
PWGSC

Big Beaver Creek Bridge Culvert
Culvert Liner Installation
Alaska Highway km 399.4
British Columbia

03 10 00

CONCRETE FORMING AND ACCESSORIES

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PART 1 - GENERAL

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| 1.1 | Related Sections | .1 | Cast-In-Place Concrete – Section 03 30 00 |
| 1.2 | References | .1 | Canadian Standards Association (CSA International) |
| | | .1 | CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete. |
| | | .2 | CSA-O86S1-05, Supplement No. 1 to CAN/CSA-O86-01, Engineering Design in Wood. |
| | | .3 | CSA O121-M1978(R2003), Douglas Fir Plywood. |
| | | .4 | CSA O153-M1980(R2003), Poplar Plywood. |
| | | .5 | CAN/CSA-O325.0-92(R2003), Construction Sheathing. |
| | | .6 | CSA O437 Series-93(R2006), Standards for OSB and Waferboard.CSA S269.1-1975(R2003), Falsework for Construction Purposes. |
| | | .7 | CAN/CSA-S269.3-M92(R2003), Concrete Formwork, National Standard of Canada. |
| 1.4 | Action and Informational Submittals | .1 | Submit in accordance with Section 01 33 00 - Submittal Procedures. |
| | | .2 | Submit shop drawings for formwork and falsework. |
| | | .1 | Submit drawings stamped and signed by professional engineer registered or licensed in Province of British Columbia, Canada. |
| 1.5 | Delivery, Storage and Handling | .1 | Store and manage hazardous materials in accordance with Section 02 81 01 – Hazardous materials. |
| | | .2 | Waste Management and Disposal: |
| | | .1 | Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal. |
| | | .2 | Divert wood materials from landfill to an appropriate facility as approved by Departmental Representative. |
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- .3 Divert plastic materials from landfill to a recycling facility as approved by Departmental Representative.
- .4 Divert unused form release material from landfill to an official hazardous material collections site as approved by the Departmental Representative.

PART 2 – PRODUCTS

2.1 Materials

- .1 Materials and resources in accordance with Section 01 61 10 – Product Requirements.
 - .2 Formwork materials: use wood and wood product formwork materials to CSA-O121 and CAN/CSA-O86.
 - .3 Form ties:
 - .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
 - .2 For Architectural concrete, use snap ties complete with plastic cones and light grey concrete plugs.
 - .4 Form liner:
 - .1 Plywood: medium density overlay Douglas Fir to CSA O121 with square edges, 20 mm thick.
Form release agent: non-toxic, biodegradable, low VOC.
 - .5 Form stripping agent: colourless mineral oil, low VOC, open cup.
 - .6 Falsework materials: to CSA-S269.1.
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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 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.
 - .5 Do not place shores and mud sills on frozen ground.
 - .6 Provide site drainage to prevent washout of soil supporting mud sills and shores.
 - .7 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.
 - .8 Align form joints and make watertight.
 - .1 Keep form joints to minimum.
 - .9 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.
 - .10 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
 - .11 Construct forms for architectural concrete, and place ties as indicated.
 - .1 Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
 - .12 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections.
 - .1 Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.
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.13 Line forms for following surfaces:

- .1 Outer face of outside pier caps.
- .2 Secure lining taut to formwork to prevent folds.
- .3 Pull down lining over edges of formwork panels.
- .4 Ensure lining is new and not reused material.
- .5 Ensure lining is dry and free of oil when concrete is poured.
- .6 Application of form release agents on formwork surface is prohibited where drainage lining is used.
- .7 If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.
- .8 Cost of textile lining is included in price of concrete for corresponding portion of Work.

.14 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 Removal and Reshoring

- .1 Leave formwork in place at least 3 days after placing concrete or upon attainment of 50% of its design strength, whichever comes later, and replace immediately with adequate reshoring.
- .2 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

END OF SECTION

PART 1 - GENERAL

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| 1.1 | Section Includes | .1 | Cast-in-place Concrete |
| 1.2 | Related Sections | .1 | Concrete Forming and Accessories – Section 03 10 00 |
| 1.3 | Price and Payment Procedures | .1 | Measurement Procedures: in accordance with Section 01 29 01 – Method of Measurement and Payment. |
| 1.4 | References | .1 | Abbreviations and Acronyms: <ul style="list-style-type: none">.1 Portland Cement: Type GU - General use cement..2 Fly ash: Type F - with CaO content less than 15%..3 GGBFS – Ground, granulated blast-furnace slag. |
| | | .2 | Reference Standards <ul style="list-style-type: none">.1 British Columbia Ministry of Transportation Standard Specifications for Highway Construction (SS)<ul style="list-style-type: none">.1 SS 211-12, Portland Cement Concrete |
| | | .2 | Reference Standards <ul style="list-style-type: none">.1 CSA International<ul style="list-style-type: none">.1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete..2 CSA A283-06, Qualification Code for Concrete Testing Laboratories..3 CSA A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005). |
| 1.4 | Administrative Requirements | .1 | Pre-installation Meetings: in accordance with Section 01 32 17 – Construction Progress and Reporting.

Convene pre-installation meeting one week prior to beginning |
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concrete works.

- .1 Ensure key personnel, site supervisor, Departmental Representative, Consultant, concrete producer and testing laboratories attend.
 - .1 Verify project requirements.
 - 1.5 Action and Informational Submittals
 - .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .2 At least 4 weeks prior to beginning Work, provide Departmental Representative with samples of materials proposed for use as follows:
 - .1 5 L of curing compound.
 - .2 3 kg of each type of supplementary cementing material.
 - .3 5 kg of each admixture.
 - .4 10 kg of each fine and coarse aggregate.
 - .3 Provide test results and inspection reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.
 - .4 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
 - .5 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.
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| 1.6 Quality Assurance | .1 | Quality Assurance: in accordance with Section 01 45 00 - Quality Control. |
| | .2 | Provide a valid and recognized certificate from plant delivering concrete to Departmental Representative a minimum of 4 weeks prior to starting concrete work. |
| | .1 | Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture will meet specified requirements. |
| | .3 | Minimum 4 weeks prior to starting concrete work, provide 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. |
| | .4 | Quality Control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS. |
| 1.7 Delivery, Storage and Handling | .1 | Delivery and Acceptance Requirements |
| | .1 | Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching. |
| | .1 | Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2. |
| | .2 | Deviations to be submitted for review by Departmental Representative. |
| | .2 | Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2. |
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PART 2 - PRODUCTS

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| 2.1 Design Criteria | .1 | Performance : to CSA A23.1/A23.2, and as described in MIXES of PART 2 – PRODUCTS. |
| 2.2 Performance Criteria | .1 | Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE. |
| | .2 | Portland Cement: to CSA A3001, Type GU. |
| | .3 | Water: to CSA A23.1/A23.2 |
| | .4 | Aggregates: to CSA A23.1/A23.2. |
| | .5 | Admixtures: |
| | .1 | Air entraining admixture: to ASTM C260. |
| | .2 | Chemical admixture: to ASTM C494. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing. |
| 2.3 Mixes | .1 | Concrete mixes shall be proportioned to provide a workable mix suitable for the complexity of that class of work without segregation or bleeding. |
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- .2 Proportion normal density concrete in accordance with CSA A23.1 Alternative 1, for the specified exposure class, to give the properties stipulated in this section for each concrete type.
- .3 Slump shall be measured at time and point of discharge. Slump indicated is without superplasticizer. Concrete shall be placed at the lowest possible slump possible with conditions of placement.
- .4 Preparation of Class B concrete in accordance with CSA A23.1 and SS 211-12:
 - .1 28 Day strength: 25 MPa.
 - .2 Range of slump: 100 – 160 mm.
 - .3 Total air: 4 – 7%.
 - .4 Maximum water-cementitious materials ratio: 0.45.
 - .5 Nominal aggregate size: 5 – 20 mm.
- .5 Special requirements for concrete:
 - .1 Mix Design and curing for concrete shall comply with CSA A23.1-09, Clause 8.7 for HVSC-2 Concrete.
 - .2 The concrete mix shall be proportioned to minimize drying shrinkage. Measures shall include appropriate aggregate gradation and proportioning and appropriate use of admixtures, approved by the Departmental Representative, to reduce the water content of the mix.
 - .3 Concrete thermal gradients shall be controlled to prevent cracking in accordance with CSA A23.1-09, Clause 7.4.1.3.

PART 3 - EXECUTION

- 3.1 Preparation
 - .1 Provide Departmental 24 hours minimum notice before each concrete pour.
 - .2 Concrete mix design, initial concrete temperature, placing procedure, formwork and insulation shall be employed to ensure that the maximum temperature differential over the cross-section of any reinforced concrete element does not exceed 20°C.
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- .3 During concreting operations:
 - .1 Development of cold joints not allowed unless approved by Departmental Representative.
 - .2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.
 - .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.
 - .5 Protect previous Work from staining, and remove existing stains prior to application of concrete finishes.
 - .6 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
 - 3.2 Installation/Application
 - .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
 - .2 Cast in sleeves, anchors, reinforcement, bolts, joint fillers and other inserts are required to be built in.
 - .3 Adhesive set anchor rods:
 - .1 Drill holes are to be drilled with percussion drill using a template to guide the alignment and to accurately locate each hole. Hole diameters to match anchor manufacturer's recommendations.
 - .2 Ream holes with a wire brush and blow clean with compressed air immediately before grouting. Ensure that the compressed air is free of oil or other deleterious material detrimental to the bonding of the epoxy. Install anchor dowels in accordance with manufacturer's instructions.
 - .3 Inject adhesive into the prepared holes from a nozzle-mix injection tube. Fill each hole with adhesive before inserting the anchor dowel.
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- .4 Twist the anchor after inserting it into the epoxy and “bottom” it in the hole in accordance with the manufacturer’s instructions.
- .5 Take appropriate measures to prevent excess epoxy material from contaminating adjacent surfaces.

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.
- .3 Weep holes in existing concrete walls installed as detailed on drawings.

3.3 Finishes

- .1 Formed surfaces exposed to view: smooth form finish in accordance with CSA A23.1/A23.2.
 - .2 Use procedures as reviewed by Departmental Representative or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface is not damaged.
 - .3 Use curing compounds compatible with applied finish on concrete surfaces. Provide written declaration that compounds used are compatible.
 - .4 Provide non-slip surface to concrete approach slab using a flat wire texture broom finish. Submit sample of finished surface to the Departmental Representative.
 - .5 Provide broom finish unless otherwise indicated.
 - .6 Provide minimum slope of 2% to approach slab in order to achieve adequate drainage as outlined on the drawings.
 - .7 Supply and apply high performance penetrating sealers on new concrete surface in accordance with manufacturer’s recommendations.
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| 3.4 Curing | .1 | Leave forms in place for 7 days and cover the top of wall with wet burlap and polyethylene and cure in accordance with CSA A23.1/A23.2. |
| 3.5 Site Tolerances | .1 | Concrete finishing tolerance in accordance with CSA A23.1/A23.2. |
| 3.6 Field Quality Control | .1 | Site tests: conduct tests as follows and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.1 Concrete pours.
.2 Slump.
.3 Air content.
.4 Compressive strength at 7 and 28 days.
.5 Air and concrete temperature.

.2 Inspection and testing of concrete and concrete materials will be carried out by testing laboratory designated by Contractor and approved by Departmental Representative for review to CSA A23.1/A23.2.

.1 Ensure testing laboratory is certified to CSA A283.

.3 Contractor will pay for costs of tests.

.4 Contractor will take additional test cylinders during cold weather concreting. Cure cylinders on job site under same conditions as concrete which they represent.

.5 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.

.6 Inspection or testing by Departmental Representative will not augment or replace Contractor quality control nor relieve Contractor of his contractual responsibility.

.7 A Quality Control plan approved by the Departmental Representative shall be implemented throughout the concrete production in accordance with the requirements of CSA A23.1.

.8 The Quality Control Plan shall include, but is not limited to, the following:

.1 Based on mix design, determine by lab testing the adiabatic heat generation for concrete mix to be used. |
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- .2 Provide information on temperature sensing and recording equipment to be used. Include details of installation locations of the temperature probes for each planned mass concrete placement.
- .3 Provide Monitoring Plan to control temperature gradient. Include proposed methods for early identification of trends in concrete properties and for taking corrective actions. This includes identifying internal and external concrete temperatures during the curing process to ensure temperatures are within limits set by CSA A23.1-09.
- .4 Details of proposed protective systems and procedures for placing and curing concrete, including situations where ambient temperatures are less than 5°C or over 25°C, and the influences of tide levels on the underside of the foundation.
- .5 Identify how corrective actions will be performed to maintain acceptable differential temperatures in accordance with CSA A23.1-09.
- .6 Proposed Quality Control Plan to be certified by a qualified Professional Engineer registered in the Province of British Columbia, Canada.

3.7 Cleaning

- .1 Clean in accordance with Section 01 74 11 – Site Cleaning.
 - .2 Designate cleaning area for tools to manage water use and runoff in accordance with Section 01 35 43 – Environmental Protection.
 - .3 Coordinate appropriate area on site where concrete trucks can be safely washed with Departmental Representative.
 - .4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 - .1 Divert unused concrete materials from landfill to local facility after receipt of written approval from Departmental Representative.
 - .2 Divert unused admixtures and additive materials to official hazardous material collection site after receipt of written
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approval from Departmental Representative.

- .5 Do not dispose of unused admixtures and additive materials into sewer systems, into lakes, streams, onto ground or in other location where it will pose a health or environmental hazard.
- .6 Prevent admixtures and additive materials from entering drinking water supplies or streams.
- .7 Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal. Dispose of waste in accordance with applicable local, Provincial/Territorial and National regulations.

END OF SECTION
