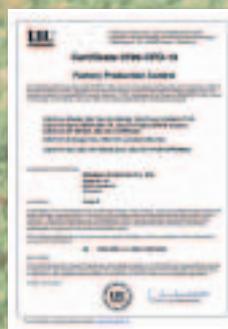


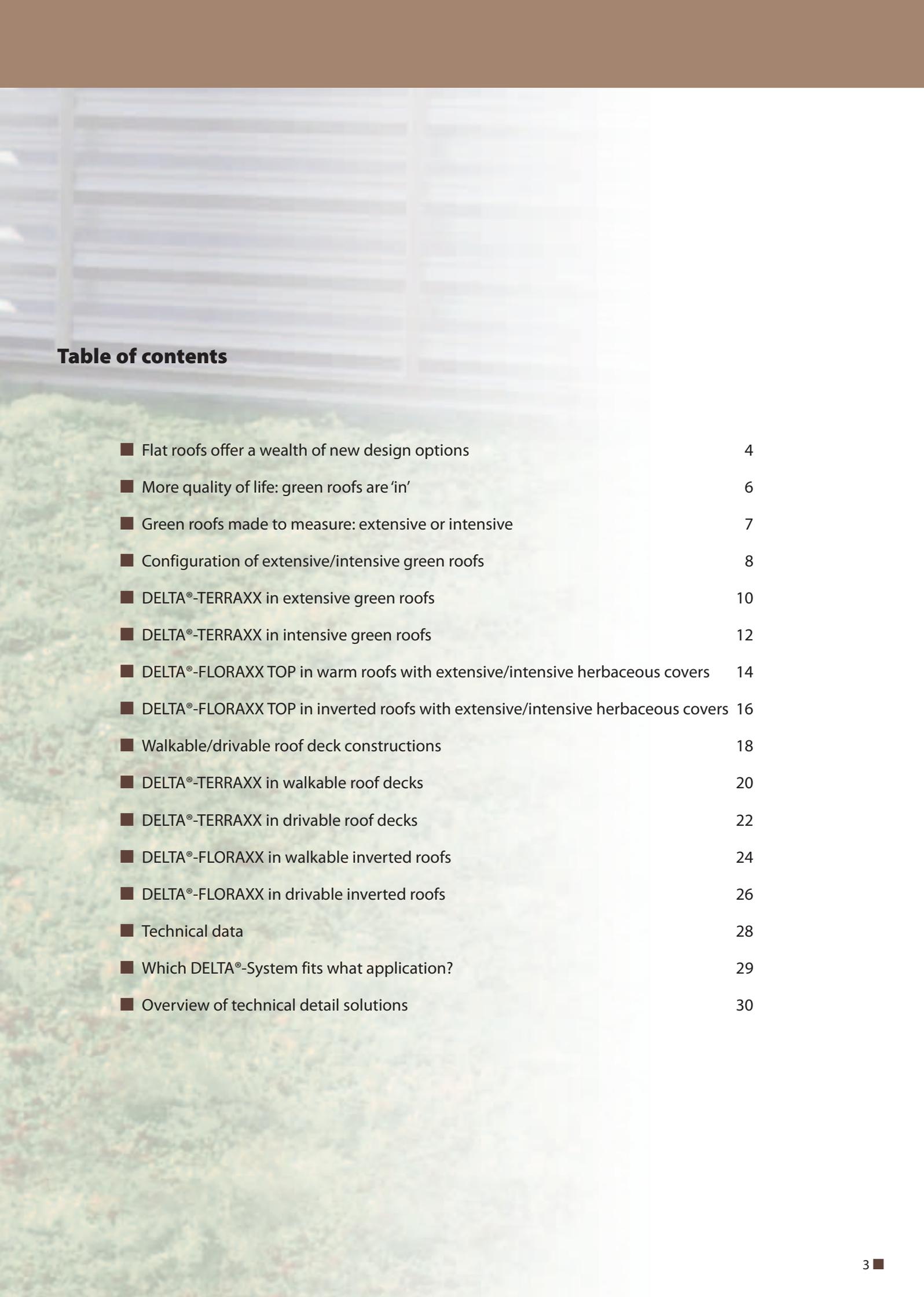
## Flat Green Roof Systems for Gardens, Terraces, Walkways & Parking

### Planning information

## Dörken – leading through competence. For more than 100 years.

Developed from innovative ideas and manufactured in leading-edge production facilities, the top-quality products made by Dörken GmbH & Co. KG for foundation protection, waterproofing, and drainage set standards for reliability, durability, and energy conservation. Located in the Westphalian town of Herdecke, the company traditionally offers its clients top-quality products and customised solutions. Having lived up to this standard for more than 100 years, Dörken is and will always be a powerful partner for planners, dealers, and craftsmen.



The background of the page features a blurred image of a green roof with a window. The window has horizontal blinds, and the green roof is covered in various plants and grasses. The overall tone is natural and eco-friendly.

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## Flat roofs offer a wealth of new design options



Large flat roofs and ceilings can be put to a wide variety of uses: games and leisure activities, additional parking space, or partial/complete seeding/planting. After all, usable space is at a premium especially in urban areas: there are many ways in which flat roofs may serve to enhance the quality of life in residential areas.

However, this will work only if rain water as well as any run-off from outer walls can be safely and reliably drained away at the surface and the waterproofing level. Therefore, the construction of the deck must include an efficient structural drainage system so that stagnant water cannot attack, or cause frost damage to, areas open to traffic. In herbaceous roofs, stagnant water may cause waterlogging, harming plants and flooding the drainage system.

Mineral drainage layers of gravel or chip-pings do not really comply well with these requirements: not only is there a constant risk of silting up with the attendant negative effect on drainage performance, their requisite minimum thickness constitutes a planning problem, frequently causing considerable additional costs.

Flat roofs are multi-layer structures with no or a very small gradient (minimum gradient: c. 3°). Most are warm roofs, meaning that they are unvented.

Users need to observe the regulations applying to the various construction systems. The actual configuration of a waterproofing system depends on the materials used as well as on the following regulations:

- Waterproofing standards
- Code of practice for roofs with waterproofing
- European product certifications
- Building authority certifications
- Manufacturer's working instructions

What type of herbaceous cover is actually chosen depends on applicable construction requirements, the configuration of the waterproofing, and the materials used.

### Inverted roofs – a special case

Unlike conventional flat roofs, the arrangement of component layers is turned upside down in inverted roofs. In a departure from the usual structure of a warm roof, the waterproofing layer is applied directly to the supporting construction and the insulation laid out on top. Water-tolerant insulation materials are used exclusively. If an inverted roof is to be used for traffic, the insulation layer must be covered with a breathable drainage layer to prevent the formation of a coherent film of water on the insulation surface. In other words: the heat insulation layer may not be covered with any other layer that forms a vapour barrier.

### The solution: DELTA<sup>®</sup>

DELTA<sup>®</sup> branded drainage sheets offer cost-efficient solutions for all flat-roof applications. The distinguishing characteristics of these top-quality sheets include superior protection, high drainage capacity, permanent filtration stability, high compression resistance, outstanding longevity, and low thickness.



## More quality of life: green roofs are 'in'

As environmental awareness grows, the proportion of green roofs featured in building and rehabilitation projects increases. In addition to their visual appeal, herbaceous covers offer a number of essential technical advantages: not only do they protect roofs from extreme temperatures and wind suction, they also enhance both noise abatement and heat protection. Small wonder, then, that green roofs are growing steadily more popular these days among architects, planners, and owners.

Two types of green roof may be distinguished by the nature of their herbaceous cover: while the design options offered by an intensive green roof are unlimited in the field, depending solely on the expense and effort involved, an extensive green roof performs the function of an ecologically efficient protective covering just as well, while requiring considerably less care.

Dörken, the specialist manufacturer, offers no fewer than three sheet types that are tailor-made for the conversion of flat roofs: DELTA<sup>®</sup>-TERRAXX, DELTA<sup>®</sup>-FLORAXX TOP, and DELTA<sup>®</sup>-FLORAXX. Distinguished by professional quality and versatility, they are extremely easy to lay. Once again, users benefit here from the proven know how of Europe's No. 1 manufacturer of sarking and waterproofing sheets, insulation underlays, and soft sheathing.

# Green roofs made to measure: extensive or intensive

## Extensive green roof

This type of herbaceous cover is largely left to itself. Consequently, the plants employed should adapt particularly easily to the conditions prevailing on a roof, and they should not be demanding as far as irrigation is concerned. Suitable plants include mosses, succulents, herbs, and grasses.



## Intensive green roof

This type of herbaceous cover resembles cultivations on the ground in terms of diversity and optional uses. The plants employed in this case require a regular supply of water and nutrients. This, in turn, calls for continuous care; plants recommended for cultivation include perennials, bushes, lawns, and trees.



## Green pays

A green roof improves the quality of life of a property in visual and climatic terms and increases its value: benefits that translate into pounds and pennies. In addition, green roofs offer a habitat for many plants and animals, such as butterflies, besides relieving the burden on the drains by retaining large volumes of water. Furthermore, they filter fine dust and pollutants out of the air and generate oxygen – a good thing for our environment, particularly in urban areas. DELTA® sheets are just right for the purpose.

## Configuration of an extensive/intensive green roof

### Functional layers

If a flat roof is to be planted, several layers are needed to ensure that the entire structure of the green roof remains permanently functional:

- compression and root-resistant waterproofing
- additional protection cloth/separation foil
- seepage layer
- filtration layer
- substrate
- plants

If perfectly matched, all these functional layers will ensure the long-term survival of the vegetation, each performing its own individual task:

### 1. Compression and root-resistant waterproofing

Reliably protecting the roof waterproofing from being damaged by penetrating plant roots, this layer is laid out immediately on top of the roof waterproofing and attached to it, even in inverted roofs.

### 2. Additional protection cloth and/or separation foil

To protect structural drainage layers from mechanical damage and ensure their unimpeded filtration effect, a protection cloth weighing at least 300 g/m<sup>2</sup> should be employed according to the FLL guideline for herbaceous roofs.

### 3. Seepage layer

To ease the impact of extreme volumes of water on the underlying waterproofing layer, DELTA<sup>®</sup> dimpled sheets double as drainage layers, ensuring unimpeded drainage on the horizontal plane. In addition, DELTA<sup>®</sup>-FLORAXX TOP is capable of storing water, a valuable feature in times of drought.

### 4. Filtration layer

For filtration purposes, DELTA<sup>®</sup> dimpled sheets feature a fused-on thermally consolidated permanent-filtration geotextile that keeps the underlying dimple structure from silting up, thus ensuring that any excess water may drain away completely and



An extensive green roof

freely. Thanks to their structure, DELTA®-TERRAXX and DELTA®-FLORAXX TOP combine the functions of a filtration and a seepage sheet.

### 5. Substrate

No matter whether a herbaceous cover is extensive or intensive, its substrate must in any case be stable and capable of making any incoming water available to the plants and conveying the excess to the dimpled-sheet layer. A substrate may consist, for example, of natural volcanic pumice, such as VULCAPLUS® extensive or VULCAPLUS® intensive that both conform to the FLL guidelines for planning, building, and cultivating green roofs.

Extensive green roofs need a substrate layer that is 8 – 20 cm thick to support the vegetation. The vegetation on intensive green roofs must be supported by a substrate layer no less than 15 cm thick.

Depending on the kind of vegetation, the substrate layer may be as thick as 200 cm. Where DELTA® dimpled sheets are used, the substrate may be applied directly to the geotextile.

### 6. Plants

The plants most suitable for extensive cultivation include undemanding sedum and moss sedum species that are easy to care for, as well as herbs and grasses. Vegetation may be planted in the form of root stocks or flat bales or, alternatively, lawn mats.

Where intensive green roofs are concerned, the only limits are those imposed by the financial investment. The spectrum ranges from lawns, perennials, underbrush, bushes, and small trees to trees 15 m in height.

Whatever the type of herbaceous roof, local climate and weather conditions, the characteristics of the building, and the peculiarities of the plants need to be taken into account. We recommend consulting your local horticultural specialist.



*An intensive green roof*

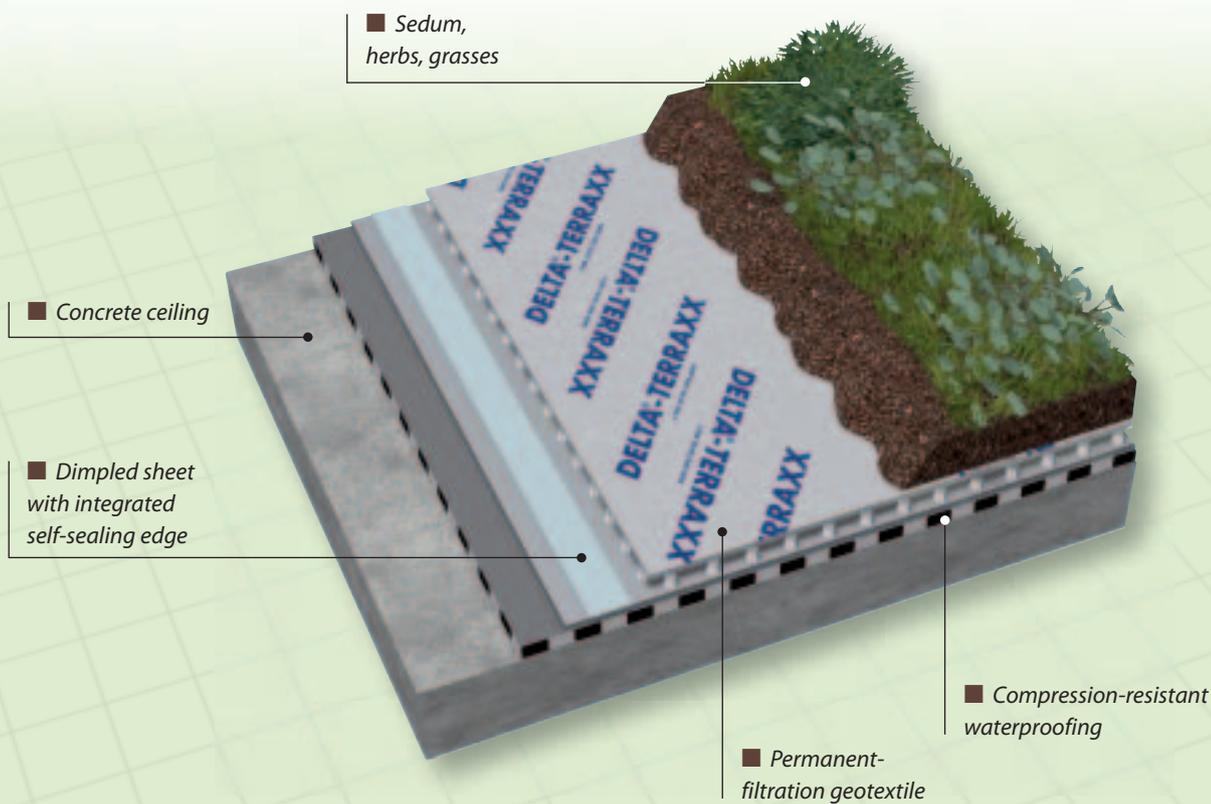
## DELTA®-TERRAXX in extensive green roofs

Optimised for the requirements of horizontal drainage, the 2-ply DELTA®-TERRAXX sheet may be used in extensive green roofs as a protection, filtration, and seepage layer. Applied directly on top of the waterproofing, it effectively keeps water from accumulating. The drainage capacity of this sheet is markedly superior to that of a bed of gravel or chippings. Its smooth back

ensures that any loads impinging on the waterproofing are distributed evenly across the surface. As it is compatible with all common waterproofing sheets, no additional protective layers are needed. Its thickness of no more than 9 mm keeps the entire structure flat.



PREMIUM QUALITY





## DELTA<sup>®</sup>-TERRAXX in intensive green roofs

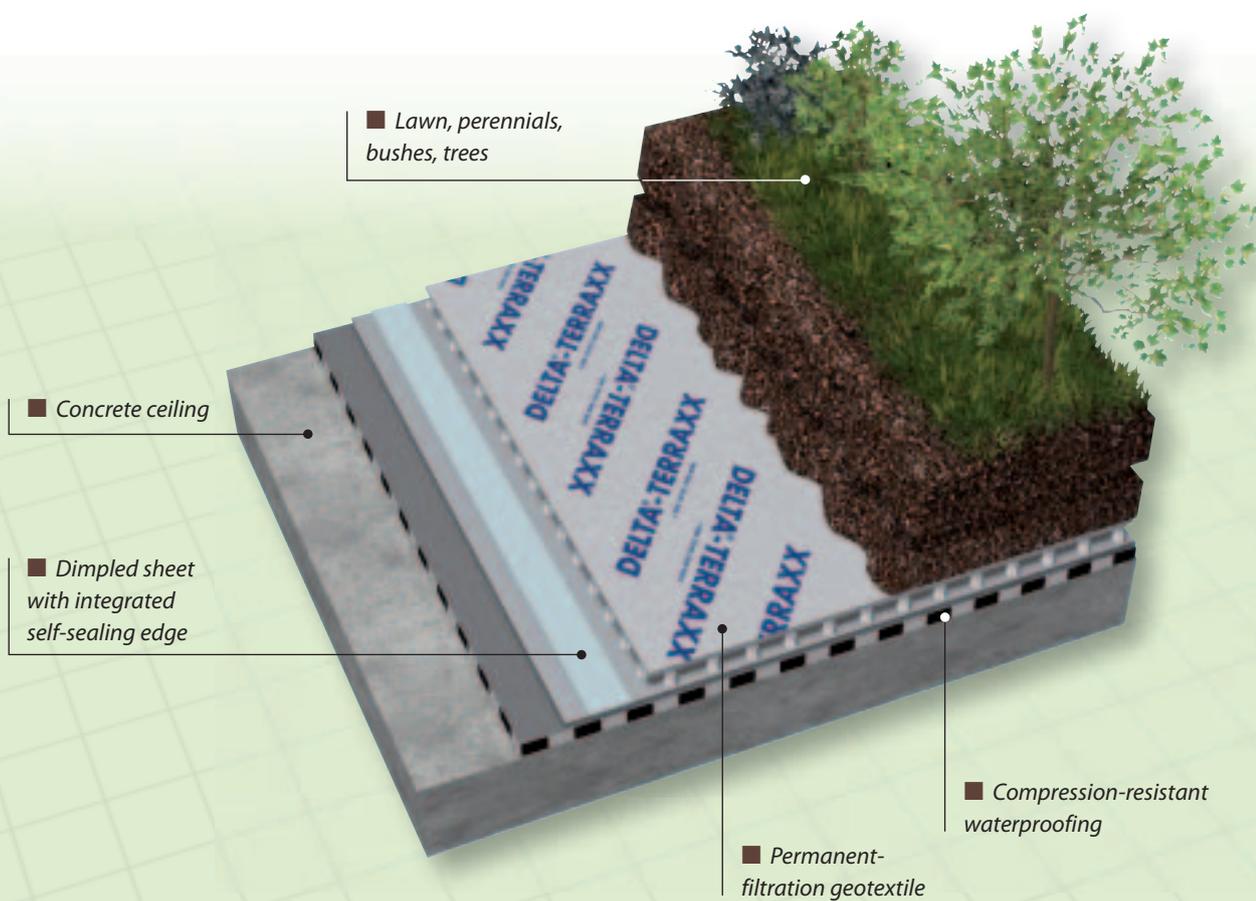
In intensive green roofs, the 2-ply DELTA<sup>®</sup>-TERRAXX sheet similarly serves as a protection, filtration, and seepage layer. Forming a protection and drainage course with a high load-bearing capacity, it effectively keeps water from accumulating. The drainage capacity of this sheet is markedly superior to that of a bed of gravel or chippings. Its smooth back ensures that any loads impinging on the waterproofing are distributed evenly across the surface. As it is com-

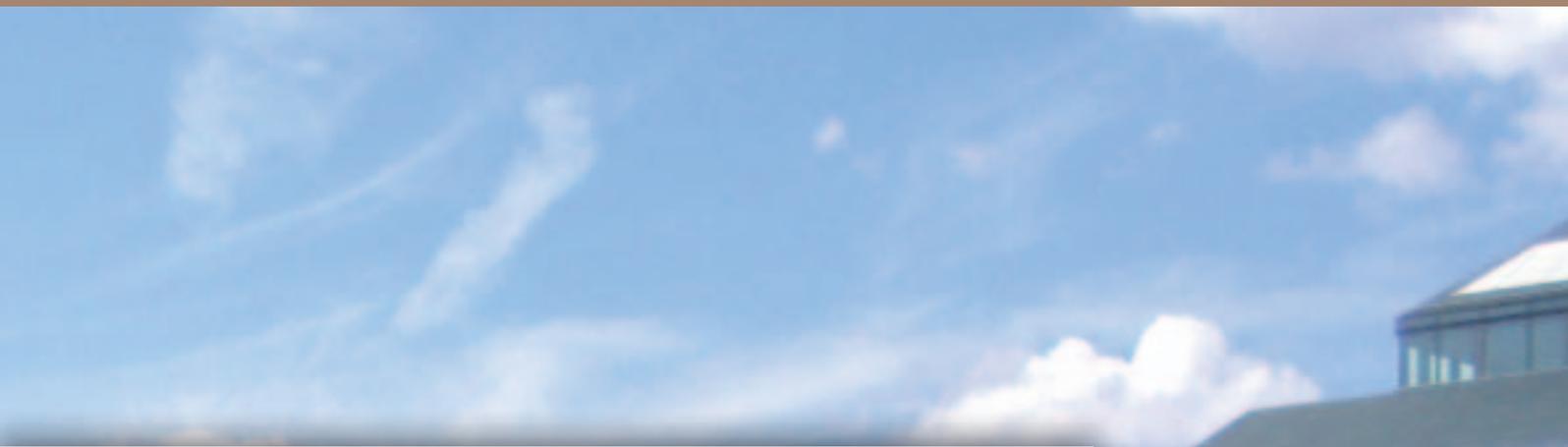
patible with all common waterproofing sheets, no additional protective layers are needed. Its thickness of no more than 9 mm keeps the entire structure flat.

Moreover, DELTA<sup>®</sup>-TERRAXX is ideal for intensive green roofs which, because of the density of their substrate, do not require additional water storage but do require a high drainage capacity.



PREMIUM QUALITY





## DELTA<sup>®</sup>-FLORAXX TOP

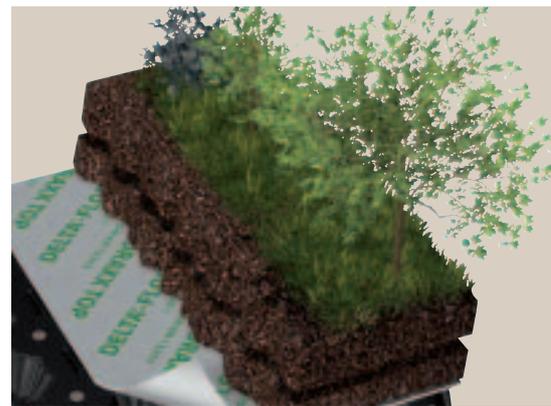
### in warm roofs with an extensive/intensive herbaceous covers

Developed specifically for use in green roofs, DELTA<sup>®</sup>-FLORAXX TOP, an innovative dimpled sheet, forms a protection and drainage layer with a high load-bearing capacity which is optimised for the requirements of horizontal drainage. Acting as a protection, filtration, and seepage layer, it retains 7 L of water per m<sup>2</sup> within its thickness of 20 mm. This is optimal for herbaceous covers that are supposed to survive for prolonged periods without irrigation.

Thanks to its robust octagonal dimples additionally reinforced by ribs, the sheet will safely support even heavy loads.

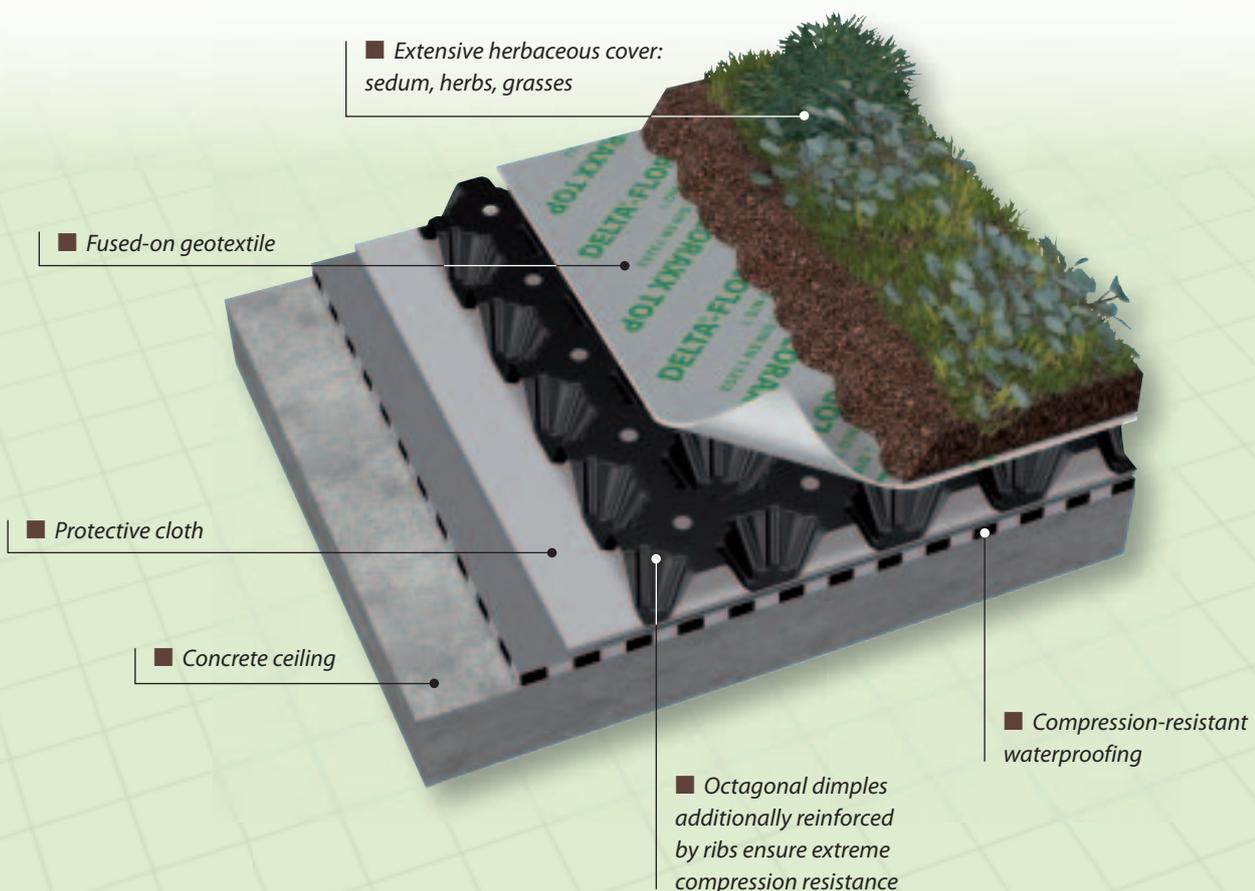
As the filtration layer is fused to the top of the sheet and does not need to be laid out separately, the substrate for planting may be spread directly on the sheet that prevents water from accumulating.

**Extensive and intensive herbaceous covers differ in the plant varieties and substrates used as well as in the thickness of the substrate.**



*Intensive herbaceous cover: lawn, perennials, bushes, and trees*

PREMIUM QUALITY



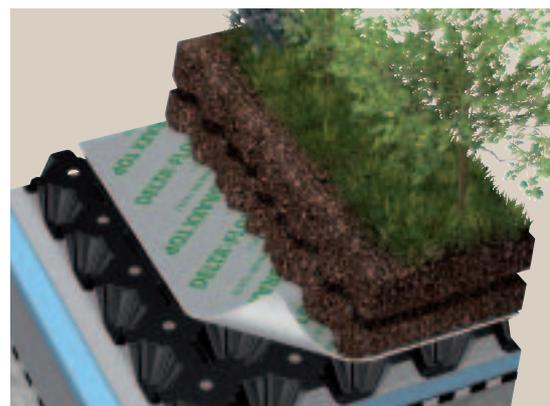


## DELTA®-FLORAXX TOP in inverted roofs with extensive/intensive herbaceous covers

In inverted roofs with a herbaceous cover, DELTA®-FLORAXX TOP serves as a protection, filtration, and seepage layer. In addition, it is capable of storing 7 L of water per m<sup>2</sup> within its thickness of 20 mm. This is ideal for herbaceous covers that are supposed to survive for prolonged periods without irrigation. Thanks to its robust octagonal dimples additionally reinforced by ribs, the sheet will safely support even heavy loads. Being perforated, it is breathable with an S<sub>d</sub> value of 0.4 m, which makes it suitable for inverted roofs.

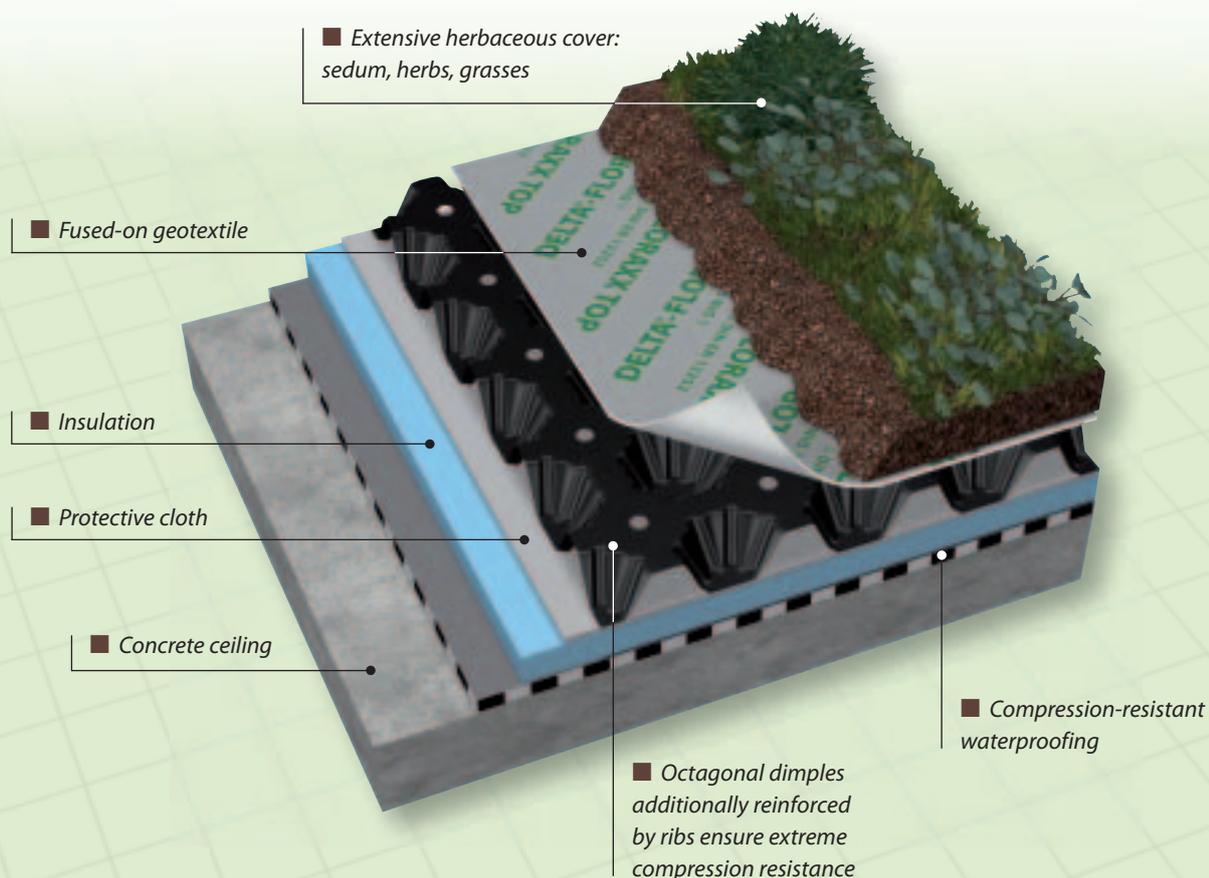
The integrated filtration layer permits spreading planting substrates directly on top of the sheet, eliminating the need for a separate filtration cloth. Because the resultant surface is uniformly homogeneous, there are no more problems with loose cloth layers slipping, sliding, or being blown about by the wind. Moreover, the sheet reliably prevents any accumulation of water.

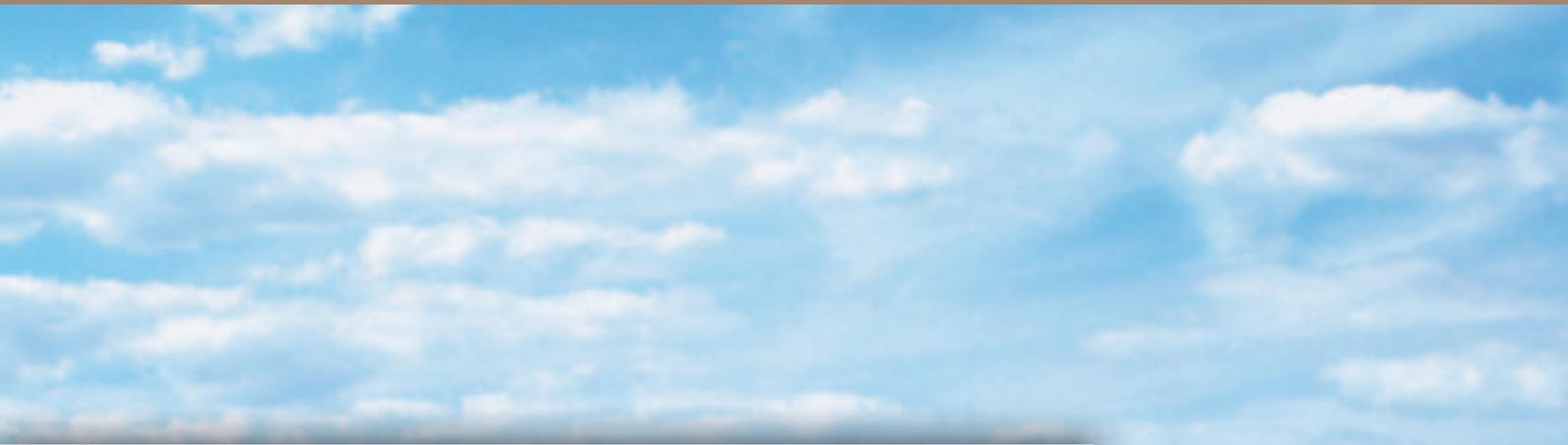
**Extensive and intensive herbaceous covers differ in the plant varieties and substrates used as well as in the thickness of the substrate.**



*Intensive herbaceous cover: lawn, perennials, bushes, and trees*

PREMIUM QUALITY





## Walkable/drivable roof deck constructions

### Functional layers

To successfully construct a durable system of layers for roof decks that are to be used by pedestrians/vehicles, a sequence of layers is needed, each fulfilling its own individual task:

- Separation layer
- Protection layer
- Seepage layer
- Filtration layer
- Sub-base course
- Bedding course
- Wearing course

### 1. Separation layer

This layer is applied directly on top of the roof waterproofing in order to protect it permanently from any damage that may be caused by incompatibilities between building materials or components.

### 2. Protection layer

It protects the waterproofing of a roof from mechanical and dynamic damage. As well as performing this protective function DELTA® dimpled sheets keep waterproofing and roof-deck layers from being damaged by frost.

### 3. Seepage layer

To mitigate the impact of extreme volumes of water on the underlying waterproofing, DELTA® dimpled sheets double as a drainage layer, making sure that water can escape freely in the horizontal plane.

### 4. Filtration layer

DELTA® dimpled sheets feature a fused-on thermally consolidated permanent-filtration geotextile which, by acting as a filtration layer, keeps the underlying dimple structure from silting up, thus ensuring that any excess water may drain away completely and freely.



*A walkable roof deck*

### 5. Sub-base course

Made of gravel or another material, the function of a sub-base course is to drain off any excess water on the horizontal plane, absorb static and/or dynamic loads, and transfer them to the underlying layers. This load-distributing course needs to be compacted to withstand the load class it is exposed to. In inverted roofs that are to be used for traffic, the DELTA®-FLORAXX dimpled sheet offers – thanks to its breathable perforation – efficient ventilation as well as free drainage on the underside, so that no coherent film of water may form on the waterproofing.

### 6. Bedding course

The courses that serve to bed paving stones and/or slabs consist of crushed or uncrushed rock grains ranging between **0 to 4 mm Ø and 2 to 5 mm Ø** in size. Requisite material properties include permeability to water and permanent filtration. The bedding course crucially influences the stability of the wearing course.

### 7. Wearing course

In most cases, the wearing courses on flat roofs, parking decks, and garage roofs consist not of concrete or asphalt but of paving stones, slabs, and other materials. The reasons for this are architectural and, more importantly, cost-related. The thickness of a wearing course depends on the loading, the manner in which it is laid, and the interaction of all functional layers. Wearing courses need to be given a minimum gradient, depending on the nature of the pavement.



*A drivable roof deck*

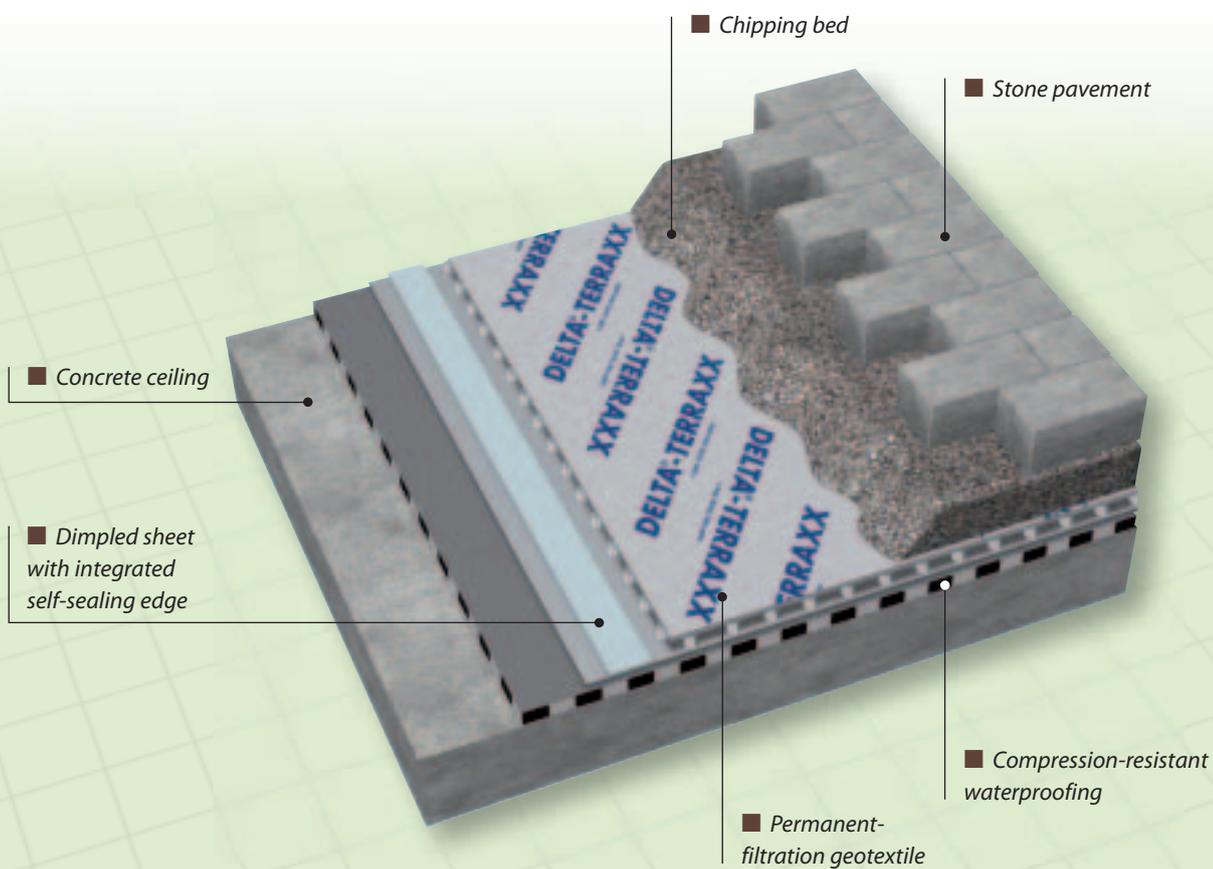
## DELTA<sup>®</sup>-TERRAXX in walkable roof decks

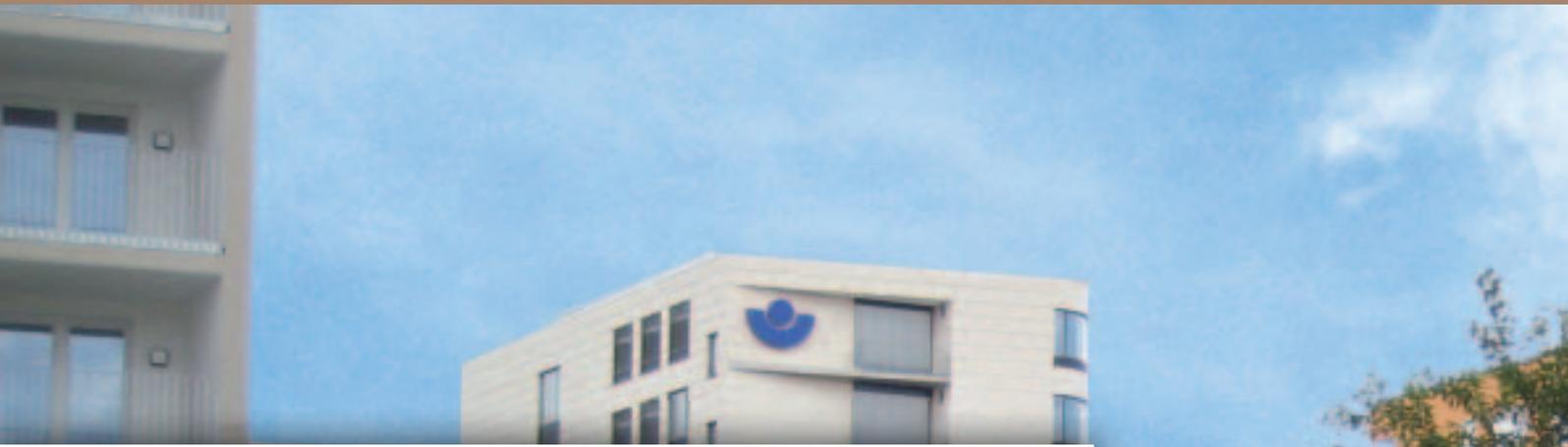
Laid out under walkable roof decks, the DELTA<sup>®</sup>-TERRAXX 2-ply sheet acts as a protection, filtration, and seepage course. Applied to the waterproofing, it forms a protection and drainage layer with a high load-bearing capacity. A bedding course of sand, gravel, or chippings may be spread directly on top of it to receive the stone and/or slab pavement.

Installed under a pavement of stones or slabs, this structural drainage layer ensures that any precipitation water which seeps through the courses above is drained off without delay. Conversely, a course of gravel or chippings, whose drainage capability is limited, is threatened by the danger of banked-up water freezing, expanding, and causing the pavement to warp.



PREMIUM QUALITY

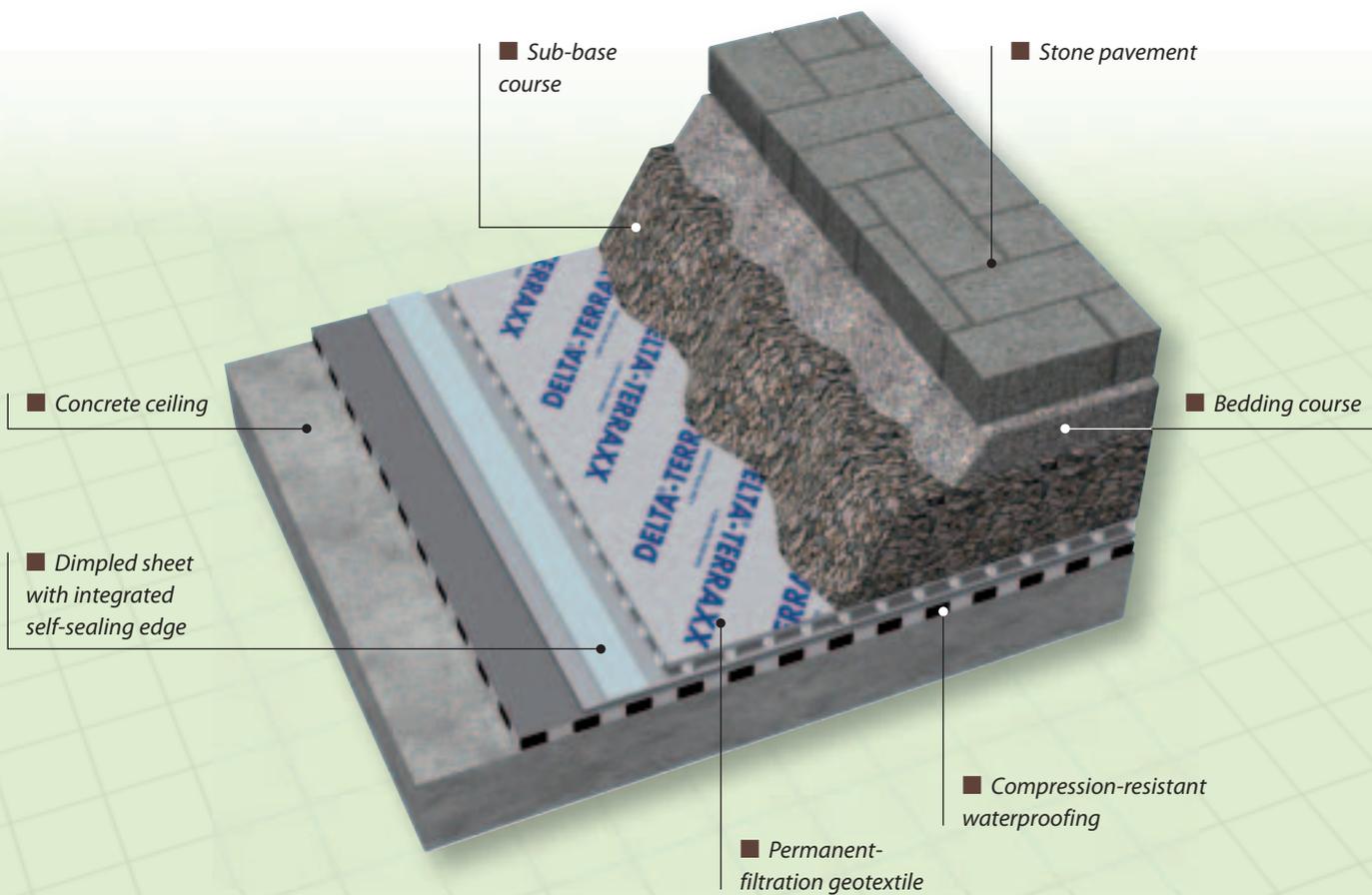
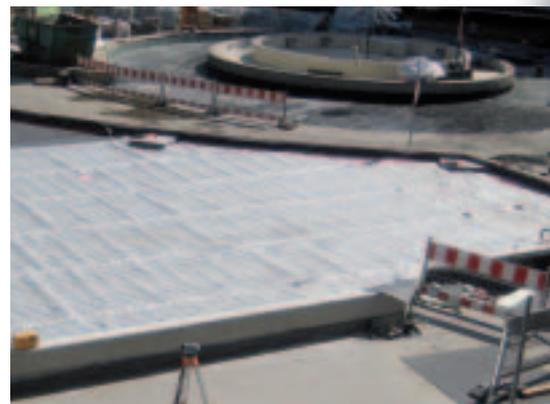


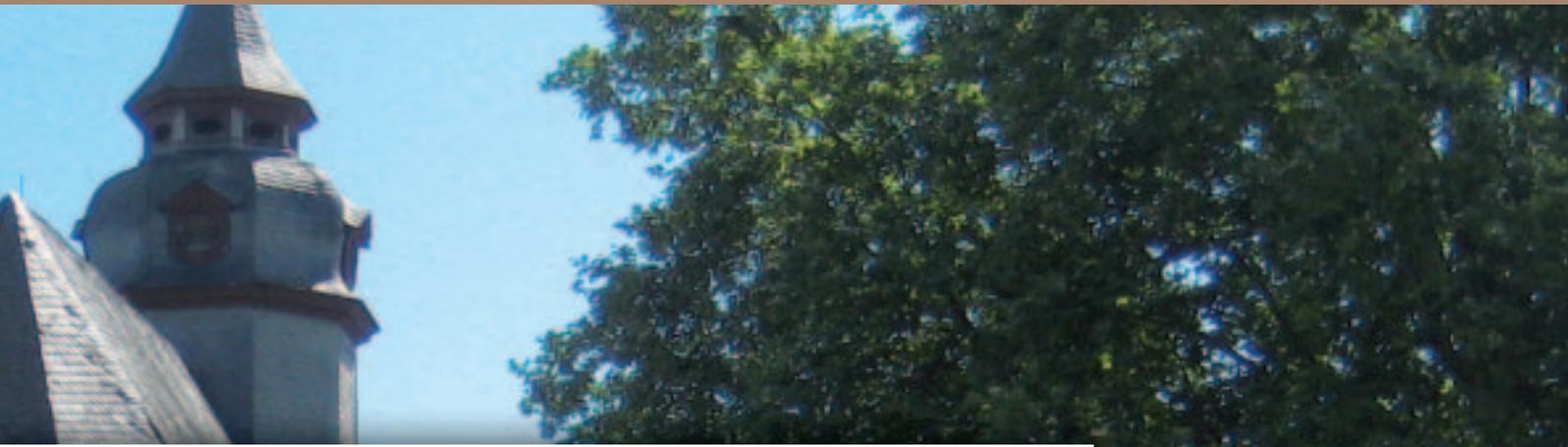


## DELTA®-TERRAXX in drivable roof decks

In drivable roof decks, the DELTA®-TERRAXX 2-ply sheet acts as a protection, filtration, and seepage layer. Applied to the waterproofing, it forms an extremely robust protection and drainage layer on which the sub-base and bedding courses may be spread and covered with a drivable pavement.

Installed under a pavement of stones or slabs, this structural drainage layer ensures that any precipitation water which seeps through the courses above is drained off without delay. Conversely, a course of gravel or chippings, whose drainage capability is limited, is threatened by the danger of banked-up water freezing, expanding, and causing the pavement to warp.



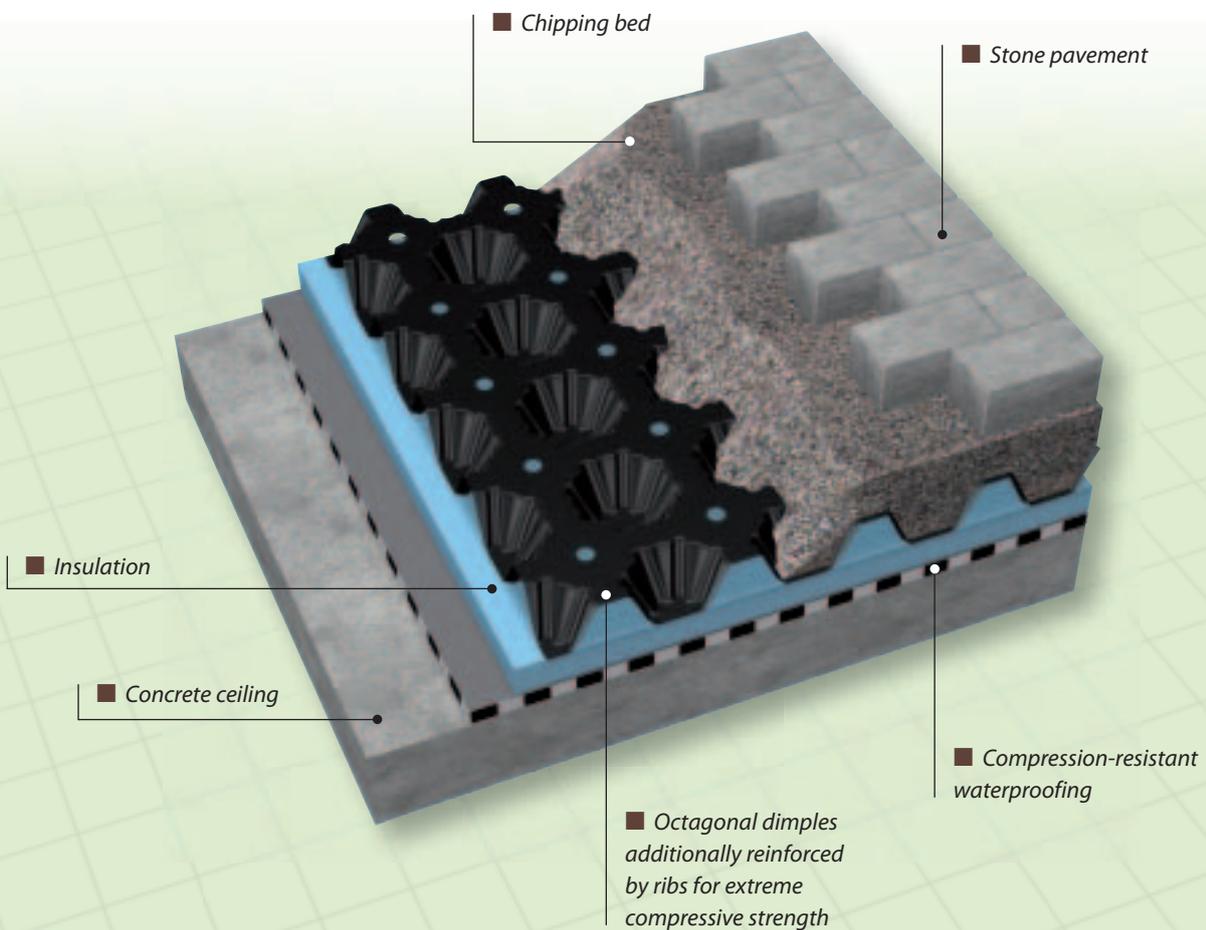


## DELTA®-FLORAXX in walkable inverted roofs

Used as an efficient structural drainage layer in walkable inverted roofs paved with stones or slabs, the innovative DELTA®-FLORAXX dimpled sheet acts as a protection and seepage layer which permits water to drain away freely. Breathable because of the perforation which permits air to circulate, the sheet prevents the formation of a coherent film of water on the waterproofing. Thanks to its robust octagonal dimples additionally reinforced by ribs,

its compressive strength is as high as 200 kN/m<sup>2</sup>. Levelling or bedding material may be spread directly on top of the sheet, to be covered by a pavement of stones or slabs.

**NB: DELTA®-FLORAXX may also be used as a protection and drainage layer under extensive or intensive herbaceous covers.**

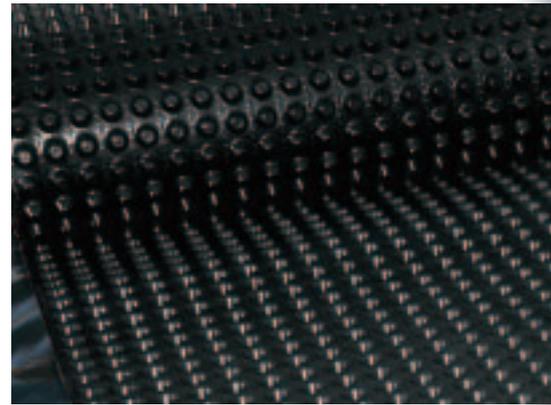




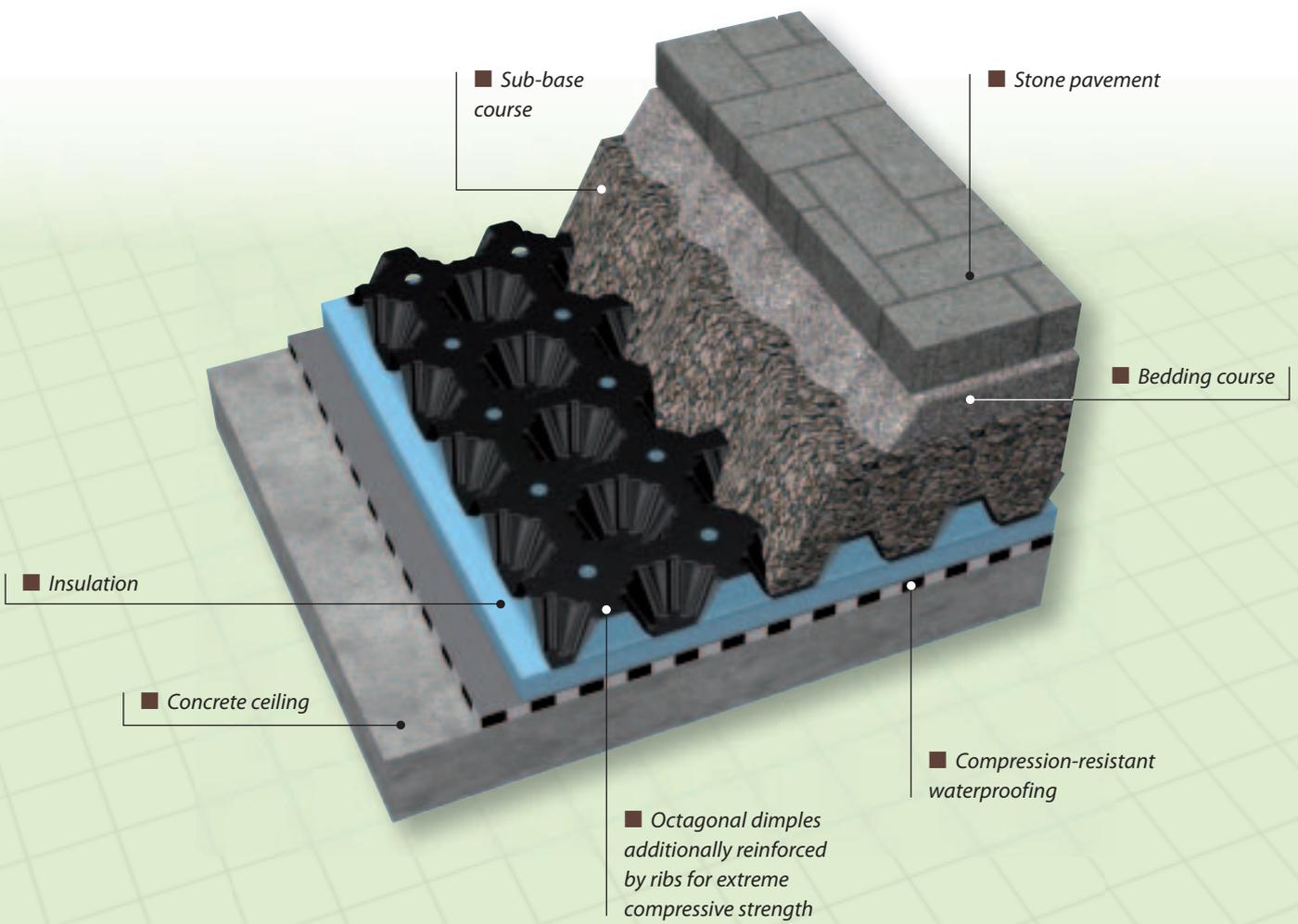
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STANDARD QUALITY





## Technical data

### DELTA<sup>®</sup>-TERRAXX

Dimpled sheet	High-density polyethylene, silver
Filtration cloth	Fused-on PP geotextile, grey
Flat edge/self-sealing overlap edge	Yes/yes
Dimple height	c. 9 mm
Air gap	c. 7.9 L/m <sup>2</sup>
Contact area dimples/ground	c. 8.000 cm <sup>2</sup> /m <sup>2</sup>
Compressive strength (transient loading)	c. 400 kN/m <sup>2</sup>
Compressive strength (permanent loading)	c. 90 kN/m <sup>2</sup>
Drainage capacity, water flow capacity in the plane	3.1 · 10 <sup>-3</sup> m <sup>2</sup> /s (EN ISO 12958) at 20 kN/m <sup>2</sup>
Geotextile water permeability	c. 0.08 m/s (EN ISO 11058)
Service temperature range	- 30 °C to + 80 °C
Tensile strength	6.0 kN/m (EN ISO 10319)
Dynamic perforation resistance (cone drop test)	40 mm (EN 918)
Geotextile characteristic opening size/O90	c. 0.15 mm/150 µm (EN ISO 12956)
Chemical properties	Resistant to chemicals and micro-organisms, non-polluting for drinking water
Roll size	12.5 m x 2.4 m
Durability	To be covered within 2 weeks after installation. No deterioration after 25 years in natural soil having a pH value between 4 and 9 and a temperature of < 25 °C
CE conformability	DIN EN 13252 corresponding to the 4095 drainage standard and the DIN 18195 water-proofing standard

### DELTA<sup>®</sup>-FLORAXX TOP

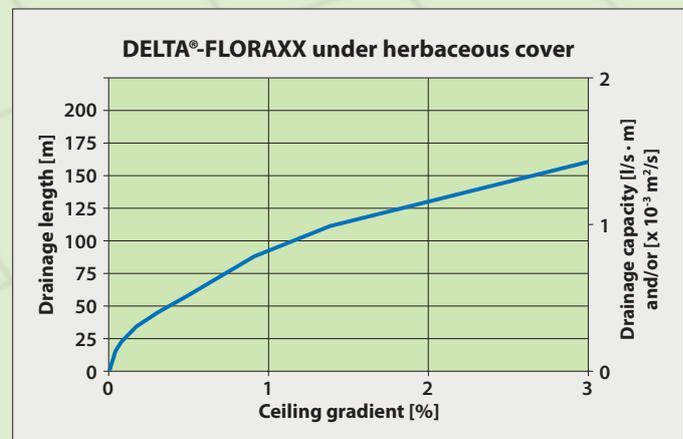
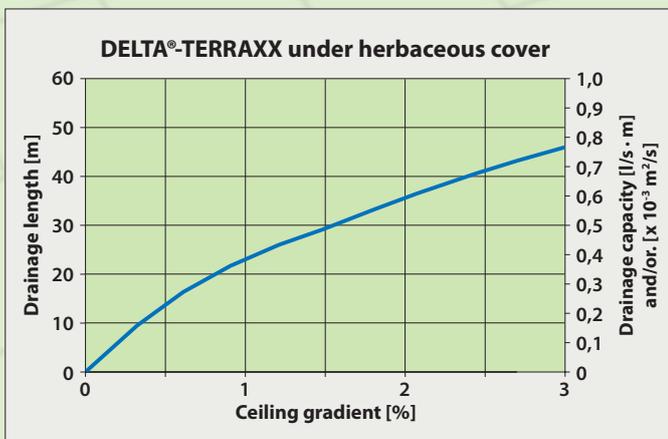
Dimpled sheet	High-density polyethylene, perforated, black
Filtration cloth	Fused-on PP geotextile, grey
Dimple height	c. 20 mm
Air gap	c. 14 L/m <sup>2</sup>
S <sub>d</sub> value	c. 0.4 m
Compressive strength (transient loading)	c. 200 kN/m <sup>2</sup> (EN ISO 604)
Compressive strength (permanent loading)	c. 50 kN/m <sup>2</sup> (EN ISO 604)
Drainage capacity, water flow capacity in the plane	10 · 10 <sup>-3</sup> m <sup>2</sup> /s (10L/s · m) (EN ISO 12958)
Vertical water flow capacity	c. 1.2 L/m <sup>2</sup> · s
Geotextile water permeability	c. 0.08 m/s (EN ISO 11058)
Water retention capacity	c. 7 L/m <sup>2</sup>
Service temperature range	- 30 °C to + 80 °C
Tensile strength	6.0 kN/m (EN ISO 10319)
Dynamic perforation resistance (cone drop test)	40 mm (EN 918)
Geotextile characteristic opening size, O90	c. 0.15 mm/150 µm (EN ISO 12956)
Chemical properties	Resistant to chemicals and micro-organisms, non-polluting for drinking water
Roll size	10 m x 2.0 m; cloth width: 2.10 m
CE conformability	DIN EN 13252, TBU test report 1.1/13525/0580.0.1-2009

### DELTA<sup>®</sup>-FLORAXX

Dimpled sheet	High-density polyethylene, perforated, black
Dimple height	c. 20 mm
Air gap	c. 14 L/m <sup>2</sup>
S <sub>d</sub> value	c. 0.4 m
Compressive strength	c. 200 kN/m <sup>2</sup>
Drainage capacity, water flow capacity in the plane	10 · 10 <sup>-3</sup> m <sup>2</sup> /s (10L/s · m) (EN ISO 12958)
Vertical water flow capacity	c. 1.2 L/m <sup>2</sup> · s
Water retention capacity	c. 7 L/m <sup>2</sup>
Service temperature range	- 30 °C to + 80 °C
Chemical properties	Resistant to chemicals and micro-organisms, non-polluting for drinking water
Roll size	20 m x 2.0 m
CE conformability	DIN EN 13252, test report no. 1.1/13525/0394.01-2009

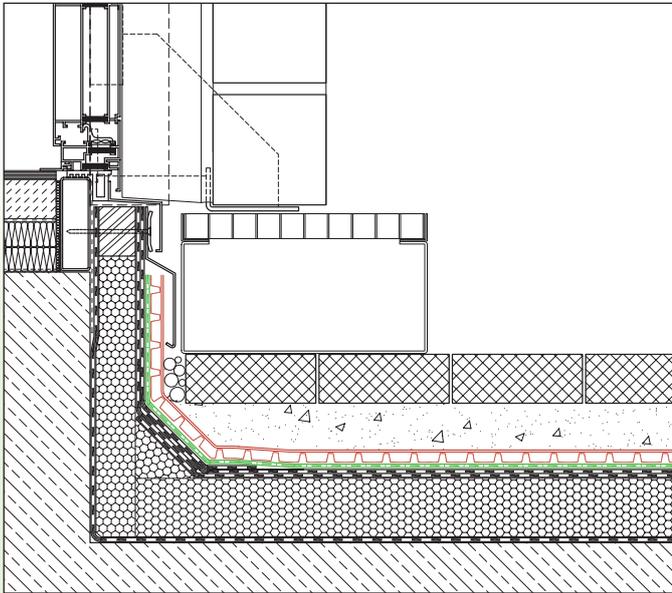
# Which DELTA®-System fits what application?

Application	DELTA®-FLORAXX	DELTA®-FLORAXX TOP	DELTA®-TERRAXX
Green roof			
Warm roof			
Intensive herbaceous cover		■	■
Extensive herbaceous cover		■	■
Inverted roof			
Intensive herbaceous cover	■	■	
Extensive herbaceous cover	■	■	
Roof decks used for traffic			
Warm roof			
Walkable surface			■
Drivable surface			■
Inverted roof			
Walkable surface	■		
Drivable surface	■		

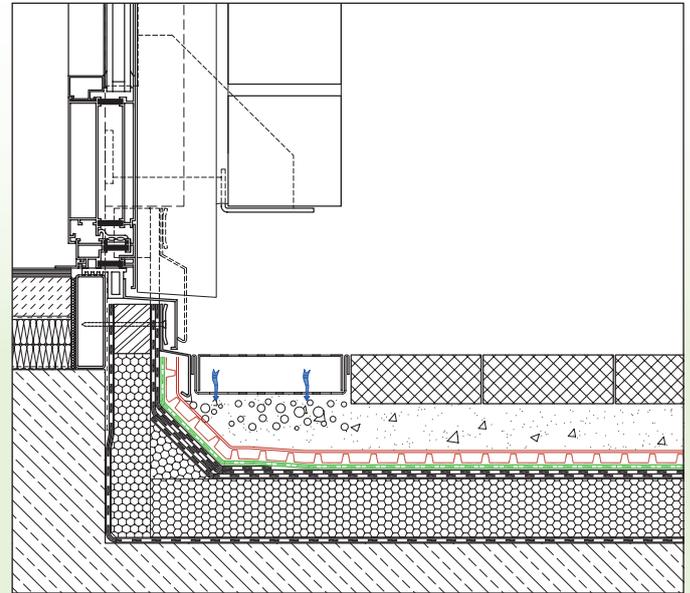


## Overview of technical detail solutions

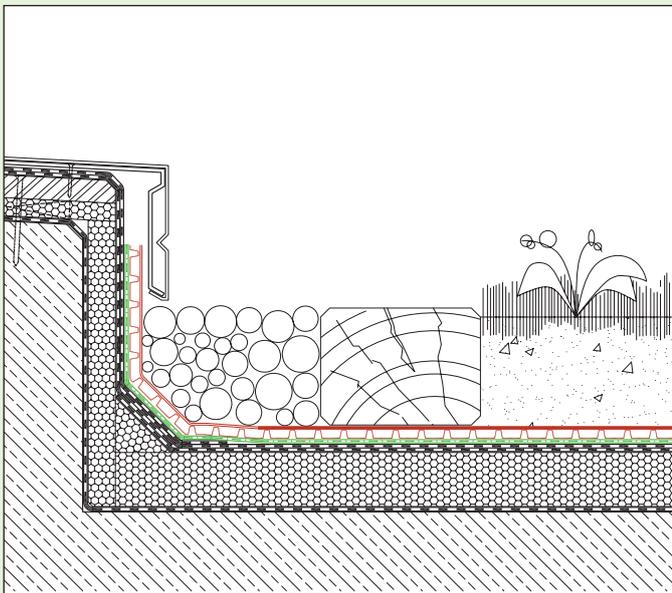
### DELTA<sup>®</sup>-TERRAXX



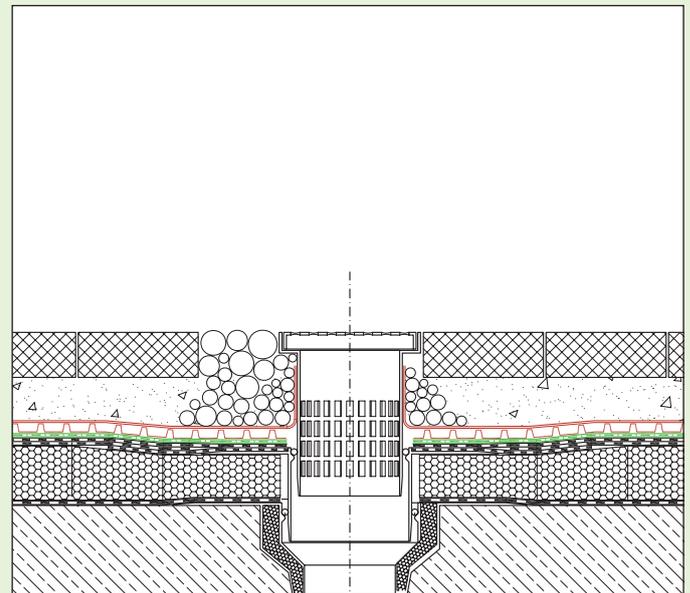
DELTA<sup>®</sup>-TERRAXX – accessible roof paved with stones or slabs.  
Connection to a door with an outside step. Splash guard height: 15 cm.



DELTA<sup>®</sup>-TERRAXX – accessible roof paved with stones or slabs.  
Connection to a barrier-less door with an outside box gutter.

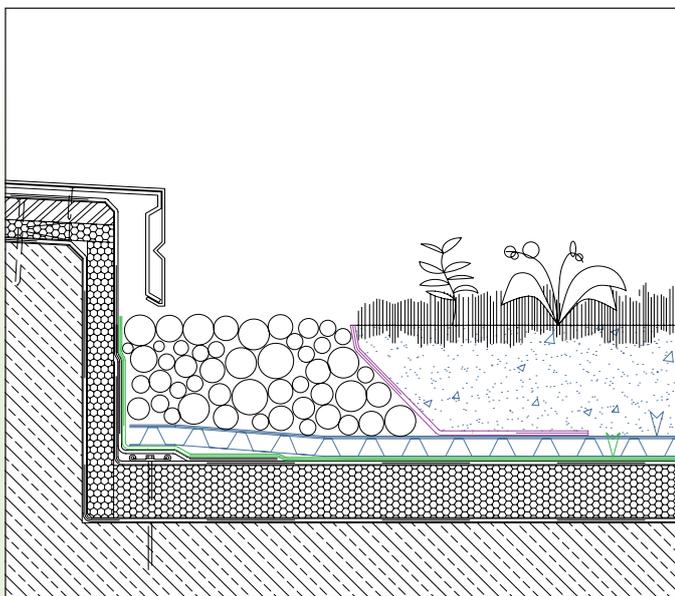


DELTA<sup>®</sup>-TERRAXX – fascia with metal cover.

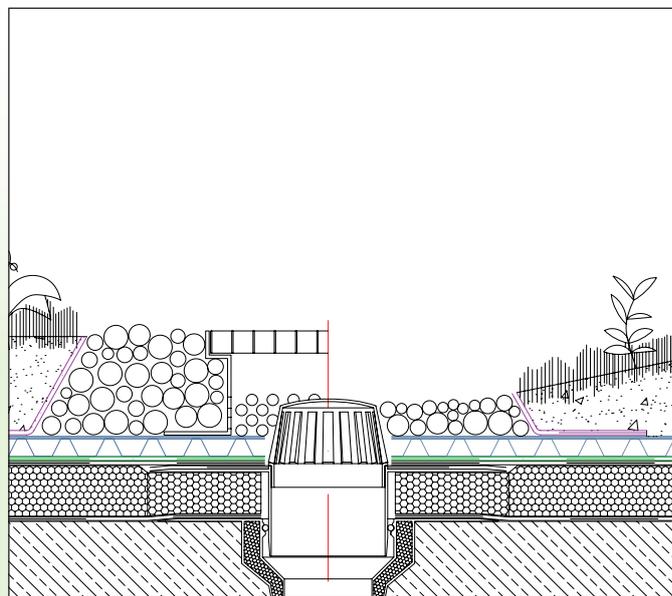


DELTA<sup>®</sup>-TERRAXX – accessible roof paved with stones or slabs.  
Roof drain connection.

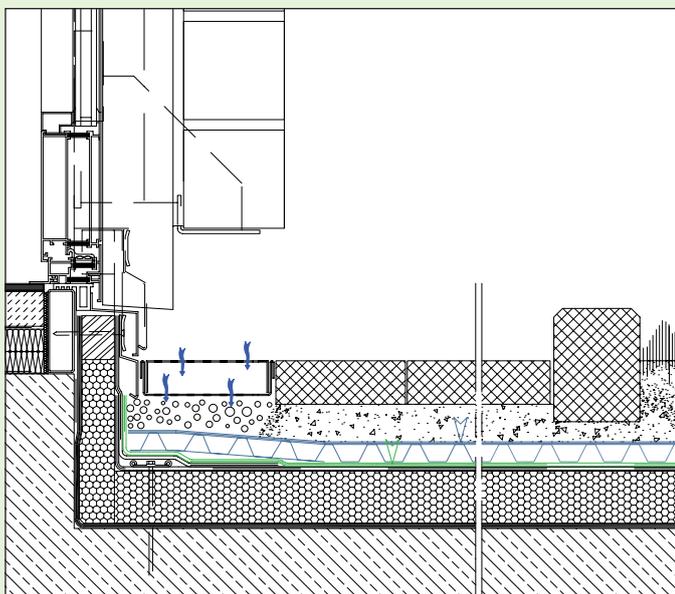
## DELTA®-FLORAXX TOP/DELTA®-FLORAXX



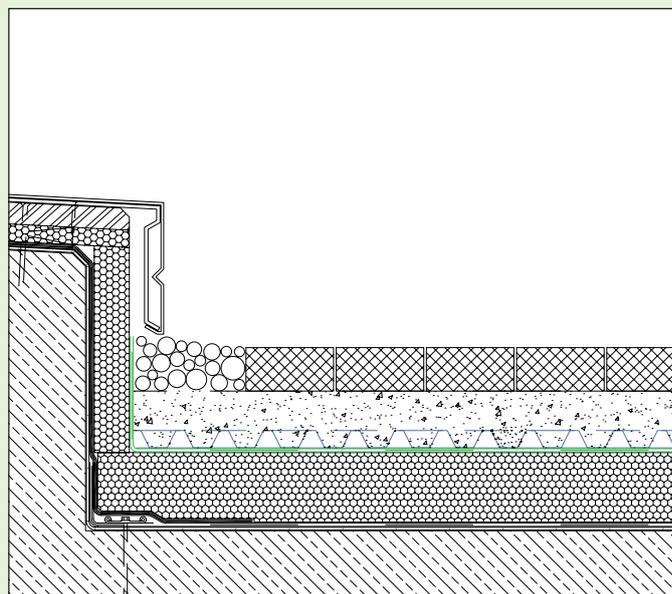
DELTA®-FLORAXX TOP – fascia with metal cover.



DELTA®-FLORAXX TOP – roof drain connection.



DELTA®-FLORAXX TOP – connection to a barrier-less door with an outside box gutter.



DELTA®-FLORAXX – accessible inverted roof paved with stones or slabs.  
Fascia with metal cover.

# DELTA® Information

about protection and drainage systems for horizontal applications.

## Technical planning

Valuable explanations about how the various DELTA®-Systems may be used to protect buildings, cellars, underground parking lots, and tunnels effectively from damp and water.



## Technical Guide

DELTA®-TERRAXX for horizontal applications.



Standard requests for tender as well as **detailed installation instructions** for all DELTA® products may be obtained at [www.doerken.com](http://www.doerken.com) as pdf files for you to print out and save.

# DELTA®



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