

## SECTION 353 CONCRETE PAVEMENT SLAB REPLACEMENT

### 353-1 Description.

Replace the existing defective area of concrete pavement with portland cement concrete free of any uncontrolled cracks. Repair the damaged area of adjacent slabs, caused by slab removal at no cost to the Department.

### 353-2 Materials.

Meet the following requirements:

Portland Cement Concrete .....	Section 346
Coarse Aggregate.....	Section 901
Fine Aggregate.....	Section 902
Portland Cement.....	Section 921
Water.....	Section 923
Admixtures.....	Section 924
Curing Materials .....	Section 925
<i>Post-Installed Anchor Systems For Structural Applications In Concrete Elements</i> <del>Epoxy Compounds</del>	Section 937 <del>26</del>
Pozzolans and Slags* .....	Section 929
Embedded Items.....	Section 931
Calcium Chloride .....	AASHTO M-144, Type 1

\*For concrete pavement slab replacement, the use of pozzolans and slag is

optional.

Concrete pavement containing only dowel bars will be considered non-reinforced concrete.

### 353-3 Composition of Concrete.

**353-3.1 Mixture Proportions:** Designate the actual proportions to be used to produce a concrete with a minimum 6-hour compressive strength of 2,200 psi and a minimum 24-hour compressive strength of 3,000 psi.

Prior to producing concrete, submit the design mix for approval on a form acceptable to the Department. Ensure the 24-hour acceptance strength has a minimum over design of 400 psi. Indicate slump before and after addition of accelerator. Use mixes approved by the Department and from an approved concrete production facility meeting the requirements of Section 105.

When an accelerating admixture is used in solution, the amount of water in the solution is considered to be part of the mixing water. Make necessary adjustment to the concrete mix-water to account for the amount of water in the accelerating admixture solution. Test the concrete for consistency subject to the following values from the approved mix design values:

Slump Tolerance** .....	plus or minus 1.5 inches
Entrained Air** .....	1% to 6%
Temperature .....	not to exceed 100°F

\*\*For values as specified in the approved Design Mix prior to the addition of accelerating admixture.

**353-3.2 Certification:** Provide certification in accordance with 346-6.3.

**353-3.3 Demonstration Slab:** Prior to batching production concrete, demonstrate the ability to furnish replacement slabs by constructing a demonstration slab on site. Demonstrate production techniques for slab removal, dowel installation, concrete placement, finishing, slab curing, sample preparation and curing, and proper timing of joint sawing. Demonstrate the ability to achieve the required compressive strengths. Demonstrate the ability of the slabs to achieve the maturity needed for opening to traffic within the required time. Schedule construction of the demonstration slab during the same time period specified in the Contract Documents. If the Engineer determines that elements of the demonstration slab fail to meet requirements of the Contract Documents, propose adjustments to the construction processes and/or materials for the Engineer's approval. The Engineer may require additional demonstration slabs until a demonstration slab conforms with the Contract Documents.

**353-4 Batching and Mixing Concrete.**

Obtain concrete that meets the requirements of 346-7 with the following additional requirements:

Add all the concrete ingredients, excluding the accelerator to the truck mixer at the plant. Mix each batch at the plant at the mixing speed for 70-100 revolutions of the drum.

Agitate the concrete en route to the job site at a speed of no more than three revolutions per minute. Add the accelerator to the concrete at the job site. Mix the concrete for 40 additional revolutions at mixing speed after the accelerator is added to the mixer. Do not add accelerator to any concrete which has attained the age of 60 minutes, measured from the beginning of the initial mixing at the plant.

Incorporate the accelerator into the concrete design mix in accordance with the recommendations of the admixture supplier.

**353-5 Test Requirements.**

Perform concrete sampling and testing in accordance with Section 346-5. Perform the plastic property tests in accordance with 346-8, except when the mix design contains an accelerator; perform the plastic property tests prior to the addition of the accelerator. The requirements of 346-9 apply to this Section with the following modification: 28-day requirements will be replaced with 24-hours and if the design mix includes an accelerator, then the compressive strength cylinders will be fabricated after all ingredients, including the accelerator, are added.

Make a minimum of four test cylinders from the last slab for each day of placement to assess strength for protection and opening to traffic (protection set). Cure the protection set of cylinders by methods identical to those used in curing the concrete replacement slabs. Cure the acceptance set of cylinders identical to the protection set of cylinders for the first 6-hours, then by laboratory cured conditions thereafter until the 24-hour strength test. Provide a location and curing facility for initial curing of verification cylinders.

Test two cylinders from the protection set within 6-hours of sampling and consider the average compressive strength of these two tests to be the 6-hour compressive strength. If the compressive strength is below 2,200 psi, test the remaining 2 cylinders from the protection set no longer than 6-hours from sampling. The Maturity Method specified in 353-10.2 may be used as an alternate to the protection set of concrete cylinders.

Test the acceptance and verification cylinders at 24-hours from the time of sampling.

### **353-6 Concrete Slab Acceptance.**

Reject any Concrete not meeting the plastic property requirements of 353-5. Acceptance will be based on plastic properties, achieving the 2,200 psi compressive strength prior to opening the slabs to traffic and the 24-hour compressive strength.

If the compressive strength of any set of test cylinders fails to meet the strength requirements, take immediate corrective measures to ensure that concrete placed in the future meets the specified strength requirements. The Engineer will evaluate the particular circumstances in each instance where a strength deficiency occurs. If the Engineer determines that there will be a significant effect on the service life of the replacement slab, replace the concrete at no expense to the Department.

If any uncontrolled cracks appear during the life of the contract, remove and replace the cracked slab at no expense to the Department. Repair by removing and replacing the pavement across the full width of all affected lanes or shoulders and to the nearest transverse joint in each direction. Investigate and implement immediate effective solutions to eliminate further cracks, in consultation with, and subject to the approval of, the Engineer.

### **353-7 Placing, Striking Off, Consolidating and Finishing Concrete.**

Place concrete as specified in 350-8.

The requirements of 350-9 and 350-10 are applicable to this Section.

Perform straight edging while the concrete is still in plastic state after floating is completed and the excess water removed. Furnish and operate a 10 foot straightedge meeting the requirements of 350-3.6. Hold the straightedge in successive positions parallel to the road centerline, in contact with the surface, testing until the replacement slab is straight edged from one side to the other. Advance along the road in successive stages of not more than one-half the length of the straightedge. Fill any depressions immediately with freshly mixed concrete, strike-off, consolidate and refinish. Cut down and refinish any high areas. Continue straightedge testing and surface correction until the entire surface conforms to the required grade and cross section. Ensure that transverse slope deviations of the finished pavement do not exceed 1/8 inch with the straightedge laid in a direction perpendicular to the centerline. When portland cement concrete pavement abuts bridge approaches or pavement not under this Contract, ensure that the longitudinal slope deviations of the finished pavement do not exceed 1/8 inch in 10 foot length. Produce a uniform, gritty textured final finish longitudinally along the pavement by dragging a broom or seamless strip of damp burlap, having at least 3 feet in contact with the pavement.

If the Engineer identifies a surface irregularity determined to be objectionable in an area to be opened to traffic and the design speed is 55 mph or greater, straightedge with a 10 foot long straightedge and address all deficiencies in excess of 1/4 inch within 72 hours of placement by grinding in accordance with the requirements of Section 352.

When required in the Contract Documents, produce a pavement surface that is true to grade and uniform in appearance with a longitudinal line type texture by grinding in accordance with Section 352.

### **353-8 Curing.**

Cure the slab as specified in 350-11, except for time and temperature restrictions. Use curing compounds as specified in 350-11.2 after completing the finishing operations. After the curing compound has been applied, cover the surface and exposed edges with two layers of white burlap-polyethylene curing blanket conforming to Section 925 or insulating blankets approved by the Engineer. Cover the slab with the curing materials as soon as the slab hardens enough to

resist marring the concrete surface. Continue curing the slab until the concrete achieves the required 6-hour strength.

### **353-9 Joints.**

**353-9.1 General:** Construct transverse joints as specified in 350-12 and as shown on the Design Standards, except that dowels bars are installed per 353-9.2. Tie bars will not be placed along the longitudinal joints unless shown in the Contract Documents. Apply a liquid bond breaker recommended by the manufacturer for the intended application to all vertical faces of the adjacent slabs.

*Clean and seal joints in accordance with Section 350.*

**353-9.2 Dowel Bars:** Provide dowel bars in accordance with the details shown in the Contract Documents.

**353-9.2.1 Dowel Bars at Transverse Joint Between two Replacement Slabs:** Follow the requirements of 350-12 when providing dowel bars at a transverse joint between two freshly placed replacement slabs.

**353-9.2.2 Dowel Bars at Transverse Joints Between Existing and Replacement Slabs:** Follow the requirements of 350-12, except drill holes and install dowel bars into the sawed face or end of the existing slab. Develop load transfer between existing and freshly placed replacement slab. The dowels shall be free to move inside the replacement slab and epoxy-bonded into the existing slab.

**353-9.2.3 Dowel Bar Installation:** Install dowel bars in accordance with Section 416 except as modified herein. Use a gang drill (several drills mounted parallel in a rigid frame), when enough operating space is available. Drill parallel to the centerline of the concrete pavement.

Inject epoxy into the hole after cleaning and prior to dowel insertion. Start injection at the back of the hole to force the epoxy to move forward during dowel insertion. Twist the dowel a minimum of one full turn during the insertion to ensure that the epoxy completely surrounds the dowel. The injection process and viscosity of the epoxy shall be adequate to insure that the space between the surface of the dowel and the inside of the hole is completely filled with epoxy.

Do not allow the epoxy to escape from the front of the hole after inserting the dowel in the hole. Use a grout retention disk 1/8 inch thick, fabricated from nylon or plastic, to hold epoxy in the hole during dowel insertion.

### **353-10 Protection and Opening to Traffic.**

**353-10.1 General:** The requirements of 350-6 apply to this Section. Keep the slab closed to traffic until the compressive strength requirement of 2,200 psi is achieved. Verify the achievement of the required strength by cylinder testing as specified in 353-5 or the use of the maturity method test as described in 353-10.2. Provide documentation that 6-hour strength was achieved prior to opening to traffic, by either a cylinder test report or a printed maturity meter monitoring record.

Protect the pavement from all traffic, including construction vehicles, until the specified 2,200 psi strength has been obtained. Include in the Quality Control Plan (QCP) what actions will be used to protect the pavement. The protective measures shall be arranged so as not to interfere with traffic lanes being utilized for required maintenance of traffic.

**353-10.2 Maturity Method Testing:** Provide and perform, with the assistance of the Engineer, Maturity Method Testing as specified in ASTM C1074 using Maturity Meter apparatus specified therein.

Maturity Method Testing may be used to estimate the in-place strength of that days production of concrete slabs. Temperature sensors will be embedded at locations designated by the Engineer.

When this method is used, a strength-maturity relationship chart, as outlined in ASTM C1074, will be prepared and tested at the concrete producer's design mix trial batch laboratory, or at other approved laboratory facilities designated by the Engineer. Compressive strength tests, as specified in ASTM C1074, will be generated to produce a five point curve with points before and after the target and with prior approval by the Engineer.

The Engineer may require compressive strength testing as outlined in 353-5. Fabricate six test cylinders for protection strength and Maturity Meter correlation testing. The compressive strength cylinder and maturity meter correlation testing will be performed for the first production day and at the discretion of the Engineer for each remaining placement week, or until terminated by the Engineer.

### **353-11 Method of Measurement.**

The pay quantity *for concrete pavement slab replacement, calculated using field-measured horizontal dimensions and thickness of the removed slab*, will be the volume, in cubic yards, of *calculated* concrete *volume* placed and accepted ~~determined by calculation. The quantity will be calculated using field-measured horizontal dimensions and thickness of the removed slab.~~

*The pay quantity for cleaning and sealing joints will be in accordance with Section 350.*

### **353-12 Basis of Payment.**

Price and payment *for concrete pavement slab replacement*, will be full compensation for all work specified in this Section and shall include demonstration slab construction, all joint construction, including tie bars and dowels, furnishing of test specimens, and all necessary incidentals.

*Price and payment for cleaning and sealing joints will be made in accordance with Section 350.*

Payment will be made under:

Item No. 353- 70- Concrete Pavement Slab Replacement - per cubic yard.