

**PART 1 - GENERAL****1.1 DESCRIPTION**

- .1 Work covered by this section includes the provision of all materials, equipment supplies and services, labour and transportation to fully carry out the following:
  - .1 Design, construct, provide, assemble, dismantle and maintain all formwork, scaffolding and falsework required for the construction of all structures specified or shown on the drawings.
  - .2 Install sleeves, anchor bolts, anchoring components, anchor plates, embedded components, grooves, sockets, angle irons, accessory parts, drains and all parts embedded in concrete shown on the plans of all disciplines or described in the invitation to tender document.

**1.2 RELATED SECTIONS**

- .1 The specialized Contractor is responsible for obtaining a copy of all the sections of these specifications even if they do not appear to pertain to his speciality. If he does not, it shall be understood that he agrees to the clauses and requirements of all sections in these specifications. The specialized Contractor must consult the table of contents of these specifications to have knowledge of the complete list of the specifications sections.

**1.3 REFERENCES**

- .1 Canadian Standards Association (CSA)
  - .1 CAN/CSA-A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction / Methods of Test and Standard Practices for Concrete.
  - .2 CAN/CSA-O86.1-01 (supplement CAN/CSA -08651-05), Engineering Design in Wood (Limit States Design).
  - .3 CSA O121-M1978, Douglas Fir Plywood.
  - .4 CSA O151, Canadian Softwood Plywood.
  - .5 CSA O153-M1980, Poplar Plywood.
  - .6 CSA 437.0-93, Standards on OSB and Waferboard.
  - .7 CSA S269.1-1975, Falsework for Construction Purposes.
  - .8 CAN/CSA-S269.3-M92, Concrete Formwork.
  - .9 CAN/CSA-S269.2-M87, Access Scaffolding for Construction Purposes.

- .2 Council of Forest Industries of British Columbia (COFI)
  - .1 COFI, Exterior Plywood for Concrete Formwork.
- .3 Quebec Official Publisher
  - .1 S-2.1, r.6; Safety Code for the construction industry.

#### 1.4 CONTRACTOR'S RESPONSIBILITIES

- .1 Assume responsibility of concrete formwork and falsework. The Departmental Representative's review of the formwork and falsework shall not release the specialized Contractor from his responsibility regarding the provision of structures that fully comply with the drawings and specifications.
- .2 The Contractor shall be aware of all laws and regulations that apply to the design and construction of formwork and falsework and shall comply with these requirements. Comply with regulations including the Quebec Safety Code, S-2.1, r.6, regarding shoring of concrete formwork.
- .3 Before using the formwork and falsework, give the Departmental Representative a signed statement written by an Engineer who is a member in good standing of the Ordre des Ingénieurs du Québec, and which bears the Engineer's seal. The statement should certify that the formwork and falsework comply with the signed and sealed drawings, and that they may be used for their intended purposes.

#### 1.5 ARCHITECTURAL CONCRETE

- .1 The concrete used to build the following components shall be considered architectural concrete.

COMPONENTS	DESCRIPTION
<ul style="list-style-type: none"> <li>▪ Staircase</li> <li>▪ Shear walls</li> <li>▪ Beams / columns</li> </ul>	<p>All surfaces of these components above the main floor level.</p>

#### 1.6 SHOP DRAWINGS

- .1 Produce shop drawings of formwork and falsework, which describe all the necessary components required to perform the work in compliance with the drawings and specifications.
- .2 Have an Engineer who is a member in good standing of the Ordre des Ingénieurs du Québec sign these shop drawings and affix his seal.
- .3 Before performing concrete formwork or falsework, submit these drawings to the Departmental Representative for review and comments. All documents shall be submitted in triplicate. A single (1) annotated copy shall be returned to the Contractor. The Contractor shall be responsible for making additional copies and distributing them.

- .4 The shop drawings shall indicate, show or include the construction method and work schedule, procedures relating to shoring, the removal of forms, and the reinstallation of supports, the materials, the specific architectural characteristics of visible surface finishes, the location of joints, fasteners, ties and interior coatings, and the location of embedded falsework components. Comply with CSA S269.1 falsework drawing requirements. Comply with CAN/CSA-S269.3 formwork drawing requirements.
- .5 Shop drawings shall indicate, show or include formwork data such as the allowable speed and temperature at which concrete may be placed into the forms.
- .6 In addition to the details requested in 1.6.4., indicate on the shop drawings, at each location where the falsework is connected or leaning on an existing structure or a structure under construction, or already completed, the intensity and direction of maximum loads exerted on the load-bearing structure, taking into account construction site loads.
- .7 Specify the order in which the concrete formwork and falsework are to be assembled and dismantled, according to the Departmental Representative's directives.

#### **1.7 FORMWORK AND FALSEWORK DESIGN**

- .1 Design the falsework according to trade practices making sure not to exert abnormal stress on the structure under construction.
- .2 Take construction sequences into account when designing the falsework. Describe on the shop drawings or in an explanatory note how and in what order to use the formworks, the position of specified construction joints and the falsework and formwork reuse principle. Submit the explanatory note and the relevant shop drawings to the Departmental Representative for review.
- .3 For vertical components, vertical construction joints shall be a maximum of 18 m apart. Submit the location of construction joints to the Departmental Representative.
- .4 The specialized Contractor is entirely responsible for engineering, locating and building the formworks.
- .5 The formworks are engineered to sustain the loads and lateral pressures described in Section 102 of the American publication "Recommended Practice for Concrete Formwork" (ACI 347). Wind loads are those recommended by the latest edition of the National Building Code.
- .6 Engineering considerations and the allowable loads shall comply with Section 103 of the above mentioned U.S. publication.
- .7 Every aspect of construction shall at all times comply with various government standards (municipal, provincial and federal standards) that govern the specialized Contractor's duties regarding worker safety on construction worksites.

#### **1.8 CONFORMITY CERTIFICATE**

- .1 When required by CNESST, the conformity certificate of the anchor bolts must be prepared by an engineer member of the "Ordre des ingénieurs du Québec" hired by the specialized contractor.

**PART 2 - PRODUCTS****2.1 MATERIALS**

- .1 Submit all formwork material in direct contact with fresh concrete to the Departmental Representative for review.
- .2 Construction Lumber:
  - .1 in contact with concrete: form plywood.
  - .2 other: structural timber not warped and sawed straight
- .3 Formwork Materials
  - .1 To pour concrete with no particular architectural characteristics, use forms made of wood and wood products that comply with the CSA O121 CAN/CSA-O86 CSA 0437 CSA O153-M1980 standards.
- .4 In the case of exposed formwork surfaces (architectural concrete), use new formwork materials. The forms shall be made of 20 mm thick 1200 x 2400 plywood, sanded and covered with a coat of high quality form release oil. For lining only, use 7 mm thick three-ply plywood. Exposed formwork surfaces are those indicated in Section 1.5 of these specifications and those shown on the architectural drawings.
- .5 Interior formwork liners
  - .1 Plywood: Douglas fir in compliance with the CSA O121-M1978 standard.
  - .2 Waferboard: that complies with the CSA O437.0-93 standard.
- .6 Form release agent: non-toxic, biodegradable, and with low VOC content.
- .7 Form release oil: Colourless, non-toxic, biodegradable, low VOC content, mineral oil free from kerosene, whose viscosity is 15 to 24 mm<sup>2</sup>/s at 40°C and whose flashpoint in an open crucible is at least 150°C.
- .8 Falsework Materials: in compliance with the CSA S269-1-1975, Table 1 standard. Identify the materials using a quality index or provide certificates, trial data or other attestations of compliance.
- .9 Form release oil with chemical properties, containing compounds that react with the free lime in the concrete to form insoluble soaps in the water and prevent the concrete from adhering to the form.
- .10 Form ties can be:
  - .1 metal ties embedded in concrete, designed to be broken at least 25 mm under the surface of the hardened concrete after the forms have been removed;
  - .2 fixed or variable length metal ties whose ends are moveable bolts. The part of the tie embedded in the concrete is embedded at least 25 mm under the surface of the hardened concrete;

- .3 Spacety and Acrow-Richmond brand ties equipped with moulded water barriers at each end, for all the work. Both ends of these formwork ties shall be equipped with plastic cones at least 25 mm in diameter, which provide a minimum 25 mm of coverage on the broken end of the tie embedded in the concrete.
- .11 In the case of an exposed formed surface (architectural concrete), type 1) or 2) ties shall be equipped with plastic cones a maximum 38 mm in diameter, which provide a minimum 25 mm of coverage.
- .12 In the case of concrete that requires architectural features, use ties equipped with plastic cones and pale grey concrete plugs.
- .13 Sleeves, fasteners, anchors and other parts embedded in concrete meet the requirements of the drawings and specifications, and comply with Sections 6.2 and 6.7 of the CAN/CSA-A23.1-04/A23.2-04 standard. Sleeves embedded in concrete shall be equipped with a steel water barrier able to withstand a minimum of 60 kPa of hydrostatic pressure or the pressure in the line if it is greater.

### **PART 3 - PERFORMANCE**

#### **3.1 CONSTRUCTION AND ASSEMBLY**

- .1 Unless otherwise specified, build and use the formwork in compliance with the CAN/CSA-A23.1/A23.2 standard.
- .2 Before using the forms, clean and treat the form surfaces with form release oil in compliance with Section 6.5.3.3 of the CAN/CSA-A23.1/A23.2 standard.
- .3 Before starting formwork and falsework construction, check the alignments, levels and centrelines, and make sure the dimensions match those indicated on the drawings.
- .4 Build and assemble the formwork in compliance with the CAN/CSA-S269.3-M92 standard to obtain finished concrete structures whose shape, dimensions and levels comply with the indications and are situated in the locations indicated on the drawings and specifications. Properly truss the forms and join them so as to keep the desired position and shape while the concrete is being poured and keep them trussed until the concrete has set.
- .5 Location tolerances and tolerances regarding the geometric configuration of components embedded in concrete after removal of the forms according to indications in the drawings shall comply with Section 6.4 of the CAN/CSA-A23.1/A23.2 standard.
- .6 Manufacture and build the falsework and assemble it in compliance with the CSA S269.1-1975 standard and the COFI "Exterior Plywood for Concrete Formwork" guide.
- .7 Obtain the Departmental Representative's written approval before pouring concrete directly on the ground or making openings in a form component, which are not indicated on the drawings, but which may be required for construction purposes.

- .8 Align the formwork joints and seal them to prevent any loss of cement. The formwork shall contain as few joints as possible. Adequate reinforcements shall be installed behind the joints between the plywood panels to ensure that the plywood panels form a smooth, continuous surface capable of withstanding all phases of the pour without losing their shape or shifting.
- .9 Before pouring concrete directly on the ground, level the walls and the bottom of the excavated area, then remove the loose soil.
- .10 Refer to the architectural drawings regarding concrete components with visible architectural finishes.
- .11 The footings and supports installed on the ground shall not be assembled on a frozen surface.
- .12 Design lot drainage to prevent the ground from being washed away from under the footings and the supports installed at ground level.
- .13 Arrange all formwork joints and ties symmetrically on all concrete surfaces that will be visible (architectural concrete) after the forms are removed. Submit for inspection by the Departmental Representative.
- .14 Build the grooves, dovetail joints, mouldings, mortises and tenons, openings, drips, recesses, expansion and construction joints according to the indications of the drawings and specifications. See Section 03 25 00 for isolation or expansion joint requirements.
- .15 Place the formwork, trusses and supports so workers are able to remove them without causing any shocks or damage to the concrete.
- .16 Forms may be reused except in the case of exposed formed surfaces. They may be reused after sufficient cleaning, providing their surfaces are not cracked or rough; cracked or rough forms must be trimmed and patched to the Departmental Representative's satisfaction.
- .17 Install openings in the forms or other devices to enable workers to inspect and clean the forms, and to enable concrete placement and consolidation.
- .18 Unless otherwise indicated, provide and install in the forms the sleeves, fasteners, anchors and other embedded components required in the drawings and/or specifications of all disciplines, in compliance with Section 6.7 of the CAN/CSA-A23.1/A23.2 standard. Immediately before pouring the concrete, use surveyor's equipment to check the dimensions required in the drawings and specifications and make sure that these parts meet specified tolerances.
- .19 Before closing the forms, notify the Departmental Representative beforehand to allow him to perform the required inspections. The pouring of the concrete into the forms shall not take place before the Departmental Representative's written authorization has been received.
- .20 Use 25 mm bevelled moulding for exterior corners and/or 25 mm corner guards for the inside corners of beams, walls, slabs, joints and columns, unless otherwise indicated.
- .21 Slab and beam formwork shall have a camber of 6 mm per 3,000 mm of length, unless otherwise indicated. Keep the height of the beam and the thickness of the slab even throughout the length of the cambered surface.

- .22 Build forms for the architectural concrete components and install the ties according to the indications or directives provided. At times, the location of the joints may preclude the use of standard-sized panels or reduce the maximum allowable space between ties.

### **3.2 ANCHORS, SLEEVES AND EMBEDDED PARTS**

- .1 Provide and install in the forms, the sleeves, fasteners, anchor plates and other embedded components required in the drawings and/or specifications, in compliance with Section 6.7 of the CAN/CSA-A23.1/A23.2 standard. The work shall comply with Section 03 25 00.
- .2 Provide and install in the forms, the anchor bolts for fasteners and machinery as shown and detailed in the drawings, in compliance with Section 6.7 of the CAN/CSA-A23.1/A23.2 standard.
- .3 Install in the forms, the sleeves, conduits and ducts provided by others at the levels and locations shown on the mechanical, electrical, procedural and architectural drawings.
- .4 In all cases, comply with the installation tolerances specified in Article 6.7.3 of the CAN/CSA A23.1/A23.2 standard.
- .5 In slabs, place conduits between the upper and lower rows of reinforcement.
- .6 Install sleeves, conduits and ducts in compliance with the following requirements:
- .1 The exterior diameter of the sleeves, conduits or ducts shall not exceed one third of the thickness of the beams, slabs or walls in which they are embedded;
  - .2 The centreline between adjacent components must be greater than or equal to three diameters;
  - .3 These parts shall not be positioned in a manner that reduces the strength of the structure;
  - .4 These parts shall not be embedded in ground slabs exposed to the weather;
- .7 If the requirements of Article 3.2.6 cannot be met, notify the Departmental Representative and await his instructions on how to proceed.
- .8 Make sure aluminium sleeves, conduits or ducts embedded in concrete are covered or adequately coated to protect them against aluminum corrosion.
- .9 Submit a sleeve location plan for approval by the Structural Departmental Representative.
- .10 Coordinate with subcontractors responsible for their supply the delivery (to the construction site) and the installation in the formwork of accessory parts.
- .11 It is forbidden to place in the formwork any accessory parts which are not indicated in the drawings, or required in the specifications or the drawings referred to in Sub-article .2 above, unless the Departmental Representative so authorizes.

**3.3 REMOVAL OF THE FORMS AND REINSTALLATION OF THE SUPPORTS**

- .1 Remove the formwork and dismantle the falsework in compliance with Article 6.5.3.5 of the CAN/CSA-A23.1/A23.2 standard, unless otherwise indicated.
- .2 Do not disturb or remove the formwork or falsework as long as the concrete has not become strong enough to support its own weight and the load it supports.
- .3 Have the Departmental Representative authorize the removal of the formwork and falsework.
- .4 Leave the formwork in place after the concrete has been poured for the following lengths of time:
  - .1 Walls and sides of beams: 3 days;
  - .2 Slabs and beam soffits: 28 days or 3 days if all the supports removed to enable the removal of each of the form panels are immediately reinstalled within 30 minutes or less, and remain in place until expiry of the aforementioned 28-day period;
  - .3 Columns: 7 days;
  - .4 The periods of time specified above represent a cumulative number of hours, days or fractions of days, not necessarily consecutive, during which the ambient temperature is maintained above 10°C.
- .5 Reinstall all the supports required when frame components might be subject to additional loads during construction of the structure.
- .6 Notwithstanding the provisions of Sub-article .4 above, do not remove the forms unless the Departmental Representative authorizes their removal because he is satisfied with the measures taken to ensure the concrete cures properly and the concrete is protected against cold or heat and the weather.
- .7 However, the Departmental Representative may cancel the provisions of Sub-article .4 above if the non-destructive trials on the concrete placed in beam and slab forms indicate that the concrete has achieved 80% of the compression strength specified in Section 03 30 00 of these specifications. The non-destructive trials mentioned above shall have a recognized value and be approved by the Departmental Representative; he will determine beforehand the locations where they are to be performed. The costs of all these trials shall be borne by the specialized Contractor.
- .8 Even when the Departmental Representative has authorized him to remove the forms, the specialized Contractor remains solely responsible for all damage caused to concrete components if action is taken prematurely.
- .9 Depending on weather conditions, the placement of the concrete and curing conditions, the Departmental Representative may specify a minimum period of time that must elapse before the forms are removed from the various pours.
- .10 Reuse the formwork and falsework, notwithstanding the requirements of the CAN/CSA-A23.1/A23.2 standard.
- .11 The maximum spacing between the supports reinstalled at each of the main load inflection points is 2400 mm.

**3.4 FILLING OF FORM TIE HOLES**

- .1 Use Sikatop 122 mortar to fill all cone-shaped cavities left after removal of the plastic cones at the ends of the form ties. Moisten beforehand as required by the manufacturer. Carefully smooth the surface after applying the mortar so that it blends in with the adjacent concrete surfaces. Allow to cure.
- .2 In the case of exposed surfaces (architectural concrete), check with the Architect whether the cone-shaped cavities need to be filled. Have the Architect approve the filling products used. The products used shall be of the same texture and colour as the concrete utilized.

**END OF SECTION**