Technical Book

WATERPROOFING SYSTEMS FOR GREEN ROOFS

MAPEPLAN T B

POLYGLASS MAPEI GROUP

MAPEPLAN T B

INDEX

1. Foreword

The aim of this Technical Book is to provide technical, design and construction information and solutions for the correct installation of green roof and roof garden waterproofing and thermal insulation systems, with the use of MAPEPLAN T B flexible polyolefin (FPO/TPO) synthetic waterproofing membranes.

Waterproofing systems are a key factor in the construction of a green roof. Indeed, a successful build starts with the waterproofing system, which must ensure a perfect seal, functionality and long service life, otherwise all the work that has gone in to creating a superior standard of roof will be negated by leak issues.

This document, therefore, will be covering in depth aspects relating to thermal insulation/waterproofing systems using MAPEPLAN T B flexible polyolefin (FPO/TPO) synthetic membranes. We will also be giving a more general overview - but with as much information as possible - of the construction of the actual “green roof assembly”. There are various systems and technical solutions available on the market, all of which are effective and functional, so we will leave it up to you to determine which best suits your needs. Remember, no matter which green roof you choose, you can still apply MAPEPLAN T B waterproofing systems underneath.


MAPEI
STOP

2. Polyglass SpA

POLYGLASS SpA is one of the leading and most active European manufacturers of waterproofing systems using FPO/TPO and PVC-P synthetic membranes and polymer distilled bitumen membranes.

We were the first Italian manufacturer to venture into the world market, with Polyglass products and technologies present in over 40 countries.

Our main manufacturing facility is in Ponte di Piave in the province of Treviso in Italy's Northeast, which is also home to our company headquarters.

POLYGLASS SpA is part of the MAPEI Group, an international construction chemicals giant that, at the end of 2016, comprises 81 subsidiaries, including 9 service companies, 18 main R&D centres, including 1 corporate centre, and 70 manufacturing sites operating in 32 countries on five continents, each with its own quality control laboratory.

POLYGLASS waterproofing systems are distributed and applied successfully worldwide, exposed to a whole range of different and critical environmental and service conditions.

POLYGLASS SpA has been an ISO 9001-certified company since 1995 and ISO 14001-certified since 2010, and is a member of the Green Building Council Italia.

All POLYGLASS products can help earn credits for LEED certification of buildings.

3. Green roofs

Despite green roofs dating back to ancient times in human history, it is only in the last few decades that they have started making a comeback and been reintroduced around the globe, across Europe and more recently in Italy too. Much of the credit for this return to designing, building and using green roofs goes to the grand masters of the modern architectural movement, one of the most important names being Le Corbusier, who included the roof garden in his list of the top five key points of modern architecture. An ever-growing interest in energy efficiency and improving environmental conditions has also been instrumental in its revival.

It is precisely this increasing focus and importance placed on environmental sustainability in new builds and in building in general, that has led to the analysis and ascertainment of the benefits and multiple advantages that green roofs bring to the urban ecosystem, the building itself and to people's lives. Amazingly, the first in-depth technical studies into the advantages provided by roof gardens and their usefulness date all the way back to 1867, published in a paper by the German architect Carl Rabitz.

Every country has specific reference standards for green roofs. For example, after years at the study stage, the *Italian standard UNI 11235: Instructions for the design, installation, control and maintenance of green roofs* was finally introduced in 2007, and later reviewed and amended in 2015. The standard defines design, installation, control and maintenance criteria for continuous green roofs, depending on the specific context in terms of climate, building type and intended use.

Advantages and features

There are great advantages to be had in designing and building a green roof:

Improved thermal insulation during both the winter months and in summer, resulting in **improved occupant comfort** and a considerable **saving in energy consumption and bills** to heat and cool interiors.

Improved sound insulation and **reduced noise pollution** due to the mass of the roof and the green roof's dual action of absorbing and reducing the spread of sound waves as it is made up of surfaces that are not level and different materials with impressive soundproofing capability.

Reduction in particulate (including PM10) **and smog** by virtue of the **absorption** and **retention** effect provided by the vegetation.

Reduced CO_2 emissions (reduced greenhouse effect) as a result of a decreased use of air-conditioning in summer and heating in winter. In addition, through the photosynthesis process, the vegetation absorbs CO_2, transforming it and releasing it in the form of oxygen.

Most electromagnetic waves absorbed. Research conducted by the University of Kassel (Germany) has shown that a green roof with a 15 cm substrate can absorb approx. 94.4% of emissions in the cell phone network frequency range from 1.8 to 1.9 GHz. In the range of electromagnetic waves for UMTS frequencies between 1.92 and 2.17 GHz (latest generation mobiles), the research revealed an even greater reduction. For waves in the amateur radio range of 4 GHz, the reduction was as high as 99.9999%.

Decreased "urban heat island" effect (the term urban heat island is used to describe the phenomenon whereby the temperature generated in urban areas is higher than that recorded in rural areas) as green roofs absorb and retain rainwater and irrigation water, releasing it back into the atmosphere through evapotranspiration (the combined effect of transpiration - through the plants - and evaporation directly from the soil), thus cooling the surrounding air.

Slowed rainwater runoff into drains and the sewer system due to the optimization of the hydraulic regime by the soil and vegetation, whereby water is absorbed and slowly released.

Prolonged life expectation of waterproofing membranes, which are protected from UV rays, weather, mechanical damage and temperature variations. On a green roof the maximum surface temperatures in summer are around 25 °C, while on an unprotected roof they can be far higher, especially if the roof is a dark colour.

Increased photovoltaic panel efficiency. On a green roof, where surface temperatures are lower, photovoltaic panels perform near their peak efficiency, hence producing their maximum energy output.
According to published research in this field, as far as optimal temperature is concerned, 25 °C is estimated to provide the classic photovoltaic panel with the best conditions for producing energy. In this regard, a useful indicator is the temperature coefficient, which indicates how much panel efficiency decreases as outside temperature increases.

New amenity and green spaces created, even in densely built-up urban environments.

New habitats created for flora and fauna, which help protect biodiversity.

Aesthetic improvement, beautifying both the urban environment - helping redevelop run-down areas - and the building itself, which also benefits in terms of **resale value**, while increasing occupants' wellbeing and **quality of life**.

Green roof types

Based on the maintenance required, the type of vegetation planted and, consequently, the depth of the growing medium required, green roofs can be split into two main categories:

- **Extensive green roof** - low maintenance, approx. substrate depth <20 cm.
- **Intensive green roof** - medium/high maintenance, approx. substrate depth ≥20 cm.

Key functional layers of a green roof

The typical build-up of a green roof waterproofed with synthetic membranes is relatively simple. The key functional layers are described below.

Load-bearing structural support

The load-bearing structural support must be sized to withstand permanent loads and accidental overloading resulting from the weight of the actual garden itself, the weight of irrigation water and the weight of people and equipment required for its maintenance in the event the roof is an amenity space. Various kinds of load-bearing structural support can be used, such as a traditional or prefabricated reinforced concrete deck, a composite steel deck or timber deck. Depending on the green roof design, the load-bearing structure can have a slope varying from steep to shallow, or may even have no slope (in the latter case, the slope will be created with concrete screed or with suitably arranged insulating panels).

Levelling layer

The purpose of the levelling layer is to level out and compensate for protuberances and unevenness in the surface the roof is being installed on in order to avoid the risk of the waterproofing membrane being punctured. This layer is produced using geotextiles with a suitable weight and relevant properties.

Root-resistant waterproofing layer

The purpose of the waterproofing layer is to stop rainwater and irrigation water getting inside, as well as protecting the load-bearing structural support from deterioration. This layer must also be resistant to penetration by roots that it might come into contact with.

Protection layer

The purpose of the protection layer is to Protection the waterproofing layer from mechanical damage. The waterproofing system is exposed to the risk of mechanical damage both during the building of the actual garden and while it is in service. There are green roof systems that, given the nature of the materials and/or systems, do not require this layer to be built or already have protection built in.

Drainage or drainage/water storage layer

The purpose of the drainage layer is to allow excess rainwater or irrigation water to drain away so that the growing medium does not become saturated, which could compromise the correct development of the vegetation's root system. Many green roof systems feature a water storage layer incorporated into the drainage layer so as to have a reserve of water for "bottom-up" irrigation of the vegetation. The water storage means sprinkler irrigation can be used at greater intervals and, in certain favourable situations, irrigation can be done away with altogether.

Filter layer

The purpose of the filter layer is to stop the growing medium from being wash away and thus clogging and compromising the operation of the drainage layer or drainage/water storage layer.

Growing substrate

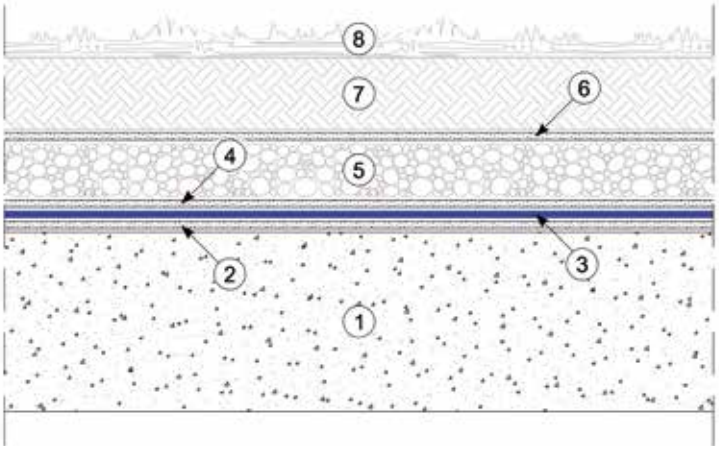
This is the growing medium, more specifically the natural substrate comprising a blend of soils in which the roof's vegetation can grow and survive.

Vegetation

Vegetation must be chosen carefully, taking into account the environmental conditions and various factors that can affect its development and survival, such as local climate, exposure, the roof's use and maintenance requirements.

Note: Some green roof systems combine the protection, drainage or drainage/water storage and filter functions in a single layer. These layers are generally geocomposites or preformed panels.

Sample build-up with key functional layers



1. Load-bearing structural support, possibly sloping
2. Levelling layer
3. Root-resistant waterproofing membrane
4. Protection layer
5. Drainage or drainage/water storage layer
6. Filter layer
7. Growing substrate
8. Vegetation

Complementary functional layers of a green roof

Building a more complete and well-structured green roof involves the use of certain complementary elements, as described below.

Vapour barrier layer

To be included in the building of a green roof with thermal insulation. The purpose of this layer is to control the flow of vapour passing through the structure, from the inside of the building to the outside, in order to avoid the issue of condensation forming inside the roof assembly. It must be applied under the thermal insulation layer.

Thermal insulation layer

To be applied when building thermally insulated green roofs. This layer can be produced using the various usual commercially available insulating materials. Suitable compressive strength is one essential requirement of this layer, which must also be compatible with the waterproofing membrane to be applied on top.

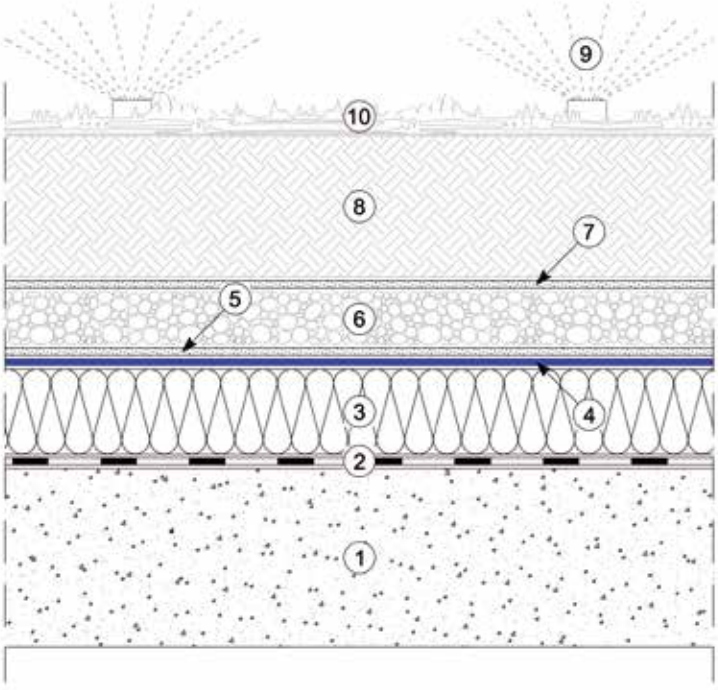
Erosion control/soil-retention systems or layer

Erosion control/soil-retention systems are used when producing green roofs on pitched roofs. Their purpose is to stop the growing medium from slipping and eroding when laid on a slope. Refer to chapter 5 for further information.

Irrigation system

The purpose of the irrigation system is to supplement the water that vegetation on the roof is receiving from rainfall in order to ensure correct plant growth and survival. Various kinds can be used, from sprinkler systems - with fixed or oscillating sprinklers - to soaker hoses, drip lines or sub irrigation to water from the bottom up. If used in conjunction with a water storage layer, the irrigation system required may be much smaller or watering times may be reduced considerably.

Sample build-up with key and complementary functional layers



1. Load-bearing structural support, possibly sloping
2. Vapour barrier layer
3. Thermal insulation layer
4. Root-resistant waterproofing membrane
5. Protection layer
6. Drainage or drainage/water storage layer
7. Filter layer
8. Growing substrate
9. Irrigation system
10. Vegetation

4. MAPEPLAN T B solutions - Flat roofs

Using MAPEPLAN T B waterproofing membranes, you can design and build functional, reliable, modern, technologically advanced and exceptionally eco-friendly green roofs.
The coming pages feature a series of build-ups showing correct technical solutions with and without thermal insulation.
As you can see, the MAPEPLAN T B waterproofing assembly - which is the roof's actual thermal and waterproofing system - can be applied under all the various types of green roof build-ups available on the market.
As mentioned in the foreword, we will not be going into the different green roof systems in detail: each has its own merits and, despite their differences and specific features, we seem them all as effective, applicable solutions. Consequently, we will leave it up to the Designer, Constructor and building Owner to determine which green roof build-up best suits their specific needs.

Please find below a number of technical issues that we have factored in when formulating the MAPEPLAN T B build-ups and solutions given.

No risk of condensation

On a green roof, it is important that neither surface nor interstitial condensation be allowed to form as any condensation that forms over winter is highly unlikely to evaporate over the summer months. Top-down evaporation to the outside is possible in theory, while bottom-up evaporation through the garden's various layers is very limited (if not practically nil).
Appropriate measures that can/must be taken to avoid the risk of condensation involve correctly sizing the vapour barrier and thermal insulation layer. With a proper hygrothermal analysis, the designer can determine the correct size of the thermal insulation and waterproofing assembly.
Our MAPEPLAN T B technical solutions involve the use of vapour barriers produced by POLYGLASS (POLYVAP SA - POLYVAP RADONSHIELD - PLANA P) bitumen membranes that have a suitable controlled water vapour transmission value (Sd value). A secondary advantage of these vapour barriers is that they also serve as a provisional waterproofing measure, before the full system is implemented.

Minimum requirements of thermal insulation panels

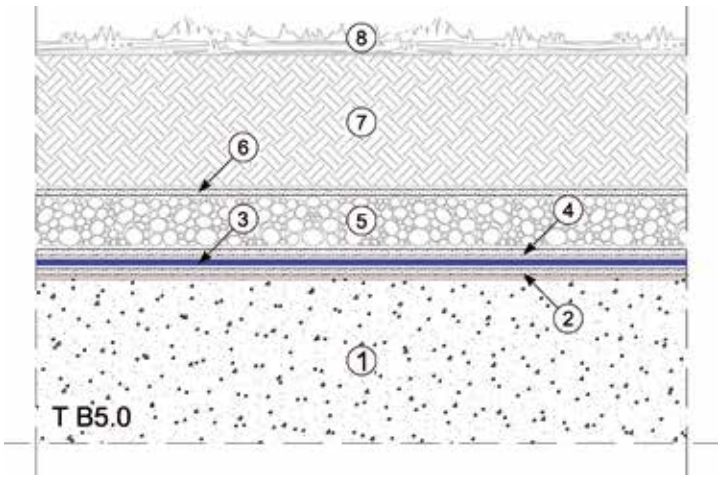
The thermal insulation panels normally used in the building industry are generally also suitable for building green roofs (you are advised to refer to the technical literature and directions issued by the individual manufacturers). In our technical solutions, we generally indicate the thermal insulation layer so that the designer, builder and customer can decide on the product they deem best meets their needs and demands.

Whatever the case, thermal insulation panels must meet the following minimum requirements:

- Must have adequate compressive strength, which will need to be checked against the anticipated loads and overloading.
- Must be highly dimensionally stable.
- In the case of “inverted roof” applications - where the thermal insulation is not protected by the waterproofing membrane - you will need to use suitable extruded polystyrene (XPS) panels certified for this kind of application.

BUILD-UP T B5.0

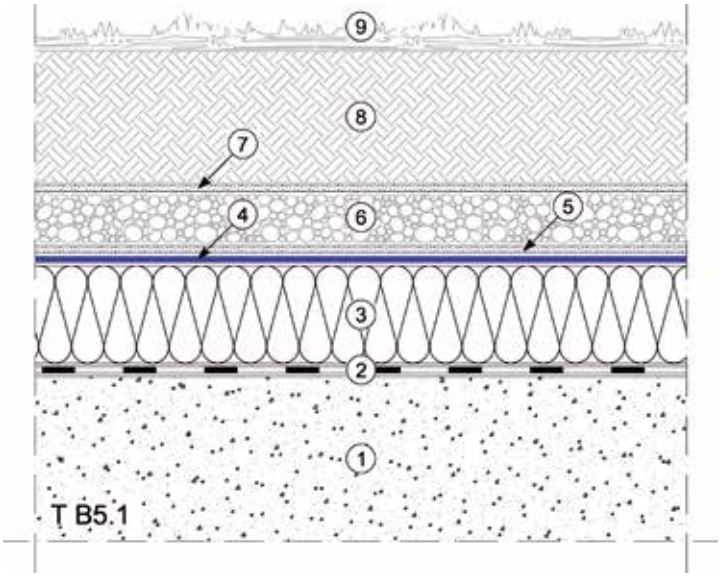
MAPEPLAN T B membrane - Non-insulated roof with gravel or expanded clay drainage



1. Structure
2. **POLYDREN PP** levelling layer
3. **MAPEPLAN T B** waterproofing membrane
4. **POLYDREN PP** protection layer
5. Drainage or drainage/water storage layer (gravel or expanded clay)
6. **POLYDREN PP** filter layer
7. Growing substrate
8. Vegetation

BUILD-UP T B5.1

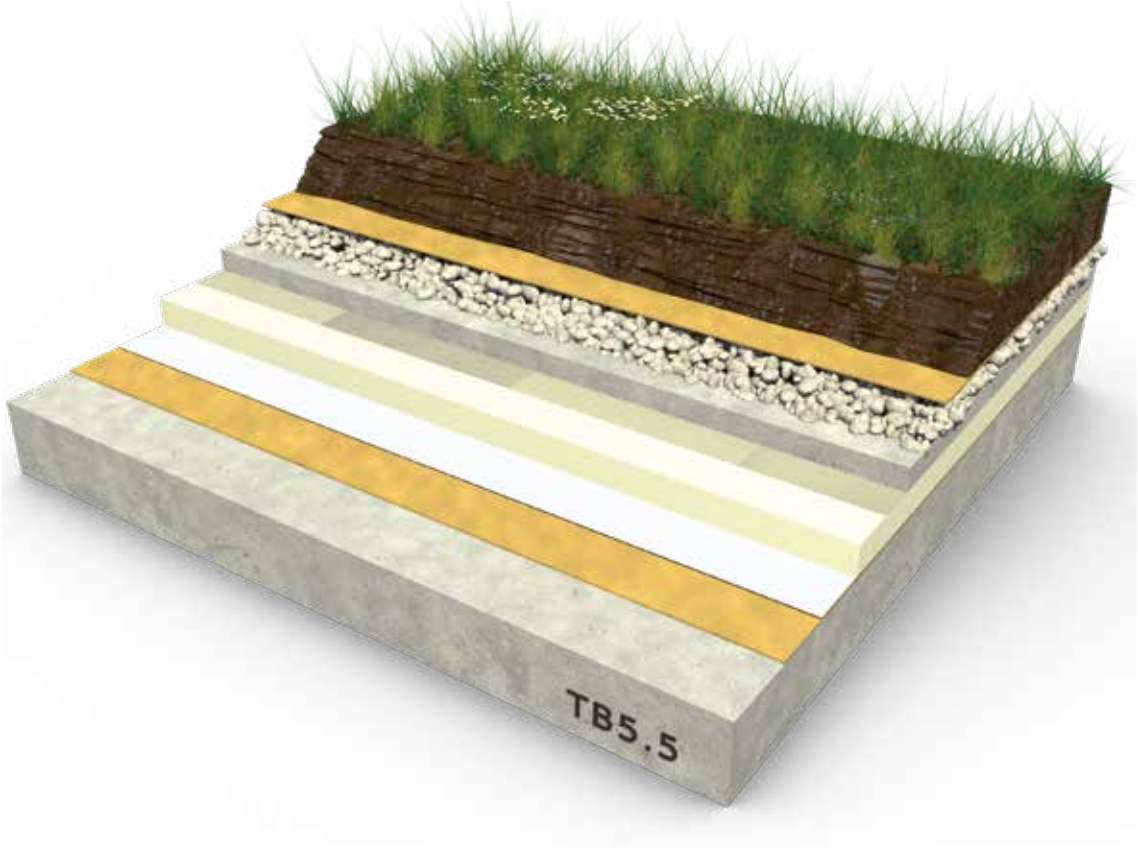
MAPEPLAN T B membrane - Insulated roof with gravel or expanded clay drainage

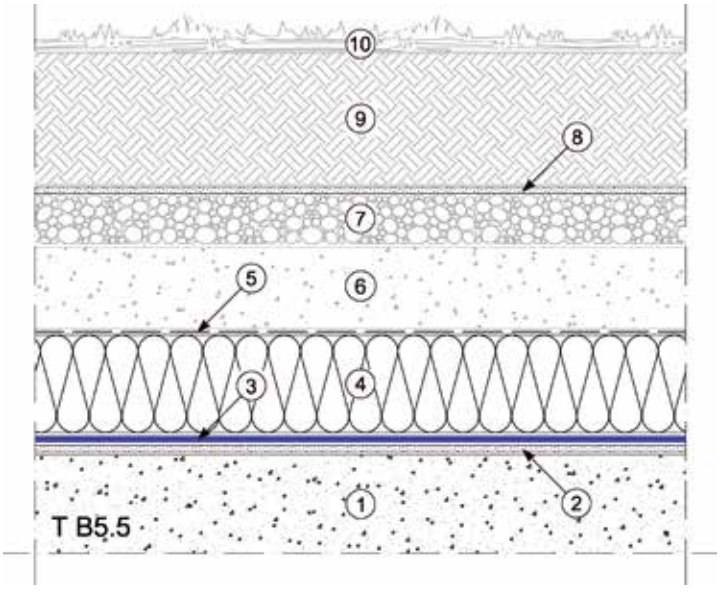


1. Structure
2. Vapour barrier layer (e.g. **IDROPRIMER** + **POLYVAP**)
3. Thermal insulation layer
4. **MAPEPLAN T B** waterproofing membrane
5. **POLYDREN PP** protection layer
6. Drainage or drainage/water storage layer (gravel or expanded clay)
7. **POLYDREN PP** filter layer
8. Growing substrate
9. Vegetation

BUILD-UP T B5.5

MAPEPLAN T B membrane - Inverted roof with screed and gravel or expanded clay drainage

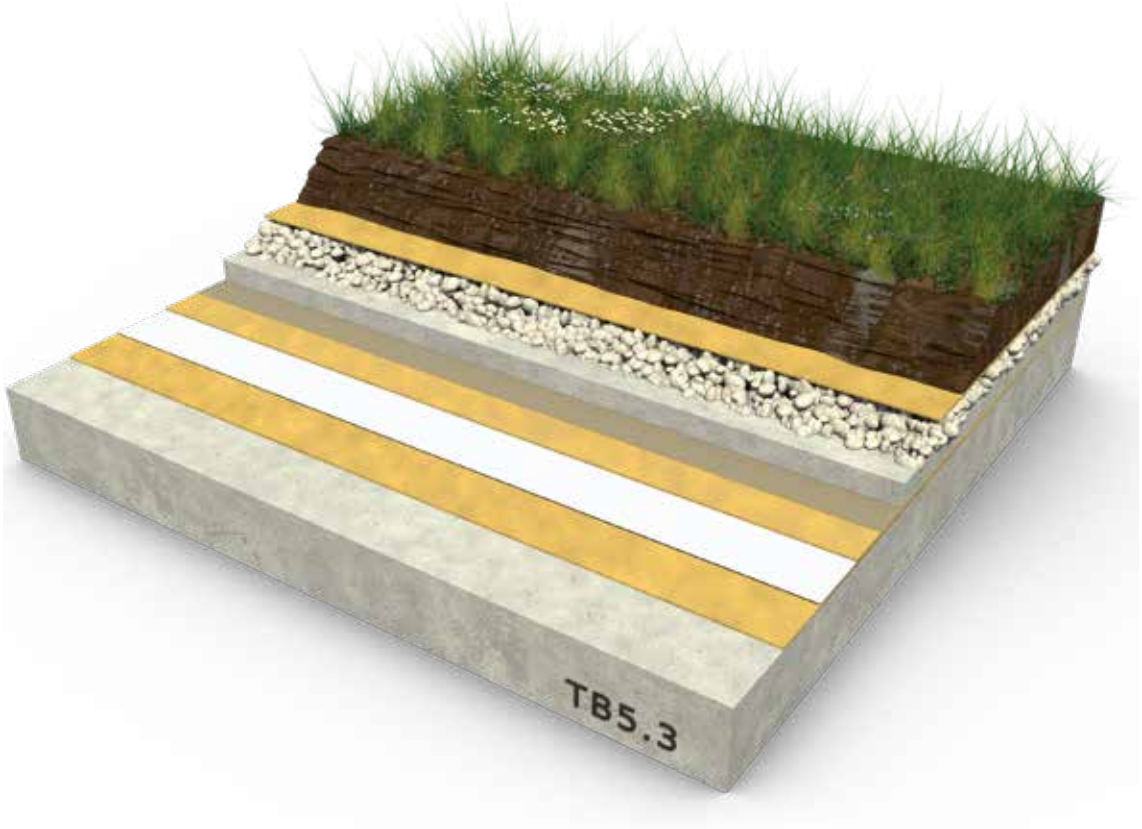


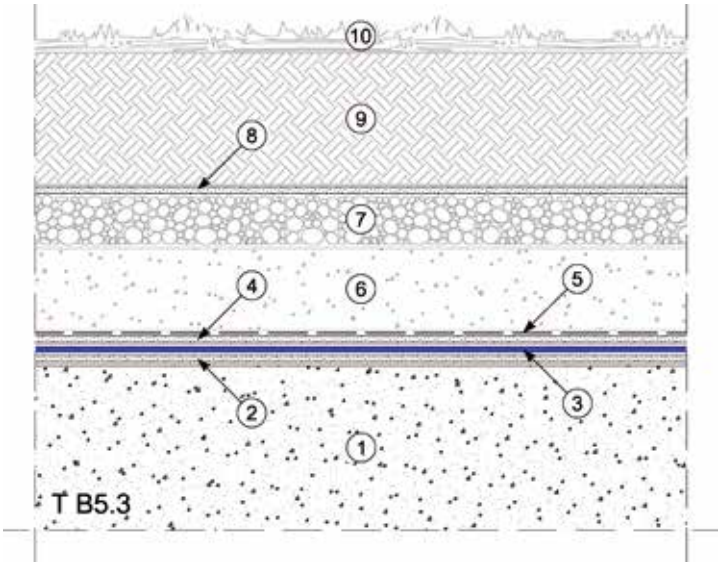


1. Structure
2. **POLYDREN PP** levelling layer
3. **MAPEPLAN T B** waterproofing membrane
4. Thermal insulation layer
5. Anti-soaking layer **MAPEPLAN PE micro-perforated**
6. Protective concrete screed
7. Drainage or drainage/water storage layer (gravel or expanded clay)
8. **POLYDREN PP** filter layer
9. Growing substrate
10. Vegetation

BUILD-UP T B5.3

MAPEPLAN T B membrane - Non-insulated roof with screed and gravel or expanded clay drainage

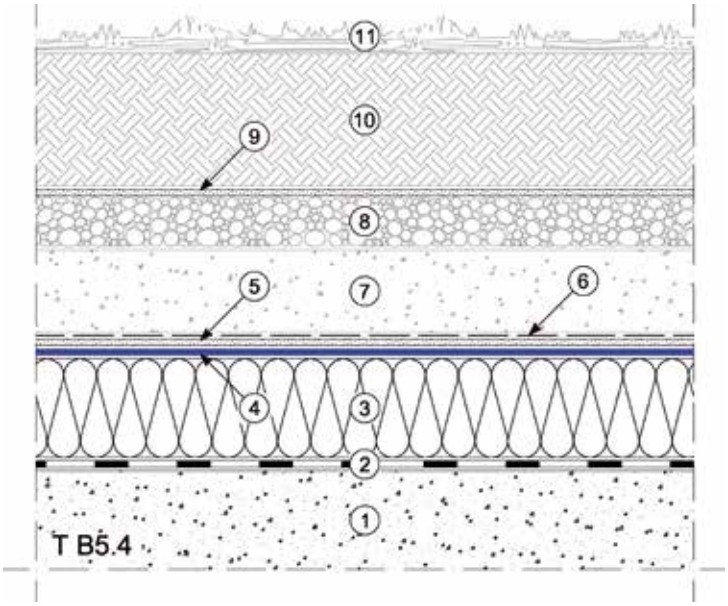




1. Structure
2. **POLYDREN PP** levelling layer
3. **MAPEPLAN T B** waterproofing membrane
4. **POLYDREN PP** protection layer
5. Anti-soaking layer **MAPEPLAN PE micro-perforated**
6. Protective concrete screed
7. Drainage or drainage/water storage layer (gravel or expanded clay)
8. **POLYDREN PP** filter layer
9. Growing substrate
10. Vegetation

BUILD-UP T B5.4

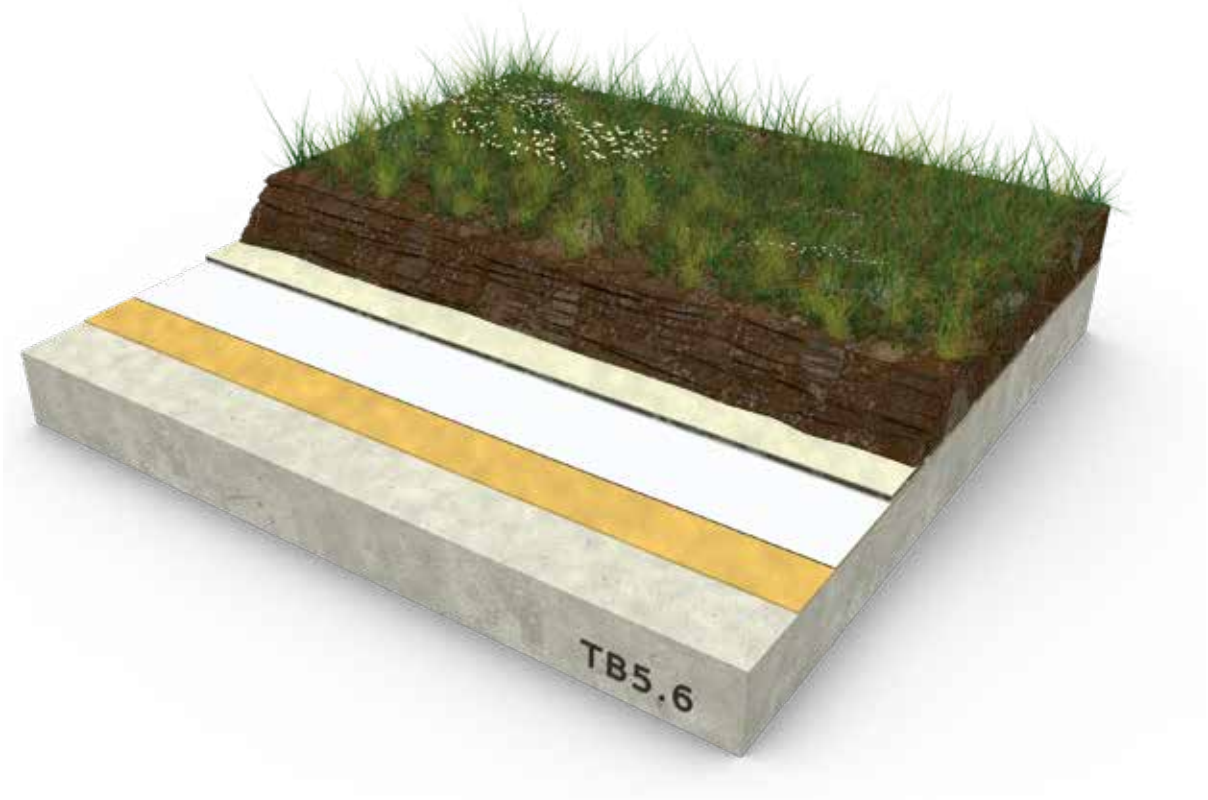
MAPEPLAN T B membrane - Insulated roof with screed and gravel or expanded clay drainage

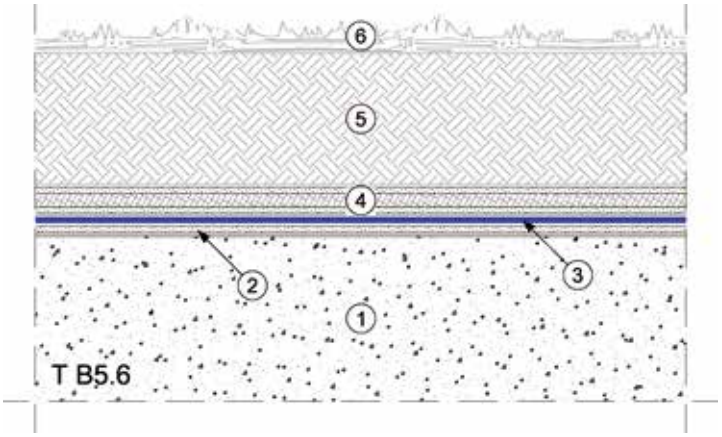


1. Structure
2. Vapour barrier layer (e.g. **IDROPRIMER** + **POLYVAP**)
3. Thermal insulation layer
4. **MAPEPLAN T B** waterproofing membrane
5. **POLYDREN PP** protection layer
6. Anti-soaking layer **MAPEPLAN PE micro-perforated**
7. Protective concrete screed
8. Drainage or drainage/water storage layer (gravel or expanded clay)
9. **POLYDREN PP** filter layer
10. Growing substrate
11. Vegetation

BUILD-UP T B5.6

MAPEPLAN T B membrane - Non-insulated roof with POLYSTUOIA geocomposite drainage

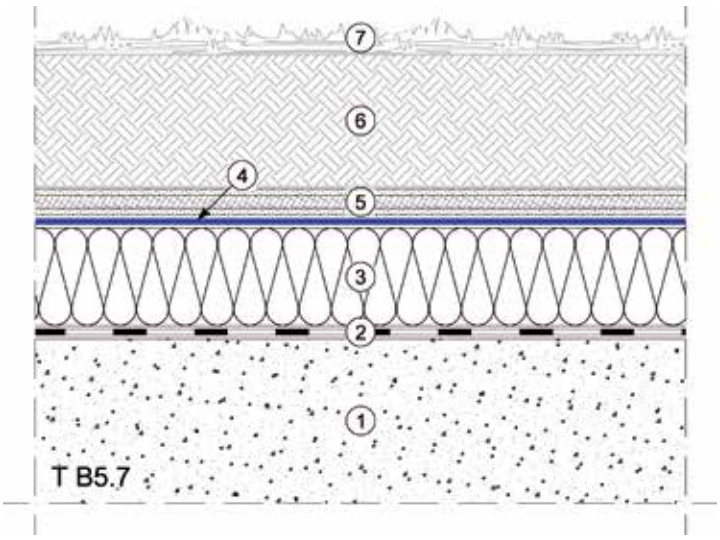




1. Structure
2. **POLYDREN PP** levelling layer
3. **MAPEPLAN T B** waterproofing membrane
4. **POLYSTUOIA** protection and drainage layer
5. Growing substrate
6. Vegetation

BUILD-UP T B5.7

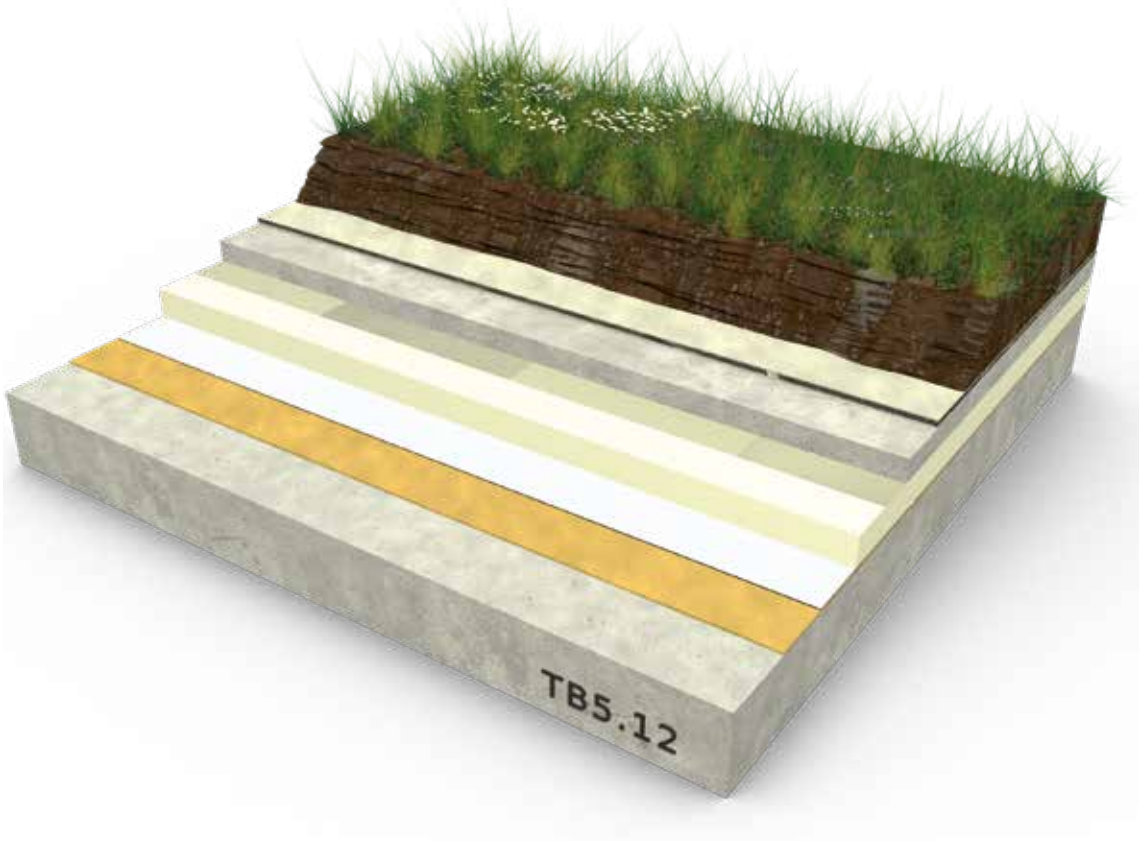
MAPEPLAN T B membrane - Insulated roof with POLYSTUOIA geocomposite drainage

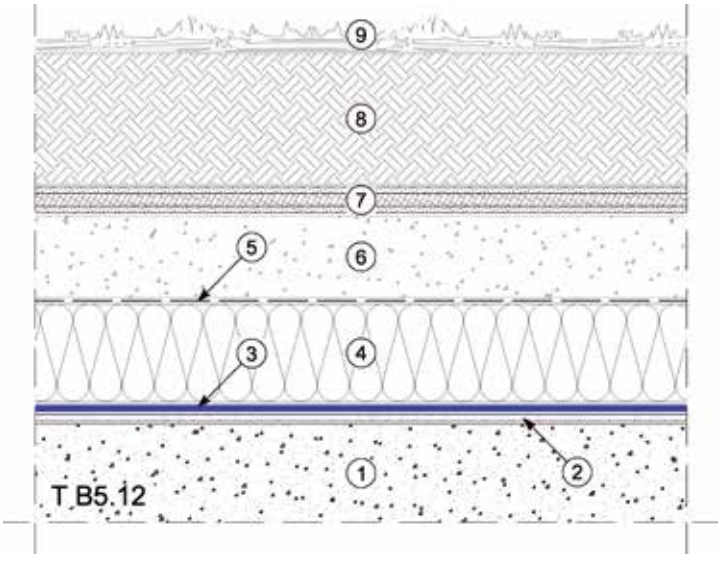


1. Structure
2. Vapour barrier layer (e.g. **IDROPRIMER** + **POLYVAP**)
3. Thermal insulation layer
4. **MAPEPLAN T B** waterproofing membrane
5. **POLYSTUOIA** protection and drainage layer
6. Growing substrate
7. Vegetation

BUILD-UP T B5.12

MAPEPLAN T B membrane - Inverted roof with screed and POLYSTUOIA geocomposite drainage

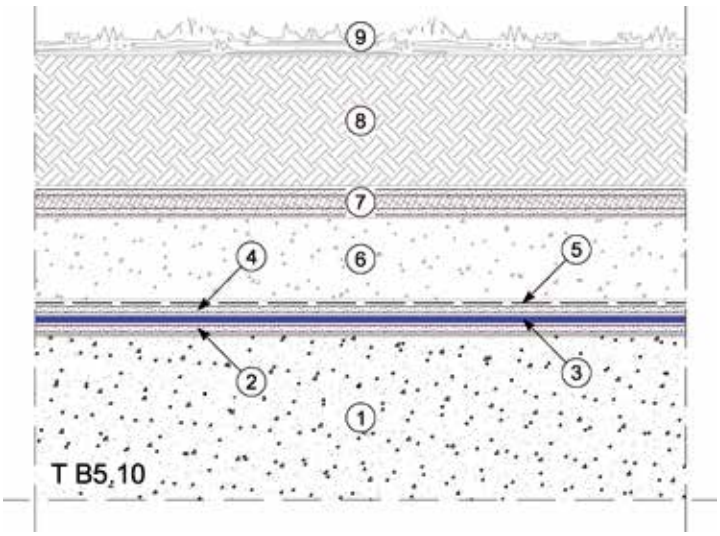




1. Structure
2. **POLYDREN PP** levelling layer
3. **MAPEPLAN T B** waterproofing membrane
4. Thermal insulation layer
5. Anti-soaking layer **MAPEPLAN PE micro-perforated**
6. Protective concrete screed
7. **POLYSTUOIA** drainage layer
8. Growing substrate
9. Vegetation

BUILD-UP T B5.10

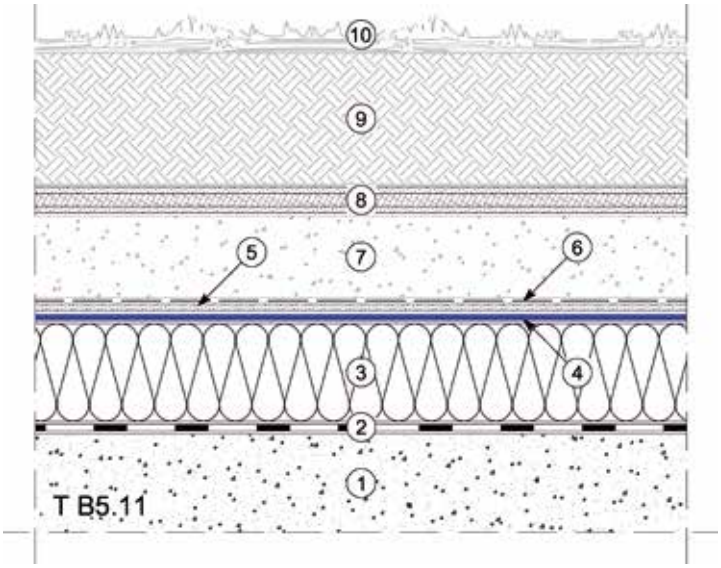
MAPEPLAN T B membrane - Non-insulated roof with screed and POLYSTUOIA geocomposite drainage



1. Structure
2. **POLYDREN PP** levelling layer
3. **MAPEPLAN T B** waterproofing membrane
4. **POLYDREN PP** protection layer
5. Anti-soaking layer **MAPEPLAN PE micro-perforated**
6. Protective concrete screed
7. **POLYSTUOIA** drainage layer
8. Growing substrate
9. Vegetation

BUILD-UP T B5.11

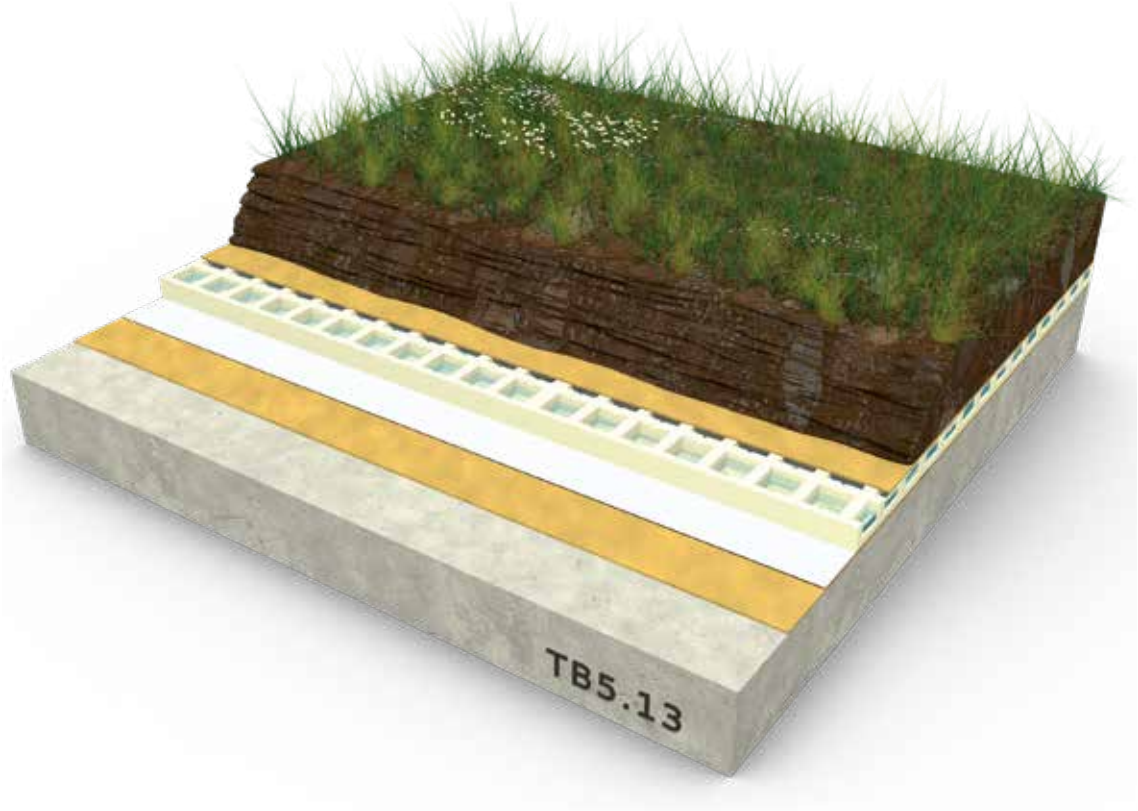
MAPEPLAN T B membrane - Insulated roof with screed and POLYSTUOIA geocomposite drainage

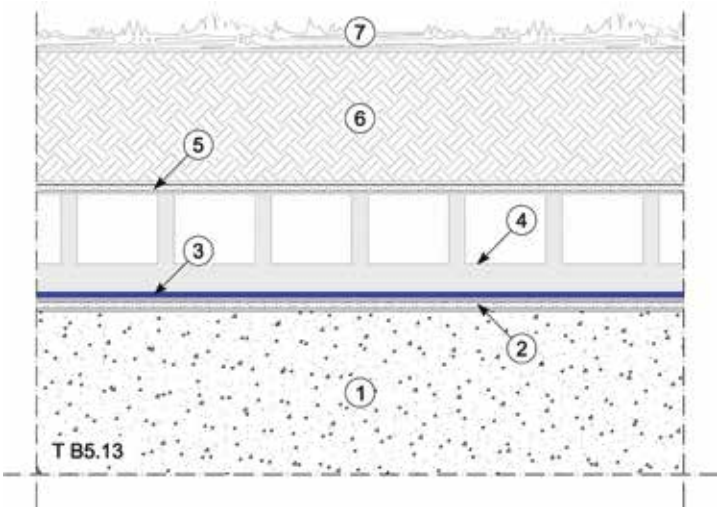


1. Structure
2. Vapour barrier layer (e.g. **IDROPRIMER** + **POLYVAP**)
3. Thermal insulation layer
4. **MAPEPLAN T B** waterproofing membrane
5. **POLYDREN PP** protection layer
6. Anti-soaking layer **MAPEPLAN PE micro-perforated**
7. Protective concrete screed
8. **POLYSTUOIA** drainage layer
9. Growing substrate
10. Vegetation

BUILD-UP T B5.13

MAPEPLAN T B membrane - Non-insulated roof with water storage and drainage layer produced with EPS panels

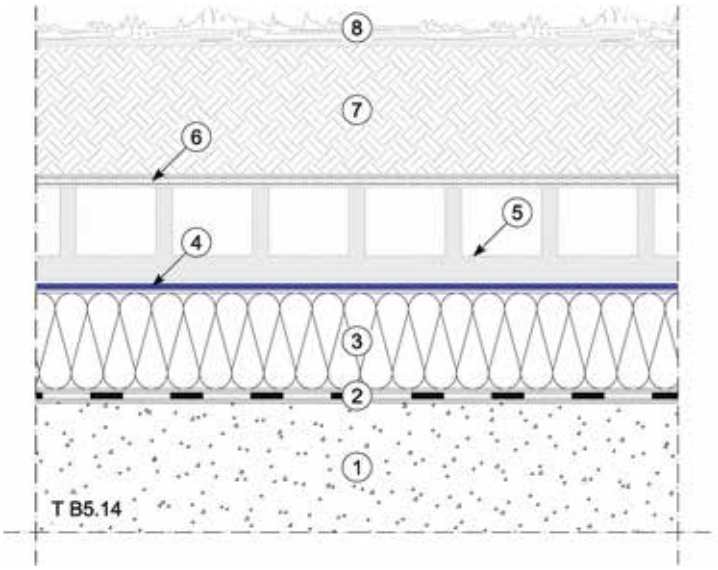




1. Structure
2. **POLYDREN PP** levelling layer
3. **MAPEPLAN T B** waterproofing membrane
4. Drainage/water storage layer produced with preformed EPS panels
5. Geotextile filter layer
6. Growing substrate
7. Vegetation

BUILD-UP T B5.14

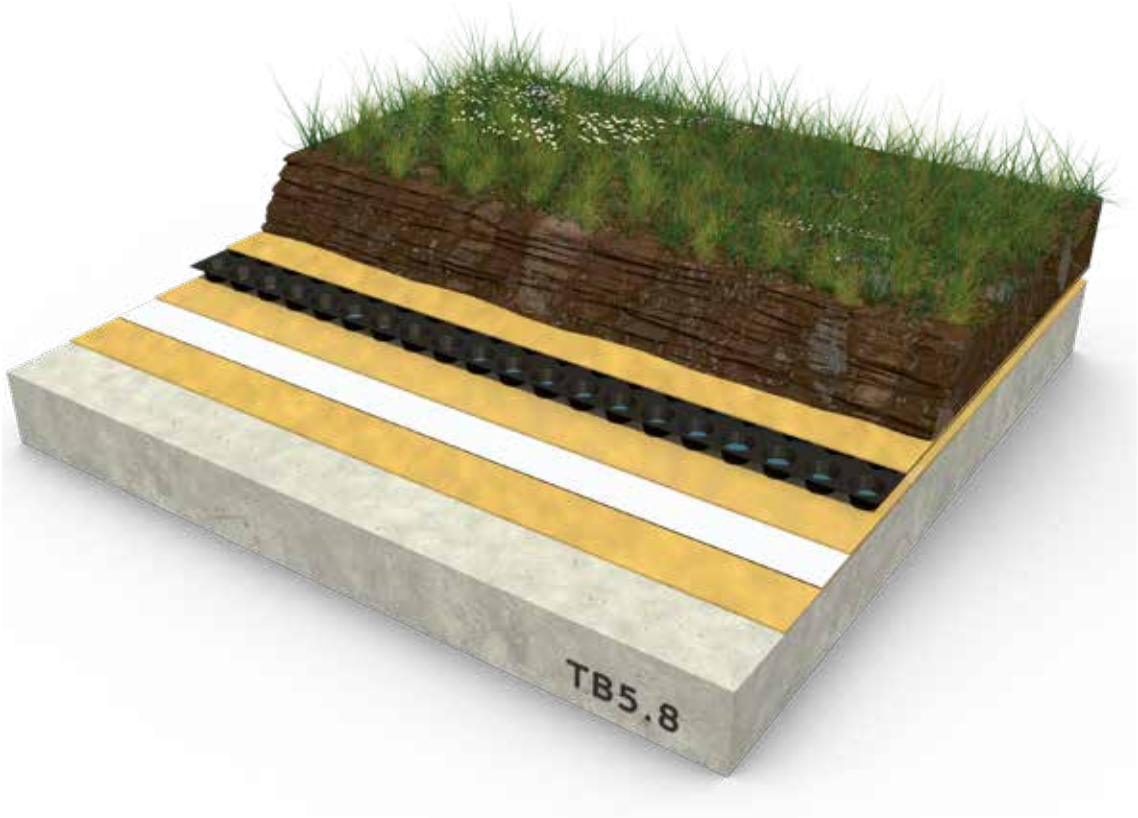
MAPEPLAN T B membrane - Insulated roof with water storage and drainage layer produced with EPS panels

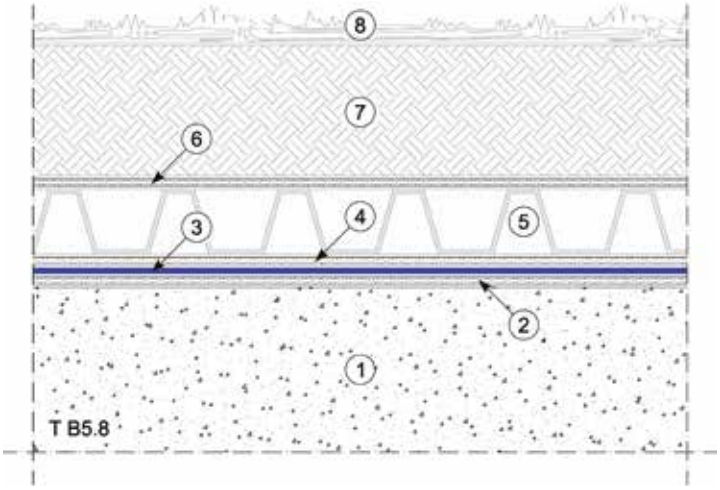


1. Structure
2. Vapour barrier layer (e.g. **IDROPRIMER** + **POLYVAP**)
3. Thermal insulation layer
4. **MAPEPLAN T B** waterproofing membrane
5. Drainage/water storage layer produced with preformed EPS panels
6. Geotextile filter layer
7. Growing substrate
8. Vegetation

BUILD-UP T B5.8

MAPEPLAN T B membrane - Non-insulated roof with water storage and drainage layer produced with HDPE elements

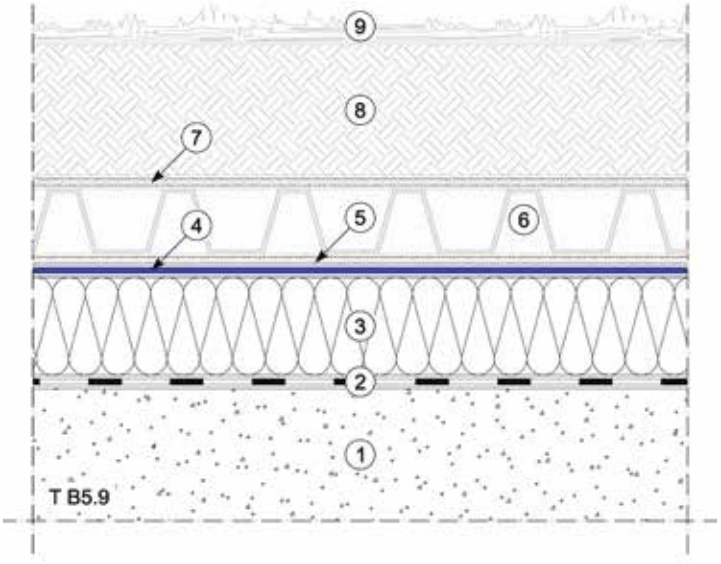




1. Structure
2. **POLYDREN PP** levelling layer
3. **MAPEPLAN T B** waterproofing membrane
4. **POLYDREN PP** protection layer
5. Drainage/water storage layer produced with preformed HDPE elements
6. Geotextile filter layer
7. Growing substrate
8. Vegetation

BUILD-UP T B5.9

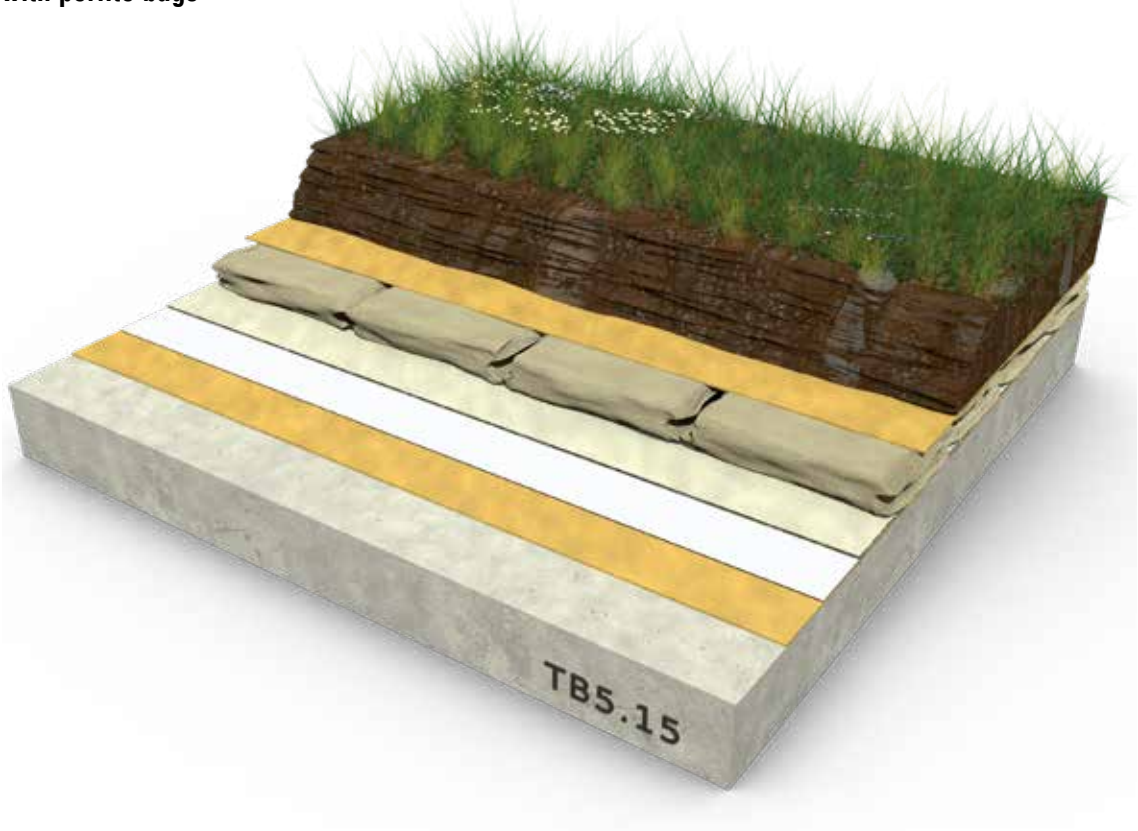
MAPEPLAN T B membrane - Insulated roof with water storage and drainage layer produced with HDPE elements

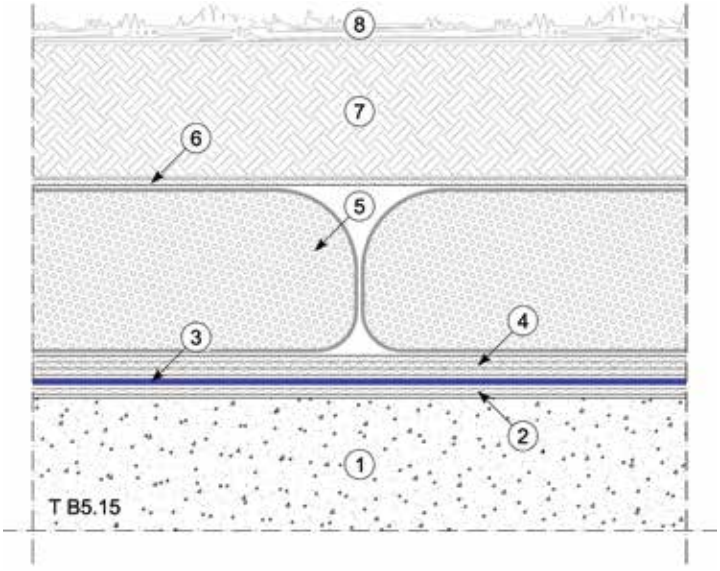


1. Structure
2. Vapour barrier layer (e.g. **IDROPRIMER** + **POLYVAP**)
3. Thermal insulation layer
4. **MAPEPLAN T B** waterproofing membrane
5. **POLYDREN PP** protection layer
6. Drainage/water storage layer produced with preformed HDPE elements
7. Geotextile filter layer
8. Growing substrate
9. Vegetation

BUILD-UP T B5.15

MAPEPLAN T B membrane - Non-insulated roof with water storage and drainage layer produced with perlite bags

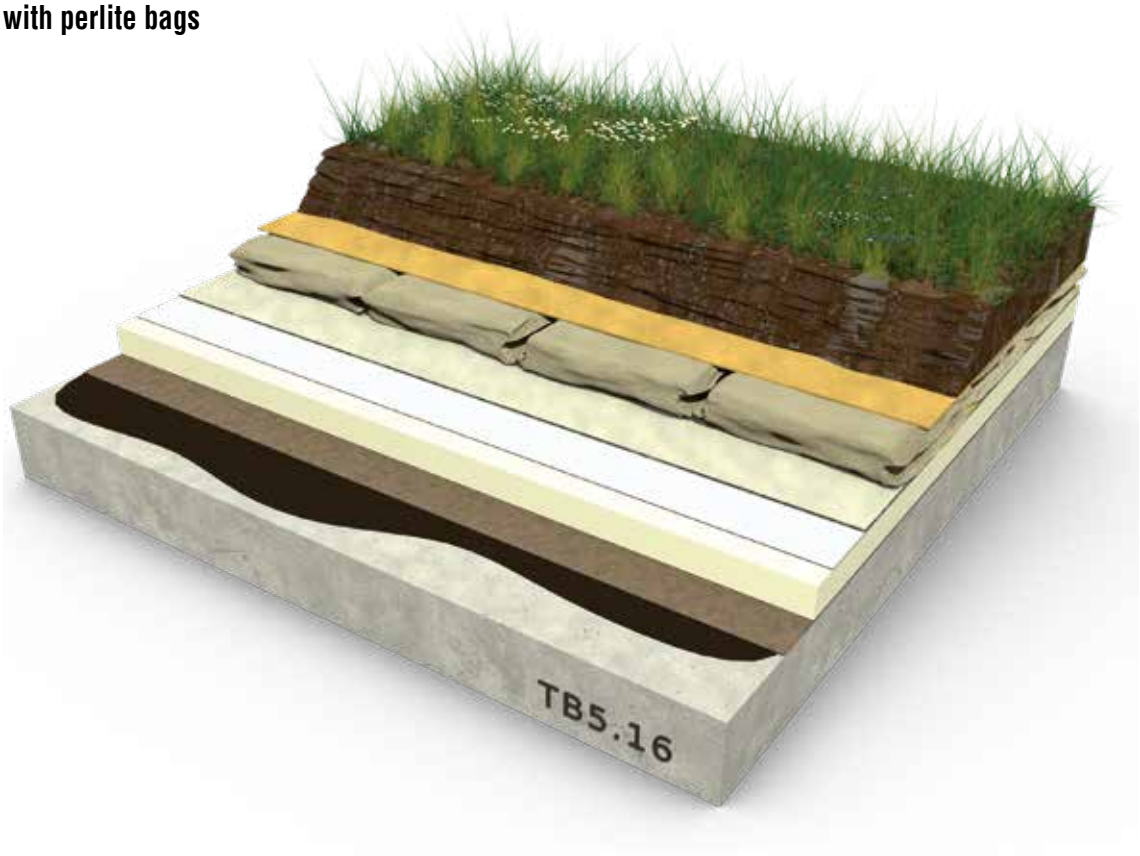


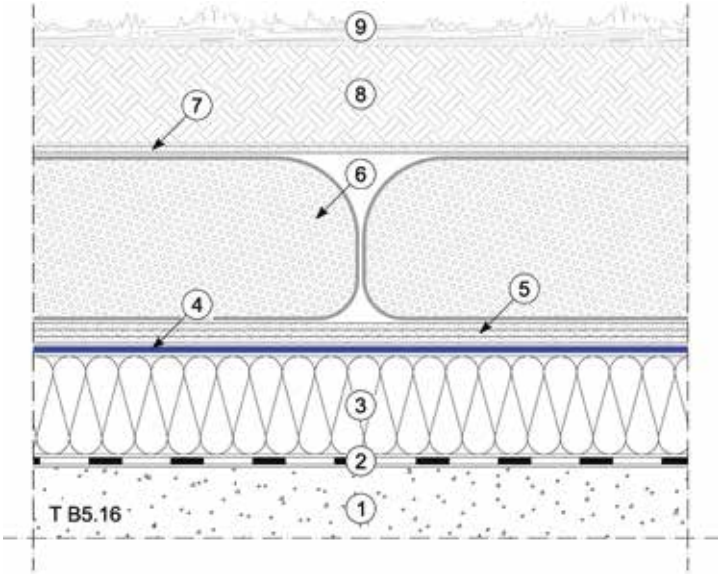


1. Structure
2. **POLYDREN PP** levelling layer
3. **MAPEPLAN T B** waterproofing membrane
4. Geocomposite protection and drainage layer
5. Drainage/water storage layer produced with perlite bags
6. Geotextile filter layer
7. Growing substrate
8. Vegetation

BUILD-UP T B5.16

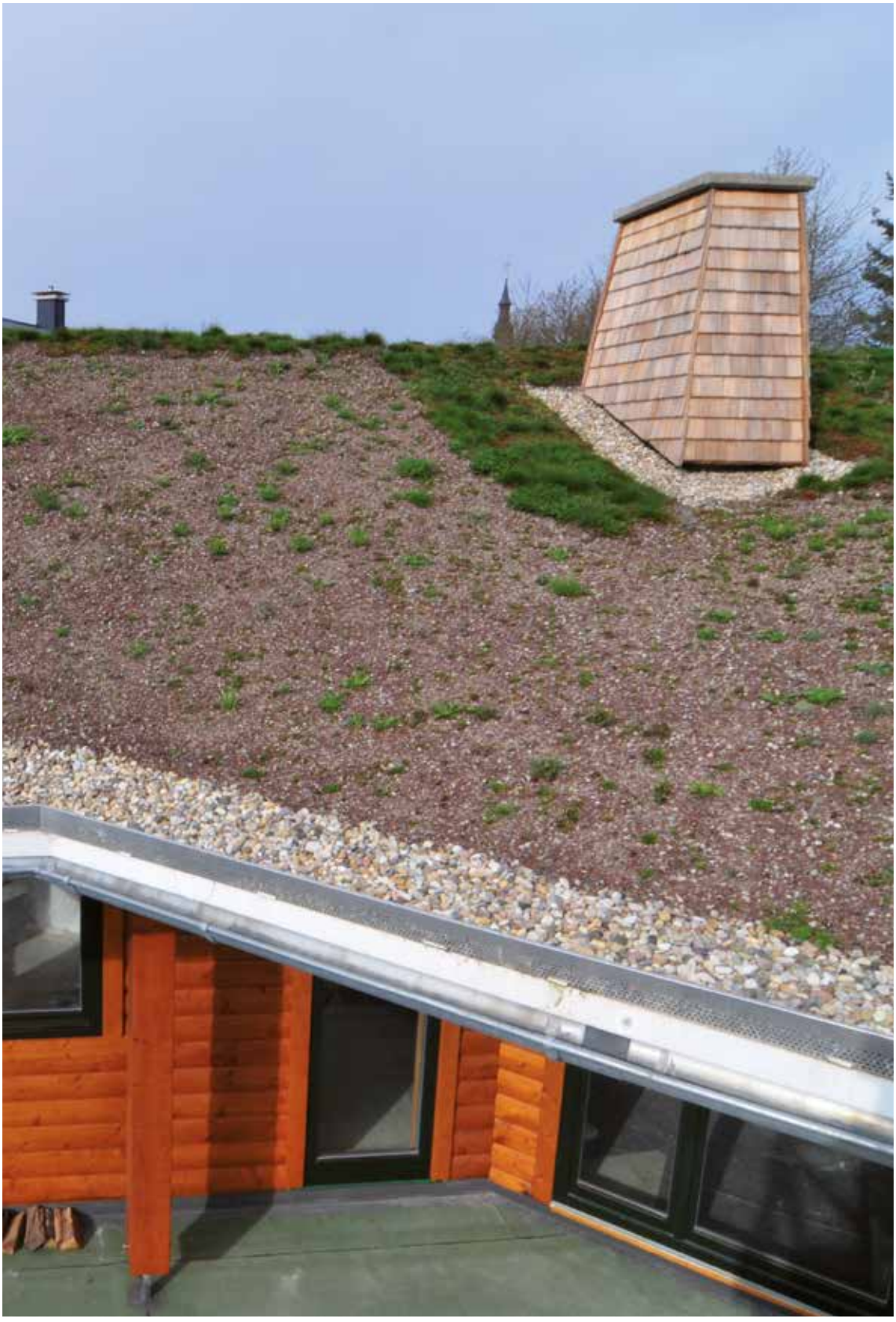
MAPEPLAN T B membrane - Insulated roof with water storage and drainage layer produced with perlite bags





1. Structure
2. Vapour barrier layer (e.g. **IDROPRIMER** + **POLYVAP**)
3. Thermal insulation layer
4. **MAPEPLAN T B** waterproofing membrane
5. Geocomposite protection and drainage layer
6. Drainage/water storage layer produced with perlite bags
7. Geotextile filter layer
8. Growing substrate
9. Vegetation

MAPEPLAN T B



5. MAPEPLAN T B solutions - Pitched roofs

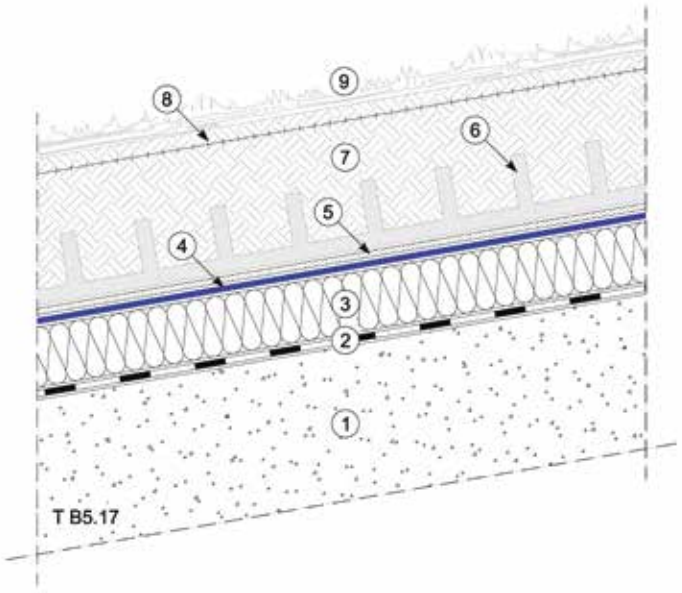
Green roofs with a gradient over 5° are known as pitched green roofs and require specific measures and technical/design assessments. Generally speaking, this kind of roof will be extensively planted so as to be low maintenance and require a shallower substrate.

The Italian standard on green roofs, UNI 11235, gives the following instructions to be followed when designing and building a pitched green roof:

- The green roof system must be checked along the retaining edge to ensure it is adequate and can withstand the loading from above.
- Drainage elements must be used that also serve to retain the growing substrate.
- If the gradient of the roof is over 15°, an erosion barrier layer must be installed, which will generally consist of geomats, natural fibre matting, natural fibre blankets or geocells.
- When the gradient is over 20°, the build-up must incorporate soil-retention elements - to be inserted in the growing substrate - consisting of geonets or suitable alternative solutions, arranged to ensure the maintenance and stability of the system and water runoff.
- Pitched roofs do not generally have the filter component as it encourages slippage of the layers on top (substrate + vegetation), except in areas where there is a need for separation between the layers, such as in the case of the roof's outer edges.
- When the roof pitch exceeds 5%, the waterproofing membranes must be anchored to the deck to stop them slipping, allowing for the angle of the slope and the load on top.

BUILD-UP T B5.17

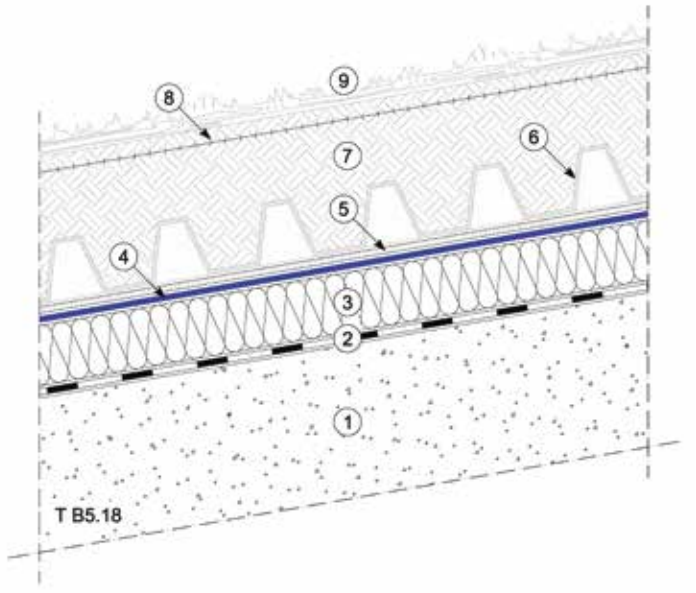
MAPEPLAN T B membrane - Pitched roof with drainage layer produced with preformed EPS panels



1. Structure
2. Vapour barrier layer (e.g. **IDROPRIMER** + **POLYVAP**)
3. Thermal insulation layer
4. **MAPEPLAN T B** waterproofing membrane
5. **POLYDREN PP** protection layer
6. Drainage/water storage layer produced with preformed EPS panels
7. Growing substrate
8. Erosion control layer (for pitch ≥15°)
9. Vegetation

BUILD-UP T B5.18

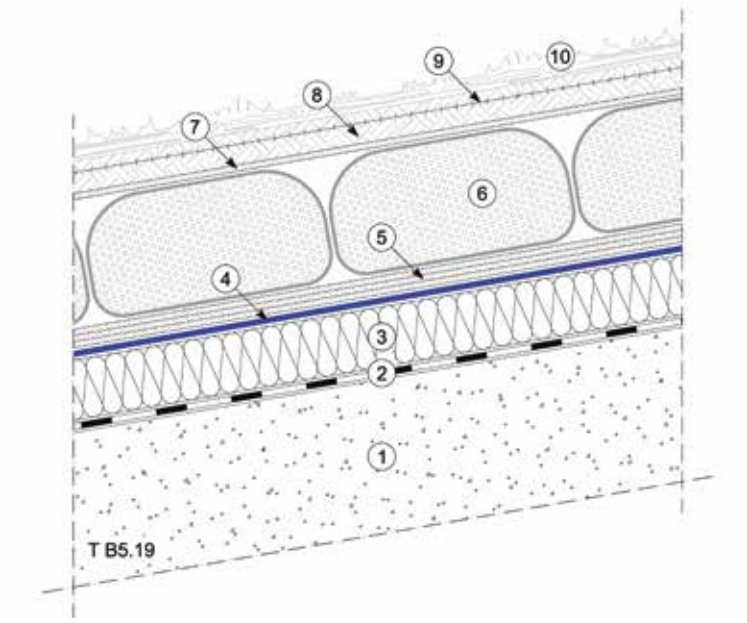
MAPEPLAN T B membrane - Pitched roof with drainage layer produced with preformed HDPE elements



1. Structure
2. Vapour barrier layer (e.g. **IDROPRIMER** + **POLYVAP**)
3. Thermal insulation layer
4. **MAPEPLAN T B** waterproofing membrane
5. **POLYDREN PP** protection layer
6. Drainage/water storage layer produced with preformed HDPE elements
7. Growing substrate
8. Erosion control layer (for pitch ≥15°)
9. Vegetation

BUILD-UP T B5.19

MAPEPLAN T B membrane - Pitched roof with drainage layer produced with perlite bags



1. Structure
2. Vapour barrier layer (e.g. **IDROPRIMER** + **POLYVAP**)
3. Thermal insulation layer
4. **MAPEPLAN T B** waterproofing membrane
5. Geocomposite protection and drainage layer
6. Drainage/water storage layer produced with perlite bags
7. Geotextile filter or levelling layer (where necessary)
8. Growing substrate
9. Erosion control layer (for pitch ≥15°)
10. Vegetation

6. Basic requirements of synthetic waterproofing membranes for green roofs

As mentioned earlier in the foreword, the waterproofing system of a green roof is a key factor in producing a roof that is built properly and will have a long service life. More specifically, the synthetic waterproofing membrane must meet specific basic requirements, which are key to ensuring adequate and necessary performance. MAPEPLAN T B waterproofing membranes meet all the requirements given below.

To be fit for use on green roofs, the synthetic waterproofing membrane must:

- Meet the requirements, points and conditions listed in standard EN 13956, according to the relevant tests described, in order for the membrane to earn the certificate of conformity with harmonized European standards and hence CE marking. Specific reference standard: *standard EN 13956 - Flexible sheets for waterproofing - Plastic and rubber sheets for roof waterproofing - Definitions and characteristics.*

- Be waterproof and withstand the pressure of the water. Specific reference standard: *Determination of watertightness test according to standard EN 1928.*

- Be resistant to root penetration. Roots must not pierce the waterproofing membrane either on the continuous surface or at any point along the main seams or secondary seams. Specific reference standards: *Determination of resistance to root penetration test according to standard EN 13948* and the even stricter *FLL test (Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e.V.).* Refer to the specific chapter for further information.

- Feature great dimensional stability and have a low coefficient of thermal expansion. This trait is essential when the waterproofing membrane is being applied: the membrane can actually be exposed to high temperatures and considerable changes in temperature between being laid and the green roof being built on top. During this stage, the membrane must not move from its original position, thus minimizing the risk of mechanical damage. This trait is also important during its service life as an unstable material will be subjected to strain at the fixed points, with the result that the membrane may be damaged or tear. Only a membrane with an internal glass mat reinforcement can guarantee this kind of performance. Specific reference standard: *Determination of dimensional stability test according to standard EN 1107-2.*

- Have high mechanical strength. The waterproofing membrane must be able to withstand, with a sufficient safety margin, the anticipated permanent and accidental loads and accidental impact and damage that might occur during the roof's construction and service. Specific reference standards: *Determination of resistance to static loading test according to EN 12730* and *Determination of resistance to impact test according to standard EN 12691.*

- Have excellent foldability at low temperatures as this indicates that the synthetic membrane is good quality. Specific reference standard: *Determination of foldability at low temperature test according to standard EN 495-5.*

- Be resistant to ageing and durable, ensuring the waterproofing system offers decades of service. Especially given that repairing/refurbishing the waterproofing system is a very costly operation as it involves removing and disposing of the vegetation and soil on top. Specific reference standard: *Artificial ageing by long-term exposure to the combination of UV radiation, elevated temperature and water test according to standard EN 1297.*

- Be easy to work with and weld so that even the most complex shapes and complicated features on the roof can be covered securely. Specific reference standards: *Determination of peel resistance of joints test according to standard EN 12316-2* and *Determination of shear resistance of joints test according to standard EN 12317-2.*

- Be resistant to microorganisms and any leachate they might come into contact with, as well as chemicals and various other products that might be used for the maintenance of the vegetation layer.

MAPEPLAN T B

7. MAPEPLAN T B waterproofing membranes

The MAPEPLAN T B waterproofing system comprises the FPO/TPO flexible polyolefin waterproofing membrane, which offers UV stability and weathering resistance and has a high dimensional stability internal glass mat reinforcement. The membrane is specifically designed and produced for loose-laid and subsequently ballasted systems, like green roofs (extensive and intensive).

Features and advantages of the MAPEPLAN T B system

The MAPEPLAN T B waterproofing membrane is made from FPO/TPO flexible polyolefin. The special features of this membrane are summarized below.

INTERNAL FLEXIBILITY

Innovative waterproofing membrane formulated without plasticizers or volatile substances.

The membrane gets its flexibility from the special chemical structure of its polymer component: the element that renders it so flexible is found in the molecular chain and is "chemically bonded" to it. This chemical bond is very strong and difficult to separate, which essentially results in the membrane inherent qualities lasting longer, in greater resistance to aggressive substances, as well as improved weathering resistance and resistance to microorganisms and bacteria.

DIMENSIONAL STABILITY

Dimensional stability is assured by the internal glass mat reinforcement and by the "multi-extrusion coating" production process.

Internal glass mat reinforcement with great dimensional stability and low coefficient of linear thermal expansion, which ensure minimal movement as a result of changes in temperature (day/night, summer/winter). This is an essential quality in systems with loose-laid membranes, both during the initial installation stage and when it is in service.

RESISTANCE TO ROOT PENETRATION - FLL TEST

The MAPEPLAN T B waterproofing membrane is completely resistant to penetration by roots and rhizomes, as required by the strictest FLL test conducted over a period of two years, and also meets the requirements of standard EN 13948.

Resistance to root penetration is one of the product's inherent properties and is not achieved with the addition of volatile substances or additives likely to wash off. The hot air welding of the overlaps and details ensure the resistance to root penetration.

Another advantage of the MAPEPLAN T B membrane, therefore, is that it serves a dual function, offering a waterproofing membrane and root barrier all in one product.

DURABILITY

The MAPEPLAN T B waterproofing membrane have a higher durability. In point of fact, accelerated ageing tests confirm many decades of service.

These values are also confirmed by numerous tests carried out by the producers of the raw material (flexible polyolefins). Flexible polyolefin membranes have been applied worldwide for decades with excellent results.

To draw a comparison that everyone can understand, let's take those plastic shopping bags (which are also made mostly from polyolefin): the issue with these bags is not durability, on the contrary it's their excellent and long-lasting resistance to chemicals and physical and mechanical strength that are the problem. In the case of shopping bags, these traits are not seen as advantages, while they definitely are for a waterproofing membrane that is instead required to last a long time.

Below is an excerpt from the BBA Technical Agrèment, section 12 - DURABILITY: "Accelerated weathering tests confirm that satisfactory retention of physical properties is achieved. Under normal conditions, the membranes will have a service life in excess of 25 years".

SMART WHITE SURFACE COLOUR

The MAPEPLAN T B waterproofing membrane has a special white top layer, Smart White, which gives the product its excellent solar reflectivity.

MAPEPLAN T B reduces roof surface temperature by over 50% compared to a black/dark-coloured roof.

This is an undeniable advantage during the waterproofing membrane's application and the building of the garden as the low surface temperature reduces movements caused by thermal expansion.

The Italian standard UNI 11235 states: *"High dimensional stability is essential during the waterproofing membrane's application. Until the green roof has been laid, the membrane may be exposed to high temperatures when in direct sunlight and is exposed to changes in temperature between day and night. To avoid mechanical damage during this period, the membrane must not move from the position it is originally laid in and must not be strained at fixed points, such as: roof edges, drain outlets, penetrations and protrusions, etc. A highly dimensionally stable membrane minimizes the risk of damage as a result of the above-mentioned movements."*

It is also worth remembering that this unique Smart White colour runs through the material and is an integral part of it, which is of more benefit than subsequently applied treatments.

The SRI (Solar Reflectance Index) value is 102 according to standard ASTM E1980.

SIGNAL LAYER SURFACE COLOUR

The different colour on the membrane's surface also has the advantage of acting as a warning layer, providing visual evidence of any accidental mechanical damage or surface scratching as a result of work carried out once the membrane has been laid.

"MULTI-EXTRUSION COATING" PRODUCTION PROCESS

The MAPEPLAN T B membrane is manufactured in a modern, technologically advanced and environmentally friendly "Multi-extrusion coating" plant.

This production system allows the FPO/TPO synthetic matrix to be applied directly and at the same time to both faces of the carrier in one go, thus ensuring that it is incorporated perfectly in the membrane's structure.

This special process means the MAPEPLAN T B membrane is not prone to delamination problems, instead essentially qualifying as a single-ply membrane that offers good resistance to foreseeable stress (physical, chemical, thermal).

MAPEPLAN T B membranes are not produced using pre-laminated sheets that then have to be bonded together.

MOLECULAR WELDING

The MAPEPLAN T B waterproofing membranes are thermoplastic plastomers, which means they have excellent weldability properties and are actually thermal welded with hot air. This welding method effectively fuses together the molecular chains: the welding of MAPEPLAN T B membrane withstand the pressure of the water and are mechanically strong.

LOOSE-LAID SYSTEM WITH BALLAST

The loose-laid system used for all layers in the roof build-up offers the advantage of being able to absorb movements and expansion - of both the substrate and protective screed - without them affecting the waterproofing membrane, which can slide accordingly.

Consequently, splitting, cracking or any other defects that might occur in the cast concrete substrate or protective screed, if any, cannot damage the waterproofing membrane.

The MAPEPLAN T B system offers the highest performance in terms of "crack bridging".

Loose laying also means waterproofing membrane welding and surfaces can be checked using a "Tracer gas" or "Geoelectric" system: the same type of systems also used to detect leaks as well as to conduct functional testing in service.

This loose-laid system means the waterproofing membrane can even be installed on damp substrates. Indeed, unlike other systems, the roof deck's moisture content has very little bearing on the job's successful outcome.

GREEN CREDENTIALS

Being free from plasticizers and volatile substances and containing no substances that are detrimental or harmful to people or the environment, MAPEPLAN T B is a highly eco-friendly product. The modern and technologically advanced production system has been designed and built to deliver the lowest possible environmental impact.
This low environmental impact is guaranteed during all stages of the membrane life cycle: manufacture, transport, installation, service life, end-of-life disposal. Once the waterproofing membrane reaches the end of its life cycle, it can be removed and recycled/reused to produce new raw material.

EPD - Environmental Product Declaration

MAPEPLAN T B waterproofing membranes come with an EPD (Environmental Product Declaration).
The EPD is defined by standard ISO 14025 as a document containing quantified environmental data for a product with pre-set categories of parameters calculated using the Life Cycle Assessment (LCA) method and hence based on the ISO 14040 series of standards.
The Environmental Product Declarations (EPD) are just another mark of the transparency espoused by POLYGLASS SpA and the MAPEI Group in their dealings with the market to provide information on the environmental performance of their products and services, according to relevant categories of parameters and following internationally standardized guidelines.

Additional information on the environmental impact of MAPEPLAN T B waterproofing membranes:

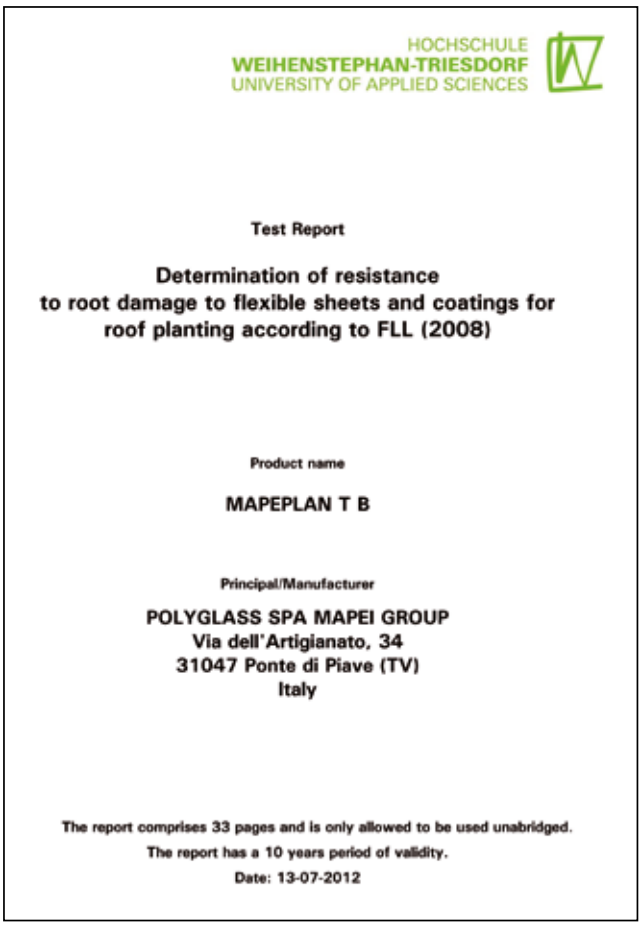
- Production system that uses water in a closed loop, hence waste free.
- Production scrap is reused/recycled.
- The POLYGLASS facility complies with all pollution control parameters, including air quality standards.
- POLYGLASS pursues a policy of total energy efficiency (electricity, heating) regarding the production cycle and all business activities.
- POLYGLASS has a cogeneration plant for rational and environmentally conscious electricity production.

LEED CERTIFICATION

MAPEPLAN T B waterproofing membranes help meet the requirements for earning credits for LEED (Leadership in Energy and Environmental Design) certification.

POLYGLASS is a member of the Green Building Council.

8. Resistance to root penetration - FLL test



HOCHSCHULE
WEIHENSTEPHAN-TRIESDORF
UNIVERSITY OF APPLIED SCIENCES

Test Report

Determination of resistance to root damage to flexible sheets and coatings for roof planting according to FLL (2008)

Product name

MAPEPLAN T B

Principal/Manufacturer

POLYGLASS SPA MAPEI GROUP
Via dell'Artigianato, 34
31047 Ponte di Piave (TV)
Italy

The report comprises 33 pages and is only allowed to be used unabridged.
The report has a 10 years period of validity.
Date: 13-07-2012

FLL stands for Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau, a German research society concerned with landscaping and landscape development.

The FLL test is an internationally recognized test method and a benchmark for determining the resistance to penetration by roots and rhizomes of materials applied on green roofs, especially waterproofing materials, whether synthetic, polymer bitumen or liquid membranes.

The FLL test is conducted using two plant varieties with different root systems.

More specifically, testing also takes into consideration the very aggressive effect of rhizomes by seeding and growing couch grass, which has a reputation as a very invasive species of weed.

The European standard EN 13948 has been drawn up based on the FLL test for determining the root penetration resistance of waterproofing membranes, the only difference being that this standard takes into account only the action of roots and not rhizomes, hence the FLL test is regarded as more thorough.

The FLL test consists in lining eight boxes measuring 80x80x30 cm with the root-resistant membrane to be tested.
The waterproofed boxes are filled with the soil that the vegetation will be grown in, according to specific standardized parameters set out in the rules.

The bottom of the box is transparent, being made from Plexiglas, to allow for visual inspection at six-month intervals (to see whether roots have gone through the membrane).
The test lasts for a total of two years, during which time visual inspections are carried out twice a year.

The root-resistant membrane must be placed inside the boxes according to a specific arrangement and must feature welding, T-joints and 4 corners.
Indeed, it is very important to determine the product's specific resistance to root and rhizome damage, as well as check the strength of welding and more fragile construction details.

Detail of T-joints.

Particularly invasive plant species are used whose roots develop quickly: more specifically, Agropyron repens, commonly known as couch grass (rhizome) and Pyracantha coccinea, commonly known as firethorn (root).
Testing takes place in a greenhouse where conditions encourage good growth.

After two years, the vegetation is thriving and the roots are suitably developed.
During testing, the vegetation that has grown in the boxes waterproofed with the MAPEPLAN T B membrane meets expectations and the requirements of the standard.

After two years, the vegetation is removed along with the soil and the root-resistant waterproofing membrane is cleaned with a water blaster.
The membrane is checked for damage: there must be no signs of piercing or evidence of roots passing through.
In addition to the surface as a whole, the flat and detail welding also checked thoroughly.

After two years lining the growing boxes, the MAPEPLAN T B lining proves perfectly undamaged and features no signs of piercing or deterioration either on the surface or along the main and detail welding.

This is the vegetation taken out of one of the boxes lined with the MAPEPLAN T B waterproofing membrane.

You can see how the root system is well developed, confirming the fact that the MAPEPLAN T B waterproofing membrane is absolutely inert as far as roots are concerned and does not inhibit their growth.

The test carried out according to the FLL method takes into account the action of roots and rhizomes.

The test carried out according to standard EN 13948 takes into account only the action of roots.

The MAPEPLAN T B membrane is fully resistant to penetration by roots and rhizomes, meets the stricter FLL test requirements and is in compliance with the harmonized standard EN 13948.

Forschungsgesellschaft Landschaftsentwicklung Landschaftsbau e. V.

Test conducted c/o:

Institut für Gartenbau Forshungsanstalt für Gartenbau Hochschule Weihenstephan-Triesdorf D-85354 Freising (Germany).

Test start July 2010 - end July 2012.

9. System accessories:

The waterproofing system of a green roof does not consist of just the waterproofing membrane. All the complementary layers and finishing and junction accessories also play a key role in producing a functional, long-lasting roof.
The MAPEPLAN T B system's accessories and complementary products are outlined below. For more detailed information, please refer to the specific technical data sheets.

PREFABRICATED MAPEPLAN T ACCESSORIES

MAPEPLAN T system accessories include: laminated sheet metal, inside and outside corners, outlets, connections, flashings and other special prefabricated parts.

MAPEPLAN T SEAM PREP

MAPEPLAN T SEAM PREP is an organic-solvent-based liquid cleaner specially formulated for preparing overlaps prior to welding of MAPEPLAN T FPO/TPO waterproofing membranes, to be used to boost the membrane's weldability properties.

MAPEPLAN ADS 300 - MAPEPLAN ADS 310

MAPEPLAN ADS 300 is a policloroprenic monocomponent solvent adhesive for double coating (contact adhesive), designed to bond MAPEPLAN T B membrane on vertical surfaces.

MAPEPLAN ADS 310 is one component solvent adhesive for double coating (contact adhesive), to bond FPO/TPO synthetic waterproofing membranes MAPEPLAN T, supplied in pressurized canister for spray application.

MAPEPLAN METALBAR - MAPEPLAN T CORD

MAPEPLAN METALBAR is a metal fixing profile in galvanized carbon steel, prepunched, with oval perforations, to be used around the perimeter of the waterproofing membrane to anchor the sheet.

Anti-tear cord MAPEPLAN T CORD is applied adjacent to the slotted profiles to complete the fastening of the perimeter.

POLYDREN PP

POLYDREN PP is a 100% polypropylene woven-non-woven geotextile, needle punched and thermocalandered.

POLYDREN PP has been manufactured to meet standards EN 13249; EN 13254; EN 13250; EN 13255; EN 13251; EN13256; EN 13252; EN 13257; EN 13253; EN 13265.

It is used as a levelling, protection and filter layer in green roof construction.

MAPEPLAN PE micro-perforated

MAPEPLAN PE micro-perforated is an anti-soaking layer made from low-density polyethylene LDPE of transparent colour, with a nominal thickness of 0.10 mm and having a micro-perforation, which makes it permeable to vapour.

When producing build-up systems for warm, cold and inverted roofs, it is laid before the protective concrete screed is poured.

The micro-perforation means inspection and testing can be carried out with the "Tracer gas" and "Geoloectric" system.

POLYSTUOIA 20 - POLYSTUOIA 20 L

POLYSTUOIA 20 and POLYSTUOIA 20L are protective and drainage geocomposites comprising two UV-stabilized, needle-punched polypropylene staple-fibre filter geotextiles with a 3-dimensional drainage structure sandwiched between them made up of polypropylene monofilaments. The two geotextiles are heat bonded to the drainage core using a continuous process.

Meet the requirements of standard EN 13252.

IDROPRIMER

IDROPRIMER is a water-based bituminous primer made with select bitumen used as an adhesion promoter and dust-repellent primer before laying prefabricated bitumen membranes, in this case used as a vapour barrier.

It has the major advantage of not being flammable and being odourless.

POLYVAP SA

POLYVAP SA is a prefabricated double-sided self-adhesive bitumen membrane produced using ADESO technology, made up of a special self-adhesive elastomeric compound (SBS) reinforced with an aluminium foil.
For use as a vapour barrier, it meets the requirements of standard EN 13970.
Its use is recommended in all cases where application does not involve torching.

POLYVAP RADONSHIELD

POLYVAP RADONSHIELD is a prefabricated waterproofing elastomeric-plastomeric membrane, with a distilled bitumen-based compound modified with polypropylene, reinforced with a 6/100 thickness aluminium strip bonded to reinforced glass fibre.
For use as a vapour barrier and as a provisional waterproofing measure to stop water getting in temporarily, it meets the requirements of standard EN 13970.

PLANA P

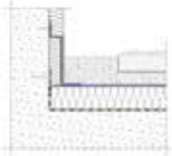
PLANA P is a prefabricated waterproofing elastomeric-plastomeric membrane, with a distilled bitumen-based compound modified with polypropylene and staple non-woven polyester fabric reinforcement.
For use as a vapour barrier and as a provisional waterproofing measure to stop water getting in temporarily, it meets the requirements of standard EN 13970 and EN 13707.

MAPEPLAN T B

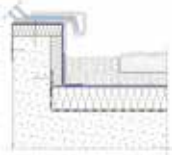
10. Technical drawings

ROOF PARAPET

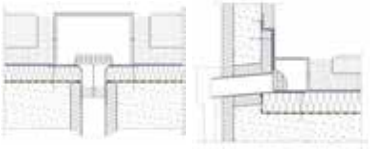
WALL CONNECTION



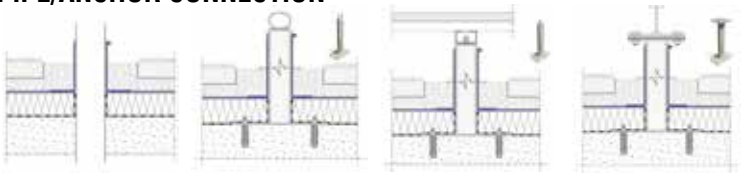
SKYLIGHT CONNECTION



ROOF DRAIN



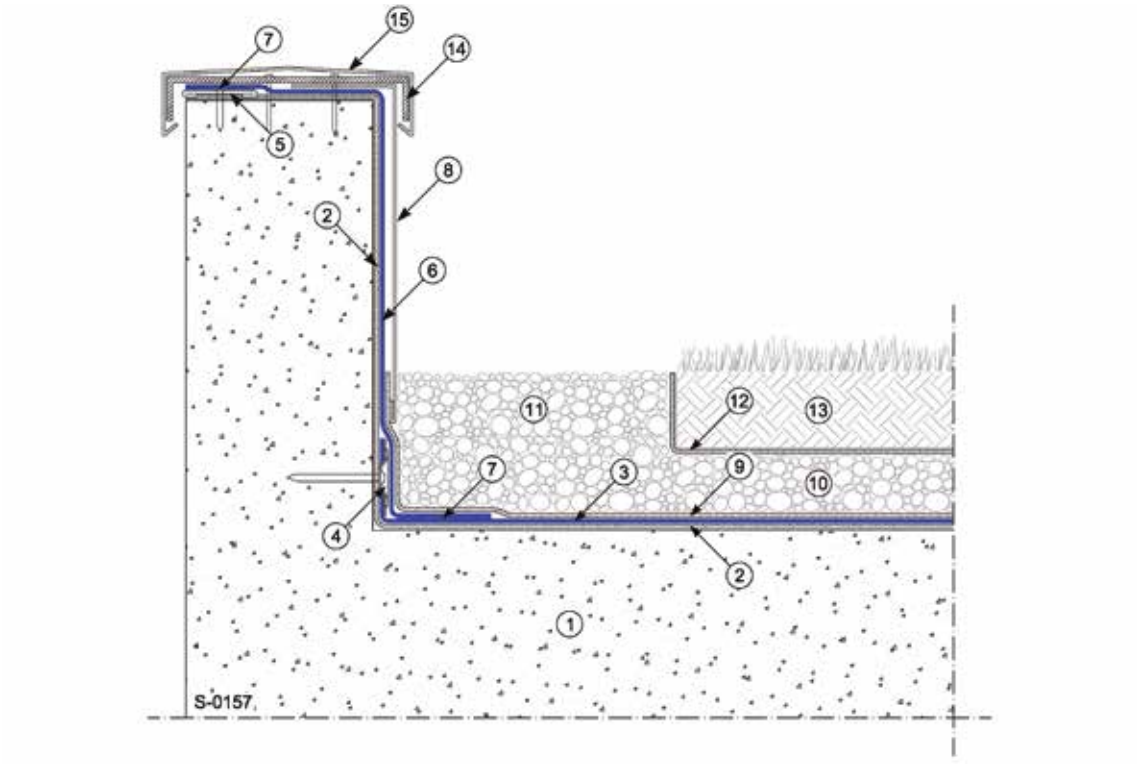
PIPE/ANCHOR CONNECTION



EXPANSION JOINT

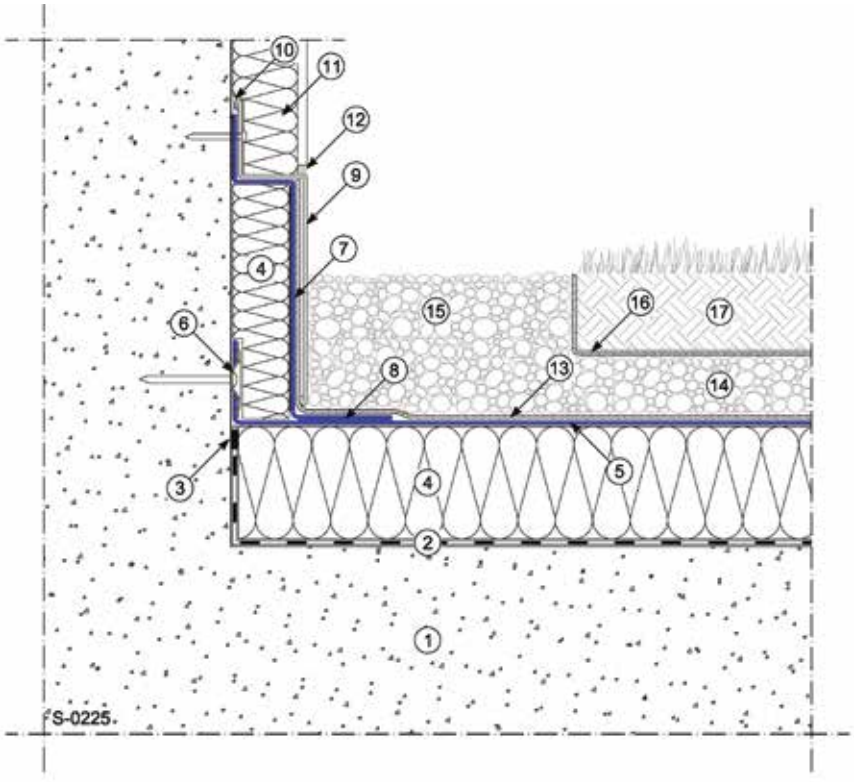
GREEN ROOF/WALKABLE ROOF CONNECTION

Detail S-0157 - Roof parapet



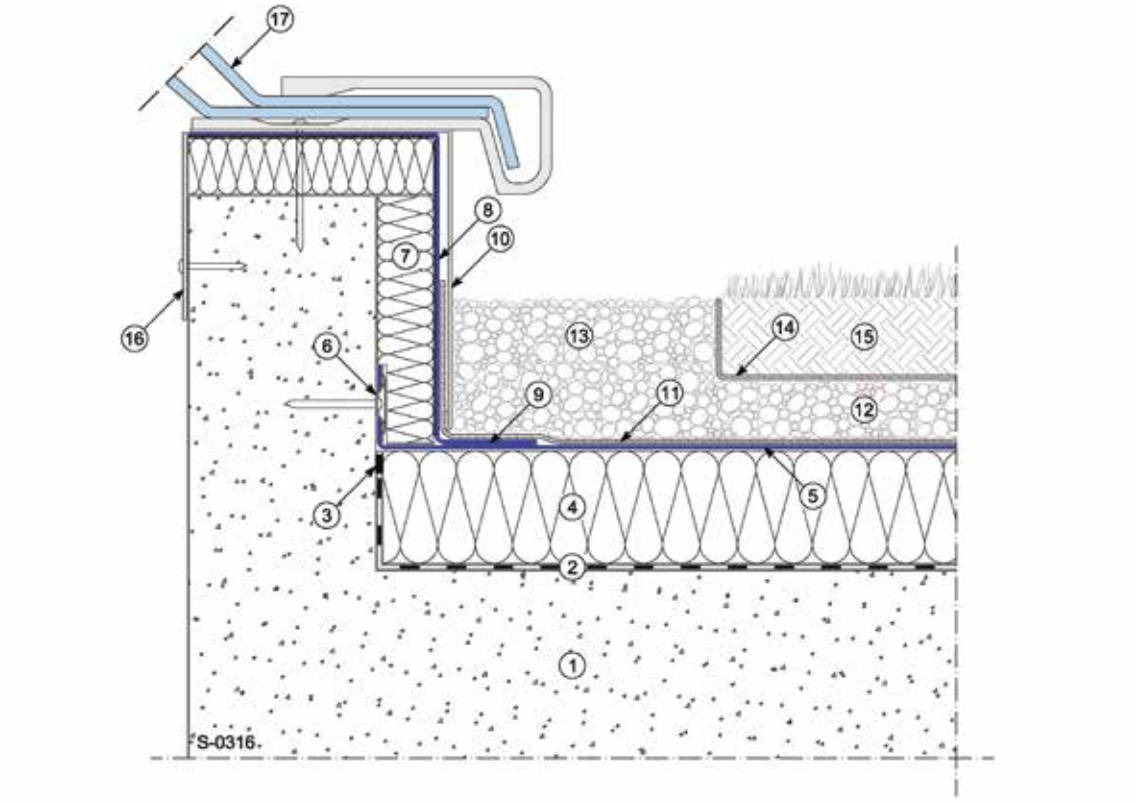
1. Structure
2. Levelling layer **POLYDREN PP**
3. Waterproofing membrane **MAPEPLAN T B**
4. Perimeter mechanical fixing with plates
5. Strip profile **MAPEPLAN T**
6. Fixed membrane **MAPEPLAN T**
7. Welding
8. Protective metal flashing
9. Protection layer **POLYDREN PP**
10. Drainage or drainage/water storage layer
11. Perimeter ballast
12. Filter layer **POLYDREN PP**
13. Growing substrate
14. Anchor bracket
15. Finishing flashing

Detail S-0225 - Wall connection



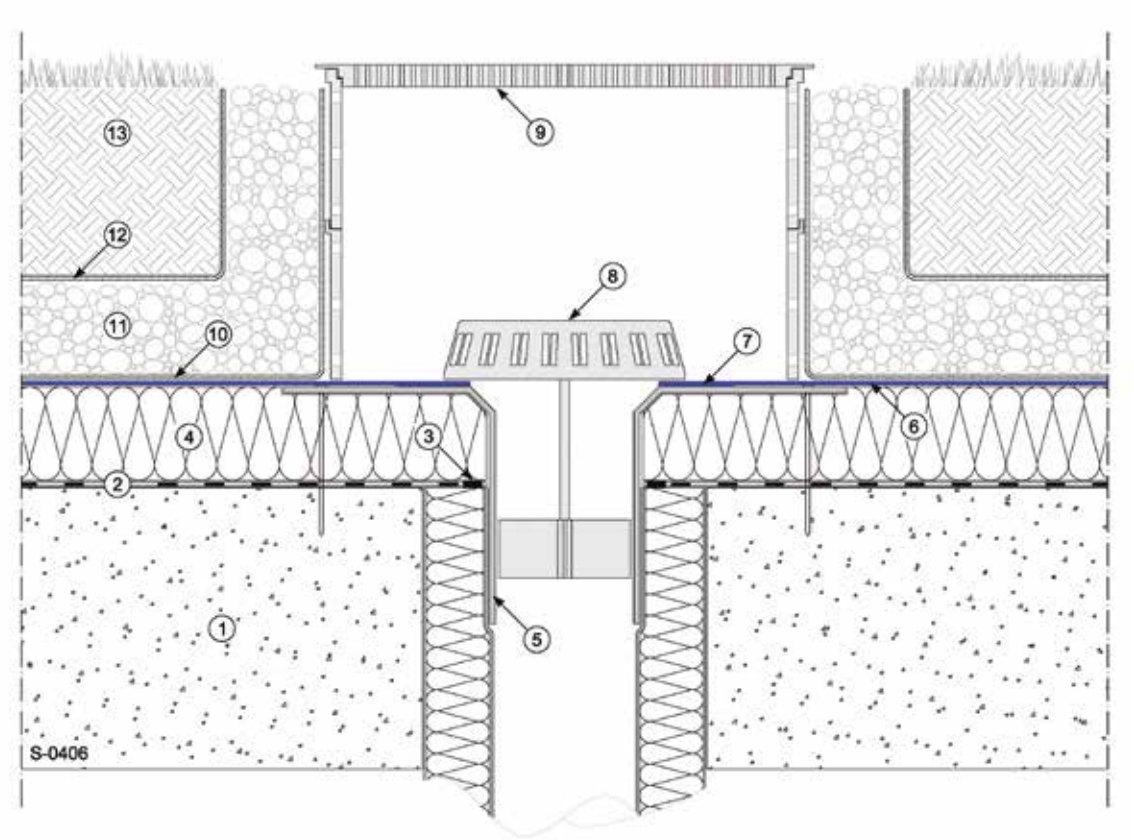
1. Structure
2. Vapour barrier sealed on overlaps and on perimeters (e.g. **IDROPRIMER** + **POLYVAP**)
3. Perimeter sealing (e.g. adhesive tape)
4. Thermal insulation layer
5. Waterproofing membrane **MAPEPLAN T B**
6. Perimeter mechanical fixing with plates
7. Fully adhered membrane **MAPEPLAN T**
8. Welding
9. Metal flashing
10. Sealing with **MAPEPLAN SEALANT KIT**
11. Façade insulation panel
12. Elastic sealing
13. Protection layer **POLYDREN PP**
14. Drainage or drainage/water storage layer
15. Perimeter ballast
16. Filter layer **POLYDREN PP**
17. Growing substrate

Detail S-0316 - Skylight connection



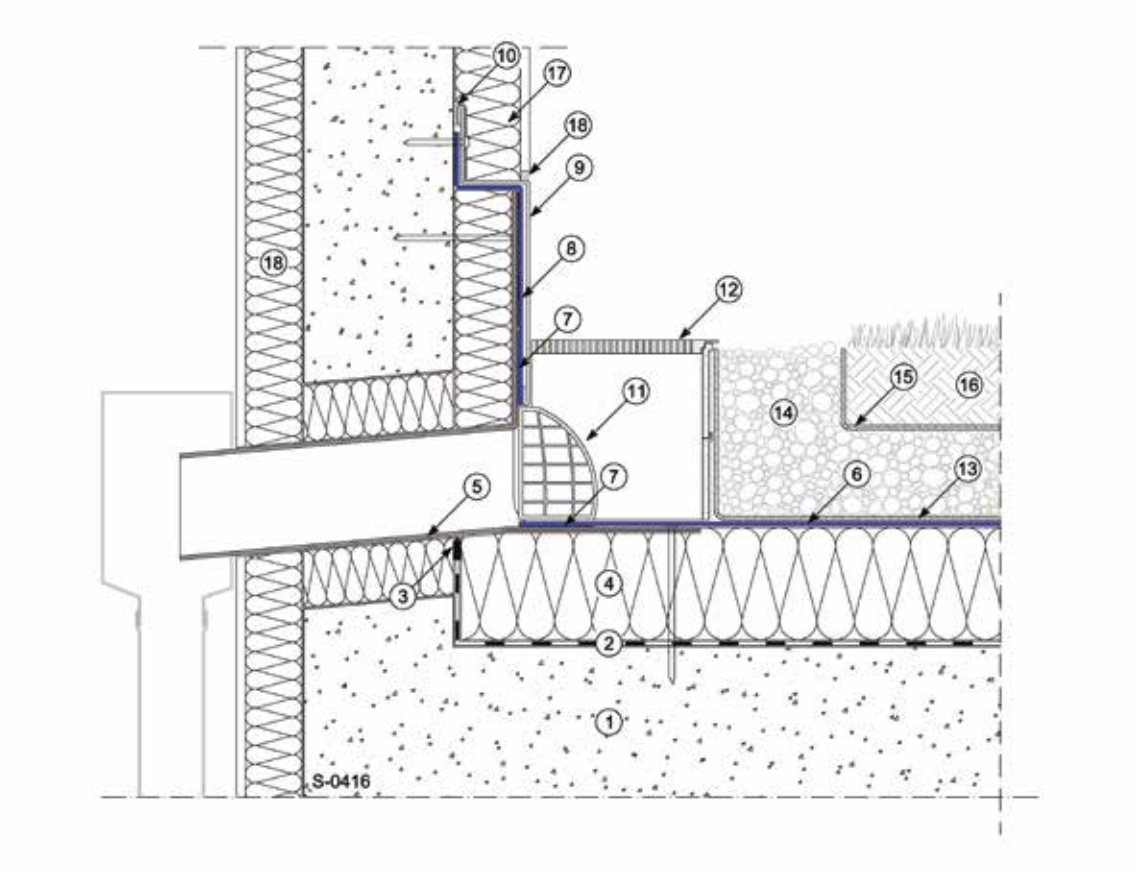
1. Structure
2. Vapour barrier sealed on overlaps and on perimeters (e.g. **IDROPRIMER** + **POLYVAP**)
3. Perimeter sealing (e.g. adhesive tape)
4. Thermal insulation layer
5. Waterproofing membrane **MAPEPLAN T B**
6. Perimeter mechanical fixing with plates
7. Thermal insulation
8. Fully adhered membrane **MAPEPLAN T**
9. Welding
10. Metal flashing
11. Protection layer **POLYDREN PP**
12. Drainage or drainage/water storage layer
13. Perimeter ballast
14. Filter layer **POLYDREN PP**
15. Growing substrate
16. Closing and/or finishing profile
17. Skylight

Detail S-0406 - Roof drain



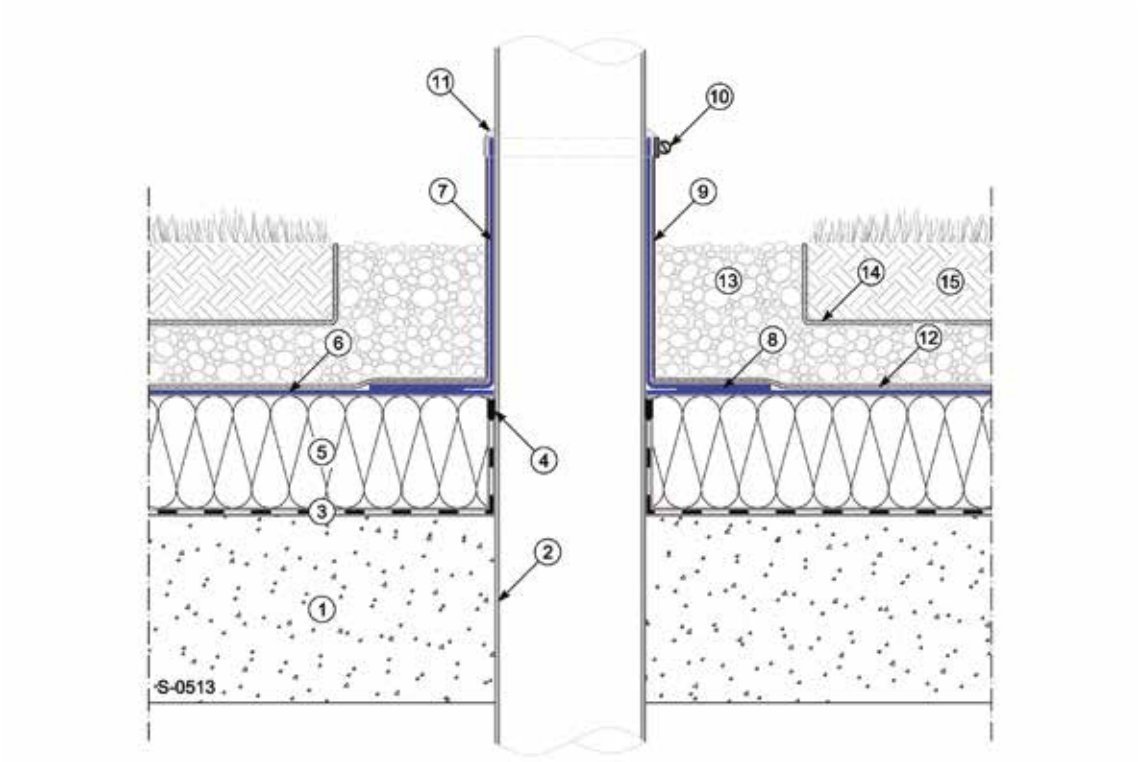
1. Structure
2. Vapour barrier sealed on overlaps and on perimeters (e.g. **IDROPRIMER** + **POLYVAP**)
3. Perimeter sealing (e.g. adhesive tape)
4. Thermal insulation layer
5. Outlet
6. Waterproofing membrane **MAPEPLAN T B**
7. Welding
8. Gravel guard
9. Drain chamber
10. Protection layer **POLYDREN PP**
11. Drainage or drainage/water storage layer
12. Filter layer **POLYDREN PP**
13. Growing substrate

Detail S-0416 - Roof drain



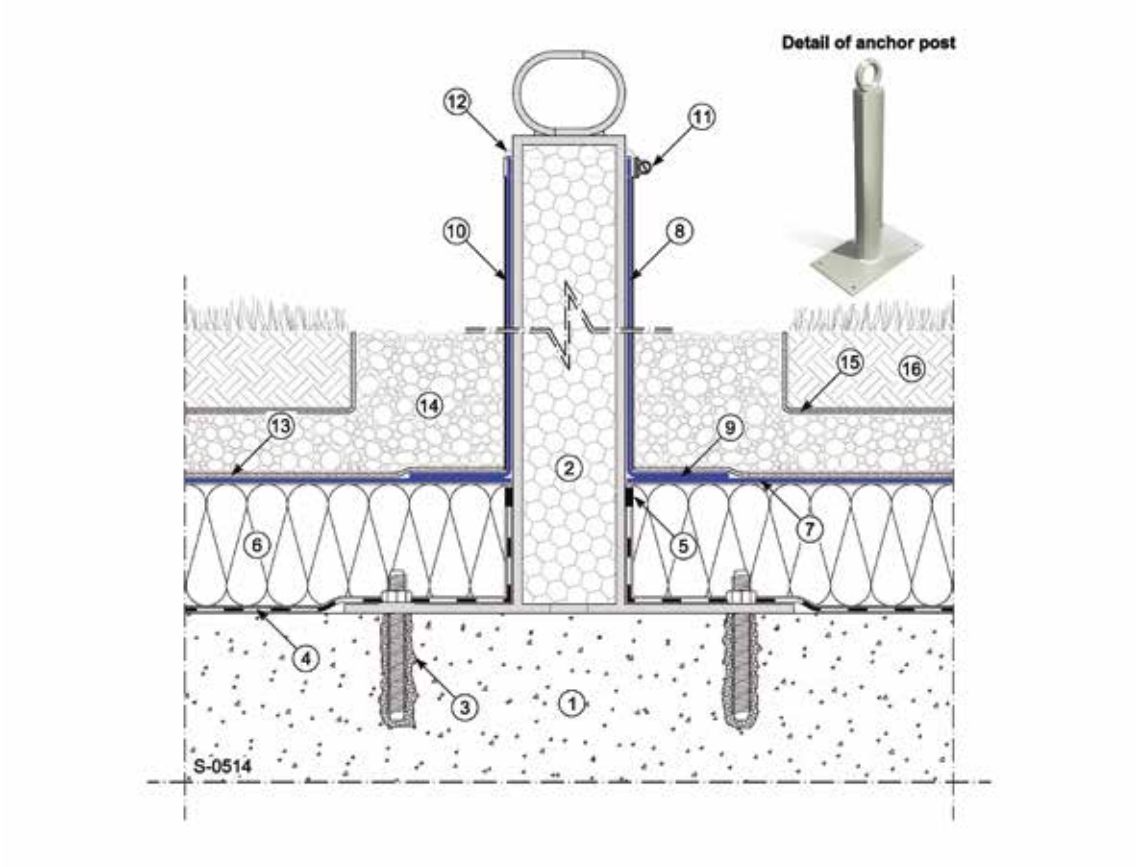
1. Structure
2. Vapour barrier sealed on overlaps and on perimeters (e.g. **IDROPRIMER** + **POLYVAP**)
3. Perimeter sealing (e.g. adhesive tape)
4. Thermal insulation layer
5. Outlet **MAPEPLAN T**
6. Waterproofing membrane **MAPEPLAN T B**
7. Welding
8. Fully adhered membrane **MAPEPLAN T**
9. **MAPEPLAN T** metal sheet
10. Sealing with **MAPEPLAN SEALANT KIT**
11. Gravel guard
12. Drain chamber
13. Protection layer **POLYDREN PP**
14. Drainage or drainage/water storage layer
15. Filter layer **POLYDREN PP**
16. Growing substrate
17. Facade insulation panel
18. Elastic sealing

Detail S-0513 - Pipe penetration



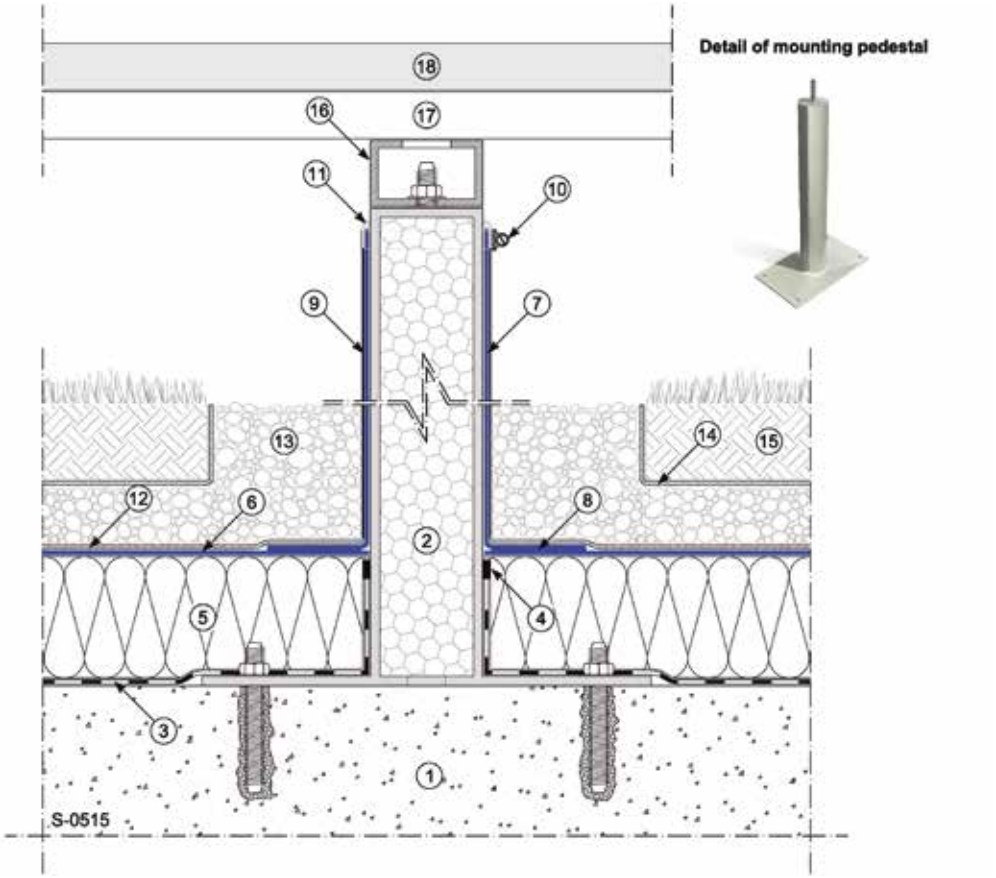
1. Structure
2. Pipe
3. Vapour barrier sealed on overlaps and on perimeters (e.g. **IDROPRIMER** + **POLYVAP**)
4. Perimeter sealing (e.g. adhesive tape)
5. Thermal insulation layer
6. Waterproofing membrane **MAPEPLAN T B**
7. **MAPEPLAN T** collar
8. Welding
9. Protective metal flashing
10. Worm gear clamp
11. Sealing with **MAPEPLAN SEALANT KIT**
12. Protection layer **POLYDREN PP**
13. Drainage or drainage/water storage layer
14. Filter layer **POLYDREN PP**
15. Growing substrate

Detail S-0514 - Fall arrest anchor fastening



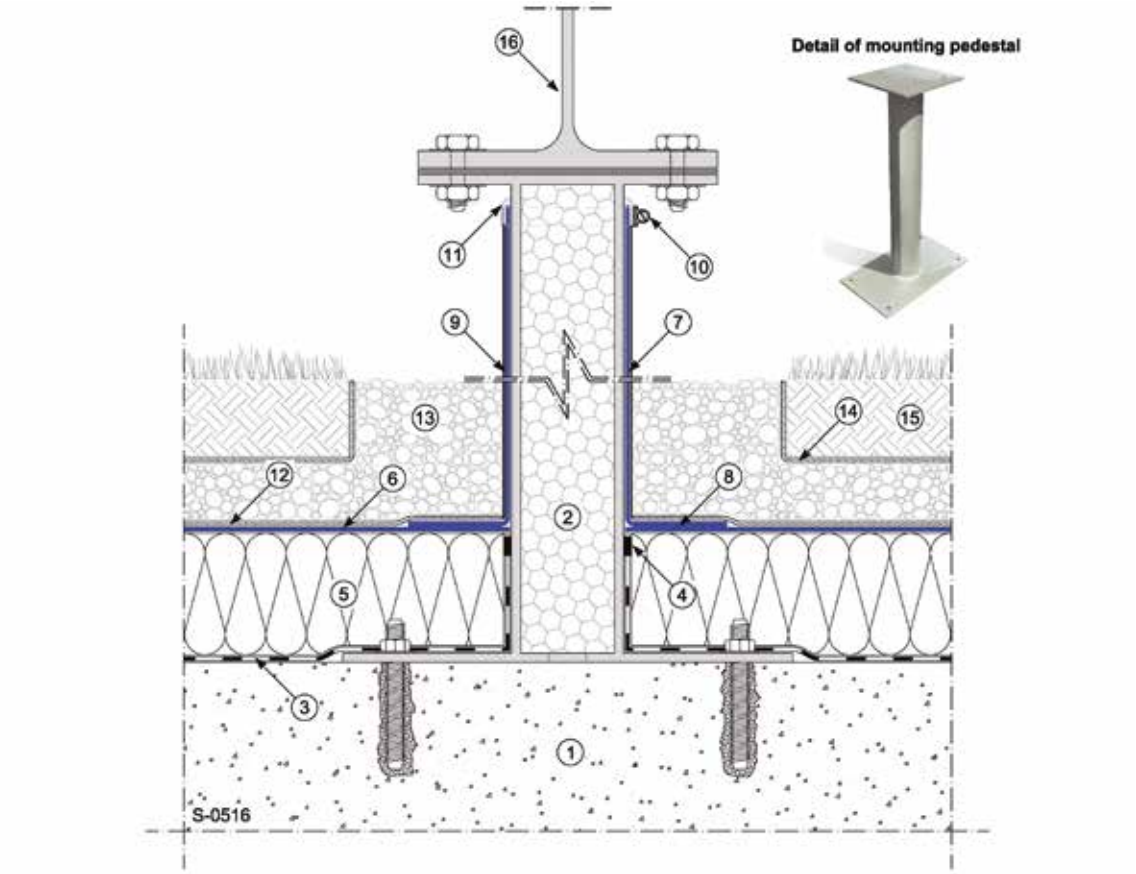
1. Structure
2. Fall arrest anchor post
3. Fall arrest anchor fastening
4. Vapour barrier sealed on overlaps and on perimeters (e.g. **IDROPRIMER** + **POLYVAP**)
5. Perimeter sealing (e.g. adhesive tape)
6. Thermal insulation layer
7. Waterproofing membrane **MAPEPLAN T B**
8. **MAPEPLAN T** collar
9. Welding
10. Protective element
11. Worm gear clamp
12. Sealing with **MAPEPLAN SEALANT KIT**
13. Protection layer **POLYDREN PP**
14. Drainage or drainage/water storage layer
15. Filter layer **POLYDREN PP**
16. Growing substrate

Detail S-0515 - Photovoltaic panel fastening



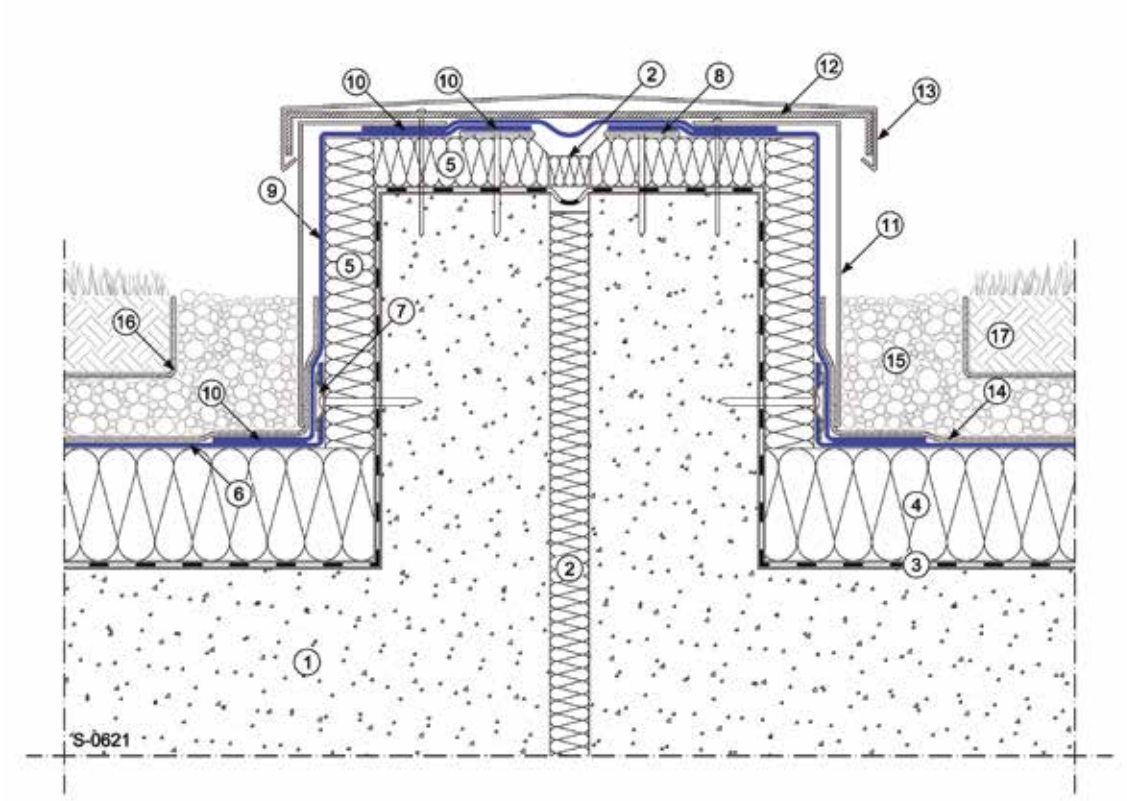
1. Structure
2. Mounting pedestal
3. Vapour barrier sealed on overlaps and on perimeters (e.g. **IDROPRIMER** + **POLYVAP**)
4. Perimeter sealing (e.g. adhesive tape)
5. Thermal insulation layer
6. Waterproofing membrane **MAPEPLAN T B**
7. **MAPEPLAN T** collar
8. Welding
9. Protective element
10. Worm gear clamp
11. Sealing with **MAPEPLAN SEALANT KIT**
12. Protection layer **POLYDREN PP**
13. Drainage or drainage/water storage layer
14. Filter layer **POLYDREN PP**
15. Growing substrate
16. Load-bearing tubular attachment
17. Photovoltaic module mounting profile
18. Photovoltaic module

Detail S-0516 - Services fastening



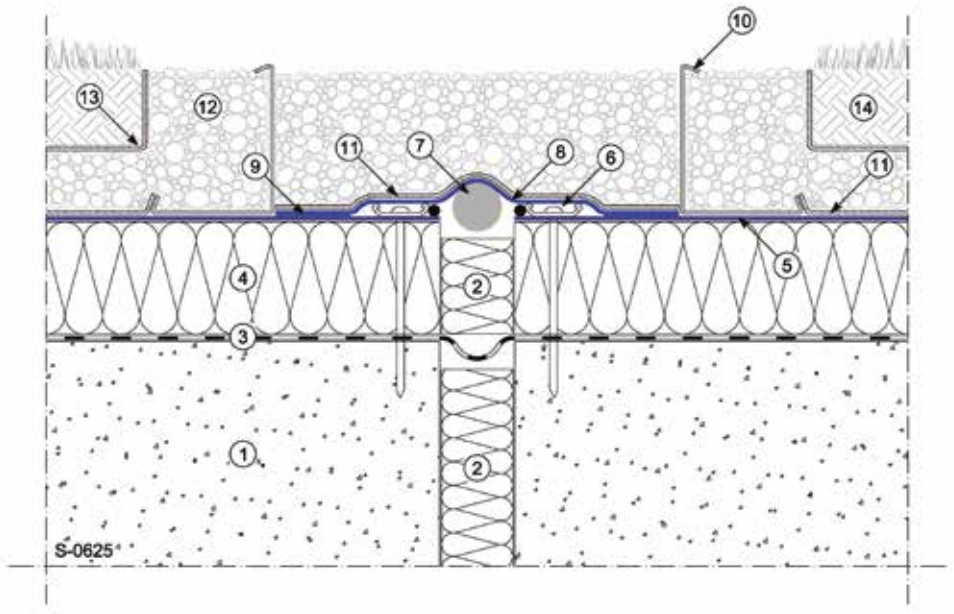
1. Structure
2. Mounting pedestal
3. Vapour barrier sealed on overlaps and on perimeters (e.g. **IDROPRIMER** + **POLYVAP**)
4. Perimeter sealing (e.g. adhesive tape)
5. Thermal insulation layer
6. Waterproofing membrane **MAPEPLAN T B**
7. **MAPEPLAN T** collar
8. Welding
9. Protective element
10. Worm gear clamp
11. Sealing with **MAPEPLAN SEALANT KIT**
12. Protection layer **POLYDREN PP**
13. Drainage or drainage/water storage layer
14. Filter layer **POLYDREN PP**
15. Growing substrate
16. Services mounting profile

Detail S-0621 - Expansion joint



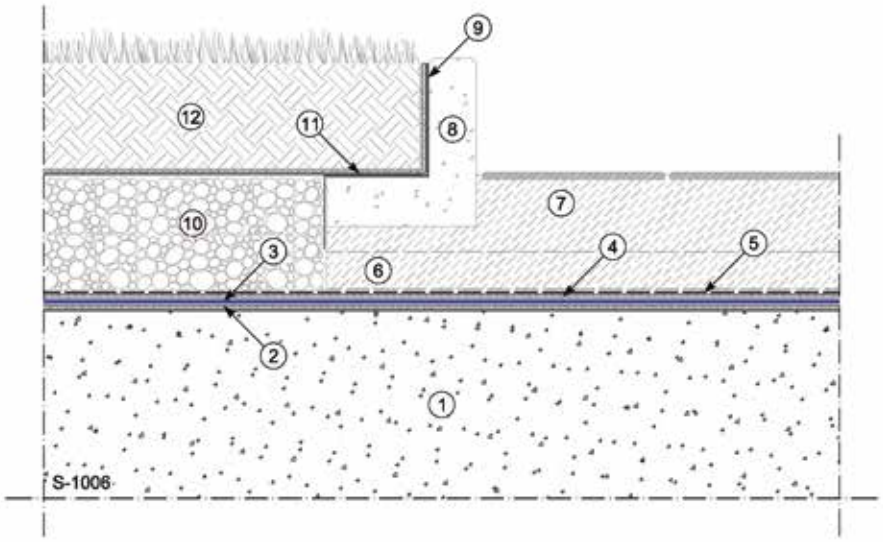
1. Structure
2. Compressible insulation
3. Vapour barrier sealed on overlaps and on perimeters (e.g. **IDROPRIMER** + **POLYVAP**)
4. Thermal insulation layer
5. Fully adhered or fastened thermal insulation
6. Waterproofing membrane **MAPEPLAN T B**
7. Perimeter mechanical fixing with plates
8. Strip profile **MAPEPLAN T**
9. Fixed membrane **MAPEPLAN T**
10. Welding
11. Protective metal flashing
12. Anchor bracket fixed on one side only
13. Finishing metal flashing
14. Protection layer **POLYDREN PP**
15. Drainage or drainage/water storage layer
16. Filter layer **POLYDREN PP**
17. Growing substrate

Detail S-0625 - Expansion joint



1. Structure
2. Compressible insulation
3. Vapour barrier sealed on overlaps and on perimeter (e.g. **IDROPRIMER** + **POLYVAP**)
4. Thermal insulation layer
5. Waterproofing membrane **MAPEPLAN T B**
6. Mechanical fixing **MAPEPLAN METALBAR** + **MAPEPLAN T CORD**
7. Expanded Polyethylene backer rod
8. Strip of **MAPEPLAN T B** membrane
9. Welding
10. **MAPEPLAN GRAVEL PROFILE**
11. Protection layer **POLYDREN PP**
12. Drainage layer
13. Filter layer **POLYDREN PP**
14. Growing substrate

Detail S-1006 - Green roof/walkable roof connection



1. Structure
2. Levelling layer **POLYDREN PP**
3. Waterproofing membrane **MAPEPLAN T B**
4. Protection layer **POLYDREN PP**
5. Separation and anti-imbibition layer **MAPEPLAN PE micro-perforated**
6. Drain pipe/channel (if required)
7. Concrete screed and paving
8. Kerb
9. Waterproofing treatment
10. Drainage or drainage/water storage layer
11. Filter layer **POLYDREN PP**
12. Growing substrate

RELATED TECHNICAL DOCUMENTS

The technical literature mentioned below can be accessed via the website www.polyglass.com

Technical book ROOFING SYSTEM MAPEPLAN T FPO/TPO

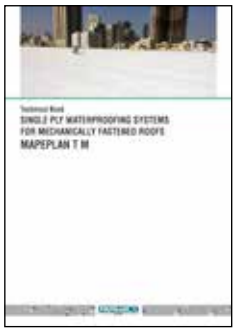
This document contains technical information of roofing system doable with MAPEPLAN T waterproofing membranes.

Use, inspection and maintenance SYNTHETIC WATERPROOFING MEMBRANES MAPEPLAN T FPO/TPO

This document contains more in-depth technical information on the use, inspection and maintenance of MAPEPLAN T waterproofing membranes.

MAPEPLAN T FPO/TPO installation manual

This document contains correct, detailed instructions on installing and laying MAPEPLAN T waterproofing membranes.



Technical book SINGLE PLY WATERPROOFING SYSTEMS FOR MECHANICALLY FASTENED ROOFS MAPEPLAN T M

This document provides technical, design and construction information and solutions for the correct installation of single ply waterproofing systems for mechanically fastened roofs, with the use of MAPEPLAN T M flexible polyolefin (FPO/TPO) synthetic waterproofing membranes.

Standard roofing details ROOFING AND WATERPROOFING SYNTHETIC MEMBRANES MAPEPLAN T FPO/TPO

This document contains the collection of some standard roofing details that can be realized with MAPEPLAN T waterproofing membranes.

Standard roofing systems ROOFING AND WATERPROOFING SYNTHETIC MEMBRANES MAPEPLAN T FPO/TPO

This document contains the collection of some standard roofing systems that can be realized with MAPEPLAN T waterproofing membranes.

NOTES

Technical Book
WATERPROOFING SYSTEMS FOR GREEN ROOFS
MAPEPLAN T B

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