

416 Concrete Pavement – Repair and Replacement

416.1 Description

416 Rename section from Concrete Pavement - “Appurtenant Construction” to “Repair and Replacement”. Edit to include only concrete repair and replacement. Remove subsections and content relating to, concrete driveways, truck aprons, surface drains, and concrete rumble strips.

- (1) This section describes **constructing concrete repair and replacement; and** drilling in tie bars to tie existing **concrete** to new concrete and drilling in dowel bars to transfer load between existing **concrete** and new concrete.

416.2 Materials

416.2 Update to the latest calcium chloride requirements according to AASHTO M144 for SHES concrete. Update tie bar and dowel bar information.

416.2.1 General

- (1) Furnish concrete conforming to [501](#) as modified for class II concrete in [716](#). Provide QMP for class II ancillary concrete as specified in [716](#).
- (2) The contractor may use HES concrete even where the contract does not require it.
- (3) Furnish calcium chloride for concrete placed under SHES bid items as follows:
 1. Conform to AASHTO M144, type S as grade N1 or grade N2, class A.
 2. Conform to AASHTO M144, type L, in a concentration of approximately 30 percent for premixed solutions.
 3. Do not exceed the manufacturer’s recommended maximum dosage.
 4. If the engineer requests, provide a written copy of the manufacturer’s dosage recommendations.

416.2.2 Tie bars and Dowel bars

416.2.2.1 General

- (1) **Furnish steel reinforcement conforming to [505.2.4](#).** Furnish tie bars and dowel bars **as the plans show and** conforming to [505.2.6](#).

416.2.2.2 Epoxy for Anchoring Dowel Bars and Tie Bars

- (1) Furnish epoxy consisting of a 2-component epoxy material of contrasting colors and conforming to [AASHTO M235](#), grade 3 - non-sagging consistency, type IV epoxy, except as modified below:
 1. Use class B material for mid-depth slab temperatures between 40 and 60 F.
 2. Use class C material for mid-depth slab temperatures between 60 F and the highest temperature allowed by the manufacturer of the product.
- (2) Bond strength, tensile strength, and elongation testing is not required.
- (3) Achieve a minimum compressive yield strength of 5000 psi at 8 hours for special high early strength concrete, or at 3 days for grades A, C, and E concrete. Test according to AASHTO M235 and [ASTM D695](#), with the following restrictions:
 1. Mold and cure compressive test specimens in cylinders with a one-inch nominal diameter.
 2. Machine specimen ends square to produce a final specimen length of 2 inches.
- (4) Before using the epoxy submit a manufacturer's certificate of compliance, and a certified report of test or analysis, from a qualified independent laboratory to the engineer certifying that the epoxy conforms to these specifications. Identify the temperature classes and compressive strength cure times for which the product is certified.
- (5) The contractor may furnish an engineer-approved acrylic adhesive that meets the same physical requirements specified for epoxy.

416.2.3 Concrete Pavement Repair and Replacement

416.2.3 Add via ASP-6 for Nov 2022 LET. Reduced opening strength from 3000 psi to 2000 psi for concrete pavement repair and replacement. Revise and renumber section since ASP-6 to allow grade A concrete for pavement repair and replacement.

- (1) Use grade **A or C** concrete as specified in [501](#).
- (2) **The engineer will allow the contractor to open to construction and public traffic when the concrete reaches 2000 psi.**

416.2.4 Special High Early Strength Concrete Pavement Repair and Replacement

416.2.4 Revise to remove prescriptive requirements for SHES concrete mixes to accommodate variable closure windows.

416.2.4.1 Composition and Proportioning of Concrete

- (1) The engineer will allow the contractor to open to construction and public traffic when the concrete reaches 2000 psi. During the contract closure window, the contractor is required to complete all construction operations for the work and provide a concrete mixture that meets the required opening strength and air content to be able to open to service. The contractor may use one or more admixtures or other ingredients to the concrete mixture to obtain the required performance. Do not retemper the concrete mixture.
- (2) If adding calcium chloride in solution, use an engineer-approved procedure to the batch ingredients while placing them in the mixer. Provide sufficient water in job-mixed solutions to dissolve the calcium chloride completely and ensure that the solution is of a uniform and known concentration. Reduce the quantity of mixing water by the quantity of solution used. Introduce the correct quantity of calcium chloride into the mixer using a method by which the quantity added cannot vary appreciably from the target value.
- (3) Discharge concrete within 45 minutes after adding mixing water to the cement, or the cement to the aggregates, or within 30 minutes after adding an accelerating admixture, whichever comes sooner.

416.2.4.2 Evaluating Strength

- (1) At least 3 business days before starting construction, provide the engineer with adequate evidence that the required strength is obtainable in the field with the materials used and at the various temperatures encountered. Conduct a continued strength evaluation, if the engineer requires, during the course of the work to ensure continued compliance with the strength requirements.
- (2) Notify the engineer before making test cylinders and, if the engineer chooses, make arrangements for the engineer to observe cylinder production. Use a department qualified laboratory and an HTCP-certified technician to conduct preliminary and continued strength evaluations. Base each reported value on a minimum of 2 cylinders. After submitting data showing obtainment of the required strength, do not change the mix without first submitting a complete new set of test data showing compliance with the requirements.

416.3 Construction

416.3 Revise to clarify construction language for pavement repair and replacement. Move concrete driveway and truck apron subsection and renumber. Concrete driveways moved to 602.3.2 and concrete truck aprons moved to 415.5.

416.3.1 General

- (1) Remove existing pavement at the locations the plans show or where the engineer directs. Conform to pavement repair and replacement plan details for placement of new concrete. Conform to concrete pavement repair plan details for individual areas at least one lane wide that are 15 feet or less in length. Conform to concrete pavement replacement plan details for individual repair areas at least one lane wide and greater than 15 feet to less than 300 feet long.
- (2) Place concrete to the thickness of the contiguous pavement.
- (3) Construct conforming to the following:
 - Remove concrete pavement, remove asphaltic patch, and prepare the base as specified under [416.3.6.1](#).
 - Place concrete in repair and replacement areas as specified under [416.3.6](#).
 - Place concrete in special high early strength concrete repair and replacement areas conforming to [416.3.6](#) and [416.3.6.3](#).
- (4) The engineer will inspect concrete repair and replacement, as defined in [601.5.2](#) and built under 416, for transverse cracking as specified in [415.3.17](#). Repair cracked concrete as the engineer directs.

416.3.2 Removing Existing Pavement

- (1) Remove deteriorated slabs without damaging adjacent pavement. If removing only a portion of an existing slab, make a straight full lane-width full depth saw cut to facilitate removal without damaging the remaining pavement. Ensure that repair areas in adjacent lanes match longitudinally.
- (2) Remove existing asphaltic patches. Saw the existing pavement full depth, to an area of sound concrete, as the plans show.
- (3) If the contractor damages pavement remaining in place, repair as the concrete pavement repair and replacement details show. Ensure that the length of the damage pavement and the adjacent planned repair or replacement area are the same and both are a full lane wide. If damage is done to pavement

not adjacent to a planned **removal and replacement area**, conform to the minimum removal length the repair and replacement details show and remove and **replace** the full lane width.

- (4) Remove concrete with minimal disturbance to the aggregate base. At the close of each day's work, ensure that slabs have been removed from the project limits and stored away from the roadway. Incorporate or dispose of removed pavement as specified in [203.3.5](#).
- (5) Replace areas of the asphaltic shoulder removed during these pavement removal operations to the elevation of the adjacent shoulder using a commercially produced asphaltic patching material. Before patching, clean, dry, and provide a uniform edge for the repair area.

416.3.3 Base Course

- (1) Place the concrete on existing base course shaped to the required cross-section. Remove concrete rubble and foreign material with minimal disturbance of the base. Fill low areas or depressions in the base following removal operations with either compacted aggregate base or additional concrete.

416.3.4 Placing Tie Bars in Hardened Concrete

416.3.4 Update nomenclature from "existing" to "hardened" throughout section to clarify that department pays for tie bars drilled into existing concrete and recently hardened concrete for repairs and replacements.

416.3.4.1 Force Driven

- (1) Drill a suitably sized hole into the edge of the **hardened** concrete. Force drive the tie bar to a depth of 6 inches into the prepared hole as the plans show.

416.3.4.2 Epoxied

- (1) Drill holes into the edge of the **hardened** concrete to the dimensions the plans show. Anchor the tie bars into the **hardened** concrete with an epoxy conforming to [416.2.3.2](#) and install conforming to [416.3.4](#) except no bond breaker is required.

416.3.5 Placing Dowel Bars in Hardened Concrete

416.3.5 Move surface drains from 416.3.5 to 602.3.5 and renumber.

- (1) Drill holes into the edge of the **hardened** concrete to the dimensions the plans show. Anchor the dowel bars into the **hardened** concrete with an epoxy conforming to [416.2.3.2](#).
- (2) Clean drilling dust, debris, and excess moisture from holes before inserting the epoxy and dowel bar.
- (3) Inject the epoxy into the back of the drill hole. Use an epoxy with a workable viscosity, pumpable, yet thick enough to remain in the hole. Insert a sufficient volume of epoxy into the hole to provide a small quantity of excess material at the face of the concrete after fully inserting the dowel.
- (4) Insert dowel bars in the drill holes and rotate 1/2 turn. Do not force drive dowel bars into the drill holes.
- (5) Completely fill the annular space between the dowel bar and the concrete with epoxy. Insert a retaining ring over the bar and push the ring flush against the concrete surface to retain the epoxy.
- (6) Coat the protruding portion of each dowel bar with a thin uniform layer of bond breaking lubricant.
- (7) Use a positive fixed displacement dispensing system, equipped with a nozzle of sufficient length to deposit the epoxy at the back of the drilled hole. Use a system equipped with a means of checking the mix ratio of the epoxy components. Use the manufacturer's recommended mix ratio and check the ratio at least once a day.
- (8) For minor quantities of dowel bars, the contractor may use hand-powered mixing and injecting equipment capable of thoroughly mixing and depositing the epoxy at the back of the drill hole.

416.3.6 Placing Concrete

416.3.6 Move concrete rumble strips from 416.3.6 to 602.3.6 and renumber.

416.3.6.1 General

416.3.6.1 Add information for placing concrete pavement for repair and replacement.

- (1) Place each repair in one continuous, full depth operation. Consolidate the concrete in place using an immersion type vibrator. Finish the surface by screeding twice, floating, and texturing. Orient the length of the screed parallel to the pavement centerline unless the repair is over 12 feet in length.
- (2) Make transverse edges of the finished repair flush with the edges of the existing concrete pavement. Make the longitudinal surface form a straight line from edge to edge with a tolerance of +/- 1/8 inch.
- (3) Finish the final surface of full depth concrete repairs to match the edge of existing HMA or concrete pavement and, if the abutting pavement is concrete, match the existing pavement texture.
- (4) Place each repair or replacement area in conforming to [415.3.6](#) through [415.3.15](#); follow opening strength requirements in [416.2.3](#).
- (5) Date each replacement slab with the month and year of construction.

416.3.7 Special High Early Strength Concrete Pavement Repair and Replacement

416.3.7 Revise to clarify SHES concrete pavement repair and replacement.

- (1) Place, cure, and open special high early strength concrete to traffic on the same day removing the old pavement. Follow opening strength requirements in [416.2.4](#).

416.4 Measurement

- (1) The department will measure the Drilled Tie Bars and Drilled Dowel Bars bid items as each individual bar acceptably completed.
- (2) The department will measure the Concrete Pavement Repair and Concrete Pavement Replacement bid items by the square yard acceptably completed.

416.5 Payment

416.5.1 General

416.5.1 Revise to add information to drilled tie bar payment information.

- (1) The department will pay for measured quantities at the contract unit price under the following bid items:

<u>ITEM NUMBER</u>	<u>DESCRIPTION</u>	<u>UNIT</u>
416.0610	Drilled Tie Bars	EACH
416.0620	Drilled Dowel Bars	EACH
416.1710	Concrete Pavement Repair	SY
416.1715	Concrete Pavement Repair SHES	SY
416.1720	Concrete Pavement Replacement	SY
416.1725	Concrete Pavement Replacement SHES	SY

- (2) The department will adjust pay for concrete pavement repair and replacement crack repairs as specified in [415.5.3](#).
- (3) Payment for Drilled Tie Bars is full compensation for providing tie bars, including coating; for drilling holes in hardened concrete not placed under the contract; and for epoxying or driving. Drilled Tie Bars into hardened concrete placed under the contract will be paid for when the following is met:
 - Adjacent concrete is to be removed in a subsequent stage and concrete placed must abut the existing concrete.
 - Bent tie bars are not able to be inserted into concrete placed under the contract due to traffic staging operations.
- (4) Payment for Drilled Dowel Bars is full compensation for providing dowel bars, including coating; for drilling holes in **hardened** concrete not placed under the contract; and for epoxying.
- (5) Payment for the Concrete Pavement Repair and the Concrete Pavement Replacement bid items is full compensation for furnishing, hauling, preparing, placing, curing, and protecting materials; for replacing damaged pavement designated to remain in place; for removing existing pavements and excavated materials; for repairing asphaltic shoulders; for sawing joints; for preparing the foundation; for backfilling; and for testing concrete cylinders. The department will pay for individual repairs at least one lane wide and greater than 15 feet to less than 300 feet long as Concrete Pavement Replacement. Payment includes jointing and providing tie bars and dowel bars in unhardened concrete. The department will pay separately for associated work as follows:
 - For tie bars and dowel bars in concrete not placed under the contract, exclusive of those necessary to repair contractor-caused damage, under the Drilled Tie Bars and Drilled Dowel Bars bid items.
 - For sawing existing concrete for removal, under the Sawing Concrete bid item as specified in [690.5](#).
 - For repairs 300 feet long or longer, under the Removing Concrete Pavement bid item as specified in [204.5](#) and the Concrete Pavement bid items as specified in [415.5](#).