

<b>MANUAL CHANGE TRANSMITTAL</b>		NO. <b>12-4</b>
TITLE: Department of Transportation <i>Construction Manual</i>	APPROVED BY: <i>for</i> Mark Leja <i>Scott Davis</i> Chief Division of Construction	DATE ISSUED: September 26, 2012
SUBJECT AREA Table of Contents and various sections of the <i>Construction Manual</i>	ISSUING UNIT Division of Construction	
SUPERSEDES	DISTRIBUTION All Requested Manual Holders	

This manual change transmittal delivers the revisions of Chapter 4, Sections 4-24, 4-27, 4-28, 4-29, 4-41, 4-42, 4-53, 4-54, and 4-73 of the *Construction Manual*. Updated sections may contain updated language, information, corrections, and references resulting from updates to the 2010 *Standard Specifications*, and from policy, and procedural changes. Change bars in the margins of the revised sections indicate text that was changed, added, or moved.

Please update your manual according to the table below.

Section(s)	Incorporates	Remove Old Page(s)	Insert New/Revised Page(s)
Table of Contents	None	TOC.1 thru TOC.2	TOC.1 thru TOC.2
Chapter 4, Section 24, "Stabilized Soils"	None	4-24.1 thru 4-24.3	4-25.1 thru 4-25.3
Goldenrod, Chapter 4, Section 27, "Cement Treated Bases"	None	4-27.i	4-27.i
Chapter 4, Section 27, "Cement Treated Bases"	None	4-27.1 thru 4.27.4	4-27.1 thru 4.27.4
Chapter 4, Section 28, "Concrete Bases"	None	4-28.1 thru 4.28.5	4-28.1 thru 4.28.5
Goldenrod, Chapter 4, Section 29, "Treated Permeable Bases"	None	4-29.i	4-29.i
Chapter 4, Section 29, "Treated Permeable Bases"	None	4-29.1 thru 4-29.3	4-29.1 thru 4-29.3

Section(s)	Incorporates	Remove Old Page(s)	Insert New/Revised Page(s)
Chapter 4, Section 41, “Concrete Pavement Repair”	None	4-41.1 thru 4-41.2	4-41.1 thru 4-41.9
Chapter 4, Section 42, “Groove and Grind Pavement”	None	4-42.1 thru 4-42.4	4-42.1 thru 4-42.3
Chapter 4, Section 53, “Shotcrete”	None	4-53.1 thru 4-53.3	4-53.1 thru 4-53.3
Chapter 4, Section 54, “Waterproofing”	None	4-54.1	4-54.1
Chapter 4, Section 73, “Concrete Curbs and Sidewalks”	None	4-73.1 thru 4-73.3	4-73.1 thru 4-73.3

#### Section 4-24, “Stabilized Soils”

- Updates references to align with 2010 *Standard Specifications*.
- Updates section title to align with 2010 *Standard Specifications*.
- Adds introductory paragraph encompassing future soil stabilization types (e.g., cement stabilization).
- Notes requirement for contractor's QC laboratory certification to be in conformance with Caltrans' Independent Assurance Program.
- Notes requirement that lime source is to be included on authorized material source list.
- Notes adoption of "drop pan or calibration pan" method terminology.
- Removes offsite mixing to align with 2010 *Standard Specifications*.
- Clarifies additional lime requirement when required depth is exceeded.
- Adds "test result disputes" item.

#### Section 4-27, “Cement Treated Bases”

- Updates reference to align with 2010 *Standard Specifications*.
- Changes SI units to US customary units.
- Updates SMARA information pursuant to CPB 11-5.

#### Section 4-28, “Concrete Bases”

- Updates references to align with 2010 *Standard Specifications*.
- Updates terminology (e.g., concrete pavement, HMA, Bid Item List, etc.).
- Updates SMARA information pursuant to CPB 11-5.

#### Section 4-29, “Treated Permeable Bases”

- Updates references to align with 2010 *Standard Specifications*.
- Updates terminology (e.g., concrete pavement and HMA).
- Updates *Highway Design Manual* reference.
- Clarifies measurement and payment.

**Section 4-41, “Concrete Pavement Repair”**

- Updates section title to align with 2010 *Standard Specifications*.
- Updates references to align with 2010 *Standard Specifications*.
- Updates terminology (e.g., concrete pavement, HMA, and Bid Item List).
- Reorganized to accommodate new concrete repair items within 2010 *Standard Specifications* (i.e., 2006 SSPs that were incorporated into the 2010 *Standard Specifications*).
- Incorporates new concrete repair information.
- Expands approved brand list information.
- Updates certificate of compliance information.
- Adds manufacturer's recommendation and instruction information.
- Adds and clarifies measurement and payment information.

**Section 4-42, “Groove and Grind Pavement”**

- Updates references to align with 2010 *Standard Specifications*.
- Updates terminology (e.g., concrete pavement and HMA).
- Updates California Test Methods.
- Changes SI units to US customary units.
- Corrects reference to MTAG and updated web link.
- Adds information concerning temporary onsite drying of concrete grooving and grinding residue.
- Adds additional payment guidance.

**Section 4-53, “Shotcrete”**

- Updates references to align with 2010 *Standard Specifications*.

**Section 4-54, “Waterproofing”**

- Adds information on preformed membrane waterproofing.

**Section 4-73, “Concrete Curbs and Sidewalks”**

- Updates references to align with 2010 *Standard Specifications*.
- Updates references to *Standard Plan* sheets.
- Changes SI units to US customary units.
- Includes additional language concerning layouts (e.g., wheelchair ramps).
- Modifies references to "Order of Work."
- Adds language concerning detectable warning surfaces.

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This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

### Section 24 Stabilized Soils

#### 4-2401 General

Stabilization of underlying soils is critical for successful pavement performance. Methods of stabilizing soils include reworking existing soils with or without additives, or removal and replacement. One method of stabilizing soils is lime stabilization.

Lime stabilization increases the stability of native materials. It is particularly effective for materials containing a large percentage of clay particles. Lime stabilization results from spreading lime over the native material, thoroughly mixing it in place, compacting it at an appropriate moisture content, and curing. The special provisions specify the amount of lime to be added to the native material. If necessary, to achieve the compressive strength designated in the special provisions, the resident engineer may order an adjustment in the percentage of lime to be used.

#### 4-2402 Before Work Begins

Before work begins, take the following steps:

- Obtain samples of the materials to be treated. Request the district materials unit to run initial tests to determine the amount of lime required to meet the design criteria. Advise the contractor of the percent of lime required and optimum moisture content for each soil type.
- If necessary, obtain samples of the water that will be mixed with the soil and lime, and test the water for compliance with the specifications. Generally, potable water will meet the specification requirements.
- Verify that the contractor's quality control laboratory is certified in accordance with Caltrans' Independent Assurance Program.
- Obtain a lime sample with a certificate of compliance, including a statement certifying the lime to be furnished is the same as on the Authorized Material Source List.
- Observe the preparation of the material that will be treated. Ensure the material is scarified and thoroughly broken up to the width and depth specified. Make notes of such inspections in the daily report.
- If required by the specifications, observe a test strip that demonstrates the contractor's equipment and methods provide uniform distribution of lime and achieve the specified compaction.
- If necessary, prepare a change order to provide for the removal and disposal of any oversized material.

### Section 24 Stabilized Soils

#### 4-2401 General

#### 4-2402 Before Work Begins

#### 4-2403 During the Course of Work

- Prohibit lime stabilization when ground temperature is below specified temperature or expected to fall below specified temperature before mixing and compaction can be completed.

#### 4-2403 During the Course of Work

Once work begins, do the following:

- Ensure the preparation of the material that requires stabilizing conforms to the requirements in Section 24-2.01D(2) [24-1.04], "Preparing Soil," of the Standard Specifications.
- For each delivery of lime, obtain the certificate of compliance and the certified weigh slip. Obtain samples of the lime at the frequency rate shown in Section 6-1, "Sample Types and Frequencies," of this manual.
- Observe the spreading of the lime to determine that the equipment and method used meet the specified requirements.
- Check the spread rate of the lime. When dry lime is spread, the rate of spread may be checked by either of the following means:
  1. Placing building paper on a section before spreading and then weighing the material from a known length of spread (8 to 10 ft), similar to the drop pan or calibration pan method.
  2. Weighing the distributor before and after spreading a known length.
- When lime is spread in a slurry, the rate is normally checked by either of the following means:
  1. Weighing the spreader before and after spreading.
  2. Determining the volume of slurry spread for a known length and reducing the resulting value to the weight of lime.
- Prohibit any method of spreading lime that precludes determining the spread rate. Record daily spread rates, both spot-check and overall, in the daily report.
- Decide how far ahead of the mixing operation the lime may be spread and advise the contractor accordingly. Base the decision on the variables involved in each particular situation. The contractor must not spread the lime so far ahead of the mixing operation that wind might blow it away. Neither must lime in a slurry form be spread so far ahead of the mixing operation that it would dry before being mixed.
- After the spreading of the lime and until the end of the specified curing period, prohibit any traffic, except equipment performing the work, from passing over the native material.
- During the mixing operation and throughout the mellowing period, sample and test the material to ensure the moisture content exceeds the optimum required for compaction.
- Ensure rolling equipment meets specifications.
- Make necessary measurements to ensure the thickness of each compacted layer conforms to the specifications. Note the results of such measurements in the daily report.

- Test the mixture with a phenolphthalein alcohol indicator. If the reaction produces a non-uniform color, require the contractor to perform additional mixing.
- Ensure the depth of mixing meets the required thickness of the stabilized material. Where mixing depth exceeds the specified tolerance, ensure additional lime is added proportionally. Note this in the daily report, including the additional lime quantity provided at the contractor's expense.
- Ensure the contractor completes all mixing within the specified time.
- After final mixing, ensure compaction begins within the specified time.
- To determine maximum density, obtain samples of the mixed material, and test the material before initial compaction.
- Test for compaction in accordance with Section 24-2.03E [24-1.07], "Compaction," of the *Standard Specifications*.
- Ensure any disputes regarding test result discrepancies follow Section 24-2.01D (7), "Test Result Disputes," of the *Standard Specifications*.
- Order trimming of any material above the grade tolerance, and ensure subsequent rolling is performed.
- Ensure the compacted surface is kept moist until the placement of a subsequent layer or curing is applied.
- Ensure the contractor uses one of the specified methods for curing. Also, obtain necessary certificates of compliance and samples where a curing seal is used.
- Ensure the contractor meets the time and temperature requirements for the curing seal. Order any necessary repairs to the damaged curing seal.
- Where a curing seal is used, decide the curing seal's application rate, and advise the contractor accordingly. Base the decision on an amount that will provide a complete membrane without appreciable thickness. To ensure the correct application rate, also check the curing seal's spread rate. Record measured spread rates in the daily report.

#### **4-2404 Measurement and Payment**

To determine the pay quantity for lime stabilization, make area measurements of the planned surface.

At the point of delivery, collect weight slips for the lime. Deduct the weight of any wasted or unused lime from the pay quantity for lime and document these quantities in the daily report. If the contractor has added additional lime to compensate for depths exceeding the specified allowance, make the required adjustment to the scale weights of the lime.

Measure the quantity of curing seal in accordance with Section 94, "Asphaltic Emulsions," of the *Standard Specifications*. Payment for water cure or moist material blanket curing methods is included within the lime stabilization pay item.

#### **4-2404**

#### **Measurement and Payment**



### Section 27 Cement Treated Bases

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#### 4-2702 Before Work Begins

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This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

### Section 27 Cement Treated Bases

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#### 4-2701 General

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Cement treated base (CTB) is composed of a mix of aggregate, portland cement, and water. CTB specified as either Class A or Class B is generally used only with asphalt pavements and can be either plant mixed or road mixed. However, plant mixed is most common.

CTB can be spread by three allowable methods, Type 1, Type 2, or Type 3. The Bid Item List and plans will specify the class and mix method and the special provisions may specify the spread method.

#### 4-2702 Before Work Begins

#### 4-2702 Before Work Begins

Before work begins, take the following steps:

- Hold a preproduction meeting with the contractor and the district materials unit to discuss the contractor's method of operations.
- From the bid item list, plans, and special provisions, determine the class of CTB required and the percent of cement to be added to the aggregate.
- For initial testing, obtain representative samples from the contractor's source of CTB aggregate, and test for the required quality. Compressive strengths of CTB can vary significantly because of variations in aggregate gradation and the type of cement used. The fine aggregate usually has the most variable effect on strength. Advise the contractor that any significant material change, including variations in gradation, must be covered by new tests for quality characteristics. Request strength tests at 5 percent of cement and other percentages above and below 5 percent (usually in 0.5 percent increments). For aggregates of borderline quality, consider making additional initial strength tests at varying gradations (within specifications), using 5 percent cement.
- For sources with reliable information on past performance, consider using such information in lieu of testing. However, a test should always be made at 5 percent for aggregate qualification.
- Based on test results, decide whether the percent of cement specified in the special provisions will produce the design strength in the finished product. When making the decision, consider that, because of production variables, a significant difference can exist between the strength indicated by a cylinder and the actual strength of the finished product. Allowable variations in cement content and compaction requirements are major contributors to differences between design and actual strength. If it is difficult to determine the effect of production variables on final strength, use the following guidelines:

1. Increase cement content if the 7-day compressive strength of initial samples is less than approximately 1000 psi.
  2. Decrease cement content if the 7-day compressive strength of initial samples at the percent specified is more than approximately 1250 psi.
- Verify that safe and convenient facilities have been provided for sampling cement.
  - Ensure the aggregate material source complies with Section 7-103D (2), “Surface Mining and Reclamation Act,” of this manual
  - If the contractor will be batch mixing, examine the mixer before use and call to the contractor’s attention any excessively worn or missing paddles.
  - Before spreading any CTB materials, ensure that the subgrade complies with specifications and that the grade is free of loose or extraneous material. Record the findings in the daily report, including any instructions to the contractor.
  - Determine that the asphaltic emulsion used for curing seal is the material specified, and obtain necessary certificates of compliance and samples.
  - Decide on the application rate for the curing seal to be used, and advise the contractor accordingly. Base the determination on an amount that will provide a complete membrane without appreciable thickness. Ensure the application rate conforms to requirements.

#### **4-2703 During the Course of Work**

#### **4-2703 During the Course of Work**

During the work, do the following:

- Before mixing, obtain samples of the aggregate and test them for the specified attributes in accordance with the frequencies shown in Section 6-1, “Sample Types and Frequencies,” of this manual.
- To evaluate the compressive strength of Class A CTB, obtain samples during the first day of operation and approximately every fifth day of production thereafter. If these tests reasonably match the anticipated results based on the initial tests, you can reduce the frequency of the tests (unless a change in material is suspected or the material sources were changed).
- To determine compliance with permissible variations in cement content, obtain sufficient samples for California Test 338, “Determination of Cement or Lime Content in Treated Aggregate by the Titration Method.” Section 6-1, “Sample Types and Frequencies,” of this manual states the frequency should be “as necessary for control.” This frequency may vary depending on the efficiency of the contractor’s operation and rate of production. At a minimum, assign one inspector full time to run the titration tests while the operation is in full-time production. At the start of operations or when problems persist, more effort may be required.
- Determine whether compaction requirements are being met. It is Caltrans’ policy to measure compaction separately for each lift whenever this separate measurement is physically possible.

#### 4-2703A Road-Mixed CTB

For road-mixed CTB used during the course of work, do the following:

- If you think the quantity being placed is insufficient to complete the required structural section thickness, advise the contractor. Record any conversation in your daily report.
- Ensure the mixer introduces water by approved methods. To keep the resulting mixture uniformly moist, the mixer should be able to accurately vary the water rate. Advise the contractor to correct leaks or excessive water applications.
- Observe the mixing operation to ensure the uniform distribution of cement and water. When the mixer has a bottom shell or pan to pick up the material and separate it from the mixing table, ensure the shell or pan picks up all the material and doesn't cut into the subgrade.
- Ensure the cement is spread by mechanical equipment that can be calibrated to uniformly distribute the cement in the correct amount. Placing cement by hand methods, such as by sacks, is unacceptable.
- Take sufficient moisture tests to ensure the completed mixture's moisture content will not fall below 1 percentage point from optimum before initial compaction.
- For multilayer construction, ensure the contractor mixes and compacts each layer separately.

#### 4-2703B Plant-Mixed CTB

For plant-mixed CTB used during the work, do the following:

- To calibrate and check the accuracy of weighing and metering devices, request assistance from the district weights and measures coordinator.
- Ensure the contractor is adding water by a method that permits the amount or rate to be verified. Obtain sufficient moisture tests to ensure the completed mixture's moisture content does not fall below 1 percentage point from optimum at the point of delivery to the work.
- To detect any obvious faults, observe the mixing operation and the mixture. Time the mixing operation to ensure it takes longer than 30 seconds. If observations or tests indicate poor cement distribution, require a longer mixing cycle.

#### 4-2703C Depositing and Spreading CTB

During the depositing and spreading of CTB, do the following:

- Ensure the contractor uses the specified type of spreading operation.
- Generally, if loads are hauled in hot weather and if the haul takes more than 30 minutes, require covers on hauling units.
- Spreading can be a separate operation from depositing or it can be combined in a single operation with depositing. If spreading is a separate operation, ensure the contractor complies with the requirements for uniform placement.
- If you think the quantity being placed is insufficient to construct the required structural section thickness, advise the contractor. Record any conversation in the daily report.

- Immediately before placing CTB, ensure the underlying material is moist but not excessively wet.
- Observe whether significant segregation is occurring. If problems persist, perform additional tests to document the problem.
- Observe the surface condition of any lower layer of CTB. Ensure the contractor complies with moisture requirements for lower layers. Keep separate records for any curing seal placed on lower layers.
- Ensure the contractor uses satisfactory methods to place CTB in areas inaccessible to mechanical spreading equipment. The end product must be homogeneous, placed to the required thickness, and properly compacted.
- Ensure the contractor complies with temperature requirements for spreading CTB.

#### 4-2703D Compacting CTB

During the compacting of CTB, do the following:

- Measure the operation's total time interval to ensure it conforms to Section 27-2.03G [27-1.08], "Operation Time Requirement," of the *Standard Specifications*.
- To ensure compliance with compaction requirements, test each layer of multilayer construction.
- After the initial rolling, ensure the finished surface is within the specified tolerance. Require the contractor to trim high spots and to meet the requirements for filling low areas. Prohibit the contractor from filling low areas with loose material from the trimming operation.
- Ensure the equipment used for final compaction repairs any surface areas that the trimming has torn or segregated.
- To ensure compliance with the specified tolerance, measure the finished surface with a straightedge.

#### **4-2704 Measurement and Payment**

#### **4-2704 Measurement and Payment**

For measurement and payment, do the following:

- Use change orders to cover ordered changes in the cement content.
- Do not pay as CTB any excess material used at other locations.
- When CTB is paid for by the ton, refer to the discussion of weighing and metering procedures in Section 3-9, "Measurement and Payment," of this manual. Make any appropriate deductions for excess moisture.
- When CTB is to be paid for by the cubic yard, obtain quantity calculations from the project engineer to determine if they are sufficiently detailed and accurate to be used in the project records. Make appropriate deductions for any lack of compliance with thickness specifications.
- For more information about measuring curing seal, refer to Section 4-94, "Asphaltic Emulsions," of this manual.

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### Section 28 Concrete Bases

#### 4-2801 General

Lean concrete base is normally used under concrete pavement and is more rigid and less erodible than cement-treated base. The quality of aggregates for both bases is similar. However, lean concrete base is proportioned, mixed, and placed in a manner similar to concrete pavement while cement treated base is not.

The contractor must proportion the aggregate so that it meets the specified grading requirements. The engineer determines the cement content to be used. For design considerations for lean concrete base, see Chapter 660 of the *Highway Design Manual*.

Resident engineers need to plan carefully to fully meet the requirements for inspecting and testing materials. When planning for the inspection of lean concrete base, consider the following:

- The production of lean concrete base.
- The placing, finishing, and curing of the base.
- The subgrade, specified equipment, and construction of joints for the base.

At the mixing plant, plant inspection specialists and acceptance testers who are not directly assigned to the resident engineer usually perform inspection and testing duties. However, the resident engineer is as responsible for enforcing the specifications at the plant as at the job site. Thus, the resident engineer must ensure contract compliance at the mixing plant as well as on-site. Good communication is essential between plant inspection specialists and assistant resident engineers. The resident engineer must be kept informed of test results in a timely manner.

This section focuses on the resident engineer's onsite inspection duties. For information on producing and transporting lean concrete base, see Section 4-90, "Portland Cement Concrete," of this manual.

#### 4-2802 Before Work Begins

Before work begins, take the following steps:

- For general requirements, review the *Standard Specifications* and plans. For any special requirements, review the special provisions.
- Review the Bid Item List quantity to verify accuracy.
- Verify that Form CEM-3101, "Notice of Materials to Be Used," includes the aggregate, cement, and curing compound for lean concrete base. Refer to Section 6-202, "Responsibilities and Procedures for Acceptance of Materials," of this manual for additional information.
- Section 28-2.02 [28-1.01], "Materials," of the *Standard Specifications*, specifies the cement content for lean concrete base. After testing the contractor's proposed

### Section 28 Concrete Bases

#### 4-2801 General

#### 4-2802 Before Work Begins

aggregate supply, the cement content may be increased. To test the proposed aggregates in accordance with Section 28-2.02 [28-1.02], "Materials," of the *Standard Specifications*, take the following steps:

1. Obtain in writing the contractor's proposed grading and source of aggregate.
  2. Ensure the aggregate material source complies with Section 7-103D (2), "Surface Mining and Reclamation Act," of this manual.
  3. At least 45 days before the planned start of lean concrete base, ensure that samples of the proposed aggregates are obtained and shipped to the Office of Engineering Materials and Testing Services (METS). Coordinate sampling and shipping of samples with district materials laboratory personnel. It is the resident engineer's responsibility to ensure this process has begun and is completed in a timely manner to avoid delays to the project. The district materials engineer may be a good initial contact.
  4. METS may perform the required testing to determine cement content or it may establish the cement content based on previous aggregate testing from the same source. In either case, METS will notify the resident engineer of the cement content to be used. In accordance with Section 28-2.04, "Payment," of the *Standard Specifications*, if the amount is greater than the specified content, prepare a change order to provide an adjustment in compensation.
- Should the contractor change the supply source, repeat the procedure for determining cement content.
  - Examine equipment or tools to be used for placement following the steps listed below. When obvious inadequacies exist, advise the contractor and enter the details in the daily report.
    1. For sideform construction:
      - a. Examine the forms to ensure they have the specified attributes for items such as composition, weight, dimensions, and rigidity. Before each use, ensure the forms are cleaned and oiled.
      - b. Ensure the installation of the forms complies with specifications. Before the placement of concrete, order any necessary corrective work.
      - c. Ensure the paving equipment complies with specifications.
    2. For slipform construction, ensure the paver has the specified attributes. Require the specified demonstration of satisfactory operation and note such activity in the daily report.
    3. To ensure the contractor meets the requirements for protecting the base, examine all equipment that will travel on the completed base.
  - Just before the start of paving, check the accuracy of the final grade stakes.
  - Inspect the subgrade to ensure it conforms to the tolerances specified for compaction and elevations. Ensure that any low areas are identified and will be filled with additional base and that any high areas are trimmed as specified. Additional thickness is paid for as part of the lower layer and must not be included when calculating base thickness.
  - When slipform pavers are used, inspect the grade upon which the paver will ride to determine if it is smooth enough to prevent abrupt vertical changes in the finished



surface. When the paver controls the grade and alignment by a wire, sight along the wire for any obvious variations, and order necessary corrections. Ensure the wire is tensioned sufficiently so no measurable sag occurs between the supporting stakes. Advise the contractor if you anticipate any problems. Keep in mind that the contractor is responsible for compliance with thickness and grade requirements.

- Check the facilities proposed for producing and transporting lean concrete base. Section 4-90, "Portland Cement Concrete," of this manual covers the items involved.
- Ascertain the curing methods and type of material the contractor proposes to use. Discuss with the contractor the requirements for labeling and packaging the curing compound.
- The material specified for curing depends on whether the overlying surface will be concrete pavement or hot mix asphalt (HMA) pavement. When the overlying surface is concrete pavement, the specifications require a much higher percentage of paraffin wax in the curing compound than that required for an overlying surface of HMA pavement.
- The curing compound required when the overlying surface is concrete pavement serves a dual purpose. It both cures the lean concrete base and also, after the pavement is placed, provides a bond-breaking membrane between the pavement and base. The bond breaker is very important if cracks and the longitudinal weakened plane joint in the lean concrete base are to be prevented from reflecting through the concrete pavement.
- Examine the equipment to be used for applying the curing compound to determine whether it meets specifications.
- Before paving begins, ensure equipment for constructing longitudinal weakened plane joints is onsite and conforms to specifications.
- Confirm placement dates with the contractor and arrange Caltrans personnel for plant inspection and testing.
- If paving or finishing operations will extend beyond daylight hours, ensure the project has adequate lighting before the contractor begins placing the lean concrete base.
- When the project requires long hauls, review the contractor's proposed placement method to ensure adequate time.
- Before placing the lean concrete base, ensure the subgrade is uniformly moist.

#### **4-2803 During the Course of Work**

Once work begins, take the following steps:

- Before mixing, obtain samples of the aggregate. Also, in accordance with the frequency shown in Section 6-1, "Sample Types and Frequencies," of this manual, test for the specified attributes. Initially, and in the case of borderline material, take and save additional samples. In case the first samples tested do not meet the requirements for contract acceptance, the extra samples may be tested to determine the extent of the failing material.
- When the results of grading or sand equivalent tests, or both, are outside the limits for contract compliance, determine whether the lean concrete base represented by

#### **4-2803**

#### **During the Course of Work**



the tests is structurally adequate. When lean concrete base is left in place, even though it does not comply with the contract, the specified payment by the contractor must be made by administrative deduction. Document the reasons for leaving the concrete in place, and notify the contractor of your decision and the deduction amount.

- Prior to mixing and placement of concrete base, ensure the subgrade is not frozen and the ambient temperature exceeds the minimum specified.
- As it is placed, observe the lean concrete base for any improper proportions or inadequate mixing. In the daily report, record the reasons for rejecting any lean concrete base and the approximate amount rejected.
- Ensure the contractor furnishes the required tachometer. Also, check to ensure that frequencies are as specified. Immediately replace inoperative vibrators.
- To ensure the correction of any problems related to mixing or hauling, maintain good communication with the engineers who inspect operations at the mixing plant. For more detailed information about transporting concrete and receiving load tickets at the delivery point, see Section 4-90, "Portland Cement Concrete," of this manual.
- Obtain samples of the plastic concrete, and perform penetration and air content tests in accordance with the frequencies shown in Section 6-1, "Sample Types and Frequencies," of this manual.
- Compressive strength tests of the lean concrete base are only necessary to confirm design assumptions. For information, it is recommended that you test compressive strength near the start of placing lean concrete base.
- Ensure the material for longitudinal weakened plane joints is placed to the dimensions specified. Also, ensure the contractor vibrates the lean concrete base to cause an even flow of material about the joint.
- Ensure the construction of a contact joint whenever an interval exists that is greater than the specifications allow between the placement of any two successive loads of lean concrete base.
- When the contractor uses side form construction, ensure screeding and tamping conform to the specifications. Where the hand-float method is permissible, ensure the contractor uses the specified floats and methods.
- Ensure the surface of the lean concrete base is textured as specified. Lean concrete base to be surfaced with HMA pavement must have a rough texture to prevent slippage between surfacing and base. Lean concrete base to be surfaced with concrete pavement must have a smooth texture to allow the pavement to adjust for early thermal and moisture changes without forming random cracks.
- Ensure the contractor uses the proper material for curing the lean concrete base.
- Ensure shipments of curing compound are labeled and packaged as specified. If the compound is shipped in tanks or tank trucks, obtain a copy of the shipping invoice, and verify that the invoice contains the specified information. Prohibit the use of an improperly identified curing compound until it has been sampled and tested. For details about these procedures, see Section 6-2, "Acceptance of Manufactured Material and Sampling Methods," of this manual.

- As required under Section 6-1, “Sample Types and Frequencies,” of this manual, obtain samples of the curing compound for acceptance tests.
- Ensure the curing compound is properly agitated before and during application to achieve complete mixing. Also, observe that the compound is applied as a uniform membrane at the specified time. Ensure any disturbed areas receive additional curing compound.
- Ensure that the curing compound is not contaminated, diluted, or altered in any way before application, that it is applied when surfaces are still visibly moist, and that the compound film remains unbroken during the specified curing period.
- To determine the curing seal’s application rate, perform both measurements and calculations. You may also use California Test 535, “Determining the Application,” to determine the application rate. Record such measurements in the daily report.
- Ensure curing compound is applied at an ambient temperature above the minimum specified.
- When specified, require additional applications of curing compound.
- Measure the finished surface of the lean concrete base. Record the measurements, and require the specified corrections for areas not meeting elevation requirements. Ensure high areas are addressed immediately. For high areas that have been ground, ensure the curing compound is reapplied as specified.
- Enforce the requirements in Section 28-2.03F [7-1.02], “Curing,” of the *Standard Specifications*, which covers the use of the completed lean concrete base by traffic or the contractor’s equipment.

#### **4-2804 Measurement and Payment**

Using the dimensions shown on the plans, calculate the quantity of lean concrete base for which payment must be made. In these calculations, account for curves in alignment by using curve corrections.

#### **4-2804**

#### **Measurement and Payment**

### Section 29 Treated Permeable Bases

#### 4-2901 General

#### 4-2902 Before Work Begins

#### 4-2903 During the Course of Work

4-2903A Asphalt-Treated Base

4-2903B Cement-Treated Permeable Base

4-2903C Protection

4-2903D Surface Tolerance

#### 4-2904 Measurement and Payment

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

### Section 29 Treated Permeable Bases

### Section 29 Treated Permeable

#### 4-2901 General

#### 4-2901 General

Treated permeable base, used under concrete pavement and under hot mix asphalt (HMA) pavement, provides a highly permeable drainage layer within the structural section. It also provides part of the strength of the base layer.

The special provisions specify the type of treatment, either asphalt or cement. Many of the requirements for producing and placing treated permeable bases are also those specified for HMA pavement, concrete, and concrete pavement.

#### 4-2902 Before Work Begins

#### 4-2902 Before Work Begins

During this preliminary inspection, take the following steps:

- Review the contract plans and specifications to determine the requirements for the treated permeable base.
- Obtain samples of aggregates to test for contract compliance. If the same source is used to produce aggregate for other Caltrans work, decide whether current test reports represent the material to be used. If so, initial sampling and testing can be waived.
- Examine the contractor's plant and storage areas to determine contract compliance. Section 4-39, "Asphalt Concrete," and Section 4-90, "Portland Cement Concrete," of this manual provide guidelines.
- Review compaction tests of the subgrade that is to receive treated permeable base. Determine if the material underlying the grading plane meets compaction requirements. Also ensure that the grading plane is firm and stable. Pay special attention in isolated areas where pumping occurs. Determine that the subgrade is free of loose or extraneous material and that the subgrade is not higher than the grade established by the engineer, plus tolerance. Spot-check areas both between stations where stakes are set as well as at staked locations.
- Verify that filter fabric meets specifications.
- Review planned locations of cross-drain interceptors. (Refer to Sheet D99D of the *Standard Plans*.) Ensure the interceptors are properly located to prevent impounding water under the pavement. Inspect the placement of filter fabric. See Section 4-68, "Subsurface Drains," of this manual for information about underdrains.
- Examine spreading and compacting equipment to determine contract compliance.
- Determine that the atmospheric temperature meets the specified minimum before spreading begins.

## 4-2903 During the Course of Work

- Determine that the subgrade is uniformly moist before spreading cement-treated permeable base (CTPB).

### 4-2903 During the Course of Work

During the work, follow the inspection steps listed within each of the four areas below:

#### 4-2903A Asphalt-Treated Permeable Base

- Determine which compaction method the contractor plans to use.
- Check the temperature of the asphalt-treated permeable base (ATPB) to ensure that compaction is performed within the specified temperature range.
- Take samples of the completed mix from trucks at the plant or from the mat behind the paver.
- Verify that filter fabric is placed on the high side of the ATPB blanket in accordance with the plans and specifications.
- During placement of the ATPB over edge drains, verify that the temperature of the material falls within the limits specified in Section 68-4.03 [68-3.03], “Construction,” of the *Standard Specifications*, which covers the installation of subsurface drains. Staying below the maximum limit is critical to prevent damage to the edge drains.

#### 4-2903B Cement-Treated Permeable Base

- Verify that the contractor meets the time and temperature requirements for mixing and transporting CTPB.
- Reject any segregated or non-uniformly mixed CTPB.
- Observe rolling to determine that compaction meets specifications.
- Determine that the base is cured as specified.
- Verify that filter fabric is placed on the high side of the CTPB blanket in accordance with the plans and specifications.
- During placement, ensure the cement does not plug the openings in the edge drains.

#### 4-2903C Protection

Contamination, filling voids with foreign material, will destroy the base’s function. The engineer should be alert to this problem and require the contractor to take steps to ensure the base remains free of any foreign material.

Do not allow any equipment on the completed mat except what is permitted in Section 5-1.37 [7-1.02], “Maintenance and Protection,” of the *Standard Specifications*.

#### 4-2903D Surface Tolerance

For the finished surface of treated bases, the specifications provide for tolerances above and below the grade established by the engineer. Check the finished surface as described for subgrade under “Before Work Begins” in this section. Record the results, and require the specified corrections for low or high areas. You may have to decide whether low-treated permeable base is removed and replaced or allowed to remain in place by correcting with specified pavement materials. Information in Chapter 650 of the *Highway Design Manual* may be used to determine the adequate thickness of

treated permeable base layers. If low-treated permeable base is left in place, ensure the contractor compensates for the deficiency in the thickness of the overlying pavement.

#### **4-2904 Measurement and Payment**

Calculate the quantities for treated permeable bases from the dimensions shown on the plans, adjusted by the amount of any changes ordered by the engineer. The volume of treated permeable base placed for edge drains and cross-drain interceptors is included in the payment for edge drains.

#### **4-2904 Measurement and Payment**

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

### Section 41 Concrete Pavement Repair

### Section 41 Concrete Pavement Repair

#### 4-4101 General

#### 4-4101 General

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**

### **4-4102 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 and Procedures for Acceptance of Materials," 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:

1. Manufacturer recommendations and instructions are submitted for storage and installation of specified materials.
2. A plan for protecting pavement during cold weather is submitted.
3. Samples of cement from each proposed lot and proposed admixtures are submitted.
4. 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.
5. 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.
6. 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,

**4-4103  
During the Course  
of Work**

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.

7. Contingency plan equipment, materials and personnel for temporary roadway pavement are present at the job site during individual slab replacement operations.
8. 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**

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 sealed 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.

#### **4-4104 Measurement and Payment**



This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

### Section 42 Groove and Grind Pavement

### Section 42 Groove and Grind Pavement

#### 4-4201 General

#### 4-4201 General

*Maintenance Technical Advisory Guide (MTAG), Volume II - Rigid Pavement Preservation, Second Edition*, discusses groove and grind strategies for rehabilitation of existing rigid pavements, and is available at the following website:

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

Grooving is usually performed on:

- Existing pavements to improve drainage of water at the pavement surface.
- New and existing pavements to improve skid resistance.

Grinding is usually performed to improve the ride quality of new or existing pavements.

#### 4-4202 Before Work Begins

#### 4-4202 Before Work Begins

Before work begins, take the following steps:

- Review the contract plans and specifications.
- Discuss traffic handling with the contractor and review the contractor's plan for lane closures. For a discussion of traffic handling devices and lane closure procedures, see Section 4-12, "Construction Area Traffic Control Devices," and Section 2-2, "Traffic," of this manual.
- Ensure the contractor's equipment meets specified requirements.
- Before the grooving or grinding operation, inspect and locate any existing detector loops on either new or existing pavement to prevent damage to the detector loop's sealant. If detector loops are not visible, consult with the district traffic unit.
- Check local noise ordinances and review specified noise requirements.
- In areas to be grooved and ground, verify that yellow stripe and pavement markings do not contain lead. For instructions regarding this issue, see Section 4-15, "Existing Highway Facilities," of this manual.
- Verify that the required water pollution control plan is approved and in place.
- The contract may show locations for on-site drying of concrete grooving and grinding residue before disposal. Verify that temporary storage materials for this purpose conform to WM-8, Concrete Waste Management, in the *Construction Site Best Management Practices (BMPs) Manual* or Section 13-9.02, "Materials," of the *Standard Specifications*.



- The contract or materials information handout may identify locations within the right-of-way for final disposal of concrete grinding and grooving residue. The resident engineer must verify that a Regional Water Quality Control Board (RWQCB) permit or approval is included in the materials information handout or resident engineer file. If an RWQCB permit or approval has not been included, contact your environmental-construction liaison for assistance in obtaining these documents. Refer to the contract special provisions to obtain information about offsite disposal facilities for concrete grooving and grinding residue.
- When the contract documents do not allow final disposal of grooving and grinding residue within the right-of-way, obtain from the contractor the name and location of the disposal facility that will receive the concrete grooving and grinding residues, in accordance with Sections 42-1 [7.1.13], "General," and 5-1.20B(4), "Contractor-Property Owner Agreement," of the *Standard Specifications*. Obtain a copy of the facility's RWQCB or other applicable agency permit; the RWQCB's or other agency's written approval; or applicable local, state, or federal agency permits if located outside California. Also ensure the following:
  1. Verify that the disposal facility is permitted to accept concrete residue, by the California Environmental Protection Agency (Cal/EPA). Oral confirmation from the facility operator and documentation in the resident engineer's daily report are sufficient verification of the permit status of commercial disposal facilities on this list.
  2. When the contractor chooses to use a noncommercial offsite disposal facility, the contractor must provide a copy of the Cal/EPA permit for disposal of the liquid concrete residue.
  3. When the contractor chooses a disposal site that is located outside of California, the contractor must provide a copy of the permit issued by the state agency having jurisdiction over the site to the resident engineer. The permit must be provided before disposal.

#### 4-4203 During the Course of Work

#### 4-4203 During the Course of Work

##### 4-4203A Grooving and Grinding Operations

The following apply to both grooving and grinding operations:

- Observe the operation to ensure that equipment and noise levels comply with specifications.
- Ensure that the handling of residue and dust from the operation meets specifications.
- Ensure that the grooved or ground widths meet specifications.
- Ensure that a vacuum device picks up the concrete residue and that the residue does not flow across the pavement or enter storm drain inlets.
- For projects that temporarily store concrete residue in washout facilities, ensure that the plastic liner seams are installed in accordance with manufacturer requirements. Regularly inspect the liners during installation and operations to ensure that they are free of holes, tears, or other defects that will compromise the impermeability of the liner. Inspect washout facilities to ensure that adequate holding capacity and minimum freeboard are maintained.

- When the operation is complete, and offsite disposal is specified, obtain from the contractor, final proof of delivery of the residue to the off-site disposal facility.

#### 4-4203B Grooving

When grooving is specified:

- At the beginning of the work shift, check behind the grooving machine to ensure that all the blades are cutting grooves to the specified depth.
- Record the locations of omitted grooves. When specified, require the cutting of omitted grooves.

#### 4-4203C Grinding

When grinding is specified:

- As work progresses, check the ground pavements with the specified straightedge.
- Determine if any abnormally depressed areas must be excluded from testing with the profilograph and the 12-foot straightedge. Measure these areas to ensure they do not exceed the specified percentage of the total ground area.
- In accordance with California Test 526, "Operation of California Profilograph and Evaluation of Profiles," measure ground concrete pavements for a profile index.
- Ensure ground areas on structures, approach slabs, and 50 feet of approach pavement meet the smoothness and cover requirements in Section 51-1.01D(4)(b) [51-1.17], "Surface Smoothness," of the *Standard Specifications*.
- In accordance with California Test 342, "Surface Skid Resistance with the California Portable Skid Tester," determine the coefficient of friction for surfaces that have been ground.

### **4-4204 Measurement and Payment**

Measure both grooving and grinding by the area grooved or ground. As the work progresses, make transverse measurements to ensure the grooved or ground areas meet the widths specified. You may compute lengths by measuring the distance to start and stop locations from known stations and by computing the length grooved or ground from the stationing. Include curve corrections in the calculations.

Where grinding has begun on an area that is then replaced by concrete pavement, do not pay for the original grinding area. Instead, measure the area of replaced concrete pavement and pay under the item for grind existing concrete pavement. Do not pay for grinding replacement concrete pavement or for additional grinding to comply with smoothness requirements.

### **4-4204 Measurement and Payment**

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

### Section 53 Shotcrete

#### 4-5301 General

Shotcrete is concrete pneumatically projected onto a surface. Shotcrete may be used for lining ditches and channels, paving slopes, and constructing warped sections. If allowed by the special provisions, shotcrete may also be used for structural applications.

#### 4-5302 Before Work Begins

Before work begins, do the following:

- Review the contract to determine the areas and conditions in which shotcrete is to be used. Determine whether the contractor intends to use shotcrete as allowed by the special provisions or by Section 51-1.03B [51-1.11], “Methods and Equipment”; Section 53, “Shotcrete”; Section 72-5 [72-4.01], “Concrete Slope Protection, Gutter Lining, Ditch Lining, and Channel Lining”; or Section 72-11 [72-6.01], “Slope Paving,” of the *Standard Specifications*. Verify that Form CEM-3101, “Notice of Materials to Be Used” includes cement and aggregate. Refer to Section 6-202, “Responsibilities and Procedures for Acceptance of Materials,” of this manual for additional information.

#### 4-5303 During the Course of Work

The following instructions are for nonstructural and structural applications of shotcrete:

- Examine the foundation that will receive the shotcrete to ensure the foundation is evenly graded and free of high areas that would cause a thinner layer of shotcrete than required. Also, at the time the shotcrete is placed, ensure the foundation is firm and moist as specified. Note such observations in the daily report.
- Ensure the reinforcement is placed and firmly held in position as specified. Check joints, side forms, shooting strips, and where used, the position of ground or gauging wires.
- Obtain certificates of compliance and samples of cementitious material and aggregate, and test them for all specified attributes. Ship the samples to the district materials unit for testing at the frequency shown in Section 6-1, “Sample Types and Frequencies,” of this manual. For testing aggregate, the district establishes the frequency, which can vary depending on the particular operation. Sufficient tests are to be run to ensure substantial compliance.
- Ensure the contractor proportions the specified amount of cementitious material and aggregate.
- To support payment for the work, take measurements and keep records.
- Limit the placing of shotcrete to the specified lifts.

### Section 53 Shotcrete

#### 4-5301 General

#### 4-5302 Before Work Begins

#### 4-5303 During the Course of Work

- Periodically check the working pressures of the equipment to ensure they meet specifications.
- Ensure the contractor uses clean reused rebound material in the specified amount.
- For placing dry-mix shotcrete, ensure the materials are used within 45 minutes of mixing the cementitious material with the aggregate.
- For placing wet-mix shotcrete, ensure the materials are used within 90 minutes of mixing.
- Through observation, ensure a reasonably smooth and uniform finished surface for the type of work involved. Require low spots or depressions to be brought up to proper grade.
- Ensure the shotcrete is cured by one of the specified methods. When curing compound is used, ensure the specified application rate.
- Ensure the shotcrete is protected as specified.

Follow these instructions for structural shotcrete applications:

- For locations where shotcrete can be used, refer to the special provisions and plans.
- Ensure the contractor abides by all the elements of the following prequalification process for structural shotcrete:
  1. Ensure the nozzle person's experience conforms to the requirements for applying shotcrete in the intended location.
  2. Ensure the contractor sets up and shoots a preconstruction test panel that contains rebar and any other obstructions that are identical to the most heavily reinforced section to be shot.
  3. Ensure the contractor takes and tests the cores as necessary or required.
  4. After the time specified in the special provisions, ensure the contractor demolishes the preconstruction panel, and verify that a dense homogeneous mass completely encases the reinforcement.
- Ensure the proper mix is delivered by checking the delivery ticket of the first truck and by also checking the delivery tickets periodically throughout the day.
- Ensure that the nozzle person and the blowpipe operator work together and that the nozzle person does not get ahead of the blowpipe operator.
- Ensure the finishers rake away any loose material the blowpipe could not remove.
- Watch vertical surfaces to ensure no slough-off occurs because of mix that is too wet. Reference any areas that do slough-off so they can be carefully sounded later. Any wet mix that does slough off should be removed and then reshot.
- The nozzle person should make the extra effort to ensure complete encasement of the reinforcement. On double mats of reinforcement, this extra effort will require placing the nozzle through the front mat of the reinforcement and shooting from the sides of large bars to properly place the concrete behind the bars.
- To verify that shotcrete fully encases the reinforcement, occasionally rake out areas of congested reinforcement. Look for rock or sand pockets.

- Verify the shotcrete is homogeneous and the compressive strength adequate by taking random production cores from the completed work, as specified in the contract. To lay the cores out, follow the latest policies of the Office of Structure Construction.
- Verify that the surface finish matches the one demonstrated in the preconstruction panel.
- During the shotcrete application, ensure the contractor meets all the applicable safety standards and uses the proper safety equipment.
- Discuss with the structure representative or the area construction manager any proposal to use shotcrete at a location not indicated in the contract plans and special provisions.

#### **4-5304 Measurement and Payment**

Measure shotcrete by the cubic yard, computed from the actual area placed and the theoretical thickness shown in the plans. The special provisions may allow you to modify the measurement method.

Keep records of rejected shotcrete loads, and provide the reasons (preferably including test data) for such actions. Also, keep records of any significant amounts of concrete placed outside of pay limits.

#### **4-5304**

#### **Measurement and Payment**

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

### Section 54 Waterproofing

#### 4-5401 General

Waterproofing consists of sealing concrete surfaces to prevent the passage of water. Dampproofing consists of treating concrete surfaces to retard the passage or absorption of water or water vapor. Section 54, “Waterproofing,” of the *Standard Specifications*, provides for asphalt membrane waterproofing, dampproofing, and preformed membrane waterproofing. Other types of waterproofing may be specified in the special provisions.

#### 4-5402 Before Work Begins

Before work starts, do the following:

- Verify that Form CEM-3101, “Notice of Materials to Be Used,” includes waterproofing materials. Refer to Section 6-202, “Responsibilities and Procedures for Acceptance of Materials” of this manual for additional information.
- Upon delivery of the waterproofing materials, note whether they are identified by marks or inspection tags.
- You may accept preformed membrane sheets on the basis of a certificate of compliance. Complete Form CEM-4102, “Material Inspected and Released on Job.”

#### 4-5403 During the Course of Work

During the course of work, do the following:

- Sample waterproofing materials in accordance with Section 6-1, “Sample Types and Frequencies,” of this manual.
- Ensure the contractor prepares surfaces to be waterproofed or dampproofed as specified.
- For applying primer or asphalt, ensure weather conditions meet the specifications.
- Ensure the temperature of waterproofing asphalt is within the specified range.
- Inspect the operation to ensure the contractor applies asphalt membrane waterproofing, dampproofing, and preformed membrane waterproofing as specified.

#### 4-5404 Measurement and Payment

Field-measure areas covered by asphalt membrane waterproofing, dampproofing, and preformed membrane waterproofing unless the quantities are designated as final pay quantities.

### Section 54 Waterproofing

#### 4-5401 General

#### 4-5402 Before Work Begins

#### 4-5403 During the Course of Work

#### 4-5404 Measurement and Payment

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

### Section 73 Concrete Curbs and Sidewalks

#### 4-7301 General

This section covers concrete curbs and sidewalks. For information on the production and transportation of portland cement concrete, see Section 4-90, “Portland Cement Concrete,” of this manual.

For specifications about the construction of concrete curbs and sidewalks, see Section 73, “Concrete Curbs and Sidewalks,” of the *Standard Specifications*.

#### 4-7302 Before Work Begins

During this preliminary review, take the following steps:

- Review the contract for details about the project’s concrete curbs and sidewalks, and compare these details with conditions in the field. As appropriate, review sheets A87A, A88A, and A88B of the *Standard Plans*.
- Before constructing any curbs, gutters, or sidewalks other than those shown on the plans, review the *Highway Design Manual* to determine the policy. Ensure the curbs, gutters, or sidewalks:
  1. Conform to the current policy of replacing existing facilities
  2. Or, are necessary to comply with previous agreements
  3. Or, are necessary to provide proper drainage
- Discuss the construction operation with the contractor. Determine whether the contractor has considered the public’s convenience, a consideration required by Section 7-1.03 [7-1.08], “Public Convenience,” of the *Standard Specifications* and also by applicable sections of the special provisions. Advise the contractor of any necessary modifications to the operation.
- Make a general check of the layout as staked, including the location of gutter depressions, curb ramps (wheelchair ramps), and driveways. Also review the stakes for accuracy. Ensure grades will accommodate finished slope requirements. If layout and grades will not meet requirements, process a change order to correct the problem.
- Ensure that an approved grading for the combined aggregate for minor concrete is on file in the project records. Note that any testing of minor concrete is at the resident engineer’s discretion. Normally, testing is not necessary for minor concrete produced at a plant with a good history of producing concrete for Caltrans work. For minor concrete from a source that has not been previously used on the project, require the contractor to submit a certificate of compliance.

### Section 73 Concrete Curbs and Sidewalks

#### 4-7301 General

#### 4-7302 Before Work Begins



- Examine the subgrade to ensure the following:
  1. The subgrade has been constructed to the proper elevation and cross section. As specified, require the contractor to check the subgrade with a template.
  2. The foundation has been watered and compacted. When the subgrade is constructed in a structural layer, the compaction required in such a layer usually applies. When the subgrade is original ground outside of those areas where 95 percent compaction is required, no specific compaction value is required; however, to obtain a stable foundation, a watering and compacting operation is required. Unless the contractor chooses to allow soft or spongy areas to dry before placing concrete, order their removal.
  3. The subgrade is wet immediately before placing concrete.
- Ensure the contractor has implemented appropriate best management practices for washing out concrete mixer trucks.

#### **4-7303 During the Course of Work**

#### **4-7303 During the Course of Work**

Once work begins, take these steps:

- Examine the forms to ensure the following:
  1. They are smooth on the side next to the concrete.
  2. They have a true, smooth upper edge.
  3. They are rigid enough to withstand the pressure of fresh concrete without distortion. Order the replacement of forms that will not produce an end product within specified tolerances.
  4. They are coated with form oil as specified.
  5. They have the specified full depth.
  6. They are placed to the lines and grades shown on the control stakes. Also, ensure the adjustment of any unsightly changes in vertical or horizontal alignment. Adjustment from staked grades is sometimes necessary near joints with existing curbs or sidewalks.
- Ensure that gutters will drain. When new curbs are to be joined with existing facilities, check the existing elevations against the planned grades.
- Ensure that curb and sidewalk construction conforms to any construction staging specified in the contract.
- Finished appearance is important and is noticeable by the public. Existing edges of pavement and sidewalks or existing pavement surfaces should not be used directly to establish a grade line for curbs.
- Ensure that all dowels and reinforcements are in place.
- In fixed-form construction, the contractor may choose to use anchor bolts instead of dowels. When the bolts are equivalent to the dowels, approve the use of the bolts.
- Ensure joints are sawed as specified.



- For extruded-form construction, the contractor may choose to use an adhesive instead of dowels. When this option is chosen, ensure the contractor cleans the pavement as specified and uses the required adhesive. Inspect the slipform machine to ensure it meets specifications.
- Ensure the contractor does not place concrete on frozen or ice-coated material.
- Inspect the placement of weakened plane and expansion joints to ensure they are constructed as specified.
- During the placement of minor concrete, check temperatures, mixing time, elapsed time, number of revolutions, and penetration. Ensure that load slips, with the required information, are delivered with each load of minor concrete.
- Observe concrete as it is placed. In the daily report, record the reasons for rejecting any concrete and the approximate amount rejected. Ensure the contractor does not allow concrete to segregate while being placed and being compacted in the forms. Stop the operation if the concrete requires patching with grout or mortar. Insist the contractor correct the placing operation.
- Before the forms are removed, ensure the contractor uses the required 10-foot float to finish the surface.
- Note whether the forms are being removed within the specified time limits. When corrective measures are necessary, advise the contractor, and note such advice in the daily report.
- Ensure the finishing meets specifications, and measure the finished product to ensure it conforms to the required tolerances.
- Ensure the curing complies with one of the specified methods.
- Ensure the contractor protects the concrete after placement according to the specifications.
- Ensure detectable warning surfaces are on the authorized material list and comply with required color. Ensure prefabricated detectable warning surfaces are installed according to manufacturer recommendations and obtain the 5-year manufacturer warranty of replacement for defects.

#### **4-7304 Measurement and Payment**

Measure concrete curbs and sidewalks by the cubic yard from the dimensions shown on the plans or by longitudinal field measurement.

To determine pay quantities for curb when minor concrete is paid for by the cubic yard, you may use the table for curb quantity factors (cubic yards/foot) in the *Standard Plans*.

#### **4-7304 Measurement and Payment**