

CHAPTER 605

Pavement Project Elements

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The design memorandum applicable revision date is noted in brackets next to each section heading below.

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PAVEMENT PROJECT ELEMENTS

605-1.0 PAVEMENT PROJECT ELEMENTS

605-1.01 Subgrade

A prepared subgrade is required before construction of the pavement. Subgrade is the upper portion of the natural ground or constructed embankment upon which the pavement structure and shoulders are to be constructed. A geotechnical investigation is required for new pavement, reconstructed pavement, rubblized concrete, cracked and seated concrete, or widening (mainline or shoulder). A limited geotechnical investigation is required for preventive maintenance or structural overlays. The geotechnical investigation should be requested by the district Pavement Engineer, Project Manager, or the consultant's pavement designer or project engineer. A full geotechnical investigation usually takes 120 calendar days. Specified subgrade treatments should be in accordance with recommendations in the geotechnical report and INDOT *Standard Specifications* Section 207.

605-1.02 Foundation Improvements

Foundation improvements should be considered as listed in the Geotechnical report for the project. Depending on the soil conditions and the pavement conditions, the Geotechnical report should list a recommendation regarding foundation improvement for the project site.

605-1.03 Temporary Pavement

Temporary pavement is used for maintenance of traffic (MOT) and will take the form of:

1. temporary cross-over;
2. temporary shoulder strengthening;
3. temporary run-around, see *Standard Drawings* 713-TCTR-01 and -04;
4. temporary widening (auxiliary lane); or
5. temporary ramp.

Temporary pavement may be designed on a case-by-case basis based on project specifics including traffic loading and length of time that the temporary pavement will be in service. If MEPDG is not used in the design of temporary pavement, including shoulder strengthening, FWD data should be obtained to determine the remaining structure of the existing pavement. For projects that will require the use of temporary pavement for an extended period of time, temporary pavement should be designed using AASHTOWare Pavement ME Design software considering 95% reliability and minimum 2 construction seasons or as specified in the pavement design request. The temporary pavement should be designed with the proper geometric and design speed considerations, i.e., cross slope, superelevation, profile grade, etc. The subgrade should be prepared based on Geotechnical Report recommendation. If the Geotechnical Report is not available, use a Resilient Modulus of 4000 psi to 5000 psi for the prepared subgrade, 2500 psi for the natural subgrade and Type II subgrade treatment. If a temporary pavement is to be used as a permanent pavement, pay items should not be temporary pavement, but should be QC/QA HMA. Any temporary pavement used for MOT purposes, that results in a width that is less than a full lane width, must be removed after MOT and replaced with a full lane width of permanent pavement for mainline traffic.

605-1.04 Driveways

Standard Drawing series E 610-DRIV.

605-1.05 U-Turn Median Opening

Standard Drawing series E 610-UTMO.

605-1.06 Turn Lanes

A geotechnical recommendation for subgrade treatment is required. A minimum pavement section of 10 in. is required. If the existing pavement section is greater than 10 in., the pavement section should match the existing pavement thickness.

605-1.07 Passing Blisters

A geotechnical recommendation for subgrade treatment is required. A minimum pavement section of 10 in. is required. If the existing pavement section is greater than 10 in., the pavement section should match the existing pavement thickness.

605-1.08 Public Road Approach

The pavement design for a public-road-approach pavement should be in accordance with the INDOT *Standard Drawings* series 610-PRAP. An individual pavement recommendation for a public road approach is required only where the AADTT exceed the values listed in the INDOT *Standard Drawings*.

605-1.09 INDOT Catalog Design Process:

The INDOT Catalog Design Process consists of determining the appropriate pavement design for small structure replacement projects, using a database that selects the appropriate pavement materials and pavement treatment details based on INDOT District, INDOT ESALs, and design speed. The INDOT Catalog Design Process may be used for small structure replacement project that meet the appropriate conditions.

Pavement designers may use the INDOT Catalog Design Process if the project meets the following conditions:

1. The project is a small structure replacement project.
2. The project requires mainline and shoulder replacement or rehabilitation at or adjacent to the structure only. The project does not require special design elements.

If the appropriate conditions are met, the pavement designer may use the Catalog Design Process tables and report template found on the INDOT Pavement Design website to determine the appropriate pavement design elements and complete the catalog pavement design.

605-1.10 Bridge Deck Overlay

An individual pavement design is required for a bridge deck overlay project if it is utilized for MOT purposes or if there is a profile grade change. A minor abbreviated pavement design or standard pavement design may be used for bridge deck overlay projects.

605-1.11 Pavement Design for Bridge Rehabilitation and Replacement

Bridge rehabilitation and replacement projects will require a pavement design where existing pavement is affected by construction. As discussed below, the specific project needs and effects on the existing pavement will dictate whether or not a Minor/Abbreviated pavement report can be

issued for the pavement design and whether or not there is a need for PavementME analysis. Depending on the scope of the bridge work and the route that the bridge is on, the pavement design may require designs for temporary widening, permanent pavement widening, approach pavement patching, and, but not limited to, a transition pavement design to meet new or existing profile grades.

The specific project needs and effect on the existing pavement structures will dictate the specific pavement cross section design and the need for auxiliary pavement design items such as safety edges, underdrains, or temporary widening.

1. Standard Design

If the work being performed for a bridge structure requires a full depth pavement design for approach pavement, shoulder pavement, or temporary pavement for MOT, then analysis using MEPDG will be required. PavementME analysis should be included with the report and should meet all design criteria for the pavement being constructed. The report should also list design requirements for additional pavement related elements

2. Minor/Abbreviated Pavement Design

If the bridge work being performed does not require a full depth pavement design for approach pavement, temporary pavement or shoulder pavement, then the pavement report may be composed as a Minor/Abbreviated report. The pavement design may be listed without MEPDG analysis or mention of PavementME results. Any existing shoulder that may be used for MOT purposes should however be checked with PavementME to ensure that it is suitable to carry traffic for the design period.

605-1.12 Pavement Design for Small Structure Replacement

Small structure replacement projects will always require a full depth pavement design in addition to possible transition overlay designs and shoulder widening. The removal of the existing structure will require that new full depth pavement is placed over the small structure. Small structure replacement projects may utilize the INDOT Catalog Design Process if they meet the appropriate criteria.

If the INDOT Catalog Design Process is not used, PavementME analysis should be included with the report and should meet all design criteria for the pavement being constructed. The report should also list design requirements for additional pavement related elements.

605-1.13 Bridge Rehabilitation and Replacement and Small Structure Project Reporting

As noted previously, INDOT will evaluate small structures projects for the catalog design process. When applicable, small structure projects should follow the INDOT Catalog Design Process. For bridge projects and projects that are identified as not being eligible for the catalog design process because they contain non-standard design elements, the standard or Minor/Abbreviated Design Process should be followed.

The report requirements for a Standard Design Report and a Minor/Abbreviated Design Report are as follows:

1. Standard Design Report

A pavement designer contracted by INDOT should submit the final pavement design by memorandum on their letterhead including a report with the following information. The submittal should provide evidence that all pavement designs are checked and signed by a qualified peer.

- a. Project Description;
- b. Pavement History;
- c. Methodology for selecting preferred pavement strategy;
- d. Assessment of Current Pavement Condition with photographs;
- e. Pavement Design and Recommendations;
- f. Construction and Maintenance; and
- g. Appendices as follows
 - i. Traffic Data;
 - ii. Geotechnical Investigation Report;
 - iii. Pavement Cores with Photographs and Pavement Distress Photographs if available;
 - iv. Non-Destructive Testing Results, such as FWD if available;
 - v. HMA Binder Selection using LTPPBind;
 - vi. Typical Sections;
 - vii. AASHTOWare Pavement ME Design Input Summary; and
 - viii. AASHTOWare Pavement ME Design output, at least the optimal design and then one failure iteration

2. Minor/Abbreviated Design Report

A pavement designer should submit the final pavement design by memorandum on their letterhead including a report with the following information. The submittal should provide evidence that all pavement designs are checked and signed by a qualified peer.

- a. Project Description (General project information detailing project highlights);
- b. Pavement History;
- c. Assessment of Current Pavement Condition with photograph(s) of the pavement transition;
- d. Pavement Design and Recommendations;
- e. Construction and Maintenance; and
- f. Appendices as follows
 - i. Traffic Data;
 - ii. Photographs and Pavement Distress Photographs if available; and
 - iii. HMA Binder Selection using LTPPBind

605-1.14 Seal Coat

Seal coat, or chip seal, is used to seal a shoulder, to seal a very low-traffic-volume roadway, or during construction to bond loose material to allow construction traffic to use the surface. The requirements for seal coat are shown in the INDOT *Standard Specifications* 404.

605-1.15 Prime Coat

Prime coat is only required for a rubblized base that is to be overlaid. The prime coat binds the top portion of the rubblized base with the first HMA layer so that the HMA material will not slide relative to the base material during compaction of the HMA. Prime coat should not be specified to be placed on a compacted aggregate before an HMA Base or Intermediate is laid on subgrade. Prime coat should not be specified on chemically modified soil or soil compacted to density and moisture requirements before an HMA Base or Intermediate is laid on subgrade. Prime coat should not be used as a separation layer. The requirements for prime coat are shown in the INDOT *Standard Specifications* Section 405.

605-1.16 Tack Coat

Tack coat is required beneath each course of HMA material that is placed on an existing pavement or newly-constructed HMA course. The tack coat binds the new HMA material to the material already in place. HMA or PCCP is to be tacked prior to placement of an HMA mixture. The requirements for tack coat are shown in the INDOT *Standard Specifications* 406.

605-1.17 Curbs and Shoulders

PCCP is constructed with curb and gutter sections, integral concrete curbs, a widened outside lane with HMA shoulder, or tied full-depth concrete shoulders. The curb and gutter sections, integral curbs, widened outside lane, or tied shoulders stiffen the outside edge of pavement to reduce deflections. D-1 joints are required across the entire PCCP mainline. Compacted aggregate and/or geotextile should be specified alongside concrete curbs or shoulders.

605-1.18 Reinforced Concrete Bridge Approach (RCBA)

The requirements for an RCBA are shown in the INDOT *Standard Specifications* Section 609. The RCBA is constructed on subbase for PCCP on prepared subgrade.

An RCBA is used at a bridge to transition from PCC or HMA pavement to the bridge deck or mudwall. Where a terminal joint is used the RCBA spans from the sleeper slab to the pavement ledge. Where a terminal joint is not used, the RCBA spans from the end of the HMA pavement to the pavement ledge. The RCBA is reinforced to account for unsupported conditions due to settlement at the end bent or abutment. See Section 409-2.04 for additional information on RCBAs and the use of a terminal joint. The RCBA and reinforcing details are shown on INDOT *Standard Drawings* series 609-RCBA. The terminal joint details are shown on INDOT *Standard Drawings* series 503-BATJ.

605-2.0 UNDERDRAINS

An underdrain is a system of perforated pipe and coarse aggregate installed longitudinally in the vicinity of a pavement edge. The purpose of an underdrain is to remove water from the subgrade and the pavement structure. An Underdrain Table is required in the plans. The designer should consult the Geotechnical Investigation Report for the need for subsurface drains. The pavement designer must determine whether underdrains are a benefit to the life of the pavement and are cost effective. See INDOT *Standard Specifications* Section 718.

It is possible that underdrains may not be warranted; however, subsurface drains may be required on a project to remove ground water as required by the Geotechnical Investigation Report.

605-2.01 Definitions

Aggregate for Underdrains. Coarse aggregate No. 8 or coarse aggregate, No. 9 used to backfill an underdrain pipe trench.

Clean Out Port. Opening from the top of the shoulder to allow for access to clean and inspect underdrains.

Dual-Access Underdrain. A run of underdrain that features outlet pipes connected to both ends of the underdrain pipe. The dual-access outlet pipes are installed to provide access to the underdrain pipe for inspection and maintenance purposes.

Geotextiles for Underdrain. An engineered geotextile fabric used to prevent soil particles from contaminating an underdrain pipe and aggregate for underdrains. See INDOT *Standard Specifications* 900 for geotextile materials.

HMA for Underdrains. An open-graded HMA used to patch an existing asphalt shoulder over a retrofitted underdrain pipe or an outlet pipe.

Intercept Elevation. The invert elevation at the connection between an underdrain pipe and a PVC connection at a drainage structure or outlet pipe.

Intercept Station. The station at which the connection between an underdrain pipe and a Polyvinyl Chloride (PVC) connection at a drainage structure or outlet pipe occurs.

Obstacle. A project feature, such as a paving exception or bridge, culvert, that prevents the continuous installation of underdrain pipe.

Outlet Elevation. The invert elevation of an outlet pipe or PVC pipe connection where the collected water leaves the outlet pipe.

Outlet Pipe. A non-perforated pipe that conveys water collected by the underdrain pipe to a side ditch, median ditch, or drainage structure. An outlet pipe may also be installed at the high end of an underdrain pipe to create a dual-access underdrain.

Outlet Protector. A concrete slab constructed on a side slope to protect the outlet-pipe end.

Outlet Station. The station where an outlet pipe discharges to the side slope or is connected to a drainage structure.

Retrofit Underdrain. An underdrain pipe installed along an existing pavement edge in conjunction with a pavement rehabilitation operation, such as rubblization, cracked and sealed, or overlaying.

Rodent Screen. Metal mesh screen fabricated in accordance with the specifications that fits inside the outlet pipe to prevent rodents and debris from entering the underdrain system.

Single-Access Underdrain. A run of underdrain that features an outlet pipe connected to the low end of the underdrain pipe only.

Special Underdrain. An underdrain pipe installed at a specified slope that is not parallel to the pavement profile or a constant depth that differs from that shown in typical underdrain figures in Section 602-3.0, Pavement Types.

Tangent Grade. The specified grade between two adjacent points of vertical inflection (PVIs) on the vertical alignment of the proposed pavement.

Underdrain Pipe. A perforated pipe installed at the bottom of a longitudinal or transverse underdrain trench.

Underdrain Run. An individual segment of underdrain pipe and its associated outlet pipe or pipes.

Underdrain System. The system that collects water from the subgrade and pavement structure and conveys it to the drainage system. Underdrain-system elements include the underdrain trench, underdrain pipe, aggregate for underdrains, geotextiles for underdrain, outlet pipe, rodent screen, outlet protector etc.

Video Inspection. The process of inspecting an individual underdrain run after installation using a video camera. Video inspection can also be performed on existing underdrains to find damaged portions that need repaired.

605-2.02 Existing Underdrain Perpetuation

A roadway with existing underdrains should have all outlet pipes perpetuated as part of the work. The project designer should determine if any existing underdrains, longitudinal or transverse, are present, and locate all existing outlet pipes to evaluate them for needed maintenance or repair. Required repair or maintenance, such as unearthing and replacing an outlet pipe or reconstructing an outlet protector, should be included in the proposed work. If there are retro-fit underdrains on a project, the designer should determine if any existing underdrains are present and locate all existing outlet pipes to coordinate them with any new outlets proposed.

605-2.03 Underdrain Warrants

Underdrains must be considered and are required for each project that meets condition 1 below. Underdrains should be considered but are not required for each project that meets condition 2-6 below

1. new pavement or reconstructed pavement with a design-year Average Annual Daily Truck Traffic (AADTT) volume of 300 per day or greater, and a length of at least 1 center lane mile;
2. permeability of the soil in the project area is 100 ft/day;
3. For a curb and gutter sections with enclosed drainage system;
4. the pavement sections adjacent to the project area have existing underdrains;
5. where specific geotechnical conditions, such as low permeability natural soils, are identified that require subsurface drains as stated in the Geotechnical Investigation Report; or
6. drainage issues have been noted within the project area.

Underdrains are also required when using Subbase for PCCP, HMA class OG mixture QC/QA-HMA 4, 76, Intermediate, OG, 19.0 mm, or where an existing PCCP is to be cracked and seated or rubblized.

Underdrains are not typically constructed on a minor structural or preventive maintenance treatment project, except where existing underdrains are not performing adequately. Geosynthetic drainage systems may be used in lieu of underdrains.

605-2.04 Design Criteria

Proper design of the underdrains is critical for the life of the pavement. The following items should be addressed in the design of underdrains.

605-2.04(01) Slope

1. Underdrain Pipe. Where the tangent grade is 0.2% or steeper, the underdrain pipe will be installed at a fixed depth below the pavement. Where the tangent grade is flatter than 0.2%

or if the Geotechnical Report indicates that the underdrain pipe should be installed at a depth other than that shown in typical underdrain figures in Section 602-3.0, special underdrains are required. The special underdrain slope should be 0.2% or steeper.

2. Outlet Pipe. The flattest outlet pipe slope permitted is 0.3%.

605-2.04(02) Size

1. Underdrain Pipe. Construction of new pavement and rehabilitation of existing pavement requires underdrain pipe of 6-in. diameter. Geocomposite edge drains (vertical) are not to be used on any project.
2. Outlet Pipe. Outlet pipe of 6-in. diameter is required.

605-2.04(03) Outlet Spacing

An outlet pipe is required at the low point of a sag vertical curve. It is also required at other low points encountered along the vertical alignment, such as the project beginning or ending point, or at an obstacle location.

Additional outlet pipes are likely to be required throughout the project limits. The maximum underdrain-pipe length should not exceed 600 ft. If the proposed underdrain-pipe length is greater than 400 ft, a dual-access underdrain is required. If the outlet spacing results in an underdrain-pipe length that is 400 ft or less, a single-access underdrain should be utilized.

605-2.04(04) Location

An underdrain, where warranted in accordance with Section 605-2.03, should be constructed along each pavement edge. The underdrain should be continuous through each intersection, ramp, turn lane, taper, etc., and should be located in the pavement section as shown in the series of typical figures. For an approach where an underdrain is warranted, the underdrain should extend from the mainline underdrain to the limit of the new approach pavement.

1. Underdrain Pipe. The underdrain-pipe location within each proposed cross section should be as shown in typical underdrain figures.

If an inlet, catch basin, manhole, or similar structure is located along the alignment of an underdrain pipe, the underdrain pipe may be connected directly to the drainage structure. The connection should be at least 6 in. above the structure invert elevation and a rodent screen should be placed on the outlet end of the underdrain pipe.

A direct connection of an underdrain pipe to a pipe culvert or a precast-concrete culvert should be avoided.

2. Outlet Pipe. The connection between an outlet pipe and an underdrain pipe should be as shown on the INDOT *Standard Drawings*. 90-deg elbows or tees should not be utilized in these connections.

One of the 45-deg elbows may be omitted if necessary to provide a satisfactory outlet.

Separate outlet pipes should be provided for each underdrain pipe. Outlet pipes for adjacent underdrain pipes at a sag-vertical-curve low point or for adjacent dual-access underdrains should be installed in a common trench as shown on the INDOT *Standard Drawings*. Outlet pipes installed in a common trench should outlet at the same elevation.

The outlet elevation should be at least 2 ft above the flowline elevation of a side ditch, 1 ft above the flowline elevation of a median ditch, or 0.5 ft above the invert elevation of an inlet, catch basin, manhole, or similar structure.

If an underdrain pipe has no suitable outlet available at an adjacent ditch line or drainage structure, the outlet pipe may be installed under the pavement to an acceptable outlet on the opposite side of the roadway. The outlet-pipe installation should be designed so as not to conflict with the underdrain-pipe installation along the opposite pavement edge. In some cases, where freeboard cannot be met, cleanouts may be constructed at regular intervals until a point at which outlets can be constructed. The District Pavement Engineer and Central Office Pavement Engineer should be contacted prior to the use of cleanouts in lieu of underdrain outlets.

605-2.04(05) Backfill

1. Underdrain Pipe. Aggregate for underdrains is used to backfill an underdrain pipe trench. A retrofit underdrain requires HMA for underdrains for patching an existing asphalt shoulder above the underdrain-pipe trench as shown on the INDOT *Standard Drawings*.
2. Outlet Pipe. Outlet-pipe backfill includes structure backfill and suitable material placed as shown on the INDOT *Standard Drawings*. HMA for underdrains is required for patching

an existing asphalt shoulder above the outlet-pipe trench associated with a retrofit underdrain as shown on the INDOT *Standard Drawings*.

605-2.04(06) Outlet Protector

An outlet protector is required at each location where an outlet pipe intersects a median or side slope. An outlet protector may contain two outlet pipes.

The INDOT *Standard Drawings* series E718-UNDR includes details for each available protector type.

See figure [605-2A](#), Outlet Protector Slope Limits, for acceptable construction slopes of each outlet-protector type.

The outlet protector selected should be the largest protector appropriate for the proposed slope that can be constructed considering all conflicts to the outlet location. Type 1 outlet protectors should typically be used on new alignment projects for the side slope outlets. The smaller Type 2 and Type 3 outlet protectors should only be used for median outlets and in limited applications on these type projects.

605-2.04(07) Geotextiles for Underdrain

There are two applications where geotextiles are used in conjunction with underdrain-pipe installation. The first application is as an underdrain-pipe trench liner. Trench lining should be used only if the Geotechnical Investigation Report recommends such an installation. The second application for geotextile is to prevent the contamination of the underdrain-pipe backfill during the construction of embankment behind a concrete curb. Installation of the geotextile is required in conjunction with curb construction above an underdrain pipe and should be as shown in the series of typical figures in Section 602-3.0, Pavement Types. Installation of geotextile should be in accordance with geotextile recommendations in the Geotechnical report. Recommendations should be in accordance with INDOT *Standard Specifications* 918. Geotextile should be required everywhere an open graded drainage material is in contact with an in-situ soil, compacted aggregate shoulder wedge, or other material that has fine grain particles with the ability to infiltrate and clog the drainage layer.

605-2.04(08) Video Inspection

Video inspection of an underdrain system should be included in each new construction as well as rehabilitation project with at least 3,000 ft of underdrain pipe. See figure [605-2B](#), Video Inspection Contract Quantities for contract quantities to be shown.

605-2.05 Contract Document Preparation

605-2.05(01) Plans

Information related to underdrains should be shown on the plans as follows:

1. Typical Cross Sections Sheet.
 - a. The underdrain pipe location as illustrated in the series of typical underdrain figures in Section 602-3.0, Pavement Types.
 - b. Underdrain-pipe trench and backfill details.
2. Plan and Profile Sheet. Special-underdrain limits and slopes should be shown on the profile portion of the sheet.
3. Detail Sheets. All project-specific details should be shown on these sheets.
4. Underdrain Table.
 - a. Underdrain Pipe.
 - 1) Beginning and ending stations
 - 2) Flowline elevations at beginning and ending stations
 - 3) Pipe size
 - 4) Special-underdrain grade, if applicable
 - 5) Pipe quantity
 - 6) Aggregate for underdrains quantity
 - 7) HMA for underdrains quantity, if applicable
 - 8) Geotextiles for underdrains quantity, if applicable
 - b. Outlet Pipe.

- 1) Outlet station
- 2) Outlet elevation
- 3) Intercept station
- 4) Intercept elevation
- 5) Outlet protector or structure number at outfall
- 6) Outlet ditch or drainage structure invert elevation at outfall
- 7) Pipe quantity
- 8) Structure-backfill quantity
- 9) HMA for underdrains quantity

c. Outlet Protectors.

- 1) Type
- 2) Location
- 3) Quantity

605-2.05(02) Specifications

Requirements for underdrains are shown in INDOT *Standard Specifications* Divisions 700 and 900.

605-2.05(03) Standard Drawings

Details for underdrains and outlet protectors are shown on the INDOT *Standard Drawings* series E718-UNDR.

605-2.05(04) Pay Items

The designer should determine the contract quantities for the appropriate pay items associated with the underdrain construction. See Chapter 17.

Outlet Protector Type	Outside		Median	
	Flattest	Steepest	Flattest	Steepest
1 (large)	10:1	2:1	10:1	4:1
2 (medium)	4:1	1:1	4:1	3:1
3 (small)	2:1	1:1	2:1	1:1

OUTLET PROTECTOR SLOPE LIMITS

Figure 605-2A

Type 4 Pipe Used As Underdrain Pipe, ft	Video Inspection Pay Quantity, ft
$3,000 \leq \text{Type 4 Pipe} < 30,000$	3,000
$30,000 \leq \text{Type 4 Pipe} < 80,000$	6,500
$80,000 \leq \text{Type 4 Pipe} < 150,000$	10,000
$150,000 \leq \text{Type 4 Pipe} < 300,000$	13,000
$\geq 300,000$	16,000

VIDEO INSPECTION CONTRACT QUANTITIES

Figure 605-2B