

Your Project in Safe Hands

Geosynthetic Solutions for Earthworks and Foundations

 **HUESKER**
Ideen. Ingenieure. Innovationen.

Our Solutions at a Glance

Discover the many benefits of our geosynthetic engineering solutions

HUESKER's geosynthetics and systems facilitate the reliable, sustainable and cost-efficient construction of earthworks such as embankments, steep slopes and retaining walls, even under the most demanding conditions. However difficult the soil conditions, the company's products can guarantee the long-term stability of heavily loaded structures. Typical applications include subgrades exhibiting low bearing capacity, high deformability or high dynamic action, such as karst soils or creep-prone slopes.



Embankments on Weak Subsoils
Page 6 – 13

System Solutions for Geosynthetic-Reinforced Soil
Page 14 – 17

Bridging of Sinkholes
Page 20 – 21

Pipeline Construction
Page 22 – 23

Your Project in Safe Hands


Economical, sustainable and reliable performance

Whenever earthworks have to be built on weak subsoils, you can place your trust in the world-class geogrids, geofabrics and system solutions supplied by HUESKER. Our high-tensile geogrids and systems by far outperform conventional (e.g. reinforced-concrete) constructions through their exceptional durability, sustainability and cost-effectiveness. You too can profit from our many years of experience, state-of-the-art production, quality assurance regime and project-specific engineering solutions. We look forward to lending you a helping hand with the planning, design, costing and implementation of your projects.

Engineering excellence

- Advice on complex questions and issues
- Support in the technical design of structures
- On-site advice and support
- International engineering team with a wealth of knowledge

At HUESKER,
every 7th
employee
is an engineer




NorGeoSpec

Product and system excellence

- World's strongest geogrids and wovens
- Wide range of special products
- Fully co-ordinated systems
- Custom manufacture of project-specific solutions
- Numerous independent certifications
- Over 50 years of project experience



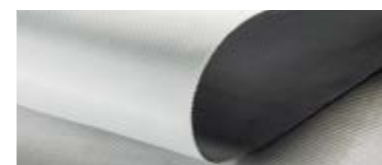
Fortrac®
Flexible, high-tensile geogrid



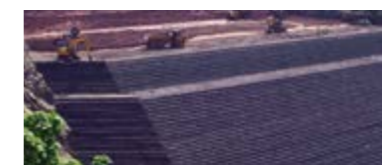
Stablenka®
Reinforcement woven (PET)
for soils with pH values from 2 to 9



Stablenka® Xtreme
Reinforcement woven (PVA)
for soil with pH values from 2 to 13



Ringtrac®
Geotextile-encased columns



Geosynthetic Reinforced Soil
Steep slopes, retaining structures



Incomat®
Concrete mattress system



Incomat® Pipeline Cover
Concrete formwork mattress for pipe encasement



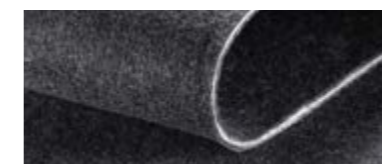
HaTe®
Nonwovens for separation, protection and filtration



Basetrac® Duo-C
Geocomposite fulfilling reinforcement, separation and filtration functions



Fortrac® PipeGuard
Robust geogrid used as an early-warning system for pipelines



Tektoseal® Active AS
Active geocomposite for oil absorption on site

Embankments on Weak Subsoils

Challenges and system solutions

Infrastructure projects often involve overcoming challenging conditions in the form of soft, marshy, impassable or contaminated terrain. Apart from large-scale settlement and lateral deformation, potential risks in constructing embankment foundations include bearing and slope failure, or the squeezing out of soft soil from beneath the embankment base. The measures needed to counteract these mechanisms typically entail considerable cost and effort. Our reinforcement and ground improvement solutions will provide you with a simple, reliable and cost-effective route to project success, however demanding the site conditions.



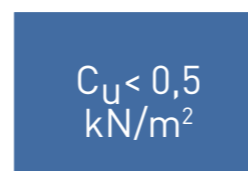
Prevention of bearing and slope failure



Three foundation systems to meet virtually every challenge



Single-layer reinforcement thanks to high-tensile geogrids and wovens

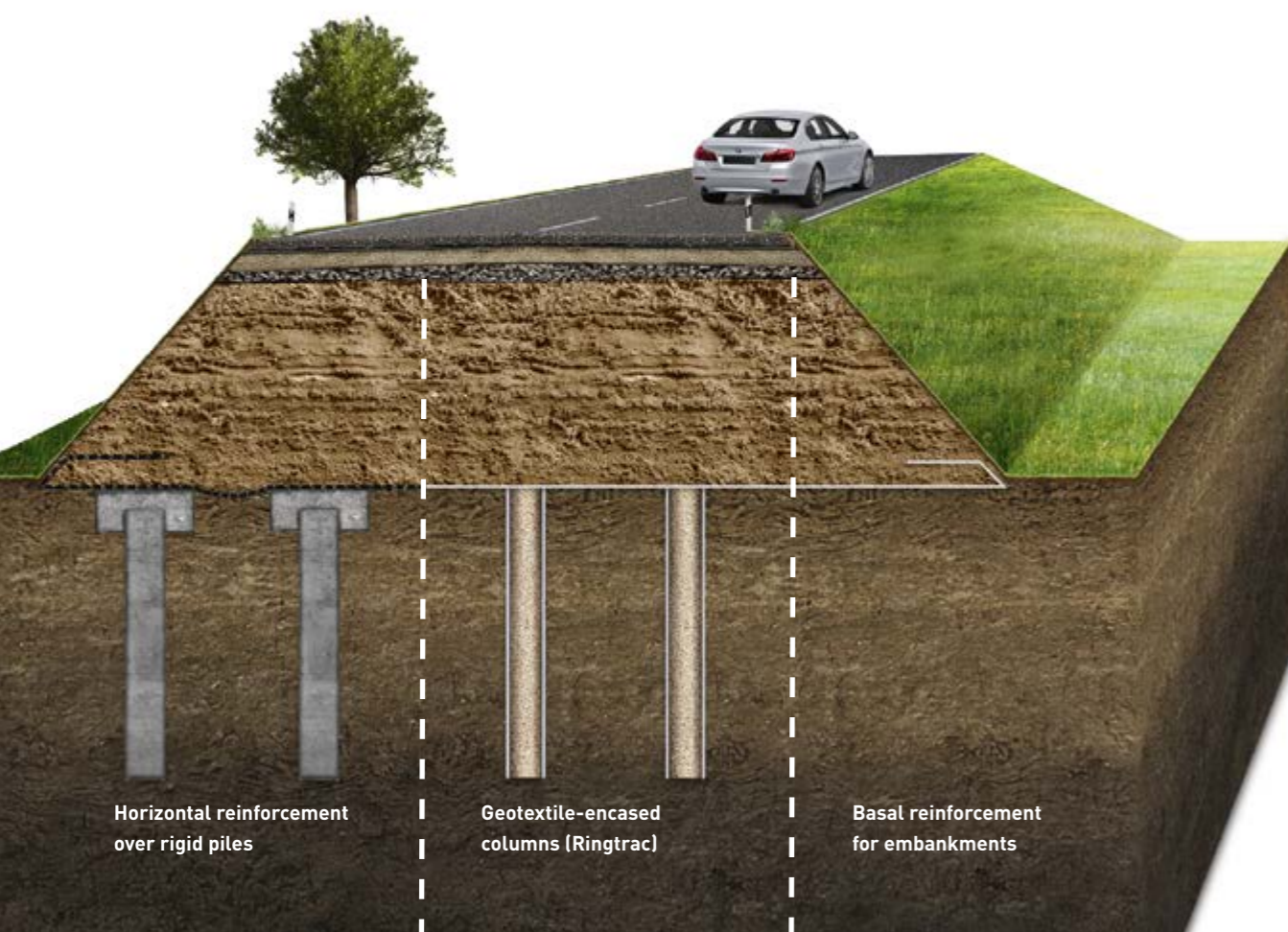


Suitable even for extremely soft subsoils

Other benefits

- Fast, straightforward installation
- Suitable for soils with pH values between 2 and 13
- Loadability soon after completion
- Sustainable, eco-compatible construction
- Customised designs and product solutions
- Measurement and monitoring as an option

Our foundation systems at a glance



Horizontal reinforcement over rigid piles

Geotextile-encased columns (Ringtrac)

Basal reinforcement for embankments

CBR [%]	E_{v2} [MN/m ²]	C_u [kN/m ²]	Soil conditions
9	35	270	good
7	30	210	average
6	25	180	
5	20	150	adequate
4		120	
3	15	90	poor
2	10	30	
1		15	very poor

CBR California bearing ratio [%]
 C_u Undrained shear strength [kN/m²]
 E_{v2} Deformation modulus on reloading [MN/m²]

System selection

Key parameters for describing soil conditions include the CBR, E_{v2} and C_u . We will consult with you in selecting the most suitable foundation method, as dictated by the soil conditions, loads, requirements placed on the structure and cost frame. Design guidance and codes are available worldwide, e.g. in:

- AASTHO
- BS8006
- CUR
- EBGEO
- Eurocode
- FHWA

Basal Reinforcement

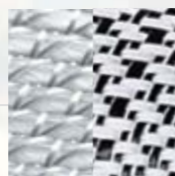
Ensuring global and local stability

With tensile strengths of up to 2,800 kN/m, HUESKER's Stablenka reinforcement woven helps to speed up progress on site while reliably protecting against slope or soil shear failure. It accommodates and distributes both vertical embankment loads and lateral spread.

Inhomogeneous subsoil conditions are evened out and major differential settlement prevented. Stablenka thus vouches for the local and global stability of embankment structures, also in situations where ecological or economic factors rule out the adoption of standard solutions. Additional benefits include faster construction, significantly shorter waiting times for subsoil consolidation and the maximisation of slope inclinations during the construction phase.

Benefits

- Embankments with high structural stability
- Enables steep embankments already under construction: saves basic width and bulk material
- Single-layer installation thanks to high tensile strengths
- Accommodation of differential settlement
- Also suitable for highly alkaline soils
- Numerous product certifications



Stablenka



Application example

A26 motorway extension

The approx. 58 km extension to the A26 motorway to link Hamburg and Stade involved crossing stretches of very weak subsoil. Yet, even under such difficult conditions, the use of Stablenka basal reinforcement and Ringtrac foundation systems allowed the fast and reliable construction of stable motorway embankments.



Safety enhancing wraparound

By increasing the resistance to lateral spread, the wraparound further improves embankment stability.

Ringtrac Foundation System

Ground improvement even for extremely soft soils

The Ringtrac foundation system combines Stabilenka horizontal reinforcement with a regular arrangement of columns of non-cohesive material placed inside a geosynthetic casing. Geotextile-encased columns are a development of the traditional vibro stone columns. The structural action of the geotextile casing transforms granular columns into efficient loadbearing elements. The system, which can be used in soft strata with $C_u < 0.5 \text{ kN/m}^2$, offers high ductility and adaptability to variable subsoil conditions. Given that the full-surface drainage capability of the Ringtrac columns vastly speeds up consolidation times, over 90% of settlement already takes place during the construction period. Creep settlement is also reduced by 50 - 75% compared to unimproved ground. The fact that locally sourced mineral mixes can be used as fill brings additional savings on time and cost.

Benefits

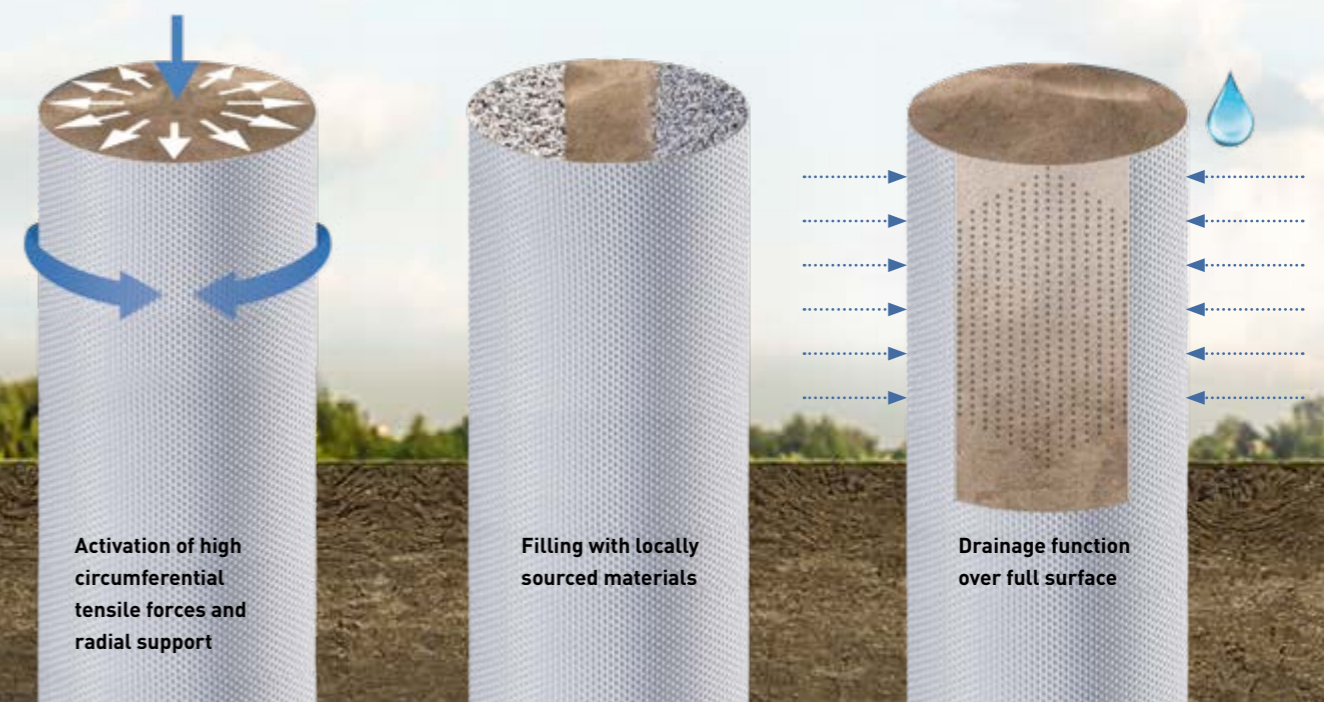
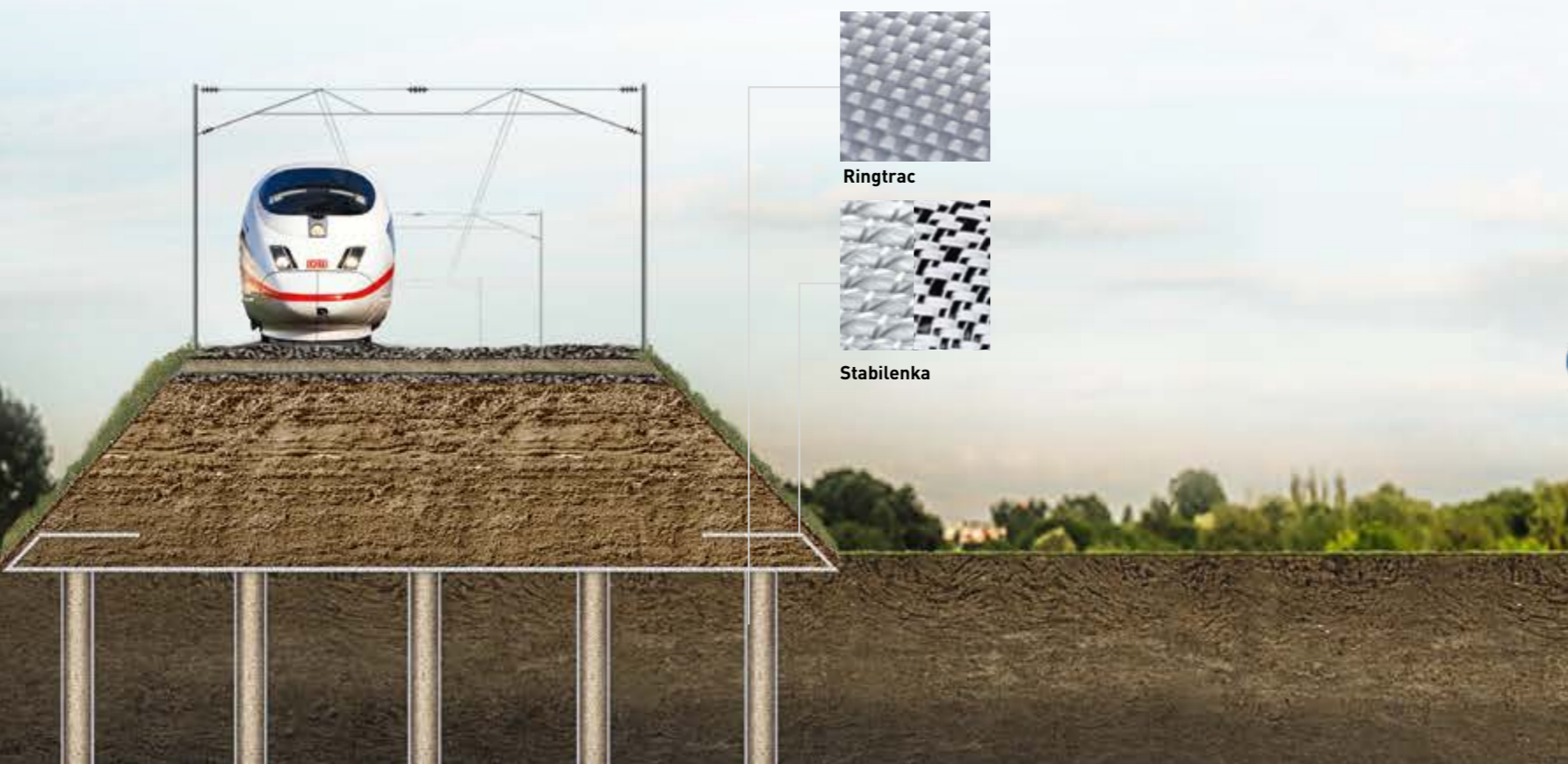
- Extremely reliable due to high ductility
- Rapid consolidation speeds up construction
- Rapid construction of high embankments without risk of bearing failure
- Cost-efficient thanks to use of locally sourced mineral mixes (sand etc.)
- Project-specific adaptability to local conditions and loads
- Also for use in very soft soils and earthquakes regions

Suitable even for
extremely soft soils
 $C_u < 0,5$
 kN/m^2

Application example

Mühlenberger Loch land reclamation scheme

A scheme to extend the DASA Airbus plant at the Mühlenberger Loch site in Hamburg involved the reclamation of 140 ha of land in the River Elbe estuary. The extremely soft subsoil conditions necessitated the adoption of a foundation system incorporating 60,000 Ringtrac columns. This system offered tremendous advantages over the originally envisaged sheet piling solution: apart from shortening the construction period by over a year, it eliminated the need for 35,000 tonnes of sheet piling, approx. 1.1 million cubic metres of sand and 8 million litres of fuel.



Vertical Piles with Horizontal Reinforcement

Larger pile grids and enhanced safety

The placement of geosynthetic-reinforced soil over vertical piles delivers a virtually settlement-free foundation system that is ideal for the rapid construction of embankments on soft soils. Embankments built with this system can come into service immediately upon completion, without any need for advance surcharging or allowance for consolidation times. Even with large pile grids, HUESKER's Fortrac geogrids provide for the formation and long-term stabilisation of a soil arch above the piles to ensure the low-settlement transmission of loads to the deeper foundation horizon. No raked piles are required at the perimeter. At the same time, the broad selection of high-modulus, low-creep Fortrac geogrid types allows optimisation of the overall cost. Typical applications include railway lines, motorway embankment and tank foundations.

Benefits

- High structural stability
- Virtually settlement-free during construction and operation
- High efficiency due to large pile grids
- No raked piles required at perimeter
- Can be put into service immediately

Application example

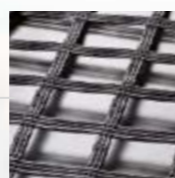
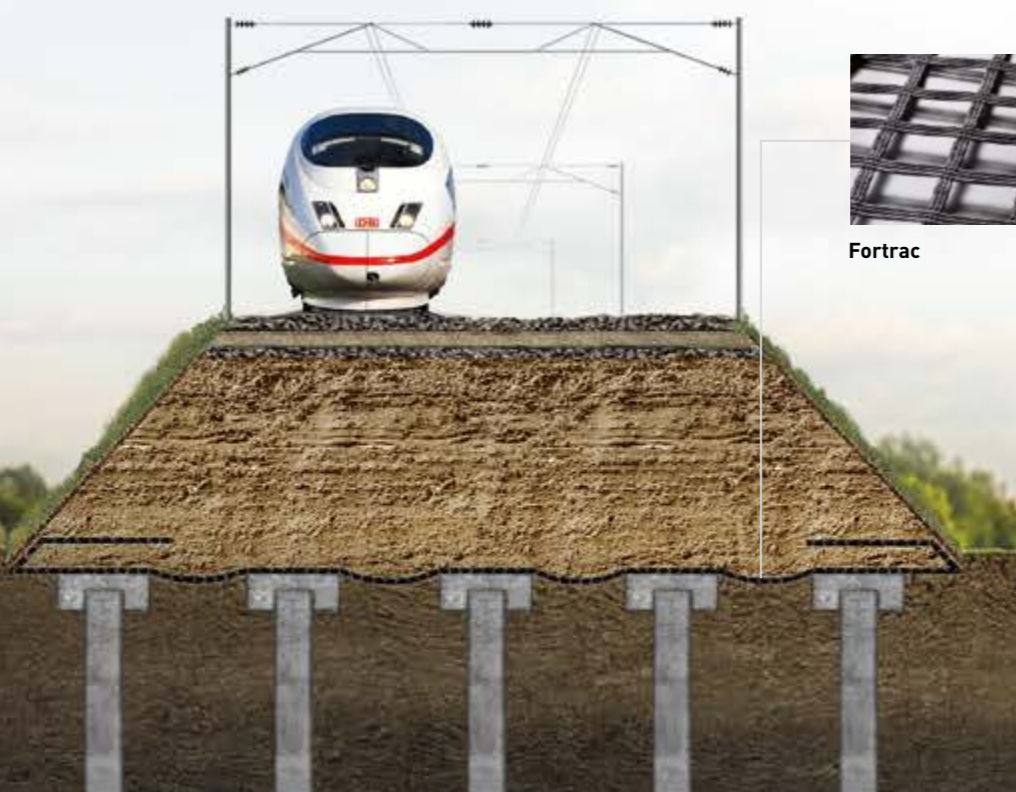
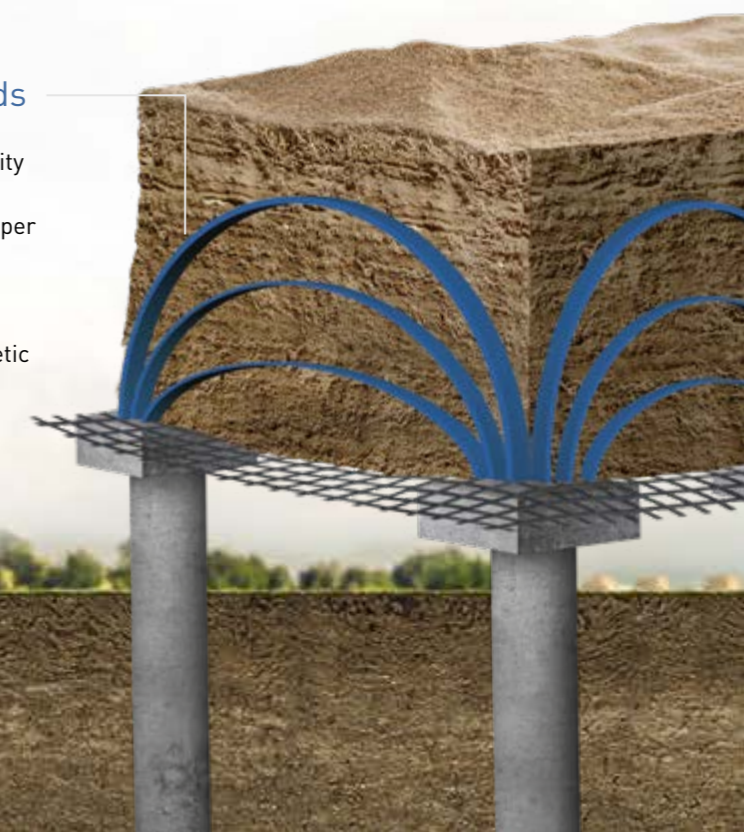
N210 national road

The 14 km section of the N210 national road in the Netherlands crosses soft organic strata up to 15 metres thick. The road was, therefore, carried on a geosynthetic-reinforced embankment built on driven precast-concrete piles with pile caps. As part of the DCM (design, construction, maintenance) contract, a 50 m trial embankment section was constructed and fitted with a monitoring system. The recorded data were used to verify the design and confirm the high safety standard of the system. Under the quality assurance regime, data logging will continue for at least another 20 years.



Stable soil arch thanks to geogrids

- Facilitated formation and guarantees durability of loadbearing soil arch over piles
- Low-settlement transmission of loads to deeper foundation horizon
- Reliable design based on approach set out in EBGEO (Recommendations for Design and Analysis of Earth Structures using Geosynthetic Reinforcements)



Fortrac

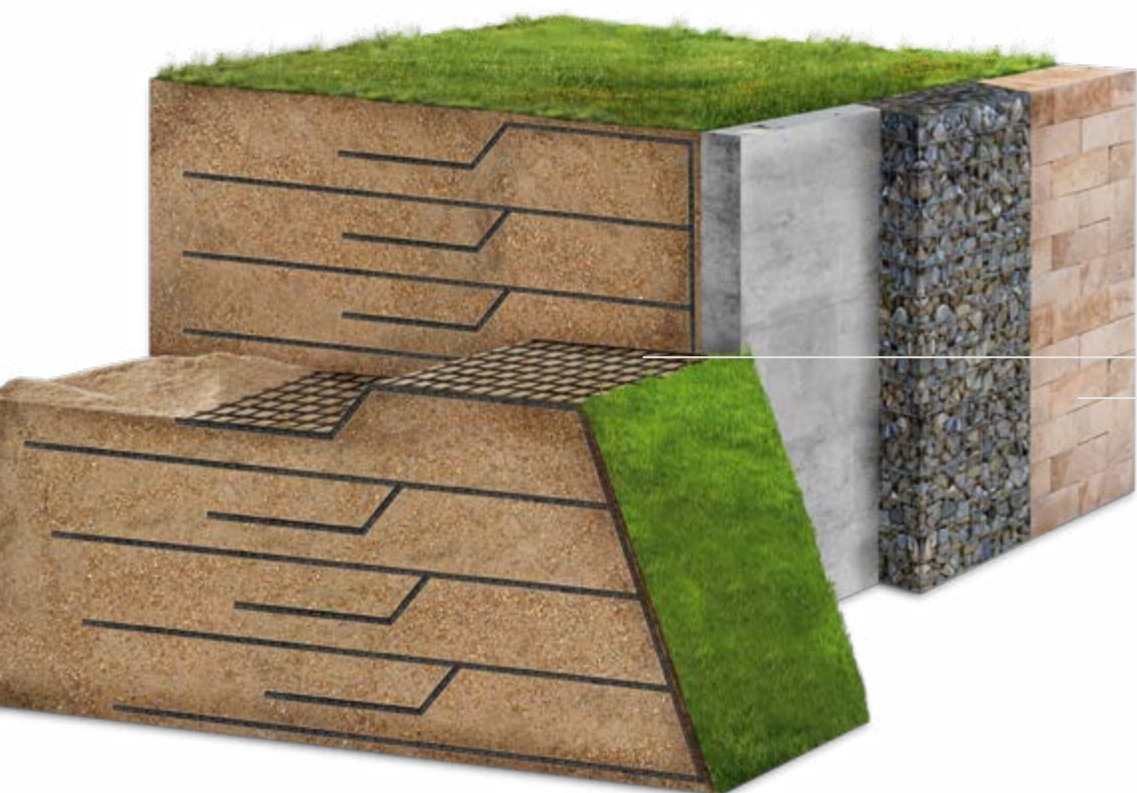
System Solutions for Geosynthetic-Reinforced Soil

Steep slopes and retaining structures

Though a routine task in ground and foundation engineering, the construction of steep slopes and retaining structures often poses unexpected challenges. HUESKER's geosynthetic-reinforced soil (GRS) system offers innovative and cost-effective solutions for engineering structures. The many advantages of GRS structures over conventional methods include their wide ranging design options, high stability and rapid on-site installation. Our settlement-resistant GRS systems provide a simple, efficient and ecologically sustainable solution, even for extra steep slopes.

Benefits

- Fast, space-efficient and cost-effective construction
- Maximum interlock between soil and interaction-flexible geogrids
- Small base area, reducing space and material requirement
- Ecological through use of locally sourced soil and spoil material
- Project-specific co-ordination of system components
- Structures with heights up to 60 m feasible
- Technical consulting, design services, on-site support



Perfectly reinforced earthworks

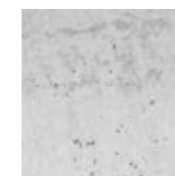
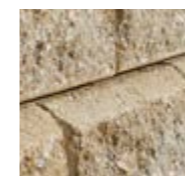


- Interaction-flexible geogrids for maximum system stability
- Rapid earthwork construction with straightforward connection for facings
- Slope inclinations between 45° and 110°
- For use in practically all soil types
- Also suitable for soils with very low bearing capacity

Facings to match the surroundings



- Active and passive wall systems
- Solutions with natural look/vegetation
- Gabions and half gabions with various fill options
- Blockwork with natural stone finish
- Concrete panels, in-situ concrete, sprayed concrete
- Sheet-pile walls



Special system options



- Installation in/by water
- Flood control
- Sound insulation and absorption
- Rockfall protection
- Avalance protection
- Lateral earth pressure containments



Our system brands include Fortrac Natur, Fortrac Natur S and Muralex

We will be happy to advise you!

Range of Applications

Solutions to practically every challenge



Retaining walls/steep slopes



Lateral earth pressure containments



Noise control



Bridge abutments

Other possible applications:

Ramps, wildlife/green bridges, rockfall protection, avalanche protection dams, cofferdams, flood control, widening schemes for transport infrastructure, reinstatement after embankment slips, stabilisation of breaks in terrain etc.

Application example

Buitenring bypass

The Buitenring scheme is one of the biggest transport and infrastructure projects in the Dutch Province of Limburg. The 26 km long, four-lane bypass will contribute to environmental protection by reducing traffic congestion in six municipalities. The GRS system was adopted for 30 of the 39 engineering structures on the project. These included steep slopes, bridge abutments, ramps, wildlife bridges and noise barriers. With their adoption encouraged by innovative tendering procedures, e.g. the two-envelope method, GRS constructions have long been established in the Netherlands as a standard cost-effective and eco-friendly solution.



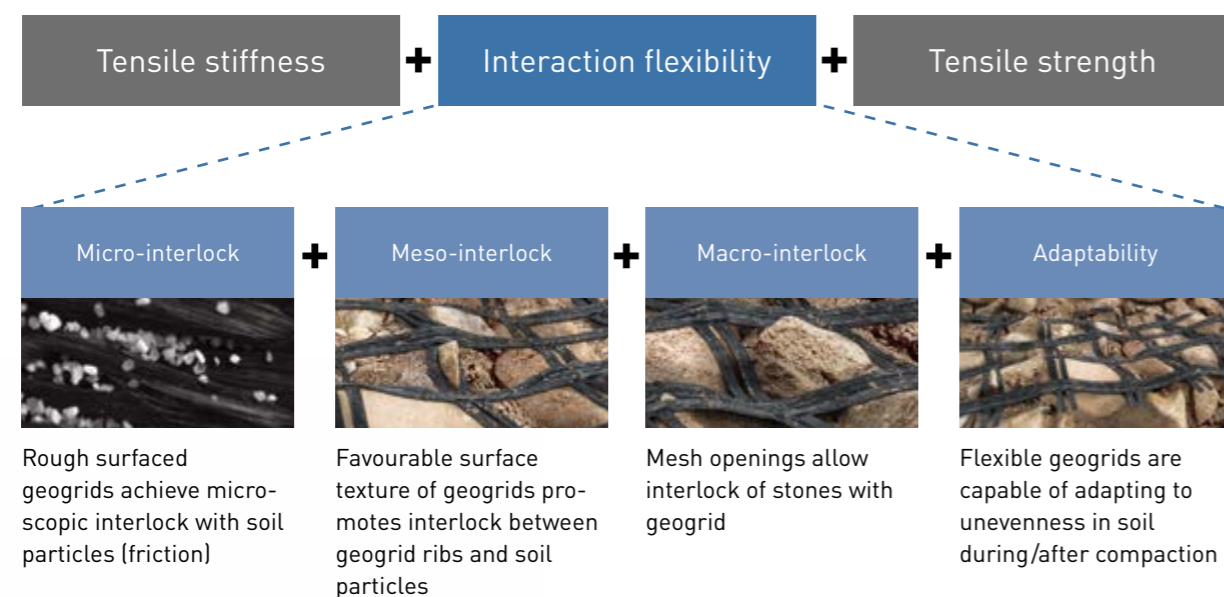
Efficiency Boosting Interaction-Flexible Geogrids

Ideal interaction and simple installation for your GRS

The function of geogrids in GRS systems is to improve the mechanical properties of soils. To resist forces with only minor deformation, they need to exhibit a certain tensile stiffness. In order to allow the mobilisation of ground shear forces, the tensile stiffness should not be too high. An optimal bond with the soil is favoured by a low bending stiffness. Fortrac geogrids excel not only by their very high tensile stiffness and tensile strength, but also by their outstanding interaction flexibility – a property offered only by flexible geosynthetics. Good interaction flexibility implies a perfect blend of macro-, meso- and micro-interlock plus a high degree of adaptability to the soil. This substantially improves the interaction or bond between soil and reinforcement.

Benefits

- Dense bedding of soil thanks to high adaptability of geogrid
- Activation to tensile strengths even during installation
- Accommodation of settlement
- Formation of a flexible integral system with soil
- Lower installation effort than that of rigid grids



	Flexible Grids	vs.	Rigid Grids
Unroll	No loading necessary 		Loading with weight of staff necessary
Pre-cut	Easily with a knife 		Electric cutting device
Handling	No sharp edges 		Sharp cutting edges
Preparation on site	Foldable pre-cut 		Pre-cut remains in roll format
Transport to installation point	Space saving on pallets 		Space consuming as rolls
Shaping at installation	Simple installation and compaction Good alignment to front element 		Difficult installation and compaction Poor alignment to front element
Installation rate	Big roll dimensions for minor loss due to offcut and overlapping 		Smaller roll dimensions with more loss due to offcut and overlapping

= Quick and simple installation saves costs 30 – 50 % more time-intensive installation*

*Advice on the pricing and planning of earthworks involving the use of geosynthetic reinforcement published extract from: Bautechnik, Heft 9/2007 Verlag Ernst & Sohn, Berlin

Geosynthetic Bridging of Sinkholes

Temporary and permanent protection of transport routes

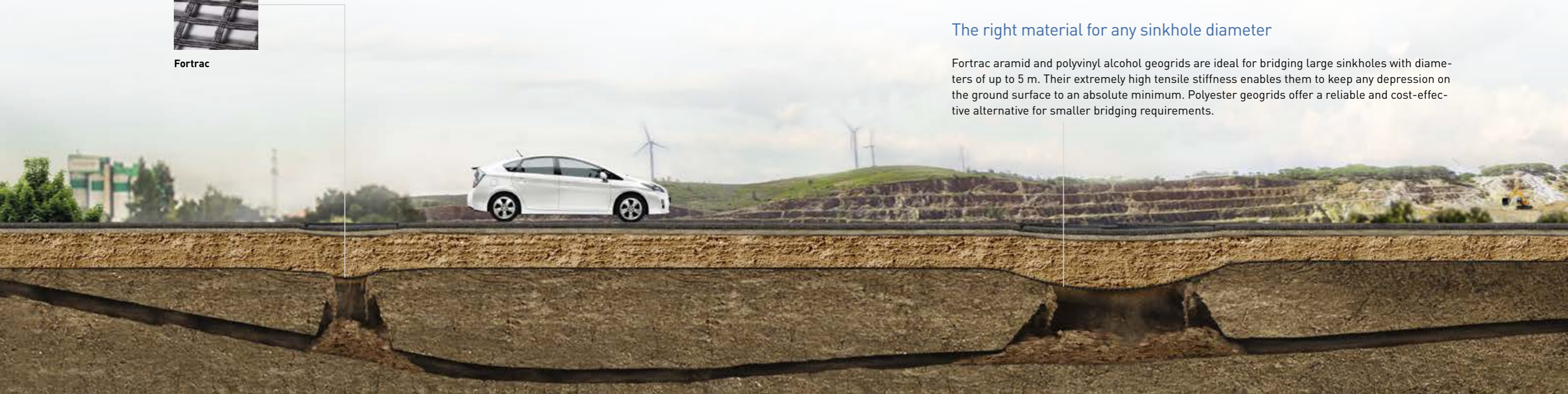
Sinkholes pose an extreme risk for infrastructure routes. Diverse concepts exist for bridging sinkholes, many of which are very elaborate. Boasting tensile strengths of up to 3,000 kN/m coupled with high tensile stiffness, our Fortrac geogrids offer both temporary and permanent protection in areas prone to sinkholes. Not only do they eliminate the need for costly, ecologically unsustainable and less ductile reinforced-concrete structures, they can also cater for project-specific requirements through selection of the most suitable raw material, e.g. polyester, polyvinyl alcohol or aramid. Furthermore, their inherent spare capacity can be mobilised for the short term to accommodate sudden loads imposed by unforeseen, large diameter sinkholes. We would also be happy to custom-develop system solutions to meet your specific requirements.

Benefits

- Structural stability in areas prone to sinkholes
- No risk of spontaneous failure thanks to high ductility
- Cheaper and more eco-friendly than alternative solutions, e.g. reinforced concrete
- Inherent spare capacity to accommodate unexpected loads from large sinkholes
- Easy installation without memory effect
- Cost-effective product selection and customised system solutions



Fortrac



Application example

Gröbers railway junction

On this major project in a former coal mining region, the sinkhole-prone area was approx. 800 m long by around 120 m wide, with potential sinkholes some 4 m in diameter. The bridging solution with a high-tensile Fortrac aramid geogrid was designed to accommodate speeds of up to 300 km/h. As an additional safeguard for the eight-track section, the composite earthwork construction was equipped with a monitoring and warning installation. The innovative system thus allows the continuous computer-controlled monitoring and protection of this key node in the Deutsche Bahn AG rail network.



The right material for any sinkhole diameter

Fortrac aramid and polyvinyl alcohol geogrids are ideal for bridging large sinkholes with diameters of up to 5 m. Their extremely high tensile stiffness enables them to keep any depression on the ground surface to an absolute minimum. Polyester geogrids offer a reliable and cost-effective alternative for smaller bridging requirements.

Pipeline Construction

Speed and reliability from end to end

Our geosynthetics offer an effective means of stabilising and protecting pipelines, e.g. against buoyancy and uplift forces, mechanical loads or environmental actions. They are robust, durable, versatile in their application and easy to install. HUESKER's solutions can also achieve vast improvements in site conditions and ensure the safe installation of plant. Our services span the entire construction process, from design consulting to on-site support during implementation of your project. Our assistance will enable you to find a prompt and effective answer to virtually any extreme situation.

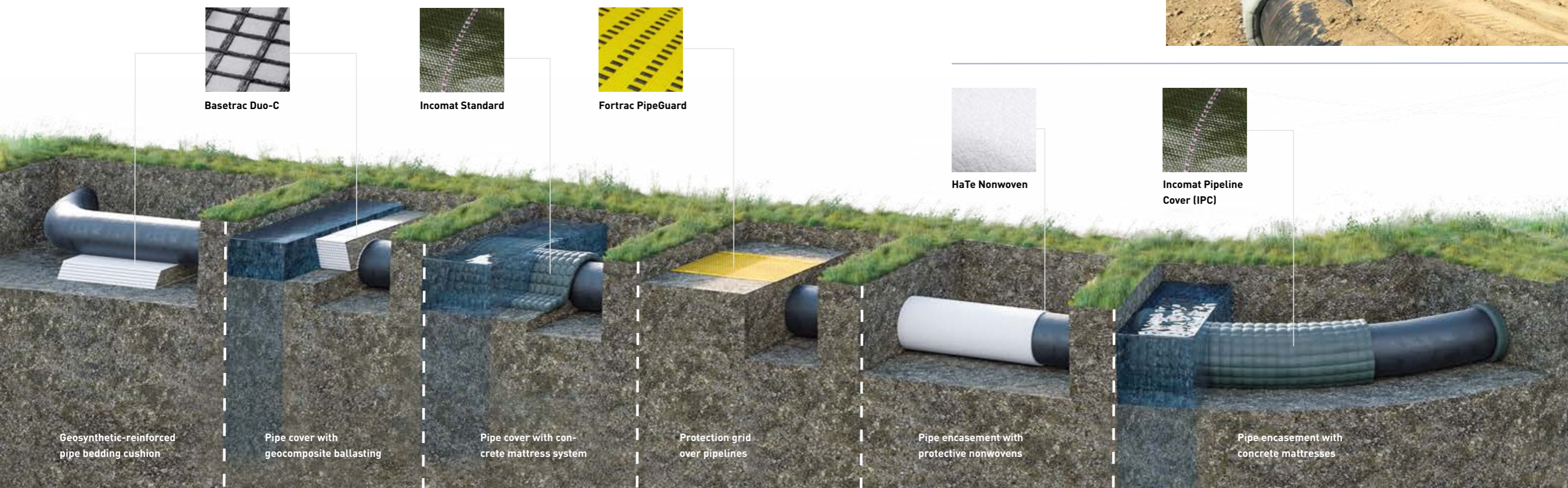
Benefits

- Easy to install solutions for protection and stabilisation of pipelines
- Protection against buoyancy/uplift and mechanical action
- No impairment of cathodic protection
- Technical consulting and design
- Project-specific detailing and custom-manufacture
- Certified, eco-friendly products that are used worldwide

Application example

Trans Adriatic Pipeline (TAP)

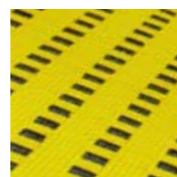
The Trans Adriatic Pipeline (TAP), at 870 km long, is an economically important natural gas pipeline. Its route through Albania and Greece has to cross impassable terrain, high water tables, rivers and other obstructions. Accordingly, HUESKER's Incomat Pipeline Cover was installed along certain sections to protect the pipe against both uplift and mechanical action. Thanks to its custom-manufacture, our geotextile concrete formwork mattress can also readily accommodate pipeline bends and varying pipe diameters. As on other projects, the straight-forward installation and short filling times allowed the works to proceed much faster than with conventional formwork systems, thereby saving valuable construction time.



Basetrac Duo-C



Incomat Standard



Fortrac PipeGuard



HaTe Nonwoven



Incomat Pipeline Cover (IPC)

Fortrac®, Stabilenka®, Ringtrac®, Incomat®, HaTe®, Basetrac® and Tektoseal® are registered trademarks of HUESKER Synthetic GmbH.

HUESKER Synthetic is certified to ISO 9001 and ISO 50001.



HUESKER Australia Pty Ltd

23 Dacmar Road
Coolum Beach
QLD 4573, Australia
Phone: 07 30888000
Mail: office@HUESKER.com.au
Web: www.HUESKER.com.au

