

1.0 GENERAL

- .1 The complete work under this trade shall be governed by the dictates of good practice in all details of materials and methods even if not minutely specified. The work shall be properly coordinated with the requirements of other units of work specified in other sections.
- .2 All concrete work shall be constructed in accordance with the Standard Drawings in locations noted on the plans. The dimensions shall be as specified on the drawings and in the Bid Form.
- .3 The Contractor shall notify the City of Prince Albert prior to the removal of any existing street and traffic signs. The Contractor will notify the City of Prince Albert upon construction completion to ensure that signs are replaced.

1.1 Related Work Specified Elsewhere

- .1 Adjustment of Appurtenances Section 02840
- .2 Subgrade Construction Section 02705
- .3 Granular Base Course Section 02721

1.2 Existing Structures

- .1 Temporary support, adequate protection and maintenance of all underground and surface structures and utilities and other obstructions encountered in the progress of the work shall be furnished by the Contractor at his own expense and under the direction of the Engineer. The structures and utilities which may have been disturbed or damaged shall be restored to their original or new condition at such a time as deemed necessary or upon completion of the work.

1.3 Measurement for Payment

- .1 Payment for new and replacement concrete pavement shall be full compensation for excavation, preparing the subgrade and compaction to 98% Standard Proctor density, supply and placing granular bedding where required, forming, supplying and placing concrete, jointing, jointing materials, finishing, curing, stripping forms, and backfilling. Measurement for new and replacement concrete pavement shall be as follows:
 - .1 The subgrade area for the new concrete pavement shall be excavated in conjunction with the adjacent roadways excavation and be filled with compacted granular base course material and geotextile filter fabric as indicated on the plans. Common excavation, subgrade preparation and geotextile filter fabric quantities and payments are included in the roadways pay items.

- .2 Concrete pavement shall be measured by the square metre. Payment for concrete pavement shall be at the unit price bid per square metre and shall include all preparation work required to prepare the site and all reinforcement steel.
 - .3 Removal of existing concrete pavement will be paid for at the unit price per square metre regardless of the depth. The unit price shall include disposing of the concrete removed at a location designated by the Engineer.
 - .4 Compacted granular base where required shall be paid for at the unit price bid per cubic metre for compacted granular base course under concrete pavement.
- .2 Payment for concrete pavement shall be subject to the penalties outlined in Section 3.13 for deficient concrete.

2.0 PRODUCTS

2.1 Granular Base Course

- .1 Material for the granular base course shall consist of sound, hard, durable crushed rock or crushed gravel and shall not contain organic or soft, thin elongated, or laminated materials, materials that break up when alternately frozen and thawed or wetted and dried, or other deleterious materials. When compacted near the optimum moisture content to not less than 100% of the maximum dry density corrected for the stone content as determined by ASTM D698, the material shall have a minimum CBR value of 65 and a maximum particle size of 18 mm.
- .2 Granular base course shall meet the following gradation when tested to ASTM C136 and ASTM C117, and give a smoother curve without sharp breaks when plotted on a semi-log grading chart:

BASE COURSE		
Sieve Designations (mm)	Percent by Weight Passing	
	Lower Limit	Upper Limit
19.0	100	100
12.5	75	100
5.0	50	75
2.0	32	52
0.900	20	35
0.400	15	25
0.160	8	15
0.071	6	11
Plasticity Index	0	6
% Fractured Face	60 Minimum	
% Light Weight Pieces	5 Maximum	

2.2 Cement

- .1 All cement used shall be Normal Portland Cement and shall conform to CSA standard CAN3-A5 Type 10 or Type 50.

2.3 Aggregates

- .1 Samples: Before any aggregates are used in the work, the Contractor shall obtain and ship to a testing laboratory designated by the Engineer for preliminary approval, representative samples containing not less than 25 kg of aggregate. Sampling shall be done in accordance with CSA Test Method A23.2 – 1A. The Contractor shall pay for all costs of obtaining and shipping samples and for all Laboratory Tests.

- .2 Materials: Fine and coarse aggregate shall conform to the requirements of CSA CAN3-A23.1-M77 with the following gradation limits:

- .1 Coarse Aggregate: Shall conform to the following gradation limits:

<u>Sieve Opening</u>	<u>Percent Passing</u>
28 mm	100%
19 mm	90 - 100
9.5 mm	25 - 60
5 mm	0 - 10
2.5 mm	0 - 5
80 um	0 - 1

Coarse aggregate shall consist of crushed stone or gravel or combination thereof, having hard, strong, durable particles, free from elongated particles, dust, shale, earth, vegetable matter or other injurious substances.

- .2 Fine Aggregates: Shall conform to the following gradation limits:

<u>Sieve Opening</u>	<u>Percent Passing</u>
10 mm	100%
5 mm	95 - 100
2.5 mm	80 - 100
1.25 mm	50 - 90
630 um	25 - 65
315 um	10 - 35
160 um	2 - 10
80 um	0 - 3

Fine aggregate shall consist of sand, stone screenings or there inert materials with similar characteristics or a combination thereof having clean, hard, strong, durable uncoated grains and free from an injurious amount of dust, lumps, shale, alkali, organic matter, loam or other deleterious substances.

- .3 Approval: Preliminary approval of the aggregate as represented in the samples and test results shall not constitute general acceptance of all material in the deposit or source of supply, and acceptance

shall be subject to field tests taken at the discretion of the Engineer. Materials may be considered unsuitable, even though particle sizes are as required, if particle shapes are thin or elongated or if the material fails to provide a suitable concrete. Rejected material will not be paid for. The acceptability of the final material will be determined by the Engineer.

- .4 Storage: The aggregates shall be stockpiled in such a manner as to minimize segregation. Stockpiles should be built up in layers of uniform thickness.

2.4 Concrete Strength

- .1 All concrete shall be proportioned and mixed to produce a concrete having a minimum compressive strength of 32 MPa at 28 days.

2.5 Water

- .1 The water used in mixing or curing concrete shall be clean and free from salt, oil, acids, alkalies, and organic or other deleterious substances.

2.6 Air Entraining Admixture

- .1 An air entrainment admixture conforming to the requirements of CSA Standard A266.1 shall be used to produce an air entrained concrete containing not less than 5% and not more than 8% entrained air, as determined by the standard test described in CSA Standard CAN3-A23.2-4C.

2.7 Reinforcing Steel

- .1 Reinforcing steel shall conform to the following requirements:
 - .1 Welded steel wire fabric shall conform to CSA standard G30.5.
 - .2 Billet steel bars shall conform to CSA standard G30.12-M.

2.8 Expansion Joint Filler

- .1 Expansion joint filler shall be a 19 mm thick non-extruding bituminous type and shall conform to ASTM D1751 for preformed expansion joint filler.

2.9 Expansion Joint Sealer

- .1 Joint sealer shall conform to CGSB standard specification for polyurethane sealing compound 19-GP-15 or ASTM standard specification for hot poured joint sealer D-1190.

2.10 Membrane Curing Compound

- .1 Curing compound shall be impervious resin base, conforming to ASTM standard specification C309 Type, 1D-Type B. The membrane curing compound shall be applied in accordance with the manufacturer's instructions.

2.11 Concrete

- .1 Design Mix

The Contractor shall submit to the Engineer three copies of a proposed design mix showing the proportions of the material to be used. From concrete mixed according to this design, the Contractor shall have three cylinders taken and tested according to CSA Standard CAN3.A23.2-9C and shall forward three copies of the test results to the Engineer. The costs of the design mix and concrete samples and test shall be borne by the Contractor. No concrete shall be used in the work before a mix design from a recognized testing laboratory has been submitted to the Engineer.

The concrete mix shall be designed as follows:

- | | | |
|----|-------------------------------------|----------------|
| .1 | Minimum 28 day compressive strength | 32 Mpa |
| .2 | Slump | 30 mm ± 10 mm |
| .3 | Maximum aggregate size | 20 mm |
| .4 | Air entrainment | 5.0 % to 8.0 % |

- .2 Concrete Mixing

- .1 On Site: Concrete shall only be made on the site with the approval of the Engineer.
- .2 Ready-Mixed: Ready-mixed concrete shall be mixed and transported in accordance with CSA Standard CAN3-A23.1-M77.

3.0 EXECUTION

3.1 Grade Preparation

- .1 The prepared bed for the concrete pavement shall be excavated in conjunction with adjacent roadways excavation and shall be filled with compacted granular base course material and geotextile filter fabric to the lines, grades and cross sections as indicated on the plans. The Contractor shall coordinate and schedule with other contractor as required. The Owner shall not be responsible for delays caused by other contractors.

- .2 The subgrade shall be scarified and compacted to a minimum of 98% Standard Proctor Density at optimum moisture content, over the full width of the cross-section. The material shall be worked to ensure as much uniformity as possible in material.
- .3 Granular base course shall be installed as specified as a foundation material under concrete pavement. The base on which the concrete will rest shall be thoroughly wetted immediately prior to placing the concrete and must not be frozen, muddy or have areas of water pondage.
- .4 All granular base course layers shall be compacted near the optimum moisture content to not less than 100% of the maximum dry density corrected for the stone content as determined by ASTM D698 Method A for the material used.

3.2 Forms

- .1 Forms shall be of steel or wood of sufficient strength to resist the pressure of wet concrete, and the supply shall be sufficient to permit their remaining in place not less than 12 hours after concrete has been placed, or longer if the Engineer considers it necessary. The use of bent, twisted, battered or worn-out forms will not be permitted. Forms shall be held securely by approved methods to prevent movement and bulging when the concrete is placed. Forms will be checked for alignment and elevation by the Engineer before concrete is poured, and shall be cleaned and oiled before each use.

3.3 Reinforcement

- .1 Where required, reinforcement shall be secured in the location shown on the Standard Drawings or as directed by the Engineer and shall be free from mill scale, grease and rust immediately prior to placing concrete. Reinforcement shall be drilled and dowelled into existing concrete at all joints.

3.4 Equipment

- .1 Slipform paver suitable to the work shall be used and equipped with adequate internal vibrators to consolidate concrete to full depth and width of slab; adjustable crown and crossfall; subject to the approval of the Engineer. Slipform paver shall be capable to uniformly spreading, shaping, and consolidating fresh concrete to produce a dense homogeneous mass with surfaces requiring a minimum of hand finishing.

3.5 Slipforming

- .1 Set and maintain grade line by establishing taut string line or wire, based on the lines and grades in the Drawings and as set by the Engineer.
- .2 Provide stable support of the travelling slipform machine. Protect adjacent work and repair if damaged.

- .3 Remove excess mortar that may accumulate on a slipformed vertical edge.
- .4 If slab edge sags, repair immediately by hand forming; do not use concrete mortar to top off the sag. If edge sagging persists, suspend operations and perform corrective measures.

3.6 Hand Forming

- .1 Hand forming and placing concrete without extruding machine shall only be used on areas impractical for slipforming and with the approval of the Engineer.
- .2 The concrete shall be thoroughly consolidated against and along the faces of the forms. Hand spreading shall be done with shovels, not with rakes, in order that the concrete will not be segregated. Precautions should be taken to prevent overworking of the concrete.

3.7 Placement

- .1 The concrete shall be placed as soon as possible after mixing, but not later than one hour after mixing has begun. Retempered concrete shall not be used. The concrete shall be transported, by methods which will prevent segregation, and deposited on the subgrade so that as little handling as possible is required.
- .2 Concrete thickness shall be those shown on Standard Drawings.
- .3 Concrete shall be placed continuously until the scheduled pour is complete. Arrange the rate of concrete delivery to ensure that the discharge interval between successive loads does not exceed 30 minutes. If the discharge interval is exceeded, place a construction joint.

3.8 Appurtenances

- .1 Appurtenances shall be located, examined for deficiencies and staked by the Contractor prior to work beginning on a particular section and any deficiencies noted must be reported to the Engineer immediately. Upon completion of a block of work, the Contractor shall relocate these structures and inspect them with the Engineer. Any damage which may have occurred during the concreting operations, and deficiencies not previously reported to the Engineer, shall be repaired at the Contractor's expense. The Contractor shall schedule his work in such a manner as to not have more than seven days or 1000 m, whichever is greater, of work in progress at one time. This includes the entire process of preparing the subgrade for the concrete, to the final backfilling and cleaning up. All costs involved in using an extruding machine shall be included in the contract unit prices tendered for concrete pavement.

3.9 Finishing

- .1 Surfaces shall be struck off and screeded to the slope, cross-section and elevation shown on the drawings and staked by the Engineer. The surface shall be consolidated and smoothed using a wood float. Light steel trowelling shall be used followed by a uniform burlap finish. Drag multiple ply burlap equal in length equal to the width of the slab and having at least a 1.0 m strip in contact with the plastic concrete surface. Drag carefully in the direction of concrete placement to produce a finished surface simulating a sandy texture with no disfiguring marks. No patching will be allowed.

3.10 Joints

- .1 Construct joints as required in each type of construction to the following standards as applicable.
- .2 Expansion and Contractor Control Joints
 - .1 Intended to control the location of shrinkage cracks in hardening concrete. Construct joints to the indicated dimensions, depth, spacing, and pattern, with a maximum spacing of 6.0 m by any of the following methods:
 - .1 Formed Joint: Form the groove by inserting a metal or fibre strip, or polyethylene film into the plastic concrete. Finish the edges to a 6 mm radius. Remove the insert immediately after initial set of the concrete. Seal the joint with a specified sealant.
 - .2 Tooled Joint: Hand form the groove using a jointing tool with a thin metal blade to impress a plane of weakness into the plastic concrete. Finish the edges to a 6 mm radius. Seal the joint with a specified sealant.
 - .3 Sawed Joint: Cut the groove with a concrete saw as soon as the concrete surface has hardened sufficiently to resist raveling as the cut is made, but before shrinkage cracks form in the concrete. The Contractor is responsible for the proper timing of the saw cut. Immediately flush the saw cut clean with water. Once the joint surfaces are dry, seal the joint with a specified sealant.
 - .2 Isolation Joint: required where concrete is placed adjacent to an immovable structure or where indicated on the Standard Drawings. Construct the joint by sawing or forming to create a clean break through the full cross-section of the concrete member. Make the joint wide enough to permit a snug fit for the pre-formed joint filler.

Alternatively, place the pre-formed joint filler against the structure and pour the concrete against the pre-formed joint filler.

- .3 Construction Joint: required between concrete pours or for joining new concrete to existing work. Construct the joint with dowels as detailed on the Standard Drawings or as directed by the Engineer. Finish edges to a 6 mm radius. Vertically trim the existing concrete by sawing at least 50 mm deep and breaking. Leave the joint form in place until the concrete has set, then remove the joint form without damaging the concrete.

3.11 Curing

- .1 All concrete shall receive two applications of membrane curing compound. The first application is to be applied after the disappearance of the water sheen and the final finishing of the concrete. During hot, dry, windy days, the first application shall be applied immediately after final finishing and before all free water on the surface has evaporated. The second applications shall be made immediately at right angles to the first so that complete coverage on the surface is attained. Immediately after removal of the forms all exposed surfaces shall be thoroughly wetted with water and then sprayed with membrane curing compound. The membrane curing compound shall be applied in accordance with the manufacturer's instructions.

3.12 Cold Weather Requirements

- .1 When the temperature of the surrounding atmosphere is at, or below 4°C, the aggregate and the mixing water shall be heated. The aggregate and mixing water shall have a temperature of not less than 4°C and be entirely free of frozen materials. The aggregate shall not be heated to more than 60°C, and the concrete when deposited in the forms shall have a temperature of not less than 10°C and not more than 38°C. The concrete shall be maintained at a minimum temperature of 10°C for not less than four days after placing.

3.13 Tolerances

- .1 The finished surfaces of all concrete work shall be true to the required cross-section with a tolerance of ± 3 mm from the required elevation and dimensions. Surface of concrete pavement shall not show any depressions or bumps under a straight edge 3 m long exceeding 3 mm parallel to the street direction of travel. Depressions shall not exceed 6 mm in transverse to the direction of travel and at intersections and ramps. Concrete not meeting the requirements specified shall be removed to the nearest joint and replaced at the Contractor's expense.

3.14 Field Tests

- .1 Tests shall be made of the concrete to ensure that it meets these specifications. Testing shall be done to conform to the following standard specifications:

Test	Current Issue of ASTM
Sampling of Fresh Concrete	C172
Test for Slump of Concrete	C143
Compression and Flexure Test	C31
Compressive Strength of Molded Concrete Cylinders	C39
Measurement of Air Content	C173 or C231

- .2 Concrete: The services of an independent, qualified, materials testing laboratory shall be retained to perform the field and laboratory concrete tests. The Contractor shall be responsible for arranging for and paying the full cost of all control testing including sampling, transporting the samples for compression tests of the cylinders taken to the designated testing labs. The cost required for sampling and shipping of samples to the laboratory shall be included in the unit prices tendered for concrete work.

The cost of compression testing of concrete specimens in the laboratory will be paid for by the Owner.

The Owner shall appoint the laboratory to be used for concrete testing.

Copies of all test results shall be promptly forwarded to the Contractor, the Concrete Supplier and the Engineer.

- .3 Sub-Grade Density: The Owner shall pay the cost of the sub-grade density control testing required to ensure performance of the Contract. Only tests that indicate that the density is at or above that specified will be paid for. The costs of any test which indicate the density does not meet or exceed the minimum specified will be deducted from the Contractor's Progress Certificate.

The Owner will appoint the laboratory to be used for quality control testing.

- .4 Three concrete cylinders shall constitute one test and shall be made from the same batch or load. They shall be stored undisturbed on site for 24 hours, covered with a plastic sheet to prevent loss of moisture. They shall then be delivered to an approved testing laboratory for curing with one cylinder tested at seven days and the other two at twenty-eight days. A set of three cylinders shall be taken for every 100 m³ of concrete poured or for each side of each block or portion thereof placed in one day, or as directed by the Engineer.

- .5 When construction begins, the Engineer may take additional cylinders in order to establish a concrete strength pattern in the early stages of the project.
- .6 At the City's request, the quality assurance laboratory will take one or more sets of cores from suspect concrete pavement, each set comprising of 3 cores whose average thickness represents not more than 500 m² of concrete pavement.

3.15 Failure to Meet Strength Requirements

- .1 The Owner reserves the right to reject any concrete whatsoever which does not meet all the specified requirements for the concrete.
- .2 The Owner may, however, at the discretion of the Engineer, accept concrete which does not meet the specified strength requirements and, in such case, payment shall be made on the basis of a percentage scale for the concrete product represented by each test as follows:

32.0 MPa Concrete:

32.0 MPa and over	100% of the unit bid price
29.2 MPa to 32.0 MPa	90% of the unit bid price
26.5 MPa to 29.1 MPa	70% of the unit bid price

All concrete below 26.5 MPa will be rejected.

- .3 Furthermore, the Owner reserves the right to reject any particular portion of a pour if there exists manifest evidence that this particular portion of the pour has a strength that is below the minimum acceptable strength required under this Section.
- .4 If any concrete tested in accordance with this Specification fails to meet the specified strength, the Contractor may request coring of the concrete in question. When such coring is approved by the Engineer, arrangements shall be made by the Contractor, through the Engineer, to employ an independent, qualified testing service, all at the expense of the Contractor. The cores shall be taken and tested within seven days of the testing of the twenty-eight day cylinders representing the concrete in question. Three cores shall be taken for each strength test previously taken and there shall be no doubt that the cores taken and the cylinders under consideration represent the same batch of concrete. Cores shall be tested in accordance with the requirements of CSA A23.2-14C and the average strength of the cores as reported by the independent testing service shall constitute a test. When more than one core strength test is taken, the average of all the core strength tests shall represent the strength of the concrete in question.
- .5 The foregoing procedure may be altered if the concrete in question was placed during weather conditions not suitable, in the opinion of the Contractor, to permit satisfactory curing. When 7 day test results indicate that the concrete is likely to be sub-standard or rejected, the Contractor will

be notified and can either request to arrange coring at that time or can continue to provide curing for the remainder of the 28 day period. In the event that the Contractor chooses to take cores after 7 days, they shall be taken as described in the foregoing paragraph, transported to an approved laboratory, and cured for a period of time such that the total curing time in place in the structure, plus the curing time in the laboratory is equal to 28 days. The cores shall then be tested and reported as described in the foregoing paragraph.

- .6 In cases where the concrete strength, as indicated by the cores, is higher than the strength based on the concrete cylinder results, the core results shall be used as the basis of acceptance and payment of the concrete. If the core strengths are lower than the strength from the concrete cylinder tests, the cylinder tests shall govern.

3.16 Failure to Meet Thickness Requirements

- .1 The Owner reserves the right to reject any concrete whatsoever which does not meet all the specified requirements for the concrete.
- .2 The Owner may, however, at the discretion of the Engineer, accept concrete which does not meet the specified thickness requirements and, in such case, payment shall be made on the basis of a percentage scale for the concrete product represented by the average core thickness test as follows:

$$\text{Thickness } (X = \frac{\text{actual thickness}}{\text{design thickness}})$$

Variation in Thickness From Design Thickness	Pavement
more than specified thickness – 3 mm thin	100%
3 mm thin – 10 mm thin	X ² (100%)
10 mm thin – 15 mm thin	X ⁵ (100%)
more than 15 mm thin	No Payment

- .3 Concrete pavement with excess thickness may be accepted if surface and grade tolerances are met, but no claim for additional payment will be accepted.

3.17 Construction Record Imprints

- .1 Each block of street constructed shall be marked at each end with a suitable tool showing legibly the name of the Contractor and year of construction.

3.18 Protection

- .1 Keep all animals and pedestrians off the newly constructed concrete. The Contractor shall also be responsible for keeping all vehicles off the work

until cylinder testing has confirmed that the concrete has attained 75% of the specified strength or as directed by the City.

3.19 Backfilling

- .1 Backfill areas between alley pavement, parking lots, or driveways with specified granular material compacted to a minimum density of 97% Standard Proctor Density.
- .2 Backfill other areas along alley edges with 150 mm of lightly tamped topsoil shaped to match adjacent landscaped areas.

3.20 Final Cleanup

- .1 As the work progresses, the Contractor shall clean up the site and all areas in which work has been done shall be left in a neat and presentable condition. All gutters and street drainage ditches which have been blocked as result of the Contractor's trenching operation shall be restored or repaired at the Contractor's expense.
- .2 The Contractor shall, at his own expense, dispose of all surplus excavated material, organic soil, rock boulders and pieces of concrete and masonry, including those less than 0.1 m³ in volume at an approved off-site disposal area.

3.21 Concrete Deterioration

- .1 Concrete that shows surface scaling, deterioration or loss of cement or aggregate during the maintenance period will be rejected and require removal and replacement by the Contractor at no cost to the Owner.

END OF SECTION