

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Section 04 05 10 – Common Work Results for Masonry
- .2 Section 05 70 10 – Decorative Metal Restoration

**1.2 UNIT PRICES**

- .1 Foundation Detail on Fill: Construction of a concrete foundation bearing on fill, where no bedrock is encountered during excavations to proposed underside of footing, upon direction from Departmental Representative. The unit price will include all costs necessary to complete the work, including supplying materials, additional shoring and executing work as described herein and reflected in contract. This work will be paid based on the actual quantities measured on site and the unit prices stated in the Bid and Acceptance Form.
- .2 Dowelled Foundation Detail: Construction of dowelled concrete foundation where sound bedrock is encountered close below grade, upon direction from Departmental Representative. The unit price will include all costs necessary to complete the work, including supplying materials, additional shoring and scaffolding and executing work as described herein and reflected in contract. This work will be paid based on the actual quantities measured on site and the unit prices stated in the Bid and Acceptance Form.

**1.3 REFERENCES**

- .1 American Concrete Institute (ACI)
  - .1 ACI 347 – 04, Guide to Formwork for Concrete
- .2 Canadian Standards Association (CSA)
  - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction.
  - .2 CSA-O86-09, Engineering Design in Wood (Limit States Design).
  - .3 CSA O151-09, Canadian Softwood Plywood.
  - .4 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
  - .5 CAN/CSA-S269.3-M92 (R2008), Concrete Formwork.
- .3 Council of Forest Industries of British Columbia (COFI)
  - .1 COFI Exterior Plywood for Concrete Formwork.

**1.2 DESIGN OF FORMWORK AND FALSEWORK**

- .1 Design formwork, and falsework, to support construction loads and fluid pressures without overstressing the material and without excessive deflection. Design formwork and falsework for concrete such that deflection is limited to not more than 1/400th of the span of any element. Provide positive means of adjustment to permit realignment or readjustment.

**1.3 SUBMITTALS**

- .1 Shop Drawings
  - .1 Submit shop drawings for formwork and falsework in accordance with Section 01 45 00 – Quality Control.
  - .2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, exposed finishes, ties, liners, and

- locations of temporary embedded parts. Comply with CAN/CSA S269.3 for formwork drawings.
- .3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
- .4 Shop drawings must be stamped and signed by a Professional Engineer, licensed to practice in the Province of Ontario.
- .5 Before preparing and submitting shop drawings, coordinate with Section 04 05 10 – Common Work Results for Masonry, Section 05 70 10 – Decorative Metal Restoration and General Contractor to assist with preparation of coordination and interference drawings.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Storage
  - .1 Store formwork material so that it is not in contact with the ground and protected from water, oil, dirt or other contamination. Support so as to prevent warping or distortion.
- .2 Waste Management and Disposal
  - .1 Separate and recycle waste materials in accordance with the Waste Reduction Workplan.
  - .2 Place materials defined as hazardous or toxic waste in designated containers.
  - .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
  - .4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- .1 Formwork materials:
  - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O86 and CSA O151. Use new materials throughout except for concrete in unexposed locations such as foundations where used material is acceptable. Fabricate all forms from sound, undamaged sheets with clean true edges, sealed and factory treated with form sealer. Thicknesses as required to support concrete at rate poured with no bowing of forms between supports. If forms are not new, obtain approval before using.
- .2 Steel Forms: Minimum 16ga thick, stiffened to support weight of concrete with minimum of deflection.
- .3 Grooves, reglets, chamfers and rustification strips: Use White Pine selected for straightness and accurately dressed to size. Provide 1 to 3 draw unless otherwise shown. Provide continuous saw-cut at back of strip. Chamfers at 45° unless noted.
- .4 Form ties:
  - .1 For unexposed concrete surfaces, use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface. Maximum spacing 600mm o.c.
  - .2 Wire ties and wood spacers not permitted.
- .5 Form liner:

- .1 Plywood: Canadian Softwood Plywood to CSA O151, 2 grade, T and G edge, 16mm thick.
- .6 Joint tape for sealing panel joints: Tape must be capable of preventing leakage of concrete in form joints.
- .7 Caulking for joints between panels: Use grey urethane catalyst cured, non-sag or self-levelling sealant, as applicable.
- .8 Form release agent: chemically active release agents containing compounds that react with free lime in concrete resulting in water insoluble soaps, preventing concrete from sticking to forms, non-toxic, biodegradable, low VOC.
- .9 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm<sup>2</sup>/s at 40°C, flashpoint minimum 150°C, open cup.
- .10 Falsework materials: to CSA S269.1.

### **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 Obtain Departmental Representative's approval for use of earth forms or framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1 and COFI Exterior Plywood for Concrete Formwork.
- .5 Refer to architectural drawings for concrete members requiring exposed finishes.
- .6 Do not place shores and mud sills on frozen ground.
- .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .8 Provide mud sills of suitable size, bedded in sand or stone beneath shores when they would otherwise bear on soil. Adequately prepare the sub-grade so that settlement will not occur during or after concreting.
- .9 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.
- .10 Obtain Departmental Representative's permission before framing openings not indicated.
- .11 Align form joints and make watertight. Keep form joints to minimum.

- .12 Use 25mm chamfer strips on external corners and/or 25mm fillets at interior corners of concrete members, unless specified otherwise.
- .13 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .14 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
- .15 Provide access openings as required for cleaning and inspection of forms and embedded items, prior to placing concrete.
- .16 Clean and prepare formwork surfaces in accordance with CSA A23.1, before placing concrete. Apply form release agents to formwork in accordance with manufacturer's instructions, prior to placing accessories and reinforcement. Do not apply form release agent where concrete surfaces will receive special finishes or coating which are affected by the agents.
- .17 Re-use formwork and falsework subject to requirements of CSA A23.1. Do not re-use forms if there is any evidence of surface damage or wear which would impair the quality of the concrete surface.
- .18 When formwork is to be re-used, apply non staining parting agent in accordance with CSA A23.1.
- .19 Construct formwork and falsework such that loads are not transmitted to an adjacent existing structure.

### **3.2 REMOVAL AND RESHORING**

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
  - .1 2 days for walls and sides of beams.
  - .2 1 day for footings.
- .2 Remove formwork when concrete has reached 75% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
- .3 The sequence of removal of formwork and reshoring of concrete must be done in accordance with CSA A23.1.
- .4 Remove forms without damage to concrete surfaces. Repair all blemishes by patching and sacking.
- .5 Re-use formwork and falsework subject to requirements of CSA A23.1.

### **3.3 QUALITY CONTROL ON-SITE**

- .1 Do not close deep forms until reinforcement has been reviewed by Departmental Representative.
- .2 Check elevations, camber and plumbness of formwork continuously during concreting and after, until initial set occurs using pre-installed tell-tale devices. Appropriate adjustments shall be promptly made where necessary. Report all adjustments made after initial set to the Departmental Representative.

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**CONCRETE FORMING AND ACCESSORIES**  
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**END OF SECTION**

**PART 1 GENERAL**

**1.1 REFERENCES**

- .1 American Society for Testing and Materials (ASTM)
  - .1 ASTM A82/A82M-07, Specification for Steel Wire, Plain for Concrete Reinforcement.
  - .2 ASTM A123-09, Specification for Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products.
  - .3 ASTM A 955/A955M-05, Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement.
- .2 Canadian Standards Association (CSA)
  - .1 CSA A23.1-09, Concrete Materials and Methods of Concrete Construction.
  - .2 CAN/CSA A23.3-04 Design of Concrete Structures.
  - .3 CAN/CSA G30.18-M92 (R2007), Billet-Steel Bars for Concrete Reinforcement.
  - .4 CSA W186-M1990 (R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .3 Reinforcing Steel Manual of Practice, Reinforcing Steel Institute of Canada.

**1.2 UNIT PRICES**

- .1 Foundation Detail on Fill: Construction of a concrete foundation bearing on fill, where no bedrock is encountered during excavations to proposed underside of footing, upon direction from Departmental Representative. The unit price will include all costs necessary to complete the work, including supplying materials, additional shoring and executing work as described herein and reflected in contract. This work will be paid based on the actual quantities measured on site and the unit prices stated in the Bid and Acceptance Form.
- .2 Dowelled Foundation Detail: Construction of dowelled concrete foundation where sound bedrock is encountered close below grade, upon direction from Departmental Representative. The unit price will include all costs necessary to complete the work, including supplying materials, additional shoring and scaffolding and executing work as described herein and reflected in contract. This work will be paid based on the actual quantities measured on site and the unit prices stated in the Bid and Acceptance Form.

**1.3 SUBMITTALS**

- .1 Shop Drawings
  - .1 Submit shop drawings including placing of reinforcement in accordance with Section 01 45 00 – Quality Control.
  - .2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings. Show location of construction joints and detail reinforcement at joints. Draw plans and elevations of walls. Indicate sizes, spacings and locations of chairs, spacers and hangers. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice - by Reinforcing Steel Institute of Canada.
  - .3 Detail lap lengths and bar development lengths to CAN/CSA A23.3, unless otherwise indicated. Provide type B tension lap splices unless otherwise indicated.
  - .4 Indicate on drawings, locations of Fall Arrest Anchors to ensure correct placement of reinforcing to accommodate anchors.

- .5 Do not release shop drawings for reinforcing bars whose length may be affected by field conditions, such as the final elevation of footings, until such time as the governing field dimensions have been ascertained, and affected reinforcing bar lengths are revised. Determine rock elevations at bearing level of all footings, walls and piers, by field survey and show this information on foundation placing diagrams.
- .6 Make corrections required by previous review before re-submitting drawings. Do not add new details to drawings which have been reviewed.

#### **1.4 QUALITY ASSURANCE**

- .1 Source Quality Control
  - .1 Provide Departmental Representative with certified copy of mill test report for reinforcing steel, showing physical and chemical analysis, minimum four (4) weeks prior to commencing reinforcing work.
- .2 Substitutes
  - .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .3 Qualifications
  - .1 Welding of reinforcing bars shall only be undertaken by firms certified by the Canadian Welding Bureau in conformance with CSA W186.

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- .1 Storage
  - .1 Store all reinforcement material on racks or skids so that it is protected from dirt and maintained in its fabricated form.
- .2 Waste Management and Disposal
  - .1 Separate and recycle waste materials in accordance with the Waste Reduction Workplan.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- .1 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA G30.18, unless indicated otherwise.
- .2 Cold-drawn annealed steel wire ties: to ASTM A82.
- .3 Chairs, bolsters, bar supports, spacers: to CSA A23.1.
- .4 Mechanical splices: subject to approval of Departmental Representative.

#### **2.2 FABRICATION**

- .1 Fabricate reinforcing steel in accordance with CSA A23.1, and Reinforcing Steel Manual of Practice, unless indicated otherwise.

- .2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.
- .4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

### **PART 3 EXECUTION**

#### **3.1 FIELD BENDING**

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

#### **3.2 PLACING REINFORCING**

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA A23.1.
- .2 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .3 Ensure cover to reinforcement is maintained during concrete pour.
- .4 Before placing, remove all loose scale, dirt, oil or other coatings which would destroy or reduce bond. Place reinforcement within the specified tolerances and secure in position by the use of chairs, spacers and hangers. Tie reinforcement securely together using 16 ga. annealed wire to prevent displacement during concrete placing and vibrating. Turn the ends of all ties towards the interior of the concrete. Use galvanized tie wire at all exposed and at all exterior locations.
- .5 Position reinforcing for exposed concrete, using snap-on plastic positioners and plastic chairs of the same colour as the concrete. Use concrete chairs for slabs on grade.
- .6 No splicing of reinforcement is permitted unless indicated on the Drawings. Do not cut reinforcement to permit placing of embedded items.
- .7 Provide additional reinforcement around all openings and at fall arrest anchor locations in concrete members as detailed on Drawings.
- .8 Maintain clean cover for reinforcement in accordance with drawings.
- .9 Avoid passage of heavy equipment over reinforcing steel in place.
- .10 Reset immediately, reinforcing steel displaced during concrete pour.

#### **3.3 QUALITY CONTROL ON-SITE**



- .1 Reinforcement must be complete, adequately supported, tied and properly positioned for cover in advance of the time scheduled for casting concrete.
- .2 Notify Departmental Representative for inspection of reinforcement prior to enclosing the reinforcement in the forms. Provide 24 hours notice in advance for this inspection to occur.

**END OF SECTION**

**PART 1 GENERAL**

**1.1 RELATED SECTIONS**

- .1 Section 03 10 00 - Concrete Forming and Accessories

**1.2 UNIT PRICES**

- .1 Foundation Detail on Fill: Construction of a concrete foundation bearing on fill, where no bedrock is encountered during excavations to proposed underside of footing, upon direction from Departmental Representative. The unit price will include all costs necessary to complete the work, including supplying materials, additional shoring and executing work as described herein and reflected in contract. This work will be paid based on the actual quantities measured on site and the unit prices stated in the Bid and Acceptance Form.
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**1.3 MEASUREMENT PROCEDURES**

- .1 Submit separate schedule of unit prices for cast-in-place concrete. Include in unit price: cost of material, delivery and unloading, installation, overhead and profit. Measurement will be based on cubic metres of concrete.

**1.4 REFERENCES**

- .1 American Iron and Steel Institute (AISI).
- .2 American Society for Testing and Materials (ASTM)
  - .1 ASTM C109-11/C109M-11, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50mm Cube Specimens)
  - .2 ASTM C309-07, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - .3 ASTM C494/C494M-08a, Specification for Chemical Admixtures for Concrete.
  - .4 ASTM C578-14a, Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  - .5 ASTM C827-01a (2005), Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
  - .6 ASTM C881-10/C881M-10, Specification for Epoxy Resin Base Bonding Systems for Concrete.
  - .7 ASTM C939-02, Test Method for Flow of Grout for Preplaced-Aggregate Concrete.
  - .8 ASTM D1751-04 (2008), Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - .9 ASTM F593-02 (2008)e1, Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.
  - .10 ASTM F594-09e1, Specification for Stainless Steel Nuts.
- .3 Canadian General Standards Board (CGSB)
  - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.

- .4 Canadian Standards Association (CSA)
  - .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
  - .2 CAN/CSA A3000-08, Cementitious Materials Compendium.

## **1.5 SUBMITTALS**

- .1 Certificates
  - .1 Submit certificates in accordance with Section 01 45 00 – Quality Control.
  - .2 Submit to Departmental Representative, minimum 4 weeks prior to starting concrete work, valid and recognized certificate from plant delivering concrete.
  - .3 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA A23.1, and that mix design is adjusted to prevent alkali aggregate re-activity problems.
- .2 Record Documentation
  - .1 Maintain a set of record drawings on site on which the progress of the work can be recorded.
  - .2 Record the time and casting date for each section of concrete and the date for removal of each section of formwork.
  - .3 When heat curing is required, record maximum and minimum daily temperatures outside the enclosure and the average temperature within each enclosure, for a period of 3 days after placing the concrete.
  - .4 Record all modifications to the foundations and superstructure on a set of prints in a neat and legible manner. Use the information to make as-built drawings at the completion of the work. Dimension all changes.

## **1.6 QUALITY ASSURANCE**

- .1 Quality Control
  - .1 Minimum 2 weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative's approval for the following items:
    - .1 Hot weather concrete.
    - .2 Cold weather concrete.
    - .3 Curing.
    - .4 Finishes.
    - .5 Joints.
  - .2 Fifteen (15) days prior to placing concrete, submit mix designs for each concrete mix to Departmental Representative.
- .2 Mock-ups
  - .1 Construct mock-up 1.0m x 1.0m to demonstrate sand blasting finish on exposed concrete surface.
  - .2 Construct mock-up where directed.
  - .3 When accepted by Departmental Representative, mock-up will demonstrate minimum standard for this work.
  - .4 Mock-up may remain as part of finished work, if finish is accepted.

## **1.7 DELIVERY, STORAGE AND HANDLING**

- .1 Ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
- .2 Store materials as follows:
  - .1 Concrete materials: to CSA A23.1.
  - .2 Concrete admixtures: in accordance with manufacturer's directions.

- .3 Concrete hauling time: maximum allowable time limit for concrete to be delivered to site of Work and discharged, not to exceed 120 minutes after batching.
  - .1 Modifications to maximum time limit must be agreed to by the Departmental Representative and concrete producer as described in CSA A23.1/A23.2.

#### **1.8 SITE CONDITIONS**

- .1 Visit site to determine available access, storage and working areas. Determine any interference from existing services.
- .2 Establish base horizontal and vertical control points on site, referenced to established bench marks by survey control points and indicate on drawings, prior to starting work. Preserve permanent reference points during construction.
- .3 Coordinate with Division 04 and Division 05 when setting out wall location, heights and ledges.
- .4 Use of accelerating or set retarding admixtures during hot or cold weather concrete placing shall be subject to the Departmental Representatives' approval.

#### **1.9 FOUNDATION CONDITIONS**

- .1 Foundation design is based upon a Geotechnical Investigation, File No. PG3172-LET.01 Rev 2 prepared for the project by Paterson Group, dated December 30, 2014.
- .2 The soils report is furnished in good faith for the information of the Contractor, but the possibility of deviation from reported conditions must be recognized. The Departmental Representative assumes no responsibility for any interpretation or deduction that the Contractor may make from the data, and will establish the nature of observable conditions to his or her own satisfaction.
- .3 Notify the Departmental Representative in accordance with the requirements of the General Conditions of the Contract, if during the execution of the work, subsurface conditions are found to differ materially from those indicated in the Contract Documents or soils report.
- .4 If foundation elevations or dimensions are revised by the Departmental Representative because of differences between reported and actual subsoil conditions discovered at the time of excavation, the Contract Price will be adjusted. Extras will not be paid because of over-excavation or other conditions within the control of the Contractor.
- .5 A Departmental Representative will be appointed to examine and report on the sub-soil at founding elevations at the time of excavation. Notify the Departmental Representative as to when such examination will be required. Do not proceed with construction of foundations until the Departmental Representative has reported.
- .6 Keep construction traffic and loads on the subgrade to a minimum.
- .7 Set footings on sound rock unless otherwise noted, capable of safely supporting the allowable bearing pressures noted on the Drawings. Founding elevations shown are based upon the soil investigation and are set at a level where it is presumed that the specified bearing pressures can be safely supported. After excavation, determine if these conditions are fulfilled. If they are not met, notify the Departmental Representative so that footing elevations may be adjusted accordingly.

- .8 If field conditions result in a lower bearing elevation than was anticipated, a revision will have to be made to the wall length or the footing dimensions. The Departmental Representative will decide which alternative will be adopted after the bearing area is inspected.
- .9 Check the soundness of the rock directly beneath foundations by drilling a minimum 50 mm diameter, 1.5 m deep hole beneath each spread footing and 900 mm deep holes at 7.2m centres along wall footings. Record results and report to the Departmental Representative before placing concrete.
- .10 Ensure rock surface is clean and sound prior to placing concrete.
- .11 In areas where concrete is installed above tunnel locations, ensure maximum allowable loading on tunnel structure is not exceeded.

#### **1.10 WASTE MANAGEMENT DISPOSAL**

- .1 Separate and recycle waste materials in accordance with the Waste Reduction Workplan.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate a cleaning area for tools to limit water use and runoff.
- .4 Carefully coordinate the specified concrete work with weather conditions.
- .5 Ensure emptied containers are sealed and stored safely for disposal, out of the reach of children.
- .6 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, non-combustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .7 Choose least harmful, appropriate cleaning method which will perform adequately.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- .1 Portland cement Normal (type GU) to CAN/CSA A3000.
- .2 Supplementary cementing materials: to CAN/CSA A3000.
- .3 Water: to CSA A23.1.
- .4 Aggregates: to CSA A23.1. Coarse aggregates to be normal density. Aggregate to be suitable for NBC type N concrete. Normal size 20mm unless noted on Drawings.
- .5 Obtain coarse and fine aggregate for exposed concrete from the same sources and select from uniformly of colour. Stockpile supplies for project.

- .6 Air entraining admixture: to CSA A23.1.
- .7 Chemical admixtures: to CSA A23.1. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents.
  - .1 Compressive strength: 45 MPa at 28 days.
  - .2 Consistency:
    - 1. Fluid: to ASTM C827. Time of efflux through flow cone (ASTM C939), under 30s.
    - 2. Flowable: to ASTM C827. Flow table, 5 drops in 3s, (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.
  - .3 Net shrinkage at 28 days: maximum 2%.
- .9 Non premixed dry pack grout: composition of non metallic aggregate Portland cement with sufficient water for the mixture to retain its shape when made into a ball by hand and capable of developing compressive strength of 45 MPa at 28 days.
- .10 Dry packed concrete: 1:3 cement-sand and minimum water to dampen mixture. Minimum strength 30 MPa at 28 days.
- .11 Unshrinkable fill: to CSA A23.2.
- .12 Closed cell foam insulation: Compressive strength: 690 kPa; to ASTM C578.
- .13 Curing compound: to CSA A23.1 and to ASTM C309, Type 1-chlorinated rubber, colourless, transparent liquid.
- .14 Ribbed waterstops: extruded PVC, Artic Grade with shop welded corner and intersecting pieces with legs not less than 500 mm long.
- .15 Premoulded joint fillers: Bituminous impregnated fibre board to ASTM D1751.
- .16 Polymer modified repair mortar, cementitious, two component, fast setting, prepackaged and suited for the proposed application.
- .17 Weep hole tubes: plastic.
- .18 Adjustable wedge action insert, malleable iron.
- .19 Construction Joint Sealant: The following materials are acceptable:
  - .1 Grey, epoxy urethane catalyst cured self levelling sealant.
  - .2 Grey, low-modulus silicone joint sealant.
- .20 Epoxy Adhesive: High-modulus, high-strength, epoxy bonding/grouting adhesive, to ASTM C881.
- .21 Polyethylene film: 6 mm thickness to CAN/CGSB-51.34.

- .22 Curing paper: Consisting of two sheets of kraft paper cemented together with a bituminous material in which are embedded cords or strands of fiber running in both directions.
- .23 Cast-in-Place Anchors: Stainless steel threaded rod to ASTM F593.
  - .1 Minimum  $F_y$ : 448 MPa.
  - .2 Minimum  $F_u$ : 689 MPa.
- .24 Stainless steel nuts and washers: to ASTM F594.
- .25 Fall Protection Anchors: Capacity 22.2kN
  - .1 D-ring type, stainless steel to AISI 304.
  - .2 To suit 15.9mm diameter anchor bolt.
  - .3 Base dimensions approximately 101mm x 46mm.
  - .4 Clear interior diameter 41mm minimum.
- .26 Design and installation of Rock Dowels to follow recommendations of NPWPh3-PG3172 – Paterson Group Memorandum, dated October 30, 2014.

## **2.2 MIXES**

- .1 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1, to give following properties for all concrete.
  - .1 Cement:
    - 1. Type GU Portland cement.
  - .2 Minimum compressive strength at 28 days: As noted on drawings.
  - .3 Minimum cement content: 320 kg/m<sup>3</sup> of concrete.
- .2 For remainder of concrete mix properties, see Drawing S-103.

## **2.3 PRODUCTION**

- .1 Use ready-mixed concrete, produced in accordance with CSA A23.1, Clause 5.2.
- .2 Heat concrete and deliver at a temperature conforming to CSA A23.1, Clause 5.2.4.4.

## **PART 3 EXECUTION**

### **3.1 CO-OPERATION**

- .1 Provide casual labour to the independent inspection and testing agency's field personnel for the purpose of obtaining and handling sample materials. Provide free access to all portions of work and co-operate with the Testing Agency.
- .2 Cooperate with all engaged on the work. Exchange with related trades shop drawings and other data required to coordinate and schedule the work. Notify other trades as to when items which are to be installed by them are to be set and protect items after installation.
- .3 Do not allow trades to cut holes through existing concrete, unless approved by the Departmental Representative.

- .4 Cooperate with other trades to ensure that concrete surfaces are compatible with finishes and to obtain a surface which will ensure adequate bond.
- .5 Install 15 MPa concrete backfill in all excavations made below mat foundation, mud slabs, or for over-excavation.
- .6 Provide waterstops and keys around temporary openings in exterior walls for shoring rakers or similar purposes.
- .7 Provide dowels from concrete to all masonry walls reinforced with bars, as indicated on the drawings.

### **3.2 PROTECTION OF EXISTING STRUCTURE**

- .1 Take precautions necessary to protect the existing structure from damage. Assume responsibility for damage or claims for damage.
- .2 Protect exposed faces of excavation. Keep areas adjacent to existing foundations from freezing.

### **3.3 PREPARATION**

- .1 Do not begin operations before making a thorough examination of existing conditions and the work of related trades. Report inconsistencies to the Departmental Representative immediately.
- .2 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours notice prior to placing of concrete.
- .3 Pumping of concrete is permitted only after approval of equipment and mix.
- .4 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .5 Compact granular backfill.
- .6 Prior to placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .7 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .8 In locations where new concrete is dowelled to existing work, drill holes in existing concrete. Place steel dowels of deformed steel reinforcing bars and pack solidly with epoxy grout to anchor and hold dowels in positions as indicated.
- .9 Do not place load upon new concrete until authorized by Departmental Representative.
- .10 Comply with protection measures as noted, to avoid exceeding allowed loading capacity over existing structures.



### **3.4 JOINTS**

- .1 Construction Joints:
  - .1 Provide construction joints as specified unless indicated otherwise on the Drawings. Locate joints so as not to impair the strength of the structure. Locate joints subject to vehicular traffic at high points where possible, and never at low points. Joints are subject to the approval of the Departmental Representative.
  - .2 Locate construction joints at masonry pier locations, as shown on drawings. Provide additional reinforcement as required and as shown on typical detail.
  - .3 Extend reinforcing through construction joints. Add dowels, if necessary to make total steel passing through bulkhead at least the equivalent of 15M @ 400mm centres each face. Embed dowels at least 600mm each side of joint.
  - .4 Remove all dirt, loose aggregate and laitance from face of existing concrete before placing new concrete. Saturate other contact surfaces with clean water for 24 hours prior to pouring new concrete, and leave damp. Remove free water from surface.
  - .5 Provide construction joint sealant for joints in exterior walls below grade.
- .2 Saw-Cut Joints
  - .1 Make saw-cut joints, to the size indicated on Drawings, between 12 to 20 hours after concrete pour so that the concrete can be cleanly cut and before shrinkage cracks can form.
  - .2 Fill all saw-cuts, not less than 21 days after casting, with saw-cut joint filler. Ensure that joints are clean and dry before filling. Prime joints prior to filling, in accordance with joint filler manufacturer's recommendations.

### **3.5 CONSTRUCTION**

- .1 Cast-in-place concrete work in accordance with CSA A23.1.
- .2 Sleeves and inserts.
  - .1 Ensure sleeves, ducts, pipes or other openings do not pass through walls or footings, except where indicated or approved by Departmental Representative.
  - .2 Where approved by 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 Departmental Representative.
  - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from Departmental Representative before placing of concrete.
  - .4 Check locations and sizes of sleeves and openings shown on drawings.
  - .5 Coordinate with Fall Arrest Anchor locations and procedure for installation.
- .3 Anchor bolts.
  - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
  - .2 With approval of Departmental Representative, grout anchor bolts in preformed holes or holes drilled after concrete has set. Formed holes to be minimum 100mm diameter. Drilled holes to be minimum 25mm larger in diameter than bolts used.
  - .3 Protect anchor bolt holes from water accumulation, snow and ice build-up.
  - .4 Set bolts and fill holes with shrinkage compensating grout.
  - .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.

- .4 Drainage holes and weep holes:
  - .1 Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.
  - .2 Install weep hole tubes and drains as indicated.
- .5 Do not embed in walls, any conduit or pipe whose outside diameter is greater than one quarter the concrete thickness. Do not space less than 6 diameters on centre. Locate so as not to impair the required strength of the member. Place embedded conduits between top and bottom reinforcement.
- .6 Concrete Placement.
  - .1 Remove water from excavations before placing concrete.
  - .2 Clean all forms of debris and deleterious materials before placing concrete. Remove all contaminants which lessen bond of concrete to reinforcement prior to placing concrete.
  - .3 Adjust reinforcement immediately before concrete is placed to ensure that all bars are secured in their correct positions. Arrange to have a crew of reinforcing setters on hand as concrete is placed, in order to make any last minute adjustments that are required.
  - .4 Use form vibrators for thin sections where rodding, spading or the use of internal vibrators is impractical. Attach vibrators firmly to the forms and so spaced that the complete lift of concrete is visibly affected.
  - .5 Platform and screed type vibrators may be used to ensure a dense top surface where this cannot be obtained by the use of internal equipment. Obtain approval from the Departmental Representative before using platform or screed type vibrators.
  - .6 Do not place concrete in the rain. Protect exposed surfaces from rain or other adverse weather conditions until final set occurs.
  - .7 The maximum average time from charging the mixer to final deposit is 60 minutes, the maximum individual time from charging the mixer to final deposit is 90 minutes. Do not add water to the mix without the expressed approval of the Departmental Representative.
  - .8 Where concrete is rejected by the Departmental Representative, refer to clause entitled "Field Quality Control".
- .7 Finishing.
  - .1 Finish concrete in accordance with CSA A23.1.
  - .2 Use procedures noted in CSA A23.1 to remove excess bleed water. Ensure surface is not damaged.
  - .3 Provide screed finish unless otherwise indicated.
  - .4 Ensure positive slope away from the wall.
- .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 construction joints as indicated. Install joint filler.
  - .3 Use 12mm thick joint filler to separate existing wall surface from new wall surface.

### **3.6 SITE TOLERANCE**

- .1 Concrete tolerance in accordance with CSA A23.1.

### **3.7 CURING AND PROTECTION**

- .1 Provide curing and protection for concrete to CSA A23.1, Clause 7.4.

- .2 High performance concrete, with strength of 35 MPa or greater, must be wet cured for a minimum of 7 days.
- .3 Do not pile, store, or transport materials over slabs until concrete has been in place for at least 7 days.
- .4 Do not use combustion heaters of any kind in the presence of new concrete during construction.
- .5 Shrinkage cracking as a result of improper curing will be cause for rejection of the concrete element in question. If such cracking occurs, remove and replace concrete at no cost to the Departmental Representative.

### **3.8 SURFACE FINISHING**

- .1 Finish formed surfaces in accordance with CSA A23.1, Clause 7.7.
- .2 Form Ties:
  - .1 Break snap ties 38mm. from surface. Fill voids with a sand-cement grout. In the case of exposed concrete, match surface texture and colour of grout with concrete. Incorporate a latex bonding agent in the grout.
  - .2 Disconnect threaded ties. Plug holes with precast plugs set 6mm from concrete face with a latex bonding agent.
- .3 Sand Blasting:
  - .1 Finish exposed concrete surfaces on the slope side as required for smooth rubbed finish. Obtain Departmental Representative's approval before sand blasting.
  - .2 After concrete is at least 21 days old and thoroughly cured, lightly sand blast using a hard sharp sand until coarse aggregate is in uniform relief, and the appearance of the surface skin is softened.

### **3.9 FIELD QUALITY CONTROL**

- .1 Inspection and testing of concrete and concrete materials will be carried out by a Testing Laboratory designated by Departmental Representative, in accordance with CSA A23.1.
- .2 Departmental Representative will pay for costs of tests.
- .3 Departmental Representative will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.
- .4 Non-destructive Methods for Testing Concrete in accordance with CSA A23.2. Provide reports on form, conforming to CSA A23.2, Annex B.
- .5 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.
- .6 Be responsible for payment for additional testing including testing of the structure and its performance, load testing required by changes of materials or mix design requested by the Contractor, and failure of completed work to meet specified requirements and testing.
- .7 Notify the Testing Laboratory as to the concreting schedule. Provide samples and standard test cylinders.

- .8 Provide a group of three test cylinders for each standard strength test. One cylinder will be tested at 7 days and two at 28 days.
- .9 Take samples at the discharge end of the pipe when concrete is pumped. Take samples prior to the addition of plasticizing admixtures to the concrete.
- .10 The percentage of entrained air will be determined and reported for concrete requiring an air entraining agent.
- .11 In cold weather conditions, where concrete is exposed to temperatures below +5 degrees C, carry out non-destructive testing to CSA A23.2, Annex A and related ASTM Standards to determine concrete strength prior to stripping formwork. Report results to the Departmental Representative.
- .12 The independent concrete inspection and testing agency will evaluate and report upon the proposed equipment, mixing and quality control procedures and storage arrangements planned for site mixed concrete for concrete construction. Minimum acceptable standard of quality is CSA A23.1. This agency will also test aggregates and design proposed mixes quantity of superplasticizer admixtures and slump following addition of superplasticizer. Report final mix designs to the Departmental Representative and obtain approval, prior to placing of the related concrete. Report all admixtures used.
- .13 Concrete tests:
  - .1 One standard strength test is required for each 50m<sup>3</sup> of concrete placed, but not less than one test for each mix design of concrete placed each day. For non-critical concrete pours under 10m<sup>3</sup> in size, no test is required. The Departmental Representative must make the decision, as to what is "non-critical" concrete. Store cylinders in metal lined curing boxes maintained at a temperature of not less than 10 degrees C until shipped to the testing laboratory. Store additional cylinder required for cold weather conditions adjacent to work for 7 days. The 7 day test must meet at least 60% of the 28 day requirements.
  - .2 One standard air entrainment test is required for each 50m<sup>3</sup> of air-entrained concrete or portion thereof placed each day. Test in accordance with CSA A23.2.
  - .3 Make slump tests in accordance with CSA A23.2, with each standard strength test and when so directed by the Departmental Representative.
  - .4 Ship test cylinders with completed shipping tag attached. Provide identification and sufficient information to correlate the cylinder to the information taken by the testing agency, to complete the report form as per Annex B, CSA A23.2.
- .14 Install thermometers for recording temperatures when concrete is placed under cold weather or hot weather conditions.
- .15 Ensure that supervisory personnel are on hand when concrete is being cast so that the placing and curing procedures of the specification will be properly observed.
- .16 Immediately cease further concrete placement on advice that concrete already in place has been rejected by the Departmental Representative. Replace rejected work in a manner approved by the Departmental Representative and at the Contractor's expense. Make good cracking or finish not accepted by the Departmental Representative, to their satisfaction, at no additional cost to the Departmental Representative.

### **3.10 RESTORATION**

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- .1 Restore areas of existing concrete work affected by the Contract.

**3.11 CLEAN-UP**

- .1 Remove rubbish and surplus materials leaving the work ready for the Trades that follow.

**END OF SECTION**