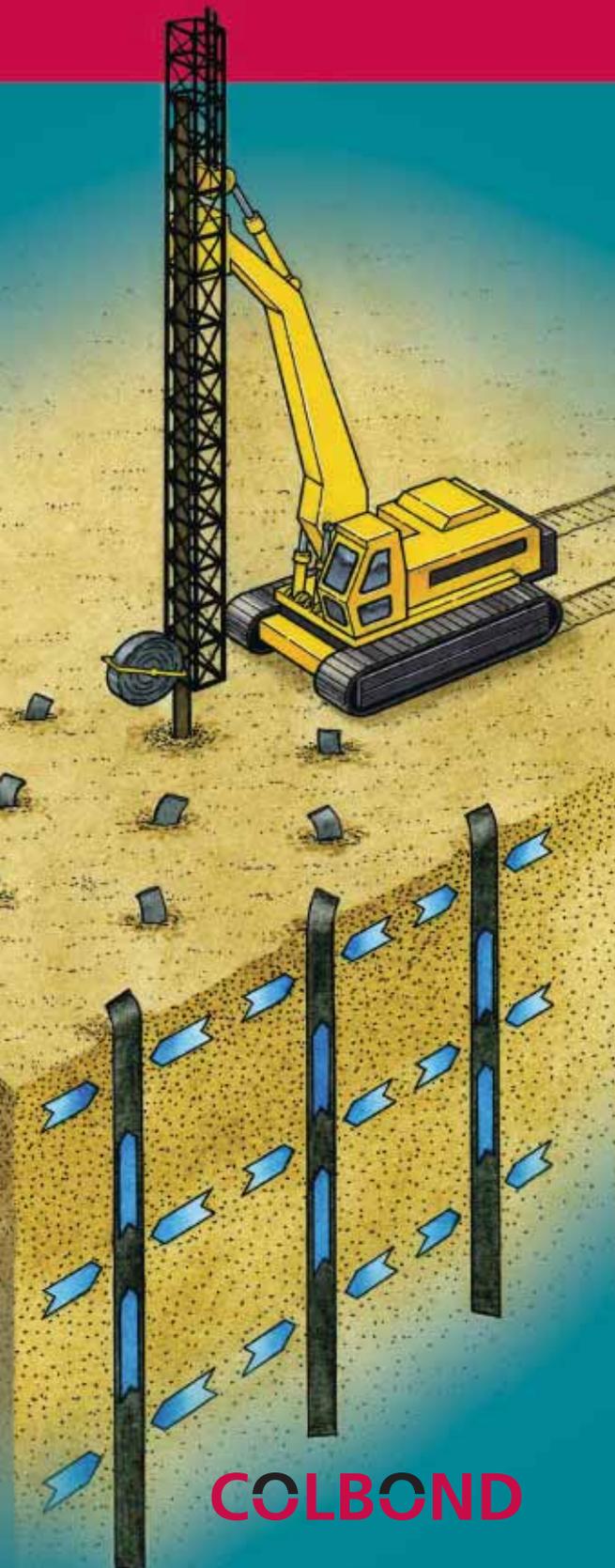
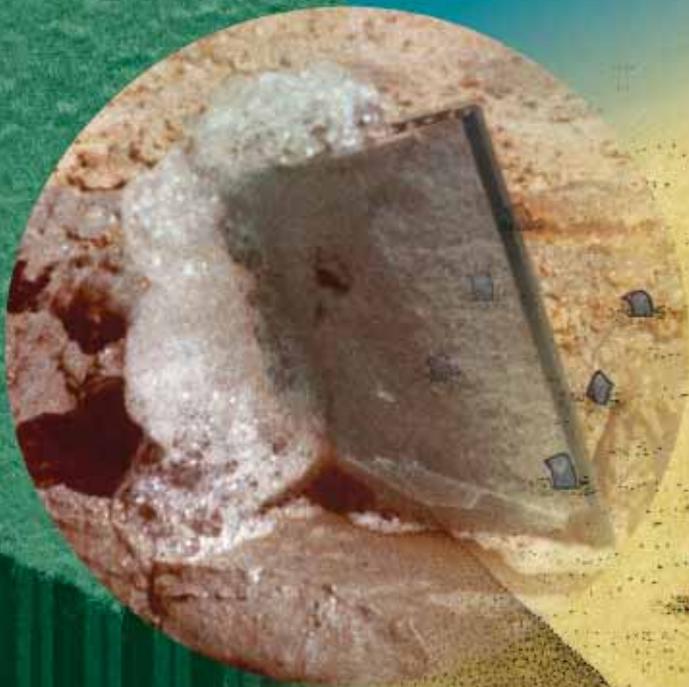


Next Generation

Colbondrain®

SOIL CONSOLIDATION



Consolidating performance
on a roll

COLBOND

Colbond

Colbond is a leading producer of high-quality synthetic nonwovens for flooring, automotive and construction applications and three-dimensional polymeric mats and composites for civil engineering, building and industrial applications. Colbond is based in Arnhem, the Netherlands, with production facilities in Emmen and Arnhem (NL), Obernburg (D) and Asheville (NC, USA). Regional sales offices are located all over the world. The company is part of the specialist flooring and technical textile group Low & Bonar.

Proven Performance

Data from computer studies, laboratory tests and full scale field trials conducted by Delft Geotechnics, Geosyntec Consultants and Colbond Research Laboratories have been used in the design of Colbondrain PVD; to date more than 300 million linear meters of Colbondrain have been installed. Colbond is one of the leading suppliers of vertical drains in the world.



Colbondrain

Application

Over the past years Colbondrain CX1000-50 has continually evolved to remain a state-of-the-art vertical drain and retain its position as the product setting the benchmark in the world of soil consolidation solutions. The original Colbondrain vertical drain was launched in 1975. Since then, our research & development work has married laboratory tests with extensive practical experience gained from millions of meters of Colbondrain in service in the field. As a result, every new drain brings a significant improvement in product characteristics and performance, meeting and exceeding the demands made of it on construction sites worldwide.

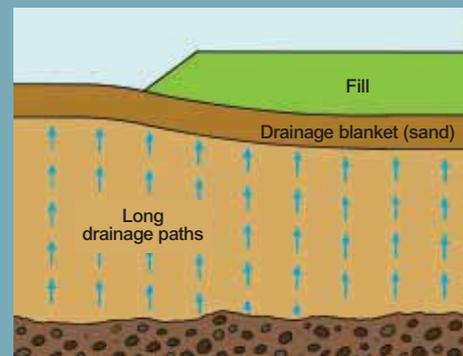
Our new Colbondrain CX1000-50 is based on an **innovative extrusion and shaping technique**. It is a high-performance tough and durable vertical drain designed primarily to accelerate the consolidation of soft soils before construction.

The slow consolidation of soft clays (up to 25 years to achieve 90% consolidation) is an increasingly significant challenge. Examples are the many infrastructure projects which are being built in marshland areas. Our new Colbondrain CX1000-50 prefabricated vertical drain (PVD) provides an economical solution, delivering consolidation in months instead of years.

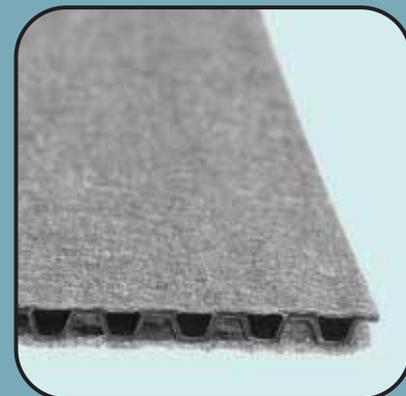
This substantial reduction of the time taken to consolidate compressible clay leads to a higher factor of safety and reduces the time taken to finish construction, reducing project costs to the client.

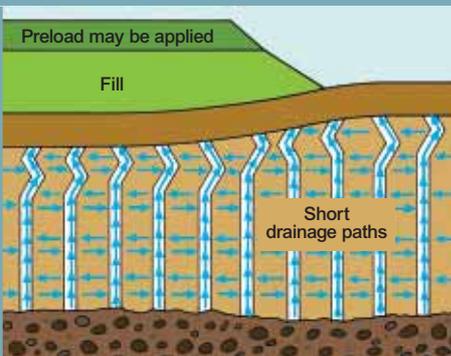
Product

- 10 cm wide product with a solid polymer core covered on both sides with a strong and permeable filter fabric
- Outer filter fabric bonded to the core structure over its entire surface to form a homogeneous geocomposite product
- **Unique patented hydraulically-designed core profile for maximum water flow capacity**



Without vertical drains





With vertical drains



Thanks to its high performance Colbondrain is often the chosen PVD for major, technically demanding projects, such as the third runway at Changi Airport, Singapore. In this project Colbondrain has been installed to depths of up to 50 meters. The project required a total of 60 million linear meters of PVD and is probably the largest vertical drain reclamation project in the world.



Functions

- Forms a path for excess pore-water created by the overburden; water is drained off to the surface resulting in a stable subgrade on which construction can take place
- Reduces consolidation time of soft soils significantly, which results in substantial cost savings

Product Benefits

High performance

- Unique combination of patented core structure and nonwoven filter increases water flow capacity by more than 50%
- Core: Hydraulic channel profile (core) ensures laminar flow for maximum performance
- High flow rate maintained even when Colbondrain is buckled beyond 90° (which can occur due to consolidation settlement of up to 50% in the upper clay layers)
- Innovative manufacturing technique maximizes performance
- Nonwoven filter layers deliver optimum filtration, permeability and strength. Thickness of core walls is increased in specific locations to offer high crushing strength to allow use of CX1000-50 to depths of 100 m
- Tensile strength of new CX1000-50 is 25% higher allowing usage on all installation rig types
- Suitable for use in all soil types

Easy to handle

- Roll length increased to 330 linear meters reduces number of connections on site
- 30% volume reduction resulting in less storage space used on site
- New packaging of 10 rolls to a pack allows faster unloading of container

Durable

- Thermal bonding of filter to the entire surface of the core structure ensures that the filter is kept taut across the flow channels
- Filter cannot tear or become separated from the core when passing over the pulleys at the rig top or during soil consolidation

Vertical Drain Design

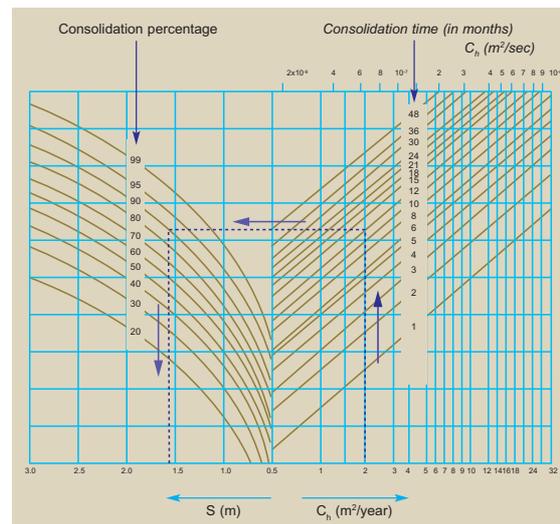
An assessment of the effect of vertical drains on the consolidation process can easily be made using a method first proposed by Kjellman and is shown in equation form below:

$$t = \frac{D^2}{8C_h} \left[\ln \left(\frac{D}{d} \right) - \frac{3}{4} \right] \ln \frac{1}{1-U_h}$$

- t = consolidation period (year)
- D = diameter of drained soil cylinder (m)
- C_h = horizontal coefficient of consolidation (m²/year)
- d = equivalent diameter of PVD (m)
- U_h = average degree of consolidation

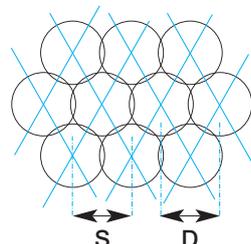
The equation has been developed into a design chart which relates the degree of consolidation, time available for consolidation, coefficient of consolidation (C_h) and thus the required drain spacing (S) can be determined assuming the normal triangular grid of drain installation.

The use of a triangular grid for installation gives the most efficient relationship between the area of an equilateral triangle of side length S and the circle of influence of each drain.



Design chart for Colbondrain CX1000-50

Reference: Elzen, L.W.A. van den (1982), "Accelerated consolidation of compressible, low-permeable subsoil by means of Colbondrains"

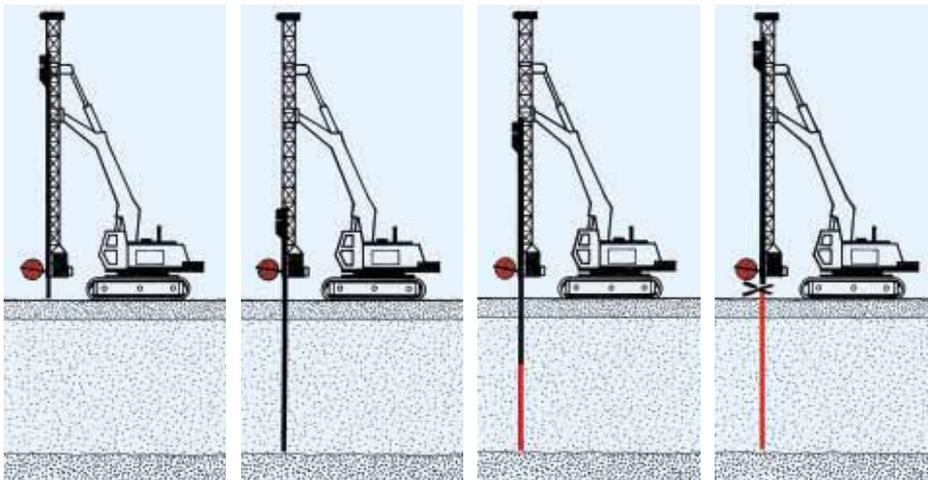


Triangular grid layout

- D = 1.05S
- S = spacing of the drains
- D = diameter of the equivalent cylindrical column of soil, drained by each drain

Colbondrain

Installation



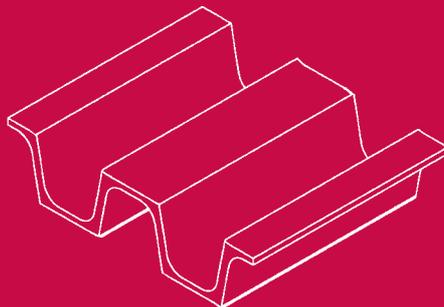
Installation

A purpose-built installation rig mounted on a hydraulic excavator is usually used to install Colbondrain. The height of the rig is equal to the installation depth of the PVD.

If the compressible clay is very deep and/or contains gravel bands, special techniques such as vibrators and heavy mandrels may be required.

Unique Core Design

Hydraulically designed core for 50% higher flow capacity



* Patent number EP 1819880

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ISO 9001
The Quality Management of Colbond at Amhem, Emmen and Obensburg (development, production and sales) has been approved by Lloyd's Register Quality Assurance to the NEN-EN-ISO 9001:2000 Quality Management System Standard (Certificate No. 935136).

CE Certification
Colbondrain CX1000-50 is CE-certified by an independent notified body (Certificate No. 0799-CPD).

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