

SECTION 10

CONCRETE

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SECTION 10**CONCRETE**10.1 **SCOPE**

This section shall cover the preparation and placement of concrete used in the construction of Municipal works.

10.2 **PROPERTIES**

Concrete used in the construction of Municipal works shall have the following properties:

10.2.1 **Compressive Strength**

Concrete curbs and sidewalks shall attain a compressive strength of 32 MPa (4640 psi) in 28 days. Unless otherwise specified, other concrete works shall attain a compressive strength of 28 MPa (4060 psi) in 28 days.

10.2.2 **Slump**

Slump shall be maintained at the minimum possible while permitting efficient placing and providing a homogeneous mass. Maximum slumps shall be as indicated in CAN/CSA A23.1

10.2.3 **Air Content**

The air content may range between 4% and 7% for normal applications; however, the air content for concrete exposed to freezing and de-icing agents must average 6%, with a minimum of 5% and a maximum of 7%.

10.3 **MATERIALS**10.3.1 **Cement**

Cement used on the work shall be Portland Cement. Bulk or bag cement may be used, but bulk cement shall be batched by an approved weighing device. The cement shall meet the requirements of ASTM Des. C150-59, Type I (Portland Cement).

10.3.2 **Aggregates**

- (a) **Fine Aggregate** shall meet the requirements of ASTM Des. C33-59 except as modified by the following:
- (i) Fine Aggregate shall be natural sand, washed clean, having hard, strong, sharp, durable uncoated grains, and shall be free from injurious amounts of dust, lumps, soft or flaky particles, mica shale, alkali, organic matter, loam or other deleterious substance.

(ii) Sand containing more than 3% by weight of clay or loam shall be washed before using. Deleterious substances shall not exceed one percent of each substance and not more than five percent (5%) altogether. Should the necessity for frequent rejections occur, no further sand will be accepted from this source and another and approved source will be required.

(b) Coarse Aggregate shall conform to the requirements of ASTM Des: C33-59 except as modified by the following:

Coarse aggregate shall consist of gravel or broken stone composed of strong, hard, durable, uncoated pebbles, or rock fragments, washed clean and free from injurious amounts of shale, coal, clay, lumps, soft fragments, dirt, glass, and organic or other deleterious substances.

10.4 READY MIX CONCRETE

10.4.1 Ready mix concrete shall be mixed and delivered in accordance with the requirements set forth in ASTM Des. C94-58.

10.4.2 The rate of delivery of the mixed concrete shall be such that the interval between placing of successive batches shall not exceed 30 minutes, unless the last load completed the work to a proper expansion joint. The elapsed time between the introduction of mixing water to the cement and aggregates and depositing concrete in the work, shall not exceed 70 minutes.

10.5 PLACING

10.5.1 Special care shall be taken to place the concrete, particularly in corners, in order to prevent voids, pockets, rough areas and honeycombing. The concrete shall be tamped in such a manner as to work the coarse aggregate away from the exposed surfaces. Vibrators or vibrator screeds used in placing concrete shall be a minimum of 5,000 cycles per minute. The technique and use of vibrators and vibrator screeds shall be at the discretion of the Engineer.

10.5.2 Every precaution shall be taken to make all concrete masonry solid, compact, watertight, and smooth.

10.5.3 The base, forms and/or rails shall be approved by the Engineer prior to the placement of concrete.

10.5.4 Concrete shall be placed within 1.5 hours of batching time into approved preset forms or an approved extruding machine.

10.5.5 Successive batches shall be deposited in a continuous operation. Under no circumstances shall partially set concrete be used.

10.5.6 Concrete shall not be placed during wet weather, on ponded water, on a frozen base, or when it appears likely that the air temperature will fall below 5 deg. C within 24 hours. Concrete shall be kept at a temperature of not less than 13 deg. C for at least 72 hours after placing.

10.5.7 Concrete damaged by freezing shall be removed from the site and replaced with new concrete.

10.5.8 The concrete placing operation shall be timed to permit edging and finishing in daylight hours.

10.5.9 Granular base shall be moistened prior to placement of concrete.

10.5.10 Concrete placement shall only be discontinued at expansion, construction or isolation joints.

10.6 **CURING**

10.6.1 Moist curing shall commence immediately following the final set and shall continue uninterrupted for at least seven (7) days.

10.6.2 Concrete surfaces shall be kept moist by continuous light sprinkling, ponding, or an approved membrane curing material.

10.6.3 Curing compounds shall not be used unless expressly authorized by the Engineer.

10.6.4 The Contractor shall be responsible for the protection of the concrete work from damage resulting from inclement weather and all other possible sources of damage. No works shall be accepted where foot marks, depressions, or other irregularities exist.

10.7 **CONCRETE TESTS**

10.7.1 During the progress of the work test cylinders will be made by the Consulting Engineer or a recognized Testing Laboratory appointed by the Consulting Engineer. The test cylinders shall receive, insofar as practicable, the same protection during the first twenty-four hours as is given to the construction they represent.

10.7.2 At all times cylinders shall be handled in a manner that will provide adequate protection against damage to ensure that test results will provide a sound basis for evaluation of concrete quality.

10.7.3 One set of three test cylinders shall be taken for each 150 lineal metres (500 feet) of curb and gutter or sidewalk, with a minimum of one set per day. One cylinder shall be tested at 7 days and two at 28 days. Test cylinder shall be taken and secured in accordance with CSA Spec. A23.2-3c and tested in accordance with CSA Spec. A23.2-9c. A copy of the test results shall be submitted to the Engineer.

10.7.4 For every test made or as often as required by the Engineer, a slump test shall be made in accordance with CSA specification A23.2-5c and an air test in accordance with CSA specification A23.2-4c, 7c.

10.7.5 The cost of testing and inspections of the work shall be borne by the Developer with a report on the concrete tests to be forwarded to the Engineer.

10.8 **TOLERANCES**

- 10.8.1 The finished surfaces of all concrete work shall be true to the required cross-section with a tolerance of plus or minus 6 mm from the required elevation and dimensions.
- 10.8.2 Surfaces of curbs or gutters shall not show any depressions or bumps exceeding 6 mm under a straight edge 3 m long placed parallel to the curb or sidewalk.
- 10.8.3 Concrete not meeting the requirements specified shall be removed to the nearest joint and replaced at the Contractor's expense.

10.9 **DEFECTS**

All finished concrete shall be in accordance with the approved dimensions, tolerances, and properties as specified in these standards and on the approved design drawings.

The finished concrete shall be free of honeycombing, cracking, spalling, surface irregularities, and other defects. Unless otherwise approved by the Engineer, all defective concrete shall be removed and replaced at the Contractor's expense.