



GODELMANN
MASTERS OF STONE

The Climate Stone
Water-sensitive urban planning







Added value for our cities

The GODELMANN brand has always been a step ahead of its time. That's why, 40 years ago, we committed ourselves to environmental protection with innovation and courage. We have now developed a very special paving stone to reflect this stance. It combines all the know-how that GODELMANN has developed over 40 years in its pursuit of sustainability - for maintaining the quality of life in cities.



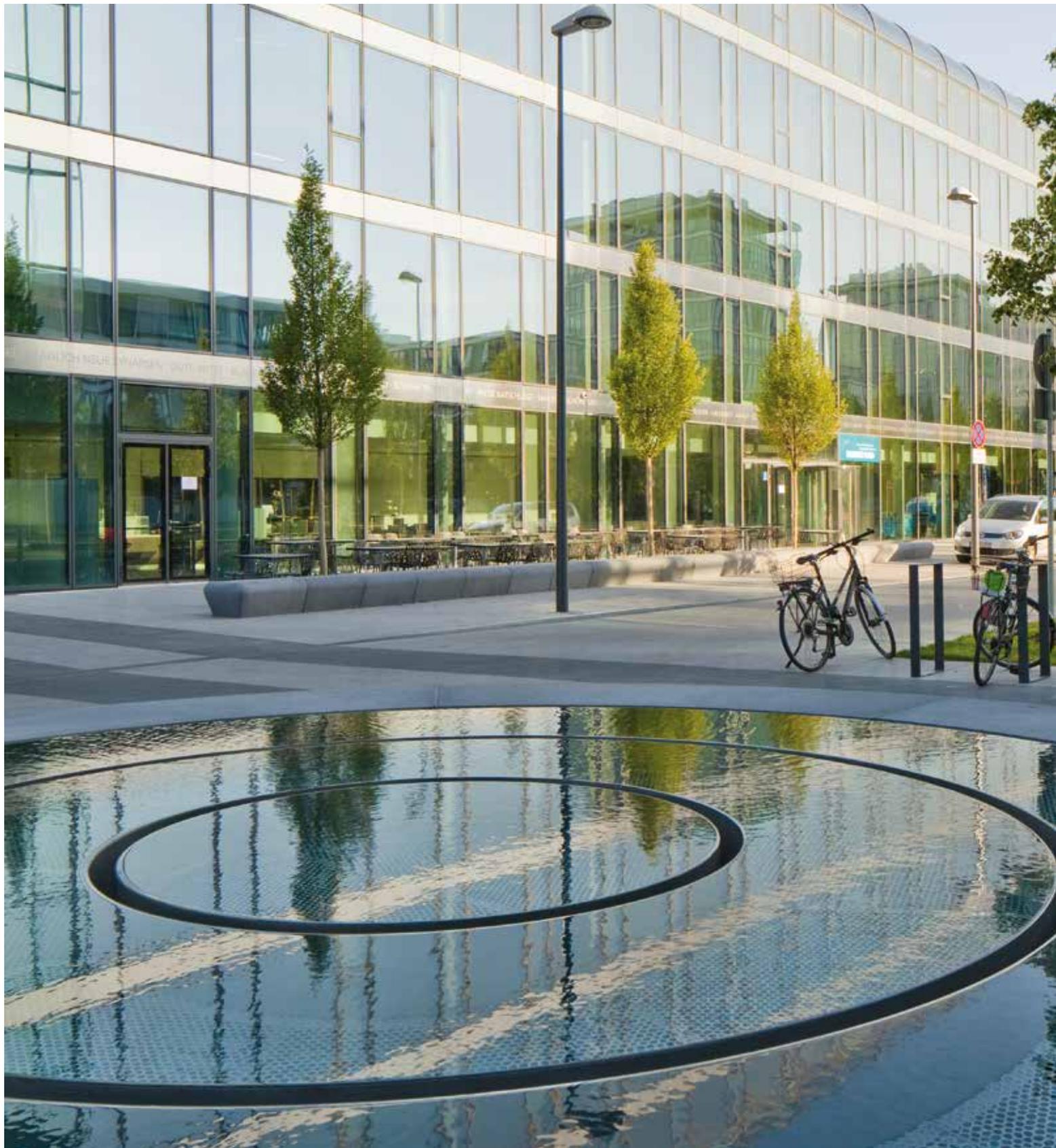
Bundespreis
ecodesign
nominiert 2014

NOMINEE



German
Sustainability
Award 2021

Silvia and Bernhard Godelmann





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Our environmental policy

Sustainability as a matter of principle

We want our concrete products to be ever greener. That is why we consistently focus on CO₂ reduction, energy-efficient processes and resource-saving production and recycling. Our commitment is based on these three pillars.

1 GODELMANN is certified according to ISO 50001:2018¹. This leads to ongoing improvements in energy efficiency with a corresponding reduction in energy consumption and CO₂ emissions. The process is regularly evaluated and reviewed.



2 Energy-intensive industries cannot produce completely CO₂-free. We have therefore decided to offset unavoidable emissions by voluntarily supporting environmental protection projects and purchasing CO₂ certificates. As a result, our company became certified as climate neutral in 2015².



3 We produce in circular flow according to the Cradle to Cradle principle³. All materials can be reused after initial use or recycled without harmful residues. The material quality is retained over several product life cycles (no downcycling)

To have your construction project certified as sustainable, you'll need a life cycle assessment showing the environmental impact of the building materials used. Our concrete paving stones come with the corresponding Environmental Product Declaration⁴ (EPD).



WHAT ELSE WE DO

- regular review of our CO₂ footprint
- heat and energy recovery
- closed water circulation using rainwater
- taking back used materials for recycling purposes
- use of photovoltaics, additional electricity from renewable energies
- short transport routes, over 80% of raw materials from the region
- vehicle fleet conversion to electric and gas

Urban **space** **development** faces enormous **challenges.**

"The loss of soil resources through urbanisation and the conversion of our landscape is one of the major environmental challenges facing Europe. There is an urgent need to use this valuable resource more wisely in order to secure its many vital services for future generations. We simply cannot pave over our chances for a sustainable future."

Environment Commissioner Janez Potocnik, April 2021



Disturbed water balance
Groundwater scarcity
Groundwater pollution
Heat stress
Air pollution
Noise pollution
Local flooding
Cost of sewage systems



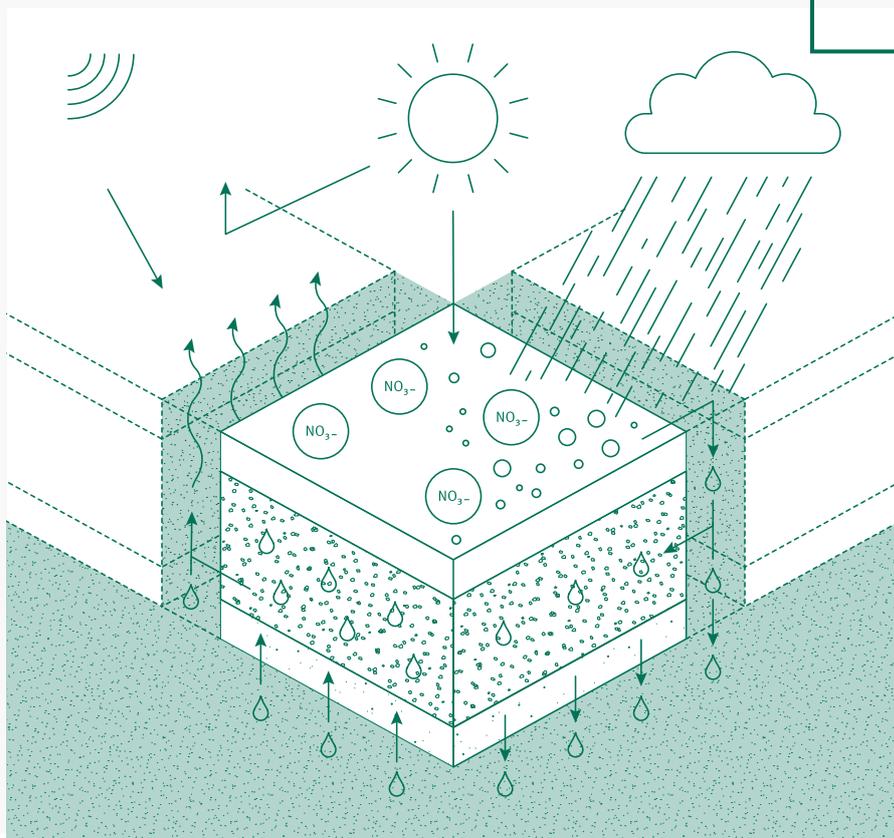
Climate protection is more important for our future than anything else - we are preparing the ground for this. With the Climate Stone as a paving stone, sealed surfaces are given climate-friendly properties that previously seemed unthinkable.

Thanks to its three-layer structure, the Climate Stone achieves a significantly higher evaporation rate and ensures reliable groundwater protection. In addition, it is a fully recyclable system based on the Cradle to Cradle principle.

In the latest evolutionary step at Godelmann, the Climate Stone combines our extensive expertise in resource efficiency and sustainability in one product.

We have reinvented the paving stone.

**Climate
protection
through
innovation**





Systematic surface paving

It's a paradox: everyone is talking about environmental protection and climate change. But the daily land consumption for settlements and traffic was still around 56 hectares in 2020.

About half of the areas will be permanently paved. Here the rainwater does not feed the groundwater, but instead mainly channels and surface water.





New perspectives for the city

Developed and paved areas must contribute to a positive urban climate. The Climate Stone provides new answers to the most pressing questions. With it, the soil can be reclaimed as a natural resource. The small-scale moisture balance after development is much closer to that of undeveloped areas.



CLIMATE RESEARCH PERSPECTIVE

We live in the Urban Age. Drought and heat stress affect the urban climate. Torrential rain occurrences are increasing. Time for a new post on paving surfaces. Time for paving stones that achieve a significantly higher evaporation rate, almost as high as a meadow, and on top of that can do even more for the city of the future.



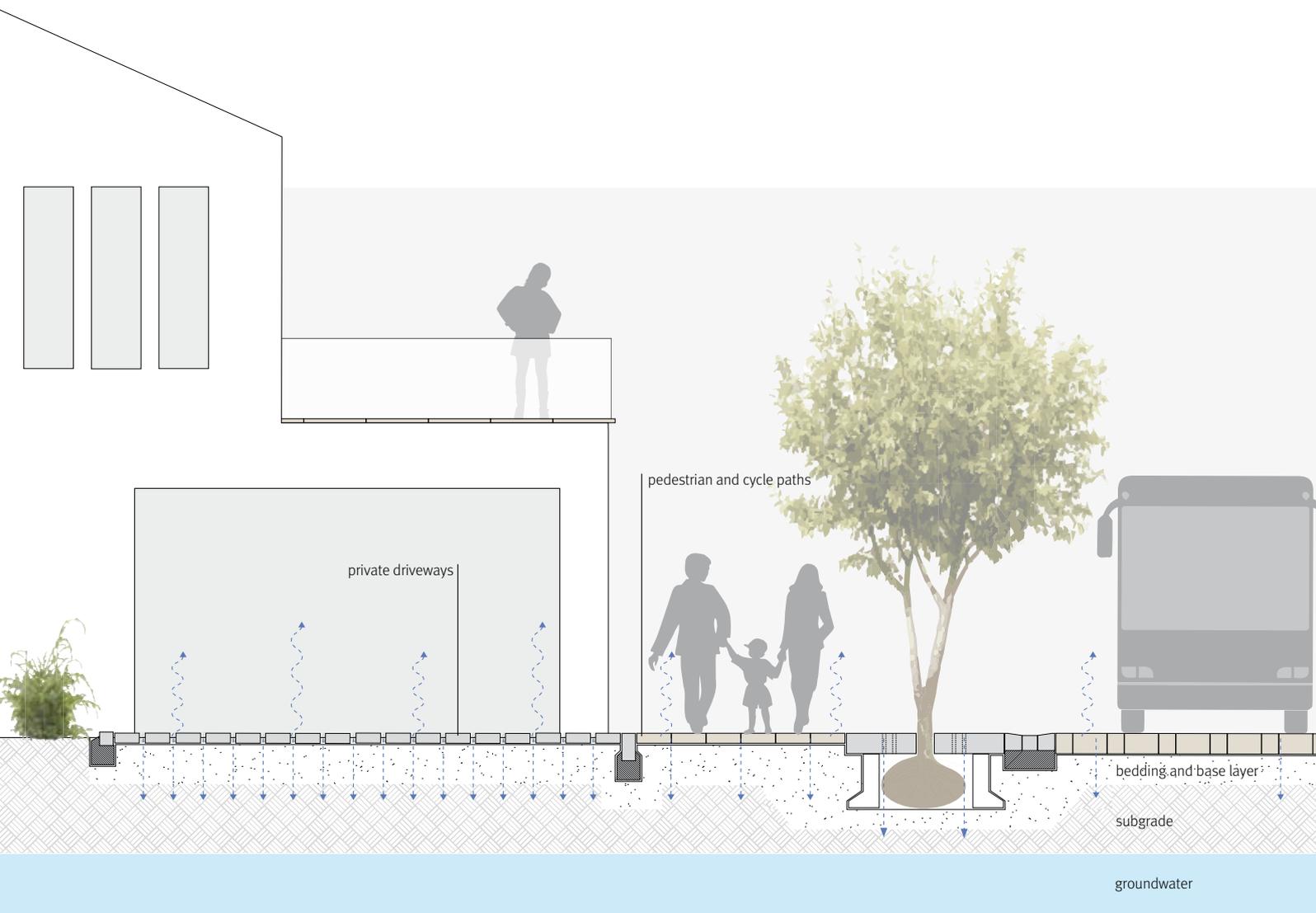
Improve the city climate

Nowhere else are the effects as drastic as in the densely built-up cities with the intractable mix of paving and local flooding, overheating, fine dust, nitrogen oxides and high ozone values. Here, the air is thick. On top of this, climate change is looming with increasing torrential rain occurrences, heat waves and dry periods.

A paving stone has three tasks in the climate-resilient city of the future:

1. Protect the environment from noise, heating up and pollutants.
2. Drainage, retain moisture to achieve a high rate of evaporation at the bottom.
3. Stop pollutant inputs so that they do not get into the groundwater.

The Climate Stone can do all that and much more. Thanks to its intelligent **proActive** properties, GDM.KLIMASTEIN surfaces can do more for the urban climate than ever before.



proActive concept



proDrain

Decentralised surface infiltration keeps the natural water balance largely intact on location and relieves the sewage network.

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proVapo

Evaporative activity improves the urban climate: higher humidity and more cooling.

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proWater

The jointing material filters pollutants from the rainwater in traffic areas: groundwater protection.

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proAir

Thanks to the modified concrete formula, the surface helps to reduce air pollutants.

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proReflect

The surface reflects the heat of the sun's rays and protects against overheating.

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proSilence

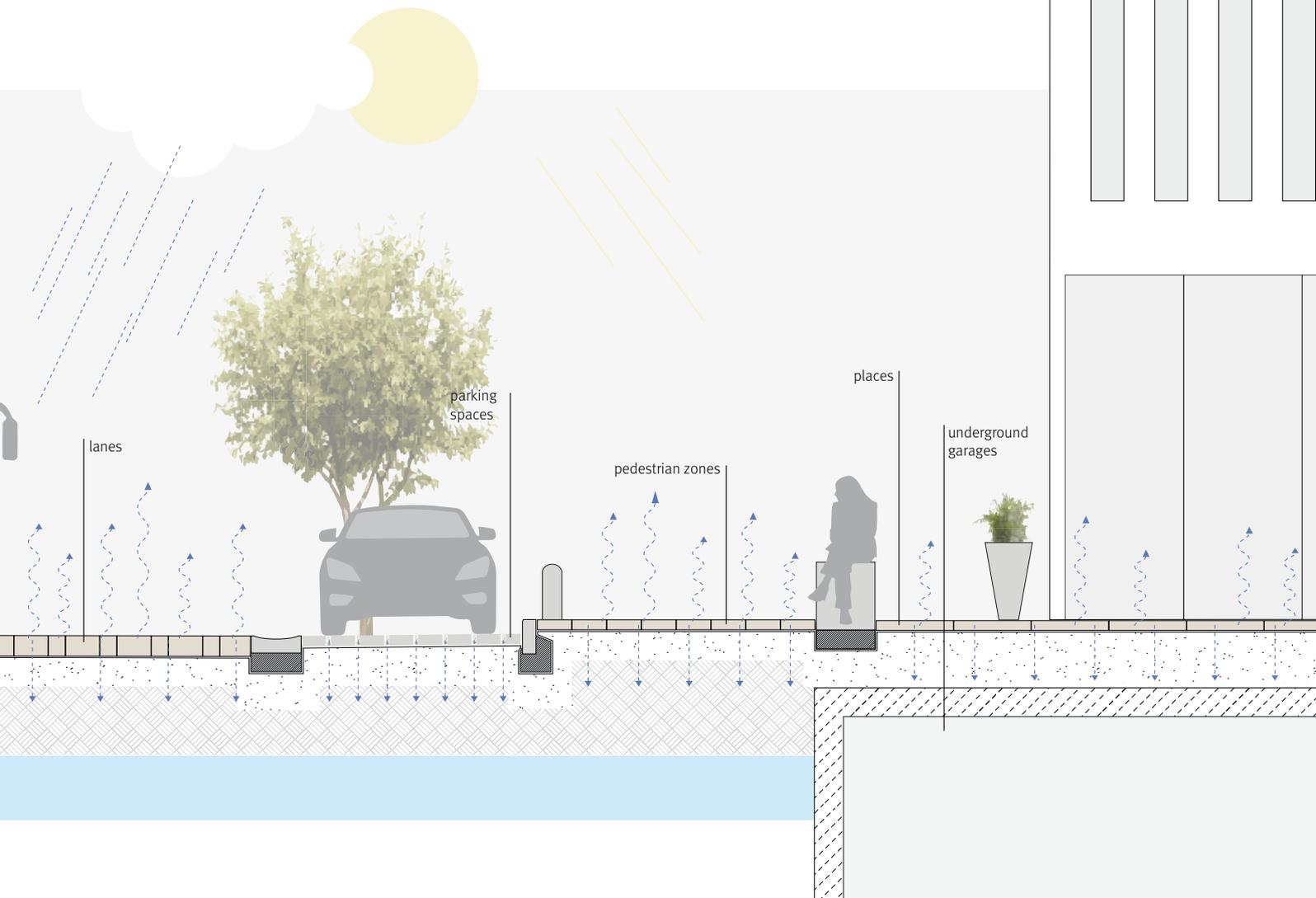
Certain formats, the joint width and surface structure, as well as the laying pattern guarantee a particularly quiet pavement.

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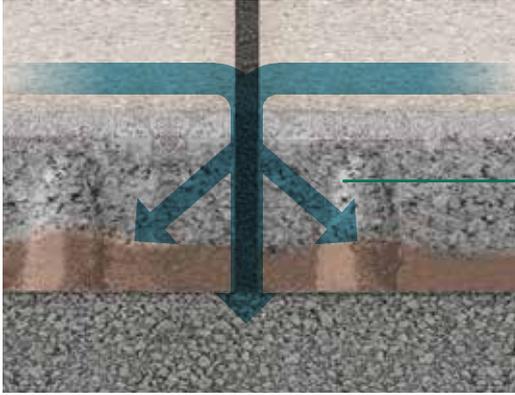
proCycle

Conserves raw material resources through recycling and upcycling



The Climate Stone – Our innovation

The GDM.KLIMASTEIN combines the visual aesthetics of a paving stone with proven and innovative environmental functions.



Within the paving system, rainwater seeps away through the joints. The joint width required for joint seepage is between 5 and 9 mm, depending on the stone thickness, with the joints accounting for between 5 and 10% of the total paved surface area.

The surface infiltration for the GDM.KLIMASTEIN serves as a practical flood protection, it relieves the drainage systems and sewage treatment plants and recharges the groundwater. The system with aBG acts like a treatment facility for rainwater, ensuring reliable groundwater protection. Thanks to its innovative three-layer structure, the GDM.KLIMASTEIN achieves significantly higher evaporation rates than conventional systems.

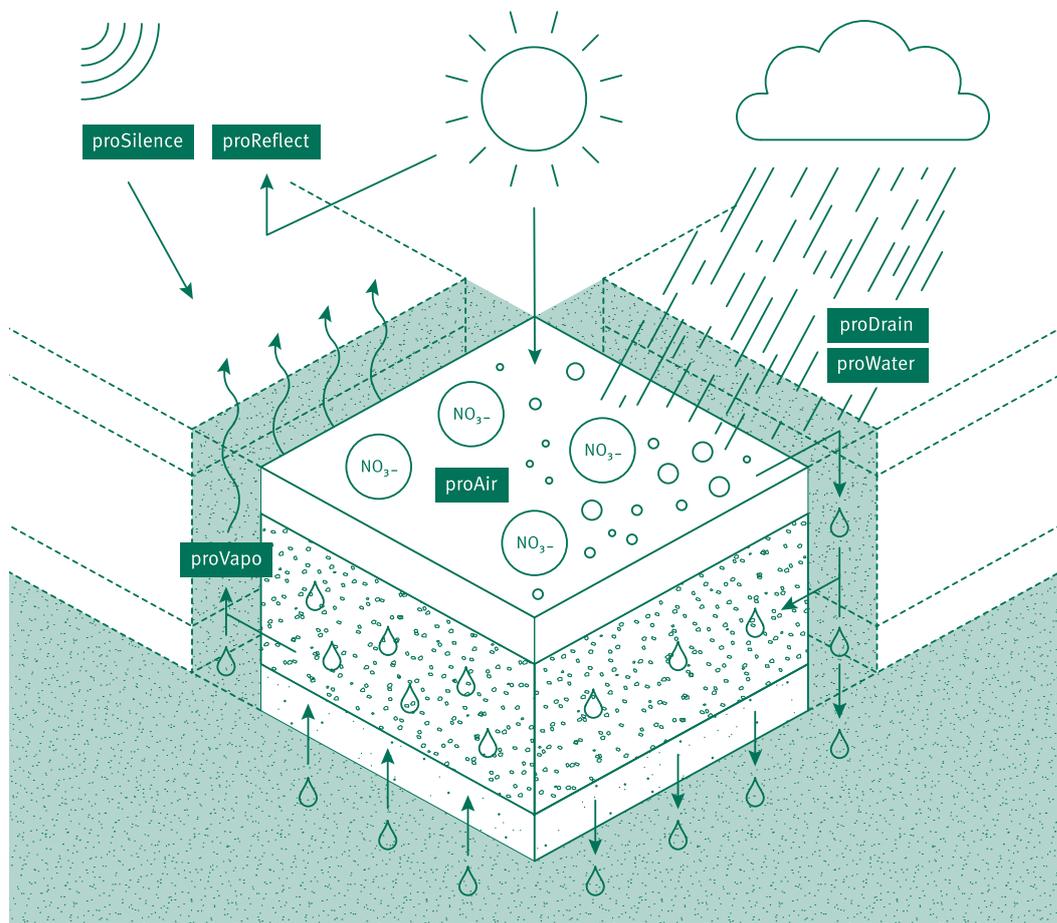
THREE LAYERS FOR CLIMATE-POSITIVE SPACES IN THE CITY

- 1 **Catalyst layer:** The outer surface reflects heat radiation, reduces noise emissions and neutralises air pollutants. The moisture seeps through the joints into the storage layer and into the ground.
- 2 **Storage layer:** The core can absorb and release large amounts of moisture. This allows paved areas to achieve a high evaporation rate similar to that of a meadow.
- 3 **Capillary layer:** The bottom layer is less permeable, more moisture is stored and also absorbed by the soil. This leads to increased evaporation.



Restoring natural properties to the soil

URBAN CLIMATE PROTECTION ACCORDING TO THE PROACTIVE CONCEPT



GDM.KLIMASTEIN



SURFACES

- ferro – blasted with roughened natural stone grains

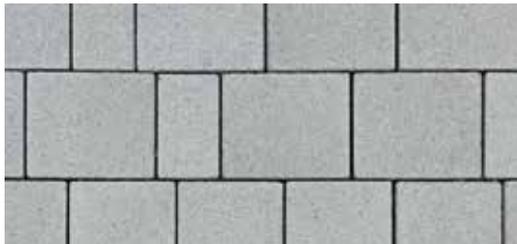
PRODUCT FEATURES

- TÜV certified, CO₂ neutral production
- Cradle to Cradle gold certificate
- Product and environmental declaration (EPD)
- Sharp-edged with GDM. edge protection
- With concealed spacers/composite stabilizers
- Non-slip for sure-footedness

PROACTIVE

- **proDrain:** approx. 7,1 % infiltration area percentage, regenerable system, discharge coefficient $\psi \approx 0$
- **proVapo:** increased evaporation
- **proWater** (only GDM.KLIMASTEIN aBG): Groundwater protection through rainwater treatment
- **proAir:** improves air quality
- **proReflect:** prevents overheating
- **proSilence:** low-noise surface
- **proCycle:** Concrete recycling material in core concrete

COLOURS AND FORMATS



Lime-Grey



Beige nuanced



Stock item

Individual formats



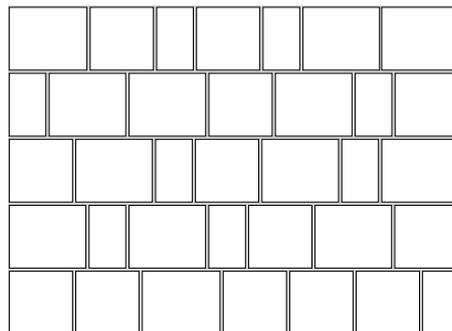
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Upon request

Multi-stone system with 6 mm joint type AP



Delivered mixed in layers

DURABLE IN QUALITY AND DESIGN

- Paving stones made of concrete DIN EN 1338 – quality DI¹
- High concrete quality due to high-strength quartz, granite or basalt aggregates
- Fine coating with natural stone chippings and sands in combination with UV-resistant iron oxide paints
- High dimensional accuracy of the stone thicknesses

ENVIRONMENT BENCHMARKS

- 100% rainwater infiltration – at 270 l/(s x ha) discharge coefficient $\Psi \approx 0$
In case of higher rainfall intensities, additional planning requirements must be taken into account.
- 100% groundwater protection through DIBt²-tested pollutant retention
- City climate friendly due to increased evaporation rate: > 50%
- Compensates for local flooding
- Relieves sewage network and sewage treatment plants
- Promotes groundwater recharge
- Revitalises soil functions
- Saves rainwater fees and investments in drainage systems
- Other features include
 - 1 NO₂ removal
 - 2 UHI effect reduction
 - 3 Low-noise paving surfaces
- Most cost-effective system for infiltration and treatment of rainwater
- Production: resource-saving, climate-neutral

LEADING TECHNOLOGY

- DIBt-tested safety for planning, execution, operation and maintenance
- Product design: paving stone
- Suitable for traffic areas up to Bk1.8 to RStO 12
- Groundwater depth: only 1 m
- Meets water law and road construction requirements
- Areas of application: extended, also water protection area
- Can be used as a retention system in an underground car park
- Flatness: only 1% slope
- Regenerable eco-functions
- Longest maintenance intervals: 10 years

BEDDING AND JOINTING MATERIAL

Both materials are systemically relevant. GODELMANN provides the joint material as a ready-to-install mixture. This is a O/4 construction material mix according to German Institute for Building Technology (DIBt) type approval³ and TL Pflaster-StB⁴ (delivery terms). A commercially available O/5 construction material mix with aggregates according to TL Gestein-StB⁶ (delivery terms), which corresponds to the specifications of the DIBt type approval, can be used as bedding material.

DIBt TYPE APPROVAL

The general design certification (allgemeine Bauartgenehmigung - aBG) is a reliable certificate of usability for building products and designs. It is issued after testing by the German Institute for Building Technology (DIBt) in Berlin.



The DIBt title for the GDM.KLIMASTEIN aBG is "Surface covering for the treatment and infiltration of rainwater run-off in traffic areas". The type approval offers a high degree of reliability in planning, tendering and professional execution, since the construction method and products are specifically described.

In addition, the DIBt seal ensures simplified authorisation procedures without individual verification and expanded areas of application.



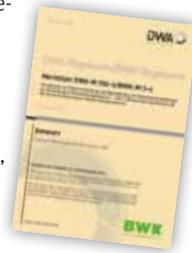
proDrain I proVapo – Infiltration and evaporation

THE WATER PROVIDER

The GDM.KLIMASTEIN is designed for traffic areas up to load class Bk1.8 according to RStO 12¹. (road traffic regulation). These include streets and squares as well as depots, car parks and areas where infiltration is usually not possible. For example, on the on the ceilings of underground car parks, when the covering buffers the rainwater like a retention system, allows it to evaporate and releases it into the subsoil with a time delay.

According to experts at H2O Research GmbH, the improved evaporation rate is approx. 50% (otherwise approx. 11 - 18%²). In addition, due to the hydraulic performance, there is no or no significant surface runoff. Good for the natural water cycle and water balance - and good for future demand.

The background to this is the planned **water balance** in accordance with DWA-A 102/BWK-A 3³, (German Association for Water, Wastewater and Waste guideline), which gives the planning offices new tasks. In essence, it is about minimising interventions in the local water balance as a result of settlement activities and technical drainage renovation and maintaining the status quo as far as possible. Here, the focus is increasingly on evaporation (evapotranspiration⁴) in urban areas.

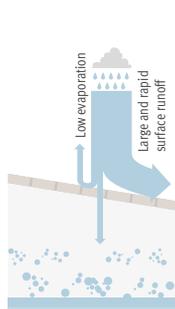


The goal: More than 50% of the annual precipitation should evaporate or transpire, for example via green flat roofs.

In many cases, the calculation will only work for traffic areas that have an active evaporation structure. However, in order to ensure this, the corresponding pavement coverings must achieve significantly higher evaporation rates. **In this respect, the GDM.KLIMASTEIN already fulfils the requirements of tomorrow.**

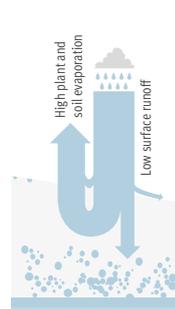


SEALED GROUND



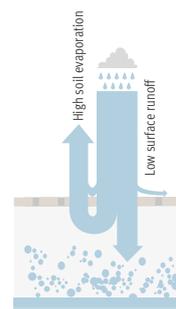
Minimal groundwater recharge

NATURAL GROUND



Good groundwater recharge

GDM.KLIMASTEIN



Good groundwater recharge



"When developing new settlement areas, one of the key goals is to ensure that the small-scale water balance after development comes as close as possible to that of an undeveloped area."

Baden-Württemberg Regional Office for Environment, Survey and Nature Conservation,
May 2005

proWater – water protection

THE POLLUTANT STOPPER

The GDM.KLIMASTEIN aBG enables surface infiltration even where conventional infiltration pavement has reached its approval limits. **The reason:** The paving system is officially also considered a treatment system for rainwater run-off. This keeps the **groundwater clean**.

The rules for the areas of application can be found in the DWA-M 153¹ leaflet. It states that conventional infiltration paving is only permitted in "little-used traffic areas" with "low surface pollution". The maximum limit is currently 300 vehicles/day, which roughly corresponds to a quiet residential street. For all other surface types, a type approval for the paving is required. For example, for busier residential roads or shopping centre car parks.

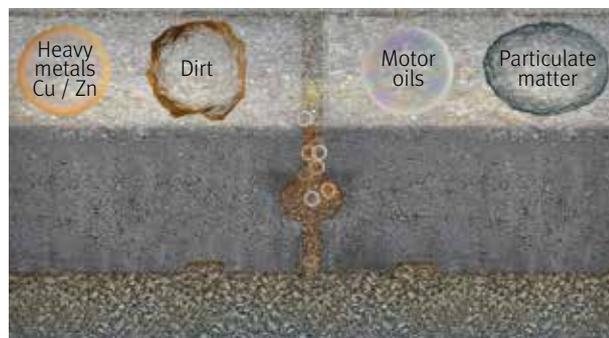
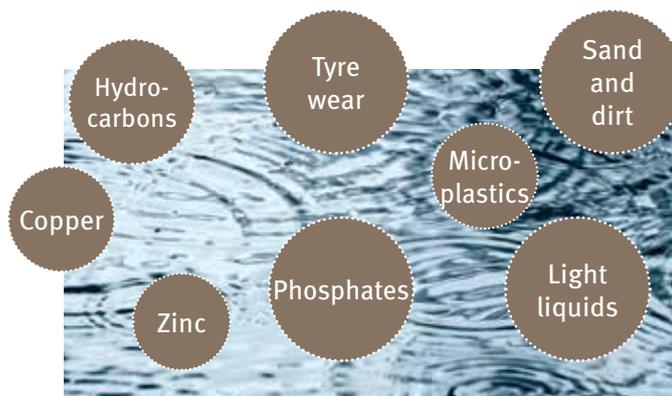
The restrictions serve to protect water bodies with groundwater, our largest source of drinking water. In a nutshell: **These measures are designed to prevent pollutants² such as oil, petrol or microplastics from vehicle traffic getting into the groundwater.**

The GDM.KLIMASTEIN aBG is able to achieve this. The paving stone treats pollutants and retains them on the surface. The process occurs naturally³ within the pavement⁴. The effective filtering mechanisms reduce the depth of the groundwater table⁵ to ≥ 1 m (usually ≥ 2 m). The extended areas of application also include water protection areas.

POLLUTANTS	EXAMPLES	SOURCE
Heavy metals	Copper, zinc, lead, cadmium	Vehicle traffic
Petroleum hydrocarbons (PHs)	Petroleum and lubricating oils, petrol and diesel fuels	Oil and petrol spillst
Polycyclic aromatic hydrocarbons (PAH)	Benzo(a)pyren, anthracene Benzo(g,h,i)perylen	Combustion of fuels, tyre wear
OTHER		
Filterable substances	Filtration of fine particles, which are contained in most water-polluting substances	



SURFACE TYPES	SURFACE POLLUTION EFFECT
BASED ON LEAFLET DWA-M 153	LOW
Roof and terrace areas in residential and comparable commercial areas	All commercially available water-permeable surface systems
Cycle paths and sidewalks outside the spray radius of roads (distance > 3 m)	
Courtyard areas and car parking spaces without frequent vehicle change in residential and comparable commercial areas	
Low-traffic areas (up to 300 vehicles/24 h) in residential and comparable commercial areas	
	MEDIUM
Streets with 300 – 5,000 vehicles/24 h, e.g. residential, access and county roads	only with general type certification (aBG)
Courtyard areas and car parking spaces without frequent vehicle change in mixed, commercial and industrial areas	
Roads with 5,000 – 15,000 vehicles/24 h, e.g. main roads	
	HIGH – possible in certain cases, clarify with local water authorities
Car parks with frequent vehicle change, e.g. in front of shopping centres	only with general type certification (aBG)
HGV rest stops and parking spaces	



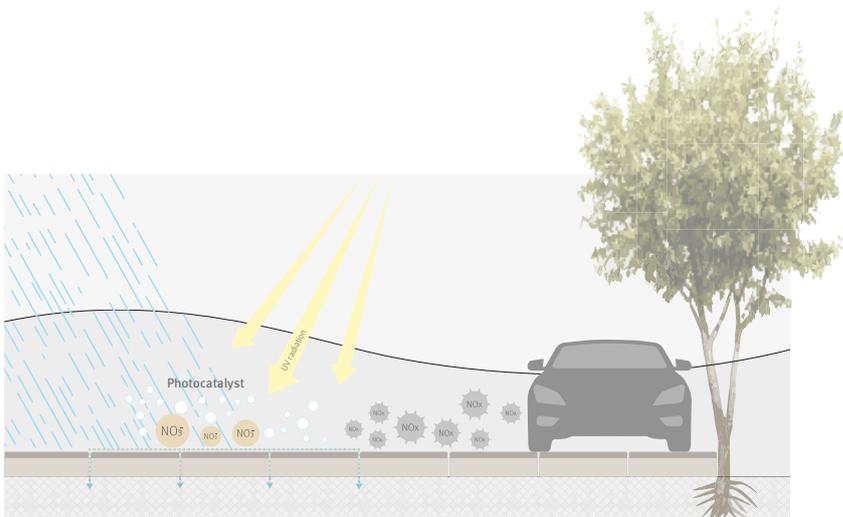
proAir – air pollution control

THE CATALYST

The air in our cities must be improved, because particulate matter, ozone and nitrogen dioxide¹ (NO₂), especially from the exhaust gases of diesel vehicles, are harmful to our health. With this in mind, photocatalytically active pavement coverings are gaining in importance because they are proven to **eliminate nitrogen oxides**. The GDM.KLIMASTEIN is also equipped with this proAir function.

The concept: The paving stone's face concrete is mixed with titanium dioxide² during production. Once laid, the white, non-toxic pigment converts harmful nitrogen oxides into nitrate³ when exposed to UV radiation, i.e. sunlight. Nitrate itself is harmless and easily soluble in water, it is washed away with the rainwater and does not pose any environmental pollution in these concentrations. Since the photocatalysis remains unexhausted, the process is permanently available.

For the **GDM.KLIMASTEIN**, we use the most effective additive with degradation capacity⁴ of more than 7,0 mg NO/m²h. In addition, the modified face concrete creates a super hydrophilic surface with a self-cleaning effect when it comes into contact with water. This makes the pavements particularly easy to clean.







proReflect – protection against overheating

THE TEMPERATURE REDUCER

The Urban Heat Island or UHI effect¹ is a sign of times. The annual mean temperatures in our metropolitan areas are now sometimes more than 10°C higher than in the surrounding areas. The result is hot summer days with tropical nights and heat stress, which claims numerous victims² every year.



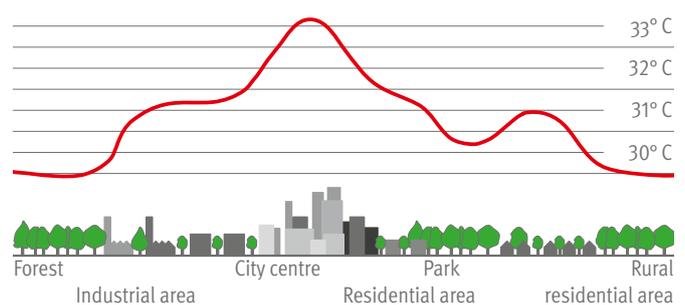


The heat island is the result of dense concentrations of buildings and surface paving. The effect is intensified by dark coverings of roofs and traffic areas, which store heat from the sun and thus heat up the ambient air. Even at night it hardly cools down.

Light-coloured surface coverings can reduce the UHI effect, because they reflect sunlight and store little heat. They also make the street space brighter. This saves on street lighting and improves the look of the city, as well as road safety.

The SRI value³ stands for the reflectivity of surfaces, with the scale ranging from black = 0 to white = 100. Our GDM.KLIMASTEIN has an SRI value of > 35. In this way, design standards and urban climate protection can be perfectly combined.

URBAN HEAT ISLANDS



 proSilence – noise protection

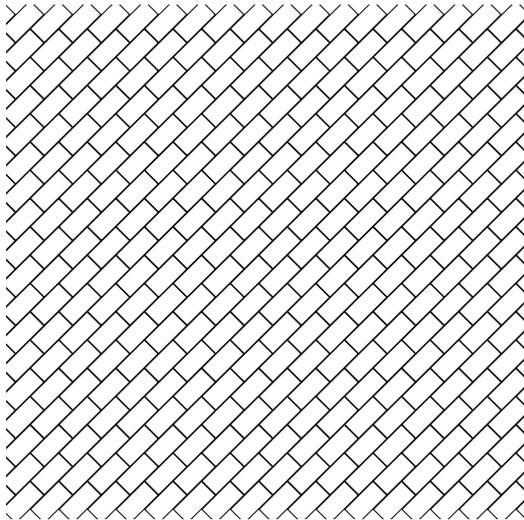


THE QUIET ONE

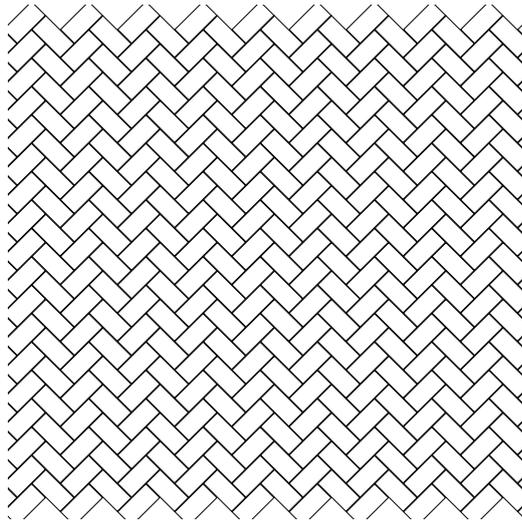
Germans consider road traffic noise as the greatest source of noise¹. No matter what the road surface, noise pollution is generally getting out of hand and should be contained. This also applies to low-noise paving with the GDM.KLIMASTEIN.

We follow the recommendations of the M LP². That means we configure the stone in such a way that the noise emitters are largely muted. This is done through the design of the surface texture, the joint width and edge formation as well as the length and width of the stones. The stone thickness is only relevant with regard to a uniform target height and the load class. Here, the regulation³: stipulates: at least 10 cm for Bk1.8 and Bk3.2.

The paving format also influences the noise levels. Laying patterns with rectangular stones arranged diagonally to the direction of travel tend to be particularly low-noise.



Diagonal pattern 45°, suitable up to load class Bk1.8



Herringbone pattern, suitable up to load class Bk3.2

Cost effectiveness

THE MOST EFFICIENT

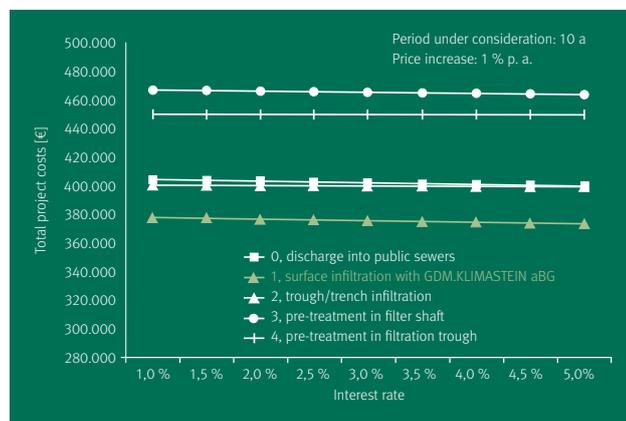
Plants for infiltration and evaporation of precipitation water with GDM. Klimastein aBG are more economical compared to other plant types. This is the conclusion of the revised study by the engineering office Dr. Dierschke¹. In addition to the investment costs, the long-term costs of, for example, prescribed maintenance work and, if necessary, cleaning were taken into account.

The study was carried out on the basis of a parking lot with 107 parking spaces and approx. 2,400 m² total area. For this purpose, the different types of plants were measured and their investment and operating costs were determined with the project cost present value for a reference period of 30 and 10 years.

FOR COMPARISON:

Variant 0	Drainage of rainwater into the public sewer system without pre-treatment
Variant 1	Surface infiltration with GDM.KLIMASTEIN aBG
Variant 2	Trough-trench infiltration with cleaning of the rainwater in the living topsoil layer
Variant 3	Pre-treatment in a decentralised shaft treatment plant and discharge into a body of water
Variant 4	Pre-treatment in a filtration channel and discharge into a body of water

According to the study, the GDM.KLIMASTEIN aBG represents the most cost-effective variant under the assumed average hydraulic and geological conditions. In terms of overall economic efficiency, paving pavements perform best, as they do not require any further investment in drainage and rainwater treatment. In addition, operating costs are relatively low in comparison.



MAINTENANCE AND CLEANING

The good hydraulic capacity of the pavement can be regenerated if necessary² i.e. restored. Rinse-suction methods are suitable for this purpose.

The process is the same as for a high-pressure surface cleaner, in addition, the loosened dirt is sucked up directly. The original permeability is then almost completely restored (> 85%), and the pavement will look like it is newly laid. The jointing material rinsed out during the cleaning operation is replaced, and the dirty water with the embedded pollutants is properly disposed of.

All systems for treating rainwater run-off require regular maintenance and testing. A test cycle of ten years is planned for the GDM.KLIMASTEIN aBG, which is longer than other system types.



Environmental pioneers

FROM SEEPAGE STONE TO CLIMATE STONE

The GDM.KLIMASTEIN is the culmination of more than 40 years of research and development.

No other stone system currently provides more seepage, evaporation and groundwater protection, plus all the additional features for climate-resistant urban development. **A success story over five development generations.**

1984 – 1st generation:

GODELMANN launches its first in-house developed water-permeable concrete block systems.

1990 – 2nd generation:

The problem of seeping pollutants from rainwater runoff in traffic areas is recognised early on - the no-fines concrete blocks are given a fine-pored filter face concrete.

1992 – 1997

First studies on the retention of fuels and oils on GEOSTON type pavement surfaces - a pilot project on the paving stones of a ten-year-old car park confirms the pollutant retention.

1998

Bedding and jointing materials are incorporated as construction materials for treating pollutants in the ongoing development of paving stones.

2001

A newly developed cleaning vehicle for restoring the hydraulic capacity and the pollutant filter function is launched.

2002 – 2006 – 3rd generation:

A certificate of suitability is issued for the design of the GEOSTON system as a surface covering for infiltration and pollutant treatment - the first step towards general building authority approval.

2006

The GEOSTON water-permeable paving system is issued the general type approval from the German Institute for Building Technology (DIBt).

2006 – 2014 – 4th generation:

The DIBt issues the ECOSAVE protect product line with general building authority approval as a "surface covering for the infiltration and treatment of rainwater runoff in traffic areas".

2019 – 2021 – 5th generation:

The GDM.KLIMASTEIN is developed - it features a new three-layer structure with maximised evaporation capacity, supplemented by additional functions to combat current environmental problems.



Terms | Sources | References

- Page 6/7
- 1 Energy management system, DEKRA Certification GmbH, 2019
 - 2 Certificate 20193113, myclimate Deutschland gGmbH, 2019
 - 3 Principle for a systematic circular economy
 - 4 Environmental Product Declaration according to ISO 14025 and DIN EN 15804, Institute for Construction and Environment, 2019
- Page 16/17
- 1 Stone with a diagonal ≤ 30 cm. Meets the highest class for resistance to weathering and abrasion and is resistant to freeze-thaw exposure.
 - 2 German Institute for Structural Engineering
 - 3 General building authority approval Z-84.1-29 – German Institute for Building Technology (DIBt), Berlin, 2017.
 - 4 Technical delivery conditions for construction products for the production of stone and slab pavements and borders
 - 5 Technical delivery conditions for aggregates in road construction
- Page 18/19
- 1 Guidelines for the standardization of the superstructure of traffic areas, Road and Transportation Research Association (FGSV), 2012
 - 2 Annual evaporation of conventional seepage paving systems, exception: grass pavers (65%)
 - 3 Principles for the management and treatment of rainwater run-off for discharge into surface water – German Association for Water, Wastewater and Waste e. v.; (yellow paper, published February 2021)
 - 4 Evapotranspiration – sum of the evaporation of water from flora and fauna (transpiration) and from soil and water surfaces (evaporation).
- Page 20/21
- 1 Recommendations for action on dealing with rainwater – German Association for Water Management, Wastewater and Waste e. V. (DWA)
 - 2 and other filterable substances (AFS), microplastics, heavy metals (e.g. copper, zinc, lead), petroleum hydrocarbons (e.g. engine oil, fuels), PAH (polycyclic aromatic hydrocarbons), e.g. benzo(a)pyrene, anthracene
 - 3 Precipitation (binding of substances), sorption (adhesion to surface), filtration, biochemical conversion
 - 4 Paving stones, joints and bedding
 - 5 Vertical distance between the groundwater surface of the upper aquifer and the ground surface
- Page 22/23
- 1 Red-brown, toxic, pungent gas from the group of nitrogen oxides (NOx)
 - 2 White pigment, which is used for confectionery, cosmetics, paints, varnishes, paper and plastics, etc.
 - 3 Salts and esters of nitric acid or nitrogen compounds that occur naturally in the soil
 - 4 Photocatalytic sil, degradation rate according to ISO 22197-1 (test method for air purification capacity of photocatalytic materials), Institut d-tox, 2017
- Page 24/25
- 1 Urban Heat Island
 - 2 Approx. 6,000 heat-related deaths in 2015, source: Federal Environment Agency
 - 3 Solar Reflectance Index – Index for solar radiant reflectance (albedo) and thermal emissivity
- Page 26/27
- 1 Noise pollution in Germany as a percentage - UBA publication, February 2020
 - 2 Leaflet for “low-noise pavement construction methods” – Research Society for Roads and Transport e.V. (FGSV), Cologne, 2019
 - 3 Guidelines for the standardisation of traffic area superstructures, Research Society for Roads and Traffic e. V. (FGSV), 2012
- Page 28/29
- 1 Planning and consulting companies for real estate, environment, infrastructure and water; Darmstadt
 - 2 If specific infiltration rate < 270 l (s x ha)

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