



PLANNING GUIDE

Green Roof Basics

Life on Roofs



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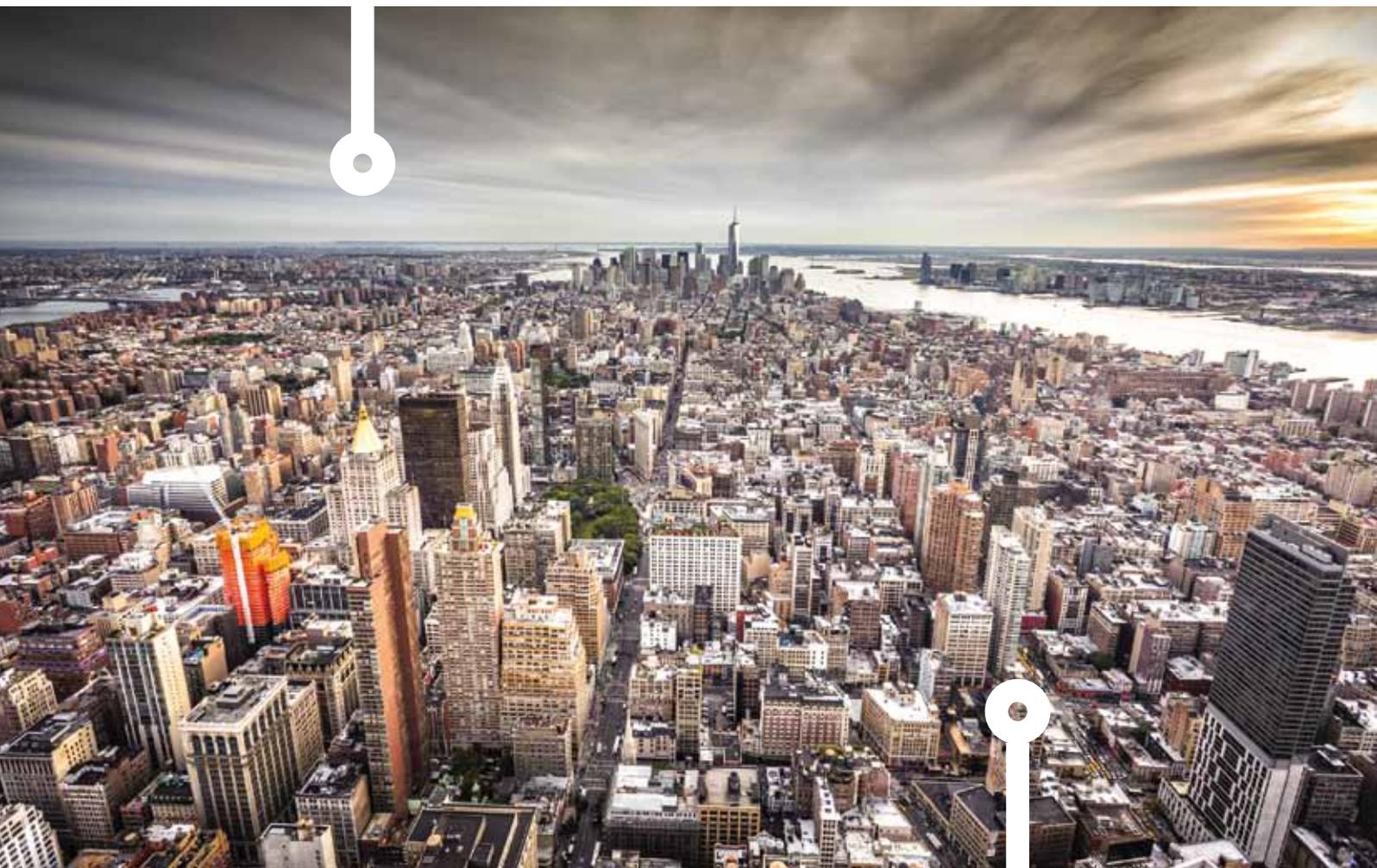
ZinCo Green Roofing Systems now
with European Technical Assessment.

The Roofs of the Future are Green

Roofs are more than just “functional components” for the protection of the building structure. Roofs give character to individual buildings and entire city districts.

Beyond that, roofs are more and more considered as open resource areas. They attract urban planners looking for socially responsible concepts that counteract the loss of natural living space and provide solutions for problems such as stormwater management and urban heat island effect in densely populated cities.

Green Roofs are extending the formal language of contemporary architecture and confer a new significance and value on the concept of “Roof Landscape”: Nature – increasingly ousted by buildings and paved surfaces – returns as an attractive green element in residential, recreational and working environments.



Important soil functions such as water transport are being lost due to ground sealing in towns and cities. Stormwater is less able to seep into the surface, therefore increasing the flood risk in the event of heavy rainfall.

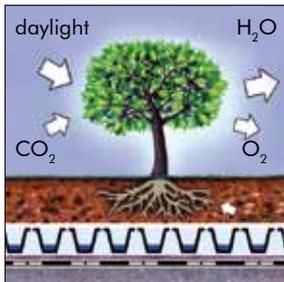
Ongoing soil sealing has the additional effect, at the same time, of further heating up inner cities in the summer. The reason is that evaporation, which contributes to air cooling cannot take place from sealed surfaces.

A green roof can help here by retaining water, providing moisture for the air and creating a new habitat for plants, animals and people.

Why Have a Green Roof?

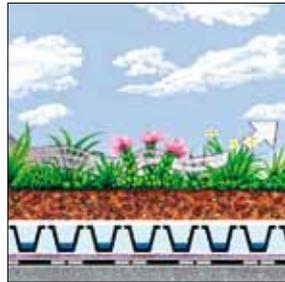
Beyond their attractive visual nature, Green Roofs offer many undisputable benefits, both ecological and economical, provided they are built with the right system.

Improve the Microclimate



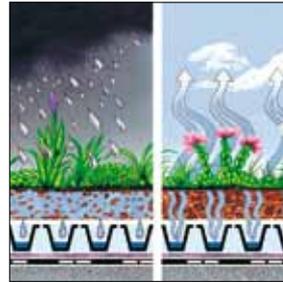
Green Roofs cool and humidify the surrounding air. Thus they contribute to improving the microclimate in urban centres. This cooling effect significantly increases the performance of air-conditioning systems, reducing carbon emissions.

Bind Dust and Toxic Particles



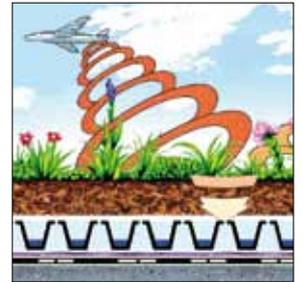
Green Roof vegetation helps to filter out dust and smog particles. Nitrates and other harmful materials are absorbed by the plants out of the air and rainfall and bound within the substrate.

Increase Rainwater Retention



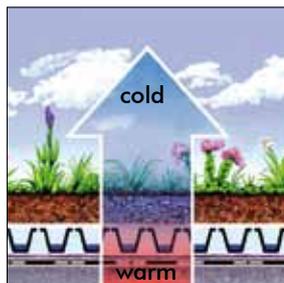
A Green Roof can reduce water run-off by 50–90%; any water flows from the roof with a delay. Outlets, pipes and drains can be reduced in capacity, thereby saving construction costs. Sewer costs can be reduced in some areas.

Improve Noise Protection



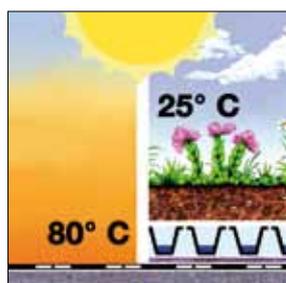
Planted areas are natural sound insulators and absorb more sound than hard surfaces. Green Roofs reduce reflective sound by up to 3 dB and improve sound insulation by up to 8 dB. This is very effective for buildings near airports, noisy nightclubs and factories.

Reduce of Energy Costs



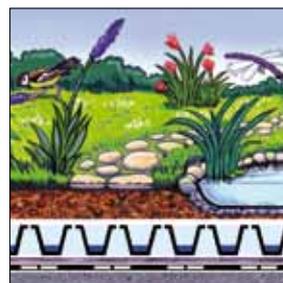
A Green Roof has the ability to buffer temperature extremes and improve the buildings energy performance.

Protect the Waterproofing



A Green Roof protects the waterproofing from climate extremes, UV exposure and mechanical damage. This greatly increases the life expectancy of the waterproofing and results in reduced maintenance and replacement costs.

Offer a Natural Habitat



Landscaped roofs compensate for green spaces, which are lost to building development. They provide natural habitats for wildlife and bring nature back into the cities.

Provide Additional Space

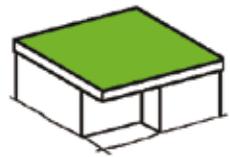


Green Roofs offer additional space for numerous uses. Whether you want a relaxing garden, a playground or a golf course, it all can be achieved as part of the existing footprint.

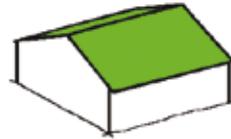
Roof Technology

Roof Shape and Pitch

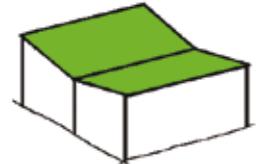
The foundation for a green roof is generally a sealed roof with sufficient load-bearing capacity. Whether it is a typical flat roof with a 2 % minimum pitch slope, a pitched or vaulted roof or a zero pitch roof is of minor importance initially. However, when choosing the green roof build-up factors such as ponding water on the waterproofing membrane or the shear forces and potential erosion which may occur with pitched roofs must be taken into consideration.



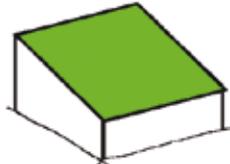
"Typical flat roof"



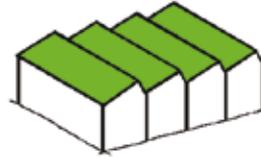
"Gable roof"



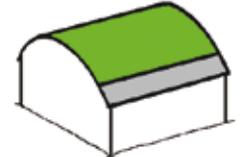
"Butterfly roof"



"Mono pitch roof"



"Saw-tooth roof"



"Barrel roof"



Roof Structures

Provided they are planned and installed correctly, a green roof can be installed on almost every kind of roof structure.

Roofs without thermal insulation, that is roofs over unheated rooms such as garage roofs, and **"warm roofs"** (single-skin, non ventilated roofs) can be fitted with any type of green roof and vegetation.

"Cold Roofs" (double-skin, ventilated roofs) have a second skin above the thermal insulation, often with a low load-bearing capacity, on which the waterproofing membrane is installed. From an engineering point of view, there is no reason for not installing a green roof on this type of roof if the load-bearing capacity of the second skin allows for it and it is possible to ensure that the green roof does not prevent ventilation.

With an **"inverted roof"**, the thermal insulation is installed on top of the roof waterproofing membrane, i. e. in the damp area. When installing a green roof it is important to ensure that water vapour is not prevented from diffusing from the thermal insulation and that ponding water does not occur.

Roof Technology

Roof Waterproofing Membrane

The waterproofing membrane can be made of bituminous, plastic or rubber sheeting or even of a liquid seal. The important thing is that the waterproofing membrane is root-resistant or that it is sufficiently secured by installing a separate root protection system. As regards to sheet thickness, you should not adhere to the minimum thickness required but choose a quality grade that will allow the planned load.

Root Barrier

Plant roots are a strain on a roof both from a chemical and a physical point of view. Not every waterproofing membrane is capable of permanently withstanding such strain. If in doubt and particularly if the roof membrane has not been tested for root-resistance, an additional root barrier should be installed.



Roof Pitch

With flat roofs, it is important to avoid ponding water. This is done by choosing a suitable system build-up with a sufficiently high level of capillary-breaking drainage.

In the case of zero pitched roofs, greater demands are placed on the roof waterproofing membrane.

Where ponding water cannot be avoided, ZinCo offers suitable solutions involving high-level drainage elements, so that green roofs can even be installed on zero pitched roofs.

With pitched roofs, increased attention must be paid on the one hand to shear protection and on the other to ensuring that sufficient water is retained in the System Build-up.

Connection Heights

The same connection or termination height should be adhered to for green roofs and otherwise utilised or even non-utilised roofs. The upper finish of the connections must be waterproof and must be prevented from slipping.



Roof Technology

Protection against Wind Suction

Particular attention must be paid to increased wind loads on roofs, particularly on top of high and exposed buildings. Roof waterproofing membranes and other accompanying layers can be prevented from being lifted by wind loads by means of gluing, mechanical fixing or by the use of ballast. If a green roof is to function as ballast, it must be installed without delay and must be sufficiently heavy.

The wind loads and therefore the required ballast will depend upon the:

- location (wind zone)
- height and type of building
- roof shape and pitch
- roof zone (corner, edge, centre) and
- type of roof structure (open or closed)



Vegetation and wind loads

It is also important for the vegetation to be suited to the conditions on the roof. In particular, both vegetation that will grow high and that has insufficient root space should be deemed to be fragile.

A balanced nutrient supply and irrigation will ensure that the woody plants develop a large root plate. Too lavish a supply of nutrients that will result in a shallow and insufficient root system should be avoided.

The plants should also be properly secured when they are first planted and during the growth phase, until such time as the wood has properly put down roots.

Drainage

Green roofs retain a large quantity of stormwater but, depending on the season, there will be more or less excess water that must be able to run off without a problem.

Drainage elements in green roofs can consist of:

- roof gutters
- internal drainage channels
- outer-lying roof gutters
- water spouts
- emergency or safety overflow systems

Roof outlets must always be separate from the green roof and the gravel layer and accessible. Therefore, inspection chambers are to be placed over roof



outlets within vegetation areas and terrace grilles are to be placed within paved areas.



The tree anchorage system Robafix® is developed specially for root ball anchoring on intensive Green Roofs and underground car parks.

Roof Technology

Fire Safety

ZinCo green roofs are classified in accordance with German Industrial Standard DIN EN 13501-5 ("Fire classification of construction products and building elements") as BROOF(t1), provided the requirements and advice included below are adhered to.

Roofs with an intensive green roof that have to be irrigated and maintained (e. g. roof gardens, underground park decks) and that generally have a deeper substrate level, are to be automatically classified as resistant to sparks and radiant heat.

Roofs with an extensive green roof that are not generally irrigated and only have to be maintained once a year, are deemed to be resistant to sparks and radiant heat if:

1. the substrate layer (system substrate, Zincolit®, etc.) is at least 30 mm thick,
2. a maximum of 20 % of the substrate weight is organic material (all ZinCo system substrates are below this figure),
3. in the case of large-scale green roofs, a fire zone is created every 40 m (e. g. using a strip of gravel, Zincolit® or concrete pavers or upstands),
4. a strip of rough gravel, Zincolit®, concrete pavers or similar is installed before the openings in the roof area (sky domes, light bands) and before any walls with openings.

In addition, a number of build-ups have been successfully tested in line with BROOF(t2) and BROOF(t3).



Load-bearing Reserves

The additional weight of a green roof, specifically in a waterlogged state, must be factored in when calculating the load capacity of the roof. Snow loads typical for the location should be factored in too.

In our experience, areas can be found on a roof where it is possible to use deeper substrate layers or mounds, e. g. above walls, columns or beams. Taller perennials or small woody plants can be planted here, for example, allowing an increase in the design variety. However, any resulting additional weight must be taken into consideration and verified by a structural engineer.



Vegetation Technology

Types of Green Roofs



Extensive landscaped roofs are an ecological alternative to conventional surface protection or ballast layers such as gravel and pavers. They are lightweight and have a shallow build-up height. Suitable plants include various

Sedum species, herbs and some grasses. They cope with the conditions on the roof (sun, wind, drought, etc.) by nature. After establishment of the vegetation, the maintenance is limited to one or two inspections a year.

Extensive Green Roofs

Minimal maintenance required

- inspection 1–2 x / year
- supply of water and nutrients mostly by natural processes

Adapted plant communities

- undemanding, drought-tolerant
- self-regenerating

Little weight and shallow build-up height

- mainly mineral substrate with depth up to 120 mm
- weight approx. 50–150 kg/m²

Surface protection with ecological functions



Intensive Green Roofs can most easily be compared to building a garden on a roof. They are usually multifunctional and accessible. They require more weight and a deeper system build-up. The maintenance is regular and depends on

the landscape design and the chosen plant material. Depending on the substrate depth, anything is possible from lawns, perennials, shrubs, trees including other landscape options such as ponds, pergolas and patios.

Intensive Green Roofs

Regular maintenance required

- garden maintenance such as mowing, fertilizing, watering, weeding etc.

Weight and build-up height depending on plant selection

- e. g. ornamental lawn, summer flowers, demanding shrubs, bushes and trees
- substrate with higher amount of organic material, with depth > 150 mm
- weight > 150 kg/m²

Well kept Roof Garden

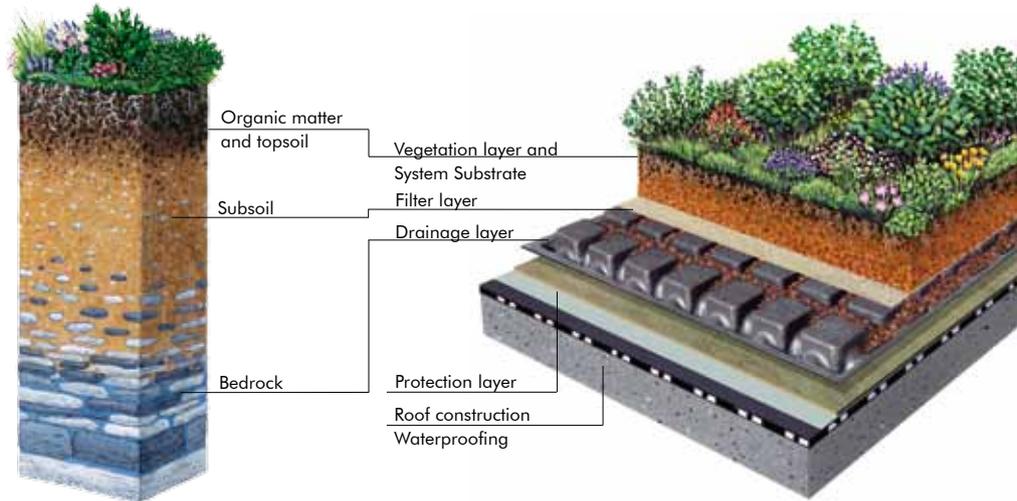
Vegetation Technology

Replicating Nature on Roofs

When designing and installing a Green Roof it is important to provide a growing environment as close as possible to the plants` natural environment. The most important issue is to compensate for the lack of subsoil.

In areas with temperate climates ZinCo systems are able to retain the necessary quantities of water to support the plants, while draining off the excess. The required amount of water is determined by the plant type, the geographical region and the roof itself. Besides building the correct Green Roof system to support the plants, it is very important to protect the waterproofing from both mechanical damage and attack from plant roots.

ZinCo systems provide a number of solutions to these problems. They have been designed to function naturally. The plants receive a stable environment without adversely affecting the waterproofing.



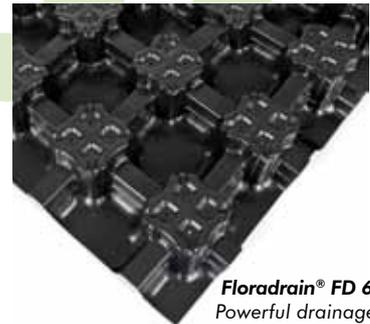
Drainage Elements

ZinCo systems store water on the one hand and allow excess water to run off, on the other hand. The amount of water actually needed depends on the type of vegetation planted, on the location and on the roof itself.

While extensive green roofs with drought-resistant perennials require less moisture, and would suffer with "wet feet", simple intensive green roofs have a greater water requirement. In a moderate climate zone such as central and northern Europe, natural precipitation is generally sufficient for the required water supply. But in the case of more sophisticated roof gardens, additional irrigation should be planned for.

ZinCo drainage elements are light in weight, low-lying and nonetheless solid so that they gain in height and weight in terms of the overlying substrate layer.

The element cells retain some of the stormwater even on a pitched roof and excess water can run off in the underlying channel system.



Floradrain® FD 60 neo: Powerful drainage and water storage element made of reinforced plastic for use in intensive green roofs and otherwise utilised roofs.

Floradrain® FD 25-E: Pressure-resistant, low drainage and water storage element made of recycled polyethylene for use in extensive green roofs.



Vegetation Technology



Substrates

In contrast to the situation with natural ground, there is only a limited amount of root space available on roof areas. Nonetheless, optimum growth conditions must be created for the vegetation in conjunction with the overall system build-up. Water/air balance, which in nature is carried out by powerful soil horizons, is dealt with in a roof situation by substrate layers that are sometimes very shallow. This is addressed by ensuring the appropriate mixture of organic and mineral components.

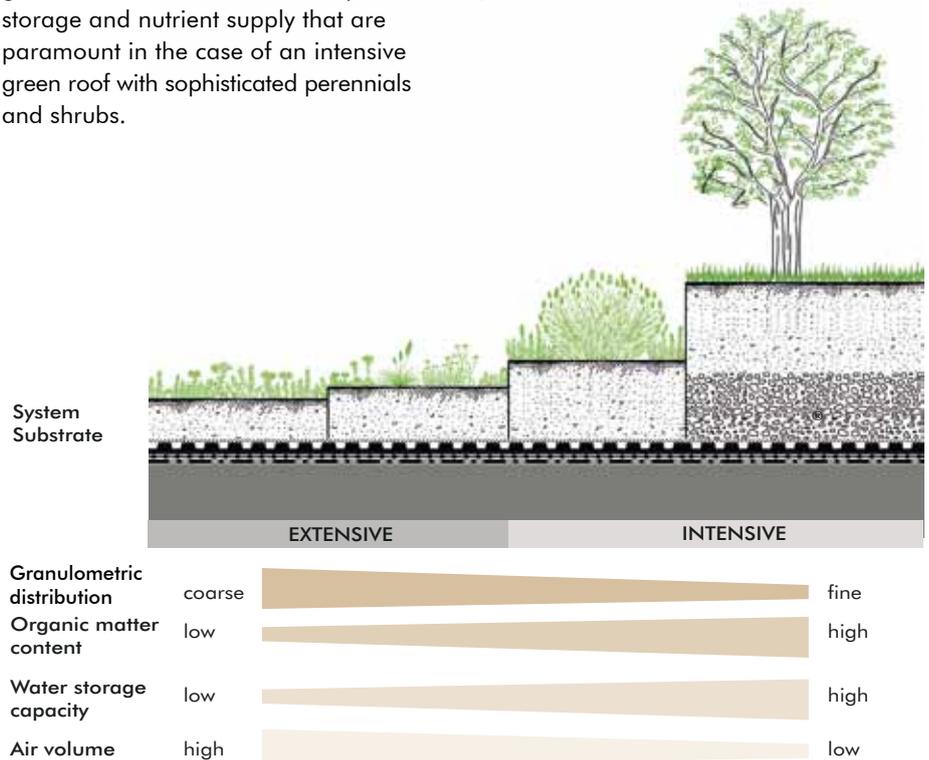
There are two additional specific requirements regarding roof substrates: firstly, they should supply water for the vegetation for as long as possible and secondly, the level of maintenance (of extensive green roofs) should be minimal. Excess water capacity can result in water logging, can cause the build up of moss and the increased weed growth. Knowing the specific weight of a substrate is important. Possible wind loads on one hand and restricted structural requirements on the other hand generally need to be taken into consideration.

Substrate Depth

In addition to choosing the correct substrate for the relevant vegetation, the substrate depth is significant for the success of the green roof.

Where the focus is more on drainage performance with a simple extensive green roof with sedum, it is mainly water storage and nutrient supply that are paramount in the case of an intensive green roof with sophisticated perennials and shrubs.

The result is a finer granulation from extensive to intensive substrates, in conjunction with increased organic matter content. This ensures that the plants are supplied with the required level of water, without reducing the volume of air in the substrate that is required by the plant roots.



System Build-up "Sedum Carpet"



The "Sedum Carpet" is a standard build-up for extensive Green Roofs. It is a shallow and lightweight Green Roof type with an attractive "back-to-nature" appearance, that requires little maintenance.

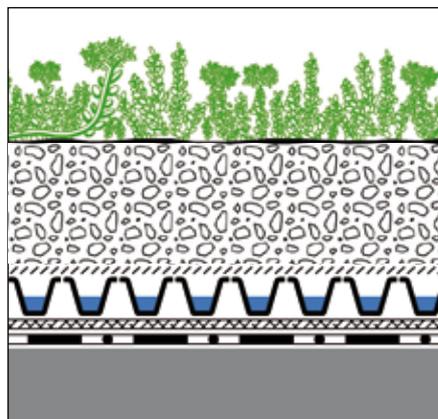
Floradrain® FD 25-E is the appropriate drainage and waterstorage element for this system. It has the necessary compressive strength, a low profile height, little weight and is walkable.

Proven Sedum species, in combination with the adapted substrate and system build-up, guarantee a durable Green Roof. The main blooming time is early summer with yellow, red and white flowers dominating. During the year, "Sedum Carpet" is represented in various shades of green. Red shades show particularly in autumn and are a nice change in the Green Roof's appearance.

Sedum cuttings are produced by cutting off the shoot tips of selected types of Sedum. This is only possible during the non-flowering period (spring or autumn), as flowering shoots do not easily grow roots. With Sedum cuttings, good ground cover is achieved within 2–3 years. A faster ground coverage is achieved with plug planting.

Features:

- Proven simple green roof build-up requiring only little maintenance, especially for roofs with low design demands.
- Can be used on roofs with no severe ponding up to a slope of about 8°.
- Environmental protection layer instead of a gravel cover.



Suitable Vegetation layer

Suitable System Substrate

Filter Sheet SF
Floradrain® FD 25-E
Protection Mat SSM 45
Root Barrier WSF 40,
if waterproofing is not root-resistant.

Build-up height: from ca. 90 mm
Weight, saturated: from ca. 95 kg/m²
Water retention capacity: from ca. 25 l/m²



System Build-ups with European Technical Assessment.
Details at <https://zinco-greenroof.com/european-technical-assessment>

System Build-up “Irrigated Extensive Green Roof”



Crédits photos@Drone-view

Due to the ongoing climate change, many regions are increasingly having to deal with long periods of drought. This will lead to species-poor green roofs with plant growth being more or less up and down. Very often only succulents will survive with perhaps bare patches that are only temporarily green. Therefore, irrigation in many regions is the only way to achieve biodiversity on green roofs.

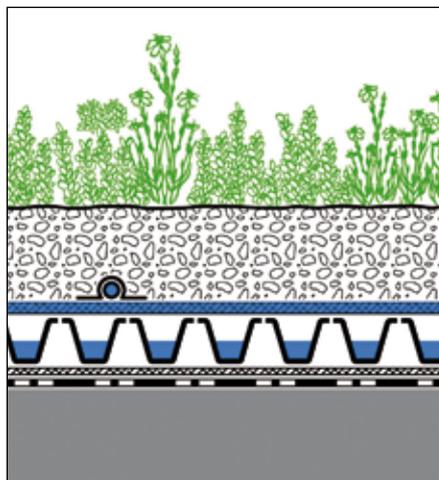
This green roof build-up will help to strike a balance between a cost-effective solution and the permanent proper functioning of green roofs in dry climates.

As is the case with the “Urban Climate Roof” build-up, irrigation takes place beneath the substrate.

As a result, the water is available where a plant needs it - in the root zone. However, unlike the Urban Climate Roof system build-up, the system supplies only the amount of water that the plants need for healthy growth. Thanks to the shallower substrate depth, the green roof build-up is not only lighter but also other plant communities are used.

Features:

- Biodiversity and long-term greening success are achieved through targeted underground irrigation.
- Relatively low water consumption due to the fact that water is being distributed throughout the Aquafleece AF 300 and is fed to the plants from below.
- Applicable on 0°-roofs as well as on roofs with an inclination of up to 5°.



Suitable Vegetation layer

Suitable System Substrate

Dripperline 500-L2
 Aquafleece AF 300
 Floradrain® FD 40-E*
 Protection Mat SSM 45
 Root Barrier WSF 40,
 if waterproofing is not root-resistant.

Build-up height: from ca. 110 mm*
Weight, saturated: from ca. 125 kg/m²
Water retention capacity: from ca. 41 l/m²

* If a different type of drainage element is used, the build-up height is reduced or increased correspondingly.

0°-Roof

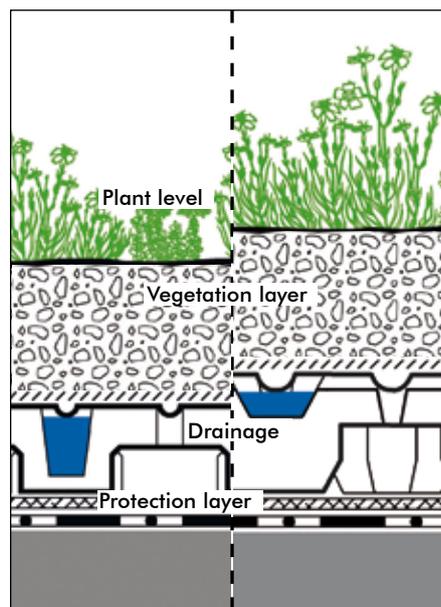


On 0°-roofs where deeper puddles might remain, the standard extensive system build-up is to be modified.

By installing higher Floraset® elements (50 or 75 mm) the necessary distance to the water level is ensured. The Green Roof build-up will be somewhat higher but not heavier as these elements are made of extruded polystyrene hard foam and therefore have a negligible weight. The Protection Mat TSM 32 with its lower retention capacity is sufficient, as water from the puddles is made available to the plants.

Features:

- For 0°-Roofs with standing water;
- Can also be used for roofs with a slight slope up to 10°.
- Requires minimum maintenance.
- Great variety of Sedum species and drought resistant grasses.



Suitable Vegetation layer

Suitable System Substrate

Filter Sheet SF

Floraset® FS 50 or FS 75

Protection Mat TSM 32

Root Barrier WSF 40,
if waterproofing is not root-resistant.

Build-up height: ca. 120 resp. 150 mm

Weight, saturated: ca. 105 kg/m²

Water retention capacity: ca. 33 l/m²

Inverted Green Roof

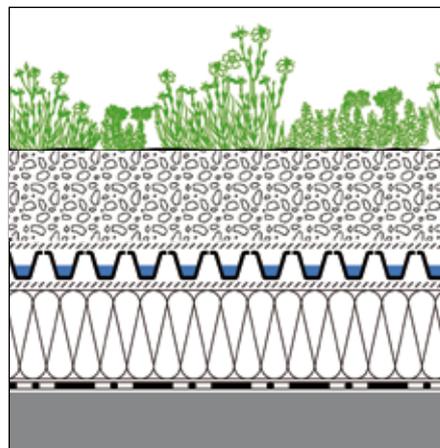


The characteristic of an inverted roof is that the insulation is above the waterproofing. The extruded polystyrene insulation (XPS) which is used for this kind of roof is impervious to water, but not to water vapour. Forming a vapour barrier directly above it when installing a Green Roof must therefore be avoided. Layers that prevent moisture from diffusing out mustn't be installed over the thermal insulating XPS boards and the layer above should be vapour permeable.

The protection mat has to be replaced by the permeable separation membrane TGV 21. If a root barrier is required, it has to be placed below the insulation directly onto the waterproofing. A deeper substrate layer compensates for the water retention capacity of the missing protection mat and prevents wind uplift of the insulation boards.

Features:

- Build-up for inverted roofs allowing diffusion and vaporisation.
- Large variety of species as an ecological protection layer instead of gravel covering.
- For roofs without standing water and with a slight slope up to 8°.
- Requires minimum maintenance.



Suitable Vegetation layer

Suitable System Substrate

Filter Sheet SF

Floradrain® FD 25-E

Separation Membrane TGV 21

Roof construction with XPS thermal insulation

Root Barrier WSF 40, if waterproofing is not root-resistant (beneath the thermal insulation layer).

Build-up height: from ca. 110 mm
 Weight, saturated: from ca. 120 kg/m²
 Water retention capacity: from ca. 36 l/m²

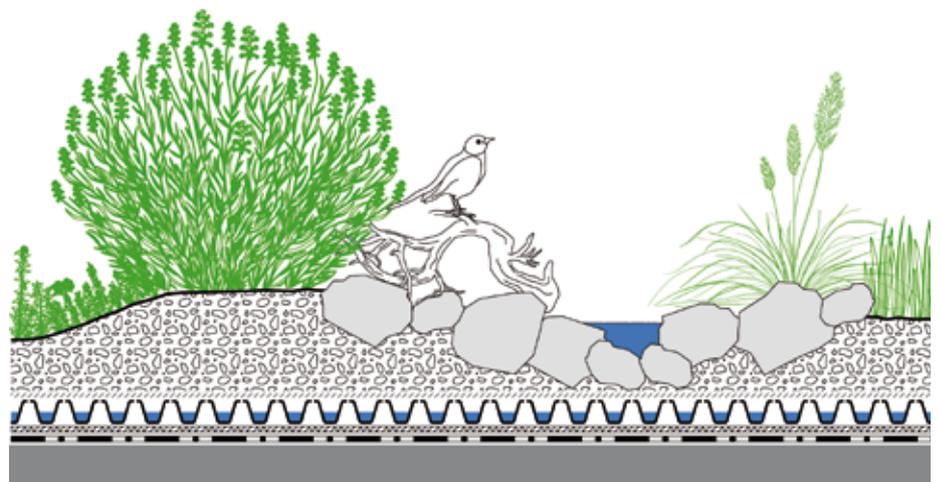
Biodiversity



In areas where nature has been destroyed by construction works and the ground is sealed, green roofs can partially compensate for lost green areas and can provide replacement habitats for flora and fauna. Above all, natural, low-maintenance extensive green roofs are important refuges for flora and fauna. Wild bees, butterflies and ground beetles find food and shelter there. However, the development of biodiversity depends to a great extent on how the habitats that are provided for the flora and fauna on a roof are structured. Pure sedum green roofs that are frequently installed in conjunction with very shallow substrate depths are not suitable for exploiting this potential. Indeed, the biotope function of greened roof areas can be specifically fostered with very little work using various design features and applying basic biodiversity principles during the planning and implementation stages.

Biodiversity module

<p>Modulating the substrate surface</p> <p>Varying the substrate depth creates different habitats that will extend the range of species available in the planting areas.</p>	<p>Introducing deadwood</p> <p>Dead branches and tree trunks are a particularly valuable structural element. Deadwood is used as a habitat by moss, lichens, fungi, beetles, flies, midges, ants and wild bees, among others.</p>	<p>Temporary water bodies</p> <p>Using borders and sheeting, areas can be created to retain stormwater on the roof for an extended period of time. It improves the amount of water available, e.g. for insects and birds.</p>	<p>Sand pockets and coarse gravel beds</p> <p>Plant-free areas are an important enrichment of the biotope and are used by insects and other roof inhabitants as a hideaway, breeding ground and a sun trap.</p>	<p>Plant selection, e.g. forage plants</p> <p>Creating deeper substrate zones (mounds) makes it possible to plant a wider range of native species or forage plants for pollinators and birds.</p>	<p>Nesting aids</p> <p>The use of nesting aids specifically fosters insect colonisation.</p>
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Extensive System Build-up with the drainage element Floradrain® FD 25-E as a possible basis for a biodiversity green roof.

System Build-up “Stormwater Management Roof”



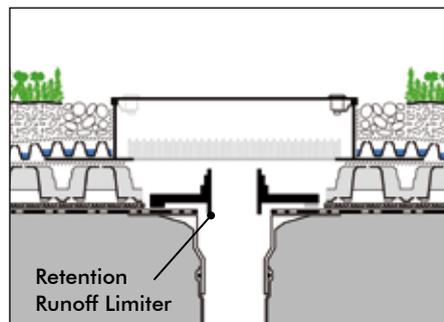
The word “retention” in water management refers to the balancing effect of storage space on the run off of stormwater into watercourses. The need for retention is becoming more frequent as changing weather conditions (e.g. severe local rain events) can lead to an entire stormwater

drainage system becoming overloaded. First of all, a large proportion of the precipitation is retained on the roof area with a stormwater management roof, in the full sense of expanded flood control, and is then released over a pre-defined period (e.g. 24 hours) into

the drainage system. All elements that are important for the correct functioning of the green roof are preserved (water storage for the plants, air-water balance in the root area, etc.).

Features:

- System Build-up combining benefits of a species-rich extensive green roof and efficient stormwater management.
- A roof surface without inclination and controlled-flow roof drains are preconditions for a Stormwater Management Roof.
- Even with a simple Build-up 80 l/m² can be retained.



Build-up height:	from ca. 150 mm
Weight, saturated:	from ca. 155 kg/m ²
Water retention capacity:	from ca. 80 l/m ²

Suitable Vegetation layer

Suitable System Substrate
 Filter Sheet SF
 Floradrain® FD 25-E
 Filter Sheet PV
 Retention Spacer RS 60
 Filter Sheet PV
 Root Barrier WSF 40, if waterproofing is not root-resistant (beneath the thermal insulation layer).

* Values apply where the full 60 mm are accumulated.

System Build-up “Urban Climate Roof”



The sealing of former planted areas continues unabated. This has a considerable impact on the heating up of towns and cities. As a result, global radiation is used in a totally different way. On sealed surfaces, it can no longer be used as an engine for plant growth and can therefore hardly be used for cooling evaporation. This means that the considerable rise in thermal radiation is heating up urban centres

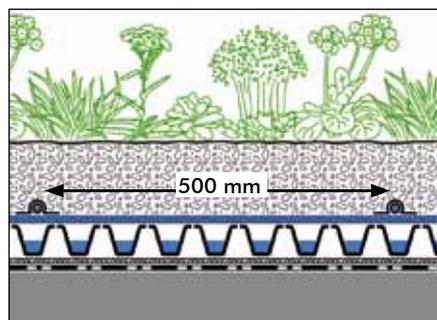
and the resulting urban heat islands are having a negative effect on well-being. In addition, an increased level of sensible heat, or perceived heat, will ensure that time spent here will be associated with discomfort. There are various types of green roof that can help to counter this. The decisive thing in each case is that there is sufficient water for evaporation.

In contrast, thanks to irrigation, an urban climate roof with its specially developed plant community will ensure a high level of evaporation also or particularly during hot, dry periods.

The maximum evaporation capacity can already be achieved during the first, or at the latest, the second vegetation period.

Features:

- Green Roof build-up designed for a maximum evaporation, which can actively contribute to an improvement of city climate in particular during hot and dry periods.
- Applicable on 0°-roofs as well as on roofs with an inclination of up to 5°, including inverted roofs.



Plant Community “Urban Climate Roof”
 Suitable System Substrate
 Dripperline 500-L2
 Aquafleece AF 300
 Floradrain® FD 40-E*
 Protection Mat SSM 45
 Root Barrier WSF 40, if waterproofing is not root-resistant (beneath the thermal insulation layer).

Build-up height:	from 140 mm*
Weight, saturated:	from 155 kg/m ²
Water retention capacity:	from 51 l/m ²
Evaporation capacity:	to 7–10 mm/d

* The Build-up height can be reduced or increased as required using a different drainage element.

System Build-up "Pitched Green Roof"



In general, flat roofs should have a slope of at least 2 %. Pitched roofs, as described in this brochure, start with a slope of 10° (18 %). From 10° on, the Green Roof system build-up differs significantly from system build-ups below 10°. Shear forces increase with the roof slope and have to be transferred into stable beams. The substrate layer has to be protected against erosion.

Plant selection and planting methods are to be adjusted to the relevant slope and exposure.

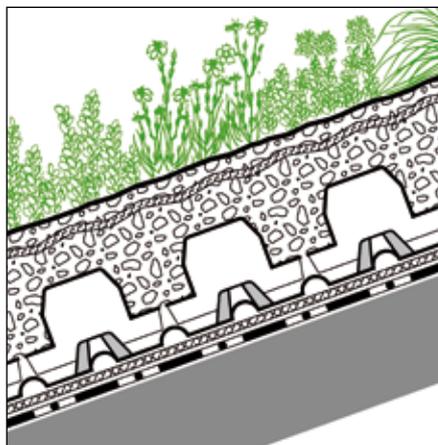
A professionally waterproofed roof surface, e.g. with bituminous or high-polymer membranes, is a precondition for a durable long-lasting Green Roof. The waterproofing should be root-resistant and a protection mat with high water storage is needed.

Floraset® FS 75, a multi-functional drainage element of expanded polystyrene is the perfect element for Pitched Green Roofs.

It is very important to take the Green Roof upkeep and maintenance aspects into account from the early planning stage of the project. Skylights can be installed as access for the maintenance personnel.

Features:

- Proven system, low maintenance, requires root-proof waterproofing on roofs with slopes between 10°–25°.
- Floraset® elements retain the substrate and prevent it from sliding off.
- The elements transfer shear forces into the roof construction; eaves and shear barriers have to be in compliance with the structural design.



Plug plants as per plant list
"Pitched/Steep Pitched Green Roof"
Jute Anti-Erosion Net JEG, if required
System Substrate "Rockery Type Plants"

Floraset® FS 75
Protection Mat BSM 64
A root-resistant waterproofing membrane is required.

Build-up height:	ca. 130–150 mm
Weight, saturated:	ca. 115–145 kg/m ²
Water retention capacity:	ca. 38–44 l/m ²

Steep Pitched Green Roof



The system build-up “Steep Pitched Green Roof”, based on the Georaster® elements, enables the installation of Green Roofs with slopes exceeding 20° and up to 35°. Above 35° special solutions can be designed by the ZinCo engineers.

The Georaster® elements are made of recycled polyethylene (HD-PE) and interlock without requiring tools, creating a stable structure. This structure is safely accessible and can be infilled with system substrate. The Georaster® elements allow for plenty of space for the plant root systems to establish and develop.



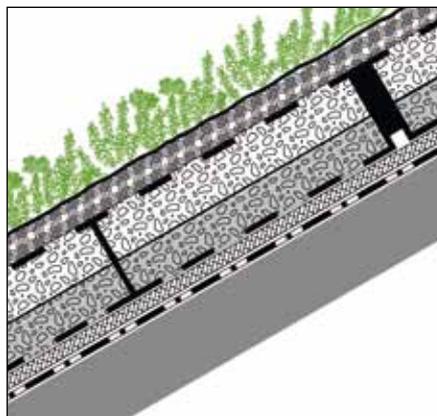
The plant selection has to be well adapted to the extreme conditions of Steep Pitched Green Roofs, where the solar radiation is the highest on the south facing roof side and the water run off is much faster than of a flat roof. The irrigation should be planned for, even if it is only needed in times of drought. It can avoid gaps in the vegetation coverage, which would lead

to erosion. A transfer of existing shear forces into stable eaves and into additional shear barriers is necessary.

Georaster® elements can also be installed under reinforced lawns, footway constructions, in slope protection, etc.

Features:

- Georaster® elements transfer the shear forces into the eaves or into additional shear barriers.
- Pitched Green Roofs require periodic maintenance. Depending on the location, slope and exposure, additional irrigation may be necessary.
- Vegetation may develop differently on the north and the south side.



Vegetation Mat “Sedum Carpet”
System Substrate “Heather with Lavender-Light” (ca. 10 mm above Georaster® elements)
Georaster® elements
Protection Mat WSM 150
Roof construction with a root resistant waterproofing

Build-up height:	ca. 120 mm
Weight, saturated:	ca. 155 kg/m ²
Water retention capacity:	ca. 64 l/m ²

System Build-up “Heather with Lavender”



The semi-intensive system build-up “Heather with Lavender” allows for sophisticated planting design. Nevertheless, compared to intensive green roof build-ups, it manages with relatively low maintenance and relatively low build-up heights.

The plant community can be chosen amongst a wide variety of draught resistant perennials, grasses and low shrubs, for example thyme, origanum or lavender. The system substrate “Heather with

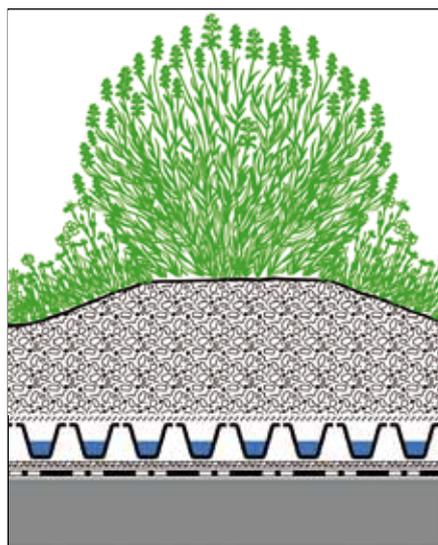
Lavender” has been specifically designed for this plant community. In combination with the water retention and drainage element type Floradrain® FD 40-E creates the necessary habitat conditions so that the “Heather with Lavender” – once rooted – requires little maintenance. Floradrain® FD 40-E is ideal as a substructure for green roofs, but it can be applied just as well under concrete slabs or paved surfaces. Moreover, borders between different areas can be founded in

a stable and secure manner. Kerbs can be set directly in concrete or mortar onto the Floradrain® without impeding the water run off.

Floradrain® also safely drains the excess water out of the channels or grills, which are often installed to safeguard door sills.

Features:

- Visually appealing green roof build-up including perennials, grasses, fragrant herbs such as Lavender, Thyme or Marjoram.
- Applicable on roofs with no inclination up to an inclination of approx. 8°.
- A modulation of the substrate surface results in a diversified appearance at reasonable costs and medium requirements regarding maintenance
- Additional irrigation is necessary during dry periods.



Build-up height: from 140 mm
Weight, saturated: from 160 kg/m²
Water retention capacity: from 60 l/m²



System Build-ups with European Technical Assessment.

Details at <https://zinco-greenroof.com/european-technical-assessment>

Plants according to plant list
“semi intensive – Heather with Lavender”

System Substrate “Heather with Lavender”

Filter Sheet SF
Floradrain® FD 40-E
Protection Mat SSM 45
Root Barrier WSF 40,
if waterproofing is not root-resistant.

System Build-up "Roof Garden"



The "Roof Garden" is a multifunctional Green Roof build-up with high water retention capacity. It is suitable for lawns, perennial plants, and with deeper system substrate, for shrubs and trees. The Roof Garden build-up allows a variety of design concepts, even waterfeatures. It is also possible to integrate hard landscapes, such as walkways, terraces, driveways or play areas, etc. Within the Roof Gar-

den, it is useful to store as much rain-water as possible to reduce the need for additional watering. The system build-up "Roof Garden" optimizes the water retention capacity. Floradrain® FD 60 neo can also be used with a dam up irrigation. Water reaches the plants by capillary action and diffusion.

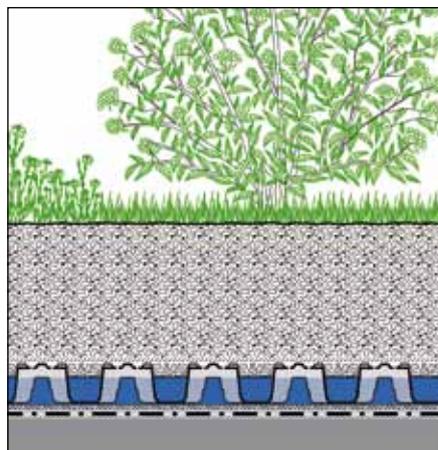


System Build-ups with European Technical Assessment.

Details at <https://zinco-greenroof.com/european-technical-assessment>

Features:

- Multifunctional Green Roof system build-up with high water retention capacity and roof dam irrigation.
- Various combinations are possible, for example with walkways, patios, driveways or playgrounds.
- Floradrain® FD 60 neo can be filled with concrete as a sub-construction for driveways without penetrating the waterproofing or interrupting the drainage.



Lawn and perennials; with a deeper substrate level, bushes and small trees

System Substrate

Filter Sheet SF
Floradrain® FD 60 neo with Zincolit® Plus infill
Protection Mat ISM 50
Root Barrier WSB 100-PO, if waterproofing is not root-resistant.

Build-up height: from 270 mm
Weight, saturated: from 370 kg/m²
Water retention capacity: from 136 l/m²

Irrigation and Substrate Depth

Roof Dam Irrigation

In roof gardens it is useful to conserve as much rainwater as possible to reduce the need for additional watering. The spacious channels forming the underside of the Floradrain® FD 60 neo allow for water storage of 50 mm in depth. The water is stored across the roof area and reaches the plants by capillary action and evaporation. Water storage is easily achieved by installing roof dam elements above the roof outlets. A roof laid at 0° fall is required to include this system, along with a suitable membrane for such use. Water storage can also be easily achieved by installing roof dam elements above the roof outlets. A roof laid at 0° fall is required to include this system, along with a suitable waterproofing membrane for such use.

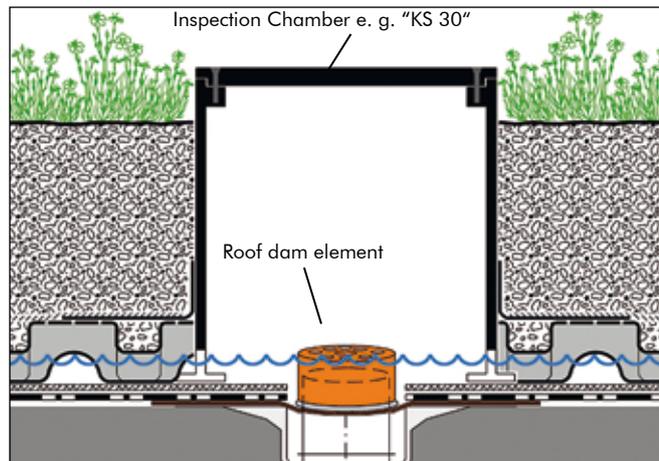
Inspection chambers make it possible to examine and maintain the roof dam elements at any time. With automatic irrigation machines a minimum water storage can be maintained even in periods of drought. Drinking water, as well as "recycled" grey water, can be used for irrigation.



An inspection chamber incorporated into the system build-up

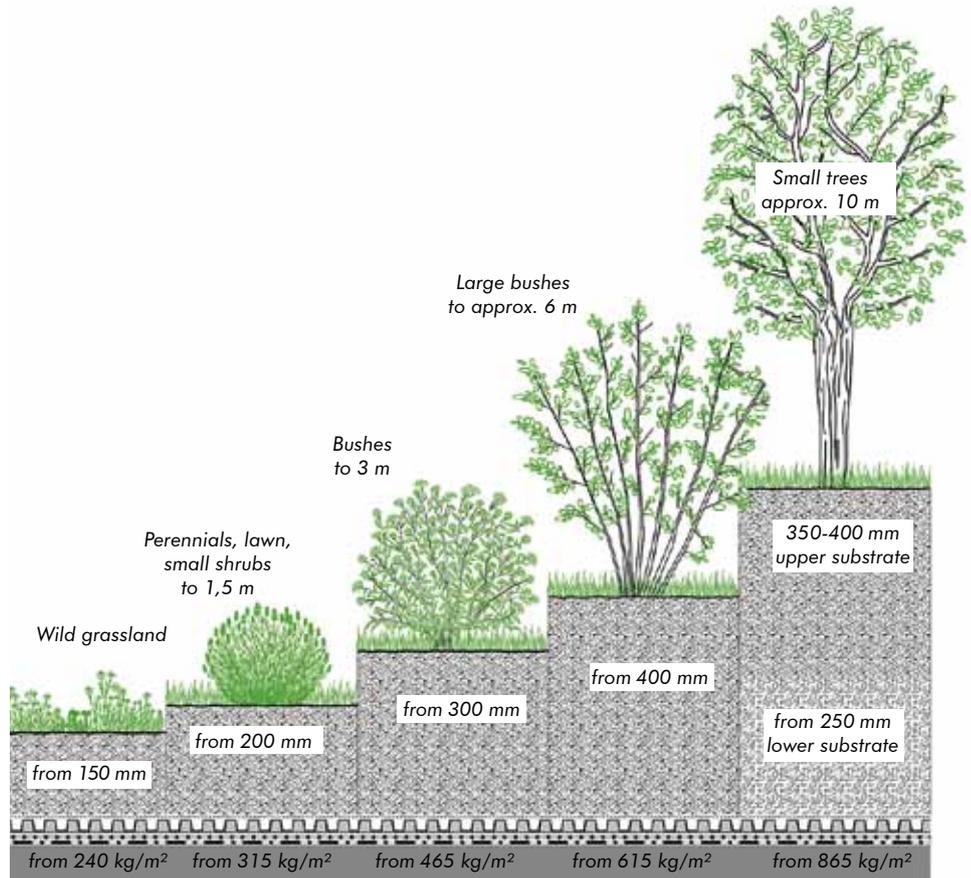


Roof dam element for long-term irrigation



Substrate Depth Depends on Type of Plants

Plant growth is especially affected by the type and depth of applied substrate. On a substrate height of approx. 150 mm, near-natural wild grasslands are possible. For sophisticated perennial plantings, as well as for bushes and trees, higher substrate levels are required. The potential for horizontal extension of the roots of trees and bushes must be ensured. ZinCo offers a range of substrates with which every Green Roof request can be fulfilled.



System Build-up "Roof Garden" with Aquatec® AT 45



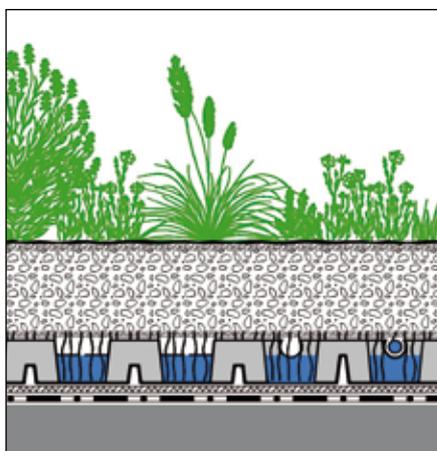
Up to now, light-weight solutions were only possible in the field of extensive green roofs. However, with the System Build-up "Roof Garden" with Aquatec® AT 45 the balancing act between "light-weight" and "intensive" can easily be mastered. It allows for visually appealing prestigious designs even on roofs with a low load bearing capacity.

The drainage element Aquatec® AT 45 and the Wicking Mat DV 40 are the heart of this build-up. The basic principle involves the distribution and storage of water in the element cells which is then drawn upwards when required, through the wicks in the mat to the substrate layer. The water is fed through special dripperlines and the amount is controlled by the specially-developed electronic Irrigation Manager BM 4.

Water consumption is significantly lower with this type of irrigation than is the case with irrigation from above, as the water is available directly in the root area and there is considerably less evaporation. Due to this sophisticated kind of irrigation substrate depths can be reduced up to 50 % in comparison to other intensive build-ups which results in a lower system weight.

Features:

- A particularly lightweight system buildup solution for intensive green roofs.
- Applicable on 0°-roofs as well as on roofs with an inclination of up to 5°, including inverted roofs.
- The water storage capacity of the Aquatec®-elements ensures a maximized retention and supply even during hot and dry periods.



Build-up height:	from 150 mm
Weight, saturated:	from 180 kg/m ²
Water retention capacity:	from 60 l/m ²

Lawn, perennial plants, and small shrubs (over substrate mounds)

Zincohum®
System Substrate "Sedum Carpet",

Dripperline 100-L1
Wicking Mat DV 40
Aquatec® AT 45
Filter Sheet PV
Root Barrier WSB 100-PO,
if waterproofing is not root-resistant.

System Build-up "Urban Rooftop Farming"



It makes absolute sense, therefore, to use these roof areas for growing vegetables, fruit and herbs as the benefits are considerable both in terms of the environment and economics. For example, given the vicinity to the consumer, supply routes and emissions are minimized. Short supply routes mean that the produce is fresher and as a result tastier.

Circular techniques that integrate urban vegetable production are also profitable, given that urban farming on roof areas uses local resources: rainwater and filtered waste water, solar energy and the heat from the building. On the other hand, a vegetable garden will serve the building well as the plants provide cooling in the summer and thermal protection in the winter. This is good for the building climate and just as beneficial for the roof waterproofing membrane because it is no longer exposed to extreme fluctuations in temperature. In addition, plants help to improve the urban climate.

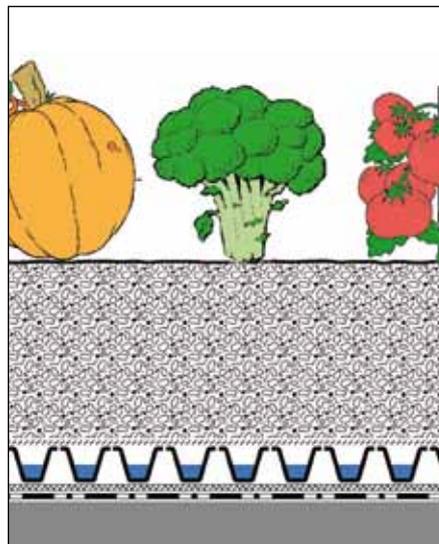


The number of densely-populated urban centres is steadily rising. As more than half of the global population now lives in towns or cities, the demand for residential zones and infrastructure in urban areas is naturally also on the increase. Undeveloped land and green areas are becoming increasingly rare, resulting in the loss of agricultural land. In order to counter this development from an urban development and climatic point of view, Green Roofs have become popular in densely-populated areas.

The specific requirements of a rooftop location (e.g. wind, structural requirements, water run-off and above all the issue of safety) must be addressed at the planning stage.

Features:

- With 200 mm ZinCo System Substrate, suitable for fruit and vegetables such as lettuce, onions, zucchini, eggplant, squash, cabbage, melons, strawberries, herbs and such like.
- For vegetables and fruits e.g. tomatoes, green beans, raspberries, blackberries, currants and such like a substrate depth of 280 to 400 mm is recommended.
- The amount of fertilizer and irrigation depends on the requirements of the cultivated fruit and vegetable species and on local climate conditions.



Fruits and vegetables

Suitable System Substrate

Filter Sheet TG

Floradrain® FD 40-E

Protection Mat ISM 50

Root Barrier WSB 100-PO,

if waterproofing is not root-resistant.

Green Roofs and Solar Systems



Green Roofs include a range of benefits. They can add thermal insulation, protect the waterproofing, improve biodiversity, retain storm water and improve the micro-climate. ZinCo extends the advantages of Green Roof technology with the development of support bases for solar panels. With the innovative Solar Base, solar energy can be integrated into Green

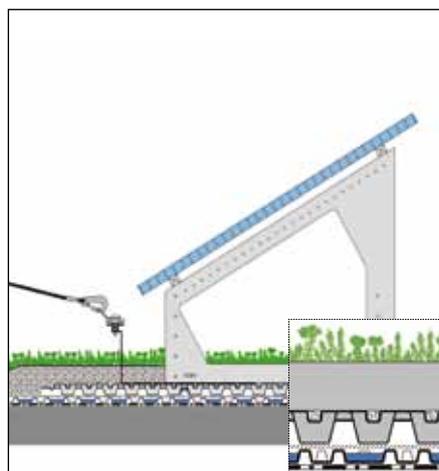
Roof Systems without penetration of the roof membrane, the Green Roof build-up providing the necessary load to keep the structure in place. The Solar Base can be used for photovoltaic as well as for solar thermal applications. The inclusion of solar power can be seen as another valuable ecological benefit and will contribute towards compliance

with various building regulations, environmental standards and assessments. Furthermore, this system makes use of synergy effect, as the efficiency of solar panels is significantly improved if combined with a Green Roof.

Solar Base SB 200

Complete assembly of sub-structure, for e.g. the Solar Base Frame SGR, made of recycled hard plastic with aluminium profile underneath the plastic element.

- Features:**
- Assembly without roof penetrations, green roof build-up used as superimposed load
 - Even load distribution
 - Lightweight components easy to transport
 - Project specific planing is offered by ZinCo technical department
 - Completely pre-assembled base plate for quick and easy installation of support frame



Solar Panel

Solar Base Frame SGR

- Suitable vegetation layer
- Suitable System Substrate
- ZinCo Solar Base SB 200
- Fixodrain® XD20
- Root Barrier WSF 40 and Filter Sheet PV, if waterproofing is not root-resistant

Safety Systems on Green Roofs

Working on a roof always involves risks, no matter whether it's inspecting technical equipment, upkeeping gravel roofs or maintaining Green Roofs.

Accident prevention saves lives! Therefore, regulations prescribe safety measures for work that is being carried out on roofs.

ZinCo offers a maximum of safety to people and buildings through their innovative Fallnet® solutions specifically designed for the use on Green Roofs.

There are various types of Fallnet® Fixing Devices, all of them non-penetrating and based on the idea of using the actual Green Roof build-up as necessary ballast.

For instance, the Fallnet® SR Fixing Device consists of interlocking grid elements and a centralised fixing point made of stainless steel. It offers new dimensions in terms of flexibility and can be adapted to nearly any construction requirement and geometry. Light domes, drainage outlets and roof penetrations can be smartly embedded within the Fallnet® SR. The Fallnet® SR Rail option is even more comfortable and ideal for large roof areas. Provided that this rail system is planned individually and considering the project specific requirements, it covers the complete danger zone with a horizontally mobile fixing point, the so called runner.



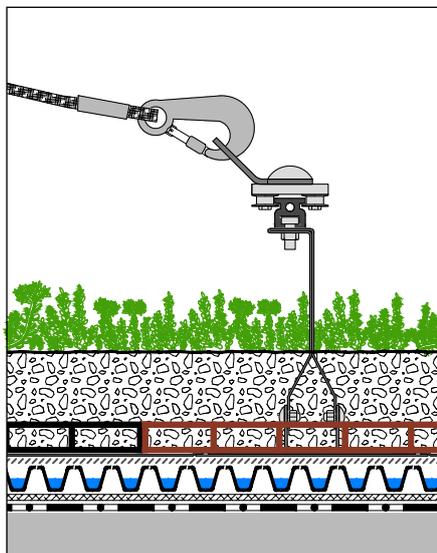
The Fallnet® SB 200 Rail option perfectly combines this rail system with photovoltaic systems.

All Fallnet® systems offer attractive solutions for providing anchorage points for safety harnesses, without penetrating the waterproofing membrane. Whatever the sub-structure, their installation is possible on most flat roofs with slopes up to 5°. They can be supplemented by personal protective equipments (ZinCo PPE-Set), as well as ZinCo Guardrail Systems.



Features:

- No roof penetration.
- Quick and easy installation, no specific tools required.
- Suitable for all roofs with minimum load-bearing capacity.
- Independent of the substructure.
- Neutral with regards to building physics (thermal bridges).
- No visual nuisance.
- Certified according to European Standard EN 795:2012, Type E.
- Project specific planning is offered by ZinCo technical department



Runner

Rail support with base plate

Suitable System Substrate

Fallnet® grid elements

Filter Sheet SF

Floradrain® FD 25-E

Protection layer

Guardrails on Rooftops



Roofs that are intended for access require a surrounding guardrail for safety purposes.

The ZinCo Guardrail Base GB provides the perfect solution without penetrating the roof membrane. It is suitable for both a ZinCo Guardrail and a proprietary handrail adapted to suit the architecture of the building. The guardrail can be fitted without special tools.

The Guardrail Base GB is placed either beneath the Green Roof, a gravel strip or suitable paving slabs providing the required load.



Fallnet® ASG – the penetration-free maintenance guardrail

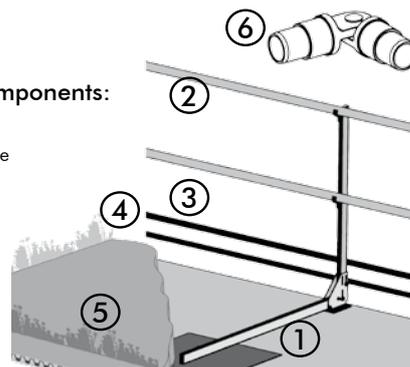


Features:

- Quick assembly
- No high point loads
- No roof penetration
- Visually unobtrusive at a 67.5° inclination
- Meets the requirements of EN 13374 Class A
- Suitable for roofs with a pitch of up to 5°
- Green roof build-up used as ballast
- Easy and quick installation, regardless of the sub-structure

ZinCo Fallnet ASG components:

- 1 post module (including foot and counterweight plate)
- 2 handrail
- 3 mid rail
- 4 toe board
- 5 ballast
- 6 corner joint



System Build-up "Walkways"



Rooftops are being used holistically at an ever increasing rate. Nearly everything that can be realised on the ground is now possible on roofs too, provided the right technology is used.

For instance, long lasting and functioning walkways and driveways on rooftops require well-engineered systems. These assure the continuance of the roof function (e.g. continuous waterproofing and drainage capacity).

If walkways are combined with Green Roofs, not only drainage and compressive strength are important, but also the water retention capacity. Stabilodrain® SD 30, the core piece of this build-up, meets all requirements and ensures durable functionality.

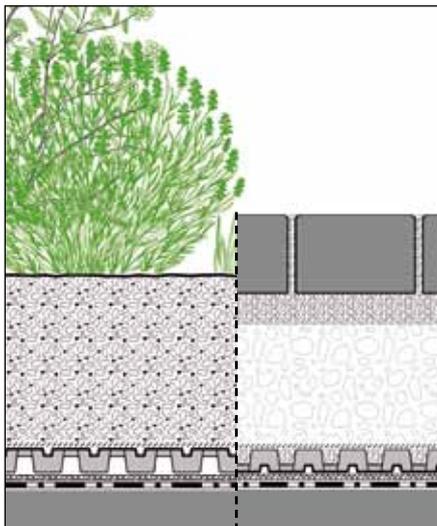
Stabilodrain® SD 30 is an extremely stable, high pressure resistant drainage element that is quick and easy to install with its lateral, specially shaped connecting profiles.

Depending on the installation, it allows for drainage of water (diffusion holes facing downwards) or for drainage combined with water retention (diffusion holes facing upwards).

Stabilodrain® SD 30 can also be installed on inverted roofs, where it is essential to avoid creating a vapour barrier above the XPS insulation material.

Features:

- Heavy duty Hybrid Solution with high pressure resistance.
- Suitable for walkways, driveways, lawn and shrubs, bushes, small trees etc..
- Trafficable with wheel loaders, also without infill.
- Suitable on flat roofs with standing water and on inverted roofs.



Concrete or natural stone pavers

Bedding layer
Gravel base layer (only for driveways)

Filter Sheet PV
Stabilodrain® SD 30 with infill
Protection Mat ISM 50
Root Barrier WSB 100-PO,
if waterproofing is not root-resistant.

“Low weight” Walkways on Roofs and Terraces



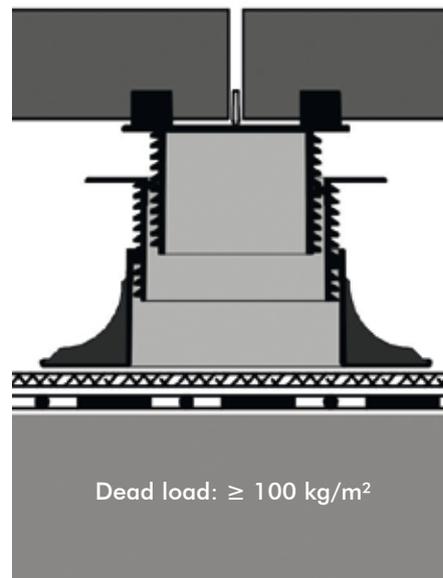
Some roofs do not have the load bearing capacity to carry the load of the base layer, bedding material and surface layer. In this instance the ZinCo Elefeet® are able to bear the load, and as a result of its minimal weight, only the weight of the surface has to be taken into consideration.

Surface water can be drained quickly and easily through the open joints and into the lower cavity; in addition, this open sub-space provides good aeration. If higher Elefeet® are used, water pipes, cables, or water hoses can be accommodated and used, for example, to irrigate adjacent intensive green areas.



Features:

- Precise levelling with vertical adjustment ring.
- Very low weight – only the surface layer needs to be considered.
- Open joints, free from pollution and weeds.
- Proper drainage of paved surfaces and roofs.
- Useable on roofs without any slope due to large drainage cavity.
- Load bearing capacity up to 500 kg/pc.



Slabs of concrete, natural stone, $d \geq 40$ mm or wooden surfaces

ZinCo Elefeet® (in various heights)

Elastosave ES 30
if necessary, separation layer
e. g. Slip Sheet TGF 20

Roof construction with suitable waterproofing

System Build-up “Driveways”



Driveways on roofs require both a load-bearing system build-up and an adequate strength in roof construction. Moreover, vehicular traffic on a roof deck induces very significant horizontal forces and torsional movements through steering, breaking and accelerating, that must be absorbed.

 The System Build-up for cars uses the extremely stable Elastodrain® EL 202 specifically designed for low applications, without base layer. The Elastodrain® EL 202 has a very high compressive strength and distributes the load evenly into the substructure.

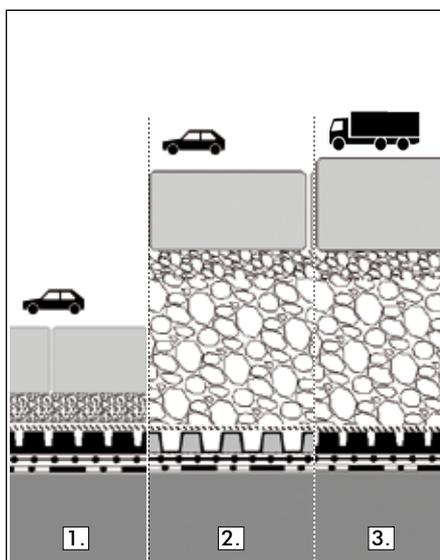
This system is designed for heavy loads. A precondition is that the slope of the future driveway surface is taken into account in the planning. A slope is not a problem, if the waterproofing and surface have the same slope. If the slope on the surface has to be different from the slope of the waterproofing, a gravel base layer is necessary. The slope cannot be created with the bedding layer, as it will result in uneven settlement. For applications with gravel base layer the drainage element Protectodrain® PD 250 is the perfect solution. Moreover, the pavement thickness must be suitable for this application.

 Occasionally, roofs and their surfaces have to bear exceptionally heavy loads, e. g. in case of delivery or fire brigade access.

The thickness of the pavers or concrete slabs must enable a horizontal absorption of forces. For wheel loads exceeding 1 ton, a load distributing base layer has to be designed. Extreme stresses require extremely good protection layers in order to protect the waterproofing. Here again the Elastodrain® EL 202 with its high compressive and tensile strength is the perfect drainage element.

Features:

- A solid base for creative surface designs. Mainly for use under driveways, fire brigade access or parking areas.
- Elastodrain®/Protectodrain® protect the waterproofing during construction works from mechanical damages.
- After installation, Elastodrain®/Protectodrain® form a durable base for all types of roof landscapes.
- Elastodrain®/Protectodrain® ensure long lasting drainage, hence it prevents frost damages.



1. Concrete or natural stone pavers
Bedding layer
Filter Sheet TG
Elastodrain® EL 202
Slip Sheet TGF 20 (2 layers)
2. Concrete or natural stone pavers
Bedding layer
Gravel base layer
Filter Sheet PV
Protectodrain® PD 250
Slip Sheet TGF 20 (2 layers)
3. Concrete or natural stone pavers
Bedding layer
Gravel base layer
Filter Sheet PV
Elastodrain® EL 202
Slip Sheet TGF 20 (2 layers)

What ZinCo can do for you

ZinCo provide a comprehensive package of environmentally sound Green Roof Systems and customized project support, based on:

- 35+ years of experience in Green Roofs
- Tested & proven Green Roof Systems
- Exceeding quality standards & permanent innovation through research and development
- Compliance with relevant international standards
- Experts in structural engineering, landscape architecture, horticulture, material and soil science, ...
- Support from planning to completion (design, specifications, CAD, consultancy, on-site)
- An international network of partners
- Comprehensive warranties

To date, ZinCo Green Roof solutions have inspired planners and contractors throughout the world, providing them with the necessary flexibility to accommodate a wide range of designs and building needs.

Tell us about your project!
We've got the expertise to bring it to life.



System Build-ups with
European Technical Assessment

More Information can be found at
<https://zinco-greenroof.com/european-technical-assessment>



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