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Section 27 Cement Treated Bases

4-2701 General

This section provides guidelines for inspecting cement treated base (CTB). Section 27, “Cement Treated Bases,” of the *Standard Specifications* provides requirements for placing CTB—a mix of aggregate, portland cement, and water. CTB specified as either Class A or Class B is generally used with asphalt pavements and can be either plant-mixed or road-mixed. However, plant-mixed is most common.

Although the spread method may be specified in the special provisions, CTB may be spread by one of three allowable methods: Type 1, Type 2, or Type 3. The Bid Item List and plans will specify the class and mix method. The special provisions will specify the percent of cement to be added to the CTB.

4-2702 Before Work Begins

Include the following steps in the preliminary review and inspections:

- Obtain the contractor’s quality control plan, which details the methods the contractor will use to ensure quality of work and conformance with the requirements of *Standard Specifications*.
- If mutually agreed with the contractor, hold a preconstruction meeting with the contractor and the district materials unit prior to construction to discuss the quality control plan and contractor’s method for performing each element of work affecting material quality, including acceptance testing priorities, shipping of samples, lines of communication for test results, timeframes for reporting quality control and acceptance test results, and any contractual testing dispute resolution processes.
- For initial testing, obtain representative samples from the contractor’s source of CTB aggregate and test for the required quality characteristics. 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, requires new tests for quality characteristics. Request strength tests at 5 percent cement and other percentages above and below 5 percent (usually in 0.5 percent increments) to determine the correct cement content. For aggregates of borderline quality, consider making additional initial strength tests at varying gradations (within specifications), using 5 percent cement.
- For suppliers whose past performance has been reliably verified, 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 1,000 psi.
 2. Decrease cement content if the 7-day compressive strength of initial samples at the percent specified is more than approximately 1,250 psi.
- Verify that safe and convenient facilities have been provided for sampling cement.
- Ensure the aggregate material source complies with Section 7-103H (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 placing 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.

4-2703 During the Course of Work

During the course of work, do the following:

- For acceptance quality characteristics and associated sampling and testing frequencies, refer to Chapter 6-1, “Sample Types and Frequencies,” of this manual.
- Before mixing, obtain samples of the aggregate for acceptance testing.
- 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 tests reasonably match the anticipated results based on the initial tests, the frequency of the tests can be reduced (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.” 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 layer whenever this separate measurement is physically possible.

If the contractor disputes Caltrans' acceptance results, follow Section 23-1.01D(1)(b), "Test Result Disputes," of the *Standard Specifications*. An independent third party performs referee testing and must have no prior direct involvement with the contract as specified and be mutually selected with the contractor.

4-2703A Road-Mixed Cement Treated Base

For road-mixed CTB, do the following:

- 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 Cement Treated Base

For plant-mixed CTB, 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 Cement Treated Base

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 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 Cement Treated Base

During the compaction of CTB, do the following:

- Measure the operation's total time interval to ensure it conforms to Section 27-1.03G, "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.

4-2703E Curing Cement Treated Base

Ensure that the asphaltic emulsion used for curing seal is diluted, mixed, and uniformly applied on the completed CTB as required under 27-1.03I, "Curing."

Ensure that the contractor keeps the CTB surface moist until curing seal is applied.

Determine 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.

Obtain necessary certificates of compliance and samples of asphaltic emulsion.

4-2704 Level of Inspection

Suggested levels of inspection for typical cement treated base work activities are:

- Benchmark inspection of subgrade grading plane.
- Intermittent sampling and testing of cement treated base materials.
- Intermittent inspection of placement, spreading, and compaction operations.
- Intermittent review of contractor's quality control program including quality control test results.
- Benchmark inspection of finished surface grading plane.

4-2705 Quality Control

Guidance for quality control activities included in this section is summarized as follows:

- Ensure the contractor is actively performing quality control on CTB materials throughout production operations by reviewing copies of quality control records, including quality control test results.
- The quality control plan must include, but is not limited to:
 - Frequency of quality control sampling and testing that meets or exceeds specification requirements as listed in Section 27-1.01D(2)(d), "Quality Control Testing," of the *Standard Specifications*.
 - Time and frequency of submitting test results.
 - Action and suspension limits and details of corrective action to be taken if any process is outside of those limits. Suspension limits must not exceed specified acceptance criteria.
 - Responsibilities of subcontractors and testing laboratories.
 - Quality control manager if the quantity of subbase or base exceeds the requirements listed in the "QC Manager Requirement" table of Section 23-1.01D(2)(a), "Quality Control," of the *Standard Specifications*.

4-2706 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 weight, refer to the discussion of weighing and metering procedures in Section 3-902E, "Weighing Equipment and Procedures," of this manual. Make any appropriate deductions for excess moisture.

- When CTB is to be paid for by volume, review the plans and quantity calculations in the resident engineer's file to determine if there is sufficient detail and accuracy to be used in the project records. Make appropriate deductions for any lack of compliance with thickness specifications.
- For information about measurement and payment of curing seal, refer to Section 4-94, "Asphaltic Emulsions," of this manual.