

1. GENERAL

1.1 SPECIFICATION INCLUDES

- 1.1.1 Production and supply of Portland Cement Concrete for structural concrete footings for base mounted lighting, trolley, sign and signal poles.
- 1.1.2 The requirements for concrete mix design, quality control and quality assurance testing.

1.2 Referenced Documents

<u>CAN/CSA-A23.1</u>	<u>Concrete Materials and Methods of Concrete Construction</u>
CAN/CSA-A3000	Cementitious Material Compendium
CAN/CSA-A3001	Supplementary Cementing Materials
CAN-A266.1	Air-Entraining Admixtures for Concrete
CAN-A266.2	Chemical Admixtures for Concrete
CAN-A266.6	Superplasticizing Admixtures for Concrete
<u>CAN/CSA-A23.2</u>	<u>Methods of Test for Concrete</u>
A23.2-1C	Sampling Plastic Concrete
A23.2-4C or 6C	Air Content of Plastic Concrete by Pressure Method
A23.2-5C	Slump of Concrete
A23.2-3C	Making and Curing Concrete Compression and Flexural Test Specimens
A23.2-9C	Compressive Strength of Cylindrical Concrete Specimens
A23.2-14C	Obtaining and Testing Drilled Cores For Compressive Strength Testing

2. PRODUCTS

2.1 CONCRETE MATERIALS

- 2.1.1 Portland Cement: to CAN/CSA-A3000, A3001-03 of the following types.. Submit to the Engineering Services Section the cement manufacturer's mill test reports monthly or as requested by the Engineer.
 - 2.1.1.1 Type HS – High sulphate-resistant hydraulic cement
- 2.1.2 Aggregates: to clause 4.2.3, CAN/CSA-A23.1.
- 2.1.3. Water: to clause 4.2.2, CAN/CSA-A23.1, clear, free from injurious amounts of oil, acid, alkali, organic matter, sediment, or other substance harmful to mixing and curing of concrete.
- 2.1.4 Air-Entraining Admixture: to CAN/A266.1.
- 2.1.5 Chemical Admixtures: to CAN/A266.2, including water-reducing agents, retarders and accelerators. Do not use chemical admixtures unless permitted in writing by the Engineer.
- 2.1.6 Fly Ash: to CAN/CSA-A3000, A3001-03 pozzolan type F or Cl. . Submit to the Engineering Services Section physical test reports monthly or as requested by the Engineer.

2.1.7 Superplasticizing Admixtures: to CAN/A266.6 and shall not contain calcium chloride. Do not use superplasticizing admixtures unless permitted in writing by the engineer. If approval is granted, superplasticizing admixtures are to be used in low to medium dosage ranges.

2.1.8 Mix Requirements

Supply "Controlled Concrete" in accordance with the following table.

Minimum Specified Compressive Strength	Slump (mm)	Entrained Air Limits % by Volume	Maximum Aggregate Size (mm)	Maximum Water/Cementing Materials Ratio	Minimum HS Cement Content (kg/m ³)
30MPa @ 28 Days	80±20	5.5-8.0	20	0.45	335
30 MPa @ 7 Days	80±20	5.5-8.0	14	0.45	335

2.1.9 Submit to Engineering Services Section a mix design for each class of concrete at least 14 days prior to initial concreting work and when there is a change in materials, sources or proportions. The mix design shall be performed by a qualified laboratory or by the concrete supplier if he has the capability and facility approved by the Engineer.

2.1.10 if requested, provide evidence that proportions in the mix design will produce concrete of the quality Specified, include strength tests on trial mixes made under plant conditions.

2.1.11 No concrete production can proceed until the applicable mix design has been approved by the Engineer.

3. EXECUTION

3.1 DELIVERY OF CONCRETE

3.1.1 Deliver concrete to jobsite according to clause 5.2.4, CAN/CSA-A23.1, as supplemented or modified below.

3.1.2 Rotating Drum Trucks: Transport concrete using only equipment with mixing or agitating capability.

3.1.3. Rotate the drum on jobsite at mixing speed for 3 minutes just before discharge.

3.1.4 **Retempering with Water:** Do not add water after initial introduction of mixing water at plant except as follows:

3.1.4.1 When slump at point of discharge is less than specified, and only if permitted by the Engineer.

3.1.4.2 Introduce additional water into drum mixer in an amount not exceeding 12 liters/m³ to bring the slump within required limits.

3.1.4.3 Rotate drum a minimum 30 revolutions at mixing speed until the required uniformity of concrete is attained.

3.1.4.4 Do not add water to the load at any later time.

3.1.5 Retempering with Air: permissible under the following conditions.

3.1.5.1 Retempering on site with an approved air-entraining admixture shall only be performed by a quality control technician working for the concrete supplier or the Contractor. Dry, powdered, bagged or pre-measured liquid air-entraining admixtures may be added by the concrete truck operator under the direction of the supplier's quality control technician. For rettempering purposes the concrete supplier shall use a comparable air-entraining admixture to what was originally approved for use in the mix design. Rotate the drum for 3 to 5 minutes or until the mix is uniform, after the addition of the air entraining admixture.

3.1.5.2 The quality control technician shall perform an air content test on each load of concrete rettempered with air, and shall provide results immediately to the Engineer.

3.1.5.3 Guidelines for rettempering with air-entraining admixtures

Measured Air Content (%)	Action
5.0 – 5.4	Addition of water or air-entraining admixtures as deemed necessary by the supplier to meet specifications
4.0 – 4.9	Air-entraining admixtures or air-entraining admixtures and water must be added as deemed necessary by the supplier to meet specifications
< 3.9	No re-tempering with air-entraining admixtures or water is permitted; load will be rejected

3.1.6 Discharge Time: Complete the discharge of concrete within 1.5 hours, or before drum has turned 300 revolutions, whichever occurs first, after initial introduction of mixing water to cement and aggregates at the plant.

3.1.7 Delivery Record: Provide Engineer with delivery ticket showing batch plant location, supplier's name, ticket and truck numbers, mechanically punched date and time of initial plant mixing, class and mix design designation, cement type and aggregate sizes, type and amount of admixtures, water added, volume of concrete, site arrival time, discharge time, and other information requested by Engineer.

3.1.8 Concrete temperature: Concrete shall arrive at the work site with a temperature of not less than 15°C nor greater than 30°C.

3.2 QUALITY CONTROL

3.2.1 The Contractor shall be responsible for conducting his own program of testing and inspection that will ensure concrete quality and workmanship meet specified requirements. Provide test results if requested by the Engineer.

3.3 QUALITY ASSURANCE

3.3.1 The Contractor shall provide without charge facilities for the Engineer to inspect equipment, materials and processes used in the production and delivery of concrete and to obtain samples for testing.

3.3.2 Approval of mix design, inspection and testing by the Engineer shall not relieve the Contractor of responsibility for the quality of concrete used in the work.

3.3.3 The quality assurance laboratory will perform concrete plant checks and quality assurance sampling and testing for slump, air content, and compressive strength as described in the following articles.

3.3.4 Slump Tests

3.3.4.1 Methods: to A23.2-1C and A23.2-5C.

3.3.4.2 Frequency: Slump tests will be taken between the 10% and 90% points of discharge of concrete load with every strength test and as required by the Engineer.

- 3.3.4.3 Deficient Slump: For any load or concrete, if the measured slump is outside the specified limits, a check test is taken on another portion of the load, or a retest is done if retempering with water is permitted by the Engineer. If the second test fails, the Engineer may reject that load of concrete.
- 3.3.5 Air Content Tests
 - 3.3.5.1 Methods: to A23.2-1 C and A23.2-4C or A23.2-6C.
 - 3.3.5.2 Frequency: Air content tests will be taken between the 10% and 90% points of discharge of concrete load with every strength test and as required by the Engineer.
 - 3.3.5.3 Deficient Air Content: For any load of concrete, if the measured air content is outside the specified limits, the engineer may reject that load concrete.
- 3.3.6 Strength Tests
 - 3.3.6.1 Methods: to A23.2-3C and A23.2-9C.
 - 3.3.6.2 Frequency: Standard tests for strength will be carried out by Engineering Services at a frequency of not less than one strength test for each 60m³ of concrete or fraction thereof, for each type of concrete placed in any one day.
 - 3.3.6.3 Definition of a Strength Test: to clauses 17.5.4.1 and 17.5.4.2, CAN/CSA-A23.1.
 - 3.3.6.4 Required Strength: The result of each compressive strength test shall equal or exceed the specified minimum compressive strength as required in clause 2.1.8
 - 3.3.6.5 Deficient Strength: Concrete work represented by a strength test result which is less than specified may be accepted subject to a pay factor according to the following Table . If strength deficiencies persist, the Engineer will also require changes in concrete mix design for the remainder of work.

CONCRETE STRENGTH PAY FACTORS

CYLINDER STRENGTH of Specified <u>Strength</u>)	PAY FACTOR (% of Contract <u>Price</u>)
<u>97.0</u>	100.0
96.0	99.2
95.0	98.2
94.0	96.9
93.0	95.4
92.0	93.6
91.0	91.7
90.0	89.4
89.0	86.7
<u>88.0</u>	83.5
87.0	79.7
86.0	75.5
85.0	70.0
Under 85.0	<u>No Payment</u>

END OF SECTION