Underdrain Construction

Guidelines for Inspectors and Contractors
Although a relatively simple operation, the proper installation of underdrains plays an important role in determining the life of any type of pavement.

The following presentation contains “Points of Emphasis” for construction of underdrains. It is recommended viewing for any INDOT or consultant team involved in a contract that includes this type of work. It is further recommended that, prior to construction, the presentation be viewed jointly by the inspection team and any contractor personnel that will be specifically responsible for constructing underdrains on their project.
Whether a trencher is used or the material is hand-dug, loose material, including clumps, at the bottom of the trench should either be removed or compacted in order to keep drainage from being compromised.
Periodic depth checks should be made to ensure appropriate depth below subgrade is achieved.

Typically 24”

Typically 14”

Check plans for trench dimensions specified, which are frequently found in the “miscellaneous detail” section of the plans.
Underdrains prevent water from accumulating under the pavement and causing premature subgrade failure.

Open-graded material placed directly above the underdrain helps move water out from between asphalt layers.

- Depth: 24”
- Width: 14”
For bituminous pavement, the drainage layer is an open graded HMA mix. This mix also covers the underdrain subgrade.

For concrete pavement, Coarse Aggregate #8 is used for the drainage layer and the underdrain aggregate.

The Coarse Aggregate #8 combines with the Compacted Aggregate #53 to form the subbase.
Underdrain Tables
Underdrain Installation

Note the location of the open graded material within the layers of a typical HMA mix.

UNDERDRAIN DETAIL FOR CURB AND GUTTER
Underdrain table provides useful information regarding material quantities, locations, and instructions. Be sure to check planned outlet locations to determine if they make sense.

Outlet elevation essentially determines the offset. Once the outlet elevation is staked, be sure it is in a location that is practical.
Field conditions must be checked to make sure of the following:

- Outlets must be placed at the sags of vertical curves.
- Two outlet pipes must be placed at the sags of vertical curves to accommodate water draining from two different directions.
- Appropriateness of locations on the slope (offset).

- 2 Pipes per outlet at bottom of sag vertical curve.
- 1 Pipe per outlet on slope.
- No outlet pipes at crest of curve – no drainage will occur here.
Note that the geotextile material is to extend a specified horizontal distance outside the trench.
Geotextile material will be specified by the plans to line the trench.

Geotextile material is used to prevent “fines” from the surrounding soil from contaminating the aggregate backfill and hindering drainage.
Typical Cross Section
Underdrain Installation

Make sure the correct material has been delivered to the job site.

Check pipe diameter:
Often 6”, but check plans

Check pipe for perforation:
Drains will be ineffective without perforation.

Perforations
Geotextile Material
Underdrain Installation

See 718.04 for additional information regarding geotextile material.

Check plan sheets for the distance geotextiles should extend to either side of the trench.

Typically 12”

Proper placement and verification of geotextiles provides additional insurance that “fine” material will not contaminate the aggregate envelope.
Geotextile Material
Underdrain Installation

The upstream roll should overlap the downstream roll when placing a subsequent roll of material within a long run. This overlap should be a minimum of 1 foot, as per 718.04.

Pin the fabric as shown here to keep the fabric in place during paving.

Fabric Pin
Aggregate should easily fall to both sides of the pipe.
Aggregate Fill
Underdrain Installation

See section 718.02 for appropriate aggregate sizes

Although close to one side of the trench, the pipe does not appear to be hindering the aggregate from reaching the bottom of the trench.
Aggregate Fill
Underdrain Installation

Aggregate should be removed from the fabric after placement

Fabric Pin
Pipe will either connect directly into a storm inlet
Or will outlet onto a slope.

A hole may have to be cored into the side of the inlet for underdrain pipe.

Recurring Plan Detail 718-R-639d contains important information about the various aspects of outletting an underdrain.
Outlet pipes shall be backfilled as shown here.

**NOTE:**
1. If underdrain outlet pipe elevations are not shown on Underdrain Table, the minimum outlet pipe slope shall be 0.3%. The minimum freeboard between the outlet pipe outfall and the ditch line shall be 1'-0" for medium ditches and 2'-0" for side ditches.
Pipe Outlets: Slope Outlet
Underdrain Installation

When outletting to a slope, outlet protectors are used.

It is a good idea to run the pipe as far down the slope as possible in order to avoid situations like this.
In many cases, it is not a matter of “if” the slope below the protector will wash out, but “when”. Although 718-R-639d indicates the placement of sod immediately below the protector, erosion will typically occur just below the limits of the sod.

It is not uncommon to place a strip of sod on either side of the protector to prevent erosion alongside the protector. However, unless good sod notches are cut, the slope will erode between the sod and the seeded area.
Pipe Outlets: Slope Outlet
Underdrain Installation

Riprap is a common fix to the area eroded out between the protector and ditch or toe of slope. This is a common punch list item once the job is substantially complete.

To prevent fine material under the riprap from washing out, geotextile material should be placed under the riprap from the outlet protector to the ditch.
Pipe Outlets: Slope Outlet
Underdrain Installation

To avoid spending money on riprap or even remobilizing a contractor’s crew, consider extending the outlet pipe further down the slope and constructing the protector closer to the ditch line. A small amount of riprap can then be placed as a matter of course between the protector and the ditch line. Although pipe cost will increase, the cost to repair any eroded area by the contractor or by an INDOT maintenance crew is avoided in the future. See 718-R-639d (3 of 7, Note 1) for parameters regarding protector placement.
Pipe Outlets: Slope Outlet

Underdrain Installation

Here, the outlet protector was constructed close to the bottom of the slope. Any future repair of erosion below the protector can be performed easily and without heavy equipment.
Pipe Outlets: Rodent Screen

Underdrain Installation

Proper Installation

Outlet Protector

Pipe End Cut to Match Slope

Open End of Rodent Screen

6" Outlet Pipe

Closed End of Rodent Screen
Pipe Outlets: Rodent Screen

Underdrain Installation

Incorrect Installation

Mesh Size = 3 Openings per 1" Wire Ø = 0.072"
Pipe Outlets: Rodent Screen

Underdrain Installation

Rodent screens must be placed on all outlet pipes.

See 718-R-639d (3 and 7 of 7) for more information on rodent screens.

Rodent screens must also be placed at inlet structures.
Pipe Outlets: Maintenance

Underdrain Installation

Blockages can occur, even during construction.
Pipe Outlets: Maintenance
Underdrain Installation

Outlets should be checked occasionally during construction to ensure no blockages have developed. Mulch from seeding operations or recently placed sod that has moved due to heavy rains could lead to outlet blockages. Water back-up from these blockages could have a relatively immediate impact on the life of the highway if not removed in a timely manner.

In addition to checking outlets during the course of the project, all outlets should be checked again at the pre-final inspection. If significant time has elapsed between the pre-final and final inspections, they should be checked again.
There are 3 different types of outlet protectors. The type for any specific location is shown in the underdrain table. Be sure the type shown makes sense.
Proper construction of the lug is critical to keep the outlet protector in place on the slope.