BECO
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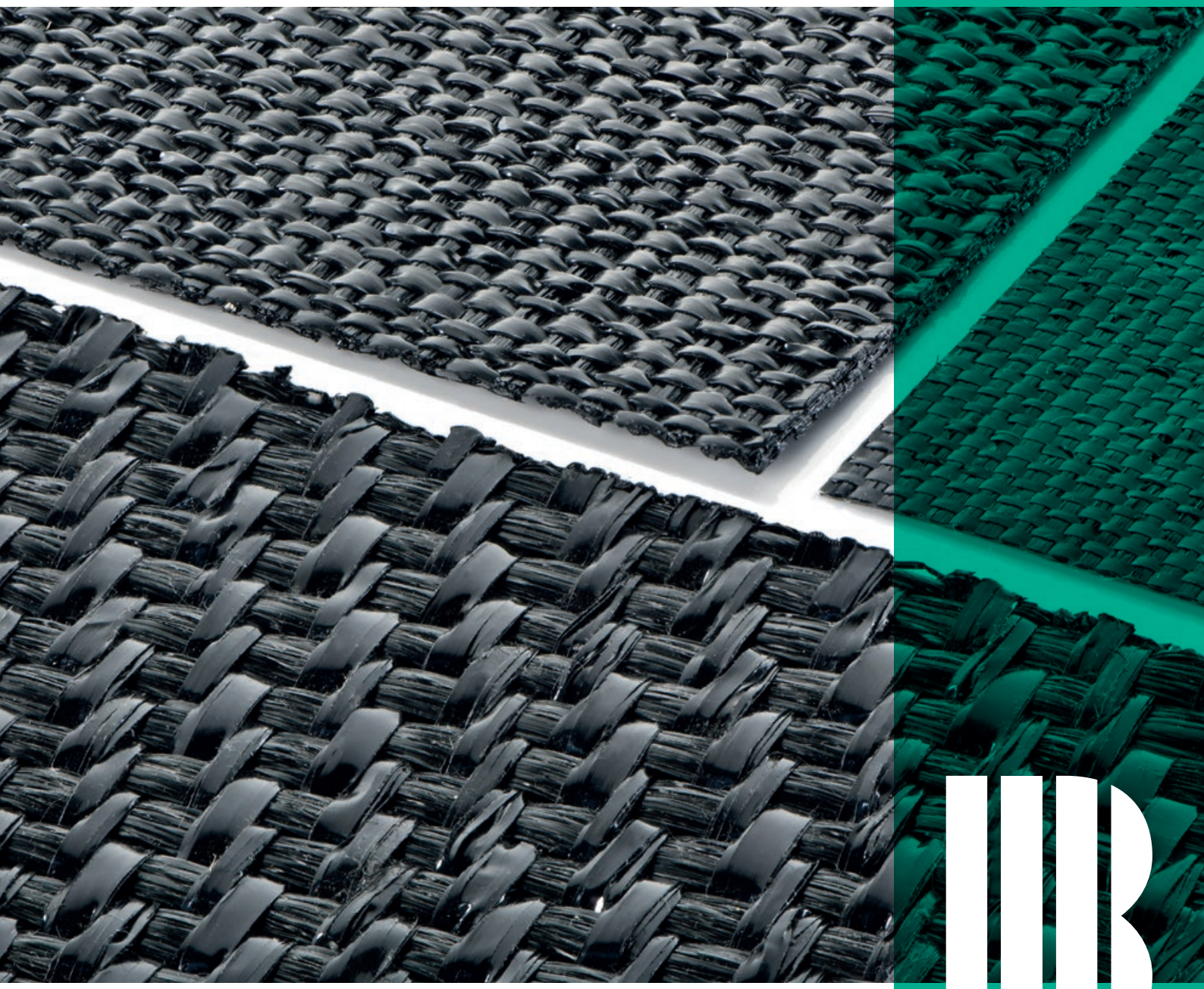

BEFORCE

Woven Geotextiles

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KEY ADVANTAGES
at a glance

→ Separation of bearing course material from substrate

→ Reinforcing effect in the foundation course; increases the load-bearing capacity; reduces deformation and ruts

→ Easy to install; low labour input

→ Cost savings due to reduction in thickness of unbound base course

BEFORCE
Woven Geotextiles

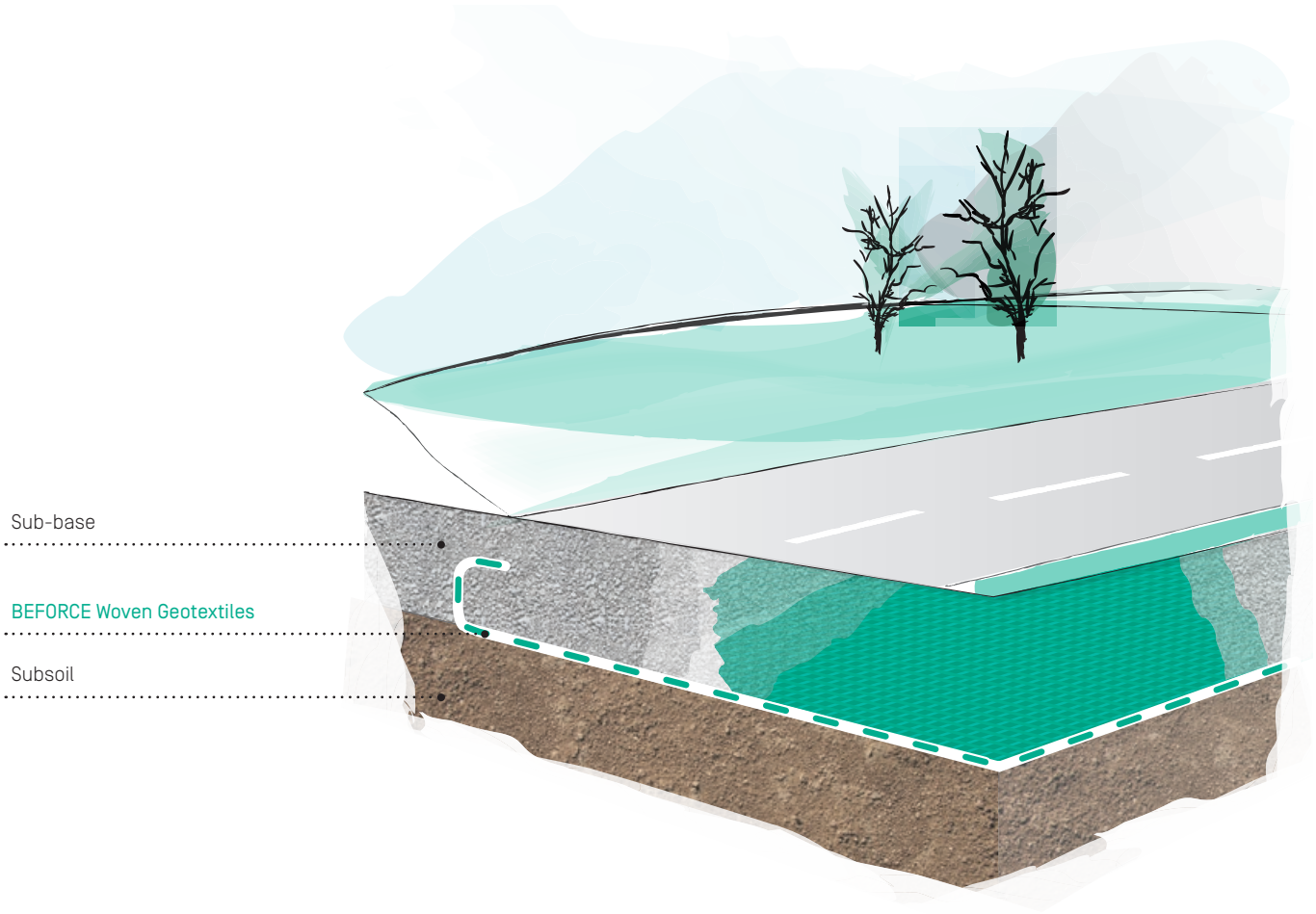
A common problem encountered in the construction of traffic routes is the inadequate load-bearing capacity of the subgrade. In order to permanently increase the load-bearing capacity, either the loads must be transferred to sufficiently load-bearing layers at a deeper level (deep foundations) or suitable measures must be taken to improve the existing subgrade.

Traditional soil stabilisation methods such as soil replacement or soil treatment using lime are very laborious and costly and are not always possible. This is where BEFORCE Woven Geotextiles offer a simple and cost-effective solution for improving the load-bearing capacity of bound or unbound foundation layers.

PRODUCT DETAILS
and properties

BEFORCE Woven Geotextiles offer a simple and cost-effective solution for improving the load-bearing capacity of unbound upper or foundation layers.

The woven tape fabric is manufactured by cutting narrow strips from a polypropylene membrane and then stretching the strips and weaving them together. The result is a uniaxial or biaxial geotextile in the longitudinal (warp) and lateral (weft) directions.



Project-specific requirements

The BEFORCE range of polypropylene woven fabrics offers a wide spectrum of special reinforcing products.

The standard BEFORCE PH 55 (PP 80) version can be used for filling with coarse-grained base-course material as well as on subgrades that deform and have a poor load-bearing capacity. It therefore exceeds the requirements for geotextile robustness class 5, as defined on pages 105-107 of the “Merkblatt über die Anwendung von Geokunststoffen im Erdbau des Straßenbaues” (Leaflet on the use of geosynthetics in earthworks for highway construction).

If there are other, special requirements in specific cases, we would be happy to determine which type of product is suitable for you.

The standard version, BEFORCE PH 55 (PP 80), is suitable for most applications.

FUNCTIONS
BEFORCE Woven Geotextiles

Separation

The tightly interwoven structure of the BEFORCE Woven Geotextiles ensures effective separation of the different soil layers. This characteristic distinguishes woven geotextiles from geogrids, which only reinforce the soil and therefore require the use of an additional separating layer (such as a non-woven geotextile) in certain applications.

The standard product BEFORCE PH 55 (PP 80) exceeds the requirements for geotextile robustness class 5. This makes it a particularly robust material that provides a low-cost solution in comparison to the use of a combination of geogrids and non-woven fabrics.

Reinforcement

In order for the fabric to be able to absorb the forces acting on it, its tensile strength needs to be activated by establishing friction between the soil and the fabric (coefficient of friction). The encased soil is contained by the fabric and acts as a compression member.

When stabilising foundation soils using BEFORCE Woven Geotextiles, the modulus of deformation, E_{V2}, of the subgrade must first be determined in order to establish its load-bearing capacity. As a general rule, a modulus of deformation, E_{V2}, of 45 MN/m² is required for the subgrade and 120 MN/m² for example for the frost protection layer. In order to reduce deformation and increase the load-bearing capacity to the required level, the woven geotextile must be laid on the raw subgrade. Traffic loading causes deformation of the unbound pavement layers and this is absorbed by the BEFORCE Woven Geotextiles. In accordance with the "Merkblatt über die Anwendung von Geokunststoffen im Erdbau des Straßenbaues" (M Geok E 2016) (Leaflet on the use of geosynthetics in earthworks for highway construction), woven geotextiles are used in applications where a reinforcing and/or separating effect is required.

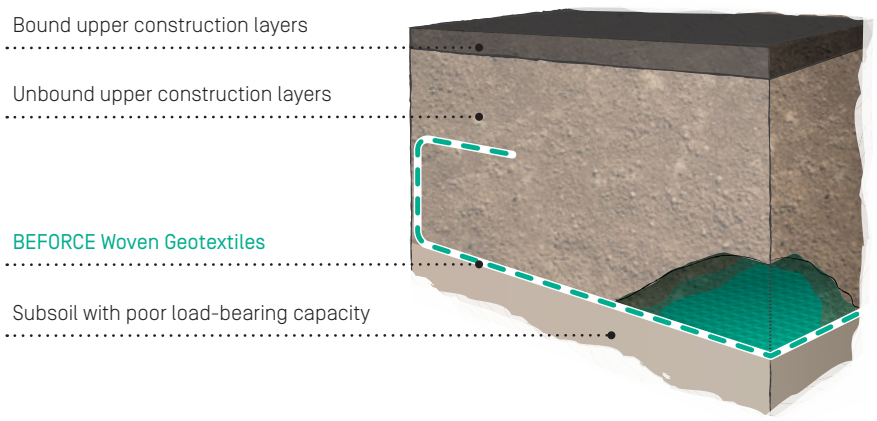
One of the great advantages of BEFORCE PH 55 (PP 80) Woven Geotextile is that it combines the functions of "separating" and "reinforcing" in a single product.

TECHNICAL DETAILS
at a glance

Improved foundation layer

Without partial soil replacement

If a reinforced base layer is constructed, there is no need for a separate analysis of the lead bearing capacity on top of the subgrade, provided that the requirement of $E_{V2} \geq 120$ MN/m², where $E_{V2}/E_{V1} \leq 2.3$, is met at the upper surface of the frost protection layer.



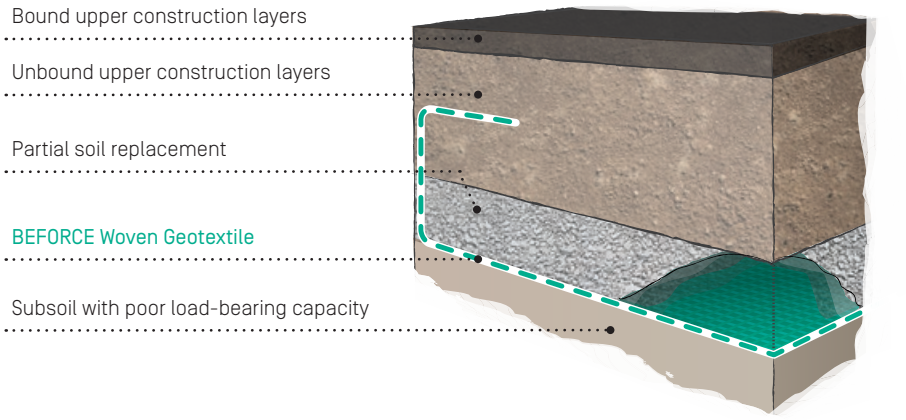
E_U [= E_{V2} of the rough formation]	MN/m²	10	15	20	25	60
Required minimum thickness of the frost protection or sub-base layer, reinforced	cm	53	42	35	35	29
Required minimum thickness of the frost protection or sub-base layer, no reinforcement	cm	81	63	51	45	40
Potential savings	**%**	**34**	**33**	**31**	**31**	**27**

Professional assessment on site

The correct static analysis and assessment of the geotextile-reinforced structure are the responsibility of the on-site specialist and include the appraisal and interpretation of all matters relating to the proposed structure and the subgrade.

With partial soil replacement

If it is expected that the existing subgrade will not have the required load-bearing capacity of E_{V2} 45 MN/m², the subgrade or sub-base layer must be improved. One method of improvement is by replacing the existing soil and this can be minimised by using BEFORCE PH 55 (PP 80) Woven Geotextile.



E_U (= E_{V2} of the rough formation)	MN/m²	10	15	20	25	30
Required minimum thickness of the frost protection or sub-base layer, reinforced	cm	21	16	13	10	9
Required minimum thickness of the frost protection or sub-base layer, no reinforcement	cm	45	35	28	24	21
Potential savings	**%**	**53**	**54**	**53**	**58**	**57**

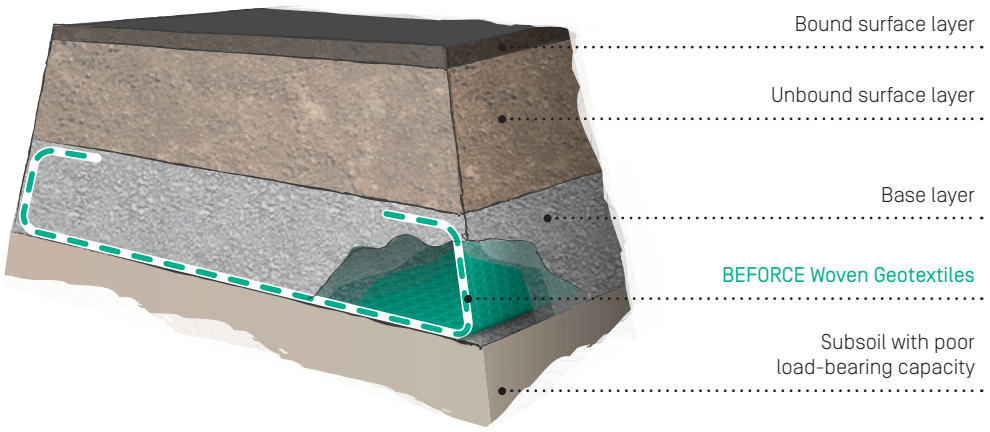
Because the foundation soil often varies greatly across the site, a trial area for the proposed reinforced structure should be chosen at the most problematic location. The load-bearing capacity of the soil improvement layer and the frost protection layer is determined by carrying out plate load tests.

APPLICATIONS
BEFORCE Woven Geotextiles

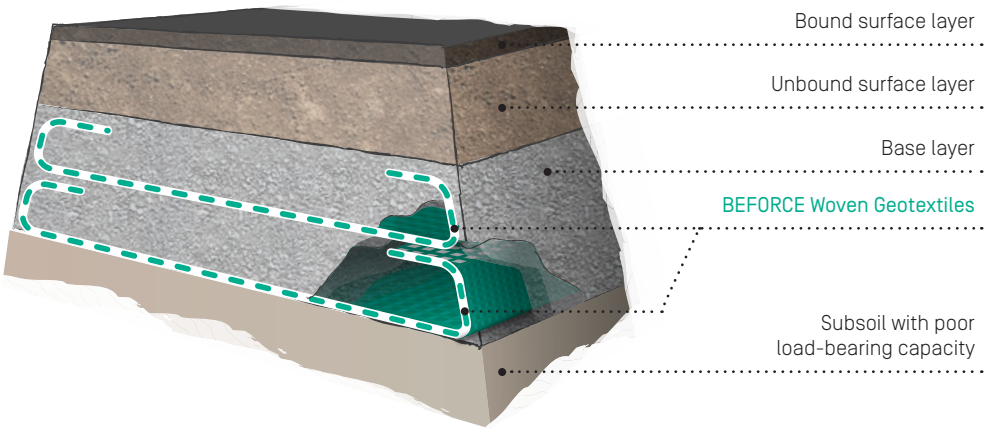
Woven tape fabric is the preferred geotextile for surface stabilisation and for increasing load-bearing capacities in highway, traffic route and rail construction.

Particularly where substrate stabilisation for paved or unpaved traffic routes is concerned, BEFORCE Woven Geotextiles provide a far simpler and more cost-effective solution than conventional methods such as soil replacement or soil stabilisation using lime. Other applications include service roads, car parks, cycle paths and construction site access roads.

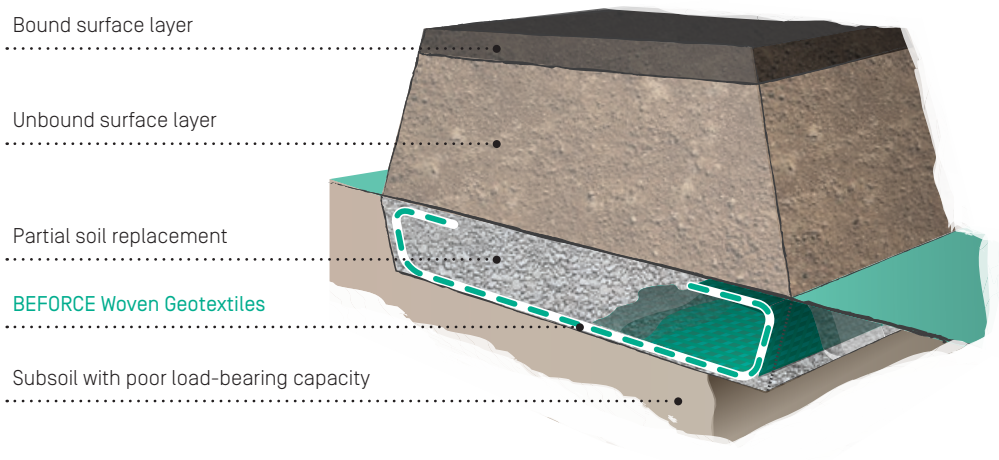
Reinforcing layer under a dam



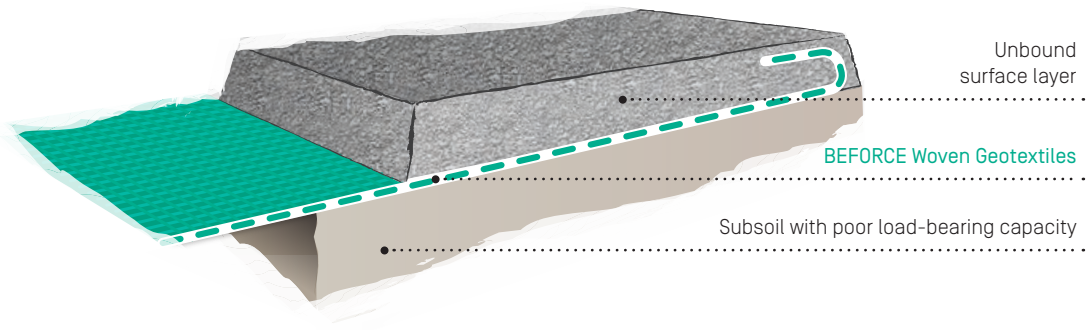
Several reinforcing layers



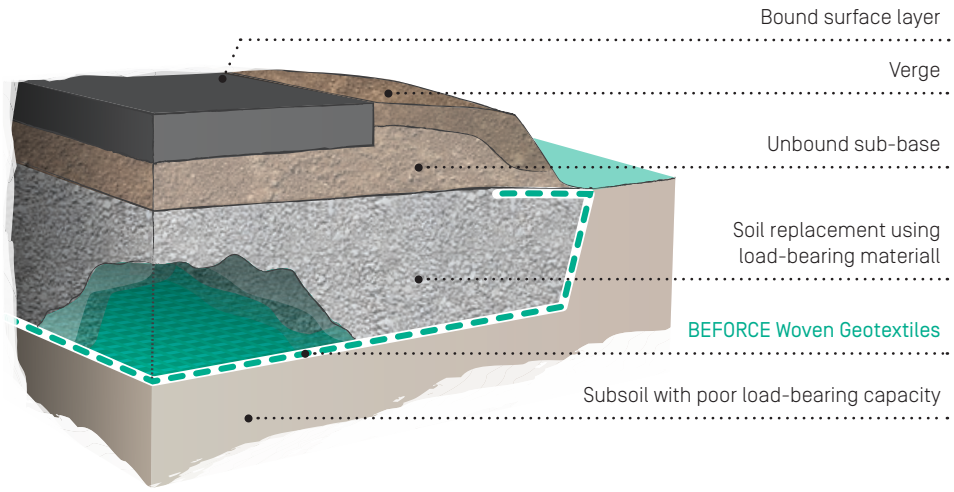
Reinforced layer as soil replacement



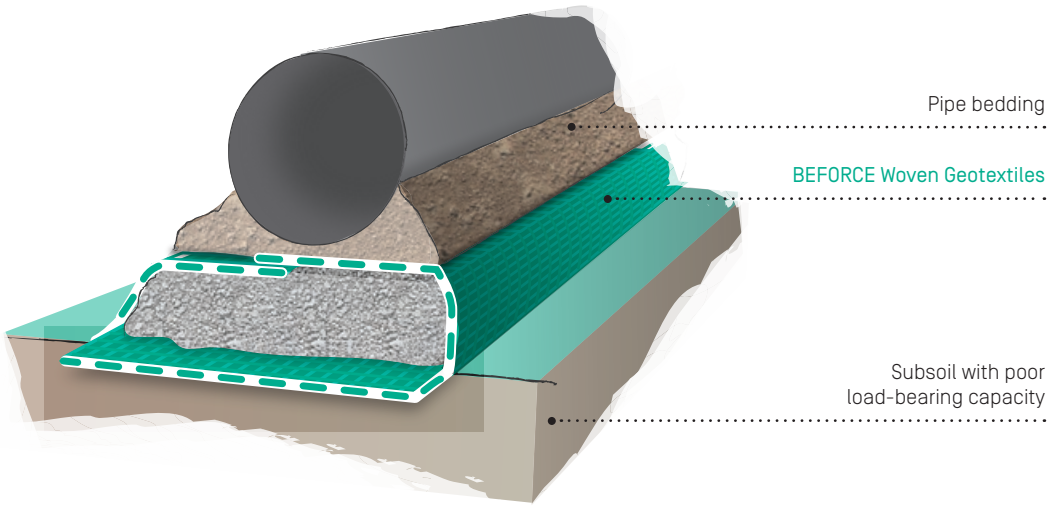
Reinforcing layer under roads with unbound surfaces (construction site access roads, service roads and access routes for site development)



Separating and reinforcing a layer of replaced soil to improve the load-bearing capacity of the formation layer and to support vehicular traffic during the construction phase



Reinforced foundation bed as a bearing layer for pipelines



Applications matrix at a glance

We are happy to supply current data sheets, specifications, certificates and technical verifications on request.

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Properties	PP 40	PP 50	PP 60	PH 55 (PP 80)
Product type	Woven fabric			
Raw material	Polypropylene (PP)			
Geotextile robustness class (GRK)	3	4	5	5
Maximum tensile strength longitudinal / transverse	40 kN/m	50 kN/m	60 kN/m	80 kN/m
Fields of application				
Dike and hydraulic structures	●	●	●	●
Earthworks and foundations	●	●	●	●
Canal structures	●	●	●	●
Riding arenas		○	●	●
Road and traffic areas	●	●	●	●
Road construction	●	●	●	●

● very suitable ○ suitable

Special types available on request.

APPLICATION
in practice

Drensteinfurt L 851

Construction time:	from July 2017, approx. 4 Months
Site location:	L 851 Drensteinfurt / Sendenhorst
System:	BEFORCE PH 55 (PP 80)
Quantity:	approx. 60,000 m²
Notes:	the need for costly and extensive soil replacement was eliminated

Probably the most demanding range of applications for geosynthetics is the reinforcement and stabilisation of soil.
The products used form the basis for safe and durable solutions that would not be possible using traditional earthwork methods or would be technically difficult and costly.

Soils with a poor load-bearing capacity present a major challenge in the construction and refurbishment of infrastructure. Traditional construction methods used for stabilising the subsoil, such as soil replacement measures, often involve considerable additional costs and effort. In the case of fine-grained subsoils, in particular, it is often necessary to ensure that the unbound sub-base layers are not only reinforced but also separated from the subsoil.

In the Drensteinfurt project, it was planned to use coarse fill material on a relatively deformable subsoil. The high loading applied during construction therefore required a material that surpassed even geotextile robustness class GRK 5.

The use of BEFORCE PH 55 (PP 80), with its reinforcing effect, made it possible to achieve the desired load-bearing capacity at the top surface of the unbound sub-base course and to minimise any additional soil replacement measures. At the same time, it ensured that the unbound sub-base layers were separated from the fine-grained subsoil.

As with non-woven and woven geogrids, the forces in woven fabrics are transferred according to the principle of the geosynthetic's membrane effect. This means that the product must be tensioned across its entire area, by pinning or wrapping over.

The effort required for laying the material was also reduced, since the geotextile was supplied in rolls 5.2 m wide. This meant that only two widths, with an overlap of 50 cm, were required to cover the 9 m wide road.

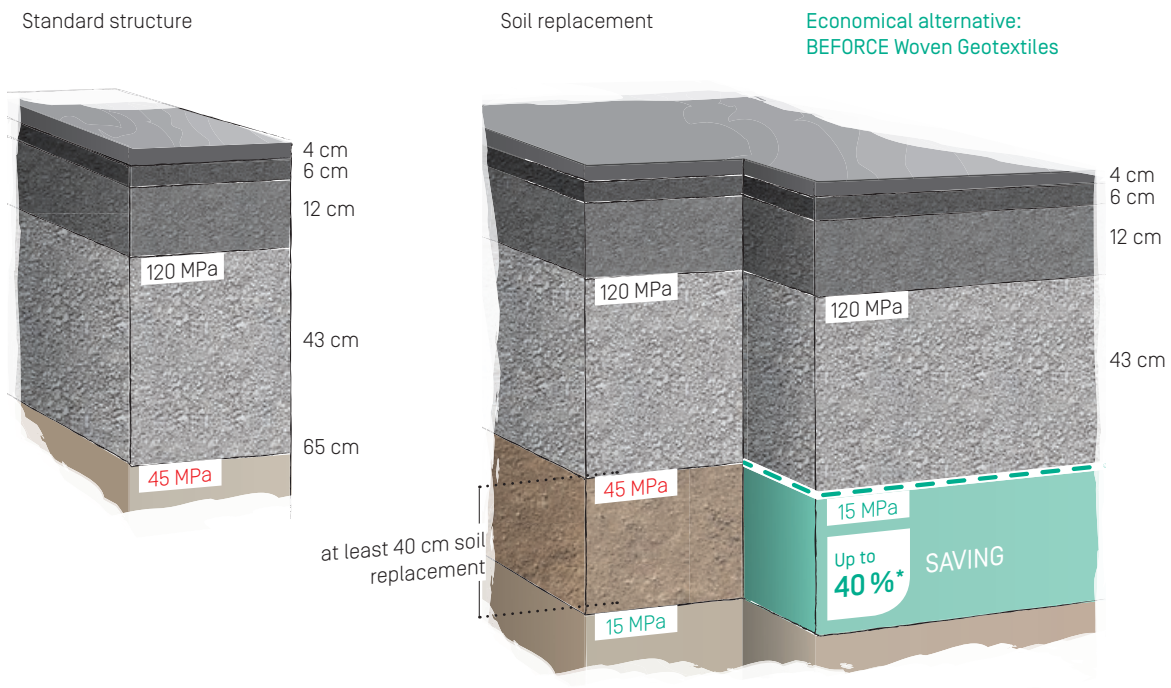
POTENTIAL SAVINGS
and base layer dimensioning

The economical use of resources in road and traffic route construction no longer refers only to economic and ecological criteria in the deployment of construction equipment and personnel. Today, construction projects are subject to an overall sustainability assessment.

In a comprehensive study conducted by EAGM, the life cycle analysis of construction methods using geosynthetics revealed their ecological and economic advantages in comparison to conventional construction methods.

By using BEFORCE Woven Geotextiles, it is possible to largely or completely avoid conventional soil replacement.

Example: Road construction class Bk3.2, row 1, Table 1 RStO
(Guidelines for the standardisation of traffic area pavements), published 2012
Soft - semi-solid, clayey, silty subsoil; E_{V2} = 15 MPa



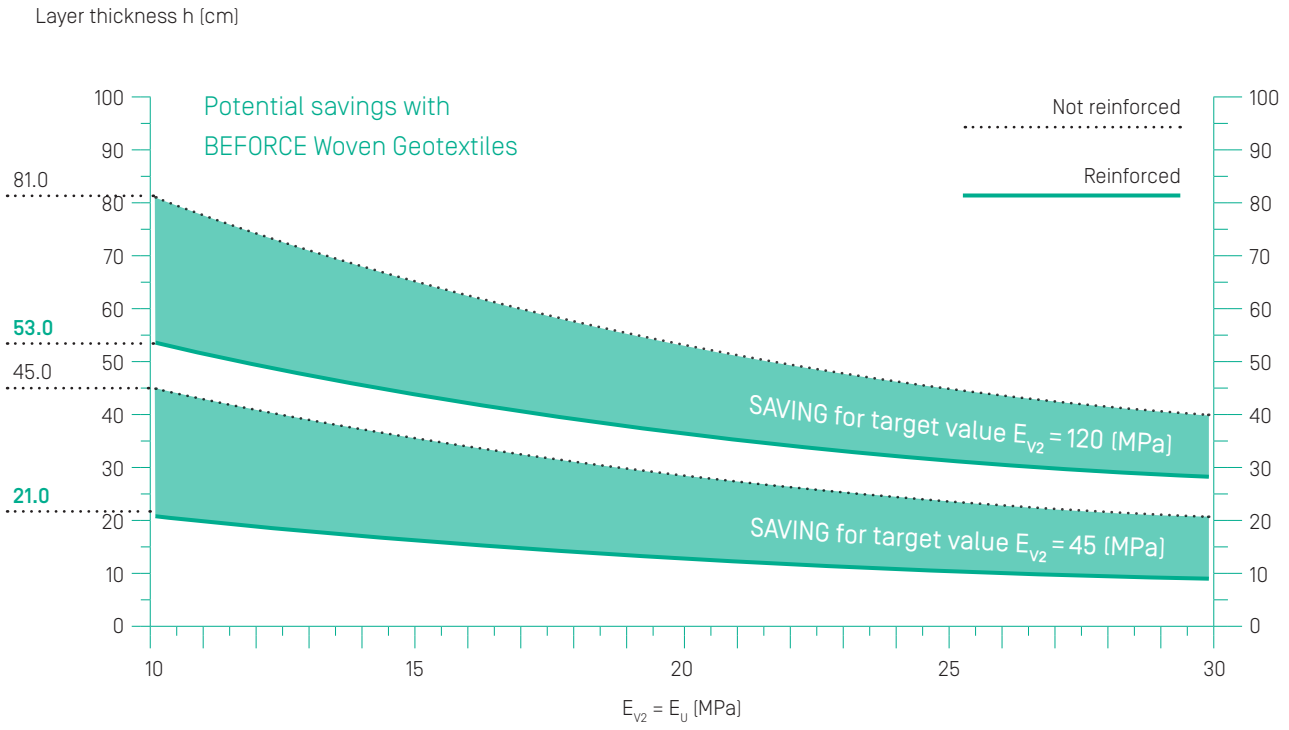
With BEFORCE Woven Geotextiles, the costs of at least 40 cm of excavation and disposal and of the delivery and installation of replacement material are saved.

POTENTIAL SAVINGS
up to
40 %*

The potential savings made, in comparison to soil replacement for example, can be up to 40 %, depending on the project. Added to this are the cost and time savings for excavation and disposal of the unsuitable soil and the provision, delivery and installation of replacement material. At the same time, all these savings also benefit our environment.

*The actual potential savings may vary depending on the boundary conditions of the specific project and on the frost resistance of the road pavement and the load-bearing capacity of the substrate.

Improvement in load-bearing capacity due to BEFORCE PH 55 (PP 80) Woven Fabric



Example, based on a modulus of deformation
E_U = 10 MPa

INSTALLATION
BEFORCE Woven Geotextiles

To be considered:

1. The subsoil should be as flat and even as possible in order to ensure full contact with the woven fabric across the entire surface.
2. The woven geotextile must be laid flat and free of creases.
3. When filling and compacting material on top of the fabric, care must be taken to prevent displacement or creasing of the fabric.

Our detailed installation and laying instructions for BEFORCE Woven Geotextiles must also be followed.

ADVANTAGES
BEFORCE
Woven Geotextiles

- → Separation of bearing course material from substrate
- → Reinforcing effect in the foundation course
- → Reduction in thickness of sub-base layer for traffic routes
- → Reduced rut formation in roads with unbound surfaces
- → High design reliability
- → Simple to lay
- → Low labour input
- → Low transport costs
- → Potential cost savings compared to conventional methods

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