



PLANNING GUIDE

Water Retention with a “Stormwater Management Roof”

Life on Roofs





More Options with ZinCo

The Definition of a Stormwater Management Roof 3



Flood Protection for All Types of Roof Use 4



Perfect Technology for Stormwater Management 5



System Build-up „Stormwater Management Roof“ on an Extensive Green Roof 6

System Build-up „Stormwater Management Roof“ Type “Roof Garden” 8



System Build-up “Sponge City Roof” 10

System Build-up “Driveways” with Retention Spacer RSX 100 12



Cascade-style Drainage on Underground Garages 13



Stormwater Management Roofs in Practice 14



Building-specific Water Retention Calculation 15

Checklist for Stormwater Management Roof

We will be happy to assist you with your calculations. Simply send us the necessary data using the form “Checklist for Stormwater Management Roof”.

https://zinco-greenroof.com/checklist_stormwater_management_roof



Checklist for Stormwater Management Roof
 Please fill out a separate check list for each roof area and send them back to: engineering@zinco-greenroof.com Page 1 of 2

Project name: _____ Date: 19.05.2023

Sheet, house number: _____

Postal code, city: _____

Roof area*: _____ Roof 1: Extensive Green Roof - Total Area 630 m²

Plaster: _____

Contact person: _____

Sheet, house number: _____

Postal code, city: _____

Phone number: _____

Requirements: Roof surface without inclination and with a sufficient load bearing capacity
 Roof construction roof without insulation insulated roof covered roof

Roof surface: minimum allowable load _____ 1,0 kN/m² 2,0 kN/m² 3,0 kN/m² 4,0 kN/m² 5,0 kN/m² 6,0 kN/m² 7,0 kN/m² 8,0 kN/m² 9,0 kN/m² 10,0 kN/m² 11,0 kN/m² 12,0 kN/m² 13,0 kN/m² 14,0 kN/m² 15,0 kN/m² 16,0 kN/m² 17,0 kN/m² 18,0 kN/m² 19,0 kN/m² 20,0 kN/m² 21,0 kN/m² 22,0 kN/m² 23,0 kN/m² 24,0 kN/m² 25,0 kN/m² 26,0 kN/m² 27,0 kN/m² 28,0 kN/m² 29,0 kN/m² 30,0 kN/m² 31,0 kN/m² 32,0 kN/m² 33,0 kN/m² 34,0 kN/m² 35,0 kN/m² 36,0 kN/m² 37,0 kN/m² 38,0 kN/m² 39,0 kN/m² 40,0 kN/m² 41,0 kN/m² 42,0 kN/m² 43,0 kN/m² 44,0 kN/m² 45,0 kN/m² 46,0 kN/m² 47,0 kN/m² 48,0 kN/m² 49,0 kN/m² 50,0 kN/m² 51,0 kN/m² 52,0 kN/m² 53,0 kN/m² 54,0 kN/m² 55,0 kN/m² 56,0 kN/m² 57,0 kN/m² 58,0 kN/m² 59,0 kN/m² 60,0 kN/m² 61,0 kN/m² 62,0 kN/m² 63,0 kN/m² 64,0 kN/m² 65,0 kN/m² 66,0 kN/m² 67,0 kN/m² 68,0 kN/m² 69,0 kN/m² 70,0 kN/m² 71,0 kN/m² 72,0 kN/m² 73,0 kN/m² 74,0 kN/m² 75,0 kN/m² 76,0 kN/m² 77,0 kN/m² 78,0 kN/m² 79,0 kN/m² 80,0 kN/m² 81,0 kN/m² 82,0 kN/m² 83,0 kN/m² 84,0 kN/m² 85,0 kN/m² 86,0 kN/m² 87,0 kN/m² 88,0 kN/m² 89,0 kN/m² 90,0 kN/m² 91,0 kN/m² 92,0 kN/m² 93,0 kN/m² 94,0 kN/m² 95,0 kN/m² 96,0 kN/m² 97,0 kN/m² 98,0 kN/m² 99,0 kN/m² 100,0 kN/m²

Green area substrate: 451,4 m² C₁ _____ Substrate depth: 130 mm

Green area intensive: _____ m² C₂ _____ Substrate depth: _____ mm

Walkway: _____ m² C₃ _____ Substrate depth: _____ mm

Driveway: _____ m² C₄ _____ Substrate depth: _____ mm

Gravel: _____ m² C₅ _____

Other areas without substrate: 88,6 m² C₆ _____

Parade: _____ m² C₇ _____

Further areas without substrate: _____ m² C₈ _____

* Please indicate the high water and substrate depth to be used after
 ** According to DIN 1986-100, the average rainfall coefficient for each roof surface, the relevant retention coefficient
 *** The roof area and substrate depth may vary per area which is not clear for selection.

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Live on Roofs

The Definition of a Stormwater Management Roof

Why a Stormwater Management Roof?

An increase in severe rainfall events, flooding and the reduction in the water table is making it very clear that the water cycle ecology has been seriously disrupted – due to climate change and ongoing land sealing. This results in stormwater no longer being able to seep into the ground and the municipal drainage systems becoming quickly overloaded during severe rain events.

Green roofs provide important, additional green areas in densely built-up areas. Each green roof stores a specific volume of rainwater and releases it with a time delay, or it evaporates on the roof. The ZinCo Stormwater Management Roof multiplies this specific retention effect while at the same time effectively balancing out precipitation peaks.

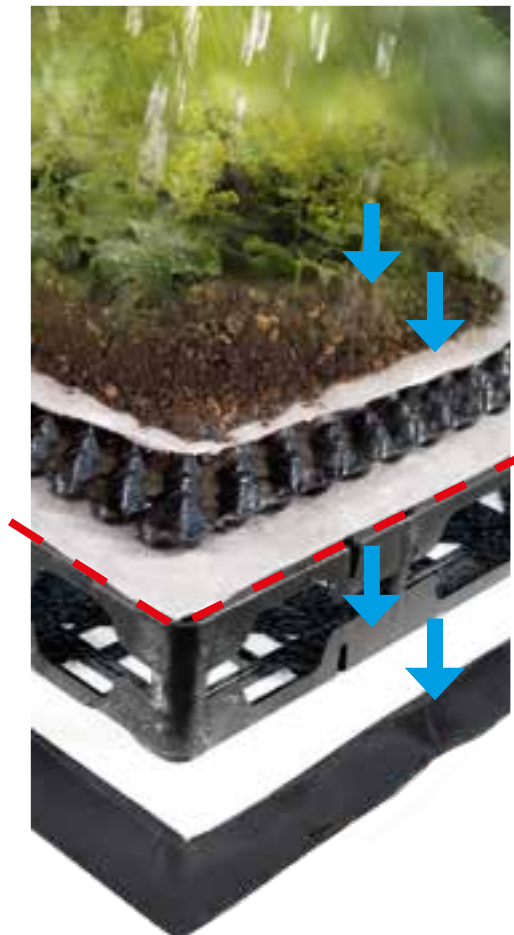


What is a Stormwater Management Roof?

In water management, retention refers to the balancing effect created by storage areas on stormwater run-off into waterways. There is an increasing demand for stormwater retention as changing weather conditions (i.e. more extreme local rain events) can result in an entire drainage system being overwhelmed.

With a Stormwater Management Roof, for the purposes of flood protection, a large portion of precipitation is detained on the roof area and is then released into the drainage system during a pre-defined period (between 24 hours and a few days). Meanwhile, all those elements (water storage for the plants, water-air balance in the root area etc.) that are of vital importance for the proper functioning of the green roof are preserved.

The principle of a Stormwater Management Roof



- 1: The green roof build-up absorbs some of the stormwater and the excess water runs off.
- 2: A spacer is used to increase the quantity of retained stormwater. This takes the pressure off the sewer system during heavy rainfall.
- 3: The water flow is regulated using a run-off limiter and is released over a pre-defined period into the sewer system or, for example, into an infiltration system



Flood Protection for All Types of Roof Use

In principle, all types of green roof, from the simple Sedum Carpet to the complex Roof Garden can be implemented on Stormwater Management Roofs, including in combination with walkways and driveways.

The conditions required for the proper functioning of the green roof are provided by the green roof build-up overlying the spacer. This includes sufficient root space, a balanced air-water household for each plant community, and the quick run-off of excess water. Naturally, an intensive green roof will require greater quantities of water than an extensive green roof with its drought-resistant Sedum plants.

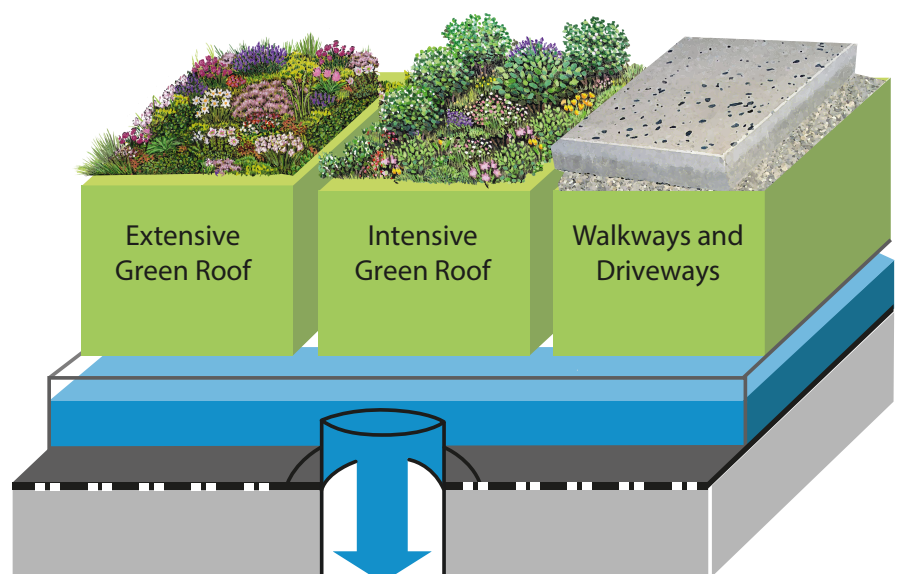
Additional storage space required is created with the ZinCo Stormwater Management Roof in a cavity beneath the actual green roof build-up. This cavity is created with spacer elements (usually RS 60) installed over the entire area, above which the required system build-up is then installed.

The division means that a lot of water can be stored, regardless of the quantity of water needed by the greenery itself.

Provided the Run-off Limiter or limiters are properly adjusted and the spacers are correctly sized, it is possible to avoid vegetation restructuring or an increase in the care and maintenance required which would result from an excess supply of water.

The limited run-off water can, of course, be collected in reservoirs and re-used to irrigate the green roof vegetation or for other purposes.

We do not recommend storing the water for plant irrigation on the roof area for an extended period of time, as on the one hand, the water supply would be limited. On the other hand, the water storage space has to be available again for the next precipitation event. Instead, a different solution should be found for irrigation during periods in which there is little precipitation.



Perfect Technology for Stormwater Management

Precise limitation of water run-off

The flow rate of the rainwater that goes through the roof drain and into the down pipes has to be limited as required. ZinCo has developed a precision-adjustable run-off limiter element that is simply placed over the roof drain with a screw flange, regardless of the manufacture of the drain. The pre-calculated flow rate is easily pre-set and fixed. Adjusting rings are used for



The limiter element is protected beneath the inspection chamber and regulates the slow discharge of water. At the same time, it acts as an overflow.

Adjusting the run-off limiters

The choice of run-off limiter depends on the planner's specifications. Where the planner stipulates a specific water retention level, a spacer is chosen in relation to the relevant storage capacity. Some cities have a limitation on discharge for construction activities, i.e. a certain drainage rate (l/s) – up to an including properties with no drainage – must not be exceeded. The required spacer and the settings for the run-off limiter are then determined on this basis, also having regard to the time required to empty the water retention cavity.

The precipitation event (e.g. hundred-year event) and its duration are relevant for the calculations. Another factor that has to be taken into consideration is the point in time when the emergency overflows should spring into action. We recommend the following order: Once the pre-set water retention level has been exceeded, the water will drain into the overflow pipes of the limiter elements. Once these pipes are flooded to a specific, pre-defined level the emergency overflow will respond.

this. Generally speaking, the settings will ensure that the water storage element is empty again after 24 hours, but different settings are also possible.

Naturally, the limiter functions as an overflow element. It can be set to a certain overflow height using a screw thread, and ensures that excess rainwater flows into the downpipes where the precipitation is greater than can be accumulated on the roof.



Run-off Limiter set RDS 28 is suitable for flat roof drains with foam-sealed flashing.

However, it is also possible to stipulate that the emergency overflows are the first to respond before the maximum pre-set water retention level is reached.

With the ZinCo Run-off Limiter, both the pre-set water retention level and the drainage cross-section can be infinitely adjusted post-installation.

If the discharge time is more than 24 hours and a pre-set water retention level of > 10 cm is required, please note that greater demands may be placed on the roof waterproof membrane.

Required information for calculating the limiter opening:

Precipitation event to be applied
+ time it takes to empty storage area
+ area dimensions and division
= maximum pre-set water retention capacity and maximum drainage rate per time unit

Additional information

One thing that must be taken into consideration is the possible additional load that might be incurred due to the Stormwater

In order to ensure the permanent and proper functioning of the system, the roof drain and limiter are protected beneath an inspection chamber that can be locked. It has narrow slots that prevent foreign matter from entering and allows for maintenance work to be carried out as part of the usual care and maintenance regime.



The Retention Limiter Set RDS 48 is used for installations over flat roof outlets with a screw flange.

Management Roof, which, with the written permission of all parties involved, can be calculated in the place of snow loads.

The ZinCo Limiter RD 28 is suitable for use in all drains with foam-sealed flashing. Run-off Limiter RD 48 is available for roof drains with a screw flange.

Retention Spacer RS 60 is normally used here. If greater pressure resistance or a greater retention height is required, alternative products such as the heavy-duty Retention Spacer RSX 65 are available.

Emergency discharge

If the level of rainwater exceeds the maximum possible water retention height, water must be emergency released onto ground that can be flooded without causing damage. The emergency outlets should be placed at least 1 to 2 cm above the maximum water accumulation level in order to avoid water discharge during the retention phase.

For more information on emergency overflow, please see DN 1986-100:2016, point 14.2.6.



System Build-up „Stormwater Management Roof“ on an Extensive Green Roof

Low-maintenance extensive green roofs are well suited to be combined with additional water accumulation on the roof. The Retention Spacer RS 60 (100 % RC, EPD) in the ZinCo Stormwater Management Roof allows for additional storage of almost 57 l/m² of water on the roof. Installed right across the roof area, these spacer elements ensure a defined distance between the highest point of the accumulated water and the green roof build-up.

The height of this cavity will depend on the precipitation event on which it is based, the type of use, the run-off limitation or the discharge duration, among other things.

This type of construction requires an appropriate load-bearing flat roof without a slope and with sufficient connection height.

Roofs with 0° slope

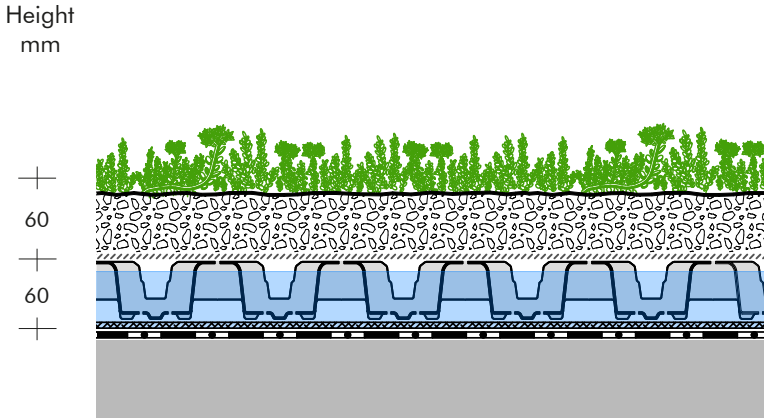
Roofs with 0° slope are no longer a “special construction” but, in certain justified cases, can also be planned and built in line with both the Flat Roof Guidelines and DIN 18531. In that case, the “heavy surface protection” required is automatically provided, for example, by the vegetation.





System build-up "Extensive Green Roof" with Retention Spacer RS 60

Weight kg/m ²		Height mm
dry	water-saturated	
67	84	60
3	58	60
70	142	



Sedum cuttings or plug plants according to plant list "Sedum Carpet"

System Substrate "Sedum Carpet"

Filter Sheet PV
Retention Spacer RS 60
Filter Sheet PV
Roof construction with root resistant waterproofing

Build-up height: ca. 120 mm
Weight, saturated: ca. 142 kg/m² *
Water storage capacity: ca. 72 l/m² *

(* Weight specifications refer only to build-up without vegetation and a maximum retention height of 60 mm).



System Build-up with EPD verification.

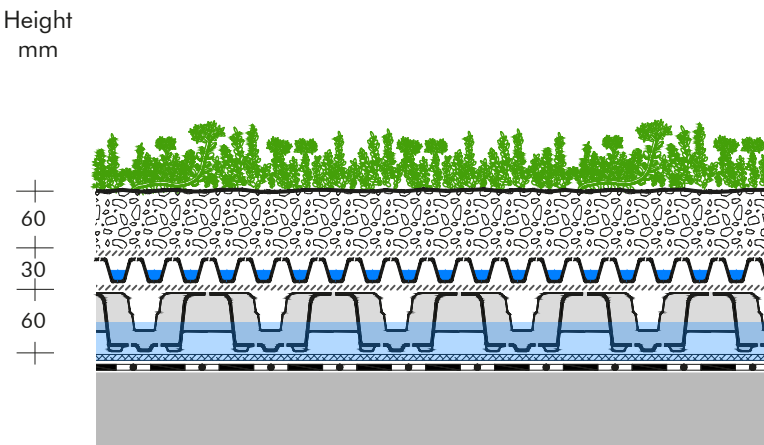
System build-up "Extensive Green Roof" with Retention Spacer RS 60 and Floradrain® FD 25-E

The additional drainage element allows for the storage capacity to be expanded as the drainage element can also be

used to retain water (6 cm water accumulation becomes 8.5 cm). In addition, the Floradrain® element FD 25-E has a

water storage capacity of approx. 3 l/m³ that is available for the plants.

Weight kg/m ²		Height mm
dry	water-saturated	
67	84	60
2	5	30
3	58	60
72	147	



Sedum cuttings or plug plants according to plant list "Sedum Carpet"

System Substrate "Sedum Carpet", ca. 60 mm

Filter Sheet SF
Floradrain® FD 25-E
Filter Sheet PV
Retention Spacer RS 60
Filter Sheet PV
Roof construction with root resistant waterproofing

Build-up height: ca. 150 mm
Weight, saturated: ca. 150 kg/m² *
Water storage capacity: ca. 75 l/m² *

(* Weight specifications refer only to build-up without vegetation and a maximum retention height of 60 mm).



System Build-up with EPD verification.

System Build-up „Stormwater Management Roof” Type “Roof Garden”

The sky is the limit

The system build-up combines effective stormwater management with all possible variations of green roof and types of use of an intensive green roof.

This requires a roof with a 0° slope and water discharge limitation. Stormwater can accumulate up to a pre-defined level and it then runs off at the required limitation rate.

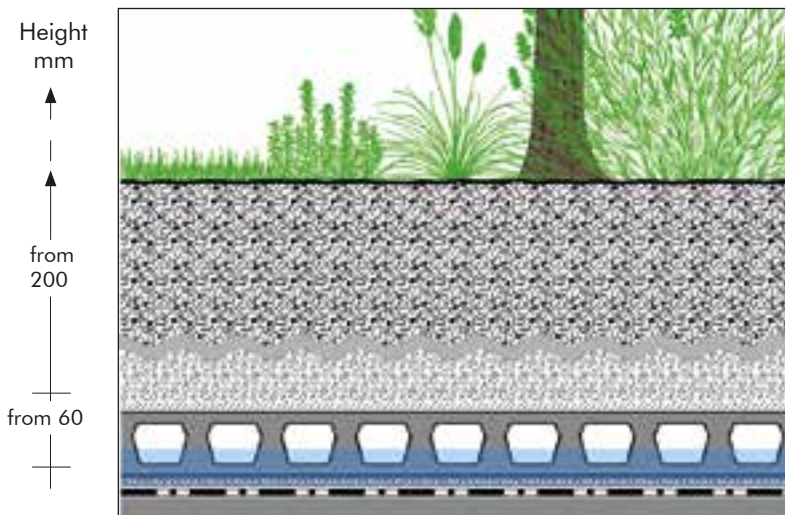
Due to its extreme pressure resistance, the Retention Spacer RSX 65 is particularly suited for use with greater substrate depths or, for example, where the substrate has to be applied to the roof of an underground garage using a wheel loader. In addition, the spacer is perfect for use beneath walkways and play areas.





System build-up "Roof Garden" with Retention Spacer RSX 65

Weight kg/m ²		Height mm
trocken	wasser- gesättigt	
from 200	from 300	from 200
6	67	from 60
206	367	



Lawn, perennials, with deeper substrate layers also shrubs and small trees

System Substrate "Roof Garden" resp. System Substrate "Lawn" (in case of substrate depths > 350 mm in combination with mineral sub-substrate Zincolit® Plus)

Filter Sheet PV
Retention Spacer RSX 65

Filter Sheet PV
Roof construction with root resistant waterproofing

Build-up height: from ca. 260 mm
Weight, saturated: from ca. 360 kg/m² *
Water storage capacity: from ca. 160 l/m² *

(* Weight specifications refer only to build-up without vegetation and a maximum retention height of 65 mm).

* At maximum retention height of 55 mm. The weight of the vegetation must be taken into account additionally (see FLL Green Roof Guidelines, table 26).

System Build-up “Sponge City Roof”

Temporary water retention, maximum water storage and increased evaporation

The system build-up combines the advantages of an insect-friendly, species-rich extensive green roof with an additional water storage element available to the plants and temporary water retention capacity with run-off limiter.

The accumulated water stored in the retention spacer on the waterproof membrane

level is available to the plants through the wicking mat. Rainwater is collected above the retention spacer up to a pre-defined level and is discharged at the required flow rate.

This results in a dynamic development of the vegetation depending on the annual precipitation distribution. We recommend having the final and also the development care and maintenance regime carried out by specialists.

Additional irrigation may be necessary during long drought periods during the summer.

The accumulated water should be removed during the winter months and, depending on the geographic region, reinstated at the start of the following vegetation period.

A roof design with 0° slope is a basic requirement for this build-up.

Additional expert information in line with FLL Green Roof Guidelines, Chapter 9.3.5 “Additional Water Retention Capacity”:

- this type of Stormwater Management Roof is a planned deviation from the usual type of drainage. This should be pointed out at the planning stage.
- The retained water must never result in a permanently wet green roof.
- Both the drainage elements located above the required pre-set water retention level and the emergency drainage system must be fully functional at all times.
- The required pre-set water retention capacity, maximum permissible discharge rate per time unit and the period after which the maximum pre-set retention capacity has to be available once again, are to be determined for each individual project.
- The waterproof membrane must be appropriate for the specific load.



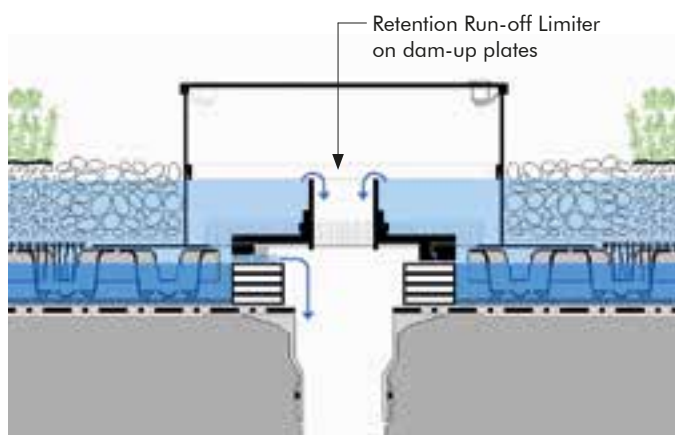
For further information about our plant mixture Bee Pasture, which is specially adapted to the needs of the bee population, please see our homepage at: <https://zinco-greenroof.com/bee-pasture>





System build-up "Sponge-City-Roof" with Retention Spacer RS 60

Weight kg/m ²		Height mm
dry	water-saturated	
100	152	100
3	58	6
103	210	



Vegetation, e.g. "Bee Pasture"

System Substrate "Rockery Type Plants",
ca. 100 mm
Wicking Mat DV 40
Retention Spacer RS 60
Retention Run-off Limiter with
dam-up plates
Filter Sheet PV
Roof construction with root resistant
waterproofing

Build-up height: ca. 160 mm
Weight, saturated: ca. 210 kg/m² *
Water storage capacity: ca. 107 l/m² *

Temporary water retention volume
Periodic plant available water accumulation

*including max. periodically plant-available water accumulation (4 slices each 13 mm) and max. temporary retention volume up to 20 mm below substrate surface.



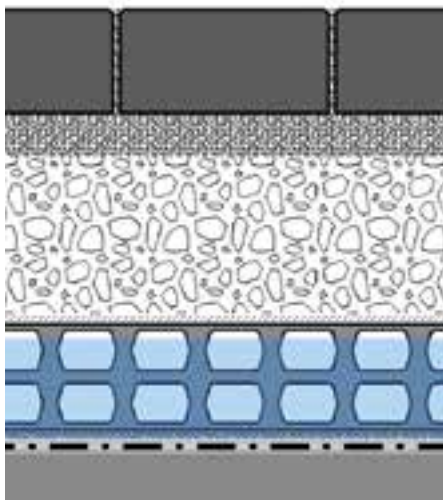
System Build-up “Driveways” with Retention Spacer RSX 100

This system build-up is particularly suitable for roofs of underground car parks without inclination, if water retention is to be realized using a throttle element, e.g. under parking lots or fire brigade

accesses. The overall height depends on the required load capacity. The system solution can be combined with greenery or otherwise utilized areas (e.g. play grounds or sports grounds).

The base of the build-up is formed by extremely stable spacer elements. Thanks to this, the substrate can be easily brought onto the underground garage roof with a wheel loader.

System build-up “Driveways” with Retention Spacer RSX 100



Pavement:

Depth (Cars up to 3 t): ≥ 100 mm

Depth (Trucks up to 16 t): ≥ 120 mm

Depth (Trucks over 16 t): ≥ 140 mm

Bedding layer, lime-deficient, 30–50 mm

Gravel base layer, lime-deficient:

Depth (Cars up to 3 t): ≥ 150 mm

Depth (Trucks up to 16 t): ≥ 200 mm

Depth (Trucks over 16 t): ≥ 250 mm

Filter Sheet PV

Retention Spacer RSX 100

Filter Sheet PV

Roof construction with root resistant waterproofing

Build-up height: from ca. 38 cm
 Dead load: from ca. 595 kg/m²
 Max. retention volume: ca. 95 l/m² *

(* The indicated weights do not include the weight of the vegetation and a maximum retention height of 100 mm.)

Cascade-style Drainage on Underground Garages

Cascade-style drainage consists of rainwater cascading down from higher-placed roofs to lower-lying roof areas and possibly into an infiltration trench downstream.

This type of rainwater cascade allows for interim storage of precipitation, the discharge of the water at a time delay and, consequently, helps to avoid flooding.

The additional structural load is frequently easier represented on the roof of an underground garage than the roof of a building.

In order to avoid structural overload, the weight of the maximum pre-set water retention capacity must be taken into consideration in addition to the weight of the system build-up (saturated).



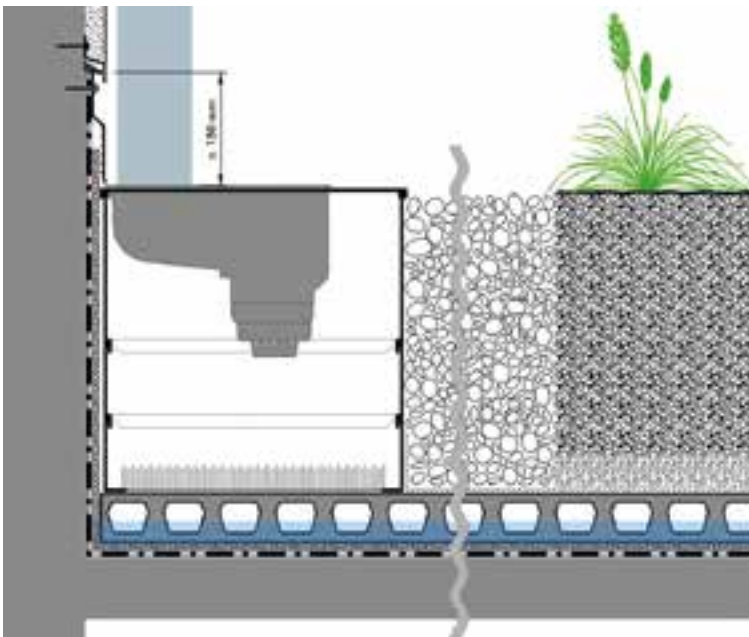
© Generalunternehmer: Schmeing Bau GmbH, Bocholt. Bauherr: Caja 16 Projekt GmbH, Bocholt

With the Cascade Inspection Chamber KKS 30/40, a down pipe, coming from an overlying area, can be integrated to allow for the discharge of run-off water into the drainage or retention level of a lower-lying roof.



Cascade Inspection Chamber KKS 30/40

System build-up "Stormwater Management Roof" with Retention Spacer RSX 65



Lawn, perennials, with deeper substrate layers also shrubs and small trees

System Substrate "Roof Garden" resp. System Substrate "Lawn" (in case of substrate depths > 350 mm in combination with mineral sub-substrate Zincolit® Plus)

Filter Sheet PV
Retention Spacer RSX 65
Filter Sheet PV
Roof construction with root resistant waterproofing

Stormwater Management Roofs in Practice

Project Example: Underground garage with RSX 80



Noltemeyer Hoefe in Braunschweig

The residential development, Noltemeyer Hoefe in Braunschweig, consisting of six apartment blocks with 242 apartments, illustrates how underground parking spaces are concealed beneath a landscaped terrain comprising green areas, terraces, playgrounds and driveways.

The trick is in the ZinCo system build-up “Stormwater Management Roof” which can store large volumes of water during heavy rain events and can release the water into the sewer system at a time delay. The special retention spacers RSX 80, together with the precision-adjustable run-off limiter elements, comprise this perfect technology.

Additionally there are 2,500 m² of extensive green roof with photovoltaic elements. The residential development, Noltemeyer Hoefe, is an impressive example of how “Stormwater Management Roofs” are a proven means of reducing the risk of flooding today.



The planted and surface areas at Noltemeyer Hoefe conceal an impressive 5,780 m² of stormwater management area.



The fully installed stormwater management layer RSX 80 can store more than 75 l/m² of rainwater in its cavities.



Thanks to the stable ZinCo system build-up with RSX 80, using diggers to apply the substrate is not a problem. © Strassen- und Tiefbau Urban GmbH

Project Example: Roof Garden with RSX 65

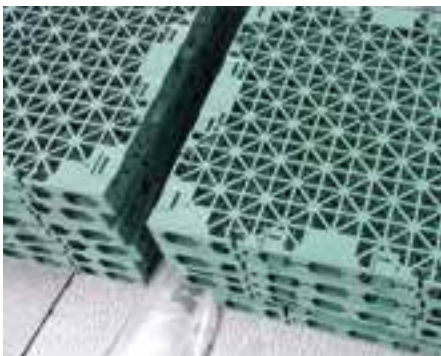


Soho House, Amsterdam

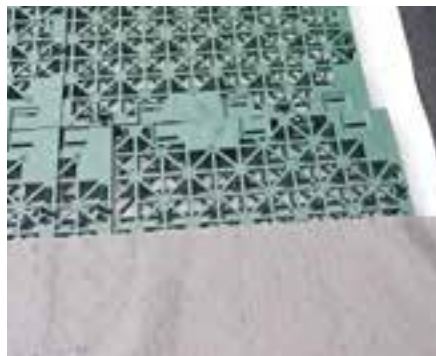
This protected building from the year 1934 was completely refurbished in 2018 and converted to an exclusive private club with hotel. The Roof Garden installed across an area of 900 m², in addition, makes an invaluable contribution to ecology and

sustainability. The special ZinCo system build-up “Stormwater Management Roof” used in Soho House stores up to 61,75 l of rainwater/m² of roof area and releases it with a time delay. In the event of heavy rain, this relieves the municipal sewage

system and therefore provides protection against flooding. The roof consists of various roof areas at different various levels. The Stormwater Management Roof is on the lower-lying roof areas and can store more than 50,000 litres of rainwater at short notice.



A tower crane was used to lift all the material onto the roof – here the stacked Retention Spacer elements RSX 65. © ZinCo Benelux B.V.



The Retention Spacer elements RSX 65 were covered entirely with the Filter Sheet PV, followed by an additional ZinCo System Build-up for the planted areas and walkways. © ZinCo Benelux B.V.



Any type of design is possible on a “Stormwater Management Roof” – planters, walkways and even this pool. © ZinCo Benelux B.V.

Building-specific Water Retention Calculation

The Stormwater Management Roof is designed to suit the specific building and takes into consideration the roof size, precipitation data (as per KOSTRA-DWD, meteorological data from Germany), required retention capacity, flow rate and discharge duration. Our ZinCo engineers in Application Technology will be happy to help you.

You can send us the details of your project and the local specifications such as discharge limitations. We will use this data to prepare your individually tailored water retention calculation together with our recommendation for the system build-up and the settings for the limiter elements.

The Checklist for Storm Management Roofs can be downloaded here and completed by inputting your data: https://zinco-greenroof.com/checklist_stormwater_management_roof



Example of a completed "Checklist for Storm Management Roofs"

Checklist for Stormwater Management Roof Page 1 of 2
Date: 19.05.2023

Please fill out a separate check list for each roof area and send them back to engineering@zinco-greenroof.com

Project name: _____ Date: 19.05.2023
Street, house number: _____
Postal code, city: _____
Roof area*: Roof 1 Extensive Green Roof - Total Area 630 m²

Planner: _____
Contact person: _____
Street, house number: _____
Postal code, city: _____
Phone number: _____

Requirements: Roof surface without inclination and with a sufficient load bearing capacity
Roof construction roof without insulation insulated roof inverted roof
Maximum admissible load 3,5 kN/m² (traffic load and snow load not included)

Roof surfaces: Please state the runoff coefficient (C*) if it needs to be considered in the calculation!
Total area (outer edge): 630 m²
a) Available retention area*** m²
Green area extensive 461,4 m² C= _____ Substrate depth 130 mm
Green area intensive _____ m² C= _____ Substrate depth _____ mm
Walkway _____ m² C= _____
Driveway _____ m² C= _____
Gravel 88,6 m² C= _____
b) Areas without retention _____ m²
Pavement 80 m² C= _____ Further areas without retention volume _____ m³ C= _____

* Please number the single areas and indicate them in the overview plan.
** According to DIN 1986-100, the average runoff coefficient C_{av} is used to calculate the volume of stormwater retention facilities.
*** Total area minus roof openings, skylights, and any further areas which do not allow for retention.

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Life on Roofs

Please send the checklist to: engineering@zinco-greenroof.com

Example of an individual water retention calculation

ZinCo Stormwater Management Roof 22.05.2023

Calculation of the required retention volume for the following project

Date of checklist: 19.05.2023

Recommended system build-up

Spacer: Retention-Spacer RS 60
Art.-Nr. 3403

Flordrain FD 40
Art.-Nr. 3040

Run-off Limiter: Run-off Limiter Set RDS 48
Art.-Nr. 4002

Setting of the ZinCo Run-off Limiter: Set the value 11 of the outer ring

Limitation of discharge rate:
Discharge rate Q₀: 0,500 l/s
Number of devices: 2 pieces
Basis level (DN): 100 to 350 mm

Calculation of the required retention volume

Results of calculation

h ¹ (mm)	Q ¹ (l/s)	V ¹ (m ³)	V ² (m ³)
10	233,3	12,22	12,22
20	233,3	24,44	24,44
30	233,3	36,66	36,66
40	233,3	48,88	48,88
50	199,9	59,99	59,99
60	166,6	69,99	69,99
70	133,3	79,99	79,99
80	100,0	89,99	89,99
90	66,6	99,99	99,99
100	33,3	109,99	109,99
110	0,0	119,99	119,99
120	0,0	129,99	129,99
130	0,0	139,99	139,99
140	0,0	149,99	149,99
150	0,0	159,99	159,99
160	0,0	169,99	169,99
170	0,0	179,99	179,99
180	0,0	189,99	189,99
190	0,0	199,99	199,99
200	0,0	209,99	209,99
210	0,0	219,99	219,99
220	0,0	229,99	229,99
230	0,0	239,99	239,99
240	0,0	249,99	249,99
250	0,0	259,99	259,99
260	0,0	269,99	269,99
270	0,0	279,99	279,99
280	0,0	289,99	289,99
290	0,0	299,99	299,99
300	0,0	309,99	309,99
310	0,0	319,99	319,99
320	0,0	329,99	329,99
330	0,0	339,99	339,99
340	0,0	349,99	349,99
350	0,0	359,99	359,99
360	0,0	369,99	369,99
370	0,0	379,99	379,99
380	0,0	389,99	389,99
390	0,0	399,99	399,99
400	0,0	409,99	409,99
410	0,0	419,99	419,99
420	0,0	429,99	429,99
430	0,0	439,99	439,99
440	0,0	449,99	449,99
450	0,0	459,99	459,99
460	0,0	469,99	469,99
470	0,0	479,99	479,99
480	0,0	489,99	489,99
490	0,0	499,99	499,99
500	0,0	509,99	509,99
510	0,0	519,99	519,99
520	0,0	529,99	529,99
530	0,0	539,99	539,99
540	0,0	549,99	549,99
550	0,0	559,99	559,99
560	0,0	569,99	569,99
570	0,0	579,99	579,99
580	0,0	589,99	589,99
590	0,0	599,99	599,99
600	0,0	609,99	609,99
610	0,0	619,99	619,99
620	0,0	629,99	629,99
630	0,0	639,99	639,99
640	0,0	649,99	649,99
650	0,0	659,99	659,99
660	0,0	669,99	669,99
670	0,0	679,99	679,99
680	0,0	689,99	689,99
690	0,0	699,99	699,99
700	0,0	709,99	709,99
710	0,0	719,99	719,99
720	0,0	729,99	729,99
730	0,0	739,99	739,99
740	0,0	749,99	749,99
750	0,0	759,99	759,99
760	0,0	769,99	769,99
770	0,0	779,99	779,99
780	0,0	789,99	789,99
790	0,0	799,99	799,99
800	0,0	809,99	809,99
810	0,0	819,99	819,99
820	0,0	829,99	829,99
830	0,0	839,99	839,99
840	0,0	849,99	849,99
850	0,0	859,99	859,99
860	0,0	869,99	869,99
870	0,0	879,99	879,99
880	0,0	889,99	889,99
890	0,0	899,99	899,99
900	0,0	909,99	909,99
910	0,0	919,99	919,99
920	0,0	929,99	929,99
930	0,0	939,99	939,99
940	0,0	949,99	949,99
950	0,0	959,99	959,99
960	0,0	969,99	969,99
970	0,0	979,99	979,99
980	0,0	989,99	989,99
990	0,0	999,99	999,99
1000	0,0	1009,99	1009,99

Discharge rate Q₀: 0,500 l/s
Total retention volume: 44,98 m³ **
Volume (m³): 9,9 m
Retention height: 9,9 m
Discharge period: 23,46 h

Value of the ZinCo run-off limiter:
Height: 72 mm
Value: 11 (measured from the upper end flange of the R)

The required average volume is calculated based on the German standard DIN 1986-100 and according to the worksheet DWA-A 117 "Design of Retention Retention Height of the German Association for Water Management and Waste e.V. (using the simple method)". The required average volume results from the maximum difference between the amount of precipitation occurring during a period and the discharge volume present on via the run-off limiter during this period.

** In order to consider possible possible formation due to unevenness of the roof, a permanent filling level of 5 mm is additionally retained.
The calculated values were taken from the chart with the above-mentioned axis of runoff.

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