

PART 1 - GENERAL

1.1 REFERENCES

- .1 ASTM C109/C109M-16A, Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2 in. or 50 mm Cube Specimens).
- .2 ASTM C260-10A(R2016), Specification for Air-Entraining Admixtures for Concrete.
- .3 ASTM C309-2011, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
- .4 ASTM C494/C494M-16, Specification for Chemical Admixtures for Concrete.
- .5 ASTM C827-16, Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
- .6 ASTM C939-16A, Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).
- .7 ASTM D624-00(R2012), Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
- .8 ASTM D1653-2013, Test Methods for Water Vapour Transmission of Organic Coating Films.
- .9 ASTM D1751-04(R2013), Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
- .10 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .11 CAN/ULC S701-2011, Standard for Thermal Insulation, Polystyrene, Rounds and Pipe Covering.
- .12 CSA A23.1-14, Concrete Materials and Methods of Concrete Construction.
- .13 CSA A23.2-14, Methods of Test for Concrete.
- .14 CSA A3000-13, Consolidation - Cementitious Materials Compendium.

1.2 SAMPLES

- .1 At least four (4) weeks prior to commencing Work, inform the Departmental Representative of proposed source of aggregates and provide access for sampling.

1.3 CERTIFICATES

- .1 Minimum four (4) weeks prior to starting concrete work submit to the 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 Supplementary cementing materials.
 - .1 For fly ash, provide details of supply, supplier's quality control program, test data for at least three (3) samples from the previous months supply and details of proposed quality control tests to be made between shipment to concrete supplier and use in the concrete.
 - .3 Grout.
 - .4 Admixtures.
 - .5 Aggregates.
 - .6 Water.
 - .7 Joint filler.
 - .8 Waterstops.
- .2 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CSA- A23.1 and that mix design is adjusted to prevent alkali aggregate reactivity problems.
- .3 Provide certification that mix proportions selected will produce concrete of specified quality and yield and that strength will comply with CSA-A23.1 and that mix design is adjusted to prevent alkali aggregate reactivity problems.
- .4 Provide written confirmation from concrete supplier the percent replacement of Portland cement for fly ash/supplementary cementing materials for all concrete mix designs.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Do not clean trucks and chutes on-site without written approval of Departmental Representative.
- .2 Separate and recycle waste materials in accordance with applicable local provincial and national regulations.
- .3 Use trigger operated spray nozzles for water hoses.
- .4 Designate a cleaning area for tools to limit water use and runoff.
- .5 Carefully coordinate the specified concrete work with weather conditions.

- .6 Seal emptied containers and store safely for disposal away from children.
- .7 Prevent plasticizers, water-reducing agents and air-entraining agents from entering drinking water supplies or streams. Using appropriate safety precautions, collect liquid or solidify liquid with an inert, noncombustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .8 Choose least harmful, appropriate cleaning method which will perform adequately.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Portland cement and supplementary cementing materials: to CAN/CSA-A3000.
- .2 Water: to CSA-A23.1.
- .3 Aggregates: to CSA-A23.1. Coarse aggregates to be normal density.
- .4 Air entraining admixture: to ASTM C260.
- .5 Chemical admixtures: to ASTM C494. Have the Departmental Representative approve accelerating or set retarding admixtures during cold and hot weather placing.
- .6 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
 - .1 Compressive strength: 50 MPa at 28 days.
 - .2 Consistency:
 - .1 Fluid: to ASTM C827. Time of efflux through flow cone (ASTM C939), under 30 s.
 - .2 Flowable: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portion) 125 to 145%.
 - .3 Plastic: to ASTM C827. Flow table, 5 drops in 3 s, (ASTM C109, applicable portions) 100 to 125%.
 - .4 Dry pack to manufacturer's requirements.
- .7 Pre moulded joint fillers:
 - .1 Bituminous impregnated fibre board: to ASTM D1751.
- .8 Curing compounds: to CSA-A23.1 and to ASTM C309, Type 1-D with fugitive dye, except for exposed concrete. Do not use curing compound in areas where floor hardener, applied finish or finishing floor adhesive is to be applied.

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- .9 Rigid board under-slab and foundation wall perimeter insulation to CAN/ULC S701 and as specified in Section 07 21 13 - Board Insulation. See architectural drawings for locations and requirements.
- .10 Waterstops: Expanding bentonite concrete waterstops, 25mm x 19mm.

2.2 CONCRETE MIXES

- .1 Proportion normal density concrete in accordance with CSA-A23.1, Alternative 1 to give following properties for concrete in all concrete duct banks, transformer pad, and light pole base:
 - .1 Cement: Type GU.
 - .2 Minimum compressive strength at 28 days: 25 MPa.
 - .3 Class of exposure: F-2.
 - .4 Nominal size of coarse aggregate: 20 mm.
 - .5 Slump at time and point of discharge: 80 mm \pm 30 mm.
 - .6 Air content: 4 to 7%.
 - .7 Chemical admixtures: type as approved, and in accordance with ASTM C494.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Confirm founding material on which concrete work are to be placed are free from water. Place concrete only on frost-free ground. Remove previously frozen bearing surfaces.
- .2 Confirm geotechnical conditions existing on site are capable of supporting bearing capacity requirements assumed in structural design.
- .3 All foundation bearing surfaces will be inspected and approved by the Departmental Representative prior to placing concrete.
- .4 Place all structural fill as directed by the Departmental Representative and in the presence of the Departmental Representative.

3.2 WORKMANSHIP

- .1 Obtain the Departmental Representative's approval before placing concrete. Provide 48 hours notice prior to placing of concrete.
- .2 Pumping of concrete is permitted only after approval of equipment and mix.
- .3 Do not disturb reinforcement and inserts during concrete placement.
- .4 Prior to placing of concrete, obtain the Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.

- .5 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .6 Do not place load upon new concrete until authorized by the Departmental Representative.
- .7 Place concrete protective cover to reinforcement as noted on the drawings.
- .8 Support bars in slabs on grade on plastic coated steel chairs to maintain exact cover requirements.
- .9 In cold weather protect concrete work to CSA-A23.1 and following:
 - .1 Cold weather is defined as a period when the mean air temperature drops below 5°C for more than three successive days.
 - .2 When air temperature is above 0°C and is forecast to remain so for 48 hours after placing, insulated tarps are acceptable protection provided concrete temperatures are monitored and comply with temperature limits specified in the following paragraph.
 - .3 For all other cold weather conditions protect concrete with a windproof enclosure of canvas or other material to allow free circulation of inside air around fresh concrete. At no point let walls of enclosure touch formwork and provide sufficient space for removal of formwork and for finishing. Supply approved heating equipment capable of keeping inside air at sufficiently curing temperatures:
 - .1 For an initial three days, at a temperature of not less than 15°C.
 - .2 Maintain concrete at temperatures of not less than 10°C for a total period of seven days plus the initial three (3) days specified above.
 - .3 At no time shall concrete temperatures exceed 30°C at surfaces.
 - .4 Reduce enclosure air temperature at a rate not exceeding 10°C per day until outside air temperature has been reached.
 - .5 Take temperature readings both of air and of concrete surfaces at several points within area protected at start and at end of working day. Maintain complete records of temperature readings.
- .4 Verify concrete has cured without suffering damage. When enclosure is provided, avoid rapid drying of the concrete.
- .10 Monitor concrete temperature and moisture evaporation rates and provide appropriate hot weather protection as defined in clause 21 of CSA-A23.1. Maintain records of all measurements during hot weather periods for review by the Departmental Representative.

- 3.3 CONSTRUCTION
- .1 Do cast-in-place concrete work in accordance with CSA-A23.1.
 - .2 Where approved by the Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100mm x 100mm not indicated, must be approved by the Departmental Representative.
 - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from the Departmental Representative before placing concrete.
 - .4 Coordinate locations and sizes of sleeves and openings required in concrete elements with architectural, civil, mechanical and electrical drawings and sub-contractors.
 - .5 Set special inserts for strength testing as indicated and as required by non- destructive method of testing concrete.
 - .6 Anchor bolts:
 - .1 Place anchor bolts to templates under supervision of trade supplying anchors prior to placing concrete.
 - .2 Protect anchor bolt holes from water accumulations.
 - .7 Core-drilling/cutting of holes in any concrete element is not permitted without written consent from the Departmental Representative. Submit all proposed core-drilling/cutting to the Departmental Representative for review prior to execution of work. Request for core-drilling/cutting must have 72 hours notice to allow the Departmental Representative time to review proposed locations.
- 3.4 PLACING CONCRETE
- .1 Place concrete as specified in CSA-A23.1.
 - .2 Inform the Departmental Representative at least 48 hours before each concrete placing operation.
 - .3 Do not place concrete when it is raining or likely to rain. If rain begins after concrete is placed, protect with waterproof covers until set.
 - .4 Do not permit vertical free fall of concrete mix to exceed 1.5m.
 - .5 For exposed concrete, take special precautions when placing to prevent segregation of concrete, and to avoid cold joints, honeycombing or voids. Do not allow vibrator to touch formwork.

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- .6 Use form vibrators only when sections are too narrow for internal type. Employ a sufficient number of vibrators to provide complete consolidation of concrete throughout entire volume of each layer. Have available at least one extra vibrator on hand for emergency.
- .7 Do not use vibrators for interior and exterior concrete slabs on fill.
- .8 Use only tools and handling equipment that are clear of rust or other harmful and foreign material to avoid efflorescence and staining of slabs or hardened concrete.
- .9 Use concrete pumps to place concrete only with approval of methods, equipment and mix design.
- .10 Provide continuous supervision during placement of concrete including concrete grout to ensure reinforcing steel is maintained in correct position.

3.5 PLACING GROUT

- .1 Grout where indicated using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.

3.6 SAW CUTTING

- .1 Commence sawing as soon as the concrete has hardened sufficiently to permit cutting without chipping, spalling or tearing and before all controlled shrinkage cracking occurs. See Section 20.2.1 of CSA-A23.1.

3.7 SURFACE TOLERANCE

- .1 Completed elevation of the top surface of all slabs to be within the surface tolerances specified in CSA A23.1, Table 15 for moderately flat, class C (interior slab- on-grade) and conventional smooth, class A (for floating floors).
- .2 Elevation Survey of completed floor finishes is to be in accordance with the straight edge method defined in CSA A23.1, clause 22.1.2.

3.8 REPAIRS

- .1 In the event that the post- finishing survey shows that the slab surface does not meet the specified tolerances, take corrective action within five (5) working days, or as directed by the Departmental Representative.
- .2 Submit proposed corrective action in writing, with complete details of methods, tools, and materials for the Departmental Representative's approval. Upon acceptance of the proposed method,

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prepare a test area, and upon acceptance, will be the standard for the remainder of the repairs.

- .3 Grind down high points to a smooth surface conforming to the specifications and with a surface finish equal to the remainder of the slab. If cutting or chipping by hammer is required at high areas, then cut the area low with square saw cut edges and patch as noted below.
- .4 Fill low areas by patching with a bonded topping. Chip and saw cut square the edges of patch areas a minimum of 6mm deep. Alternatively, the Departmental Representative may approve feather edging if epoxy type topping is used and a properly bonded smooth finish can be removed before placing patch material. Finish patches to a smooth surface equal to the finish on the remainder of the slab, and cured adequately. Do all patching procedures in strict accordance with the manufacturer's directions and to the approval of the Departmental Representative.

3.9 FINISHING

- .1 Finish concrete in accordance with CSA-A23.1.
- .2 Use smooth form finish for all concrete surfaces. Use form facing material that will produce a smooth, hard, uniform texture on the concrete. Do not use material with raised grain, torn surfaces, worn edges, patches, dents or other defects that will impair the texture of the concrete surface. Patch the holes and defects. Completely remove fins.
- .3 Use smooth steel trowel finish for concrete slabs on grade.
- .4 Remove tie cones and patch with latex modified concrete finish. Mix to be in strict accordance with manufacturers instructions.
- .5 Rub exposed sharp edges of concrete with carborundum to produce 3mm radius edges unless otherwise indicated.
- .6 Apply curing compounds to concrete surfaces as required. Confirm in writing the compatibility of curing compound with the applied finish on each concrete surface.
- .7 Slab Finish Classifications:
 - .1 Concrete slabs are to have a moderately flat finish as defined in CAN/CSA A23.1, table 22, class C.
- .8 Tolerances:
 - .1 Surface tolerances are to be within the specified limits of CAN/CSA A23.1, table 15.
 - .2 Tolerances are to be in accordance with CAN/CSA A23.1 unless noted otherwise.

3.14

FIELD QUALITY CONTROL

- .1 Inspection and testing of concrete and concrete materials will be carried out by the the Departmental Representative or a Testing Laboratory designated by the Departmental Representative in accordance with CSA-A23.1.
- .2 Pay for costs of tests.
- .3 Provide a minimum of three (3) test cylinders, as follows:
 - .1 Each day's pour.
 - .2 Each change of supplier.
 - .3 Each 50 m3 or fraction thereof.
 - .4 Additional test at the request of the Departmental Representative.
 - .5 If Contractor wants to strip formwork early, request additional cylinders to be cast and pay for additional cylinders and testing of the additional cylinders.
- .4 The Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .5 Conduct non-destructive Methods for Testing Concrete in accordance with CSA-A23.2.
- .6 Inspection or testing by the Departmental Representative will not augment or replace Contractor quality control nor relieve them of their contractual responsibility.

END OF SECTION