|  |  |  |
| --- | --- | --- |
| Version | Date | Description of Revisions |
| 1 | August 30, 2006 | Approved final document. |
| 2 | November 5, 2007 | Minor revisions by Legal Services. |
| 3 | November 13, 2009 | Modified ‘Related Section’ |
| 4 | March 15, 2011 | Minor changes from Legal |
| 5 | June 5, 2012 | Added References and Replacement Parts Section |
| 6 | June 29, 2012 | Reformatted to Remove White Space |
| sa7 | April 24, 2015 | General formatting |
| 8 | August 17, 2015 | First draft review of updated spec. (AV) |
| **9** | **September 16, 2015** | **Updated, Finalized Specification – Reference eDOCS #6263145 v3 (AV)** |
| 10 | April 26, 2018 | 2.1.5.2.5 Manufacturers and products removed (BM) |

# GEneral

## Related Sections

#### Section 01300 – Submittals

#### Section 03200 – Concrete Reinforcement

#### Section 03300 – Cast in Place Concrete

#### Section 03345 – Concrete Curing and Finishing

#### Section 07900 – Joint Sealers

## Measurement and Payment

.1 All costs associated with the work of this Section shall be included in the price(s) for Item No(s). \_\_\_ in the Bid Form.

## References

### Canadian Standards Association (CSA)

#### CAN/CSA A23.1-19, Concrete Materials and Methods of Concrete Construction

#### CAN/CSA A23.2-19, Test Methods and Standard Practices for Concrete.

#### CAN/CSA O86.1-19, Engineering Design in Wood.

#### CSA O121-17, Douglas Fir Plywood.

#### CSA O151-09 (R2014), Canadian Softwood Plywood.

#### CSA O153-19, Poplar Plywood.

#### CSA S269.1-16 Falsework and Formwork

### American Concrete Institute (ACI)

#### ACI 347R-14, Guide to Formwork for Concrete

### Ontario Provincial Standards Specifications (OPSS)

#### OPSS 919, Construction Specification for Formwork and Falsework.

### Council of Forest Industries of British Columbia (COFI)

#### COFI Exterior Plywood for Concrete Formwork.

## Design and Performance Requirements

### Design formwork in accordance with ACI 347R-14, CSA S269.1-16 and CSA A 23.1-19. Formwork to provide specified finishes. Design formwork and falsework to carry dead loads and construction live loads. The Contractor shall conform to CSA standards for design formwork and falsework as specified in the Contract Documents.

### When high range water reducer (super plasticizer) is used in concrete mix, design forms for full hydrostatic pressure.

### Make joints in forms watertight. Ensure that the joints are in line and level to get required finishes to comply the architectural requirement and concrete finishes in accordance with Section 03345 - Concrete Curing and Finishing.

### Limit deflection of formwork to limits specified in CSA S269.1-16.

## Quality Assurance

### A professional engineer licensed to practice in the Province of Ontario shall design, supervise installation as required, and inspect concrete formwork and false work to ensure that formwork and falsework will carry dead loads and construction live loads.

### The Contractor shall utilize personnel with demonstrated competence and experience are to install concrete formwork and falsework, to ensure that the joints are in line and level.

## Quality Control

### Upon completion of the falsework foundation and prior to installation of falsework, the Contractor’s engineer who completed the falsework foundation design shall conduct an interim inspection of the work to verify that the falsework foundation has been constructed according to the Falsework Foundation Design Report and issue written permission to proceed with the work.

### The Contractor shall arrange for inspection of formwork and falsework by a Professional Engineer .

## Shop Drawings

### Submit shop drawings in accordance with Section 01300 - Submittals.

### Submit formwork and falsework drawings bearing seal and signature of a Professional Engineer for record purpose.

### Formwork and falsework shop drawings will not be reviewed for structural adequacy.

### Be fully responsible for the design, construction, supervision and maintenance of formwork and falsework.

#### Show design criteria as specified in clause 6.5.2.1 of CSA A23.1-19 for Formwork.

### Indicate:

#### For suspended slabs:

##### Shoring left in place until concrete has reached specified strength.

##### Re-shoring below slabs or beams supporting shoring above.

##### Lateral bracing system.

#### For walls and columns on top of slabs and beams:

##### Shoring left in place until concrete in walls and columns above has reached specified strength.

##### Lateral bracing system.

### Layout of panel joints and tie hole pattern.

### Indicate the method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with the requirements of CAN/CSA S269.1 for falsework drawings

### Indicate formwork design data, such as the permissible rate of concrete placement, and temperature of concrete, in forms. Where super-plasticizer is used in the concrete mix; design the forms for full hydrostatic pressure. Indicate re-shoring below slabs or beams supporting the shoring above. Provide a lateral bracing system.

### Indicate the sequence of erection and removal of the formwork/falsework for review by the Consultant.

### Each shop drawing submission shall bear the stamp and signature of a qualified professional engineer registered or licensed in the Province of Ontario.

### Submit samples for form ties.

## Waste Management and Disposal

### Place materials defined as hazardous or toxic waste in designated containers.

### Ensure that emptied containers are sealed and stored safely for disposal.

### Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low volatile organic compounds (VOC).

# PRODUCTS

## Materials

### Formwork materials:

#### For concrete without special architectural features, use wood and wood product formwork materials in accordance with CAN/CSA O86.1-19

#### For concrete with special architectural features, use formwork materials in accordance with CAN/CSA A23.1-19.

### Pan forms: removable as indicated in the Contract Documents.

### Form ties:

#### 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 in diameter in the concrete surface.

### Form:

#### Plywood: high density overlay Douglas Fir in accordance with CSA O121-08 (R2017) # 1 grade, square edge, 20 mm thick.

### Form release agent: non-toxic, biodegradable, low VOC.

### Falsework materials: in accordance with CSA S269.1.

### Sealant: in accordance with Section 07900 - Joint Sealers.

# EXECUTION

## Fabrication and Erection

### Verify all lines, levels and centres before proceeding with formwork/false work and ensure that the dimensions agree with the Contract Drawings.

### Lumber for formwork and falsework: Grade-marked sawn lumber graded in

### accordance with NLGA and CSA-O121.

### Refer to the architectural drawings for concrete members requiring architectural exposed finishes.

### Do not place shores and mud sills on frozen ground.

### Provide site drainage in order to prevent the washout of soil supporting mud sills and shores.

### Fabricate and erect formwork in accordance with CSA S269.1-16 to produce finished concrete conforming to the shape, dimensions, locations and levels indicated within the tolerances required by CAN/CSA A23.1-19.

### Align form joints and make them watertight. Keep form joints to a minimum.

### Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners and joints, unless specified otherwise in the Contract Documents.

### Form chases, slots, openings, drips, recesses, expansion and control joints as indicated in the Contract Documents.

### Construct forms for architectural concrete, and place ties as indicated in the Contract Documents and/or as directed by the Consultant. The joint pattern is not necessarily based on using standard size panels or the maximum permissible spacing of ties.

### Build in anchors, sleeves, and other inserts which may be required to accommodate the items of Work specified in other Sections. Ensure that all anchors and inserts will not protrude beyond the surfaces designated to receive applied finishes, including painting.

### Clean all formwork in accordance with CAN/CSA A23.1-19 before placing any concrete.

### If slip forming and/or flying forms are used, submit details of the equipment and procedures for the Consultant's review.

## Removal and Re-shoring

### Leave formwork in place for the following minimum periods of time after placing concrete:

#### Seven (7) Day for walls and sides of beams.

#### Seven (7) Day for columns.

#### Remove formwork after concrete has reached 75% of its specified 28 Day compressive strength determined by a field cured test cylinder for beam soffits, suspended slabs, decks and other structural members.

#### Seven (7) Day for footings and abutments. Contractor Note: The ambient conditions may require additional curing at the discretion of the Consultant.

### Provide all necessary reshoring of members where the early removal of forms may be required or where members may be subjected to additional loads during construction as required.

### Space reshoring in each principal direction shall be a maximum of 3,000 mm apart.

### Do not re-use damaged forms. Re-use formwork and falsework subject to the requirements of CAN/CSA-A23.1-19.

**END OF SECTION**