

OFFICE OF STATE AID ROAD CONSTRUCTION			S.O.P. NO. SA II-3-20
STANDARD OPERATING PROCEDURES			Page 1 of 6
Subject: S.O.P. APPROVAL OF CONCRETE JOB MIX FORMULAS			Distribution A, B, C, D, E
EFFECTIVE July 1, 2005	ISSUED July 1, 2005	SUPERSEDES Page of S.O.P. NO. EFFECTIVE:	APPROVED J. Brooks Miller, Sr. STATE AID ENGINEER

PURPOSE: To establish uniform procedures to be used in distributing a Portland cement concrete job mix formula (JMF) for approval.

1. REQUEST FOR APPROVAL OF A JMF BY THE CONTRACTOR

- 1.1. At least thirty (30) days prior to production of concrete, the Contractor is to submit to the County/LSBP Engineer proposed JMF's. The JMF is to be designed by a Class III Concrete Technician. Production of concrete is not to begin until the Engineer has in hand a tentatively approved JMF or a JMF transfer approval.
- 1.2. The County/LSBP Engineer will check the Contractor's JMF for conformity with the contract requirements and to ascertain that all information listed in Subsection 2.2 below, and Section 3, 4, or 5 below as applicable, is included. If it is found not acceptable, the County/LSBP Engineer will return the JMF to the Contractor along with his written cause for rejection. If it is found to be acceptable, the Engineer will submit a written request along with a copy of the Contractor's JMF to the MDOT Central Laboratory or other approved laboratory, with AASHTO concrete (CCRL) accreditation, for approval.
- 1.3. The MDOT Central Laboratory or other approved Laboratory will return written acceptance, modification, or rejection of the Contractor's JMF to the County/LSBP Engineer. A copy of the above correspondence will be furnished to the State Aid Materials Engineer.
- 1.4. The County/LSBP Engineer will furnish the Contractor with a written notification of his concurrence of the MDOT Central Laboratory's or other approved laboratory's acceptance, modification, or rejection of the Contractor's JMF.

2. CONCRETE MIX DESIGNS

- 2.1. Each JMF must be assigned a permanent number that is unique to the JMF having unique sources of materials. The JMF is to be based on previous field experience as stated in Section 3, laboratory trial mixture as stated in Section 4 below, or JMF transfer as stated in Section 5 below.

Prior to acceptable field verification data, JMF's are only tentatively approved for use on State Aid work. Acceptable field verification results are required prior to final acceptance of the JMF and any subsequent transfer of the JMF from one project to another. For JMF's submitted under Section 3 and 4 given tentative approval, the field verification process must be completed prior to final approval of the JMF. JMF's having been tentatively approved for use on a project may not be submitted again for tentative approval under Sections 3 or 4 below for other projects. Only JMF's having completed the field verification process with the current proportions may be transferred per Section 5 below. The JMF is to be based on oven-dried aggregate weights and specific gravities. The absolute volume of each material except water reducing admixtures is to be calculated.

OFFICE OF STATE AID ROAD CONSTRUCTION			S.O.P. NO. SA II-3-20
STANDARD OPERATING PROCEDURES			Page 2 of 6
Subject: S.O.P. APPROVAL OF CONCRETE JOB MIX FORMULAS			Distribution A, B, C, D, E
EFFECTIVE July 1, 2005	ISSUED July 1, 2005	SUPERSEDES Page of S.O.P. NO. EFFECTIVE:	APPROVED J. Brooks Miller, Sr. STATE AID ENGINEER

2.2. The following information shall be included with the JMF:

2.2.1. Mixture Proportioning.

2.2.2. Coarse Aggregate Information

Plant Number
Size Number
Gradation
Bulk Specific Gravity
Absorption
Dry Rodded Unit Weight

2.2.3. Fine Aggregate Information

Plant Number
Gradation
Fineness Modulus
Bulk Specific Gravity
Absorption

2.2.4. Sources of materials and certifications for cement, pozzolans, and chemical admixtures.

3. PREVIOUS FIELD EXPERIENCE

3.1. Where a concrete production facility has a record, based on at least 10 consecutive strength tests within the past 12 months, the standard deviation is to be calculated. The record of tests from which the standard deviation is calculated shall:

1. Represent similar materials and conditions to those expected. Changes in materials and proportions within the test record shall not have been more closely restricted than those for the proposed work.
2. Represent concrete produced to meet a specified strength.
3. Consist of 10 consecutive tests (average of two cylinders per test, tested at 28 days).

OFFICE OF STATE AID ROAD CONSTRUCTION			S.O.P. NO. SA II-3-20
STANDARD OPERATING PROCEDURES			Page 3 of 6
Subject: S.O.P. APPROVAL OF CONCRETE JOB MIX FORMULAS			Distribution A, B, C, D, E
EFFECTIVE July 1, 2005	ISSUED July 1, 2005	SUPERSEDES Page of S.O.P. NO. EFFECTIVE:	APPROVED J. Brooks Miller, Sr. STATE AID ENGINEER

3.1.1. The standard deviation, S , shall be calculated as:

$$s = \left[\sum (X_i - \bar{X})^2 \div (N - 1) \right]^{1/2}$$

where:

x_i = the strength result of an individual test

\bar{X} = the average of individual tests in the series

N = number of tests in the series

3.2. The required average compressive strength (f'_{cr}) used as the basis for selection of concrete proportions shall conform to the inequality listed below, while using a standard deviation, S , calculated as shown above.

$$\bar{X} \geq f'_{cr} \quad \text{where:}$$

$$f'_{cr} \geq f'_c + 1.43s$$

where:

f'_c = specified compressive strength of concrete, psi

f'_{cr} = required average compressive strength of concrete, psi

s = standard deviation, psi

1.43 represents the Lower Quality Index necessary to assure that 93% of compressive strength tests are above f'_c .

3.3. The following additional data shall be submitted with the mix design.

3.3.1. The compressive strength test reports (10 consecutive) used to calculate the standard deviation.

3.3.2. The average strength of the tests which shall be equal or greater than the required average strength.

OFFICE OF STATE AID ROAD CONSTRUCTION			S.O.P. NO. SA II-3-20
STANDARD OPERATING PROCEDURES			Page 4 of 6
Subject: S.O.P. APPROVAL OF CONCRETE JOB MIX FORMULAS			Distribution A, B, C, D, E
EFFECTIVE July 1, 2005	ISSUED July 1, 2005	SUPERSEDES Page of S.O.P. NO. EFFECTIVE:	APPROVED J. Brooks Miller, Sr. STATE AID ENGINEER

3.3.3. The calculation of the standard deviation, s , and the required average strength, f'_{cr} .

3.3.4. Aggregate sampling and analyses for both coarse and fine aggregates, per Subsections 2.2.2 and 2.2.3 above, shall be performed within 30 days of the JMF submittal.

4. LABORATORY TRIAL MIXTURE

- 4.1. When an acceptable record of field test results is not available, concrete mixture proportions are to be established based on laboratory trial mixtures.
- 4.2. The combination of materials shall be those intended for use in the proposed work.
- 4.3. Trial mixtures having proportions and consistencies suitable for the proposed work shall be made using ACI 211.1 as a guide to proportion the JMF.
- 4.4. Trial mixtures shall be designed to produce a slump within $\pm \frac{3}{4}$ in. of the maximum permitted, and for air-entrained concrete, 6.0 ± 0.5 percent total air content. The temperature of freshly mixed concrete in trial mixtures shall be reported.
- 4.5. Aggregate samplings and analyses for both coarse and fine aggregates, per Subsections 2.2.2 and 2.2.3 above shall be performed within the previous 30 days of the beginning of the trial mixture compressive test cylinders curing period. The fineness modulus from the aggregate analysis shall be within ± 0.20 of the approved base modulus.
- 4.6. For each proposed JMF, at least three (3) compressive test cylinders shall be made and cured in accordance with AASHTO Designation: T 126. Each change of water-cementitious material ratio shall be considered a new mixture. The cylinders shall be tested for strength in accordance with AASHTO Designation: T 22. Cylinders may be tested for compressive strength at any time for compliance with the average strength requirements specified in Subsection 4.7 below.
- 4.7. The required average strength of laboratory trial mixtures shall exceed f'_c by 1200 psi for JMF's specified less than 5000 psi, and by 1400 psi for JMF's specified of 5000 psi or more.

OFFICE OF STATE AID ROAD CONSTRUCTION			S.O.P. NO. SA II-3-20
STANDARD OPERATING PROCEDURES			Page 5 of 6
Subject: S.O.P. APPROVAL OF CONCRETE JOB MIX FORMULAS			Distribution A, B, C, D, E
EFFECTIVE July 1, 2005	ISSUED July 1, 2005	SUPERSEDES Page of S.O.P. NO. EFFECTIVE:	APPROVED J. Brooks Miller, Sr. STATE AID ENGINEER

4.8. The following data shall be submitted with the mix design:

Maximum* Permitted Slump
Air Content
Unit Weight
Yield
Compressive Strength Tests

*Maximum permitted slump is the maximum slump assigned by the JMF designer to fit the application. This may be less than the maximum allowable slump as listed in the specification. Currently, the primary application where the maximum permitted slump is desired to be less than the maximum allowable slump is slip-form casting, but other applications may exist and be used. For a maximum permitted slump less than the maximum allowable slump the batching tolerances listing in the specification still apply.

5. JMF TRANSFER

5.1. When a concrete production facility has a previously approved JMF with previously approved field verification data, the JMF may be transferred to another project. The following additional information shall be submitted:

5.1.1. A letter from the County Engineer stating the use of similar materials and conditions.

5.1.2. Previously approved field verification data for the JMF.

OFFICE OF STATE AID ROAD CONSTRUCTION			S.O.P. NO. SA II-3-20
STANDARD OPERATING PROCEDURES			Page 6 of 6
Subject: S.O.P. APPROVAL OF CONCRETE JOB MIX FORMULAS			Distribution A, B, C, D, E
EFFECTIVE July 1, 2005	ISSUED July 1, 2005	SUPERSEDES Page of S.O.P. NO. EFFECTIVE:	APPROVED J. Brooks Miller, Sr. STATE AID ENGINEER

6. JMF REVISION

6.1. The Contractor shall submit to the County Engineer JMF revisions prior to production of the revised JMF. For JMF's used on multiple projects, the Contractor shall submit to each applicable County Engineer the revision. The following information shall be included with a revised JMF:

6.1.1. Mixture Proportions

6.1.2. Written justification for the change corresponding to one or more of the following:

- Change in Source of Materials, per Section 7 below
- Adjustment in the proportion of materials to comply with the field acceptance criteria
- Mixture optimization

6.2. For JMF's currently assigned to the project, the County Engineer may tentatively approve the JMF pending acceptable field verification.

6.3. For JMF's currently assigned to the project, the County Engineer will follow the submittal process in Subsection 1.2 above.

7. CHANGE IN SOURCE OF MATERIALS

7.1. CEMENT A change in cement supplier, but not type, does not require a new JMF. The existing JMF must be submitted identifying the new supplier. The mill certifications for the new cement source shall also be submitted. A sample of both the old and new cement must be submitted to the Central Laboratory for a color comparison. A new field verification will be required.

7.2. CHEMICAL ADMIXTURES A change in chemical admixture(s) supplier, but not type, does not require a new JMF. The existing JMF must be submitted identifying the new supplier and admixture(s). The certification(s) for the admixture(s) shall also be submitted. A new field verification will be required.

7.3. POZZOLANIC MATERIALS A change in source of pozzolanic materials requires a new JMF by either previous field experience or laboratory trial batch. The JMF shall then be field verified.

7.4. AGGREGATES A change in aggregate source requires a new JMF by either previous field experience or laboratory trial batch. The JMF shall then be field verified.