

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

- A. Notify Construction Manager of proposed date for use of materials. Order and schedule shipments to coincide with construction schedule.

1.2 SUMMARY

- A. Section Includes Concrete Paving. Including the Following:
 - 1. Walks.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place Concrete" for general building applications of concrete.
 - 2. Section 32 13 73 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.

1.3 MEASUREMENT PROCEDURES

- A. Measure Portland cement concrete paving in square metres.
- B. Measure supply of Portland cement in tonnes.
- C. Measure sealing of joints including saw cutting and preparation, in linear metres.

1.4 REFERENCE STANDARDS

- A. ASTM International
 - 1. ASTM A775/A775M-07b, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - 2. ASTM C171-07, Standard Specification for Sheet Materials for Curing Concrete.
 - 3. ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete.
 - 4. ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 5. ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
 - 6. ASTM C666/C666M-03(2008), Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.

7. ASTM D1752-04a(2013), Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Bituminous Expansion Joint Fillers for Concrete Paving and Structural Construction.
 8. ASTM D2628-91(2011), Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
 9. ASTM D3569-95(2000), Standard Specification for Joint Sealant, Hot-Applied, Elastomeric, Jet-Fuel-Resistant Type for Portland Cement Concrete Pavements.
 10. ASTM D5329-09, Standard Test Methods for Sealants and Fillers, Hot-Applied, For Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements.
 11. ASTM D6297-13, Standard Specification for Asphaltic Plug Joints for Bridges.
 12. ASTM D6690 -12, Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
- B. CSA Group
1. CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 2. CSA-A3000-13, Cementitious Materials Compendium.
 3. CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
 4. CSA G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- A. Submit in accordance with Section 01 33 00- Submittal Procedures.
- B. Product Data:
1. Submit manufacturer's instructions, printed product literature and data sheets for concrete paving material and include product characteristics, performance criteria, physical size, finish and limitations.
 2. Submit following sampling and testing data:
 1. Sieve analysis for gradation of bedding and joint material.
 2. Evaluation of sealing and cleaning compound.
- C. Samples:
1. Inform Construction Manager of proposed source of aggregates and provide sampling at least 4 weeks prior to commencing work.

1.6 QUALITY ASSURANCE**A. Qualifications:**

1. Installer: Company or person specializing Portland cement concrete paving with 5 documented years of experience.

B. Certifications:

1. Submit to Construction Manager manufacturer's test data and certification that following material meets criteria and requirements of this section prior to starting concrete work:
 1. Portland Cement.
 2. Blended Hydraulic Cement.
 3. Supplementary Cementing Material.
 4. Admixtures.
 5. Joint Sealants.
 6. Curing Materials.
 7. Joint Filler.
2. Submit certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA A23.1/A23.2, and that mix design is adjusted to prevent alkali aggregate reactivity problems.

1.7 DELIVERY, STORAGE AND HANDLING**A. Deliver, store and handle materials in accordance with manufacturer's written instructions.****B. Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.****C. Storage and Handling Requirements:**

1. Store materials off ground in a dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 1. Unload cement and store in weathertight bins or silos that protect cement from dampness and contamination and provide easy access for inspection and identification of each shipment.
 2. Stockpile minimum 50% of total required amount of each size of aggregate prior to commencing mixing operation.
2. Replace defective or damaged materials with new.

PART 2 PRODUCTS**2.1 MATERIALS**

- A. Portland cement: to CSA A3000.
- B. Aggregates: to CSA A23.1/A23.2 and to following requirements:
 - 1. Coarse aggregate:
 - 1. Produce coarse aggregate in at least two separate sizes which, when combined, yields gradation specified. Each component size to form approximately equal percentage of total coarse aggregate.
 - 2. Gradation: to CSA A23.1/A23.2, table 5, nominal size 28-5.
 - 3. Flat and elongated particles: to CSA A23.1/A23.2 (13A) (length to width and width to thickness ratio greater than 3) not to exceed 0.5% by mass.
 - 2. Fine aggregate:
 - 1. Gradation: to CSA A23.1/A23.2, Table 1. Material passing 0.160 mm sieve: maximum 5%.
 - 2. Aggregates for use in concrete pavement shall not be susceptible to D-cracking. Unless field experience, aggregate history or prior laboratory testing have proven otherwise.
 - 3. Aggregates for use in concrete pavement shall be tested in accordance with ASTM C666/C666M. Test shall be in accordance with Procedure A for a period of 350cycles.
- C. Supplementary cementing materials: to CSA A3000.
- D. Air entraining admixture: to ASTM C260/C260M.
- E. Chemical admixtures: to ASTM C494/C494M. Construction Manager to approve accelerating or set retarding admixtures during cold and hot weather placing.
- F. Curing compound: to ASTM C309, Type 1-D or 2.
- G. Joint seal, preformed polyurethane sealant: to ASTM C920.
- H. Polyethylene backer rod, properly friction-fitted for use with self-leveling sealants.
- I. Preformed 12.7 mm thick bituminous expansion joint filler: to ASTM D1752.
- J. Dowels and tie-bars: to CSA G30.18.
 - 1. Dowels: clean, straight and free from flattened or burred ends, plain round bars of grade 300 or better conforming to CSA G40.20/G40.21 and be epoxy-coated to ASTM A775/A775M.

2. Tie-Bars: deformed steel bars in compliance with CSA G30.18 and be epoxy-coated to ASTM A775/A775M.

- K. Protective covers and insulation for cold weather concreting: to CSA A23.1/A23.2.

2.2 MIXES

- A. Job mix formula to be reviewed by Construction Manager in accordance with CSA A23.1/A23.2, Table 13 and as specified below.
- B. For concrete proportioned in accordance with Alternative 1:
 1. Use type 10 cement.
 2. Compressive strength when tested in accordance with CSA A23.1/A23.2, (9C): average 28 day compressive strength to be minimum 28MPa for pedestrian paving and 35MPa for heavy duty vehicular paving.
 3. Cementing materials content: 290 to 335 kg/m³ of concrete mix.
 4. Air content when tested in accordance with CSA A23.1/A23.2, (4C), immediately after discharge: in accordance with CSA A23.1/A23.2, Table 10.
 5. Class of exposure: Class C-2.
 6. Use of chemical admixture will be approved only when specified mix requirements or workability cannot be achieved by proportioning of aggregates, water, cement and air entraining admixture.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for concrete paving installation in accordance with manufacturer's written instructions.
 1. Visually inspect substrate in presence of Construction Manager.
 2. Inform Construction Manager of unacceptable conditions immediately upon discovery.
 3. Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Construction Manager.

3.2 EQUIPMENT

- A. Concrete plant: in accordance with CSA A23.1/A23.2.
- B. Where fixed form paving is used provide equipment with following features:
 1. Mechanical self-propelled spreader capable of moving concrete forward and laterally.

2. Vibrator locations and spacings whether surface or internal to be installed as per manufacturer's specifications or as directed by the Construction Manager .
 3. Mechanical, self-propelled finisher with two independently operated transverse screeds.
 4. Float to be aluminium or magnesium, straight, smooth, sufficiently light to avoid sinking into concrete surface, operated mechanically or manually from edge to edge while advancing longitudinally.
- C. Use following equipment on approval of Construction Manager :
1. Hand operated transverse screeds spanning side forms.
 2. Mechanically powered vibrating beam spanning side forms.
 3. Hand operated floats and fluting tools used by skilled workers.
- D. Provide following miscellaneous equipment where required:
1. Edging tool.
 2. Water truck equipped with pump, hose line and fine spray nozzle.
 3. Self-propelled concrete saws equipped with rubber-tired wheels, readily adjustable blade depth controls, and sawing line guide pointers both front and rear. Provide adequate number of units to complete sawing at rate required and have ample supply of suitable saw blades and at least one standby sawing unit available on job site before concrete placement is started.

3.3 SUBGRADE AND SUBBASE PREPARATION

- A. Soft, yielding materials or other portions of subgrade that will not compact to specification shall be removed and replaced with suitable material. Subgrade to be brought to a firm unyielding condition with a uniform density. It shall be compacted at or above optimum moisture content to 95% Standard Proctor density.
- B. When concrete is placed directly on subgrade, it will be checked for conformity with the cross-section tolerance. Finished surface shall not deviate more than 0mm above and 20mm below specified grade and cross-section, and the surface shall not deviate more than 10mm at any place on a 3mm template.
- C. Subbase to consist of specified material and have a compacted thickness of not less than specified.
- D. Subbase shall be compacted to specified density.
- E. Prepared subbase shall be checked for conformity with the cross-section and grad tolerances. Finished surface of subbase shall not deviate more than 0mm above and 20mm below specified grade and cross-section, and surface shall not deviate more than 10mm at any place on a 3mm template.

- F. Repair damage to subbase resulting from hauling or equipment operations.
- G. Prior to placing concrete, subbase shall be thoroughly wetted. Wetting shall be carried out, such that standing water is not present on grade.
- H. Surface condition of base to be approved by Construction Manager before placing concrete.

3.4 REINFORCING STEEL AND DOWELS

- A. Place reinforcing steel and dowels as indicated and to Section 03 20 00- Concrete Reinforcing.
- B. Dowel bars shall be plain round bars of grade 300 or better conforming to CSA G40.20/G40.21 and be epoxy-coated to requirements of ASTM A775/A775M, also coated with bond breaker material.
- C. Steel for tie bars or tie bolts to comply to CSA G30.18 and be epoxy-coated to ASTM A775/A775M.
- D. Place sufficient number of joint dowel assemblies in advance of paver to avoid delay in concrete placement.
- E. Remove oil, grease, dirt and deleterious material from reinforcing bars before placing concrete.
- F. Steel placement to be approved by Construction Manager before placing concrete.

3.5 PLANT AND MIXING REQUIREMENTS

- A. If crusher screenings are approved as mixture component, proportion separately from sand.
- B. If washing of aggregate required, allow aggregate to drain for 24 hours or longer as required to stabilize moisture content.
- C. For truck mixers, mixing to be in accordance with CSA A23.1/A23.2.
- D. Mix produced to be within following tolerances from mix design:
 - 1. Air content: as per CSA A23.1/A23.2, Table 10.

3.6 TRANSPORT AND DELIVERY OF MIX

- A. Time from initial mixing to final placing to be not more than 120 minutes if mix is transported by agitating equipment (e.g. truck mixer) in accordance with CSA A23.1/A23.2, clause 18.4.2 - Delivery with Agitating Equipment.
- B. Transport mix by non-agitating equipment only if;
 - 1. Time from addition of cement to time of placing not to exceed 45 minutes.

2. Haul units to be of sufficient capacity to transport at least one regular size batch from mixer.
3. Haul routes to be well maintained to prevent undue disturbance of concrete mix during transport.

3.7 PLACING

- A. Place concrete to lines, grades and depths as indicated.
- B. Discharge concrete into forms as soon as practical after mixing.
- C. Construct pavement lanes in sequence approved by Construction Manager.
- D. Use hand placing where machine spreading is not feasible.
- E. Spread uniformly with approved equipment to thickness sufficient to allow for proper consolidation and finishing. Do not apply external tractive force to paver.
- F. Operate with continuous forward momentum. Schedule concrete supply to minimize interruptions.
- G. Insert tie bars as indicated.
- H. When completing concrete placement for day, carry placement through to scheduled control joint location.
- I. Where concrete placement is stopped for more than 30 min due to breakdowns, weather or other reasons, construct extra bulkhead and construction joint as directed by Construction Manager.
- J. Do not place concrete on frozen surface.
- K. No concrete shall be placed during rain.
- L. When rain appears imminent paving operation should cease. Protect freshly laid concrete from rain damage and adverse weather condition and in accordance with CSA A23.1/A23.2. Extend protective coverings over edges of concrete and arrange so as not to bear on unprotected edges.
- M. Concrete shall be placed when the projected temperature is 10 degrees C or higher for a minimum of 72 hours.
- N. If concrete has been placed when the ambient temperature is at or above 32 degrees C, the concrete is to be cured by continuous water curing from soaker hoses providing complete coverage of the pavement to minimize the temperature rise of the concrete.
- O. If concrete has been placed in cold weather and the site temperature is expected to drop below 10 degrees C, insulating curing blankets or other suitable material shall be placed on the concrete pavement and weighted to prevent movement. Curing to continue until the cumulative number of days, or fraction thereof, during which the temperature of the concrete is above 10 degrees C, has totalled a minimum of 7days. Alternatively, if

compressive tests of cylinders cured under field conditions achieve at least 70% of the specified compressive strength, curing may be discontinued.

- P. Concrete pavement placed in cool weather shall experience a minimum of 30 day air-drying period, following final curing, before first application of de-icing salts.

3.8 CONSOLIDATION

- A. When internal vibrators are used:

1. For slab depths up to 50mm, mount vibrators parallel to base at mid depth. For slab depths greater than 50mm, mount vibrators with tips minimum 50mm above base and tops minimum 50mm beneath pavement surface.
2. Operate at manufacturer's recommended number of vibrations and specifications.

- B. When surface vibrators are used:

1. Synchronize units on each individual screed or pan.
2. Operate at minimum of 3,500 vibrations per minute and minimum amplitude of 0.4mm.
3. Treat each pavement section to at least 2 passes of vibratory equipment unless otherwise directed by Construction Manager.

- C. Stop vibrators when paver stops.

- D. Use hand operated vibrator on odd shaped slabs inaccessible to frame mounted units. Do not operate vibrator in one location longer than 5 seconds.

- E. Ensure concrete adjacent to edge forms or previously constructed slabs is thoroughly vibrated.

3.9 FINISHING

- A. After consolidation by vibration, finish with equipment approved by Construction Manager.

- B. When striking off concrete surface, maintain uniform roll of concrete ahead of first screed for its full length when finishing machine is on first pass.

- C. Make 2 passes with transverse finishing machine.

- D. Where joints are formed rather than sawn, form longitudinal and transverse joints after final pass of finishing machine.

- E. Hand finish areas inaccessible to finishing machines to same quality and surface characteristics as machine finished surfaces.

- F. Finish concrete surface with approved float at proper time. Operate from edge to edge with wiping motion while advancing, with each succeeding pass overlapping previous one.
- G. Check surface with approved 3.5m long straightedge. Correct irregularities exceeding 5mm before concrete takes initial set.
- H. Finish edges of slabs with edging tool to form smooth squared surface on city sidewalks only. Do not apply the smooth squared surface on internal site concrete paving inside property lines. Do not patch with cement paste.

3.10 SURFACE TEXTURING

- A. Commence texturing immediately after float finishing.
- B. Use stiff bristled broom to produce nonslip concrete surface finish approved by Construction Manager, with fine granular texture free from disfigurations.
- C. Texturing to be straight, precise and not damaging to pavement edges.

3.11 CURING

- A. Cure for minimum 7 days by one of following methods:
 - 1. Curing compound:
 - 1. Apply in two coats with approved spray equipment to form complete and unbroken film on surface of concrete. Mechanically agitate compound before and during use.
 - 2. For hand application apply first coat immediately after texturing operations, second coat to be applied immediately after first coat in a perpendicular direction.
 - 3. For machine application curing compound to be applied in accordance with manufacturers' specifications.
 - 4. Apply second spray in accordance with manufacturer's instructions.
 - 5. Apply each spray at application rate recommended by manufacturer.
 - 6. Spray slab edges immediately after removal of forms.
 - 7. Protect formed or sawed joints from evaporation during curing period.
 - 8. Respray areas where membrane is damaged during curing period.
 - 2. Burlap or cotton mats:
 - 1. As soon as concrete surface has been finished and can bear weight without marking, carefully cover with burlap or cotton mats.

2. Place mats to overlap each other by 300mm or more and to overlap concrete slab by 300mm or more at each side secured by a continuous bank of sand and gravel.
3. Cover sides and ends of slab with mats as soon as forms are removed.
4. Thoroughly wet mats before placing them on concrete and keep saturated during curing period with water spray sufficiently fine to avoid damaging concrete surface, avoiding wet/dry cycles.

3.12 PROTECTION

- A. Do not open concrete pavement to traffic or construction equipment until joints have been sealed and concrete has cured for a minimum of 3 days.
- B. When placing concrete in lanes adjacent to existing concrete, operate placing equipment on rubber wheels or pads to prevent damage to existing surface.

3.13 TOLERANCES

- A. Finished concrete surface to be within 5mm of design grade but not uniformly high or low.
- B. Finished concrete surface not to have irregularities exceeding 5mm when checked with 4.5m straight edge placed in any direction.
- C. Horizontal deviations of slab edge from alignment of pavement not to exceed 10mm.

3.14 JOINTS

- A. General:
 1. Construct joints plumb, straight and square to details indicated.
 2. Transverse joints to coincide with those in adjacent pavement unless indicated or directed otherwise.
 3. Install preformed joint filler at locations and to details indicated.
 4. Install isolation joints around structures and features that project through, into or against pavement.
- B. For sawn joints.
 1. Ensure joints are sawn straight. Install end stakes to ensure straight joint alignment across paved area. Mark joint alignment with chalk line or other suitable guide to approval of Construction Manager .
 2. Saw joints using approved equipment and methods to produce joint dimensions indicated.

3. Restrict speed of saw cutting to ensure proper joint alignment and to avoid damage to concrete.
4. Supply sufficient workers and equipment including standby equipment, to maintain satisfactory sawing schedule.
5. Make initial saw cuts in progressive manner and as soon as concrete surface has hardened sufficiently to resist ravelling as cut is made and before shrinkage cracks occurs.
6. If cracking occurs ahead of saw cut, stop sawing immediately. Move ahead several joints and cut one or more joints before returning to saw intermediate joints. Where cracking persists, make 1m saw cut from one edge and complete sawing from opposite edge. Adjust sawing schedule accordingly.
7. If uncontrolled cracking or other surface damage results from inadequate or improper sawing techniques suspend further concrete operations until situation is corrected and immediately remove and replace damaged slabs.
8. Immediately on completion of sawing, flush joints with water to remove laitance.

C. Sealing:

1. Seal joints before allowing vehicular traffic on new pavement.
2. Provide Construction Manager with copy of sealant manufacturer's instructions for application.
3. Just prior to sealing joint, clean with compressed air or flush with high pressure water to remove laitance, curing compound and protrusions of hardened concrete. Clean and dry by compressed air and vacuum to remove loose and foreign material.
4. Do not apply joint sealant in rainy weather or when ambient temperature is less than 5degrees C.
5. Insert approved filler and bond breaking material in joint prior to applying sealant, then fill joint from bottom up with sealant to avoid trapping air.
6. Prepare sealant for application using equipment and methods approved by Construction Manager.
7. Apply sealant strictly in accordance with manufacturer's recommendations and cleanliness of concrete to be bonded.
8. On completion of first application of sealant, return and top up any underfilled areas.
9. Replace sealant which fails to bond to concrete or fails to cure properly, as directed by Construction Manager .

3.15 DEFECTIVE CONCRETE

A. Concrete is defective when:

1. It contains: honeycombing, embedded debris, uncontrolled shrinkage cracking, or other surface defects.
2. It is damaged by freezing.
3. It is placed at too high temperature.
4. Standard deviation of 28 day strength test results exceeds CSA A23.1/A23.2 clause 17.6.7.1 requirements.

3.16 REPAIR/RESTORATION**A. Repair of defective concrete work:**

1. Where defective concrete is identified by Construction Manager during plastic condition, repair using methods approved by Construction Manager .
2. Grind off high surface variations where directed by Construction Manager .

B. Remove and replace defective concrete where directed by Construction Manager .

1. Remove minimum 3m of pavement by sawing through concrete across full lane width.
2. Replace with new concrete to this specification.
3. Construct contraction joint at boundary between sawn face of existing concrete and new concrete.

3.17 CLEANING**A. Progress Cleaning: clean in accordance with Section 01 74 11- Cleaning.**

1. Leave Work area clean at end of each day.

B. Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11- Cleaning.**3.18 PROTECTION**

- A. Keep vehicular traffic off newly paved areas until paving has properly cured and joints have been sealed.

END OF SECTION