

Part 1 General**1.1 DESCRIPTION**

- .1 This section specifies requirements for installation of concrete formwork and accessories.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.3 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-O86S1-14, Supplement No. 1 to CAN/CSA-O86-14, Engineering Design in Wood.
 - .3 CSA O121-08(R2003)], Douglas Fir Plywood.
 - .4 CSA O151-09 (R2014), Canadian Softwood Plywood.
 - .5 CSA O153-13, Poplar Plywood.
 - .6 CSA S269.1-16, Falsework for Construction Purposes.
 - .7 CAN/CSA-S269.3-M92(R2003), Concrete Formwork, National Standard of Canada

1.4 SUBMITTALS

- .1 Shop Drawings:
 - .1 Upon request, submit to the Departmental Representative for review four (4) sets of formwork shop drawings, in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, ties, and locations of embedded anchors. Comply with CAN/CSA-S269.3 for formwork drawings.
 - .3 Indicate formwork design data: permissible rate of concrete placement, and temperature of concrete in forms.
 - .4 Indicate sequence of erection and removal of formwork as directed by Departmental Representative.

1.5 MEASUREMENT FOR PAYMENT

- .1 This item will not be measured separately.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.7 WASTE MANAGEMENT

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products**2.1 MATERIALS**

- .1 Formwork lumber materials to CSA A23.1 and CAN/CSA O86.
- .2 Falsework materials to CSA S269.1.
- .3 Form stripping agent: colourless mineral oil, free of kerosene, with viscosity between 15 to 24 mm²/s at 40 degrees C, flash-point minimum 150 degrees C, open cup.
- .4 Form ties: removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25mm dia in concrete surface. When forms are removed, no metal will be less than 75mm from the surface of the concrete.

Part 3 Execution**3.1 FABRICATION AND ERECTION**

- .1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Fabricate and erect formwork in accordance with CAN/CSA S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .3 Align forms and make watertight.
 - .1 Keep form joints to a minimum.
- .4 Use 25mm chamfer strips on external corners and/or 25mm fillets at interior corners, joints, unless specified otherwise.
- .5 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

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- .6 All holes from form ties and rods to be plugged with mortar to requirements of CSA A23.1.
 - .7 Build in anchors, sleeves, conduit, and other inserts required to accommodate Work specified in other sections.
 - .8 Clean formwork in accordance with CSA-A23.1/A23.2 before placing concrete.

3.2 REMOVAL

- .1 Leave formwork in place for at least 7 days prior to removal.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

- .1 This section specifies concrete reinforcing materials, their fabrication and placing.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 03 30 00 - Cast-In-Place Concrete.

1.3 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CSA-A23.3-14, Design of Concrete Structures.
 - .3 CSA-G30.18-09(R2014), 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.
 - .5 CAN/CSA-G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .6 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .2 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.4 SUBMITTALS

- .1 Provide submissions in accordance with Section 01 33 00 Submittal Procedures.
- .2 Shop Drawings:
 - .1 Clearly indicate bar sizes, spacing, location and quantities of reinforcement, mesh, chairs, spacers and hangers with identifying code marks to permit correct placement without reference to structural drawings; to Reinforcing Steel Manual of Standard Practice.
- .3 Product Data/Samples:
 - .1 Provide product data for supports and spacers.
- .4 Test Results:
 - .1 Provide Mill Test Certificates cross referenced to the product supplied to the site.

1.5 STORAGE

- .1 Store reinforcing steel on racks or sills that will permit easy access for identification and handling and prevent it from becoming coated with material which would adversely affect bond.
- .2 Do not store reinforcing steel in direct contact with the ground.

1.6 MEASUREMENT FOR PAYMENT

- .1 No measurement will be made under this section.
 - .1 Supply and placement of reinforcement, wire ties and spacers to be considered incidental to the work of Section 03 30 00 - Cast-In-Place Concrete.

1.7 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.8 WASTE MANAGEMENT

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products**2.1 MATERIALS**

- .1 Reinforcing steel: to CSA G30.18; billet steel grade 400W deformed bars.
- .2 Wire ties: to CSA G30.3 plain, cold drawn annealed steel wire.
- .3 Spacers: PVC, fabricated to suit site dimensions.

2.2 REINFORCING STEEL FABRICATION

- .1 Fabricate reinforcing to CSA A23.1.
- .2 Fabrication tolerances for reinforcing steel to Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .3 Obtain the Departmental Representative's acceptance for location of reinforcement splices other than shown on steel placing drawings.

CONCRETE REINFORCING

Page 3

- .4 Ship bundles of bar reinforcement clearly identified in accordance with the shop drawing bar list.
- .5 Do not weld reinforcing steel.

Part 3 Execution

3.1 PLACING

- .1 Accurately place reinforcing in positions indicated and hold firmly during placing, compacting and setting of concrete.
- .2 Tie reinforcement where spacing in each direction is:
 - .1 Less than 300mm: tie at alternate intersections.
 - .2 300mm or more: tie at each intersection.
- .3 Ensure cover to reinforcement is maintained during concrete pour.

3.2 FIELD BENDING

- .1 Do not field bend reinforcement except where indicated or authorized by the Departmental Representative.
- .2 When authorized, bend reinforcement without heat, by applying slow and steady pressure.
- .3 Replace bars which develop cracks or splits.

3.3 CLEANING

- .1 Clean reinforcing before placing concrete.

3.4 INSPECTION

- .1 Do not place concrete until the Departmental Representative has inspected and accepted reinforcement work in place.

3.5 SURFACE CONDITIONS

- .1 Reinforcement (at time concrete is placed) to be free from mud, oil or other nonmetallic coatings that adversely affect bonding capacity.
- .2 Reinforcement with rust, mill scale, or a combination of both to be considered as satisfactory provided minimum dimensions, including height of deformations, and mass of hand wire brushed test specimens are not less than specified requirements in applicable CSA standards.

END OF SECTION

Part 1 General

1.1 RELATED WORK

- .1 Refer to other Specification Sections for related information on aggregates, form work, concrete reinforcement, and miscellaneous items.
- .2 Refer to Section 01 33 00 for Shop Drawing/Submission requirements.

1.2 REFERENCE STANDARDS

- .1 Do structural concrete work in accordance with CSA A23.1-94 (or latest edition), Concrete Materials and Methods of Concrete Construction, except where stricter standards specify otherwise.
- .2 CAN/CSA-A5/A8/A362-93 (or latest edition), Portland Cement/Masonry Cement/Blended Hydraulic Cement.
- .3 CSA A23.5-M86 (R1992) (or latest edition), Supplementary Cementing Materials.
- .4 ASTM C494-92 (or latest edition), Chemical Admixtures for Concrete.

1.3 SUBMISSIONS

- .1 Shop Drawings
 - .1 Upon request, submit shop drawings and erection drawings for formwork and falsework. All such drawings to be stamped and signed by a Professional Engineer registered in the Province of Nova Scotia.
 - .2 Upon request, submit placement drawings for reinforcing steel.
 - .3 Upon request, submit placement drawings for miscellaneous items.
- .2 Product Data/Samples:
 - .1 Provide technical data and/or samples for curing compounds (winter/summer/green/white/red), evaporation retardant and finishing aids, expansion joint materials, sealants, grouts.
- .3 Certificates:
 - .1 Minimum four weeks prior to starting concrete work submit to Departmental Representative manufacturer's test data and certification by qualified independent inspection and testing laboratory that the following materials will meet specified requirements:
 - .1 Portland cement
 - .2 Admixtures
 - .2 Provide certification that plant, equipment, and materials to be used in concrete work comply with requirements of CSA A23.1

CAST-IN-PLACE CONCRETE

Page 2

- .3 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CSA A23.1
- .4 Provide certification that concrete will not include alkali reactivity aggregates.
- .4 Methodology:
 - .1 Submit methodology for cold weather concreting.
 - .2 Submit methodology for hot weather concreting.
 - .3 Submit methodology for concrete placement operations.
 - .4 Submit methodology for concrete deck finishing operations.
 - .5 Submit methodology for supporting reinforcing steel.
- .5 Test Results:
 - .1 Provide design mix test results.
 - .2 Provide mill test certificates for reinforcing steel.

1.4 STORAGE OF MATERIALS

- .1 Store all materials to prevent contamination or deterioration, whether at the plant or at the job site.
- .2 Store cement in watertight bins or silos that provide protection from dampness and easy access for inspection and identification of each shipment whether at the plant or at the job site.
- .3 Prevent stored liquid admixtures and compounds from freezing and powdered admixtures and compounds from absorbing moisture.

1.5 SOURCE SAMPLING

- .1 At least 4 weeks prior to commencing work, inform Departmental Representative of proposed source of aggregates and provide access for sampling.

1.6 READY-MIX CONCRETE SUPPLY

- .1 Provide, with each load of concrete delivered to site, duplicate delivery slips containing the following:
 - .1 Name of ready-mix batch plant
 - .2 Serial number of ticket
 - .3 Date and truck number
 - .4 Project identification
 - .5 Class of concrete or mix
 - .6 Amount of concrete in cubic meters
 - .7 Time of loading or first mixing of aggregate, cement and water
 - .8 Time of discharge of concrete
 - .9 Admixtures added at plant
 - .10 Amount of water added at plant

1.7 MEASUREMENT FOR PAYMENT

- .1 Heating of water and aggregates and providing cold weather protection will not be measured but considered incidental to work.
- .2 Cooling of concrete and providing hot weather protection will not be measured but considered incidental to work.
- .3 Supply of anchor bolts, washers and nuts will not be measured but considered incidental to work. Bolt grouting will be considered incidental to the work.
- .4 Supply and installation of rigid PVC sleeves, expansion joint/sealants and curing compounds, or other compounds will be considered incidental to the work.
- .5 Concrete work will be measured in accordance with Section 01 29 00.

Part 2 Products**2.1 MATERIALS**

- .1 Aggregates: to CSA A23.1, for Class "C-1" exposure.
- .2 Portland Cement: to CSA A5, normal type 10.
- .3 Water: to CSA A23.1
- .4 Admixtures:
 - .1 Air entraining admixtures: to CSA A23.5
 - .2 Chemical admixtures: to CSA A23.5 and ASTM C494
 - .3 Pozzolanic mineral admixtures: to CSA A23.5
- .5 Non-shrink grout: premixed compound consisting on non-metallic aggregate, Portland cement, water reducing and plasticizing agents, of pouring consistency, capable of developing compressive strength of 50 MPa at 28 days.
- .6 Curing compound: To ASTM-C309-M81 and CSA A23.1-M94 (or latest editions) type 1, 1D, or 2.
- .7 Premoulded joint fillers:
 - .1 Bituminous impregnated fibre board: to ASTM D1751 (latest edition), non-extruding resilient type.
- .8 Joint sealers: self levelling, two component sealant capable of remaining resilient over temperatures ranging from -25°C to 35°C. Materials will be capable of an elongation of 300%, have tensile recovery of 90% ASTM D412-75 (or latest edition), hardness of 25-35 Shore A and have a high bond strength to the concrete faces.

2.2 CONCRETE MIXES

- .1 Prior to starting concrete work, submit to the Departmental Representative the proposed mix design(s) for approval. Mix design(s) to be in accordance with Alternative 1 of Table 11 in CSA A23.1-94 (or latest edition). Comply with additional requirements of CSA A23.1-94 (or latest edition), Clause 15 for concrete placed near sea water.
 - .1 Use concrete mix designed to produce air entrained concrete meeting the following requirements:
 - .2 Cement to be normal Portland cement, Type 10.
 - .3 Minimum compressive strength at 28 days: 35 MPA.
 - .4 Exposure: Class C-1.
 - .5 Maximum aggregate size to CSA A23.1-M94 (or latest edition) Table 2, Group 1, 20 mm sieve size.
 - .6 Minimum cement content 390 kg/m³.
 - .7 Air content: 6% to 8%.
 - .8 Maximum water/cement ratio to be 0.40.
 - .9 Slump at time and point of discharge 80 mm +/- 20 mm. Where the nature of the work requires larger slumps, they are to be obtained by the use of admixtures rather than increasing the water content. The use of such admixtures and the increase in slump to be approved by the Departmental Representative prior to implementation in the work.
 - .10 Modify concrete mix to the approval of the Departmental Representative and the recommendation of the manufacturer. Admixtures must be dispersed separately into mixing water.
- .2 Do not use calcium chloride or compounds containing calcium chloride.
- .3 Weigh aggregates, cement, water and admixtures separately when batching. Inspect and test scales for accuracy as directed. Accuracy to be such that successive quantities can be measured within one percent of desired amounts. Test certificates to be submitted to Departmental Representative upon request.
- .4 Where seven day strength is less than 70% of specified 28 day strength, provide additional protection curing and make changes to mix proportions to the satisfaction of the Departmental Representative.
- .5 Provide certification that plant, equipment and all materials to be used in concrete comply with the requirements of CSA A23.1-94 (or latest edition).
- .6 Provide certification from independent testing and Inspection Company that mix proportions selected will produce concrete of specified quality and can be effectively placed and finished for all work under this contract.

Part 3 Execution**3.1 GENERAL**

- .1 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours notice of intended placement.
- .2 Place, consolidate, finish, cure and protect concrete to CSA A23.1-94 (or latest edition) except where specified otherwise.
- .3 Prior to placing of concrete, obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .4 Comply with additional requirements of CSA A23.1-94 (or latest edition) Section 15 except where specified otherwise, for concrete exposed to seawater environment.
- .5 Do not commence placing concrete until Departmental Representative has inspected/reviewed forms, inserts, dowels, reinforcing steel, joints, conveying, spreading, consolidation, finishing, curing and protective methods.
- .6 Ensure that reinforcement and anchorage are not disturbed during placing.
- .7 Maintain accurate records of placed concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .8 Do not place load(s) upon new concrete until Departmental Representative is satisfied that the Contractor has carried out all calculations and tests necessary to confirm that the load(s) will not cause damage or create a safety hazard. Calculations and tests to be stamped by a Professional Engineer registered in the Province of Nova Scotia.
- .9 Comply with additional requirements of CSA A23.1-94 (or latest edition), Clause 15, for concrete exposed to seawater environments during placement and curing.

3.2 REINFORCING STEEL

- .1 Place new reinforcing steel according to Section 03 20 00.
- .2 Provide 75 mm minimum cover for all reinforcing steel unless indicated otherwise on drawings.

3.3 FORMWORK

- .1 Verify field dimensions to determine applicable sizes of formwork.
- .2 Design and construct formwork to allow adequately for proper placement and consolidation while conforming with shape and dimensions shown on plans.

CAST-IN-PLACE CONCRETE

Page 6

- .3 Formwork design will include closures at both top and bottom of form, and all necessary hardware to support the forms.
- .4 Upon request, submit drawings for review by the Departmental Representative, at least 3 weeks before placement of concrete. Drawings, will show formwork details and illustrate dimensions, method of placing of concrete, connections and support.
- .5 Strip formwork after a minimum 7 days. This condition might be waived if an alternative method of curing and preventing alternating wetting and drying is provided, to the satisfaction of the Departmental Representative.

3.4 PLACEMENT OF CONCRETE

- .1 Place and consolidate concrete to CSA A23.1-94 (or latest edition).
- .2 If allowed by Departmental Representative, pump concrete to following requirements:
 - .1 Arrange equipment so that no vibrations result which might damage freshly placed concrete.
 - .2 Where concrete is conveyed and placed by mechanically applied pressure, provide suitable equipment.
 - .3 Operate pump so that concrete, without air pockets, is produced.
 - .4 When pumping is discontinued and concrete remaining in pipe line is to be used, void pipe line in a manner that prevents contamination of concrete or separation of ingredients.
- .3 Concrete will be deposited in all cases as neatly as practicable, directly in its final position, and will not be caused to flow in a manner to permit or cause segregation.
- .4 Each layer of concrete will be vibrated and tamped with an appropriate vibrator as allowed by the Departmental Representative. The concrete must be compacted to the maximum practicable density, free of air pockets, and until it is in complete contact with the reinforcement and formwork.

3.5 INSERTS

- .1 Set galvanized sleeves and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100 mm not indicated on drawings must be approved by Departmental Representative.
- .2 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of all modifications from Departmental Representative before placing concrete.
- .3 Galvanized items embedded in concrete will be completely separated from reinforcing steel.

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- .4 Anchor bolts:
 - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
 - .2 Protect anchor bolt holes from water accumulations.
 - .3 Set bolts and fill holes with non-shrink grout.
 - .4 Anchor bolts for base plates will be set to allow at least 25 mm of grout under the base plates.

3.6 PROTECTION AND CURING

- .1 Provide protection and curing in accordance with CSA A23.1
- .2 Protect concrete with windproof shelter to allow free circulation of inside air around fresh concrete. Do not let walls of shelter touch formwork and provide sufficient space for removal of formwork.
- .3 Supply approved heating equipment to maintain inside air at following temperatures:
 - .1 For an initial three days, at not less than 10°C nor more than 25°C at surfaces.
 - .2 At not less than 10°C for an additional 4 consecutive days or for the time necessary to attain 70% of the specified 28-day compressive strength of the concrete.
 - .3 Reduce temperature near end of curing period at rate not exceeding 20°C per day.
 - .4 Do not overheat.
- .4 Keep concrete surfaces continuously moist during protection stage and allow concrete to dry before removal of protection.
- .5 Freshly deposited concrete will be protected from premature drying and excessively hot and cold temperatures and will be maintained without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete. It will be protected from harmful effects of sunshine, drying winds, cold weather, running or surface water and mechanical shock.
- .6 Wood floating, broom finishing, placing of burlap and inspection of concrete to be done from transverse bridges of rigid construction free from wobbles and springing under use, unless other methods have been submitted and accepted.

3.7 FINISHING

- .1 Finish concrete in accordance with CSA A23.1-94 (or latest edition).
- .2 Grind off fins, nibs and other raised protuberances with an approved hand stone.

- .3 When concrete has hardened sufficiently, give deck surface a uniform finish free from porous spots, irregularities, depressions, small pockets or rough spots using a float.
- .4 Following use of float, provide coarse broom finish using stiff, coarse, fibre broom. Use broom to produce transverse ridges satisfactory to Departmental Representative. Brooming will be delayed until concrete is sufficiently hard to retain ridges.
- .5 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radius edges unless otherwise detailed.

3.8 JOINT FILLERS

- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative. When more than one piece is required for a joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
- .2 Locate and form separation joints and install joint filler as indicated.

3.9 FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by Testing Laboratory designated by the Departmental Representative in accordance with CSA A23.1-94 (or latest edition).
- .2 Departmental Representative will pay for costs of tests as specified in Section 01 45 00.
- .3 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job sites under same conditions as concrete which they represent.
- .4 If tests do not meet requirements of the Departmental Representative, take such measures as indicated in CSA A23.1-94 and CSA A23.2-94 (or latest editions).
- .5 Arrange and pay for inspection and testing when necessary for production control to meet requirements.
- .6 Inspection and testing by Departmental Representative will not augment Contractor's quality control or relieve him of contractual responsibility.

3.10 DEFECTIVE WORK

- .1 Concrete is defective when:
 - .1 Failing to meet any requirements of this specification.
 - .2 Concrete contains honeycombing or embedded debris.

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- .3 28-day strength in any area is less than 95% of specified minimum.
 - .2 Repair or remove and replace defective work as directed by the Departmental Representative.
 - .3 Take corrective measures as directed by the Departmental Representative to prevent occurrence of further defective concrete.

END OF SECTION

Part 1 General

1.1 DESCRIPTION

- .1 This section specifies the requirements for finishing of cast-in-place concrete.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 03 30 00 - Cast-In-Place Concrete.

1.3 REFERENCES

- .1 CSA International
 - .1 CAN/CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 Submittal Procedures.

1.5 MEASUREMENT FOR PAYMENT

- .1 No measurement will be made under this section.
 - .1 Concrete finishing and cutting of joints to be considered incidental to the work of Section 03 30 00 - Cast-In-Place Concrete.

1.6 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29 - Health and Safety Requirements.

1.7 WASTE MANAGEMENT

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

Part 2 Products

- .1 Not used.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify that slab surfaces are ready to receive work and elevations are as indicated on drawings.

3.2 PREPARATION OF SLAB

- .1 Slab surface to have a broom finish.
- .2 Saw cut control joints to CAN/CSA-A23.1, 24 hours maximum after placing of concrete.

END OF SECTION