

PART 1 GENERAL

1.1 REFERENCES

- .1 American Concrete Institute (ACI)
 - .1 ACI 347 – 04, Guide to Formwork for Concrete
- .2 Canadian Standards Association (CSA)
 - .1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction.
 - .2 CSA-O86-09, Engineering Design in Wood (Limit States Design).
 - .3 CSA O151-09, Canadian Softwood Plywood.
 - .4 CSA S269.1-1975 (R2003), Falsework for Construction Purposes.
 - .5 CAN/CSA-S269.3-M92 (R2008), Concrete Formwork.
- .3 Council of Forest Industries of British Columbia (COFI)
 - .1 COFI Exterior Plywood for Concrete Formwork.

1.2 DESIGN OF FORMWORK AND FALSEWORK

- .1 Design formwork, and falsework, to support construction loads and fluid pressures without overstressing the material and without excessive deflection. Design formwork and falsework for concrete such that deflection is limited to not more than 1/400th of the span of any element. Provide positive means of adjustment to permit realignment or readjustment.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Storage
 - .1 Store formwork material so that it is not in contact with the ground and protected from water, oil, dirt or other contamination. Support so as to prevent warping or distortion.
- .2 Waste Management and Disposal
 - .1 Separate and recycle waste materials in accordance with the Waste Reduction Workplan.
 - .2 Place materials defined as hazardous or toxic waste in designated containers.
 - .3 Ensure emptied containers are sealed and stored safely for disposal away from children.
 - .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 O86 and CSA O151. Fabricate all forms from sound, undamaged sheets with clean true edges, sealed and factory treated with form sealer. Thicknesses as required to support concrete at rate poured with no bowing of forms between supports.
- .2 Grooves, reglets, chamfers and rustification strips: Use White Pine selected for straightness and accurately dressed to size. Provide 1 to 3 draw unless otherwise shown. Provide continuous saw-cut at back of strip. Chamfers at 45° unless noted.

- .3 Form ties:
 - .1 For unexposed concrete surfaces, use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm dia. in concrete surface. Maximum spacing 600mm o.c.
 - .2 Wire ties and wood spacers not permitted.
- .4 Form liner:
 - .1 Plywood: Canadian Softwood Plywood to CSA O151, 2 grade, T and G edge, 16mm thick.
- .5 Joint tape for sealing panel joints: Tape must be capable of preventing leakage of concrete in form joints.
- .6 Caulking for joints between panels: Use grey urethane catalyst cured, non-sag or self-levelling sealant, as applicable.
- .7 Form release agent: chemically active release agents containing compounds that react with free lime in concrete resulting in water insoluble soaps, preventing concrete from sticking to forms, non-toxic, biodegradable, low VOC.
- .8 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 15 to 24 mm²/s at 40°C, flashpoint minimum 150°C, open cup.
- .9 Falsework materials: to CSA S269.1.

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 or 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 and COFI Exterior Plywood for Concrete Formwork.
- .5 Refer to architectural drawings for concrete members requiring exposed finishes.
- .6 Do not place shores and mud sills on frozen ground.
- .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.
- .8 Obtain Departmental Representative's permission before framing openings not indicated.

- .9 Align form joints and make watertight. Keep form joints to minimum.
- .10 Use 25mm chamfer strips on external corners and/or 25mm fillets at interior corners of concrete members, unless specified otherwise.
- .11 Clean and prepare formwork surfaces in accordance with CSA A23.1, before placing concrete. Apply form release agents to formwork in accordance with manufacturer's instructions, prior to placing accessories and reinforcement. Do not apply form release agent where concrete surfaces will receive special finishes or coating which are affected by the agents.
- .12 Re-use formwork and falsework subject to requirements of CSA A23.1. Do not re-use forms if there is any evidence of surface damage or wear which would impair the quality of the concrete surface.
- .13 When formwork is to be re-used, apply non staining parting agent in accordance with CSA A23.1.
- .14 Construct formwork and falsework such that loads are not transmitted to an adjacent existing structure.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 1 day for footings.
- .2 Re-use formwork and falsework subject to requirements of CSA A23.1.

3.3 QUALITY CONTROL ON-SITE

- .1 Do not close deep forms until reinforcement has been reviewed.
- .2 Check elevations, camber and plumbness of formwork continuously during concreting and after, until initial set occurs using pre-installed tell-tale devices. Appropriate adjustments shall be promptly made where necessary. Report all adjustments made after initial set to the Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A82/A82M-07, Specification for Steel Wire, Plain for Concrete Reinforcement.
 - .2 ASTM A123-12, Specification for Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products.
 - .3 ATSM A775/A775M-07b, Specifications for Epoxy-Coated Reinforcing Steel Bars.
 - .4 ASTM A 955/A955M-12e1, Specification for Deformed and Plain Stainless-Steel Bars for Concrete Reinforcement.
- .2 Canadian Standards Association (CSA)
 - .1 CSA A23.1-09, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA A23.3-04 (R2010), Design of Concrete Structures.
 - .3 CAN/CSA G30.18-M92 (R2007), Billet-Steel Bars for Concrete Reinforcement.
 - .4 CSA W186-M1990 (R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .3 Reinforcing Steel Manual of Practice, Reinforcing Steel Institute of Canada.

1.2 SUBMITTALS

- .1 Shop Drawings
 - .1 Submit shop drawings including placing of reinforcement in accordance with Section 01 00 10, 1.4 Submittal Procedures.
 - .2 Detail lap lengths and bar development lengths to CAN/CSA A23.3, unless otherwise indicated. Provide type B tension lap splices unless otherwise indicated.
 - .3 Make corrections required by previous review before re-submitting drawings. Do not add new details to drawings which have been reviewed.

1.3 QUALITY ASSURANCE

- .1 Substitutes
 - .1 Substitute different size bars only if permitted in writing by Departmental Representative.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Storage
 - .1 Store all reinforcement material on racks or skids so that it is protected from dirt and maintained in its fabricated form.
- .2 Waste Management and Disposal
 - .1 Separate and recycle waste materials in accordance with the Waste Reduction Workplan.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA G30.18, unless indicated otherwise.
- .2 Epoxy coating of non-prestressed reinforcement: to ASTM A775/A775M
- .3 Cold-drawn annealed steel wire ties: to ASTM A82.
- .4 Chairs, bolsters, bar supports, spacers: to CSA A23.1.
- .5 Mechanical splices: subject to approval of Departmental Representative.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA A23.1, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada unless indicated otherwise.
- .2 Obtain Departmental Representative's approval for locations of reinforcement splices other than those shown on placing drawings.
- .3 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 REINFORCING

- .1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CSA A23.1.
- .2 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.
- .3 Ensure cover to reinforcement is maintained during concrete pour.
- .4 Before placing, remove all loose scale, dirt, oil or other coatings which would destroy or reduce bond. Place reinforcement within the specified tolerances and secure in position by the use of chairs, spacers and hangers. Tie reinforcement securely together using 16 ga. annealed wire

to prevent displacement during concrete placing and vibrating. Turn the ends of all ties towards the interior of the concrete. Use galvanized tie wire at all exposed and at all exterior locations.

- .5 No splicing of reinforcement is permitted unless indicated on the Drawings. Do not cut reinforcement to permit placing of embedded items.
- .6 Provide additional reinforcement around all openings in concrete members as detailed on Drawings.
- .7 Maintain clean cover for reinforcement in accordance with drawings.
- .8 Avoid passage of heavy equipment over reinforcing steel in place.
- .9 Reset immediately, reinforcing steel displaced during concrete pour.

3.3 QUALITY CONTROL ON-SITE

- .1 Reinforcement must be complete, adequately supported, tied and properly positioned for cover in advance of the time scheduled for casting concrete.
- .2 Notify Departmental Representative for inspection of reinforcement prior to enclosing the reinforcement in the forms. Provide adequate time for this inspection to occur.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

- .1 Section 03 10 00 - Concrete Forming and Accessories.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C109-11/C109M-11, Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50mm Cube Specimens).
 - .2 ASTM C309-07, Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C494/C494M-08a, Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C827-01a (2005), Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.
 - .5 ASTM C881-10/C881M-10, Specification for Epoxy Resin Base Bonding Systems for Concrete.
 - .6 ASTM C939-10, Test Method for Flow of Grout for Preplaced-Aggregate Concrete.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34-M86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 Canadian Standards Association (CSA)
 - .1 CSA A23.1-09/A23.2-09, Concrete Materials and Methods of Concrete Construction.
 - .2 CAN/CSA A3000-08, Cementitious Materials Compendium.

1.3 SUBMITTALS

- .1 Certificates
 - .1 Submit certificates in accordance with Section 01 00 10, 1.4 Submittal Procedures.
 - .2 Submit to Departmental Representative, minimum 2 weeks prior to starting concrete work, valid and recognized certificate from plant delivering concrete.
 - .3 Provide certification that mix proportions selected will produce concrete of quality, yield and strength as specified in concrete mixes, and will comply with CSA A23.1, and that mix design is adjusted to prevent alkali aggregate re-activity problems.
- .2 Record Documentation
 - .1 Maintain a set of record drawings on site on which the progress of the work can be recorded.
 - .2 Record the time and casting date for each section of concrete and the date for removal of each section of formwork.
 - .3 When heat curing is required, record maximum and minimum daily temperatures outside the enclosure and the average temperature within each enclosure, for a period of 3 days after placing the concrete.
 - .4 Record all modifications to the foundations and superstructure on a set of prints in a neat and legible manner. Use the information to make as-built drawings at the completion of the work. Dimension all changes.

1.4 QUALITY ASSURANCE

- .1 Quality Control
 - .1 Minimum 2 weeks prior to starting concrete work, submit proposed quality control procedures for Departmental Representative's approval for the following items:
 - .1 Hot weather concrete.
 - .2 Cold weather concrete.
 - .3 Curing.
 - .4 Finishes.
 - .5 Joints.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
- .2 Store materials as follows:
 - .1 Concrete materials: to CSA A23.1.
 - .2 Concrete admixtures: in accordance with manufacturer's directions.
- .3 Concrete hauling time: maximum allowable time limit for concrete to be delivered to site of Work and discharged, not to exceed 120 minutes after batching.
 - .1 Modifications to maximum time limit must be agreed to by the Departmental Representative and concrete producer as described in CSA A23.1/A23.2.

1.6 SITE CONDITIONS

- .1 Visit site to determine available access, storage and working areas. Determine any interference from existing services.
- .2 Use of accelerating or set retarding admixtures during hot or cold weather concrete placing shall be subject to the Departmental Representatives' approval.

1.7 FOUNDATION CONDITIONS

- .1 If foundation elevations or dimensions are revised by the Departmental Representative because of differences between reported and actual subsoil conditions discovered at the time of excavation, the Contract Price will be adjusted. Extras will not be paid because of over-excavation or other conditions within the control of the Contractor.
- .2 The Departmental Representative will appoint a Soils Consultant to examine and report on the sub-soil at founding elevations at the time of excavation. Notify the Departmental Representative as to when such examination will be required. Do not proceed with construction of foundations until the Soils Consultant has reported.
- .3 Keep construction traffic and loads on the subgrade to a minimum.

1.8 WASTE MANAGEMENT DISPOSAL

- .1 Separate and recycle waste materials in accordance with the Waste Reduction Workplan.
- .2 Use trigger operated spray nozzles for water hoses.
- .3 Designate a cleaning area for tools to limit water use and runoff.
- .4 Carefully coordinate the specified concrete work with weather conditions.
- .5 Ensure emptied containers are sealed and stored safely for disposal, out of the reach of children.
- .6 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, non-combustible material and remove for disposal. Dispose of all waste in accordance with applicable local, provincial and national regulations.
- .7 Choose least harmful, appropriate cleaning method which will perform adequately.

PART 2 PRODUCTS

2.1 MATERIALS

- .1 Portland cement Normal (type GU) to CAN/CSA A3000.
- .2 Supplementary cementing materials: to CAN/CSA A3000.
- .3 Water: to CSA A23.1.
- .4 Aggregates: to CSA A23.1. Coarse aggregates to be normal density. Aggregate to be suitable for NBC type N concrete. Normal size 10mm unless noted on Drawings.
- .5 Air entraining admixture: to CSA A23.1.
- .6 Chemical admixtures: to CSA A23.1. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Concrete adhesive:
 - .1 Two-component anchorage adhesive, designed for use in concrete.
- .8 Fast setting polymer modified mortar:
 - .1 Polymer modified mortar, latex based, prepackaged, suited for the proposed application which allows the application of a waterproofing membrane within 3 days of installation.
 - .2 For repairs exceeding a thickness of 50mm, extend fast setting polymer modified mortar using clean 10mm aggregate in accordance with manufacturer's instructions.
 - .3 Submit datasheet to Departmental Representative for approval prior to use.

2.2 MIXES

- .1 Proportion normal density concrete in accordance with CSA A23.1, Alternative 1, to give following properties for all concrete.
 - .1 Cement:
 - .1 Type GU Portland cement.
 - .2 Concrete:
 - .1 25 MPa compressive strength at 28 days.
 - .2 5-8% air content.

2.3 PRODUCTION

- .1 Use ready-mixed concrete, produced in accordance with CSA A23.1, Clause 5.2.
- .2 Heat concrete and deliver at a temperature conforming to CSA A23.1, Clause 5.2.4.4.

PART 3 EXECUTION

3.1 CO-OPERATION

- .1 Provide casual labour to the independent inspection and testing agency's field personnel for the purpose of obtaining and handling sample materials. Provide free access to all portions of work and co-operate with the Testing Agency.
- .2 Cooperate with all engaged on the work. Exchange with related trades shop drawings and other data required to coordinate and schedule the work. Notify other trades as to when items which are to be installed by them are to be set and protect items after installation.
- .3 No trade shall cut holes through existing concrete unless approved by the Departmental Representative.

3.2 PROTECTION OF EXISTING STRUCTURE

- .1 Take precautions necessary to protect the existing structure from damage. Contractor is responsible for damage or claims for damage.
- .2 Protect exposed faces of excavation. Keep areas adjacent to existing foundations from freezing.

3.3 PREPARATION

- .1 Do not begin operations before making a thorough examination of existing conditions and the work of related trades. Report inconsistencies to the Departmental Representative immediately.
- .2 Obtain Departmental Representative's approval before placing concrete. Provide 24 hours notice prior to placing of concrete.
- .3 Pumping of concrete is permitted only after approval of equipment and mix.

- .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 Do not place load upon new concrete until authorized by Departmental Representative.

3.4 CONSTRUCTION

- .1 Cast-in-place concrete work in accordance with CSA A23.1.
- .2 Concrete Placement;
 - .1 Remove water from excavations before placing concrete.
 - .2 Clean all forms of debris and deleterious materials before placing concrete. Remove all contaminants which lessen bond of concrete to reinforcement prior to placing concrete.
 - .3 Adjust reinforcement immediately before concrete is placed to ensure that all bars are secured in their correct positions. Arrange to have a crew of reinforcing setters on hand as concrete is placed, in order to make any last minute adjustments that are required.
 - .4 Use form vibrators for thin sections where rodding, spading or the use of internal vibrators is impractical. Attach vibrators firmly to the forms and so spaced that the complete lift of concrete is visibly affected.
 - .5 Platform and screed type vibrators may be used to ensure a dense top surface where this cannot be obtained by the use of internal equipment. Obtain approval from the Departmental Representative before using platform or screed type vibrators.
 - .6 Do not place concrete in the rain. Protect exposed surfaces from rain or other adverse weather conditions until final set occurs.
 - .7 The maximum average time from charging the mixer to final deposit is 60 minutes, the maximum individual time from charging the mixer to final deposit is 90 minutes. Do not add water to the mix without the expressed approval of the Departmental Representative.
- .3 Finishing.
 - .1 Finish concrete in accordance with CSA A23.1.
 - .2 Use procedures noted in CSA A23.1 to remove excess bleed water. Ensure surface is not damaged.

3.6 SITE TOLERANCE

- .1 Concrete tolerance in accordance with CSA A23.1.

3.7 CURING AND PROTECTION

- .1 Provide curing and protection for concrete to CSA A23.1, Clause 7.4.
- .2 Do not pile, store or transport materials over slabs until concrete has been in place for at least 7 days.
- .3 Do not use combustion heaters of any kind in the presence of new concrete during construction.

- .4 Shrinkage cracking as a result of improper curing will be cause for rejection of the concrete element in question. The concrete must be removed and replaced at no cost to the Departmental Representative.

3.8 RESTORATION

- .1 Restore areas of existing concrete work affected by the Contract.

3.9 CLEAN-UP

- .1 Remove rubbish and surplus materials leaving the work ready for the Trades that follow.

END OF SECTION