

PART 1 General

1.1 MEASUREMENT FOR PAYMENT

- .1 No measurement will be made under this Section. Include costs in items of work for which concrete formwork and falsework are required.

1.2 RELATED SECTIONS

- .1 Section 03 20 00 - Concrete Reinforcing.
- .2 Section 03 30 00 - Cast-in-Place Concrete

1.3 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-2014, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA-O86:19, Engineering Design in Wood (Limit States Design).
 - .3 CSA O121-17, Douglas Fir Plywood.
 - .4 CSA O151-17, Canadian Softwood Plywood.
 - .5 CSA O153-13 (R2017), Poplar Plywood.
 - .6 CAN3-O188.0, Standard Test Methods for Mat-Formed Wood Particleboards and Waferboard.
 - .7 CSA O437 Series-93 (R2013), Standards for OSB and Waferboard.
 - .8 CSA S269.1-2016, Falsework for Construction Purposes.
 - .9 CAN/CSA-S269.3-M92 (R2013), Concrete Formwork.
- .2 Council of Forest Industries of British Columbia (COFI)
 - .1 COFI Exterior Plywood for Concrete Formwork.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings for formwork and falsework 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, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1, for falsework drawings.
- .3 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.
- .4 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in Province of PEI, Canada.

1.5 QUALITY CONTROL

- .1 Pre-Pour Meeting

- .1 Attend a quality control meeting including all relevant sub-trades to review the quality of the formwork reinforcement installation, exposed concrete finishes, under floor services, pour sequence and related issues.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal.
- .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-0121.
 - .2 For concrete with special architectural features, use formwork materials to CAN/CSA-A23.1.
- .2 Form ties:
 - .1 High tensile strength fiberglass ties (Guenette) fixed or adjustable length free of devices leaving holes larger than 25mm diameter in concrete surface.
- .3 Form release agent: non-toxic, chemically active release agents containing compounds that react with free lime present in concrete to provide water insoluble soaps, preventing concrete from sticking to forms.
- .4 Falsework materials: to CSA-S269.1.

PART 3 Execution

3.1 FABRICATION AND ERECTION

- .1 Examine lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Hand trim sides and bottoms of excavation and remove loose earth from earth forms before placing concrete.
- .3 Fabricate and erect falsework in accordance with CSA S269.1 and COFI Exterior Plywood for Concrete Formwork.
- .4 Do not place shores and mud sills on frozen ground.

- .5 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 CAN/CSA-A23.1.
- .6 Align form joints and make watertight. Keep form joints to minimum.
- .7 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
- .8 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .9 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.
- .10 Clean formwork in accordance with CAN/CSA-A23.1, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete:
 - .1 3 days for walls and sides of beams.
 - .2 3 days for columns.
 - .3 28 days for beam soffits, slabs, decks and other structural members, or 7 days when replaced immediately with adequate shoring to standard specified for falsework.
 - .4 3 days for footings and abutments.
- .2 Remove formwork when concrete has reached 80% of its design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.
- .3 Provide all necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.
- .4 Re-use formwork and falsework subject to requirements of CAN/CSA-A23.1.

END OF SECTION

PART 1 General

1.1 MEASUREMENT FOR PAYMENT

- .1 No measurement will be made under this Section. Include costs in items of work for which concrete formwork and falsework are required.

1.2 RELATED SECTIONS

- .1 Section 03 10 00 - Concrete Forming and Accessories.
- .2 Section 03 30 00 - Cast-in-Place Concrete

1.3 REFERENCES

- .1 American Concrete Institute (ACI)
 - .1 ACI 315R-2018, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.
- .2 American National Standards Institute/American Concrete Institute (ANSI/ACI)
 - .1 ANSI/ACI 315-99, Details and Detailing of Concrete Reinforcement.
- .3 American Society for Testing and Materials (ASTM)
 - .1 ASTM A775/A775M-01, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
- .4 Canadian Standards Association (CSA)
 - .1 CAN/CSA-A23.1-14, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN3-A23.3-14, Design of Concrete Structures for Buildings.
 - .3 CSA G30.3-M1983 (R1998), Cold Drawn Steel Wire for Concrete Reinforcement.
 - .4 CSA G30.5-M1983 (R1998), Welded Steel Wire Fabric for Concrete Reinforcement.
 - .5 CSA G30.14-M1983 (R1998), Deformed Steel Wire for Concrete Reinforcement.
 - .6 CSA G30.15-M1983 (R1998), Welded Deformed Steel Wire Fabric for Concrete Reinforcement.
 - .7 CAN/CSA-G30.18-09, (R2014) Billet-Steel Bars for Concrete Reinforcement.
 - .8 CAN/CSA-G40.21-13, Structural Quality Steels.
 - .9 CAN/CSA-G164-2018, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .10 CSA W186-M1990 (R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.4 SOURCE QUALITY CONTROL

- .1 Upon request, provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks

prior to commencing reinforcing work.

- .2 Upon request inform Department Representative of proposed source of material to be supplied.

1.5 SHOP DRAWINGS

- .1 Submit shop drawings including placing of reinforcement in accordance with Section 01 33 00 - Submittal Procedures.
- .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. 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 Design detail lap lengths and bar development lengths to CAN3-A23.3, unless otherwise indicated. Provide type A tension lap splices where indicated.
- .4 Each drawing shall bear the signature and stamp of qualified professional engineer registered to practice in Prince Edward Island.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Dispose of waste materials in appropriate on-site bins in accordance with Waste Management Plan, Section 01 74 21.

PART 2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Departmental Representative.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.
- .3 Cold-drawn annealed steel wire ties: to CSA G30.3.
- .4 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.
 - .1 All 152 x 152 MWE x 18.7 x 18.7
- .5 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1. Chairs and bar supports shall be plastic on stainless steel.
- .6 Mechanical splices: subject to approval of Departmental Representative.
- .7 Plain Round Bars: to CAN/CSA-G40.21.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.
- .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 REINFORCEMENT

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CAN/CSA-A23.1.
- .2 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint. When paint is dry, apply a thick even film of mineral lubricating grease.
- .3 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .4 Ensure cover to reinforcement is maintained during concrete pour.
- .5 Provide concrete half-bricks to support welded wire mesh in proper position in floor slabs during placing of concrete.

3.3 FIELD TOUCH-UP

- .1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

END OF SECTION

PART 1 General

1.1 MEASUREMENT FOR PAYMENT

- .1 Refer to Section 01 29 00 - Measurement for Payment.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 03 10 00 - Concrete Forming and Accessories.
- .3 Section 03 20 00 - Concrete Reinforcing.
- .4 Section 31 23 10 - Excavation, Trenching and Backfilling.

1.3 REFERENCES

- .1 American Society for Testing and Materials (ASTM):
 - .1 ASTM C109/C109M-16, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 in. or 50mm Cube Specimens).
 - .2 ASTM C 260-10a (2016), Specification for Air-Entraining Admixtures for Concrete.
 - .3 ASTM C 309-11, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .4 ASTM C 332-17, Specification for Lightweight Aggregates for Insulating Concrete.
 - .5 ASTM C 494-17, Specification for Chemical Admixtures for Concrete.
 - .6 ASTM C 827-16, Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
 - .7 ASTM C 939-16a, Test Method for Flow of Grout for Preplaced-Aggregate Concrete.
 - .8 ASTM D1751-04(2013), Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .9 ASTM D1752-04a(2013), Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian General Standards Board (CGSB):
 - .1 CAN/CGSB-19.24-M90, Multicomponent, Chemical-Curing Sealing Compound.
 - .2 CAN/CGSB-37.2-M88, Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing, and for Roof Coatings.
 - .3 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 Canadian Standards Association (CSA):
 - .1 CAN/CSA-A5 Portland Cement.

- .2 CAN/CSA-A23.1-14, Concrete Materials and Methods of Concrete Construction.
- .3 CAN/CSA-A23.2-14, Methods of Test for Concrete.
- .4 CAN/CSA A3000-18, Cementitious Materials Compendium.

1.4 CERTIFICATES

- .1 Submit certificates in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CAN/CSA-A23.1.
- .3 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.

1.5 TESTING AND INSPECTION

- .1 Testing and inspection of concrete and concrete materials will be carried out by testing laboratory engaged and paid for by the Departmental Representative. Frequency of tests will be determined by the Departmental Representative.
- .2 Remove defective concrete and embedded debris and repair as directed by Departmental Representative.

1.6 QUALITY ASSURANCE

- .1 Pre Pour Meeting:
 - .1 Convene a pre-pour meeting 2 weeks prior to beginning concrete works.
 - .2 Ensure concrete forming, finishing and concrete supplier personnel, attend.
 - .3 Verify project requirements.
 - .4 Review all aspects of the work including construction sequence, access to work by other Trade Contractors, Quality of falsework for trueness to dimensions, quality of finish expected at exposed concrete and all other aspects of the work.
- .2 Submit to Departmental Representative, minimum 4 weeks prior to starting concrete work, valid and recognized certificate from plant delivering concrete.
- .3 Minimum 4 weeks prior to starting concrete work, submit proposed quality control procedures for review by Departmental Representative on following items:
 - .1 Falsework erection
 - .2 Hot weather concrete
 - .3 Cold weather concrete
 - .4 Curing

- .5 Finishes
- .6 Formwork removal
- .7 Joints

1.7 WASTE MANAGEMENT AND DISPOSAL

- .1 Dispose of waste material in appropriate on-site bins in accordance with Waste Management Plan, Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Designate a cleaning area for tools and concrete trucks to limit water use and runoff.
- .3 Carefully coordinate the specified concrete work with weather conditions.
- .4 Ensure emptied containers are sealed and stored safely for disposal.
- .5 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.
- .6 Choose least harmful, appropriate cleaning method which will perform adequately.

PART 2 Products

2.1 MATERIAL

- .1 Portland cement: to CAN/CSA-A5.
- .2 Supplementary cementing materials: to CAN/CSA A3000-13.
- .3 Cementitious hydraulic sag: to CAN/CSA A3000-03.
- .4 Water: to CAN/CSA-A23.1.
- .5 Aggregates: to CAN/CSA-A23.1. Coarse aggregates to be normal density.
- .6 Air entraining admixture: to ASTM C 260.
- .7 Chemical admixtures: to ASTM C 494. 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: 50 MPa at 28 days.
 - .2 Consistency:
 - .1 Fluid: to ASTM C 827. Time of efflux through flow cone (ASTM C939), under 30s.
 - .2 Flowable: to ASTM C 827. Flow table, 5 drops in 3s, (ASTM C109, applicable portion) 125 to

- 145%.
- .3 Plastic: to ASTM C 827. 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 0%.
- .9 Curing compound: to CAN/CSA-A23.1 white and to ASTM C 309, Type 1-chlorinated rubber.
- .10 Premoulded joint fillers:
 - .1 Bituminous impregnated fiber board: to ASTM D 1751.
- .11 Weep hole tubes: PVC on galvanized steel.
- .12 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots.
- .13 Dampproofing:
 - .1 Emulsified asphalt, mineral colloid type, unfilled to: CAN/CGSB-37.2.
- .14 Polyethylene film: 6 mil and 10 mil thickness to CAN/CGSB-51.34.
- .15 Joint Sealer: chemical curing, multi-component, Class B, Type I for horizontal joints, Type II for vertical joints to CAN/CGSB 19.24.
- .16 Silane Sealer: Self penetrating, 100% silane, clear, breathable.

2.2 MIXES

- .1 Proportion normal density concrete in accordance with CAN/CSA-A23.1. Alternative 1 to give the following properties:
 - .1 All Concrete for deck, cap, anchor blocks, and slab-on-grade:
 - .1 Cement: use Type 10 Portland Cement. Cement coated 386 kg/m³ of concrete.
 - .2 Minimum compressive strength at 28 days: 35 MPa.
 - .3 Class of exposure: C-1.
 - .4 Nominal size of coarse aggregate: 20mm.
 - .5 Slump at point and time of discharge: Mass Concrete 40mm +/-20 & Structural Concrete 80mm +/-20
 - .6 Air content: 5-8% and to Table 4 in CSA A23.1.
- .2 Provide certification that plant, equipment, and all materials to be used in concrete comply with the requirements for CAN/CSA-A23.1.
- .3 Use of calcium chloride not permitted.
- .4 Use of alkali-silica reactive aggregates shall not be permitted.

2.3 ADMIXTURES

- .1 Admixtures will be permitted only to correct deficiency in mixture or to make correct placement requirements as recommended by Testing Laboratory and approved by Departmental Representative.
- .2 Use of accelerating admixtures, if approved by Departmental Representative, will not relax cold weather placement requirements of CAN/CSA-A23.1.
- .3 Provide and install epoxy anchor as indicated to secure ladders to concrete and suitable for marine work. Adhesive to be injectable, high strength epoxy to ASTM C881, Type IV, Grade 3.

PART 3 Execution

3.1 PREPARATION

- .1 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours notice prior to placing of concrete.
- .2 Pumping of concrete will be permitted. Place concrete in accordance with CAN/CSA-A23.1 to meet all requirements of mix design at point of placement.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Prior to placing of concrete obtain 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 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 shrinkage compensating grout to anchor and hold dowels in positions as indicated.
- .7 Do not place load upon new concrete until authorized by Departmental Representative.
- .8 Cold joints will not be allowed.

3.2 CONSTRUCTION

- .1 Do cast-in-place concrete work in accordance with CAN/CSA-A23.1.
- .2 Sleeves and inserts.
 - .1 No sleeves, pipes or other openings shall pass through concrete elements, except where indicated or approved by Departmental Representative.

- .2 Where approved by Departmental Representative, set sleeves, ties, hangers and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 x 100 mm 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.
- .3 Anchor bolts.
 - .1 Set anchor bolts to templates under supervision of appropriate trade prior to placing concrete.
- .4 Dowels: In locations where new concrete is dowelled to existing concrete drill holes in existing concrete to depths, diameters and spacing indicated and install dowels using natural aggregate grout mixed to flow consistency to suit application, in strict accordance with manufacturers instructions.
- .5 Finishing.
 - .1 Finish concrete in accordance with CAN/CSA-A23.1.
 - .2 Deck surfaces and slab-on-grade to have uniform broom finish.
 - .3 Rub exposed edges of concrete with Carborundum to produce 3mm radius edges unless otherwise detailed.
- .6 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 isolation joints as indicated. Install joint filler.

3.3 CURING

- .1 Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures, and mechanical injury, and shall be maintained with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete in accordance with CAN/CSA A23.1.
- .2 Wet cure dredge platform and concrete slabs on grade.

- .3 Wet curing shall be continued for at least seven (7) days. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, moisture retention measures may be terminated when the average compressive strength has reached seventy percent (70%) of the specified concrete strength.
- .4 Perform curing of concrete by moist curing. Provide moisture curing by one of the following methods:
 - .1 Keep concrete surface continuously wet by covering with water.
 - .2 Use continuous water-fog spray.
 - .3 Cover concrete surface with moisture retaining cover. Place cover to provide coverage of concrete surfaces and edges with four- (100mm) lap over adjacent moisture retaining covers, and seal using waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- .5 Provide liquid membrane curing compound specified to other concrete surfaces as follows:
 - .1 Apply specified curing compound to concrete surfaces within one (1) hour of final finishing operations or within one (1) hour of form removal. Apply uniformly in continuous operation by spray or roller in accordance with manufacturer's directions. Maintain continuity of coating and repair damage during curing period.

3.4 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 CAN/CSA-A23.1.
- .2 Departmental Representative will pay for costs of tests as specified.
- .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 shall be in accordance with CAN/CSA-A23.2.
- .5 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve him of his contractual responsibility.

3.5 DEFECTIVE CONCRETE

- .1 Remove defective concrete and repair as directed by the Departmental Representative.

3.6 SITE TOLERANCE

- .1 Concrete tolerance in accordance with CAN/CSA-A23.1
straight edge method.

END OF SECTION