

OFFICE OF STATE AID ROAD CONSTRUCTION			S.O.P. NO. SA II-1-80
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Subject: S.O.P. STRUCTURAL CONCRETE - GENERAL			Distribution A, B, C, D, E
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PURPOSE: To Establish Uniform Policies And Procedures For The Placement of Structural Concrete.

REFERENCE: Sections S-600 and S-800 of the Standard Specifications.

1. BATCHING, MIXING, TRANSPORTING, PLACING AND FINISHING CONCRETE:

1.1. Preliminary: At least thirty (30) days prior to production of concrete, the Contractor is to submit to the County/LSBP Engineer proposed mix designs. See S.O.P. No. SA II-3-20 for details.

1.2. Batching: Batching and field verification of a concrete mix design is the responsibility of the Contractor's Quality Control (QC) Technicians. See S.O.P. No. SA II-3-21 for details.

1.3. Mixing:

1.3.1. Truck Mixing: If a commercial plant is being used, check to be sure it has been certified in accordance with S.O.P. No. SA II-3-19.

Inspect all transit mix trucks and correct any unsatisfactory conditions before permitting their use. Check the trucks for the following items.

1.3.2.1. The truck should have a legible plate supplied by the manufacturer showing the capacity of the mixer drum.

1.3.2.2. The calibration of the water discharge mechanism should be plainly marked.

1.3.2.3. Check all water valves for leaks.

1.3.2.4. Check the mixer drum for leaks, excessively worn blades, and clogging with hardened concrete.

1.3.2.5. Check the water tank for leaks.

1.3.2.6. Check that the revolution counters are working properly.

1.3.2.7. Complete Ticket for Truck Mixed Concrete for each batch. The batching inspector is to complete and sign the ticket and record the reading of the revolution counter at the beginning and end of the mixing cycle if the cycle is completed before leaving the plant. Also, show the amount of additional water added at the delivery site. If the batch is mixed in transit, the reading at the end of the mix cycle is to be entered by the placement inspector who is to also complete and sign the ticket.

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- 1.4. Handling and Placing Concrete: First check that the mixture is within the specified ranges for slump, air content and temperature.

During the placing of the concrete, watch the consistency of the concrete and the methods of spreading and working. See that segregation is avoided, that the finished product is well consolidated, and that the monolithic mass is free from surface cavities resulting from the trapping of air and water along the forms. Careful spading of the concrete along vertical forms will usually release the air and water bubbles. "Sand streaking" must also be avoided. This is usually the result of leaky forms permitting the escape of cement paste. Forms should be watched closely and any leak discovered must be caulked immediately.

Concrete should not be dumped indiscriminately through the reinforcement, nor should it be deposited continuously at one point and forced to flow for considerable distance. Start at one point and work from that point by dumping the succeeding batches in such a way that the concrete will flow along and under the reinforcement and will be vibrated into the preceding batch.

Concrete must be vibrated and spaded immediately upon dumping. The vibrator should be applied to the concrete systematically at short intervals so that the vibrated areas of concrete overlap. The vibrator should be inserted to the full depth of the concrete being placed and into any previously placed concrete which has not taken its initial set.

- 1.5. Forms: Before placing any concrete, the forms must be completely checked for conformance with the plans and specifications, and all irregularities corrected. They should be checked for ease of removal without injury to the concrete.

Any element of the forms, such as chamfer strips or other light decorative forming, likely to warp or distort from moisture absorbed from the concrete should be waterproofed with shellac, or equivalent, or thoroughly soaked with water immediately prior to placing of concrete.

All sawdust, dirt, and other foreign material, including ponded water, must be removed from within the forms before placing any concrete in the forms. If the forms are too deep to permit easy removal at the top, an opening should be left at the bottom through which this material can be removed. This opening must be closed and made mortar tight after the forms have been cleaned.

- 1.6. Removal of Forms: The specifications state the minimum time the forms must remain in place for different types of structures, if test cylinders are not used as a guide.

Keep an accurate day by day record of weather conditions, including high and low temperatures as a guide in determining when the falsework may be safely removed if test cylinders are not used as a control. When test cylinders are used to determine the time to remove the forms, they should be

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made and cured in the same manner as job control cylinders.

Any honeycomb or damaged areas noted upon removal of the forms should be repaired by removing all improperly bonded aggregate and filling the cavity with grout made from the same cement used in the mix.

- 1.7. Curing of Concrete: The proper curing of concrete requires the proper control of three major factors, Humidity, temperature, and protection against disturbance. The concrete should be kept under conditions of humidity and temperature that will produce a uniform hydration of the cement at the fastest economical and practical rate. The specifications require that, unless high early strength cement is used, all concrete shall be kept continuously moist for a minimum period of seven days. Frequent inspections of curing concrete should be made to see that it is kept moist.

When wooden forms are left in place during curing, they should be wetted frequently to prevent opening of cracks that would permit loss of moisture from the concrete.

For temperatures below 40°F, protection and/or artificial heat must be provided. If salamanders or other producers of dry heat are used, the surface of the concrete must be kept continuously moist. If steam is used, it must be supersaturated. It is very important that the rate of temperature change and the maximum temperature be kept within the specification limits.

- 1.8. Finishing Concrete Surfaces: The various classes of surface finishes are described in detail in the specifications. The following items in the specifications will need special attention:
- 1.8.1. Surfaces to be patched must be kept saturated with water for at least three hours immediately before patching.
 - 1.8.2. For concrete surfaces requiring a rubbed finish, rubbing is to begin as soon as the forms can be safely removed without danger of injuring the concrete. The surfaces should be thoroughly saturated with water for at least three hours immediately before rubbing begins, and kept saturated during rubbing operations.

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2. CHECK LIST:

A suggested check list for inspectors of concrete box culverts and minor structures is as follows:

2.1. Storage of Materials:

2.1.1. Steel and cement must be properly stored and protected from the weather.

2.2. Location of Structure:

2.2.1. Check on location as to stationing and barrel length compared to roadway cross section, skew and flow lines.

2.2.2. Check survey stakes for proper information.

2.2.3. Check invert elevations in relation to stream bed.

2.3. Excavation and Foundation Exploration:

2.3.1. Record the data necessary to compute excavation quantities.

2.3.2. Foundation material should be uniform for the entire length of the structure. Where unsuitable materials are encountered special treatment may be needed. In these instances, notify the County Engineer.

2.3.3. Provide for bypass of drainage.

2.4. Forming:

2.4.1. Form dimensions must be checked.

2.4.2. Forms must be well built, with tight joints and smooth surfaces.

2.4.3. Forms must be oiled or wetted before use.

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2.5. Mixing and Placing Concrete:

- 2.5.1. Concrete must be accurately batched and delivered in accordance with the applicable specifications.
- 2.5.2. Required finishing tools must be on hand.
- 2.5.3. Reinforcing steel must be tied and secured in proper position before concrete placement.
- 2.5.4. Be sure all spacers are removed as placement progresses.
- 2.5.5. Finish concrete to neat lines.
- 2.5.6. Provide the proper curing environment for the fresh concrete.
- 2.5.7. Make the necessary additional test cylinders if the Contractor plans to remove forms or backfill the culvert, before the prescribed time has elapsed.
- 2.5.8. If curing compound is used, be sure it is thoroughly mixed and properly applied.
- 2.5.9. Make job control test cylinders according to State Aid schedule.

2.6. Removal of Forms:

- 2.6.1. Require tie-bar holes and honeycomb to be patched as soon as possible after form removal.
- 2.6.2. Enforce specifications in regard to time or compressive strengths for form removal.

2.7. Reports:

- 2.7.1. Keep in a bound field notebook an accurate record of dates and concrete placed.
- 2.7.2. Keep record of key dimension checks made.
- 2.7.3. Complete State Aid Form, Daily Record of Concrete Placed in Structures.