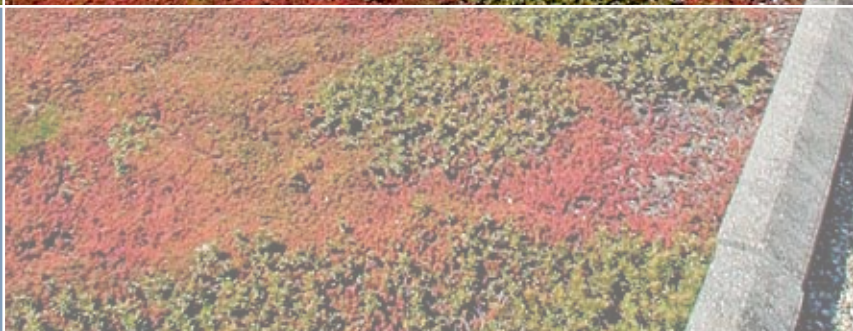
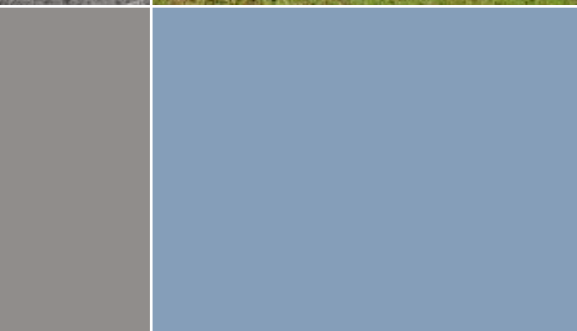
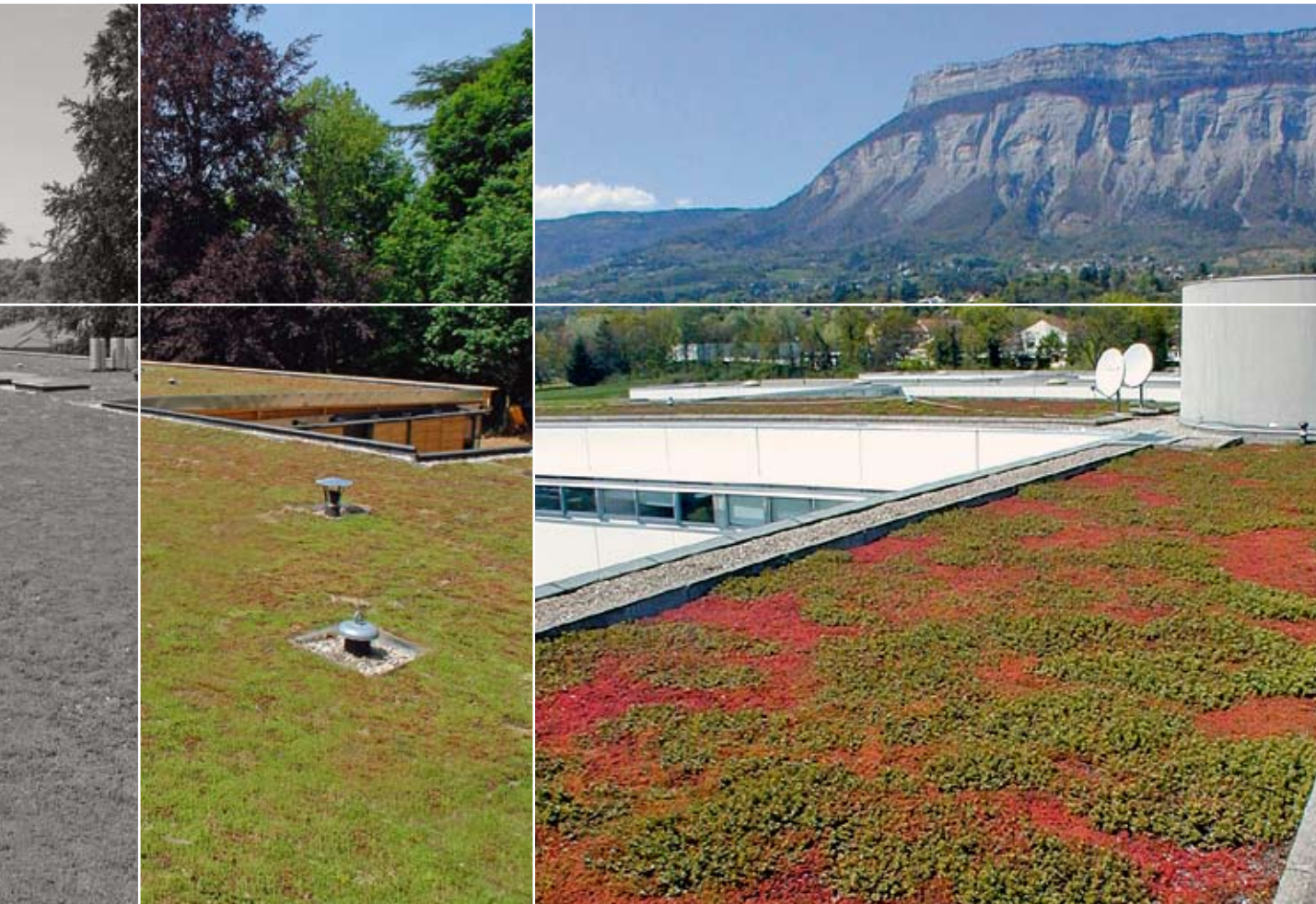


Roof garden & planted areas

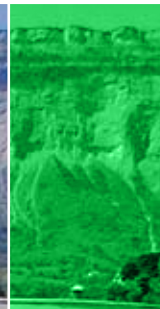
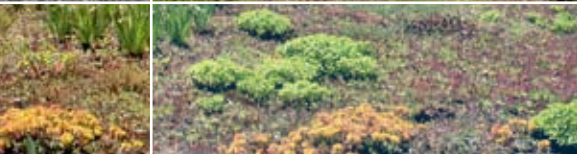


Intensive green roof/Extensive green roof

Main area and upstand descriptions



Waterproofing systems
for roof gardens
Intensive & Extensive green roofs



Roof garden & planted areas

Intensive green roof/Extensive green roof

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Attention : the information herein is a general guideline, but does not take into account restrictions or special instructions related to the bearing element, to certain insulations, to the geographical location, to the structural configuration, etc.

This information does not relieve the professionals from obtaining full knowledge of the reference documents (prevailing Local Technical Standards, Technical Assessments, Installation Specifications, etc.) This entails consulting them in their integral textual form.

Again this document is only a guide; Siplast-Icopal reserves the right to modify the composition and the installation instructions of its products, depending upon the evolution of knowledge and technology.

Main systems

Waterproofing systems			
For roof garden & large planted areas : Slope and bearing substrates	Type of green roof	Waterproofing system If thermal insulation, class C (compressibility according to UEAtc directive) is compulsory	
0 to 5% on concrete substrate	Intensive green roof	Preflex + Graviflex fully bonded, or loose-laid on insulation boards with torched overlaps	
3 to 20% on various substrates : concrete, steeldeck, wooden board	Extensive green roof	Preflex + Graviflex fully bonded, or loose-laid with torched overlaps if slope < 5%	
For planters	Intensive green roof	Parastar Green 64 fully bonded	
Intensive System			
Roof garden system	Mode of installation	Appearance	Maximum load**
Basic intensive green system with mini 30 cm thick soil, Gravifiltre filter geotextile, Draina G10 drainage board laid over Preflex + Graviflex elastomeric bitumen waterproof 2-layer system	Plantation on site	Large choice of landscaping: lawn, shrubs and trees	On masonry ≥ 600daN/m ²
Extensive System with modular green roof packs ("Hydropack" type)			
Roof garden system	Mode of installation	Appearance	Maximum load*
Basic system with pre-grown modular green roof pack ("Hydropack" type), all-in-one product with water retention system directly laid over Preflex+ Graviflex elastomeric bitumen waterproofing 2 layer system.	Pre-grown	Uniform	
"Varied appearance" variant: same as basic system with additional perennials.	Pre-grown and plantation on site	Varied	On masonry 120daN/m ²
"Mixed appearance" variant: same as basic system with additional perennials and grasses	Pre-grown, plantation and seeded	Mixed	On steeldeck 130daN/m ²
Extensive System with pre-grown vegetation (green blanket or plug plants or cuttings)			
Roof garden system	Mode of installation	Appearance	Maximum load*
Basic system with pre-grown vegetation blankets (Gravi-Tapis type or similar) on Gravidrain drainage board+ Gravifiltre filter geotextile + Graviflor substrate soil. The system described above is laid on Preflex-Graviflex elastomeric bitumen waterproofing 2 layer system.	Pre-grown	Uniform	
"Varied appearance" variant: same basic system with pre-grown sedum cuttings or plug plants ("Gravi-Motte" type or similar) as replacement for vegetation blankets	Plantation on site	Varied	On masonry 130daN/m ² ,
"Mixed appearance" variant: same basic system with sedum cuttings ("Gravi-Motte Sedum" type) and perennials ("Gravi-Motte Vivace" type) as replacement for vegetation blankets	Pregrown, plantation and seeded	Mixed	On steeldeck 140 daN/m

* Maximum load, including water retention, is the maximum load including retained water taken into consideration for structural calculations. These values are indicative and assume 100mm thermal insulation.

Roof garden & planted areas

Intensive green roof/Extensive green roof

1. Information about Green Roof Systems

Intensive green roof

For landscape development, the choices are vast and leave full liberty to the creator who will be defining the works within a specific green space project. This type of roof garden (or planted area) is called "intensive" because of the intensive maintenance to expect when planning this type of roof.



Extensive green roof

Green roof system with low maintenance and no irrigation required in Northern European regions.

In Southern regions, automated watering network is required.

Usually specified for lightweight and relatively shallow inaccessible roofs, it is suitable for all types of bearing structures (masonry, steel, timber) with slope up to 20%.

These systems also include a selection of hardy plant species, allowing for optimised low-intensity maintenance. In many temperate areas, these plant systems induce cost savings in terms of watering (by keeping down irrigation water consumption and obviating the need to set up a plant watering network). Since the first extensive green roof projects dating back to the 1990s, they have been recognised as a solution of great interest in the environmental quality approach.



A number of special features need to be taken into account. Among these are exposure, roof pitch, appearance, load per unit area, capital expenditure budget, maintenance budget etc. Taking into account these considerations is part of the process to select the most appropriate technical solution.

Therefore it is advised to contact a professional in roof gardens who will make his experience and assistance available to decision-makers in the construction process (building owners, architects and contractors).

Soil thickness and weight

The type of plantation is selected according to the soil thickness available. See the chart hereunder.

To take into account that the weight of the soil for plantation is approx. 2,100 kg/m².




Thickness according to type of plantation & soil	Grass, bushes	Perennial flowers, rose bush	Shrub	Trees	Big trees
If drainage with Gravidrain polystyrene board, thickness minimum (m)	0.035	0.035	0.035	0.035	0.035
If drainage with gravels, thickness minimum (m)	0.10	0.10	0.10	0.15	0.30
Soil, thickness minimum (m)	0.30	0.40	0.40	0.60	1.00

2. Choosing appearance of roof garden

For intensive green areas: the choice of landscaping is vast and leave full liberty to the creator: lawn, shrubs and trees. The soil thickness needs to comply with the type of plantation.

For extensive green roofs: there are mainly 3 approaches to select the appearance of a roof garden according to the type of selected plant varieties and the different systems of pre-grown vegetation available on site such as: pre-grown modular green roof pack

(“Hydropack” type or similar); or vegetation blankets (“Gravi-Tapis” type or similar); or seedlings in miniature turf squares (“Gravi-Motte Sedum”, “Gravi-Motte Perennial” types or similar); or segregated seeding elements (“Gravi-Fragment” type or similar).

Uniform appearance	Varied appearance	Mixed appearance
Homogeneous distribution of plant varieties	Concentrations of different varieties distributed over entire roof garden area	Additional grasses and bulbs rising higher than the base vegetation
		

Additional information on roof appearance

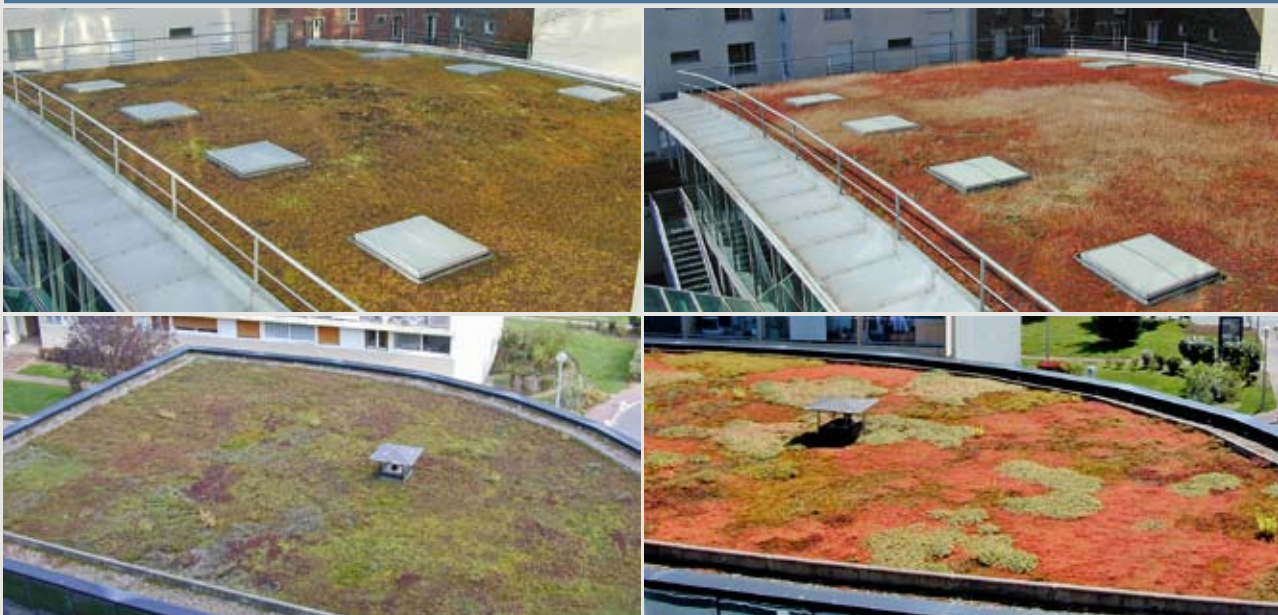
In the basic system, the plants selected are evergreen or deciduous sedums that naturally regenerate on site. The growth

of non-invasive weeds (such as dandelions, wild pansies, low growing grasses) can be beneficially promoted on the roof garden (in which case its growth tends to the creation of an ecosystem). In this

case the roof garden appearance will be perpetually changing, making it unnecessary to lay out the plantation to a precise plant distribution pattern*

*except in the case of specific projects where suitable maintenance procedures have been provided for.

Changing appearance over time: winter/summer



Illustrative but non-contractually binding photos. These illustrative photographs are not contractually binding. This is because due to the natural environment, to growing conditions and to the configuration of the roof, changes of the appearance in the roof garden must be expected.

Roof garden & planted areas

Intensive green roof/Extensive green roof

3. Choosing the way of installation

The methods available for putting out vegetation in roof locations involve the use of:

- ▶ Pre-grown elements such as :pre-grown modular green roof pack ("Hydropack" type or similar) or vegetation blankets ("Gravi-Tapis" type or similar).
- ▶ Seedlings in miniature turf squares ("Gravi-Motte Sedum", "Gravi-Motte Perennial" types or similar).
- ▶ Segregated seeding elements ("Gravi-Fragment" type or similar).

Important!

The choice of type of roof plantation has a direct influence on:

- ▶ Site scheduling.
- ▶ Appearance at time of the delivery and acceptance of the plant materials;
- ▶ Time required to achieve full plant coverage.
- ▶ Initial maintenance (see table below).



Pack System (with gravity-fed water retention): 3 steps

Photos shown hereunder are with "Hydropack" green roof pack distributed by Siplast In France.



Delivery and assembly



Set up



Appearance on acceptance

Appearance on acceptance on site: other systems

Pre-grown system with vegetation blankets ("Gravi-Tapis" type)



On delivery, joints between elements in the vegetation carpet are visible, but become less so as plant materials grow with time.

Plantation systems with plug plants ("Gravi-Motte" type)



The soil medium supporting plant growth is broadly visible, and the individual seedlings are clearly visible, because dense plant coverage is not fully grown at this time.

Seeding systems with sedum cuttings ("Gravi-Fragment" type)



The soil medium supporting plant growth virtually bare of visible plant material on delivery. The plants must first take root, followed by leaf development in a second phase.

4. Maintenance

The maintenance for roof gardens using these systems is undemanding, although some maintenance is essential, especially during the first three years.

Maintenance helps stabilise the growth process in its environmental ecosystem, particularly if plants are seeded out, or planted out as seedlings.

As a waterproofing contractor, you need to keep at your disposal professional advice or assistance on the maintenance of extensive roof gardens.



Spraying of Graviflor growing substrate



Laying of vegetation blankets ("Gravi-Tapis" type)



Micro-turf plantation



Removal of unwanted growth and monitoring over one year

Roof garden & planted areas

Intensive green roof

4.1

Intensive roof garden & planted area suitable for pedestrian traffic

On concrete substrate

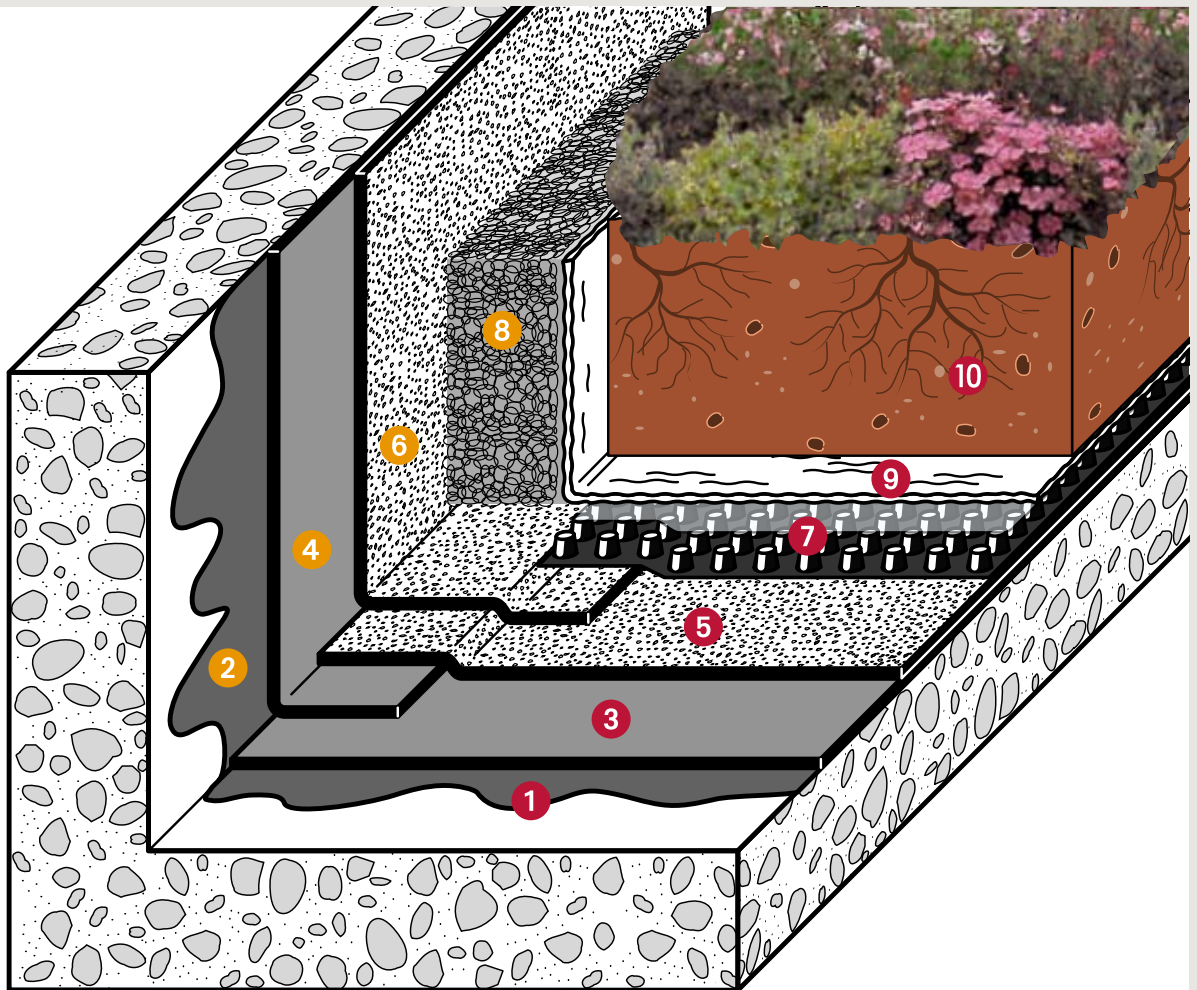
Without insulation

Torch-applied SBS elastomeric bitumen double-layer waterproofing system

Slope
0 to 5%

600kg/m²

Preflex + Graviflex with soil and traditional vegetation



1 Siplast Primer SBS bitumen primer.

2 Upstands: Siplast Primer SBS bitumen primer.

3 Torched Preflex.

4 Upstands: torched Preflex.

5 Torched Graviflex.

6 Upstands: torched Graviflex.

7 Loose-laid Draina G10 drainage board.

8 Vegetation barrier with gravel
(or Draina G10 for surfaces < 100m²).

9 Gravifiltre filter geotextile loose-laid horizontally and vertically along the upstands.

10 Top soil (≥ 30cm high according to the type of vegetation).

Roof garden & planted areas

Intensive green roof

4.2 Intensive roof garden & planted area suitable for pedestrian traffic

On concrete substrate

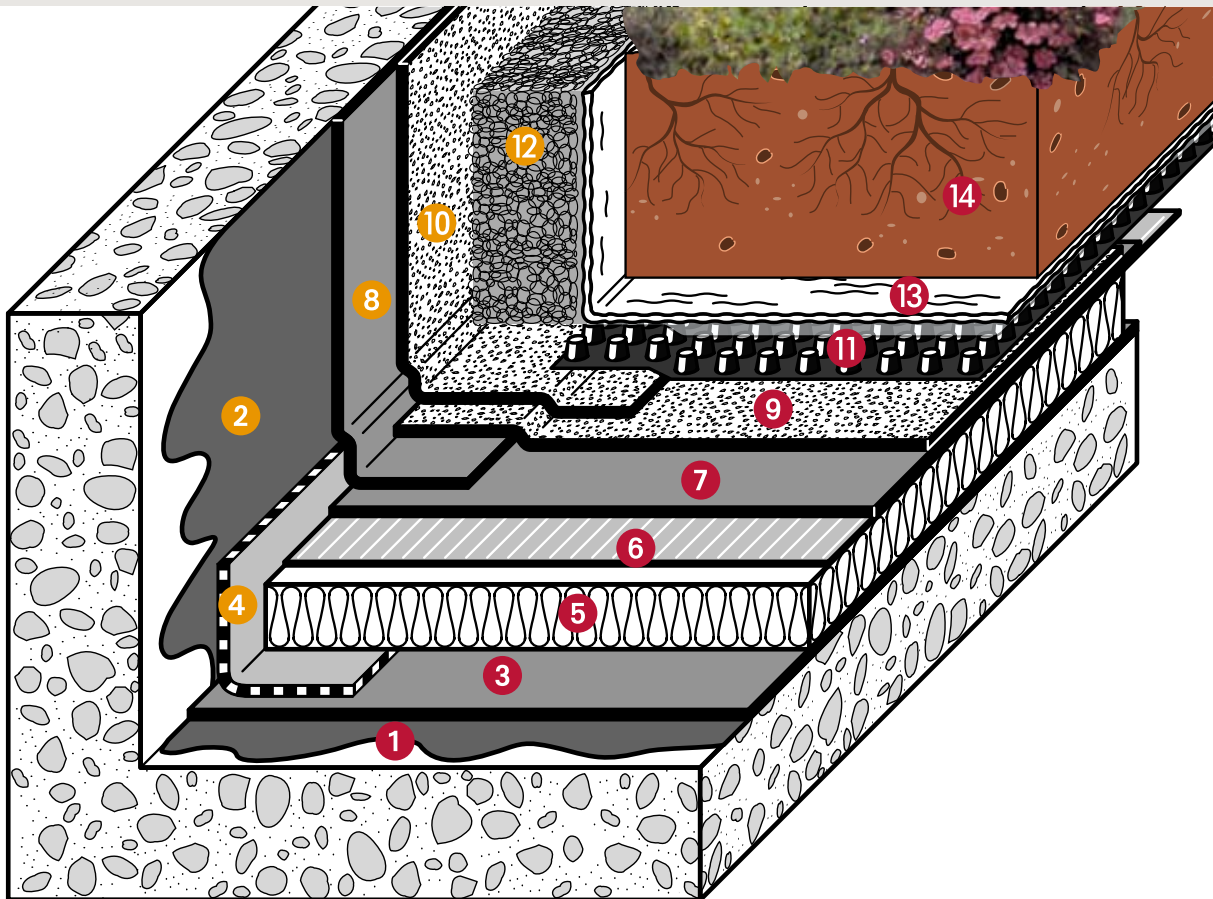
With insulation board

Torch-applied SBS elastomeric bitumen double-layer waterproofing system

Slope
0 to 5%

600kg/m²

Preflex + Graviflex with soil and traditional vegetation



- 1** Siplast Primer SBS bitumen primer.
- 2** Upstands: Siplast Primer SBS bitumen primer.
- 3** Torched Irex Profil vapour control layer (VCL)*
- 4** Upstands: torched Irex Profil vapour control layer.
- 5** Insulation board: polyisocyanurate board with composite or fibre-reinforced facing, perlite fibre board, bitumen-surfaced foam-glass.**
- 6** Loose-laid Verecran 100 separating layer.
- 7** Loose-laid Preflex with torched overlaps.
- 8** Upstands: torched Preflex.
- 9** Torched Graviflex.
- 10** Upstands: torched Graviflex.
- 11** Loose-laid Draina G10 drainage board.
- 12** Vegetation barrier with gravel (or Draina G10 for surfaces < 100m²).
- 13** Gravifiltre filter geotextile loose-laid horizontally and vertically along the upstands.
- 14** Top soil (≥ 30cm high according to the type of vegetation).

* VCL is not necessary in tropical or equatorial regions when buildings are not heated.

** Consult the supplier's technical documentation and local regulations for compliance with all building and security requirements. The insulation boards are held by 1 or 2 mechanical fixations, see supplier's installation manual.

Roof garden & planted areas

Extensive green roof

4.3

Extensive roof garden for non accessible areas

On various substrates : concrete, steeldeck, wooden-board

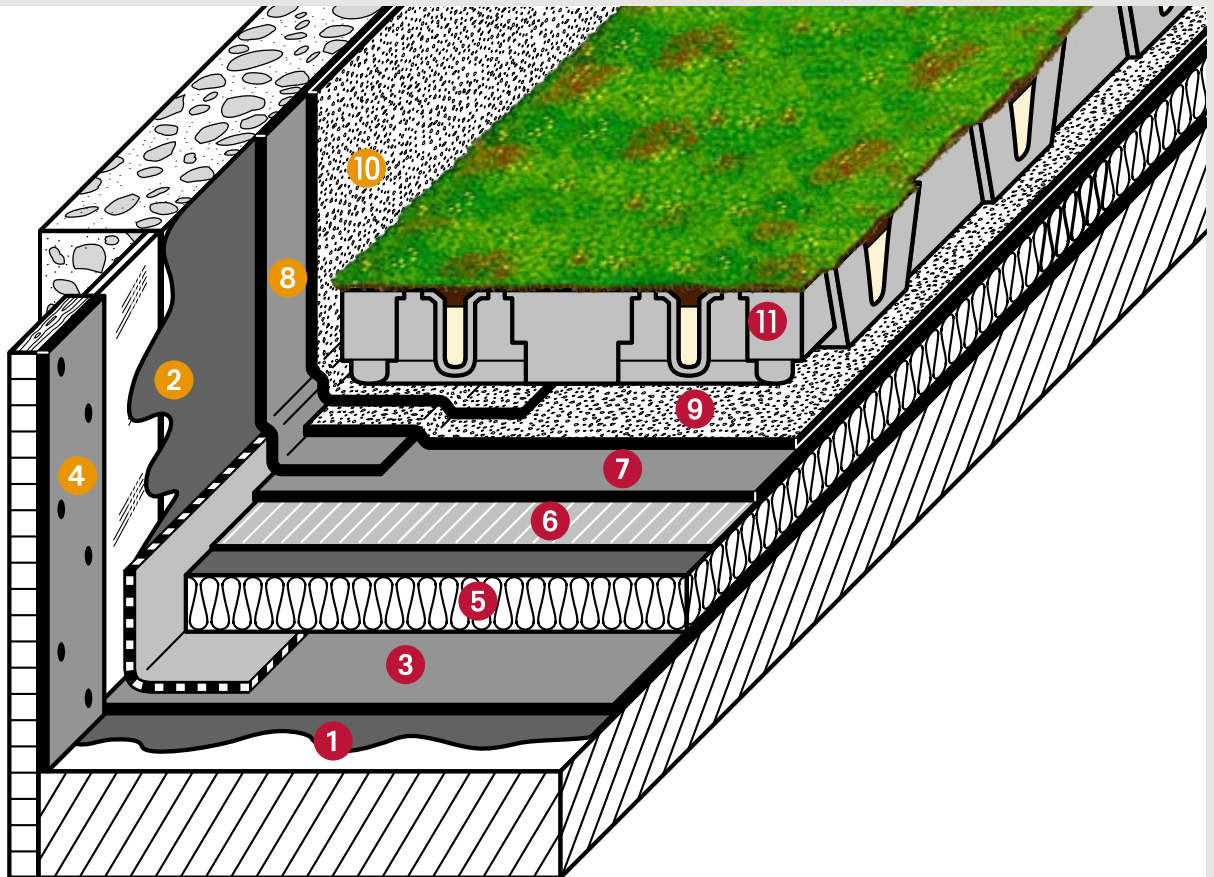
With insulation board

Torch-applied SBS elastomeric bitumen double-layer waterproofing system

Slope
3 to 20%

130kg/m²

Preflex + Graviflex with pre- vegetated modular green roof pack: "Hydropack" type



1 Siplast Primer SBS bitumen primer on concrete substrate.

2 Upstands: Siplast Primer SBS bitumen primer on concrete or steeldeck upstand.

3 Torched Irex Profil vapour control layer (VCL)*; nailed if wooden boarding substrate.

4 Upstands: torched Irex Profil vapour control layer; nailed if wooden boarding upstand.

5 Insulation board: polyisocyanurate board with composite or fibre-reinforced

facing, perlite fibre board, bitumen-surfaced foam-glass, mineral wool board with Class C compressibility.**

6 Loose-laid Verecran 100 separating layer.

7 Loose-laid Preflex with torched overlaps.

8 Upstands: torched Preflex.

9 Torched Graviflex.

10 Upstands: torched Graviflex.

11 Pre-grown modular green roof pack ("Hydropack" type) or similar.

Hydropack: 600 x 400 x 90mm container designed to contain varieties of mixed sedums to be delivered on site. The honeycomb underside of the container is designed for the twin purposes of retaining water required for plant life and drainage of excess water.

* VCL is not necessary in tropical or equatorial regions when buildings are not heated.

** Consult the supplier's technical documentation and local regulations for compliance with all building and security requirements. The insulation boards are held by 1 or 2 mechanical fixations, see supplier's installation manual.

4.4 Extensive roof garden for non accessible areas

On various substrates: concrete, steeldeck, wooden-board

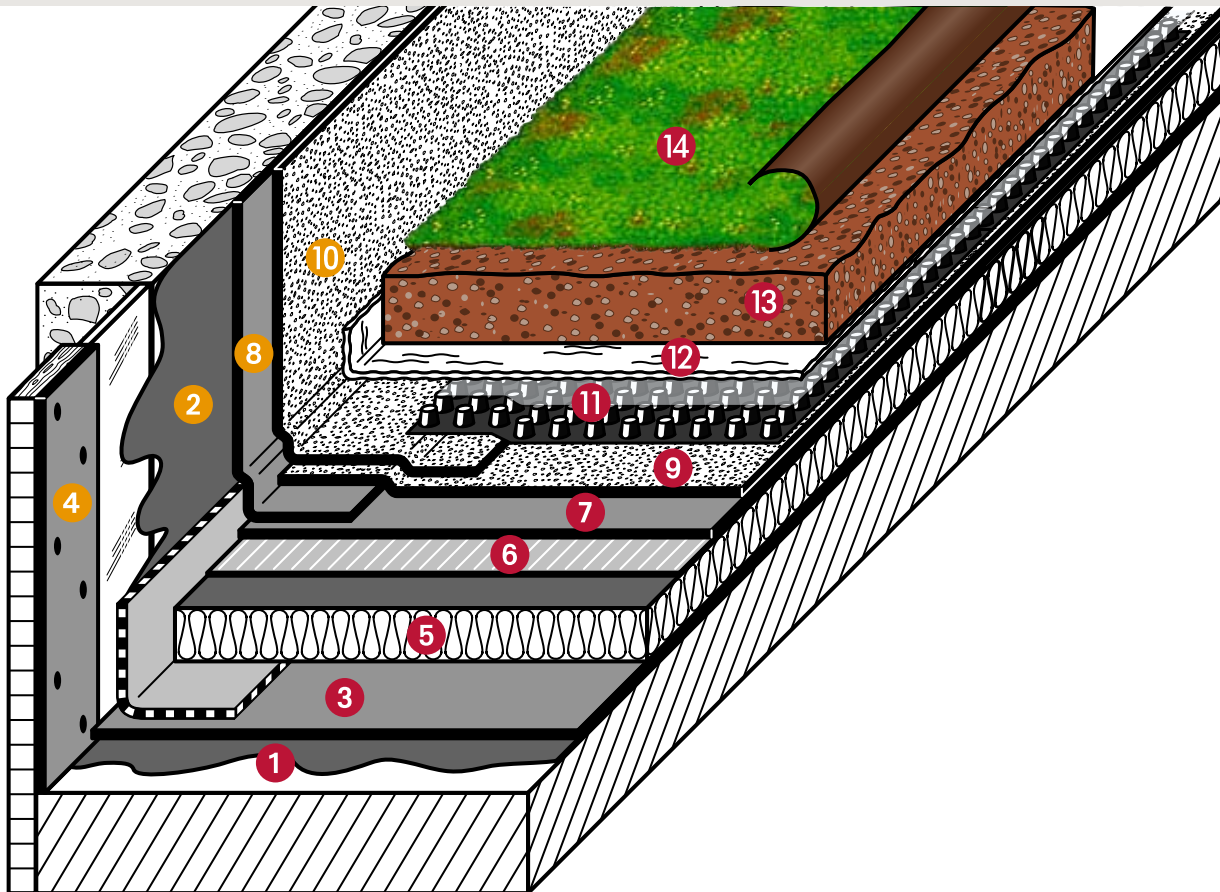
With insulation board

Torch-applied SBS elastomeric bitumen double-layer waterproofing system

Preflex + Graviflex with pre-grown vegetation blankets (Gravi-Tapis type or similar)

Slope
3 to 20%

130kg/m²



- | | | |
|--|---|---|
| <p>1 Siplast Primer SBS bitumen primer on concrete substrate.</p> <p>2 Upstands: Siplast Primer SBS bitumen primer on concrete.</p> <p>3 Torched Irex Profil vapour control layer (VCL)*: nailed if wooden boarding substrate.</p> <p>4 Upstands: torched Irex Profil vapour control layer (nailed if wooden boarding upstand).</p> <p>5 Insulation board: polyisocyanurate board with composite or fibre-reinforced facing, perlite fibre board,</p> | <p>bitumen-surfaced foam-glass, mineral wool board with Class C compressibility.**</p> <p>6 Loose-laid Verecran 100 separating layer.</p> <p>7 Loose-laid Preflex with torched overlaps.</p> <p>8 Upstands: torched Preflex.</p> <p>9 Torched Graviflex.</p> <p>10 Upstands: torched Graviflex.</p> <p>11 Loose-laid Draina G10 drainage board.</p> | <p>12 Gravifiltre filter geotextile loose-laid horizontally and vertically along the upstands.</p> <p>13 Graviflor substrate soil.</p> <p>14 Pre-grown vegetation blankets (Gravi-Tapis type or similar) on Gravidrain drainage board + Gravifiltre filter geotextile.</p> |
|--|---|---|

* For premises of high airborne moisture content: High-rated vapour barrier is requested.

** Consult the supplier's technical documentation and local regulations for compliance with all building and security requirements. The insulation boards are held by 1 or 2 mechanical fixations, see supplier's installation manual.

5. Instructions for roof garden features at building perimeter

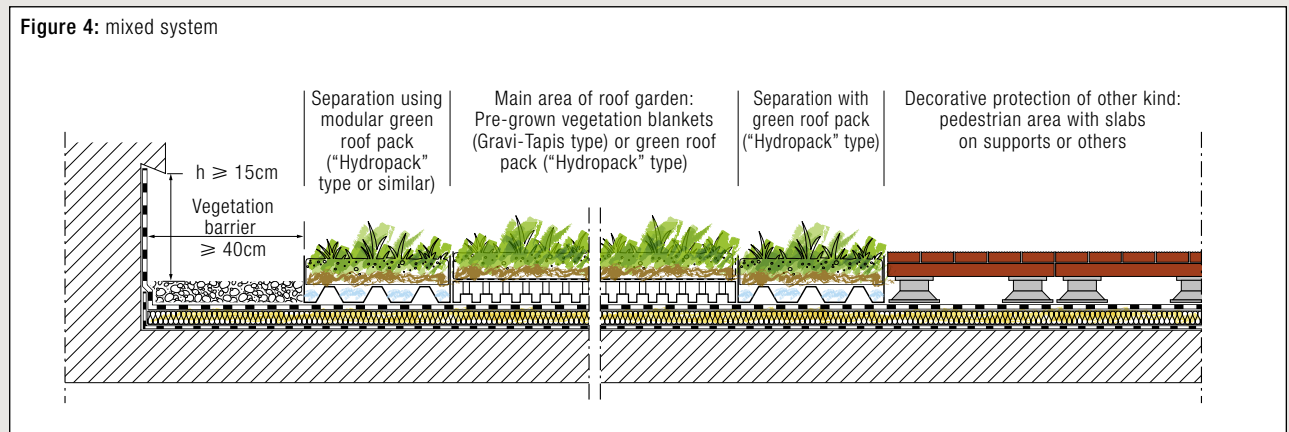
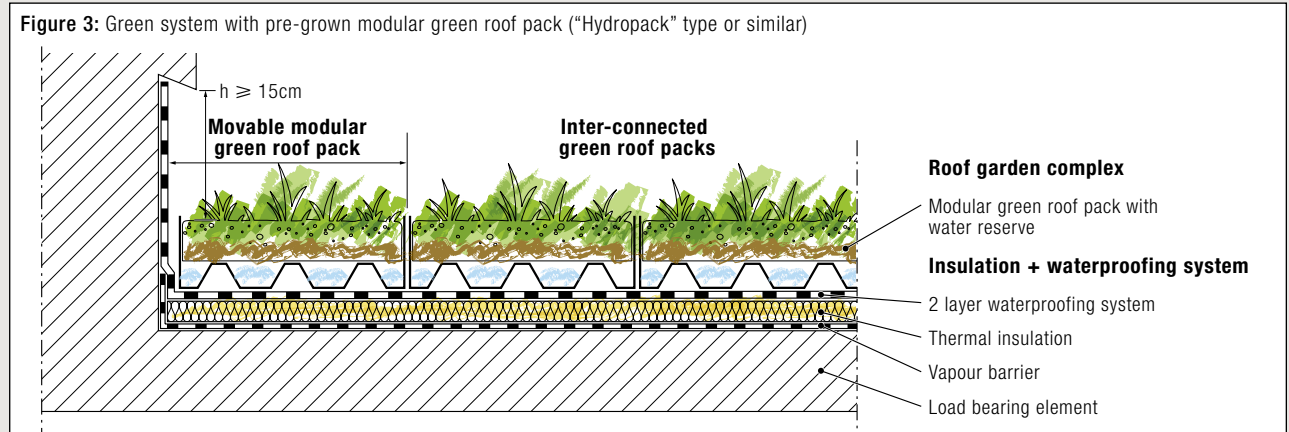
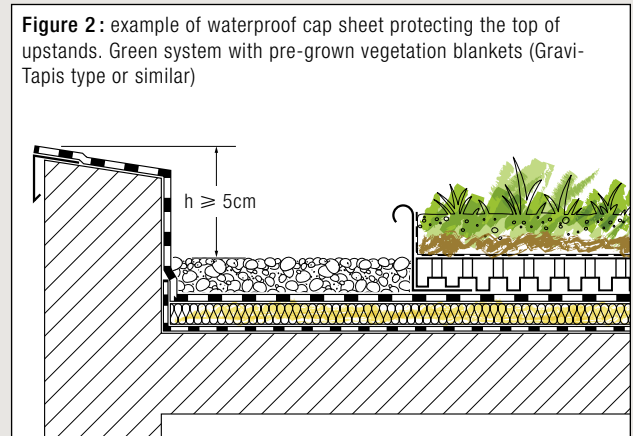
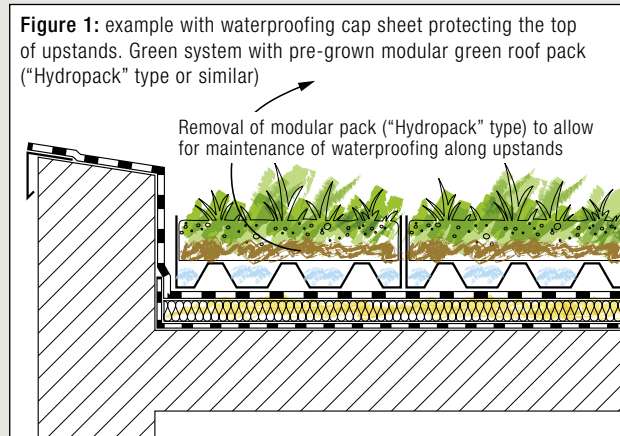
Maintenance work on upstands should be facilitated either by the easy-to-displace elements (cf. figure 1 with green roof pack, "Hydropack" type) or by creating a vegetation barrier, 40cm wide (figure 2 with GraviLand S, waterproofing membrane with self overprotection or protected with gravels,

slabs on supports etc.) constructed in compliance with the professional rules relating to roof gardens.

In the standard situation, irrespective of the techniques used for upstand construction (on masonry, brickwork, steel, wood, with or without thermal insulation), the waterproofing upstand

is raised 15cm above the upper level of protection (figure 3).

When the roof is provided with different types of protection and zones, the green roof pack, "Hydropack" type, are useful as a means of separation between these zones as shown in figure 4.



6. Provision for retaining rainwater

The extensive green roof systems, using modular green roof packs, may be designed to retain part of the natural rainwater. (As an example, the Hydropack type is fitted with a water reserve having a retention capacity of 32l/m²).

If required, the further introduction of

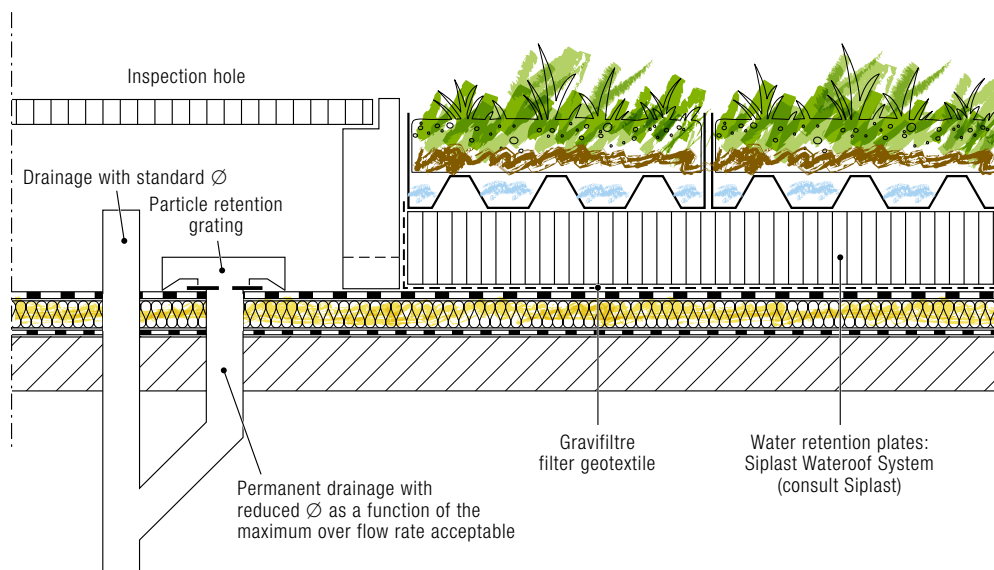
a layer of retention plates (e.g.: Siplast Waterproof System) is a simple and low cost solution meeting the most exacting demands for rainwater storage capacity.

Information

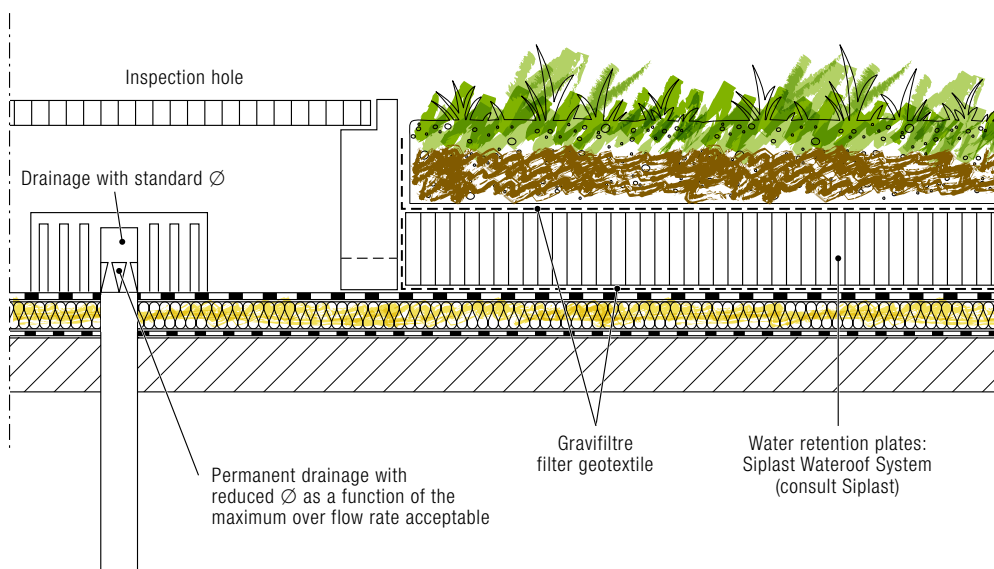
Under regulations and in order to comply with the maximum over flow rate

authorized, the rainwater inlets are sized and built in compliance with local standards related temporary retention of rainwater on roofs.

Modular green roof pack ("Hydropack" type or similar) with permanent drainage and separate drainage outlet.



Modular green roof pack ("Hydropack" type or similar) with permanent drainage and drainage outlet set together.



Roof garden & planted areas

Intensive green roof/Extensive green roof

7. Description of roof garden systems

Acceptable load-bearing elements

- Masonry and concrete complying to local technical standards.
- Masonry in reinforced autoclaved cellular concrete slabs complying to the Supplier's technical assessments and General Conditions of Use.
- Pre-lacquered steeldeck complying to local technical standards.
- Wood:
 - ▶ Solid timber boarding and wood derivative panels complying to local technical standards or to the Supplier's technical assessments and General Conditions of Use.
 - ▶ Composite sandwich boards (non traditional) benefiting from technical assessments covering their use as a direct substrate for waterproof systems.

Loading considerations

In addition to the standing load, the maintenance load to be taken into consideration under EN 1991 March 2003 and local standards, except if otherwise specified in particular contractual documents, are:

- ▶ 1.0kN/m² for inaccessible roofs and areas designed to take the weight of pedestrian access.
- ▶ 1.5kN/m² for technical zones (applied over the whole surface of load-bearing elements in the case of wood and derivatives).

Higher loading values may need to be adopted, if allowance (under standard calculations) is made for snow lying on roof or for water accidentally spilled, resulting in extra load values greater than the above.

Beware: in accordance with the professional rules for the design and construction of roof terraces and gardens, in addition to the maximum standing loads including water retention, and the loads from the plant material (conventionally set at 10kg/m² for sedums), an allowance is made for an additional conventional load of 15kg/m² for systems supported by masonry and steel (raised to 115kg/m² for wood support).

Loads and admissible rates in non-mountainous climate

Roof garden	Masonry	Cellular concrete	Steel	Wood & derivatives ⁽²⁾
Intensive green roof	0 to 5%			
Extensive green roof with pre-grown modular green roof pack ("Hydropack" type or similar) Indicative load ⁽¹⁾	0 to 20% 120kg/m ²	1 to 20% 120kg/m ²	3 to 20% 129kg/m ²	3 to 20% 231kg/m ²
Extensive green roof with pre-grown vegetation blanket (Gravi-Tapis type or similar) ⁽¹⁾	0 to 20% 128kg/m ²	1 to 20% 128kg/m ²	3 to 20% 137kg/m ²	3 to 20% 239kg/m ²

(1) Indicative load for total complex (excluding weight specific to load-bearing support) including thermal insulation 100mm thick, and maximum load including water retention (which must also include conventional load 15kg/m² under CSFE rules). For each project, the load must be verified.

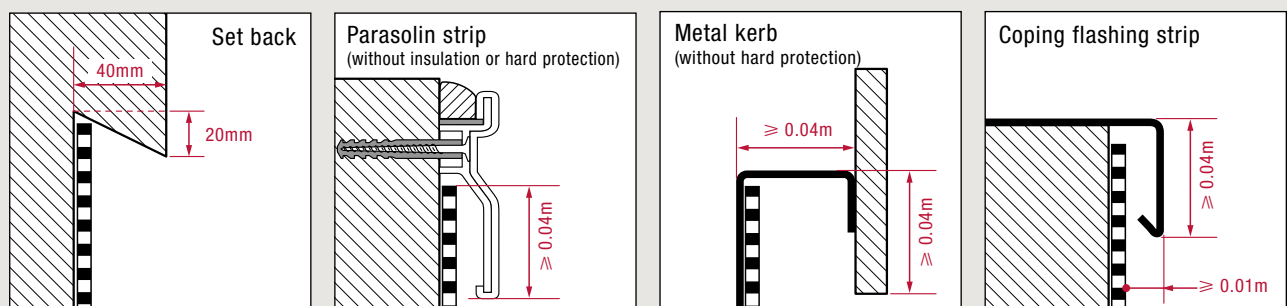
(2) For gardens supported by wood structures: additional conventional extra load allowance 100 kg/ m²

Instructions for tops of upstands

The upper part of upstands and parapets must be designed with waterproofing to prevent the run-off water from penetrating in back of the upstand

flashing. The diagrams below present some possibilities. These are represented without thermal insulation and without hard protection. The width of

the projection of the above-mentioned watertight structure will take into account the thickness of any thermal insulation board and of any protection.



8. Siplast product descriptions

Ceceal: vapour barrier made up of 60g/m² surfacing mat composite and aluminium foil 4/100mm.

Colle Par: bituminous cold adhesive.

Draina G10: drainage and separating layer to apply under heavy ballast made of concrete screed, prefabricated slabs of concrete or hard stone.

Gravi-Fragment: segregated seeding substrates containing variegated sedums for growing on site (Album, Acre, Sexangulare, Floriferum, Spurium, Reflexum, etc.).

Gravi-Motte Sedum: miniature turf squares for planting out variegated sedums on site (Album, Acre, Sexangulare, Floriferum, Spurium, Reflexum, etc.).

Gravi-Tapis: pregrown carpet of variegated sedums, thickness 20mm made up of substrate reinforced by meshes of natural biodegradable fibre.

Gravidrain: expanded polystyrene drainage panels for roof gardens.

Gravifltre: polyester filter layer for roof gardens.

Graviflex: polyester-reinforced, SBS-modified elastomeric bitumen granule-surfaced cap sheet with root-repellent additive for roof garden waterproofing. Surfaced with slate flakes, thermofusible film on the underside.

Graviflor: draining and aerated plant growing substrate made up of 70 % minimum granules of volcanic rock, pH neutral, density 0.7 dry and 1.4 at maximum water retention.

Hydropack: pre-grown container of different varieties of sedums grown over 6cm substrate. Recycled HDPE container with draining underlayer and water reserve, maximum capacity 32l/m².

Irex Profil: elastomeric bitumen, glass fibre reinforced vapour control layer.

Parastar Green 64: polyester-reinforced, SBS-modified elastomeric bitumen capsheet with root-repellent additive for planted areas. Surfaced with green coloured granules, thermofusible film on the underside.

Preflex: polyester reinforced, elastomeric underlayer for roof garden waterproofing, thermofusible film on both sides.

Siplast Primer: cold-applied, quick drying, universal elastomeric bitumen primer. Approx. coverage from 0.10 litre/m² on steel to 0.40 litre/m² on concrete.

Verecran 100: Glass fleece separating layer free-laid.



