Section 41 Concrete Pavement Repair

Bracketed section numbers refer to the 2006 *Standard Specifications*.

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4-4101 General

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Multiple strategies are used for repair of concrete pavements. The following common types of concrete pavement repair are covered in this section:

- Pavement subsealing consists of filling voids under the pavement without disturbing the elevation of the finished surface by drilling holes through the pavement and underlying base, cleaning the holes, injecting grout, and filling holes with mortar.
- Pavement jacking consists of filling voids present under the pavement and raising the pavement's finished surface to a desired elevation by drilling holes through the pavement, cleaning the holes, injecting grout through the holes, grinding or replacing concrete pavement raised too high, and filling holes with mortar or concrete.
- Repair spalled joints consists of removing unsound or damaged concrete, filling the area with fast-setting grout or polyester grout, and replacing existing sealed joints at spalled locations.
- Sealing concrete pavement joints consists of constructing or replacing sealed joints in concrete pavement at existing transverse and longitudinal contraction joints with silicone or asphalt rubber liquid sealant.
- Crack existing concrete pavement consists of cracking and seating pavement to form discrete segments of pavement and includes cleaning loose debris and filling joints, cracks, and spalls.
- Pavement transition taper may consist of removal of existing concrete pavement, placement of temporary HMA, and construction of pavement transition tapers with replacement concrete.
- Dowel bar retrofit consists of placing dowel bars at transverse joints in existing concrete pavement.
- Individual slab replacement with rapid strength concrete consists of removing existing pavement, and possibly the underlying base, and constructing concrete pavement, and possibly the underlying base, using rapid strength concrete.

The contract will describe which concrete pavement repairs are to be performed.

- Additional background information concerning concrete repairs may be found within the *Maintenance Technical Advisory Guide (MTAG), Volume II - Rigid Pavement Preservation, Second Edition* at the following website:

  http://www.dot.ca.gov/hq/maint/roadway.htm

4-4102 Before Work Begins

4-4102A General

Before work begins, take the following steps:

- Review the contract plans and specifications for all contract requirements, including those covering traffic handling, equipment, and materials to be used.
- Verify that the plan to control water pollution is approved and in place.
- Verify that Form CEM-3101, "Notice of Materials to Be Used," includes all materials to be used. Refer to Section 6-202, "Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products," of this manual for additional information.
- Review the contractor's proposal for materials to be used and for the required data from an authorized laboratory.
- Verify that the materials the contractor plans to use comply with Section 41 [*41-1.02*] of the *Standard Specifications*. Where specified, ensure that the proposed products are on the current authorized material list.
- Require certificates of compliance for fly ash, admixtures, cement, joint sealant, dowel bars, chemical adhesive, compression seal, backer rods, joint filler materials, and epoxy powder coating.
- Require manufacturer recommendations and instructions for materials as specified.
- Inspect packaged fly ash, cement, or combined fly ash and cement to determine that these materials are labeled as required in the specifications. For proper labeling, also collect and review shipping invoices for fly ash and cement delivered in bulk.
- Examine the contractor's equipment to determine that it meets specified requirements.
- Discuss traffic handling with the contractor, and review the contractor's plan for lane closures. See Sections 4-12, "Construction Area Traffic Control Devices," and 2-2, "Traffic," of this manual for a discussion of traffic handling devices and lane closure procedures.
- Check the existing condition of the pavement, and revise areas to receive concrete repair as needed.
- Check for the presence of traffic loop detectors.
- Verify that the atmospheric and subgrade temperatures are above the specified minimums and that weather conditions are suitable before beginning concrete repairs.

4-4102B Pavement Subsealing or Pavement Jacking

- Check the plans for the pattern and location of injection holes.
- Check the contractor's actual layout of injection hole locations to see that it conforms to the planned pattern.
- Establish vertical control for monitoring pavement grades during subsealing or jacking operations.

4-4102C Crack Existing Concrete Pavement

Verify the contractor's procedure for cracking pavement through a test section and visually inspecting concrete cores for conformance with specification requirements.

4-4102D Dowel Bar Retrofit

Discuss dowel bar retrofit methods at the preinstallation conference with personnel who perform the work. Ensure that a training class on dowel bar placement techniques is attended by appropriate personnel or that the contractor has provided written verification of prior acceptable work experience and training involving the retrofit of existing concrete pavement with dowel bars. Ensure the dowel bar retrofit in the required test strip is acceptable prior to beginning production work. Before slot cutting, survey the existing traffic striping, pavement markings, and pavement markers and determine where delineation repairs will be required.

4-4102E Individual Slab Replacement with Rapid Strength Concrete

For individual slab replacement with rapid strength concrete, ensure the following:

- Manufacturer recommendations and instructions are submitted for storage and installation of specified materials.
- A plan for protecting pavement during cold weather is submitted.
- Samples of cement from each proposed lot and proposed admixtures are submitted.
- Submittal of mix design(s) for rapid strength concrete including opening age, aggregate gradations, proportions of constituents, maximum time allowance between batching and placing, range of ambient temperatures over which mix design is effective, final set time, and any special requirements such as water temperature. Note that each mix design has a specified maximum ambient temperature range that may result in multiple mix designs for a single project. Modulus of rupture development data is required for each mix design and must include the following minimum age tests: 1 hour before opening age, opening age, 1 hour after opening age; and 24 hours, 7 days, and 28 days after placement.
- Methods of performing each item of the work are discussed with the specified personnel at the prepaving conference. The purpose of the prepaving conference is to familiarize personnel with the project's specifications. Items to be discussed include process for production, transportation, placement, replacing pavement, contingency plan, sampling, and testing.
- Successful performance of trial slabs for each mix design. Ensure the contractor is capable of constructing slab replacement in compliance with the specifications within the specified time periods, including delivery, placement, finishing, and curing times, and under similar atmospheric and temperature conditions expected during replacement operations. Additional time for pavement removal, base removal, base replacement, bond breaker, and dowel bar installation as required, must be factored into specified time periods. Trial slabs are not to be placed on the roadway or within the project limits. During trial slab construction, obtain a split sample of aggregate from the contractor for grading, cleanness value, and sand equivalent testing. Ensure the contractor fabricates test beams in accordance with specification requirements for determining early age and 7-day modulus of rupture values. Verify the contractor's method for curing beams for early age testing.

Verify the contractor's means to monitor and record internal temperatures of trial slabs and early age beams. Reject trial slabs not meeting early age and 7-day modulus of rupture requirements. Require the contractor dispose of trial slabs.

- Contingency plan equipment, materials and personnel for temporary roadway pavement are present at the job site during individual slab replacement operations.
- For projects with larger individual slab replacement quantities, the special provisions may include additional requirements covering materials, construction, and payment. Be sure to review these requirements well in advance of the intended work.

4-4103 During the Course of Work

4-4103A Pavement Subsealing

Do the following during the course of work:

- Verify that the colloidal mixer operates within the specified rpm.
- Verify that the pump can sustain the specified gauge pressure.
- Verify that the washing device meets the specified number of jets and that the contractor operates it as the specifications require.
- Perform California Test 541, "Flow of Grout Mixtures (Flow Cone Method)," to ensure that the efflux time is within the required range during grouting operations.
- Monitor the slab for movement during subsealing.
- Monitor grout mixing so that grout not used within the specified time is disposed of properly.

4-4103B Pavement Jacking

Do the following during the course of work:

- Verify that the colloidal mixer operates within the specified rpm.
- Verify that the pump can sustain the specified gauge pressure.
- Verify that the washing device meets the specified number of jets and that the contractor operates it as the specifications require.
- Perform California Test 541, "Flow of Grout Mixtures (Flow Cone Method)," to be sure the efflux time is within the required range during grouting operations.
- Monitor the slab for movement during subsealing. Observe and monitor the contractor's string lines during jacking to determine when the slab has been raised to the established grade.
- Monitor grout mixing so that grout not used within the specified time is disposed of properly.
- Ensure grinding of slabs conforms to Section 42, "Groove and Grind Pavement," of the *Standard Specifications*.

4-4103C Repair Spalled Joints

Do the following during the course of work:

- Verify that concrete removal is preceded by sawcutting at the required depth along the rectangular areas to be removed. Ensure that any contractor-damaged concrete

outside the designated limits of repair is repaired at the contractor's cost and note these areas and quantities in the daily reports.

- Verify that exposed concrete surfaces are cleaned with equipment conforming to specification requirements.
- Prior to grout placement, observe joint form board installation and ensure any bonding agent is mixed in accordance with manufacturer instructions and applied to concrete surfaces.
- Ensure grout is mixed, placed, cured, and protected in accordance with specification requirements.
- Ensure removed or damaged joint sealant is repaired at spall locations in accordance with Section 41-5, "Sealing Concrete Pavement Joint," of the *Standard Specifications*. Section 41-5.03C requirements do not apply. Refer to Section 4-4103D, "Sealing Concrete Pavement Joints," for additional guidance.

4-4103D Sealing Concrete Pavement Joints

Do the following during the course of work:

- Ensure removal of existing joint sealant material does not damage the existing sealant reservoir or pavement.
- Where joint sealant reservoirs are constructed, ensure concrete residue from sawing operations is collected, contained, and disposed of properly.
- Prior to backer rod installation, ensure sealant reservoir is free of debris, dried, sandblasted, air blasted, and vacuumed in accordance with the specifications.
- Ensure backer rod installation does not leave a residue or film on the reservoir walls that will later receive sealant.
- Ensure sealant is prepared and installed in accordance with manufacturer instructions and specification requirements.
- Prior to opening to traffic, ensure the sealant is tack free and firm enough to prevent embedding of roadway debris into the sealant.

4-4103E Crack Existing Concrete Pavement

Do the following during the course of work:

- Ensure contractor's equipment and methods for cracking and seating concrete pavement meet specification requirements.
- Ensure cracked pavement segments conform to specified nominal dimensions.
- Ensure uncontrolled methods for cracking pavement are not used.
- Ensure that authorized equipment and procedures for cracking pavement are producing desired results through the contractor's pavement cores and visual inspection in accordance with specified frequencies. Require additional test sections and cores if results are not achieved or equipment or procedures are changed.
- When existing concrete pavement is covered with asphalt concrete of 0.10-foot or less, specifications provide a method for verifying desired results through use of an inspection strip involving the removal and disposal of the asphalt concrete surfacing.

- Prior to opening cracked concrete pavement to traffic, ensure the pavement is swept of loose debris. Ensure public traffic is allowed on newly cracked pavement or on the first layer of hot mix asphalt (HMA) for no more than 15 days.
- Ensure cracked concrete pavement is seated in accordance with seating specification for equipment and procedures. Once seated, verify that loose debris from joints and cracks has been cleaned using compressed air.
- Ensure all joints, cracks, and spalls exceeding specified dimensions receive an application of tack coat and are filled and compacted HMA prior to either opening to traffic or applying tack coat for first layer of HMA.
- Ensure seated segments of cracked concrete pavement receive the first layer of HMA within 24 hours of seating.

4-4103F Pavement Transition Taper

Do the following during the course of work:

- Verify that removal operations do not damage concrete pavement to remain in place and do not create flying debris.
- Ensure that replacement concrete complies with concrete for individual slab replacement in Section 41-9, "Individual Slab Replacement with Rapid Strength Concrete," of the *Standard Specifications*.

Requirements concerning temporary HMA are discussed in the specifications.

4-4103G Dowel Bar Retrofit

Do the following during the course of work:

- Ensure fast-setting grout and joint sealants are stored and installed in accordance with manufacturer recommendations and instructions.
- Ensure saw cut equipment conforms to requirements in the specifications and that saw cuts meet specified tolerances. Verify that concrete debris, water residue, and paste are immediately removed during saw cutting operations.
- Prior to concrete removal operations, verify that the contractor has sufficient temporary backfill material on hand in accordance with the specifications.
- Ensure concrete removal operations do not damage concrete pavement to remain in place. Verify that contractor's removal equipment does not exceed the class specified.
- Ensure the Contractor has scheduled work shifts so removal of concrete for dowel bar slots, placement of dowel bars, and placement of fast-setting grout with required cure time will occur prior to opening to traffic. Use of temporary backfill material is a back-up plan if anticipated production is not achieved. Subsequent work shift operations should be adjusted in consideration of actual production rates.
- Ensure dowel bar slots are constructed and cleaned in accordance with specification requirements.
- Verify transverse joints are sealed with caulking filler material meeting specifications.

- Ensure dowel bars are clean prior to application of dowel bar lubricant. Ensure proper clearance is provided between the dowel bar and pavement surface and placement tolerances are maintained. Verify that expansion caps have been placed on dowel bars and will provide at least the minimum specified joint movement at each end of the bar.
- To ensure proper performance of the dowel bars, pay particular attention to the foam core insert, which, when properly installed, helps isolate adjacent slabs. Leakage or displacement of the foam core insert during placement of fast-setting grout may damage concrete pavement and shorten design life. Likewise, dowel bar support chairs must securely hold dowel bars during placement and consolidation of fast-setting grout or future problems may arise.
- Ensure fast-setting grout is mixed in accordance with manufacturer instructions. Mixing portions of prepackaged components is not allowed. Where dual-component magnesium phosphate is used, water is not to be added. Ensure containers and tools are appropriate for mixing fast-setting grout.
- Prior to placement of fast-setting grout, verify minimum surface temperatures of areas to receive grout and surface conditions (for example, dry or damp) are appropriate for the type of grout being used. When the contractor has proposed methods to heat surfaces, ensure minimum temperatures are obtained immediately prior to grout placement.
- Grout is to be placed while fresh and immediately consolidated with a small handheld vibrator that thoroughly consolidates the grout. Retempering of the grout is not allowed. Finishing tools for grout should be dried thoroughly prior to use.
- Finishing of the grout within the dowel bar slots should result in a slightly rounded surface of 3/32 to 5/32 inch above the existing concrete surface. Verify that grout areas are cured under Section 90-1.03B(3), "Curing Compound Method," of the *Standard Specifications*.
- Once dowel bar slot grout has cured but prior to 30 days from initial saw cutting, ensure that retrofit pavement lanes are ground to comply with smoothness and finishing specifications. Pavement grinding is to be performed prior to any sawing and sealing of the transverse joints within the retrofit lanes.
- Joint sealing of transverse joints includes removing existing sealant, shaping sealant reservoir by sawcutting the transverse joint, repairing minor spalling, cleaning joint, installing backer rod, installing sealant, and curing. Consult the specification for these requirements.
- The contractor must perform random cores to ensure proper alignment of dowel bar ends. Consult the specification for these requirements. If cores indicate dowel bars were installed incorrectly, stop dowel bar retrofit activities until the contractor has demonstrated that the problem causing the improper positioning has been corrected. Ensure that dowel bars identified as damaged or misaligned are replaced.
- Ensure that pavement delineation removed or damaged due to dowel bar retrofit is repaired in accordance with the specifications.

4-4103H Individual Slab Replacement With Rapid Strength Concrete

Do the following during the course of work:

- Verify that contingency plan equipment, materials, and personnel for temporary roadway pavement structure are present at the job site.
- Where saw cutting is performed in separate work shifts than concrete removal, ensure no more than 2 business days expire prior to concrete removal. Saw cutting parallel or diagonal to the travelled way is only allowed during the work shift when concrete removal will take place. Prior to concrete removal, dowel bars and tie bars must be sawn. Ensure concrete pavement is not impacted within 18 inches of pavement remaining in place. Verify that pavement and base to be removed does not damage pavement or base remaining in place. Ensure removed materials are disposed of by contractor. Verify contractor prepares the finished surface of the remaining material in accordance with the specification requirements and to the established grade. Any over-excavated areas are to be filled with base replacement material, in the same operation as the base replacement, at the contractor's cost.
- Examine base replacement layer to verify smooth surface, free of voids, porous areas, and projections such as mortar ridges.
- Prior to placing bond breaker, ensure any foreign or loose materials are removed from the base surface. Ensure bond breaker is placed in accordance with specification requirements.
- Ensure installation of dowel bars at transverse construction joints conforms to specification requirements and manufacturer instructions. Dowel bars must be supported during the chemical adhesive minimum cure time.
- Where rapid strength concrete will be placed against existing concrete, ensure joint filler is placed along the existing transverse and longitudinal joint faces and extending to the full depth, in accordance with the specifications. Depending on existing transverse joint spacing in adjacent lanes, additional transverse contraction joints may require construction as specified.
- Coordinate inspection of rapid strength concrete with plant inspection personnel. Ensure lines of communication are maintained between the plant and the field so contingencies can be used appropriately. Rapid strength concrete must conform to Section 90-3 of the *Standard Specifications*.
- Spreading, compacting, shaping, and protecting of rapid strength concrete must conform to specified requirements.
- Sample and fabricate beam specimens to determine modulus of rupture at opening age and 7 days. Cure fabricated beams for contract acceptance and payment determination. The modulus of rupture value is determined under California Test 524 by testing three beam specimens for each age. No single test represents more than that day's production or 130 cubic yards, whichever is less.
- Ensure that rapid strength concrete surface is finished in accordance with specification requirements. Visually inspect final texturing of concrete pavement for compliance with coefficient of friction requirements. Schedule coefficient of friction testing on questionable areas. Where friction requirements have not been met, the contractor must groove or grind the pavement in accordance with Section 42 of the *Standard Specifications*. Check concrete pavement smoothness using a 12-foot straightedge placed parallel with and perpendicular to the centerline in

accordance with the specifications. Ensure the contractor corrects pavement surfaces out of compliance with smoothness requirements.

- When needed, ensure temporary roadway pavement structure is placed, maintained, removed, and disposed of in accordance with specification requirements.

4-4104 Measurement and Payment

4-4104 Measurement and Payment

Measure areas of concrete pavement repair. Deduct any areas that were repaired due to contractor's damage.

For subsealing/jacking, count the number of holes drilled. Verify that the holes to be paid for are only those holes shown on the plans or those ordered to be drilled.

Count bags of packaged fly ash and cement to determine pay quantities for grout (subsealing/jacking). During counting, ensure that duplication or omission does not occur. Collect weigh tickets for materials delivered in bulk, and remember to deduct quantities of materials not used or wasted.

For sealing concrete pavement joints, measure the actual length of joints installed for seal/replace concrete pavement joint quantity.

For crack existing concrete pavement, measure the full width and length of pavement cracked and seated for payment. Do not deduct areas in existing pavement where cracked segments are observed.

For pavement transition tapers, payment is measured from dimensions shown. No additional compensation is made when temporary HMA is used.

For dowel bar retrofit, measure the number of dowel bar retrofits performed acceptably. Do not pay for those dowel bar retrofits that show damage or misalignment of dowel bars. Unless otherwise specified, all work within the dowel bar retrofit specification is fully compensated within the dowel bar retrofit pay item. Payment for the 4-hour training class as part of the preinstallation conference is change order work except if payment is made by force account; no markups are allowed.

For individual slab replacement, payment is based on field measurements. Drill and bond dowel bars are not included in payment for individual slab replacement. Specified pay factor adjustments are applicable for low modulus of rupture of rapid strength concrete. In accordance with the pay factor adjustment, rapid strength concrete not meeting modulus of rupture minimums is to be replaced at the contractor's expense.