



BUILDINGS BULLETIN 2010-018

Technical

Supersedes: None

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Purpose: This document establishes the Department's requirements for preparing and submitting concrete mix designs, procedures for acceptance of field changes to an approved concrete mix design, and acceptance testing of concrete associated with field changes.

Related Code Section(s): BC Table 1704.4 BC 1905.3 BC 1905.5 BC 1905.8
BC 1905.2 BC 1905.4 BC 1905.6 1 RCNY 101-07

Subject(s): Concrete, cast-in-place, concrete design mix; Concrete, concrete proportions, field experience; Concrete, concrete proportions, trial mixtures.

A. Concrete mix designs

Where the 2008 NYC Building Code requires a concrete mix design, the Department requires the submittal of a Concrete Design Mix Technical Report, TR3, prior to permit. The TR3 requires a Department licensed concrete testing laboratory to state the concrete proportions for each mix listed. This form also requires the director of a concrete testing lab to certify that all testing performed to verify the suitability of concrete proportions was conducted according to the Building Code and under the director's supervision. As per 1 RCNY §101-07 (c)(ix) a Department licensed concrete testing laboratory that provides the concrete mix design for a given project shall not perform acceptance testing of the concrete pursuant to section BC 1905.6 and BC table 1704.4 **on the same project.**

B. Determining concrete proportions

Building Code section BC 1905.3 allows concrete proportions to be determined either by field experience or trial mixtures. A TR3 must be submitted with all applicable support documentation (i.e. trial mixture reports or field experience data).

1. Proportions on the basis of field experience

Section BC 1905.3 permits concrete proportions to be determined on the basis of field experience in accordance with ACI 318 "*Building Code Requirements for Structural Concrete*"¹ section 5.3. Consecutive strength tests used to verify the adequacy of concrete proportions shall meet the following criteria:

- a. In accordance with ACI 318 section 5.3.1.1 (a), test data shall represent similar proportions, materials of similar densities and admixtures.
- b. In accordance with ACI 318 section 5.3.1.1 (b), test data shall represent concrete having a compressive strength within 1,000 psi of the concrete being certified for proposed work.

- c. Test data shall not be older than one year measured from the date the concrete was placed.

2. Proportions on the basis of trial mixtures

When acceptable test data is unavailable, trial mixtures prepared in accordance with ACI 318 section 5.3.3.2 shall be used to determine concrete proportions as required by section BC 1905.3. Trial mixtures shall be prepared and reported by a Department licensed concrete testing laboratory under the supervision of the laboratory director. The following restrictions imposed by the Department and ACI 318 section 5.3.3.2 shall be used to prepare trial mixtures:

- a. In accordance with ACI 318 section 5.3.3.2 (b), trial mixtures having proportions and consistencies required for proposed work shall be made using at least three different water-cement material ratios or cementitious materials contents that will produce a range of strengths encompassing the required average strength f'_{cr} .
- b. In accordance with ACI 318 section 5.3.3.2 (d), for each water cementitious materials ratio or cementitious material content, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C192, "*Method of Making and Curing Concrete Test Specimens in the Laboratory*"². Cylinders shall be tested at 28 days or at a test date designated for determination of f'_{c} .
- c. Only trial mixtures batched and tested within the past year by a Department licensed concrete testing laboratory shall be acceptable to the Department. The past year shall be measured from the date of mixing the trial batch.

See ACI 318 section 5.3.3.2 for additional requirements.

3. Field changes to concrete proportions which do not require determination on the basis of trial mixtures.

Based on test data and observations during the course of construction, changes to concrete mixture proportions may be required. Section BC 1905.2.2 states that where different materials are used for different portions of proposed work, each combination shall be evaluated. ASTM C94 "*Specification for Ready Mix Concrete*"³ also describes adjustments to admixture quantities. The changes to concrete mix proportions described in sections 3.1 and 3.2 below are permitted without requiring additional trial mixtures, provided the following general requirements are met:

- a. Materials - There are no changes to the type and source of materials.
- b. Batch Tickets – In accordance with section BC 1905.8.2, the applicant of record for the structural design shall require batch tickets supplied by the concrete producer to accompany every load of concrete delivered to the site. The batch tickets shall be given to the concrete testing laboratory responsible for the field testing in accordance with section BC 1905.6.2.
- c. Admixtures - The range of admixture dosages shall be as specified in documentation provided by the admixture manufacturer. The compatibility of admixtures added to the concrete shall be verified by the admixture manufacturer. Final admixture quantities shall be indicated on the batch ticket by the concrete producer and shall not exceed the manufacturers recommended dosage.
- d. The changes described in this bulletin cannot be used for the submission of an initial mix design to demonstrate that a previously prepared mix design meets strength or air content requirements that differ from the original mix design without compressive strength test results as described in section B.1 above or trial mixtures complying with section B.2 above.
- e. Documentation - Documentation of these changes shall be maintained by the concrete producer and the concrete contractor. Changes may require prior approval of the applicant of record. See section B.3.2 below. Where required in section B.3.2, documentation of these changes shall be submitted for acceptance to the applicant of record for the structural design by the concrete producer. Copies of the revised mixtures shall be maintained at the construction site and provided to the licensed concrete testing laboratory performing the field and strength testing of concrete per item 4 of table BC 1704.4. This documentation shall be made available to the Department upon request.

- f. Any changes beyond this scope shall be verified by at least a one-point trial mixture performed by a concrete testing laboratory licensed by the Department.

3.1 Changes that do not require prior approval of the applicant of record for the structure.

The following admixture modifications to the concrete proportions can be made without requiring prior acceptance by the applicant of record:

- a. Air-entraining admixtures - Air entraining admixture dosages can be increased or decreased as needed to obtain the air content specified in the contract documents.
- b. Water reducing admixtures - Water reducing admixture dosages can be increased or decreased to produce the specified workability, provided that the design water is not exceeded and the changes do not segregate the concrete mix.

3.2 Changes that require prior approval of the applicant of record for the structure.

The following modifications to the concrete proportions can be made only with prior acceptance by the applicant of record. Any added materials and the final mix proportions shall be indicated in a revised mix design submitted to the applicant of record prior to use:

1. Retarding and Accelerating admixtures - Retarding and accelerating admixture dosage can be added or modified as needed to maintain practical set times.
2. Pigment - Pigment dosage may be adjusted to maintain uniform concrete color.
3. Fibers - Synthetic, glass or natural fibers may be added to the mix within the manufacturer recommended range, but not steel fibers. Any loss in workability shall be compensated with a water reducer.
4. Corrosion inhibitor - Corrosion inhibiting admixtures may be added provided the corresponding adjustment of mix water shall be made to remain within the limits of the required water/cementitious material ratio. The added materials and the revised design mix shall be submitted for review by the applicant of record for the structure prior to use.
5. Cementitious content and Water-Cementitious Materials Ratio (w/cm) - The cementitious content can be increased by a maximum of 12%, or the w/cm ratio can be decreased while maintaining the same cementitious content, but the w/cm and air content shall not be increased. Aggregate quantities shall be adjusted as required to maintain the mix proportion and yield.

3.3 Acceptance testing requirements.

Acceptance testing of concrete shall be performed by a Department licensed concrete testing laboratory in accordance with section BC 1905.6.2 and BC table 1704.4. Changes made to the concrete proportions shall require confirmatory tests be performed by a Department licensed concrete testing laboratory to verify acceptance. Sampling and acceptance tests shall be performed after any of the field additions stated in sections B3.1 and B3.2 have been made. In addition to the evaluation and acceptance testing required by sections BC 1905.6 and BC 1704.4, the following tests shall be performed on fresh concrete when field changes have been made:

- a. Changes in water-reducing admixture quantities of the concrete shall require a slump test.
- b. Changes in air-entraining admixture quantities of the concrete shall require an air-content test complying with ASTM C173, "*Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method*"⁴ or ASTM C231, "*Test Method for Air Content of Freshly Mixed Concrete by Pressure Method*"⁵.
- c. Changes outlined in section B3.2 of this bulletin shall require a complete set of field tests and strength specimens be made even if tests performed prior to the field change constitute a code compliant frequency.
- d. Following field modifications, when slump or air content measurements exceed the specified limits for the project and the concrete is accepted for placement, additional specimens shall be made for compressive strength testing in accordance with ASTM C31, "*Practice for Making and Curing Test Specimens in the Field*"⁶.

In addition to the documentation of changes by the concrete producer, the laboratory performing the acceptance testing shall document any changes made to the concrete proportions in the field reports. The reports required by section BC 1905.6.1 shall be provided to the registered design professional of record, the concrete producer, the owner, and the contractor within seven calendar days.

**Referenced
Standards:**

1. ACI 318-02 *"Building Code Requirements for Structural Concrete"*
2. ASTM C192-07 *"Method of Making and Curing Concrete Test Specimen in the Laboratory"*
3. ASTM C94-00 *"Specification for Ready-Mixed Concrete"*
4. ASTM C173/C173M *"Test Method for Air Content of Freshly Mixed Concrete by Volumetric Method"*
5. ASTM C231 *"Test Method for Air Content of Freshly Mixed Concrete by Pressure Method"*
6. ASTM C31/C31M-98 *"Practice for Making and Curing Test Specimens in the Field"*