

Extensive Green Roofs with System



Engineered Green Roof Systems

Extensive Green Roofs by ZinCo – are permanent,

exceed standards and do so with high ecological value.

Benefits of green roofs regarding ecology, urban development and construction



New habitats



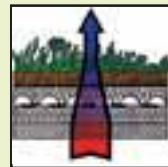
High water retention



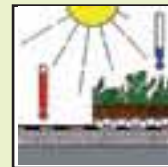
Dust absorption



Noise reduction



Thermal insulation



Protection of waterproofing/roof membrane

Green roofs have beneficial environmental effects. Green roofs offer new habitats for fauna and flora to remain within urban areas and reduce the immediate water run-off by rainwater retention on site.

Moreover, green roofs improve the microclimate and reduce dust and smog levels. Green roofs reduce sound reflection and improve sound insulation. Green roofs also improve the thermal insulation, which


reduces the cost for heating and cooling. They protect the waterproofing from UV exposure, heat, cold, and hail, which considerably increases the life expectancy of the roof.

After completion, an “Extensive Green Roof” compared to an “Intensive Green Roof” does not need human involvement. Generally, one or two maintenance visits per year are sufficient. Therefore an extensive roof has the function of an ecological protection layer; instead of a gravel layer, for example.

For extensive green roofs, plant communities that are proven to be specially adapted, have to be used because of the severe conditions of the roof surface – sun, wind, drought,

Features of an Extensive Green Roof

Minimal maintenance required: <ul style="list-style-type: none">- Inspection 1-2 times/ year.- Supply of water and nutrients mostly by natural processes.	Little weight and shallow build-up height: <ul style="list-style-type: none">- Mainly mineral substrate in layers of up to 120 mm.- Load approx. 50 - 150 kg/ sqm.
Adapted plant communities: <ul style="list-style-type: none">- Undemanding, close-growing.- Self-regenerating.	Low cost: <ul style="list-style-type: none">- Installation.- Maintenance.



etc. System build-ups for extensive green roofs are shallow, not very heavy and can be installed at a reasonable price. It is important to

install proper drainage to ensure water flow, and to reduce the shear forces on perimeters and adjacent joints.

Green roof build-ups according to “Standards” – six principles:

The correct system build-up...

1 ... must be adjusted to the roof construction.

2 ... ensures permanent drainage even under heavy loads and with little slope.

3 ... provides a well-balanced water/ air supply.

4 ... depends on the desired vegetation type.

5 ... allows for low upkeep and maintenance costs.

6 ... results in a high life expectancy of the green roof.



Which system build-up for which type of roof ?



System build-up
“Rockery Type Plants“
 High demand design –
 Planting with root ball plants.

(see page 4)



System build-up
“Sedum Carpet“
 Low demand design –
 “Sedum Carpet“ cuttings.

(see page 10)



Low pitched roofs

Page 5

Page 11



Thermal insulation

Page 7

Page 13



0°- roofs
 (ponding water)

Page 6

Page 12



Low load bearing capacity

Page 14



Inverted roofs

Page 6

Page 12



Special drainage requirements

Page 15

Further types of vegetation:

Light Weight Green Roof Systems without any design requirements.

For build-up information refer to “Rockery Type Plants“



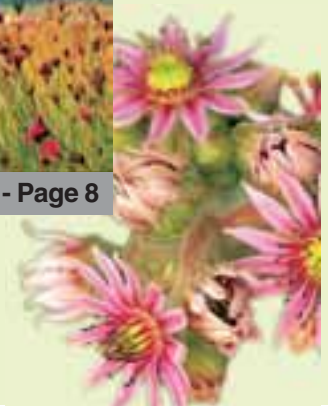
“Meadow Scents“ - Page 8



“Grassy Pasture“ - Page 8



“Country Colours“ - Page 8



Designed extensive green roofs: System built on low pitched roofs.



“Rockery Type Plants“ leads to an extensive green roof with sophisticated design and individual character. The “Rockery Type Plants“ substrate is a minimum of 70 mm in depth. “Rockery Type Plants“ vegetation consists of various species which provide a long blooming period and allow for different accents throughout the vegetation period.



Environmental Promotion Centre
Neckar-Fils, Plochingen



State Bank, Potsdam



Sedum species and other perennials are primarily used as a ground cover. The installation of “Rockery Type Plants“ is achieved by root ball plantings. Drought resistant perennials bloom throughout the year and add height to the design, for example, the “*Dianthus carthusianorum*“ reaches up to 400 mm. The perennial blossoms are also more colourful and differentiated in comparison to “*Sedum Carpet*“.

Plant list “Rockery Type Plants“

(groups of 3, 5 or 7 plants)

Botanical Name	Common Name	height (cm)	blossom colour	blossom period (month)
Accent plants.				
<i>Dianthus carthusianorum</i>	Clusterhead pink	40	red	6-9
<i>Festuca Cinerea-Hybride</i>	Blue Fescue	25-30	brown	6-7
<i>Gypsophila repens</i>	Baby’s Breath			
e.g. ‘ <i>Rosa Schönheit</i> ’		10-15	rose	5-7
<i>Helianthemum nummularium</i>	Sun Rose	5-10	yellow	5-7
<i>Koeleria glauca</i>	Large blue Hair Grass	45-50	bluish	6-7
<i>Petrorhagia saxifraga</i>	Tunic Flower	10-20	rose-white	6-9
<i>Saponaria ocymoides</i>	Rock Soapwort	15-20	rose	5-7
<i>Satureja montana ssp. illyrica</i>	Winter Savory	10-15	violet	8-9
<i>Saxifraga paniculata</i>	Livelong Saxifrage	20-25	white	6-7
<i>Sempervivum-Hybriden</i>	Houseleek hybrids	10-20	red/rose	7-8

Filler Plants. (minimum of four different *Sedum* species)

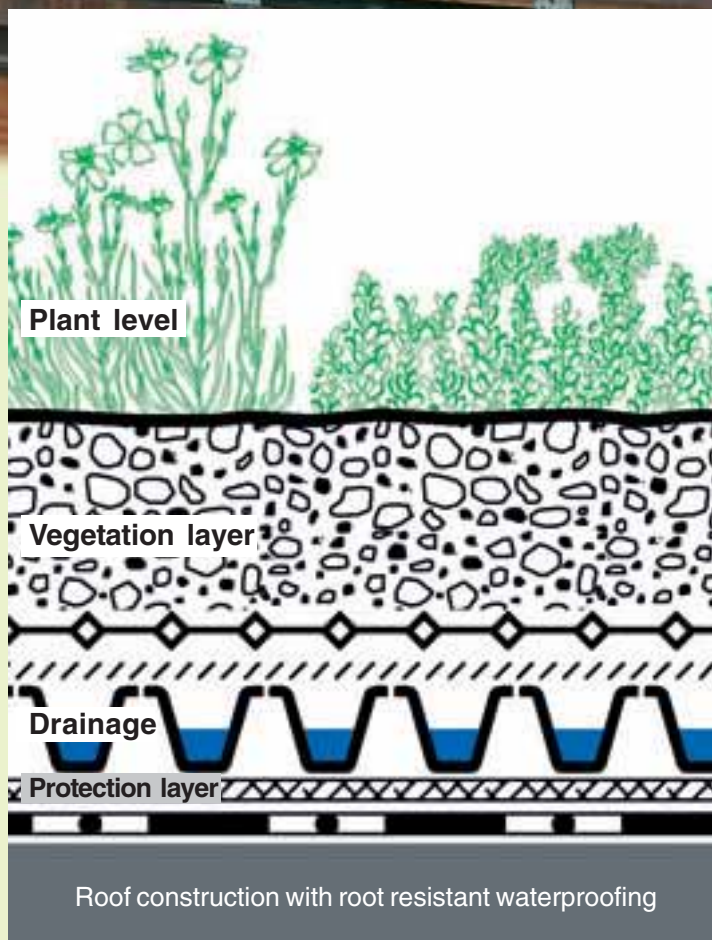
<i>Cerastium arvense</i>				
‘ <i>Compactum</i> ’	Field Mouse-Ear Chickweed	5-10	white	5-6
<i>Hieracium pilosella</i>	Mouse-Ear Hawkweed	15-20	yellow	5-7
<i>Potentilla neumanniana</i>	Cinquefoil	10-15	yellow	3-4
<i>Prunella grandiflora</i>	Self heal	20	violet	6-8
<i>Thymus doerfleri</i>				
‘ <i>Bressingham Seedling</i> ’	Bressingham-Thyme	6-8	rose	5-7
<i>Thymus serpyllum</i>	Wild Thyme	5	violet	5-9

Additional *Sedum* varieties from the plant community “*Sedum Carpet*“ on page 10.

Build-up “Rockery Type Plants”



Weight kg/m ²		Height mm
dry	water-saturated	
70	98	70
2	10	30
72	108	



Build-up height:	ca. 100 mm
Weight, saturated:	ca. 108 kg/m²
Water storage capacity:	ca. 36 l/m²
Run-off coefficient C*:	ca. 0.34



Plant level “Rockery Type Plants” (Page 4)

System Substrate “Rockery Type Plants”

Safety device Fallnet®
Filter Sheet SF

Floradrain® FD 25

Protection Mat SSM 45

Note:
If the waterproofing is not root resistant, install Root Barrier WSF 40.

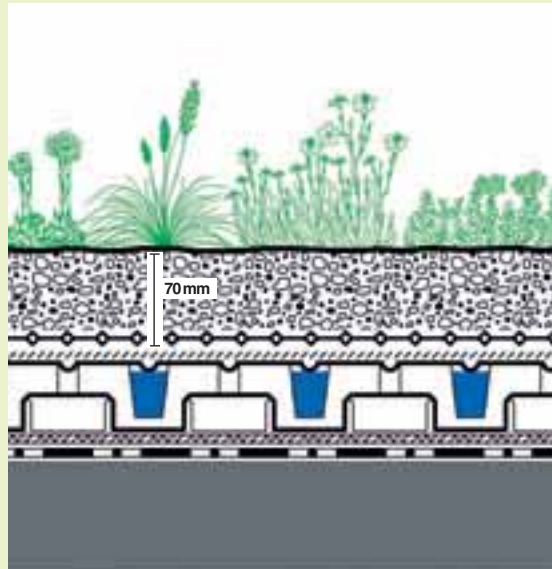
*design rainfall 300l / (s x ha)

System build-up “Rockery Type Plants“ for

On 0°- roofs with Floraset® FS 50 / FS 75



On 0°- roofs where deeper puddles remain, the standard system build-up “Rockery Type Plants“ is to be modified. By installing deeper Floraset® elements (50 or 75 mm) the necessary distance from the water level is ensured. The system build-up is now deeper, but compared to the standard build-up not heavier. The elements of recycled expanded polystyrene are very low in weight. The Protection Mat TSM 32 is sufficient, as water from the puddles is made available to the plants.



Build-up height:	ca. 120 / 150 mm
Weight, saturated:	ca. 105 kg/m ²
Water storage capacity:	ca. 33 l/m ²
Run-off coefficient C*:	ca. 0.34

Plant level
 “Rockery Type Plants“
 System Substrate
 “Rockery Type Plants“

Safety device Fallnet®
 Filter Sheet SF

Floraset® FS 50 or FS 75
 Protection Mat TSM 32

Roof construction with
 root-resistant waterproofing

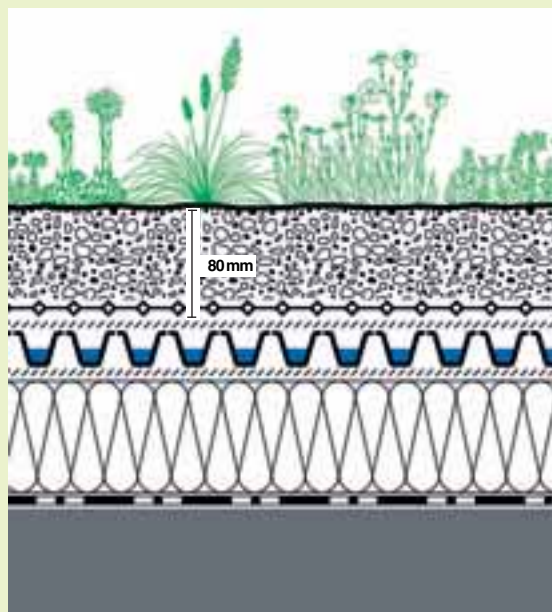
*design rainfall 300l / (s x ha)

“Rockery Type Plants“ on inverted roofs with Floradrain® FD 25



Layers which prevent moisture from vaporisation should not be installed over the thermal insulation XPS boards. Therefore, the protection mat must be replaced by the diffusion permitting Separation Membrane TGV 21. In the case, that root barriers are necessary they have to be placed below the insulation boards directly onto the waterproofing.

A deeper substrate layer compensates the low water storage capacity of the protection mat and also prevents wind uplift.



Build-up height:	ca. 110 mm
Weight, saturated:	ca. 115 kg/m ²
Water storage capacity:	ca. 35 l/m ²
Run-off coefficient C*:	ca. 0.34

Plant level
 “Rockery Type Plants“

System Substrate
 “Rockery Type Plants“

Safety device Fallnet®
 Filter Sheet SF
 Floradrain® FD 25
 Separation Membrane TGV 21

Thermal insulation XPS

Root barrier (if necessary)

Roof construction
 with waterproofing

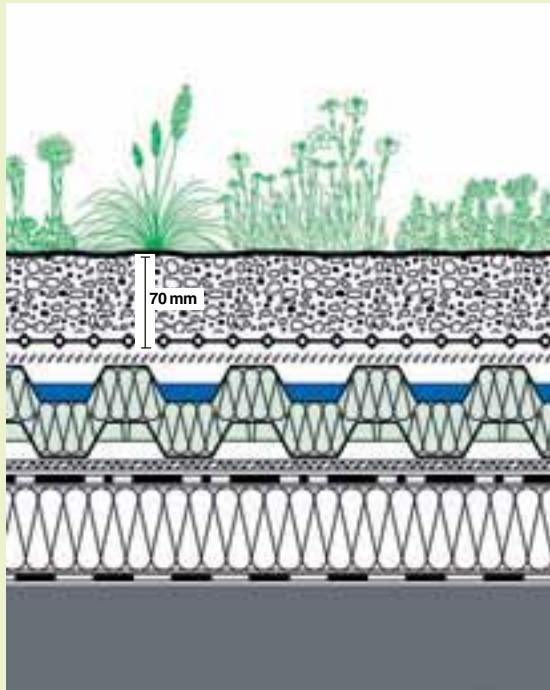
*design rainfall 300l / (s x ha)

different roof constructions:

Thermally insulating green roof / DUO-Roof with Floratherm® WD



Floratherm® elements, creditable and certified by construction supervision authorities, function as additional thermal insulation. They save costs for heating and cooling and meets the requirements of energy saving regulations in cases of refurbishment. Floratherm® elements are available in 65 and 120 mm heights, with different thermal resistance values. So almost all requirements can be met.



Plant level
“Rockery Type Plants“

System Substrate
“Rockery Type Plants“

Safety device Fallnet®
Filter Sheet SF

Floratherm® WD
to meet thermal insulation requirements

Protection mat SSM 45

Roof construction with original thermal insulation and renewed waterproofing

Build-up height:	ca. 130 / 180 mm
Weight, saturated:	ca. 108 kg/m ²
Water storage capacity:	ca. 36 l/m ²
Run-off coefficient C*:	ca. 0.34

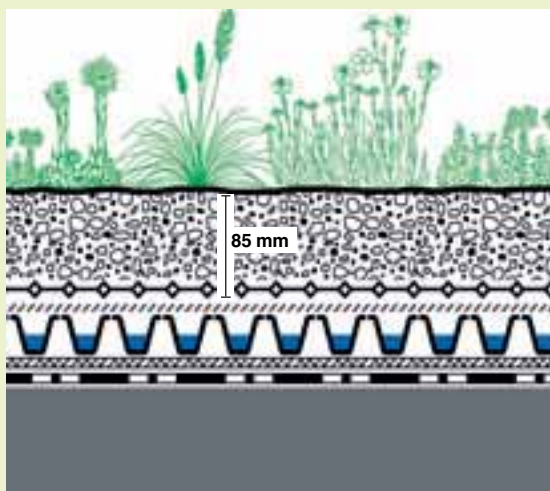
*design rainfall 300l / (s x ha)

System build-up “Rockery Type Plants“ with run-off coefficient $C \leq 0.3$



A deeper substrate level leads to a lower run-off coefficient of $C \leq 0.3$ in the “Rockery Type Plants“ system build-up. Plants of the vegetation types “Rockery Type Plants“, “Country Colours“, “Grassy Pasture“ and “Meadow Scent“ use this surplus water.

The choice of the appropriate system build-up for the roof construction is important to ensure a functioning green roof. A low run-off coefficient also results from one layer build-up systems, but they are to be viewed critically regarding the well-being of the vegetation.



Plant level
“Rockery Type Plants“

System Substrate
“Rockery Type Plants“

Safety device Fallnet®
Filter Sheet SF
Drainage elements and protection mat depending on roof construction

Roof construction with root resistant waterproofing

Build-up height:	ca. 110 mm
Weight, saturated:	ca. 130 kg/m ²
Water storage capacity:	ca. 42 l/m ²
Run-off coefficient C*:	ca. 0.29

*design rainfall 300l / (s x ha)

Different seed mixtures allow for vegetation variations

on extensive roofs: “Meadow Scent“, “Country Colours“

Seed-sowing is an efficient way of starting vegetation. However, in the beginning they are more sensitive than Sedum cuttings or plug plants. Depending on the season they may

require additional irrigation. Not all plant species of the seed mixture will establish; therefore, results will vary when seed-sowing. All seed-sowing variations are applicable on the differ-

ent system build-ups of “Rockery Type Plants“. In temperate climates, all seed mixtures are installed on ≥ 70 mm “Rockery Type Plants“ system substrate.



The seed mixture “Country Colours“ provides a large number of drought resistant species of herbs and grasses for extensive green roofs. Various varieties allow for a long lasting blooming period.



There is hydro-seeding and there is dry-seeding. In each case, adhesive is necessary to ensure efficient contact between substrate and seeds. The ZnCo seed mixtures already include dry organic adhesive.



The seed mixture “Grassy Pasture“ is a mixture with a dry meadow character. It contains drought resistant species of grasses for extensive green roofs. Every few years, it is necessary to mow it in order to maintain the character.



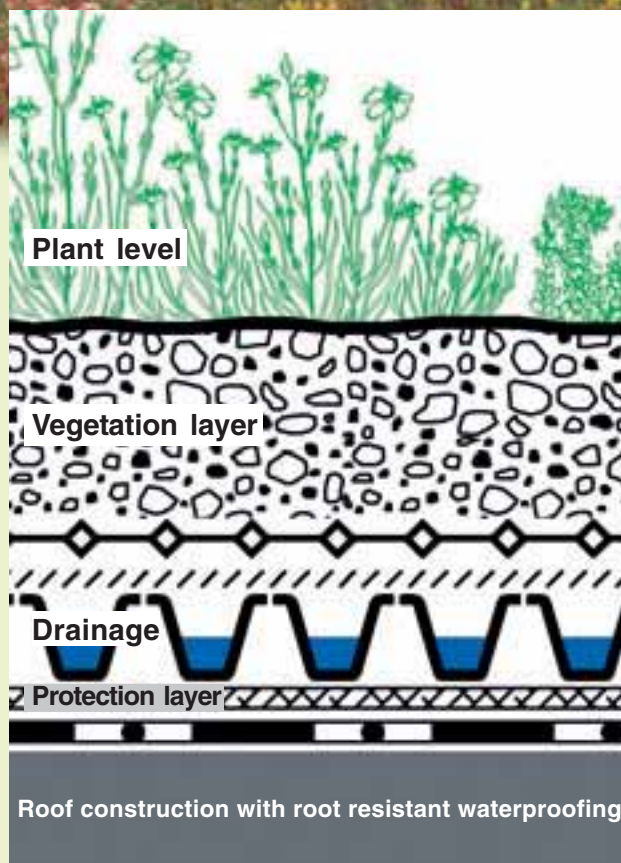
and “Grassy Pasture“



“Meadow Scent“, in combination with different types of Sedum cuttings, allows for a species-rich extensive green roof without any grasses. The diversity of species ensures blooming throughout the vegetation period.

Example:

System build-up for low pitched roofs (additional system build-up types see pages 6-7)



Build-up height:	ca. 100 mm
Weight, saturated:	ca. 108 kg/m²
Water storage capacity:	ca. 36 l/m²
Run-off coefficient C*:	ca. 0.34

Seed mixtures

“Meadow Scent“

“Country Colours“

“Grassy Pasture“



System Substrate

“Rockery Type Plants“

Safety device Fallnet®

Filter Sheet SF

Floradrain® FD 25

Protection Mat SSM 45

Note:

If the waterproofing is not root resistant, install Root Barrier WSF 40.

*design rainfall 300l / (s x ha)



Extensive Green Roofs: System build-up on low pitched roofs



Office building, Stuttgart

“Haus am Österberg”,
Tübingen



Daimler Chrysler AG,
Sindelfingen



Head quarter “Spinnrad”, Gelsenkirchen

The plant community “Sedum Carpet” contains various low-growing Sedum species. The main blooming time is in early summer, with yellow or red and white flowers dominating. During the year, “Sedum Carpet” is represented in various shades of green. Red shades, particularly in autumn, are a welcome change in the visual appearance. “Sedum Carpet” is installed either by Sedum cuttings or plug plants.

Plant list “Sedum Carpet”

(groups of 3, 5 or 7 plants)

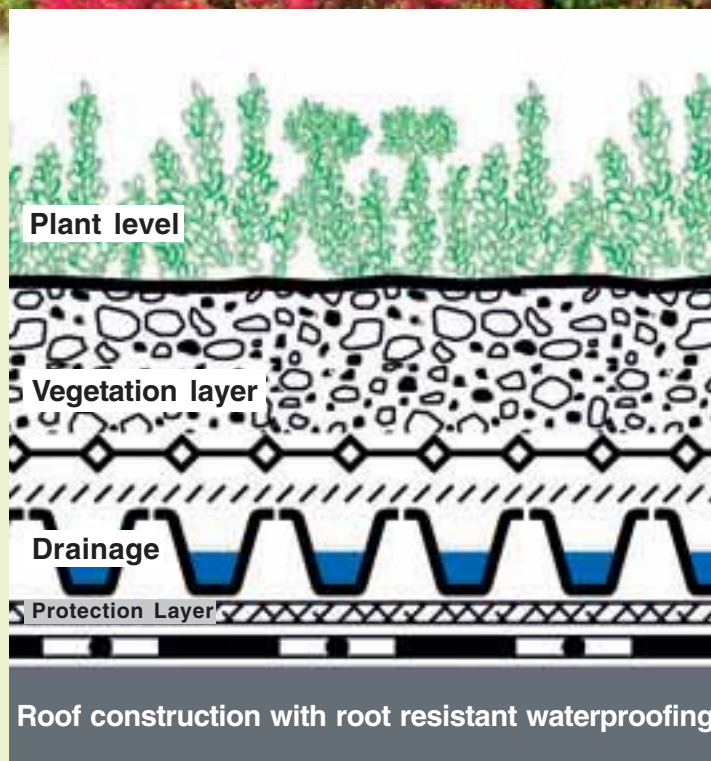
Botanical Name	Common Name	height (cm)	Blossom Colour	Blossom period (month)
Sedum album varieties	white stonecrop varieties	5-10	white	6-8
‘Coral Carpet’		5-10	white	6-8
‘Murale’	Nettle-leaved goosefoot	5-10	pale-rose	6
Sedum caucolicum	Stonecrop	10-15	rose	8-9
Sedum floriferum	Gold Sedum			
‘Weihensteph. Gold’		10-15	golden	6-7
Sedum hybridum	Hybrid Stonecrop			
‘Immergrünchen’		10-15	yellow	7-8
Sedum reflexum	Crooked Yellow Stonecrop	20-25	yellow	6-7
Sedum sexangulare	Tasteless Yellow Stonecrop	5-10	yellow	6-7
Sedum spurium	Dragons Blood			
in varieties				
eg. ‘Album Superbum’	Stonecrop	10-15	white**	7-8
‘Fuldaglut’		10-15	red	7-8
‘Roseum Superbum’		10-15	rose	7-8
‘Splendens’		10-15	rose	7-8
‘Variegatum’		10-15	rose	7-8

** infrequent blooming

“Sedum Carpet“



Weight kg/m ²		Height mm
dry	water-saturated	
67	84	60
2	10	30
69	94	



Mixture of Sedum cuttings according to plant list “Sedum Carpet“ (Page 10)

System Substrate “Sedum Carpet“

Safety device Fallnet®

Filter Sheet SF

Floradrain® FD 25

Protection Mat SSM 45

Note:
If the waterproofing is not root resistant, install Root Barrier WSF 40.

Build-up height:	ca. 90 mm
Weight, saturated:	ca. 95 kg/m ²
Water storage capacity:	ca. 25 l/m ²
Run-off coefficient C*:	ca. 0.38

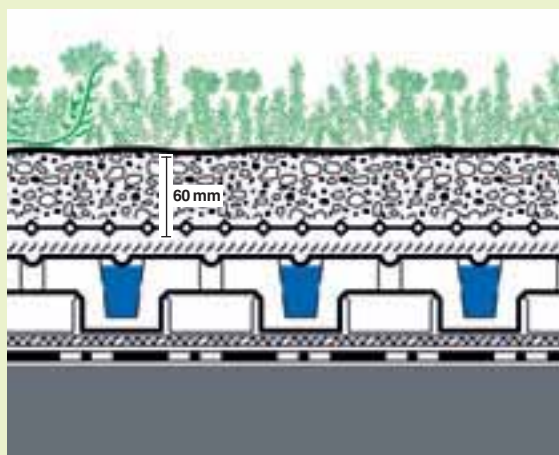
*design rainfall 300l / (s x ha)

Other possibilities with “Sedum Carpet“: Pro

On 0°- roofs with Floraset® FS 50 / FS 75



Even on green roofs with Sedum Carpet build-up, it is crucial to prevent puddles and standing water from negatively influencing the substrate layer. Using Floraset® FS 50 or 75 the distance between waterproofing and substrate will be increased to 50 or 75 mm. The Protection Mat TSM 32 is sufficient: The uneven roof, and sub-sequent standing water, make up for the lower water storage capacity of the TSM 32 compared to the SSM 45.



Plant level
“Sedum Carpet“

System Substrate
“Sedum Carpet“

Safety device Fallnet®
Filter Sheet SF

Floraset® FS 50 or FS 75
Protection Mat TSM 32

Roof construction with
root resistant waterproofing

Build-up height:	ca. 110 / 140 mm
Weight, saturated:	ca. 90 kg/m ²
Water storage capacity:	ca. 22 l/m ²
Run-off coefficient C*:	ca. 0.38

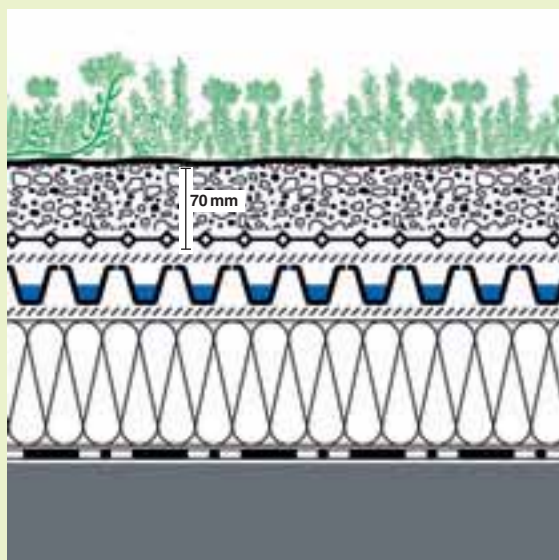
*design rainfall 300l / (s x ha)

On inverted roofs with Floradrain® FD 25



Layers which prevent moisture from vaporisation should not be installed over the thermal insulation XPS boards. Therefore, the protection mat must be replaced by the diffusion permitting Separation Membrane TGV 21. In the case, that root barriers are necessary they have to be placed below the insulation boards directly onto the waterproofing.

A deeper substrate layer compensates the water retention capacity of the protection mat and also prevents wind uplift.



Plant level
“Sedum Carpet“

System Substrate
“Sedum Carpet“

Safety device Fallnet®
Filter Sheet SF

Floradrain® FD 25
Separation Membrane TGV 21

Thermal insulation XPS

Note:
Root barrier WSF 40 (if necessary)

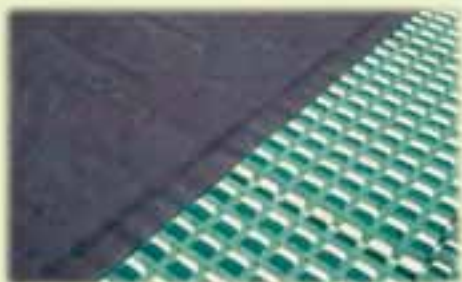
Roof construction with
waterproofing

Build-up height:	ca. 100 mm
Weight, saturated:	ca. 105 kg/m ²
Water storage capacity:	ca. 23 l/m ²
Run-off coefficient C*:	ca. 0.38

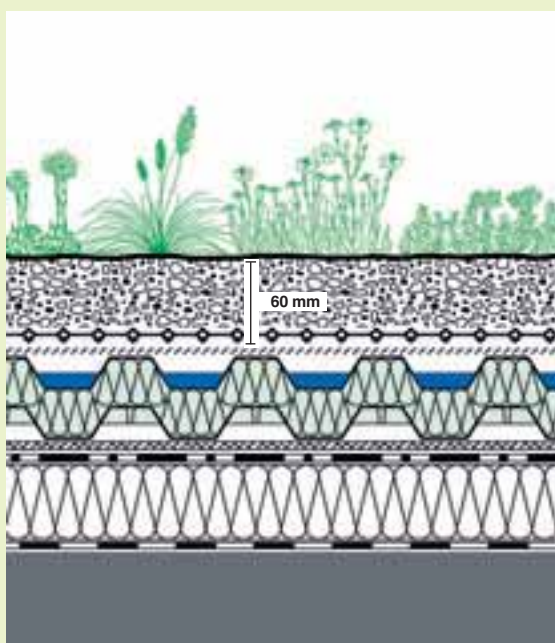
*design rainfall 300l / (s x ha)

ject-specific modifications.

Thermally insulating green roof / DUO-Roof with Floratherm® WD



“Sedum Carpet“ can be credited as additional thermal insulation. For this purpose, Floratherm® elements which are certified by construction supervision authorities are used as a drainage layer. Floratherm® elements are available in 65 and 120 mm heights, with different thermal resistance values. They replace up to 90 mm of common thermal insulation material.



Plant level
“Sedum Carpet“

System Substrate
“Sedum Carpet“

Safety device Fallnet®
Filter Sheet SF

Floratherm® WD
to meet thermal insulation requirements
Protection Mat SSM 45

Roof construction with
original thermal insulation
and waterproofing

Build-up height:	ca. 130 / 180 mm
Weight, saturated:	ca. 95 kg/m ²
Water storage capacity:	ca. 25 l/m ²
Run-off coefficient C*:	ca. 0.38

*design rainfall 300 l/(s x ha)

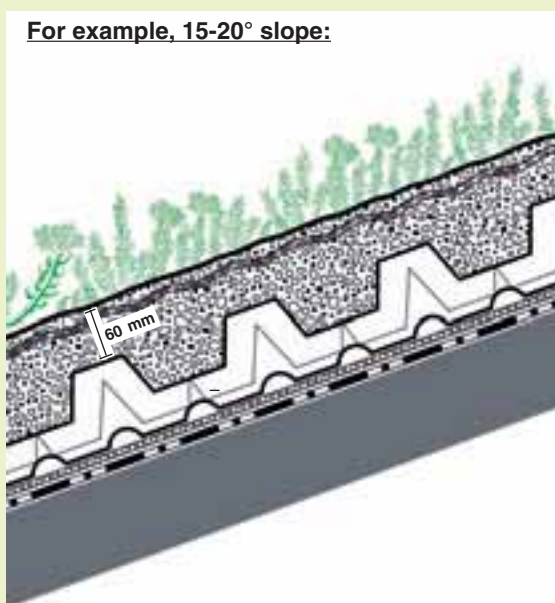
System build-up „Pitched Green Roof“



Extensive green roofs are mostly used on flat roofs; nevertheless, they can also be installed on pitched roofs. For slopes of more than 10° the system build-up has to be adjusted according to the conditions.

In this case, Floraset® FS 75 elements are used as they transfer the shear forces into the eaves / shear barriers. In addition a protection mat with a high water storage capacity as well as a jute net protecting the soil against erosion is needed.

Detailed information about pitched green roofs is provided in the relevant ZinCo brochure.



Plant level
“Pitched Green Roof“ Plants
Jute Anti-Erosion Net JEG
System Substrate
“Rockery Type Plants“

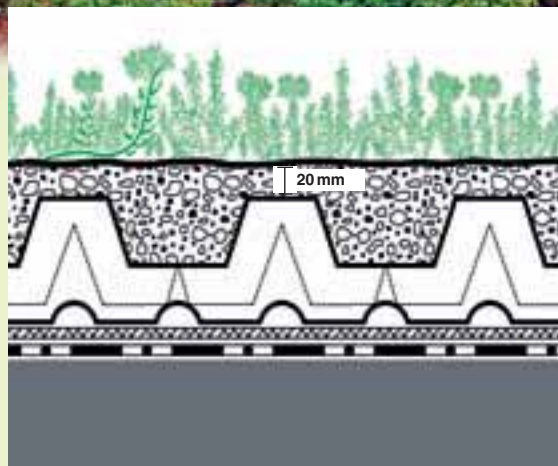
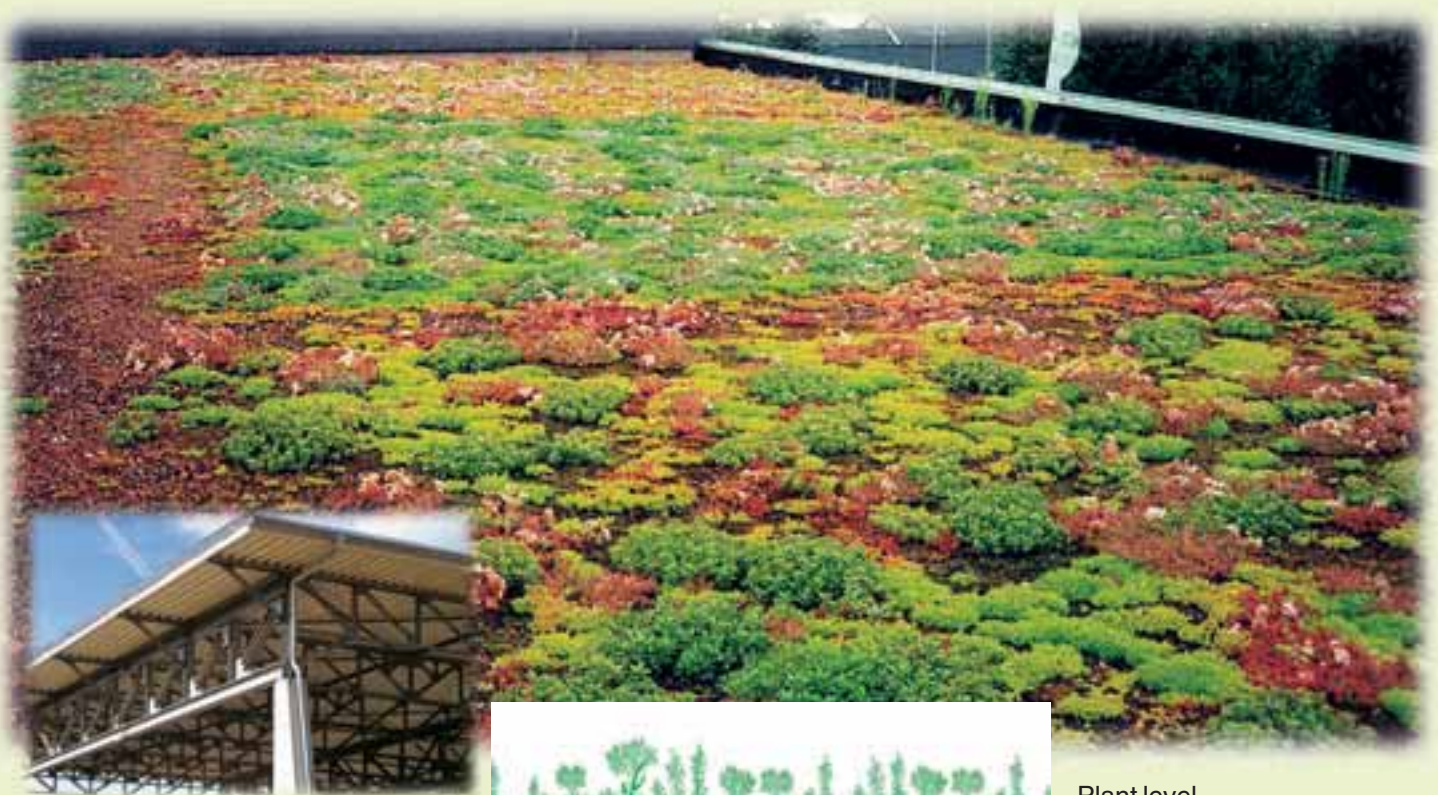
Floraset® FS 75
Protection Mat BSM 44

Roof construction
with root resistant waterproofing

Build-up height:	ca. 140 mm
Weight, saturated:	ca. 130 kg/m ²
Water storage capacity:	ca. 36 l/m ²
Run-off coefficient C*:	not available

* design rainfall 300l / (s x ha)

System build-up “Extreme Light Weight“ on roofs with little load bearing capacity for slopes up to ca. 5°.



Plant level
“Sedum Carpet“

System Substrate
“Rockery Type Plants Light“

Floraset® FS 75
 Protection Mat TSM 32

Roof construction with
 root resistant waterproofing

For some roof areas, even the standard build-up “Sedum Carpet“ is too heavy. The solution is a system build-up with Floraset® FS 75. Less substrate is required as it conforms to the pocket structure of the Floraset® elements. The pockets, in turn, serve as planting pots for the vegetation. Although they are laid out in a grid shape, the Sedum plants still form a dense-looking community which is supported by mosses over the course of time. The build-up weight is approx. 60 kg/m². In areas with little annual precipitation and also on pitched roofs additional substrate which effects weight and build-up height is required or irrigation is to be provided.

Build-up height:	ca. 100 mm
Weight, saturated:	ca. 60 kg/m ²
Water storage capacity:	ca. 21 l/m ²
Run-off coefficient C*:	not available

*design rainfall 300l / (s x ha)

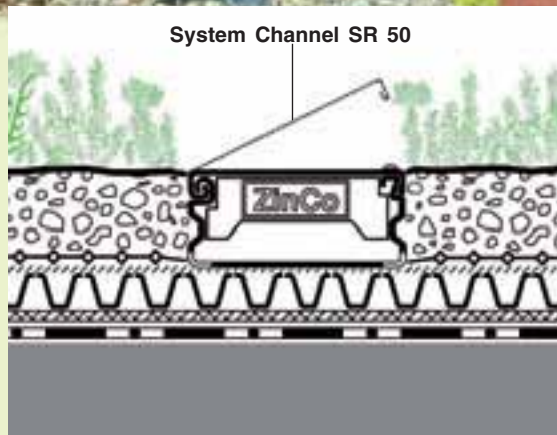
Trials run by the Research Institute of Geisenheim/Germany have proven the long performance of extreme light weight system build-ups.

After a two year period there was 80% ground coverage. Almost all varieties were well developed.

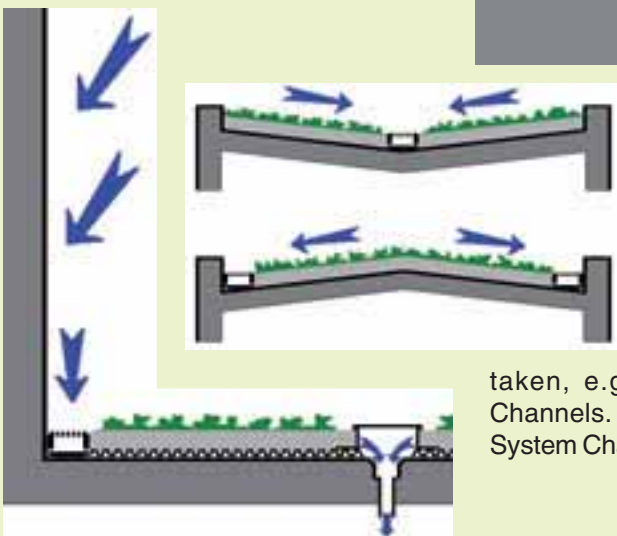


Proper drainage of green roofs system build-ups

where high water amounts occur.



- Plant level
- System Substrate
- Floradrain® FD 25
- Protection Mat SSM 45
- Roof construction with root resistant waterproofing



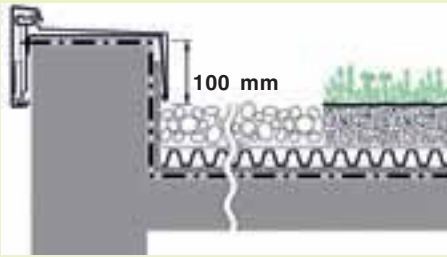
In areas with a higher water accumulation, for example, on steep facades or in roof valleys, additional measures for water run off into the drainage layer are to be taken, e.g. installation of System Channels. The design and height of System Channels SR 50 and SR 75 are

compatible with the extensive green roof system build-ups. Slots in the cover and the channel body collect the water and transfer it towards the drainage layer. Water logging which may damage vegetation is prevented. The hinged cover of the inspection chamber allows for easy maintenance and inspection.

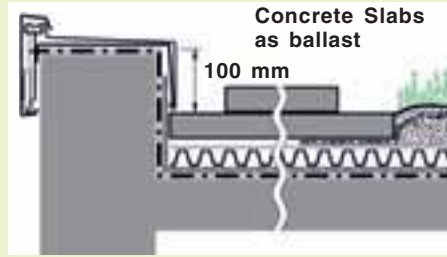


Technically sound and detailed solutions

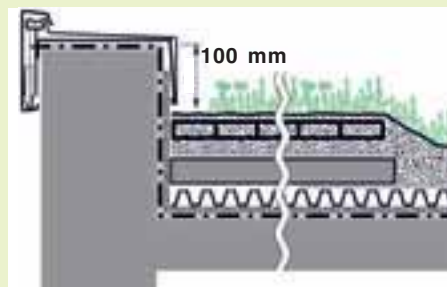
Perimeters



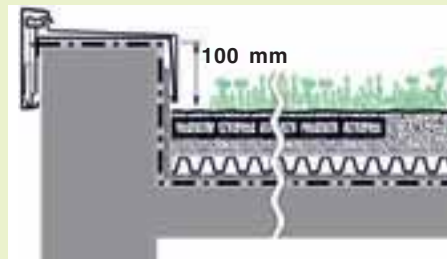
Standard perimeter solution



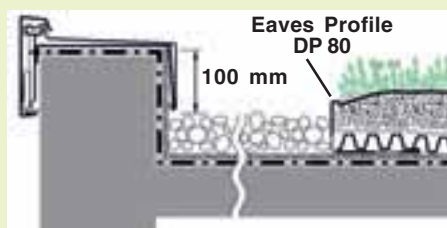
Perimeter solution for high wind uplift conditions (loose waterproofing)



Perimeter solution for high wind uplift conditions with pavers and EcoSedum (loose waterproofing)



Perimeter solution for high wind uplift conditions with EcoSedum (fixed waterproofing)



Low perimeter

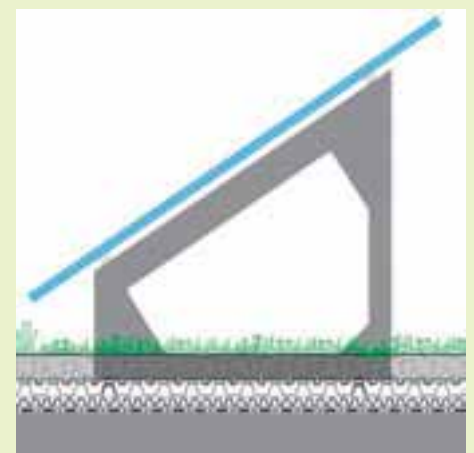
According to the German “Flat Roof Principles” a perimeter height of at least 100 mm above the surface is required. The roof edge should have a cover with a fall to the inside of the roof. The protection mat and root barrier are to be taken above the water-bearing level and protected. In the case of high wind uplift conditions and loosely laid waterproofing, for e.g., on high buildings, exposed locations, etc., the edge area can be secured for example by concrete slabs.

If also corner and edge areas should be covered by plants, the ground coverage must be complete from the beginning. EcoSedum is particularly suited to obtain this cover of vegetation. Precultivated EcoSedum elements may be used, either in combination with concrete slabs (loosely laid waterproofing) or on its own (fully bonded or mechanically fixed waterproofing).



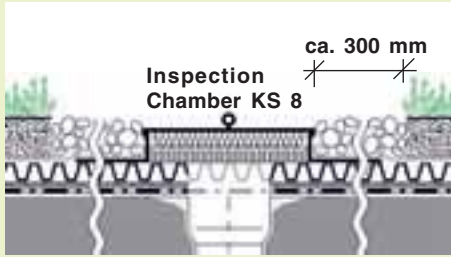
Solar Energy and Green Roofs

“ZinCo Solar Base” enables solar energy and green roofs to be combined. The substrate fills in below the solar panels on the base where it acts as additional ballast against wind uplift and also as an area for plant growth.



– ZinCo flat roof accessories.

Run-off and Inspection Chambers

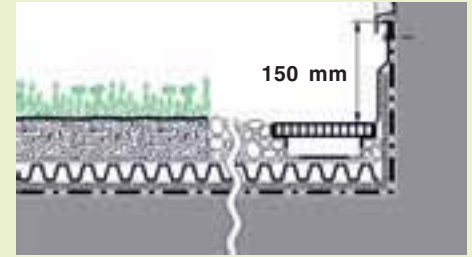
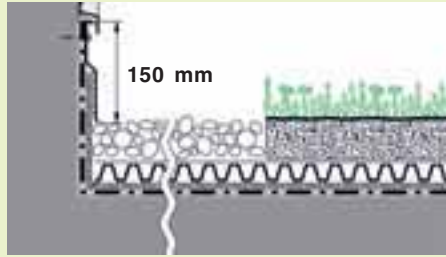


Usually, the drainage of flat roofs is achieved through roof outlets. Their quantity as well as their dimension is to be determined in accordance with European and German Standards DIN EN 12056-3 and DIN 1986. Inspection chambers ensure the permanent accessibility of outlets, and can be cleaned easily, if necessary.

Accident prevention

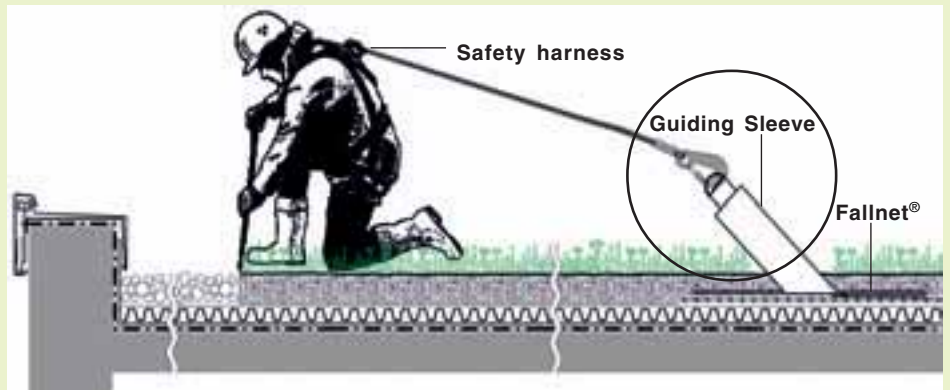
According to the "German Standards" DIN 4020, DIN 4426 and the accident prevention regulations, safety devices for fall protection are necessary for roof heights of more than 3 m. The "Fallnet"® which can be integrated into ZinCo Green Roof system build-ups offer fixing possibilities for safety harnesses without penetrating the waterproofing.

Wall connection



The waterproofing must be taken up on perimeters approx. 150 mm above the finished surface of the roof. The upper edge of the flashing must be protected from rain water, which can be achieved by using the FZ bar, in connection with the Clamping and Protection Profile EP 150. The Filter Sheet, Protection Mat and Root Barrier, when necessary,

are also to be taken up under the protection profile. In front of facades the installation of additional drainage or system channels is recommended in order to drain the rainwater from the building, directly into the drainage layer. If little water is expected, a gravel strip is sufficient.



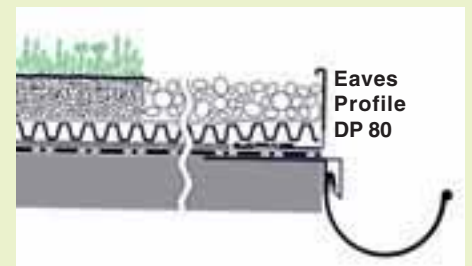
Water spout with Inspection Chamber

It is also possible to drain the water on flat roofs via parapet outlets or parapet water spouts. The inspection chamber ensures the permanent accessibility of the outlets, and can be cleaned easily, if necessary.

Drainage via the roof edge, in case of a missing perimeter

If the drainage of a green roof is intended to be through an external gutter, the green roof build-up can be bordered by an eaves profile, which is attached to the waterproofing.

Eaves profiles hold / edge the build-up but allow water to penetrate easily due to their drainage slots.



Ecological protection layers

with system!

This planning guide is intended to provide a detailed overview of the available ZinCo technology. It supports you in developing project-specific, highly effective extensive green roof solutions for your building projects.

Our

ZinCo Technical Department

as well as our

technical consultants

will assist you with help and advice: from the planning stage through to the writing of the

specification documentation.

Challenge us!



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