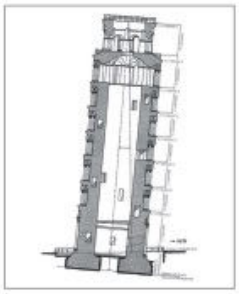
TechDrain
PREFABRICATED VERTICAL DRAIN

TECHFAB INDIA

TECHDRAIN™ Prefabricated Vertical Drains

The Consolidation Problem



Consolidation occurs very slowly in saturated, fine grained soils because the low permeability of these soils impedes the escape of pore water from the soil voids. Even under large temporary surcharge loads, settlements can take many years because of this slow water movement and the great distance the water must move to exit the soil. Without some sort of soil treatment construction is usually impractical due to unpredictable long-term settlement.

To achieve rapid consolidated settlement it is necessary to create shorter paths for movement of the water.

TECHDRAIN™
Prefabricated
Vertical Drain

The Solution

Since early 1970's prefabricated vertical drains (commonly called PVD, band drains or wick drains) have been used all over the world to accelerate the consolidation of fine-grained soils. In India also PVD's have been used in several projects especially in ports and infrastructure projects in coastal areas. The installation of PVD creates artificial drainage paths thereby reducing the distance the water must travel to exit the zone of ground subjected to excess pore-pressures and thus greatly accelerating the consolidation rate.

TechDrain™ PVD

Continuing with our sustained efforts to indigenously manufacture world class geosynthetic products in India, Techfab India Industries Ltd. has recently started commercial production of our **TechDrain**™ range of prefabricated vertical drains. **TechDrain**™ are engineered for high performance and produced to stringent quality standards at our manufacturing facility at Silvassa, Union Territory of Dadra & Nagar Haveli.

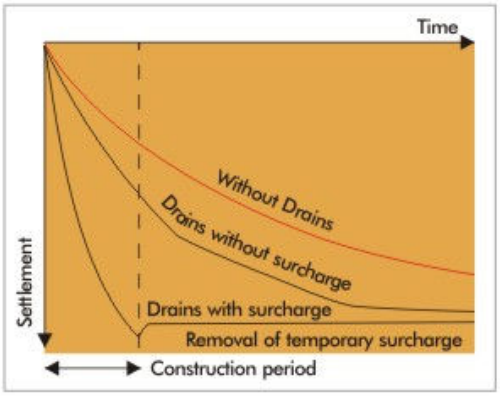
Using **TECHDRAIN**™ can cut the time required for primary soil consolidation from 20 to 25 years without the use of vertical drains to just a few months. Most settlement can occur during construction, thus keeping post-construction settlements to a minimum.

In large infrastructure and commercial construction projects such as ports, airfields, highways, road embankments, land reclamation by hydraulic fill or dykes, PVDs would enable considerably earlier development of the site leading to significant time and cost saving for designers and clients. leading to significant time and cost saving for designers and clients.

PVD Applications

TECHDRAIN™ is predictable, in both technical and financial terms. PVD technology has proven itself in hundreds of projects in the last thirty years. Over 1 billion linear meters of similar prefabricated vertical drain have been installed worldwide to date.

- **Land reclamation projects**
- **Construction of highways, railways, airfields and dykes**
- **Ports and harbour construction**
- **Development industrial sites**
- **Mitigation of liquefaction**



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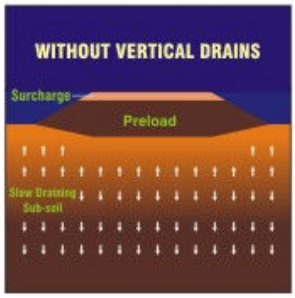
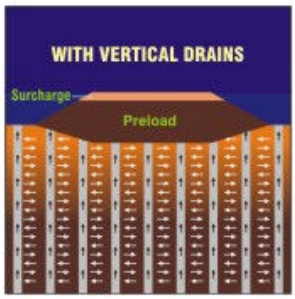
How does TECHDRAIN™ PVD work?

By installing PVDs at a suitable spacing, the distance that water has to travel through the low permeability soil is reduced considerably and consequently water drains out in a relatively very short period of a few weeks or months.





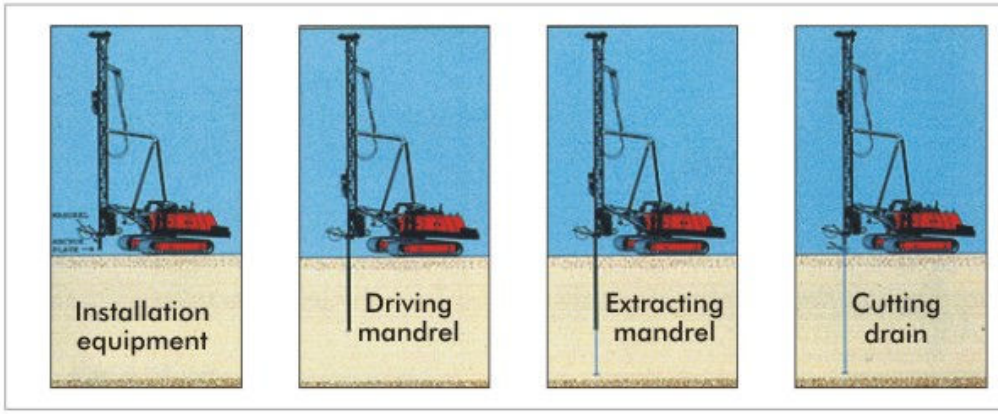
TECHDRAIN™ band drains can be installed vertically to depths exceeding 65 meters. The drains are usually placed in a square or triangular configuration of 1 to 1.5 m - depending on the desired consolidation time.

Under excess hydrostatic pressure, water has only to travel the horizontal distance to the nearest drain to reach a free drainage path. Consequently the higher horizontal permeability of the clay is also taken to advantage. The water flows through the filter fabric of the drain and into the channels of the drain core where it can flow vertically out of the soil. This flow may be either up or down to intersecting natural sand layers or to the surface where a sand drainage blanket or prefabricated strip drains are provided.

Vertical drains are normally used in conjunction with preloading with surcharge embankment or vacuum pressure.

Installing TECHDRAIN™ vertical drains

Vertical drains may be installed employing either vibratory or static methods. In either case, the drain is enclosed in a tubular steel mandrel of small cross-sectional area usually 50 x 125 mm. A small steel anchor plate is attached to the drain at the bottom of the mandrel. The mandrel is then driven in to the soil either with a static or vibratory rig. When the design depth is reached, the mandrel is extracted. The anchor plate retains the drain in the soil. When the mandrel is fully extracted, the drain is cut off, a new anchor plate is installed and the process begins again. Typically between 5,000 to 20,000m of PVD can be installed in a day depending on equipment, ground and working conditions.



Techfab India Industries Ltd can also arrange the installation of PVD's at the clients site through our associates.

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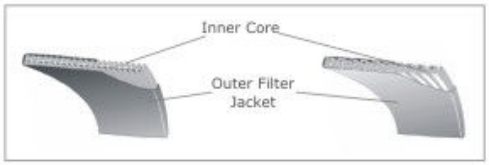
How is TECHDRAIN™ PVD manufactured?

Since the 1970's, PVDs are typically made of a two piece composite drainage material consisting of an inner polymer core and an outer non-woven filter fabric. A great deal of development and testing has gone into producing TECHDRAIN™ to make sure they meet international best practice and are capable of reliable performance under the rigors of installation, and soil deformation and stresses.



TECHDRAIN™ inner cores are made of polypropylene material by continuous extrusion technology. The extruded corrugated or fin-shaped profiles on both sides of the core provide multiple channels for large hydraulic flow in the longitudinal direction of the core even when distorted under significant pressures, vertical settlements or lateral displacements.

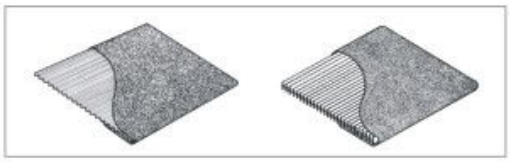
The **TECHDRAIN™** core is tightly wrapped in a geotextile filter jacket of spun-bonded polypropylene or polyester selected to have a very high water permeability and filtration properties. The **TECHDRAIN™** filter is almost impossible to clog, with even the finest soil particles, ensuring a free drainage path to discharge excess pore water.

When combined, the composite wick drain has exceptional flexibility and mechanical strength to withstand the rigours of installation and maintains its discharge capacity throughout the consolidation process.

*The properties of **TECHDRAIN™** PVDs have been verified by a comprehensive series of tests conducted at Asian Center for Soil Improvement and Geosynthetics, at the Asian Institute of Technology, Bangkok, Thailand who are leaders in research and consultancy in the field of ground improvement and geosynthetics in Asia.*

Which TECHDRAIN™ should I select?

TECHDRAIN™ has engineered a range of product that optimally meets most PVD project requirements.



- **TECHDRAIN™ TD3520F** is our superior PVD with 4.10mm X 100mm corrugated core profile with premium polyester spun bond filter for a broad range of soft soil conditions.
- **TECHDRAIN™ TD3520U** is our standard PVD with 4.60 mm X 100mm corrugated core profile with polypropylene non-woven filter for a broad range of soft soil conditions.
- **TECHDRAIN™ 5mm X 100mm** corrugated core profile with premium polyester spun bond filter/ polypropylene non-woven filter for a broad range of soft soil conditions.

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Consolidation Design with PVD

Barron (1948) presented the first exhaustive solution to the problem of consolidation of a soil cylinder with a central drain. The differential equation for equal vertical strain governing consolidation is given by:

$$\partial u/\partial t = C_h \left(\partial^2 u/\partial r^2 + 1/r \left(\partial u/\partial r\right)\right) \quad \ldots. (1)$$

For the case of radial consolidation only, Barron's (1948) solution under ideal conditions (no smear and no well resistance) is as follows:

$$\bar{U}_h = 1 - exp\left[-8\, T_h / F(n)\right] \quad \ldots. (2)$$

Hansbo (1981) modified the equations by Barron (1948) for consolidation with vertical drains. The term $F(n)$ in Equation 2 is replaced by a term $F = F(n) + F_s + F_r$, which incorporates the effects of smear and well resistance.

Taking into consideration smear and well resistance effects, the time, t, taken for a given degree of consolidation, $\bar{U}_h$, is given by Hansbo (1981) as:

$$t = (D_e^2 / 8C_h)\, (F(n) + F_s + F_r)\, ln\, (1/(1-\bar{U}_h)) \ldots. (3)$$

where

t = time required to achieve the desired consolidation

u = average excess pore pressure

r = radial distance from point from centre of drained cylinder

T_h = time factor = $C_h\ t / D_e^2$

$\bar{U}_h$ = average degree of consolidation desired

D_e = diameter of zone of influence of the wick drain

C_h = coefficient of consolidation for horizontal drainage

$F(n)$ = drain spacing factor = $ln(D_e / d_w) - 3/4$

d_w = equivalent diameter = $2(a+b)/\pi$, or $(a+b)/2$, where a = width of drain and b = thickness of drain

F_s = soil distance factor = $((k_h/k_s) - 1)\ ln(d_s/d_w)$

k_h = coefficient of horizontal permeability in the undisturbed soil

k_s = coefficient of permeability in the disturbed soil zone

d_s = diameter of the idealized disturbed zone around the drain

F_r = factor for drain resistance = $\pi\ z\ (L-z)\ (k_h/q_w)$

z = distance below the top surface of the compressible layer

L = effective drain length, i.e., total drain length when drainage occurs at one end only, half length when drainage occurs at both ends

q_w = discharge capacity of the wick drain at a gradient of 1

How do I get TECHDRAIN™ technical properties?

TECHDRAIN™ product samples, properties sheets, design manual, design charts, and technical specifications and other literature are available upon request from the manufacturer, distributors or the website http://www.techfabindia.com

About Techfab India Industries Ltd.

Techfab India was founded in 2003 with the objective of providing world class geosynthetic products and services to serve the needs of infrastructure development in India. From a modest beginning with the setting up of a manufacturing facility for woven geotextiles at Silvassa, we have rapidly grown to become the largest manufacturer of geosynthetics in India. Today we manufacture a wide range of products at our factories in Silvassa – TFI 5000 series of Woven polypropylene slit-film/fibrillated tape geotextiles, TFI 1000 series of woven polypropylene multifilament geotextiles, TFI 3000 series of woven polyester geotextiles, TechGrid knitted and PVC coated polyester geogrids, Copper and Polymer Gabions, Geotextile bags and tubes, and TechDrain™ Prefabricated Vertical Drains. We also regularly export many of our products to Europe and USA.

TECHFAB INDIA

At the heart of Geosynthetic activity

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