

CONCRETE

5-393.300

5-393.301 GENERAL

The discussion in this section applies to the proper control of procedures and operations used to produce concrete in its plastic state.

Placing, consolidating, finishing, curing and protecting the mixed concrete are discussed in [5-393.350](#) Concrete Bridge Construction under the specific work items such as substructures, girders, slabs, railings and wearing courses.

Procedures for sampling, testing and inspecting the cement, aggregate, admixtures and concrete are included in the Concrete Manual and specific references to that manual are made in the following text.

5-393.302 CONCRETE MIX

All concrete used for bridges is given a mix designation commonly referred to as a concrete mix number (See Specification [2461](#) and Concrete Manual [5-694.200](#)). Concrete Manual [Table A 5-694.312](#) tabulates the various mixes in general use for specific parts of a bridge.

The bridge plans will list the different mixes required for that particular bridge in the summary of estimated quantities, and the various detailed bridge plan sheets usually show the mix to be used for the various parts of the structure. The use of these mixes is required except that higher strength mixes may sometimes be substituted. In the case of slope paving, the concrete type and minimum strength grade will be shown in the construction notes on the standard slope paving plan sheet. The concrete mix for cast-in-place steel shell piles is given in Specification [2452.2D2](#).

Estimated mix proportions for each concrete mix are furnished to the field engineer by the Concrete Engineer, Office of Materials (see [Concrete Manual 5-694.300](#)). Soon after a bridge contract has been awarded, Materials Engineering will forward a blank 2416, "Concrete Information," to the Project Engineer for completion (see [Concrete Manual 5-694.300](#)).

The Project Engineer or inspector will then request proportions for the concrete mix number shown in the bridge plans, and complete Form 2416 based on information supplied by the Contractor and his or her supplier of concrete materials.

In some cases, the project plans or special provisions will require the Contractor to develop their own mix design for a particular concrete element or component. In this case you should refer to the project special provisions and consult with the Concrete Engineer if you have questions.

5-393.303 MATERIAL REQUIREMENTS

All concrete and concrete materials are subject to testing and inspection and come under the general requirements of Specifications [1603](#) and [1604](#), "Materials: Specifications, Samples, Tests and Acceptance" and "Plant Inspection-Commercial Facility" respectively. The detailed specification requirements for concrete are contained in Specification [2461](#), "Structural Concrete," with current modifications shown in the Special Provisions for the particular bridge under contract.

Each bridge contract proposal includes a copy of the "Schedule for Materials Control" mentioned in Specification [1603](#). The extent of sampling will vary depending on Contract requirements which may specify a "certification" process with quality control sampling by the concrete supplier.

Detailed certification, inspection, sampling and field testing procedures for concrete and concrete materials are contained in the Concrete Manual prepared by the Materials Section.

The Project Engineer should decide as early as practicable whether materials will be inspected and tested at the source or at the bridge site and arrange for all testing equipment and supplies to be on hand at the proper location. Regardless of where the materials are inspected and tested, the inspector should bear in mind the following sentence of Specification [1603](#) - "Final inspection and acceptance of materials will be made only at the site of the work, after all required tests have been met."

Specification [1601](#) states that all materials required for the work shall be furnished from reliable sources capable of producing and delivering uniformly acceptable products. An example of a non-uniform product is concrete produced by a ready-mix plant using two different brands of cement having different colors. It sometimes happens, where concrete production for other jobs may be in progress, that the brand of cement used for a particular bridge may be exhausted and permission to substitute another brand is requested. For concrete not exposed to view a change in color is not objectionable. When non-uniform colors are used on exposed surfaces, a special surface finish may be required to hide the variation. For additional information see Concrete Manual 5-694.100.

5-393.304 CONCRETE QUANTITIES

Specification [2401](#) under "Method of Measurement" provides as follows:

1. Concrete will be measured, as indicated in the Proposal, by volume or by area, based on the dimensions shown in the Plans.

2. Each mix of concrete will be measured separately. It is general practice to disregard keyways between pours using different mixes, in the computation of the quantities.
3. No deductions will be made in concrete quantities for the volume displaced by metal reinforcement, structural steel, floor drains, conduits, pile heads, chamfer strips with side dimensions of 50 mm (2 inches) or less or for variations in camber and deflections from that which is indicated in the plans.
4. No increase will be allowed for any concrete used to secure true conformity to the plan requirements for the elevation profile and cross section in the finished roadway slab.

The pay quantity of concrete for a bridge may be computed in advance of placement and differs from some other items of highway work where the quantity must be measured and computed after the item of work is in place.

It is important that the concrete quantity required for each concrete pour in a bridge be computed well in advance of concrete placement. Computations of concrete quantities by pours in advance serve several useful purposes which are as follows:

1. Quantity computations familiarize the inspector with the detail plans. The plans will show the total estimated quantity of each concrete mix required for each unit (pier, abutment, superstructure, etc.). If the summation of the inspector's quantities for each placement totals the estimated plan quantity for the unit, it is reasonably certain that he has interpreted the plans correctly.
2. The quantity required for each placement is useful in coordinating the concrete delivery and production rate, with the rate of rise within the forms, finishing operations, and available time for the placement.
3. The quantities may be used for computation of yields and progress estimates besides being used as pay quantities in the final estimate.
4. Differences in computed and "as delivered" quantities which arise from shortages or overruns are easier to resolve at the time of placement.

In the computation of the estimated concrete quantities shown on plans, concrete volumes are shown to the nearest cubic meter (cubic yard) so as to avoid errors in bidding. Field computations are to be made to the accuracy and on the form described in the Documentation Manual issued by the Office of Construction.

When there are unexplained discrepancies between field quantity computations and the plan estimated quantity, the

Project Engineer can request a copy of the plan estimated quantity computation from the Bridge Designer for comparison.

Specification [1901](#) states that the plan quantity will be accepted for payment except for the following conditions: (a) incorrect plan quantities, (b) plan alterations, or (c) other method of measurement provisions of the contract. Field quantity computations should be submitted with the final even if the plan quantity is the basis for payment.

Examples of conditions when the proposal quantity will be revised are as follows:

1. A discrepancy between the field computed quantity and the estimated plan quantity indicates a mathematical error made during the computation of the estimated plan quantity.
2. A plan alteration was made during construction such as lowering a footing one-half meter (1.5 feet) below the plan elevation because bed rock conditions were not as anticipated.
3. The provision in Specification [2451](#) requiring rock excavation to be paid for as the actual measured quantity is used.