State of Illinois
Department of Transportation
Bureau of Materials
POLICY MEMORANDUM
Springfield

Revised: June 1, 2017 20-08.3
This Policy Memorandum supersedes number 20-08.2 dated November 1, 2013

TO: REGIONAL ENGINEERS AND HIGHWAY BUREAU CHIEFS

SUBJECT: FIELD TEST PROCEDURES FOR MIXER PERFORMANCE AND CONCRETE UNIFORMITY TESTS

## I. SCOPE

These methods describe the procedures for obtaining and testing representative samples of fresh concrete in the field to determine the consistency and mixer efficiency of stationary mixers at different mixing time periods.

The concrete produced during the mixing time investigation and not used in the test program may be incorporated in the project provided it conforms with the Standard Specifications for Road and Bridge Construction.

As specified in Article 1020.11(c) a maximum of two mixing times will be considered by the Department. The Contractor shall provide all of the necessary equipment and personnel to perform the tests, and the Department will observe the testing.

## II. EQUIPMENT

The following equipment shall be provided by the Contractor.

a. Three (3) air meters according to Illinois Modified AASHTO T 152.

b. Three (3) slump cone kits according to Illinois Modified AASHTO T 119.

c. One (1) No. 4 sieve with a minimum screen area of 0.19 $m^2$ (2 sq. ft.) according to AASHTO M 92.

d. One (1) unit weight weighing equipment according to Illinois Specification 101, “Minimum Requirements for Electronic Balances”.

e. Flexural strength molds according to Illinois Modified AASHTO T 23, or compressive strength molds according to Illinois Modified AASHTO T 23.

f. Strength testing apparatus according to Illinois Modified AASHTO T 22 or T 177.

g. Curing equipment according to Illinois Modified AASHTO T 23.

h. Small tools such as shovels, scoops, buckets, etc., and water shall be furnished as required.

## III. PROCEDURE

For an initial request, a minimum of ten (10) batches per drum shall be tested and evaluated for each original reduced mixing time. If the initial request is for a twin drum mixer, ten (10) batches shall be tested for the first drum and three (3) for the second drum.

Subsequent verification or a check test, consisting of three (3) batches, shall be required if the mixer is moved, major maintenance is performed (such as replacement of the mixer blades), the source/type/gradation of aggregate has changed, the batching sequence/procedure is altered, or twelve (12) months have elapsed between an initial or subsequent verification. For a twin drum mixer, a check test consisting of three (3) batches shall be performed on each drum. The Engineer reserves the right to request a check test if concrete build up or mixer blade wear is determined to be a concern because of use.

a. Mixing.

The mixing time and batch size to be evaluated shall be proposed by the Contractor. A tolerance of two (2) seconds will be permitted for the mixing time.

If approved by Engineer, minor adjustments in admixture dosage and water content will be allowed to account for weather conditions, provided that the maximum w/c ratio is not exceeded.

In the event of a plant malfunction, the Engineer will determine the need for a new batch.

b. Sampling.

At the conclusion of the mixing cycle, the mixer shall be discharged and appropriate samples obtained from the first, middle, and last third portions of the batch. Samples shall be obtained according to Illinois Modified AASHTO R 60.

As an alternate, the mixer may be stopped, and the samples removed by any suitable means at equally spaced points from the front to the back of the drum.

c. Testing.

1. Each third portion of the batch shall be tested simultaneously. The Contractor shall provide sufficient personnel to meet this requirement. The Contractor personnel performing the testing shall be Level I PCC Technicians or Concrete Testers. However, a Level I PCC Technician shall be provided to supervise the Concrete Tester.

2. From each third portion of the batch the mass (weight) of the concrete in one air meter measuring bowl shall be determined.

3. The air content of each third portion of the batch shall be determined according to Illinois Modified AASHTO T 152. The air content shall be

the arithmetic average of two (2) tests from each third portion of the batch.

4. The target slump will be determined by the Engineer, but shall be a maximum 63 mm (2.5 in.). The slump of each third portion of the batch shall be determined according to Illinois Modified AASHTO T 119. The slump shall be the arithmetic average of two (2) tests from each third portion of the batch.

5. Flexural strength specimen(s) (two (2) breaks required) or two (2) compressive strength specimens shall be prepared from each third portion of the batch according to Illinois Modified AASHTO T 23. Flexural strength specimen(s) (two (2) breaks required) shall be tested according to Illinois Modified AASHTO T 177 at seven (7) days of age. Compressive strength specimens shall be tested according to Illinois Modified AASHTO T 22 at seven (7) days of age.

6. The contents from the weighed air meter measuring bowl (Step 2) shall be washed over a No. 4 sieve. Shake as much water as possible from the material retained on the sieve and then weigh the material The coarse aggregate content (portion of mass (weight) of sample retained on a No. 4 sieve), expressed as a percent, shall be calculated.

7. After the required number of batches have been mixed and tested at the proposed mixing time, the mixing time shall revert back to the minimum time allowed without mixer performance testing, as specified in Article 1020.11(c).

## IV. CONCRETE UNIFORMITY REQUIREMENTS

a. Test results from each third portion of the batch shall be compared to one another according to TABLE 1. Each batch shall be evaluated individually.

b. Mixer performance tests consisting of ten (10) batches: If more than seven (7) tests out of the total or more than three (3) in any one criteria are not in compliance with the uniformity requirements (air content, slump, coarse aggregate content, and strength), a reduced mixing time will not be granted.

c. Mixer performance tests consisting of three (3) batches: If more than three (3) tests out of the total are not in compliance with the uniformity requirements, a full ten (10) batch investigation shall be required.

| TABLE 1 - REQUIREMENTS FOR UNIFORMITY OF CONCRETE | | |
|---|---|---|
| Test | Requirement (Note 1) | |
| Air Content, percent by volume of concrete | 1.0 | (Note 2) |
| Slump, mm (inch) | 25 (1.0) | (Note 3) |
| Coarse aggregate content, portion by mass (weight) of each sample retained on the No. 4 sieve, percent | 6.0 | |
| Average flexural or compressive strength at 7 days for each sample based on average strength of all comparative test specimens, percent | 7.5 | (Note 4) |

Note 1. Expressed as maximum permissible difference in results of tests of samples taken from three locations in the concrete batch.

Note 2. The average air content sample shall be the arithmetic average of two (2) tests.

Note 3. The average slump sample shall be the arithmetic average of two (2) tests.

Note 4. The average flexural strength of each sample shall be the arithmetic average of two (2) beam breaks. The average compressive strength of each sample shall be the arithmetic average of two (2) cylinder breaks.

**V. REPORT**

Send copies of the report to the Bureau of Materials, District Materials office, and the Resident Engineer/ Technician if applicable.

Brian A. Pfeifer, P.E.
Engineer of Materials

Attachments

JMK/jab/jy

The following pages include a three batch example report and a blank ten batch report. A version of the spreadsheet with calculations following this Policy Memorandum is available to be downloaded from the IDOT web page.

# MIXER PERFORMANCE TESTS

| | | | | | |
|---|---|---|---|---|---|
| Plant Name | W.S Babbitt | Serial Number | 123-456 | County | Sangamon |
| Mixer Capacity | 9 cy | Capacity Checked | 9 cy | Section | (14-3,3-1)RS-2 |
| Mixer Make | Erie | Mixing Time Checked | 60 sec. | Route | I-55 |
| Contractor | Doland & Sons | Approved Mixing Time | 75 sec. | District | 6 |
| Mix Design Used | 86PCC1234 | Date | 09/30/2002 | Contract Number | 94270 |
| | | Drum RPM | 20 | Job Number | C-97-062-94 |
| | | | | Project | IM-57-3(133)94 |

| Batch No. | Test No. | Slump (in) | Average | Total Var.(in) | Air (%) | Average | Total Var. (%) | Conc. Wt. | Plus #4 Wt. | CA % | Total Var. (%) | Strength (psi) | Avg. psi | Tot. Avg. | % of Average | Total Var. from Average | Maximum Var. from Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2.50 | 2.38 | 0.25 | 4.9 | 4.70 | 0.60 | 30.62 | 16.56 | 54.08 | 3.33 | 3890 | 3899 | 3961 | 98.4 | 1.6 | 5.2 |
| | | 2.25 | | | 4.5 | | | | | | | 3908 | | | | | |
| | 2 | 2.50 | 2.50 | | 5.4 | 5.30 | | 30.69 | 17.62 | 57.41 | | 3749 | 3820 | | 96.4 | 3.6 | |
| | | 2.50 | | | 5.2 | | | | | | | 3890 | | | | | |
| | 3 | 2.75 | 2.63 | | 5.0 | 5.15 | | 30.50 | 17.31 | 56.75 | | 3908 | 4165 | | 105.2 | 5.2 | |
| | | 2.50 | | | 5.3 | | | | | | | 4421 | | | | | |
| 2 | 1 | 2.50 | 2.63 | 0.12 | 4.2 | 4.10 | 1.10 | 31.00 | 16.50 | 53.23 | 2.22 | 3378 | 3466 | 3578 | 96.9 | 3.1 | 4.3 |
| | | 2.75 | | | 4.0 | | | | | | | 3554 | | | | | |
| | 2 | 2.75 | 2.63 | | 5.0 | 4.85 | | 30.87 | 16.87 | 54.65 | | 3554 | 3731 | | 104.3 | 4.3 | |
| | | 2.50 | | | 4.7 | | | | | | | 3908 | | | | | |
| | 3 | 2.75 | 2.75 | | 5.4 | 5.20 | | 31.00 | 17.19 | 55.45 | | 3537 | 3537 | | 98.9 | 1.1 | |
| | | 2.75 | | | 5.0 | | | | | | | 3537 | | | | | |
| 3 | 1 | 2.00 | 1.88 | 0.25 | 7.8 | 7.65 | 0.55 | 30.12 | 16.94 | 56.24 | 1.76 | 3908 | 3820 | 3840 | 99.5 | 0.5 | 1.3 |
| | | 1.75 | | | 7.5 | | | | | | | 3731 | | | | | |
| | 2 | 1.75 | 1.75 | | 6.9 | 7.15 | | 30.50 | 17.69 | 58.00 | | 3890 | 3890 | | 101.3 | 1.3 | |
| | | 1.75 | | | 7.4 | | | | | | | 3890 | | | | | |
| | 3 | 1.50 | 1.63 | | 7.2 | 7.10 | | 30.31 | 17.12 | 56.48 | | 3890 | 3811 | | 99.2 | 0.8 | |
| | | 1.75 | | | 7.0 | | | | | | | 3731 | | | | | |
| 4 | 1 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| 5 | 1 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

# MIXER PERFORMANCE TESTS

Plant Name _____
Mixer Capacity _____
Mixer Make _____
Contractor _____
Mix Design Used _____

Serial Number _____
Capacity Checked _____
Mixing Time Checked _____
Approved Mixing Time _____
Date _____
Drum RPM _____

County _____
Section _____
Route _____
District _____
Contract Number _____
Job Number _____
Project _____

| Batch No. | Test No. | Slump (in) | Average | Total Var.(in) | Air (%) | Average | Total Var. (%) | Conc. Wt. | Plus #4 Wt. | CA % | Total Var. (%) | Strength (psi) | Avg. psi | Tot. Avg. | % of Average | Total Var. from Average | Maximum Var. from Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| 2 | 1 | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| 3 | 1 | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| 4 | 1 | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| 5 | 1 | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |

# MIXER PERFORMANCE TESTS

Plant Name _____
Mixer Capacity _____
Mixer Make _____
Contractor _____
Mix Design Used _____

Serial Number _____
Capacity Checked _____
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County _____
Section _____
Route _____
District _____
Contract Number _____
Job Number _____
Project _____

| Batch No. | Test No. | Slump (in) | Average | Total Var.(in) | Air (%) | Average | Total Var. (%) | Conc. Wt. | Plus #4 Wt. | CA % | Total Var. (%) | Strength (psi) | Avg. psi | Tot. Avg. | % of Average | Total Var. from Average | Maximum Var. from Average |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 1 | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| 7 | 1 | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| 8 | 1 | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| 9 | 1 | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |
| 10 | 1 | | | | | | | | | | | | | | | | |
| | 2 | | | | | | | | | | | | | | | | |
| | 3 | | | | | | | | | | | | | | | | |