

September 1, 2011

**Tennessee Department of Transportation
Division of Materials and Tests**

**Submittal and Approval of
Concrete Mixture Designs (SOP 4-4)**

Purpose: The purpose of this document is to establish a submittal and approval process for all concrete mixtures including ready mix, prestressed, and precast concrete (not including precast pipe).

Discussion: Concrete mixture designs submitted to the TDOT for approval must exhibit certain physical performance properties indicated in Standard Specifications including but not limited to slump, air content, temperature, unit weight, and yield; the hardened concrete must meet compressive strength requirements.

The contractor shall first determine from the Plans the class of concrete required along with the design criteria for the mix (i.e. a project-specific requirement of 3000 psi in 18 hours).

Procedure: A new concrete mix design shall be subject to the following procedures prior to being approved for use in TDOT work:

A Concrete Mix Design Technician (Level 3) or a Tennessee Professional Engineer shall determine, by using volumetric mix design procedures, the proportions of all materials in the mix in accordance with Standard Specifications 501.03(a) and 604.03(a).

A trial batch shall be mixed according to those proportions, including appropriate admixtures, and the tests for the freshly-mixed concrete shall be conducted to determine the actual slump, temperature, air content, unit weight, and yield. The hardened specimens, after proper curing, shall then be tested for compressive strength.

If all test results meet the required design criteria, the design must be submitted to Headquarters Materials and Tests no less than 14 working days prior to mix production. Email submissions are preferred but will be accepted by fax or posted mail.

Attachment 1 shows a [Concrete Mix Design Submittal Checklist](#) and is available on the Materials and Tests SOP web page.

Materials: Cement: The source and location must be listed on the Qualified Products List (QPL 15) and meet the requirements outlined in Section 901.01 of the Standard Specifications. A mill test report/certification representing the cement in stock must be submitted with the mix design; the specific gravity on the mill test should be used to determine proportioning. Any change of cement shall require a new submittal, including a new trial batch complete with test results.

Fly Ash: The source and location must be listed on the Qualified Products List (QPL 16) and meet the requirements outlined in Section 918.31 of the Standard Specifications. A mill test report/certification representing the fly ash in stock must be submitted with the mix design; the specific gravity on the mill test should be used to determine proportioning. Any change of fly ash shall require a new submittal, including a new trial batch complete with test results. Fly ash replacement shall be in accordance with Standard Specifications 501.03(a) or 604.03(a).

Ground Granulated Blast Furnace Slag (GGBFS): The source and location must be listed on the Qualified Products List (QPL 16) and meet the requirements outlined in Section 918.32 of the Standard Specifications. A mill test report/certification representing the GGBFS in stock must be submitted with the mix design; the specific gravity on the mill test should be used to determine proportioning. Any change of GGBFS shall require a new submittal, including a new trial batch complete with test results. GGBFS replacement shall be in accordance with Standard Specifications 501.03(a) or 604.03(a).

Silica Fume: The source and location must be listed on the Qualified Products List (QPL 16). A mill test report/certification representing the silica fume in stock must be submitted with the mix design; the specific gravity on the mill test should be used to determine proportioning. Any change of silica fume shall require a new submittal, including a new trial batch complete with test results.

Water: Must be from an approved source; refer to Standard Specification 918.01.

Coarse Aggregate: The source and location must be from an approved source meeting quality test requirements outlined in Section 903.03 of the Standard Specifications. Gradation and specific gravity test results must be submitted reflecting the characteristics of the stockpile to be used in the mix.

In the event that a project may be delayed due to an insufficient supply of coarse aggregate, the source of aggregate may be changed to another approved source of like material (e.g. limestone for limestone, or granite

for granite) provided the specific gravity of the new material is within 0.15 of the original material. The request must be made in writing and the Regional Materials Supervisor shall be the approving authority for the written change.

Fine Aggregate: The source and location must be from an approved source meeting quality test requirements outlined in Section 903.01 of the Standard Specifications and AASHTO M-6. Gradation and specific gravity test results must be submitted reflecting the characteristics of the stockpile to be used in the mix. The fineness modulus shall also be reported with the test data; allowable tolerances shall be in accordance with AASHTO M-6.

Any change of fine aggregate shall require a new submittal, including a new trial batch complete with test results. Manufactured sand shall not be used in mixes designed as surface courses.

Chemical Admixtures including Air-Entraining Admixtures: All admixtures must be listed on the QPL (QPL 4A for air-entrainers and QPL 4B for all other chemical admixtures) and, in a given mix, must all be supplied by the same manufacturer. A change in admixture may be approved by the Regional Materials Supervisor to prevent delays in a project or to adjust the physical characteristics of the concrete (workability, for example).

Distribution:

Once the submittal is approved, the design will be distributed as follows:

- A copy is sent to HQ Materials and Tests Administrative Section. Administration sends an official copy to the project file; Regional Materials and Tests; the Prime Contractor; and the Project Engineer.
- Regional Materials and Tests and the producer will receive an electronic copy.
- Regional Materials and Tests will forward copies to the Project Supervisor; the Project Supervisor will ensure that the Project Inspector receives a copy

The [Concrete Mix Design Submittal and Approval Process Flowchart](#) is shown in Attachment 2 and is available on the Materials and Tests SOP web page.

Further Guidance:

Once approved, the mix design will be valid for any other State project provided that the test results, including compressive strength, are

satisfactory and within allowable tolerances. The mix must also have been in use within the previous 6 months.

Acceptance testing and quality control (QC) testing shall be conducted in accordance with Part 2 of SOP 1-1. Random sampling shall be conducted in accordance with Part 4 of SOP 1-1.