

Part 1 General

1.1 SECTION INCLUDES

- .1 Wood formwork for cast-in place concrete, with shoring, bracing and anchorage.
- .2 Openings for other work.
- .3 Form accessories.
- .4 Form stripping.
- .5 Void Forms.

1.2 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- .1 Section 033000 - Cast-In-Place Concrete: Supply of concrete accessories for placement by this Section.
- .2 Section 042000 - Unit Masonry System: Supply of masonry accessories for placement by this Section.
- .3 Section 051200 - Structural Steel: Supply of weld plates, base plates, edge angles, anchor bolts, etc.
- .4 Section 055000 - Metal Fabrications: Supply of metal fabrications for placement by this Section.
- .5 Divisions 21 to 23: Supply of mechanical items for placement by this Section.
- .6 Divisions 26 to 28: Supply of electrical items for placement by this Section.

1.3 RELATED SECTIONS

- .1 Section 032000 - Concrete Reinforcement.
- .2 Section 033000 - Cast-in-Place Concrete.
- .3 Section 033550 - Concrete Floor Finishing.

1.4 REFERENCES

- .1 ACI 347 - Recommended Practice for Concrete Formwork.
- .2 CAN3-A23.1M - Concrete Materials and Methods of Concrete Construction.
- .3 CSA S269.1 - Falsework for Construction Purposes.

1.5 DESIGN REQUIREMENTS

- .1 Design, engineer and construct formwork, shoring and bracing to fully support construction loads and to conform to code requirements. Resultant concrete to conform to required shape, line and dimension.

1.6 QUALITY ASSURANCE

- .1 Perform Work in accordance with CAN3-A23.1M.
- .2 Maintain one copy of document on site.

1.7 QUALIFICATIONS

- .1 Design formwork under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the Province of Manitoba.

1.8 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for design, fabrication, erection and removal of formwork.

1.9 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver void forms and installation instructions in manufacturer's packaging.
- .2 Store off ground in ventilated and protected manner to prevent deterioration from moisture.

1.10 COORDINATION

- .1 Coordinate this section with other sections of work which require attachment of components to formwork.

Part 2 Products

2.1 FORM MATERIALS

- .1 Plywood: Douglas Fir species; sheathing grade; sound undamaged sheets with clean, true edges.
- .2 Lumber: SPF species; No. 2 grade; with grade stamp clearly visible.
- .3 Void Forms: Moisture resistant treated paper faces, biodegradable, structurally sufficient to support weight of wet concrete mix until initial set; 150 mm thick shearmat.
- .4 Vapour Barrier: 0.5 mm thick clear polyethylene film.
- .5 Tubular column forms: round, spirally-wound, laminated fibre forms, internally treated with release material.

2.2 FORMWORK ACCESSORIES

- .1 Form Ties: Removable or Snap-off type, galvanized metal, fixed or adjustable length, cone type, with waterproofing washer, free of defects that could leave holes larger than 25 mm in concrete surface.
- .2 Form Release Agent: Colourless mineral oil which will not stain concrete, or absorb moisture.
- .3 Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify control lines, levels and centres before proceeding with layout. Ensure that dimensions agree with drawings.

3.2 EARTH FORMS

- .1 Earth forms are not permitted.

3.3 ERECTION - FORMWORK

- .1 Erect formwork, shoring and bracing to achieve design requirements, in accordance with requirements of CAN/CSA-A23.1M.
- .2 Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to overstressing by construction loads.
- .3 Arrange and assemble formwork to permit dismantling and stripping.
- .4 Do not damage concrete during stripping.
- .5 Align joints and make watertight. Keep form joints to a minimum.
- .6 Obtain Contract administrators review before framing openings in structural members which are not indicated on Drawings.
- .7 Install void forms in accordance with manufacturer's recommendations. Protect forms from moisture or crushing. Place vapour barrier over all void form under structural slabs. Tape all laps with polyethylene tape.

3.4 APPLICATION - FORM RELEASE AGENT

- .1 Apply form release agent on formwork in accordance with manufacturer's recommendations.
- .2 Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

- .3 Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces wet prior to placement of concrete.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

- .1 Provide sleeved openings where required for items passing through concrete work.
- .2 Locate and set in place items which will be cast directly into concrete.
- .3 Coordinate work of other Sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, bolts, anchors, and other inserts. Do not perform work unless specifically indicated on drawings or reviewed prior to installation.
- .4 Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.
- .5 Install waterstops continuously without displacing reinforcement. Heat seal joints watertight.
- .6 Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.
- .7 Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.
- .8 Block out around column base plate sufficient to allow for structural steel connection at base plate. Confirm requirement with structural steel contractor.

3.6 FORM CLEANING

- .1 Clean forms as erection proceeds, to remove foreign matter within forms.
- .2 Clean tops of piers and formed cavities of debris prior to placing concrete.
- .3 Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through clean-out ports.
- .4 During cold weather, remove ice and snow from within forms. Do not use de-icing salts or water to clean out forms. Use compressed air or other means to remove foreign matter.

3.7 FORMWORK TOLERANCES

- .1 Construct formwork to maintain tolerances required by CAN/CSA-A23.1M.
- .2 Deviation from horizontal to maintain maximum tolerance of 6 mm in 3.0 m
- .3 Deviation of building dimensions indicated on drawing and position of columns, walls and partitions: 6 mm.
- .4 Deviation in cross sectional dimensioning of columns or beams or in thickness of slabs and walls: +/- 6 mm.

3.8 FIELD QUALITY CONTROL

- .1 Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.
- .2 Re-use of formwork and false work subject to requirements of CAN3-A23.1. Do not patch formwork.
- .3 Inform Contract administrator when formwork is completed and has been cleaned, to allow for inspection. Obtain review prior to placing concrete.

3.9 FORM REMOVAL

- .1 Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads. Concrete compressive strength to be minimum of 67% of the specified 28 day strength. Unless approved otherwise by contract administrator, formwork shall be left on a minimum of 72 hours on beams and walls. Verify strength of concrete by compressive test results.
- .2 Remove formwork progressively and in accordance with code requirements and so that no shock loads or unbalanced loads are imposed on structure.
- .3 Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
- .4 Reshore structural members where required due to design requirements or construction conditions and as required to permit progressive construction. Remove load supporting forms only when concrete has attained 75 percent of required 28 day compressive strength, provided construction is reshored.
- .5 Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

Part 1 General

1.1 SECTION INCLUDES

- .1 Reinforcing steel bars, welded wire fabric and accessories for cast-in-place concrete.

1.2 RELATED SECTIONS

- .1 Section 031100 - Concrete Formwork.
- .2 Section 033000 - Cast-in-Place Concrete.
- .3 Section 042000 - Unit Masonry System.
- .4 Reinforcement for friction pile foundations.

1.3 REFERENCES

- .1 CAN3-A23.1M - Concrete Materials and Methods of Concrete Construction.
- .2 CRSI 63 - Recommended Practice For Placing Reinforcing Bars.
- .3 CSA G30.5M - Welded Steel Wire Fabric for Concrete Reinforcement.
- .4 CSA G30.18M - Billet-Steel Bars for Concrete Reinforcement.
- .5 CSA W186M - Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .6 CRSI - Concrete Reinforcing Steel Institute - Manual of Practice.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings to requirements of Section 01 33 00.
- .2 Indicate bar sizes, spacings, locations, and quantities of reinforcing steel and wire fabric, bending and cutting schedules, and supporting and spacing devices. Detail lap and bar development lengths as required.

1.5 QUALITY ASSURANCE

- .1 Perform Work in accordance with CRSI 63 and CAN3A23.1M unless specified otherwise in this section.

1.6 QUALIFICATIONS

- .1 Design reinforcement under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the Province of Manitoba.

1.7 COORDINATION

- .1 Coordinate with placement of formwork, formed openings and other Work.

Part 2 Products

2.1 REINFORCEMENT

- .1 Reinforcing Steel: CSA G30.18M, 400 MPa yield grade; deformed billet steel bars. 300 MPa yield grade for beam stirrups and column or pile ties.
- .2 Welded Steel Wire Fabric: CSA G30.5M deformed welded in flat sheets.

2.2 ACCESSORY MATERIALS

- .1 Tie Wire: CSA G30.3M, minimum 1.52 mm size, annealed type.
- .2 Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions including load bearing pad on bottom to prevent vapour barrier puncture.

2.3 FABRICATION

- .1 Fabricate concrete reinforcing in accordance with CRSI Manual of Practice and ACI 318.
- .2 Locate reinforcing splices not indicated on drawings, at point of minimum stress. Review location of splices with Contract administrator.
- .3 Where indicated, weld reinforcing bars in accordance with CSA W186M.

Part 3 Execution

3.1 PLACEMENT

- .1 Place, support and secure reinforcement against displacement. Do not deviate from required position. Before placing concrete, ensure reinforcing is clean, free of loose scale, dirt, or other foreign coatings which would reduce bond to concrete.
- .2 Do not displace or damage vapour barrier.
- .3 Accommodate placement of formed openings.
- .4 Maintain concrete cover around reinforcing as indicated on drawings.
- .5 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.
- .6 Protect paint coated portions of bars with covering during transportation and handling.

3.2 FIELD QUALITY CONTROL

- .1 Field inspection and testing will be performed under provisions of Section 01 45 00.

Part 1 General

1.1 SECTION INCLUDES

- .1 Cast-in-place concrete slabs, grade beams, supported slabs, piles, pile caps and topping slabs.
- .2 Control, expansion and contraction joint devices associated with concrete work.
- .3 Grouting under steel base plates and bearing plates.

1.2 RELATED SECTIONS

- .1 Section 031100 - Concrete Formwork: Formwork and accessories.
- .2 Section 032000 - Concrete Reinforcement.
- .3 Section 033550 - Concrete Floor Finishing.
- .4 Section 042000 - Unit Masonry System.
- .5 Section 051200 - Anchorage for Structural Steel.
- .6 Divisions 21 to 23: Mechanical items for casting into concrete.
- .7 Divisions 26 to 28: Electrical items for casting into concrete.
- .8 Section 316323: Cast-in-Place Concrete Piles.

1.3 REFERENCES

- .1 ACI 318 - Building Code Requirements for Reinforced Concrete.
- .2 CAN3-A5M - Portland Cements.
- .3 CAN3-A23.1M - Concrete Materials and Methods of Concrete Construction.
- .4 CAN3-A23.3M - Code for the Design of Concrete Structures for Buildings.
- .5 CAN3-A266.1M - Air-Entraining Admixtures for Concrete.
- .6 CAN3-A266.2M - Chemical Admixtures for Concrete.
- .7 CAN3-A266.4M - Guidelines for the Use of Admixtures in Concrete.

1.4 SUBMITTALS

- .1 Submit sealed mix design to contract administrator for approval. Include granular gradation of materials to be used with submission. 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.

- .2 Provide certification that plant, equipment, and materials to be used in concrete comply with requirements of CAN/CSA-A23.1.
- .3 Do not commence work until mix design has been reviewed.

1.5 QUALITY ASSURANCE

- .1 Perform cast-in-place concrete work in accordance with CAN3-A23.1M and CAN3-A23.3M unless specified otherwise in this section.
- .2 Conform to CAN3-A266.4M and CSA A266.5M in the use of admixtures.
- .3 Acquire cement and aggregate from same source for all work.
- .4 Conform to CAN3-A23.1 when concreting during hot weather.
- .5 Conform to CAN3-A23.1 and the following when concreting during cold weather:
 - (i) Take following cold weather precautions, preparations:
 - .1 Ensure site preparations, keep special supplementary equipment in readiness while placing concrete in cold weather.
 - .2 Prepare as required for expected temperatures and type of work.
 - .3 Ensure concrete when deposited, not less than 16°C, more than 32°C when air temperature is below 5°C or the probability exists of falling to 5° during placing in Contract administrators opinion.
 - (ii) When air temperature is below +5°C or the probability exists of falling to +5°C during the four days after placement, protect concrete with tarps and/or heat to maintain the temperatures indicated below.
 - (iii) For grade beams, piers, footings and walls provide protection and/or heat for maintaining temperature of concrete surfaces not less than 18°C for 72 hours.
 - (iv) For slabs, maintain concrete above 18°C for a minimum of 96 hours, keep from alternate freezing, thawing minimum fourteen days after placement.
 - (v) For grade beams and slabs take an extra test cylinder and field cure under the same conditions as the poured element. Test sample prior to removing cold weather protection. Do not remove cold weather protection if the sample has not reached 60% of the specified strength.
 - (vi) Reduce concrete temperature gradually at end of specified protection period, at rate not exceeding 10°C per day until outside air temperature is reached.
 - (vii) Provide protection by adequate supplementary insulation, by enclosing concrete surfaces with raised tarpaulins or other approved methods.
 - (viii) Provide for introduction of heat into enclosure. Provide and maintain temperatures with heat for period specified.

- (ix) Provide means to humidify air within enclosed space if dry type heat is used. Ensure combustion gases do not contact green concrete surfaces.
- (x) Vent heaters outside enclosed space. Do not use heaters which release products of combustion into enclosed space.
- (xi) Do not place concrete on or against surface with temperature less than 4°C.
- (xii) Protect slabs and subgrade from frost.
- (xiii) Protect floor slab, exposed concrete surfaces and surfaces to have applied finishes from grease, soil and other contaminants that affect appearance, impair topping, finish materials bond.

1.6 TESTING

- .1 Field inspection and testing will be performed in accordance with CAN/CSA-A23.1M and under provisions of Section 01 45 00 - Quality Control.
- .2 Provide free access to Work and cooperation with appointed firm.
- .3 Submit proposed mix design of each class of concrete to inspection and testing firm for review prior to commencement of Work.
- .4 Tests of cement and aggregates to be performed to ensure conformance with specified requirements.
- .5 Three concrete test cylinders will be taken for every 50 or less cu metres of each class of concrete placed each day.
- .6 One additional test cylinder will be taken during cold weather concreting and cured on job site under same conditions as concrete it represents.
- .7 One slump test and one air entrainment test will be taken for each set of test cylinders taken.

Part 2 Products

2.1 CONCRETE MATERIALS

- .1 Cement: CAN3-A5M, Normal GU (Type 10) unless noted. Use Sulphate resisting HS (Type 50) cement for piles and pile caps as indicated on drawings.
- .2 Fine and Coarse Aggregates: CAN3-A23.1M. Coarse aggregate to be normal density. Use same source for all concrete on project.
- .3 Water: Clean, and free from injurious amounts of oil, alkali, organic matter, or other deleterious material.

2.2 ADMIXTURES

- .1 Air Entrainment: CAN3-A266.1M.

- .2 Chemical admixtures: CAN3-A266.2M.

2.3 ACCESSORIES

- .1 Non-Shrink Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 17 MPa in 48 hours and 50 MPa in 28 days.
- .2 Vapour Barrier: 10 mil thick polyethylene film, type recommended for below grade application.

2.4 CONCRETE MIX

- .1 Mix concrete in accordance with CAN3-A23.1.
- .2 Provide concrete to the criteria outlined on the drawings.
- .3 Use accelerating admixtures in cold weather only when approved by Contract administrator. Use of admixtures will not relax cold weather placement requirements.
- .4 Use of calcium chloride is not permitted.
- .5 Use set retarding admixtures during hot weather only when approved by Contract administrator.
- .6 Add air entraining agent to normal weight concrete mix for work exposed to exterior.

Part 3 Execution

3.1 EXAMINATION

- .1 Verify site conditions are ready to accept concrete work.
- .2 Verify requirements for concrete cover over reinforcement.
- .3 Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

3.2 PREPARATION

- .1 Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.
- .2 In locations where new concrete is dowelled to existing work, drill holes in existing concrete, fill with Sikadur Injection Gel epoxy grout, or Hilti Hit HY-150 adhesive, and insert steel dowels.

3.3 PLACING CONCRETE

- .1 Place concrete in accordance with CAN3-A23.1M.

- .2 Request a field inspection after preparation is complete and a minimum 48 hours prior to commencement of concreting operations.
- .3 Use a pencil vibrator or vibratory screed when placing all concrete.
- .4 Use elephant trunks or other accessories to ensure that concrete does not drop more than 1.5 metres.
- .5 Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, are not disturbed during concrete placement.
- .6 Maintain records of poured concrete items. Record date, location of pour, quantity, air temperature and test samples taken.
- .7 Separate slabs on grade from vertical surfaces with 13 mm thick joint filler.
- .8 Place concrete continuously between predetermined expansion, control, and construction joints.
- .9 Do not interrupt successive placement; do not permit cold joints to occur.
- .10 Screed floors level, maintaining surface flatness of maximum 6 mm/3m.
- .11 Grout under base plates with non-shrink grout. Ensure full contact with base plate and concrete. Modify consistency of grout to ensure full penetration of grout. Ensure final strengths are achieved.

3.4 CONCRETE FINISHING

- .1 Provide concrete surfaces to be left exposed with smooth rubbed finish.
- .2 Broom finish surface of exterior slabs.

3.5 CURING AND PROTECTION

- .1 Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
- .2 Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
- .3 Cure floor surfaces in accordance with CAN/CSA-A23.1M and as outlined on drawings.
- .4 Spraying: Spray water over floor slab areas and maintain wet for 7 days.
- .5 Provide heating and hoarding as required to maintain minimum conditions required under "Quality Assurance".

3.6 PATCHING

- .1 Allow for inspection of concrete surfaces immediately upon removal of forms.
- .2 Excessive honeycomb or embedded debris in concrete is not acceptable. Notify Contract administrator upon discovery.
- .3 Patch imperfections as directed.

3.7 DEFECTIVE CONCRETE

- .1 Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- .2 Repair or replacement of defective concrete will be determined by the Contract administrator.
- .3 Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of the Contract administrator for each individual area.

PART 1 GENERAL

1.1 SECTION INCLUDES

- .1 Finish floors
- .2 Concrete curing.
- .3 Control joints on slab on grade.

1.2 RELATED SECTIONS

- .1 Section 03 30 00: Cast-in-Place Concrete

PART 2 PRODUCTS

2.1 HARDENERS/SEALERS

- .1 Sealer: Sternson Florseal or as approved by hardener manufacturer; colour to match hardener. Apply in accordance with manufacturers written instructions.
- .2 Non-metallic hardener: Colorplete manufactured by Sternson colour - light Grey.
 - .1 Other acceptable manufacturers: CDP Floor Hardener; W.R.Meadows Sealtight; Target Non-Metallic Floor Hardener.

PART 3 EXECUTION

3.1 FLOOR FINISHING

- .1 Finish concrete floor surfaces in accordance with CAN3-A23.1 and as amended herein.
- .2 Uniformly spread, screed and float concrete. Do not spread concrete by vibration. Bring surfaces to elevations indicated on Drawings.
- .3 Maintain surface flatness with maximum variation 3 mm in 3 m.
- .4 Steel trowel surfaces which are to receive carpeting and resilient flooring.
- .5 Steel trowel all surfaces left exposed.
- .6 Provide a light broom finish on garage floor.
- .7 Apply concrete hardener on floor surfaces indicated on Room Finish Schedule. Apply in accordance with manufacturers instructions.
- .8 Apply concrete sealer only on floors with hardener.

3.2 CONCRETE CURING

- .1 Cure finish floor areas in accordance with CAN3-A23.1 and as per Section 03 30 00.
- .2 Colour hardened floors shall be cured employing matching coloured curing membrane.

- .3 Ensure curing compound/hardeners are compatible with flooring to be applied before proceeding.

3.3 CONTROL JOINTS IN SLAB ON GRADE

- .1 Garage floor: provide saw cut control joints to locations indicated on drawings.
- .2 Soft cut a 3 mm x 25 mm deep control joint when concrete is cast originally.
- .3 After 28 day cure, cut a 9 mm x 12 mm reglet.
- .4 Apply sealant in accordance with Section 07 92 00.
- .5 Coordinate with section 09 95 00 for application of floor finish.

END OF SECTION