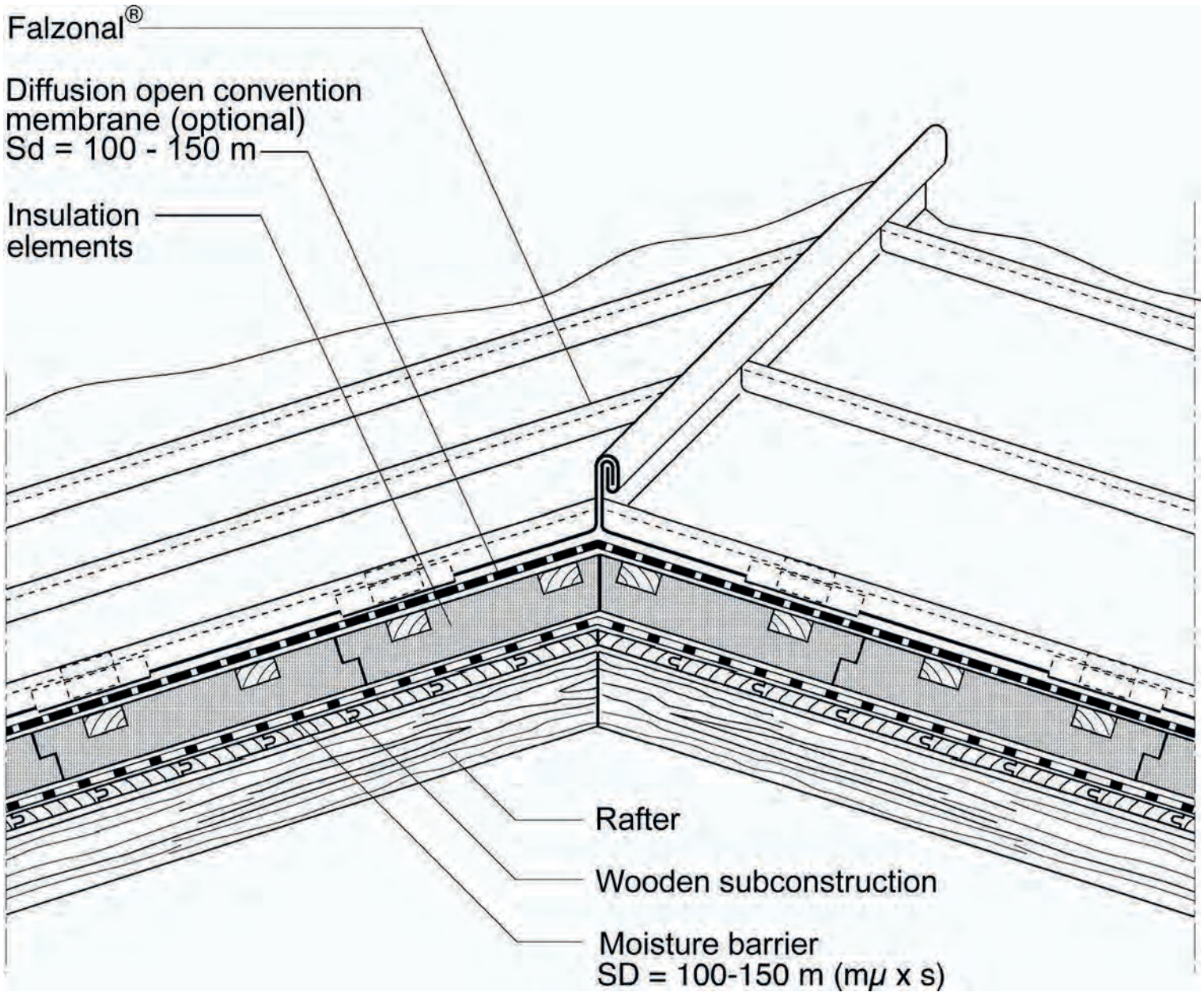
Flashing penetrations- antenna, pipes



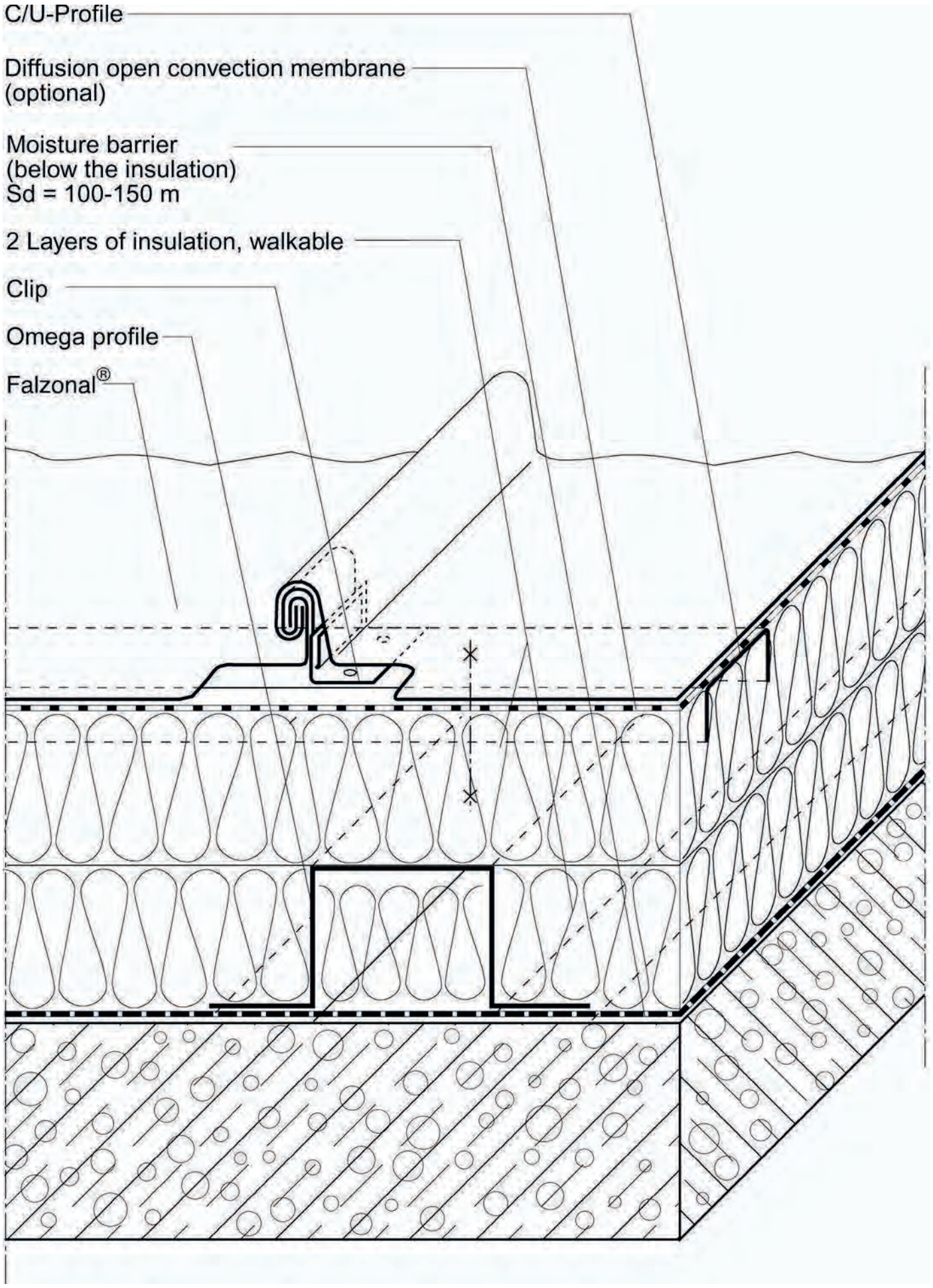
Rooflight penetration



Warm roof construction on Endele insulation WLG 025/030



Pro - Dach System ®



Angled seam (fig.)

↑ TOP

Batten roll (fig.)
Belgian system (fig.)
Bonding

↑ TOP

Canopy
Convection barrier (remarks)
Convection barrier (for heat-insulated roof structures [1])
Convection barrier (for heat-insulated roof structures [2])
Connecting device
Crosswelt-step
Crosswelt-step (fig. [1])
Crosswelt-step (fig. [2])
Crosswelt, 100 mm lap
Cross-seam connection
Cross-seam connection (fig.)
Cross-seam
- double
- single
- single, with additional seam
Crosswelt-step, ventilated (fig.)

↑ TOP

Double seam (fig.)
Double lock standing seam, vertical finish (fig.)

↑ TOP

Eaves (fig. [1])
Eaves (fig. [2])
Eaves (fig. [3])
Eaves (fig. [4])
Eaves (fig. [5])
Eaves (fig. [6])
Eaves (fig. [7])
Eaves (fig. [8])
Eaves (fig. [9])
Eaves (fig. [10])
Eaves (fig. [11])
Eaves cladding (fig. [1])
Eaves cladding (fig. [2])
Eaves cladding (fig. [3])
Eaves cladding (fig. [4])
Eaves cladding (fig. [5])
Eaves cladding (fig. [6])
Eaves area (fig. [1])
Eaves area (fig. [2])
Eaves area (fig. [3])
Eaves area (fig. [4])
Eaves interface
- double standing seam, curved (fig.)
- standing seam with rounded finish (fig.)
Edge construction (fig. [1])
Edge construction (fig. [2])
Edge construction (fig. [3])
Exhaust ventilation
- of roofs
- of wall cladding

↑ TOP

Fascia (fig.)
Fascia / roof slope interface
Facade flashing (fig: fascia / roof slope interface)
Facade flashing (fig: fascia-drip edge)
Facade flashing (fig: window cill)
Facade flashing (fig: wall flashing, vertical section)
Facade flashing (fig: lateral window flashing)
Facade flashing (fig: wall capping)
Fire protection
Fixed clip (introduction)
Fixed clip (fig.)
Fire protection (remarks)
Flashing penetrations antenna, pipes (fig.)
Flashing, seamed (fig.)
Flat roof interface (fig.)
French system (fig.)

↑ TOP

German system (fig.)
Gutter, internal, without secondary lining (fig.)
Gutter, internal (fig.)
Gutter, internal (fig: valley gutter)
Gutter, internal (fig: gutter without secondary lining)
Gutter, internal (fig: gutter with secondary lining)
Gutter, internal (fig: north light gutter)

↑ TOP

Hip construction, standing seam (fig.)

↑ TOP

Intake ventilation
- of roofs
- of wall cladding

↑ TOP

Lightning protection
Lightning protection (remarks)

↑ TOP

Membrane
Moisture protection
Monopitch roof, ventilated ridge (fig. [1])
Monopitch roof, ventilated ridge (fig. [2])
Monopitch roof edge construction with interfacing fascia (fig. [1])
Monopitch roof edge construction with interfacing fascia (fig. [2])

↑ TOP

Noise protection
North light gutter (fig.)

↑ TOP

Planning

↑ TOP

Ridge construction (fig: unventilated)
Ridge construction (fig: ventilated)
Ridge construction (fig: ventilated [1])
Ridge construction (fig: ventilated [2])
Ridge construction (fig: ridge cap, ventilated)
Ridge construction (fig: ridge point, glazed)
Ridge construction (fig: monopitch roof, ventilated ridge interface [1])
Ridge construction (fig: monopitch roof, ventilated ridge interface [2])
Ridge construction (fig: hip construction, standing seam)
- ventilated (fig. [1])
- ventilated (fig. [2])
- ventilated (fig. [3])
- unventilated (fig.)
Ridge, seamed
Ridge cap, ventilated (fig.)
Ridge point, glazed (fig.)
Roof, non-ventilated, heat-insulated
Roof interface (fig.)
Roof kerb (fig: rooflight kerb)
Roof kerb (fig: roof hatch)
Roof kerb (fig: roof penetrations)
Roof kerb (fig: antenna penetration)
Roof kerb (fig: corner area)
Roof kerb (fig: flashing - seamed)
Roof hatch (fig.)
Roof penetration (fig.)
Rooflight abutment

↑ TOP

Shielding (lightning protection)
Sliding clip (fig.)
Snow guard carrier (fig.)
Standing seam technologies (fig: double seam)
Standing seam technologies (fig: systems)
Standing seam technologies (fig: fixed cleats, sliding cleats)
Standing seam technologies (fig: eaves interface-standing seam with inclined finish)
Standing seam technologies (fig: double lock standing seam, vertical finish)
Standing seam technologies (fig: eaves interface-standing seam with rounded finish)
Standing seam technologies (fig: eaves interface-double standing seam with flange)
Swiss system (fig.)

↑ TOP

Thermic protection

↑ TOP

Valley construction
- Valley construction (fig: single seam)
- Valley construction (fig: with additional seam)
- Valley construction (fig: boxed valley)
Valley, gutter (fig.)
Vent hood
- triangular
- half round
- cross-section
- trapezoidal
Verge with interfacing fascia (fig. [1])
Verge with interfacing fascia (fig. [2])
Verge with interfacing fascia (fig. [3])
Verge termination (fig.)

↑ TOP

Wall capping (fig: fascia)
Wall capping (fig: fascia and roof interface)
Wall capping (fig.)
Wall capping (fig: flat roof interface)
Wall capping (fig: wall flashing)
Wall flashing (fig.)
- lateral, with closure (fig. [1])
- lateral, with closure (fig. [2])
Warm roof (fig. [1])
Warm roof (fig. [2])
Warm roof on concrete (fig.)
Window flashing, lateral (fig.)
Window sill (fig.)
Wooden shell