DELTA® System

DELTA® protects property. Saves energy. Creates comfort.

DÖRKEN

Technical Guide

DELTA® protection and drainage systems for horizontal application.

PREMIUM QUALITY

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

Developed from innovative ideas and made in modern production facilities: The top-quality products offered by Dörken GmbH & Co. KG for foundation protection, drainage, and waterproofing set standards for reliability, durability, and energy conservation. Located in the Westphalian town of Herdecke, the company traditionally offers its clients high-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 tradesmen.

TESTED DELTA® QUALITY Certified DIN ISO 9001

All our drainage products, DELTA®-NP DRAIN, DELTA®-DRAIN, DELTA®-TERRAXX, DELTA®-GEO-DRAIN Quattro, DELTA®-GEO-DRAIN 800 TP conform to the requirements of the CE sign and those of the EN 13252 standard (Certificate No. 0799-CPD-13).

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Stringent Requirements in Horizontal Applications.

Large flat roofs and ceilings covering underground parking lots and buildings need not remain unused. They are ideal for performing more useful functions as traffic routes, playgrounds, or leisure areas as well as for creating extra parking space. When partially or entirely planted with a herbaceous covering, such areas may improve the microclimate in residential areas to a marked extent. In such cases, any water delivered by precipitation or possibly building run-off must be conducted away safely both at the surface and in the waterproofing layer below, and a high-performance drainage system is needed even within these structures. Otherwise, stagnant water might destabilise the subgrade of traffic areas, plants might be damaged when their soil becomes waterlogged, and the whole might constitute an additional burden on the waterproofing system itself. Commercial mineral drainage systems consisting of gravel or chippings will meet these requirements only at great expense. Not only is there a danger of such structures becoming clogged up by sludge and gradually losing their drainage capability, in consequence, the requisite minimum thickness of such a layer constitutes a handicap for planners and a static cost factor that must be taken into account.
DELTA® branded drainage sheets offer an economical alternative in these applications. The material combines low thickness with a high protective effect, a large drainage capacity, permanently stable filtration, high compression resistance, and outstanding durability.

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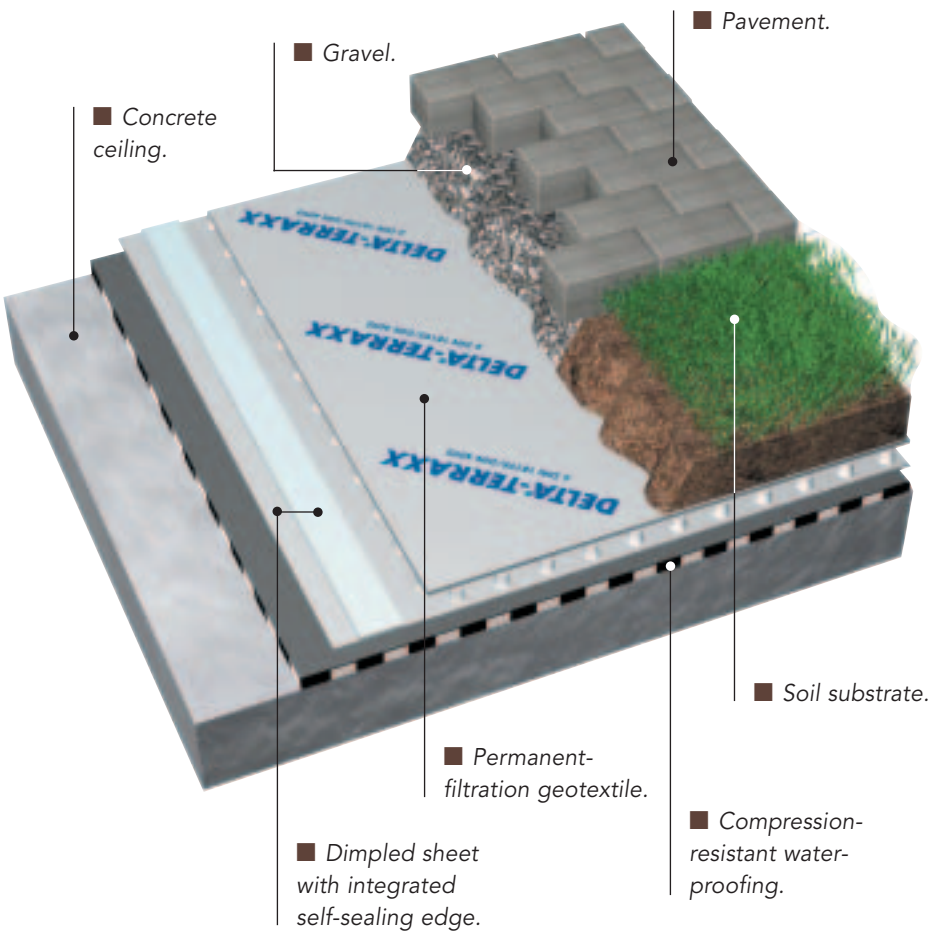
DELTA®-TERRAXX – the All-round Solution for Outstanding Protection.

DELTA®-TERRAXX an extremely robust protection and drainage system, has been optimised for different applications in horizontal drainage. Consisting of a dimpled sheet with a fused-on geotextile, the composite material forms a highly effective drainage layer: Facing up, the geotextile acts as a filter protecting the air gap created by the dimpled sheet underneath. Under a covering of gravel, chippings, or soil, the heat-bonded permanent-filtration geotextile keeps the dimple structure from being clogged up by sludge, thus ensuring that any excess water is drained away completely and freely. Its integrated self-sealing edge makes the dimpled sheet easy to lay out and helps to prevent root penetration. The smooth backing of the material ensures that any impinging loads are distributed evenly across the waterproofing surface. Thus, DELTA®-TERRAXX makes it safe for workers to walk on any compression-resistant waterproofing layers during the construction phase, at the same time protecting the waterproofning from mechanical damage and harmful exposure to heat.



DELTA®-TERRAXX is a powerful foundation for safe surface drainage.

The advantages of DELTA®-TERRAXX at a glance:

- Reliably protects and insulates waterproofing layers against mechanical damage.
- Withstands extreme compression loads of 400 kN/m² (up to type-60 heavy trucks, depending on the covering).
- High drainage capacity prevents frost damage and encrustations.
- Water-vapour pressure is drained away through the structure.
- Water drainage capacity exceeds that of gravel or chipping layers.
- No obstruction by sludge underneath the covering layer.
- Good load distribution prevents point loads on the waterproofing layer.
- Resultant static building loads lower than those of gravel layers.
- Easy and cost-efficient installation.

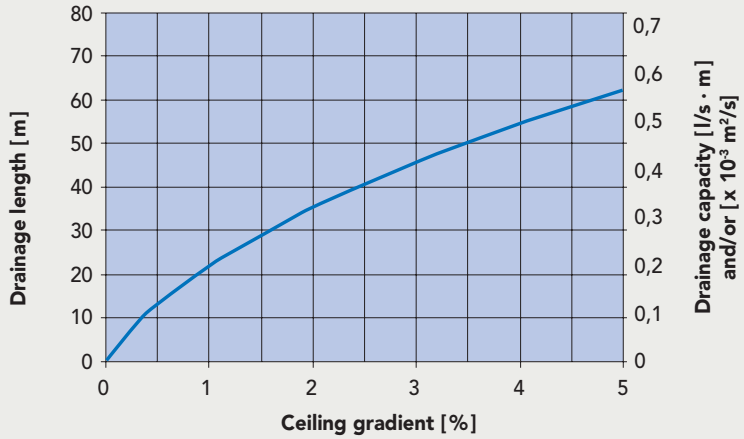
Horizontal Drainage Layers.

Parking decks.
Before a waterproofed parking deck can be paved with concrete, a drainage layer must be installed. This is done by laying out DELTA®-TERRAXX drainage sheeting on the waterproofed surface of the parking deck and applying the steel reinforcements on top, held in place by spacers. Once this is done, the concrete paving may be poured on directly. When installed, DELTA®-TERRAXX forms a drainage layer which keeps frost from damaging both the waterproofing and the pavement by preventing accumulations of water that might cause harm to these layers.

Walkways and flagstones.
Under superstructures covered with paving stones or slabs, a drainage layer covering the entire surface will carry away safely and without delay any rainwater that may seep into the structure. In a layer of gravel or chippings, whose drainage capacity is limited, water may accumulate, expand as it freezes, and push the pavement upward. Even the waterproofing layer may be damaged by frost in these cases. When DELTA®-TERRAXX is used, such damage can be avoided, and clogged-up gravel or chipping layers become a thing of the past. The regulations for the roofing trade similarly demand walk-on surfaces in Sect. 4.7.2.2: In roof terraces, for example, drainage layers must be included to ensure that any water impacting the waterproofing is drained away effectively. This drainage layer must be laid out on the waterproofing, after which it may be covered directly with sand, gravel, or chippings and topped with paving stones or slabs.

Soil-covered ceilings.
DELTA®-TERRAXX also prevents water accumulations on soil-covered waterproofed ceilings. Any excess rainwater that cannot be stored in the vegetation layer is absorbed and carried off by the drainage layer across the entire surface, with the geotextile reliably preventing minuscule particles from penetrating into the drainage level.
When covered with soil, DELTA®-TERRAXX will support wheeled loaders during the construction phase, and the completed surface will even bear the weight of heavy fire engines, given a thick enough soil covering (see table on page 9).

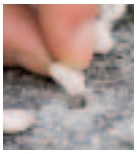
DELTA®-TERRAXX
Drainage capacity under a herbaceous roof



The diagram shows the drainage capacity of DELTA®-TERRAXX under a common load of 20 kN/m² in relation to the ceiling gradient. Thus, for example, the drainage capacity is 0.32 l/s · m at a gradient of 2 % (maximum length: 30 m), soaring to 0.42 l/s · m at a gradient of 3 % (maximum length: ca. 42 m). The resultant drainage lengths are based on the specifications of DIN 1986-100, Sect. 9.3.2.: To arrive at the drainage length, the rainfall yield (commonly 0.03 l/s · m) is multiplied by a reduction factor (0.3 in the case of soil substrates).

Protection and drainage of gravel-covered flat roofs.

In conventional flat roofs, where the top protective covering consists of a layer of gravel, the top layer of waterproof sheeting is generally sheeted with PE material. However, these thin sheets afford no protection whatever from mechanical damage that might be inflicted on the waterproofing layer by gravel splinters, maintenance activities, or other external influences.



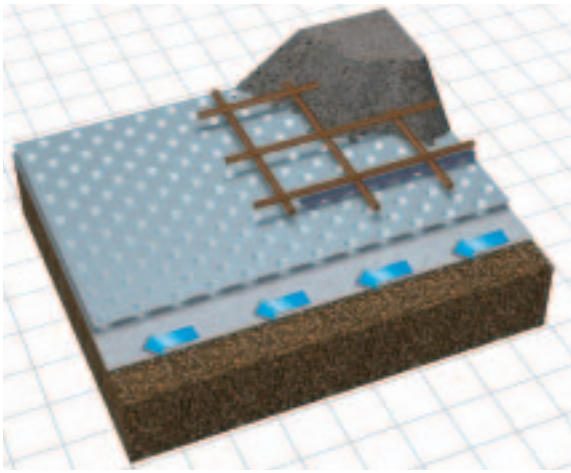
Especially gravel that has been extracted 'pneumatically' is very likely to contain a higher proportion of fragments due to relatively high impact speeds during extraction, so that a robust protective layer becomes indispensable. This is another problem which DELTA®-TERRAXX may help to solve. Laid out under gravel, the material forms a highly effective and cost-efficient protective layer. In addition to offering optimum protection to the skin of the roof, the sheets form an extremely efficient surface-drainage layer: Even after a gravel layer has become clogged up by sludge over the years, DELTA®-TERRAXX will reliably carry away any water above the waterproofing, thus permanently preventing the formation of water accumulations.

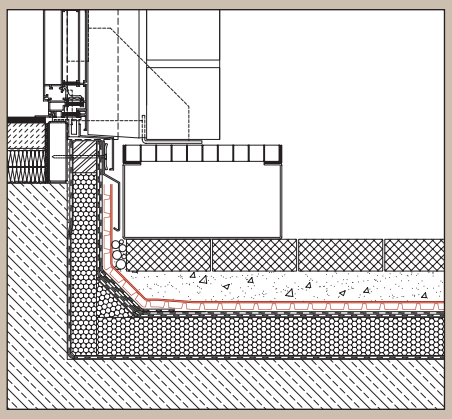
Horizontal drainage below foundation slabs.

When a building is erected on a slope, the excavation often cuts into the aquifer. If the water emerges below the foundation slab, it must be drained off, not only to keep hydrostatic pressure form building up but also to avoid a negative impact on the water regime. To keep the impact on the natural behaviour of aquifer water to a minimum, an efficient drainage system below the foundation slab is indispensable.

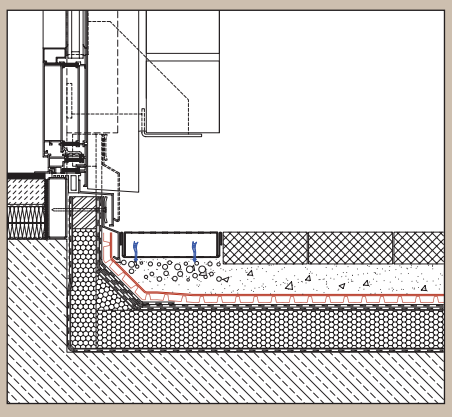
In this instance, DELTA®-TERRAXX may constitute an alternative with a markedly better performance than a conventional horizontal drainage system consisting of a 30-cm mineral layer.

DELTA®-TERRAXX acts as a sub-base course, at the same time separating the foundation slab from the moist subsoil. Once the drainage sheets have been laid out with the cloth side facing downward, concrete may be poured on. The drainage capacity of the sheet will not change because the dimples are filled with concrete. Cement paste cannot seep into the ground when the concrete is poured. Drain pipes must be integrated in the continuous footing to catch and carry the aquifer water.





Accessible roof covered with paving stones or slabs. Connected to a door with an outside step. Splash guard height: 15 cm.

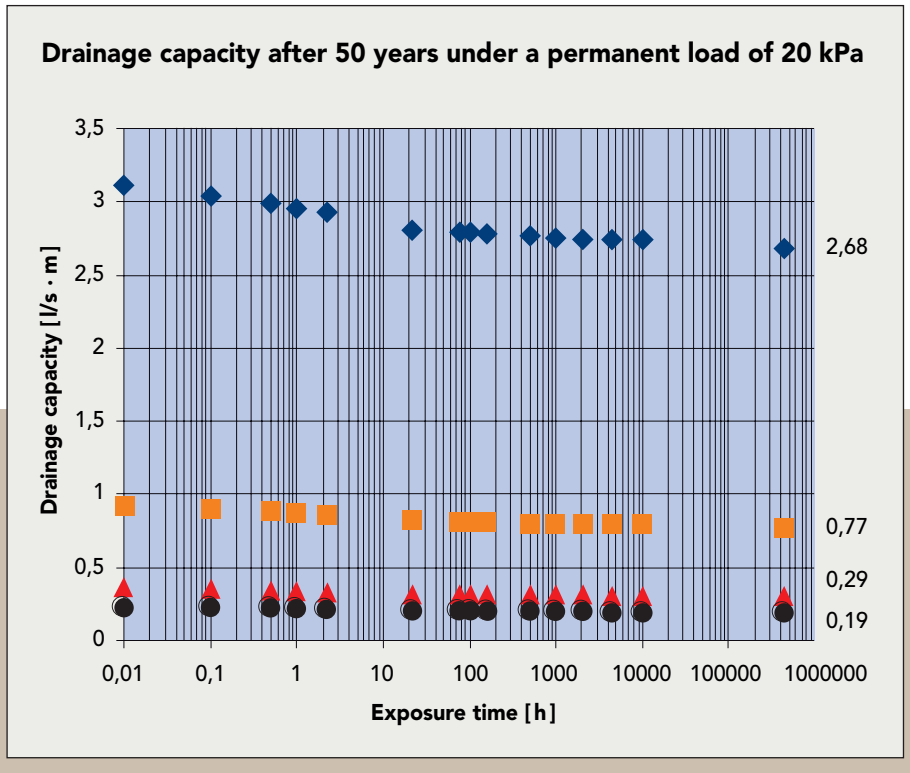


Accessible roof covered with paving stones or slabs. Connected to a barrier-less door with an outside box gutter.

Certified Safety under Permanent Loading.

To judge which drainage system is suitable for a certain application, it is crucial to consider not only its vertical but also its horizontal drainage capacity. All commercial drainage elements undergo compression over time to an extent that depends on the nature of the system and the structure. At all events, planners must feel certain that the drainage system selected will remain functional over prolonged periods, and that its safety is documented.

For this reason, the creep strength of both DELTA®-TERRAXX and DELTA®-GEO-DRAIN Quattro was investigated by a reputable materials-testing institute to see how their drainage capacities are modified by exposure to a permanent load of 20 kN/m² over a period of 50 years. The result is highly convincing: In vertical applications, both drainage sheets display an outstanding drainage capacity of 3.1 l/s · m on installation, which diminishes only slightly to 2.68 l/s · m after 50 years' exposure to a load of 20 kN/m². Laid out horizontally under a burden of 20 kN/m², the performance of the two sheets is no different: Installed on a gradient of 10 %, their initial drainage capacity is 0.91 l/s · m, declining to 0.77 l/s · m after 50 years. On a 2 % gradient, their drainage capacity amounts to 0.35 l/s · m on installation, dwindling only minimally after 50 years to 0.29 l/s · m, ten times the value specified in the drainage standard DIN 4095, which is 0.03 l/s · m. The conclusion is that DELTA®-TERRAXX and DELTA®-GEO-DRAIN Quattro offer a maximum of security to planners, owners, and tradesmen.



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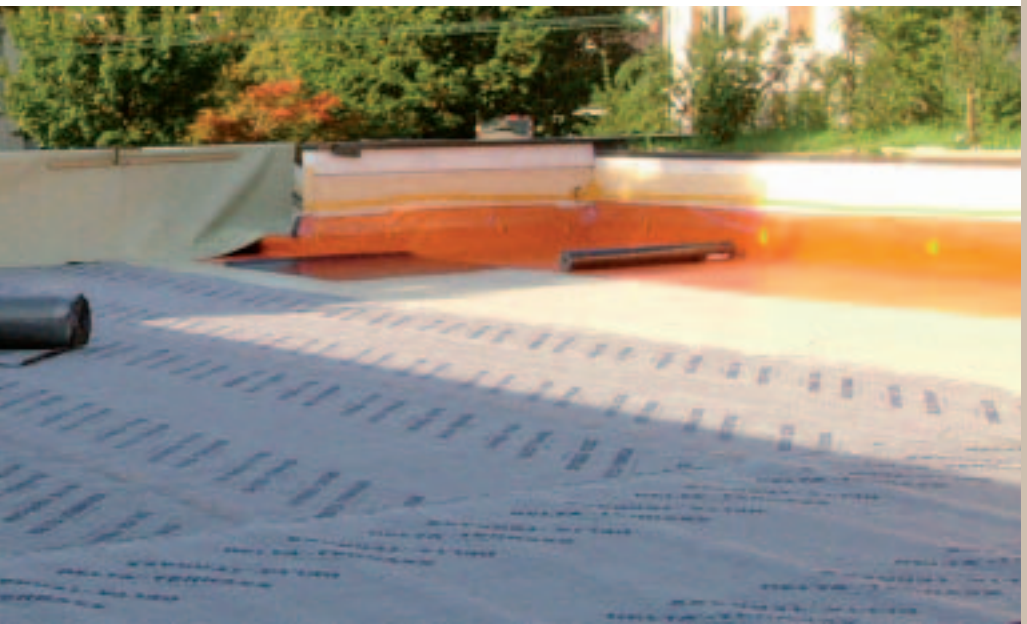
Fast and Easy Installation.

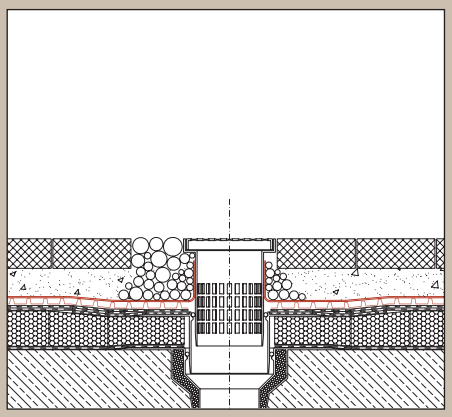
DELTA®-TERRAXX can be laid out quickly, safely, and cost-efficiently straight from the roll. Sheets are simply rolled off on top of the waterproofing, with the permanent-filtration geotextile always facing up. One roll yields 30 m^2 of high-performance drainage in a single pass. The time required for laying amounts to no more than one minute per square metre. The drainage sheet should cover the entire waterproofing layer as well as the foot of any vertical element, such as a parapet or a wall. Exposed vertical surfaces should be protected from mechanical influences by sealing lips or similar accessories.

Finishing comes easy even where details are concerned. In the overlap zones, one edge of the sheet is free of dimples and equipped with a self-adhesive strip. To join a sheet to its neighbour, you merely need to lift up the geotextile and push the adjacent sheet underneath it. Then, you pull off the paper that covers the adhesive tape and glue the two sheets together. Once this is done, the sheets can no longer shift, and their edges cannot be raised up by wind.
Immediately after laying, the drainage sheets will easily bear the weight of a wheelbarrow or even a wheeled loader when covered with made ground, which should be at least 20 cm thick for a wheeled loader.

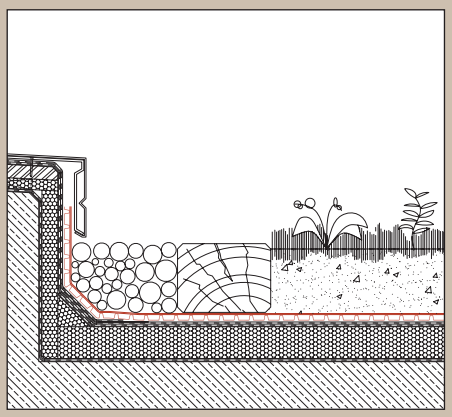
To bear the weight of a vehicle, the made ground should have the minimum thickness listed below:

Vehicle type	Ground thickness
Passenger car	≥ 10 cm
Truck 3/3	≥ 10 cm
Truck 6/6	≥ 15 cm
Truck 9/9	≥ 15 cm
Truck 12/12	≥ 20 cm
Truck 16/16	≥ 20 cm
Heavy truck 30	≥ 20 cm
Heavy truck 60	≥ 35 cm

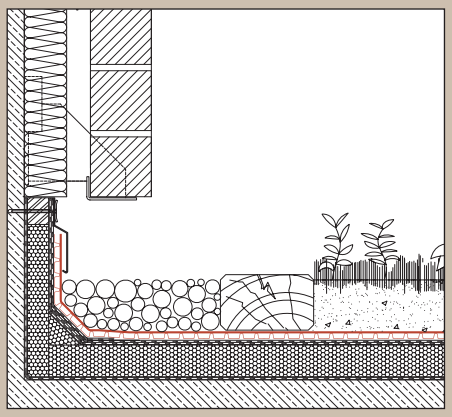




Accessible roof covered with paving stones or slabs. Roof drain connection.



Herbaceous roof detail – fascia with metal cover.



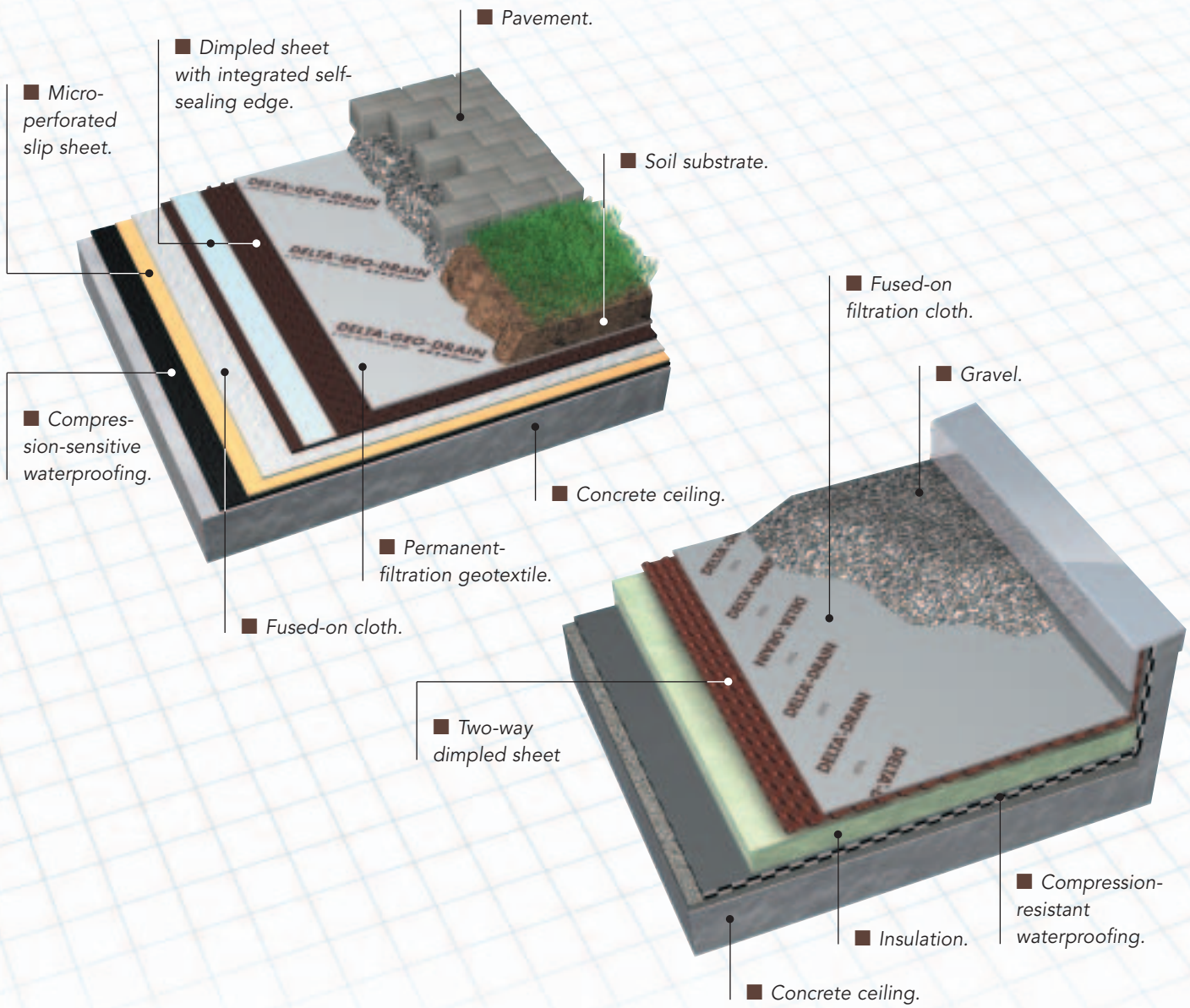
Herbaceous roof detail – connection to a double-shelled masonry structure.

(For further detail drawings of horizontal applications, visit us at **www.doerken.de**)

Protection of Compression-sensitive Waterproofing and Insulation Boards in Inverted Roofs.

Waterproofing that is compression-sensitive such as, for instance, thick horizontal bitumen coatings calls for a special protection and drainage system. DELTA®-GEO-DRAIN Quattro, a four-ply sheet specifically developed for this end use, offers that special protection: Its slip-sheet backing protects the waterproofing layer and distributes the continuous pressure exerted by soil, gravel, and pavement covers.

DELTA®-DRAIN is used as a drainage system for insulation boards in inverted roofs. This sheet is remarkable for its two-way dimple structure which ensures unimpeded drainage both on the upper and the lower side of the sheet: While the dimples on the lower side prevent the formation of a continuous sheet of water on top of the waterproofing, those on the upper side, which face the soil, are equipped with a fused-on filtration cloth, thus forming another complete drainage layer.



Technical Data Overview.

DELTA®-TERRAXX ensures drainage and permanent filtration

DELTA®-GEO-DRAIN Quattro protects compression-sensitive waterproofing.

DELTA®-DRAIN is the ideal drainage system for insulation boards in inverted roofs.

Dimpled drainage sheets		DELTA®-TERRAXX	DELTA®-GEO-DRAIN Quattro	DELTA®-DRAIN
Dimpled sheet		HDPE silver	HDPE brown	HDPE brown, with two-way dimples
Filter cloth		PP grey	PP grey	PP grey
Micro-perforated slip sheet and cloth		–	PE yellow + PP white	–
Flat edge/self-sealing overlap edge		Yes/yes	Yes/yes	No/no
Dimple height		ca. 9 mm	ca. 9 mm	ca. 12 mm
Air gap		ca. 7,7 l/m²	ca. 7,7 l/m²	ca. 6,0 l/m²/side
Contact area dimples/ground		ca. 8.000 cm²/m²	ca. 10.000 cm²/m²	ca. 1.100 cm²/m²
Compressive strength (transient loading)		ca. 400 kN/m²	ca. 400 kN/m²	ca. 90 kN/m²
Compressive strength (permanent load.)		ca. 90 kN/m²	ca. 90 kN/m²	ca. 50 kN/m²
Installation depth		10 m	10 m	5 m
Service temperature range		-30 °C to +80 °C	-30 °C to +80 °C	-30 °C to +80 °C
Tensile strength	**EN ISO 10319**	6,0 kN/m	6,0 kN/m	6,0 kN/m
Dynamic perforation resistance (Cone drop test)	**EN 918**	40 mm	40 mm	40 mm
Opening size 090	**EN 12956**	150 µm	150 µm	150 µm
Roll size		12,5 m x 2,4 m	12,5 m x 2,0 m	12,5 m x 2,0 m
Hydraulic properties				
Drainage capacity without loading in l/s · m	**i = 0,02**	0,40	0,40	0,15
	i = 0,03	0,51	0,51	0,21
	i = 0,10	1,03	1,03	0,47
	i = 1,0	3,50	3,50	1,75
Drainage capacity with 20 kN/m² load in l/s · m	**i = 0,02**	0,32	0,32	0,14
	i = 0,03	0,42	0,42	0,19
	i = 0,10	0,84	0,84	0,42
	i = 1,0	3,10	3,10	1,50

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. **Accessories:** DELTA®-DRAINAGEVLIES separation and filter cloth to ensure the filtration function of drainage systems.

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.

Product prospectus
Detailed information about the two protection and drainage systems DELTA®-GEO-DRAIN Quattro (for thick coatings) and DELTA®-TERRAXX (for compressionresistant waterproofing).

DELTA®-foundation protection details
Design drawings showing foundation protection, drainage, and waterproofing systems are available at www.doerken.de in pdf format for you to print out and save. The same information is available on CD-ROM.

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