

**CONCRETE PLACEMENT**

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**1.0 CONCRETE**

**1.1 WORK INCLUDED**

This section refers to the supply of materials and construction of concrete curbs, gutters, sidewalks, swales and driveway crossings.

**1.2 READY-MIXED CONCRETE**

Concrete mix shall be in accordance with the following unless shown otherwise on the drawings.

Minimum Cement Content of 300 kg

MINIMUM 28 DAY COMPRESSIVE STRENGTH	MAXIMUM SIZE OF AGGREGATE	SLUMP MIN & MAX	AIR ENTRAINMENT
30 MPa	25 mm	40mm – 75mm	5.5%-8%

1.2.1 Ready Mixed Concrete shall be mixed and delivered in accordance with the requirements set forth in A.S.T.M. Des. C94-64 and shall be subject to all provisions therein relative to material strength, proportioning consistency, measurements and mixing except:

- 1.) Paragraph 8(a) of A.S.T.M. Des. C94-64 shall mean mixer trucks only for this contract.
- 2.) Paragraph 9 (1.) of A.S.T.M. Des. C94-64 Item 2 and 3 shall apply to this contract.

1.2.2 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 has completed the work to a proper expansion joint or divisional plate. The elapsed time between introducing water to the mix shall not exceed 45 (forty-five) minutes.

**1.3 PROPORTIONING**

The measure and batching of fine and coarse aggregates shall be by weight only and all weighting devices shall be approved by the Engineer and subject to tests and calibration at any time. Scales used shall be accurate to within four-tenths (0.4) of one percent (1%) throughout the entire weight range.

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- 1.3.1 The actual proportions of the mix shall either be designed by the Engineer or subject to the Engineer's approval. No change in these proportions shall be made without the Engineer's approval or direction. The approval of the mix design shall in no way relieve the Contractor of any responsibility for the quality of the concrete.

**1.4 MIXING**

The mixing of the concrete, unless otherwise authorized by the Engineer, shall be done in a batch mixer approved by him. The mixer shall be equipped with suitable discharging hopper, water storage and measuring device. It shall be cleaned at frequent intervals when in use and maintained in such condition that the mixing action will not be impaired.

The mixing of each batch shall continue not less than one and one-half (1/2) minutes after all the materials are in the mixer, during which time the mixer shall rotate at a speed of 14 to 20 revolutions per minute, unless otherwise rated by the manufacturer.

**1.5 RE-MIXING**

The re-mixing of concrete without additional cement, aggregate or water will not be permitted.

**2.0 EXECUTION**

**2.1 PLACING CONCRETE**

- 2.2.1 Place concrete in accordance with requirements of Clause 19 of CAN3-A23.1-M77 and as indicated on the Drawings.
- 2.1.2 Notify the Engineer and the inspection and testing firm twenty-four (24) hours prior to commencement of concrete operations.
- 2.1.3 Concrete shall be placed only in forms that have been approved by the Engineer.
- 2.1.4 Ensure that all anchors seats, plates and other items to be cast into concrete are securely placed and will not interfere with concrete placement.
- 2.1.5 Before placing concrete all equipment for mixing and transporting the concrete shall be cleaned of hardened concrete and foreign material.

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- 2.1.6 Immediately before concrete is placed all forms shall be carefully inspected to ensure that they are properly placed, sufficiently rigid and tight and that all reinforcing steel is in the correct position and secured against movement during the placing operation. All forms shall be thoroughly cleaned and all debris, snow, ice or other foreign material removed. Chemicals will not be permitted to remove ice or hardened concrete from the forms. All forms shall be thoroughly soaked with water before placing concrete except in freezing weather.
- 2.1.7 Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent the separation or loss of the ingredients. Concrete shall be poured in the forms as nearly as practicable in its final position to avoid rehandling or flowing. Vibrators shall not be used to move concrete.
- 2.1.8 When concreting is started, it shall be carried on as a continuous operation until the placing of the section is completed. When shown on the drawings, concrete shall be placed in the sections indicated and according to the sequence given.
- 2.1.9 When concrete is placed on an inclined surface, the placing operations shall begin at the lower end of the slope and progress upward; unless otherwise permitted by the Engineer.
- 2.1.10 Concrete shall be thoroughly compacted by mechanical vibrators during placing operations. It shall be thoroughly worked around reinforcement, embedded fixtures and into the corners of the forms.
- 2.1.11 Internal vibrators shall operate at a speed of not less than 7,000 vibrations per minute and shall be applied at the point of deposit and in the area of freshly placed concrete.
- 2.1.12 Internal vibrators shall be allowed to sink of their own weight in the concrete until they penetrate to the previous layer of concrete. They shall be withdrawn immediately at the same speed at which they sank, moved approximately 0.3 meters to a new location and the process repeated. Where required, internal vibration shall be supplemented by external form vibrators or chipping hammers which shall be applied to wall forms directly opposite where the internal vibrators are operating. Chipping hammers shall be fitted with a 50mm by 50mm steel plate to bear against the walls. External vibration shall be continued for approximately the same period of time as internal vibration.

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- 2.1.13 Where placing operations would involve dropping the concrete more than 1.5 meters, it shall be placed through “canvas elephant trunks” or galvanized iron chutes. Concrete shall not be placed at a rate greater than that for which proper vibration may be affected.
- 2.1.14 The concrete surfaces shall be protected from rain until the final set occurs.
- 2.1.15 A minimum of seventy-two (72) hours shall elapse before adjacent pours separated by the construction joints or expansion joints.
- 2.1.16 Maintain accurate records of cast-in-place concrete items. Record date, location of pour, quantity, air temperature and test samples taken.
- 2.1.17 Ensure reinforcement, inserts, embedded parts, formed expansion and control joints and water stops are not disturbed during concrete placement.
- 2.1.18 Place concrete continuously between preset construction and control joints.

**2.2 FINISHING AND TROWELLING**

- 2.2.1 After placing, concrete shall be adequately worked with wood or steel trowels. Excess trowelling is to be avoided. No plaster coat will be allowed. The top of the gutter and the top and face of the curb shall be trowelled to a smooth finish with the required edges neatly rounded with an edging tool. The final finish on the face of the curb may be a lengthwise brush finish with a soft bristle brush approved by the Engineer. The brushing shall be carried out in such a manner and at such a time to minimize the depth and quantity of brush marks. All surplus water from the brush must be removed before commencing brushing.

**2.3 CONSTRUCTION JOINTS**

- 2.3.1 Sidewalks shall be jointed and finished as shown on the drawings. Surface joints six (6)mm deep shall be marked transversely at three (3) meter intervals midway between contraction joints. Unless otherwise directed by the Engineer, the surface shall be brush finished by means of an approved brush. Lane crossing and driveway crossings shall be finished with a lengthwise brush finish.

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- 2.3.2 Where the Contractor elects to employ construction joints other than shown on the drawings and the Engineer so approves, water stops shall be provided for the full length of the joint if required by the Engineer and without any additional compensation to the Contractor.
- 2.3.3 The surface of hardened concrete shall be roughened and thoroughly cleaned of foreign material and shall be wetted with water but not saturated and the forms re-tightened against the face of the hardened concrete before depositing additional concrete.

**2.4 EXPANSION AND CONTRACTION JOINTS**

- 2.4.1 Contraction joints shall be placed at intervals of 3 meters in sidewalk, curb and gutter and shall be constructed by means of a marking tool to a width of six (6) mm and a depth of not less than thirty-two (32)mm. The edge of the joint shall be rounded off with an edger having a thirty-two (32) mm radius. These joints shall extend through the full width of the structure.

Expansion joints shall be placed as required and shall consist of strips of pre-molded bituminous material twelve (12) mm thick and conforming to the cross-section of the work.

Both contraction and expansion joints shall be placed truly perpendicular to the surface and the longitudinal axis of the work. Expansion joints shall be required where the work abuts existing buildings or other structures, or as directed by the Engineer.

**2.5 WORK AROUND POLES, VALVES AND CATCH BASINS**

- 2.5.1 The Contractor will be required to box in neatly with 12mm expansion joint material around all telephone poles, iron covers, stop-cock boxes, hydrants and also around projecting steps or window grating or any other openings that may be in present walks. Any alterations in grades or alignment of hydrants, valve boxes, manholes, or poles which are necessary will be made by the City of Lethbridge crews. It will be the responsibility of the Contractor to notify the Engineer of any alterations and to schedule his work so as to allow sufficient time for these alterations.

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2.5.2 Any necessary alterations to Catch Basin frames and tops within (plus or minus) 150mm vertically and 75mm horizontally are to be made by the Contractor prior to pouring of concrete in order that they conform in both line and grade with the finished work. No extra payment will be allowed for these minor adjustments. Any alterations to catchbasins requiring major adjustments in structure or relocation will be made by the City of Lethbridge crews upon sufficient notification from the Contractor.

**2.6 LANE CROSSINGS**

2.6.1 Lane crossings are to be constructed as shown on the detailed drawings. The concrete shall be 178mm deep and be a minimum of thirty (30) MPa at twenty-eight (28) days.

**2.7 REINFORCED CROSSINGS**

2.7.1 The Engineer may specify that wire mesh reinforcing can be used on certain crossings, in which case, payment will be made at the unit rate on the Tender Form for the supply and placing of mesh.

**2.8 WIRE MESH**

2.8.1 Reinforcing mesh shall be clean and free from defects, kings, loose rust or mill scale at the time of concrete being placed. Any coatings or hardened mortar shall be removed from the steel.

2.8.2 The wire mesh placed in the walk portion shall be 152mm x 152mm, No p9.2/p9.2 gauge wire mesh. All wire mesh shall meet the requirements of A.S.T.M. Des. A-185-64 and cold drawn steel wire shall meet the requirements of A.S.T.M. Des. A82-62T. Overlapping shall be minimum of 300mm and shall be wired together. A cover depth of 50mm will be required.

**2.9 COLD WEATHER CONCRETING**

2.9.1 Special measures over and above those generally described in this Specification shall be taken by the Contractor during concreting in cold weather. Cold weather, for the purpose of this Specification, is when the air temperature is at or below five (5) degrees C., or when, in the opinion of the Engineer, the air temperature is likely to fall below this limit when the next twenty-four (24) hours. In these circumstances, concrete must be heated for placing and then protected from the adverse affects of low temperatures as determined by the Engineer.

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- 2.9.2 During cold weather the Contractor must have equipment for heating materials, for enclosing the freshly deposited concrete and maintaining temperature and humidity during the curing period, on site. The cost of all heating and protecting shall be borne by the Contractor. Concrete damaged by freezing shall be removed from the site and replaced at the Contractors expense, with new concrete in place subject to the terms of this contract.
- 2.9.3 If the temperature is or was, at any time during the previous twenty-four (14) hours, at zero (0) degrees C., or if the stockpiles of fine and coarse aggregate contain frozen material or are snow covered, then the aggregates shall be heated to a temperature of not less than twenty (20) degrees C. nor more than sixty-five (65) degrees C. The aggregates shall be uniformly heated in the stockpiles and/or bins by steam, either injected, live or circulated in coils or by using heat before the aggregates are place din the mixer. Whatever system is used, it shall be designed to give uniform heating which will avoid local overheating which may be injurious to the materials. That part of the stockpile in use shall be protected with tarpaulins, waterproof paper or plastic sheeting against the formation of ice and the accumulation of snow.
- 2.9.4 The temperature of the reinforcement and forms shall be above ten (10) degrees C.prior to placing the concrete
- 2.9.5 The temperature of the concrete at the time of placing shall be between twenty (20) degrees C. and twenty-five (25) degrees C. unless the Engineer directs otherwise in relation to ambient conditions, the type of work and the protective system in use.
- 2.9.6 The form work, existing concrete and reinforcing steel against which concrete is to be placed shall be free from ice, snow and within the stipulated temperature range before the Engineer will authorize placing to commence. The Contractor shall preheat the area in which the concrete is to be placed when the air temperature is zero (0) degrees C. or below, with live steam or moist hot air; this shall also remove the snow and ice and heat existing concrete to prevent the formation of a cold joint.
- 2.9.7 Concrete shall not be placed on frozen subgrade or against frozen ground. The Contractor shall protect excavations with appropriate covering prior to placing concrete.
- 2.9.8 The concrete shall be placed rapidly and evenly as near to its final position as possible to reduce the risk of segregation, flow lines and cold joints.

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- 2.9.9 The use of salt, calcium chloride or other chemicals in the mix to lower the freezing point or accelerate the sets is prohibited unless specifically authorized by the Engineer.

**2.10 IDENTIFICATION STAMPING**

- 2.10.1 The Contractor shall mark the sidewalk or curb and gutter with a suitable marking tools approved by the Engineer, showing the initials of the Contractor and the year constructed. The letters and numbers shall be forty (40)mm high.

**3.0 CONCRETE TESTING**

**3.1 TESTING-GENERAL**

Notify the Engineer when completed form work and concrete reinforcement is ready for inspection subject to Clause 2.1.1, Placing Concrete of these Specifications.

- 3.1.2 Allow ample time for notification, inspection and corrective work, if required, before scheduling concrete placement.
- 3.1.3 Provide free access to all portions of the work and cooperate with the appointed firm.
- 3.1.4 Submit proposed mix design of each class of concrete to the Engineer for review two (2) weeks prior to commencement of the work.
- 3.1.5 During the progress of the work a reasonable number of test cylinders shall be made and restored in accordance with A.S.T.M. Des. C31-59 except that the test cylinders shall receive, insofar as practicable, the same protection during the first twenty-four (24) hours as that given to the work, and will be tested in accordance with A.S.T.M. Des. C39-59. The test cylinders shall be placed in boxes provided by the inspection firm immediately following casting.
- 3.1.6 The minimum number of tests shall be as follows:

There shall be three (3) test cylinders taken from each side of City Block, or portion thereof of sidewalk, curb and gutter or combined sidewalk, curb and gutter. Should the City Block be more than one hundred and fifty (150) meters long, then the number of additional cylinders to be taken shall be at the discretion of the Engineer.



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- 3.1.6.1 All cylinders shall be taken at the place of pour. Slump and air content tests in accordance with A.S.T.M. Specifications shall be made, or as often as directed by the Engineer.
- 3.1.6.2 The inspection and testing of the concrete shall be done by a firm appointed by the Engineer. The cost of cylinder tests including the cost of the molds, shall be borne by the City.
- 3.1.7 In the case where the compressive strength of the test cylinder for any portion of the work falls below the requirements specified herein, the City shall require the following:
- .1) Where the twenty-eight (28) day strength of the test cylinder is under 30 MPa but over 25 MPa Engineer be completely removed and replaced, or covered by a five (5) year Maintenance Bond, either of which shall be at the Contractors' expense. The limits of the location covered by this Maintenance Bond, either of which shall be at the Contractors' expense. The limits of the location covered by this Maintenance Bond shall be the measured length of the block or as determined by the Engineer.  
  
The amount of the five (5) year Maintenance Bond shall be twenty-five percent (25%) of the measured area or length of the work multiplied by the unit price submitted in the Tender Form.
  - .2) Where the twenty-eight (28) day compressive strength of the test cylinder is under 25 MPa the City shall require complete replacement of the work, the limits of the location of which shall be the measured length of the block or as determined by the Engineer. The replaced work shall be subject to the terms and conditions of this Contract.

**3.2 DISPOSAL OF REJECTED MATERIAL AND REPAIR OF DEFECTS**

Condemned or rejected material shall be immediately removed from the work and disposed of as directed by the Engineer.

All defects or imperfections due to rain, frost, trespass, improper workmanship or materials appearing before final acceptance of the work shall be repaired to the satisfaction of the Engineer by the Contractor at his own expense during construction.

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