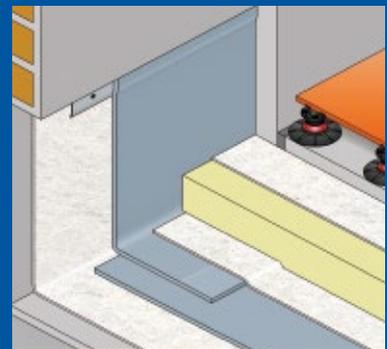
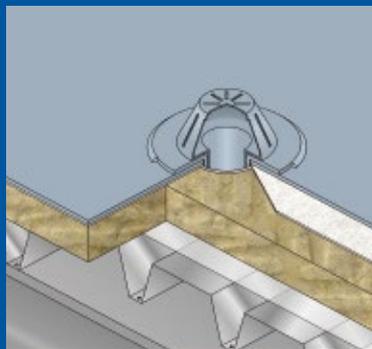
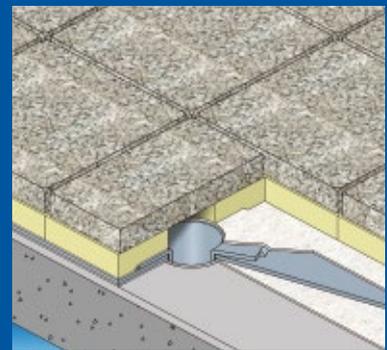


DANOPOL SYNTHETIC WATERPROOFING APPLICATION GUIDE



Waterproofing



Acoustic insulation



Drainages-Geotextiles



Skylights

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1 ON-SITE APPLICATION

1.1 COMPATIBLE SUBSTRATES

The membranes can be laid over:

- Concrete structural substrates.
- Mortar beds.
- Wooden and wood-derivative boards.
- Aerated concrete.
- Fine-aggregate concrete.
- Thermal insulation compatible with the waterproofing membrane.
- Old waterproofing membranes (including separator, if applicable).

1.2 SUBSTRATE SPECIFICATIONS

The substrate should meet the following criteria:

Design

It should be dimensioned and designed to meet appropriate deformation, vibration, cracking and deterioration criteria. Types of use covered by Spanish building regulations (CTE) should comply with the regulations' reference documents on structural safety.

Stability and strength

The surface of the base substrate should be strong, even, smooth, clean, dry and free of foreign objects. This requirement should extend to walls, housings and projecting elements to which the waterproofing is joined.

When the base substrate is made of concrete or cement mortar, the surface should be solid, dry and free of pits or projections greater than 1 mm.

When the substrate is made of aerated concrete or fine-aggregate mortar, it should be finished with a minimum 2-cm-thick layer of low-shrinkage cement mortar.

If the substrate is made of prefabricated concrete, all of the joints should be filled with low-shrinkage mortar to create a smooth surface.

The minimum thickness of the wooden boards should be determined by the distance between the purlins. This should be calculated according to the CTE's reference documents on structural safety. The boards should be kept dry before and during fitting of the waterproofing and should not present projecting elements such as nails, etc.

When the base substrate is made of a thermal insulation material, it should consist of rigid panels specifically designed for this purpose. The panels should be cross-laid (at right angles) and without more than a 0.5-cm gap between them.

Laying the thermal insulation material and fastening it to the substrate should be performed as indicated by the manufacturer.

If the waterproofing substrate is a thermal insulation material, the minimum compression strength of the same should be as follows:

- walkable roofs for private use: 150 kPa;
- non-walkable and intensive green roofs: 100 kPa; and
- extensive (environmentally friendly) green roofs: 60 kPa.

In all cases, the manufacturer of the thermal insulation material should guarantee the material's suitability for the use described.

If the base substrate is made of corrugated sheet metal, this should be galvanised steel with a thickness of ³ 0.70 mm and a minimum S 280 specification in accordance with the EN 10147 standard (EOTA 006 Guideline).

The system used to anchor the roof to the building's structure is independent of the waterproofing system and will therefore depend on each building's design and construction features.

If the joints between the metal sheets are not completely sealed, a hygrometric calculation should be made to assess whether it is necessary to employ a vapour barrier.

Cleanliness and flatness

The surfaces should be free of water, oil and organic matter (moss, plants, roots, etc.).

They should also be free of materials incompatible with synthetic materials, such as greases, oil-based products (mineral or vegetable), tar and strong acids.

The surface on which the waterproofing is to be laid should not present pits, projections or other features that could puncture the waterproofing membrane.

1.3 SUBSTRATE PREPARATION

On both newly constructed and, above all, renovated buildings, the condition of the substrate should be checked to ensure that the surface is even, flat, clean and dry. Special attention should be paid to site-specific features such as drains, perimeters, etc.

Depending on the condition of the substrate (flatness, evenness, etc.) it may be necessary to apply a layer of mortar or concrete to the surface to eliminate slopes and/or irregular features¹. The characteristics of this layer should be defined by the designer in each particular case. It should be strong and stable enough to withstand the foreseen mechanical and thermal stresses (see reference document HS1 of the CTE, 2.4.3.1.) and should comply with the criteria indicated in point 1.2.

1.4 CLIMATIC CONDITIONS

Waterproofing should not be fitted under potentially damaging climatic conditions. In particular, it should not be fitted when it is snowing, when there is ice on the roof, when it is raining, when the roof's surface humidity is > 8% or when there is strong wind.

Likewise, waterproofing should not be fitted when the ambient temperature is below

-5 °C for hot-air welding; and

+5 °C for solvent welding.

1.5 PRODUCT HANDLING

The materials should be placed on the roof using suitable lifting equipment and distributed evenly across the roof to spread the load.

1.6 TOOLS

The following tools are required to fit the waterproofing:

- Manual welding tools and equipment:
 - Hot-air welder (40-mm nozzle + 20-mm angled reduction nozzle); and
 - Pressure roller.
- Cutting and marking tools:
 - Scissors;
 - Hook blade;
 - Stanley knife; and
 - Tape measure.
- Curved needle to check the welds.
- Depth-stop screwdriver.
- Chemical welding tools:
 - Flat brush;
 - Solvent tub; and
 - Ballast sacks.

1.7 APPLICATION METHOD

When waterproofing a roof, irrespective of the type of substrate and membrane, in addition to the criteria indicated in reference document HS1 of the CTE, the specifications applicable to laying auxiliary layers, dealing with site-specific features and testing welds and watertightness indicated in the reference documents and in others such as the UNE 104416:2009 standard (entitled 'Synthetic materials. Waterproofing roofing systems made of membranes with flexible synthetic sheets. Instructions, control, use and maintenance'), should be taken into account. In addition, the indications described below should be followed:

1.7.1 WATERPROOFING MEMBRANE

The membrane is formed by overlapping and welding together the prefabricated sheets. This membrane is always a single-ply sheet (i.e. it is composed of a single layer).

To ensure that the stability of the waterproofing membrane is not affected by wind pressure, the membrane and other system components should be either:

- Mechanically fastened to the structural substrate or self-supporting base substrate; or
- Held in place by ballast (non-fastened).

Mechanically fastened membranes

The membrane is held in place using metal fasteners inserted into the overlap on the edge of the membrane before it overlaps an adjacent one.

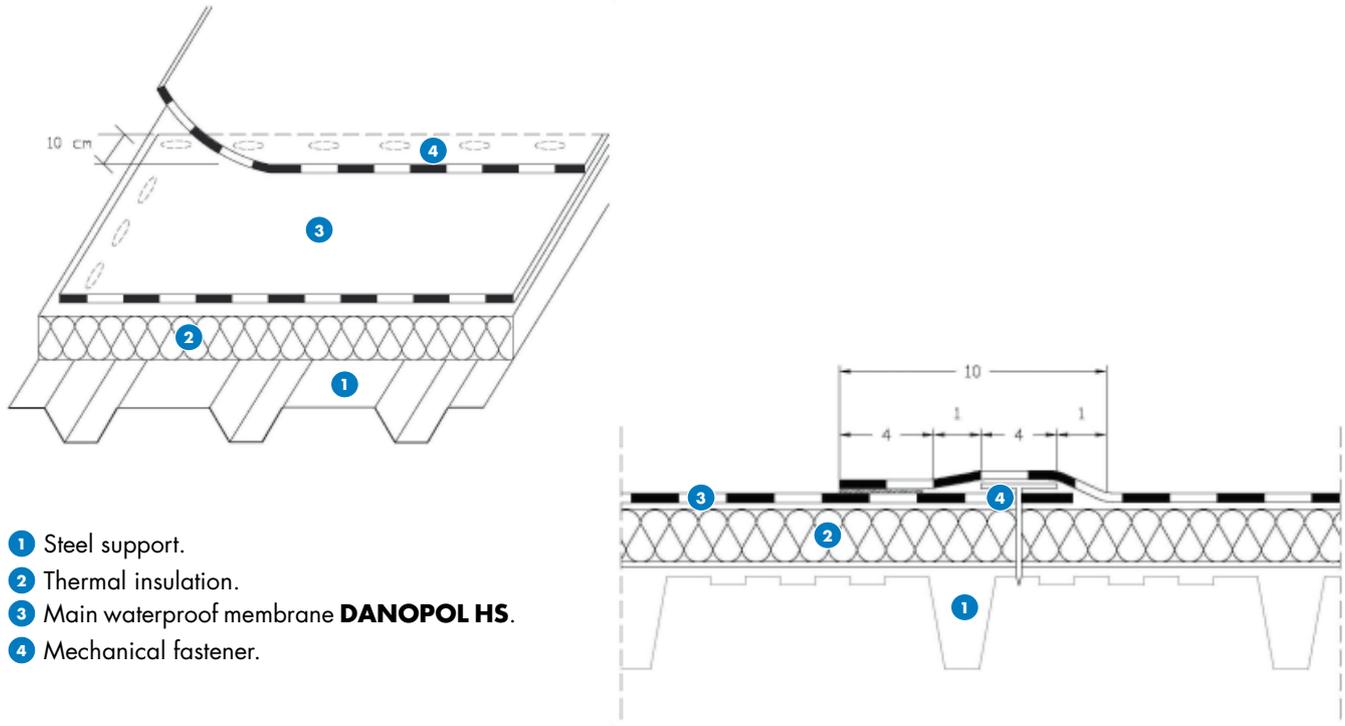
¹ This layer should never be applied on top of the thermal insulation.

ON-SITE APPLICATION

When the waterproofing membrane is mechanically fastened in place, the lower layers, such as the vapour barrier, thermal insulation, etc. are also fastened in place individually or simultaneously.

The lengthwise overlap between sheets should always be ≥ 10 cm. The crosswise overlap between sheets should always be ≥ 5 cm. The weld between the sheets can be created either by using a hot-air welder or by using a THF (tetrahydrofuran) chemical agent.

The system is mechanically fastened on the overlaps using fasteners suitable for this type of membrane. The washers should be positioned ≥ 1 cm from the edge of the sheet, as shown in Figure 1.



The number of fasteners per m^2 will depend on the wind pressure to which the roof is subject, which in turn will depend on geographic region, roof location and building height. The number of fasteners applied per m^2 should be based on the resistance to wind pressure measured in testing, national regulations and EU legislation.

Non-fastened membranes

The membrane is laid on the substrate on top of an auxiliary geotextile sheet.

Once the geotextile sheet is in place, the next step is to lay out the waterproofing.

Preferably, the sheets should be laid perpendicular to the line of maximum slope, starting from the bottom of the same. The next rows should be laid up the slope until the hip is reached, making sure that each new row overlaps the previous one. The overlap of each new row should favour the water flow and each row should overlap the previous one.

On flat roofs, the rows should be laid in the same way, i.e. starting from a drain until a point equidistant from the next drain is reached.

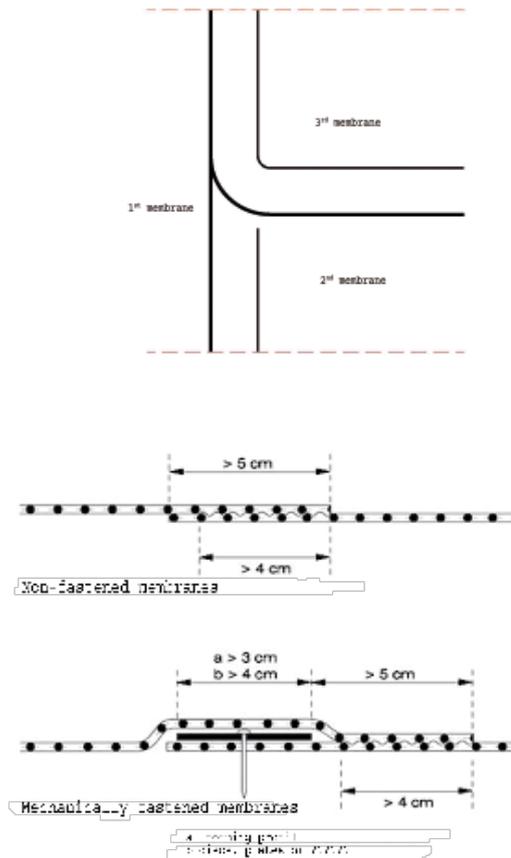
The sheets should be joined by a thermoplastic weld, created using either a hot-air welder² or a THF (tetrahydrofuran) chemical agent. Any further finishing required should be done using the hot-air welder.

The overlaps should be at least 5 cm wide and the weld between the lower sheet and the upper one should be at least 4 cm wide.

Care should be taken to avoid alignment of the crosswise overlaps of two consecutive rows of sheets. Likewise, care should be taken to avoid more than three sheets joining at a single point.

At T-joints (where three sheets cross at a single point) the bottom sheet should either be chamfered to prevent capillary percolation or the joint should be welded using the hot-air welder. The vertex of the angle formed by the crosswise and lengthwise edges of the upper sheet should be cut into a curve.

² Weldability and weld quality will depend on atmospheric conditions (temperature and humidity), welding conditions (temperature, speed, pressure, prior cleanliness) and state of the membrane surface (cleanliness and humidity). Therefore, the hot-air welder will need to be adjusted accordingly to ensure the overlaps are joined correctly.



If thermoplastic welding is used, immediately after welding the joint should be pressed with a roller to ensure uniform adhesion. To check the joins, a round-tipped metal needle (with a tip radius of 1 to 3 mm) should be run along the edge of the joint. If any irregularities are detected in the weld, the welding procedure described above should be repeated.

If solvent welding is used, a layer of solvent should be applied with a brush to the surfaces in contact with the overlap. The joint should be pressed for one or two seconds to give the solvent time to melt and weld together the faces of the two sheets in direct contact with one another. In this case, the welds should be left for at least 5 hours before checking.

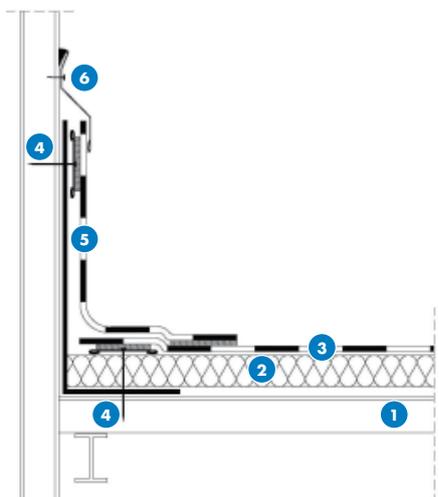
In accordance with technical approval no. 551/10 DANOPOL pendiente CERO, the dimensional stability of the DANOPOL FV membrane means that it is not necessary to anchor the perimeter when laying this product.

1.8 SITE-SPECIFIC FEATURES

1.8.1 MECHANICALLY FASTENED MEMBRANES

1.8.1.1 JOINS WITH WALLS

Joins with walls are made as shown in the figure below:



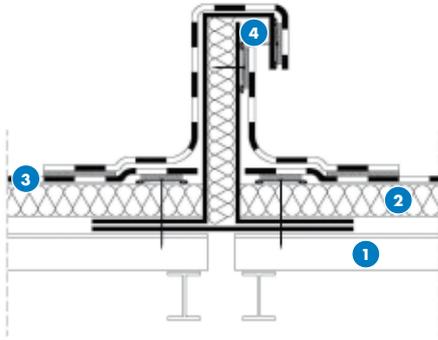
- 1 Steel support.
- 2 Thermal insulation.
- 3 Main waterproof membrane **DANOPOL HS.**
- 4 Laminated metal.
- 5 Waterproof membrane **DANOPOL HS.**
- 6 Sealed profile.

ON-SITE APPLICATION

Joints with projections (pipe housings, etc.) should be finished using a strip of profiled sandwich panel fastened mechanically to the sheet-metal substrate.

1.8.1.2.1 STRUCTURAL JOINS

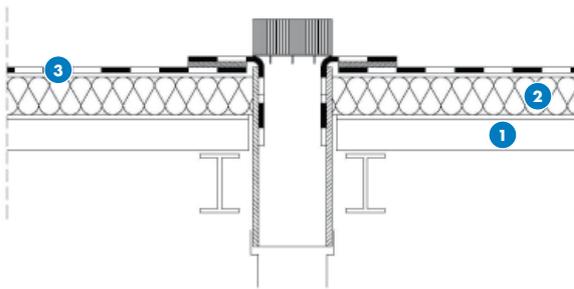
Prior to laying the membrane and insulation panels, the profiled structural joint components should be assembled (see Figure 2). These comprise a flat metal panel anchored in place to form the base of the joint, the profiled panels that form the joint itself (anchored to the sheet-metal substrate and spaced to accommodate the expected movement), and the insulation inserted inside the joint (which should be inserted before closing the joint with the second panel).



- 1 Steel support.
- 2 Thermal insulation.
- 3 Main waterproof membrane. **DANOPOL HS.**
- 4 Laminated metal.

1.8.1.2.2 DRAINS

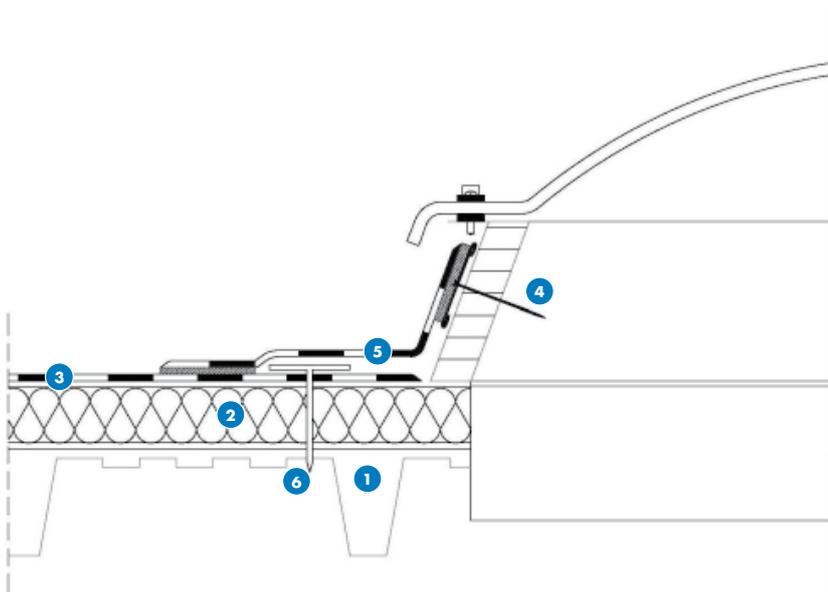
Prefabricated PVC-P-based drains with a rigid flange at least 6 cm wide should be used. The waterproofing membrane should be welded to the drain flange (see Figure 4).



- 1 Steel support.
- 2 Thermal insulation.
- 3 Main waterproof membrane. **DANOPOL HS.**

1.8.1.2.3 JOINS WITH SKYLIGHTS

Waterproofing should be performed as indicated in Figure 5.



- 1 Corrugated sheet support.
- 2 Thermal insulation.
- 3 Waterproofing membrane **DANOPOL HS.**
- 4 Colaminated profile.
- 5 Waterproofing membrane in parapet. **DANOPOL HS.**
- 6 Metal fixing.

1.8.1.2.4 WALKWAYS

Walkways should be suitably protected using DANOLOSA-type lightweight tiles, etc. to prevent damage to the waterproofing membrane.

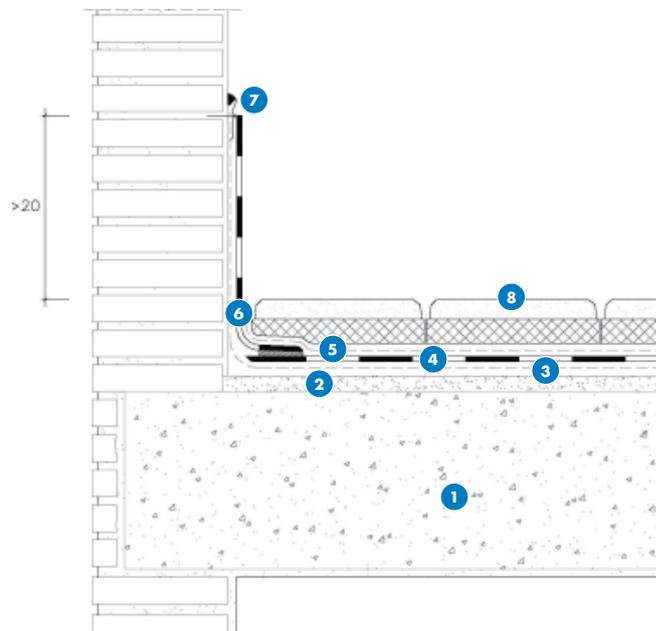
1.8.2 NON-FASTENED MEMBRANES

1.8.2.1 JOINS TO WALLS

Where the waterproofing membrane is joined to a vertical surface, the indications stipulated in reference document HS1 (Chapter 2.4.4.1.2)³, as well as those stated in the UNE 104416:2009 standard, should be followed.

Door thresholds, window sills and pipe housing openings should be at least 20 cm above the height of the highest part of the finished roof surface (exposed membrane, ballast or flooring). This is necessary to prevent water entering the building interior in the case of heavy snow, flooding due to blocked drains or splashing during heavy rain.

When joins to walls are made leaving the membrane joining strip exposed, the sheet should be fastened in place using profiled sandwich strips. The section of sheet that ascends the wall should be welded to these strips. These profiled strips should have a flange at the top to accommodate a bead of non-biodegradable sealant that should fill the gap between the strip and the wall. These profiled strips should be fastened in place using a Rawl plug and galvanised steel screw (never nails). The fasteners should be spaced 25 cm apart.



- ① Resistant support (concrete).
- ② Construction of slopes.
- ③ Anti-punching and separating layer. **DANOFELT PY 300**
- ④ Waterproofing membrane. **DANOPOL FV 1,2**
- ⑤ Separating layer. **DANOFELT PY 300**
- ⑥ Waterproofing membrane on vertical surface. **DANOPOL FV 1,2.**
- ⑦ Laminated Metal.
- ⑧ Pavement. **DANOLOSA.**

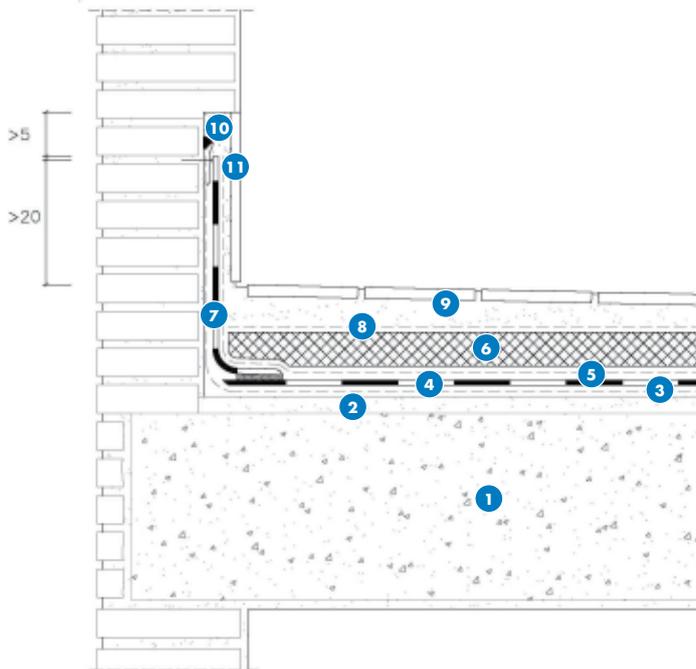
³ CTE: The waterproofing membrane should extend up the vertical surface to a height of at least 20 cm above the roof protection. Therefore, the vertical joint should be made at this height.

To prevent rainwater or water running down the wall entering the top edge of the waterproofing membrane, the parapet should be modified in one of the following ways:

- Create a setback with a depth of at least 5 cm from the external vertical surface of the wall.
- Attach a profiled metal strip that accommodates a bead of sealant between the strip and the wall.

ON-SITE APPLICATION

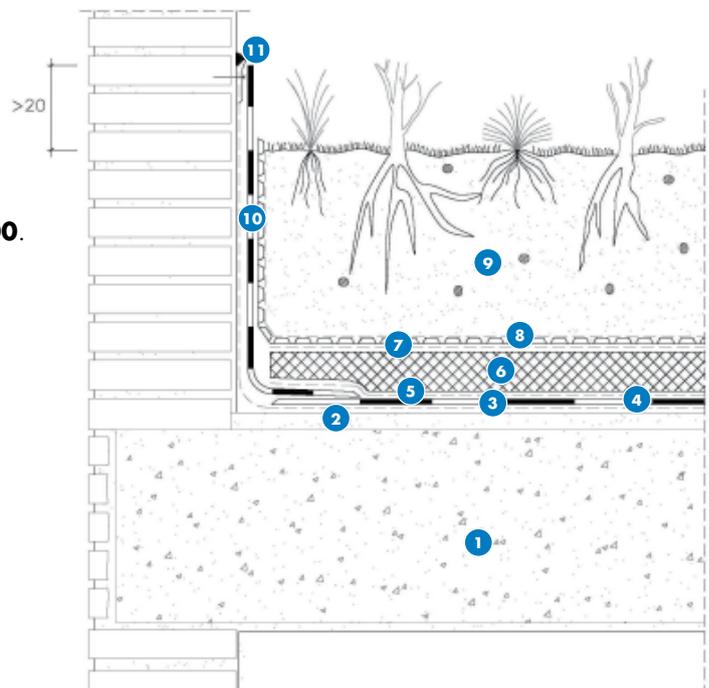
If it is necessary to set back the joining strip to hide it behind a skirting board or similar element, it should be set back at least 5 cm from the external surface of the wall and at an appropriate height for the membrane. In order to fix a skirting board or other finishing element to the wall, there should be a gap of at least 5 cm between the edge of the membrane and the top of the setback.



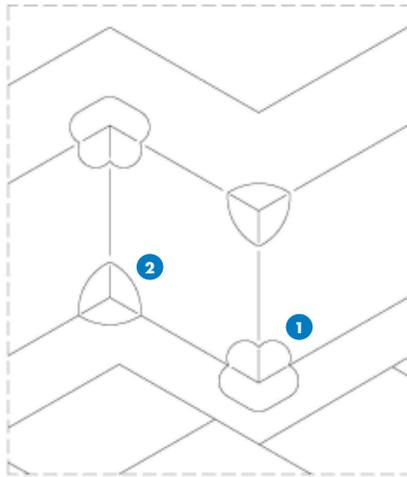
- 1 Resistant support (concrete).
- 2 Construction of slopes.
- 3 Anti-punching layer. **DANOFELT PY 300.**
- 4 Waterproofing membrane. **DANOPOL FV 1,2**
- 5 Separating layer. **DANOFELT PY 300.**
- 6 Thermal insulating panel (extruded polystyrene). **DANOPREN.**
- 7 Waterproofing membrane on vertical surface. **DANOPOL FV 1,2.**
- 8 Separating and filtering layer. **DANOFELT PY 200.**
- 9 Pavement. **DANOLOSA.**
- 10 Laminated Metal.
- 11 Protection on vertical surface.

In the case of green roofs, the drainage membrane and geotextile sheet should be extended vertically to protect the waterproofing membrane against root penetration. Depending on plant type, it may be necessary to apply additional protection (DANOPREN thermal insulation panels, DANOLOSA, etc.).

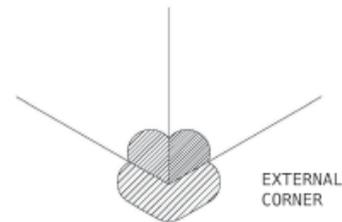
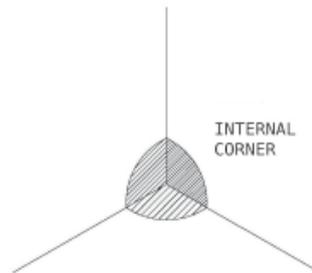
- 1 Support.
- 2 Construction of slopes.
- 3 Anti-punching and separating layer. **DANOFELT PY 300.**
- 4 Waterproofing membrane. **DANOPOL FV 1,2**
- 5 Separating layer. **DANOFELT PY 300**
- 6 Thermal insulating. **DANOPREN.**
- 7 Separating layer. **DANOFELT PY 200**
- 8 Drainage layer. **DANODREN JARDIN.**
- 9 Soil.
- 10 Waterproofing layer on vertical surface.
- 11 Laminated profile with flap (top side sealed).



To facilitate joining of the membrane to the vertical surfaces and to install the required prefabricated reinforcements on the internal and external corners, the membrane and substrate should form a right angle without the chamfers or mouldings prescribed for other membrane types.

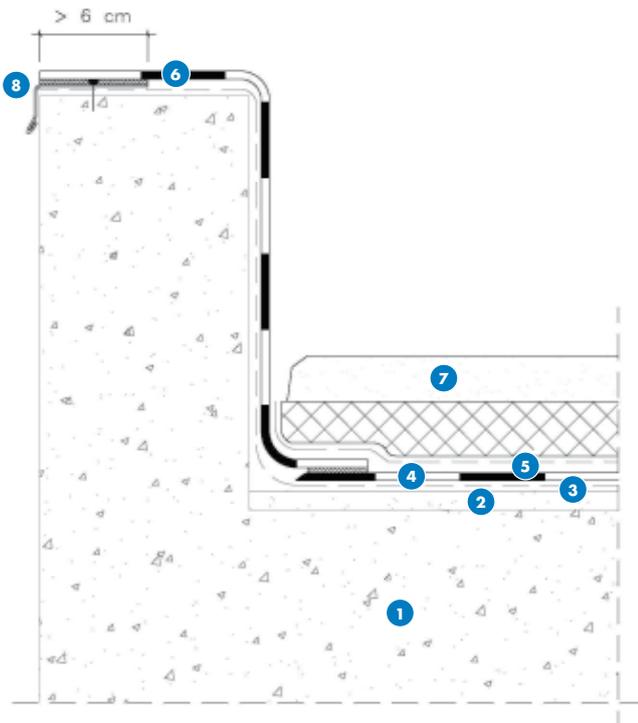


- 1 External corner reinforcement.
- 2 Internal corner reinforcement.



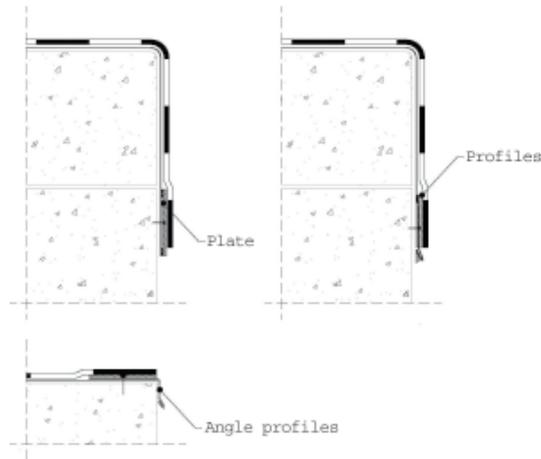
If the parapet is less than 20 cm high, or if a perimeter parapet does not exist, the join with the parapet or roof slab edge may be made in one of the following ways:

- Using a right-angled profiled sandwich panel hung from the outer edge of the parapet like a drip. This profiled panel should be fastened to the parapet horizontally. The horizontal section of the panel should be at least 6 cm wide and the fasteners should be spaced no more than 25 cm apart. The membrane should be welded to the profiled sandwich panel so that the screw heads are hidden.



- 1 Support.
- 2 Construction of slopes.
- 3 Anti-punching and separating layer. **DANOFELT PY 300.**
- 4 Waterproofing membrane. **DANOPOL FV 1.2**
- 5 Separating layer. **DANOFELT PY 300**
- 6 Waterproofing layer on vertical surface. **DANOPOL FV 1.2**
- 7 **DANOLOSA.**
- 8 Laminated profile.

- By folding the joining strip over the edge of the parapet or slab. The membrane can be fastened in place using either profiled or flat sandwich strips. The profiled sandwich strips should have a flange that acts as a drip. The flat sandwich strips should be fastened to the edge of the projecting roof slab and should descend approximately 1 cm below the edge that it forms with the roof. Both the profiled flanged sandwich strips and the flat strips should be fastened to the wall on the descending side using fasteners spaced no more than 25 cm apart. The joining strip should extend over the edge and should be welded to the profiled or flat strips so that the screw heads are hidden.



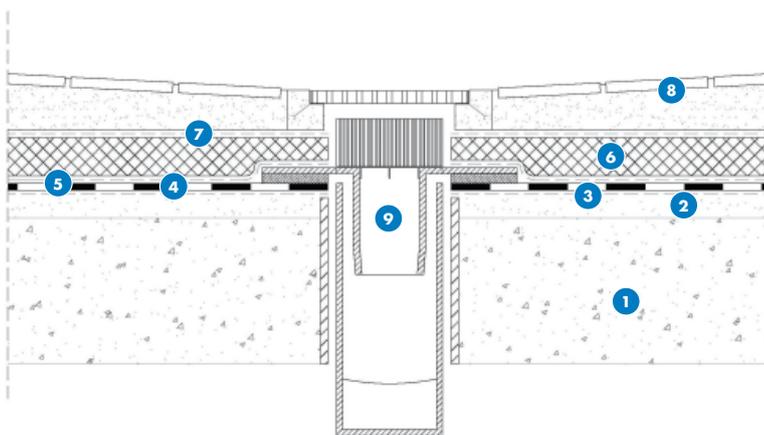
1.8.2 DRAINS

When creating the drain openings, the criteria indicated in reference document HS1 (Chapter 2.4.41.4) should be followed, using the figures in this chapter as an example.

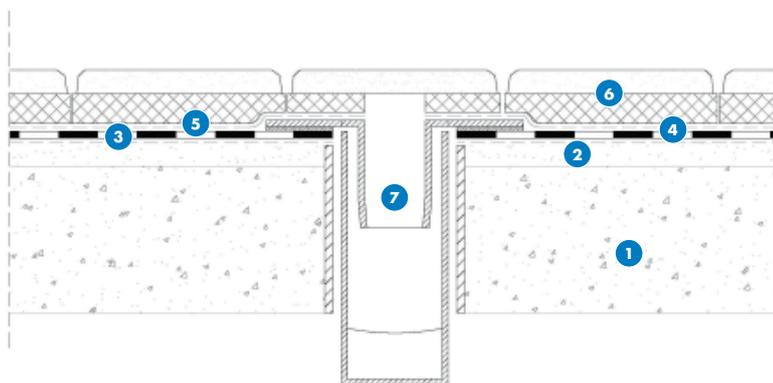
All exposed drains should be fitted with a suitable grille, gravel guard, etc to prevent entry of material that could block the down-pipes.

Prefabricated PVC-P-based vertical or horizontal drains with a rigid flange, or with a connection ring of the same material as the membrane, should be used. The flange or ring should be at least 6 cm wide and the waterproofing membrane should be welded to the same.

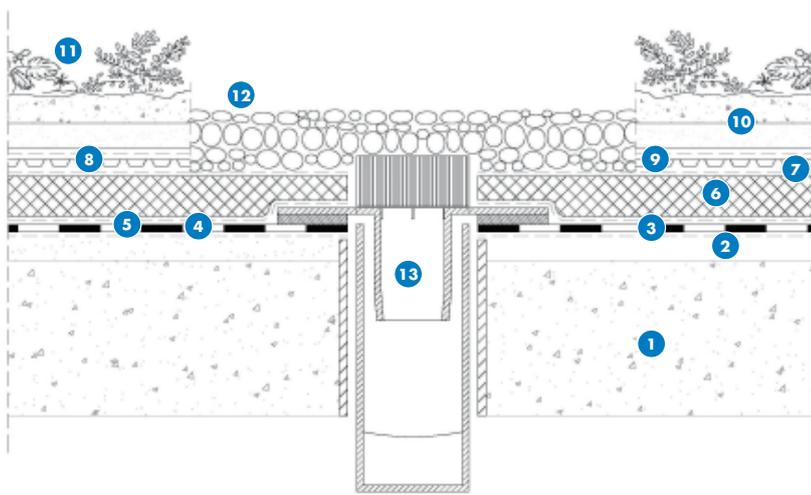
In the case of intensive green roofs, the drains will need to be inspected and therefore they should be fitted with inspection chambers.



- 1 Support.
- 2 Construction of slopes.
- 3 Anti-punching and separating layer. **DANOFELT PY 300.**
- 4 Waterproofing membrane. **DANOPOL FV 1,2**
- 5 Separating layer. **DANOFELT PY 300**
- 6 Thermal insulating. **DANOPREN**
- 7 Separating layer. **DANOFELT PY 200**
- 8 Pavement termination.
- 9 Drain bowl.



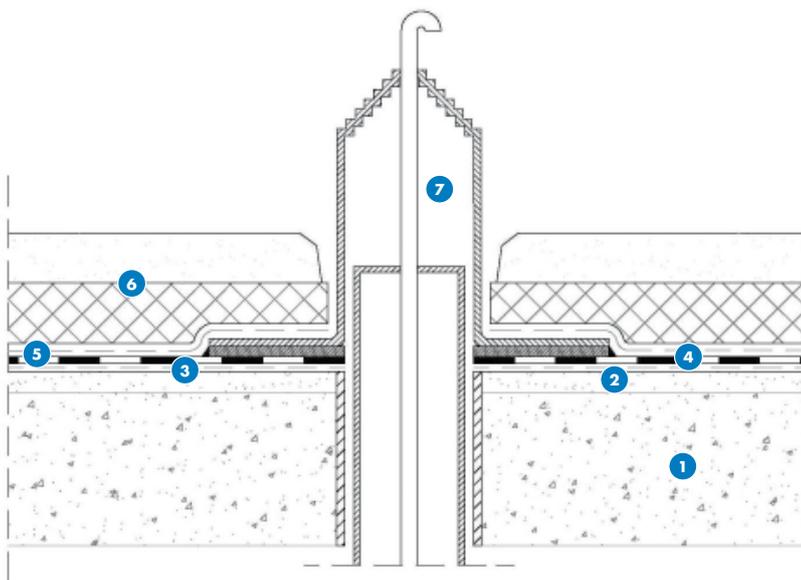
- 1 Support.
- 2 Construction of slopes.
- 3 Anti-punching and separating layer. **DANOFELT PY 300.**
- 4 Waterproofing membrane. **DANOPOL FV 1,2**
- 5 Separating layer. **DANOFELT PY 300**
- 6 **DANOLOSA.**
- 7 Drain bowl.



- 1 Support.
- 2 Construction of slopes.
- 3 Anti-punching and separating layer. **DANOFELT PY 300.**
- 4 Waterproofing membrane. **DANOPOL FV 1,2**
- 5 Separating layer. **DANOFELT PY 300**
- 6 Thermal insulating. **DANOPREN.**
- 7 Separating layer. **DANOFELT PY 200.**
- 8 Drainage layer. **DANODREN R-20.**
- 9 Separating layer. **DANOFELT PY 200.**
- 10 Soil. **SUSTRATO ECOTER.**
- 11 Volcanic rock layer.
- 12 Plants **SEDUM** type.
- 13 Drain bowl.

1.8.3 PIPE HOUSINGS

Prefabricated PVC-P-based pipe housings with a rigid flange, or with a connection ring of the same material as the membrane, should be used. The flange or ring should be at least 6 cm wide and the waterproofing membrane should be welded to the same.



- 1 Support.
- 2 Construction of slopes.
- 3 Anti-punching and separating layer. **DANOFELT PY 300.**
- 4 Waterproofing membrane. **DANOPOL FV 1,2**
- 5 Separating layer. **DANOFELT PY 300**
- 6 **DANOLOSA.**
- 7 Insert-tube.

1.8.4 EXPANSION JOINTS

The characteristics of this membrane mean it is not necessary to take special measures to accommodate expansion joints (as indicated in technical approval **no. 551/10 DANOPOL pendiente CERO**).

1.9 SUSPENDING AND RESUMING WORK

If climatic conditions during fitting are likely to damage the waterproofing system, work should be suspended unless specific measures are taken to prevent potential damage.

A check should be carried out to verify that the existence of water in one or more of the waterproofing system's layers will not have a negative effect on the system as a whole.

Interruptions to work on the roof should be managed to ensure that they do not result in damage to the materials used. Special care should be taken to ensure that elements fitted before suspending work are not disturbed by the wind.

Before starting or resuming waterproofing work, the base substrate should be checked to ensure that it meets the specified conditions. If this is not the case, work should be suspended for as long as it takes for these conditions to be met.

1.10 REPAIR

Tears or punctures in the membrane should be repaired by welding a piece of the same membrane over all of the damaged area. Repairs should be carried out following the indications described for on-site application of the waterproofing membrane.

1.11 TESTING

To test the welds and the watertightness of the roof, it is recommended to follow the procedure described in Chapter 13 of the UNE 104416:2009 standard.

Users are recommended to perform two tests — one when the waterproofing membrane has been fitted, and another when the protection has been added and the required elements have been arranged on the roof.

Testing should consist of flooding the roof up to approximately 5 cm below the top of the lowest joint between the waterproofing membrane and the vertical surfaces, making sure that the weight of the water does not exceed the roof's limit.

Drains should be covered and an overflow-type system should be put in place to allow water to escape should rain input raise the water level above the test limit.

Flooding to the height indicated should be maintained for at least 24 hours.

The test should be considered completed once 72 hours have passed. Nevertheless, the flood may be maintained for longer if required to protect the membrane against possible damage by other tradesmen.

Once the test has been completed, the drains should be uncovered. This should be done progressively to avoid the sudden release of water damaging the downpipes.

On roofs on which it is not possible to perform a flood test, the roof should be subjected to continual watering/sprinkling for at least 48 hours.

1.12 ROOF USE AND CONSERVATION

The main specifications taken into account should be those indicated in Part 1 of the CTE and in Chapter 6 of reference document HS1. In particular, users are recommended to inspect the roof at least once a year and to always do so after extreme weather conditions. Users should check the state of the protection (gravel or tiles), membrane, joints, fasteners, seals, accessories, etc. In the case of green roofs, users should especially check for the presence of vegetation not planted when fitting the roof (originating from seeds carried by the wind). This vegetation should be removed as its root action could affect the membrane's performance.

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