Chapter 4 Construction Details

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Chapter 4 Construction Details

Section 68 Subsurface Drains

4-6801 General

This section provides guidelines for inspecting subsurface drains as specified under Section 68, “Subsurface Drains,” of the *Standard Specifications*. Subsurface drains include underdrains, horizontal drains, edge drains, and geocomposite drain systems.

Subsurface drains remove groundwater from the pavement structure, underlying foundation materials, or adjacent soil and rock formations. The drains are intended to intercept groundwater or lower its level before it adversely affects the highway.

Be alert for indications of problem groundwater, particularly before clearing and during grading. Swamps, bogs, springs, and areas of lush growth are possible indicators of excess groundwater. Carefully inspect fill foundations before starting embankments. As excavation progresses, personnel may encounter standing water or aquifers near slopes or at the grade.

If problem groundwater is found, it may be necessary to issue a change order to add subsurface drains.

Request assistance from the district materials engineer or the district geologist for subsurface investigations.

4-6801A Underdrains

Underdrains consist of perforated pipe placed in permeable material. Single installations, in which a pipe and filter material are placed in a narrow trench, are used at the following locations: along the toe of a cut slope; along an upstream (with respect to groundwater) toe of fill; and across the roadbed at the lower end of a through cut.

Multiple installations of perforated pipe are used in permeable blankets and stabilization trenches. Permeable blankets are placed over the width of a roadbed and may be considered part of the structural section.

Permeable material is enclosed in filter fabric, which prevents the migration of fine material into the permeable material.

Pipes that act to collect groundwater must be perforated or slotted; however, pipes that discharge collected water should not be perforated or slotted.

When feasible, the contractor should locate underdrain systems below the invert of adjacent storm water systems. When working in the presence of high groundwater tables and highly erodible soils, consider using watertight joints in culverts.

4-6801B Horizontal Drains

Horizontal drains are made from 1-1/2-inch schedule 80 polyvinyl chloride (PVC) pipes. Horizontal drains can be slotted, perforated, or plain. They are placed in holes drilled into aquifers. Normally they are placed in cut slopes or under fills and their purpose is to reduce the possibility of slides or slipouts.

The extent of groundwater may be determined with exploratory, vertical wells. Where the wells may be kept open, such wells serve as gauges to indicate changes in the elevation of the water table. However, for most situations, vertical wells may not be necessary, since it is obvious that groundwater requires drainage by horizontal drains because of signs of distress or saturation at the surface. Where vertical wells are not needed, the exploration and installation of drains may occur concurrently. Each newly installed drain adds information needed to solve the problem. For instance, the extent of the aquifer may be discovered or the volume of flow will indicate whether more, or fewer, drains are required.

4-6801C Edge Drains

Edge drains are installed beneath a paved shoulder, just out from the edge of the concrete pavement. Slotted PVC pipe is placed within asphalt-treated or cement-treated permeable material that is partially encapsulated in filter fabric. These drains remove water from the structural section and prevent migration of fine material from the base or subbase to the area beneath the slab.

4-6801D Geocomposite Drain Systems

Geocomposite drain systems are most commonly used as structure approach drainage systems, which consist of geocomposite drain, filter fabric, plastic pipe, treated permeable base, and drainage pads.

4-6802 Before Work Begins

During this preliminary inspection, take the following steps:

- Make sure the contractor requests staking for control of line and grade.
- Verify that Form DOT CEM-3101, “Notice of Materials to Be Used,” includes all fabricated materials. Refer to Section 6-2, “Acceptance of Manufactured or Fabricated Materials and Products,” of this manual for additional information.
- Check that the contractor has provided a certificate of compliance for each type of subsurface drain. The certificate of compliance must cover the pipe, tubing, fittings, and specified materials to be used. Generally, there will be no Form TL-0624, “Inspection Release Tag,” for these materials with the exception of coatings or fasteners used with subsurface drains.
- Verify that permeable material is of the class required under the contract.
- Double-check to verify the use of the proper type and size of materials at each location, and verify the planned quantities for solid and perforated pipe.

4-6802A Underdrains

- Review the locations planned for underdrains to make sure that all areas requiring underdrains have been identified.
- Review Sheet D102, “Underdrains,” of the *Standard Plans* for underdrain details.

4-6802B Horizontal Drains

- Determine the drain locations and sequence of placement based on plans, exploration work, and observations during excavation. Determine the system by which horizontal drains will be designated and marked, and provide the contractor with this information.
- Plan the placement of collectors and outlets so they are positioned for public safety and ease of maintenance operations.
- Verify planned quantities.

4-6802C Edge Drains

- Refer to Section 4-29, “Treated Permeable Bases,” of this manual for guidelines for the production of treated permeable material.
- Verify planned quantities.
- Review Sheets P50, “Pavement Structure — Drainage System Details”; P51, “Edge Drain Outlet and Vent Details”; and P52, “Edge Drain Cleanout and Vent Details,” in the *Standard Plans* for edge drain details.

4-6802D Geocomposite Drain Systems

- Obtain a certificate of compliance for geocomposite drain and accompanying flow capability graph with authorized laboratory verification. Geocomposite drain material must conform to Section 96-1.02C, “Geocomposite Wall Drain,” of the *Standard Specifications* unless otherwise specified.
- Review project plan sheets for structure approach drainage details with geocomposite drain systems. Project plan sheets may also identify “Weep Hole and Geocomposite Drain” alternatives, which contractors may choose to use.

4-6803 During the Course of Work

During the work, take the following steps:

- Subsurface drains are hidden from view for the most part, so make sure complete as-built records are created. Pictures, plans, elevations, and complete descriptions will enable efficient and more complete maintenance and repair.
- Verify that the contractor conforms to the water pollution control plan in handling any water discharged from subsurface drains.

4-6803A Underdrains

- Make sure that the contractor places only one type of alternative pipe at an installation.
- Immediately before placing the filter fabric, examine the condition of the trench. Require the contractor to remove any loose material and any sharp objects that may damage the filter fabric.
- Observe the placement of the filter fabric, and check that any tears or punctures are repaired as specified.
- Verify that permeable material is of the class required under the contract.
- In accordance with frequencies shown in Section 6-1, “Sample Types and Frequencies,” of this manual, test the permeable material for all specified attributes.
- Initially, more frequent testing may be advisable if any indication exists that segregation or contamination is occurring during handling and placing.
- Require the contractor to place pipe in the manner specified in Section 68-2.03, “Construction,” in the *Standard Specifications*.
- Terminal cleanouts and intermediate risers are vulnerable to damage throughout the contract’s life. Before recommending contract acceptance, check that they are in good condition.

4-6803B Horizontal Drains

- Require the contractor to determine the elevation of drilled holes at specified intervals. Record these elevations so that they become part of the permanent records.
- Determine the length of nonperforated pipe to be placed at the drain mouths. Use the minimum specified length when the aquifer extends to the surface. Require outlet pipes to be connected to the collector system.
- Require the space between the drilled hole and the pipe to be tightly plugged with earth, as specified.
- Keep a boring log of material types encountered during drilling; also keep a log of production rates.
- Each drain must be identified by a brass plate bearing an assigned number or other label. Collect data about the drain’s location, outlet elevation, grade, lengths of drilled hole and casing, plan of system, and flow. Furnish this data, including the identification information, to Geotechnical Services in the Division of Engineering Services.
- For the most part, horizontal drains are hidden from view, so make sure complete as-built records are created. Pictures, plans, elevations, and complete descriptions will enable efficient and more complete maintenance and repair.

4-6803C Edge Drains

- Inspect trench excavation for proper location, alignment, and cross-sectional dimensions. Require the contractor to remove any loose material and any sharp objects that may damage the filter fabric during installation.
- Observe the installation of the filter fabric. Require that it be free of wrinkles and that any tears or punctures are repaired as specified.
- Verify that the contractor meets the requirements for atmospheric temperature and mix temperatures for cement-treated and asphalt-treated permeable materials.
- Cement-treated permeable material delivered in truck mixers may have a tendency to segregate at the end of the load. When the material is obviously segregated, do not allow its use. An excess of fines and water can enter and plug the slotted pipe. Moreover, an overly coarse aggregate grading may not bond and will be unstable.
- Require that the curing of cement-treated permeable material meets specifications.
- Require that edge drains, vents, and cleanout pipes be tested, as required by the specifications, for obstructions. Animal guards, if required, should be positioned immediately after the placement of the drains. Pipes may also be damaged by asphalt-treated material that is too hot or may be plugged by excessive free mortar in cement-treated permeable material. Observe all testing, and record that it was done. Require the replacement of any pipe that the flushing nozzle cannot penetrate.
- For the most part, edge drains are hidden from view, so make sure complete as-built records are created. Pictures, plans, elevations, and complete descriptions will enable efficient and more complete maintenance and repair.

4-6803D Geocomposite Drain Systems

- Check that that the geocomposite drain is installed with the filter fabric side facing the embankment and oriented so that corrugations are placed perpendicular to the drainage collection system.
- Check that joints in the geocomposite drain have the required overlaps and positioning is maintained throughout subsequent operations.
- Check that exterior edges are wrapped with filter fabric to prevent soil migration from these areas.
- Require any tears or punctures in the fabric of the gecomposite drain be replaced with new fabric or repaired as specified.

4-6804 Level of Inspection

Suggested levels of inspection for typical stabilization work activities are:

4-6804A Underdrains and Edge Drains

- Intermittent inspection of trench excavation
- Benchmark inspection of trench surfaces before installation of filter fabric

- Intermittent inspection of filter fabric placement
- Benchmark inspection of repairs to filter fabric and pipe installation
- Intermittent inspection of backfill with permeable material for underdrains, treated permeable material for edge drains, or with specified material
- Intermittent inspection of sampling and testing of materials
- Intermittent inspection of curing of cement treated permeable material when used as backfill for edge drains

4-6804B Horizontal Drains

- Continuous inspection during drilling operations
- Intermittent inspection of installation of collector system
- Intermittent inspection of backfill around pipe at end of drilled hole and connection to collector system
- Benchmark inspection of identification marking at each horizontal drain

4-6804C Geocomposite Drain Systems

- Intermittent inspection of geocomposite drain placement and replacement of damaged material
- Benchmark inspection of repairs

4-6805 Quality Control

- Make sure that the contractor submits a certificate of compliance for geocomposite drain including a flow capability graph for the geocomposite drain.
- While specific levels of quality control sampling and testing for subsurface drains are not included in Section 68, “Subsurface Drains,” of the *Standard Specifications*, the contractor is responsible for providing quality control under Sections 5-1.01, “General,” and 6-2.02, “Quality Control,” of the *Standard Specifications*. Check that the contractor is actively performing quality control on subsurface drain materials throughout production operations by reviewing copies of quality control records, including quality control test results.

4-6806 Payment

Measurement and payment must conform to the special provisions, *Standard Specifications*, or both.

Underdrains, horizontal drains, edge drains, and geocomposite drains each have different measurement and payment clauses.

For underdrains and edge drains, refer to Section 4-65, “Concrete Pipe,” in this manual for a discussion of slope length designated by the engineer. Note that in Sections 68-2, “Underdrains,” and 68-4, “Edge Drains,” of the *Standard Specifications,* the actual length designated is to be paid for and no provision exists for paying for additional length because of cutoff.

As horizontal drain installation progresses, measure the length of drain placed so that a final quantity can be determined. Pay for exploratory work, furnishing, and installing collector systems as change order work.

Payment for geocomposite drains is included in related items of work unless specifically excluded.