



City of Estevan

Construction Specifications

SECTION 1050
CAST IN PLACE PORTLAND CEMENT CONCRETE

1.0 GENERAL

This section governs the requirements for cast in place Portland Cement Concrete and constituent materials in the construction of concrete structures, flatwork and elements.

2.0 MATERIALS

2.1 Cements and Supplementary Cementing Materials

2.1.1 Portland Cement

All cement shall be either Type 10 Normal Portland Cement or Type 30 High Early Strength Portland Cement or Type 50

Sulphate

Resistant Portland Cement conforming to the requirements of CSA Standard A5.

2.1.2 Supplementary Cementing Materials

Use of Type C Flyash, conforming to the requirements of CSA Standard A23.5, is permitted as follows:

- .1) Not more than 20% of the mass of the total cement material content may be replaced with flyash.
- .2) Submit concrete mix design with flyash when used.

2.1.3 Aggregates

- 1) Fine and coarse aggregates shall conform to the requirements of **CSA A23.1**, Section 5.
- 2) The nominal size of coarse aggregates shall be 20 mm as per Section 5.4.2, Table 2.CSA 123.1
- 3) The maximum aggregate size for non shrink fill shall be 6mm.
- 4) The maximum allowable shale content in the aggregate shall not exceed one half of one percent.

Representative samples of all aggregates proposed for use shall be submitted, when requested, to the Engineering Services Division sufficiently in advance of the commencement of operations to permit the required testing.

SECTION 1050
CAST IN PLACE PORTLAND CEMENT CONCRETE

2.1.4 Water

Shall be clear and free from injurious amounts of oil, acid, alkali, soluble chlorides, organic matter, sediment or any other deleterious substances.

2.1.5 Admixtures

These admixtures shall conform to the latest requirements of CSA A23.1. Other admixtures shall not be used, unless specified herein, without the written approval of the Engineering Services Division. The manufacturer shall ensure that any additives used are compatible with the cement and with each other.

- 1) Air-entraining: Shall conform to the requirement of ASTM C260.
- 2) Chemical: Shall conform to the requirement of ASTM C494.
- 3) Calcium Chloride shall not be used.

2.1.6 Storage of Materials

Materials shall be stored and handled in accordance with CSA A23.1 Section 9.

2.1.7 Strengths and Proportions

The proportions of materials shall be such as to produce a concrete mix which will work readily into the corners and angles of forms and around reinforcement.

To conform to the strength requirements of this specification, the average of all test samples shall exceed the specified strength.

The Contractor shall assume responsibility for the design and production of the concrete mixture in accordance with alternate Number 1, Table 11, CSA Standard A23.1. Section 7.5.7 Compressive Strength Requirements and Section 17.5.8 Failure of Tests to Meet Requirements of CSA Standard A23.1 are superceded by the Strength Tests and Understrength Concrete requirements of this Specifications.

SECTION 1050
CAST IN PLACE PORTLAND CEMENT CONCRETE

The concrete mixes shall, in addition to any other provisions of these specifications, conform to the following table:

Cement Type	Minimum 28-day Compressive Strength	Total Air Content	Maximum Water/ Cementing Materials Ratio by Weight	Concrete Slump
<u>Handformed Concrete</u>				
Normal - 10	32MPa	6.5% ± 1%	0.45	70mm±20mm
High Early Strength	32MPa	6.5% ± 1%	0.45	70mm±20mm
Sulphate- Resistant-50 Sulphate	30MPa	6.5% ± 1%	0.45	70mm±20mm
Resistant-50	25MPa	6.5% ± 1%	0.45	70mm±20mm
<u>Extruded Concrete</u>				
Normal -10 Sulphate	32MPa	6.5% ± 1%	0.45	30mm±10mm
Resistant -50	30MPa	6.5% ± 1%	0.50	30mm±10mm
<u>Unshrinkable Fill</u>				
Normal - 10	0.25 - 0.75MPa			175mm±30mm

No concrete shall be placed until the Engineering Services Division has received copies of the mix design and has given written approval of its use.

2.1.8. Mix Design

At least 7 days prior to placing concrete, the Contractor shall supply the Engineering Services Division with a concrete mix design and the results of tests on the selected mix and its constituent components, at the Contractors own cost and expense. Any subsequent mix designs required due to changes in constituent components or for any other reason shall be done at the contractors own cost and expense.

SECTION 1050
CAST IN PLACE PORTLAND CEMENT CONCRETE

3.0 EXECUTION

3.1 Batch Plants

- .1) Concrete Production shall conform to CSA A23.1 - Section 18 Cement and Aggregate shall be measured by weight. All measuring devices shall permit rapid adjustments of quantities as required. Gates and closing devices shall be positive in action and prevent leakage of materials when closed. Water shall be measured by weight or volume. Measuring devices shall be capable of measuring water within $\pm 1\%$. The operating mechanism shall be such that no leakage will occur when valves are closed and discharge valves cannot be opened until filling valves are closed. Material proportions shall account for the moisture content of aggregate and sand.
- .2) Temperature control of concrete mixes may be accomplished by the following measures at the batching plant:

a) Hot weather:

To conform to the maximum permissible temperature of 35°C of concrete at the point of delivery, aggregate may be shaded or sprinkled or by the mechanical refrigeration of water or mixing water with crushed ice.

b) Cold weather:

Concrete materials may be heated to provide a minimum permissible temperature of concrete at placing of 10°C.

3.2 Delivery and Mixing

Concrete shall be delivered in truck mixers, or mixed on site with an approved weigh-batching plant. The concrete shall be delivered to the site of the work and discharge shall be completed within one and one-half hours after the introduction of mixing water to the cement and aggregates, or the introduction of the cement to aggregates. The allowable concrete temperatures at delivery shall be 10°C to 35°C.

4.0 ACCEPTANCE

4.1 Inspection

The Engineering Services Division shall be afforded access to inspect ingredients and processes used in the manufacture and delivery of the concrete and for securing samples to determine whether the concrete is

SECTION 1050
CAST IN PLACE PORTLAND CEMENT CONCRETE

being furnished in accordance with these specifications. Samplings of concrete shall conform to CSA Standard A23.1 (Test Method A23.2-1C).

4.2 Testing

The following tests shall be carried out, at its own cost, by the Owner, in conformance with CAN/CSA-A23.2 and performed on concrete delivered to the site of the work. All other tests to establish conformance with CAN/CSA-A23.2 including aggregate tests, mix designs and tests on air-void systems in accordance with CAN/CSA-A23.2-17C shall be paid for by the Contractor including any retests due to non-conformance or required due to variability of concrete constituents:

1) Strength Tests

100mm x 200mm or 150mm x 300mm test cylinders for compressive strength tests shall conform to A23.2-3C subject to aggregate size limitations. Test cylinders conforming to CSA A23-3C shall form the basis of acceptance of the concrete compressive strength. Strength tests on field cured cylinders or cored samples will not be considered representative of the concrete and shall not constitute a basis of acceptance. A strength test for any class of concrete shall consist of two standard cylinders made from a sample secured from a single load of concrete in accordance with CSA Test Method A23.2-1C. A total of three test cylinders are to be cast with one cylinder tested at seven days and two tested at twenty-eight (28) days. The test result shall be the average of two (2) specimens at twenty-eight (28) days except that if one specimen in a test shows evidence of improper sampling, molding or testing, it shall be disregarded. In the case of discrepancy between the test results of the Contractor and the Engineering Services Division, the Engineering Services Division's results shall govern.

2) Air Content

Measured as in CAN/CSA A23.2-4C Air content tests shall be made at the point of delivery as directed by the Engineering Services Division. If the measured air content falls outside the limits specified, a check test shall be made immediately on another portion of the same sample. In the event of a second failure, the concrete shall be at the discretion of the Engineering Services Division considered to have failed to meet the requirements of this standard and shall be rejected.

3) Slump Test

Measured as in CAN/CSA A23.2-5C concrete delivered to the site which exceeds the maximum specified slump shall be rejected. When concrete delivered to the site is less than the specified range

SECTION 1050
CAST IN PLACE PORTLAND CEMENT CONCRETE

of slump additional water may only be injected into the mixture at the discretion of the Engineering Services Division. The drum or blades shall be turned an additional thirty (30) revolutions or more if necessary at mixing speed, until the uniformity of the concrete is within the allowable limits.

4.3 Understrength Concrete

This provision shall govern when the average strength of a test sample fall below that specified.

Notwithstanding the options of the Owner suggested in section 17.5.8, of CSA A23.1. Failure of Tests to Meet Requirements , the Owner reserves the right, in the Owner's sole discretion, in the case of understrength concrete being delivered to the site, to accept such concrete, with or without conditions, and to reduce payment therefore in accordance with the following:

- 1) Type 10 Cement, 32 MPa concrete mixes represented by concrete cylinder tests between 24MPa and 32MPa will be subject to payment reduction per cubic metre. Such concrete represented by cylinder test below 24MPa shall be rejected and replaced at the contractor's cost.
- 2) Type 50 Cement, 30MPa concrete mixes represented by concrete cylinder tests between 22.5MPa and 30MPa will be subject to payment reduction per cubic metre. Such concrete represented by cylinder tests below 22.5 MPa shall be rejected and replaced at the expense of the contractor.
- 3) Type 50 Cement, 25MPa Concrete mixes represented by concrete cylinder tests between 18.5MPa and 25MPa will be subject to payment reduction per cubic metre. Such concrete represented by cylinder tests below 18.5MPa shall be rejected and replaced at contractor's cost.
- 4) Reduction in payment described in (1), (2), and (3) above shall be calculated as follows:

$$\begin{aligned} &\text{Reduction in Payment} \\ &= \frac{\text{Specified Strength} - \text{Actual Strength}}{\text{Specified Strength}} \times 4.0 \end{aligned}$$

x price per cubic metre specified for the contract.

Costs of replacement of rejected concrete shall include removal and disposal of the rejected concrete and replacement thereof and

SECTION 1050
CAST IN PLACE PORTLAND CEMENT CONCRETE

all labour, equipment and material costs, including applicable overhead, associated therewith.

No bonus shall be paid for supply of concrete that exceeds the minimum specified strength.

Payment reductions will only apply to those batches that were tested and did not meet the minimum specified strength. Payment reduction will be assessed on the total quantity of the batch. If the delivered quantity is not known, the payment reduction will be calculated on the basis of five cubic metres (5cum) per batch.

4.4 Concrete with deficient air content

This provision shall govern when the air content of a test sample falls below that specified.

Notwithstanding the provisions of “Air Content” herein, the Owner at its sole discretion, in the case of concrete delivered to the site of the work being deficient in air content, as measured at the point of placement of concrete, may accept such concrete with or without conditions and to reduce payment therefor in accordance with the following schedule:

<u>Measured Air Content</u>	<u>% Reduction in Payment</u>
5.5 and higher	0%
4.5 - 5.49 %	25%
3.5 - 4.49 %	45%
2.5 - 3.49 %	65%
2.49 % - and less	85%

Payment reduction shall be applied to the extent of concrete structure flatwork or element considered deficient in air content by the Engineering Services Division. No bonus will be paid for supply of concrete with greater than specified air content.

5.0 MEASUREMENT AND PAYMENT

5.1 The work items in this section shall be deemed incidental to the supply and installation of work items in other sections of these specifications.