

PREFABRICATED VERTICAL DRAIN GUIDE SPECIFICATIONS

Prefabricated Vertical Drains

Prefabricated Vertical Drains, also known as “wick drains”, “band drains”, “geocomposite drains”, or “PVD’s”, are light-weight, flexible drains that are inserted into the ground primarily for purposes of enhancing or altering drainage in subsurface layers. The most common use of wick drains is to accelerate consolidation in fine-grained, slow-draining layers. Other applications for wick drains include collecting contaminated groundwater or relieving pore water pressure.

At many sites, wick drains are installed prior to the placement of a pre-load/surcharge, with the pre-load exerting similar or greater stresses than the proposed structure. For earthen structures such as embankments, levees, dams, and MSE walls, wick drains are used to accelerate the increase in strength gain of the underlying consolidating soils so that waiting times between lifts of fill can be reduced, and much of the settlement has occurred prior to the feature being put in service.

Wick drains serve to reduce the travel time for water flowing out of the consolidating layer. The consolidation theory assumes that the layer is laterally continuous and water must escape from the layer by flowing into an overlying or underlying permeable layer. With wick drains, water flowing horizontally will be intercepted by a drain and excess pore water pressure will rapidly push the water into and through the drain. Drainage is enhanced not only by reducing the drainage distance, but greater horizontal drainage velocities than those in the vertical direction due to the presence of thin silty or sandy layers and horizontal bedding planes.

Today, most wick drains are comprised of a channeled polypropylene core encased in polypropylene geotextile fabric. The drains are approximately 4-inches wide by 1/8 inch thick. Water flows through the porous fabric and is conveyed vertically up or down until a porous layer is encountered.

Installation

Following the initial set up and feeding of the wick drain material, the drains are installed by pushing a hollow, steel mandrel, rectangular in section, into the ground in a single stroke. The mandrel houses the wick material and protects it from damage as the mandrel is inserted into the ground to the termination depth. At the base of the mandrel, the wick material is looped through or around an anchor, which holds the drain securely in place and prevents the inflow of the soils during insertion, and holds the drain securely at the driven depth as the mandrel is extracted. Once the mandrel has been extracted from the ground, the wick drain is cut and the next drain is installed.

Vertical drain installation units are typically powered and supported by large crawler excavators. Pull down is typically accomplished by heavy chain, cable, or gear systems. Depending on the subsurface conditions, the mandrel may be vibrated or statically pushed into the ground.

Site Considerations

Because wick drains are commonly installed at sites where soft soils are present near the ground surface and the equipment is very tall and heavy, it is necessary to provide a stable working surface. In many cases, the installation of a twelve (12) inch to twenty-four (24) inch thick sand or stone platform will

provide sufficient support for the wick drain installation equipment. Where the ground is especially soft, geotextile fabric or geo-grid is installed prior to the placement of the granular platform.

It is typically necessary to provide drainage at the surface that is adequate to receive the flow of water conveyed through the wick drains. The granular working platform can be designed to double as the drainage blanket. Horizontal strip drains may be used in lieu of the sand blanket if the existing ground can provide a suitable working surface.

For safety reasons, the site should be as flat as reasonable, with minimal pitch to affect positive drainage. With special precautions, it may however be possible to install wick drains on gentle slopes. The designer should consider topographic features such as hills and slopes, and be cognizant of the presence of overhead or buried utilities when designing a wick drain program. With special modifications, battered and low headroom drains can be installed to help overcome site constraints. Where hard layers are present, drilling or augering can be used to loosen the ground to allow for wick drain installation.

1.0 DESCRIPTION

This work consists of furnishing all necessary labor, equipment, and materials to install prefabricated vertical (wick) drains in the ground in accordance with the plans and as specified herein.

2.0 QUALIFICATIONS

The Contractor shall have successfully completed a minimum of ten (10) wick drain installation projects in similar conditions, and installed not less than five million (5,000,000) linear feet of wick drain in the past three (3) years.

C2.0 To expedite the bidding process, the owner may add a list of pre-qualified wick drain subcontractors.

3.0 SUBMITTALS

At least thirty (30) days prior to the commencement of work the Contractor shall submit the following for review and approval:

3.1 Experience. A list of a minimum of ten (10) completed wick drain projects identified by name, location, project description, size, completion date, description of soil conditions, and contact person for the contracting organization.

3.2 Manufacturer's wick drain material specifications identifying compliance with the requirements of Section 4.0 Materials.

3.3 A five (5) foot long sample of the wick drain that will be installed. The sample shall be stamped or labeled by the manufacturer as being representative of the wick drain having the specified trade name.

3.4 Size, type, weight, maximum pushing force, vibratory energy (if applicable), and configuration of the installation rig in accordance with the requirements of Section 5.0 Equipment.

3.5 Dimensions and configuration of mandrel in accordance with the requirements of Section 5.0 Equipment.

3.6 Details of wick drain anchorage.

3.7 Detailed description of proposed installation methods, including methods for overcoming obstructions and methods for splicing wick drains.

4.0 MATERIALS

The prefabricated drains shall be of newly manufactured materials and consist of a polymer drainage core fully wrapped

C4.0 The minimum material requirements given in this specification are adequate for

in non-woven geotextile. To ensure the fabric is durable to endure the installation, and to support the retention of the soil without distress, or infiltration into the core, index tests on the fabric shall be tested independently from the core. Fabric from a master roll representative of the produced materials may be used for testing, if samples from the wick sample are too small for the required test. The tested results for the product shall meet the following minimum properties:

Tests to perform on assembled/composite material

Discharge Capacity (@ 35 psi, i=1.0, with fabric on core)	1.5 gpm	ASTM D4716
Tensile Strength	400 lbs	ASTM D4595

Tests to perform on Filtration Fabric

Grab Tensile Strength	130 lbs	ASTM D4632
Puncture Resistance	41 lbs	ASTM D4833
Permittivity	0.7 s ⁻¹	ASTM D4491
A.O.S.	70 sieve	ASTM D4751

Further material requirements shall be adhered to as follows:

- 4.1 During shipment and storage, the wick drain material shall be wrapped in a heavy-duty protective covering. The storage area shall be such that the wick drain material is protected from sunlight, mud, dirt, dust, debris, and detrimental substances. The drains shall be free of defects, rips, holes, or flaws. Damaged materials shall be replaced at the Contractor's expense.
- 4.2 All wick drain material delivered to the site shall be labeled or tagged for quality control purposes. Each roll shall be identified by lot or control numbers, individual roll number, date of manufacture, manufacturer, and product identification.

5.0 EQUIPMENT

- 5.1 The wick drains shall be installed with equipment which will cause a minimum of disturbance to the subsoil during the installation. The wick drains shall be installed with a sleeve or mandrel that will be advanced to the required depth using constant load, or constant rate of advancement methods. The mandrel shall be shaped to minimize disturbance to the subsoil, having a uniform exterior shape. The mandrel shall protect the wick drain material from tears, cuts, and abrasions during installation and shall be withdrawn after the installation

typical conditions where wick drains are used. However, it is the responsibility of the designer to verify that all material properties are appropriate for their specific site. (For instance, sites where extreme amounts of settlement are anticipated, more stringent 'buckled drain discharge' standards may be required). The designer may add a clause which allows the use of specific pre-approved products. The designer may also add a clause which requires that a certain amount of the product has been successfully used on recent projects (e.g. five million (5,000,000) linear feet in the past five years).

For large projects, the designer may require a set of lab tests to be performed/submitted at a regular frequency (e.g. five hundred thousand (500,000) linear feet, which is an approximate truckload quantity).

of the drain. The drain shall be installed with an anchor plate or rod to the required depth at the time of mandrel removal. The cross-sectional area of the mandrel and anchor combination shall not be greater than twelve (12) square inches. The wick drain installation unit shall be capable of applying a minimum downward force of thirty thousand (30,000) pounds. when sitting on firm ground.

5.2 The use of falling weight impact hammers shall not be permitted for installation of the wick drains. Vibratory techniques may be used to penetrate stiff upper soil layers but may not be used once the wick drain has penetrated underlying soft material. Water may be permitted to facilitate anchorage or mandrel lubrication in highly plastic soils.

6.0 CONSTRUCTION

6.1 Mark the proposed locations of the wick drains and take all reasonable precautions to preserve the markers. The locations of the markers shall not vary more than six (6) inches from the locations indicated on the Plans. Verify the location of all existing utilities and instrumentation devices prior to installing the wick drains.

6.2 Wick drains that deviate from the marked location by more than six (6) inches, or are damaged, or are improperly installed, will be rejected and no compensation will be allowed for any materials furnished or for any work performed on such wick drains. Replacement wick drains shall be offset from the location of the rejected wick drains as directed by the Engineer. The rejected wick drains shall remain in place.

6.3 Install the wick drains vertically to the depth(s), elevation(s), described levels, or to the firm substratum indicated in the Plans. Firm substratum is defined as the layer which resists further penetration at a reasonable effort. The Contractor shall provide the Engineer with a suitable means of verifying the plumbness of the mandrel and determining the tip elevation of the wick drain at any time. The equipment shall be carefully checked for plumbness and shall not deviate more than (0.25) inches per foot from the vertical.

C5.2 Vibration may reduce permeability or increase remolding in certain soil types.

C6.0 Preparation of the working area will greatly affect wick drain installation rates. Separate specifications should be used for preparing the ground surface and installing the working/drainage pad. Typically, the surface is smoothed and leveled to no steeper than 1 in 6 (1:6). In most cases the drainage blanket is installed before the drains to function as a working pad and to protect the underlying soils from damage, however, possible contamination from drill/auger spoils should be considered.

C6.3 In cases where the compressible layer is very thick and the drains will not reach the bottom, wick drain lengths may be specified by depth (or elevation). Otherwise, illustrating the approximate top of the firm substratum in the plans is usually preferable. In any case, the designer should clearly convey the expected lengths of the wick drains in the

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- 6.4 Splices or connections in the drain material shall be done by overlapping the jacket and core of the new roll to the jacket and core of the previous roll a minimum of six (6) inches, and stapling in a workmanlike manner to ensure structural and hydraulic continuity of the drain.
- 6.5 Where obstructions or hard layers are present that prevent the installation of a wick drain, the Contractor will make two additional attempts to install a wick drain within eighteen (18) inches of the original location. If the drain can still not be installed, the location will be marked and designated for obstruction clearance by means of augering, drilling, punching, or spudding. Obstruction clearance in accordance with the approved procedure will be permitted to a maximum depth shown on the Plans, or as directed by the Engineer, and only where prior approval is given by the Engineer.
- 6.6 Where obstructions cannot be cleared by the methods listed in Section 6.5, the Engineer will determine if the wick drain is to be abandoned or installed to the required tip elevation.
- 6.7 Cut wick drains neatly at the upper end with a four (4) inch to eight (8) inch length protruding above the working surface, or as shown on the Plans.
- 7.0 METHOD OF MEASUREMENT
- 7.1 Mobilization will be paid for by lump sum.
- 7.2 Wick drains will be measured and paid for as the number of linear feet satisfactorily installed, or abandoned as directed by the Engineer, from the tip elevation to the level of the working surface, plus the allowable length of wick drain protruding above the working surface.
- 7.3 Obstruction clearance will be measured and paid for as the number of linear feet from the working surface to the depth penetrated by the auger, spud, drill, or punch.
- 8.0 BASIS OF PAYMENT
- 8.1 Mobilization shall include the cost of furnishing of all equipment and materials necessary to properly execute the work.
- plans and specifications and provide the contractor with all available subsurface information.
- C6.5** The designer may require that pre-loosened holes be backfilled. If required, sand is typically used as the backfill material. Contractor should be allowed to push or dump the sand into the drill hole, either before or after the wick drains are installed.
- C6.7** The cutoff length may be reduced if the wick drains are installed through the drainage blanket.
- C7.2** On large projects the Engineer should be allowed to use roll count to track the quantity of wick drain installed. However, this should not relieve the Engineer from observing installations and verifying that design depths are achieved.
- C7.3** If significant obstructions are anticipated, an estimated quantity of obstruction clearance should be included in the contract documents. If obstructions are not anticipated, obstruction clearance work

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- 8.2 The unit bid price for wick drains shall include the cost of survey and stakeout, installing wick drains, and furnishing all labor, tools, incidentals necessary to complete the work.
- 8.3 The unit bid price for obstruction clearance shall include the cost of satisfactorily clearing obstructions to facilitate the installation of the wick drains, disposal of spoils, any required backfilling, furnishing all labor, tools, incidentals necessary to complete the work.

should be paid for by force account.

C8.2 On projects where shallow drain lengths (less than thirty (30) feet deep) are anticipated, a per each payment unit is recommended.