|  |
| --- |
| **Section Cover Page** |
|  **Section 03 11 00****2019-06-05 Concrete Forms and Accessories** |
| Refer to “Green Building Notes” page for additional guidance for projects following a sustainable rating system.Revise Green Building requirements if the Province has determined that the work of this Contract is not to attain a sustainable rating system certification. |

Use this Section to specify formwork materials and accessories for large scope (e.g. more than $25,000) cast-in-place concrete work except:

.1 Concrete sidewalks, driveways, aprons, pads, curbs and gutters, specified in Section 32 13 13 - Concrete Paving, Curbs and Gutters.

.2 Concrete for street light bases, car plug-in posts, guard posts, etc., specified in Section 32 17 10 - Road and Parking Appurtenances.

.3 Use Section 03 30 10 - Cast-in-Place Concrete (Short Form) for small scope cast-in-place concrete work.

This Master Specification Section contains:

.1 This Cover Sheet

.2 Green Building Notes

.3 Specification Section Text:

**1. General**

1.1 Products Installed but Not Supplied Under This Section

1.2 Reference Documents

1.3 Submittals

1.4 Quality Assurance

1.5 Delivery, Storage and Handling

**2. Products**

2.1 Materials

2.2 Accessories

**3. Execution**

3.1 Formwork Preparation

3.2 Tolerances

3.3 Fabrication and Erection

3.4 Inserts, Embedded Items and Openings

3.5 Cleaning

3.6 Form Removal

3.7 Reshoring

3.8 Field Quality Control

**Green Building Notes:**

If the project is **not** designated to use a sustainable rating system it is still be prudent to leave in relevant green building requirements as part of an effort towards sustainability.

**Review and incorporate requirements from the following documents into the project:**

Section 1.0 “Sustainability” and “Appendix G – Green Building Standards” of the “Technical Design Requirements for Alberta Infrastructure Facilities”

<http://www.infrastructure.alberta.ca/doctype486/TechDesignRequirements.pdf>

**LEED Specific Documents (if required):**

LEED Project Delivery Process Manual

<http://www.infrastructure.alberta.ca/Content/docType486/Production/LEED_PD_Manual.pdf>

LEED Project Delivery Process Manual – Appendices

<http://www.infrastructure.alberta.ca/Content/docType486/Production/LEED_PD_Appendices.pdf>

All documents can be found on Infrastructure’s Technical Resource Centre, Guidelines and Standards page: <http://www.infrastructure.alberta.ca/992.htm> .

1. General
	1. PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION
		1. Install following materials specified to be supplied under other Sections of these project specifications:
			1. Fabricated components, anchor bolts, bearing plates, sleeves and other inserts to be built into concrete.
	2. RELATED WORK SPECIFIED IN OTHER SECTIONS

.1 Section 03 20 00 – Concrete Reinforcing

.2 Section 03 30 00 – Cast-in-Place Concrete

.3 Section 03 30 10 – Cast-in-Place Concrete Short Form

.4 Section 03 35 10 – Concrete Floor Finishes

.5 Section 05 50 00 – Custom Metal Fabrications

* 1. REFERENCE DOCUMENTS

*SPEC NOTE: Latest versions of the following standards to be used*

* + 1. American Concrete Institute (ACI):
			1. ACI 347-14 Guide to Formwork for Concrete
		2. Canada Green Building Council (CaGBC):
			1. LEED Canada 2009 Rating System LEED Canada for New Construction and Major Renovations. LEED Canada for Core and Shell Development. Website: [www.cagbc.org](http://www.cagbc.org)]
		3. Canadian Standards Association (CSA):
			1. CSA A23.1‑14 Concrete Materials and Methods of Concrete Construction
			2. CSA O86-14 Engineering Design in Wood
			3. CSA O121-17 Douglas Fir Plywood
			4. CSA O151-17 Canadian Softwood Plywood
			5. CSA O153-13 Poplar Plywood
			6. CSA S269.1-16 Falsework and Formwork
			7. CAN/CSA Z809-08 (R2013) A Sustainable Forest Management System
	1. SUBMITTALS
		1. Shop Drawings:
			1. Submit shop drawings for formwork, falsework, shoring and reshoring in accordance with Division 01.
			2. Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of construction and movement joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. [Comply with CSA-S269.1 for formwork drawings.]
			3. Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.
			4. Each shop drawing submission shall bear stamp and signature of a qualified professional engineer registered or licensed in the Province of Alberta.
		2. Sample Panel:
			1. Construct and erect a sample formwork panel for architectural concrete surfaces receiving special formed finish. Sample panel shall be of sufficient size to fully indicate special treatment, pattern, module, or finish required. Obtain the Consultant’s approval prior to casting concrete sample.
			2. Cast concrete against sample panel. Obtain the Consultant’s approval of resulting concrete surface finish prior to erecting subsequent forms.
			3. Approved concrete surface of sample will be considered the standard of quality for the finished work. Quality of all formwork shall match the approved sample panel.
			4. Leave sample panel and concrete sample exposed to view for duration of concrete work.
			5. Remove sample panel and concrete sample, if not incorporated into the work, from site when directed by the Consultant.
		3. Sustainable Design Submittals:
			1. LEED Submittals: submit LEED submittal forms for Credit MR 7 in accordance with Section 01 35 18 LEED Requirements and the following:
				1. Documentation listing quantity of wood products that are FSC certified and vendor’s invoices and/or letters clearly indicating supplied wood products meet FSC certification.
				2. Calculations demonstrating that the project incorporates the required percentage of FSC certified materials/products and their cost together with the total cost of all materials for the project.
			2. Product Data and MSDS sheets for form release agents indicating verification of Ecologo certification and/or product is non-toxic , biodegradable, or low VOC.
	2. QUALITY ASSURANCE
		1. Design, construct, and erect formwork in accordance with CSA A23.1, CSA S269.1, ACI 347, and all applicable construction safety regulations for the place of the work.
	3. DELIVERY, STORAGE AND HANDLING
		1. Waste Management and Disposal:
			1. Separate waste materials for [reuse] [and] [recycling] in accordance with Section 01 74  19 – Waste Management and Disposal.
1. Products
	1. MATERIALS
		1. Wood formwork materials:
			1. Wood formwork shall be Forest Stewardship Council (FSC) Certified unless it is rented or otherwise re-cycled wood material.
		2. Formwork materials:
			1. Concrete without special architectural features: use plywood and wood formwork materials to [CSA O121] [CSA O151] [CSA O153] [CAN/CSA O86]. Square-edged, smooth surfaced panels true in plane, free of holes, surface markings, or defects.
			2. Concrete with special architectural features: use formwork materials to CAN/CSA A23.1 [mouldings] [battens] [                ] fabricated from [mill finished pine] [injection moulded plastic] [formed steel] [                  ] [raised grain boards] [                       ].
		3. Pan forms: [removable] [permanent] [steel] [reinforced plastic] as indicated, free of bends, dents and residual concrete, well matched, tight fitting and adequately stiffened to support concrete weight without deflection detrimental to appearance of finished concrete surfaces.
		4. Tubular column forms: round, [spirally wound laminated fibre forms] [steel], internally treated with release material. [Spiral pattern [to show] [not to show] in hardened concrete.]
		5. Form ties:
			1. Concrete without special architectural features: 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. Concrete with special architectural features: use snap ties complete with plastic cones and light gray concrete plugs.
		6. Form liner: [high density overlay] [medium density overlay] [Douglas Fir Plywood to CSA O121] [Canadian Softwood Plywood to CSA O151] [Poplar Plywood to CSA O153], [          ] grade, [T&G] [square] edge, [           ] mm thick.
		7. Void Forms: [moisture resistant treated paper faces; biodegradable] [low density bead board], structurally sufficient to support weight of wet concrete mix until initial set, [50] [100] [150] mm thick.
	2. ACCESSORIES
		1. Formwork release agent: Use commercially manufactured formwork release agent that reduces formwork moisture absorption, inhibits bond with concrete, does not stain exposed concrete surfaces, and is Ecologo certified under the Environmental Choice Program (ECP) or, if not Ecologo certified, the Contractor shall:
			1. provide a product that conforms to the requirements for concrete release agents in accordance with ECP Certification Criteria Document (CCD) 143 governing Asphalt and Concrete Release Agents, excluding the provisions under Conditions for Ecologo Use and,
			2. if requested, provide the Consultant with the same rights as the ECP under CCD 143 with regard to verification for product compliance.
			3. or [biodegradable] [non-toxic] [low VOC].
		2. Sealant: as specified in Section [07 92 00 – Joint Sealers].
		3. Corner or Chamfer Fillets: [extruded plastic] [mill finished pine], [40] [25] [20] [13] mm [radius] [width], maximum possible lengths, mitre ends.
		4. Sealing Tape: [reinforced] [self-adhesive] [waterproof kraft] [polyvinylchloride].
		5. Other embedded items – Use waterstops, sleeves, inserts, anchors, and other embedded items of material and design indicated in the Contract Documents.
2. Execution
	1. FORMWORK PREPARATION
		1. Apply form release agent in accordance with manufacturer’s recommendations, prior to placing reinforcing steel, anchoring devices and embedded parts.
		2. Do not apply form release agent where concrete surfaces are to receive [special finishes] [or] [applied coverings] which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces moist prior to placing concrete.
		3. Do not apply form release agent where [wood graining characteristics] [                    ] are required on the finished concrete surfaces.
	2. TOLERANCES
		1. Construct formwork to produce concrete with dimensions, lines, and levels within tolerances specified in ACI 347.

**OR**

.1 Construct formwork to produce concrete with dimensions, lines, and levels within the following tolerances. Tolerances are not cumulative.

* + - 1. Deviation from Vertical Line: 6 mm in 3 m, 9 mm in 6 m, and 20 mm in 12 m or more.
			2. Deviation from Flat Surface, for Walls and Floors: 3 mm in 3 m.
			3. Deviation from Horizontal Line: 6 mm in 3 m.
			4. Deviation from Linear Building Lines from Drawings and Position of Columns, Walls, and Partitions: [6] [ ] mm.
			5. Deviation in Cross Sectional Dimensions of Columns and Beams, and in Thickness of Slabs and Walls: plus or minus 6 mm.
		1. Camber slabs and beams 6 mm per 3 m of span [unless otherwise shown on drawings]. Review method of providing camber with the Consultant prior to proceeding. Maintain beam depth and slab thickness from cambered surface.
	1. FABRICATION AND ERECTION
		1. Verify lines, levels, and centers before proceeding with formwork/falsework and ensure dimensions agree with drawings.
		2. Obtain the Consultant’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. Refer to architectural drawings for concrete and concrete members requiring architectural exposed finishes.
		5. Do not place shores and mud sills on frozen ground.
		6. Provide site drainage to prevent washout of soil supporting shores and mud sills.
		7. Fabricate and erect formwork in accordance with CAN/CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CAN/CSA A23.1.
		8. Provide a camber of 0.2% of span for beams unless noted otherwise on drawings.
		9. Provide a camber of 0.2% of span for joists and slabs spanning over 3 m unless noted otherwise on drawings.
		10. Align form joints and make watertight. Keep form joints to a minimum.
		11. Locate horizontal form joints for exposed columns [2400] [              ] mm above finished floor elevation.
		12. Use [25] [ ] mm chamfer strips on external corners and [25] [ ] mm fillets at interior corners of concrete members, unless specified otherwise.
		13. Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
		14. Construct forms for architectural concrete, and place ties as indicated and as directed. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
		15. Build in anchors, sleeves, and other inserts required to accommodate work specified in other sections. Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including paint.
		16. Line forms for the following surfaces:
			1. Outer face of [outside] [girders] [beams] [                   ].
			2. Exposed surfaces of [girders] [beams] [                    ].
		17. Do not stagger joints of form lining materials. Align joints to obtain uniform pattern.
		18. Clean formwork in accordance with CAN/CSA-A23.1, prior to placing concrete.
		19. Re-use of formwork and falsework subject to requirements of CAN/CSA-A23.1.
		20. If [slip forms] [and] [flying forms] are used, submit details of equipment and procedures for the Consultant’s approval.
		21. Arrange and assemble formwork to permit removal without damage to concrete. Arrange forms to allow removal without removal of principle shores, where these are required to remain in place.
		22. [Provide shoring under steel beams or steel floor deck as required by design. Do not remove until concrete has achieved 75% of required 28-day strength.]
	2. INSERTS, EMBEDDED ITEMS, AND OPENINGS
		1. Provide formed openings where required for pipes, conduits, sleeves or other work to be embedded in and passing through concrete members. Obtain the Consultant’s approval before framing openings in slabs, beams, and columns, not shown on drawings.
		2. Accurately locate and set in place items which are to be cast directly into concrete.
		3. Coordinate forming of openings, slots, recesses, chases, and setting of sleeves, bolts, anchors, and other inserts with work of other Sections as required.
		4. Coordinate installation of concrete accessories.
		5. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings in bottom of forms to allow flushing water to drain.
		6. Close temporary ports or openings with tight fitting panels, flush with inside face of forms, neatly fitted so no leakage occurs and to provide uniform surface on exposed concrete.
	3. CLEANING
		1. Clean forms as erection proceeds, to remove foreign matter. Remove cuttings, shavings, and debris from within forms. [Flush completely with water] [Clean with compressed air] to remove foreign matter. Ensure that water and debris drain to the exterior through clean-out ports.
		2. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless formwork and concrete construction proceed within a heated enclosure. Use compressed air or other means to remove foreign matter.
	4. FORM REMOVAL
		1. Leave formwork in place for following minimum periods of time after placing concrete.
			1. [Three] [              ] days for walls and sides of beams.
			2. [Three] [              ] days for columns.
			3. [Fourteen] [                  ] days for beam soffits, slabs, decks and other structural members, or [two] [             ] days when replaced immediately with adequate shoring to standard specified for falsework.
			4. [Two] [             ] days for footings and abutments.

**OR**

.1 Do not remove forms and falsework until concrete has gained sufficient strength to carry its own weight, plus construction loads and other design loads that are liable to be imposed. Verify strength of concrete by compression tests to the satisfaction of the Consultant.

* + 1. Remove falsework progressively, in accordance with CSA 269.1 and ensure that no shock loads or unbalanced loads are imposed on the structure.
		2. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
		3. Leave forms loosely in place for protection until curing requirements are complete.
		4. Store removed forms for exposed architectural concrete in a manner that surfaces to be in contact with fresh concrete will not be damaged. Marked or scored forms will be rejected.
	1. RESHORING
		1. Prepare a schedule of reshoring and submit to the Consultant for review.
		2. Reshore structural members where required due to design requirements or construction conditions. Remove load supporting forms only when concrete has attained [75] [           ] percent of required 28 day strength and reshore.
		3. Install reshoring as required to permit progressive construction. [Provide reshoring under the previously constructed concrete floors for two levels below the floor being constructed.]
	2. FIELD QUALITY CONTROL
		1. Inspect and check complete formwork, falsework, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties and parts are secure.
		2. Inform the Consultant when formwork is complete and has been cleaned, to allow for inspection.
		3. For all exposed concrete surfaces do not re-use wood type formwork more than [3] [5] [  ] times. Do not patch formwork.
		4. Allow the Consultant to review each section of formwork prior to re-use. Formwork may be re-used if approved by the Consultant.

end of section