

Section 51 Concrete Structures

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Section 51 Concrete Structures

4-5101 General

This section covers items related to constructing concrete structures. Section 51, “Concrete Structures,” of the *Standard Specifications* provides requirements for constructing concrete structures. Concrete structures include concrete bridges, structure approach slabs, culverts, headwalls, endwalls, drainage inlets, retaining walls, and other concrete structures shown on the plans.

Many specified requirements for concrete structures apply only to bridges and other major structures and are covered in detail in Structure Construction’s *Bridge Construction Records and Procedures* manual at:

<https://dot.ca.gov/programs/engineering-services/manuals>

Additional reference material can be found in the *Foundation Manual*, the *Prestress Manual*, and the *Bridge Deck Construction Manual* at the website.

Section 3-703, “Public Safety,” of this manual contains guidelines for work that temporarily impairs horizontal and vertical bridge clearance.

4-5102 Before Work Begins

Before work begins, take the following steps:

- Review the plans and specifications. Determine the cementitious material content and compressive strength of the concrete to be used. Review Section 4-90, “Concrete,” of this manual, which covers the mix design review, authorization, and production of concrete.
- Review and discuss with the contractor plans for placing concrete in each of a structure’s parts. Before allowing the work to commence, discuss any obvious shortages of workers, equipment, or material that may prevent the completion of the structure’s parts without interruption in the placing of concrete. Also discuss and evaluate project specific conditions for safely placing concrete, such as avoiding overhead lines.
- Determine which tests will be performed, and the frequency and location of such testing, and assign the duties accordingly. For guidelines, refer to Chapter 6, “Sampling and Testing,” of this manual.
- Verify that Form CEM-3101, “Notice of Materials to Be Used,” includes concrete structure materials. Refer to Section 6-202, “Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products,” of this manual for additional information.

4-5103 During the Course of Work

Once work begins, take the steps listed for inspecting the following items:

- Placing of concrete
- Concrete placed under water
- Minor structures
- Forms
- Joints and bearings
- Drains in walls
- Surface finishing

4-5103A Placing Concrete

During the placement of concrete, do the following:

- Check for any movement or deformation of forms that may exceed the specified tolerance. If the movement or deformation exceeds the specified tolerances, take appropriate action. This action may include halting concrete placement to install additional bracing or changing the rate or sequence of concrete placement to achieve the required lines and grade.
- Ensure the contractor follows the specified placement order. Also, ensure that concrete for horizontal members or sections is not placed until the concrete in the supporting vertical members or sections has been consolidated and subsidence has occurred.
- Through observation, verify that concrete is placed without causing segregation. Also, ensure that high-frequency internal vibrators consolidate the concrete when specified. The method used to vibrate concrete directly affects the structure's strength. Check for minimum contact between the vibrator and reinforcing steel. Concrete must be vibrated to the point where mortar and water flush to the surface; vibration beyond this point is not necessary or desirable. Insufficient vibration, on the other hand, will leave rock pockets (voids).
- Determining when subsidence has occurred will require judgment based on experience with various concrete mixes. In general, subsidence has occurred when bleed water at the surface has disappeared.

4-5103B Concrete Placed Under Water

Ensure the contractor meets all specifications related to Section 51-1.03D(3), "Concrete Placed Under Water," of the *Standard Specifications*. Unless otherwise provided for in the special provisions, only concrete designated as "seal course concrete" is to be placed under water.

4-5103C Minor Structures

Ensure that paving or surfacing has been completed immediately adjacent to a structure before the structure has been constructed to final grade.

4-5103D Forms

When using concrete forms, do the following:

- Ensure the forms are located properly. To detect any major discrepancy, include both spot-checking from the control stakes as well as general observation independent of the stakes.
- For proper dimensions, measure inside the forms.
- Ensure forms are mortar tight.
- When specified, ensure the use of form oil.
- Ensure that all materials required to be embedded in concrete, such as reinforcement and miscellaneous metal, are in place and secured properly. For details, refer to Section 4-52, "Reinforcement," and Section 4-75, "Miscellaneous Metal," of this manual.
- Decide whether forms are sufficiently rigid to prevent undulations that exceed the specified values. If corrective measures are necessary, advise the contractor accordingly, and note the circumstances in the daily report.
- Check the forms for exposed surfaces to ensure the surfaces are faced with form panels as specified. Where required, ensure the use of triangular fillets.
- Verify that form bolts and fasteners are the types specified.
- Before concrete placement, ensure the removal from the forms of dirt, chips, sawdust, and other foreign materials. Also, ensure the contractor dewateres the forms and does any necessary pumping as specified and in accordance with the contract's environmental provisions.
- Before concrete placement, inform the contractor of any corrective action required. Note such action in the daily report.
- Ensure forms are removed in the specified manner. When forms are removed before the end of the specified curing period, require proper curing of the concrete.

4-5103E Joints and Bearings

For specific requirements for joints and bearings, review the contract plans and specifications. For bridges and other major structures, refer to the *Bridge Construction Records and Procedures* manual.

Ensure that joints are constructed as specified. Verify they are constructed in a way that ensures they will function as intended. The following are some of the important items to check:

- Verify material has been inspected at the source and is properly identified for shipment. When required, ensure the material is sampled and tested in accordance with Chapter 6, "Sampling and Testing," of this manual.
- When an open joint is required, ensure the reinforcement does not extend across the joint.

- Ensure sheet piling, preformed pads, and board fillers are held in place as specified.
- During concrete placement, check that expansion joint armor is placed and firmly held in position.
- Verify bearing devices are placed as specified and measure concrete bearing areas to ensure placement falls within specified tolerances.
- Before additional concrete placement, ensure horizontal construction joints are cleaned as specified. Ensure that expansion joint filler or bond-breaking compound is placed where required. Note such observations in the daily report.
- If an emergency makes a construction joint necessary, decide on the construction details of this joint and direct the contractor during its construction.
- Check the placement of any dowels to ensure the contractor cleans the holes before grouting or bonding and places the grout or bonding material and dowels as specified.
- When mortar is used, ensure the contractor proportions, places, and cures the mortar as specified.
- Ensure water stops are installed as specified and where shown on the plans. During concrete placement, make sufficient observations to ensure the water stops are not materially shifted out of position or shape.

4-5103F Drains in Walls

Ensure that drain holes and weep holes are constructed as specified. Examine the excavation and consider other factors that could contribute to the buildup of hydrostatic pressure. When necessary, order additional drain holes or weep holes.

4-5103G Surface Finishing

Ensure the various concrete surfaces comply with the specifications. Ensure that the required finishing work is performed before structures are backfilled and that the appropriate finish is applied to all surfaces. For additional information, refer to the *Bridge Construction Records and Procedures* manual.

4-5104 Quality Control

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

- Verify that the contractor's quality control records are submitted timely and that results comply with contract requirements.
- If rapid strength concrete (RSC) is used, ensure the contractor prequalifies RSC before use.
- If test panels are specified, ensure that concrete test panels and slabs are constructed at authorized locations and that test results comply with contract requirements before starting work.

- Verify that material and lubricant-adhesive is tested.
- For joint seal assemblies with a movement rating of more than 4 inches, ensure that a manufacturer technical representative is present during installation.
- For asphaltic plug joint seals, verify binder material is tested.
- Witness the contractor's proof testing of structural load bearings.
- If using RSC to construct approach slabs, ensure the contractor constructs trial slab for each concrete mix design. Verify trial slabs are constructed in compliance with finish, cure, and compressive strength requirements as specified in Section 51-5.01D(2)(b), "Rapid Strength Concrete," of the *Standard Specifications*.
- Ensure that temperature monitoring and data recording is done for mass concrete elements and verify that recorded temperatures comply with the specified requirements.

4-5105 Payment

Take the following steps:

- In conformance with the dimensions shown on the plans, measure the quantity of concrete in structures by the cubic yard unless the quantities are designated as final pay quantities.
- Keep records of rejected concrete loads, and provide the reasons (preferably including test data) for such actions. Also keep records of any significant amounts of concrete placed outside of areas or limits for which payment is to be made.