OPTIGRÜN®
ROOF GREENING

WELL THOUGHT-OUT SOLUTION FROM GREEN ROOFING EXPERTS

TECHNICAL BROCHURE

DEAR READERS,

Isn't it incredible how the Green Roof business has taken off? We've gone from a niche market that few people took seriously to being the focus of widespread attention. The German government is taking an active role with the publication of its white paper entitled "Green Cities". The construction industry is booming. Demand for green structures is higher than ever – and not only in Germany.

Hardly anything is left to remind us of those days, almost 50 years ago, when we started out as a small team trying to get people interested in the concept of Green Roofs. The market has grown immensely – and so have we. These days, we green over 3.7 million square metres of roof a year in locations all around the world. It fills me with pride to know that we have become the market leader in our industry.

Our technical brochure has experienced some big changes, too. It has been completely overhauled and expanded to give you an even better compendium of greening solutions. We hope that you find it useful for your own Green Roof projects. Of course, we're always here for you if you need any further assistance. We look forward to your enquiries.

Sincerely,
Uwe Harzmann
Managing Director

YOUR TRUSTED PARTNER IN ROOF GREENING

Optigrün is the leading roof and building greening specialist in Europe. With our solutions and products, we strive to make cities greener and more pleasant to live in while also helping to mitigate man's contribution to climate change.

In addition to our headquarters in Germany, we have locations in six other European countries, around 120 partner companies in the Optigrün network, plus close collaborations with numerous other landscaping businesses and construction material vendors. All this contributes to our success and continued growth. Every year, we green over 3.7 million square metres of roof and underground car park space. And that number keeps going up!

We are committed to sustainability. That's why our products and solutions not only contribute to a greener environment – they're also made mostly of recycled or natural raw materials themselves. What's more, Optigrün utilises a 100% ecological power supply, maintains carbon neutrality in the production of printed materials and operates a low carbon emission vehicle fleet.

Optigrün stands for dedicated customer service and high standards of consulting. Architects, planners and builders alike benefit immensely from our expertise on various types of roof greening, rainwater management and fall protection. We're also renowned for our ability to find solutions to unusual and particularly difficult challenges.

With almost 50 years of experience, we design every item individually based on the latest technology available and in compliance with applicable standards and requirements. Optigrün delivers the product and systems solutions, which are then installed and maintained on site by specially trained landscaping companies.

▲
Optigrün company headquarters
in Krauchenwies-Göggingen

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OUR TECHNICAL SUPPORT

In addition to proven, quality products and solutions, Optigrün is also known for offering a wide range of high-level support services – services without which some projects would not be possible at all.

Consulting

At Optigrün, every project starts with comprehensive consulting. Optigrün provides you with consulting services in the following areas:

- Extensive and intensive roof greening, including plant selection and vegetation technology
- Traffic areas of building structures
- Greening of pitched, flat and inverted roofs
- Application of our products; including on site at major construction sites
- Optimal multi-layered build-ups; including with regard to weight optimisation or greening goal
- Optimising site procedures to speed up implementation

ⓘ **Service inquiries** info@optigruen.com
info@optigreen.co.uk (UK Only)

Planning

In conjunction with the planning phase, we design multi-layered build-ups based on your greening goal. Depending on the project, we develop customised solutions and details for your property.
This also includes the provision of site-specific special products. Other services included in the planning phase:

- Production of installation layout for solar panel stand and for fall protection systems
- Individual planning of Planters and Edge Elements and raised beds
- Drainage system design with Optigrün products and hydraulic testing for proper drainage in compliance with DIN 1986-100 and German FLL Guideline for Green Roofs
- Planning of multi-layered build-ups and systems based on long-term rainwater management simulations

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Calculations

Every properly planned and executed project is founded on comprehensive calculation. To pave the way for successful greening projects, Optigrün provides customers with a whole range of calculations. These can include:

- Load calculations
- Wind loading calculations
- Production of simulation models for rainwater management systems
- Static and dynamic overflow testing for our retention roofs
- Rainwater discharge calculation as basis for drainage recommendation
- Testing of water balances and amounts of discharge into public drainage system
- Overflow testing in accordance with DIN 1986-100
- Calculation of live load on driveable rooftops and load reduction calculation
- Thrust and traction calculations for pitched roofs, plus static testing for load reduction

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Documentation

We also provide our customers with comprehensive documentation. This includes:

- Informational materials on our systems solutions and products and general industry information
- Data sheets for all products
- Ongoing product testing and documentation for the products in accordance with applicable standards
- Specification texts for system structures and individual products, including photos and technical data
- CAD drawings of standard details
- BIM models for system structures and individual products for the four conventional CAD programmes
- Assembly and installation instructions
- Letters of confirmation and statements
- Supporting documents for certification purposes
- Product Carbon Footprints (PCF) and CO_2 balance of our most frequently purchased products

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ADVANTAGES OF GREEN ROOFS

Green Roofs and underground parking areas have positive effects that are not only visual but above all climatic, ecological, economic and relate to urban planning and wastewater technology. Here is an overview of the various advantages:

VISUAL

A more appealing environment
With well-considered planning, a Green Roof matches with the architecture and complements it in an advantageous way. This creates magnificent roof landscapes that not only beautify and enhance your own building but also make your neighbours happy. Wouldn't you prefer to look at fragrant flower meadows full of daisies, thyme and lavender instead of bare roof waterproofing or lifeless tile, metal and gravel roofs?

Extreme locations
Roofs are often exposed to prolonged dry periods, high temperatures in summer, significant temperature fluctuations and wind movements. Particularly barren roof areas look very worn out after just a short time. Despite the extreme conditions, it is possible to develop extensive Green Roofs with species-rich vegetation here. Native plants, which usually grow slowly and only require a small amount of care, are particularly suitable.

ECOLOGY

Ecological compensation area
Green Roofs are measures to reduce interventions in terms of the impact compensation regulation as they provide temporary or permanent habitats for plants and animals that need places to rest, feed and nest.

Improved working and living environment
Green Roofs serve as an integral part of sustainable building to improve people's working and living environments. Roof areas that can be walked on, for example, offer additional living space, an area for playing and sports, and a meeting place.

CLIMATE

Improved heat and cold protection
Green Roofs have an insulating effect. They protect the interior of the building from heat in the middle of summer and from minus temperatures in winter. The temperatures in the building under a Green Roof are around 3 – 4°C lower in summer than with a non-green and uninsulated roof.

Improvement in the (micro)climate
The evaporation and transpiration of the green plants causes the retained rainwater to evaporate, which cools the surrounding air.

Bonding of dust and pollutants in the air
Fine dust and air pollutants are filtered out by the Green Roof and bonded in the substrate, broken down and absorbed by the plant. Plant growth reduces CO_2 pollution by binding CO_2 permanently.

RESIDUAL WATER TECHNOLOGY

Rainwater retention
Extensive Green Roofs retain around 40 – 80% of the annual precipitation where it falls, namely on the roof. With intensive Green Roofs, it can even be 80 – 99%. This is a measure that contributes to creating a “sponge city”.

Relieving of the sewer system
The maximum drainage peaks during heavy rain are reduced by 50 – 100% compared to a non-Green Roof area and are also discharged into the sewer system with a delay. The drainage behaviour of Green Roofs can be calculated using digital simulation programmes while taking into account regional precipitation data.

Restrictions on discharge
With retention roofs, local restrictions on discharge into the sewer network can be easily observed. Values from 0.1 l/s are possible.

ECONOMY

Cost savings with split precipitation water charges
More and more cities and municipalities have split wastewater charges to make the owners of heavily sealed areas take greater responsibility for their (cost) obligation. Green Roofs are recognised by most cities and municipalities as a desealing measure, thus reducing precipitation water charges by 50 – 100%.

Funding of Green Roofs
Many cities and municipalities have their own funding programmes for Green Roofs and support private property owners, companies and housing associations. You will find lists of cities that already actively operate such funding on the website of Bundesverband GebäudeGrün (German Association of Building Greening), www.bugg.de.

More living space
A non-Green Roof is wasted space. Valuable useful areas and roof gardens that can be walked on, which could not be realised at ground level due to the price of building plots and the lack of space, can be created on industrial and office buildings, clinics, residential buildings and even on garages and annexes.

Protection of the waterproofing
The Green Roof protects the waterproofing from extreme temperatures and weather conditions. Thanks to this protection, the service life of waterproofing under Green Roofs is about twice as long as for non-Green Roof types.

Yield increase for photovoltaics systems
The operating temperature of the solar panels influences their performance. Temperatures above 25°C lead to a decrease in performance. Solar panel manufacturers generally expect a power loss of about 0.5% per °C. The proven evaporative cooling of Green Roofs can thus increase the efficiency of the photovoltaic system.

URBAN PLANNING

Extensive design element
Green Roofs are extensive design elements for urban and landscape planners. They can also be used to implement fresh air lanes.

Reduction of aircraft and street noise
A non-Green Roof is a “source” for reflected street and aircraft noise. Due to its structure, the plant cover reduces sound reflection. The mass of the Green Roof construction and the structure of vegetation help to reduce noise in large cities and on approach paths.

Improvement in the urban climate
Green Roofs not only retain rainwater but also release it back into their surroundings via evaporation processes. The result is an increase in humidity and cooling of the environment. Fine dust and heavy metals are filtered out and trapped in the Green Roof. Green Roofs thus actively contribute to improving the urban climate.

Protection against electric smog and mobile phone radiation
Green Roofs dampen radiation in the frequency range of the mobile networks and cordless telephones.

SYSTEM SOLUTIONS

12 Economy Roof

Weight [1]	from 90 kg/m² or 0.9 kN/m²
Build-up depth	from 80 mm
Vegetation form	Sedum-herbs-grasses
Water retention	50 – 60 %/year
Cost factor [2]	■□□□□
Ecological value	■■□□□
Maintenance costs	■□□□□

16 Lightweight Roof

Weight [1]	from 55 kg/m² or 0.55 kN/m²
Build-up depth	from 60 mm
Vegetation form	Sedum Moss
Water retention	40 – 50 %/year
Cost factor [2]	■■■□□
Ecological value	■□□□□
Maintenance costs	■■□□□

20 Nature Roof

Weight [1]	from 95 kg/m² or 0.95 kN/m²
Build-up depth	from 100 mm
Vegetation form	Sedum-herbs-grasses, possibly woody plants
Water retention	50 – 70 %/year
Cost factor [2]	■■□□□
Ecological value	■■■■■
Maintenance costs	■■□□□

26 Retention Roof Meander

Weight [1]	from 90 kg/m² or 0.9 kN/m²
Build-up depth	from 90 mm
Vegetation form	Sedum-herbs-grasses
Water retention	50 – 70 %/year
Cost factor [2]	■■□□□
Ecological value	■■□□□–■■■■□
Maintenance costs	■□□□□–■■□□□

34 Retention Roof Flow Control

Weight [1]	from 100 kg/m² or 1.0 kN/m²
Build-up depth	from 140 mm
Vegetation form	Sedum-herbs-grasses, perennials-shrubs-lawns-trees
Water retention	Project specific settings possible
Cost factor [2]	■■■□□–■■■■■
Ecological value	■■■□□–■■■■■
Maintenance costs	■■□□□–■■■■■

[1] The weight of the material varies from region to region. The information refers to the water-saturated state; the dry weight is approximately 60 – 70% of this. [2] Cost benchmark at 1,000 m² net incl. installation, varies from region to region

44 Pitched Roof

Weight [1]	from 100 kg/m² or 1.0 kN/m²
Build-up depth	from 80 mm
Vegetation form	Sedum Moss, Sedum-herbs-grasses
Water retention	approx. 50 %/year
Cost factor [2]	■■■□□–■■■■□
Ecological value	■■□□□
Maintenance costs	■■■□□

60 Garden Roof

Weight [1]	from 320 kg/m² or 3.2 kN/m²
Build-up depth	from 260 mm
Vegetation form	Perennials-shrubs-lawns, herbs, vegetables, berry bushes, fruit trees
Water retention	70 – 95 %/year
Water storage	approx. 45 – 126 l/m² or approx. 110 – 160 l/m²
Cost factor [2]	■■■□□ – ■■■■□
Ecological value	■■■■□
Maintenance costs	■■■■□

68 Landscape Roof

Weight [1]	from 600 kg/m² or 6.0 kN/m²
Build-up depth	from 420 mm
Vegetation form	Perennials, woody plants, trees
Water retention	80 – 95 %/year
Cost factor [2]	■■■■■
Ecological value	■■■■□
Maintenance costs	■■■■□

72 Public Roof

Weight [1]	from 400 kg/m² or 4.0 kN/m²
Build-up depth	from 180 mm

86 Solar Green Roof

Weight [1]	from 110 kg/m² or 1.1 kN/m²
Build-up depth	from 100 mm
Vegetation form	Sedum-herbs-grasses
Water retention	50 – 70 %
Ecological value	■■□□□
Maintenance costs	■□□□□

ECONOMY ROOF

"The Economy Roof is just what it sounds like: an affordable, proven and highly effective greening method. This economical layer structure is designed for a limited variety of plants. But that's still better than a roof that's left empty or covered in gravel".

Uwe Harzmann, Managing Director

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? Service – Do you have any questions for us?
To learn about our wide range of services, see pages 4 and 5.
We offer project-specific initial calculations free of charge and provide all other calculations upon order placement.

To enquire about service, please email us at **info@optigruen.com**

ECONOMY ROOF

Extensive Semi-intensive Intensive

The ECONOMY ROOF system is our popular standard construction for extensive Green Roofs and has proven itself in practice for decades. Drainage takes place via a drainage board (FKD), which is also well-suited to non-pitched roofs. The ECONOMY ROOF is particularly resistant and can be used on most standard roofs.

› Technical data

Weight [1]	from 90 kg/m² or 0.9 kN/m²
Build-up depth	from 80 mm
Roof pitch	0 – 5 °
Vegetation form	Sedum-herbs-grasses
Water retention	50 – 60 %/year
Discharge coefficient [2]	C_S = 0.4 – 0.5
Cost factor [3]	■□□□□

› Features

Ecological value ■■□□□
Maintenance costs ■□□□□

- The most cost-efficient Green Roof solution
- Low maintenance Green Roof design
- Mainly sedum vegetation
- Suitable for inverted roofs

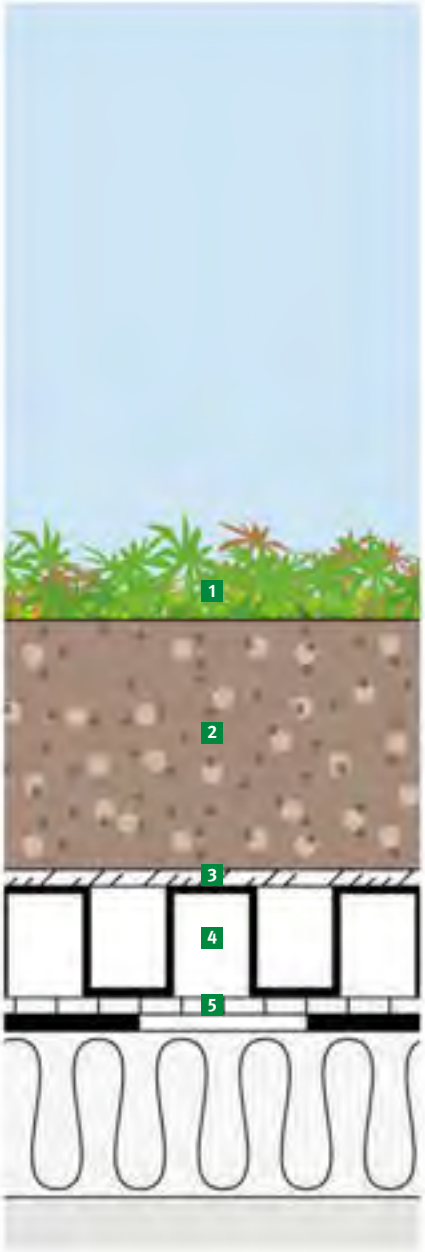
[1] The weight of the material varies from region to region. The information refers to the water-saturated state; the dry weight is approximately 60–70% of this. [2] According to the current FLL Green Roof Guidelines [3] Cost benchmark at 1,000 m² net incl. installation, material varies from region to region.

› System structure and components

The ECONOMY ROOF system is our most popular standard design for extensive Green Roofs and has been proving itself in the field for decades. Water is drained by means of a Drainage Board (FKD), which also works well with flat roofs. This long-term water reservoir makes the ECONOMY ROOF particularly resilient and can be used on most standard rooftops.

In line with the German impact mitigation regulation, the ECONOMY ROOF is a simple and affordable reduction measure and helps reduce fees in communities paying split waste water fees.

The ECONOMY ROOF system meets all requirements of the German FLL Guideline for Green Roofs.



1 Vegetation Mat
Pre-cultivated sedum mat for the rapid establishment of vegetation in order to prevent wind erosion, with decomposable carrier. Alternatively: Hydro-seeding or Optigrün Seed Mix EKR with various species of sedum, herbs and grasses.

2 Extensive Substrate E (60 mm)
A substrate with high water storage capacity and good air porosity, tailored to extensive multi-layer systems

Combi Inspection Chamber TKS PLUS
(Not included in the drawing)
Simple control of roof drainage outlets, extendible in 100 mm increments, side and top drainage openings

3 Filter Fleece FIL 105
Prevents fine particles from forming sludge in the drainage layer; high water permeability

4 Drainage and Storage Board FKD 25 (25 mm)
Prevents accumulation of water for non-pitched roofs and large drainage lengths, lightweight design with high drainage capacity, water storage

5 Protection and Storage Fleece RMS 300
Protects roof membrane against damage and stores water. With inverted roofs, use RSV 120 trickle protection mat instead of the RMS fleece.

› Wind erosion protection

The ECONOMY ROOF system does not generally require a wind erosion protection calculation. This depends on wind zone, the building height (e.g. from approx. 10 m high) and/or how exposed the building is (e.g. peripheral location, facing the main wind direction, located on a crest, etc.)

When assessing wind erosion protection, we normally indicate corner, edge and interior areas of the roof separately and make specific recommendations for each area. Usually, with tall or exposed buildings, the edge and corner areas need to be anchored most of all, e.g. using erosion protection plates ESP in the pebble boarders or vegetation mats on green spaces.

ⓘ **Wind suction technical information**
see page 122

› Maintenance

Give the area a base application of fertiliser straight away when putting down Multi-Layer Substrate E. We recommend using Slow Release Fertiliser Opticote, about 25 – 35 g/m².

After 1–2 years, depending on the vegetation, another application of fertiliser will be needed in order to provide the plants with the necessary nutrients. If nutrients are not added on a regular basis, the sedum varieties will wither, turn a very reddish hue and grow low and patchy, making them vulnerable to wind erosion.

We recommend having an upkeep and maintenance contract with one of our Optigrün partners. For a listing of partners in your area, click the “Contact” link on our homepage.

ⓘ **Maintenance technical information**
see page 132

› Vegetation

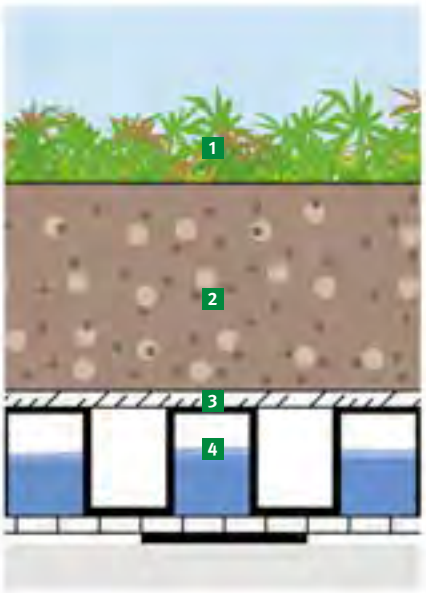
This system works particularly well with pre-cultivated sedum mats or sedum plug plants

ⓘ **Vegetation technical information**
see page 128

› Special feature
0°-roof with puddles and standing water

Due to unevenness and counterslopes, 0°-rooftops can sometimes develop puddles and standing water. With a single-layer[1] extensive Green Roof, it’s very important to avoid waterlogging. Wet substrates usually lead to changes in vegetation from sedum to grass vegetation.

Our Drainage and Storage Boards FKD 25 and FKD 40 can be used to prevent waterlogging. A portion of the excess water is guided to the drainage point, while any standing water remaining is collected. The substrate is thus drained, while the original vegetation is preserved.

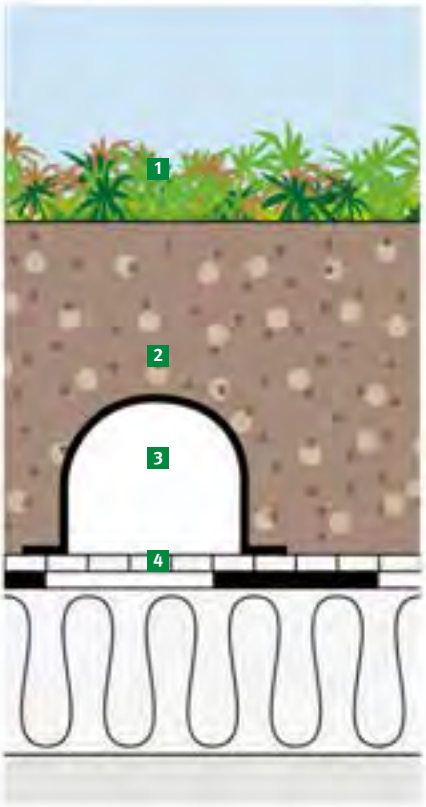


1 Vegetation
2 Extensive Substrate E
3 Filter Fleece FIL 105
4 Drainage and Storage Board FKD 25 (25 mm)
up to 15 mm standing water

› Special feature
Single-layer structure without Drainage Board (not available in the UK)

On roofs with 1–5° pitch, the ECONOMY ROOF can also be implemented as a single-layer structure a without a drainage board. Drainage is achieved by the extensive single layer substrate M in combination with the Triangle Water Conduit WLP Plus and can even be used with flow lengths of up to 30 m.

For larger roofs, we recommend having our Technical Department team perform a drainage calculation.



1 Vegetation
2 Extensive single layer substrate M
3 Triangle Water Conduit WLP Plus
4 Protection and Storage Fleece RMS 300

[1] single-layer = protective layer and substrate

LIGHTWEIGHT ROOF

"The shallow roof design is perfect for refurbishing older roofs with a limited loading capacity. It can also be used to turn a large industrial roof with a lightweight design into an ecological compensation area."

Marion Kreutner, Technical Department

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LIGHTWEIGHT ROOF

Extensive Semi-intensive Intensive

The LIGHTWEIGHT ROOF system can be used to green a roof with low load-bearing capacity. Even when saturated with water, the LIGHTWEIGHT ROOF weighs just 55 kg/m² and is significantly lighter than an average 50 mm thick gravel roof.

› Technical data

Weight [1]	from 55 kg/m² or 0.55 kN/m²
Build-up depth	from 60 mm
Roof pitch	0 – 5 °
Vegetation form	Sedum
Water retention	40 – 50 %/year
Discharge coefficient [2]	C_S = 0.5 – 0.6
Water storage	approx. 18 l/m²
Cost factor [3]	■■■□□

› Features

Ecological value ■□□□□
Maintenance costs ■■□□□

- Extremely lightweight Green Roof structure
- Can be used with non-sloping roof without deep ponding
- Automatic irrigation system available for arid regions
- For use with fixed roof waterproofing only
- Specific wind loading calculations must be considered

[1] The weight of the material varies from region to region. The information refers to the water-saturated state; the dry weight is approximately 60–70% of this. [2] According to the current FLL Green Roof Guidelines [3] Cost benchmark at 1,000 m² net incl. installation, material varies from region to region.

› System structure and components

The LIGHTWEIGHT ROOF system can be used on any flat roof with fixed insulation.

It is used with our specially developed Low Density Substrate L, combined with our vegetation mats. Despite its thin-layered design, our structure offers the plants a proper natural vegetation rooting layer.

Low Density Substrate L exceeds the requirements for extensive single-layer substrates stipulated in the FLL Guideline for Green Roofs.

The LIGHTWEIGHT ROOF is suitable for roofs with 0 – 5 ° pitch and is drained by means of a Drainage Board (FKD).

1 Vegetation mat
Pre-cultivated vegetation mat for rapid establishment of vegetation in order to prevent wind erosion, with decomposable backing

2 Low Density Substrate L 30 l/m²
Specially formulated for single-layer extensive roofs; low density but high water storage capacity

Flat Inspection Chamber LD (Not included in the drawing)
Easily monitoring of drainage outlets; for installation on the Drainage and Storage Board FKD 25

3 Drainage and Storage Board FKD 25 (25 mm)
Prevents accumulation of water for non-pitched roofs and large drainage lengths, lightweight design with high drainage capacity, water storage

4 Protection and Storage Fleece RMS 300
Protects roof system against damage and stores water

› Wind erosion protection

The combination of substrate and vegetation mats renders the LIGHTWEIGHT ROOF system wind-proof. The vegetation mat has a closed vegetation cover from the time it is put down, allowing it to take root quickly in the substrate. As a result, you'll have a well-rooted Green Roof system with complete plant coverage in a very short time.

ⓘ Wind suction technical information
see page 122

› Vegetation

The plants for this system are established as pre-cultivated vegetation mats. Our vegetation mats with various sedum and moss species provide approx. 80 – 100 % coverage from the time they are put down, keeping the Low Density Substrate protected from wind erosion. Vegetation mats are the fastest and most reliable way to establish vegetation, which makes them ideal for the LIGHTWEIGHT ROOF design.

ⓘ Vegetation technical information
see page 128

› Maintenance

To ensure optimal plant growth, apply our Slow Release Fertiliser Opticote to the substrate as soon as the vegetation is planted. For optimal plant nutrient supply, we recommend applying about 30 – 50 g/m² of Slow Release Fertiliser Opticote once a year.

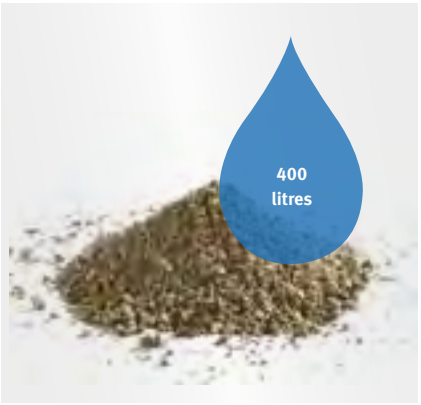
Annual fertilising is necessary in order to maintain the closed vegetation coverage from the outset. Without regular fertilising, even robust sedum species wither, grow low and patchy and turn a very reddish hue. The vegetation coverage may develop gaps and become vulnerable to wind erosion.

We recommend having an upkeep and maintenance contract with one of our Optigrün Partners. For a listing of partners in your area, click the "Contact" link on our homepage.

ⓘ Maintenance technical information
see page 132

› Special feature

- Low Density Substrate L has a purely mineral composition and was specially developed for this application.
- In conjunction with Slow Release Fertiliser Opticote, it offers plants a proper natural vegetation rooting layer, despite the thin-layered design of the greening structure.
- The maximum water capacity is approx. 40 % of the volume – twice the capacity required by the FLL Guideline for Green Roofs.



Low Density Substrate L
- 1 m³ absorbs approx. 400 litres of water
- 1 m³ weighs approx. 430 kg (dry)
- 1 m³ weighs approx. 830 kg (saturated)
- Minimum substrate height 30 mm = approx. 25 kg/m² (saturated)

Extensive Substrate E
- 1 m³ absorbs approx. 200 litres of water
- 1 m³ weighs approx. 950 kg (dry)
- 1 m³ weighs approx. 1,150 kg (saturated)
- Minimum substrate height 60 mm = approx. 78 kg/m² (saturated)

NATURE ROOF

"The Nature Roof is a great way to maintain a wide variety of species in urban areas. Not only are we preserving nature for the next generation but we're also beautifying our living space and improving our quality of life".

Thomas Gretschmann, Technical Department

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NATURE ROOF

Extensive **Semi-intensiv** Intensive

Many cities and municipalities have since developed green concepts which not only state that roofs should be greened but also, in some cases, how. In many cases, there are already minimum requirements on substrate heights to allow a correspondingly greater diversity of plants to settle permanently. In the area of extensive to simple intensive Green Roofs, the NATURE ROOF system is the type of Green Roof that offers great scope in terms of substrate height and biodiversity and can thus also achieve the highest ecological value.

› Technical data

Weight [1]	from 95 kg/m² or 0.95 kN/m²
Build-up depth	from 100 mm
Roof pitch	0 – 5 °
Vegetation form	Herbs-grasses-sedum, possibly woody plants
Water retention	50 – 70 %/year
Discharge coefficient [2]	C_S = 0.3 – 0.5
Water storage	approx. 30 – 80 l/m²
Cost factor [3]	■■□□□

› Features

Ecological value ■■■■■
Maintenance costs ■■□□□

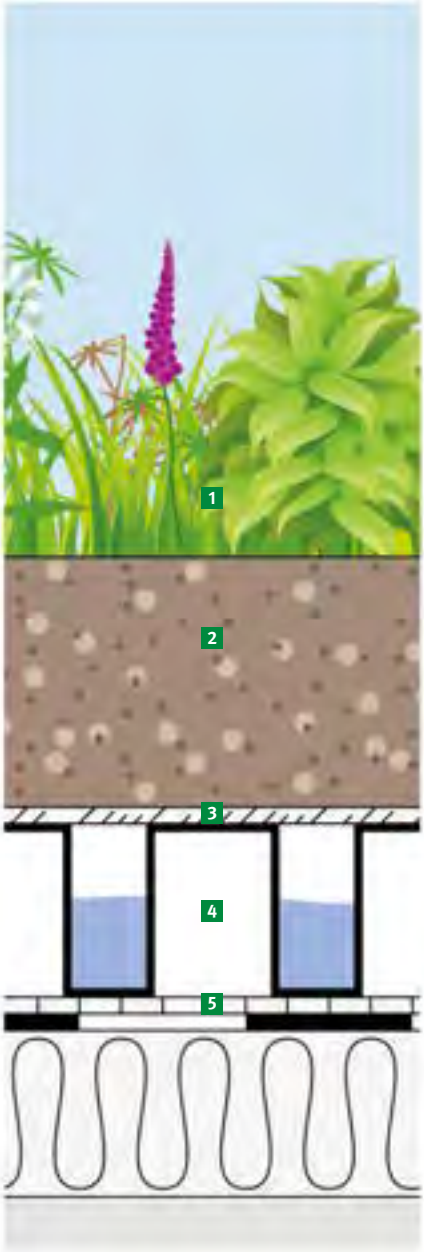
- Ecologically valuable Green Roofing
- Can be implemented as a biodiversity space
- High evaporation capacity
- Long-lasting and colourful flowering aspect
- Accommodates a wide range of plants and animals
- Load calculation for mounds and deeper layers: The weight for 10 mm of additional substrate is approx. 12 – 15 kg/m²
- Suitable for inverted roofs

[1] The weight of the material varies from region to region. The information refers to the water-saturated state; the dry weight is approximately 60–70% of this. [2] According to the current FLL Green Roof Guidelines [3] Cost benchmark at 1,000 m² net incl. installation, material varies from region to region.

› System structure and components

The NATURE ROOF is a diverse and visually appealing Green Roof solution. With a basic system structure of at least 100 mm and partial elevations of up to 250 mm, the NATURE ROOF offers a wide variety of plants and can even be designed as a biodiversity space. Drainage is achieved using our Drainage Board (FKD) solution, suitable for rooftops with 0 – 5° pitch.

The NATURE ROOF is an impact-reducing measure as stipulated by the German impact mitigation regulation and helps significantly reduce fees in communities paying split waste water fees. The NATURE ROOF system meets the requirements of the German FLL Guideline for Green Roofs.



1 Vegetation
Pre-cultivated wildflower mat or plug plants and/or wildflower seed mix

2 Extensive Substrate E (60–210 mm)
A substrate with high water storage capacity and good air porosity, tailored to extensive multi-layer systems, minimum height 60 mm, mounds up to 210 mm

Combi Inspection Chamber TKS PLUS
(Not included in the drawing)
Simple control of roof drainage outlets, extendible in 100 mm increments, side and top drainage openings

3 Filter Fleece FIL 105
Prevents fine particles from forming sludge in the drainage layer; high water permeability

4 Drainage and Storage Board FKD 40 (40 mm)
Prevents accumulation of water for non-pitched roofs and large drainage lengths, lightweight design with high drainage capacity, water storage

5 Protection and Storage Fleece RMS 300
Protects roof system against damage and stores water. With inverted roofs, use RSV 120 trickle protection mat instead of the RMS fleece.

› Wind erosion protection

The NATURE ROOF system does not generally require a wind erosion protection calculation. This depends on the building height (e.g. from approx. 10 m high) and/or how exposed the building is (e.g. peripheral location, facing the main wind direction, located on a crest, etc.)

When assessing wind erosion protection, we normally indicate corner, edge and interior areas of the roof separately and make specific recommendations for each area. Usually, with tall or exposed buildings, the edge and corner areas need to be anchored most of all, e.g. using ESP erosion protection plates in the pebble boarders or vegetation mats on green spaces.

ⓘ **Wind suction technical information**
see page 122

› Vegetation

The basic system construction with the FKD 40 and 60 mm substrate is usually created with perennials established either by a pre-cultivated wildflower mat or selected plug plants and optional seed mix.

To widen the plant variety, Extensive Substrate E is raised entirely or in certain areas to 150 mm or even 210 mm (extensive to semi-intensive). The plants can be selected from a special list of species, e.g. by blossom colour and flowering season. For a rooftop with a biodiverse flower meadow that blooms from April to October, we recommend using the Seed Mixes EKR (herbs) and EGR (grasses). These high-quality seed mixes are composed of 30 herb species and 9 grass species. With a targeted selection of low-growing perennials, you can enjoy a variety of flowers over the entire growing season. On visible or utilised rooftops, the flowers can also be used to create special design accents.

ⓘ **Vegetation technical information**
see page 128

› Maintenance

The amount of maintenance required depends on the plant species selected. An herb-grass vegetation, for example, only needs trimmed down to about 70 mm above the top of the substrate once a year in autumn after the summer bloom. The resulting grass clippings should then be removed.

Depending on the vegetation, the roof should be given an application of about 30 – 50 g/m² of Slow Release Fertiliser Opticote every 1–2 years to provide the plants with the nutrients they need. We also recommend having an upkeep and maintenance contract with one of our Optigrün partners. For a listing of partners in your area, click the “Contact” link on our homepage.

ⓘ **Maintenance technical information**
see page 132 ff

› Special feature Biodiversity

Depending on the goal, the Nature Roof can be easily transformed into a biodiversity space with a few targeted steps. From a basic upgrade to an extensive Green Roof to the use of a Green Roof as a mitigation or reduction measure or even replicating biotopes for animal species in need of protection – the sky’s the limit.

For years now, these biodiversity building blocks have relied on the following guidelines:
- Impact-reducing in accordance with the German impact mitigation regulation
- Wide variety of roof landscape designs
- High water retention and high flow retardation
- Powerful evaporation and cooling effects
- Efficient filtration of pollutants
- Use of natural materials
- Use of recycled plastic
- All materials are recyclable
- Wide variety of flora and fauna

ⓘ **Biodiversity technical information**
see page 130

› More habitats for animals

The NATURE ROOF combines the different plant species in such a way that the flowering period lasts from the beginning of April to the end of October. This provides food for insects such as butterflies, wild bees and bumblebees almost all year round.

Specially coordinated seed mixes with many herbs and, on request, with grasses are used in addition to pre-cultivated perennials and various sedum cuttings. This ensures a beautiful flowering result and a long flowering period.

Various sedum cuttings were used here and supplemented with a diverse seed mix. Golden marguerite, Carthusian pink and flowering sedum are particularly eye-catching.

› From a nature roof to a biodiversity roof

It is even possible to further enhance the ecology of a NATURE ROOF in combination with numerous biodiversity components. Different substrate heights are used and ground is filled in places so that grasses, herbs, perennials, shrubs and even small trees can be planted.

This, in turn, contributes to greater water retention and a higher evaporation performance. A versatile and ecologically high-quality Green Roof solution is created with the help of further design elements.

ⓘ **Specialist information on biodiversity**
See page 130

RETENTION ROOF MEANDER

"The most efficient way to achieve flow retardation and high ecological value at the same time".

Dominik Gößner, Research & Development

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ROOF GREENING

? Service – Do you have any questions for us?
To learn about our wide range of services, see pages 4 and 5.
We offer project-specific initial calculations free of charge and provide all other calculations upon order placement.

To enquire about service, please email us at **info@optigruen.com**

RETENTION ROOF MEANDER

Extensive **Semi-intensive** Intensive

Meanders are natural river formations caused by the swirling movement of water. Instead of moving exclusively along the actual current, the river forms little eddies that wear away at the riverbank against the actual flow direction, forming curves. This action shapes the river over time until the water ends up having to flow through S-shaped loops. This extends the flow length, which reduces the flow velocity.

A good design imitates nature: When re-purposed for retention roof design, the meander shape lets us drain water slowly. Instead of flowing in a straight line, the water has to follow winding detours – a highly effective method of reducing drainage peaks.

MEANDER 30

Extensive

Page 28

MEANDER 60

Extensive **Semi-intensive**

Page 30

RETENTION ROOF MEANDER 30

Extensive Semi-intensive Intensive

The RETENTION ROOF MEANDER 30 is particularly good for extensive Green Roof structures requiring a very low discharge coefficient. The MEANDER FKM 30 drainage element forces rainwater to follow a longer flow path, and a flow control valve at the outlet slows it down even more. This greatly reduces the discharge coefficient.

› Technical data

Weight [1]	from 90 kg/m² or 0.9 kN/m²
Build-up depth	from 90 mm
Roof pitch	0 – 5°
Vegetation form	Sedum
Water Retention	50 – 70 %/year
Discharge coefficient [2]	C_S = 0.1
Retention volume	approx. 19 l/m² temporarily
Water storage	total 40 l/m²
Cost factor [3]	■■□□□

› Features

Ecological value ■■□□□
Maintenance costs ■□□□□

- Greatly reduced drainage peaks
- For extensive Green Roof structures

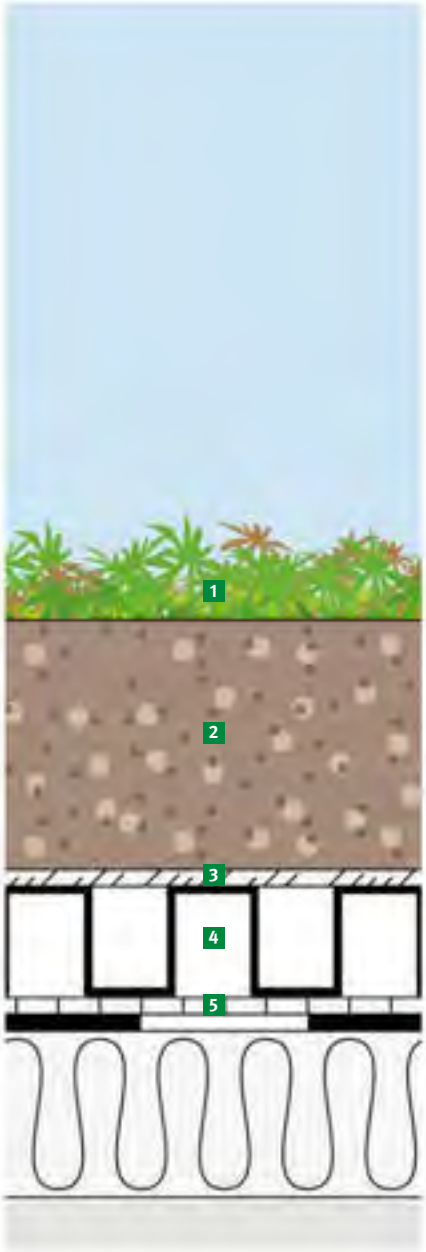
[1] In the same way as the requirements of the FLL Green Roof guidelines, a temporary water backflow is not taken into account in the weight information given. [2] Determined at 0 and 2% roof pitch based on the FLL method and with different substrate heights. [3] Cost benchmark at 1,000 m² net incl. installation, material varies from region to region.

› System structure and components

The RETENTION ROOF MEANDER 30 is a cost-effective and efficient product for flow retardation. This affordable and flat element is particularly useful for large industrial roofs since they often require compliance with restrictions on the rate of water flow into the public drainage system.

The sedum vegetation we recommend is robust and low-maintenance. This also contributes to the cost-effectiveness of the system.

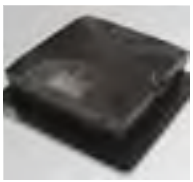
A RETENTION ROOF MEANDER 30 is an impact-reducing measure as stipulated by the German impact mitigation regulation and meets the requirements of the FLL Guideline for Green Roofs.



1 Vegetation Mat
Pre-cultivated sedum mat for the rapid establishment of vegetation in order to prevent wind erosion, with decomposable carrier
Alternatively: wildflower-based vegetation mats or plug planting

2 Extensive Substrate E (60 mm)
A substrate with high water storage capacity and good air porosity, tailored to extensive multi-layer systems

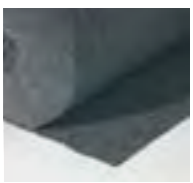
Combi Inspection Chamber TKS PLUS
(Not included in the drawing)
Simple control of roof drainage outlets, extendible in 100 mm increments, side and top drainage openings



3 Filter Fleece FIL 105
Prevents fine particles from forming sludge in the drainage layer; high water permeability

4 MEANDER and Water Retention Board FKM 30 (30 mm)
Greatly delayed drainage of excess water, lightweight structure with high drainage capacity, only temporary water storage

5 Protection and Storage Fleece RMS 300
Protects roof system against damage and stores water



RETENTION ROOF MEANDER 60

Extensive **Semi-intensive** Intensive

For extensive and semi-intensive Green Roof structures with permanent water storage and flow retardation, we recommend our RETENTION ROOF MEANDER 60. The MEANDER FKM 60 element is used as the drainage component. A portion of the rainwater is stored there long-term. At the same time, the flow rate of the remaining rainwater is slowed as it negotiates a longer flow path which is controlled at the outlet.

› Technical data

Weight [1]	from 110 kg/m² or 1.1 kN/m²
Build-up depth	from 120 mm
Roof pitch	0 – 5°
Vegetation form	Sedum-herbs-grasses
Water Retention	50 – 70 %/year
Discharge coefficient [2]	C_S = 0.17
Water storage	total 32 l/m²
Discharge yield	55 – 100 l/m²
Cost factor [3]	■■□□□

› Features

Ecological value ■■■■□
Maintenance costs ■■□□□

- Greatly reduced drainage peaks
- Long-term water storage
- For extensive and Semi-intensiv Green Roofs

[1] In the same way as the requirements of the FLL Green Roof guidelines, a temporary water backflow is not taken into account in the weight information given. [2] Determined at 0 and 2% roof pitch based on the FLL method and with different substrate heights. [3] Cost benchmark at 1,000 m² net incl. installation, material varies from region to region.

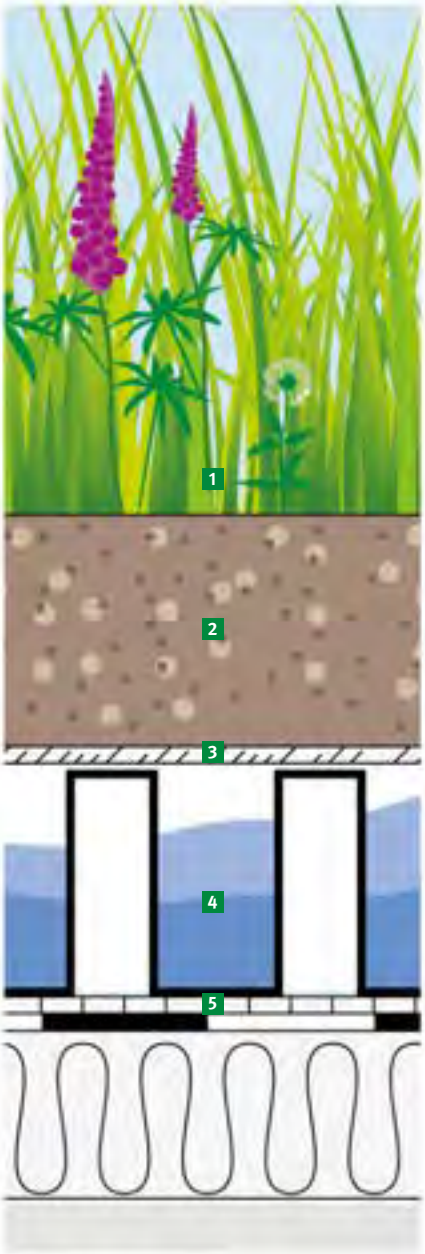
› System structure and components

The FKM 60 MEANDER element provides long-term water storage while also delaying water drainage, thus reducing the discharge coefficient.

Permanent water storage and delayed water drainage, combined with biodiversity and evaporation – this is what makes the RETENTION ROOF MEANDER 60 such a high-performing product.

The permanent storage of over 17 l/m² of water makes for thicker, lusher vegetation. This contributes to a wider variety of species and supports evaporation. This cools the environment, producing a positive effect on the urban climate.

The RETENTION ROOF MEANDER 60 is an impact-reducing measure as stipulated by the German impact mitigation regulation and meets the requirements of the FLL Guideline for Green Roofs.



1 Vegetation Mat
Pre-cultivated sedum mat for the rapid establishment of vegetation in order to prevent wind erosion, with decomposable carrier
Alternatively: wildflower-based vegetation mats or plug planting

2 Extensive Substrate E (60 mm)
A substrate with high water storage capacity and good air porosity, tailored to extensive multi-layer systems

Combi Inspection Chamber TKS PLUS
(Not included in the drawing)
Simple control of roof drainage outlets, extendible in 100 mm increments, side and top drainage openings

3 Filter Fleece FIL 105
Prevents fine particles from forming sludge in the drainage layer; high water permeability

4 MEANDER and Water Retention Board FKM 60 (60 mm)
Greatly delayed drainage of excess water, high retention with high drainage capacity, high-volume long-term water storage

5 Protection and Storage Fleece RMS 300
Protects roof system against damage and stores water

› Wind erosion protection

The RETENTION ROOF MEANDER system does not generally require a wind erosion protection calculation. This depends on Green Roof superstructure (extensive, Semi-intensiv), the building height (e.g. from approx. 10 m high) and/or how exposed the building is (e.g. peripheral location, facing the main wind direction, located on a crest, etc.)

When assessing wind erosion protection, we normally indicate corner, edge and interior areas of the roof separately and make specific recommendations for each area. Usually, with tall or exposed buildings, the edge and corner areas need to be anchored most of all, e.g. using ESP erosion protection plates in the pebble boarders or vegetation mats on green spaces.

ⓘ **Wind suction technical information**
see page 122

› Vegetation

For the RETENTION ROOF MEANDER 30 we recommend pre-cultivated sedum mat or alternatively plug plants and optional seed mix.

For the RETENTION ROOF MEANDER 60, we recommend planting perennials in combination with sedum and our EKR seed mix.

The RETENTION ROOF MEANDER 60 can be easily transformed into a biodiversity space with a few targeted steps. To do this, Extensive Substrate E is raised entirely or in certain areas to 150 or even 210 mm (extensive to semi-intensive). This allows the system to accommodate a wider variety of plants. The plants can be selected from a special list of species, e.g. by blossom colour and flowering season. For a rooftop with a biodiverse flower meadow that blooms from April to October, we recommend using the seed mixes EKR (herbs) and EGR (grasses). These high-quality seed mixes are composed of 30 herb species and 9 grass species. With a targeted selection of low-growing perennials, you can enjoy a variety of flowers over the entire growing season. On visible or utilised rooftops, the flowers can also be used to create special design accents.

ⓘ **Vegetation technical information**
see page 128

› Maintenance

The amount of maintenance required depends on the plant species selected.

Depending on the vegetation, the roof should be given an application of about 30 – 50 g/m² of Slow Release Fertiliser Opticote every 1–2 years to provide the plants with the nutrients they need.

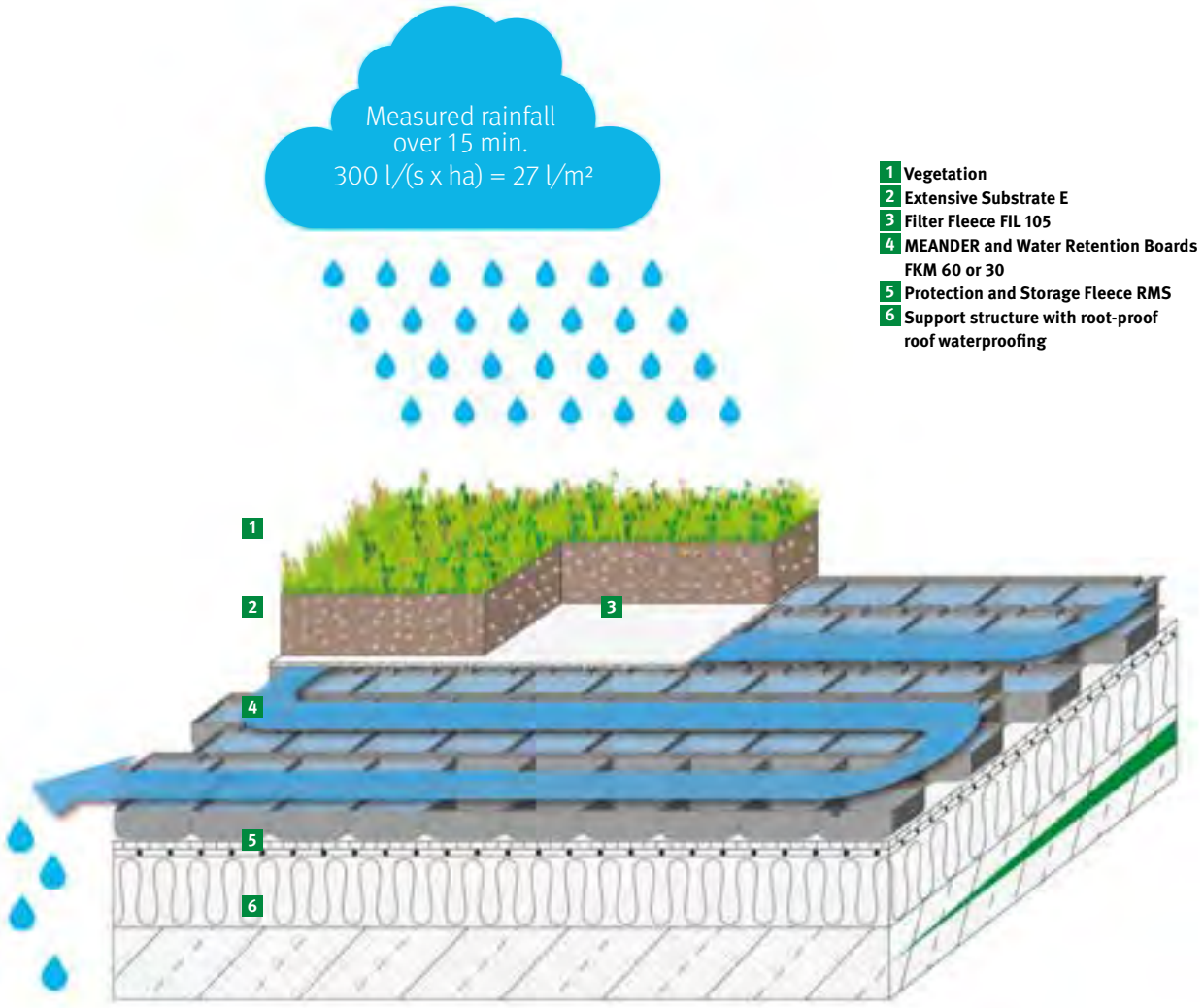
We also recommend having an upkeep and maintenance contract with one of our Optigrün partners. For a listing of partners in your area, click the “Contact” link on our homepage.

ⓘ **Maintenance technical information**
see page 132

› Special feature
Discharge coefficient C_S calculation as per FLL

The FLL Guideline specifies a special method for assessing the discharge coefficient Cs of a given system. Based on the worst case scenario for a Green Roof – full water saturation and a 2 % slope – the drainage is measured during a 15-minute heavy rain of 300 l/(s x ha). The discharge coefficient Cs indicates the relationship of the rainwater drainage rate to the rate of rainfall during a heavy rain period.

With heavy rains, the precipitation is drained into the sewage system with a severe delay.



RETENTION ROOF
FLOW CONTROL (BLUE ROOF SOLUTIONS)

"The Retention Roof Flow Control Solution is THE solution for reinstating the natural water balance in the urban environment."

Karishma Sina, Technical Department

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RETENTION ROOF FLOW CONTROL

Extensive Semi-intensive Intensive

In technical contexts, flow controls refer to connection pieces whose output, for example electricity or liquid, reduces as the input increases. They restrict flow movements.

FLOW CONTROL SOLUTION

Extensive Semi-intensive

Page 36

FLOW CONTROL SOLUTION

Intensive

Page 38

SMART FLOW CONTROL

Dynamic flow control

Page 41

RWS 4.0

Rainwater simulation programme

Page 42

RETENTION ROOF FLOW CONTROL SOLUTION

Extensive **Semi-intensive** Intensive

For extensive Green Roof structures subject to special requirements regarding overflow volume and outflow delay, we recommend a RETENTION ROOF FLOW CONTROL SOLUTION. The **W**ater**R**etention **B**ox (WRB) is used as the retention and drainage element. Depending on project requirements, the WRB element can be used for permanent water storage and/or as a temporary retention chamber for outflow delay.

› Technical data

Weight [1]	from 100 kg/m² or 1.0 kN/m²
Build-up depth	from 140 mm
Roof pitch	0°
Vegetation form	Sedum-herbs-grasses, possibly woody plants
Water retention	Project specific settings possible
Discharge coefficient [2]	Site-specific adjustments possible
Retention volume	75 l/m² (WRB 80F)
Water storage	total 95 – 150 l/m²
Cost factor [3]	■■■□□

› Features

Ecological value ■■■□□–■■■■■
Maintenance costs ■■□□□–■■■■■

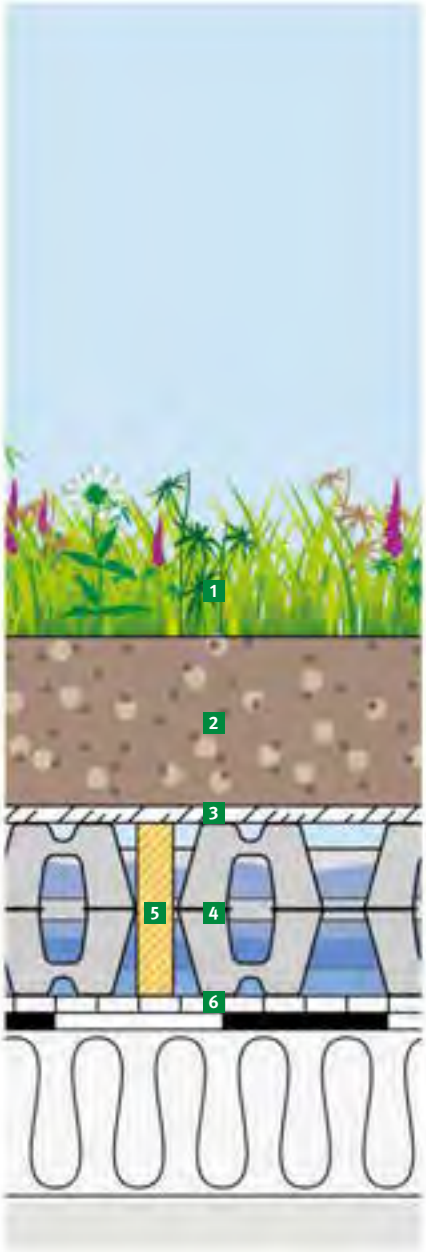
- Very low outflow rate, thanks to a specifically adjusted flow control unit
- High retention volume in the WRB 80F approx. 75 l/m²
- Lightweight thanks to hollow-body drainage unit (Water Retention Box WRB)
- High evaporation capacity thanks to integrated capillary system
- Basic prerequisite: 0° roof
- Suitable for inverted roofs

[1] The weight of the material varies from region to region. The information refers to the water-saturated state; the dry weight is approximately 60–70% of this. [2] According to the current FLL Green Roof Guidelines [3] Cost benchmark at 1,000 m² net incl. installation, material varies from region to region.

› System structure and components

The RETENTION ROOF FLOW CONTROL SOLUTION for extensive and semi-intensive Green Roofs is a cost-effective and efficient product for rainwater retention and outflow delay. Without outflow delay, the WRB 80F, has an integrated permanent water storage capacity of 6 l/m² which depends on the flow control unit. The WRB 80F is collapsible for easy transport.

The RETENTION ROOF FLOW CONTROL SOLUTION is an impact-reducing measure as stipulated by the German impact mitigation regulation and meets the requirements of the FLL Guideline for Green Roofs.



1 Vegetation Mat
Pre-cultivated sedum mat for the rapid establishment of vegetation in order to prevent wind erosion, with decomposable carrier
Alternatively: wildflower-based vegetation mats or plug planting

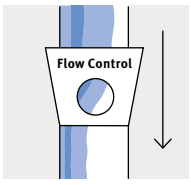
2 Extensive Substrate E (60mm)
Substrate coordinated for multiple-layer, extensive structures with high water reservoir capacity and good air void volume

3 Suction and Capillary Fleece RMS 500K
Optimal water distribution under the substrate layer

4 Water Retention Box WRB 80F
Interstitial volume for retention, tailored to the vegetation above it, lightweight, high water storage volume, with capillary columns

5 Capillary columns
Ensures the transport of the accumulated rainwater to the substrate level

Flow Control Unit (Not included in the drawing)
Retention control with defined perforations. Allows for delayed water discharge



6 Protection and Storage Fleece RMS 300
Protects roof system against damage and stores water. With inverted roofs, use RSV 120 trickle protection mat instead of the RMS fleece.

RETENTION ROOF FLOW CONTROL SOLUTION

Extensive Semi-intensive **Intensive**

For intensive Green Roof build-ups subject to special requirements regarding overflow volume and outflow delay we recommend a RETENTION ROOF FLOW CONTROL SOLUTION. The **W**ater**R**etention **B**ox (WRB) is used as the water storage and drainage element. Depending on the requirements, the WRB element can be used for permanent water storage and/or as a temporary retention chamber for outflow delay.

› Technical data

Weight [1]	from 310 kg/m² or 3.1 kN/m²
Build-up depth	from 330 mm
Roof pitch	0°
Vegetation form	Perennials-shrubs-lawns-trees
Discharge coefficient [2]	Site-specific adjustments possible
Retention volume	approx. 80 l/m² (WRB 85l)
Water storage	total 150 – 370 l/m²
Cost factor [3]	■■■■■

› Features

Ecological value	■■■■■
Maintenance costs	■■■■■

- Very low outflow rate, thanks to a specifically adjusted flow control unit
- Very high retention volume in the WRB 85i – approx. 80 l/m²
- Lightweight thanks to hollow-body drainage unit (WRB Water Retention Box)
- High evaporation capacity thanks to integrated capillary system
- Very high compressive strength
- Basic prerequisite: 0° roof
- Suitable for inverted roofs
- Also available as a public roof

[1] The weight of the material varies from region to region. The information refers to the water-saturated state; the dry weight is approximately 60 – 70% of this. [2] According to the current FLL Green Roof Guidelines [3] Cost benchmark at 1,000 m² net incl. installation, material varies from region to region.

› System structure and components

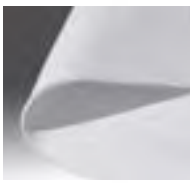
The RETENTION ROOF FLOW CONTROL SOLUTION for intensive Green Roof structures is a highly efficient product with excellent storage capacity. The WRB 85i elements have high compressive strength and are connected to one another to form an even, closed surface. This makes it possible to construct accessible rooftops with sections open to pedestrian and vehicle[3] traffic.

The RETENTION ROOF FLOW CONTROL SOLUTION is an impact-reducing measure as stipulated by the German impact mitigation regulation and meets the requirements of the FLL Guideline for Green Roofs.

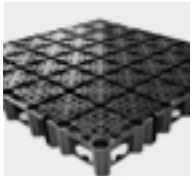
1 Intensive Roof Greening

2 Intensive Substrate i[4] (230 – 400 mm)
Alternatively:
Lawn Substrate R (200 – 300 mm)
A substrate with high water storage capacity and good air porosity, tailored to intensive multi-layer systems

3 Suction and Capillary Fleece RMS 500K
Optimal water distribution under the substrate layer

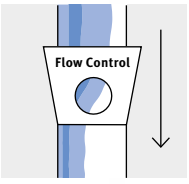


4 Water Retention Box WRB 85i
Interstitial volume for retention, high pressure stability, lightweight, with capillary columns in green spaces, without capillary columns under public roofs



5 Capillary columns
Ensures the transport of the accumulated rainwater to the substrate level

Flow Control Unit (Not included in the drawing)
Retention control with defined perforations. Allows for delayed water discharge



4 Protection and Storage Fleece RMS 900
Protects roof system against damage and stores water. With inverted roofs, use Trickle Protection Fleece RSV 120 instead of the RMS fleece.

[4] Depending on the load-bearing capacity of the substructure, either lightweight or heavy substrate can be used. The weight parameters refer to the water-saturated state; the dry weight is approx. 60 – 70 % of the saturated weight.

› Wind erosion protection

The RETENTION ROOF FLOW CONTROL SOLUTION does not generally require a wind erosion protection calculation. This depends on Green Roof superstructure (extensive, semi-intensive or intensive), the building height (e.g. from approx. 10 m high) and/or how exposed the building is (e.g. peripheral location, facing the main wind direction, located on a crest, etc.)

When assessing wind erosion protection, we normally indicate corner, edge and interior areas of the roof separately and make specific recommendations for each area. Usually, with tall or exposed buildings, the edge and corner areas need to be anchored most of all, e.g. using ESP erosion protection plates in the pebble boarders or vegetation mats on green spaces.

Special attention should also be paid to the anchorage of individual shrubs and trees to protect against wind erosion.

ⓘ **Wind suction technical information**
see page 122

› Vegetation

For an extensive green RETENTION ROOF with FLOW CONTROL, we recommend pre-cultivated vegetation mats or plug planting. And, if required, EKR seed mix. For a single-layer, intensive Green Roof, we recommend planting perennials in combination with sedum cuttings and our EKR seed mix. An extensive green RETENTION ROOF with FLOW CONTROL can be easily transformed into a biodiversity space with a few targeted features.

For an intensive green RETENTION ROOF FLOW CONTROL SOLUTION, a GARDEN ROOF or LANDSCAPE ROOF can be used. The deeper structure of the system and the large water storage capacity are conducive to the use of lawns, perennial beds, shrubbery, fruits and vegetables, as well as bushes and trees. The design possibilities are practically limitless as well. Paths, terraces or garden ponds, sandboxes, pavilions or pergolas – just about anything goes.

ⓘ **Vegetation technical information**
see page 128

ⓘ **Biodiversity technical information**
see page 130

› Maintenance

› Extensive Green Roof maintenance
The amount of maintenance required depends on the plant species selected.
Depending on the vegetation, the roof should be given an application of about 30–50 g/m² of Slow Release Fertiliser Opticote every 1–2 years to provide the plants with the nutrients they need.

› Intensive Green Roof maintenance
As with any “regular” garden, the amount of maintenance required depends on the plant species. Depending on the vegetation, the green spaces should be given an application of about 50 g/m² of Slow Release Fertiliser Opticote once a year to provide the plants with the nutrients they need.

We also recommend having an upkeep and maintenance contract with one of our Optigrün partners. For a listing of partners in your area, click the “Contact” link on our homepage.

ⓘ **Maintenance technical information**
see page 132

›Special feature:

The Flow Control Intensive Roof can also be created as a public roof. Retention public roofs are paths and areas that can be used by people, cars and trucks while simultaneously acting as retention space. They can be combined with green areas on the roof. Retention Public Roof can be used on uninsulated roofs as well as on warm and inverted roofs.

SMART FLOW CONTROL

Dynamic Flow Control 4.0 via App!

Smart Flow Control is an electronically controlled valve that dynamically regulates the retention volume in order to fully utilise the retention potential of your Green Roof structure.

ⓘ **Check out the informational video in our media library!**

https://www.optigreen.com/planning-aids/media-library/optigreen-videos/

1 Basic state of an intensive Green Roof
Rainwater is stored and made available to plants during dry periods: plant water supply, evaporative cooling.

2 Rain in the forecast
When the forecast predict rainfall, the weather app prompts the Smart Flow Control to open the drainage outlet and release the amount of stored water in line with the expected level of precipitation. This way, the retention volume matches the volume of pending precipitation. The water is drained before it rains, while the local surface water drainage system is still at normal capacity.

3 Stormwater storage during precipitation
Precipitation is stored in the Water Retention Box. No water is drained into the sewage system. So the maximum possible amount of rain is saved.

RWS 4.0

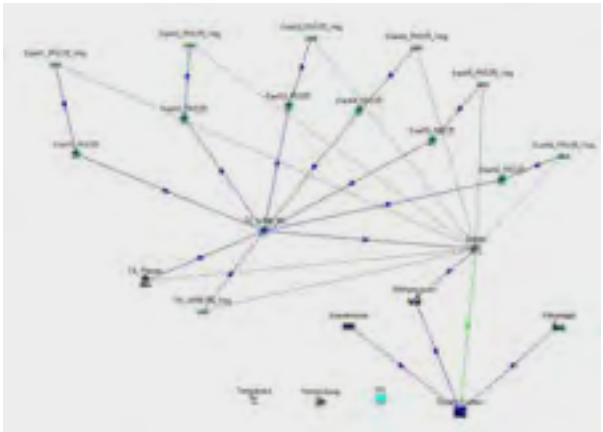
The RWS 4.0 is a rainwater simulation programme used to determine the drainage, flooding frequency and water balance of a Green Roof.

Due to climate change and increasing development in urban areas, both flooding and heat waves are becoming more frequent. Green Roofs can help counter these effects. They allow stormwater to be stored and then evaporated. Evaporation converts “sensible” thermal energy (the kind you feel) into “latent” thermal energy (the kind you don’t). This has a cooling effect on the environment. In this way, Green Roofs mitigate both heat waves and flooding. To quantify how much a Green Roof contributes to flood protection and microclimate improvement, it is necessary to determine drainage, flood frequency and water balance.

The RWS 4.0 software programme from Optigrün performs all these calculations. RWS 4.0 is a run-off model that includes special calculation modules for our Green Roofs. State-of-the-art run-off models are the most accurate method of calculating stormwater drainage and are an excellent way to ensure planning reliability. Unlike other run-off models, RWS 4.0 also indicates water balance. With this special feature, the software exceeds the current standard legal requirements.

1 Supervision of the site being simulated

2 Interconnecting the different catchment areas of the site



› How does RWS 4.0 work?

This hydrological model differentiates between the run-off generated in hard and soft landscaped spaces. Unlike the approach used with sealed areas, drainage generation in natural spaces is calculated using a soil water content formula that factors in infiltration and evaporation, as well as drainage concentration. In this case, the substrate of the vegetation layer is treated as a ground reservoir which can comprise multiple layers.

The RWS 4.0 software accounts for the following:
- Complex combined spaces and rainwater management systems
- Soil moisture for natural spaces, Green Roofs and seepage systems in different soil or substrate layers
- Capillary rise in the soil body
- Evaporation in the soil and through plants

The input parameters used are:
- Meteorological data (temperature, wind speed, sunshine duration, humidity, latitude), as daily data or, if possible, as hourly data
- Precipitation data (preferably 5-minute data)
- Substrate parameters for substrates on Green Roofs
- Retention storage volumes of different roof types
- Root depth and capillary rise for plant uptake
- Potential evapotranspiration
- Soil type
- Land utilisation

With the selection of real and virtual rainfalls (model rainfalls, long-term simulation and serial simulation), in conjunction with with the aforementioned parameters, you can calculate drainage, flooding frequencies and water balance.

› How do you get a calculation?

Simply send us a completed retention roof checklist (the template can be found on our website) with plans of the top view of the roof for your building project to:
retention@optigruen.de
info@optigreen.co.uk (UK only)

Using our current professional water management software RWS 4.0, we provide you with flooding verification, a water balance and proof of faultless drainage for your property free of charge.

▾
1+2 Site interconnection and supervision
of the site being simulated in a combined display view

PITCHED ROOF

"Sloped rooftop greening is the supreme discipline for Green Roof specialists. With our decades of experience and development, we're able to choose from a range of innovative system modules and combine them with established load calculations to create streamlined solutions."

Adrian Hänle, Technical Department

OPTIGRÜN®
ROOF GREENING

? Service – Do you have any questions for us?
To learn about our wide range of services, see pages 4 and 5.
We offer project-specific initial calculations free of charge and provide all other calculations upon order placement.

To enquire about service, please email us at **info@optigruen.com**

PITCHED ROOF

Extensive **Semi-intensive** Intensive

Sloped Green Roofs require special attention right from the initial planning phase. Roof pitch, roof design, roof structures, loading and the required shear resistance measures all need to be adjusted for the desired vegetation.

If the roof has a pitch of 10° or more, ANTI-SLIP SYSTEMS ARE GENERALLY used. For pitches of 15° or more, we also recommend using vegetation mats. Depending on the structural constraints, there are various Anti-Slip systems to choose from:

Roof shape

Suitable for monopitch roofs

Suitable for duo pitch roofs

Suitable for barrel roofs

Suitable for cupola roofs

Suitable for special designs as well as organic and curved designs

5 – 15°

WITHOUT ANTI-SLIP SYSTEM

Extensive

Page 47

15 – 35°

ANTI-SLIP SYSTEM P

Extensive **Semi-intensive**

Page 48

15 – 45°

ANTI-SLIP SYSTEM N

Extensive **Semi-intensive**

Page 50

15 – 45°

ANTI-SLIP SYSTEM T

Extensive **Semi-intensive**

Page 52

15 – 45°

ANTI-SLIP SYSTEM S

Extensive **Semi-intensive**

Page 54

SPECIAL PRODUCTS FOR PITCHED ROOFS

Page 57

PITCHED ROOF

› System structure

Due to the sometimes limited load reserves of sloped roofs, particularly timber roof structures, most sloped Green Roofs are designed as thin-layered extensive Green Roof structures.

For roof pitches of 15° and above, we recommend using Anti-Slip systems in conjunction with pre-cultivated sedum vegetation mats. When combined with our EXTENSIVE SUBSTRATE E, our Anti-Slip elements provide a stable and easily penetrable rooting layer for vegetation. The vegetation mats provide surface erosion protection and allow vegetation to establish itself quickly. For roofs with a pitch of 35° or more, an automatic watering system should also be considered.

Semi-intensive sloped Green Roofs require major load reserves and are therefore typically designed as concrete structures. Since the slope of the rooftop causes water to be drained faster, we recommend the use of automatic watering systems, especially for lawn roofs with pitches of up to approx. 25°. Intensive green structures will have higher maintenance requirements. Special precautions should therefore be taken to ensure fall protection.

WITHOUT ANTI-SLIP SYSTEM 5–15°

Extensive Semi-intensive Intensive

› Technical data

Roof pitch [1]	5–15°
Discharge coefficient [2]	$C_S = 0.6$
Water storage	from 30 l/m²
Cost factor [3]	■■□□□ – ■■■□□

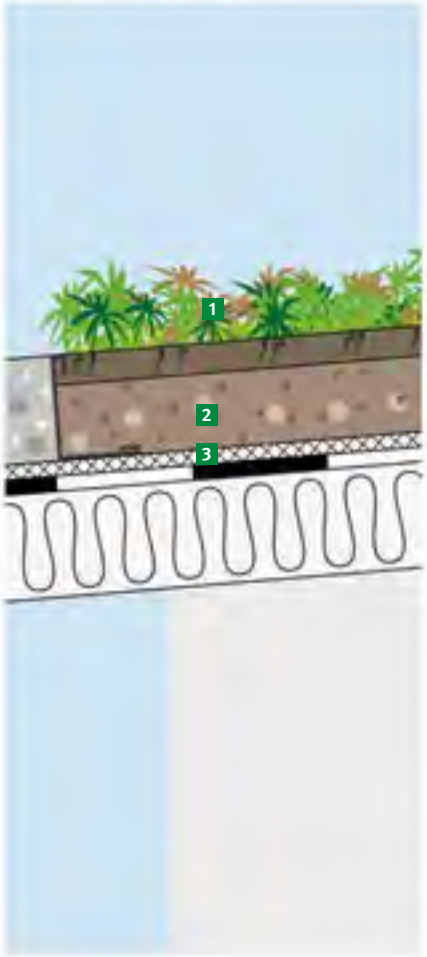
› Features

Ecological value ■■□□□
Maintenance costs ■■■□□

- Sustainable solutions for pitched Green Roofs
- With slope lengths of over 6 metres and smooth surfaced single ply waterproofing, if the roof pitch is 10° or more, the Green Roof superstructure may be at risk of slipping, for example during a severe storm. To prevent this from happening, design solutions should be implemented to prevent slippage. These solutions will be explained in the next few pages.

› System structure and components

For gently sloping pitched roofs with a pitch of 15° or less, it is possible to install a single-layer extensive Green Roof structure without Anti-Slip protection on the Structured Storage Fleece SSV 800.



1 Vegetation Mat
Pre-cultivated vegetation mats for rapid vegetation establishment, with decomposable backing (alternatively, dry seeding also possible)

2 Extensive Substrate E (80 – 100 mm)
A substrate with high water storage capacity and good air porosity, tailored to extensive systems

3 Structured Storage Fleece SSV 800
Combined protection, water storage and drainage mat for targeted excess water drainage (installed across entire surface with min. 100 mm overlap between adjoining sections)

[1] Anti-Slip protection is recommended from a roof pitch of 10° in the event of plastic waterproofing on pitched roofs with a flow length of over 6 m [2] According to the current FLL Green Roof Guidelines [3] Cost benchmark at 1,000 m² net incl. installation, varies from region to region.

ANTI-SLIP SYSTEM P 15–35°

Extensive **Semi-intensive** Intensive

Anti-Slip System P is suitable for monopitch and duo pitch roofs with pitches of up to approx. 35°. The advantages of this system are that it is quick to install, easy to cut to size and comes at an affordable price. It can be used to create sturdy and low-cost Green Roof structures on pitched roofs with slopes of up to 35°. Roofs with pitches of approx. 25° and higher, require the use of a vegetation mat fastening rail to prevent the vegetation mats from slipping.

› Technical data

Weight [1]	from 100 kg/m² or 1.0 kN/m²
Build-up depth	from 110 mm
Roof pitch [2]	15 – 35°
Vegetation form	Sedum or sedum-herbs-grasses
Discharge coefficient [3]	$C_S = 0.7$
Water storage	from 25 l/m²
Cost factor [4]	■■□□□

› Features

Ecological value	■■□□□
Maintenance costs	■■■□□

- Sustainable solutions for greening sloped and steeply pitched roofs
- Roofs with pitches of approx. 25° and higher, require the use of a vegetation mat fastening rail
- The EPS Anti-Slip board is specially adapted for watering system installation

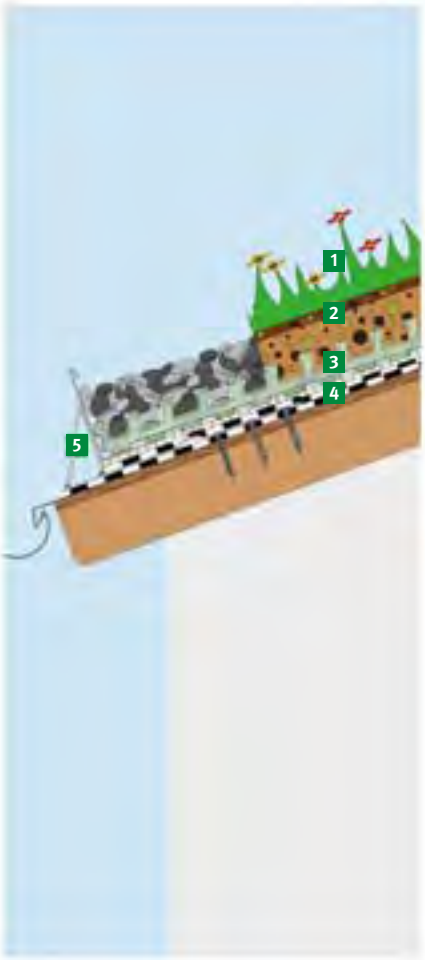
[1] The weight information refers to the water-saturated state; the dry weight is approximately 60–70% of this. [2] Anti-Slip protection is recommended from a roof pitch of 10° in the event of plastic waterproofing on pitched roofs with a flow length of over 6 m. [3] According to the current FLL Green Roof Guidelines [4] Cost benchmark at 1,000 m² net incl. installation, varies from region to region.

› System structure and components

The Pitched Roof Board FKD 58SD is used with Anti-Slip System P. The FKD 58SD was specially developed for pitched Green Roofs and made of pressure resistant EPS (expanded polystyrene). It features water storage chambers with overflow function (storage capacity approx. 3.2 l/m² with 25° roof pitch) and provides excellent drainage performance at the same time.

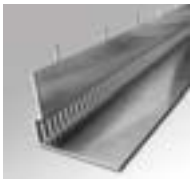
The Pitched Roof Board FKD 58SD, with precision fit Z-fold, is installed flush with the Protection and Storage Fleece RMS 500 and filled or overfilled with Extensive Substrate Type E.

Another special feature of the FKD 58SD is the device for holding drip tubes for automatic irrigation if desired/required.



1 Vegetation Mat
Pre-cultivated vegetation mats for rapid vegetation establishment, with decomposable backing

Vegetation mat securing profile VFL 100-200 (Not included in the drawing)
Anti-Slip protection for vegetation mats optionally from 25°



2 Extensive Substrate E
A substrate with high water storage capacity and good air porosity, tailored to extensive multi-layer systems, application amount at least 70 l/m²

3 Pitched Roof Board FKD 58SD
100 % EPS, lightweight, lightweight structure with high drainage capacity, can be combined with drip irrigation.

4 Protection and Storage Fleece RMS 500
Protects roof system against damage and stores water

5 Structurally effective eaves
e.g. Optigrün overhang and eaves profile

ANTI-SLIP SYSTEM N 15–45°

Extensive **Semi-intensive** Intensive

Anti-Slip N-System is suitable for barrel, monopitch, duo pitch and cupola roofs with pitches of up to 45°. For symmetric roofs, the major advantage of the N-System is that it doesn't require any drilling. It works without the need for a structural kerb at the base of the slope. The N-System maintains its own equilibrium. It's low-cost and easy to install.

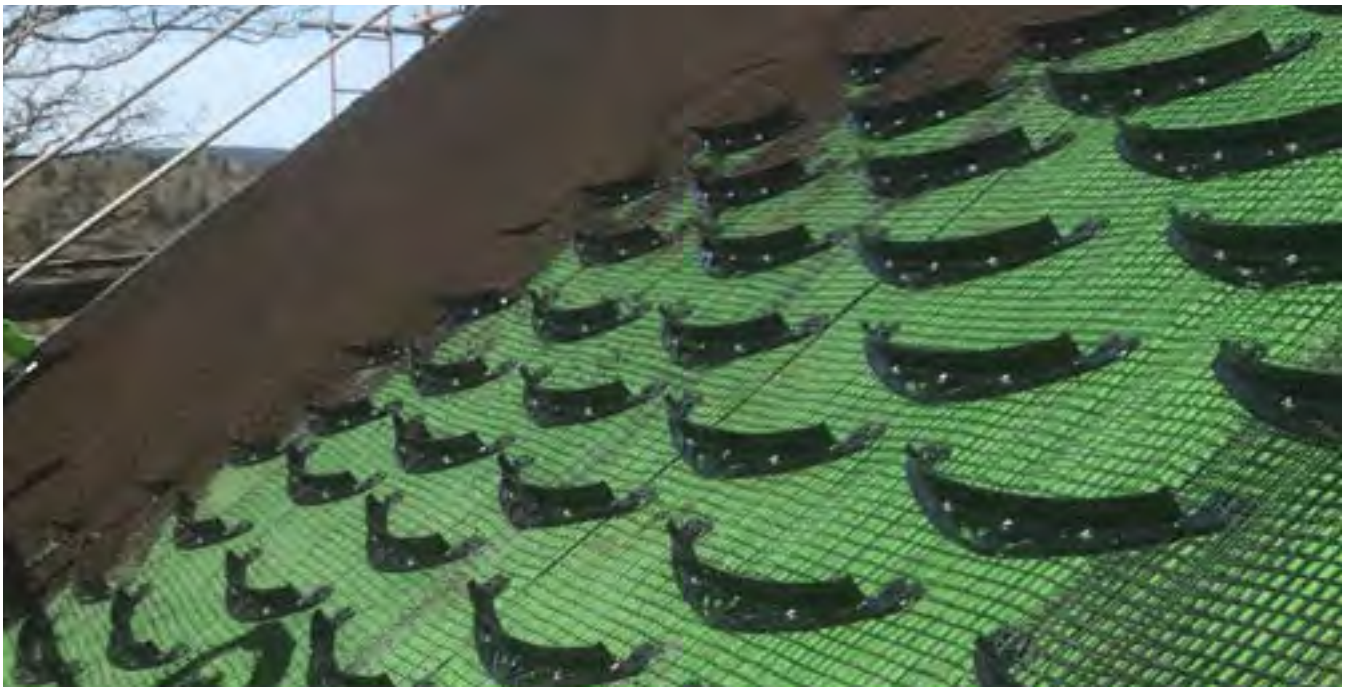
› Technical data

Weight [1]	from 100 kg/m² or 1.0 kN/m²
Build-up depth	from 80 mm
Roof pitch [2]	15 – 45°
Vegetation form	Sedum or sedum-herbs-grasses
Discharge coefficient [3]	C_S = 0.7
Water storage	from 30 l/m²
Cost factor [4] incl. Vegetation Mat	■■■■□

› Features

Ecological value ■■□□□
Maintenance costs ■■■□□

- Sustainable solutions for greening sloped and steeply pitched roofs
- Suitable for inverted roofs
- On roofs with pitches of 25° and higher, the vegetation mats should be attached to the shear barriers with metal pins to prevent them from slipping.
- On roofs with pitches of 35° and higher, we recommend installing a water system



[1] The weight information refers to the water-saturated state; the dry weight is approximately 60–70% of this. [2] Anti-Slip protection is recommended from a roof pitch of 10° in the event of plastic waterproofing on pitched roofs with a flow length of over 6 m. [3] According to the current FLL Green Roof Guidelines [4] Cost benchmark at 1,000 m² net incl. installation, varies from region to region.

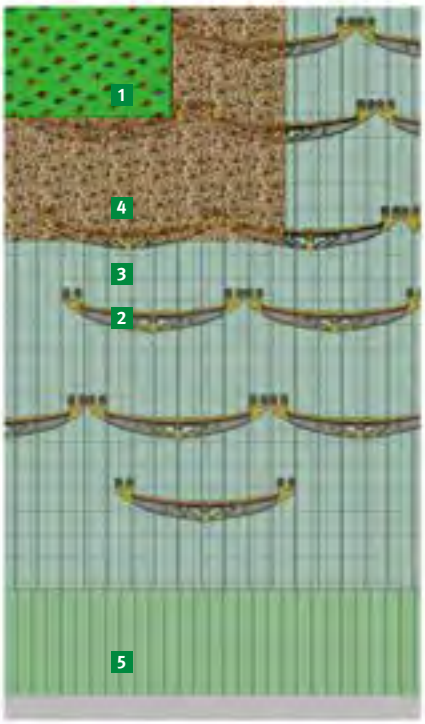
› System structure and components

Anti-Slip System N is comprised of a net that is highly resistant to tearing and decay. Its purpose is to absorb tensile forces from the shear barriers.

The special shear barriers with integrated fastening hooks are mounted on the net, which is installed over the crown or attached with fastening systems. The advantage of this system is that it is easy to install and very flexible. The distance between shear barriers can be adjusted flexibly to the roof pitch.

Thanks to a high degree of standardisation, many kinds of pitched roofs can be equipped at an affordable price.

Roof pitch	Shear barrier spacing	Number of shear barriers N
up to 20°	1000 mm	1.4/m²
21–25°	500 mm	2.8/m²
26–35°	330 mm	4.2/m²
36–45°	250 mm	5.6/m²



1 Vegetation Mat
Pre-cultivated vegetation mat for rapid establishment of vegetation

2 Pitched Roof Sill N
With fixing straps, shear stress distribution over the crown or in combination with a fastening profile

3 Pitched Roof Safety Net
Highly resistant to tearing and decay

4 Extensive Substrate E (60 mm)
A substrate with high water storage capacity and good air porosity, tailored to extensive multi-layer systems, application amount at least 70 l/m² . Minimum height 60 mm.

5 Structured Storage Fleece SSV 800
Combined protective liner with water storage and drainage function

ANTI-SLIP SYSTEM T 15–45°

Extensive **Semi-intensive** Intensive

The T-system is suitable for all monopitch and duo pitch roofs with pitches of up to approx. 45°. It is extremely sturdy and can be walked on during installation. This makes steep rooftops with pitches over 40° easier to implement.

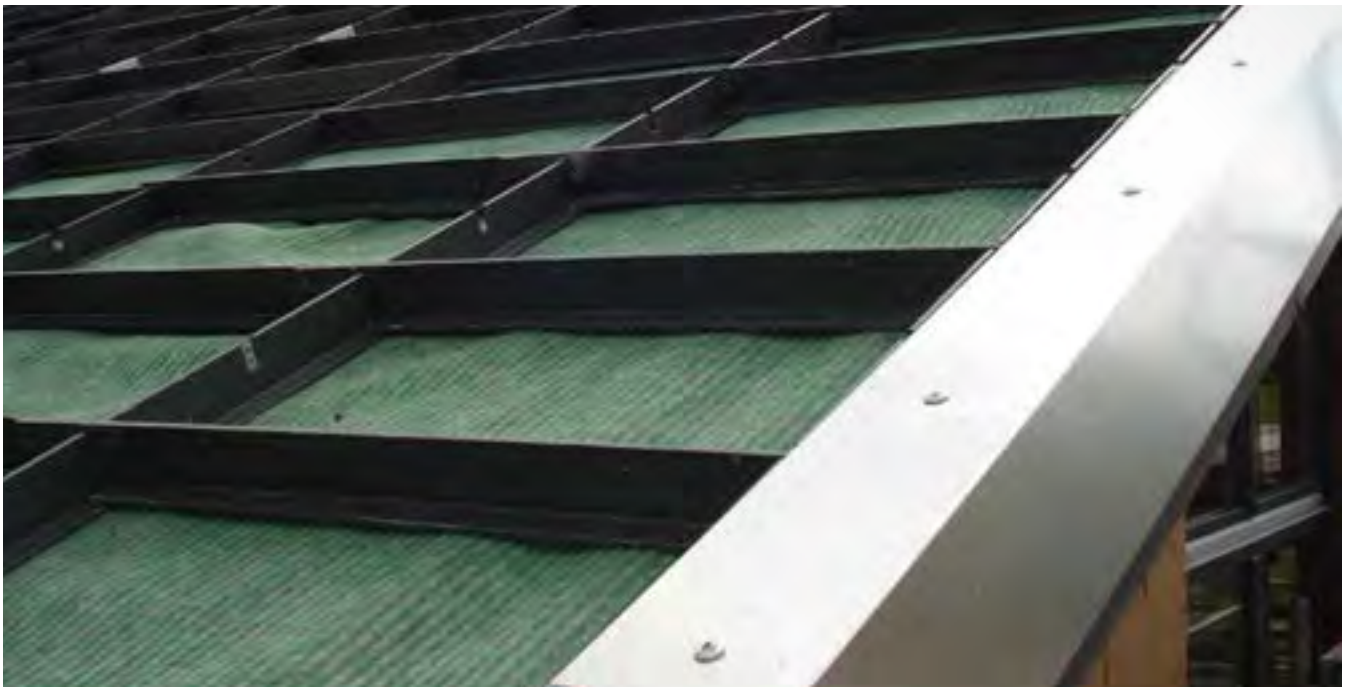
› Technical data

Weight [1]	from 120 kg/m² or 1.2 kN/m²
Build-up depth	from 100 mm
Roof pitch [2]	15 – 45°
Vegetation form	Sedum or sedum-herbs-grasses
Discharge coefficient [3]	C_S = 0.7
Water storage	from 30 l/m²
Cost factor [4] incl. Vegetation Mat	■■■■□

› Features

Ecological value ■■□□□
Maintenance costs ■■■□□

- Sustainable solutions for pitched Green Roofs
- On roofs with pitches of 25° and higher, the vegetation mats should be attached to the shear barriers with metal pins to prevent them from slipping.
- On roofs with pitches of 35° and higher, we recommend using an automatic watering system



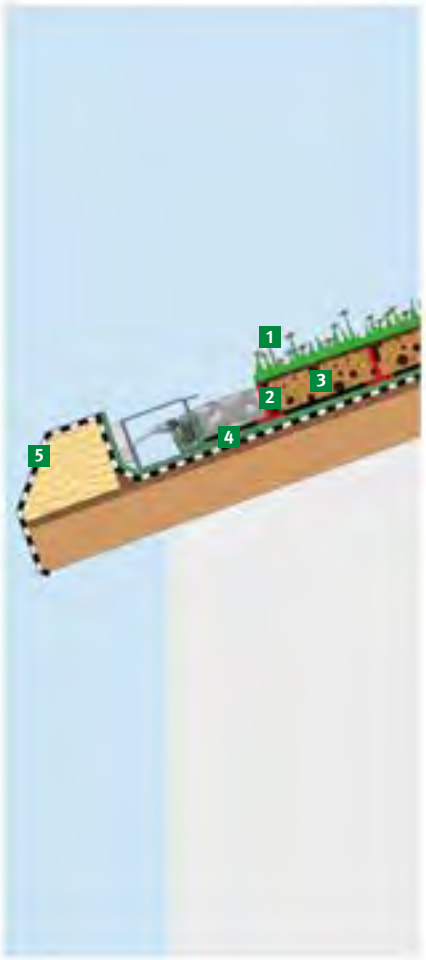
[1] The weight information refers to the water-saturated state; the dry weight is approximately 60–70% of this. [2] Anti-Slip protection is recommended from a roof pitch of 10° in the event of plastic waterproofing on pitched roofs with a flow length of over 6 m. [3] According to the current FLL Green Roof Guidelines [4] Cost benchmark at 1,000 m² net incl. installation, varies from region to region.

› System structure and components

Anti-Slip System T is manufactured from rot-proof recycled plastic. The simple plug system is composed of shear supports (3250 mm long) and shear barriers (1070 mm long) with a height of 80 mm.

The shear barriers are plugged together, spaced apart by the required distance, depending on the roof pitch and structural height. Excess water is stored and drained under the system by the SSV 800 Structured Storage Fleece.

Roof pitch	Shear barrier spacing
up to 15°	1500 mm
16 – 20°	1000 mm
21 – 30°	500 mm
31 – 45°	250 mm



1 Vegetation Mat
Pre-cultivated vegetation mat for rapid establishment of vegetation

2 Anti-Slip System T
For application against structural eaves detail, maximum shear load transfer 6.9kN per shear support

3 Extensive Substrate E (80 mm)
A substrate with high water storage capacity and good air porosity, tailored to extensive multi-layer systems, Minimum height 80 mm.

4 Structured Storage Fleece SSV 800
Combined protective liner with water storage and drainage function

5 Structural eaves detail

ANTI-SLIP SYSTEM S 15–45°

Extensive **Semi-intensive** Intensive

Anti-Slip System S is suitable for sloped roofs with pitches of up to approx. 45°. It is typically used for special roof shapes with extra high shear loads, with curved or vaulted roof surfaces or when an Anti-Slip support cannot be placed against the eaves.
The advantage of this system is that it can be used to install extensive or semi-intensive Green Roof structures on pitched roofs with complicated shapes and high shear loads. This Anti-Slip System requires detailed planning and calculations to be done in advance.

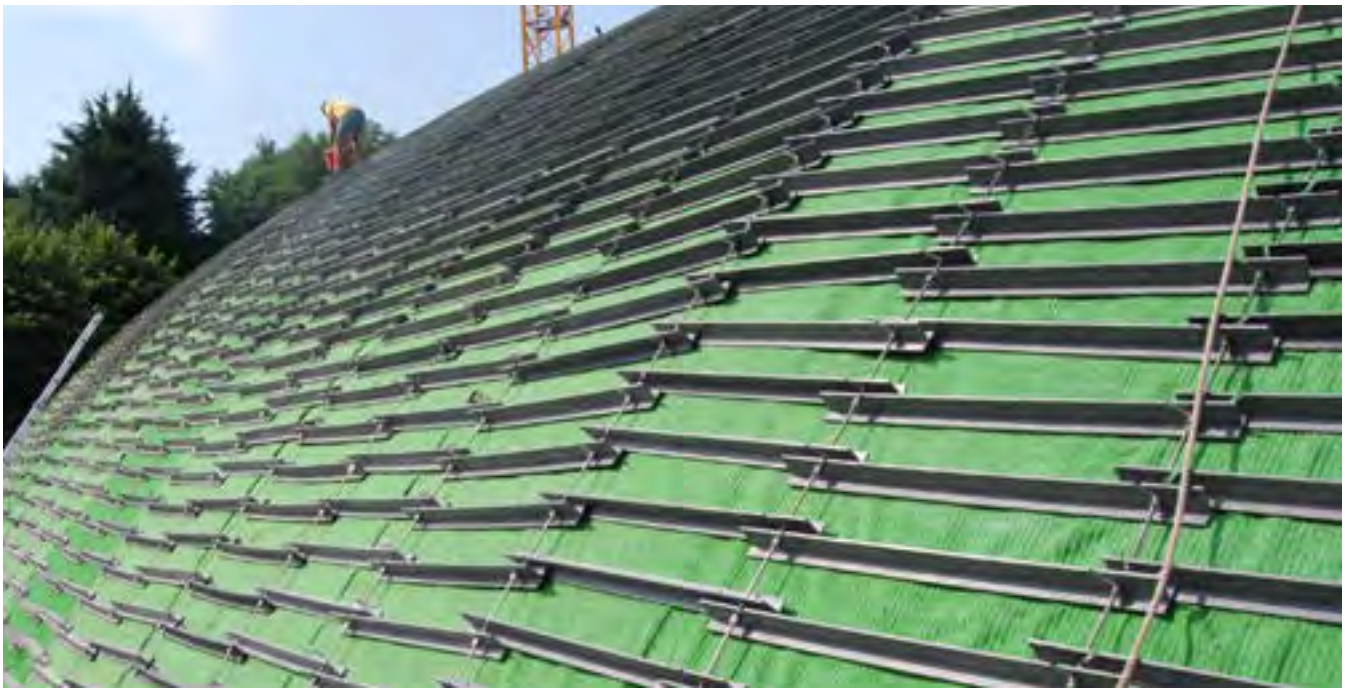
› Technical data

Weight [1]	from 120 kg/m² or 1.2 kN/m²
Build-up depth	from 100 mm
Roof pitch [2]	15 – 45°
Vegetation form	Sedum and/or sedum-herbs-grasses with higher substrate
Discharge coefficient [3]	$C_S = 0.7$
Water storage	from 30 l/m²
Cost factor [4]	on request

› Features

Ecological value ■■□□□
Maintenance costs ■■■□□

- Sustainable solutions for pitched Green Roofs
- Suitable for inverted roofs
- On roofs with pitches of 25° and higher, the vegetation mats should be attached to the shear barriers with metal pins to prevent them from slipping
- On roofs with pitches of 35° and higher, we recommend installing a water system

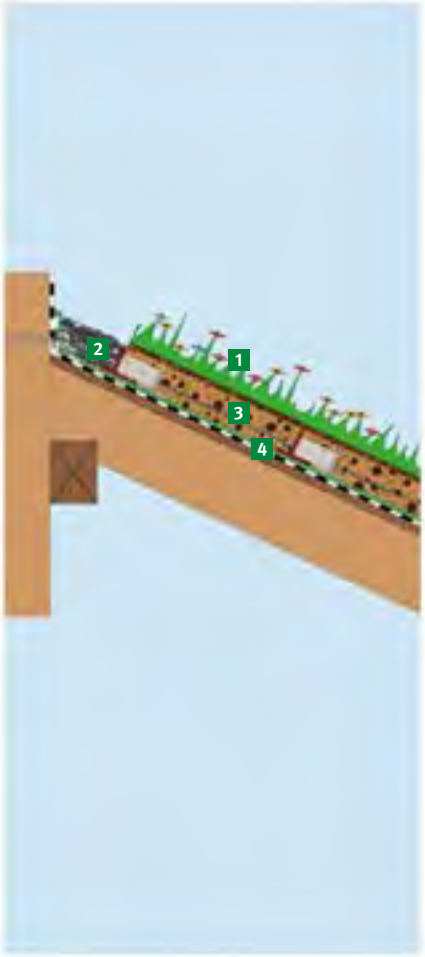


[1] The weight information refers to the water-saturated state; the dry weight is approximately 60–70% of this. [2] Anti-Slip protection is recommended from a roof pitch of 10° in the event of plastic waterproofing on pitched roofs with a flow length of over 6 m. [3] According to the current FLL Green Roof Guidelines [4] Cost benchmark at 1,000 m² net incl. installation, varies from region to region.

› System structure and components

This system is made from rotproof recycled plastic (Sills) in conjunction with high-strength stainless steel cables as a shear-load-absorbing component which is attached to the rooftop at permanently installed anchorage points. These anchorage points must be individually tailored to the building.

Roof pitch	Sill spacing
up to 15°	1500 mm
16 – 20°	1000 mm
21 – 30°	500 mm
31 – 45°	250 mm



1 Vegetation Mat
Pre-cultivated vegetation mat for rapid establishment of vegetation

2 Stainless steel with cable stopper and Pitched Roof Sill T

3 Extensive Substrate E (80 mm)
A substrate with high water storage capacity and good air porosity

4 Structured Storage Fleece SSV 800
Combined protective liner with water storage and drainage function

› Wind erosion protection

The PITCHED ROOF system does not generally require a wind erosion protection calculation. The risk of wind erosion depends on the Green Roof build-up (extensive or single layer intensive), the building height (e.g. 10 metres high and above), the location of the building and how exposed it i s as well as roof aspect. When assessing wind erosion protection we will normally identify corner, perimeter edge and interior areas separately and make specific recommendations for each. Usually with tall or exposed buildings the perimeters edges and corners are likely to need additional anchoring most of all.

ⓘ Wind suction technical information
see page 122

› Vegetation

Different types of vegetation are possible, depending on the height and type of structure. For thin-layered pitched Green Roofs, we recommend using extra drought-resistant plants such as sedum.

A walkable lawn (up to approx. 25° DN) is generally possible with semi-intensive greening structures and 150 – 200 mm substrate layer thickness. However, an automated watering system is absolutely necessary, as grasses require a great deal of water.

ⓘ Vegetation technical information
see page 128

› Maintenance

The amount of maintenance required depends on the plant species selected.

Depending on the vegetation, the roof should be given an application of about 30 – 50 g/m² of Slow Release Fertiliser Opticote every 1–2 years to provide the plants with the nutrients they need.

We also recommend having an upkeep and maintenance contract with one of our Optigrün partners. For a listing of partners in your area, click the “Contact” link on our homepage.

ⓘ Maintenance technical information
see page 132

› Special feature Drainage/irrigation

Drainage on roofs with › 5° pitch is generally not a problem. The steeper the roof, the faster the excess water runs off without retention. Similarly to the roof pitch, the discharge coefficient C_S also increases. As a result, the substrate tends to dry out faster on pitched Green Roofs.

› Roof pitch 5 to 15°
For low-gradient roofs (generally without Anti-Slip system) we recommend a single-layer structure with Substrate E on our special Protection, Water Storage and Drainage Fleece SSV 800 with sprout seeding or perennial plants. This usually doesn’t require artificial irrigation.

› Roof pitch 10° and 35°
For steeper roofs and also with nested roof geometries, we recommend using our special Anti-Slip systems. These products meet all the FLL Guideline’s requirements for an Anti-Slip System from approx. 10°.

› Roof pitch up to 45°
For pitched roofs of up to 45° that are designed with an Anti-Slip System , our Substrate E is used on our special Protection, Water Storage and Drainage Fleece SSV 800 with vegetation mats. For pitches of 35° and higher, depending on the location, we recommend automatic watering systems to ensure the long-term functionality of the green structures.

SPECIAL PRODUCTS FOR PITCHED ROOFS

We offer different Anti-Slip Systems and a wide selection of accessories for the various structural characteristics of pitched roofs.

Protection, water storage and drainage fleece with water storage and drainage function for pitched Green Roofs with and without Anti-Slip System.

Combined protective liner made of rot-proof PP plastic fibres.

SSV 800
- For targeted drainage of excess water, especially from the eaves.
- From 5° pitch, installed over entire area
- Not necessary by using Anti-Slip System P with FKD 58SD

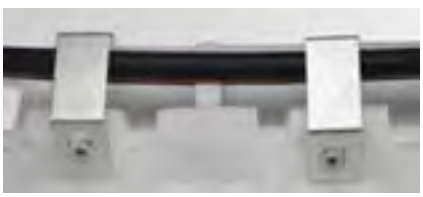
Strength class	GRK 3
Thickness	approx. 10.0 mm
Weight	800 g/m²
Water storage	approx. 6.0 l/m²
Roll	40 m²
Roll width	2 000 mm

Pitched Roof Board for anchorage, drainage and water storage under pitched Green Roofs up to 35°. [1]

100 % EPS (expanded polystyrene, HBCD-free), low net weight, lightweight construction with high drainage capacity, safe and targeted drainage of excess water, can be combined with drip irrigation, recyclable.

FKD 58SD [1]
Pitched Roof Board
- Drainage, Anti-Slip protection and water storage element
- Under extensive and semi-intensive Green Roofs
- For roofs with pitches of up 35°
- With Anti-Slip effect when storage chambers are filled
- Shear load: max. 7.0 kN/m eaves length
- Drainage capacity tested in accordance with DIN 4095
- With water storage function
- If necessary, drip hoses for irrigation can be inserted and fastened in a special groove in the board

Nominal thickness	58 mm
Weight	approx. 0.9 kg/m²
Water storage	approx. 4.3 l/m² with 15° approx. 3.2 l/m² with 25°
Max. flow capacity	approx. 1.94 l/m × s with 15° approx. 2.53 l/m × s with 25°
Compression strength	approx. 100 kN/m²



[1] Anti-Slip protection is recommended from a roof pitch of 10° in the event of plastic waterproofing on pitched roofs with a flow length of over 6 m.

Anti-Slip Systems Systems to prevent slipping for pitched roofs with slopes of 15 – 45°.

N-System [1]
Anti-Slip System Net
- Shear stress distribution over the crown or in combination with a fastening profile

Tensile strength of net	55 kN/m
Material of net	PET reel with protective jacket
Net roll	130 m² (2.6 × 50 m)
Material of sills	Recycling ABS
Sill	H 60.0 mm × L 600 mm
Sill spacing	up to DN 20° = 1000 mm DN 21–25° = 500 mm DN 26 – 35° = 330 mm DN 36 – 45° = 250 mm

T-System [1]
Anti-Slip System Carrier
- For application against structurally effective (eaves) abutments
- Max. shear load: 6.9 kN per shear support beam in flow direction

Material	Recycled-PP
Dimensions	T 10.0 mm H 80.0 mm W 80.0 mm
Girder length	3250 mm
Barrier unit length	1070 mm
Sill spacing	DN 15–20° = 1000 mm DN 21– 30° = 500 mm DN 31– 45° = 250 mm

S-System [1]
Anti-Slip System Rope
- Suspended Anti-Slip system comprised of shear barriers and stainless steel cables
- Suitable for roof pitches of up to 45°

Material of cable	Stainless steel Ø 10 mm
Material of Sill	Recycled PP
Standard dimensions	H 80 mm W 80 mm L 1200 mm L for cable axial dimension: 1000 mm
Sill spacing	DN 15–20° = 1000 mm DN 21– 30° = 500 mm DN 31– 45° = 250 mm

Anti-Slip shoe VA 110
- To hold the Optigrün Pitched Roof Carrier T80 (1 set per carrier) and a drainage channel
- Two-part consisting of lower section folded 3 times and upper section folded twice

Material	Stainless steel
Nominal thickness	3.0 mm
Dimensions	L 163 mm W 140 mm H 110 mm

[1] Anti-Slip protection is recommended from a roof pitch of 10° in the event of plastic waterproofing on pitched roofs with a flow length of over 6 m.

Vegetation Fixing Bar VFL 100–200
- Slip protection for vegetation mats
- For roofs with a pitch of 25° or more
- In combination with Anti-Slip System P
- Easy to insert into the joint fold of the EPS boards
- Anchored by superimposed weight

Material	Aluminium
Nominal thickness	2.0 mm
Dimensions	L 2000 mm W 115 mm H 100 – 200 mm (variable)

Eave Trim TP 110–160
- Water permeable edge profile for eaves used with green/gravelled roofs
- For roofs with 5 – 45° pitch
- Combined with our Anti-Slip abutment cleat
- While simultaneously feeding the excess water from the rooftop into an external roof gutter

Material	Aluminium
Nominal thickness	4.0 mm
Dimensions	L 2000 / 2005 / 3000 mm W 100 mm H 110 / 130 / 160 mm

Anti-Slip abutment cleat KN 80, KN 12
- Anti-Slip abutment for roofs with 5– 45 ° pitch for creating a structurally effective edge profile for eaves
- Combined with our Eave Trim Support

Material	Aluminium
Nominal thickness	4.0 mm
Dimensions	L 410 mm W 150 mm H 80 or 120 mm

Fastening Profile KTP 32
- For clamping the Anti-Slip net on pitched roofs › 15° pitch, that are designed with the Type-N Anti-Slip System
- Typical applications: Monopitch roofs or partially pitched roof areas under dormers, rooftop windows or large chimneys, etc.

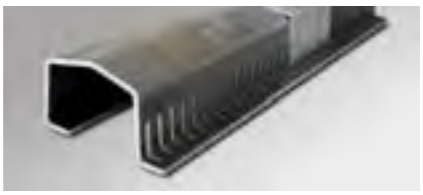
Material of top	Aluminium
Material of bottom	Edelstahl V2A
Nominal thickness of top	3.0 mm
Nominal thickness of bottom	2.0 mm
Dimensions	L 2 000 mm W 158 mm H 32 mm

Clamping Rail KS 30
- Accessories for Anti-Slip System N
- For bridging cut-out sections in the Anti-Slip net of up to a max. width of 1500 mm (e.g. chimneys, roof window, individual solar modules, etc.)

Material of top	Aluminium
Material of bottom	Stainless steel V2A
Nominal thickness of top	3.0 mm
Nominal thickness of bottom	2.0 mm
Dimensions	L up to 3 000 mm W 71 mm H 30 mm

Water Conduit TSK SD
- For transverse distribution of excess water to structural kerb detail at the eaves on pitched Green Roofs with internal drainage outlets, simultaneously providing distribution of transferred shear loads for Green Roof build-ups. For Anti-Slip System P.

Material	Aluminium
Nominal thickness	5 mm
Dimensions	L 2000 mm W 115 mm H 66 mm



GARDEN ROOF
URBAN GARDENING

"The Garden Roof design lets you take rooftops that are not in use, like office buildings, underground car parks, hospitals or schools and turn them into badly needed recreation and relaxation areas. You can also create little green islands in urban centres that just make our cities more pleasant to live in."

Ilona Nipp, Marketing

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ROOF GREENING

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GARDEN ROOF URBAN GARDENING

Extensive Semi-intensive **Intensive**

The GARDEN ROOF is a particularly versatile type of Green Roof. This intensive Green Roof can be designed with lawns, bushes and ponds and can also be combined with system accessories such as Planters and Edge Elements.
The result is a varied roof landscape with terraces, gardens or even kitchen gardens with urban gardening.

GARDEN ROOF

Intensive

Page 62

URBAN GARDENING

Intensive

Page 64

GARDEN ROOF

Extensive Semi-intensive **Intensive**

The GARDEN ROOF has a versatile range of potential uses, e.g. as a terrace or rooftop garden. The various design elements, such as raised beds, ponds or sandboxes can be created using Planters and Edge Elements.

› Technical data

Weight [1]	from 320 kg/m² or 3.2 kN/m²
Build-up depth	from 260 mm
Roof pitch	0 – 5°
Vegetation form	Perennials-shrubs-lawns
Water retention	70 – 95 %/year
Discharge coefficient [2]	C_S = 0.05 – 0.3
Water storage	approx. 110–160 l/m²
Cost estimate [3]	■■■■□

› Features

Ecological value ■■■■□
Maintenance costs ■■■■□

- Intensive Green Roof
- Additional living space thanks to roof landscape
- Perennial beds, lawns usable for sports, bushes, ponds, sitting areas and much more
- Automatic irrigation possible
- Urban gardening: fruits and vegetables on the roof. See page 64

[1] Depending on the load-bearing capacity of the substructure, light or heavy substrates can be used. The weight information refers to the water-saturated state; the dry weight is approximately 60 – 70% of this. In line with the requirements of the FLL Green Roof Guidelines, temporary water accumulation is not taken into account in the stated weight information
[2] According to the current FLL Green Roof Guidelines [3] Cost benchmark at 1,000 m² net incl. installation, varies from region to region.

› System structure and components

The GARDEN ROOF is a versatile and visually appealing Green Roof solution. With a basic system structure of at least 260 mm, the ground-level garden is simply installed on the roof, creating additional usable living space.

Drainage is achieved using our Drainage Board (FKD) solution, suitable for rooftops with 0 – 5° pitch.

1 Intensive Substrate i[4] (230 – 400 mm).
Alternatively:
Lawn Substrate R (200 – 300 mm)
A substrate with high water storage capacity and good air porosity, tailored to intensive multi-layer systems

2 Filter Fleece FIL 105
Prevents fine particles from forming sludge in the drainage layer; high water permeability. Alternatively Filter Fleece FIL 300 where drainage board is unfilled

3 Drainage and Storage Board FKD 60BO (60 mm)
High volume of water storage, rapid drain-off of excess water, prevention of waterlogging, lightweight construction with high drainage capacity, filled with Perl 8/16. Up to 400 mm substrate depth board can be left unfilled using FIL300 instead of FIL105

Combi Inspection Chamber TKS PLUS
(Not included in the drawing)
For simple control of roof drainage outlets, extendible in 100 mm increments, side and top drainage openings

4 Protection and Storage Fleece RMS 500
Protects root protection membranes and/or waterproof membrane against damage and stores water[5]

[4] Depending on the load-bearing capacity of the substructure, either lightweight or heavy substrate can be used. The weight parameters refer to the water-saturated state; the dry weight is approx. 60 – 70% of the saturated weight. Similarly to the requirements of the FLL Guideline for Green Roofs, temporary water retention is not factored into the weight specifications listed [5] In case of high loads and strong mechanical stress: Protection and Storage Fleece RMS 900 or RMS 1200. Install under the insulation on inverted roofs.

URBAN GARDENING

Extensive Semi-intensive **Intensive**

URBAN Gardening is a special variant of the GARDEN ROOF system. The Green Roof structure is used as a kitchen garden with edible plants such as vegetables and herbs. With a taller system structure, even berry bushes and fruit trees can be grown.

› Technical data

Weight	from 150 kg/m² or 1.5 kN/m²
Build-up depth	120 – 400 mm
Roof pitch	0 – 5°
Vegetation form	Herbs, vegetables, berry bushes
Water retention	50 – 80 %
Discharge coefficient [1]	C_S = 0.2 – 0.5
Water storage	approx. 45 – 126 l/m²
Cost factor [2]	■■■□□

› Features

Ecological value ■■■■□
Maintenance costs ■■■■□

- The height-adjustable structures are adapted to the desired fruit and vegetable types
- Optimised substrate with high water retention
- Drainage with water storage
- Different watering strategies (e.g. watering mat, drip hoses) can be integrated

[1] According to the current FLL Green Roof Guidelines [2] Cost benchmark at 1,000 m² net incl. installation, varies from region to region.

› System structure and components

With a base layer structure of at least 120 mm, the URBAN Gardening design lets you grow herbs and vegetables. For berry bushes, we recommend a taller substrate height of up to 460 mm.

Drainage is achieved using our Drainage Board (FKD 40) solution, suitable for rooftops with 0 – 5° pitch.

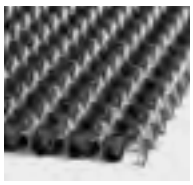
1 Herbs, fruits and vegetables
As requested, depending on layer structure

2 Intensive Substrate Urban Soil US (80 – 400 mm) [3]
Substrate with high water storage capacity, good permeability and good air porosity, tailored to fruit and vegetable cultivation

3 Filter Fleece FIL 105
Prevents fine particles from forming sludge in the drainage layer; high water permeability

4 Suction and Capillary Fleece RMS 500K
Alternative to Filter Fleece FIL 105, mat with high capillarity for horizontal water distribution, installed on of the Drainage and Storage Board FKD 40; the customer's drip hoses go on top

5 Drainage and Storage Board FKD 40 (40 mm)
Rapid drain-off of excess water, prevention of waterlogging, lightweight construction with high drainage capacity, vapour-permeable layer



Combi Inspection Chamber TKS PLUS
(Not included in the drawing)
For simple control of roof drainage outlets, extendible in 100 mm increments, side and top drainage openings

6 Protection and Storage Fleece RMS 500
Protects root protection membranes and/or waterproof membrane against damage and stores water

[3] 80 – 100 mm: herbs for example, 100 – 200 mm: strawberries for example, lettuce, onions or pumpkin, 200 – 400 mm: currants, blackberries, gooseberries or tomatoes for example

› Wind erosion protection

The GARDEN ROOF system does not generally require a wind erosion protection calculation. The risk of wind erosion depends on the Green Roof build-up (extensive or single layer intensive), the building height (e.g. 10 metres high and above), the location of the building and how exposed it i s as well as roof aspect. When assessing wind erosion protection we will normally identify corner, perimeter edge and interior areas separately and make specific recommendations for each. Usually with tall or exposed buildings the perimeters edges and corners are likely to need additional anchoring most of all.
Special attention should also be paid to the anchoring and support of individual shrubs and trees to protect against wind damage.

ⓘ **Wind suction technical information**
see page 122

› Vegetation

The basic system structure must be at least 260 mm deep. After that, the design possibilities for the garden are practically limitless. Anything is possible – perennial beds, shrubbery, terraces, paths, pavilions and pergolas, as well as lawns, ponds or planting beds:

› Lawns suitable for sports
Pre-cultivated turf is used to create an even appearance. Water retention or drip irrigation are recommended.

› Ponds
The structure is similar to a ground-level garden. Aside from that, all it takes is a separate UV resistant Root Protection Membrane, plus the Protection and Storage Fleece RMS 500 the pond and root protection membrane

› Planting beds
With our edging accessories, you can create entire planting beds with higher substrate layers, so that even trees can be planted.

› Sandboxes
Our edging accessories can also be used to enclose a sandbox for children to play in. The maximum sand filling height is approx. 400 mm.

ⓘ **Vegetation technical information**
see page 128

› Maintenance

As with any “regular” garden, the amount of maintenance required depends on the plant species.

Depending on the vegetation, the green spaces should be given an application of about 50 g/m² of Slow Release Fertiliser Opticote once a year to provide the plants with the nutrients they need. We also recommend having an upkeep and maintenance contract with one of our Optigrün partners. For a listing of partners in your area, click the “Contact” link on our homepage.

ⓘ **Maintenance technical information**
see page 132

› Special feature Options

For rooftops that are continuously in use, a collective fall protection system is an absolute must.

Our SkyGard railing system is anchored by superimposed weight and requires no drilling to install. With a variety of colours, infills and handrail versions to choose from, it can also be used as a design element.

see page 108

LANDSCAPE ROOF

"By creating Green Roofs, we're making a sustainable contribution to the cities of the future. We're replacing the deserts of glass and concrete that currently dominate our view with a range of roof landscaping designs. These green oases tell us to slow down and invite us to stay and spend some time in the city instead of sitting in traffic for hours trying to escape to the countryside."

Sebastian Krümmel, Sales

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LANDSCAPE ROOF

Extensive Semi-intensive **Intensive**

With its tall, multilayer structure, the LANDSCAPE ROOF system accommodates a wide variety of bushes and trees. So you can create rooftop landscapes that look just like green areas on the ground. An underground car park can be integrated into surrounding outdoor facilities. Lawns and playing fields, ponds, terraces, path areas, etc. can also be implemented, just like the GARDEN ROOF and PUBLIC ROOF.

› Technical data

Weight [1]	from 600 kg/ m² or 6.0 kN/ m²
Build-up depth	420 mm
Roof pitch	0 – 5°
Vegetation form	Perennials, woody plants, trees
Water retention	80 – 95 %/year
Discharge coefficient [2]	C_S = 0.05 – 0.2
Water storage	approx. 180 – 320 l/m²
Cost factor [3]	■■■■■

› Features

Ecological value ■■■■□
Maintenance costs ■■■■□

- Intensive Green Roof that is practically indistinguishable from a garden on the ground
- Lightweight with a tall Green Roof superstructure
- Sculpted roof landscapes; almost any type of greenery possible, including trees
- Sustainably functional green structure for underground car parks
- Automatic irrigation possible

[1] Depending on the load-bearing capacity of the substructure, light or heavy substrates can be used. The weight information refers to the water-saturated state; the dry weight is approximately 60 – 70% of this. In line with the requirements of the FLL Green Roof Guidelines, temporary water accumulation is not taken into account in the stated weight information
[2] According to the current FLL Green Roof Guidelines [3] Cost benchmark at 1,000 m² net incl. installation, varies from region to region.

› System structure and components

What sets the landscape roof system apart is the use of an additional mineral layer (Aeration Substrate U). From an installation depth of 350 mm, organic components should only be used in small amounts to prevent undesired anaerobic decomposition processes.

Aeration Substrate U has no effect on the drainage layer underneath. It is applied in variable thickness in order to attain the desired overall structural height in combination with Intensive Substrate i. The substrates are designed to be compatible so that they neither mix nor form a barrier to water transmission. The entire layer structure is suitable as a rooting layer for bushes and trees.

1 Intensive Substrate i[1] (200 – 350 mm)
Alternatively: Lawn Substrate R (200 – 300 mm). A substrate with high water storage capacity and good air porosity, tailored to intensive multi-layer systems or walkable lawns.

2 Aeration Substrate U[1]
Mineral substrate adapted to deep intensive structures, as a filling substrate and rooting area between the drainage and filter layer and the intensive substrate or lawn substrate

3 Filter Fleece FIL 105
Prevents fine particles from forming sludge in the drainage layer; high water permeability

4 Drainage and Storage Board FKD 60BO (60 mm)
High volume of water storage, rapid drain-off of excess water, lightweight construction with high drainage capacity, filled with Perl 8/16

Combi Inspection Chamber TKS PLUS
(Not included in the drawing)
For simple control of roof drainage outlets, extendible in 100 mm increments, side and top drainage openings

5 Protection and Storage Fleece RMS 900
Protects root protection membranes or waterproof membrane against damage and stores water. Install under the insulation on inverted roofs.

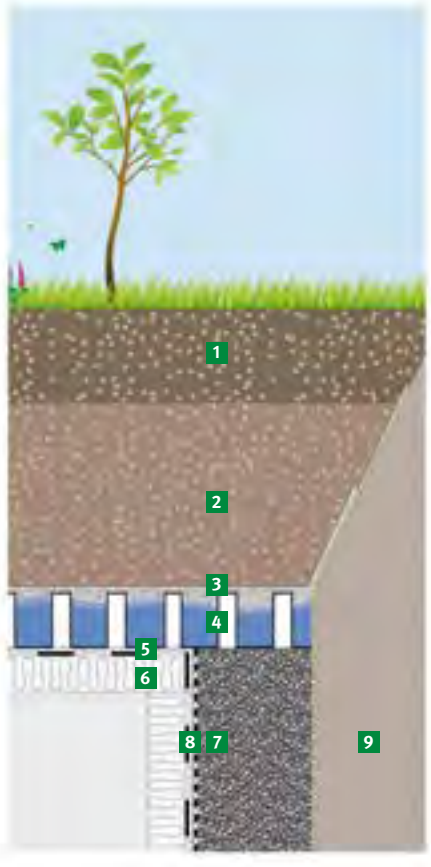
[1] Depending on the load-bearing capacity of the substructure, either lightweight or heavy substrate can be used. The weight parameters refer to the water-saturated state; the dry weight is approx. 60–70 % of the saturated weight. Similarly to the requirements of the FLL Guideline for Green Roofs, temporary water retention is not factored into the weight specifications

› Wind erosion protection

The LANDSCAPE ROOF system does not generally require a wind erosion protection calculation. The risk of wind erosion depends on the Green Roof build-up (extensive or single layer intensive), the building height (e.g. 10 metres high and above), the location of the building and how exposed it i s as well as roof aspect. When assessing wind erosion protection we will normally identify corner, perimeter edge and interior areas separately and make specific recommendations for each. Usually with tall or exposed buildings the perimeters edges and corners are likely to need additional anchoring most of all.

Special attention should also be paid to the anchoring and support of individual shrubs and trees to protect against wind damage.

ⓘ **Wind suction technical information**
see page 122



› Vegetation

With the Landscape Roof, practically any kind of vegetation can be used. Most plants that you would find in garden facilities on the ground can also be grown on the LANDSCAPE ROOF. An underground car park, for example, can be integrated into surrounding outdoor facilities. Lawns and playing fields, sandboxes, ponds, terraces, perennial beds can also be installed, as well as pavilions and pergolas.

ⓘ **Vegetation technical information**
see page 128

› Maintenance

As with any “regular” garden and park facility, the amount of maintenance required depends on the plant species.

Depending on the vegetation, the green spaces should be given an application of about 50 g/m² of Opticote slow-release fertiliser once a year to provide the plants with the nutrients they need. We also recommend having an upkeep and maintenance contract with one of our Optigrün partners. For a listing of partners in your area, click the “Contact” link on our homepage.

ⓘ **Maintenance technical information**
see page 132

The connection to the natural soil is easy to set up. What’s required is a filter fleece to act as a barrier, as well as drainage and water distribution throughout.

1. **Intensive Substrate i / Lawn Substrate R**
2. **Aeration Substrate U**
3. **Filter Fleece FIL 105**
4. **Drainage and Storage Board FKD 60BO (filled)**
5. **Protection and Storage Fleece RMS 900**
6. **Suitable support structure with root-proof roof waterproofing**
7. **Gravel packing (with pipework if necessary)**
8. **Protection and Drainage Board FKD 10**
9. **Natural soil**

› Special feature
Compensation for low load reserves
(Not available in the UK)

To compensate for large height difference with low load reserves, we offer the following options:
- Perl BT: Natural bulk material made of extra lightweight expanded clay (saturated weight approximately 680 kg/m³). Serves as drainage and levelling layer.
- Optifill: Plates of extruded polystyrene. This material absorbs very little water and is pressure resistant. Weight: approx. 40 kg/m³
- Optipor and Opticell: The lightweight Optigrün Foam Glass Gravel. Maximum saturated weight 250 – 350 kg/m³. Very high compression strength, does not permanently absorb any water through the glazed air pores. Also has insulating properties. As a result, well suited as an insulation material for underground car parks to prevent condensation.

Optigrün Foam Glass Gravel

PUBLIC ROOF

“Hardly any new building in our cities come without any multi-purpose recreation areas on top of substructures. Underground car parks are being overbuilt with gardens, terraces and playgrounds, but also parking spaces and fire brigade facilities. The technical rules for constructing streets and roads on building floors are still in their infancy. Our public roofs provide a reliable solution with tried and true products.”

Oliver Burchardt, Technical Department

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PUBLIC ROOF

Use category 1 Use category 2 Use category 3

Designing a public roof is a challenging and complex project. Load distribution, surface water drainage and underground drainage are a few of the main planning issues involved. In addition, the various use categories (U 1–3) also have to be taken into account.

PUBLIC ROOFS BY USE CATEGORY

U 1

Walkable, non-driveable surface reinforcements

Walkable
Page 74

Walkable – impact noise
Page 75

Walkable – terrace tile support pads
Page 76

U 2

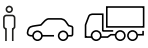
Use by passenger cars of up to 3.5 t

Driveable – for passenger cars
Page 77

U 3

Use by passenger cars and occasionally by lorries of up to 20 t

Driveable for lorries
Page 78



U 1–3

Can also be designed as UC 1, 2, or 3

Greenable pavements
Page 79

Gravel lawn
Page 80

Retention
Page 81

Inverted roof
Page 82

Lightweight construction
Page 83

Roof with zero falls
Page 84

PUBLIC ROOF WALKABLE

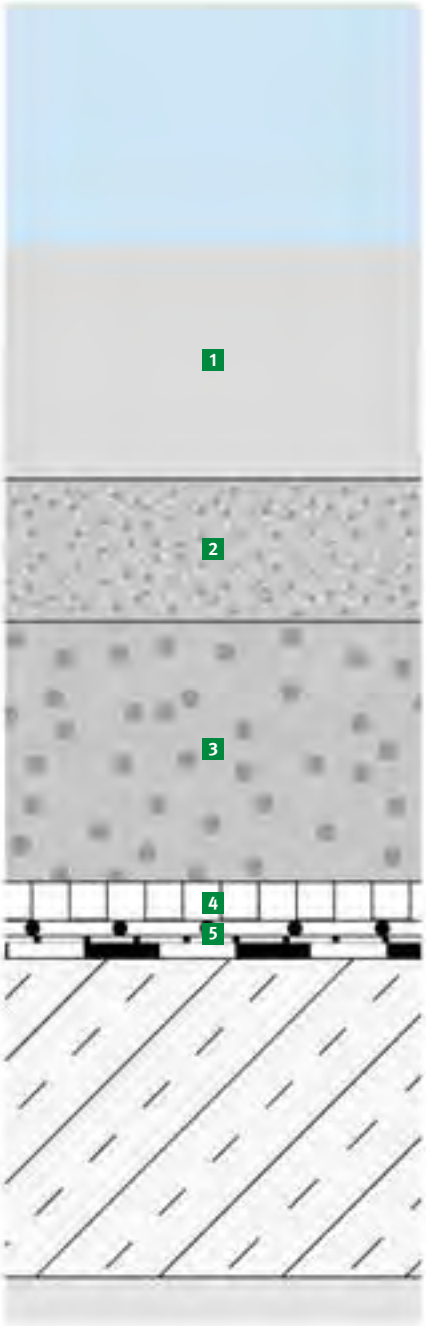
› Technical data

Weight	from 400 kg/m² or 4.0 kN/m²
Build-up depth [1]	from 180 mm
Roof pitch	1 – 5°
Use category	1 (max. 4 kN/m²)

› System structure and components

Walkable rooftop areas are paths and areas that can be used by people. They can be combined with green spaces on the roof. Walkable traffic areas can be implemented on uninsulated roofs, as well as non-ventilated flat roofs and inverted roofs. The following is an illustration of a system structure on an uninsulated roof.

For structures on non-ventilated flat roofs or inverted roofs, see www.optigruen.com

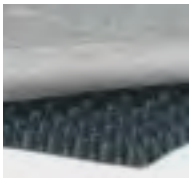


1 Cover Layer
Plaster pavement at least 60 mm high, tile pavement at least 40 mm high

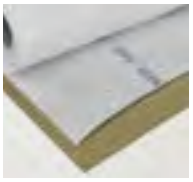
2 Suitable bedding material
e.g. 30–50 mm fine gravel 0/5, substratum for pavement (surface layer), compensation for installation and dimensional tolerances

3 Base Layer
Gravel 0/32 (0/22 for thicknesses under 120 mm), min. layer thickness 100 mm, lightweight design with Optipor see page 83

4 Protection and Drainage Board FKD 10
10 mm, for foot traffic › 2 % slope, pressure resistant, waterlogging prevention, lightweight construction with high drainage capacity



5 Protection, Separation and Slip Layer SGL 500 and Separation and Slip Layer TGF 0.2
Sliding layer, friction coefficient tested with PE film as required by DIN 53375



[1] Special designs with reduced structural height and reduced weight possible

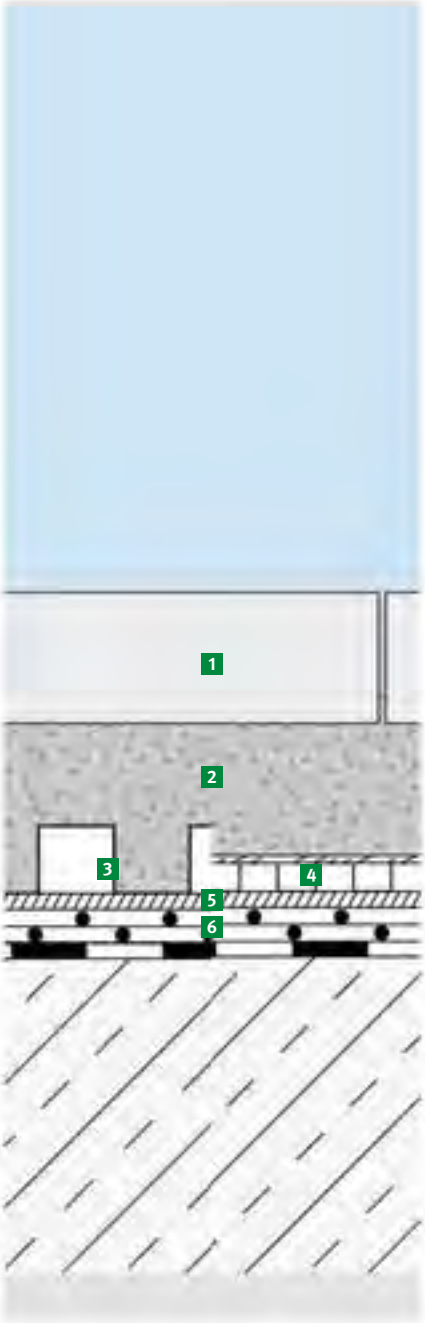
PUBLIC ROOF WALKABLE – IMPACT NOISE

› Technical data

Weight	from 170 kg/m² or 1.7 kN/m²
Build-up depth	from 100 mm
Roof pitch	0-5°
Use category	1 (max. 4 kN/m²)
Impact noise reduction[2]	Δ Lw 29–35 dB

› System structure and components

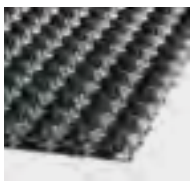
For walkable rooftops and elements such as balconies and terraces, we also offer structures with tested impact noise reduction. At the core of these structures is the RMS 950 Barrier, Protection and Noise Reduction Fleece, which can be combined with various drainage boards. All impact noise reduction values are tested and substantiated with expert reports.



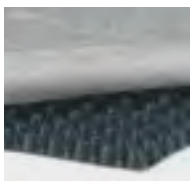
1 Suitable tile pavement
At least 40 mm high

2 Suitable bedding material
Made of hard stone chippings, min. 40 mm

3 Drainage and Storage Board FKD 25
25 mm, impact noise reduction Δ Lw 33–35 dB at › 0 % roof pitch

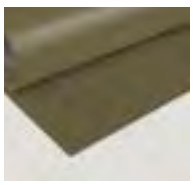


4 Protection and Drainage Board FKD 10
10 mm, pressure resistant, impact noise reduction Δ Lw 29 dB with › 2 % slope



5 Protection and Sound Reduction Fleece RMS 950TS

6 Separation and Slip Layer TGF 0.2
2 liners, sliding layer, friction coefficient tested with PE film as required by DIN 53375



[2] Test in accordance with EN ISO 10140 evaluated in accordance with ISO 717-2

PUBLIC ROOF WALKABLE – TERRACE TILE SUPPORT PADS

› Technical data

Weight	from 90 kg/m² or 0.9 kN/m²
Build-up depth	from 60 mm
Roof pitch [1]	0 – 5°
Use category	1 (max. 4 kN/m²)

› System structure and components

For walkable rooftops and elements such as balconies and terraces, we also offer a structure with pedestal supports. The pedestal supports can be precisely adjusted, even after installation. Due to the available heights of the patio tile support pads from 20 – 245 mm, it is easy to adapt the system to the structural conditions. A diverse range of accessories makes installation and subsequent use easy and safe.

1 Suitable tile pavement

2 Terrace Tile Support Pads TPL
Support and height adjustment, heights from 20 – 230 mm, accessories such as end plates, etc., available

Patio Tile Support Pad TPL NV
(Not included in the drawing)
Support and height adjustment with self-levelling head, heights from 29 – 245 mm, accessories such as end plates, etc., available

[1] Minimum slope recommended

PUBLIC ROOF DRIVEABLE – FOR PASSENGER CARS

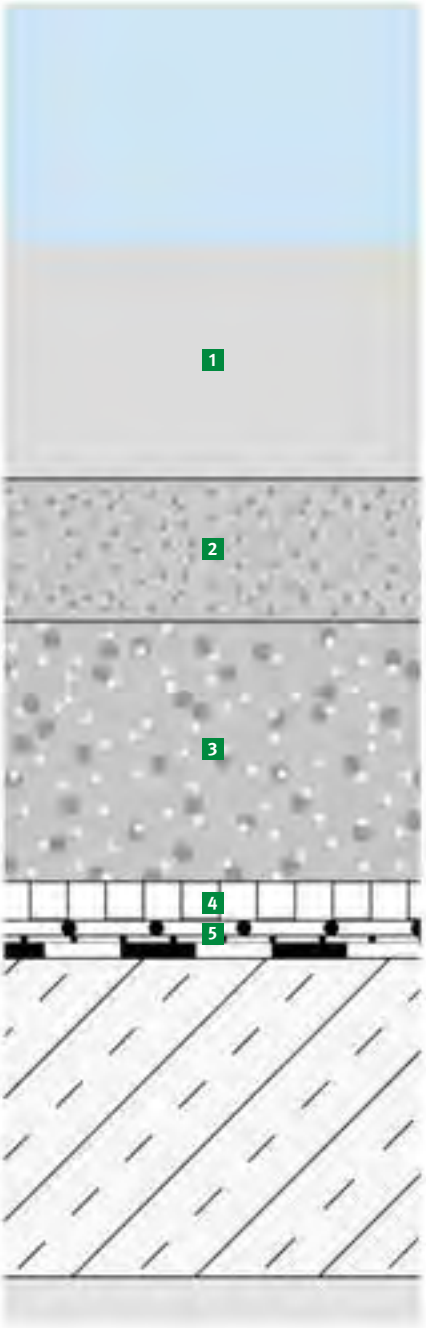
› Technical data

Weight	from 530 kg/m² or 5.3 kN/m²
Build-up depth	from 250 mm
Roof pitch	1 – 5°
Use category	2 (max. 3.5 t vehicle weight)

› System structure and components

Driveable rooftops are paths and areas that can be used by people and cars. They can be combined with green spaces on the roof. Driveable public roofs can be implemented on uninsulated roofs, as well as non-ventilated flat roofs and inverted roofs. The following is an illustration of a system structure on an uninsulated roof.

For structures on non-ventilated flat roofs or inverted roofs, see www.optigruen.com



1 Cover Layer
Plaster layer at least 80 mm high

2 Suitable bedding material
e.g. 30 – 50 mm fine gravel 0/5, substratum for pavement (surface layer), compensation for installation and dimensional tolerances

3 Base Layer
Gravel 0/32, layer thickness at least 120 mm, lightweight construction with Optipor:
See page 83

4 Protection and Drainage Board FKD 12
12 mm, pressure resistant, waterlogging prevention, lightweight construction with high drainage capacity

5 Protection, Separation and Slip Layer SGL 500
Special fleece to protect the waterproofing with combined separating and sliding function

PUBLIC ROOF DRIVEABLE – FOR LORRIES

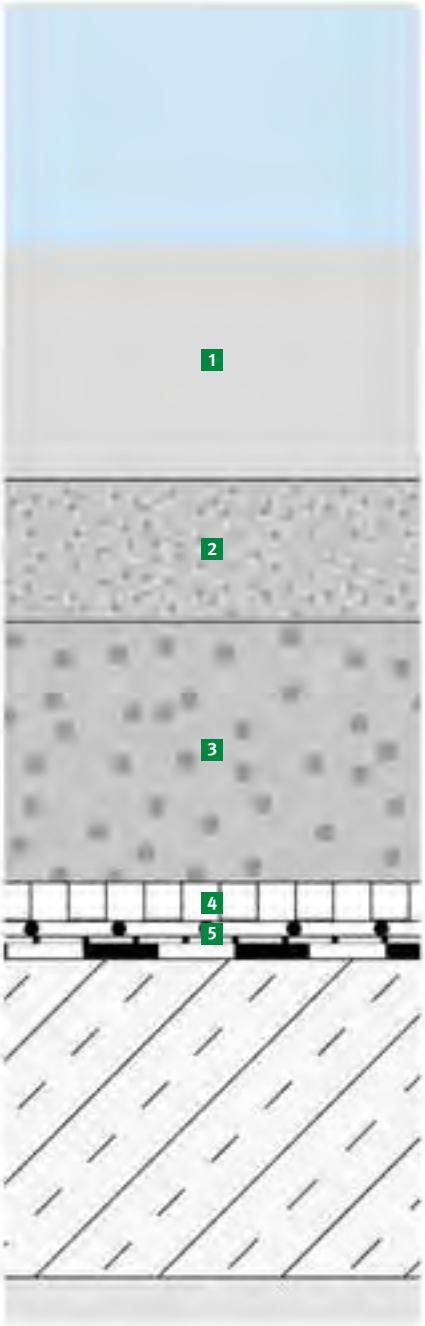
› Technical data

Weight	from 600 kg/m² or 6.0 kN/m²
Build-up depth	from 310 mm
Roof pitch	1 – 5°
Use category	3

› System structure and components

Category 3 lorry use means occasional use by vehicles weighing up to 20 t (e.g. waste collection, fire brigade, delivery vehicles). If higher frequencies of use or heavier vehicles are involved, the structures must be adjusted accordingly.

The following is an illustration of a system structure on an uninsulated roof. For structures on non-ventilated flat roofs or inverted roofs, see www.optigruen.com



1 Cover Layer
Plaster layer at least 100 mm high

2 Suitable bedding material
e.g. 30 – 50 mm fine gravel 0/5, bedding for pavement (surface layer), compensation for installation and dimensional tolerances

3 Base Layer
Gravel 0/32 or 0/45, layer thickness from 150 mm lightweight structure with Optipor: see page 83

4 Protection and Drainage Board FKD 12
12 mm, pressure resistant, waterlogging prevention, lightweight construction with high drainage capacity

5 Protection, Separation ans Slip Layer SGL 500
Special fleece to protect the waterproofing with combined separating and sliding function

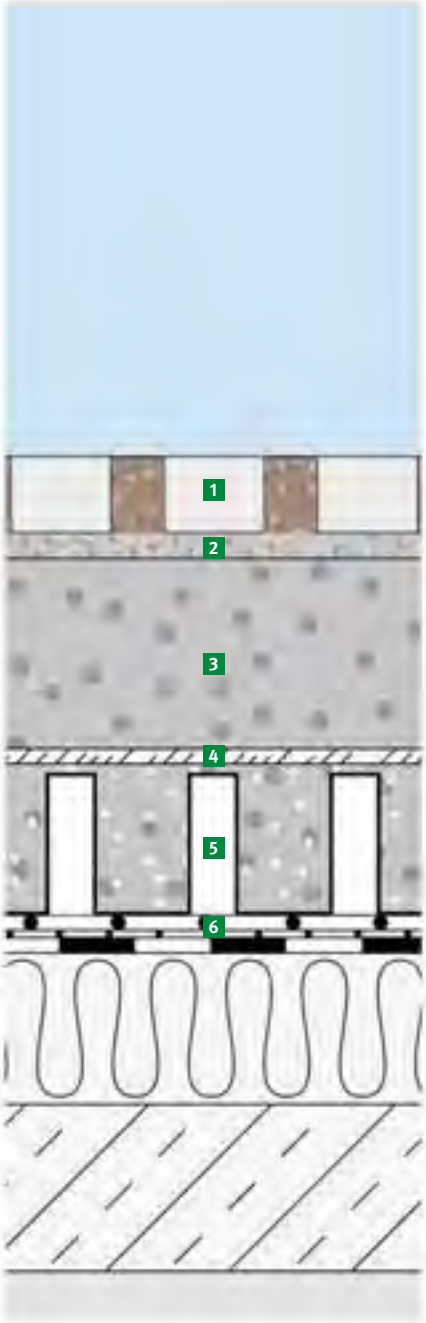
PUBLIC ROOF GREENABLE PAVEMENTS

› Technical data

Weight	from 650 kg/m² or 6.5 kN/m²
Build-up depth	from 280 mm
Roof pitch	1 – 5°
Use category	1 – 3

› System structure and components

Public roofs with greenable pavements are Green Roofs that are accessible to foot, car and lorry traffic: e.g. car parks or driveways. The structures must be adapted for the intended use category and the roof structure/ insulation.



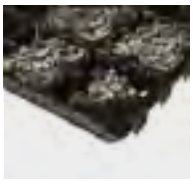
1 Lawn Paving Elements
Upper trim filled with Greenable Surface Substrate BB, lawn: RSM 5.1 or 7.2 seed mix for a durable lawn

2 Suitable bedding material
e.g. 30 – 50 mm fine gravel 0/5, bedding for pavement (surface layer), compensation for installation and dimensional tolerances

3 Base Layer
Gravel 0/32 or 0/45, layer thickness from 150 mm lightweight structure with Optipor: see page 83

4 Filter Fleece FIL 300
Prevents fine particles from forming sludge in the drainage layer but is highly water-permeable and tear-proof, very high robustness class GRK 5

5 Protection and Drainage Board FKD 60BU
60 mm, pressure resistant and resistant to lorry traffic, prevention of waterlogging, lightweight construction with high drainage capacity, filled with Perl 8/16

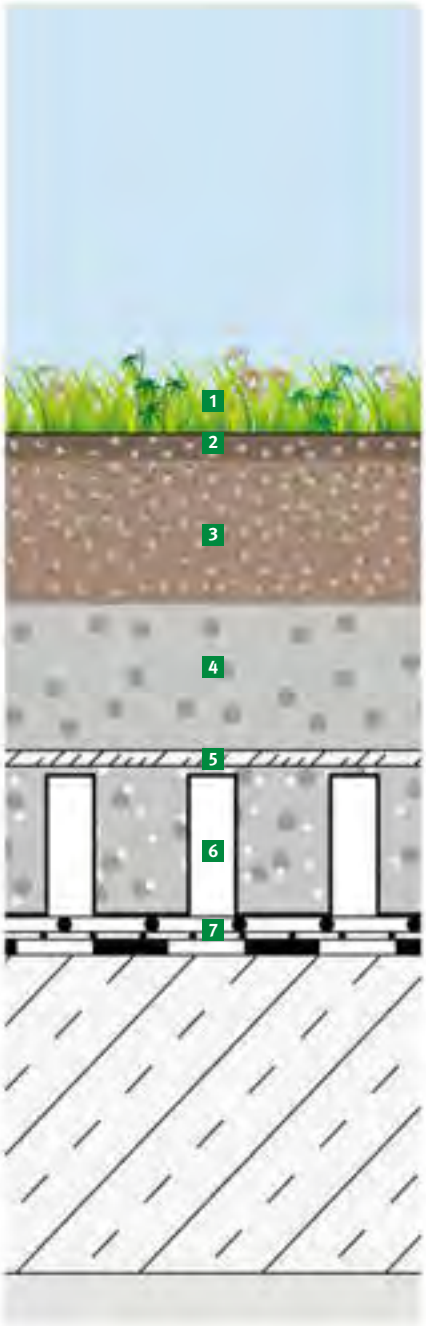


6 Protection, Separation and Slip Layer SGL 500 and Separation and Slip Layer TGF 0.2
Sliding layer, friction coefficient tested with PE film as required by DIN 53375

PUBLIC ROOF GRAVEL LAWN

› Technical data

Weight	from 400 kg/m² or 4.0 kN/m²
Build-up depth	from 370 mm
Roof pitch	1 – 5°
Use category [1]	1–3 (max. 20 t vehicle weight)



› System structure and components

Public roofs with gravel pavements are Green Roofs that are accessible to foot, car and lorry traffic. The structures must be adapted for the intended use category and the roof structure/ insulation.

1 Lawns

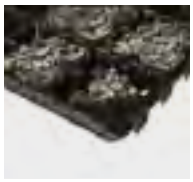
2 Gravel Lawn Cover Layer SRD (optional)
20 –30 mm, specially adapted surface layer

3 Gravel Lawn Substrate SR
From 150 mm, specially adapted vegetation layer

4 Base Layer
Gravel 0/32 or 0/45, layer thickness from 150 mm

5 Filter Fleece FIL 300
Prevents fine particles from forming sludge in the drainage layer but is highly water-permeable and tear-proof, very high robustness class GRK 5

6 Protection and Drainage Board FKD 60BU
60 mm, pressure-stable and accessible to trucks, prevents accumulation of water, lightweight super structure with high drainage capacity, filling with Perl 8/16



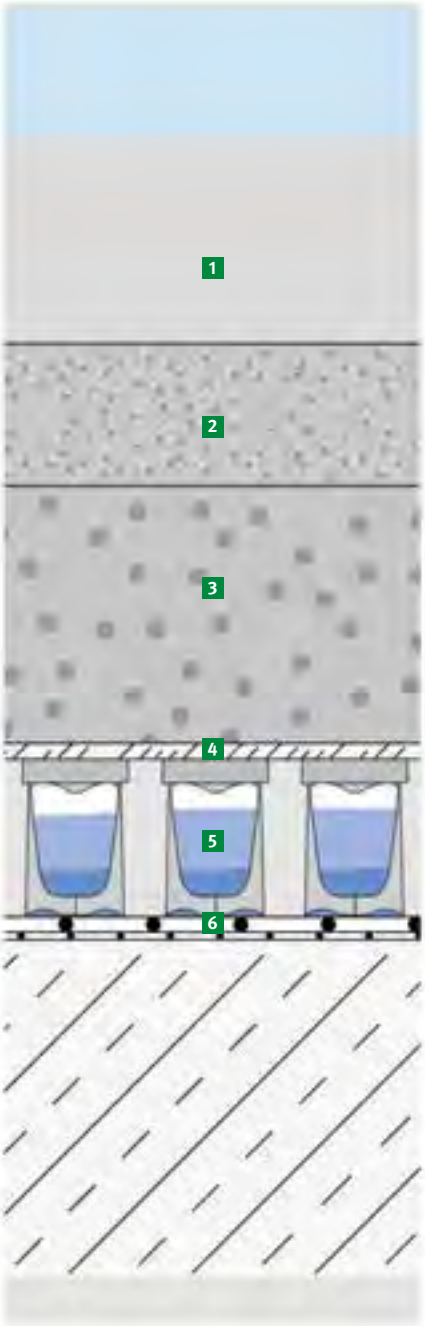
7 Protection, Separation and Slip Layer SGL 500 and Separation and Slip Layer TGF 0.2
Sliding layer, friction coefficient tested with PE film as required by DIN 53375

[1] Use Category 2 (without lorries) does not require the mineral base layer

PUBLIC ROOF RETENTION

› Technical data

Weight	from 400 kg/m² or 4.0 kN/m²
Build-up depth	from 250 mm
Roof pitch	0°
Use category	1–3 (max. up to 160 kN/m² and 16 t vehicle weight)



› System structure and components

Public retention roofs are paths and areas that can be used by people, cars and lorries but also serve as a retention space. They can be combined with green spaces on the roof.

Public retention roofs can be implemented on uninsulated roofs, as well as non-ventilated flat roofs and inverted roofs.

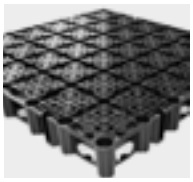
1 Cover Layer
Plaster or tiles, pavement thickness depends on use category

2 Suitable bedding material
e.g. 30 – 50 mm fine gravel 0/5, bedding for pavement (surface layer), compensation for installation and dimensional tolerances

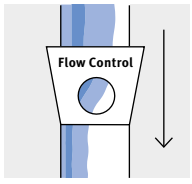
3 Base Layer
Gravel 0/32 (or 0/22 for thicknesses under 120 mm), min. layer thickness 100 mm, required base layer thickness depends on use category

4 Filter Fleece FIL 300
Prevents fine particles from forming sludge in the drainage layer but is highly water-permeable and tear-proof, very high robustness class GRK 5

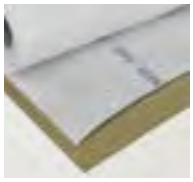
5 Water Retention Box WRB WRB 85i, WRB 85v or WRB 150 [2]
Interstitial volume for retention, high pressure stability, lightweight



Flow control unit (Not included in the drawing)
Retention control with defined perforations. Allows for delayed water discharge, dimensions tailored to local precipitation and building data and local regulations.



6 Protection, Separation and Slip Layer SGL 500 and Separation and Slip Layer TGF 0.2
Sliding layer, friction coefficient tested with PE film as required by DIN 53375

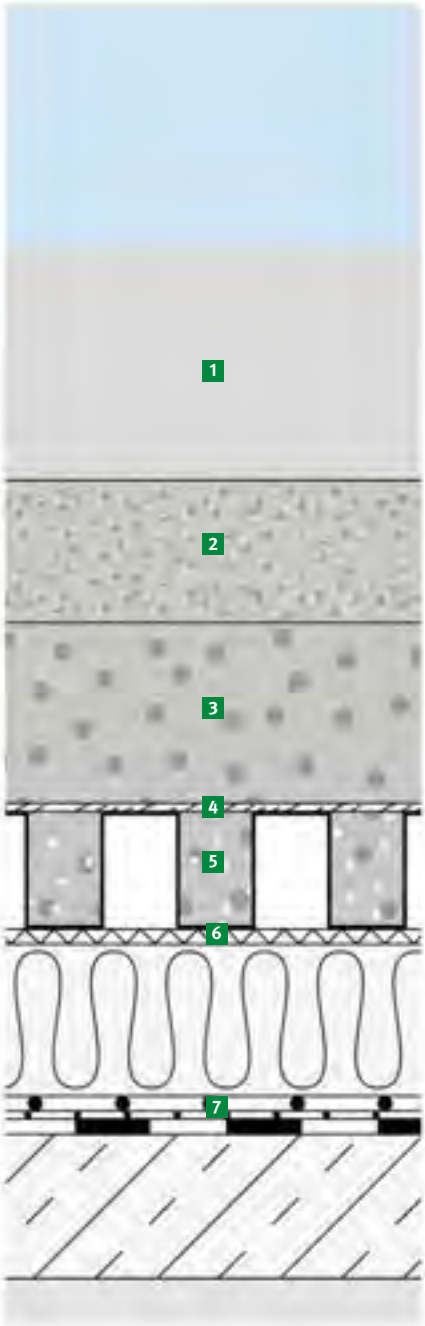


[2] Selection based on use category, roof structure and required retention level. Please consult with our Technical Department.

PUBLIC ROOF INVERTED ROOF

› Technical data

Weight	from 400 kg/m² or 4.0 kN/m²
Build-up depth [1]	from 250 mm
Roof pitch	1 – 5°
Use category [2]	1–2 (max. up to 25 kN/m² and 2.5 t vehicle weight)



› System structure and components

Traffic areas can also be implemented on inverted roofs. However they require a specially adapted design. All functional layers must be sufficiently porous for water vapour, so that the insulation does not absorb too much water. It is also necessary to determine the compressive stresses resulting from the constant load and variable load (traffic load) and make adjustments based on the compression strength of the insulation.

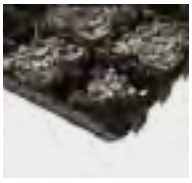
1 Cover Layer
Plaster layer 60 – 120 mm thick, depending on the Use Category, upper trim (e.g. composite pavement, tiles, concrete)

2 Suitable bedding material
e.g. 30–50 mm fine gravel 0/5, substratum for pavement (surface layer), compensation for installation and dimensional tolerances

3 Base Layer
Gravel 0/32 or 0/45 (0/22 for layer thicknesses under 120 mm). Required base layer thickness depends on use category

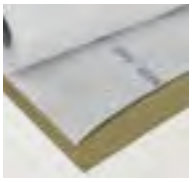
4 Filter Fleece FIL 300
Prevents fine particles from forming sludge in the drainage layer but is highly water-permeable and tear-proof, very high robustness class GRK 5

5 Protection and Drainage Board FKD 60BU
60 mm, pressure resistant, vapour-permeable, filled with gravel 2/5 or lava 8/16 (alternatively FKD 12UK can be used)



6 Trickle Protection Fleece RSV 120
Prevents fine particles from forming sludge in the insulation layer

7 Protection, Separation and Slip Layer SGL 500 and Separation and Slip Layer TGF 0.2
Sliding layer, friction coefficient tested with PE film as required by DIN 53375

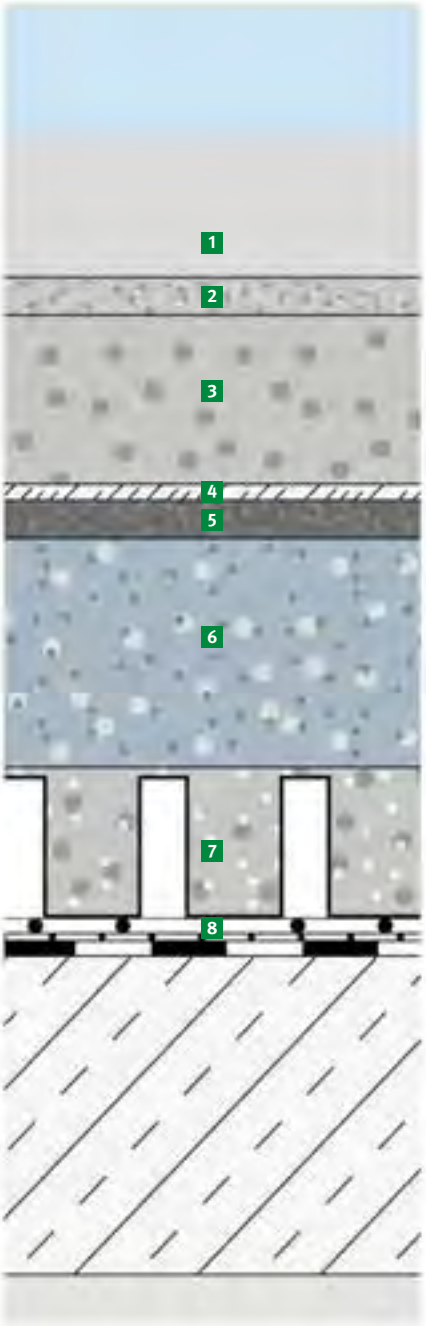


[1] Special designs with reduced build-up depth and weight are possible. [2] Construction methods for inverted roofs for use category 3 are special construction methods. Please leave consult our application technology team.

PUBLIC ROOF LIGHTWEIGHT DESIGN (Not available in the UK)

› Technical data

Weight	from 260 kg/m² or 2.6 kN/m²
Build-up depth	from 250 mm
Roof pitch	0 – 5°
Use category	1–3 (max. up to 160 kN/m² and 16 t vehicle weight)



› System structure and components

Developed and tested by Optigrün, this system version is particularly suitable for traffic area structure on roofs with low load reserves or when compensating for large height differences. Compared to conventional structures with gravel, the combination of the Protection and Drainage Board FKD 60 BU with the Optipor pressure resistant foam glass gravel results in a pressure resistant design for traffic areas on superstructures with a defined drainage capacity. A base layer made of Optipor 10/50 weighs only about 16 % as much as a gravel base layer.

1 Cover Layer
Plaster layer 60 – 120 mm thick (depending on use category), tile pavement at least 40 mm thick (use category 1)

2 Suitable bedding material
e.g. 30–50 mm fine gravel 0/5, substratum for pavement (surface layer), compensation for installation and dimensional tolerances

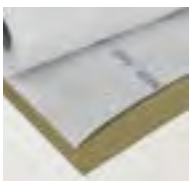
3 Gravel Base Layer
Layer thickness depends on use category, at least 100 mm. Not required for use category 1

4 Filter Fleece FIL 300
Prevents fine particles from forming sludge in the drainage layer but is highly water-permeable and tear-proof, very high robustness class – GRK 5

5 Chipped granite
8/16 grade, at least 30 mm for surface stabilisation

6 Optipor
Extremely lightweight base layer substitute made of foam glass gravel, grade 10/50 for use categories 2 and 3, layer thickness at least 150 mm

7 Protection and Drainage Board FKD 60 BU
60 mm, pressure resistant and resistant to lorry traffic, prevention of waterlogging, lightweight construction with high drainage capacity, filled with fine gravel 2/5



8 Protection, Separation and Slip Layer SGL 500 and Separation and Slip Layer TGF 0.2
Sliding layer, friction coefficient tested with PE film as required by DIN 53375

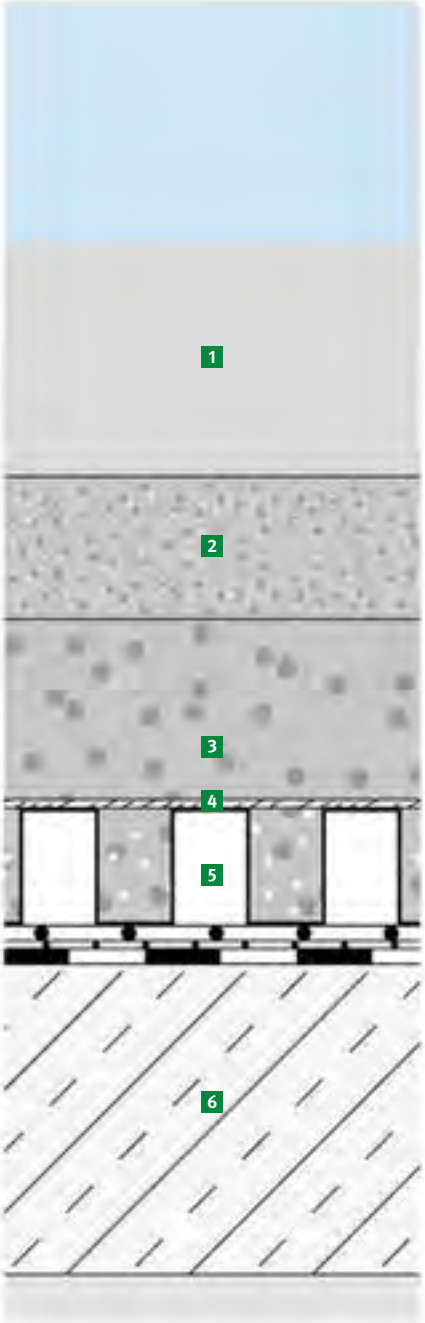
PUBLIC ROOF WITHOUT SLOPE

› Technical data

Weight	from 500 kg/m² or 5.0 kN/m²
Build-up depth [1]	from 260 mm
Roof pitch	0 – 5°
Use category	1–3 (max. 4 kN/m²)

› System structure and components

Trafficked areas on flat roofs with a waterproofing layer at zero falls require specially adapted designs. Standing water on the waterproofing or insulation layer must be separated from the base and bedding layers by means of suitable drainage systems.



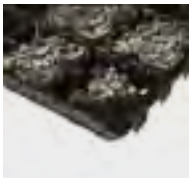
1 Cover Layer
Paving 60–120 mm high, according to the category of use, upper end (e.g. composite paving, slabs, concrete)

2 Suitable bedding material
e.g. 30–50 mm fine gravel, substratum for pavement (surface layer), compensation for installation and dimensional tolerances

3 Base Layer
Gravel 0/32 or 0/45 (0/22 for layer thicknesses under 120 mm). Required base layer thickness depends on use category

4 Filter Fleece FIL 300
Prevents fine particles from forming sludge in the drainage layer but is highly water-permeable and tear-proof, very high robustness class GRK 5

5 Protection and Drainage Board FKD 60BU
60 mm, pressure resistant, prevention of waterlogging, lightweight construction with high drainage capacity, filled with Perl 8/16



6 Protection, Separation and Slip Layer SGL 500 and Separation and Slip Layer TGF 0.2
Sliding layer, friction coefficient tested with PE film as required by DIN 53375

[1] For use category 1, special designs with reduced structural height and reduced weight possible

SOLAR GREEN ROOF

"At a time when climate change and the energy transition are mentioned almost daily, the SOLAR Green Roof represents the perfect combination of different tools to respond to these future questions:

1. The Green Roof to reduce global warming and retain heavy precipitation
2. The solar panels to safeguard the energy supply and electromobility."

Oliver Böse, Technical Department

? Service – Do you have any questions for us?
To learn about our wide range of services, see pages 4 and 5.
We offer project-specific initial calculations free of charge and provide all other calculations upon order placement.

To enquire about service, please email us at **info@optigruen.com**

SOLAR GREEN ROOF

Extensive Simple intensive Intensive

The SOLAR Green Roof is installed without roof penetrations as a system secured with a superimposed load. The Optigrün solar mounting supports are fixed in position and protected from wind suction by the Green Roof structure. The benefit of this system solution is that the solar mounting supports do not penetrate into the roof structure and waterproofing and do not require any point loads. As the vegetation runs under the modules, a large proportion of the roof area can nevertheless be greened. The evaporation cooling of the vegetation increases the efficiency of the photovoltaics system.

SOLAR FKD

Extensive

Page 88

SOLAR WRB

Extensive

Page 90

SOLAR GREEN ROOF FKD

Extensive Simple intensive Intensive

Optigrün Solar FKD is a load-supported solar mounting system for roof penetration-free mounting of PV modules or rows of PV modules. The versatile substructure makes it possible to mount almost all standard solar modules, with inclines of 10°, 15° or 20°. The rows of modules can be installed in a south-facing or east-west orientation. The modules can be attached to it both vertically (portrait) and horizontally (landscape).

› Technical data

Weight [1]	from 110 kg/m² or 1.1 kN/m²
Build-up depth	from 80 mm
Roof pitch	0 – 5°
Vegetation form	Sedum cuttings
Water retention	50 – 60 %/year
Discharge coefficient [2]	Cs = 0.4 – 0.5
Water reservoir	approx. 25 l/m²

› Features

Ecological value ■■□□□
Maintenance requirements ■□□□□

- Load-supported solar mounting support
- Roof penetration-free fastening of PV modules thanks to combination with the Green Roof
- East-west orientation possible
- Integration of the solar mounting support into the Drainage and Storage Board
- Yield increase for the photovoltaics system
- High mounting support to prevent shading of the PV modules by vegetation
- Plant growth also underneath the modules
- Low weight of the system structure
- Also suitable for inverted roofs

[1] The weight of the material varies from region to region. The weight information refers to the water-saturated state; the dry weight is approximately 60–70% of this. [2] According to the current FLL Green Roof Guidelines

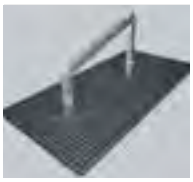
› System structure and components

The SOLAR Green Roof with the proven technology of the ECONOMY ROOF: A sophisticated and highly functional system structure for extensive Green Roofs, complemented with the solar mounting support.

The Drainage and Storage Board FKD 25 offers a spacious water reservoir and reliably drains excess water. Combined with the Filter Fleece FIL 150, optimum water distribution is guaranteed. The vegetation is thus well supplied even under the rows of PV modules.

1 Photovoltaic module
Make freely selectable

2 + **3 Solar Mounting Frame Solar FKD 25MA**
Load-supported solar mounting support consisting of base plate, bracket and Drainage and Storage Board FKD 25MA

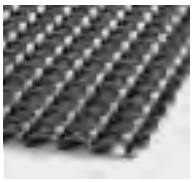


4 Sedum Cuttings
Sedum Cuttings in several species

5 Extensive substrate
Substrate tailored to the extensive construction method

6 Filter Fleece FIL 150
Prevents fine particles from forming sludge in the drainage layer with high water permeability

7 Drainage and Storage Board FKD 25 (25 mm)
With large water reservoir and optimum water distribution



8 Protection and Storage Fleece RMS 500
Protects the waterproofing against damage and stores water

9 Suitable substructure
On a suitable roof structure with 0 – 5 degree fall

SOLAR GREEN ROOF WRB

Extensive Simple intensive Intensive

Optigrün Solar WRB is a load-supported solar mounting system for roof penetration-free mounting of PV modules or rows of PV modules. The versatile substructure makes it possible to mount almost all standard solar modules, with inclines of 10°, 15° or 20°. The rows of modules can be installed in a south-facing or east-west orientation. The modules can be attached to it both vertically (portrait) and horizontally (landscape).

› Technical data

Weight [1]	from 120 kg/m² or 1.2 kN/m²
Build-up depth	from 12 mm
Roof pitch	0°
Vegetation form	Sedum cuttings
Discharge coefficient [2]	Can be adapted for the specific property
Retention volume	approx. 72 l/m²
Water reservoir	approx. 95 – 150 l/m²

› Features

Ecological value ■■■□□
Maintenance requirements ■■□□□

- Load-supported solar mounting support
- Integration of the solar mounting support into the Water Retention Box
- High water retention and water discharge delay
- Roof penetration-free fastening of PV modules thanks to combination with the Green Roof
- East-west orientation possible
- Yield increase for the photovoltaics system
- High mounting support to prevent shading of the PV modules by vegetation
- Plant growth also underneath the modules
- Low weight of the system structure
- Also suitable for inverted roofs

[1] In line with the requirements of the FLL Green Roof Guidelines, temporary water accumulation is not taken into account in the stated weight information.
[2] According to the current FLL Green Roof Guidelines

› System structure and components

The RETENTION ROOF FLOW CONTROL is an economical and efficient product for rainwater retention and water discharge delay. In combination with the solar mounting support, multifunctional roof use is possible.

The use of the proven Water Retention Box WRB F helps to maintain the natural water balance by increasing evaporation and minimising surface discharge.

1 Photovoltaic module
Make freely selectable

2 + **3 Solar Mounting Support WRB 80FMA**
Load-supported solar mounting support consisting of base plate, bracket and Water Retention Box WRB 80FMA

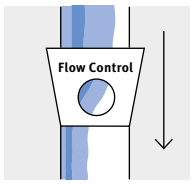
4 Sedum Cuttings
Sedum Cuttings in several species

5 Extensive substrate
Substrate tailored to the extensive construction method

6 Suction and Capillary Fleece RMS 500K
Optimum water distribution under the substrate layer

7 Water Retention Box WRB 80F
Cavity volume for retention, coordinated with the vegetation above it, low weight, high water storage volume, with capillary columns

Flow control system (Not included in the drawing)
Water retention regulator with defined perforations that allow the water to drain with a time delay.



8 Protection and Storage Fleece RMS 500
Protects the waterproofing against damage and stores water

9 Suitable substructure
On a suitable roof structure with 0 degree fall

› Wind protection

For both SOLAR GREEN ROOFS, the position stability of the mounting systems must be calculated. To do this, our Technical Department determines the necessary superimposed load and uses this to ascertain the resulting layer structure.

ⓘ **Specialist information on wind suction**
see page 122

› Vegetation

For the application of vegetation, sedum cuttings are very well-suited to this system. It should be ensured that the photovoltaic modules are not shaded by plants. Gravel strips can be incorporated or the substrate depth next to the module can be reduced. Taller plants should be removed with regular maintenance.

ⓘ **Specialist information on vegetation**
see page 128

› Maintenance

Basic fertiliser should be applied to the surface even when applying the substrate. We recommend around 25 – 35 g/m² of Opticote slow-release fertiliser for this.

Depending on the characteristics of the vegetation, fertiliser should be applied again after 1 – 2 years in order to provide the plants with the necessary nutrients. Without regularly adding nutrients, the sedum species can wither, become a deep red colour and display low and incomplete growth, which is susceptible to wind erosion.

We recommend a care and maintenance agreement with one of our Optigrün partner companies. You can find a partner company in your region on our website under “Contact”.

ⓘ **Specialist information on maintenance**
see page 132

› Specific feature load-supported

The system solution SOLAR GREEN ROOF is a system secured with a superimposed load that fixes the mounting systems for the photovoltaics modules in place securely with the load of the Green Roof structure. This means that no roof penetration is necessary.

The vegetation also runs under the modules, so that a large proportion of the roof area can be greened and the greatest possible cooling effect is achieved.

› Planning and execution

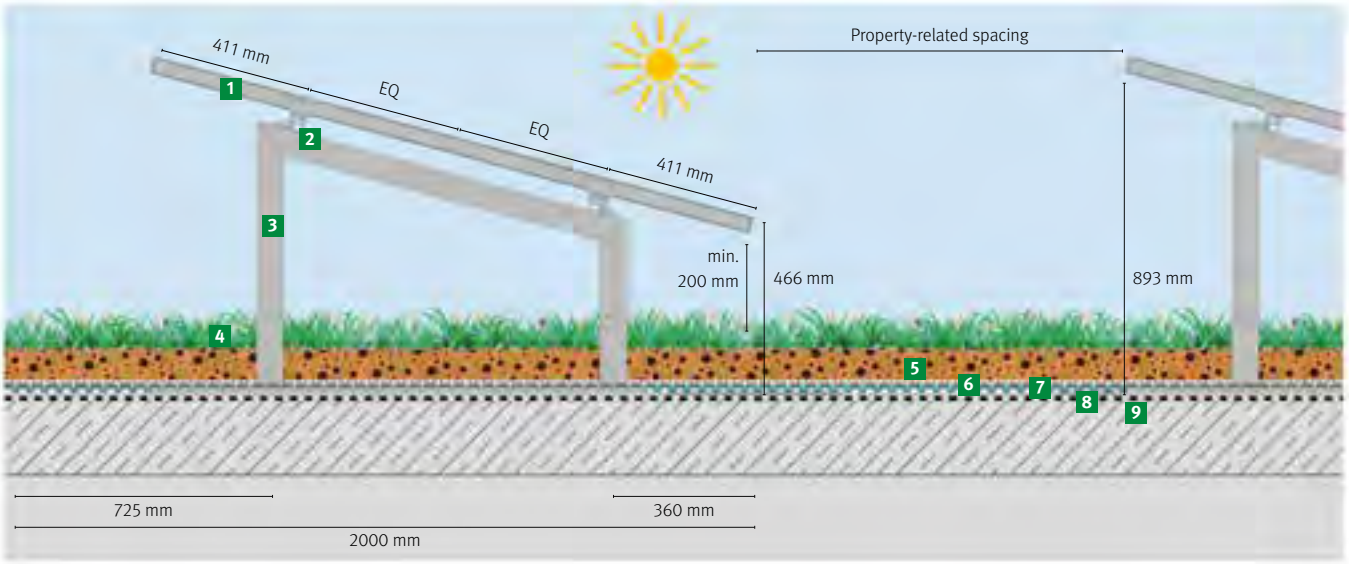
The combination photovoltaics/Green Roof requires the coordination of the trades involved (roofer, gardening and landscaping company, solar installer), even in the planning phase. The quality of the waterproofing must be designed based on use and be root proof in accordance with EN 13948.

Depending on the desired yield, building situation (height, location, wind zone) and specifications of the master plan, the combination of photovoltaics/Green Roof will be planned and costed with assistance of Optigrün.

The Optigrün partner company takes care of installing the SOLAR GREEN ROOF, including the support rails for the photovoltaics modules. The modules are installed by the solar installer, including all electrical work. It is important that the plants do not shade the modules.

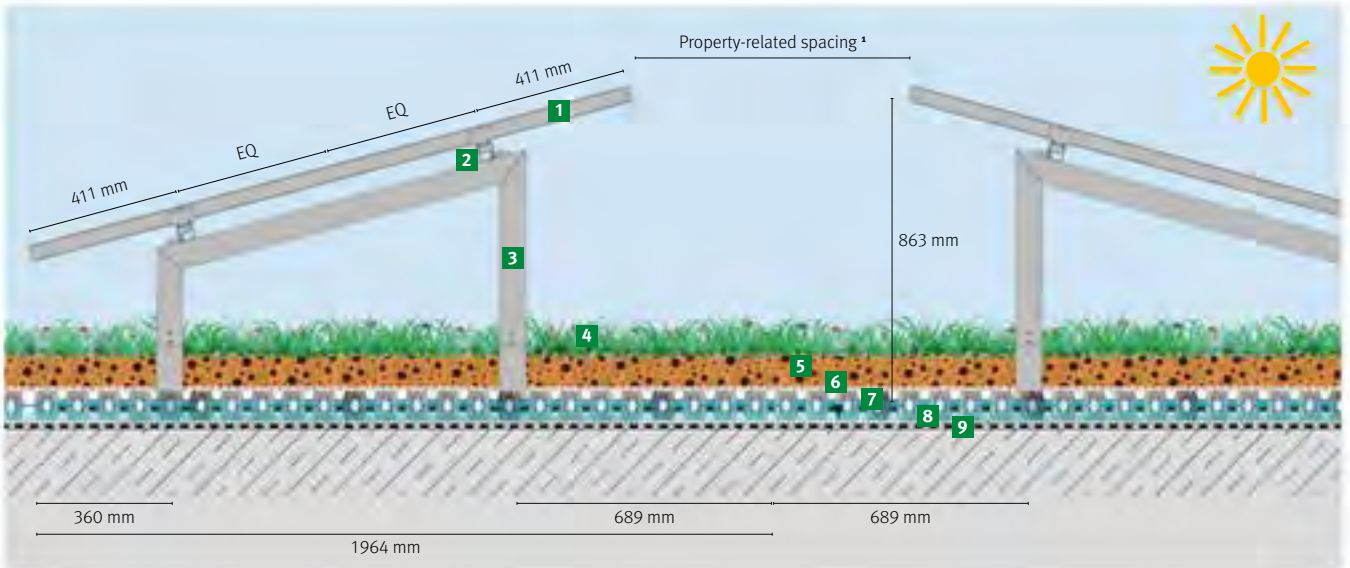
› SOLAR GREEN ROOF

Solar Green Roof Optigrün-Solar FKD



1 **Photovoltaic module**
2 + 3 **Solar Mounting support Solar FKD 25MA**
4 **Sedum Cuttings**
5 **Extensive substrate**
6 **Filter Fleece FIL 150**
7 **Drainage and Storage Board FKD 25 (25 mm)**
8 **Protection and Storage Fleece RMS 500**
9 **Suitable substructure**

Solar Green Roof Optigrün-Solar WRB



1 **Photovoltaic module**
2 + 3 **Solar Mounting support WRB 80FMA**
4 **Sedum Cuttings**
5 **Extensive substrate ²**
6 **Suction and Capillary Fleece RMS 500K**
7 **Water Retention Box WRB 80F**
8 **Protection and Storage Fleece RMS 500**
9 **Suitable substructure**

¹ Row spacing dependent on property location and latitude ² Substrate depth dependent on building geometry, wind zone and site location


OPTIGRÜN®
ROOF GREENING

SYSTEM ADD-ONS

PLANTERS

are practical and low-maintenance add-ons for garden, landscape and public roofs with a wide variety of design possibilities.

- Tailored design
- Use greenery to create accent features
- Moveable greenery
- Closed system
- Available as order-based production

Our Planters are made of high-quality materials like aluminium and stone fibre, making them extremely durable. They are watertight and weather-resistant and are precisely manufactured and skilfully installed, so their beauty is sure to last.

Use them individually or in sets. Either way, our Planters frame their plants just right, while highlighting your overall motif. They're intrinsically eye-catching and can be used to provide shade or serve as barriers and fall protection. Planters allow for a wider variety of plants. For example, they allow you to plant trees and bushes, even with relatively shallow multilayer build-ups.

In addition to a myriad of standard elements, our Planters are available in practically all shapes and sizes. And we're continuously adding to our selection of colours and surface finishes.

Planters – aluminium

› Characteristics
- Lightweight
- Very sturdy, weather-proof, frost resistant
- Wall thickness 3 – 5 mm, depending on the size
- Side walls and bottom welded watertight
- Upper container edge folded over inwards twice; width visible from the top is 30 mm

› Surfaces
- Painted according to RAL and DB standard colour palette
- Seams polished
- NCS and special colours upon request
- Limited resistance to salt and chippings and salty air near the coast

› Special features
- Overflow pipe welded into the bottom; can also be welded into the side walls upon request
- Side walls of the containers reinforced by means of welded bracing plates facing the centre of the container
- Automatic watering system optionally available
- Built-in railings available

Aluminium planters
- Available in round and rectangular shapes
- In standard and special sizes
- On request, available with automated irrigation unit and water level indicator
- All colours according to RAL and DB
- Special paint on request
- Custom shapes and sizes available as order-based production

Material	Aluminium
Material strength	3 – 5 mm
Dimensions	property-specific, please request individually

Planters – stone fibre

› Characteristics
- Environmentally friendly materials
- Very sturdy, weather-proof, frost resistant
- Wall thickness: 10 – 12 mm depending on size
- Weight: heavier than Aluminium Planters but can be handled easily without the use of mechanical equipment
- Side walls are glued and screwed to the bottom
- Waterproof interior coating

› Surfaces
- Painted according to standard-RAL, DB and NCS colour palettes
- Special paint available on request
- Limited resistance to salt and chippings and salty air near the coast

› Special features
- Sealed pipe in the bottom; can also be fitted in the side walls upon request
- Side wall reinforcing plates are both glued and screwed into place
- Integrated water retention
- Automatic watering system optionally available
- Built-in railings optionally available

Stone fibre planters
- In standard and special sizes
- On request, available with automated irrigation unit and water level indicator
- Coated according to RAL or NCS colour fans, special coating on request
- Custom shapes and sizes available as order-based production

Material	Pressed Stone fibre slabs
Material strength	10 – 12 mm
Dimensions	property-specific, please request individually

EDGE ELEMENTS

Edging can be used to delineate larger sections of garden, landscape and public roofs, e.g. as planting beds.

- Targeted greening of larger areas
- Customised shapes and colours
- Raised bed
- More plant variety

The Edge Elements are made of high-quality materials like aluminium and stone fibre. These materials render them weather-resistant, and with precise workmanship and skilled installation, they're also long-lasting.

The Edge Elements are custom-made based on the object and its dimensions. There's practically no limit to what you can create. Planting beds can be designed with angled corners, chamfers and even rounded shapes, perfectly tailored to your building project. And we're continuously adding to our selection of colours and surface finishes. Water basins, stairs and benches can also be integrated. Using planting beds on your roof lets you grow a wider variety of plants, including trees and bushes.

Edge Elements – Aluminium

› Characteristics
- Lightweight
- Very sturdy, weather-proof, frost resistant
- Wall thickness 3–5 mm, depending on the size
- Upper container edge folded over inwards twice; visible width from the top 30 mm
- Available in heights up to 800 mm

› Surfaces
- Painted according to RAL and DB standard colour palette
- Seams polished
- NCS and special colours available upon request
- Limited resistance to salt and chippings and salty air near the coast

› Special features
- Edge elements are designed as L-shaped profiles
- Bracing plates are incorporated at regular distances to reinforce the vertical wall
- Internal and external corners can be designed with different angles
- Delivered ready to install and exactly to specifications
- Interior with thermal lining to protect roots against heat and cold
- Automatic watering system optionally available

Aluminium Edge Elements
- All colours according to RAL and DB
- Versatile and suitable shapes in series, large-scale and custom manufacture
- Organic shapes possible

Material	Aluminium
Material strength	3 or 5 mm
Dimensions	property-specific, please request individually

Edge Elements – Stone Fibre

› Characteristics
- Environmentally friendly materials
- Very sturdy, weather-proof, frost resistant
- Standard wall thickness: 12 mm
- Available in heights up to 800 mm
- Waterproof interior coating

› Surfaces
- Painted according to standard-RAL, DB and NCS colour palettes
- Special paint available on request
- Joints and edges polished
- Limited resistance to salt and chippings and salty air near the coast

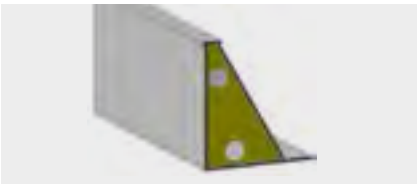
› Special features
- Edge Elements are designed as trapezoidal or L-shaped profiles
- Internal and external corners can be designed with different angles
- Delivered ready to install and exactly to specifications
- Automatic watering system optionally available

Stone Fibre Edge Elements, L-shaped
- Resistant and environmentally-friendly material stone fibre.
- Series colours and special colours e.g. RAL, NCS, etc.
- Versatile and suitable shapes in series, large-scale and custom manufacture

Material	Pressed Stone fibre slabs
Material strength	12 mm
Dimensions	property-specific, please request individually

Stone Fibre Edge Elements, trapezoid
- Resistant and environmentally-friendly material stone fibre.
- Series colours and special colours e.g. RAL, NCS, etc.
- Versatile and suitable shapes in series, large-scale and custom manufacture
- Surrounding cover strip

Material	Pressed Stone fibre slabs
Material strength	12 mm
Dimensions	property-specific, please request individually



EDGE TRIMS

Edge Trims let you easily keep Green Roof structures and pebble boarders separate from one another, leaving a clear outline around Green Roof areas.

- Tailored design
- Targeted accents
- Delineating sections

Edge Trims are used for keeping drainage fixtures (e.g. syphonic drainage) free from substrate. They also serve as fire breaks on roof edges, rising components, façades and roof openings. They are suitable for use on flat roofs and roofs with a slight slope (0–5°).

Edge Trim – Aluminium

› Characteristics
- Material: aluminium
- Colour: natural aluminium
- Height: 60 – 200 mm
  Length 2000 – 3000 mm
  Lightweight: 1 – 2 kg/1000 mm
- Edges folded, different material thicknesses, holes sizes and shapes
- Durable

Top piece for roof drainage outlets
- Especially over roof drainage outlets in floor surfaces used on foot to guide surface water on flat roof areas up to 5° roof pitch and additional drainage option for the lower drainage level due to the side slits in the base frame.

Material	Galvanised steel or stainless steel
Length	available in 300, 400 and 500 mm
Width	available in 300, 400 and 500 mm

Corner Element
- Corner element to form inside/outside corner 90° – 180°

Material	Aluminium
Material strength	1.0 mm
Dimension	H 80 / 120 mm L 200 mm W 110 mm

Edge Trim SKL

› Characteristics
- Material: recycled plastic
- Colour: black
- Affordable alternative to Aluminium Edge Trim
- SKL must be filled to the top on both sides

Plastic Edge Trims
- System edge trim SKL
- Low-cost alternative to aluminium edge trim
- SKL must be filled at both sides to the upper edge
- UV-stabilised

Material	Recycled plastic
Dimensions	H 80 / 120 mm L 300 / 1100 mm W 110 mm

Alu SKL Connector
- Painted black, for the loose connection of the SKL with shortening, or to form an expansion joint.

Material	Aluminium
Material strength	1.0 mm
Dimensions	H 80 / 120 mm L 200 mm W 110 mm

SKYGARD

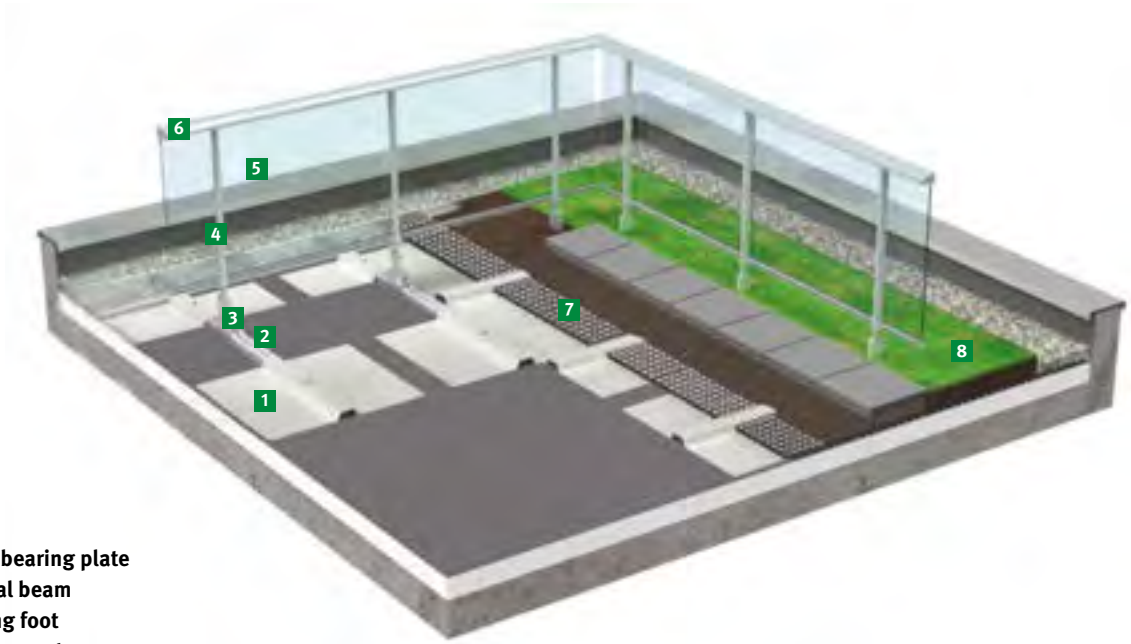
is an aluminium railing system held by superimposed weight for accessible flat roofs with 0 – 3° pitch.

- Fall protection in accordance with regional building laws
- Drill-free installation
- Type Statics
- Adjustable hinged foot
- Installation included upon request
- Held down by superimposed load
- Various railing shapes and infills
- RAL paint colours
- Corrosion-resistant – aluminium

SkyGard is a railing system for accessible roofs and is approved as a fall protection system in accordance with German building codes. The system is custom-manufactured and delivered along with an installation layout.

› Operating principle

SkyGard is installed without fixing into the roof structure and relies on the superimposed weight of the terrace or Green Roof build-up for its stability. The resistance to movement is calculated and an installation layout is produced for every project based on the specific usage requirements for the roof and the railing design. The system components are purpose-made for each roof making on-site installation quick and easy. After installation each railing foot (with lateral beam and load-bearing plate) is covered in with the terrace or Green Roof build-up.



1 Load-bearing plate
2 Lateral beam
3 Railing foot
4 Railing post
5 Infill
6 Handrail
7 Optigrün FKD drainage board
8 Optigrün systems solution (e.g. nature roof, public roof)

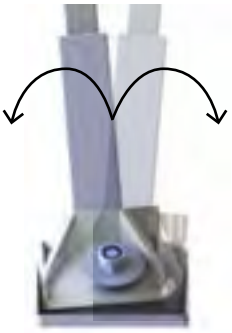
Infills

Handrail versions

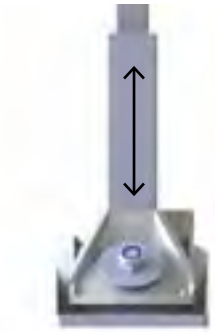
Infills and handrail versions

› Special features

With SkyGard, you can combine different infills with different types of handrails. Round or rectangular railings or glass or rod infills – we offer a wide range of combinations. All standard infills are compatible with the SkyGard railing foot and quick to install. The primary material is aluminium. Painted in the RAL colour of your choice. One popular option is our matt-silver version, which looks similar to aluminium.



up to 4.9°

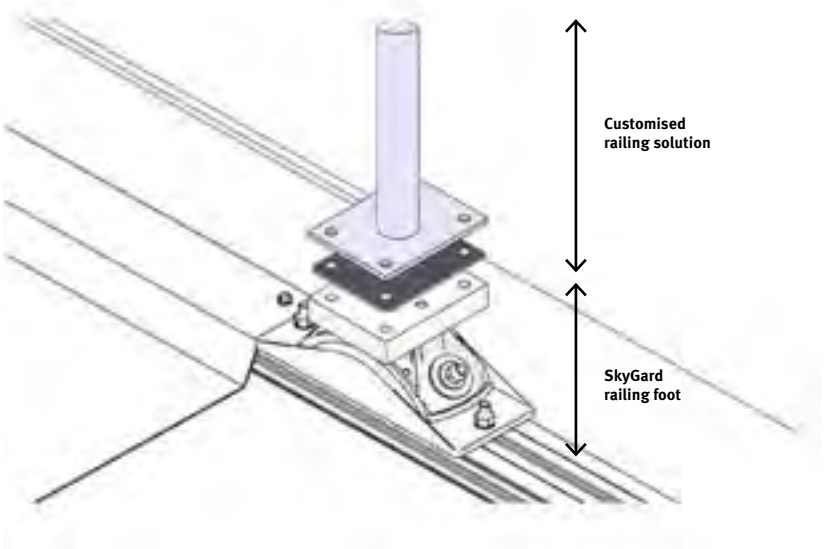


up to 90 mm
(with standard foot)

The flexible SkyGard railing foot

› Special features

Thanks to its ball joint, the SkyGard railing foot can be adjusted flexibly in all directions. All SkyGard infills are compatible with the SkyGard railing foot and quick to install. The painted aluminium components are available in all RAL standard colours. One popular option is our matt-silver version, which looks similar to aluminium.



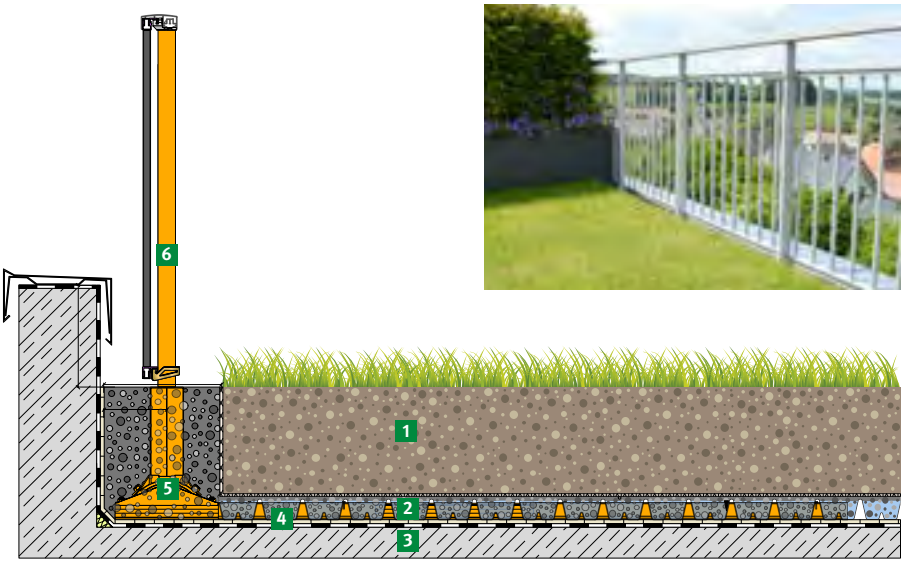
Substructure for customised railing systems

› Special features

SkyGard also allows you to create customised railing solutions, where we supply the substructure of the railing system without the superstructure. In place of the standard post fixture, the hinged foot is fitted with an “adaptor plate”. A non-standard post with a corresponding connection plate can then be bolted onto this adaptor plate. The certificate of tilt resistance which may be required for such a railing structure must be provided by the third party railing manufacturer (e.g. fitter) or by an external structural engineer.

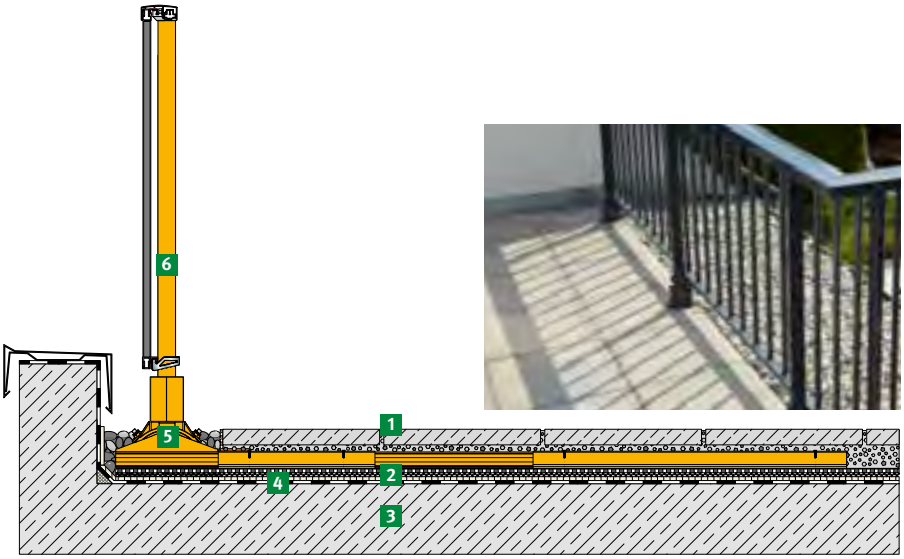
Roof with greenery

1 Greening structure on top must weigh at least 120 kg/m² (depending on conditions)
2 Optigrün drainage board
3 Appropriate substructure with root-proof roof waterproofing and protective liner
4 Lateral beam
5 Railing foot
6 Railing post



Terrace with flagging

1 Terrace structure and/or gravel on top must weigh at least 120 kg/m² (depending on conditions)
2 Optigrün drainage board
3 Appropriate substructure with root-proof roof waterproofing and protective liner
4 Lateral beam
5 Railing foot
6 Railing post



SkyGard
Railing system with glass and / or rod infill
- For flat roofs with private and / or public use of persons
- According to Eurocode 1 part 1
- Held by load
- On green, gravel or with paved roofs built up 3 ° roof pitch
- With particulated foot for exact 3D adjustment of the railing posts different slope situations
- Powder coating according to RAL color
- Type tested modular system according to ETB guideline
- Safe to climb over according to LBO
- All SkyGard systems have a Type Statics with which the stability is mathematically proven. A single proof per construction project is therefore no longer necessary.

Superimposed load	105 bzw. 135 kg/m²
Material railing components	aluminium
Material Railing Foot	Zinc die-casting
Handrail height	according LBO

SAFETY RAILINGS

OPTISAFE GWP and GFS fall protection railings qualify as collective methods to prevent falls, as required by (BS) EN 13374 – Class A for the care and maintenance of extensive green and gravel roofs.

- Drill-free installation
- No cold bridging
- No sound transmission
- Type-tested and approved
- Functional design
- Held down by superimposed load

The OPTISAFE models GWP and GFS are both self-supporting, i.e. installing and using the railings will not result in any potential weak points in the roof build-up, nor would any warranties be affected since there are no penetrations through the roof waterproofing.

Legal framework conditions
The legal framework conditions for occupational health and safety and fall protection must be complied with accordingly in all countries.

OPTISAFE Geländer GWP

› Purpose
- OPTISAFE GWP safety railings qualify as a collective method to prevent falls, as required by (BS) EN 13374 – Class A for the care and maintenance of extensive green and gravel roofs
- OPTISAFE GWP railings for fencing off domelights and lighting rows

› Applications
- Flat roofs with pitches of 0–5°
- Extensive green and gravel roofs
- New construction and refurbishment (as retrofit) without drilling into the roof waterproofing

OPTISAFE Railing GWP
Safety railing made from aluminium
- As side protection for maintenance, care and repair work
- Collective fall protection in accordance with DIN EN 13374 Class A
- Held with a superimposed load
- On green or gravelled roofs up to 5° roof pitch

Standard equipment:
- 1 knee rail and 1 hand rail
- Can be extended with 2nd knee rail and/or foot rail

Dry superimposed load	min. 78 kg/m²
Material railing components	aluminium
Material safety fleece	100 % PP
Height	max. 1100 mm
Max. post spacing	2 m

Post straight, alternatively inclined inwards 15° or 30°

OPTISAFE Geländer GFS

› Purpose
- OPTISAFE GFS safety railings as single or double enclosure for escape routes, fire escape platforms and assembly points in accordance with 14094-2.
- With skirting board.

› Applications
- Flat roofs with pitches of 0–5°
- Extensive green and gravel roofs
- New construction and refurbishment (as retrofit) without drilling into the roof waterproofing

OPTISAFE Railing GFS

Safety railing made from aluminium
- To delimit escape routes and assembly points
- In accordance with DIN 14094-2
- Held with a superimposed load
- On green or gravelled roofs up to 5° roof pitch
- Available as a single- or double-enclosure railing construction
- With standard walkway widths of 1.00 m, 1.20 m or 1.50 m

Standard equipment:
- 1 knee rail, 1 hand rail and 1 foot rail
- Can be extended with 2nd knee rail

Superimposed load	min. 78 kg/m²
Material railing components	aluminium
Material safety fleece	100 % PP
Height	approx. 1100 mm
Post spacing escape route	1.5 m
Post spacing assembly point	1.4 m

PERSONAL FALL PROTECTION SYSTEM

OPTISAFE is a new system, that does not interfere with the roof waterproofing or structure. Its proven stability is maintained by the superimposed weight of the roof greening systems solutions or by a gravel structure.

- Tested and certified in accordance with (BS) EN 795:2012
- Drill-free installation
- Not dependent on substructure [1]
- Stands up to frost
- Corrosion-resistant

Instead of using a railing system for upkeep and maintenance activities, it is also permissible to install a suspension point for securing workers with personal protective equipment (PPE). In this way, one person may be secured with the APS system and maximum 2 at a time with the ALS system.

Our patented fall protection system, OPTISAFE, is an anchor device for flat roofs with a 0–5° pitch, tested in accordance with EN 795:2012. The device can be used to secure one person (APS 16, APS 9 and APS 5) or two people (ALS 16) with personal protective equipment for upkeep and maintenance work.

Our OPTISAFE APS and ALS securing systems are self-supporting, i.e held in situ by means of the superimposed weight of the Green Roof or gravel build-up without the need for supplementary fixing into the roof structure. Installing and using the system will not result in any potential weak points in the roof waterproofing and consequently warranties are unaffected.

OPTISAFE ALS

› Purpose
Cable-operated restraint system with posts held in place by superimposed weight, running parallel to the edge of the roof, for securing workers with PPE during maintenance, upkeep and repair activities, conforming to EN 795:2012 type -E+C and BS CEN/TS 16415:2013 type E+C.

OPTISAFE APS

› Purpose
Single suspension point, held by superimposed weight, for securing a worker with PPE during maintenance, upkeep and repair activities, conforming to EN 795:2012 type E.

ⓘ Safety information
Only use in conjunction with approved and tested PPE with shock absorbers as required by EN 355, approved as a fall protection system as required by EN 363.

ⓘ Legal framework conditions
The legal framework conditions for occupational health and safety and fall protection must be complied with accordingly in all countries.

[1] for flat roofs with 0–5° pitch

OTHER SYSTEM ADDITIONS

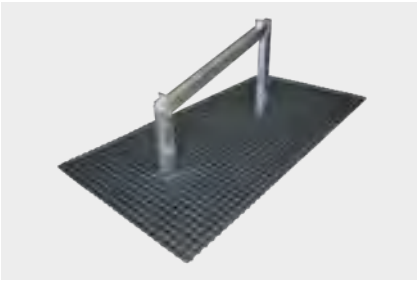
In addition to the complete systems, OPTIGRÜN also offers complementary products tailored to the system solutions.

Solar Mounting Frames Substructure for the mounting frame of photovoltaic modules. Elements held by a superimposed load for penetration-free assembly on green or gravelled roofs.

Optigrün-Solar
- Substructure for the mounting frame of photovoltaic modules with a 10 – 25° incline
- On green or gravelled roofs up to 5° roof pitch
- Elements can be fitted with vegetation or gravel
- Static calculation for supporting structure in accordance with DIN EN 1991 and Eurocode 1

Consisting of
- Aluminium base plate
- Aluminium solar bracket
- Module quick mounting rail with module clamps for the assembly of the PV modules
- Drainage and Storage Board FKD 25MA (Solar FKD) or Water Retention Box WRB 80FMA (Solar WRB)

Superimposed load	min. 80 kg/m² depending on wind load
Material base plate and bracket	aluminium
Material FKD and WRB	recycled HDPE reclaim



Terrace Tile Support Pads TPL Elevated support pad as support and height compensation for terraces outdoors.

TPL
Support and height compensation
- For terraces outdoors
- With 3 mm cross joint to hold paving
- Suitable for coverings made from stone, concrete, ceramic and wood substructures
- Can be used on all stable substrates
- Accessories such as edge holders etc., available

Material	100 % PP
Height	adjustable 20 – 30 mm 40 – 60 mm 50 – 80 mm 80 – 140 mm 140 – 230 mm

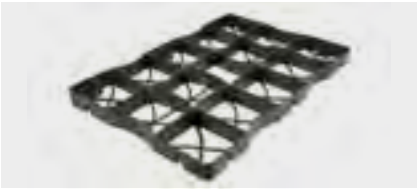
TPL NV
Support and height compensation with self-levelling head up to max. 5% fall
- For terraces outdoors
- With 3 mm cross joint to hold paving
- Suitable for all coverings made from stone, concrete or ceramic
- Can be used on all stable substrates
- Accessories such as end plates, etc., available

Material	100 % PP
Height	adjustable 20 – 30 mm 40 – 60 mm 50 – 80 mm 80 – 140 mm 140 – 230 mm

Wind Erosion Protection Wind protection measure in the gravel strip on roof areas exposed to the wind.

Erosion Protection Plate ESP
Plastic mesh
- For use as a safety measure against wind erosion in the gravel edge of non-pitched roofs
- Easy plug-in system
- Resistant to acids and alkalis

Material	recycled HDPE reclaim
Construction height	approx. 40 mm
Dimensions	605 mm × 405 mm
Compressive strength filled	approx. 1,200 kN/m²




OPTIGRÜN®
ROOF GREENING

TECHNICAL INFORMATION

WIND SUCTION AND WIND EROSION PROTECTION

Roofs that are situated high up or exposed to the elements are always subject to strong winds, not least due to the constantly growing effects of climate change. The current EN 1991-1 “Actions on Structures” addresses these new issues. When it comes to Green Roofs, two factors that need to be taken into account for planning are wind suction protection and wind erosion protection.

Terminology overview

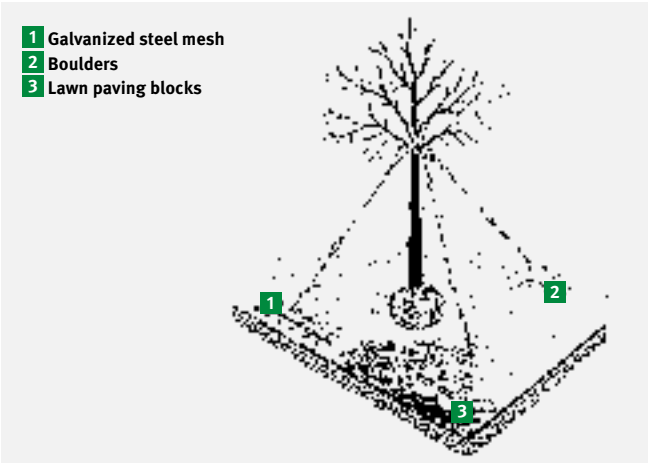
› Roof waterproofing security
A roof structure is considered securely anchored when all the individual components are designed and secured such that they cannot be lifted by wind suction effect. This is usually achieved by fully bonding the roofing layers and, if required, adding supplementary mechanical fixings in certain areas nor by ballasting the entire build-up with, for example, roof greening or pebbles. The waterproofing or insulation manufacturer will determine the correct specification.

As soon as any component of the roof build-up is no longer securely attached to the layer beneath the entire system is deemed insecure. For example, even waterproofing that is fully bonded is considered compromised if the underlying insulation is not securely attached to the vapour control layer.

› Wind erosion protection for Green Roofs
Green Rooftops are considered “wind-proof” if the eroding effect of the wind is not able to transport the individual pebbles or roof substrates. Provided that the roof structure is securely anchored, Optigrün can determine if the Green Roof build-up is wind-proof based on wind tunnel testing and our extensive experience and recommend any safety measures that might be necessary in accordance with the FLL Guideline for Green Roofs.

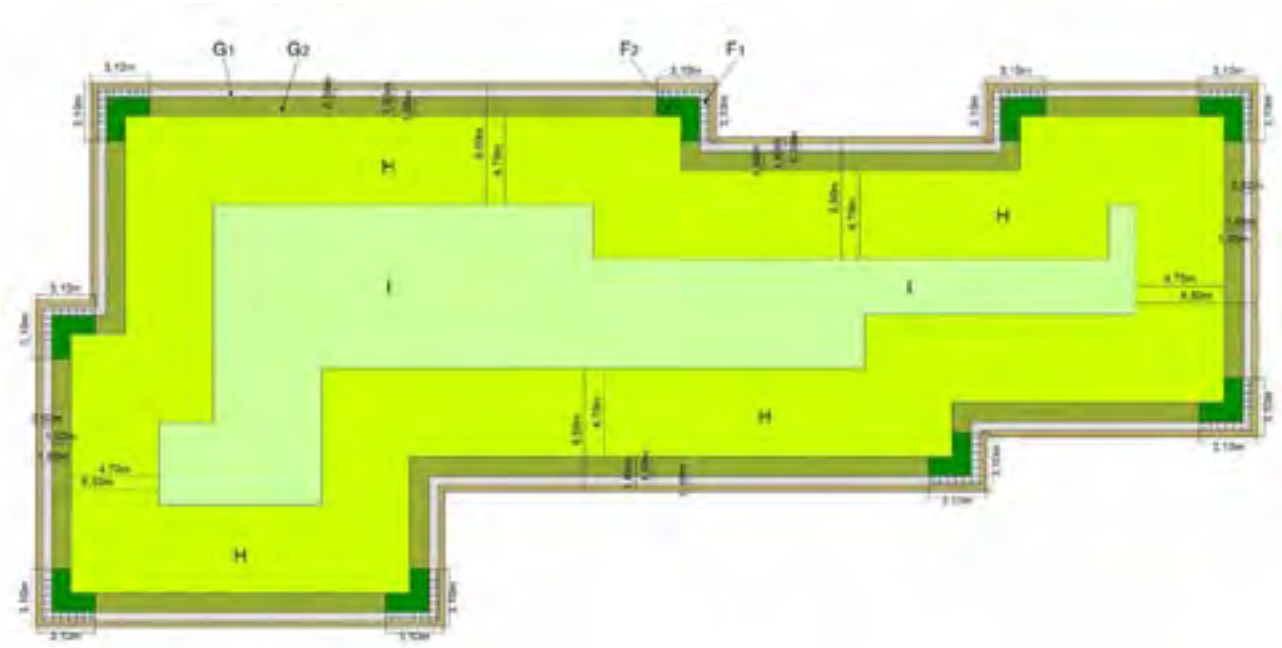
› Securing trees, shrubs and furnishings
In the case of intensive planting, additional safeguards should be considered for woody plants and furnishings (such as pergolas). This could mean using galvanized steel mesh, lawn paving blocks or boulders, as well as cast-in-situ concrete weights.

▲ Wind erosion, in this case all the way down to the roof waterproofing



Practical example: Wind erosion protection planning

The design is based on the following building parameters:
Height: 6.50 m, max. specific load: 1.95 kN/m², wind zone 1, site category III, snow load zone 2



Surface distribution and weights required to ensure wind erosion and wind suction protection:

F - 1,02 kN/m²		G - 0,68 kN/m²		H - 0,40 kN/m²	I - 0,24 kN/m²
F_1	F_2	G_1	G_2		
- 4 cm erosion protection board EPS filled with gravel 16/22 - 2 cm gravel 16/22 - Filter fleece FIL 105 - Drainage board FKD 25 - RMS 300 = 1.09 kN/m² wet	- Veg. mat - 9 cm substrate E-light - Filter fleece FIL 105 - FKD 25 - RMS 300 = 1.58 kN/m² wet	- 5 cm gravel 16/22 - Filter fleece FIL 105 - FKD 25 - RMS 300 = 0.90 kN/m² wet	- Veg. mat - 6 cm substrate E-light - Filter fleece FIL 105 - FKD 25 - RMS 300 = 1.15 kN/m² wet	- Seeding - 6 cm substrate E-light - Filter fleece FIL 105 - FKD 25 - RMS 300 = 1.05 kN/m² wet	- eeding - 6 cm substrate E-light - Filter fleece FIL 105 - FKD 25 - RMS 300 = 1.05 kN/m² wet

Anchoring and wind suction protection for Green Roofs

The wind suction forces acting on the roof waterproofing depend on site conditions and the layers of material on top. The reduction factors can vary depending on the materials and vegetation. A number of wind tunnel tests can be used to determine reduction factors R which would make it possible to reduce the Green Roof build-up (and the weights) on roofs with fully bonded thermal insulation or waterproofing.

› This produces the following advantages:
- Reduced Green Roof build-up layer height
- Reduced support structures, since less Green Roof build-ups are required, reducing the weight being supported
- The system structures tested in the wind tunnel at I.F.I. Aachen allow for reduction factors R between 0.4 and 0.6.

Wind erosion protection

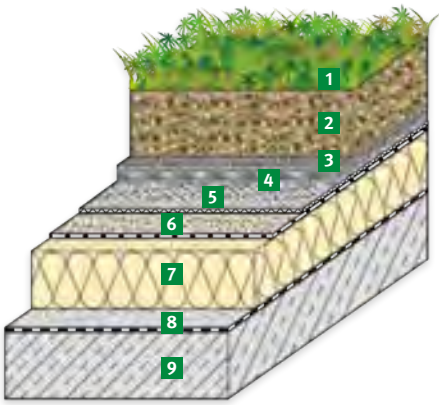
Based on wind tunnel testing conducted especially for exposed roofs, Optigrün international AG recommends the following methods. These measures should be included in the planning phases and tender specifications:
- Pebble areas in edge and corner zones. On extremely exposed buildings and high-risk areas, an ESP wind suction plate filled with gravel is used for added protection against wind drift
- Pre-grown vegetation mats, especially in edge and corner zones, depending on the position of the building
- The interior H and I parts of the Green Roofs can usually be planted using hydro-seeding, which is sufficient for wind erosion protection. Taller buildings (wind zone 3 and 4, exposed roofs) usually require the use of vegetation mats
- Regular and professional upkeep and maintenance

? Service – Do you have any questions for us?
We'll provide you individual assistance and tailored recommendations on how to wind proof your Green Roof and provide you with an installation layout. To enquire about service, please email us at **info@optigruen.com**

ROOF STRUCTURES AND GREENING POTENTIAL

As a rule, all Optigrün system structures are compatible with the roof build-ups shown here. However, in addition to the structural analysis, product features such as thermal insulation and roof waterproofing should also be taken into account in the roof structure plan. With an inverted roof, there are additional factors to consider in order to design a functional roof in combination with our roof greening systems.

Warm roof



1 **Vegetation layer**
2 **Optigrün Substrate**
3 **Optigrün Filter Fleece**
4 **Optigrün Drainage Board FKD**
5 **Optigrün Protection and Storage Fleece RMS**
6 **Roof waterproofing (root-proof as per FLL)**
7 **Thermal insulation**
8 **Vapour barrier**
9 **Concrete slabbing**

› Please note
- Pressure resistant thermal insulation required
- Highly effective vapour barrier required
- Can be greened with all system solutions

› Suitable Green Roof superstructures

ECONOMY ROOF	Page 12
LIGHTWEIGHT ROOF	Page 16
NATURE ROOF	Page 20
RETENTION ROOF	Page 26 / Page 34
PITCHED ROOF	Page 44
GARDEN ROOF	Page 60
LANDSCAPE ROOF	Page 68
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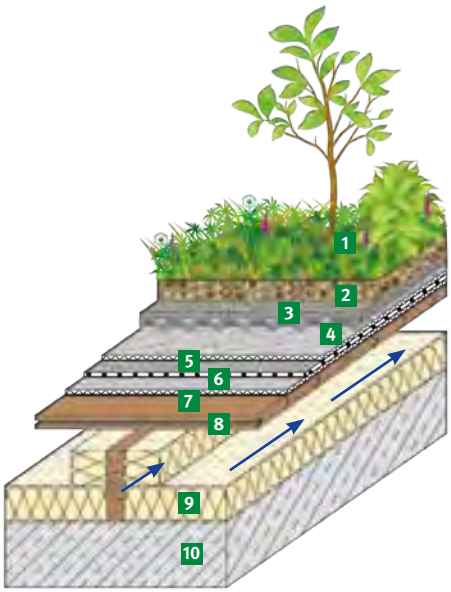
SOLAR GREEN ROOF	Page 86

Ventilated roof



1 **Vegetation layer**
2 **Optigrün Substrate**
3 **Optigrün Filter Fleece**
4 **Optigrün Drainage Board FKD**
5 **Optigrün Protection and Storage Fleece RMS**
6 **Roof waterproofing (root-proof as per FLL)**
7 **Protection and segregation layer**
8 **Substructure**
9 **Thermal insulation**
10 **Concrete slabbing**

› Please note
- Suitable ventilation must be provided
- Can be greened with all extensive system solutions
- Fraunhofer Institute for Building Physics (IBP): IBP report HTB 13-2013

› Suitable Green Roof superstructures

ECONOMY ROOF	Page 12
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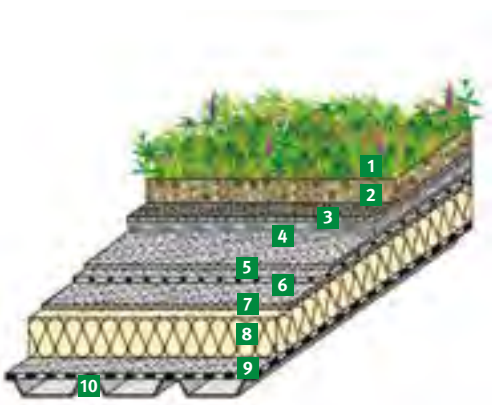
On a metal profiled deck



1 **Vegetation layer**
2 **Optigrün Substrate**
3 **Optigrün Filter Fleece**
4 **Optigrün Drainage Board FKD**
5 **Optigrün Protection and Storage Fleece RMS**
6 **Roof waterproofing (root-proof as per FLL)**
7 **Protection and segregation layer**
8 **Thermal insulation**
9 **Vapour barrier**
10 **Support structure / profiled sheet**

› Please note
- Can be greened with all light system solutions

› Suitable Green Roof superstructures

ECONOMY ROOF	Page 12
LIGHTWEIGHT ROOF	Page 16
NATURE ROOF	Page 20
RETENTION ROOF	Page 26 / Page 34
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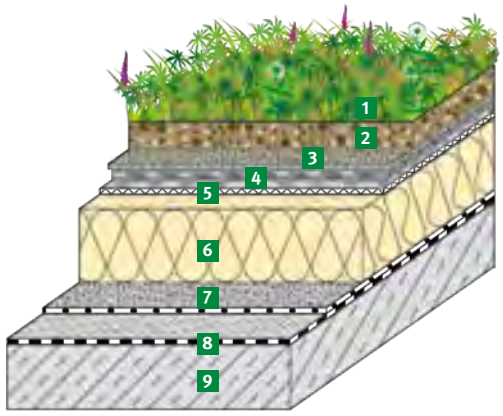
SOLAR GREEN ROOF	Page 86

Inverted roof



1 **Vegetation layer**
2 **Optigrün Substrate**
3 **Optigrün Filter Fleece**
4 **Optigrün Drainage Board FKD**
5 **Optigrün Trickle Protection Fleece**
6 **Thermal insulation**
7 **Protection and segregation layer**
8 **Roof waterproofing (root-proof as per FLL)**
9 **Concrete slabbing**

› Please note

With an inverted roof, aside from the usual basic design data, there are additional factors to consider in order to ensure the long-term functionality of the thermal insulation under the Green Roof build-ups:

› Vapour permeability
Water vapour must be released through the thermal insulation over the roof greening build-up and into the environment. For this to occur, either the Green Roof build-up needs to dry out regularly and be able to absorb water from "below" or there needs to be a sufficiently ventilated drainage layer on top of the thermal insulation. Water cannot be allowed to accumulate and stand for prolonged periods on the inverted roof waterproofing. A Water Flow Reducing Layer will normally be specified between the inverted roof waterproofing and the Green Roof layers.

› Wind suction protection
The thermal insulation boards are placed loosely on top of the roof waterproofing and must be weighted down to prevent them from blowing away. When performing the wind suction calculation, Optigrün incorporates the thermal insulation manufacturer's data on the minimum weights for the corner, edge and centre areas. This lets us work out the right green structure design.

› Compression strength
Sufficiently pressure resistant thermal insulation is especially important for deeper Green Roof build-ups and pedestrian or vehicle traffic.

› Suitable Green Roof solutions:

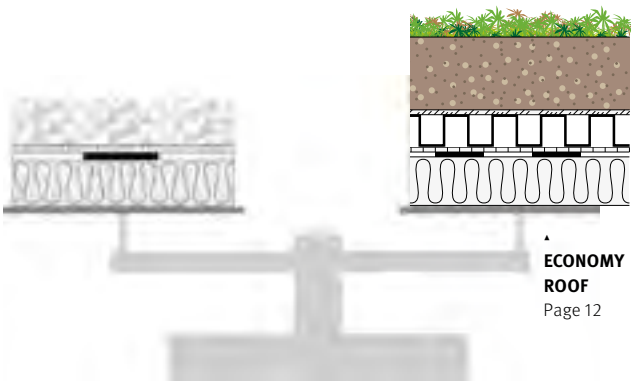
ECONOMY ROOF Generally suitable, consider min. loads for uplift protection if necessary	Page 12
NATURE ROOF Generally suitable, consider min. loads for uplift protection if necessary	Page 20
RETENTION ROOF Suitable with temporary water retention	Page 26 / Page 34
PITCHED ROOF Generally suitable, consider min. loads for uplift protection if necessary	Page 44
GARDEN ROOF suitable with FKD 60BO	Page 60
LANDSCAPING ROOF suitable with FKD 60BO	Page 68
PUBLIC ROOF Only designs with FKD 10UK, FKD 25, FKD 25 plus and FKD 60 are suitable	Page 72
SOLAR GREEN ROOF Generally suitable but individual consultation required	Page 86

STRUCTURAL REQUIREMENTS

The Optigrün system solutions are compatible with practically all roof deck constructions. It is important, however, that the roof structure is designed to accept the saturated weight loading of the Green Roof system required. If the permissible load is restricted, our Technical Department will recommend a suitable lightweight Green Roof build-up.

Additional loads

Generally, the structural analysis already accounts for snow loads (according DIN-EN 1055) in accordance with the different snow zones as well as the eventual live loads. However, the weight of a saturated Green Roof build-up (with potential water retention) needs to be considered as an additional load ahead of the building design phase. In addition to the maximum load of the Green Roof, its dry weight is also important for ensuring that it stands up to wind suction. Interestingly, a simple and affordable extensive greening like the ECONOMY ROOF weighs the same as a gravel roof! The LIGHTWEIGHT ROOF actually weighs just half as much as a gravel roof!



ECONOMY ROOF
Page 12

› Weight of the systems solutions, including vegetation

System solutions	Weight [1] with max. water saturation		Weight [1] in dry condition	
ECONOMY ROOF	from 90 kg/m²	from 0.9 kN/m²	from 65 kg/m²	from 0.65 kN/m²
LIGHTWEIGHT ROOF	from 55 kg/m²	from 0.55 kN/m²	from 30 kg/m²	from 0.3 kN/m²
NATURE ROOF	from 95 kg/m²	from 0.95 kN/m²	from 65 kg/m²	from 0.65 kN/m²
RETENTION ROOF MÄANDER	from 90 kg/m²	from 0.9kN/m²	from 65 kg/m²	from 0.65 kN/m²
RETENTION ROOF DROSSEL	from 100 kg/m²	from 1.0kN/m²	from 80 kg/m²	from 0.8 kN/m²
PITCHED ROOF	from 100 kg/m²	from 1.0 kN/m²	from 70 kg/m²	from 0.7 kN/m²
GARDEN ROOF	from 320 kg/m²	from 3.2 kN/m²	from 250 kg/m²	from 2.5 kN/m²
LANDSCAPE ROOF	from 600 kg/m²	from 6.0 kN/m²	from 500 kg/m²	from 5.0 kN/m²
PUBLIC ROOF	from 170–700 kg/m²	from 1.7–7.0 kN/m²	from 170–700 kg/m²	from 1.7–7.0 kN/m²
SOLAR GREEN ROOF	from 120 kg/m²	from 1.2 kN/m²	from 95 kg/m²	from 0.95 kN/m²

› Distributed loads of the vegetation forms (as per FLL data)

Vegetation form		
Moss-sedum	10 kg/m²	0.1 kN/m²
Sedum-herbs-grasses	10 kg/m²	0.1 kN/m²
Grasses-herbs (dry lawns)	10 kg/m²	0.1 kN/m²
Grasses-herbs (grass roof, fertilised meadow)	15 kg/m²	0.15 kN/m²
Wild perennials-shrubs	10 kg/m²	0.1 kN/m²
Shrubs-perennials	15 kg/m²	0.15 kN/m²
Shrubs up to 1.5 m	20 kg/m²	0.2 kN/m²
Lawns	5 kg/m²	0.05 kN/m²
Perennials and shrubs	10 kg/m²	0.1 kN/m²
Perennials and bushes up to 1.5 m	20 kg/m²	0.2 kN/m²
Bushes up to 3 m	30 kg/m²	0.3 kN/m²
Large bushes up to 6 m *	40 kg/m²	0.4 kN/m²
Small trees up to 10 m *	60 kg/m²	0.6 kN/m²
Trees up to 15 m *	150 kg/m²	1.5 kN/m²

› Loads of the drainages and substrates
See page 152 (drainage) and page 164 (substrates).

Service – Do you have any questions for us?
For precise, project-specific data and calculations for the loads, see here:
info@optigruen.com

[1] Reference values * Values pertain to the top of the crown.

FIRE PROTECTION

Like other roof types, Green Roofs are also subject to fire safety requirements and legal regulations. A Green Roof must be non-flammable and should serve as a protective shield against flying sparks and radiating heat in order to prevent fire from spreading.

With regard to fire protection, local fire regulations should be observed as well as specific design guidance contained in the FLL Guidelines for Green Roofs and the GRO Green Roof Code.

Intensive Green Roofs

According to construction regulations, intensive Green Roofs are categorised as “hard roofing” and are thus resistant to flying embers and radiating heat.

› Suitable Green Roof superstructures

GARDEN ROOF	Page 60
LANDSCAPE ROOF	Page 68
PUBLIC ROOF	Page 72

Extensive Green Roofs

Extensive Green Roofs are likewise classed as “hard roofing” sufficiently resistant to flying embers and radiating heat provided the following conditions are met.

› Suitable Green Roof superstructures

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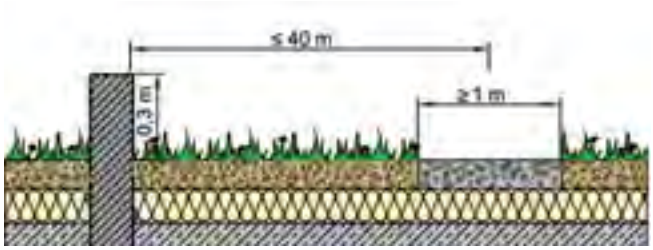
› Important

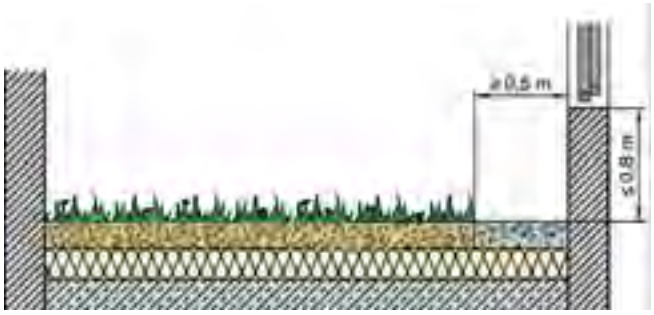
- All Optigrün System Solutions meet the aforementioned fire protection requirements and are thus classed as “sufficiently resistant to flying embers and radiating heat” “hard roofing”
- Applicable national and local requirements specific to the structure also need to be considered
- Different System Solutions are successfully tested according CEN/TS 1187:2014
- We recommend concluding a maintenance care contract with an Optigrün partner to protect vegetation from fire by removing foreign species

› Conditions

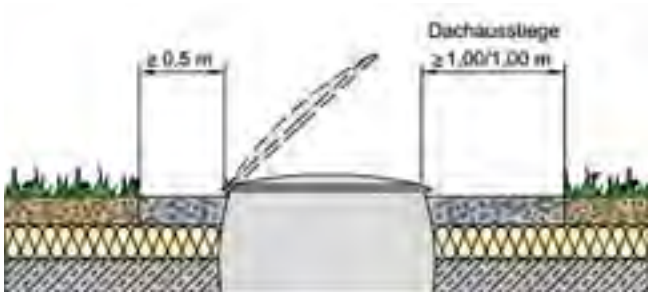
- Vegetation consists predominantly of low-growing plants such as sedum, herbs
- Substrate depth of at least 80 mm, including the thickness of pre-cultivated vegetation mats if fitted. (A minimum depth of 30 mm is applicable to the Optigrün Lightweight Roof solution only using Type L substrate).
- Substrate consists of a maximum of 20 per cent organic material (by mass)
- On large roofs a one metre wide pebble strip is installed at 40 metre intervals longitudinally across the roof.ture
- As an alternative to the above an upstand constructed of non-flammable material with a height of at least 300 mm or paving slabs with a width of at least one metre must be installed above fire walls.
- Openings on the roof (i.e. roof-lights) and windows in adjacent walls must have pebble borders or rows of paving slabs of at least 500 mm width installed in front of them. Exception: if apertures in adjacent walls are located more than 800 mm above the top of the Green Roof superstructure



▲ **Fire walls**



▲ **Rising walls**



▲ **Roof openings**

VEGETATION PLANTING AND HANDOVER

There are four different ways to plant and establish vegetation on the roof. These methods differ in terms of cost, structural constraints and the length of time involved in achieving full coverage. The development of the vegetation will depend on factors such as weather and correct maintenance during the establishment and development phases. The months of April to June and September to October are generally most suitable for applying vegetation. In the other months, there are increased care requirements or a greater risk of failure.

Dry seeding

› Areas of application
Extensive greening: For use with the ECONOMY ROOF solution or potentially with NATURE ROOF, RETENTION ROOF and PITCHED ROOF (up to 15° roof pitch).

› Brief description
This method is the most inexpensive way to apply vegetation and is used on extensive Green Roofs with extensive substrate EKR. Approximately 1 g/m² of seed mix EKR or the new biodiversity seed mix BDM and around 50 g/m² of sedum cuttings are scattered by hand and watered well.

› Characteristics
- Most cost-efficient type of vegetation planting
- Approx. 60 – 80 % coverage after one year
- Recommended for smaller roof areas of under approx. 1,000 m²
- Can also be used with only sedum cuttings, in which case approx. 70 – 90 g/m² should be used
- Higher maintenance required until handover compared to hydroseeding

› Handover [1]
At 60 %, projective coverage

Hydroseeding

› Applications
Extensive Green Roofs: For use with the ECONOMY ROOF solution or potentially with NATURE ROOF, RETENTION ROOF and PITCHED ROOF (up to 15° roof pitch).

› Brief description
This method is mostly used with large extensive vegetation. It involves combining Seed Mix, binder and water, sometimes along with germinating substrate. A special vehicle is then used to spray the mixture on the roof. Prior to this, sedum cuttings (approx. 50 g/m²) are scattered by hand.

› Characteristics
- Cost-efficient type of vegetation planting
- Uniform distribution of seeds
- Good protection against wind and rain erosion
- Approx. 60 – 80 % coverage after one year
- Suitable for roof areas from approx. 1,000 m²

› Handover [1]
At 60 %, projective coverage

[1] "Handover-ready status": The "handover-ready status" as defined in the Green Roof guidelines is usually achieved after approximately one year and is only applicable in conjunction with a proper maintenance contract. An initial handover should follow the installation of the Green Roof superstructure, including the plants and seeding. If no establishment maintenance contract has been concluded, this handover is considered final.

Vegetation mats/turf

› Applications
- Extensive Green Roofs: can be used with PITCHED ROOF and LIGHTWEIGHT ROOF systems, and potentially with the ECONOMY ROOF, NATURE ROOF, RETENTION ROOF and SOLAR GREEN ROOF systems
- Intensive Green Roofs: GARDEN ROOF and LANDSCAPE ROOF systems with lawns

› Brief description
Pre-cultivated vegetation mats and turf with pre-grown plant varieties are laid on the substrate and watered thoroughly.

› Characteristics
- Immediate complete Green Roof surface with approx. 80–100 % coverage
- Provides wind erosion protection for corners and edges of exposed extensive Green Roofs
- Erosion protection for steep Green Roofs (above 15°)
- Turf is preferable over seeding for recreational lawn surfaces
- The most costly method of establishing vegetation but also the fastest and most reliable
- Vegetation mats with different backing materials for various areas of application: decomposable natural fibres for flat roofs and sloped roofs (up to 20°), rot-proof fabric backing mats for steep roofs with pitches of 20° or more

› Handover [1]
At 80 % (vegetation mats) or 95 % (turf) coverage and secure root growth

› Products
- Optigrün Vegetation Mat SM/ G 20. Sedum on biodegradable load-bearing fabric carrier
- Optigrün Vegetation Mat S/COC 20 and 30
- Optigrün Vegetation Mat SM/KG. Sedum-Moss on a tensile strength and rotproof fabric carrier

Plug planting

› Applications
- Extensive Green Roofs: For use with the NATURE ROOF solution or potentially with ECONOMY ROOF, RETENTION ROOF, SOLAR GREEN ROOF and PITCHED ROOF (up to 15° roof pitch)
- Intensive Green Roofs: Optigrün GARDEN ROOF and LANDSCAPE ROOF systems

› Brief description
For extensive greening, small plug plants which can be sedums, wild-flowers or wild grasses are planted into the substrate. For extensive greening approximately 15 – 25 plants per square metre are required with a typical 40 – 50 mm pot size. For intensive greening the require-ments will depend on the type of vegetation selected (perennials and shrubs) and pot size.

› Characteristics
- Used with landscaped extensive Green Roofs, especially if they are visible
- For intensive greening
- Approx. 60 – 80 % coverage after one year
- Higher costs than the seeding method

› Handover [1]
Upon achievement of appropriate growth in the volume ordered

BIODIVERSITY BUILDING BLOCKS

One of the most important ecological functions of roof greening is to create refuges and habitats for plants and animals. Having a variety of different kinds of Green Roofs greatly helps to make up for the negative consequences of land development and ground sealing. Aside from that, biodiverse Green Roofs with different kinds of vegetation have additional positive effects such as rainwater retention and flow retardation, cooling and pollutant filtration.[1]

The development of biodiversity on Green Roofs depends heavily on the design of the green spaces available to the plants and animals. Both intensive and extensive Green Roofs can serve as biodiversity roofs. The biodiversity building blocks can be used both in new buildings and for the ecological enhancement of an existing Green Roof.

For years now, the biodiversity building blocks have relied on the following guidelines, which can now be found in the 2018 edition of the FLL Guideline for Green Roofs:
- Impact reduction
- Wide variety of roof landscape designs
- High water retention and high flow retardation
- Powerful evaporation and cooling effects
- Efficient filtration of pollutants
- Use of natural materials
- Use of recycled plastic
- Recyclability of all materials
- Wide variety of flora and fauna

[1] Cf. FLL Guideline for Green Roofs 2018, Sect. 9.5

What kinds of biodiversity building blocks are there?

The five biggest biodiversity building blocks can be used in combination or individually, depending on the goal. From a basic upgrade to an extensive Green Roof to the use of a Green Roof as a mitigation or reduction measure or even replicating biotopes for animal species in need of protection – the sky's the limit.

› Modelling the substrate
With different substrate heights, allowing a wide variety of plants and various design elements, you can create an ecologically valuable and visually appealing Green Roof. In contrast to the basic Green Roof build-up, the substrate depth can be increased either over the whole roof or on individual areas. Substrate mounds, shrubbery and/or deeper substrate areas serve as frost-free refuges for soil animals. By choosing plants by blossom colour and flowering season from a special list of varieties, food can be made available all year round.

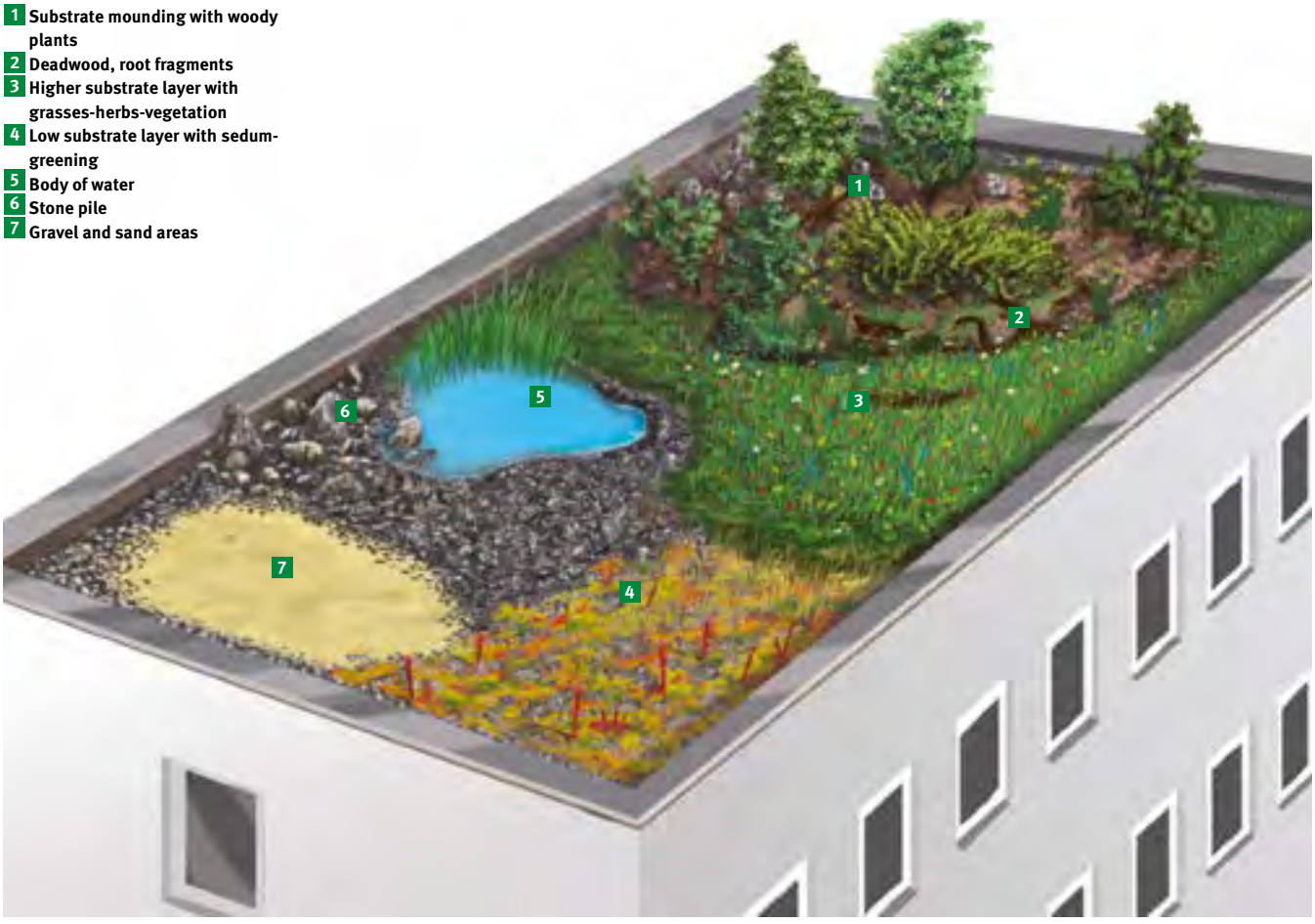
› Bodies of water
Bodies of water, both permanent and seasonal, provide animals with water for longer periods of time.

› Deadwood
Sawn wood such as tree branches and trunks, decayed log and brushwood of various thicknesses provide nesting and breeding grounds for many birds and insects.

› Nesting aids
Wind-proof nesting aids such as insect hotels, birdhouses or beehives help animals utilize the roof long-term and make their homes there.

› Sand areas and fine/coarse gravel surfaces
In order to accommodate different kinds of animals, there also need to be vegetation-free areas such as sand or clay areas, spaces with coarse gravel or crushed stone (in different shapes and sizes).

1 **Substrate mounding with woody plants**
2 **Deadwood, root fragments**
3 **Higher substrate layer with grasses-herbs-vegetation**
4 **Low substrate layer with sedum-greening**
5 **Body of water**
6 **Stone pile**
7 **Gravel and sand areas**



UPKEEP AND MAINTENANCE

To ensure the vegetation takes root and flourishes and to prevent undesired plant varieties from spreading, a Green Roof needs regular maintenance and upkeep. The amount of maintenance required depends on the plant species selected. Depending on the vegetation, the roof should also be given an application of OPTICOTE SLOW-RELEASE FERTILISER every 1–2 years to provide the plants with the nutrients they need. We also recommend having an upkeep and maintenance contract with one of our Optigrün partners to ensure that the target vegetation lasts as long as possible.

Maintenance phases

Roof greening is a process. That's why no planning and implementation work is complete without regular, professional maintenance. It is important for this to be included and detailed as early as the specification stage of the project. Aspects to consider:
- Water connections
- Accessibility
- Fall protection devices
  We recommend the affordable maintenance service offered by our qualified Optigrün partners. (e.g. OPTISAFE S. 116)

› Green Roof maintenance consists of 3 phases:
1. Establishment maintenance: This is included with the installation of the Green Roof and continues until the final approval according to a defined "handover-ready state". At approx. 60 % density, the vegetation cover is not fully complete. Duration approx. 12 – 15 months
2. Development maintenance: Follows establishment maintenance and continues until target vegetation coverage has reached approx. 90 %. Duration: approximately 2 – 4 years
3. Routine maintenance: After the target vegetation coverage is reached, it will need to be maintained. Duration: continuous.

The maintenance measures required are, as a rule, the same in all phases of care. The frequency and intensity of the maintenance work described below can vary according to the greening progress.

Measures

The following care and maintenance measures should be carried out as needed for both extensive and intensive Green Roofs:

- Watering (primarily during the initial growth phase)
- Weeding
- Mowing, if required
- Application of Opticote slow-release fertiliser
- Removal of cuttings, leaves, and debris
- Re-seeding or re-planting areas, re-filling substrate, if required
- Vegetation protection
- Keeping pebble borders, safety strips and paved areas clear
- Cleaning of gutters, inspection shafts, roof drainage outlets, etc.

› Intensive roofs may additionally require the following:
- Cutting
- Mulching
- Winter protection measures
- Adjustment and/or removal of embedded woody plant roots
- For walkable lawns: de-thatching, aerating, sand-filling
- Maintenance of irrigation facilities

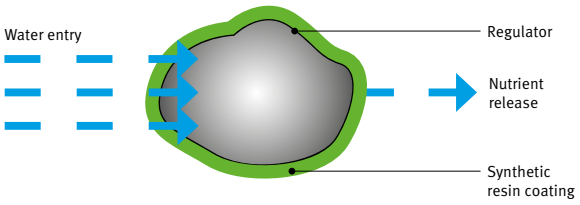
Maintenance - extensive greening:	approx. 1 – 2 times a year
Maintenance - intensive greening:	approx. 3 – 10 times a year

No maintenance work without fall protection

OPTICOTE SLOW-RELEASE FERTILISER

Opticote is a fully-coated slow-release fertiliser with an 8–9 month duration of effect. The duration of effect depends on temperature. The nutrients are released by osmosis, controlled by the regulator in the fertiliser coating.

› Diagram: How OPTICOTE SLOW-RELEASE FERTILISER works



› Benefits of Opticote

- Uniform nutrient supply over an entire growth period
- No over-fertilisation due to full coating of the fertiliser
- Opticote takes effect when plants need nutrients – when there's enough moisture and temperatures are warm
- No loss of nutrients into the drainage system due to slow release

› Composition of Opticote:

Nitrogen N	18 %
Phosphate P_2O_2	6 %
Potassium oxide K_2O	8 %
Magnesium oxide MgO	2 %

› Application amounts for Green Roofs (annually):

Extensive greening new planting	35 g/m²
Extensive greening care	30 g/m²
Intensive greening new planting	60 g/m²
Lawn carrier layer new planting	60 g/m²
Intensive greening care	50 g/m²

OPTICOTE SLOW-RELEASE FERTILISER

PLANT RECOMMENDATIONS

The vegetation of a Green Roof directly depends on the rooting space available. Together, the substrate and the drainage layer comprise the root space available to the plants. We recommend using a selection of 5–7 types of plants, starting with the sedum cuttings for all systems. A large number of the plants mentioned here are contained in our seed mixes EKR, MKR and BKR. (See page 167)

Our plant recommendations for the various systems:

Plant lists for bee-friendly roofs Seed mixes, sedum cuttings, vegetation mats and/or low-growing perennials

BEES PLANT LIST

Perennials Plug Plants

Achillea millefolium	Common Yarrow
Achillea tomentosa	Woolly Yarrow
Ajuga reptans	Bugleherb
Allium moly	Golden Garlic
Allium schoenoprasum	Chives
Allium sphaerocephalon	Round Headed Leek
Alyssum spp.	Alyssum
Antennaria dioica	Pussytoes
Anthemis tinctoria	Yellow Chamomile
Calamintha nepeta ssp. nepeta	Lesser Calamint
Campanula carpatica	Tussock Bellflower
Campanula rotundifolia	Harebell
Cerastium tomentosum	Snow-in-Summer
Corydalis lutea	Yellow corydalis
Dianthus carthusianorum	Carthusian Pink
Dianthus deltoides	Maiden Pink
Dianthus gratianopolitanus	Bath's Pink
Euphorbia cyparissias	Cypress Spurge
Fragaria vesca	Wild Strawberry
Gypsophila repens	Alpine Gypsophila
Hieracium pilosella	Mouse-ear Hawkweed
Hieracium x rubrum	Red Hawkweed
Hypericum perforatum	Common Saint John’s Wort
Hypericum polyphyllum	Aaron's Beard
Hyssopus officinalis	Hyssop
Inula ensifolia	Slender-leaved Elecampane
Iris pumila	Pygmy Iris
Iris tectorum	Roof Iris
Jovibarba sobolifera	Beard of Jupiter
Leucanthemum vulgare	Oxeye daisy
Linum perenne	Perennial Flax
Nepeta x faassenii	Catmint
Origanum vulgare	Oregano
Paronychia kapela	Mossy Whitlow-wort
Petrorhagia saxifraga	Tunic-Flower
Pimpinella saxifraga	Burnet-saxifrage
Potentilla verna	Alpine Cinquefoil
Prunella grandiflora	Large Self-Heal
Pulsatilla vulgaris	Pasque Flower
Ranunculus bulbosus	St Anthony’s Turnip
Salvia officinalis	Common Sage (varieties)
Sanguisorba minor	Small Burnet
Saponaria ocymoides	Rock Soapwort
Saponaria officinalis	Common Soapwort
Sedum acre	Goldmoss Stonecrop
Sedum album	White Stonecrop (varieties)
Sedum cauticolum	Cliff Stonecrop
Sedum cyaneum	Azure Stonecrop
Sedum ewersii	Pink Mongolian Stonecrop
Sedum floriferum 'Weihenstephaner Gold'	Stonecrop 'Weihenstephaner Gold'
Sedum hispanicum	Spanish Stonecrop
Sedum hybridum 'Immergrünchen'	'Immergrünchen' Hybrid Stonecrop
Sedum kamtschatikum	Kamschatka Stonecrop
Sedum lydium	Least Stonecrop
Sedum reflexum	Reflexed Stonecrop
Sedum selskianum	Amur Stonecrop
Sedum sexangulare	Tasteless Stonecrop
Sedum spathulifolium	Broadleaf Stonecrop
Sedum spectabile	Brilliant Stonecrop
Sedum spurium	Caucasian Stonecrop (varieties)
Sedum telephium	Stonecrop (varieties)
Sempervivum arachnoideum	Cobweb Houseleek
Sempervivum spurium	Hens and Chicks
Thymus pulegioides	Broad-leaved Thyme
Thymus serpyllum	Breckland Thyme
Verbascum phoeniceum	Purple Mullein
Veronica teucrium	Large Speedwell

Plant lists for extensive greening Seed mixes, sedum cuttings, vegetation mats and/ or low-growing perennials

ECONOMY ROOF
substrate depth: from approx. 60 mm

Perennials	
Anthemis tinctoria	Yellow Chamomile
Campanula rotundifolia	Harebell
Dianthus carthusianorum	Carthusian Pink
Hieracium aurantiacum	Orange Hawkweed
Hieracium pilosella	Mouse-ear Hawkweed
Petrorhagia saxifraga	Tunic-Flower
Potentilla verna	Alpine Cinquefoil
Sanguisorba minor	Salad Burnet
Saponaria ocymoides	Rock Soapwort
Sedum album 'Coral Carpet'	White Stonecrop 'Coral Carpet'
Sedum reflexum	Reflexed Stonecrop
Sedum sexangulare	Tasteless Stonecrop
Sedum spurium	Caucasian Stonecrop (varieties)
Sempervivum arachnoideum	Cobweb Houseleek
Sempervivum montanum	Mountain Houseleek
Thymus serpyllum	Breckland Thyme

Grasses	
Carex montana	Mountain Sedge
Festuca ovina	Sheep Fescue
Poa alpina var. Vivipara	Alpine meadow-grass

Retention roof extensive
substrate depth: from approx. 100 mm

Perennials	
Achillea millefolium	Common Yarrow
Achillea tomentosa	Woolly Yarrow
Allium schoenoprasum	Chives
Antennaria dioica	Pussytoes
Anthemis tinctoria	Yellow Chamomile
Centaurea scabiosa	Greater Knapweed
Chrysanthemum leucanthemum	Oxeye Daisy
Dianthus carthusianorum	Carthusian Pink
Hieracium pilosella	Mouse-ear Hawkweed
Hieracium x rubrum	Red Hawkweed
Petrorhagia saxifraga	Tunic-Flower
Potentilla verna	Alpine Cinquefoil
Prunella grandiflora	Large Self-Heal
Sanguisorba minor	Small Burnet
Saponaria ocymoides	Rock Soapwort
Sedum album 'Coral Carpet'	White Stonecrop 'Coral Carpet'
Sedum reflexum	Reflexed Stonecrop
Sedum sexangulare	Tasteless Stonecrop
Sedum spurium	Caucasian Stonecrop (varieties)
Thymus montanus	Mountain Thyme
Thymus serpyllum	Breckland Thyme
Verbascum phoeniceum	Purple Mullein
Veronica teucrium	Large Speedwell

Grasses	
Carex flacca	Blue Sedge
Carex humilis	Dwarf Sedge
Festuca amethystina	Amethyst Fescue
Festuca ovina	Sheep Fescue
Poa compressa	Canada Bluegrass

ⓘ An illustrated plant list can be found on our website. For further plant recommendations, see also from page 167

Plant lists for extensive and simple intensive Green Roofs

Seed mixes, sedum cuttings and/or low-growing perennials

NATURE ROOF and RETENTION ROOF semi-intensive
substrate depth: from approx. 150 mm

Perennials

Achillea millefolium	Common Yarrow
Allium roseum	Rosy Garlic
Allium schoenoprasum	Chives
Anthemis tinctoria	Yellow Chamomile
Aster linosyris	Goldilocks Aster
Campanula rotundifolia	Harebell
Centaurea scabiosa	Greater Knapweed
Chrysanthemum leucanthemum	Oxeye Daisy
Dianthus carthusianorum	Carthusian Pink
Hieracium x rubrum	Red Hawkweed
Iris pumila	Pygmy Iris
Iris tectorum	Roof Iris
Origanum vulgare	Oregano
Petrorhagia saxifraga	Tunic-Flower
Prunella grandiflora	Large Self-Heal
Pulsatilla vulgaris	Pasque Flower
Ranunculus bulbosus	St Anthony's Turnip
Scabiosa canescens	Fragrant Scabiosa
Sedum album 'Murale'	White Stonecrop 'Murale'
Sedum floriferum 'Weihen-stephaner Gold'	Stonecrop 'Weihenstephaner Gold'
Sedum reflexum	Reflexed Stonecrop
Sedum sexangulare	Tasteless Stonecrop
Sedum spurium	Caucasian Stonecrop (varieties)
Sedum telephium	Stonecrop
Teucrium chamaedrys	Wall Germander
Thymus montanus	Mountain Thyme
Verbascum nigrum	Dark Mullein
Veronica teucrium	Large Speedwell

Grasses

Bromus tectorum	Cheat Grass
Festuca rupicaprina	Chamois Fescue
Festuca valesiaca	Volga Fescue
Melica ciliata	Silky Spike Melic
Stipa pennata	Feather Grass

GARDEN ROOF and RETENTION ROOF intensive
substrate depth: from approx. 250 mm

Perennials

Allium moly	Golden Garlic
Allium ostrowskianum	Pink lily leek
Allium sphaerocephalon	Round Headed Leek
Anthericum liliago	St Bernard's Lily
Buphthalmum salicifolium	Yellow ox-eye
Campanula glomerata	Clustered Bellflower
Centaurea scabiosa	Greater Knapweed
Cichorium intybus	Common Chicory
Daucus carota	Queen Anne's Lace
Dianthus arenarius	Sand Pink
Echium vulgare	Viper's Bugloss
Galium verum	Lady's Bedstraw
Geranium sanguineum	Bloody Crane's-Bill
Hypericum perforatum	Common Saint John's Wort
Hyssopus officinalis	Hyssop
Iris germanica	German Iris
Iris tectorum	Roof Iris
Knautia arvensis	Field Scabious
Linaria vulgaris	Common Toadflax
Ononis spinosa	Spiny Restharrow
Origanum vulgare	Oregano
Ranunculus bulbosus	St Anthony's Turnip
Salvia pratensis	Meadow Clary
Scabiosa columbaria	Small Scabious
Sedum sexangulare	Tasteless Stonecrop
Sedum spurium	Caucasian Stonecrop
Sedum telephium	Stonecrop
Thymus montanus	Mountain Thyme
Verbascum bombyciferum	Mullein
Verbascum nigrum	Dark Mullein
Veronica teucrium	Large Speedwell

Grasses

Briza media	Quaking Grass
Bromus tectorum	Cheat Grass
Festuca amethystina	Amethyst Fescue
Melica ciliata	Silky Spike Melic
Stipa pennata	Feather Grass

Plant lists for intensive Green Roofs

Low-growing perennials

LANDSCAPE ROOF
substrate depth: from approx. 350 mm

Perennials

Anaphalis triplinervis 'Sommerschnee'	Pearly Everlasting 'Sommerschnee'
Aster linosyris	Goldilocks Aster
Aster pyrenaeus 'Lutetia'	Michaelmas Daisy 'Lutelia'
Aster sedifolius 'Nanus'	Rhone Aster 'Nanus'
Buglossoides purpurocaerulea	Purple Gromwell
Dictamnus fraxinella	Burning Bush
Eryngium bourgatii	Mediterranean Sea Holly
Euphorbia polychroma	Cushion Spurge
Geranium sanguineum	Bloody Crane's-Bill
Gypsophila Hybride 'Rosenschleier'	Baby's-breath 'Rosenschleier'
Hypericum perforatum	Common Saint John's Wort
Hypericum polyphyllum	Aaron's Beard
Hyssopus officinalis	Hyssop
Inula hirta	Downy Elecampane
Iris germanica	German Iris
Jasione laevis 'Blaulicht'	Sheep's Bit 'Blaulicht'
Lavandula angustifolia	Lavender (varieties)
Linaria purpurea	Purple Toadflax
Origanum vulgare	Oregano
Pulsatilla vulgaris	Pasque Flower
Salvia nemorosa	Woodland Sage (varieties)
Sedum telephium	Stonecrop
Thymus serpyllum 'Coccineus'	Thyme 'Coccineus'
Thymus vulgaris	Garden Thyme
Verbascum thapsus	Common Mullein

Grasses

Festuca amethystina	Amethyst Fescue
Festuca mairei	Atlas Fescue
Helictotrichon sempervirens	Blue Oat Grass
Stipa pennata	Feather Grass

Flower bulbs

A complement for all system solutions
substrate depth: from approx. 350 mm

Flower bulbs

Chionodoxa luciliae	Lucile's Glory-of-the-snow
Crocus species	Autumn Crocus
Eranthis hyemalis	Winter Aconite
Galanthus nivalis	Common Snowdrop
Iris reticulata	Netted Iris
Muscari armeniacum	Grape Hyacinth
Narcissus 'Geranium'	Tazetta Daffodil 'Geranium'
Narcissus 'Hawera'	Triandus Daffodil 'Hawera'
Scilla bifolia	Two-leaf squill
Scilla siberica	Siberian Squill
Tulipa batalinii 'Bright Gem'	Botanical Tulip 'Bright Gem'
Tulipa humilis var. Pulchella	Dwarf Tulip
Tulipa sylvestris	Tulpe Wild
Tulipa turkestanica	Turkestan Tulip

Woody plant lists for semi-intensiv intensive and intensive greening

Bushes, conifers and/or trees

NATURE, RETENTION, PITCHED, GARDEN AND LANDSCAPE ROOFS

Dwarf shrubs: 150–200 mm root zone thickness,
growth height 200–1000 mm

Shrubs

Berberis buxifolia 'Nana'	Dwarf Magellan Barberry
Berberis thunbergii 'Kobold'	Japanese barberry
Berberis thunbergii 'Bagatelle'	Japanese barberry
Caryopteris clandonensis	Bluebeard
Cotoneaster dammeri radicans	Bearberry cotoneaster
Cotoneaster dammeri 'Oak wood'	Bearberry cotoneaster
Cotoneaster integerrimus	Common cotoneaster
Cytisus decumbens	Prostrate broom
Cytisus x kewensis	Kew broom
Cytisus nigricans	Black broom
Cytisus supinus	Trailing broom
Daphne alpina	Alpine Daphne
Daphne cneorum	Garland Daphne
Euonymus fortunei 'Dart's Defender', 'Minimus'	Fortune's spindle
Genista pilosa	Hairy greenweed
Genista radiata	Twiggy broom
Genista sagittalis	Least concern
Hedera helix	Common ivy
Mahonia aquifolium 'Apollo'	Oregon grape, variety
Pachysandra terminalis	Japanese pachysandra
Prunus fruticosa	European dwarf cherry
Prunus tenella (own root)	Dwarf Russian almond
Rosa nitida	Shining rose
Rosa x rugotida (R. nitida x R. rugosa)	Hybrid Rugosa, Dart's Defender
Salix hastata 'Wehrhahnii'	Halberd willow
Salix repens argentea	Argentea creeping willow
Spiraea decumbens	White lace spirea
Syringa meyeri 'Palibin'	Meyer lilac

Conifers

Juniperus communis 'Hornibrookii'	Common juniper, varieties
Juniperus horizontalis 'Wiltonii'	Creeping juniper, varieties
Pinus mugo subsp. pumilio	Dwarf mountainpine
Prunus fruticosa	European dwarf cherry
Prunus tenella (own root)	Dwarf Russian almond
Rosa nitida	Shining rose
Rosa x rugotida (R. nitida x R. rugosa)	Hybrid Rugosa, Dart's Defender
Salix hastata 'Wehrhahnii'	Halberd willow
Salix repens argentea	Argentea creeping willow
Spiraea decumbens	White lace spirea
Syringa meyeri 'Palibin'	Meyer lilac

RETENTION, GARDEN AND LANDSCAPE ROOF
Regular bushes: 250–300 mm root zone thickness,
Growth height 800–2000 mm

Shrubs

Acer palmatum 'Dissectum Garnet'	Japanese maple, varieties
Amelanchier lamarckii	Juneberry
Amelanchier ovalis	Snowy mespilus
Berberis candidula	Paleleaf barberry
Berberis thunbergii 'Green Carpet'	Japanese barberry 'Green Carpet'
Berberis thunbergii 'Atropurpurea Nana'	Crimson pygmy barberry
Betula nana	Dwarf birch
Chaenomeles japonica 'Cido', 'Nicoline'	Japanese quince, varieities
Clematis viticella	Italian leather flower
Clematis alpina	Alpine clematis
Clematis montana 'Rubensv	Anemone clematis
Cotoneaster dammeri 'Coral Beauty'	Bearberry cotoneaster
Cotoneaster niger	Black cotoneaster
Cotoneaster praecox	Dwarf cotoneaster
Cytisus scoparius 'Burkwoodii'	Scotch broom
Cytisus x beanii	Bean's broom
Deutzia gracilis	Slender deutzia
Deutzia x rosea	Rose deutzia
Euonymus alatus	Winged spindle
Forsythia ovata	Korean forsythia
Hedera helix 'Arborescens'	English ivy, adult
Hydrangea arborescens 'Annabelle'	Smooth hydrangea
Hydrangea serrata 'Bluebird'	Bluebird mountain hydrangea
Hypericum 'Hidcote'	St. John's wort hedge
Kerria japonica 'Pleniflora'	Japanese kerria
Ligustrum vulgare	Wild privet
Ligustrum vulgare 'Lodense'	Common privet, variety
Lonicera korolkowii var. zabelii	Honeysuckle
Lonicera xylosteum 'Claveys Dwarf'	Clavey's dwarf honeysuckle
Mahonia aquifolium	Oregon grape holly
Malus domestica	Fruit varieties on dwarfing rootstocks M9 or M26
Paeonia x suffruticosa	Tree peony, varieties
Partenocissus tricuspidata 'Veitchii'	Boston ivy
Parthenocissus quinquefolia	Virginia creeper
Perovskia abrotanoides	Russian sage
Pieris japonica 'Purity'	Japanese pieris
Potentilla fruticosa	Shrubby cinquefoil
Rosa nitida	Shining rose
Rosa gallica	French rose
Rosa pimpinellifolia	Burnet rose
Ribes alpinum	Mountain currant
Ribes rubrum var. domesticum	Red currant
Ribes nigrum	Black currant
Ribes uva-crispa var. sativum	European gooseberry
Rhamnus saxatilis	Rock buckthorn
Rhododendron repens	'Scarlet Wonder' rhododendron
Rhododendron x obtusum	Evergreen azalea
Rosa x hybrida	Roses in varieties
Rosa micrantha	Sweet brier
Rosa rugosa	Beach rose
Salix lanata	Woolly willow
Salix purpurea 'Nana'	Dwarf Arctic willow
Salix rosmarinifolia	Rosemary willow
Spiraea japonica,	Japanese meadowsweet
Spiraea japonica 'Little Princess'	Little princess spirea
Symphoricarpos chenaultii 'Hancock'	Chenault coralberry 'Hancock'
Viburnum carlesii 'Aurora'	Koreanspice viburnum

Conifers

Juniperus communis 'Compressa'	Common juniper, low-growing varieties
Juniperus squamata 'Blue Carpet'	Flaky juniper 'Blue Carpet'
Microbiota decussata	Siberian cypress
Picea abies 'Little Gem'	Norway spruce
Picea glauca 'Alberta Globe'	Alberta globe spruce
Pinus mugo 'Gnom'	Dwarf mountain pine
Pinus pumila 'Glauca'	Glaucous dwarf Siberian pine
Taxus cuspidata 'Nana'	Japanese yew
Taxus baccata 'Repandens'	Creeping English yew
Thuja occidentalis 'Danica' or 'Tiny Tim'	American arborvitae, drawf varieties

Woody plant lists for intensive greening

Bushes, conifers and/or trees

GARDEN AND LANDSCAPE ROOFS

Regular bushes: 400–500 mm root zone thickness,
Growth height 2000–5000 mm

Shrubs

Acer palmatum 'Dissectum'	Laceleaf Japanese maple
Aesculus parviflora	Bottlebrush buckeye
Amelanchier laevis	Allegheny serviceberry
Berberis julianae	Wintergreen barberry
Berberis thunbergii 'Red Chief'	Japanese barberry
Buddleia alternifolia	Fountain butterfly-bush
Buddleia davidii- hybrids	Summer lilac
Callicarpa bodinieri 'Profusion'	Beautyberry
Caragana arborescens	Siberian peashrub
Carpinus betulus	European hornbeam
Chaenomeles 'Andenken an Carl Ramcke'	Flowering quince
Clematis 'Niobe', 'Lasurstern', 'Nelly Moser', 'Huldine'	Traveler's joys
Clematis montana	Anemone clematis
Colutea arborescens	Bladder-senna
Cornus florida	Flowering dogwood
Cornus kousa	Kousa dogwood
Cornus mas	Cornelian cherry
Corylus avellana 'Contorta'	Corkscrew hazel
Cotinus coggygria	Smoke tree
Cotoneaster divaricatus	Spreading cotoneaster
Cotoneaster multiflorus	Many-flowered cotoneaster
Cytisus praecox	Allgold broom
Deutzia scabra	Fuzzy deutzia
Elaeagnus multiflora	Cherry elaeagnus
Euonymus planipes	Flat-stalked spindle tree
Forsythia x intermedia	Border forsythia
Hamamelis x intermedia	Hybrid witch hazel, varieties
Hydrangea paniculata	Panicled hydrangea
Ilex x meserveae 'Blue Angel'	Blue angel holly
Ilex verticillata	Winterberry
Kolkwitzia amabilis	Beauty bush
Ligustrum vulgare 'Atrovirens'	Common privet, evergreen variety
Magnolia sieboldii	Siebold's magnolia
Malus toringo var. sargentii	Sargent's apple
Malus domestica	Apple varieties, e.g. resista varieties on moderate rootstocks such as MM 111
Philadelphus coronarius	Sweet mock-orange
Prunus cerasifera 'Nigra'	Black cherry plum
Prunus subhirtella 'Fukubana'	Japanese flowering cherry
Prunus avium	Sweet cherry graftings on dwarfing rootstocks, e.g. weiroot 72
Prunus domestica	Plum graftings on dwarfing rootstocks, e.g. Ishtara
Prunus tenella	Dwarf Russian almond
Pyracantha coccinea	Scarlet firethorn
Pyrus communis	Pear, on dwarfing rootstocks, e.g. quince A or pyrodwarf
Pyrus salicifolia	Willow-leaved pear
Rosa canina	Dog-rose
Rosa canina var. blondaeana	Shining rose
Rosa pimpinellifolia 'Dunwich Rose'	Burnet rose
Rosa pimpinellifolia 'Glory of Edzell'	Burnet rose
Rosa pimpinellifolia 'Latifolia'	Scots rose
Rosa pimpinellifolia 'Marbled Pink'	Burnet rose
Rosa pimpinellifolia 'Repens'	Creeping burnet rose
Rosa pimpinellifolia 'Single Red'	'Single red' burnet rose
Rosa pimpinellifolia 'Staffa'	Burnet rose
Rosa rubrifolia	Red-leaved rose
Rosa sherardii	Sherard's downy rose
Rosa villosa	Apple rose
Rhododendron catawbiense	Catawba rhododendron
Rhododendron yakushimanum	Yakushimanum rhododendron
Ribes sanguineum 'King Edward VII'	Winter currant 'King Edward VII'
Rosa hybrids	Shrub, floribunda and species roses, ADR varieties

Salix caprea 'Mas'	Pussy willow, male variety
Sorbus frutescens (= S. koehneana)	White-fruited Chinese rowan
Spiraea x arguta	Garland spiraea
Spiraea x cinerea 'Grefsheim'	Garland spirea
Spiraea chamaedryfolia	Germander meadowsweet
Syringa x chinensis	Chinese lilac
Syringa reflexa	Nodding lilac
Syringa vulgaris	Common lilac
Tamarix parviflora	Saltcedar
Viburnum x burkwoodii	Burkwood viburnum
Viburnum x bodnantense 'Dawn'	Arrowwood 'Dawn'
Viburnum carlesii	Koreanspice viburnum
Viburnum farreri	Fragrant viburnum
Viburnum plicatum 'Mariesii'	Japanese snow ball bush
Viburnum rhytidophyllum	Leatherleaf viburnum
Weigela florida	Oldfashioned weigela
Weigela hybrids	Oldfashioned weigela
Wisteria floribunda	Japanese wisteria

Conifers

Picea abies 'Ohlendorffii'	Ohlendorffii Norway spruce
Chamaecyparis lawsoniana 'Ellwoodii'	Lawson cypress
Juniperus chinensis 'Blaauw'	Chinese juniper 'Blaauw'
Juniperus chinensis 'Stricta'	Chinese Juniper
Juniperus communis 'Hibernica'	Irish juniper
Juniperus virginiana 'Canaertii'	Eastern red cedar
Pinus aristata	Rocky Mountain bristlecone pine
Pinus densiflora 'Umbraculifera'	'Umbraculifera' Japanese red pine
Pinus mugo mughus	Dwarf mountain pine
Pinus nigra 'Nana'	European black pine
Pinus sylvestris 'Watereri'	Scots pine
Taxus baccata 'Dovastoniana'	Irish yew
Taxus media 'Hillii'	Hill's yew
Thuja occidentalis 'Holmstrup'	American arborvitae

GARDEN AND LANDSCAPE ROOFS
Large shrubs and small trees: 600 – 700 mm
root zone thickness, growth height: 5000 – 10000 mm

Shrubs

Acer campestre	Field maple
Acer ginnala	Amur maple
Acer monspessulanum	Montpellier maple
Acer palmatum	Palmate maple
Aesculus pavia	Red buckeye
Amelanchier arborea 'Robin Hill'	Robin Hill downy serviceberry
Betula pendula 'Dalecarlica'	Ornäs birch
Betula pendula 'Youngii'	Young's weeping birch
Betula nigra 'Heritage'	'Heritage' river birch
Carpinus betulus 'Pendula'	European hornbeam
Cercis canadensis 'Forest Pansy'	'Forest Pansy' eastern redbud
Cornus alternifolia	Pagoda dogwood
Corylus avellana	Common hazel
Crataegus x media 'Paul's Scarlet'	English Hawthorn
Crataegus coccinea	Scarlet hawthorn
Crataegus lavallei 'Carrierei'	Hybrid cockspur thorn
Crataegus x persimilis	Broad-leaved cockspur thorn
Elaeagnus angustifolia	Russian olive
Gleditsia triacanthos 'Sunburst'	Honey locust
Koelreuteria paniculata	Golden raintree
Laburnum x watereri 'Vossii'	Golden chain tree
Liquidambar styraciflua 'Worplesdon'	Worplesdon sweet gum
Lonicera maackii	Amur honeysuckle
Magnolia kobus	Mokryeon
Magnolia x loebneri	Loebner magnolia
Magnolia liliiflora	Lily magnolia
Magnolia x soulangeana	Saucer magnolia
Malus floribunda	Japanese flowering crabapple
Malus x hybrida	Sargent's apple
Malus domestica	Cultivars on more vigorous rootstocks like A2
Parrotia persica	Persian ironwood
Photinia villosa	Oriental photinia
Prunus domestica	Plum, varieties on moderate rootstocks such as 'WaVit'
Prunus mahaleb	Mahaleb cherry
Prunus serrulata	Japanese flowering cherry
Prunus sargentii	Sargent's cherry
Robinia margaretta 'Casque Rouge'	Pink cascade tree
Robinia pseudoacacia 'Umbraculifera'	Umbrella black locust
Robinia pseudoacacia 'Tortuosa'	Corkscrew black locust
Sorbus aucuparia	Mountain ash
Sorbus aucuparia 'Fastigiata'	Mountain ash, columnar variety
Sorbus aria	Whitebeam
Sorbus x arnoldiana	Red tip mountain ash
Sorbus danubialis	Short fructiferous shoot
Sorbus intermedia 'Brouwers'	Swedish whitebeam

Conifers

Sorbus vilmorinii	Vilmorin's rowan
Chamaecyparis lawsoniana 'Stardust'	Lawson's cypress 'Stardust'
Chamaecyparis pisifera 'Filifera'	Sawara cypress
Juniperus x pfitzeriana	Pfitzer juniper
Juniperus virginiana	Eastern red cedar
Picea omorica 'Nana'	Serbian spruce
Picea orientalis 'Aurea'	Golden oriental spruce
Pinus cembra	Swiss pine
Pinus leucodermis	Heldreich's pine
Pinus contorta	Lodgepole pine
Pinus mugo	Dwarf mountain pine
Pinus sylvestris 'Glauca'	Scotch pine
Taxus baccata	English yew
Taxus baccata 'Nissen's Corona'	Nissens Corona English Yew
Thuja plicata 'Atrovirens'	Western red cedar 'Atrovirens'

GARDEN AND LANDSCAPE ROOFS

Trees: from 800–1200 mm root zone thickness,
growth height >10000 mm

Shrubs

Acer cappadocicum 'Rubrum'	Red Cappadocian maple
Acer x freemanii	Freeman maple
Acer platanoides	Norway maple
Acer pseudoplatanus	Sycamore maple
Aesculus x carnea 'Briotii'	Red buckeye
Alnus cordata	Italian alder
Alnus x spaethii	Alder
Betula ermanii	Erman's birch
Betula pendula	Silver birch
Celtis occidentalis	Common hackberry
Corylus colurna	Turkish hazel
Fagus sylvatica	European beech
Gleditsia triacanthos 'Skyline'	Skyline honey locust, thornless variety
Liquidambar stryraciflua	Worplesdon sweet gum
Malus domestica	Apple cultivars on vigorous rootstocks such as Bittenfelder or Graham's seedling
Ostrya carpinifolia	European hop-hornbeam
Platanus x acerifolia	London plane, varieties
Populus x berolinensis	Berlin poplar (seedless)
Prunus avium	Sweet cherry graftings on vigorous rootstocks such as F 1/1
Prunus avium 'Plena'	Double white cherry
Prunus domestica	Grafted plum varieties on vigorous rootstocks such as 'Prompton'
Prunus serotina	Black cherry
Pyrus communis	European pear, varieties on vigorous seedling rootstocks, e.g. 'Kirchensaller Mostbirne'
Pyrus calleryana 'Chanticleer'	Callery pear
Quercus coccinea	Scarlet oak
Quercus robur	English oak
Robinia pseudoacacia 'Semperflorens'	'Semperflorens' black locust
Salix alba 'Liempde'	White willow, fruitless variety
Sophora japonica (correct: Styphnolobium japonicum)	Japanese pagoda tree, varieities
Sorbus domestica	Service tree fruiting varieties such as 'Sossenheimer Riese' or 'Bovender Nordlicht'
Tilia cordata	Small leaf linden, varieties
Tilia tomentosa	Silver linden, varieties

Conifers

Abies pinsapo 'Kelleriis'	Spanish fir
Ginkgo biloba	Ginkgo
Larix decidua	European larch
Metasequoia glyptostroboides	Dawn redwood
Picea orientalis	Oriental spruce
Picea omorica	Serbian spruce
Pinus nigra subsp. nigra	Black pine
Pinus sylvestris	Scots pine
Tsuga canadensis	Eastern hemlock


OPTIGRÜN®
ROOF GREENING

PRODUCTS

Our main products are presented with a brief technical description on the following pages. The complete datasheets can be found on our website

ⓘ These are some of our most popular products, but we have much more to choose from in our selection.
If you don't see what you're looking for, ask us directly!

BUILDING PROTECTION, STORAGE, FILTER AND SOUND REDUCTION FLEECES

Fleeces and liners serve different functions in roof greening. Their applications are specified in various standards and directives. All fleeces meet the specifications of FLL 2018.

Fleeces and liners are used to protect the roof waterproofing from mechanical damage, friction and exposure to incompatible products (e.g. PVC and bitumen).

Filter Fleeces serve as a segretating layer between the substrate and the drainage layer underneath, preventing fine particles from clogging the drain.

Protection and Storage Fleeces protect the roof waterproofing and root protection membranes from mechanical stress, segregate layers of incompatible materials from one another and store water.

100 % recycled plastic fibres (PP/PES/Acryl), mechanically strengthened, detector-tested, rot-proof, recyclable, not UV-resistant

RMS 300
- Protective liner on roof waterproofing with low mechanical stress as well as barrier and water storage functions
- As a barrier against incompatible materials
- Protective fleece on roof waterproofing complying with FLL Directive
- Static puncture force at least 1,000 N (EN ISO 12236)

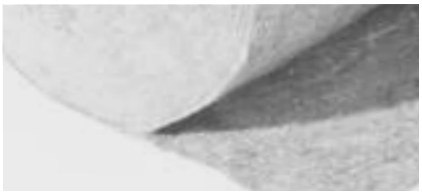
Strength class	GRK 2
Thickness	approx. 3.6 mm
Weight	300 g/m²
Water storage	approx. 2 l/m²
Roll	100 m²
Roll width	2.0 m
Sound reduction	ΔLW: 35 dB

RMS 500
- Protective liner on roof waterproofing under low mechanical stress as well as barrier and water storage functions
- As a barrier against incompatible materials
- Protective fleece on roof waterproofing complying with FLL Directive
- Also compliant with Austrian minimum requirement as protective fleece roof waterproofing
- Static puncture force at least 1,000 N (EN ISO 12236)

Strength class	GRK 2
Thickness	approx. 4 mm
Weight	500 g/m²
Water storage	approx. 3.5 l/m²
Roll	70 m²
Roll width	2.0 m

RMS 600
- Protective liner on roof waterproofing under moderate mechanical stress as well as barrier and water storage functions
- As a barrier against incompatible materials
- Protective fleece on roof waterproofing complying with FLL Directive
- With high pyramid puncture resistance (EN 14574)
- Static puncture force at least 1,500 N (EN ISO 12236)

Strength class	GRK 3
Pyramid puncture resistance conforming to BS EN 14574	› 700N
Thickness	approx. 4 mm
Weight	600 g/m²
Water storage	approx. 3.5 l/m²
Roll	60 m²
Roll width	2.0 m

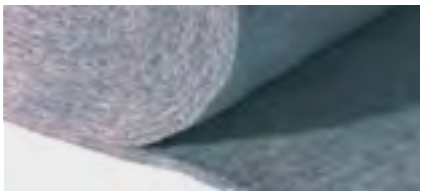


RMS 900
- Protective liner on roof waterproofing under higher mechanical stress as well as barrier and water storage functions
- Protective fleece on roof waterproofing complying with FLL Directive
- Static puncture force at least 2,500 N (EN ISO 12236)

Strength class	GRK 4
Thickness	approx. 6 mm
Weight	900 g/m²
Water storage	approx. 6 l/m²
Roll	50 m²
Roll width	2.0 m

RMS 1200
- Protective liner on roof waterproofing under high mechanical stress as well as barrier and water storage functions
- Protective fleece on roof waterproofing complying with FLL Directive
- Static puncture force at least 3,500 N (EN ISO 12236)

Strength class	GRK 5
Thickness	approx. 8.6 mm
Weight	1200 g/m²
Water storage	approx. 7 l/m²
Roll	30 m²
Roll width	2.0 m



Trickle protection fleeces are used on inverted roofs and prevent fine particles from forming sludge in the insulation layer.

100 % PP (polypropylene), mechanically and thermally strengthened, water-repellent, open to vapor diffusion

RSV 120
- Trickle protection on top of the insulation for inverted roofs, without requirements concerning joint building authority approval for insulating material and barrier layer
- Prevents fine particles from forming sludge in the insulation layer
- Static puncture force 1,500 N (EN ISO 12236)
- Vertical water permeability 100 l/s x m² (EN ISO 11058)
- Cannot be used as a replacement for separating layers from various manufacturers and approved by the building authority

Strength class	GRK 2
Thickness	approx. 0.75 mm
Weight	120 g/m²
Roll	450 m²
Roll width	4.5 m

Protection and Sound Reduction Fleeces are used under patio flooring on flat roofs or balconies with proven footstep sound reduction.

100 % recycled plastic fibres (PP/PES/Acryl), double-stitched fabric, mechanically strengthened, detector-tested, rot-proof, recyclable, not UV-resistant

950 TS
- Footstep sound reduction under walkable public areas with up to 5° pitch, on roof patios and balconies
- Protection under moderate mechanical stress
- Protective liner on roof waterproofing, combined with barrier and water storage functions, compliant with DIN 18195 Part 2
- Protective fleece on roof waterproofing complying with FLL Directive
- Footstep sound reduction in test set-up, as per EN ISO 10140: Δ Lw 35 dB

Strength class	GRK 4
Thickness	approx. 6 mm
Weight	950 g/m²
Water storage	approx. 6 l/m²
Roll	40 m²
Roll width	2.0 m

Suction and Capillary Fleece are extra absorbent. They serve as a water distribution layer and support capillary water rise.

100 % PES needle felt, hydrophilic PES, mechanically strengthened, detector-tested, rot-proof, recyclable

RMS 500K
- Used on top of the drain levels, e.g. for water distribution across a wide area
- Protective liner on roof waterproofing with excellent absorption and capillary action
- Work well with standing water
- Static puncture force 2,600 N (EN ISO 12236)

Strength class	GRK 4
Thickness	approx. 3.6 mm
Weight	500 g/m²
Water storage	approx. 4 l/m²
Roll	50 m²
Roll width	2.0 m

Filter Fleeces are horizontal filter layers between drain, substrate or gravel layers. They keep the different layers segregated and prevent fine substrate particles from forming sludge in the levels underneath.

CE-certified, 100 % PP (polypropylene), mechanically strengthened, detector-tested, recyclable

FIL 105
- Horizontal filter layer between drain and substrate layer for extensive and intensive Green Roofs
- Filters fine particles from the substrate
- Static puncture force 1,200 N (EN ISO 12236)
- Vertical water permeability 130 l/s× m² (EN ISO 11058)
- 7.5 kN/m maximum tensile force lengthwise/ crosswise

Strength class	GRK 2
Thickness	approx. 1.1 mm
Weight	105 g/m²
Roll	200 m²
Roll width	2.0 m

FIL 150
- Horizontal filter layer between drain and substrate layer for Green Roofs with walk-able structures
- Filters fine particles from the substrate
- Static puncture force 1,700 N (EN ISO 12236)
- Vertical water permeability 90 l/s × m² (EN ISO 11058)
- 10.5 kN/m and or 10 kN/m maximum tensile force lengthwise/crosswise

Strength class	GRK 3
Thickness	approx. 1.2 mm
Weight	150 g/m²
Roll	180 m²
Roll width	2.0 m

FIL 300
- Horizontal filter layer between drain and gravel layers under areas with foot and vehicle traffic
- Filters fine particles from the substrate
- Static puncture force 3,800 N (EN ISO 12236)
- Vertical water permeability 57 l/s m² (EN ISO 11058)
- 21 kN/m and or 24 kN/m maximum tensile force lengthwise/crosswise

Strength class	GRK 5
Thickness	approx. 3 mm
Weight	300 g/m²
Roll	120 m²
Roll width	2.0 m

Protection, Separation and Slip Layer are used on roof waterproofing and under drain mats with vehicular traffic to prevent shear and tensile forces from affecting the insulation and provide a barrier against incompatible materials.

Fleece: 100 % PP (polypropylene), coating: LDPE, mechanically strengthened, detector-tested, rot-proof, recyclable, not UV resistant

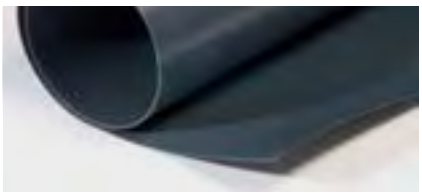
SGL 500
- Special fleece to protect the roof waterproofing, combined with barrier and sliding function
- Suitable for use as a barrier and sliding layer for public roof structures when combined with the TGF 0.2 PE barrier and sliding film
- Friction coefficient with additional PE film ‹ 0.6 in compliance with FLL requirements (DIN 53375)

Strength class	GRK 5
Thickness	approx. 4.0 mm
Weight	500 g/m²
Roll	60 m²
Roll width	2.0 m

Recycled PE (80 % HDPE/20 % LDPE), compatible with bitumen and polystyrene, resistant to most chemicals, smooth surface, non-aging, acts as vapour barrier, heat-sealable

TGF 1.2
- Barrier, protection and sliding liner on roof waterproofing and under drain mats open to vehicular traffic
- In combination with 0.2 mm PE film, can be used as second sliding liner under traffic areas to avoid transference of shear and tensile forces
- As a barrier against incompatible materials

Thickness	approx. 1.2 mm
Weight	1 200 g/m²
Roll	30 m²
Roll width	2.0 m



100 % recycled PE (polyethylene), compatible with bitumen and polystyrene, resistant to most chemicals, very smooth surface, rot-proof, recyclable, not UV resistant

TGF 0.2
- Barrier and sliding liner on roof waterproofing and under drain mats with foot and vehicular traffic
- In combination with 1.0 mm HDPE film or SGL 500, can be used as second sliding layer under traffic areas to avoid transference of shear and tensile forces
- As a barrier against incompatible materials

Thickness	approx. 0.2 mm
Weight	185 g/m²
Roll	200 m²
Roll width	1.1 m

WRB Reinforcement Mesh OVG 190
- High-tensile mesh fabric to reduce the localised pressure load when using the WRB 85i on inverted and warm roofs
- As the second slip sheet of the slip layer
- Max. tensile strength long./lat.: approx. 40/38 kN/m
- Elongation at nominal force long./lat.: approx. 30/25%

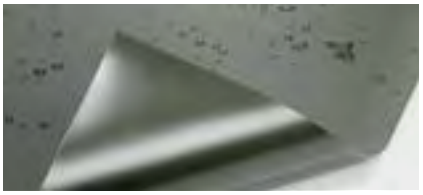
Material	PEHD
Thickness	ca. 1.0 mm
Weight	190 g/m²
Roll	500 m²
Roll width	5.0 m

Root protection membranes are used on non-root-proof roof waterproofing under extensive and intensive Green Roofs.

Also suitable for root-proof lining of Planters, not approved as roof waterproofing

TWB 1.0
- Root protection membrane under Green Roof structures on rooftops with non-root-proof insulation
- For sealing ponds and reservoirs
- Resistant to greases, oils, chemicals and microorganisms
- UV-stabilised
- Can be installed on moist substrate
- Can be solvent-welded
- Free of DEHP (DOP) plasticisers
- Not compatible with bitumen

Material	PVC-P
Thickness	approx. 0.95 mm
Weight	1,290 g/m²
Roll	40 m²
Roll width	2.0 m



PELD 0.5
- Root protection membrane under extensive Green Roof structures on rooftops with non-root-proof insulation
- Frost-proof and heat-resistant (no cold brittleness down to – 50 °C)
- Resistant to greases, oils, chemicals and micro-organisms
- UV resistance
- Free of plasticisers
- Bitumen-resistant
- Laying: 2 m overlap under extensive Green Roofs

Material	100 % highly elastic PELD
Thickness	approx. 0.5 mm
Weight	500 g/m²
Roll of	100 m², 150 m² or 200 m²
Roll width	4.0 m, 6.0 m or 8.0 m

DRAINAGE

We have developed a variety of efficient drainage boards (FKD) tailored to the various roof structures and the different drainage requirements.

Drainage boards allow delayed discharge and/or the storage of excess water. This helps unburden the sewage system and water the vegetation.

To protect buildings from being damaged by high water loads on the roof, drainage systems in compliance with BS EN 12056-3 and the FLL Guideline for Green Roofs keep track of the volume of excess water and safely drain it.

Drainage Boards Drainage Boards (FKD) are available in various designs and are selected based on the drainage goal – either flow-retarding, water-retaining or targeted rooftop draining.

100 % HDPE recycled and reclaimed materials, low net weight, lightweight construction with high drainage capacity, safe and targeted drainage of excess water, designed with or without water storage, for roofs with and without slopes, recyclable

FKD 10
Protection and Drainage Board
- Incl. PP Filter Fleece layer with 75 l/m² × s water permeability (GRK 2)
- Under hard surfaces with foot traffic
- On vertical components
- On rooftops with at least 2 % standard slope
- For preventing waterlogging
- No water storage
- CE-certified

Nominal thickness	10 mm
Weight	approx. 0.9 kg/m²
Max. flow capacity	approx. 0.45 l/m × s (with 2 % slope)
Compression strength	approx. 400 kN/m² as per EN ISO 25619-2

FKD 10 UK
Protection and Drainage Board for inverted roofs
- Incl. diffusion openings
- Incl. PP Filter Fleece layer with 75 l/m² × s water permeability (GRK 2)
- Under hard surfaces with foot traffic
- On rooftops with at least 2 % standard slope
- For preventing waterlogging
- No water storage
- CE-certified

Nominal thickness	10 mm
Weight	approx. 0.9 kg/m²
Max. flow capacity	approx. 0.45 l/m × s (with 2 % slope)
Compression strength	approx. 400 kN/m² as per EN ISO 25619-2

FKD 10 GF

Protection and Drainage Board
- Incl. PP Filter Fleece layer with 75 l/m² water permeability (GRK 2)
- includes PE film affixed on the underside, (friction coefficient ‹ 0.6) as the first slip layer
- Under hard surfaces with foot traffic
- On vertical components
- On rooftops with at least 2 % standard slope
- For preventing waterlogging
- No water storage
- CE-certified

Nominal thickness	10 mm
Weight	approx. 0.9 kg/m²
Max. flow capacity	approx. 0.45 l/m × s (with 2 % slope)
Compression strength	approx. 400 kN/m² as per EN ISO 25619-2

FKD 12

Protection and Drainage Board
- Incl. PP Filter Fleece layer with 23 l/m² × s water permeability (GRK 4)
- includes PE film affixed on the underside, (friction coefficient ‹ 0.6) as the first slip layer
- Under areas with vehicular traffic
- On rooftops with at least 2 % standard slope
- For preventing waterlogging
- No water storage
- CE-certified

Nominal thickness	12 mm
Weight	approx. 1.3 kg/m²
Max. flow capacity	approx. 0.39 l/m × s (with 2 % slope)
Compression strength	approx. 1,600 kN/m² as per EN ISO 25619-2

FKD 12 UK

Protection and Drainage Board
- Incl. diffusion openings
- Incl. PP Filter Fleece layer with 23 l/m² × s water permeability (GRK 4)
- Under areas with vehicular traffic
- Suitable for inverted roofs
- On rooftops with at least 2 % standard slope
- For preventing waterlogging
- No water storage

Nominal thickness	12 mm
Weight	approx. 1.3 kg/m²
Max. flow capacity	approx. 0.39 l/m × s (with 2 % slope)
Compression strength	approx. 1,600 kN/m² as per EN ISO 25619-2

FKD 25

Drainage and Storage Board

- Both sides usable depending on flooring or greening (large or small knobs up)
- Under triple-layer extensive Green Roofs in combination with PP Filter Fleece FIL 105 and Substrate E on flat roofs with up to 5° slope (large knobs up)
- Under thin-layered hard landscaping used only by pedestrians, without compacted base material, without Filter Fleece, filled directly with bedding material (small knobs up)
- Suitable for roofs with no slope
- Suitable for inverted roofs
- With water storage

Nominal thickness	25 mm
Weight	approx. 1.35 kg/m²
Water storage	approx. 3.6 or 5 l/m² (depending on the side)
Max. flow capacity	approx. 1.41 l/m × s (with 2 % slope)
Compression strength unfilled	approx. 200 kN/m² as per EN ISO 25619-2

FKD 25 plus

Protection and Drainage Board

- Applied under areas accessible to cars + lorries up to 16 t
- Applied under hard landscaping accessible to pedestrians with high frequency
- Generally used under areas with high compressive load and low structural height
- Suitable for roofs with no slope
- Suitable for inverted roofs

Nominal thickness	27 mm
Weight	approx. 2.5 kg/m²
Max. flow capacity	approx. 1.33 l/m × s (with 2 % slope)
Compression strength filled	approx. 460 kN/m²

FKD 40

Drainage and Storage Board

- Under extensive greening structures with high depth (nature roof up to 250 mm)
- Under single-layer intensive Green Roofs with low layering (garden roof up to 300 mm)
- Suitable for roofs with no slope
- Suitable for inverted roofs
- Suitable for long flow lengths
- With water storage

Nominal thickness	40 mm
Weight	approx. 2.3 kg/m²
Water storage unfilled	approx. 8.7 l/m²
Max. flow capacity	approx. 2.31 l/m × s (with 2 % slope)
Compression strength unfilled	approx. 144 kN/m² as per EN ISO 25619-2

FKD 60 BO

Drainage and Storage Board

- Under intensive Green Roofs, filled in with drainage material 8/16 (45 l/m²)
- Under green areas temporarily access to vehicles, e.g. fire rescue paths, parking spaces
- Suitable for roofs with no slope
- Specially adapted for inverted roofs; open to vapour diffusion
- Rapid drain-off of excess water
- Prevents waterlogging when used with non-sloping roofs and long flow lengths
- With high water storage
- With temporary retention volume

Nominal thickness	approx. 60 mm
Weight	approx. 2.3 kg/m²
Water storage	approx. 23 l/m² filled
Max. flow capacity	approx. 2.29 l/m × s (with 2 % slope)
Compression strength filled flush	approx. 650 kN/m²

FKD 60 BU

Protection and Drainage Board

- Under traffic areas without water retention, with and without slope, fill in with drainage gravel, base course gravel or drainage concrete for structural heights of 150 mm and up
- Can also be used as permanent shuttering
- Specially adapted for inverted roofs; open to vapour diffusion
- Rapid drain-off of excess water
- Prevents waterlogging when used with non-sloping roofs and long flow lengths
- Pressure resistant and withstands lorry traffic when filled
- No water storage

Nominal thickness	approx. 60 mm
Weight	approx. 2.3 kg/m²
Water storage	0 l/m²
Max. flow capacity	approx. 2.29 l/m × s (with 2 % slope)
Compression strength filled flush	approx. 650 kN/m²

FKM 30

Meander Drainage and Water Retention Board

- With excellent flow retardation effect, peak discharge coefficient C_S = 0.1 in system structure
- Suitable for roofs with no slope
- Extra high flow retardation
- With temporary water storage

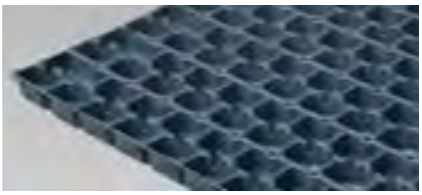
Nominal thickness	30 mm
Weight	approx. 1.7 kg/m²
Retention volume	0 l/m² continuously approx. 19 l/m² temporarily
Max. flow capacity	approx. 0.23 l/m × s (with 2 % slope)
Compression strength	approx. 115 kN/m² as per EN ISO 25619-2

FKM 60

Meander Drainage, Water Retention and Storage Board

- With excellent flow retardation effect, peak discharge coefficient C_S = 0.17 in system structure
- Suitable for roofs with no slope
- High flow retardation
- Prevents waterlogging when used with non-sloping roofs with long flow lengths
- Retention volume

Nominal thickness	60 mm
Weight	approx. 2.8 kg/m²
Retention volume	approx. 17,5l/m² continuously approx. 32 l/m² temporarily
Retention volume	approx. 32 l/m² temporarily
Max. flow capacity	approx. 0.70 l/m × s (with 2 % slope)
Compression strength	approx. 100 kN/m² as per EN ISO 25619-2



Water Retention Boxes For water storage on Blue Roofs with extensive, intensive or hard landscaping cover, we offer Water Retention Boxes with various compressive strengths.

100 % PP recycled and reclaimed materials, low net weight, lightweight construction with high drainage capacity, safe and targeted drainage of excess water, with water storage, only suitable for non-sloping roofs, recyclable

WRB 80F

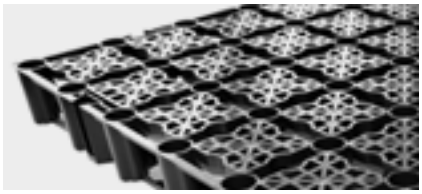
Water Retention Boxes
- On roofs which are used as retention spaces
- Under extensive and semi-intensiv Green Roofs
- Can be combined with our patented flow control system
- Capillary columns to boost evaporation capacity
- Suitable for inverted roofs but without long-term water retention
- Can be folded up and stacked, i.e. low transport volume
- With large retention volume, incl. water storage for vegetation
- For compliance with restrictions on the rate of water flow into the public drainage system

Nominal thickness	80 mm
Weight	approx. 3.6 kg/m²
Retention volume	approx. 75 l/m²
Interstitial volume	approx. 90.0 vol. %
Max. flow capacity	approx. 2.0 l/m × s (with 2 % slope)
Compression strength	approx. 100 kN/m² as per EN ISO 25619-2

WRB 85i

Water Retention Box
- On roofs which are used as retention spaces
- Can be used under extensive and intensive Green Roofs, as well as traffic areas
- Can be combined with our patented flow control system
- Capillary columns to boost evaporation capacity
- For compliance with restrictions on the rate of water flow into the public drainage system
- Can be stacked to expand the storage volume
- With high retention volume

Nominal thickness	85 mm
Weight	approx. 5.6 kg/m²
Retention volume	approx. 80 l/m²
Interstitial volume	approx. 95.0 vol. %
Max. flow capacity	approx. 6.3 l/m × s (with 2 % slope)
Compression strength	approx. 825 kN/m² as per EN ISO 25619-2



WRB 85v

Water Retention Box

- On roofs which are used as retention spaces
- Under intensive Green Roofs and traffic areas with extra heavy multilayer structures
- Can be combined with our patented flow control system
- Capillary columns to boost evaporation capacity
- For compliance with restrictions on the rate of water flow into the public drainage system
- With closed, load-distributing structure
- With high retention volume

Nominal thickness	85 mm
Weight	approx. 9.0 kg/m²
Retention volume	approx. 80 l/m²
Interstitial volume	approx. 95.0 vol. %
Max. flow capacity	approx. 5.0 l/m × s (with 2 % slope)
Compression strength	approx. 715 kN/m² as per EN ISO 25619-2

WRB 150

Water Retention Box

- On roofs which are used as retention spaces
- Under extensive and intensive Green Roofs, as well as traffic areas like terraces, fire rescue paths, car parks, etc.
- For large retention volume, multiple layers can be stacked
- Can be combined with our patented flow control system
- Capillary columns to boost evaporation capacity
- To observe restrictions on discharge into the public drainage system
- With closed, load-distributing structure
- With a very large retention volume

Nominal thickness	150 mm
Weight	approx. 12.0 kg/m²
Retention volume	approx. 140 l/m²
Interstitial volume	approx. 95.0 vol. %
Max. flow capacity	approx. 5.0 l/m × s (with 2 % slope)
Compression strength	approx. 715 kN/m² as per EN ISO 25619-2

Gravel Drainage Systems Perl gravel drainage systems from Optigrün are installed in multilayer system structures of extensive and intensive Green Roofs. They've been used successfully for over 40 years.

Depending on the region, the mineral fillers could be expanded shale, expanded clay, lava or brick. Crushed particles 2–12 mm in size for extensive Green Roofs and intensive Green Roofs without water retention; partly crushed particles 8–16 mm in size for intensive Green Roofs with water retention. Natural material, easy to recycle, drainage system for flat roofs, natural water storage that makes water available to plants: approx. 8 l/m² for an installation height of 50 mm (pore storage). For long flow lengths, assisted by the Triangle Water Conduit System Plus. Easily compensates for uneven roof surfaces.

Perl 2-10 BS
Blähschiefer, Blähton, Lava, Ziegelsplitt
- Under extensive and intensive Green Roofs
- For pressure resistant filling of plastic drainage boards
- As lightweight, draining levelling layer under paved areas with foot traffic
- For roofs with 1–5° pitch
- Complies with the specifications of ÖNORM L1131:2010
- Without water retention

Standard installation height	50 mm
Weight depending on substructure	dry approx. 680 kg/m³ wet approx. 920 kg/m³

Perl 8-16 BS
Blähschiefer, Blähton, Lava, Ziegelsplitt
- Under intensive Green Roofs
- For pressure resistant filling of plastic drainage boards
- As lightweight, draining levelling layer under paved areas with foot traffic
- For roofs with 0–5° pitch
- Complies with the specifications of ÖNORM L1131:2010
- Available with water retention

Standard installation height	120 mm
Weight depending on substructure	dry approx. 730 kg/m³ wet approx. 890 kg/m³

Optipor

Drainage fillers made of foam glass
- Under intensive Green Roofs
- As an extra lightweight substructure for terrain modelling of Green Roof structures with very high layering and limited load reserves
- As lightweight base material substitute for fortified spaces, tested as a public roof system structure by TU Munich. Usage categories N2 and N3 in compliance with "ZTV-Wegebau" (FLL)
- For roofs with 0–5° pitch
- With general construction supervision approval

10/25 MI

Particle size	10–25 mm
Weight	delivery wet approx. 190-240 kg/m³ wet approx. 341 kg/m³

10/50 MI

Particle size	10–50 mm
Weight	delivery wet approx. 160–190 kg/m³ wet approx. 347 kg/m³

10/75 MI

Particle size	10–75 mm
Weight	delivery wet approx. 120-150 kg/m³ wet approx. 290 kg/m³

Opticell

Drainage fillers made of foam glass
- Under intensive Green Roofs
- As an extra lightweight substructure for terrain modelling of Green Roof structures with very high layering and limited load reserves
- Lightweight base material substitute for fortified spaces with foot traffic only
- Not suitable under pavements accessible to cars and lorries
- For roofs with 0–5° pitch
- With general construction supervision approval

10/30 GC

Particle size	10–30 mm
Weight	delivery wet approx. 190 kg/m³ wet approx. 347 kg/m³

10/60 GC

Particle size	10–60 mm
Weight	delivery wet approx. 140 kg/m³ wet approx. 282 kg/m³

Conduits and Ducts Elements for linear drainage and to support conveyance of excess water from drainage and substrate layers, as well as green and pebble areas.

Due to the different requirements and operational demands, we offer conduits and ducts made of recycled plastic, aluminium, steel and stainless steel. Our conduits, ducts and inspection chambers are adapted to one another, and work great in combination.

WLP Plus Triangle Water Conduit
Linear drainage
- Support conveyance of excess water from drainage and substrate layers
- For roofs with 1–5° pitch
- Quickly feeds excess water in conjunction with syphonic drainage
- Can be combined with Triangle Combi Inspection Chamber TKS Plus, Triangle-Maxi-Inspection Chamber TMK, Triangle-Collection Channel Type TSK and edge trims
- Conduits will not float up as with round pipes
- Simple and variable installation thanks to snap connection system

Material	Recycled plastic (ABS)
Drainage capacity	depending on slope: approx. 1.13 – 1.25 l/s
Dimensions	H 50 mm W 100 mm L 1090 mm
Effective length	1000 mm
Cross-section	semi-circular

Triangle Collection Channel TSK
Linear drainage
- Supports conveyance of excess water from drainage and substrate layers with large collection areas due to side inlet slots
- For roofs with 0–5° pitch
- Quickly feeds excess water in conjunction with siphonic drainage
- Collecting pipeline for several triangle water conduits (WLP)
- Can be combined with TMK Triangle Maxi Inspection Chamber
- As branch channel between downpipes and drainage outlets
- Slotted on both sides for receiving excess water from the drainage level
- Cut-out for connecting the WLP Plus Triangle Water Conduit every 670 mm

Material	Aluminium
Drainage capacity	approx. 1.78 – 1.83 l/s
Dimensions	H 66 mm W 140 mm L 2000 mm
Effective length	2000 mm
Cross-section	Trapezoid topped with Roof conduit and support lugs on both sides

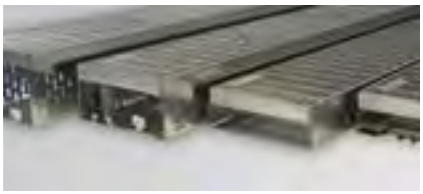
TAR Triangle Drainage Gutters
Drainage gutters
- For extension of open gutters in roof valleys, in which large volumes of water come together from the adjacent green or gravelled roof areas and need to be fed into the corresponding drainage outlets
- Particularly suitable for vacuum drainage
- For roofs with 1–5° pitch
- Cut-out for connecting the WLP Plus Triangle Water Conduit every 840 mm
- Special dimensions possible on request

Material	Aluminium
Drainage capacity	depending on dimension and slope approx. 9.6 – 15 l/s
Dimensions	TAR 120/250: H 120 × W 250 × L 2500 mm

Drainage gutters The drainage gutters are suitable for all applications in which excess water needs to be drained quickly and in a targeted manner: terraces, façades and other rising components, as well as around the eaves of pitched roofs. Gutters are particularly crucial with barrier-free designs. They are made of galvanised steel or stainless steel and are available in various lengths, heights and cross-sections.

Drainage gutters
Drainage gutters
- For draining surface water from pavements, e.g. in inspection chambers above drainage outlets
- For draining driving rain on façades
- Fixed height or height-adjustable
- Available with many different covers
- Various accessories such as branch sections and end caps

Material	Galvanised steel or stainless steel V2A
Dimensions	available in different lengths, widths and heights, height adjustable or fixed height



Inspection chambers In accordance with current Green Roof regulations, drainage outlets must be accessible at all times. For this reason, inspection chambers should be used above the drainage outlets. Depending on height, our inspection chambers can be used for both extensive and intensive Green Roof structures.

Due to the different requirements and operational demands, we offer inspection chambers made of recycled plastic, aluminium or polymer concrete. Our inspection chambers are adapted to our drainage boards, conduits and ducts and work great in combination.

Combi Inspection Chamber TKS Plus
Inspection chamber
- Versatile applications above drainage outlets on green or pebbleroof areas for inspecting the drainage outlet
- Suitable for gravity or syphonic drainage systems
- Can be connected to 8 sections of WLP Plus Triangle Water Conduit
- Chamber walls and lid with drainage slots
- Available with chequered plate lid
- Hardwearing
- Small pack size

Material	Recycled plastic (ABS)
Chamber cross section	370 × 370 mm
Floor support surface	470 × 470 mm
Height	min. 110 mm, stackable in 100 mm increments, max. height 800 mm
Chamber bottom opening	Ø 300 mm

Inspection Chamber TAR 250
Inspection chamber
- For pressure drainage and keeping drainage outlets free
- 4 possible connections for the drainage gutter TAR 80/250 or TAR 120/250 (preperforated openings)
- Chamber walls and lid with drainage slots
- With aluminium chequered plate
- Walkable

Material	Aluminium
Length	440 mm
Width	440 mm
Height	140 mm
Support leg	30 mm
Stacking element	available in 50 and 100 mm

Edge Inspection Chamber RKS 80
Special inspection chamber
- Especially suitable for use around edges in front of rising components,
- Above drainage outlets for green or gravelled rooftops
- Can be connected to 3 sections of WLP Plus Triangle Water Conduit
- Inspection lid with drainage slots
- Insulation wedge profile released from the back
- Walkable

Material	Aluminium
Length	250 mm
Width	250 mm
Height	80 mm
Floor support surface	310 × 280 mm
Stacking element	available in 50 and 100 mm

Triangle Maxi Inspection Chamber TMK
Inspection chamber
- With particularly good water conductivity
- Over roof drainage outlets for Green Roof areas
- Inspection lid with drainage slots
- Can be connected to up to 8 WLP Plus and 4 TSK
- Walkable

Material	Aluminium
Length	440 mm
Width	440 mm
Height	100 mm
Stacking element	available in 50 and 100 mm

Triangle Maxi Inspection Chamber TMK FR1

Downpipe inlet chamber

- For feeding and conveying excess water from higher roof levels to lower roof areas
- Conveys water through downpipes directly into a tie-in conduit with an open inlet at the top, e.g. in case of: Cascading drainage from smaller top floors, feeds roof drainage water from downpipes on façades into drainage levels of underground car parks or similar
- Can be connected to up to 6 WLP Plus and 3 TSK
- With perforated sheet metal intermediate partition
- Walkable

Material	Aluminium
Length	440 mm
Width	440 mm
Height	100 mm

Polymer Concrete Inspection Chamber PBK

Inspection Chamber for driveable surfaces

- For surface water infeed, complies with the specific requirements in the appropriate configuration, on sturdy foundations (e.g. underground car parks) with sufficiently thick layers.
- Different gratings available for vehicular traffic and foot traffic
- Excess water can also be infed from the drainage level with the aid of TSK water conduits

Material	Polymer concrete
Length	500 mm
Width	500 mm
Height	Base: 100 mm Stacking elements: available in 60 and 250 mm
Load class	B125 as per BS EN 124

Triangle Maxi Inspection Chamber TMK Lightweight Roof

- Inspection Chamber for use on Green Roof areas above drainage outlets
- Specially for system solution LIGHTWEIGHT ROOF up to 50 mm in height
- Chamber cover with inlet slots, can be walked on
- Chamber cover made from checker plate 3/5, can be screwed in place

Material	aluminium chamber cover made from checker plate 3/5
Length	400 mm
Width	440 mm
Height	55 mm (incl. cover 5 mm)

Top piece for roof drainage outlets

- Especially over roof drainage outlets in floor surfaces used on foot to guide surface water on flat roof areas up to 5° roof pitch and additional drainage option for the lower drainage level due to the side slits in the base frame.

Material	galvanised steel or stainless steel
Length	available in 300, 400 and 500 mm
Width	available in 300, 400 and 500 mm
Height	Fixed construction height 50 mm, Height adjustable 55 – 75 mm and 78 – 108 mm

SUBSTRATES

Our Substrates are perfectly tailored to our system structures, ensuring the long-term functionality of the system. All substrates comply with the German FLL Guideline for Green Roofs.

- High content of mesh-like mineral stabilisers, ensuring reliable drainage and keeping greenery sturdy
- Durable air porosity for optimal root penetration, as well as proper growth thanks to good particle size gradation
- High nutrient and water-storage capacity with good water permeability
- Resistant to compaction
- Use of ecologically compatible natural aggregates of mineral and organic origin
- Certified recycled materials from selected suppliers
- Material logistics determined at the work site

Substrates can be delivered as follows:
- Loose bulk
- Bulk bag 1.0 – 2.0m³
- Small 25-litre sacks

Basic Substrates are used for standard extensive and intensive greening applications and are available as light or heavy substrates.

Light and heavy substrates look different because of the different aggregates they contain, and they have different densities. *Light* substrates contain light aggregates such as expanded shale and expanded clay. *Heavy* substrates contain heavier components such as lava or brick chippings.

Extensive Single Layer M
- For extensive green flat roofs of single-layer construction with restricted plant variety (primarily sedum varieties)
- Predominantly mineral components, low organic matter content
- Combined drainage and vegetation layer

Available as:
- Extensive single layer light M/l
- Extensive single layer heavy M/s

Extensive Substrate E
- For extensive green flat roofs with a multi-layer construction (with additional drainage layer), with average to high plant diversity
- For extensive green pitched roofs with a single-layer construction with average to high plant diversity
- Primarily mineral components
- Higher organic content
- Medium-level maximum water retention capacity
- Excellent for Green Roofs with high biodiversity

Available as:
- Extensive Substrate light E/l
- Extensive Substrate heavy E/s

Lawn Substrate R
- For neat and accessible lawns (= intensive greening) based on DIN 18035 Part 4
- High maximum water capacity with good permeability
- Tread resistant due to interlocking components

Intensive Substrate i
- For intensive, multi-layer Green Roofs (with additional drainage layer) with broad suitability, as well as a great variety of plants (perennials and shrubs)
- High-level maximum water retention capacity
- Organic matter for nutrient storage and buffer capacity
- Also suitable for outdoor plant containers

Available as:
- Intensive Substrate very light i/l
- Intensive Substrate heavy i/s

Aeration Substrate U
- Base layer (subsoil) to be covered with Intensive or Lawn Substrate
- Improves the stability of shrubs and trees
- Promotes root aeration and penetration in deeper layers thanks to very low organic matter content, thus helping prevent undesirable decay processes

Available as:
- Aeration Substrate very light U/l
- Aeration Substrate heavy U/s

Supplementary Substrates are used for Green Roof structures with special requirements.

These substrates supplement the basic substrates with regard to special requirements such as lawns with and without vehicle traffic and lightweight extensive structures. Please consult with our Technical Department to find out which substrates are suitable for your project.

Gravel Lawn Substrate SR
- For gravel lawn spaces, e.g. in fire rescue paths
- Highly resistant to both foot and vehicle traffic thanks to interlocking components

Low Density Substrate L
- Specially adapted for our Lightweight Roof system
- Very lightweight with high water storage
- Can only be used in combination with vegetation mats
- Exclusively mineral components
- Very high water storage capacity

Substrate NRW 03
- For single-layer, extensive Green Roofs with no slope and high water retention
- Provides delayed drainage of excess water
- Discharge coefficient C_S < 0.1–0.3 depending on structural height

The substrates shown are examples that can vary optically depending on the production site

Special Substrates are used for Green Roof structures with special requirements

Rounding off our selection of substrates, these products feature highly specialised characteristics and are only intended for use in special installation scenarios.

Optilith
- Mineral substrate with zeolites, for improving nutrient capacity and reducing water turbidity
- With no organic matter
- Specially adapted for Green Roof structures upstream of a service water system combined with cisterns for flushing toilets and watering gardens

Tree Substrate 1
- For tree locations not overbuilt with structures
- Incorporation of tested recycled materials
- For all types of trees, including in extreme locations not conducive to trees, can be used with/without ground anchorage
- Also suitable for roadside greening
- Upon request, can also be blown from silo trucks for poorly accessible locations

Tree Substrate 2
- For tree pits overbuilt with structures
- Compactable substrate
- Incorporation of tested recycled materials
- For all types of trees, including in extreme locations not conducive to trees, can be used with/without ground anchorage
- Also suitable for roadside greening
- Upon request, can also be blown from silo trucks for poorly accessible locations

Indoor Substrate IR
- For green areas and Planters in indoor spaces
- High organic content for comprehensive, need-based nutrient storage and buffer capacity
- Complies with FLL guidelines for indoor greening

Urban Soil US
- Perfect for cultivating vegetables and fruits in the Urban Farming (Garden Roof) system
- Basic substrate that can be fertilised as needed

PLANTS FOR EXTENSIVE GREENING

In case of prolonged heat spells and low precipitation, the vegetation of an extensive Green Roof needs to be extra robust. The best way to go is seed mixes, sedum cuttings, low-growing perennials and/or vegetation mats.

Seed mixes Quality of the seed mix in accordance with the requirements of the FLL directive for Green Roofs for the condition of wild plants from seed crops. Minimum purity of the seed mix over 75%, minimum germination capacity over 70%, for extensive Green Roofs with sedum, herb and grass vegetation in conjunction with sedum shoot seeding.

New: Biodiversity seed mix BDM
Perennial approx. 55 herb types, suitable for E and M substrate

Achillea millefolium	Common Yarrow
Allium schoenoprasum	Chives
Anthemis tinctoria	Yellow Chamomile
Aquilegia vulgaris	Common Columbine
Arenaria serpyllifolia	Thyme-leaved sandwort
Aster amellus	European Michaelmas Daisy
Campanula carpatica	Tussock Bellflower
Campanula glomerata	Clustered Bellflower
Campanula persicifolia	Peach-leaved Bellflower
Campanula rotundifolia	Harebell
Centaurea jacea	Brown Knapweed
Centaurea scabiosa	Greater Knapweed
Clinopodium vulgare	Wild Basil
Dianthus armeria	Deptford Pink
Dianthus carthusianorum	Carthusian Pink
Dianthus deltoides	Maiden Pink
Dipsacus fullonum	Wild Teasel
Echium vulgare	Viper's Bugloss
Erodium cicutarium	Redstem Stork's Bill
Euphorbia cyparissias	Cypress Spurge
Fragaria vesca	Wild Strawberry
Galium verum	Lady's Bedstraw
Geranium robertianum	Herb-Robert
Helianthemum nummularium	Common Rock-Rose
Hieracium pilosella	Mouse-ear Hawkweed
Hypericum perforatum	Common Saint John's Wort
Jasione montana	Sheep's Bit
Knautia arvensis	Field Scabious
Leucanthemum vulgare	Oxeye daisy
Linaria vulgaris	Common Toadflax
Linum perenne	Perennial Flax
Myosotis sylvatica	Wood Forget-me-not
Origanum vulgare	Oregano
Petrorhagia prolifera	Proliferous Pink
Potentilla argentea	Silver Cinquefoil
Potentilla intermedia	Russian Cinquefoil

Primula veris	Cowslip
Prunella grandiflora	Large Self-Heal
Prunella vulgaris	Common Self-Heal
Ranunculus bulbosus	St Anthony's Turnip
Salvia pratensis	Meadow Clary
Sanguisorba minor	Small Burnet
Saponaria ocymoides	Rock Soapwort
Saponaria officinalis	Common Soapwort
Saxifraga granulata	Meadow Saxifrage
Scabiosa columbaria	Small Scabious
Sedum rupestre	Blue Stonecorp
Silene nutans	Nottingham Catchfly
Silene otites	Spanish Catchfly
Silene vulgaris	Bladder Campion
Teucrium chamaedrys	Wall Germander
Thymus pulegioides	Broad-leaved Thyme
Verbascum nigrum	Dark Mullein
Veronica teucrium	Large Speedwell
Viola tricolor	Wild Pansy

Biodiversity seed mix BDE
appr. 23 herb types, suitable for E and M substrate

Alyssum maritimum	Sweet Alyssum
Antirrhinum Zwerg	Snapdragons Mix
Calendula arvensis	Field Marigold
Centaurea cyanus	Cornflower
Centaurea cyanus 'Polka Dot'	Cornflower 'Polka Dot' Mix
Collinsia bicolor	Blue-eyed Marys
Convolvulus sabatius	Blue Rock Bindweed
Dianthus chinensis	Chinese Pink (Mix)
Eschscholzia californica	California Poppy
Iberis umbellata	Garden Candytuft
Layia platyglossa	Tidy Tips
Legousia speculum-veneris	Venus' Looking Glass
Linaria maroccana	Maroccan Toadflax (Mix)
Linum rubrum	Red Flax
Malcolmia maritima	Virginia Stock
Mesembryanthemum	Livingstone
Nemophila insignis	Baby Blue Eyes
Papaver argemone	Prickly Poppy
Papaver rhoeas	Common Poppy
Phacelia campanularia	California-Bluebell
Phlox drummondii	Drummond's Phlox (Mix)
Silene armeria	Sweet William Catchfly
Zinnia Lilliput	Zinnia

EKR
appr. 30 herb types, suitable for extensive substrate E

Achillea millefolium	Common Yarrow
Allium schoenoprasum	Chives
Anthemis tinctoria	Yellow Chamomile
Aster amellus	European Michaelmas
Campanula rotundifolia	Harebell

Centaurea scabiosa	Greater Knapweed
Dianthus carthusianorum	Carthusian Pink
Dianthus deltoides	Maiden Pink
Erodium cicutarium	Redstem Stork's Bill
Fragaria vesca	Wild Strawberry
Galium verum	Lady's Bedstraw
Geranium robertianum	Herb-Robert
Hieracium aurantiacum	Orange Hawkweed
Hieracium pilosella	Mouse-ear Hawkweed
Leucanthemum vulgare	Oxeye daisy
Linaria vulgaris	Common Toadflax
Linum perenne	Perennial Flax
Origanum vulgare	Oregano
Petrorhagia saxifraga	Tunic-Flower
Potentilla argentea	Silver Cinquefoil
Prunella grandiflora	Large Self-Heal
Prunella vulgaris	Common Self-Heal
Ranunculus bulbosus	St Anthony's Turnip
Sanguisorba minor	Small Burnet
Saponaria ocymoides	Rock Soapwort
Saponaria officinalis	Common Soapwort
Silene nutans	Nottingham Catchfly
Silene otites	Spanish Catchfly
Thymus pulegioides	Broad-leaved Thyme
Thymus serpyllum	Breckland Thyme

EGR
appr. 8 grass types, suitable for extensive substrate

Anthoxanthum odoratum	Sweet Vernal Grass
Briza media	Quaking Grass
Bromus tectorum	Cheat Grass
Festuca cinerea	Blue Fescue
Festuca pallens	Fescue
Festuca rupicola	Fescue
Melica ciliata	Silky Spike Melic
Phleum phleoides	Boehmer's Cat's-Tail

Biodiversity seed mix BDG
appr. 11 grass types, suitable for E and M substrate

Anthoxanthum odoratum	Sweet Vernal Grass
Briza media	Quaking Grass
Bromus tectorum	Cheat Grass
Carex sylvatica	Forest Sedge
Festuca cinerea	Blue Fescue
Festuca pallens	Fescue
Festuca rupicola	Fescue
Festuca tenuifolia	Fescue
Koeleria glauca	Blue Hair Grass
Melica ciliata	Silky Spike Melic
Phleum phleoides	Boehmer's Cat's-Tail

ⓘ You will find the various plant lists with pictures on our website

Wild native(EKR)
approx. 31 types of herbs from local plant societies

usable on multilayer extensive substrate E

Achillea millefolium	Common Yarrow
Anthemis tinctoria	Yellow Chamomile
Aster amellus	European Michaelmas
Campanula rotundifolia	Harebell
Centaurea scabiosa	Greater Knapweed
Clinopodium vulgare	Wild Basil
Dianthus armeria	Deptford Pink
Dianthus carthusianorum	Carthusian Pink
Dianthus deltoides	Maiden Pink
Erodium cicotarium	Redstem Stork's Bill
Euphorbia cyparissias	Cypress Spurge
Gallium verum	Lady's Bedstraw
Geranium robertanium	Herb-Robert
Helianthemum nummularium	Common Rock-Rose
Helichrysum arenarium	Sandy everlasting
Hieracium aurantiacum	Orange Hawkweed
Hieracium pilosella	Mouse-ear Hawkweed
Leucanthemum vulgare, wild	Oxeye daisy
Linaria vulgaris	Common Toadflax
Linum perenne	Perennial Flax
Origanum vulgare	Oregano
Petrorhagia saxifraga	Tunic-Flower
Potentilla argentea	Silver Cinquefoil
Prunella grandiflora	Large Self-Heal
Prunelle vulgaris	Common Self-Heal
Sanguiosorba minor	Small Burnet
Saponaria officinalis	Common Soapwort
Silene nutans	Nottingham Catchfly
Silene otites	Spanish Catchfly
Silene vulgaris	Bladder Campion
Thymus pulegioides	Broad-leaved Thyme

Sedum sprouts Quality of the sprout parts in accordance with the quality regulations for perennials, the number of flower stems below 5 % of the total volume.

For biodiversity we also recommend sowing seeds with seed mix EKR, EGR, MKR, BDM or BDE.

Sedum sprout

Sedum floriferum	Weihenstephaner Gold
Sedum album in Sorten	White stonecrop
Sedum reflexum	Reflexed stonecrop
Sedum spurium in Sorten	Caucasian stonecrop
Sedum sexangulare	Tasteless stonecrop
Sedum lydium glaucum	Blue carpet sedum
Sedum Kamtschaticum	Orange stonecrop
Sedum hybridum	Little evergreen stonecrop

Low-growing perennials Special sedum, herb and perennial grasses in Planters of various sizes. Cultivated in Green Roof substrate- They can be used on all Green Roof structures Depending on the planter size, the plant selection and the number per m² can vary.

The perennials are preferred according to the “Quality standards for perennials” and DIN 18916 and comply with the quality criteria stipulated by the FLL Green Roof regulations.

Sedum vegetation mats The sedum vegetation is pre-cultivated on different carriers, depending on the area of application. Required usage on lightweight roofs, pitched roofs and in areas subject to high wind suction. Optional usage on all Green Roof structures for rapid greening.

Sedum Mat S/Coc 20 and 30
- Vegetation mat on degradable fabric backing, pre-cultivated with 5 – 7 different types and varieties of sedum, for example

Sedum Mat SM /G 20
- Vegetation mat on mostly degradable fabric backing, pre-cultivated with 5 – 7 different types and varieties of sedum, for example

Sedum Mat SM/KG
- Vegetation mat on non-degradable and stretchable fabric backing and three-dimensional nylon looped fabric, pre-cultivated with 5 – 7 different types and varieties of sedum, for example

Sedum floriferum	Weihenstephaner Gold
Sedum album in varieties	White stonecrop
Sedum reflexum	Reflexed stonecrop
Sedum spurium in varieties	Caucasian stonecrop
Sedum sexangulare	Tasteless stonecrop
Sedum lydium glaucum	Blue carpet sedum
Sedum kamtschaticum	Orange stonecrop
Sedum hybridum	Little evergreen stonecrop

ⓘ You will find the various plant lists with pictures on our website

TERMS

A

Anchoring security A roof structure is considered “securely anchored” when all the individual components are designed and secured such that they cannot be lifted off due to wind suction. This is usually achieved by applying adhesive throughout and placing fastening dowels in certain locations or by weighting down the entire structure (e.g. using roof greening structures or gravel).
Annual drainage coefficient Indicates what portion of the total precipitation is discharged on average each year.
Average discharge coefficient Indicates what portion of a total precipitation is drained. Used to assess rainwater retention spaces.

B

Barrier layer A barrier layer separates materials that are chemically incompatible from each other.

C

Continuous retention volume Volume that is available for continuous water retention. The water level is only reduced through evaporation.

D

Development maintenance Maintenance work which is required in order to develop a green space and achieve a functional state. This includes establishment maintenance work as stipulated by DIN 18916 and DIN 18917.
Discharge coefficient Indicates what portion of the rainwater is discharged.
Drainage layer Channels excess water to the drainage outlets. With suitable geometry, can include water storage and/or be used as retention volume.

E

Establishment maintenance Work required in order to establish vegetation. Depending on the greenery, certain kinds of maintenance work (establishment maintenance) is required in order to establish the vegetation once it is planted. The goal is to achieve a state which will ensure continued growth, assuming that maintenance as stipulated by DIN 18919 is provided thereafter.
Extensive Green Roof Typically refers to semi-natural, unutilised green spaces on the roof requiring little effort to establish and maintain.

F

Filter layer The filter layer prevents finer soil and substrate particles from the vegetation rooting layer from forming sludge in the drainage layer, impairing affecting its drainage capacity.

I

Intensive Green Roof Garden spaces on a rooftop or in an underground car park, typically accessible for use and with a higher-end design, requiring higher investment to set up and maintain.

L

Layer depth The layer depth refers to the depth of each layer taken by itself (e.g. 50 mm drainage layer).

M

Maximum water capacity Designates the amount of water that a saturated material contains after two hours of drain-off, in accordance with the FLL.
Multi-layer Multi-layer designs have a clear separation between the drainage level and the vegetation rooting layer. The drainage level can consist of bulk material or drainage boards. The levels are typically separated by a Filter Fleece.

P

Peak discharge coefficient Indicates how large the maximum drainage is, compared to the maximum precipitation during a given period of rain. Used to determine pipe cross-sections.
Protective actions Temporary protection of a waterproof membrane during the construction phase.
Protective layer Lasting protection against mechanical and/or thermal and/or chemical effects for a waterproof membrane made of sheet materials.
Protective liner Lasting protection against mechanical and/or thermal and/or chemical effects for a waterproof membrane made of sheet materials.

R

Retention Continuous or temporary water storage.
Root barrier The root barrier must permanently protect the roof waterproofing from damage caused by invading plant roots and rhizomes.
Root zone / rooting zone The part of the Green Roof structure which plants root into. It includes both the vegetation rooting layer and the drainage layer.
Routine maintenance Maintenance work which is required in order to maintain a green space and keep it in a functional state. This work follows development maintenance (as required by DIN 18919).

S

Single-layer intensive Green Roof Utilised or unutilised, typically simply designed green areas on the roof requiring minimal set-up and maintenance.

Single-layer With single-layer configurations, the vegetation rooting layer has a draining function. Both extensive and intensive Green Roof spaces can be built as single-layer structures.

Slip layer Layer in the bottom part of a system structure, sometimes comprised of multiple sliding liners.

Slip liner A slip liner reduces friction between two layers, thereby reducing load transmission spikes in the neighbouring materials.

Substrate From materials mixed together or from prepared soils, soil substitute produced in accordance with defined requirements for growing vegetation.

Surface erosion refers to particle transport along a substrate or soil surface as a result of effects such as wind, water or ice.

Build-up depth The build-up depth refers to the total of all the layer heights in an Optigrün system (e.g. build-up depth of an Economy Roof = protective liner + drainage layer + filter fleece + vegetation rooting layer = ab 80 mm).

T

Temporary retention volume Volume that is available for temporary water retention. Rainwater is discharged through a drainage outlet with flow control valve.

V

Vegetation rooting layer The vegetation rooting layer forms the foundation for plant growth and must be penetrable by roots.

W

Water Retention Indicates what portion of the total precipitation is retained in the substrate layer and not discharged each year.

Water storage Indicates the maximum, geometrically determined water storage volume of a drainage board that is not a retention board (WRB).

Wind erosion protection Green Rooftops are considered “wind-proof” if the eroding effect of the wind is not able to transport the individual bits of gravel or roof substrates.

Work package A work package refers to manual and structural work in construction. On a roof, we typically encounter structural engineering, thermal insulation, waterproofing and greening work packages.

Work phases The scope of work pertaining to the building is split up into nine work phases which can be invoiced separately in accordance with the HOAI (Regulations on Architects' and Engineers' Fees):

WP 1: Feasibility study
WP 2: Pre-planning with cost estimate
WP 3: Draft planning and costing
WP 4: Planning for regulatory approval
WP 5: Detail planning
WP 6: Preparing the order placement, including determining quantities and defining specifications
WP 7: Involvement in order placement, including tender
WP 8: Site management – construction supervision and documentation
WP 9: Site supervision

ⓘ **Errors, changes and misprints excepted.**

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