SECTION 907

FORMWORK AND FALSEWORK

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907.01 SCOPE

The scope of this section is to cover the design and construction of formwork and falsework used in connection with the work.

Falsework is defined as structural supports, load carrying members and the necessary bracing required for the support of temporary loads during construction.

Formwork is defined as the mould into which concrete is placed.

Other definitions are as per CSA S269.1 “Falsework and Formwork.”

907.02 SUBMISSION OF SHOP DRAWINGS

The Contractor shall prepare and submit to the Engineer for review copies of detailed shop drawings and calculations in accordance with Section 927 for all false work in the project. False work drawings and calculations shall be signed and sealed by a licensed member of the Association of Professional Engineers of Newfoundland and Labrador.

Contractor shall submit to the Department 1 electronic copy and 1 hardcopy of the false work drawings and, upon request by the Engineer, design calculations for the false work. Submissions will require two weeks for review. No false work shall be placed prior to the design being accepted by the Engineer.

Acceptance of these drawings will be for conformance with the design and shall not relieve the Contractor of any responsibility for the safe design, and installation of the false work and for adherence to all applicable standards.

False work drawings shall indicate the following:

a) Design to be in accordance with limit state principles;
b) Pour pressures exerted by the liquid head of concrete;
c) Longitudinal, lateral, and vertical dead, live, and impact loads used in the design. Horizontal loads shall be designed for clause 5.3.3 of CSA s269.1, specifically the greater of Part (A)(I) and (A) (II), plus (B), plus (C);
d) Fresh concrete shall be normally taken as a dead load with a minimum load factor of 1.25 unless unusual conditions require a higher value;
e) Bearing capacity of soil beneath mudsill and falsework support reactions;
f) Grade of steel or concrete size and shape;
g) Species, grading, and size of timber members;
h) Connection details;
i) Type and weight of equipment to be supported;
j) Sequence method and rate of concrete placement;
k) For prestressed concrete slab type structures, the falsework submission shall have a side falsework design provided. The effects of the same shall be considered in the exterior leg load and load on exterior stringers;
l) Any proprietary equipment and its specifications;
m) Concrete admixtures and dosage rates (i.e. plasticizers and set retarders);

n) Calculated deflections for all spans greater than 3m.

For prestressed concrete decks, the Contractor must submit deck false work drawings including mudsills, side and end false work for review by the Engineer. The Contractor shall obtain reviewed drawings before the construction of deck superstructure false work is permitted. Submission of these drawings will not necessarily exclude the requirement to provide false work drawings for other structural components.

The Contractor shall supply, erect and maintain standard guide rail as per Form 1280-1 of the Specifications Book at all traffic openings in the falsework. The Contractor shall place additional posts at mid-span. The minimum length of installation before and after the opening is at least five and one standard lengths respectively. Guide rail shall be continuous from beginning to end with the minimum installed length at least 34 metres per installed section. The supply and installation of guide rail shall conform to Section 640.

907.03 DESIGN

907.03.01 General

For concrete pours above 3 metres in height or with spans greater than 3 metres calculations of formwork shall be provided.

Formwork drawings and calculations shall be signed and sealed by a licensed member of the Association of Professional Engineers of Newfoundland and Labrador.

All false work and formwork shall be designed to give the necessary rigidity and to support loads without appreciable settlement or deformation as determined by the Department.

All falsework to be designed to CSA Standard S269.1.

All timber design shall be in accordance with CSA 086 “Engineering Design in Wood.”

Where structural steel or concrete is used, the design shall be in accordance with CSA S6 “Canadian Highway Bridge Design Code.”

Any scaffolding, fabricated shoring, or patented accessories, shall be used in accordance with manufacturers' recommendations.

907.03.02 Loadings And Deflections

Unless noted otherwise in the contract documents all dimensional tolerances shall be +/- 5mm.

Vertical and horizontal loads on formwork shall be as specified in CSA S269.1 taking into account site conditions, placement methods, etc. The Engineer of Record for formwork shall ensure all masses and loads are appropriate for their situation.

Loadings shall take into account environmental factors, wind loads, the rate of placement, the temperature of the concrete, the effects and type of vibration and impact.

Longitudinal spans shall be considered as the distance from centerline of bearing to centerline of bearing or as otherwise decided by the Owner's Representative. Deflections for all longitudinal spans greater than 3 metres shall be clearly indicated on formwork drawings.

Lateral spans shall be considered as the centerline to centerline spacing of members, the centerline of members to the outside edge of overhangs, or outside edge to outside edge for slabs and rigid frames which have no intermediate members.

When formwork deflections for horizontal spans are expected to be greater than 10 millimetres, formwork shall be cambered or otherwise constructed such that after the dead load of concrete is applied, the final deviation from a straight line shall be the lesser of 10 millimetres or span/600 but final tolerances as per CSA S6-14 for concrete members shall also be conformed with.

Formwork deflections for vertical faces and columns shall not be greater than 5mm.

907.03.03 Provision of Screed Elevations

When the formwork is the primary load carrying system for any deck pours, such as for a cast-in-place rigid frame structure, the Engineer of Record for the formwork shall provide the screed elevations for the casting of the deck. These elevations shall be provided to the Owner's Representative at least two weeks in advance of the pour date and in advance of the dry run of the screeding machine(s), whichever is earlier.

For other systems where the formwork will not be the primary load carrying system of the deck pour, such as precast girder bridges, the Engineer of Record for the load

carrying member shall provide the screed elevations. Screed elevations shall be provided in advance of the dry run of the screeding machine(s).

Regardless of who is providing the screed elevations, the contractor is responsible for providing any required information and elevation measurements to prepare the elevations.

907.04 MATERIALS

Wood used in forms and false work shall comply with CSA 086 and shall be sound wood and free of strength reducing defects.

Steel shall meet the requirements of CSA G40.21 “Structural Quality Steels” and be in good condition.

Other materials may be used as long as manufacturer's recommendations are strictly complied with and their suitability can be confirmed by previous satisfactory use elsewhere.

Void tubes made of fibrous material shall be protected from damage and water attack at all times.

Materials rejected shall be removed from the job site immediately, as directed by the Engineer.

907.05 FORMWORK CONSTRUCTION

Forms shall be smooth, clean, free from warps, splits, holes and bulges and shall be constructed and maintained mortar tight and free from warps and open joints due to shrinking or other causes.

Formwork shall be designed and constructed strong enough to withstand the effect of placing and vibrating of concrete without movement or leakage and to permit the unrestrained shrinkage or elastic shortening of the concrete so that the forms remain true to line and grade.

Formwork shall be inspected by the Engineer prior to use. Formwork which is damaged, deformed or is otherwise deemed unacceptable by the Engineer shall be replaced at the contractor’s expense. Examples of unacceptable formwork includes, but is not limited to, the following:

a) Formwork which has gaps between formwork connections or is otherwise not mortar tight.
b) Formwork surfaces or connections that have one or more forming surface deformations or inconsistences that result in a deviation from a perfectly flat surface by more than 10mm.

The use of expanding foam, caulking or another product to create mortar tight joints between formwork will not be considered acceptable.

Plywood shall be used on all exposed faces.

Non-staining form release oil shall be applied to the faces of forms prior to reinforcement placement.

All formwork supports, bars, rods, chairs, etc., shall be non-metallic (fiberglass, plastic, or accepted equal) with the exception that for buried, non-exposed surfaces, and for all substructure concrete surfaces on bridge structures, formwork ties, bolts, and rods may be fabricated of steel matching the material utilized for concrete reinforcement (IE Black, Galvanized, or Stainless). If steel supports are utilized, there shall be no metal within 25 mm of the concrete surface after form removal. The 25 mm cover shall be provided by means of plastic cones adjacent to the exposed concrete surface. In no case will the cutting back of metal ties or tie wire be permitted after the concrete has cured. In no case will the use of tubing be permitted to allow the recovery of ties. Cavities left as a result of ties shall be filled with a cement mortar and the surface left sound, smooth, even and uniform in color. These requirements apply to both cast in place and precast components.

Ties for rebar shall be as specified in Section 905.

On concrete Jersey barriers, where the form liner has been attached to one side, a tapered rod system may be utilized. The void remaining after the tapered rod has been removed from the concrete shall be filled with grout.

The grout and grouting procedure must be consistent throughout the project and be approved by the Engineer. The grout shall blend in with the finished concrete surface and the finished appearance shall be uniform.

All exposed corners on concrete work shall be chamfered 25 mm.

Stay in place forms shall be used only when detailed in the contract or if approved by the Engineer.

Void tubes shall be accurately and rigidly fixed in position and carefully restrained from floatation.

Studs and joints shall be at centres not exceeding 400 mm. Edges of abutting sheets shall be nailed to the same stud or joint with 50 mm nails at centres not exceeding 200 mm. Jointing shall be regular and flush.

907.05.01 Supply and Installation of Form Liner

Where indicated in contract documents the Contractor shall supply and install a form liner, the form liner pattern shall be as identified in the Contract drawings.

The material type may be SPS or ABS plastic depending upon how the Contractor schedules the work, as approved by the Engineer and anticipated future requirements.

Unless otherwise specified by the contract documents, form liners shall be approximately 610mm high and be located such that approximately 140mm of untextured concrete barrier wall surface is located above and below the form liner. The horizontal distance from the end of the barrier to the beginning of the form liner shall be 150mm. The 150mm dimension shall also be applied at expansion joint locations.

The Contractor shall verify lines, levels and centres before proceeding with the form work and ensure that dimensions agree with drawings. The form liner shall be strictly installed in accordance with the Manufacturer's application guide to achieve design requirements. The Contractor shall arrange and assemble form work to permit dismantling and stripping. No damage is permitted to concrete surfaces during stripping. The form release agent shall be applied on the liner in accordance with the manufacturer's recommendations. The form release agent shall be applied prior to placing reinforcing steel, anchoring devices and embedded items. The forms are to be loosened carefully. The Contractor shall not wedge pry bars, hammers, or tools against concrete surfaces scheduled for exposure to view.

The Contractor shall plan ahead for details such as: concrete mix design, concrete placing practices, attaching liners and sealing the joints, tie selection and tie-hole

treatment, reinforcing positioning, release agents and stripping in addition to cleaning and storage of form liners and forms.

The Contractor shall use one concrete supplier, one source of aggregates and cement. An elephant trunk shall be used to prevent spattered concrete if the form is not completely filled in the first concrete operation. Falling concrete shall not be permitted to cause abrasion to the form liner. The rate of concrete placing shall not exceed the allowable pressure on the form liner.

The Contractor is reminded to use adequate vibration to avoid lift lines and reduce bugholes. Extra vibration is needed when using plastic liners because they have two or three times as much surface area as flat form panels. Vibrators shall be inserted vertically, penetrating at least 150 mm into the previous lift. Vibrators shall not touch the liner surfaces.

The Contractor shall consider temperature effects when cutting and installing liner materials. Form liner should not be exposed to direct sun in order to reduce buckling effects.

The Contractor shall give close attention to tight-fitting tie holes, reinforcing bar supports and spacers. Bar supports should be coordinated with the repeat pattern of the liner.

Cover shall be measured from the deepest indentation in the concrete surface to the nearest face of the bar.

Release agents and form liners shall be checked for compatibility before use.

Form liner stripping shall be recommended by the Manufacturer and approved by the Engineer. Stripping shall be kept uniform throughout the entire job. Form liners shall be clean and should be stored in shaded or covered areas.

Construction practice and materials must be consistent throughout the entire concrete placing operation where form liners are utilized.

907.06 FALSEWORK CONSTRUCTION

The Contractor shall build sound adjustable false work to enable a structure true to line and grade to be built.

Foundation material shall either be piled or mudsills depending on bearing capacity. Mudsills shall be of minimum dimension 235 mm x 89 mm.

Care shall be taken to prevent reduction of bearing capacity due to environmental, construction or any other reason.

Should, despite every precaution, reduction of bearing capacity occur, the Contractor shall take appropriate measures to eliminate subsidence or collapse.

All shoring shall conform to CSA S269.1

All wood posts shall be of solid material, free from splits, warps, chips and any other defects that will impair strength. Splicing will not normally be permitted. Bracing material shall be at least 38 mm x 89 mm lumber and a minimum of two 100 mm nails will be required for connecting bracing to posts.

907.07 REMOVAL OF FORMWORK AND FALSEWORK

All formwork and false work shall be removed from the job unless specified otherwise.

If authorized by the Engineer, piles used for false work may be cut off to 1.2 m below finished grade or ground level or to 0.6 m below stream bed.

Method and sequence of removal of form work and false work shall be subject to the approval of the Engineer and shall be such that it will permit the concrete to take up the stresses gradually.

The Engineer's approval shall be obtained prior to removal of any formwork or false work. Timing for form work and false work removal will be determined by strength and curing requirements.

The minimum time required before the removal of form work and false work excluding those days when the temperature is below +5 degrees Celsius, shall be 24 hours for girders and 48 hours for all other concrete provided all stipulations with regard to casting and curing have been and continue to be complied with in both the letter and intent of Sections 904.05 and 904.07 respectively. Concrete directly exposed to moving freshwater will require a minimum 7 days and 70 percent of the 28 day design strength prior to form work removal. Concrete directly exposed to seawater will require a minimum 14 days and 70 percent of the 28 day design strength prior to form work removal.

The Contractor will also be required to comply with 906.06.

The wing walls are to remain propped during construction until backfill has been placed and compacted.

907.08 HANDRAIL END BLOCK RECESSES

When shown on the contract drawings, the Department shall supply 4 800x450x19 plywood panels, complete with numerals attached for the date and site number, at the nearest Regional Office.

The Contractor shall install the date and site number panels on diagonally opposite handrail end blocks, as directed by the Engineer and shown on the Contract Drawings.

The panels shall be secured to the form work and when removed, surface finishing shall be as per Section 904.

Installation of plywood panels supplied by this Department shall be considered incidental to the work and no separate payment shall be made.

907.09 MEASUREMENT FOR PAYMENT

907.09.01 Formwork and Falsework

Formwork and falsework shall be considered incidental to the supply of concrete.

907.09.02 Form Liner

Measurement for Payment shall be in square metres rounded to the nearest 1 decimal place. Measurement for payment shall be surface length treated or covered with form liner times the nominal height of 0.610 metres. Deductions will not be made for trimming the form liner in order to conform to the ends of the barrier wall but deductions will be made for the length not treated with form liner such as at expansion joint locations.

907.10 BASIS OF PAYMENT

907.10.01 Formwork and Falsework

All costs for formwork and falsework shall be included in the contract price for the appropriate concrete or other appropriate item in the Unit Price Table. No separate payment shall be made for formwork or falsework.

The supply, installation and removal of guide rail including the excavation and backfilling of post holes as per Sections 640 and 902.05.01 "Supply and Installation of Guide Rail" and "Select Material Compacted", respectively, to the approval of the Engineer is considered incidental to the works.

907.10.02 Form Liner

Payment at the contract price for “Form Liner” in the Unit Price Table shall be full compensation for all plant, labour, materials and equipment to supply, transport to the job site, install, and remove form liner as described above.