I. SCOPE

This procedure describes the process that a precast manufacturer must follow to get a Self Consolidating Concrete (SCC) mix design qualified for use under the Precast QC/QA Program, what routine daily production testing is required, and what additional daily testing will be required if segregation problems are identified.

II. CONTENTS

I. Scope ..................................................................................................................1
II. Contents .............................................................................................................1
III. Definitions..........................................................................................................1
IV. General Method .................................................................................................2
V. Normal Production Testing ................................................................................4
VI. Identification of Concrete Segregation ..............................................................4
VII. Production Testing When Segregation Has Been Identified .........................4

III. DEFINITIONS

a. Self Consolidating Concrete (SCC) – A class of concrete which, under its own weight, is able to flow into and fill formwork with little or no consolidation effort while remaining a homogenous mixture.

b. Department - The New York State Department of Transportation.

c. Materials Bureau – A facility of the New York State Department of Transportation which may be contacted by mailing to:

   Director, Materials Bureau
   New York State Department of Transportation
   Materials Bureau, Mail POD 51
   50 Wolf Road
   Albany, NY 12232
   or by telephone at (518) 457-5956, or by fax at (518) 457-8171.

d. Precast QC/QA Program – A program administered by the Materials Bureau under which precast products are produced with all quality control activities being performed by the precast manufacturer and quality assurance activities performed by the Department.
e. **BR 155** – A Department form, filled out by the precast manufacturer, which identifies component materials used in a concrete mix design by type, source and quantity used and includes some test properties.

f. **SCC Spread** – A physical property of SCC which measures a mixture’s ability to flow under its own weight. Spread values are obtained by performing a slump flow test on a concrete sample.

g. **SCC Segregation** – The separation of component materials in a concrete mixture, during and/or after handling and placement, usually identified by the settling of coarse aggregate particles or the rise of air and water towards the surface.

### IV. GENERAL METHOD

Precast manufacturers wishing to use SCC under the Precast QC/QA Program must first develop a mix design, and then it must be qualified in accordance with this procedure before it can be used. When changes are made to an SCC mix design it must be re-qualified. Changes to a mix design which will require re-qualification of the design include:

- Any change in the type, brand or source of component materials identified on the BR 155 Precast Concrete Mix Design form.
- Any change to target batch weights identified on the BR 155, other than minor (less than 100 lb/cy) changes to aggregate batch weights due to fluctuations in Fineness Modulus (FM).
- Any change made to the Spread Range values identified on the BR 155.

Witnessing of qualification testing by a Department representative is not required. An SCC mix design may be put into use once successful qualification tests have been completed, the required documentation is on file and available and a copy of the BR 155 has been forwarded to the Materials Bureau. No further Department approvals are required.

**A. Material Requirements:** Component materials used in SCC mixes must meet the material requirements contained in Department Standard Specification Section 704-03 Precast Concrete – General. In addition, High Range WaterReducers (HRWR) proposed for use must be intended for use in SCC, as indicated in the admixture manufacturer’s product literature. If a Viscosity Modifying Admixture (VMA) is proposed for use, it must be one which is compatible with other admixtures being used. (Note that at the time this issuance was published, the Department did not have an Approved List of VMAs.)

**B. Qualification Process:** Once a mix design has been developed it must be qualified before it may be used. The concrete batched for qualification testing must be produced in the batch plant routinely used by the precast manufacturer for QC/QA production, following normal batching procedures. Manufacturers
may choose to run either a one point or a two point qualification in accordance with the following:

1. **One Point Qualification** – One batch of concrete is produced and tested to qualify the mix design. The measured spread must be within +/-1” of the desired target value. If all remaining qualification tests are acceptable the mix is qualified at the target spread value. This method restricts the spread range recorded on the BR-155 to within +/-2” of the target. (e.g. A mix is designed with a target spread of 25”, the spread on the qualification batch is measured at 24.5”, all remaining qualification tests are acceptable, the target spread is recorded as 25”, the spread range is recorded as 23”–27”)

2. **Two Point Qualification** – Two batches of concrete are produced and tested to qualify the mix design. One batch establishes the lower spread limit and the other establishes the upper spread limit. Both batches are produced to the same mix design with the only difference being the HRWR dosage rate. In order to use the spread value obtained from a batch to establish the upper or lower spread limit, all qualification tests on the batch must be acceptable. The lower spread limit recorded on the BR-155 must be within +/-1” of the spread measured in the qualification test from one batch and the upper spread limit must be within +/-1” of the spread measured in the qualification test on the other batch. (e.g. Spread values of 22” and 27” are measured on two qualification batches, all remaining qualification tests on both batches are acceptable, the manufacturer selects a lower spread limit between 21” and 23” and an upper spread limit between 26” and 28”, the manufacturer selects a target spread between the lower and upper limits.)

C. **Qualification Tests:** The following tests must be run by the precast manufacturer or their representative on each batch of concrete used for qualification testing:

1. Slump Flow (Spread) Test in accordance with ASTM C1611.
2. Visual Stability Index (VSI) in accordance with ASTM C1611. The value obtained must be either 0 or 1 to be acceptable.
3. J-Ring Passing Ability in accordance with ASTM C1621. The measured difference between the Slump Flow and J-Ring Flow must be 2” or less to be acceptable.
4. Static Segregation Using Column Technique in accordance with ASTM C1610. The measured percent static segregation must be 15% or less to be acceptable.
5. Static Segregation Resistance Using Penetration Test in accordance with ASTM C1712. The measured penetration must be less than 1” to be acceptable.
6. Air Content in accordance with ASTM C231, as modified for use with SCC in the precast manufacturer’s Quality Control Plan (QCP). The value obtained must be within the air content range recorded on the BR 155.
7. Compressive Strength of Cylinders in accordance with ASTM C39. The average value obtained from a pair of cylinders, broken at an age of 28 days or
less, must be equal to or greater than the design strength recorded on the BR 155. (See QC/QA Program requirements for determining an average when one cylinder break is below design strength.) Casting of cylinders using SCC shall be in accordance with the precast manufacturer’s QCP.

D. Documentation: Qualification test results must be documented in a clear and legible format. The following information shall be included in the documentation for each qualified SCC mix design:

1. A copy of the BR 155
2. A copy of the batch ticket for the batch of concrete that was tested
3. Corresponding results from each of the tests performed
4. Name of the person performing the tests and the date tests were performed

V. NORMAL PRODUCTION TESTING

Normal production testing of SCC mixes shall be in accordance with the requirements contained in the current Precast QC/QA Materials Procedure. Tests shall include air content, compressive strength, slump flow and VSI.

VI. IDENTIFICATION OF CONCRETE SEGREGATION

SCC mixes can be susceptible to segregation due to fluctuations in aggregate moisture content, admixture dosage rates, concrete temperatures, handling and placement practices, etc. As part of its auditing process, the Department will evaluate hardened concrete for signs of segregation by visual evaluation of spalled concrete areas and concrete cores. A noticeable non-uniform distribution of coarse aggregate within the concrete item, usually occurring in the top (as cast) ¼” to ½” of concrete, will be considered a segregation problem requiring corrective action by the manufacturer. Plastic concrete which appears excessively “wet” may also be evaluated for segregation.

VII. PRODUCTION TESTING WHEN SEGREGATION HAS BEEN IDENTIFIED

When the Department identifies segregation of SCC at a precast facility, the manufacturer will be notified that corrective actions are necessary. When subsequent audits continue to identify segregation, the Department’s Quality Assurance Manager (QAM) will direct the precast manufacturer to include daily static segregation testing in their normal production testing routine for the affected mix design. Precast manufacturers will have the best knowledge of their operations and will have to formulate corrective actions to address segregation. The Department will verify the success of those corrective actions by evaluating daily production test data generated by the precast manufacturer and by performing a visual evaluation on concrete from a finished product.
A. **Test Method:** Static segregation tests shall be run in accordance with ASTM C1712 Static Segregation Resistance Using Penetration Test. The measured penetration must be less than 1” in order for the batch to be considered acceptable for use.

B. **Test Frequency:** When a precast manufacturer has been directed to run static segregation tests on a mix design, every batch of concrete produced to that mix design must be tested for static segregation, spread and VSI.

C. **Documentation of Test Results:** Test results for static segregation, spread and VSI shall be recorded on the Manufacturer’s NYSDOT Daily Production Work Sheet.

D. **Return to Normal Production Testing:** Static segregation tests must be run on the affected mix design for a minimum of 10 days. If after 10 days fewer than 20 batches of concrete have been tested, testing shall continue for additional days until at least 20 batches have been tested. After the initial testing period the precast manufacturer may request to discontinue daily static segregation testing when, based on their test results and observations they feel the problem has been corrected. Requests, either written or e-mailed shall be forwarded to the QAM and shall include the following information:

1. A description of all corrective actions which have been implemented to correct the segregation problem.
2. Proposed Quality Control Plan (QCP) revisions, when appropriate.
3. All static segregation, spread and VSI test results for the SCC mix from the testing period. (Identify the corresponding production date and batch ID number for each of the test results reported. Include test results for batches which had unacceptable penetration, spread and/or VSI values.)

If the supporting information is not found to be acceptable, the manufacturer will be notified why and directed to continue testing as outlined above. When the supporting information provided by the precast manufacturer is found to be acceptable, the QAM will request that a minimum of one core be taken from a unit produced during the test period for visual evaluation. The Department’s representative will select the unit to be cored and the location where the core is to be taken. If there are no signs of segregation in the core the manufacturer will be notified that daily static segregation testing may be discontinued. If the core does show signs of segregation the manufacturer will be notified that further corrective actions are required. When a manufacturer is unable to identify and correct the problems causing segregation, approval to use the affected mix design or to use SCC mixes in general may be withdrawn by the Department.