



*Making the perfect match*

# Design Guide Fibertex Geotextiles

# Fibertex Geotextiles

## Fibertex Geotextiles

- are needlepunched nonwoven fabrics made from polypropylene. The drylaid needlepunch technology is based on a two step process. Firstly, polypropylene resin is extruded into fibres. Secondly, the fibres are carded and needlepunched. Finally, some types are added thermal treatment. Weights range from 100 g/m<sup>2</sup> up to 1200 g/m<sup>2</sup>.

## Focus on the environment

No chemical binders are used in Fibertex products or during the production process. Polypropylene is a polymer material and when incinerated it turns into carbon dioxide and water vapour, both completely harmless substances.

Concern for the environment is proved by the fact that Fibertex is among the first in the nonwoven industry to introduce an environmental management system and thereby obtaining the ISO 14001 certificate. This ensures continuous focus on efficient and financially viable management of environmental issues, which in return ensures minimal harmful effects resulting from the company's activities.

Implemented at all levels in the organisation, daily focus is on waste handling/recycling, implementation of new technologies and minimisation of waste and energy consumption.

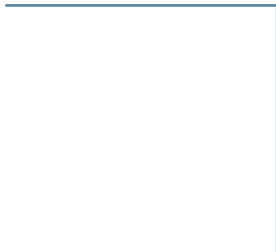
## The importance of quality

Fibertex's quality management system is certified in accordance with the most comprehensive standards set by the International Organisation for Standardisation namely DS/EN ISO 9001:2000. This means that the quality management system has been implemented and verified at all levels within the organisation.

Fibertex Geotextiles are CE marked under the EU Construction Products Directive. CE marking certifies that Fibertex's quality management system (DS/EN ISO 9001:2000) complies with the EN standards (level 2+). Fibertex Geotextiles are submitted to production control and tests in accordance with the EN standards.



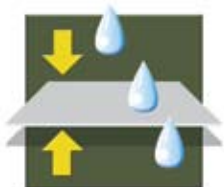
# - in any construction...



## Separation

The durability and mechanical properties of Fibertex Geotextiles make them ideal as separating layers in construction works. A strong and flexible geotextile is placed between different layers in the construction preventing migration and mingling of materials, yet allowing free movement of water ..... **page 4**

Separation



## Filtration

The characteristic opening size of Fibertex Geotextiles is designed to retain particles while allowing free movement of water, making it possible to separate two layers during intense hydraulic activity. Migration of layers will reduce the load-bearing capacity of the construction and must therefore be avoided ..... **page 8**

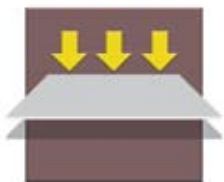
Filtration



## Drainage

Excess water is drained off the construction - not by passing through the Fibertex Geotextile as when used for filtration - but by flowing in the plane of the geotextile leading it away from the construction ..... **page 12**

Drainage



## Protection

When placing a Fibertex Geotextile on both sides of a waterproof membrane, the thickness and strength of the geotextile protect the membrane from puncture ..... **page 16**

Protection



## Applications

Fibertex Geotextiles are designed for the following applications: Road works, construction, ground systems, drainage/filtration, hydraulic works and waste disposal sites ..... **page 18**

Applications

# Fibertex Geotextiles for Separation



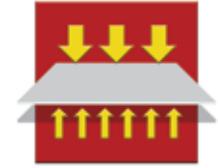
- **To prevent mixing of construction layers**
- **To increase bearing capacity by avoiding material loss into the subgrade**
- **To improve the compaction properties of the aggregate layer**
- **To provide long-term stability of foundation layers**

## Geotextile properties

The tensile strength, puncture resistance and elongation properties of the geotextile have to be sufficient not only to fulfil the requirements to a separator but also to resist damage during installation.

The characteristic opening size of the geotextile must be sufficient to retain fines and to prevent contamination of the aggregate base while the permeability must be high enough to allow free movement of water.

Separation is the basic use of geotextiles and is widely practised in road works and railway constructions. In the EN ISO standards the separation function is defined as "The preventing from intermixing of adjacent dissimilar soils and/or fill materials by the use of a geotextile".



### Required mechanical properties

The required mechanical properties of a geotextile are based on the failure possibilities shown in Fig. 1. - 4.

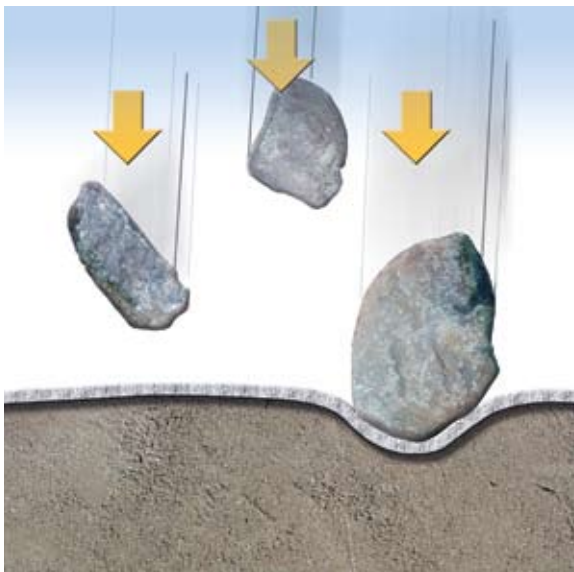


Fig. 1. High elongation and dynamic perforation resistance prevent the geotextile from being damaged when rocks are dropped during installation.

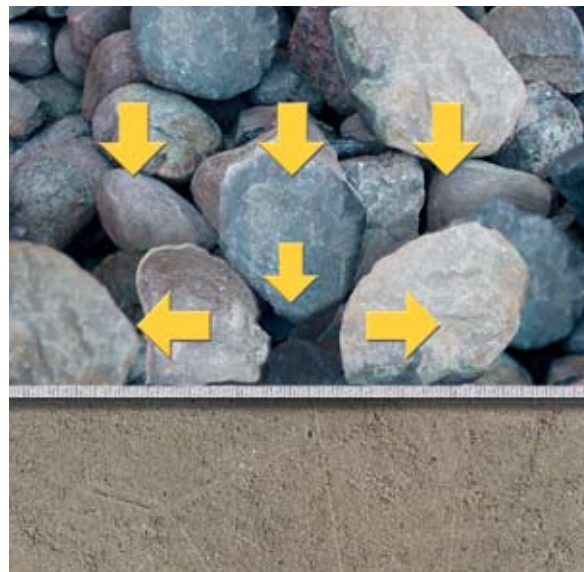


Fig. 2. High elongation and tensile strength prevent damage of the geotextile when aggregate is horizontally displaced as a result of wedge effects during vertical pressure.



Fig. 3. High elongation and static puncture resistance allow the geotextile to stretch around the irregular construction surface.

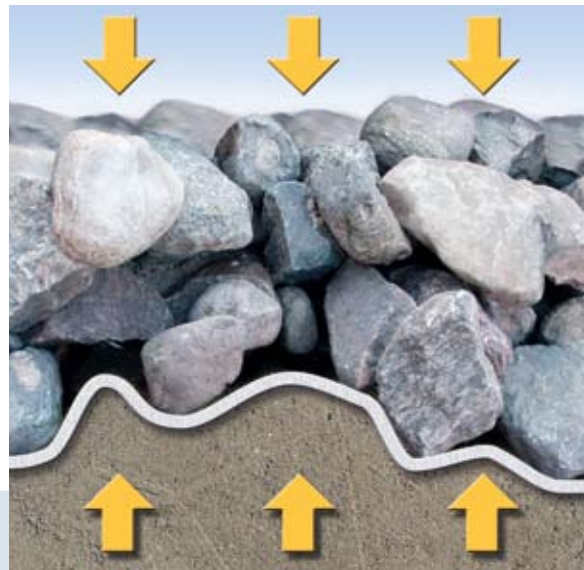


Fig. 4. High elongation and static puncture resistance prevent puncture when pressure from the fill material causes migration of fine soil into cavities in the aggregate layer.

Separation

Filtration

Drainage

Protection

Applications

# Fibertex Geotextiles for Separation

Important mechanical properties of a separation geotextile:

- $T_f$ : Tensile strength at break of the geotextile [kN/m] (Minimum value)  
According to EN ISO 10319
- $\epsilon$ : Elongation at break [%] (Minimum value)  
According to EN ISO 10319
- $F_p$ : Static puncture resistance (CBR-test) [N] (Minimum value)  
According to EN ISO 12236
- $D_c$ : Dynamic perforation (cone drop test) [mm] (Maximum value)  
According to EN 918

The requirements for these properties are influenced by the following properties of the supporting soil:

- CBR: Californian Bearing Ratio [%],  
Relative value for the plastic deformation properties of a soil.  
According to EN 13286-47
- $M_{E1}$ : Deformation modulus [MNm<sup>-2</sup>]

When knowing one of these two parameters and the load that the construction is to endure, the minimum cover layer and strength properties of the geotextile can be read from table 1.

Table 1. Choice of a geotextile, when soil properties and loads are known. [1]

Soil properties		Geotextile properties										
Soil strength		Minimum cover layer [m]		Road and Earthworks						Railway construction		
CBR [%]	$M_{E1}$ [MNm <sup>-2</sup> ]			Load ≤ 500 MN <sup>a</sup>			Load ≥ 500 MN <sup>a</sup>			Fill A*	Fill B**	Fill C***
				Fill A*	Fill B**	Fill C***	Fill A*	Fill B**	Fill C***			
< 3	< 6	0.4	$T_f$ [kN/m]	12	14	16	14	16	18	14	16	18
			$\epsilon$ [%]	40	40	50	40	50	50	40	50	50
			$F_p$ [N]	2000	2400	2700	2400	2700	3000	2400	2700	3000
			$D_c$ [mm]	24	21	20	21	20	15	21	20	15
3-6	6-15	0.3	$T_f$ [kN/m]	10	12	14	12	14	16	14	16	18
			$\epsilon$ [%]	40	40	40	40	40	50	40	50	50
			$F_p$ [N]	1900	2000	2400	2000	2400	2700	2400	2700	3000
			$D_c$ [mm]	25	24	21	24	21	20	21	20	15
> 6	> 15	0.2	$T_f$ [kN/m]	6	8	10	8	10	12	14	16	18
			$\epsilon$ [%]	30	40	40	40	40	40	40	50	50
			$F_p$ [N]	1250	1450	1900	1450	1900	2000	2400	2700	3000
			$D_c$ [mm]	27	26	25	26	25	24	21	20	15

<sup>a</sup> Total load during the design life

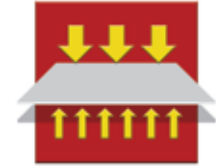
\* Fill A: Round Gravel Ø≤150mm

\*\* Fill B: Coarse Gravel Ø≤150mm

\*\*\* Fill C: Other cover materials, Round or Coarse (broken natural stone etc.)

[1] SVG, The Swiss Confederation of geotextile experts – The geotextile manual, 2001 (in German)

The read values for  $T_f$ ,  $\epsilon$  and  $F_p$  are minimum values while the read value for  $D_c$  is a maximum value. All these requirements have to be fulfilled to ensure that the geotextile will function as intended.



## Required hydraulic properties

To function correctly, the characteristic opening size of the geotextile has to match the soil conditions. If the characteristic opening size is too large, the soil particles will pass through the geotextile, whereas if it is too small, the water flow will be insufficient. The important hydraulic parameters of the geotextile are:

- $O_{90\%}$  Characteristic opening size [ $\mu\text{m}$ ]  
According to EN ISO 12956
- $k_n$  Coefficient of permeability normal to the plane  
[m/sec] (Minimum value)  
According to EN ISO 11058

The requirements for these hydraulic properties vary according to construction type, depending on the type of water flow it must endure.

### Characteristic opening size, $O_{90\%}$

#### Static water flow

(one-way water flow e.g. road and earthworks, temporary roads, parking lots, fills on poor subsoil)

Design value of the characteristic opening size,  $O_{90\%}$ , for coarse soil ( $d_{40\%} \geq 60 \mu\text{m}$ ):

Uniformly-graded subsoil,  $U (d_{60\%}/d_{10\%}) < 3$ :  

$$O_{90\%} < 2.5 \cdot d_{50\%}$$

Well-graded subsoil,  $U (d_{60\%}/d_{10\%}) \geq 3$ :  

$$O_{90\%} < 10 \cdot d_{50\%}$$

Design value of the characteristic opening size,  $O_{90\%}$ , for fine soil ( $d_{40\%} < 60 \mu\text{m}$ ):

$$50 \mu\text{m} \leq O_{90\%} \leq \frac{10 \cdot d_{50\%}}{110}$$

The lower of the two values from the upper limit is chosen.

#### Dynamic water flow

(railway constructions and other constructions where pump effects may occur)

Dynamic water flow may be a result of a pump effect generated by dynamic loads (e.g. railway constructions). Dynamic water flow can also occur naturally, which is the case with wave action on coastal areas. The function of a geotextile would then be characterised as filtration. For better readability, the required hydraulic properties under dynamic water flow are included in this chapter.

In coarse and uniformly-graded soils ( $U < 3$  and  $d_{40\%} > 60 \mu\text{m}$ ) a dynamic water flow can occur:

For  $U (d_{60\%}/d_{10\%}) < 3$  and  $d_{40\%} > 60 \mu\text{m}$ :  

$$0.5 \cdot d_{50\%} \leq O_{90\%} \leq d_{50\%}$$

In dense soils, water is unable to flow dynamically, and the condition is therefore characterised as static.

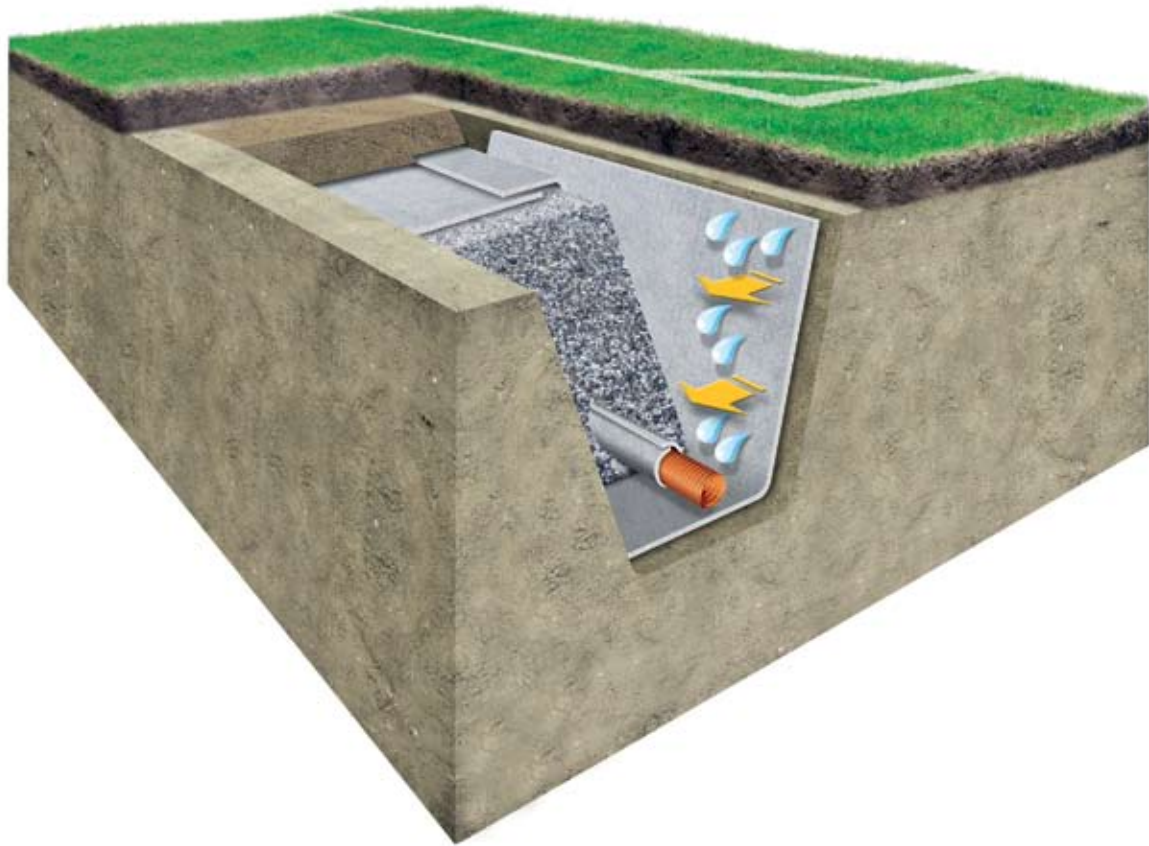
#### Coefficient of permeability, $k_n$

The coefficient of permeability normal to the plane of the geotextile must be larger than the permeability of the soil:

$$k_{n, \text{ geotextile}} > k_{n, \text{ soil}}$$

To ensure water flow, a safety factor is often added to the coefficient of permeability of the soil by multiplying by 1-100. This safety factor should be evaluated on the basis of the soil conditions and the desired service life.

# Fibertex Geotextiles for Filtration



- **To avoid migration of fine material into coarse material as a result of water flow in the soil**
- **To maintain the water flow in the soil with minimum pressure loss**
- **To prevent migration of fine material as a result of pump effects from dynamic loads such as traffic**

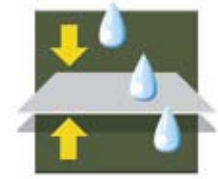
Geotextiles are widely used for filtration in road works and railway constructions as well as coastal protection. The filtration function of a geotextile serves the same purpose as the separation function, but under different circumstances. In the EN ISO standards the filtration function is defined as "The restraining of soil or other

particles subjected to hydrodynamic forces while allowing the passage of fluids into or across a geotextile".

## Geotextile properties

The tensile strength, puncture resistance and elongation properties of the geotextile have to be sufficient not only to fulfil the requirements to a filtrator but also to resist damage during installation.

The characteristic opening size of the geotextile must be sufficient to retain fines and to prevent contamination of the aggregate base while the permeability must be high enough to allow free movement of water.



### Required mechanical properties

The required mechanical properties of a geotextile are based on the failure possibilities shown in Fig. 5. - 8.



Fig. 5. High elongation and static puncture resistance allow the geotextile to stretch around the irregular construction surface.

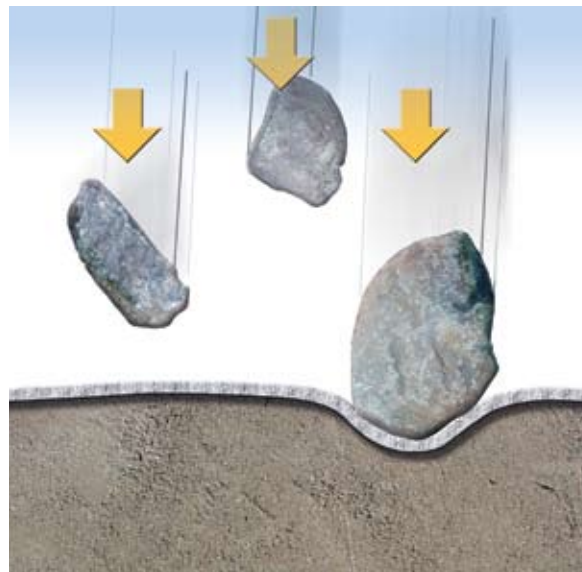


Fig. 6. High elongation and dynamic perforation resistance prevent the geotextile from being damaged when rocks are dropped during installation.

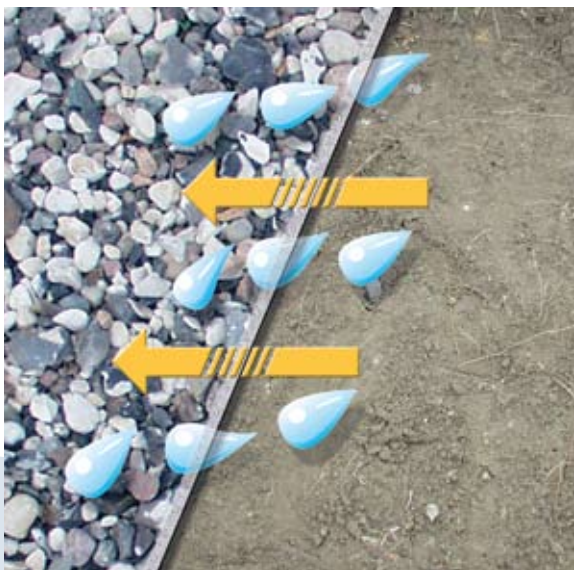


Fig. 7. The correct hydraulic properties of the geotextile ensure that soil fines are retained while maintaining the water flow.



Fig. 8. High elongation allows the geotextile to follow the contours of the irregular construction surface.

Separation

Filtration

Drainage

Protection

Applications

# Fibertex Geotextiles for Filtration

## Stressed filtration systems

Important mechanical properties of a stressed filtration geotextile:

- $T_f$ : Tensile strength at break of the geotextile [kN/m] (Minimum value)  
According to EN ISO 10319
- $\epsilon$ : Elongation at break [%] (Minimum value)  
According to EN ISO 10319
- $F_p$ : Static puncture resistance (CBR-test) [N] (Minimum value)  
According to EN ISO 12236
- $D_c$ : Dynamic perforation (cone drop test) [mm] (Maximum value)  
According to EN 918

values are influenced by the size of the load and the following properties of the supporting soil:

CBR: Californian Bearing Ratio [%],  
Relative value for the plastic deformation properties of a soil.  
According to EN 13286-47

$M_{E1}$ : Deformation modulus [MNm<sup>-2</sup>]

When knowing one of these two parameters and the load the construction is to endure, the minimum cover layer and mechanical properties of the geotextile can be read from table 2.

## Non-stressed filtration systems

If installation is the only mechanical strain the geotextile must endure, the following minimum values are sufficient:

If the geotextile is used in connection with road works, railway constructions, dams or other surfaces stressed by a load, the required strength

Cover material	$T_f$ [kN/m]	$\epsilon$ [%]	$F_p$ [N]	$D_c$ [mm]
Round	6	40	1500	25
Coarse	8	40	1500	25

Table 2. Choice of a geotextile, when soil properties and loads are known. [1]

Soil properties		Geotextile properties										
Soil strength CBR [%]	$M_{E1}$ [MNm <sup>-2</sup> ]	Minimum cover layer [m]		Road and Earthworks						Railway construction		
				Load ≤ 500 MN <sup>a</sup>			Load ≥ 500 MN <sup>a</sup>					
				Fill A*	Fill B**	Fill C***	Fill A*	Fill B**	Fill C***	Fill A*	Fill B**	Fill C***
< 3	< 6	0.4	$T_f$ [kN/m]	12	14	16	14	16	18	14	16	18
			$\epsilon$ [%]	40	40	50	40	50	50	40	50	50
			$F_p$ [N]	2000	2400	2700	2400	2700	3000	2400	2700	3000
			$D_c$ [mm]	24	21	20	21	20	15	21	20	15
3-6	6-15	0.3	$T_f$ [kN/m]	10	12	14	12	14	16	14	16	18
			$\epsilon$ [%]	40	40	40	40	40	50	40	50	50
			$F_p$ [N]	1900	2000	2400	2000	2400	2700	2400	2700	3000
			$D_c$ [mm]	25	24	21	24	21	20	21	20	15
> 6	> 15	0.2	$T_f$ [kN/m]	6	8	10	8	10	12	14	16	18
			$\epsilon$ [%]	30	40	40	40	40	40	40	50	50
			$F_p$ [N]	1250	1450	1900	1450	1900	2000	2400	2700	3000
			$D_c$ [mm]	27	26	25	26	25	24	21	20	15

<sup>a</sup> Total load during the design life

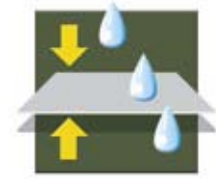
\* Fill A: Round Gravel  $\varnothing \leq 150$ mm

\*\* Fill B: Coarse Gravel  $\varnothing \leq 150$ mm

\*\*\* Fill C: Other cover materials, Round or Coarse (broken natural stone etc.)

[1] SVG, The Swiss Confederation of geotextile experts – The geotextile manual, 2001 (in German)

The read values for  $T_f$ ,  $\epsilon$  and  $F_p$  are minimum values while the read value for  $D_c$  is a maximum value. All these requirements have to be fulfilled to ensure that the geotextile will function as intended.



## Required hydraulic properties

To function correctly, the characteristic opening size of the geotextile has to match the soil conditions. If the characteristic opening size is too large the soil particles will pass through the geotextile, whereas if it is too small, the water flow will be insufficient. The important hydraulic parameters of the geotextile are:

- $O_{90\%}$  Characteristic opening size [ $\mu\text{m}$ ]  
According to EN ISO 12956
- $k_n$  Coefficient of permeability normal to the plane  
[m/sec] (Minimum value)  
According to EN ISO 11058

The water flow through the geotextile can be divided into two main situations:

Static (one-way) water flow: e.g. drains and dewatering systems.

Dynamic water flow: e.g. hydraulic works and plane filters under e.g. road and track beds.

### Characteristic opening size, $O_{90\%}$

#### Static water flow

(one-way water flow e.g. drains and dewatering systems)

Design value of the characteristic opening size,  $O_{90\%}$ , for coarse soil ( $d_{40\%} > 60 \mu\text{m}$ ):

Uniformly-graded subsoil,  $U (d_{60\%}/d_{10\%}) < 3$ :

$$O_{90\%} < 2.5 \cdot d_{50\%}$$

Well-graded subsoil,  $U (d_{60\%}/d_{10\%}) \geq 3$ :

$$O_{90\%} < 10 \cdot d_{50\%}$$

Design value of the characteristic opening size,  $O_{90\%}$ , for fine soil ( $d_{40\%} < 60 \mu\text{m}$ ):

$$50 \mu\text{m} \leq O_{90\%} \leq 10 \cdot d_{50\%} \leq 110 \mu\text{m}$$

The lower of the two values from the upper limit is chosen.

#### Dynamic water flow

(railway construction and other constructions where pump effects may occur)

Dynamic water flow may be a result of a pump effect generated by dynamic loads (e.g. railway constructions). Dynamic water flow can also occur naturally, which is the case with wave action on coastal areas.

In coarse and uniformly-graded soils ( $U < 3$  and  $d_{40\%} > 60 \mu\text{m}$ ) a dynamic water flow can occur:

For  $U (d_{60\%}/d_{10\%}) < 3$  and  $d_{40\%} > 60 \mu\text{m}$ :

$$0.5 \cdot d_{50\%} \leq O_{90\%} \leq d_{50\%}$$

In dense soils, water is unable to flow dynamically, and the condition is therefore characterised as static.

#### Coefficient of permeability, $k_n$

The coefficient of permeability normal to the plane of the geotextile must be larger than the permeability of the soil:

$$k_{n, \text{geotextile}} > k_{n, \text{soil}}$$

To ensure water flow, a safety factor is often added to the coefficient of permeability of the soil by multiplying by 1-100. This safety factor should be evaluated on the basis of the soil conditions and the desired service life.

Separation

Filtration

Drainage

Protection

Applications

# Fibertex Geotextiles for Drainage



- **To ensure that water and/or other fluids are drained with minimum pressure loss**

- **To ensure an ongoing drainage**

Geotextiles are widely used for drainage in earth and construction works.

In the EN ISO standards the drainage function is defined as "The collecting and transporting of precipitation, ground water and/or other fluids in the plane of the geotextile". In other words, it is the ability of the geotextile to drain fluids on its own, meaning that it is not part of a drainage system, but is the drainage system itself.

The drainage function is often confused with the filtration function. When a geotextile is part of a drainage system, where it is used to separate a

soil and a coarse-grained drainage layer, the function is filtration.

## Geotextile properties

Usually, the installation strains are limited and use does not apply significant mechanical strains to a drainage geotextile (for special cases design specifications for stressed drains are included in this chapter). Consequently, high mechanical strength is not required, whereas hydraulic properties are decisive for the overall performance of the entire construction, with the water flow capacity in the plane of the geotextile being the most important.



## Required mechanical properties

Important mechanical properties of a drainage geotextile:

- $T_f$ : Tensile strength at break of the geotextile [kN/m] (Minimum value)  
According to EN ISO 10319
- $\epsilon$ : Elongation at break [%] (Minimum value)  
According to EN ISO 10319
- $F_p$ : Static puncture resistance (CBR-test) [N] (Minimum value)  
According to EN ISO 12236
- $D_C$ : Dynamic perforation (cone drop test) [mm] (Maximum value)  
According to EN 918

### Stressed drains

If the drainage geotextile is used in connection with surfaces stressed by a load, the required strength values are influenced by the size of the load and the following properties of the supporting soil:

CBR: Californian Bearing Ratio [%],  
Relative value for the plastic deformation properties of a soil.  
According to EN 13286-47

$M_{E1}$ : Deformation modulus [ $MNm^{-2}$ ]

When knowing one of these two parameters and the load that the construction is to endure, the minimum cover layer and mechanical properties of the geotextile can be read from table 4.

Table 4. Choice of a geotextile, when soil properties and loads are known. [1]

Soil properties		Geotextile properties										
Soil strength		Minimum cover layer [m]		Road and Earthworks						Railway construction		
CBR [%]	$M_{E1}$ [ $MNm^{-2}$ ]			Load $\leq 500 MN^a$			Load $\geq 500 MN^a$			Fill A*	Fill B**	Fill C***
				Fill A*	Fill B**	Fill C***	Fill A*	Fill B**	Fill C***			
< 3	< 6	0.4	$T_f$ [kN/m]	12	14	16	14	16	18	14	16	18
			$\epsilon$ [%]	40	40	50	40	50	50	40	50	50
			$F_p$ [N]	2000	2400	2700	2400	2700	3000	2400	2700	3000
			$D_C$ [mm]	24	21	20	21	20	15	21	20	15
3-6	6-15	0.3	$T_f$ [kN/m]	10	12	14	12	14	16	14	16	18
			$\epsilon$ [%]	40	40	40	40	40	50	40	50	50
			$F_p$ [N]	1900	2000	2400	2000	2400	2700	2400	2700	3000
			$D_C$ [mm]	25	24	21	24	21	20	21	20	15
> 6	> 15	0.2	$T_f$ [kN/m]	6	8	10	8	10	12	14	16	18
			$\epsilon$ [%]	30	40	40	40	40	40	40	50	50
			$F_p$ [N]	1250	1450	1900	1450	1900	2000	2400	2700	3000
			$D_C$ [mm]	27	26	25	26	25	24	21	20	15

<sup>a</sup> Total load during the design life

\* Fill A: Round Gravel  $\varnothing \leq 150mm$     \*\* Fill B: Coarse Gravel  $\varnothing \leq 150mm$     \*\*\* Fill C: Other cover materials, Round or Coarse (broken natural stone etc.)

[1] SVG, The Swiss Confederation of geotextile experts – The geotextile manual, 2001 (in German)

The read values for  $T_f$ ,  $\epsilon$  and  $F_p$  are minimum values while the read value for  $D_C$  is a maximum value. All these requirements have to be fulfilled to ensure that the geotextile will function as intended.

# Fibertex Geotextiles for Drainage

## Non-stressed drains

To endure installation, the following requirements for the mechanical properties for non-stressed drains (e.g. wall drains) are to be fulfilled:

Table 5. Mechanical properties required to endure installation.

	T <sub>f</sub> [KN/m]	ε [%]	F <sub>p</sub> [N]	D <sub>c</sub> [mm]
Vertical drain	8	40	1500	25

[1] SVG, The Swiss Confederation of geotextile experts – The geotextile manual, 2001 (in German)

## Required hydraulic properties

To function correctly, the characteristic opening size has to match the soil conditions. If the characteristic opening size is too large the soil particles will pass through the geotextile, whereas if it is too small, the water flow will be insufficient. The important hydraulic parameters of the geotextile are:

q<sub>p</sub>: In plane water flow capacity [m<sup>2</sup>/s] (Minimum value) According to EN ISO 12958

O<sub>90%</sub>: Characteristic opening size [μm] According to EN ISO 12956

k<sub>n</sub>: Coefficient of permeability normal to the plane [m/sec] (Minimum value) According to EN ISO 11058

When constructing drains, the geotextile can be placed in a vertical, horizontal or inclined position.

To ensure an ongoing drainage function, the in plane water flow capacity, characteristic opening size and coefficient of permeability have to be sufficient.

## In plane water flow capacity, q<sub>p</sub>

The required in plane water flow capacity is calculated on the basis of the amount of water to be drained. The in plane water flow capacity is expressed as an amount of drained water within a given time in a given width of the geotextile [m<sup>3</sup>/sec/m = m<sup>2</sup>/sec\*]. The necessary in plane water flow capacity q<sub>p</sub> can be found as:

$$q_p = \frac{Q}{W \cdot i}$$

Where,

- Q: amount of water to be drained in the full width of the drain [m<sup>3</sup>/sec]
- W: width of the drain [m]
- i: hydraulic gradient (Δh/Δl) see fig. 9. [-] (i=1 for vertical drains)

\* 1 m<sup>2</sup>/sec = 3.6E<sup>6</sup> L/h/m ⇒ 1 L/h/m = 2.78E<sup>-7</sup> m<sup>2</sup>/sec

To ensure ongoing drainage, a safety factor is often added to the in plane water flow by multiplying by 1-5. This safety factor should be evaluated on the basis of the soil conditions and the desired service life.

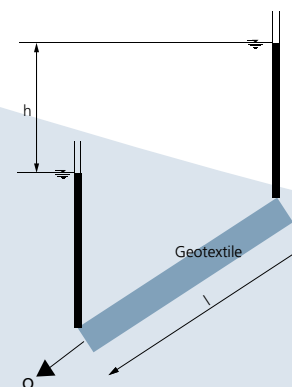


Fig. 9. Calculation of the hydraulic gradient for inclined drains.

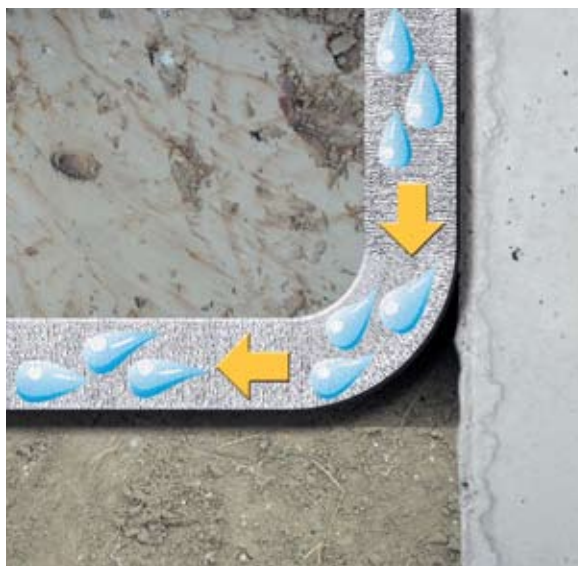


Fig. 10. The importance of sufficient in plane water flow capacity.

### Characteristic opening size, $O_{90\%}$

Design value of the characteristic opening size,  $O_{90\%}$ , for coarse soil ( $d_{40\%} > 60 \mu\text{m}$ ):

Uniformly-graded subsoil,  $U (d_{60\%}/d_{10\%}) < 3$ :

$$O_{90\%} < 2.5 \cdot d_{50\%}$$

Well-graded subsoil,  $U (d_{60\%}/d_{10\%}) \geq 3$ :

$$O_{90\%} < 10 \cdot d_{50\%}$$

Design value of the characteristic opening size,  $O_{90\%}$ , for fine soil ( $d_{40\%} < 60 \mu\text{m}$ ):

$$50 \mu\text{m} \leq O_{90\%} \leq 110 \mu\text{m}$$

The lower of the two values from the upper limit is chosen.

### Coefficient of permeability, $k_n$

The coefficient of permeability normal to the plane of the geotextile must be larger than the permeability of the soil:

$$k_{n, \text{geotextile}} > k_{n, \text{soil}}$$

To ensure water flow, a safety factor is often added to the coefficient of permeability of the soil by multiplying by 1-100. This safety factor should be evaluated on the basis of the soil conditions and the desired service life.

Separation

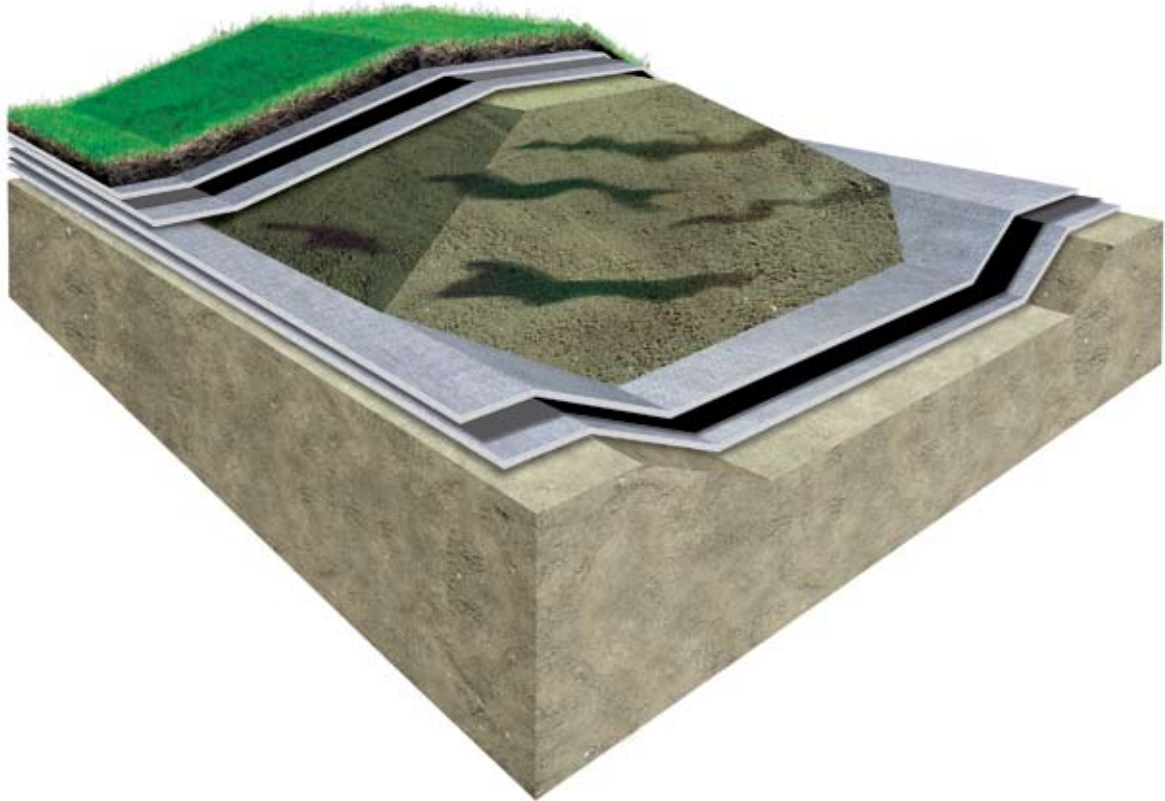
Filtration

Drainage

Protection

Applications

# Fibertex Geotextiles for Protection



Geotextiles are widely used for protection in waste disposal systems and tunnel constructions to ensure the integrity of a sealing material (e.g. geomembrane) when fill material and/or loads are applied. In the EN ISO standards the protection function is defined as "The prevention or limiting of local damage to a given element or material by the use of a geotextile".

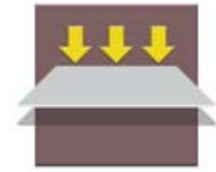
## Combined function of the geotextile

A geotextile often has several functions in the same construction. For example it can protect a membrane and at the same time, drain water in its plane. In this case, puncture resistance is important for the protection function and as described in the Drainage section, the hydraulic properties are important in order to drain water.

The different values should be combined, so that the most stringent requirements are indicated in the specification.

## Geotextile properties

As the sole purpose of this function is to protect a given element or material, the mechanical properties are essential, whereas the hydraulic properties are of less importance. The geotextile must withstand and distribute any local pressure from the layer above, ensuring that the protected material is not stressed to failure.



Important mechanical properties of a protection geotextile:

- $D_c$ : Dynamic perforation (cone drop test) [mm] (Maximum value) According to EN 918
- $F_p$ : Static puncture resistance (CBR-test) [N] (Minimum value) According to EN ISO 12236
- $d$ : Thickness at 2 kPa [mm] (Minimum value) According to EN 964-1

The requirements for the properties are influenced by the following properties of the supporting soil:

- Grading: XX/YY means that all particles have grain sizes between XX and YY [mm] (e.g. 4/8)
- $p$ : Pressure from the overlying materials (e.g. waste and drain materials)



Fig. 11. Correct thickness and puncture resistance prevent damage of the waterproof membrane.

Based on the grading of the sand/gravel and the pressure from the overlying layers, the properties required of a geotextile for protection can be read from fig. 12.

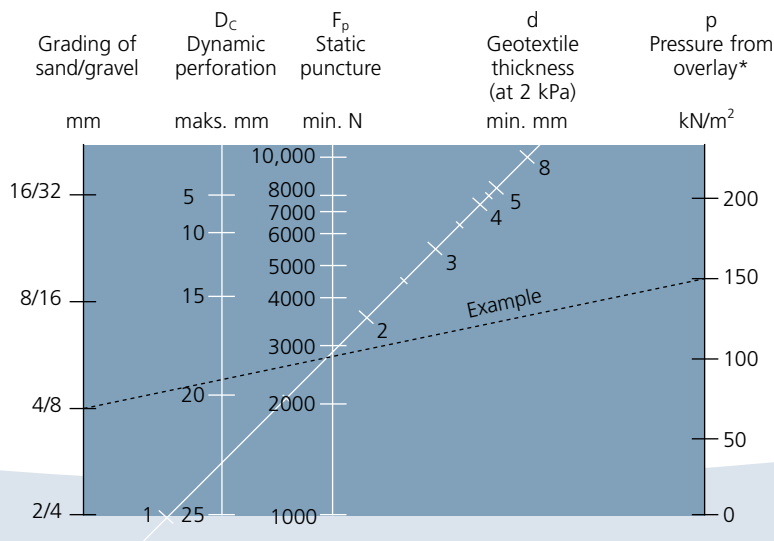


Fig. 12.  $D_c$ ,  $F_p$  and  $d$  can be read when a straight line is drawn from the sand/gravel axis to the overlay pressure axis.  
 \* 1 kg vertical pressure  $\approx$  10N  $\approx$  0.01 kN [2] DS, Danish standardisation association – DS/INF 466, 1999 (in Danish)

The read values for  $F_p$  and  $d$  are minimum values, while the read value for  $D_c$  is a maximum value. All these requirements have to be fulfilled to ensure that the geotextile will function as intended.

Separation

Filtration

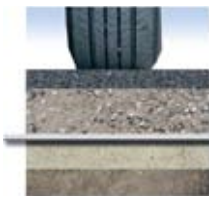
Drainage

Protection

Applications

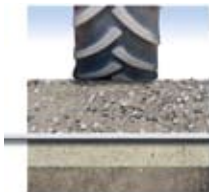
## Road works

### Permanent Roads



By separating the different layers of materials, Fibertex Geotextiles stabilise road constructions that are designed to resist dynamic and static stresses.

### Temporary roads



Fibertex Geotextiles placed below the top gravel layer increase the bearing capacity of the road to withstand continuous heavy traffic loads. No cars, tractors or other vehicles will become stuck in the gravel.

### Parking Areas



Areas subject to considerable static loads require a stable bearing course. Fibertex Geotextiles provide this by separating the different layers of materials, which is essential to maintain the bearing capacity.

### Road Widening



Fibertex Geotextiles ensure separation and stability between subsoil and added road building materials.

### Asphalt Maintenance



Bitumen-saturated Fibertex AM2 prevents surface water from penetrating the bearing course, preventing washing out of fines and reducing the occurrence of fissures and cracks considerably.

### Airports



In constructions with heavy demands on the surface, Fibertex Geotextiles stabilise the foundations enabling them to withstand dynamic loads.

### Railways



The rapidly increasing speed and weight of trains place heavy demands on the bearing course. Fibertex Geotextiles stabilise the foundation, enabling it to withstand dynamic loads.

## Construction

### Foundations



When placed under foundations, Fibertex Geotextiles replace the blinding layer. It is simple, effective and economical.

### Concrete Floors



Below concrete floors, the permeable Fibertex Geotextile protects the drainage layer from contamination from the concrete and the subsoil.

### Impact Sound Suppression



In apartment buildings, Fibertex Geotextiles are used for sound suppression purposes.

### Roofs



Fibertex Geotextiles are used as sliding layer, mechanical protection of roof membranes and as filter protection of any drainage layers.

### Roof Gardens



Fibertex Geotextiles are used as separation layer, mechanical protection of roof membranes and as filter protection of any drainage layer.

## Ground systems

### Pipes and Trenches



Placing a Fibertex Geotextile on the bottom of the trench increases the bearing capacity considerably.

### Storage Areas



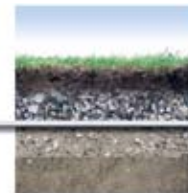
Using Fibertex Geotextiles prevents mingling or loss of fines in the bearing courses as well as clogging of the drainage layer.

### Storage Areas with AM2



Bitumen-saturated Fibertex AM2 absorbs the stresses from cracks or joints in the old surface, preventing reflection through Densiphalt composite wearing courses.

### Sport Grounds



Grass fields, cinders and gravel courts/grounds are stabilised with Fibertex Geotextiles due to the effective drainage, ensuring an even surface.

### Slopes



With Fibertex Geotextiles under the top layer, the slope will withstand subsoil water, rainwater and water from melted snow which would, otherwise, wash out the fines.

## Drainage/Filtration

### Drainage Pipes



With permeable Fibertex Geotextiles wrapped around the pipes, an effective and long lasting drainage system is ensured, without any risk of clogging.

### Drainage Trenches



Fibertex Geotextiles protect the drain system by preventing mingling of fines.

### Surface Drains



Surface drains are likely to become silted up from the surrounding soil. Fibertex Geotextiles keep the fines separated from the drainage layer ensuring the effectiveness of the drain system.

### Building Drains



In the construction of foundations and basement walls, Fibertex Geotextiles ensure a clean and effective circumferential drain, which e.g. prevents damage caused by dampness.

## Hydraulic works

### Coastal Protection



Fibertex Geotextiles protect the coast line as their flexibility and permeability ensure withstanding of the impact of waves and currents, preventing erosion and washing out of fines.

### Dams



Artificial dams and embankments need to be fortified with strong materials to resist the forces of nature. Fibertex Geotextiles stabilise and prevent washing out of fines.

### Harbour Constructions



Fibertex Geotextiles placed behind the retaining wall keep the drainage layer clean which relieves the hydraulic pressure on the wall. When placed in front of the retaining wall, Fibertex Geotextiles prevent washing out of the sea bed.

### River Banks and Canals



Fibertex Geotextiles protect river banks and canals in an effective and environmentally friendly way.

### Artificial Lakes



The waterproof membrane is protected against perforation with Fibertex Geotextiles.

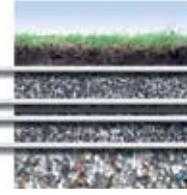
### Water Reservoirs



Fibertex Geotextiles protect the waterproof membrane against perforation.

## Waste disposal

### Waste Disposal (Top Layers)



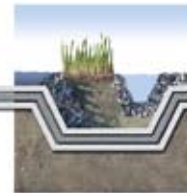
In supervised waste disposal sites, Fibertex Geotextiles on both sides of the membranes protect them from perforation. Furthermore, Fibertex Geotextiles are used as filter protection of the drainage layers.

### Waste Disposal (Bottom Layers)



As described above, Fibertex Geotextiles on both sides of membranes protect them from perforation. Fibertex Geotextiles also help to detect leaks.

### Water Purification Systems



Fibertex Geotextiles on both sides of the waterproof membrane protect the system against perforation.

Separation

Filtration

Drainage

Protection

Applications



## Facts about Fibertex

Fibertex A/S is a market leading manufacturer of needlepunch and spunmelt nonwovens for industrial, technical and hygiene applications. With corporate office in Aalborg, Denmark, and manufacturing sites in Denmark, Malaysia and the Czech Republic, Fibertex is globally represented. Since its foundation in 1968, Fibertex has continuously expanded and today manufactures nonwovens for customers all over the world for many different applications.

## Close to our customers

Our goal is to be local on the global market. Sales staff, subsidiaries and distribution network play a decisive role in helping us to achieve this. Worldwide technical service is offered close to you.

## Find inspiration on [www.fibertex.com](http://www.fibertex.com)

Visit our website for more information. Under the business area "Geotextiles" you will find detailed information about our products, data sheets and brochures for download as well as contact information.

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Quality System and Environmental Management System  
DS/EN ISO 9001  
DS/EN ISO 14001



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