Section 404. UNDERDRAINS

404.01. Description. This work consists of constructing and installing underdrains, foundation underdrains, Prefabricated Drainage Systems (PDS), and underdrain outlets.

404.02. Materials. Provide materials in accordance with the following:

- Mortar, Type R-2 ................................................................. 702
- Granular Material Class II AA .................................................. 902
- Open-Graded Aggregate 34R .................................................. 902
- End Sections ........................................................................ 909
- Pipe for Underdrains ............................................................. 909
- Rodent Screens .................................................................... 909
- Underdrain Outlets .............................................................. 909
- Drainage Marker Posts ........................................................... 909
- Geosynthetics, PDS ................................................................. 910
- Sod ..................................................................................... 917
- Topsoil .................................................................................. 917

A. Pipe. Provide geotextile-wrapped perforated pipe and tubing for underdrains, except if using with open-graded backfill material. For underdrain outlets, provide non-perforated pipe and tubing, not wrapped with geotextile. If using steel furnace slag for open-graded drainage course, provide the following slot or hole size and water inlet area for pipe.

<table>
<thead>
<tr>
<th>Table 404-1</th>
<th>Pipe Opening Sizes for Steel Furnace Slag Open-Graded Drainage Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opening Type</td>
<td>Size</td>
</tr>
<tr>
<td>Slot width</td>
<td>1/16 in – 1/4 in</td>
</tr>
<tr>
<td>Hole diameter</td>
<td>1/8 in – 1/16 in</td>
</tr>
<tr>
<td>Water inlet area (min)</td>
<td>2 in²/ft of tubing</td>
</tr>
</tbody>
</table>

B. Aggregate for Trench Backfill. Provide open-graded aggregate 34R to backfill the trench for an open-graded underdrain or PDS. Provide granular material Class II AA as backfill for other underdrains and underdrain outlets.

C. Outlet Endings. Provide a concrete ring, a steel end section, or a concrete end section for the outlet ending. Provide and install rodent screens on outlet endings.

404.03. Construction. The plans will show the locations for underdrain and underdrain outlets, or will establish a miscellaneous quantity of pipe for use on the project. The plans will show, or the Engineer will
determine, the line and grade of the underdrain. Place the outlets at the intervals shown on the plans and ensure the outlets drain.

A. **Trench Excavation.** Excavate underdrain trenches using a wheel or chain trencher, or other trenching method approved by the Engineer. Grade trench bottoms to the shape of the underdrain pipe.

Excavate PDS trenches 3 inches to 6 inches wide. Excavate a wider trench if wall collapse prevents backfill placement and compaction.

Line trenches for open-graded underdrains with geotextile blanket as required.

B. **Laying Underdrains.** Place the underdrains to the line and grade shown on the plans or established by the Engineer. Ensure a firm bearing along the length of the pipe. Place compatible end caps on the upgrade ends of the underdrain pipes. Remove and re-lay damaged or displaced pipe.

If the contract requires PDS as part of pavement rehabilitation, install PDS underdrain adjacent to the edge of the pavement. Install the PDS underdrain to the depth shown on the plans or directed by the Engineer.

Do not place equipment or materials on the installed PDS until after placement of the open-graded drainage course.

C. **Connections.** Select fittings and connection methods, in accordance with the underdrain system manufacturer's recommendations, to prevent pipe separation. Obtain the Engineer's approval of connection methods before beginning underdrain installation. Mechanically fasten connections between the underdrain and outlet pipes using aluminum blind rivets, stainless steel self-tapping screws, or interlocking parts.

Do not penetrate the inside diameter of the pipe with the self-tapping screws by more than ¼ inch. Wrap fittings with geotextile blanket and seal the geotextile to the outlet pipe with waterproof tape.

D. **Backfill and Compaction.** Place backfill in trenches only after the Engineer approves the underdrain line and grade.

1. **Foundation, Bank and Subgrade Underdrains, and Underdrain Outlets.** Backfill the following using granular material Class IIAA:
   a. Foundation underdrains,
   b. Bank underdrains,
   c. Subgrade underdrains, and
   d. Underdrain outlets.
Place the granular material around the pipe to cover the drain with at least 12 inches of material. Place the remaining backfill in layers no greater than 12 inches. Compact the trench backfill material within the influence of the roadbed to 95 percent of the maximum unit weight. Compact trenches outside the roadbed as directed by the Engineer.

If the contract calls for open-graded subgrade underdrain and open-graded bank underdrain, place the open-graded aggregate 34R as shown on the plans and as required for open-graded underdrains.

2. **Open-Graded Underdrains.** Backfill pipe and PDS open-graded underdrains with open-graded aggregate 34R. Immediately after placing the backfill, compact the backfill and the surrounding grade material with a vibrating plate compactor. Begin compaction along the shoulder side of the underdrain and progress toward the pavement. Do not operate the compactor directly above the underdrain.

Maintain the exposed underdrain and backfill to prevent contamination.

If the Engineer determines the backfill is not clean, remove and replace the backfill at no additional cost to the Department. If the Engineer determines the underdrain is obstructed, clear the obstruction at no additional cost to the Department.

E. **Underdrain Outlet.** Lay underdrain outlets on at least a 4 percent grade and install the underdrain outlet at least 4 inches above the receiving ditch or sewer flow line. If the Engineer determines that it is not practical to meet both the percent grade and the outlet elevation requirements, the Engineer may waive the percent grade requirement. Do not backfill the outlet trench until approved by the Engineer. Install underdrain outlets within 48 hours of installing adjoining longitudinal underdrains. Mark and maintain the outlets.

F. **Outlet Endings.** Place the outlet endings as shown on the plans or as directed by the Engineer. Excavate areas requiring sod to at least 4 inches deep and place topsoil and sod in accordance with subsection 816.03. Install drainage marker posts in accordance with subsection 401.03.F.

If installing underdrains in conjunction with constructing or resurfacing concrete or HMA shoulders, mark the locations of outlet endings on the adjacent shoulder. Mark locations with a ⅛-inch deep, 4 inch by 6 inch depression. Place the long edge of the depression perpendicular to the
edge of the shoulder. The Engineer may approve the following alternative methods of marking locations.

1. Stencil markers in concrete shoulders after texturing.
2. Form markers in HMA shoulders during finish rolling. Obtain the Engineer’s approval of forming method prior to beginning work.

G. **Cleanout.** Ensure installed underdrains and outlets are free of silt, debris, and other deleterious material at the time of final acceptance.

H. **Video Inspection of Underdrains.** The Department will perform video inspection of underdrains, underdrain outlets, and outlet endings after installation is complete.

The Department will perform video inspections of open-graded underdrains after the mainline pavement placement is complete, but before shoulder paving.

Submit a log detailing the locations of the drain outlets installed on the project to the Engineer. Ensure the drain outlet log includes locations for the bank drain outlets, subgrade and subbase underdrain outlets, and open-graded underdrain outlets.

1. **Deficiencies.** The Engineer will direct a more extensive video inspection with expanded video coverage if the video spot-checks reveal deficiencies. The Engineer will require corrective action, including excavation and repair or removal and replacement of the underdrain or underdrain outlets, if video inspection reveals any of the following deficiencies:
   
   a. Crushed pipe,
   b. Separated joints,
   c. Plugged underdrain or underdrain outlet pipe,
   d. Standing water greater than half the pipe diameter for greater than 25 feet, or
   e. Other defects in materials or workmanship as determined by the Engineer.

2. **Corrective Action.** Ensure the Engineer approves the repair or removal and replacement method before beginning corrective action. Complete corrective action within 10 working days of video inspection completion, or other date as approved by the Engineer.

Complete the following corrective action at no additional cost to the Department:

a. Excavate;
b. Repair or remove and replace defective underdrain, underdrain outlets and outlet endings;
c. Backfill excavated areas;
d. Replace and compact overlying fill, aggregate base separator course, and open-graded drainage course materials; and
e. Replace geotextile separator as required.

If the finished shoulder material is in place when the Department discovers a deficiency, remove the shoulder material and replace in accordance with the contract documents, and at no additional cost to the Department.

404.04. Measurement and Payment.

<table>
<thead>
<tr>
<th>Pay Item</th>
<th>Pay Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underdrain, Subgrade, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Underdrain, Bank, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Underdrain, Subgrade, Open-Graded, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Underdrain, Bank, Open-Graded, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Underdrain, Fdn, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Underdrain, Subbase, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Underdrain, Pipe, Open-Graded, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Underdrain, PDS, Open-Graded, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Underdrain, Edge of Pavt, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Underdrain Outlet, __ inch</td>
<td>Foot</td>
</tr>
<tr>
<td>Underdrain, Outlet Ending, __ inch</td>
<td>Each</td>
</tr>
</tbody>
</table>

The Engineer will measure underdrains in place.

The Engineer will measure Underdrain Outlet, of the size required, in place from the underdrain to the center of a drainage structure or from the underdrain to the end of the outlet pipe. In addition to work specified for individual pay items, the unit prices for the relevant underdrain and underdrain outlet pay items include the cost of the following:

- Excavating the trench;
- Providing and placing the pipe and fittings;
- Providing, placing, and compacting the backfill material; and
- Disposing of surplus material excavated from the trench.

The Department will not consider claims for additional compensation for time required to perform video inspection or to repair, or remove and replace deficient underdrain, underdrain outlets, and overlying materials. If the Department has performed video inspection inconsistent with the approved progress schedule, the Department may grant a time extension.
A. **Subgrade, Bank, Foundation, and Subbase Underdrains.** The unit prices for **Underdrain, Subgrade, Underdrain, Bank, Underdrain, Fdn, and Underdrain, Subbase,** of the sizes required include the cost of providing the pipe and fittings with a geotextile wrap.

B. **Underdrain, Pipe, Open-Graded.** The unit price for **Underdrain, Pipe, Open-Graded,** of the size required, includes the cost of providing and lining the trench with geotextile.

C. **Underdrain, PDS, Open-Graded.** The unit price for **Underdrain, PDS, Open-Graded** includes the cost of additional excavation and backfill to compensate for wall collapse or inability to obtain compaction.

D. **Underdrain Outlet.** The unit price for **Underdrain, Outlet,** of the size required, includes the cost of the following:

1. Locating installed outlets;
2. Maintaining the end of the outlet pipe or end section clear of obstructions; and

E. **Underdrain, Outlet Ending.** The unit price for **Underdrain, Outlet Ending,** of the size required, includes the cost of the following:

1. Excavating the area at the end of the outlet;
2. Providing and placing the concrete ring, steel end section, or concrete end section;
3. Providing and installing the rodent screen; and
4. Disposing of surplus excavated material.

The Engineer will measure, and the Department will pay for pipe or tubing used in or through the outlet ending as **Underdrain Outlet.** The unit price for **Underdrain, Outlet Ending** includes the cost of marking the outlet ending locations on the adjacent shoulder.

The Engineer will measure, and the Department will pay for drainage marker posts in accordance with subsection 401.04.