TENCATE

TenCate Solutions for Soft Foundation Consolidation

TENCATE
GEOSYNTHETICS

TENCATE GEOSYNTHETICS
Making a Difference in Geosynthetics Solutions

Doing What We Do Best

TenCate, the world's market leader in geosynthetics, aerospace, antiballistic, protective fabrics and artificial grass industries has successfully developed these core markets with a mission to protect people and the environment through innovative, high technology textiles and composites.

With more than 60 years of geosynthetics leadership globally, TenCate Geosynthetics is reputed for its reliable brands and expertise in geosynthetics solutions. Geosynthetics are ideal for engineered structures in infrastructure and environmental applications such as subgrade stabilization, reinforced walls & slopes, reinforced embankments, pavement rehabilitation, hydraulic & marine structures for erosion protection and environmental dewatering systems. TenCate Geosynthetics has manufacturing facilities in America, Europe and Asia and a global distribution network.

Advanced Knowledge, Experience & Technology

Customers worldwide are recognizing the importance of geosynthetics to solve problems in civil construction as demand for environmentally friendly, cost-effective and efficient products is increasing. TenCate Geosynthetics has met this challenge directly through advanced textile technologies to develop and manufacture innovative geosynthetic products. Modern design guidelines and performance oriented specifications are incorporated by TenCate's team of experts to provide cost effective engineered geosynthetics solutions for the most complex of engineering problems.

Uncompromised Quality

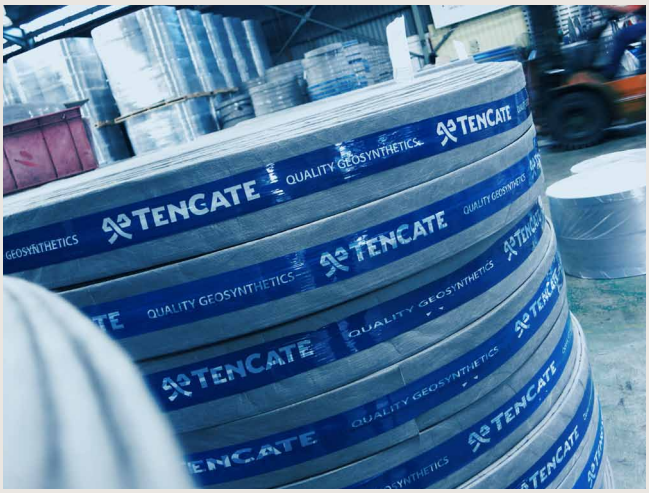
TenCate Geosynthetics Asia's products are manufactured to strict international quality standards. All products are tested and verified at specialist geosynthetics laboratories which are accredited under ISO/IEC 17025 by the Department of Standards Malaysia, Laboratory Accreditation Scheme Malaysia (SAMM), China National Accreditation Service for Conformity Assessment (CNAS) and the Geosynthetic Accreditation Institute (USA) – Laboratory Accreditation Program (GAI-LAP) to ensure products delivered to site meet specified quality requirements.

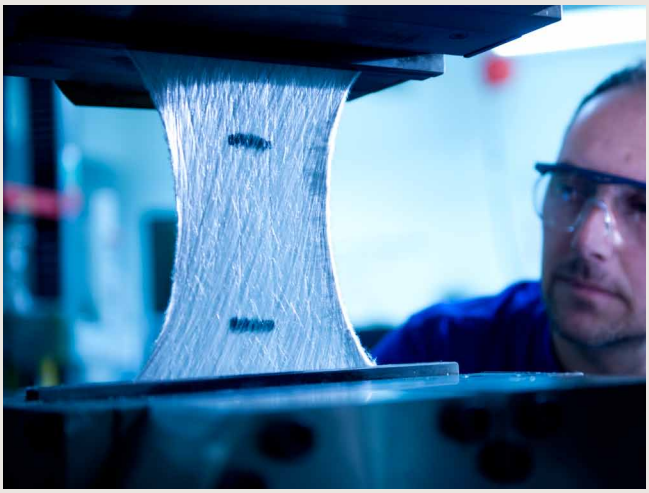
Meeting Expectations

No problem is too complicated and no location is too remote for TenCate. TenCate Geosynthetics has the capability and capacity to supply products to fast-paced projects within tight schedules in diverse locations. Our award-winning projects and extensive project history is a testament of our experience, expertise and capabilities. This reinforces our belief in the power of geosynthetic solutions and to consistently be prepared to exceed expectations.

Experience The Difference

TenCate Geosynthetics aims to protect people and their habitats with geosynthetics solutions and works towards building a safe and sustainable world using materials that make a difference!





TenCate Polyfelt® Alidrain® Prefabricated Vertical Drains

TenCate Polyfelt® Alidrain® prefabricated vertical drains (PVDs) are used to accelerate the consolidation of soft clay foundation soils. The product consists of a permeable drainage core surrounded by a robust filter jacket. The filter jacket filters the excess pore water from the soft clay foundation soil and enables it to pass into the drainage core, where it is able to rise to the ground surface and drain away.

Alidrain® PVDs are manufactured in a range of grades that conform to well-recognised international performance specifications, e.g. CIRIA (1991)[1], and meet different drainage requirements and installation conditions. The different grades account for different drainage capacities and different robustness of the filter jacket.

Alidrain® PVDs are manufactured in rolls of specific length which are then installed vertically into soft clay foundation layers by means of a special installation rig.

[1]CIRIA (1991) "Prefabricated Vertical Drains", Butterworth-Heinemann, U.K.

Alidrain® Prefabricated vertical drain

Prefabricated vertical drain installation rigs

Application of Alidrain® PVDs

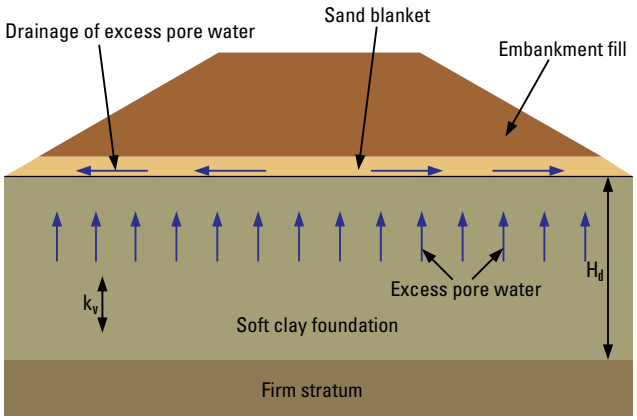
In thick deposits of soft clay, the time required for consolidation under a surcharge loading may be unacceptably long and foundation instability may be a serious concern. The rate of consolidation of the soft clay foundation layer is a function of its vertical hydraulic conductivity k_v and the vertical depth H_d over which the excess pore water has to flow in order to exit the soft clay foundation. Consolidation periods for soft clay foundations can be many years.

By inserting Alidrain® PVDs vertically into soft clay foundation deposits at calculated intervals, the consolidation time can be significantly reduced and the consequent rate of gain in foundation shear strength increased. The rate of consolidation of the soft clay foundation becomes a function of its horizontal hydraulic conductivity k_h and the horizontal spacing between the PVDs d_e. In naturally deposited soft clays, the horizontal hydraulic conductivity is several times greater than the vertical hydraulic conductivity, thus the rate of consolidation will be several times greater. Also, the spacing between the PVDs is many times less than the thickness of the soft clay foundation layer and thus the length over which the excess pore water has to travel before it can reach a PVD to drain out of the soft foundation is reduced significantly (compared to no PVDs). This results in relatively short consolidation times for the soft clay foundation.

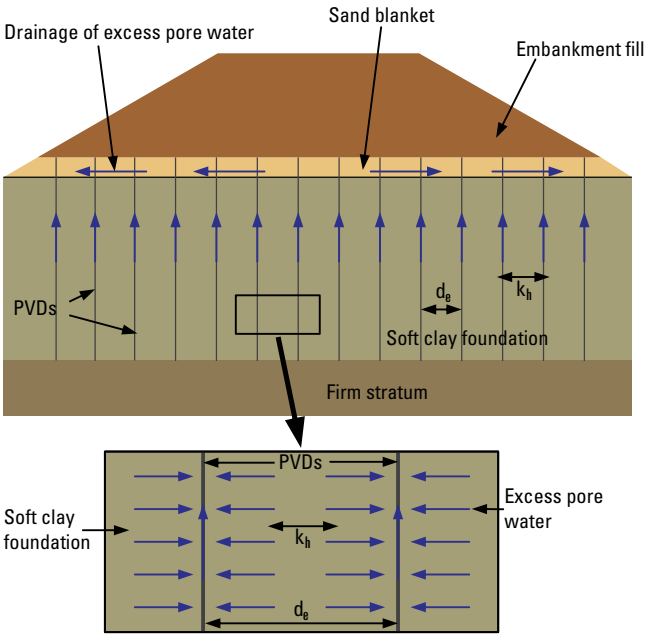
Alidrain® PVDs provide a low cost solution to the problem of long term settlements of soft clay foundations. If designed properly, foundation settlement times can be reduced to the extent they occur within the time frame of the construction project, thereby avoiding the need for expensive post-construction maintenance.

Using Alidrain® PVDs to accelerate the rate of settlement of soft clay foundation layers also accelerates the increase in undrained shear strength of the soft clay foundation. This increase in undrained shear strength provides an improvement in stability of the soft clay foundation.

Foundation consolidation with and without PVDs



a) Soft clay foundation consolidation with no PVDs



b) Soft clay foundation consolidation with PVDs

The horizontal hydraulic conductivity and stress history should be determined based on a proper analysis of the soft clay foundation. This requires a detailed site investigation to be carried out. The Alidrain® PVD, installation geometry and discharge capacity govern the rate at which excess pore water can be discharged at ground surface. The extent of the disturbed zone around the PVDs depends on the method of drain installation and the type of installation mandrel used. The magnitude of the applied surcharge loading governs the magnitude of the excess pore water pressures generated in the soft clay foundation and the resulting pore water gradients. A proper design needs to account for all of these factors.

The factors that affect the consolidation performance of Alidrain® PVDs are:

- The horizontal hydraulic conductivity of the soft clay foundation
- The stress history of the soft clay foundation
- The spacing and geometry of the Alidrain® PVDs in the soft clay foundation
- The discharge capacity of the Alidrain® PVDs
- The extent of the disturbed zone around the Alidrain® PVD's caused by PVD installation
- The magnitude of the surcharge loading applied on top of the soft clay foundation

The advantages of using Alidrain® PVDs are:

- The Alidrain® PVD installation process is very efficient and cost effective
- Alidrain® PVDs conform to internationally well-recognised PVD specifications
- Consolidation times for soft clay foundation deposits can be significantly reduced from many years to 0.5 to 2 years depending on PVD spacing
- The rate of gain in undrained shear strength of the soft clay foundation deposits can be increased when using Alidrain® PVDs

Installation of Alidrain® PVDs

The installation of Alidrain® PVDs follows a very cost efficient procedure. This involves first the construction of a stable working platform over the soft clay foundation, then the vertical installation of the Alidrain® PVDs into the soft clay foundation, and finally the application of the embankment fill loading.

Working platform

To enable suitable PVD installation equipment to be used, a stable working platform must first be constructed over the soft clay foundation. This platform normally consists of sand or gravels and doubles as a stable layer to support the Alidrain® PVD installation rigs as well as a drainage blanket to facilitate the removal of excess pore water from the soft clay foundation. To aid stability of the working platform, a subgrade stabilisation geotextile may be placed on the soft clay foundation surface prior to placement of the working platform.

Alidrain® PVD installation rigs

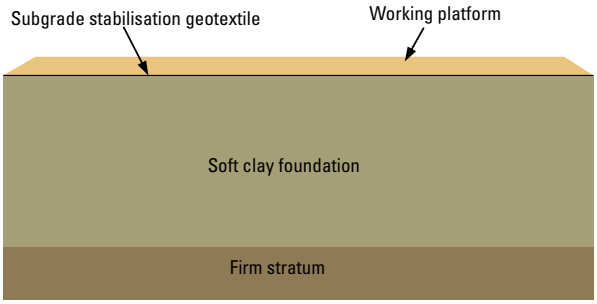
Alidrain® PVDs are installed by vertically vibrating a hollow steel mandrel containing the Alidrain® PVDs into the soft clay foundation to the required depth. The depth of installation is normally the same as the thickness of the soft clay foundation layer. The steel mandrel is then withdrawn, the PVD cut and the installation rig is moved onto the next PVD installation location where the process is repeated.

In ideal conditions, PVD installation rates may be as high as 1,500 linear metres per hour per installation rig, although installation rates are less than this if difficult foundation conditions occur.

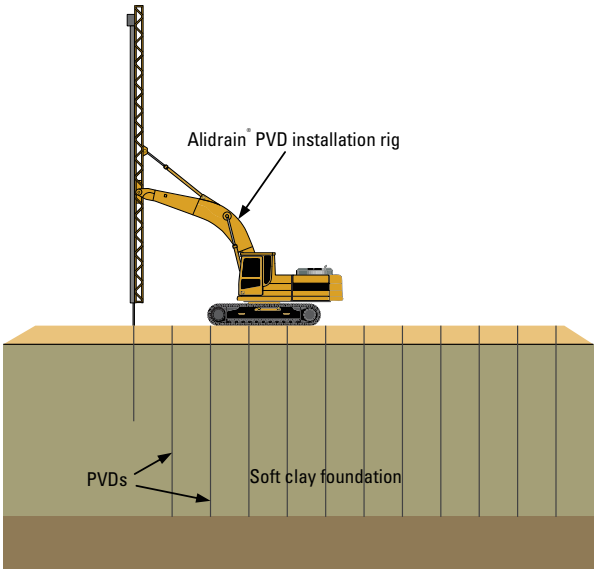
Application of embankment fill

Following installation of the Alidrain® PVDs embankment fill is placed across the top of the treated area in order to generate an excess pore water pressure regime in the soft clay foundation. The excess pore water drains through the Alidrain® PVDs up to the surface of the soft clay foundation, and dissipates within the granular working platform or drainage blanket.

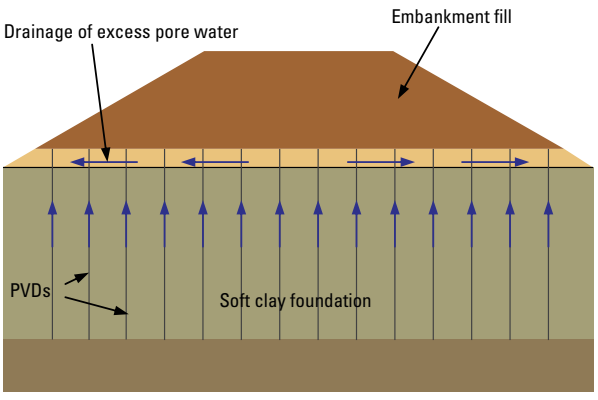
Installation of Alidrain® PVDs



a) Construction of working platform on top of soft clay foundation



b) Installation of Alidrain® PVDs into soft clay foundation



c) Drainage of excess pore water from soft clay foundation

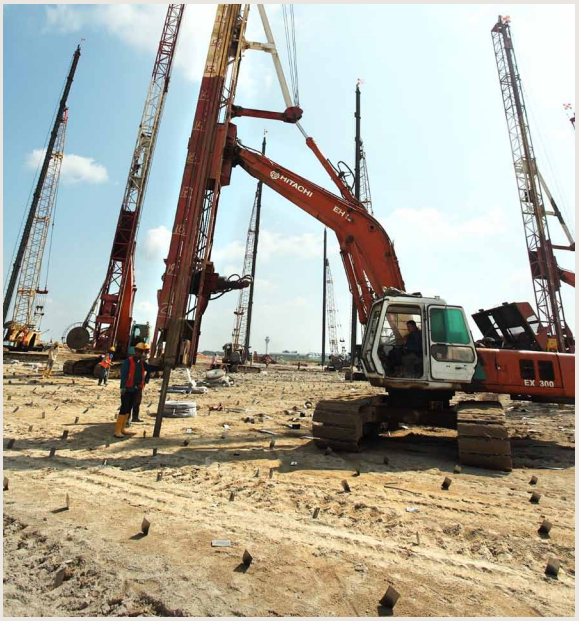
Hollow steel mandrel for Alidrain® PVD installation

As described previously, a hollow steel mandrel is used to vibrate the Alidrain® PVDs vertically into the soft clay foundation. Most commonly, this mandrel is of rectangular cross section as this results in little soil disturbance, but diamond or circular cross section mandrels may be used depending on the difficulty of PVD installation.

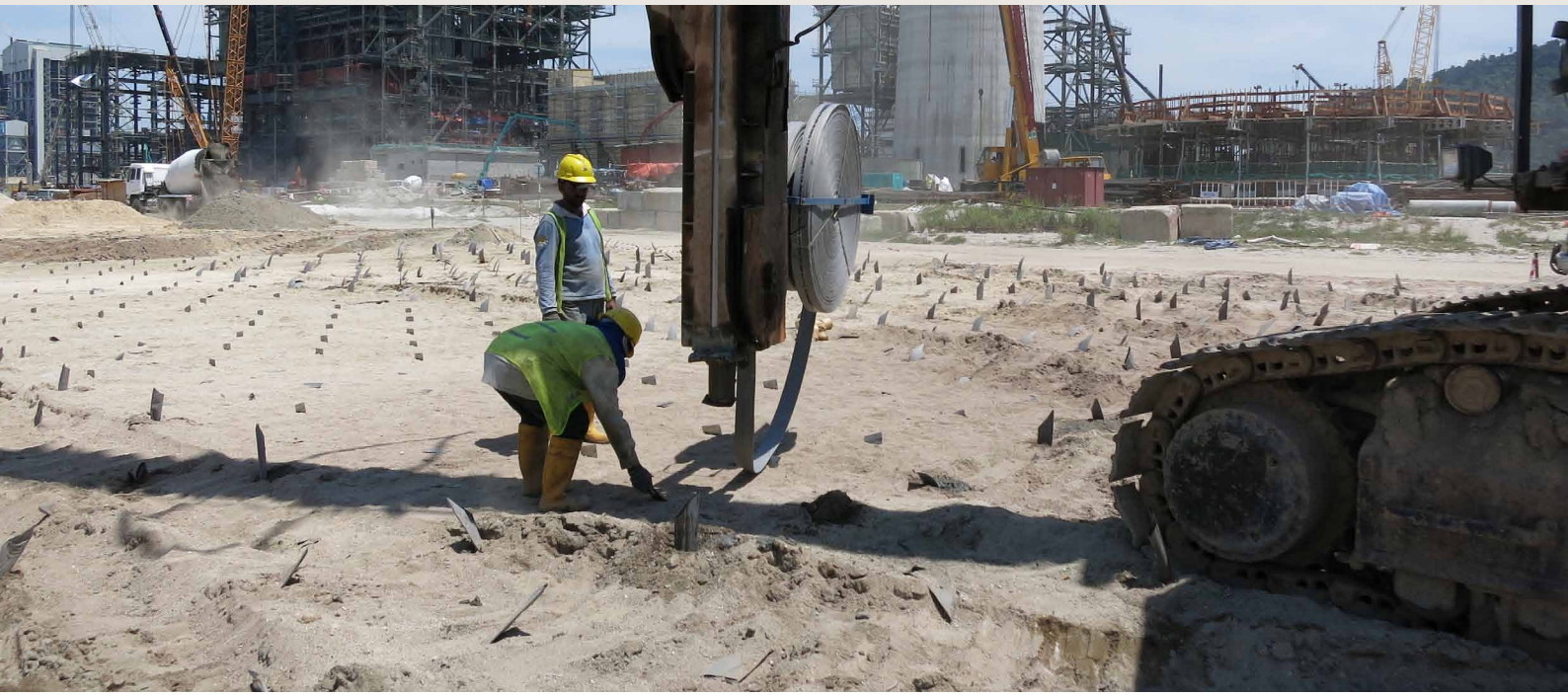
Ideally, the installation of Alidrain® PVDs should be done with as little disturbance to the soft clay foundation soil as possible. This ensures pore water channels to the Alidrain® PVDs are maintained and effective excess pore water pressure dissipation occurs relatively quickly.

Metal shoes for Alidrain® PVDs

To ensure Alidrain® PVDs remain installed when the hollow steel mandrel is withdrawn, a metal shoe is affixed to the PVD prior to its insertion into the soft clay foundation. Several different metal shoe geometries can be used depending on the local conditions. Generally, these can range from flat metal plates to circular bars.



Metal shoe for Alidrain® PVDs



TenCate develops and produces quality products that increase performance, reduce cost, and deliver measurable results by working with our customers to provide advanced solutions.

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