

4. PROPERTIES

High long-term drainage capacity

The ND 120 Drainage System exceeds the drainage requirements of the DIN 4095. With a drainage capacity of 2.0 l/(s.m) it exceeds the 0.3 l/(s.m) specified in the DIN at an installed depth of 3 m by several times. Even at a depth of 10 m the ND 120 Drainage System will meet the requirement.

The base material

The reason for the excellent drainage properties, at almost any practical installed depth, is the high impact polystyrene (HIPS) used in the manufacturing of the dimpled sheet.

The geometry

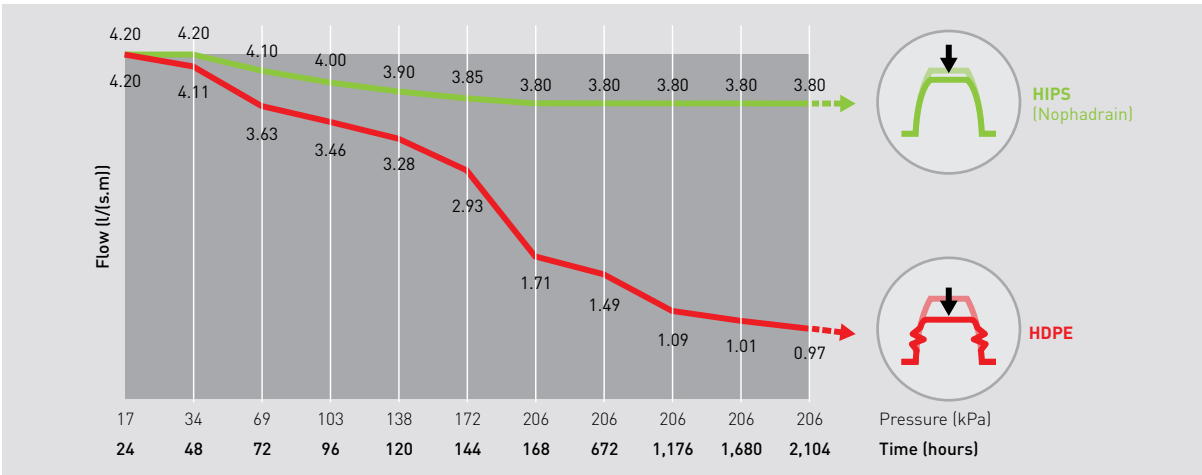
The structural geometry of the dimples has an essential influence on the mechanical properties of the ND Drainage System. The optimal shape of the dimples, formed as cones and the constant wall thickness of the dimples give the drainage system the very high compressive strength to withstand the horizontal and vertical soil pressures.

Compressive strength and creep resistance

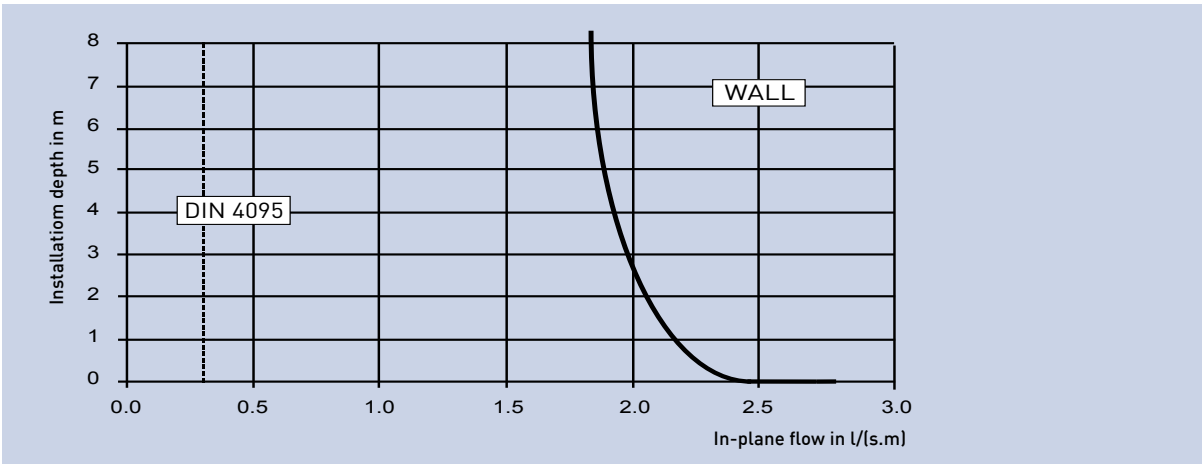
The compressive strength and the inherent creep resistance of high impact polystyrene (HIPS) against long-term loading are decisive factors for the long-term protection and drainage performance properties. The advantages of the combined structural geometry and physical strength of the base material are shown in the graph.

Drainage capacity ND 120 Drainage System

Installation depth	Pressure	Deformation %	In-plane flow
m	kPa	after 50 years	l/(s.m)
2	20	0	2.75
3	30	5	2.65
5	50	7	2.46
10	100	10	2.16
Exceptional case	200	16	1.77



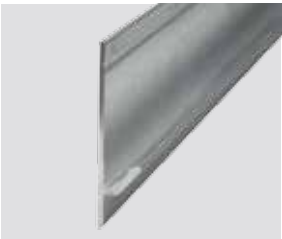
Graph: deliberate choice of materials – HIPS versus HDPE



Graph: ND 120 System measurement monogram

5. SPECIFICATIONS

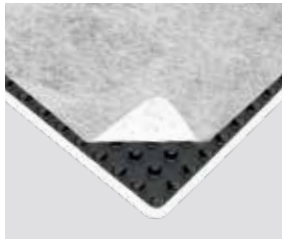
Product	Materials	Dimensions (L x W)	Weight	Packaging	Installation depth
1. ND "Clic" System-Profile			467 g/m	24 m	Up to 3 m
a. Wall profile	Aluminium	2,400 mm x 42 mm	213 g/m		-
b. Front profile	Aluminium	1,200 mm x 25 mm	254 g/m		-
2. ND 120 Drainage System	Plastic	32 m x 1.25 m	695 g/m²	40 m²	-
3. ND "Pix" Geotextile Fastener	Plastic	-	-	20 pcs.	-



1a. Wall profile



1b. Front profile



2. ND 120 Drainage System



3. ND "Pix" Geotextile Fastener

6. TESTING, STANDARDS AND GUIDELINES

- Nophadrain ND 120 Drainage System "Hydraulic testing per norm DIN 4095"
- Guidelines for the design and application of synthetically modified liquid bituminous waterproofing membranes
- DIN 18533 "Waterproofing of buildings and structures"
- Tests on the "Clic" Sub-Structure Drainage and Protection System installed against a waterproofed brick wall in combination with a heavy clay soil
- DIN 4095 "Drainage and protection of sub-structures"



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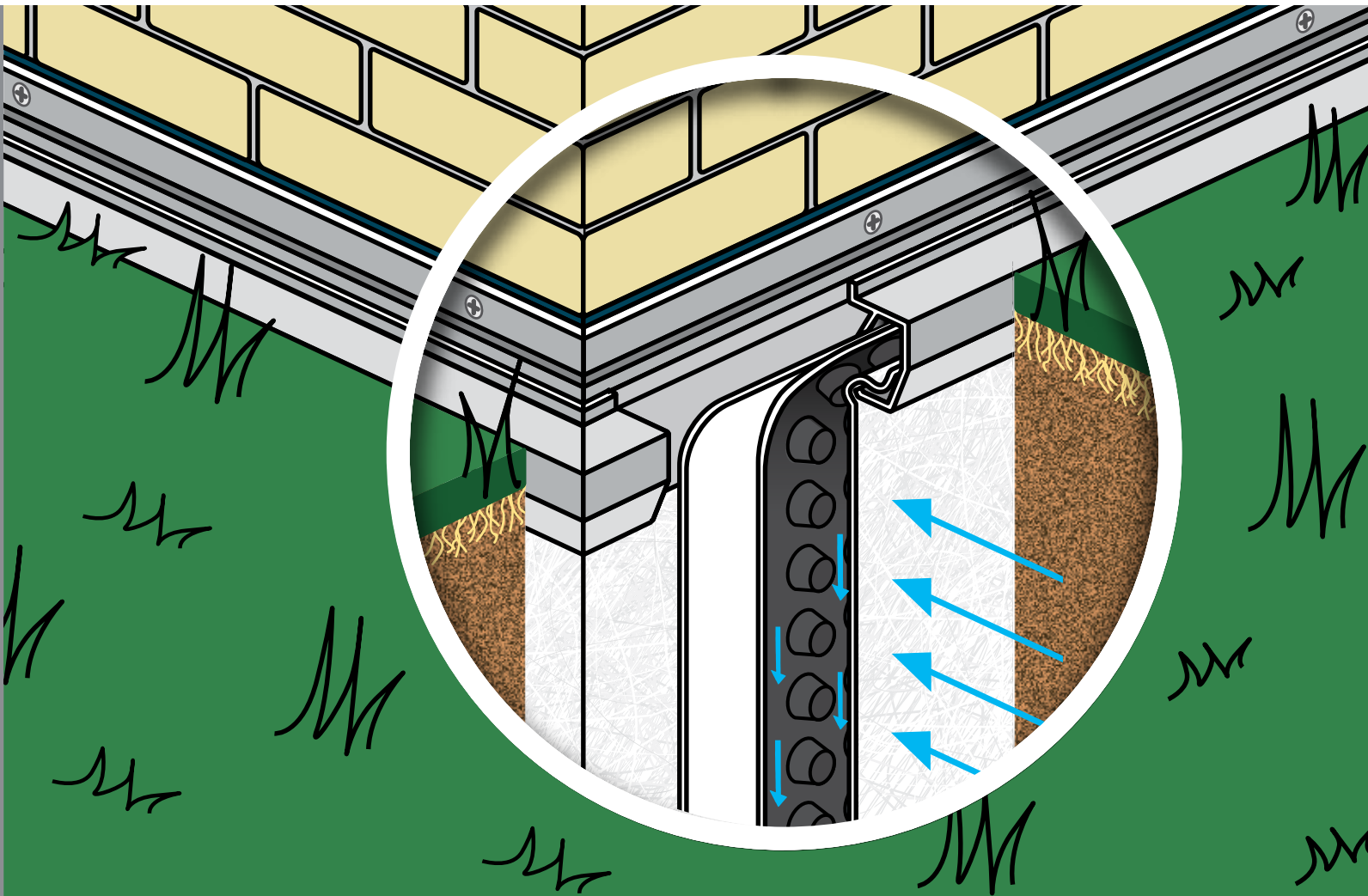
TESTED

DIN 18533 - "WATERPROOFING OF BUILDINGS AND STRUCTURES"

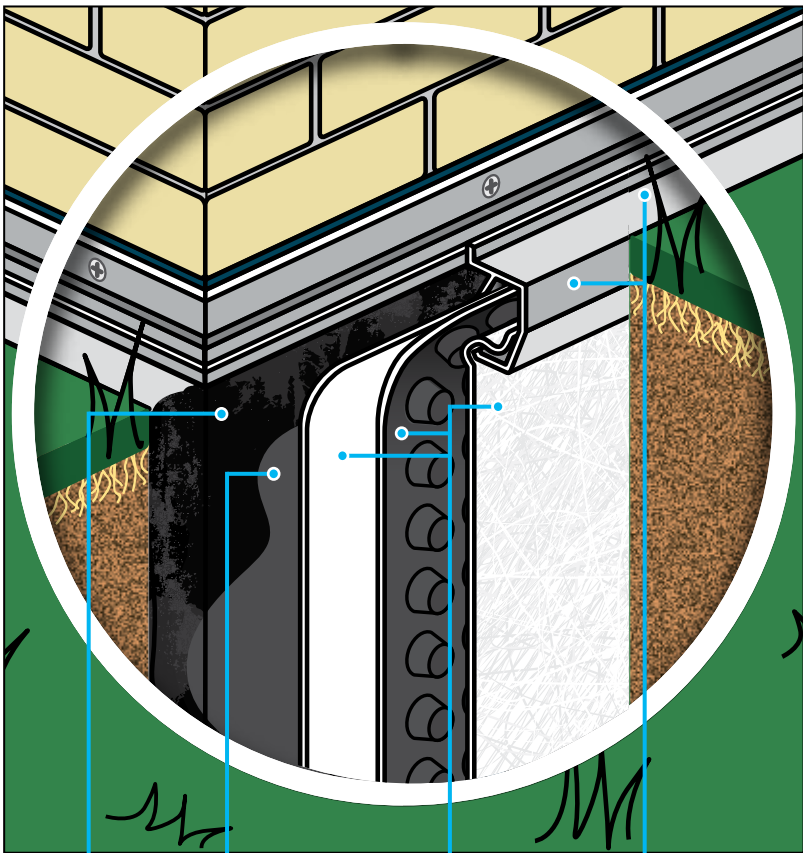
DIN 4095 - "DRAINAGE AND PROTECTION OF SUB-STRUCTURES"

GUIDELINES FOR THE DESIGN AND APPLICATION OF SYNTHETICALLY MODIFIED LIQUID BITUMINOUS WATERPROOFING MEMBRANES

ND "CLIC" SUB-STRUCTURE DRAINAGE AND PROTECTING SYSTEM



1. THE SYSTEM

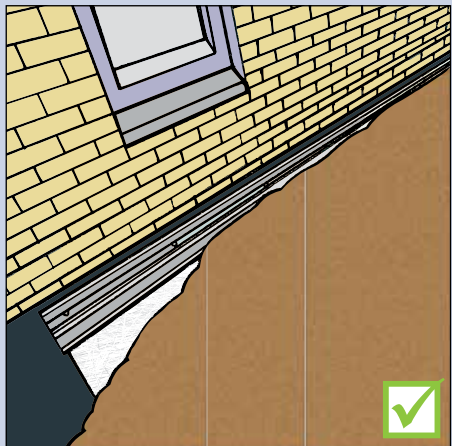


Do you also know those construction sites where the water-proofed sub-structure is not completely protected against mechanical effects despite the installation of a protection and drainage system? Stones or mortar residues then pass through an insufficient connection behind the protective layer, which damages the waterproofed sub-structure.

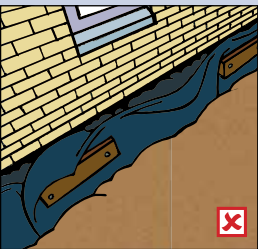
To ensure a permanent fixation of the protection- and drainage system for this structural detail, the ND "Clic" Sub-structure Drainage and Protection System was developed. The ND "Clic" system complies with the requirements of DIN 18533 - "waterproofing of buildings and structures" and DIN 4095 - "drainage and protection of sub-structures".

The ND "Clic" Sub-Structure Drainage and Protecting System consists of a high pressure resistant dimpled sheet with a special filter and sliding geotextile plus a stable pressure dividing slip film – ND 120 Drainage System – combined with a specially developed fixing and protection profile – ND "Clic" System-Profile.

2. OPERATING MODE



ND "Clic" System-Profile prevents ND 120 Drainage System from folding and sliding



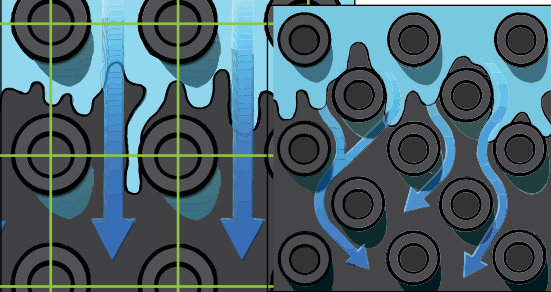
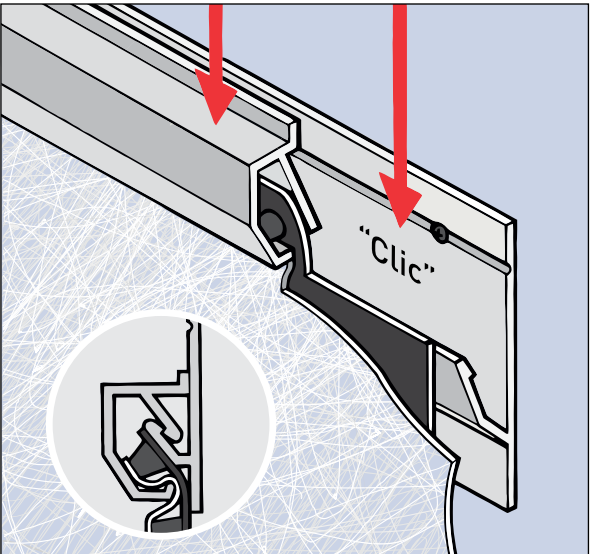
By using the ND "Clic" System-Profile the ND 120 Drainage System is quickly and securely installed against the water-proofed sub-structure. During construction the profile prevents mortar, broken bricks and other construction debris from entering between the ND 120 Drainage System and the water-proofing membrane. The waterproofing membrane is protected against mechanical damage from the start.

The profile permanently fixes the ND 120 Drainage System against the sub-structure at the finished level. During back-filling and compaction, as well as by future soil settlements, the profile prevents the ND 120 Drainage System from folding and sliding along the sub-structure damaging the water-proofing membrane. Any movement or settlement of the soil is transferred away from the waterproofing membrane along the special filter and sliding fabric of the ND 120 Drainage System.

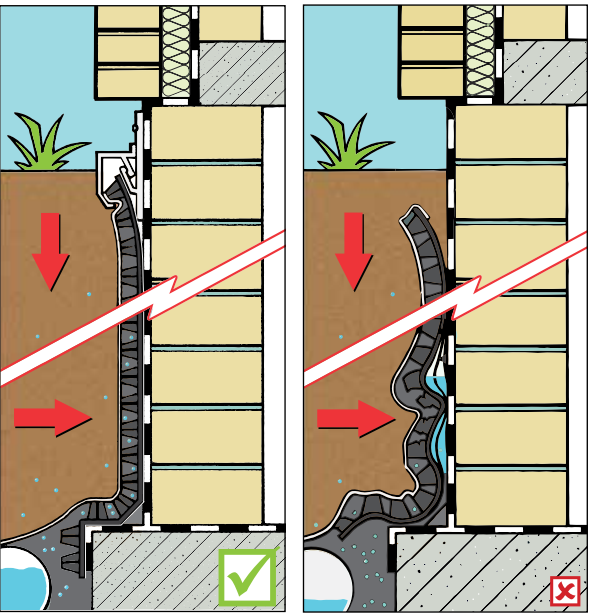
Testing by 'Pleyers Bauinstitut' as well as in the 'Institut für Bauforschung' of the RWTH Aachen (ibac) by Prof. Dr. Ing. H.R. Sasse, proved that permanent fixture of the drainage system against the sub-structure is necessary to protect the waterproofing membrane. If the drainage system is not fixed permanently it will lead to failure of the drainage system and subsequent damage to the waterproofing membrane.

The ND "Clic" Sub-Structure Drainage and Protecting System secures the drainage system permanently to the sub-structure guaranteeing continuous drainage capacity, and protection of the waterproofing membrane against mechanical damage as specified in the DIN 4095 and the DIN 18533.

3. SYSTEM DETAILS



Unobstructed water flow due to quadratic placement of the dimples



With ND "Clic" System-Profile

Without ND "Clic" System-Profile

ND "Clic" System-Profile

The profile is manufactured from a durable weather resistant aluminium. The chosen material and the special robust design of the profile, secure the ND 120 Drainage System to the sub-structure in such a way, that it can withstand tensile forces of more than 800 kg/m (equals an installation depth of 3 m).

A durable protection of the waterproofing membrane is guaranteed through all phases of construction and the life span of the sub-structure.

ND 120 Drainage System

The use of high impact polystyrene (HIPS) as a base material for the dimpled sheet gives the ND 120 Drainage System a high compressive strength.

Even when the material is put under high pressure over a longer period of time the dimples show minimal signs of creep and therefore provide a constant drainage capacity throughout its service life.

The manufacturing process developed by Nophadrain guarantees a constant wall thickness of each dimple. Together with the conical dimple geometry the drainage system achieves a high compressive strength to resist shear forces caused by backfill and soil settlements.

The quadratic placement of the dimples creates an unobstructed water flow and allows easy installation of the drainage system around external and internal corners of the sub-structure.

INSTALLATION

ND "Clic" Sub-Structure Drainage and Protecting System	Traditional Systems
Securing the ND "Clic" System-Profile against the sub-structure with hammer screws or similar proprietary fixings	Securing the drainage system against the sub-structure with screws or similar proprietary shot fired fixings, masonry nails, wood battens, hammer fixings screws, etc.
Hanging ("Clic") the ND 120 Drainage System in the ND "Clic" System-Profile	-
Backfill and compaction	Backfill and compaction
-	Removal of shot fired fixings, masonry nails, wood battens, hammer screws, etc.
-	Cutting the top of the drainage system in a straight line at the finished level
-	Installing covering profile at the finished level with hammer screws
The result: 1. Less material waste 2. Less labour costs 3. Simple and secure installation 4. Fulfills the requirements as specified in the DIN 18533 and the DIN 4095	-

ND "Clic" Sub-Structure Drainage and Protecting System compared to traditional installation

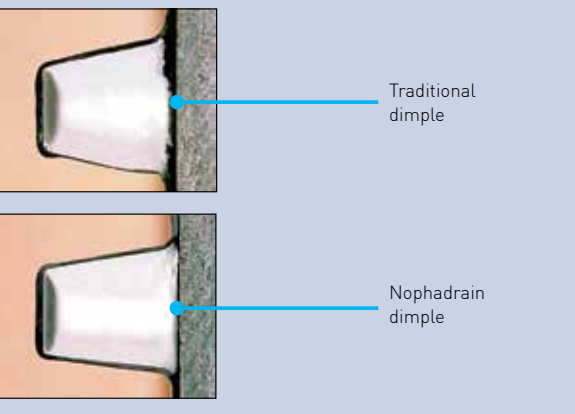
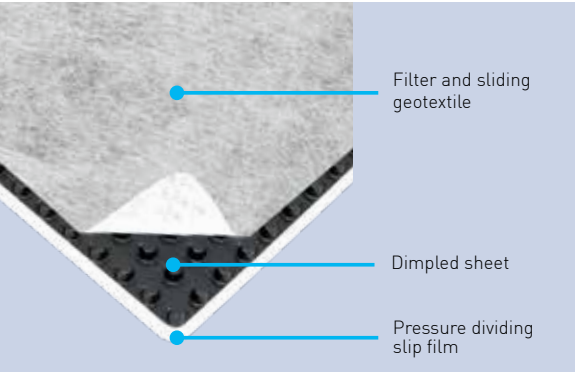
The special pressure dividing slip film prevents transfer of loadings from soils avoiding indentation or extrusion of the waterproofing membrane. The waterproofing membrane keeps its optimal thickness in accordance to the manufacturer's specifications.

The stable filter and sliding geotextile prevents clogging of the dimpled drainage system. Furthermore, any movement of the backfill caused by compaction or settlement is transferred along the filter and sliding fabric of the ND 120 Drainage System away from the waterproofed sub-structure.

The filter and sliding geotextile is glued to each dimple of the ND 120 Drainage System with special pressure sensitive hot melt glue. This prevents the filter and sliding fabric being distorted by the backfill into the flow channels of the ND 120 Drainage System obstructing the required drainage capacity.

During installation the pressure sensitive glue allows the filter and sliding geotextile to be peeled off easily. The filter and sliding fabric can be re-attached to the dimples by simple hand pressure.

The choice of high impact polystyrene (HIPS) as base material in combination with the manufacturing process and the geometry of the dimples provides a long-term guarantee for the protection and drainage of the sub-structure.



Cross section of the dimples