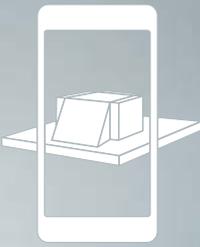
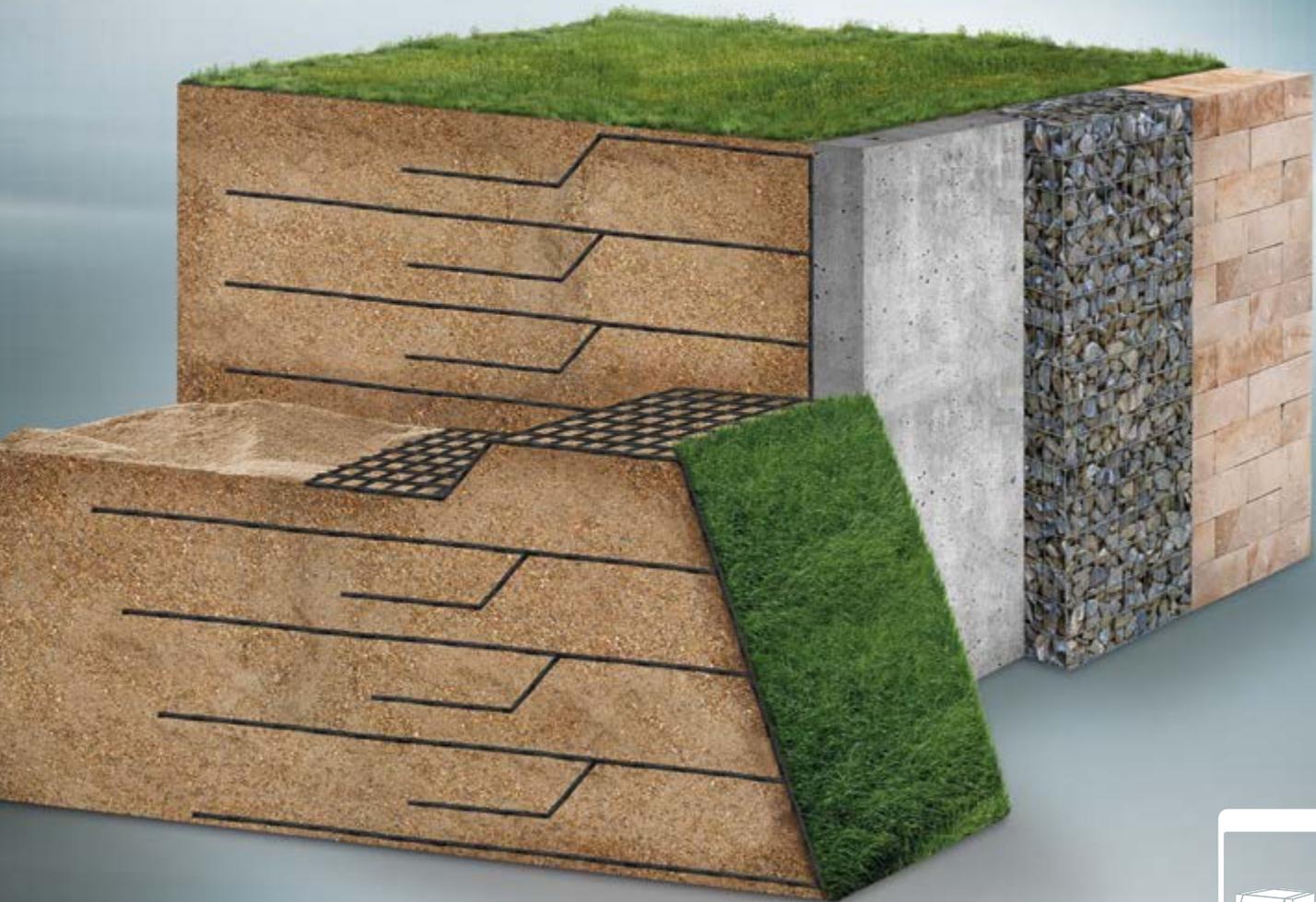


Experience now in augmented reality!



# Fortrac® Systems

Efficient Solutions for Steep Slopes and Retaining Structures

# Mastering Challenges with Fortrac Systems



**The construction of steep slopes and retaining structures is a routine, though often challenging, task in ground and foundation engineering:**

- Difficult surface and ground conditions
- Time and cost pressure
- Increasing resource shortages
- Laborious construction process
- Strict environmental regulations
- Extreme weather events

Fortrac-reinforced soil systems will enable you to build more efficiently and sustainably than is possible with standard methods:

## Fast

Our standardised system designs, customised solutions, experience and services are guaranteed to save you considerable time.



## Cost effective

Apart from speeding up operations, you can also cut costs through the use of locally sourced soils, reduced transportation, faster and easier installation, reliable long-term performance, less maintenance and fewer repairs.



## Straightforward

We work in tandem with our customers in assembling the entire system with all the necessary components, we will take any problems off your hands. By providing support from initial enquiry to project completion, backed up by the engineering know-how, systems and products to solve even the greatest challenges.



## Eco-friendly

Use of a geosynthetic-reinforced retaining structure instead of a concrete solution will, for example, cut CO<sub>2</sub> emissions by 80–85% and energy consumption by 70–75% [see 2015 life-cycle assessment by German Geosynthetics Industry Association].



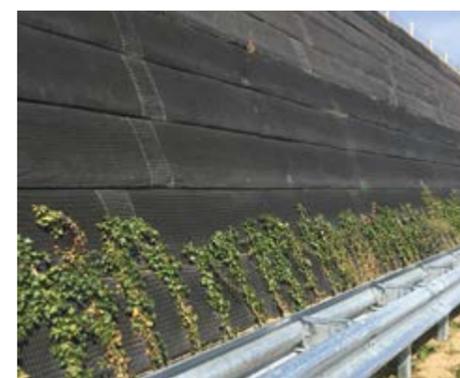
## Reliable

With over 40 years' experience in the design and installation of geosynthetic-reinforced soil (GRS) structures, we have delivered thousands of challenging projects worldwide.



## Controlled

In more demanding situations, we can deploy measurement instrumentation as an additional safeguard. Even structural monitoring over the entire service life of a facility is possible.



# Fortrac Geogrids

## The core element – robust and interaction-flexible

The function of the geogrid in geosynthetic-reinforced soil (GRS) systems is to accommodate tensile forces and improve the mechanical properties of the composite material. Fortrac geogrids excel not only by their good tensile stiffness and tensile strength, but also by their exceedingly high 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. The greater contact area brings about a substantial improvement in the interaction or bond between soil and reinforcement.

### Benefits

- Faster and easier installation than for rigid grids
- Tensile forces already activated during installation
- High adaptability of geogrid, with dense bedding of soil as a result
- Formation of a flexible integral system with soil
- Also suitable for use in alkaline soils
- Evening out of settlement

### Interaction flexibility



Micro-interlock    Meso-interlock    Macro-interlock    Adaptability



Here you will find the video on Fortrac's interaction flexibility



## Cutting GRS installation costs

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

=

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, issu no. 9/2007 Verlag Ernst & Sohn, Berlin

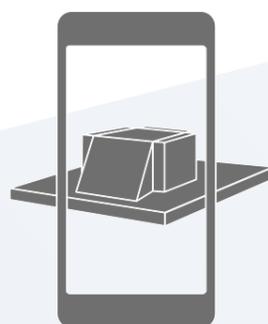
# Fortrac Systems

## Efficient solutions for steep slopes and retaining structures

Why opt for conventional construction methods when much easier ways are available? HUESKER's geosynthetic-reinforced soil (GRS) systems offer cost effective modular solutions for engineering structures. Fortrac Systems provide a simple, efficient and ecologically sustainable means of building settlement-resistant GRS structures, even with oversteep slopes. Wide-ranging options in terms of inclination, contouring and slope face design ensure that our solutions blend perfectly with virtually any landscape or architectural setting. Fortrac Systems offer numerous advantages over traditional constructions (e.g. gravity walls) while offering high stability and rapid on-site installation.

### Benefits

- Rapid installation coupled with reliable long term performance
- Cost effective modular systems
- Installation also with cohesive and contaminated soils
- Structures with heights exceeding 60 m and inclinations of 110° are feasible
- No elaborate foundations needed
- Steep slopes, reducing space and material requirement
- High resistance to settlement and deformation, depending on system
- Resource-efficient through use of soil and spoil material
- Lower CO<sub>2</sub> emissions and energy consumption than with standard solutions



Discover  
more with our  
interactive  
Fortrac Systems app!



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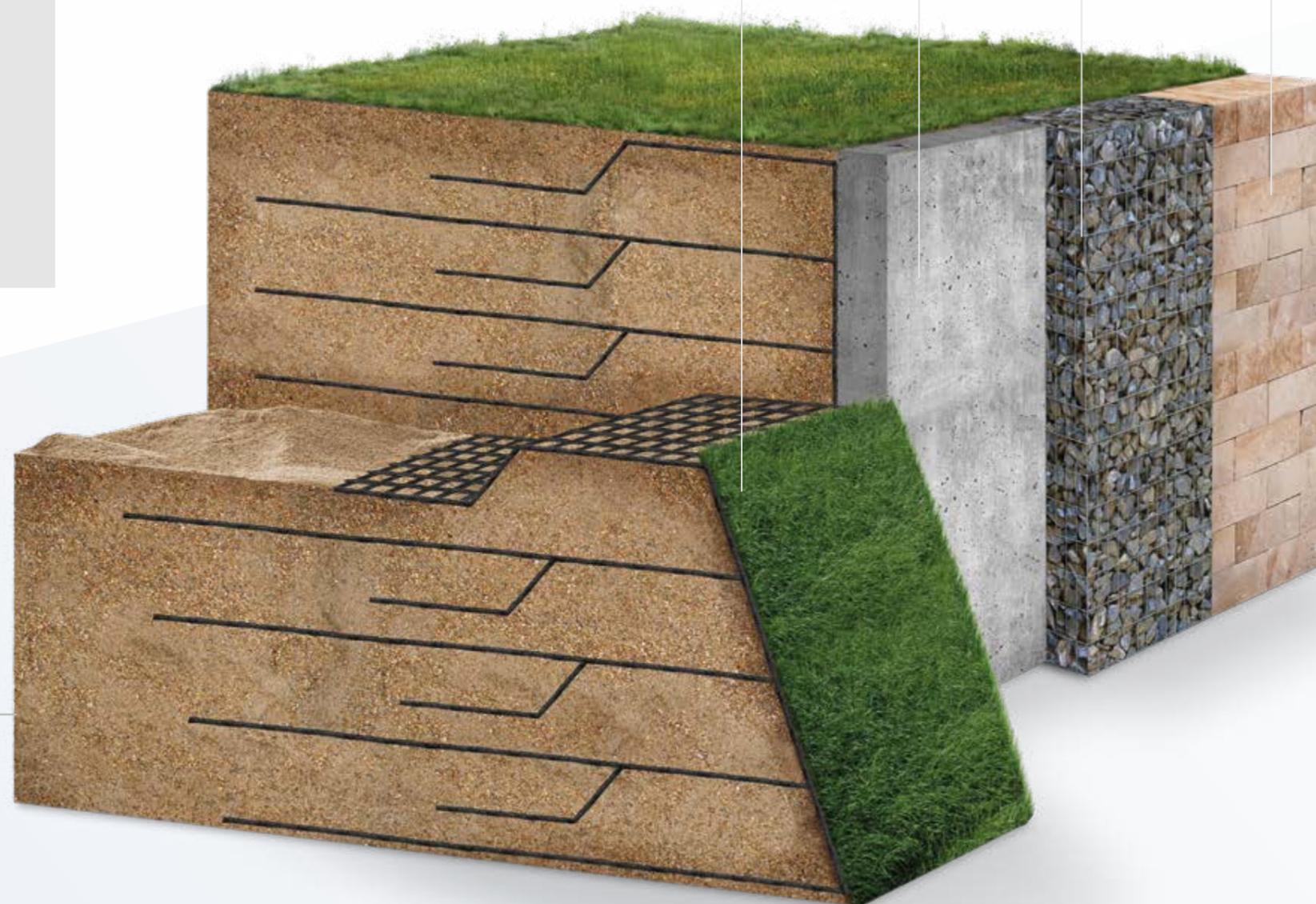
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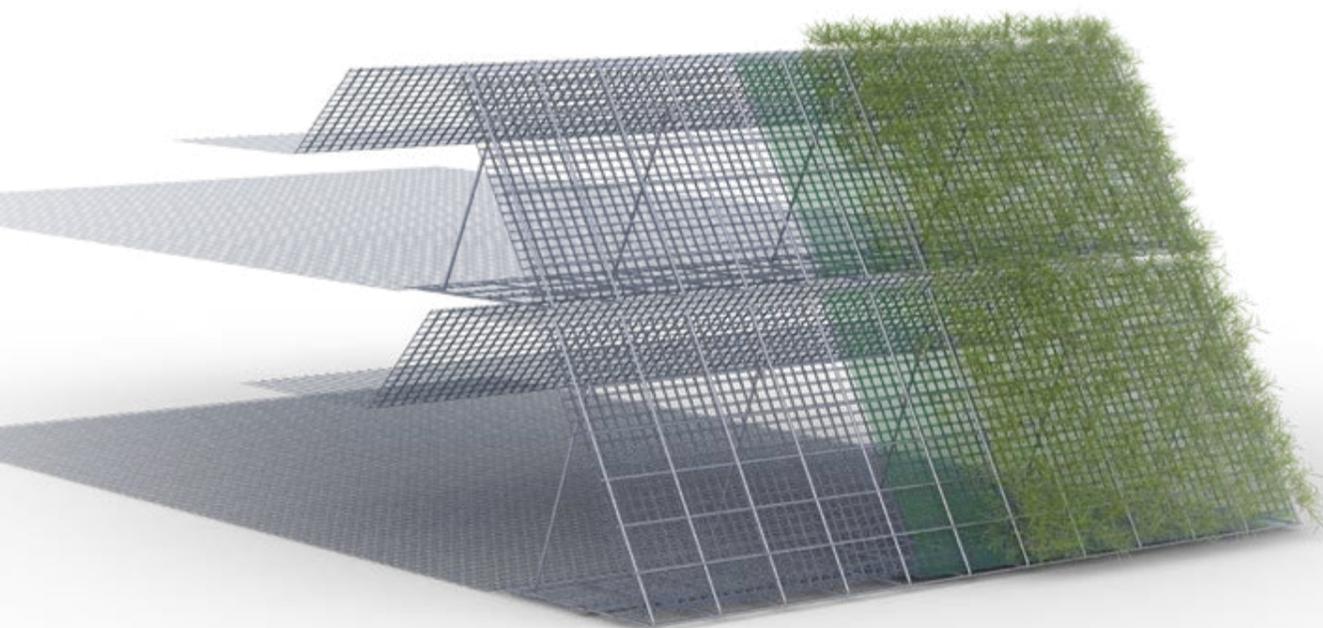
# Fortrac Nature

## Natural-looking and in harmony with the landscape

Our Fortrac Nature system models allow the rapid erection of retaining structures which, when suitably planted, blend seamlessly with the landscape setting. Unlike standard constructions, the natural-looking solution has a positive impact on the urban climate and, through appropriate vegetation, offers shelter for birds and insects. The system can cater for slope inclinations between 30° and 110°. Successful, long lasting vegetation can generally be provided for GRS structures with inclinations up to 70° and should be installed by a duly qualified specialist contractor working in consultation with the designer. No planting is, of course, needed for temporary structures or lateral earth pressure containments.

### General benefits

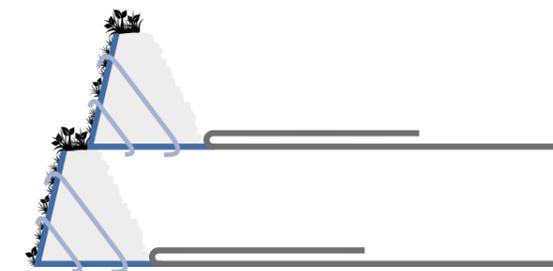
- Harmonious integration in natural landscape setting
- High flexibility in terms of inclination, contouring and vegetation
- Long-term stability and durability coupled with ductile behaviour
- Natural-looking solution, providing habitat for birds and insects
- Positive impact on micro-climate
- Easy dismantling allows use as temporary structure
- Lateral earth pressure containments of 110° feasible



## Our system models

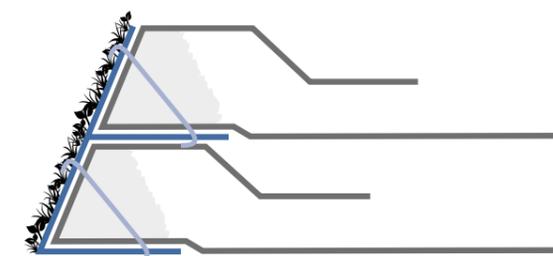
### With integrated corrosion-protected formwork

- Integrated galvanised steel formwork
- Long-term stability and high resistance to deformation
- Space-efficient installation without ancillary formwork by others



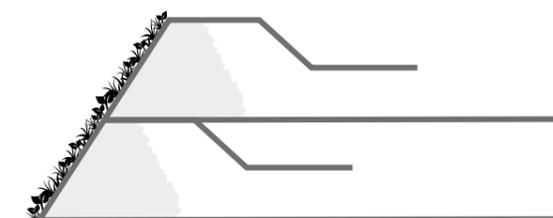
### With integrated lost formwork

- Integrated preformed structural steel formwork
- High stability and resistance to deformation
- Space-efficient installation without ancillary formwork by others



### Without integrated formwork

- Low system costs
- Erection and shaping with temporary ancillary formwork
- Customised architectural contouring possible



### Component kit



Fortrac Geogrids



Vegetation and/  
or erosion control  
mats



Ungalvanised steel  
formwork units



Galvanised steel  
formwork units



Tensioning hooks  
(galvanised/  
ungalvanised)



Planting/  
hydroseeding  
by specialist  
contractor

# Application Examples

## Fortrac Nature



**New road – Triebener Straße B114**  
Austria | New-build road offering reliable long-term performance on active creep-prone slope – Made possible by high ductility of GRS – Grid mesh size adapted to local fill material – System with integrated lost formwork – Retaining structure up to 28 m tall.



**B85 trunk road widening**  
Germany | Trunk road between Lösau and Höferänger directly on geosynthetic-reinforced retaining structure – 11 m tall, 70° inclination, with natural vegetation – System with integrated corrosion-protected formwork.



**New residential estate near motorway, Iserlohn**  
Germany | Terrain raised by up to 25 m to create residential site – Combination of 90° retaining wall and 80° noise bund – High soil pH values – Alkali-resistant Fortrac (PVA) geogrids specified – System with integrated lost formwork – Instrumentation installed for long-term monitoring.



**The first 110° earth pressure relief wall in the world**  
Netherlands | Vegetated wildlife bridge over A2 motorway with 110° earth pressure relief wall – Only cost-efficient option available to shield slender concrete structure from earth pressure – Adopted solution also incorporates steel mesh facing and vegetation.



**Buitenring Parkstad Limburg megaproject**  
Netherlands | 26 km bypass with links to A76 motorway and N281 urban motorway– Total 39 structures (e.g. ramps, steep slopes, noise barriers) includes 30 bridge abutments – In all, some 650,000 m<sup>2</sup> Fortrac geogrids incorporated.



**Trèfle art installation in Parco Arte Vivente, Turin**  
Italy | Permanent landscape artwork shaped like a four-leaf clover – Fanciful architectural concept made possible by Fortrac geogrid's high flexibility – System with integrated lost formwork.



**Avalanche protection dam for Ludrigno**  
Italy | Protection of Ludrigno's population and valley-bottom infrastructure against avalanches – System with integrated lost formwork – Protective structure is approx. 140 m long and 10 m tall.



**Rockfall protection dam in Gesäuse National Park**  
Austria | Challenging avalanche protection structure in highly inaccessible terrain – Slender dam with 70° longitudinal inclination – Geometry adapted to steep mountain – Built to ONR 2481 regulations – System with integrated lost formwork – 18,000 m<sup>2</sup> Fortrac MDT (PVA).

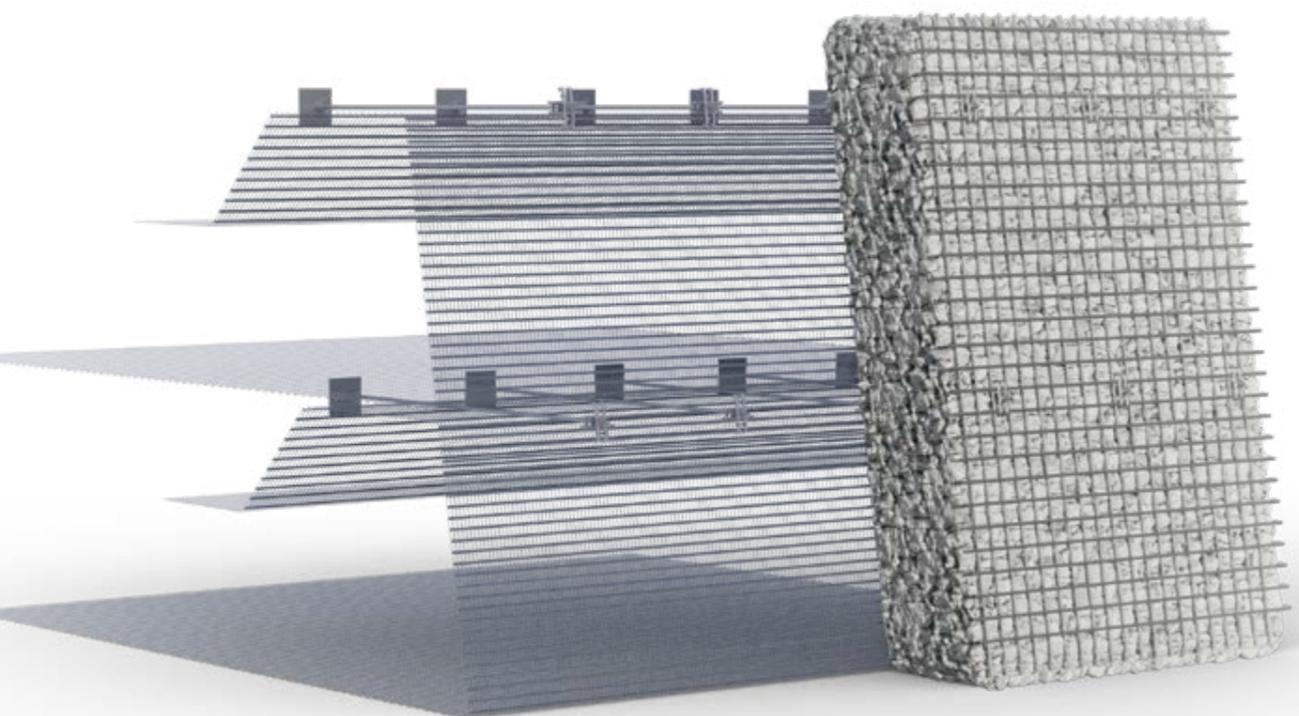
# Fortrac Gabion

## Wide variety of stone basket facing solutions

The Fortrac Gabion system comprises earthworks reinforced by Fortrac geogrid layers and a facing made from corrosion protected steel-mesh units with custom designed stone fillings. Depending on the requirements, the filled steel-mesh units may be attached to or suspended in front of the reinforced earthworks, either as an active component in the overall structural system or as a passive protective element to enhance visual appeal. Our system solutions cater for inclinations of up to 90° as well as very tall structures. Rapid erection of the earthwork structure and the use of prefabricated, easy-to-fill (in some cases, even prefilled) gabions significantly boost the efficiency of site operations. In terms of noise control, the adoption of an appropriate system configuration has been shown to achieve a high level of sound absorption (category A 3 under German regulations).

### General benefits

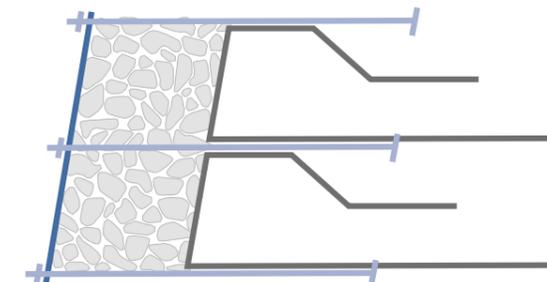
- Wide ranging design options
- Rapid installation and easy repair
- Fire, vandal and UV-resistant
- Resistant to differential settlement
- Low maintenance, with minimum costs for care and upkeep
- Can be designed to meet German noise control category A 3



## Our system models

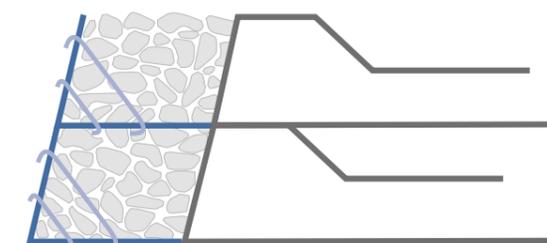
### Tie rod system

- Double-skin retaining structure with corrosion protected steel
- Particularly suitable for settlement-prone subsoils
- Staggered erection of earthworks and facing possible
- Repair of individual facing sections possible (e.g. after impact)



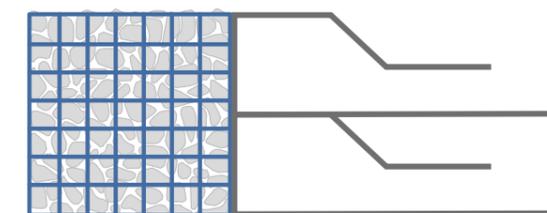
### Half-gabion facing

- System with structural facing units
- Steel mesh with tensioning hooks
- Custom-fabricated to fit slope inclinations



### Full-gabion facing

- Structural and non-structural facing units possible
- Gabions can be factory-assembled and prefilled
- Very short construction times in case of preassembled delivery to site
- Easily replaceable facings (e.g. after impact)



### Component kit



Fortrac Geogrids



Erosion and wash-out protection



Tie rod system components (corrosion protected)



Half and full-gabion units (corrosion protected)



Compression and frost-resistant stone filling



Sound-absorbing mat (for noise control)

# Application Examples

## Fortrac Gabion



**A3 motorway widening, Frankfurt/Main – Würzburg**  
Germany | Embankment widening for new six-lane motorway sections east and west of Haseltalbrücke bridge – Up to 13 m tall full-gabion walls – Self-supporting GRS retaining wall with purely cosmetic gabion facing (passive construction).



**Highly absorbent noise barrier**  
Germany | New highly absorbent noise barrier for six-lane widening of A3/A73 motorways, Fürth-Erlangen – Absorption category A 3 (sound absorption  $DL_a \geq 8 - 11$  dB) – Gabions facing carriageway and vegetation on the other side – Height up to 10 m.



**Double bridge abutment for A74 motorway**  
Netherlands | Major project near Venlo, incl. two motorway bridges directly adjacent to each other – Abutment heights 11 m and 9 m – Rapid completion on very soft subsoil – Phased installation after advance surcharging – Tie rod system.



**Modern wildlife bridge over A2 motorway**  
Netherlands | Vegetated wildlife bridge over A2 motorway – Curved approach ramp topped by modern architectural feature – Fortrac-reinforced soil system applied in conjunction with half-gabion facing – Height approx. 8 m.



**Approach ramp for new bypass motorway**  
Romania | 200 m long, 11 m tall approach ramp (A4 motorway, Constanța-Poiana) – Tie rod system – Special steel mesh aperture size – Rapid progress on site e.g. through simplified filling operation with easy-to-use plant and (140 mm dia.) natural fill material.



**Noise barrier for residential estate in Neuss**  
Germany | Development area by railway and regional road – Combination of full-gabion wall facing track and natural slope facing new housing – Gabions filled with stones, soil and vegetation – 10 m tall with 68° inclination on track side.



**Motorway widening within existing footprint**  
Netherlands | Six-lane widening of (A1/A27) motorway section near Utrecht – Natural sloping motorway embankment rebuilt as steep slope with Fortrac Gabion tie rod system – Erection of top noise barrier made possible by integration of concrete pile supports in system.



**Uncovering of River Schondelle**  
Germany | Sub-project of River Emscher ecological improvement scheme – Earthworks built with integrated lost formwork and full-gabion facing – Solution as replacement for originally planned concrete cantilever wall – Erected in three, 5 m tall vertical sections.

# Fortrac Block

## Multi-faceted concrete block facings

The Fortrac Block system offers a host of concrete block designs and finishes for use in conjunction with your Fortrac-reinforced earthworks. In most cases, the Fortrac geogrids, fill material and blocks are designed to act compositely as the loadbearing element of the retaining structure. However, passive solutions are also feasible as an alternative to this active construction. The mortar less system can be used for virtually any slope height and for inclinations up to 90°. Depending on the block sizes, the facing can be readily installed by hand, without any lifting equipment. Small-sized concrete blocks and tiered arrangements can be used to model a wide variety of topographies as well as partly vegetated walls. Our Fortrac PVA grids even allow you to build near sulphate-bearing waters and with alkaline (e.g. cement or lime-stabilised) cohesive soils.

### General benefits

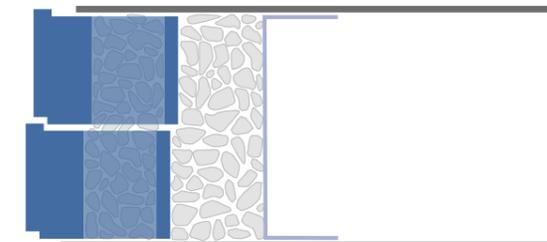
- Formwork-free, mortarless system
- Wide selection of block shapes, sizes, weights, colours and finishes
- Straight, curved and tiered walls possible
- Project-specific solutions with structural or purely cosmetic/protective facings



## Our system models

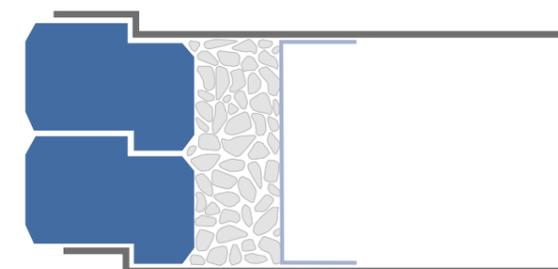
### Hollow block facings

- Medium-sized lightweight hollow concrete blocks
- Crushed stone filling ensures a very strong bond
- Fewer blocks per m<sup>2</sup> speed up installation
- Blocks placed by hand and with minimal equipment
- Curved wall sections easily formed



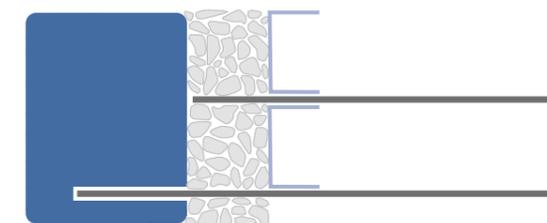
### Solid block facings

- Small-sized lightweight solid concrete bricks
- Blocks placed by hand and with minimal equipment
- Curved wall sections easily formed



### Large concrete block facings

- Large-sized solid concrete blocks
- Fewer blocks per m<sup>2</sup> vastly speed up installation
- Prefabricated blocks with cast-in geogrids further simplify installation



### Component kit



Fortrac Geogrids



Separating nonwoven



Solid blocks



Hollow blocks



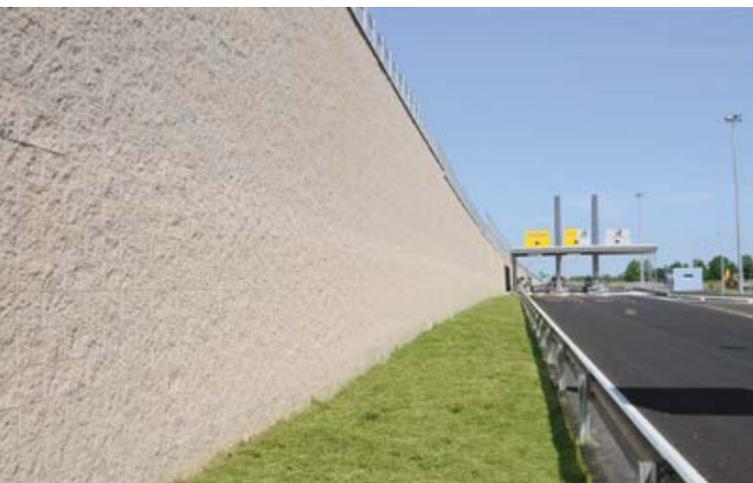
Large-sized concrete blocks (reinforced/unreinforced)



Crushed-stone drainage layer or drainage mat

# Application Examples

## Fortrac Block



### Approach ramp for new Venice bypass

Italy | Modern hollow block facing with colour to suit landscape – Built with concrete-stabilised soil – Alkali resistant Fortrac PVA geogrids specified – Installation without wrap-around – Structure approx. 10 m tall with 90° inclination.



### Quayside at new Störmthaler See lake

Germany | Renaturation of former Espenhain open-cast mine – Contemporary architecture – Resistant hollow concrete blocks and Fortrac PVA geogrids ensure durability of new quayside despite high sulphate content of impounded water.



### Abutment to bridge over river channel

Germany | Rehabilitation of two-lane L71 regional road near Lust – Crossing over small river channel – Fortrac reinforced bridge abutment built with large, rectangular concrete blocks – 90° inclination.



### Sports and leisure facilities in Waren, Müritz

Germany | Modelling of sports, leisure and park facilities for new youth hostel in Waren (Müritz) – Retaining wall built with hollow blocks – 90° inclination – Straight and curved wall sections with varying heights.



### Retaining wall along main road through Burkau

Germany | Road rehabilitation incl. embankment fill – Maximum space efficiency – Retaining wall immediately bordering pond – Built with resistant hollow concrete blocks – 84° wall inclination.



### Retaining wall for power station in Temelín

Czech Republic | Very soft ground conditions – Fortrac-reinforced soil with hollow concrete blocks and additional vertical drainage – Wall height up to 7 m with 66° inclination.



### M11 toll road, Moscow - St. Petersburg

Russia | High-speed motorway with over 60 GRS structures – Several bridge abutments erected – Reinforced earthworks with alkali-resistant Fortrac (PVA) geogrids and hollow reinforced-concrete blocks as facing – 90° inclination.



### Ayla Oasis lagoon landscape

Jordan | 4,300,000 m<sup>2</sup> landscaped oasis – 15 km beach and waterfront promenade with Fortrac-reinforced soil and hollow blocks – Designed for earthquake resistance to Eurocode 8 and for sudden drop in water levels in front of walls.

# Fortrac Panel

## Wall construction made simple with precast concrete

The Fortrac Panel system offers speedier construction than is possible with standard solutions, by eliminating the need for elaborate foundations, while benefiting from rapid GRS erection and easy-to-install precast concrete units. Depending on requirements, the precast concrete panels may be attached to/suspended in front of the reinforced earthworks as an active component in the overall structural system or a subsequently installed passive element. With the active model, the facings are directly subjected to earth pressure and act simultaneously as form work and finish. With the passive system, the geogrid takes up the entire earth pressure while the concrete facing assumes a purely cosmetic and protective function. One key advantage of the passive model is that it allows the phasing of works in case of difficult soil conditions; with the facing installed later than the retaining structure after any settlement and deformation have occurred. Our engineers will be glad to assist you with the design of your tied-back retaining structure.

### General benefits

- Rapid erection with slender precast concrete panels
- Cost-effective alternative to concrete-only solutions
- Low labour and plant requirement
- Project-specific solutions with structural or purely cosmetic/protective facings
- Tied-back sheet piling as a further option



## Our system models

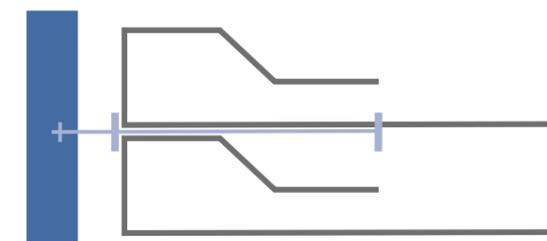
### Active model

- Panels acting simultaneously as formwork and finish
- Outer skin forming part of structural system
- Rapid on-site erection (also thanks to large intervals between geogrid layers)
- Fewer geogrids/geogrid layers
- Connectors can be used to accommodate settlement



### Passive model

- Particularly suitable for settlement-prone soils
- Freedom from restraint and deformation due to phased installation
- Minimisation of later settlement, e.g. by advance surcharging
- Damage to panels has no impact on structural stability
- Individual panels easily replaceable if damaged



### Component kit



Fortrac Geogrids



Nonwoven for erosion/wash-out protection



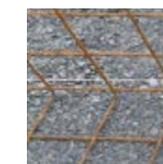
Precast-concrete panel without/with cast-in coupling



Connectors for active facing



Connectors for passive facing



Lost or temporary formwork for passive facing

# Application Examples

## Fortrac Panel



### Fast bridge construction in just 80 days

Germany | Footbridge over A3 motorway – 36.60 m span – Abutment with passive concrete panels and gabion facings – Built on small footprint in only 80 days – Only two full motorway closures – Extensive measurement instrumentation installed.



### Bridge abutment as active system

Netherlands | Wildlife bridge over N261 near Tilburg-Waalwijk – 50 m long, 90° inclination – Panels, with active/structural function, are tied to each geogrid layer while also acting as formwork – Rapid erection with only a few geogrid layers.



### Traffic interchange on N62, Sloeweg

Netherlands | Bridge abutment with central pier – Complex superstructure with roundabouts, footpaths and cycle paths – Fortrac-reinforced soil with very thin, curved concrete panels – Panels installed at later date (passive construction).



### Prinses Amalia viaduct, Maasvlakte, Rotterdam

Netherlands | Passive system with thin, curved concrete panels – Fixed with galvanised anchorage system – Alkali resistant Fortrac MDT geogrids – Maximum protection against chemical action from saline environment – High long-term resistance.



### Bridge abutment at Beukbergen wildlife bridge

Netherlands | 30 m long, 19 m wide bridge over N237 links forests around Austerlitz with northern part of the Utrechtse Heuvelrug National Park – Fortrac-reinforced soil faced by wide, passive concrete panels with highly decorative finish.



### Flyover bridge in Ajah

Nigeria | Infrastructure project to promote economic development and quality of life – Bridge structure with Fortrac-reinforced soil and very thin concrete panels as passive construction – Structure length 620 m – 90° inclination – Completed in only 10 months.



### Krammer Wind Park with 34 wind turbines

Netherlands | Tied-back sheet piling allowed rapid erection directly by water – Cost-effective alternative to standard sheet piling solutions: shorter, thinner sheet piles, reinforced area traffickable by heavy construction plant – Instrumentation installed for monitoring.



### Temporary bridge abutment for haul road

Switzerland | Temporary heavy-duty bridge (10 m tall, 11 m long) – Allowed continuous transportation of 600,000 m<sup>3</sup> excavation spoil over railway line – Tied-back soldier pile walls – Rapid erection and dismantling – Reuse of all materials.

# Straightforward installation

Just a few steps and your Fortrac System is in place

## Step 1 Formation

Prepare formation together with any necessary base area for facing on subgrade of adequate bearing capacity.

## Step 2 Fortrac-reinforced earthworks

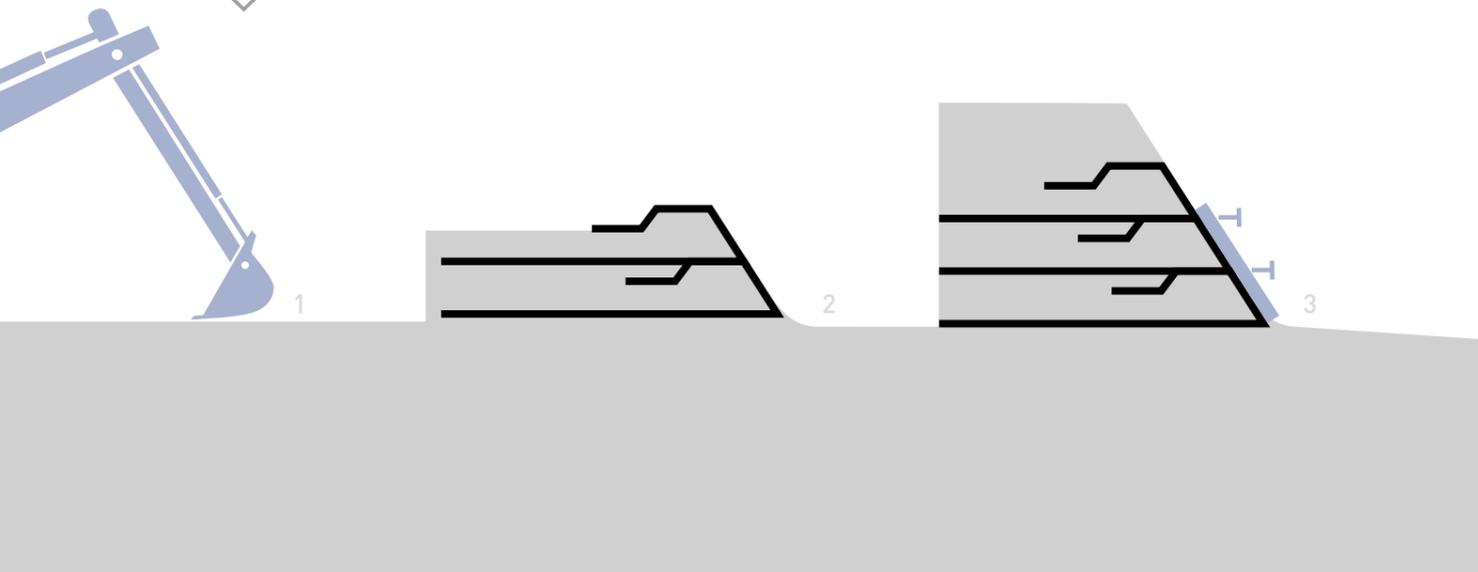
Construct Fortrac-reinforced earthworks layer by layer, with or without geogrid wrap-around, as required. Depending on system, also incorporate formwork, erosion/wash-out protection, drainage and facing connection components etc.

## Step 3 Facing

Depending on system, install facing layer by layer in tandem with earthworks or connect to earthworks as final operation. Facing may serve as active component in structural system or be simply attached as passive element.



We would be happy to recommend specialist contractors for system application and vegetation.



# Range of Applications

Solutions to practically every challenge



Retaining walls/steep slopes



Bridge abutments



Noise control



Rockfall/avalanche protection



Earth pressure relief



Landfill construction

**Other possible applications:**  
 Approach ramps, widening schemes for transport infrastructure, reinstatement after embankment slips, stabilisation of breaks in terrain, architectural structures, garden architecture and landscaping etc.



Hydraulic engineering

# HUESKER Services

HUESKER services begin with providing the customer with initial advice and it ends with supporting the realisation of the project on site. What we provide are safe, customised, ecologically sound and economically viable project solutions.

## Engineering Services

### Technical consulting

We will recommend the appropriate product types for your specific requirements.

### Technical design

Our engineers assist design practices by performing verifiable design calculations in accordance with international codes of practice.

### Project-specific placement plans

We will prepare installation and placing recommendations plus installation diagrams.

### International knowledge transfer

Best practice solutions and techniques from our global network.

## Product Services

### Custom-designed project solutions

We will partner you in developing custom-fabricated products to meet your particular requirements.

### Alternative solutions

We will propose alternative design solutions as well as recommendations for adjustments and optimisations.

## On-The-Spot

### On-site instruction

Where required, our application technicians can offer installation assistance related to the specifics of product installation.

### Installation aids

We can offer you practical installation aids to facilitate the application of our products.

### Training

Product and application-specific instruction.

## Documents

### Certificates and approvals

Our products have numerous certifications and approvals that are issued, for example, by BAM, BAW, BBA, EBA, IVG and SVG, depending on the product type.

### Tender documents

We would be happy to provide you with proposals for your specification texts.

### Technical guidelines

Technical guidelines will help you to ensure the best practice installation of your product on site.

## Digital

### Website

Here, we offer you news, videos, project reports, installation guidelines, specialist articles, scientific publications, software, brochures and much more.

You will also find us on Facebook, LinkedIn and YouTube.



All graphic material in this brochure serves an illustrative purpose only.

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HUESKER Synthetic is certified to ISO 9001 and ISO 50001.



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