

06005 Ready Mixed Concrete**Index**

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06005-1 Reference to Standard Specifications

Reference in these Specifications will be made to the latest edition of the Canadian Standards Association (C.S.A.) for Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

06005-2 Concrete Aggregate

Aggregate shall consist of clean, hard, durable, crushed stone or gravel free from lumps, soft and flaky particles, organic matter, salt, alkali, free from adherent coatings and shall conform to the C.S.A. Standard Specification for Concrete Aggregates.

2.1 Aggregate Rejection**2.1.1 Fine Aggregate:**

Aggregate shall comply with the grading requirements of C.S.A. Standard Specifications.

Aggregate shall be rejected if it:

1. Produces a colour darker than the reference standard specified in the C.S.A. Test Method for Organic Impurities in Sands for Concrete.
2. Contains more than 1% clay lumps, as determined by C.S.A. Methods.
3. Contains more than 3% of material finer than **80** um sieve.

2.1.2 Coarse Aggregate:

Coarse aggregate shall be 20mm nominal and comply with the grading requirements of C.S.A. Standard Specifications.

Aggregate shall be rejected if it:

1. Contains clay lumps in excess of 0.3% as determined by C.S.A. Methods.
2. Contains more than 1% of material finer than the No. 80 um Sieve.
3. Percentage loss is greater than 35% as determined by the Los Angeles Abrasion Test described in C.S.A. Methods.
4. Contains more than 0.5% low density material as determined by C.S.A. Methods.

06005-3 Tests on Concrete Aggregate

The Contractor shall have a Testing Laboratory, approved by the Engineer, perform certain tests on the concrete aggregate according to the current C.S.A. Specifications.

The Contractor shall, at his own expense, supply the following material tests:

1. Wash Sieve Analysis - C.S.A. - A23.2-2A / C.S.A. - A23.2-5A.
2. Organic Impurities - C.S.A. - A23.2-7A.
3. Clay Lumps - C.S.A. - A23.2-3A.
4. Specific Gravity Test - C.S.A. - A23.2-6A for sand and A23.2 - 12A for course aggregate.
5. Los Angeles Abrasion Test - C.S.A. - A23.2-16A & C.S.A. - A23.2-17A.
6. Test for Soundness of Aggregate - C.S.A. - A23.2-9A.
7. Low density material in aggregate - C.S.A. - A23.2-4A.

The above aggregate tests shall be submitted to the Engineer each year as follows:

1. Seven days before any concrete is placed.
2. During the first week in July.
3. During the first week in September.

The Contractor shall also, at his own expense, supply to the Engineer the proposed concrete mix design at least 7 days before any concrete is placed.

In the event that the original concrete design mix submitted to the Engineer requires changes, such design changes shall be approved by the Engineer or requested by the Engineer and a new concrete design mix shall be submitted at the cost of the Contractor. At no time shall the mix design be changed by the Contractor or concrete supplier unless approved by the Engineer.

All test or mix design reports shall be submitted in duplicate to the Engineer and whenever applicable, be compared to the current C.S.A. Standard or as specified. The report shall be complete and to the satisfaction of the Engineer.

06005-4 Cement

Cement used on the work shall be a type of Portland Cement conforming to C.S.A. - A23.3.1 unless a different type of cement is specified.

06005-5 Providing Chemical and Physical Tests on Cement

The results of the chemical and physical tests on the cement to be used in the production of the ready-mixed concrete shall be supplied to the City Engineer by the manufacturer of the cement. Frequency of tests shall be:

1. As specified by the Engineer.
2. Any time when there is a change in either the chemical or physical properties of the cement.

Copies of the test results supplied by the manufacturer of the cement will be sufficient, providing that they are certified.

One copy of the report shall be submitted within 5 days to the City Engineer and one copy to the supplier of the ready-mix concrete.

06005-6 Water

All water used for concrete shall be clean and free from injurious amounts of acid, oil, alkali, organic matter or other deleterious substances.

06005-7 Concrete Proportions and Consistency

The proportions of aggregates to cement for concrete shall be such as to produce a mixture which will work readily into the corners and angles of the forms without permitting the materials to segregate or excess free water to collect on the surface. The quantity of water used shall be the minimum necessary to produce workable concrete.

The consistency of the concrete shall be such that the slump shall not exceed 70mm or be less than 25mm for hand placed concrete, and less than 25mm for extruders when tested by the "Standard Method of Slump Test for consistency of Portland Cement Concrete" as described in C.S.A. A23.2-5C. Non-compliance with the slump specified shall constitute sufficient ground for rejection of the concrete.

06005-8 Mixing of Concrete

The mixing of concrete shall be done in an approved type of mixer which shall ensure a uniform distribution of materials throughout the mass so that the mixture is homogeneous and uniform in colour. The entire contents of the mixing drum shall be discharged before recharging and the drum shall be thoroughly cleaned at frequent intervals. The volume for the mixed material, per batch, shall not exceed the manufacturer's rated capacity of the mixer. The mixing of each batch shall continue for not less than 2 minutes after all the materials (including the water) are in the mixer, at the manufacturer's recommended speed.

Ready-mixed or/and transit mix concrete shall conform in every respect to all specifications herein contained and with the "Standard Specifications for Ready-Mixed Concrete" as described in C.S.A. specifications and shall further be subject to any additional written directions that the Engineer may deem necessary to ensure the obtaining of concrete of the quality specified.

06005-9 Flyash

Flyash shall not be used in concrete unless the mix design containing flyash has been approved in writing by the Engineer.

As a mineral admixture, flyash shall conform to C.S.A. specification. The material shall be sampled and tested by an independent testing laboratory and copies of the test results shall be submitted to the Engineer for approval.

Flyash shall not replace more than 20% by mass of cement in the concrete. The use of flyash will not be permitted in concrete placed after September 30 each year unless approval is given by the Engineer.

06005-10 Accelerating Admixtures

Accelerating admixtures may only be used in non-reinforced concrete with the approval of the Engineer.

The quantity accelerating admixtures shall be approved by the Engineer but at no time shall exceed 2% by weight of cement. Accelerating admixtures shall be used in the concrete when the air temperature is below 5° C or at the discretion of the Engineer.

06005-11 Winter Service and Sulphate Resistance

The Contractor shall submit additional unit prices per cubic metre for:

1. Heating concrete during cold weather construction.
2. Providing sulphate resistant - Type HS/HSb cement.
3. High early strength - Type HE cement.

06005-12 Tests on Concrete

During the progress of work, test cylinders will be taken to determine the quality of the concrete. There shall be a minimum of one test per 60 m³. Concrete tests will be done by a Testing Laboratory appointed by the Engineer and paid for by the City of Saskatoon unless otherwise specified. The following tests will be carried out:

1. Slump Test, as per Section 06005-7 of this Specification.
2. Air-Entraining Test, as per Section 06005-13, 06005-14 & 06005-15 of this Specification.
3. Concrete Compressive Strength (set of 3 test cylinders). One test cylinder will be broken at 7 days and two test cylinders will be broken at 28 days.

The Contractor shall provide, at his own expense, materials and facilities as the Engineer may require for carrying out the above mentioned tests.

The fresh concrete will be sampled in accordance with C.S.A. Specification.

Concrete with a slump greater than 75mm shall be rodded. Concrete with slump of 25mm to 75mm may be rodded or vibrated. Concrete with slump of less than 25mm shall be consolidated by vibration.

The concrete supplied shall have a basic minimum specified compressive strength at 28 days. The average of the 2 cylinders of any single test broken at 28 days shall be equal to or greater than the specified strength at 28 days.

Concrete compressive strengths are expressed in the metric designation of megapascals (MPa). The following standard compressive strengths are to be provided as requested:

20.0MPa, 25.0MPa, 30.0MPa, 32.0MPa, 35.0MPa.

Cores

The length of concrete cores shall be measured in accordance with the current C.S.A. Specification.

06005-13 Mix Design, Testing, and Deleterious Materials

Concrete shall meet CSA specifications unless otherwise specified. Concrete mix properties shall conform to exposure classification C-2 and air content is summarized as follows:

1. Minimum specified 28-day compressive strength: 32MPa
2. Maximum W/C ratio: 0.45
3. Air content: 5% to 8% (20mm aggregate)

The minimum Portland cement content shall be 285kg/m³ with a total minimum cementitious content of 330kg/m³.

Contrary to CSA, the time requirement for casting cylinders will be within 60 minutes from the time of sampling. All testing for slump, air content, and sample for casting cylinders will be done immediately after the first metre of concrete is removed from the concrete truck. Also, contrary to CSA, retempering of concrete to add air entrainment will only be considered for the first truck tested. Following a low air test the City will initiate another concrete test on the next load. The Contractor will be charged for the second concrete test.

In addition to the mix design testing requirements set out in Section 06005 - Ready Mixed Concrete, the Contractor shall provide the following information:

1. A legal description for the location of the source pits for the aggregates used in this contract.
2. A linear traverse, as per ASTM Standard C457, showing size and spacing of air bubbles entrained in the concrete.
3. Petrographic analysis as per ASTM Standard Practice C295.
4. Alkali-Silica Reactivity of Aggregate as per CSA A23.2 – 14A

In addition to the deleterious requirements contained in Clause 5.6 of CSA-A23.1-94, the following limits shall apply when the aggregate is tested in accordance with ASTM Standard Practice C295.

Table 1: Aggregate Testing Limits

Deleterious Substance	Maximum Percent by Mass of Total Sample	
	Fine Aggregate	Coarse Aggregate
Siliceous Shalestone (1)	1.0	0.5
Ironstone (2)	1.5	1.0
Chert (3)	2.0	2.0
Other Deleterious (4)	7.0	3.0

Materials above are defined as follows for the purposes of these specifications:

1. **SILICEOUS SHALESTONE** - light to medium grey, or greenish grey shale generally exhibiting a platy shape. The material absorbs water readily, and turns dark grey, dark green or black on wetting. The shalestone is composed of varying amounts of opal, clay materials and fine quartz grains.
2. **IRONSTONE** - derived from clay ironstone concretions which consist of a relatively hard, dark brown outer shell of limonite and clay surrounding a relatively soft, brown or grey core of siderite and clay. The material has a high absorption.
3. **CHERT** - this chert category also includes cherty limestones and cherty claystones. The rocks are generally dense and hard but contain varying amounts of potentially reactive chalcedony.
4. **OTHER DELETERIOUS** - physically weak and/or absorptive rocks such as sandstones, siltstones, argillaceous or deeply weathered carbonate, friable or weathered schists or gneisses.

All petrographic examination on fine and coarse aggregates for concrete must be done on material sampled in the year that the concrete is being placed, unless the following information about the concrete aggregate production is provided to the project engineer:

1. A summary of all test results for sieves sampled at a rate of a minimum of one test per 2,000 tonnes.
2. A petrographic analysis at a rate of a minimum of one analysis for coarse and one for fine aggregate based on a random sample taken during the production of the first 3,000 tonnes. If the first set of petrographic analysis detects no deleterious materials within the specified limits, a random sample taken during each 3,000 tonnes of production shall be recombined and split to produce a representative sample of the concrete aggregate produced. A petrographic analysis for fine and coarse aggregate shall be performed on this aggregate sample.
3. A summary test results for percentage of lightweight aggregates at a frequency of a minimum of one test every 5000 tonnes.
4. The production date of the aggregate stockpile and the estimated current quantity in the stockpile.
5. The location of the gravel pit where the aggregate was produced and the location of the stockpile in the pit area.

06005-14 Air-Entraining Admixtures

An approved air-entraining agent shall be used in all concrete and shall comply with the "Specifications for Air-Entraining Admixtures for Concrete" as described in C.S.A. specifications and used in strict accordance with the manufacturer's recommendations.

The Contractor shall submit a letter, at least 7 days prior to construction, to the Engineer certifying that the air-entraining agent to be used meets the C.S.A. requirements.

The air-entrainment limits shall be between 5 to 8 percent by volume as determined in accordance with C.S.A. - A 23.2-4C.

06005-15 Payment Reduction for Low Air Entrainment

Reduction of payment for air entrainment below the minimum specified value shall be calculated and applied as follows:

Table 2: Air Entrainment Payment Adjustment Factors

Air Entrainment	Payment
5.0% - 8.0%	100%
4.5% - 4.9%	95%
4.0% - 4.4%	75%
3.5% - 3.9%	30%
less than 3.5% or greater than 8%	No Payment. Concrete must be Removed. No Payment for Concrete Removed.

The first concrete test will be taken after the first cubic metre has been removed from the truck. This test result will represent all of the concrete from that truck and all concrete placed in this location until the next test.

Any additional tests for air entrainment done on this truck load shall be at the request of the Contractor and shall be at the expense of the Contractor. The result of this concrete test plus any additional tests on that load shall be averaged and used as the basis for payment. If the test results for the air entrainment do not meet specifications, the Contractor may make adjustments at the plant or request further air entrainment in the field. The cost of any additional tests shall be the responsibility of the Contractor.

06005-16 Payment Reductions for Low Strength Concrete

When the average 28 day compressive strength is less than 5.0MPa below the specified strength, the price paid for the work performed will be; the contract unit price multiplied by the average strength, divided by the specified strength.

Example:

Contract unit price \$12.00. Specified strength 32MPa.

Average measured 28 day compressive strength of 28MPa.

New unit price payable to Contractor = \$12.00 x 28/32 = \$10.50

When the average 28 day compressive strength of the test cylinders is more than 5.0MPa below but less than 7MPa below the specified strength, the price paid for the work performed will be 50% of the contract unit price. The Contractor shall be responsible for maintenance of the work as outlined in Section 00700-17 of the General Conditions.

When the average 28 day compressive strength of the test cylinders is 7MPa or more below the specified strength, the work shall be replaced at the expense of the Contractor.

The limits of work included in the price reduction or replacement shall be the entire construction represented by the low test(s), but shall not exceed a volume of 60m³ of concrete produced in any one day.

End of Specification 06005