SPECIAL SPECIFICATION

5988

Vertical Wick Drain System

1. Description. Furnishing all labor, equipment and materials necessary to install vertical wick drains, and embankment monitoring devices required to complete a system of soil improvement as indicated on the plans and as specified.

2. General.

   A. The area to be treated by the installation of vertical wick drains shall be as shown on the plans. The depth of the treatment shall be from reference elevation to the bottom target elevation indicated on the plans. All wick drains shall penetrate to practical refusal on rock.

   B. Embankment monitoring devices consisting of settlement plates, vibrating wire pore pressure gauges, and standpipe piezometers shall be constructed and monitored at locations and in the manner as specified and indicated on the plans.

   C. A scheduled stoppage or staged delay in embankment placement at a limited height of fill is not planned. The only anticipated delay currently consists of prescribed waiting times following the completion of finished grade elevation as indicated that are required for completion of settlement and pore pressure dissipation at respective embankment locations. Instrumentation monitoring shall be performed over the prescribed wait times to observe the performance of the resulting accelerated settlement of the embankment regions with the use of wick drains, as indicated. Observations of instrumentation monitoring shall be performed and provided to the Engineer to evaluate actual findings relative to anticipated procedures. Any reduction of time or lengthening of time outside the prescribed wait times following fill placement to final grades shall be determined and directed by the Engineer. If at any time the Engineer determines that a staged limit to fill height is required to promote slope stability, the Engineer will provide direction to Contractor in accordance with criteria noted for instrumentation monitoring, in particular from vibrating wire pore pressure monitoring devices and settlement gauges in order of preference.

3. Submittals

   A. At least two weeks prior to the installation of the wick drains, the Contractor shall submit, for review and approval, details of the sequence and method of installation. The submittal shall, as a minimum, contain the following specific information:

      i. Size, type, weight, maximum pushing force, and configuration of the installation rig.
i. Dimensions and length of mandrel.

iii. Details of drain anchor.

iv. Detailed description of proposed installation procedures.

v. Proposed methods for overcoming obstructions.

vi. Layout drawing showing the planned location for all wick drains, and planned monitoring instrumentation.

B. The Contractor shall submit a 5-foot sample of the vertical drain material to the Engineer to evaluate the material. The samples shall be stamped or labeled by the manufacturer as being representative of the drain material having the specified trade name. Approval of the sample material by the Engineer shall be required prior to site delivery of the wick drain material. The Contractor shall submit drain samples and indicate the source of the proposed materials prior to delivery to the site and shall allow sufficient time for the Engineer to evaluate the material.

C. At least two weeks prior to the installation of drains, the Contractor shall submit to the Engineer for his review and approval, a layout plan, details of the sequence and method of installation. Approval by the Engineer will not relieve the Contractor of his responsibility to install drains in accordance with these specifications.

D. Approval of the Engineer will not relieve the Contractor of his responsibilities to install wick drains in accordance with the plans and specifications. If, at any time, the Engineer considers that the method of installation does not produce a satisfactory drain, the Contractor shall alter his method and/or equipment as necessary.

4. Materials. Furnish materials of uniform quality that meet the requirements of the specification.

E. Assembly

i. Wick drains shall be a prefabricated type with a corrugated plastic drainage cores wrapped on all sides with non-woven synthetic geotextile filter fabric, installed plumb and vertical.

ii. The prefabricated wick drain material shall consist of a continuous plastic drainage core wrapped in a non-woven geotextile material. The geotextile wrap shall be tight around the core and shall be securely seamed in a manner that will not introduce any new materials nor present an obstruction that will impede the flow in the channels of the core.

iii. The drains shall be free of defects, rips, holes, or flaws. During shipment, the drain shall be protected from damage. During storage on site, the storage area shall be such that the drain is protected from sunlight, mud, dirt, debris, and detrimental substances. Manufacturer certification of material requirements listed below in Tables 1 and 2 shall be provided for all drain material delivered to site.
iv. One single type of assembled wick drain shall be used on the project unless otherwise specified or approved by the Engineer.

v. Wick drain material shall be labeled and tagged in such a manner that the information for sample identification and other quality control purposes can be easily read from the label. As a minimum, each roll shall be identified by the manufacturer as to lot or control numbers, individual roll number, date of manufacture, manufacturer, and product identification of the jacket and core.

vi. During shipment and storage the wick drain shall be wrapped in heavy paper, burlap, or similar heavy duty protective covering and in accordance with the manufacturer’s recommendations.

vii. The Engineer may reject material that is damaged during shipment, storage or handling; or which does not meet the minimum requirements of the wick drain material.

viii. The wick drain shall be band-shaped with an aspect ratio (width divided by thickness) not exceeding 50.

ix. Prefabricated wick drains to promote continuous vertical drainage meeting these specifications acceptable for installation shall be products from the following or equal as approved by the Engineer:

a. Alidrain

b. Amerdrain

F. Geotextile. Furnish non-woven fabric geotextile consisting of filaments or yarns of polyester or polypropylene. The fabric shall be inert to commonly encountered chemicals, hydrocarbons, mildew and rot resistant; insect and rodent resistant; and ultraviolet light resistant. The geotextile properties will be in accordance to Table 1.

<table>
<thead>
<tr>
<th>Properties</th>
<th>ASTM Spec.</th>
<th>Vertical</th>
<th>Horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grab Tensile Strength =</td>
<td>D-4632</td>
<td>130 lb.</td>
<td>90 lb.</td>
</tr>
<tr>
<td>Grab Elongation =</td>
<td>D-4632</td>
<td>50% maximum</td>
<td>50% maximum</td>
</tr>
<tr>
<td>Mullen Burst Strength =</td>
<td>D-3786</td>
<td>250 psi</td>
<td>215 psi</td>
</tr>
<tr>
<td>Permeability =</td>
<td>D-4491</td>
<td>1.25 sec. (^1)</td>
<td>-</td>
</tr>
<tr>
<td>Discharge Capacity (@ 40 psi) =</td>
<td>D-4716</td>
<td>1.7 gal./min.</td>
<td>-</td>
</tr>
<tr>
<td>AOS (0(_{90})) =</td>
<td>D-4751</td>
<td>.16 mm maximum</td>
<td>.22 mm maximum</td>
</tr>
<tr>
<td>Trapezoid Tear Strength =</td>
<td>D-4533</td>
<td>60 lb.</td>
<td>45 lb.</td>
</tr>
<tr>
<td>Puncture Resistance =</td>
<td>D-4833</td>
<td>40 lb.</td>
<td>40 lb.</td>
</tr>
<tr>
<td>UV Resistance =</td>
<td>D-4355</td>
<td>70% Strength Retained</td>
<td>70% Strength Retained</td>
</tr>
<tr>
<td>Permittivity =</td>
<td>D-4491</td>
<td>-</td>
<td>150 gal./min./ft. (^2)</td>
</tr>
</tbody>
</table>

*Jacketing wrap material shall be tested in saturated and dry conditions.
G. **Vertical Wick Drain Core.** Furnish polypropylene vertical wick drain core which will be inert to commonly encountered chemicals, hydrocarbons, mildew and rot resistant; insect and rodent resistant; and ultraviolet light resistant. The vertical wick drain core properties will be in accordance to Table 2.

<table>
<thead>
<tr>
<th>Properties</th>
<th>ASTM Spec.</th>
<th>Vertical</th>
<th>Horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compressive Strength</td>
<td>D-1621</td>
<td>-</td>
<td>8500 psf</td>
</tr>
<tr>
<td>Grab Tensile Strength =</td>
<td>D-4595</td>
<td>370 lb.</td>
<td>-</td>
</tr>
<tr>
<td>Width =</td>
<td>4 in.</td>
<td>12 in.</td>
<td></td>
</tr>
<tr>
<td>Thickness (nominal) =</td>
<td>0.135 in.</td>
<td>1 in.</td>
<td></td>
</tr>
<tr>
<td>Transmittivity =</td>
<td>D-4716</td>
<td>-</td>
<td>20 gal./min./ft.</td>
</tr>
</tbody>
</table>

H. **Vertical Wick Drain Anchors.** Furnish suitable anchoring devices consisting of a plate or rod for the bottom of the wick drains.

I. **Strip Drain Core.** Furnish HDPE core for strip drains.

2. **Equipment.** Furnish and maintain equipment so as to ensure safe, continuous, and efficient production during installation of Vertical Wick Drain System and other related operations.

   A. Wick drains shall be installed using a mandrel, which shall be pushed into the soil with a continuous static movement, and vibrated or driven in accordance with manufacturer’s recommendations.

   B. Equipment used to push mandrel and wick drains for installation shall be continuously in proper working condition and provide an adequate static force to set all wick drains to refusal upon rock.

   C. Mandrel shall protect the wick material from tears, cuts, and abrasions during installation; and shall be rectangular in shape; and of a cross sectional area not to exceed 10 square inches.

   D. Provide anchor plate at bottom of mandrel to cover mandrel end and prevent soil from entering mandrel or wick drain during installation through all soils. Anchor plate shall be sufficient strength and rigidity to anchor wick drain at required depth during mandrel removal.

3. **Construction.**

   A. **Site Preparation.** Prior to installation of the vertical wick drains strip the site of surface vegetation and complete any remedial grading to provide the water flow directions as indicated on the plans.

   B. **Vertical Wick Drains Installation.** Prior to the installation of wick drains or the mobilization of equipment to the site, perform the following:
i. Identify the location of all planned monitoring devices relative to wick drain positions and other planned construction activities so that instrumentation shall be installed within the middle of the triangular spacing of a wick drain pattern in order to avoid all potential conflicts.

ii. Submit the drawing at least 2 weeks prior to plans to mobilize equipment to the site and commencing wick drain installation for approval by Engineer.

iii. Prior to installing wick drains, the site shall be graded sufficiently to allow for proper vertical installation.

iv. Install wick drains in a triangular pattern to rock refusal, at such spacings and to such elevations as indicated on the drawings or determined from subsequent borings, unless otherwise directed by the Engineer.

v. Provide a plan or drawing identifying the proposed location for all other instrumentation monitoring devices so that their locations will not conflict with wick drain installation or its operation. This plan or drawing shall identify the location of all proposed wick drains and all proposed instrumentation; specifically settlement monitoring gauges, pore pressure monitoring devices, standpipe piezometers, and inclinometers as applicable.

vi. Locate, number, and stake the wick drains as indicated on the drawings. Take all reasonable precautions to protect and preserve the stakes and/or flagging. The granular drainage blanket shall have sufficient coarse material and sufficient compaction to provide a stable working surface. The locations of the installed wick drains shall not vary by more than 6 inches from the locations indicated on the drawings.

vii. Install the vertical drains prior to installation of granular drainage blanket as indicate. Construction of the granular drainage blanket system shall be completed prior to placement of the permanent embankment. The prefabricated drain shall be cut such that at least a 6-inch length protrudes above the top of the at each drain location.

viii. The Contractor shall demonstrate that equipment, methods, and materials produce a satisfactory installation in accordance with these specifications. For this purpose, the Contractor shall install several trial drains at locations within the work area, as designated by the Engineer. Trial drains conforming to these specifications will be paid for at the same unit price as the production drains.

ix. Install the vertical drains at the locations shown on the plans, or as directed by the Engineer. Drains that deviate from the drawing location by more than 6 inches, or that are damaged or improperly installed will be rejected. Rejected drains may be removed or abandoned in place, at the Contractor’s option. Offset replacement drains approximately 18 inches from the location of the rejected drain as directed by the Engineer. All rejected drains will be replaced at the Contractor’s expense.
x. Install vertical drains with equipment which will cause a minimum of disturbance to the subsoil during the installation. Install prefabricated drains by pushing or vibrating the mandrel or sleeve through the soils to the required depth. Jetting shall not be permitted for installation of the drain, except with the approval of the Engineer, to lubricate the mandrel when working in highly plastic clays.

xi. Install drains vertically with a tolerance of not more than 0.25 inches per foot. Carefully check the equipment for the plumbness and provide to the Engineer a suitable means of both verifying the plumbness of the mandrel and of determining the depth of the drain.

xii. Contractor shall be responsible for furnishing all necessary material, labor and equipment for the purpose of installing vertical wick drains according to these specifications. Drains which are defective, either in terms of material or as a result of unacceptable installation methods, shall not be measured for payment.

xiii. Where obstructions are encountered within the compressible clay layer which cannot be penetrated by augering or spudding, Contractor shall abandon the hole. At the direction of the Engineer, the Contractor shall then install a new drain no more than 18 inches from the obstructed drain. A minimum of two attempts shall be made to install a new drain. If the drain still cannot be installed to the design tip elevation, the drain location shall be abandoned and the installation equipment should be moved to the next drain location. The Contractor will be paid for such obstructed drains at the unit price per foot for productive drains.

xiv. Contractor may use augering or other methods to loosen stiff upper soils prior to installation of wick drains provided such operations do not extend more than 2 feet below the subsoil. All holes or voids created from such auguring operations shall be filled with sand after the wick drain is satisfactorily installed.

xv. During installation, Contractor shall provide suitable surface reference elevation and a means of measuring the vertical length of each wick drain installed at a given wick location in order to derive the tip elevation for each wick drain.

xvi. Splices or connections in the wick drain material will not be allowed.

xvii. Contractor shall provide to the Engineer at the end of each working day a summary of the total amount of vertical wick drains installed that day.

xviii. Install wick drains with continuous push using static weight or vibration with a mandrel penetration rate appropriate for the soils encountered; but generally range between 0.5 to 2.0 feet per second.

xix. Installation of wick drains shall be coordinated with the placement location and schedule for all monitoring instrumentation as identified.
Special care shall be taken to install wick drains in a manner not to damage or disturb instrumentation already installed in place. Contractor shall replace at their cost all instrumentation damaged or rendered nonfunctional as a result of any of Contractor’s activities.

xx. Approval by the Engineer of the method and equipment used to install the trial drains shall not constitute acceptance of the method for the remainder of the project. If at any time the Engineer considers that the method of installation does not produce satisfactory drainage, the Contractor shall alter his method and/or equipment as necessary to comply with these specifications.

xxi. Coordinate and assist with the installation of the geotechnical instrumentation required to monitor the soil consolidation progress. The Contractor shall observe precautions necessary for protection of instrumentation devices. After instrumentation devices have been installed, the Contractor shall replace at his cost any equipment that is damaged or becomes unreliable as a result of his actions.

C. **Predrilling for Wick Drains.** Pre-drilling of holes for the wick drains will not be allowed unless the installation rig cannot push the lance to the required depth under full power. If pre-drilling is required, the drill-hole diameter will be no larger than required to allow pushing of the lance to the designated depth and will be no larger than the maximum diameter of the lance.

D. **Horizontal and Vertical Alignment Tolerances.** The maximum vertical deviation will not exceed 3 inches from the layout center coordinate, shown on the plans. The maximum horizontal deviation will not exceed 6 inches for the specified locations indicated on the plans.

4. **Measurement.** Vertical wick drains (VWD) elements will be measured by the linear foot installed or obstructed, only within the proposed VWD areas shown on the plans or approved by the Engineer.

5. **Payment.** The work performed and the materials furnished in accordance with this Item and measured as provided for under “Measurement” will be paid for at the unit price bid for “Vertical Wick Drains.” This price is full compensation for furnishing all equipment, materials, testing, and labor required to install VWD in accordance with the specified strength requirements over the depths and limits shown on the plans.