DIVISION 9

SPECIFICATIONS FOR STRUCTURES

INDEX

SECTION 901

REMOVAL OF EXISTING STRUCTURE

INDEX

901.01 SCOPE

The scope of the work involves the demolition, removal, salvage and disposal of an existing structure, structural components and debris.

The intention of this specification is to cover both rehabilitation and complete removal and disposal works. For rehabilitation type projects, if complete structural components are to be removed, a supplementary general condition shall describe which structural components are to be removed, salvaged, and disposed of. The removal of deteriorated or damaged concrete, steel, asphalt, and other components to facilitate repairs shall be carried out as per Section 919.

Debris shall be defined as pieces of timber, concrete, steel, wood, sticks, branches, bushes, garbage and the like including that above and below the water level. Also included is the accumulation of any debris from the time of tender closing up to and including the date of substantial completion.

Structural components and related debris shall include that related to the superstructure, pavement, railings, bearings, abutments, piers, piles, footings and wing walls.

All demolition work shall be carried out in accordance with all applicable National and Provincial Regulations.

901.02 GENERAL

Contractors shall submit demolitions plans to the Department outlining their plans to complete the demolition of the existing structure. Contractors are expected to have done

a thorough site visit and have developed a comprehensive understanding of the effort, equipment and labour required to access the site, remove the structure and reinstate the area before submitting these plans. Plans shall be stamped by a Professional Engineer licenced to Practice in Newfoundland and Labrador as required by applicable legislations. Examples of drawings requiring stamps include, but are not limited to, lift plans, access platform details, and fall arrest systems. Contractors shall allow 10 business days for the Department to review the demolition plans.

The demolition, removal, disposal and salvage of an existing structure shall be carried out under the conditions specified in this section and in accordance with the following Sections and regulations:

a. Division 8
b. Section 902
c. Section 919
d. Department of Fisheries and Oceans Regulations and Best Practices
e. Applicable Environmental Permits
f. Occupational Health and Safety Regulations

The structure shall be completely removed unless otherwise accepted by the Owner's Representative. If portions of the existing structure are to remain, including piles, they shall be removed to 0.6 metres below grade or stream bed. In both cases, removal shall be carried out with as little disturbance to the area or river bed as possible. The bending down of reinforcing steel to meet the above 0.6 metre criteria shall not be permitted. Reinforcing steel shall be cut off flush with the concrete remaining. The area or stream bed or waterway will be restored as near to original condition as possible including removal of any concrete debris over 150 mm in any dimension and all metallic and asphaltic debris and all other garbage to the satisfaction of the Owner's Representative.

Demolition and disposal of asphalt on the existing structure, including approach slabs, if present, shall be incidental and disposed of in accordance with Section 919.18.

Where unwatering is required and is incidental to the work, it shall be as detailed under Section 180. Where unwatering is a separate pay item, it shall be completed in accordance with Section 902.

When all activity is complete, the affected work area must be restored to its natural condition acceptable to the Owner's Representative. This shall include the backfilling of holes left after the existing foundation has been removed with material compatible with

the natural environment, and returning side slopes to 1.5 horizontal to 1 vertical or as directed by the Owner's Representative.

The Contractor is advised that the indiscriminate disturbance of the general area or stream bed will not be permitted.

901.03 DEMOLITION, REMOVAL, SALVAGE AND DISPOSAL

The Contractor shall provide a disposal site satisfactory to all municipal, provincial and federal agencies having jurisdiction. Such disposal site shall be reviewed by the Owner's Representative before demolition commences.

Demolition, removal, salvage and disposal shall include the excavation, disassembly, breaking into pieces, handling, transportation from the job to disposal or storage site, and disposal or storage of bridge components and debris including burial and trimming of the disposal site to neat contours as required.

Demolition and removal of the old superstructure and substructures shall be carried out so no significant debris enters the watercourse or harbour. Busting of the superstructure while in place shall not be permitted. The Contractor shall submit a demolition plan to the Owner's Representative for review and approval prior to demolition commencing.

Contractors shall be aware of the requirements of the Specifications Book including, but not limited to those in Division 8, Section 180, and Section 902 ensuring that the demolition plan reflects the requirements in these sections.

Demolition, salvage and removal operations shall be conducted in a neat, orderly, safe and environmentally manner as accepted by the Owner's Representative. Debris which moves downstream during the work shall be recovered. Debris with a larger dimension of 500 mm shall be removed from streams and rivers.

The use of explosives will only be permitted where they are authorized for use by the Owner's Representative. The use of explosives will not be permitted where any part of the structure is intended for salvage or to remain in future work

Excavations deeper than 1m shall be fitted with trench boxes or sloped or stepped at a minimum of 1 Vertical to 1 Horizontal. The Contractor shall implement shallower slopes or other measures as needed to maintain a safe work site or to meet the requirements of regulatory agencies.

The Contractor shall ensure that temporary works are at no time compromised by the removal of the existing bridge. If the removal operation interferes with the temporary works, the Contractor shall provide a method of retention acceptable to the Owner's Representative at no additional cost to the Department.

In the event that areas to be occupied by new footings overlap the areas occupied by the existing footings, utmost care must be taken during removal. For shallow foundations, any material in these areas which is below the bottom elevation of the new footing or new rock mattresses and which must, in the opinion of the Owner's Representative, be disturbed to achieve the demolition, will be excavated and the area will be compacted and filled with "Select Material Compacted – Rock." For foundations supported on piles, the piles shall be removed to 0.6m below the proposed bottom of footing and be replaced with "Select Material Compacted – Rock" to the satisfaction of the Owner's Representative. If needed, the Contractor shall also replace any disturbed or excavated soil up to the bottom elevation of the new footing with "Select Material Compacted – Rock".

901.04 SALVAGE

Where structural components, regardless of material type, are destined to be salvaged, the contract shall contain a supplementary general condition indicating which components are to be salvaged, how and where they are to be stored and whatever other pertinent requirements must be fulfilled by the Contractor.

Where the removal of aluminum railing, steel guiderail and any related components is required, it shall be salvaged by the Contractor. Removal of the bridge rail posts will require concrete chipping at the base to expose the anchorages to a depth such that the anchorages can be cut and the posts removed without damage to the posts and their associated baseplates. This shall include loading, transportation to the nearest maintenance Depot, off-loading and storage in a manner acceptable to the Owner's Representative. The Contractor shall provide an inventory of all salvaged materials delivered to the Depot to the Owner's Representative prior to acceptance of delivery.

Storage shall include the provision for wooden spacers to separate the various items from the ground and from each other. Provision for suitable water tight containers necessary to store components which may become lost or scattered is also required.

901.05 MEASUREMENT FOR PAYMENT

Measurement for payment purposes shall be lump sum for the excavation, demolition, removal, disposal, and salvage if so required, of the existing structure, structural components and debris as outlined above.

Once demolition has been completed to the satisfaction of the Owner's Representative, Contractors shall provide the Owner's Representative with a minimum of 48 hours notice to conduct a survey of the site prior to further excavation or construction. Failure to provide an opportunity for this survey will negate any associated claims including, but not limited to, claims for "Removal of Existing Structure", "Excavation for Foundations" and the supply of any backfill materials.

901.06 BASIS OF PAYMENT

Payment at the contract price for "Removal of Existing Structure" in the Unit Price Table shall be full compensation for all labour, materials and equipment required to demolish, remove, salvage, and dispose of the entire existing structure, structural components and related debris as outlined above. Development and submission of demolition plans are also incidental to this item.

Demolition and disposal of asphalt on the existing structure, including approach slabs, if present, shall be incidental to the removal of the existing structure. Asphalt on the approaches to the bridge shall be paid for under a separate item.

Any excavation and replacement of any soil required to carry out the removal of the existing structure shall be considered incidental to "Removal of Existing Structure." No additional payment will be made for extra excavation required as a result of Contractor error or negligence.

For extra excavation and rock fill directed by the Owner's Representative as described under 901.03, payment will be made as per "Excavation for Foundation" and "Supply and Install Select Rock Material".

Also included in the basis of payment is the cost to the Contractor of selecting and providing the disposal site, cost of all permits, fees and royalties in addition to all necessary backfilling, grading and trimming of both the job and disposal site to neat and sightly contours.

If a significant amount of demolition debris from the bridge superstructure enters the watercourse or harbor, as determined by the Owner's Representative, the Contractor's bid price for "Removal of Existing Structure" shall be reduced by 50 percent.

Any materials identified for salvage by the Department which is damaged by the Contractor as a result of negligence will be replaced by the Contractor at their expense.

SECTION 902

EXCAVATION FOR FOUNDATIONS, UNWATERING, AND EXTRA BACKFILL FOR STRUCTURES

INDEX

902.06.04 Over Excavation

902.01 EXCAVATION FOR FOUNDATIONS

902.01.01 General

Excavation shall include the removal of all material necessary for the construction of foundations, substructures and the backfilling of the same in accordance with the plans or as directed by the Owner's Representative.

All rock or other hard foundations shall have all loose or soft material removed to present a clean firm surface. All loose and compressible material shall be removed from the excavation to the satisfaction of the Department's Geotechnical Engineer. Then, mass concrete shall be placed to the foundation elevation to create a level surface.

When a footing is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation. This shall include excavation by hand where so required or the use of excavator attachments which do not project below the final footing elevation. Alternatively, for footings excavated in the dry where the soil at or below the foundation elevation is disturbed as a result of construction operations; the foundation soil must be re-compacted to yield a bearing capacity equal to or greater than that specified for the footing as accepted by the Department's Geotechnical Engineer.

In soft conditions, the final removal of material to foundation level shall not be made until the Contractor is ready to proceed with the construction of the footing. When material at the founding elevation is Other Material and has been over excavated, the elevation shall be re-established by replacing with Select Material Compacted - Rock and compacting it to the bearing capacity indicated on the contract drawings as accepted by the Department's Geotechnical Engineer. When the founding material is Solid Rock and has been over excavated, the foundation elevation shall be re-established to the original elevation with mass concrete and shall fill the entire volume of the over excavation.

Footing elevation shall be considered as approximate only and may be ordered to be changed by the Owner's Representative on evaluation of conditions as the excavation proceeds.

Unless otherwise specified no excavation shall be made outside of that required for constructing substructure and the natural stream bed adjacent to the structure shall not be disturbed without permission from the Owner's Representative. The Contractor shall ensure that the channel is brought back to its original condition unless otherwise authorized.

After each excavation is completed, the Contractor shall notify the Owner's Representative and no concrete or other backfill shall be placed until the depths of excavation and the nature of the foundation material has been affirmed by the Department as satisfactory.

Materials excavated as excavation for foundations will be used for backfill if the material is deemed suitable by the Owner's Representative. Any costs associated with this are incidental.

Suitable excavated material beyond the requirements for backfilling the excavation will be incorporated into fill construction in accordance with Section 204 "Grading of Fill" and will include hauling up to 1km. Excavation for foundation materials not required or unsuitable for backfilling excavation or for fill construction will become the property of the Contractor. No overhaul will be paid for the removal and disposal of these materials. The use and classification of all excavation foundation materials will be as directed by the Owner's Representative.

902.01.02 Classification

Excavation shall be measured and classified as solid rock and other material. Provided that whenever the classes of material excavated cannot be separately measured on an accurate basis, the material will be classified on a percentage basis.

1) Solid Rock - shall include all rock in masses or ledges in their original or stratified bed or position and all boulders and detached pieces of rock exceeding 0.50 cubic metres.

2) Other Material - shall include all solid material other than solid rock as defined above including boulders less than 0.50 cubic metres.

902.02 PROTECTION OF EXCAVATIONS

All substructure work shall be adequately shored, braced or otherwise adequately protected in a rigid fashion in accordance with Section 907.

Where the stability, safety or function of an existing roadway, railway or other works can be impaired by an excavation or temporary slope, the Contractor shall provide such protection as may be required including sheeting, shoring and driving of piles where necessary to prevent damage to such works.

Where any excavation may endanger physical facilities, public safety or that of workers, or the face of the excavation is less than 2 metres from the edge of travelled lane or asphaltic pavement, whichever is nearest, or the excavation is more than 1 metre deep, the Contractor shall submit scaled drawings detailing the method of protection, physical dimensions and grades of sub sheeting, shoring, bracing and piling. These drawings shall be prepared, signed and stamped by a Professional Engineer licensed to practice in the Province of Newfoundland and Labrador.

All work must conform to the latest revision of the Occupational Health and Safety Act, including all amendments.

Unless otherwise specified, any materials used for protection shall remain the property of the Contractor and shall be removed from the job site when no longer required.

902.03 UNWATERING

902.03.01 General

The term "unwatering" shall mean the removal of all water that would impede the construction of the permanent structure by any means including but not limited to temporary water-tight structures and pumps.

The term “settling pond” refers to any open air, water containment structure used to manage the suspended solids or to control the discharge rate of pumped or flowing water. Other terms such as, but not limited to, dewatering basin, unwatering basin, retention ponds, etc must meet the requirements of “settling ponds”.

902.03.02 Unwatering Methods and Materials

The Contractor shall carry out all work necessary to prevent disturbance to the foundation and unless otherwise specified, all concrete shall be placed in the dry.

Any damage to the permanent structure due to any failure of the temporary structure used in the unwatering operations shall be remedied at the expense of the Contractor to the satisfaction of the Department, even to the extent of removal and reconstruction of said permanent structure.

Unwatering for bridge foundations shall include the supply of all equipment, materials and labour for the construction of the necessary water-tight temporary structures, their pumping out and subsequent removal.

Loose fill shall not be used to construct any unwatering structures unless accepted by the Owner's Representative. All fill shall be contained in sandbags or another method to allow for minimal disruption when removed from the water.

Effluent from an unwatering operation shall not be disposed of directly into a watercourse or water body. Effluent shall be discharged to a vegetated area which will cause the water to flow through a minimum of 50m of established vegetation between the discharge and watercourse. As vegetation becomes inundated with sediment, the Contractor shall relocate the discharge point into new vegetated areas as required to prevent sediment reaching a watercourse.

If appropriate vegetated areas are not available, the Contractor shall use a settling pond or other means of sedimentation removal before being returned to a watercourse.

If for any reason, all water cannot be removed from the excavation so as to permit concrete to be placed in the dry, the Owner's Representative may authorize, upon receipt of a written request from the Contractor, the placing of a concrete seal by means of a tremie pipe or similar method. When a concrete seal is authorized, the Contractor shall supply, at their own expense, all equipment, materials and labour necessary for this tremie concrete and no extra payment will be made.

Unless otherwise specified, all temporary unwatering and support structures shall remain the property of the Contractor and shall be removed from the job site when no longer required.

All earth or rock fill used in unwatering shall be removed from the watercourse upon completion of dewatering. Contractors shall incorporate necessary measures to limit sedimentation of the watercourse during this removal.

902.03.03 Turbidity Limits, Measurements, and Reductions in Payments

During all in-water or near water activities, including but not limited to, the construction, operation, and removal of unwatering systems, the upstream and downstream turbidity shall be monitored and measured. During construction, turbidity shall not increase more than 10 NTUs between the upstream and downstream measurements without prior approval by the Owner's Representative. Exceedance of turbidity limits will result in a reduction of payment as per Section 902.06.02.

Measurement of turbidity will be by the turbidity tube method or Department accepted alternative. Upstream measurements shall occur a minimum of 50 m from the project site,

downstream measurements shall occur a minimum of 25 m from the project site, or as requested by the Owner's Representative. Upstream sampling shall capture a representative sample of water not impacted by construction activities while downstream sampling shall capture the highest turbidity due to construction run-off.

Turbidity measurement systems shall be provided by the Contractor and available on-site at all times. Failure to have turbidity measuring instruments on-site while unwatering systems are being constructed, installed, or operational, regardless of whether a turbidity event has occurred or not, will result in a reduction in payment as per Section 902.06.02 being applied.

902.03.04 Unwatering Plan

The Contractor shall submit a dewatering plan for review by the Owner's Representative. No unwatering activities shall commence until the Department reviews the Contractor's unwatering plan. Contractors shall allow for 10 business days for the Department to review and comment on the unwatering plan. The unwatering plan, including drawings and specifications, shall be stamped by a Professional Engineer licensed to practice in the Province of Newfoundland and Labrador.

Unwatering plans shall conform to the requirements below, the Environmental Protection Plan, if one is needed, and the Department reviewed Contractor Environmental Mitigation Plan. Additionally, the Contractor shall abide by restrictions of the Federal Department of Fisheries and Oceans for any in-stream or near stream activity.

The engineered unwatering plan shall contain the following:

a) Drawings indicating the positioning of any water retaining/controlling structures in sufficient detail to allow for proper field positioning and construction;
b) Cross-section(s) of any water retaining structure(s);
c) The estimated infiltration rate of water into excavations;
d) Locations of: planned discharge points for pumps, settling ponds, turbidity curtains, unwatering bags, etc; in sufficient detail to allow for proper field positioning
e) Required equipment redundancies in the event of equipment failures; and
f) Design calculations used to confirm the design provided is fit for purpose.

Drawings shall clearly show the locations for items listed above. While site modifications may be required, drawings shall not specify "to be determined on site" for initial field positioning, unless the Engineer of Record provides a clear list of restrictions/requirements regarding the positioning of the item.

The Contractor is responsible for the cost of, and shall complete, any in-situ or laboratory tests that are required to determine water infiltration rates or any other information required to design or verify the unwatering plan.

If settling ponds are to be used engineered, stamped drawings of the settling ponds shall be provided. These drawings shall indicate the dimension of the structures, the maximum allowable incoming flow, and the estimated detention period of the water contained in the pond. The required amount of time for suspended solids to be settled shall be determined by the Engineer of Record for the pond but shall not result in an increase in turbidity from background levels of greater than 10 NTUs (Nephelometric Turbidity Units).

If unwatering bags, turbidity curtains, or other manufactured products are to be used, the manufacturer and model shall be indicated on the stamped drawings and product data sheets shall be submitted with the unwatering drawings. If exact products have not yet been selected when drawings are produced, then performance criteria for these products shall be provided.

Contractors shall submit copies of the design calculations used to complete the unwatering plan. Failure to provide this information when requested will result in non-approval of the unwatering plan and no payment will be made on any unwatering activity undertaken until approval is given. No extension to the completion date will be given for failure to provide the requested information.

The Department reserves the right to request the Engineer of Record for the unwatering plan or a representative nominated by the Engineer of Record to visit the site and confirm in writing to the Department that the construction of the unwatering is in accordance with the assumptions and intent of their design. Any costs or delays associated with this are to be borne by the Contractor.

Acceptance of the unwatering plan by the Department does not remove the liability of the Contractor for any costs or consequences resulting from the implementation or failure of the unwatering plan.

902.04 EXTRA BACKFILL

902.04.01 General

All backfilling and compaction work shall be conducted frost free and in the dry and under controlled conditions as accepted by the Owner’s Representative.

The use of large vibratory compactors of the type used in roadway projects is prohibited between wing walls and adjacent to wing wall legs and abutments as determined by the Owner's Representative.

902.04.02 Select Material Compacted - Granular

The grubbing and excavation of all unsuitable material, and unwatering operations shall be completed before any material is placed.

The quality of select material compacted shall be non-frost-susceptible free-draining granular material complying with the Department Transportation and Infrastructure specifications for Select Granular Base Course, Granular "A", Section 315, with the following exception:

The percentage of crushed materials is to be a minimum of 70%. This will be determined by examining the fraction retained on the 4.76 mm sieve and dividing the weight of the crushed particles by the total weight retained on the 4.76 mm sieve. Only pieces having one or more freshly fractured faces will be counted as crushed material. Pieces with only small chips removed will not be considered as crushed.

Other physical and gradation requirements shall be in accordance with Section 315.02 of the Department's specification for the select Granular Base Course.

French drains comprised of washed well-graded stone including filter fabric and perforated pipe if indicated shall be placed at weep holes and wherever else required on the contract drawings.

The limits for placing select material compacted shall be as defined on the contract drawings or in the tender documents. Where select material is to be placed below abutment or pier footings, the limits shall be defined as that extending 1.0 metre beyond all sides and ends of the footing(s) and extending to the original ground elevation or bottom of excavation whichever is more pertinent from the bottom of the footing elevation at a side slope of 1.5H:1V(minimum). The limits of placing shall be staked on the ground before placing operations begin.

Select Material Compacted - Granular placed below abutment and pier footings, behind abutments, retaining walls, wing walls, type "C" curb and gutter and similar structural components shall be placed in horizontal layers having a maximum loose thickness of 250 mm before compaction. Where permission is given in writing by the Engineer of Record or so indicated on the contract drawings, the maximum lift thickness can be

increased to 500 mm where select material is being placed in non-structural applications. The backfill can be spread with a bull dozer and after each layer is spread, a vibratory compactor must be used as directed by the Owner's Representative.

The Contractor shall compact the backfill behind abutments to a minimum of 95% of the maximum Standard Proctor Dry Density and to a minimum of 100% of the maximum Standard Proctor Dry Density below all footings, as per ASTM D698 "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort". When directed by the Owner's Representative, water may be added to assist the compaction effort but the amount of water added should not bring the moisture content above the optimum for the compactive effort used.

The Contractor shall provide the Owner's Representative with sufficient notice to perform Proctor and density testing. Acceptance shall be determined based upon samples taken from the point of final acceptance. The bottom layer must be spread, thoroughly compacted and tested before the next layer is placed.

No backfill shall be placed below a footing, against an abutment, wing wall or retaining wall until permission has been obtained from the Owner's Representative.

Backfilling around arches, rigid frames, abutments and piers shall proceed simultaneously and evenly on both sides so as to avoid differential surface elevation in excess of 500 mm. Backfill in these locations shall be fully enclosed with geotextile filter fabric.

902.04.03 Select Material Compacted – Rock

The grubbing and excavation of all unsuitable material, and unwatering operations shall be completed before any material is placed.

Select Rock Backfill shall be used as backfill under the footings or to create rock mattresses under footings, as backfill behind abutments, or as indicated on the project drawings.

Any softened or disturbed soil must be removed from excavation bases prior to setting of foundations or placement of structural fill and replaced with Select Material Compacted – Rock to achieve the proper grade lines.

The quality of select material compacted shall be non-frost-susceptible free-draining granular material complying with all the requirements of Section 204 and all requirements of 'Supply Rock Fill in Place', under the same section except that the material will meet

the gradation outlined below, have a maximum dimension of 150 mm, will be durable, well graded, and will contain no more than 5% fines (smaller than 75 micrometres).

Select Material Compacted - Rock will meet the following gradation requirements:

150mm	100% passing by dry weight
75mm	65-100%
4.76mm	20-55%
1.2mm	10-35%
0.3mm	5-20%
0.075mm	2-5%

The fill will be placed in horizontal layers having a maximum loose lift thickness of 300 mm and each layer will be thoroughly compacted.

French drains comprised of washed well-graded stone including filter fabric and perforated pipe if indicated shall be placed at weep holes and wherever else required on the contract drawings.

Select Material compacted – Rock shall be compacted until no visible movement occurs under additional passes of the compactor as determined by the Owner's Representative.

The Contractor shall provide the Owner's Representative with sufficient notice to inspect the material before, during, and after placement. The bottom layer must be spread, thoroughly compacted and tested before the next layer is placed.

No backfill shall be placed below a footing, against an abutment, wing wall or retaining wall until permission has been obtained from the Owner's Representative.

Backfilling around arches, rigid frames, abutments and piers shall proceed simultaneously and evenly on both sides so as to avoid differential surface elevation in excess of 500 mm. Backfill in these locations shall be fully enclosed with geotextile filter fabric.

902.04.04 Compacted Ordinary Fill

All material and placing shall be in accordance with Section 204. However, location of the source will be the responsibility of the Contractor.

902.05 MEASUREMENT FOR PAYMENT

902.05.01 Excavation for Foundations

"Solid Rock" and "Other Material" shall be measured in cubic metres in the original position of material excavated in conformity with the plans or as directed by the Owner's Representative. Ordinarily no volume shall be included in the measurement for payment which is outside the volume bounded by vertical planes parallel to and beyond the neat lines of the footings (or structural mattress if present) unless such excavation is indicated on the contract drawings or specifically requested by the Owner's Representative. The volume measured shall not include water or other liquids but shall include mud.

For construction sites not involving the removal of an existing structure, the top limit for payment volume is original ground or new road subgrade elevation. Material removed above road subgrade elevation will be paid under Section 206. The bottom limit is the completed bottom of footing or rock mattress, if present.

For projects that involve the removal of an existing structure, after the removal of the structure, the excavation site shall be surveyed, and the survey results provided to the Owner's Representative, prior to any further excavation. The site shall be surveyed again once the Contractor has reached the footing elevations and the site is ready construction of the substructure. Further construction shall not proceed until the Owner's Representative has been provided with the results of the second survey. Payment for "Excavation for Foundations" shall be the volume calculated as the difference between the two surveys. If either survey is not completed, payment shall be the quantity indicated in the Unit Price Table with no consideration given for additional quantities.

In the event that rock and soil are to be excavated on the same site, the Contractor shall remove all soil required to access the foundations to the satisfaction of the Owner's Representative. The site shall then be surveyed to determine the payment quantity for "Other Material." Rock excavation may then proceed. The payment quantity for "Solid Rock" shall be calculated and agreed upon by the Owner's Representative and the Contractor in writing prior to continuing the work. In the event that agreement on the quantities cannot be reached, a third survey to determine the quantity of rock excavated will be completed at the Contractor's expense.

Surveys shall be completed in accordance with Section 926.

The volume of boulders in excavation shall be determined on the basis of the three maximum rectilinear dimensions.

902.05.02 Unwatering

The measurement for “Unwatering” shall be lump sum.

902.05.03 Extra Backfill

“Select Material Compacted – Granular”, “Select Material Compacted – Rock”, and “Compacted Ordinary Fill” shall be paid by the number of cubic metres in place, to the nearest one decimal place, and the volume measured shall be that between the theoretical or final grades and the original grades or lines as shown on the drawings, or as indicated herein.

902.06 BASIS OF PAYMENT

902.06.01 Excavation for Foundations

Payment at the contract price for “Solid Rock” and “Other Material”, in the Unit Price Table shall be full compensation for all labour, services, surveying, equipment and materials for all excavation required, determination of quantities, protection of excavation, protection of adjacent works, stockpiling of excavated material for backfilling, hauling of excavated material up to 1km, placing and compaction of excavated material and disposal of any surplus or unsuitable excavated material.

Where the Owner’s Representative requires Excavation for Foundation material be hauled in excess of 1km, additional payment for overhaul will be made in accordance with Section 215.

902.06.02 Unwatering

Payment at the contract price for the item "Unwatering" in the Unit Price Table shall be full compensation for all labour, engineering services, geotechnical investigation, equipment, and material to do the work according to the specifications.

Failure to comply with the turbidity limits or to have turbidity measuring systems readily available as per Section 902.03.03 will result in a reduction in payment equal to the Liquidated Damages Daily Rate, specified in GC 46. The liquidated damages rate shall be applied for each 24 hour period in which the turbidity limits in the watercourse are exceeded or the specified measuring systems are not available on site.

902.06.03 Extra Backfill

902.06.03.01 Select Material Compacted - Granular

Payment at the contract price for “Select Material Compacted – Granular” in the Unit Price Table shall be full compensation for all labour, equipment, plant and material involved in the cost of locating, obtaining approval, providing a pit or quarry, sampling, clearing, grubbing, producing, loading, hauling, placing of granular backfill to the structure, the granular material at weep hole drains, french drains, perforated subdrain, weeping tile and filter fabric where so indicated on the contract drawings, for compacting the material and all other work required to place, spread and ensure compaction of the material according to the specifications including the payment of royalties.

902.06.03.02 Select Material Compacted - Rock

Payment at the contract price for “Extra Backfill Select Material Compacted – Rock” in the Unit Price Table shall be full compensation for all labour, equipment, plant and material involved in the cost of locating, obtaining approval, providing a pit or quarry, sampling, clearing, grubbing, producing, loading, hauling, placing of backfill to the structure, the granular material at any weep hole drains, french drains, perforated subdrain, weeping tile and filter fabric where so indicated on the contract drawings, for compacting the material and all other work required to place, spread and ensure compaction of the material according to the specifications including the payment of royalties.

902.06.03.03 Compacted Ordinary Fill

Payment at the contract price for “Extra Backfill Compacted Ordinary Fill” in the Unit Price Table shall be full compensation for all labour, equipment and material, locating, obtaining approvals, clearing, grubbing, hauling, loading, placing and compacting the fill and all other work necessary to comply with specifications in Section 204.

902.06.04 Over Excavation

Payment will not be made for over excavating due either to the Contractor's method of operation or their negligence. Neither will compensation be provided for the cost of remedial measures required by the Owner’s Representative as a result of over excavation by the Contractor.

SECTION 903

CONSTRUCTION SPECIFICATION FOR PILING

INDEX

903.01 SCOPE

The scope of this specification is to cover the supply and driving of piles, sheet piles, and associated work, in steel or timber. Piles shall be supplied by the Contractor unless noted in the contract documents that piles shall be supplied by the Department.

903.02 MATERIALS

All materials shall be new and previously unused. The Contractor shall provide Mill Certificates and a Letter of Compliance for all piling and piling related materials used in the project.

903.02.01 Timber - Round Piles

Timber piles shall be clean peeled and shall comply with CSA-056 “Round Wood Piles.” Piles shall be pressure treated with a preservation treatment in accordance with CSA-080 “Wood Preservation.”

903.02.02 Steel Sheet Piles And H-Piles

Steel sheet piles and steel H-piles shall comply with the requirements of 300W specified in CSA G40.20/G40.21 “General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel” or ASTM A328/A328M “Standard Specification for Steel Sheet Piling.” The straightness tolerance shall be 25mm in 20 metres.

Two copies of the mill certificates, indicating that the steel meets the requirements of the appropriate standards for Sheet and H piles shall be submitted to the Owner’s Representative prior to shipment to the job site.

Where mill test certificates originate from a mill outside of Canada or the United States of America the Contractor shall have the information on the mill certificates verified by testing at a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply to comply with the requirements of ISO/IEC 17025 “General Requirements for the Competence of Testing and Calibration Laboratories” for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The stamp shall include the appropriate material specification number, the date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian testing laboratory.

903.02.03 Steel Tube Piles

Steel tube piles shall be welded or seamless tube piles and shall comply with the requirements of ASTM A252/A252M “Standard Specification for Welded and Seamless Steel Pipe Piles” Grade 2 or Grade 3. If welded, they shall be welded by the Electric Arc method in accordance with CSA W59 “Welded Steel Construction.”

The straightness tolerance shall be 25mm in 20 metres.

2 copies of the mill certificates, indicating that the steel meets the requirements specified shall be submitted to the Owner’s Representative prior to shipment to the job site.

Where mill test certificates originate from a mill outside of Canada or the United States of America the Contractor shall have the information on the mill certificates verified by testing by a Canadian laboratory. The laboratory shall be certified by an organization accredited by the Standards Council of Canada to comply to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be

stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The stamp shall include the appropriate material specification number, the date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian testing laboratory.

903.02.04 Pile Tips

As per the contract documents.

903.02.05 Concrete and Reinforcement for Steel Tube Piles

Concrete and steel reinforcement shall be in accordance with Section 904 and Section 905 respectively.

903.02.06 Storage and Handling

All piles shall be stored and handled in such a manner that damage is prevented and that design strengths will not be affected by deterioration or deformation.

903.02.07 Pile Cap Plates and Anchorages

As per the contract documents.

903.03 PILE DRIVING

903.03.01 General Requirements and Restrictions

Piles shall not be driven until other excavation is completed to below cut-off level. Any material forced up between the piles shall be removed to the correct elevation. Any fill material shall be placed to the underside of footing elevation before driving piles.

Piles shall not be driven within 15 metres of concrete placed during the preceding 7 days.

The Contractor shall not drive piles in such a manner that the piles are subjected to excessive or undue abuse. Forcing piles into their proper position by the use of excessive manipulation is prohibited.

The Contractor's driving operations shall not cause vibration sufficient to harm the construction or adjacent property.

The Owner’s Representative will reject any pile that is found to be defective or damaged. No additional compensation will be made for the removal and replacement or other work made necessary through rejection of a defective or damaged pile.

Piles will be driven from the center of the pile groups and will proceed outward.

903.03.02 Tolerances

Piles shall be driven as nearly as possible in the exact position specified on the drawings. After driving, piles at the cut-off elevation shall not be more than 75 millimetres from the location shown on the drawings.

Deviation from the vertical or required batter shall not be more than 20 millimetres per linear metre of pile. Any pile so out of line or plumb as to impair its usefulness shall be pulled and re-driven or an additional pile shall be driven as required by the Owner's Representative. The piles shall not be jacked or pulled laterally to bring their tops into correct location.

903.03.03 Driving Equipment

All piles shall be driven with a hammer developing an energy per blow of not less than 6X10^6 Joules (newton metre) times the cross sectional area of the pile (square metre) or as specified in the contract document. The energy should be capable of remote regulation to prevent damage to the piles. The piles and hammer shall be held securely in the correct alignment by rigid leads extending down to the lowest point the hammer must reach.

The use of vibratory hammers to drive or partially drive either H-piles or pipe piles must be accepted by the Owner's Representative.

Prior to pile driving, a WEAP analysis will be conducted by the testing company, selected as per section 903.06, to determine the penetration resistance for the given hammer and driving system.

Unless written authorization to stop driving has been received from the Department's Geotechnical Engineer, penetration to the depths stated in the contract documents shall be achieved even if blow counts indicate the required resistances have been achieved. Piles that have been stopped at a shallower depth for any reason shall not be cut until written approval specifically approving the cutting has been received from the Geotechnical Engineer. If blow counts have not been achieved at the penetration depth stated in the contract documents, the piles shall be driven deeper until the blow counts are achieved or approval to stop driving has been received from the Geotechnical Engineer.

903.03.04 Jetting

Jetting shall not be used unless written permission has been given by the Owner's Representative. Appropriate special conditions will be given should jetting be authorized.

903.03.05 Helmets

Pile heads shall be protected by helmets having adequate cushioning material next to the pile head. The helmet shall distribute the blow of the hammer evenly throughout the pile cross-section.

Timber piles shall be prevented from splitting by collars.

903.03.06 Records

The Contractor shall not commence driving piles in the absence of the Owner's Representative.

Blows per 300 millimetres for each 300 millimetres shall be recorded. For the final 300 millimetres the blows per 25 millimetres shall be recorded.

When driving is interrupted before final penetration is reached, the final record of penetration shall not be taken until, on resumption of driving, a further penetration of 300 millimetres has been obtained.

The Owner's Representative will maintain daily records of driving for each pile which will include the type and make of hammer, rated energy, observed stroke and observed blow rate. The pile size and length, location within the pile group, the time of start and time of finish for the driving of each pile and the sequence of pile driving within each group will be recorded. The toe elevations upon termination of driving piles will be documented as will the elevation of the toes of adjacent piles before striking of any pile. Any interruption of continuous driving, and any observed pile damage will also be recorded.

903.03.07 Re-driving

Piles pushed up by driving or loosened by jetting of adjacent piles shall be re-driven to comply with the requirements of the contract. Similarly, if a pile(s) is suspected to have hung up on a boulder, the Contractor shall re-drive the pile(s) in question as well as others in the immediate vicinity.

After all piling is complete and all piles are driven to meet project criteria, the Contractor shall return to each footing and re-drive at least 10 percent of the piles in each footing rounded to the next highest number of piles plus one. The piles selected for re-driving shall be randomly selected by the Owner's Representative. If movement exists on 1 or more piles, additional piles shall be re-driven until the Owner's Representative is satisfied that all piles have met the design criteria as established on the contract drawings or in the specifications.

The Contractor is advised that piling shall not be cut-off until all re-driving is complete.

903.03.08 Driving Of Tube and H-Piles When Boulders Are Anticipated Or Driving To Bedrock

When boulders are anticipated, pile tips shall be fitted. Driving shall be carried out until the pile tips make contact with rock. Driving energy shall be decreased to about a quarter and the pile shall be subjected to twenty blows. Energy can be increased with approval from the Owner's Representative by 25% at twenty blows for each interval until the Owner's Representative is satisfied that the requirements of the contract are complied with. Adjacent piles should then be re-driven.

When steel tube and H-piles are to be driven to and chipped or socketed into bedrock, rock injector pile tips shall be fitted to the ends of the piles. The piles shall be chipped into the bedrock using low energy. When the piles are firmly seated, the energy shall be increased in stages or intervals and eventually driven to refusal at the rated energy as stipulated in the contract documents.

903.04 SPLICES

903.04.01 Timber Piles

No splices will be permitted for timber piles.

903.04.02 Steel Piles

No splices will be permitted for steel piles except where allowed for in the contract or as authorized by the Owner's Representative unless the toe elevations for the pile should extend beyond those specified in the contract drawings.

When permitted, Contractor shall provide detailed drawings and calculations for the Owner's Representative to review. Design details of splice shall bear dated signature and stamp by a Professional Engineer registered or licensed in the Province of Newfoundland and Labrador, Canada.

Welding design shall be according to CSA W59 and shall be done by a qualified welder employed by a firm certified according to CSA W47.1 "Fusion Welding of Steel Company Certification", Division 1 or Division 2.1. Welding procedures shall be according to CSA W47.1 and CSA W59, and the latest edition of CSA S6 "Canadian Highway Bridge Design Code."

If accepted by the Owner's Representative, splice piles in place during installation by welding. To prevent distortion, tack opposite points first and then weld opposite sections for pipe walls thinner than 10 millimetres weld against a backup ring. Hold members in alignment during splicing operation. Make splice by complete joint penetration groove welds as indicated on shop drawings.

If splices are within 5.0 metres of the pile cut off elevation specified then they shall be made with complete penetration welds as per the details on the contract plans and all welds shall receive 100% ultrasonic or radiographic inspection.

Pile splices specified as part of the design specifications which are below 5.0 metres from the pile cut off elevation shall be made with complete penetration welds as per the details on the contract plans. All piles shall receive visual Inspection with 20% of the piles rounded to the next highest number receiving 100% ultrasonic or radiographic inspection. Piles chosen for testing shall be determined by the Owner's Representative.

The Contractor shall employ an independent testing company with no corporate affiliation to carry out the visual inspection and non-destructive testing of welds. The independent testing company shall be certified by the Canadian Welding Bureau to the requirements of CSA W178.1 “Welding Inspection Organizations Company Certification” for bridge structures by radiographic or ultrasonic test methods. The welding inspector shall have documented evidence of training, professional knowledge, skill and experience in visual inspection of structural steel welds and material, and have a valid certificate showing qualification to a Level II or III according to CSA W178.2 “Certification of Welding Inspectors.”

903.05 CONCRETE FILL IN TUBULAR STEEL PILES

After acceptance by the Owner’s Representative, the pile shells including rejected shells left in the ground shall be cut off at the required elevation and shall be filled with concrete.

Prior to filling each pile, the inside shall be inspected with an electric lamp attached to a drop cord of sufficient length to reach the bottom of the pile. Any debris and water shall be removed before placing the concrete.

Reinforcing steel shall be installed in the concrete fill at the top of all the piles as shown on the drawings.

No concrete shall be placed until all driving within a radius of 15 metres has been completed. If this cannot be done, driving within these limits shall be stopped until the concrete in the last pile has set for at least 7 days.

Concrete shall be placed continuously until the shell is filled.

The concrete shall be worked thoroughly down into place and compacted with a vibrator to the lowest extent of the reinforcement.

After placing, the concrete shall be protected from frost for at least 3 days.

903.06 PILE TESTING REQUIREMENTS FOR DRIVEN PILES

Dynamic monitoring of the pile driving will be conducted on the greater of: 10% of all piles in each abutment or at least 4 piles in each abutment; to confirm pile resistances, energy transfer to piles and performance of the pile-driving hammer. Pile tests will be done in accordance with ASTM D4945 “High Strain Dynamic Testing of Piles”, using a Pile Driving Analyzer. Testing will be conducted by a qualified testing company selected by the Contractor from the approved list in the Contract Documents. The use of an alternate dynamic testing company other than those indicated will require the prior approval of the Department.

50% of the piles to be tested at each abutment will be driven to full penetration according to the pile driving criteria outlined above. The remaining 50% of piles to be

tested will be driven and stopped prematurely, approximately 1 to 2 metres higher. Test piles will not be driven adjacent to each other because a temporary change in pore pressures may affect the measured resistances. After waiting at least 3 days to allow soil set-up or relaxation to develop, the shallower piles will be driven to full depth while taking dynamic measurements to determine pile resistance at end of initial driving. The deeper piles will then be re-struck and monitored to determine the pile resistance at re-striking. No extra compensation will be paid for the above described waiting period.

Pile capacities as determined in the field by dynamic testing will be confirmed by the dynamic testing company by completion of a Case Pile Wave Analysis Program (CAPWAP) analysis on a minimum of one of the tested piles from each abutment.

During the dynamic testing, the testing company will provide preliminary estimates of the ultimate axial compression capacity of each pile tested as well as hammer performance and driving stresses. Conformation of tested pile capacities, by completion of CAPWAP analysis will be provided within 24 hours of testing. 1 physical copy and 1 electronic copy of the testing company's final report, signed and sealed by a licensed member of the Association of Professional Engineers and Geoscientists of Newfoundland and Labrador, containing all test results and analysis will be provided within 7 days of completion of testing.

The locations of piles to be dynamically tested will be determined in the field by the Owner's Representative and will be as recommended by the Materials Engineering Division. The Contractor will advise the Owner's Representative at least 2 weeks prior to the commencement of pile driving. Information on the dynamic testing company selected as well as the Contractor's pile driving equipment and method of installation as previously supplied to the Owner's Representative shall be confirmed at that time. The Contractor will co-ordinate with the dynamic testing company to ensure that the schedule for the dynamic monitoring is adhered to by providing all related access and assistance to enable the testing company to expeditiously perform the monitoring. No delay or other type of claims will be considered by the Department with regard to Dynamic load testing.

The Contractor will assist in the testing by providing personnel to climb the leads carrying the gages and cable and attaching the gauges by bolting them to the holes. Alternatively, the gauges will be attached to the piles before the piles are lifted and inserted into the leads. In this case, the Contractor is responsible for any damage or loss caused to the cable or gauges.

After all piles have been installed and dynamic testing of the specific number of piles has been completed, the remaining piles at both abutments will be re-struck, as per Section 903.03.7 to determine if the pile penetration resistance has decreased due to the relaxation or increased development of set-up. Where relaxation occurs the pile capacity will be re-evaluated by dynamic analysis.

903.07 MEASUREMENT FOR PAYMENT

903.07.01 Sheet Piles

903.07.01.01 Supplied

The measurement for “Supplied” will be in square metres to the nearest one decimal place. For payment purposes the measurement for sheet piles supplied will be based upon the actual quantity installed provided this quantity equals or exceeds the quantity estimated in the Unit Price Table. If the actual quantity installed is less than the quantity estimated then payment will be made for supplying the quantity installed plus the total area of unused sheet piles but not exceeding the estimated quantity. Unused sheet piles will include only uncut sheet piles in lengths originally supplied to the Contractor and, if necessary, cut-off sections of sheet pile whose lengths are 3 metre or longer. For payment purposes the length of cut off sections will be calculated based upon the difference between the estimated pile toe elevation as shown on the contract drawings and the actual pile toe elevation.

903.07.01.02 Installed

The measurement for “Installed” will be in square metres to the nearest one decimal place based upon the actual quantity of pile installed and left in place after cut off as accepted by the Owner’s Representative.

903.07.02 Piles Other Than Sheet Piles

903.07.02.01 Supplied

The measurement for “Supplied” will be in linear metres to the nearest one decimal place. This measurement shall include both battered and vertical piles.

For payment purposes the measurement for “Supplied” will be based upon the actual quantity installed provided this quantity equals or exceeds the quantity estimated in the Unit Price Table. If the actual quantity installed is less than the quantity estimated then payment will be made for supplying the quantity installed plus the total length of unused piles but not exceeding the estimated quantity. Unused piles will include only uncut piles in lengths originally supplied to the Contractor and, if necessary, cut-off sections of piles whose lengths are 3 metres or longer. For payment purposes the length of cut off sections will be calculated based upon the difference between

estimated pile toe elevation as shown on the contract drawings and the actual pile toe elevation.

903.07.02.02 Installed Vertical Piles

The measurement for “Installed Vertical Piles” will be in linear metres to the nearest one decimal place based upon the actual quantity of pile installed and left in place after cut off as accepted by the Owner’s Representative.

903.07.02.03 Installed Battered Piles

The measurement for “Installed Battered Piles” will be in linear metres to the nearest one decimal place based upon the actual quantity of pile installed and left in place after cut off as accepted by the Owner’s Representative.

903.07.02.04 Pile Splices

The measurement for “Piles Splices” will be measured according to the actual number used, authorized and accepted by the Owner’s Representative and properly installed.

903.07.02.05 Pile Tips

The measurement for “Pile Tips” will be measured according to the actual number used, authorized and accepted by the Owner’s Representative and properly installed.

903.07.02.06 Pile Cap Plates and Anchorages

Pile cap plates and anchorages will not be measured and are considered incidental to the work.

903.07.03 Rejection

Any piles, tips, plates and anchorages which are rejected for reasons of improper driving, positioning or damage shall not be included in the above measurements.

903.08 BASIS OF PAYMENT

903.08.01 Sheet Piles

903.08.01.01 Supplied

Payment at the contract price for “Supplied” in the Unit Price Table shall be full compensation for all labour, materials, supplies, and equipment required to complete the work associated with the supply of piling, loading and transportation to the jobsite, unloading, handling and storage of piling materials.

Unused sheet piles shall be loaded, transported and off-loaded by the Contractor to a designated area at the nearest maintenance depot as part of the demobilization item detailed in Section 157 of the Specifications Book. When the Contractor transports the unused piles they shall present a receipt for the piles, signed by the Depot Foreman, to the Owner's Representative.

The quantity of wastage (defined as the quantity supplied to the site less the pay quantity) shall be the Contractor's responsibility and payment will not be made for such. The Owner's Representative shall determine the quantity of wastage.

903.08.01.02 Installed

Payment at the contract price per square metre for "Installed" in the Unit Price Table and shall be full compensation for all equipment, labour, cranes, crane movements, positioning, driving, cleaning, painting, protecting, and pile cut-off.

The re-driving of piles shall be considered incidental to the work and extra payment will not be made for the same. However, where the Contractor succeeds in increasing the length of piling in the works they shall be compensated for supply and installation of this material.

No payment will be made for falsework piling.

Payment for pile template(s) shall be considered incidental to the work and payment will not be made for such.

903.08.02 Piles Other Than Sheet Piles

903.08.02.01 Supplied

Payment at the contract price for "Supplied" in the Unit Price Table shall be full compensation for all labour, materials, supplies, equipment, and testing required to complete the work associated with the supply of piling including pile cap plates and anchorages, loading and transportation to the jobsite, unloading, handling and storage of piling materials.

Unused piles shall be loaded, transported and off-loaded by the Contractor to a designated area at the nearest maintenance depot as part of the demobilization item detailed in section 157 of the Specifications Book. When the Contractor transports the unused piles they shall present a receipt for the piles, signed by the Depot Foreman, to the Owner's Representative.

Wastage (defined as the quantity supplied to the site less the pay quantity) shall be the Contractor's responsibility and payment will not be made for such. The Owner's Representative shall determine the quantity of wastage.

903.08.02.02 Installed Vertical Piles and Installed Battered Piles

Payment at the contract price for "Installed Vertical Piles" and "Installed Battered Piles" in the Unit Price Table shall be full compensation for all equipment, labour, cranes, crane movements, positioning, driving, cleaning, painting, protecting, pile cut-off, pile cap plates and pile anchorages.

The re-driving of piles shall be considered incidental to the work and extra payment will not be made for the same. However, where the Contractor succeeds in increasing the length of piling in the works they shall be compensated for supply and installation of this material.

Where pile capacity is established by dynamic analysis and relaxation occurs the Contractor shall have the pile capacity re-evaluated. Piles are defined to have relaxed when more than 125 millimetre average movement occurs in those piles subject to re-driving as defined in Section 903.03.07 above. Dynamic analysis re-evaluation shall be conducted by an agency accepted by the Owner's Representative. The cost of the dynamic analysis re-evaluation shall be paid for by the Department. All other costs including but not limited to the cost of delay shall be considered incidental to the tendered price for piles driven.

No payment will be made for falsework piling.

All costs involved in filling tube piles with concrete and reinforcing shall be incidental to "Installed Vertical Piles" and "Installed Battered Piles".

Costs for pile template(s) shall be considered incidental to the work and payment will not be made for such.

903.08.02.03 Pile Splices

Payment at the contract price for "Pile Splices" in the Unit Price Table shall be full compensation for all labour, equipment, materials and services necessary to design, supply, deliver, and install pile splices and provide the specified visual and non-destructive testing.

Any approved field splicing will be considered incidental to the work.

903.08.02.04 Pile Tips

Payment at the contract price for “Pile Tips” in the Unit Price Table shall be full compensation for all labour, equipment and materials necessary to design, supply, deliver and install the pile tips.

903.08.02.05 Pile Cap Plates and Anchorages

Pile cap plates and anchorages are incidental to the work.

903.08.03 Jetting

No additional payment shall be made for jetting, if authorized.

SECTION 904

CONCRETE STRUCTURES

Specifications specific to Concrete Structures shall be referenced at the following locations:

930 Concrete – Materials and Production
931 Concrete – Construction
932 Inspection Checklists

Any references to 904 throughout the Highway Specification Book will be considered applicable to the above new standards.

SECTION 905

CONCRETE REINFORCEMENT

INDEX

905.01 SCOPE

The scope of this section is to cover the supply, material, fabrication and placement of all reinforcing steel in concrete structures.

905.02 BLACK STEEL REINFORCEMENT

905.02.01 Material

Black reinforcing steel is any grade or size of deformed steel reinforcing bars which do not have a form of corrosion protection applied to the bars.

The Contractor shall supply all the reinforcing steel to be incorporated in the work.

All reinforcing steel supplied shall be new and previously unused billet deformed bars having a yield point of 400 MPa (400W), unless otherwise specified, and shall conform to CSA A23.1 “Concrete Materials and Methods of Concrete Construction” and CSA G30.18 type W “Carbon Steel Bars for Concrete Reinforcement.” Steel spacers for spiral reinforcement shall be according to CSA G40.20/G40.21, Grade 350 G.

Where the Contractor utilizes concrete blocks to support the reinforcing steel, the quality of the concrete blocks shall conform to Section 904 and have properties similar to that being used in the concrete member. When requested, the Contractor shall supply test results to verify this.

When concrete chairs are not used, reinforcing supports for black reinforcing steel shall be plastic coated or stainless steel chairs or beam bolsters. Equivalent types of reinforcing steel supports may be accepted by the Owner’s Representative. All reinforcing accessories, such as chairs, shall be corrosion resistant within 25mm of all exposed surfaces.

Chairs positioned on Styrofoam, evafoam, or other deformable surface shall be fitted with a baseplate or other means to prevent sinking into or damage to the deformable surface.

Reinforcing steel shall be free of excessive rust and any reinforcing steel reduced in cross section area due to rust shall be rejected.

905.02.02 Fabrication, Transportation, and Storage of Black Steel Reinforcement

All properties including laps, splices, hooks and bends in reinforcement, etc. shall be as per the most recent version of CSA S6 “Canadian Highway Bridge Design Code” and any addenda.

The Contractor shall submit 1 hardcopy and 1 electronic copy of a detailed reinforcing steel bar schedule to the Owner’s Representative. The schedule shall show all

dimensions and bending diagrams for all the reinforcing steel in accordance with ACI 315R “Guide to Presenting Reinforcing Steel Design Details.”

The Contractor retains responsibility for correctly detailing reinforcement but the schedule must be reviewed for conformity with the design by the Owner’s Representative. Fabrication of reinforcing steel should not proceed until approval of the schedule has been obtained.

The Contractor shall transport the reinforcing steel to the site and shall store it on racks or platforms with adequate identification.

All dirt, grease or other foreign materials shall be removed from the steel prior to the placement.

905.02.03 Placing of Black Steel Reinforcement

Field bending shall not be carried out unless authorized by the Owner’s Representative and heat shall not be used for this purpose. Any bends developing cracks or splits shall be rejected.

No welding shall be carried out unless specifically authorized by the Owner’s Representative and if authorized, it shall be carried out in accordance with CSA W186 “Welding of Reinforcing Bars in Reinforced Concrete Construction.”

Substitutions of different size bars must have the approval of the Engineer of Record. Splicing at locations other than those specified on the drawings must be reviewed by the Engineer of Record. All Contractor’s requests for splices other than those detailed on the contract drawings will be at the Contractors’ expense.

Reinforcing steel shall be supported and firmly held in the required positions at all times.

Bars shall be tied at all intersections except when the bar spacing is less than 250 mm in each direction, alternate intersections shall be tied. Specified distances from forms shall be maintained by supports, spacers, or other proposed means that have been reviewed and accepted by the Owner’s Representative.

If reinforcement is in position for a considerable time prior to concrete being placed, then the reinforcing steel shall be re-inspected and, where necessary, cleaned to the satisfaction of the Owner’s Representative prior to placement of concrete at no extra cost.

Bursting and spalling reinforcement shall be placed at nominal cover.

All reinforcement to be placed at nominal cover as per CSA S6 unless otherwise stated on the contract drawings.

905.03 GALVANIZED STEEL REINFORCEMENT

905.03.01 Material

The Contractor shall supply all reinforcing steel to be incorporated in the work.

Contractor shall provide the Owner's Representative with a certified copy of the mill test report(s) of reinforcing steel, showing physical and chemical analysis, a minimum of 4 weeks prior to beginning reinforcing work.

Upon request the Contractor shall inform the Owner's Representative of the proposed source of material to be supplied.

All rebar supports, bolts, chairs, and rods shall be non-metallic (fiberglass, plastic, etc). Concrete chairs shall not be used to support galvanized steel reinforcing bars.

Galvanized steel supports for rebar may be utilized provided that they meet the material requirements specified in this section and achieve the clear covers identified in the project documents.

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 galvanized steel meeting the material requirements specified in this section. If galvanized 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.

After stripping of forms, fiberglass ties shall be cut off/broken off and grinded flush with the concrete surface. Shims or another method shall be used around the tie to protect the finished surface from damage.

Chairs positioned on Styrofoam, evafoam, or other deformable surface shall be fitted with a baseplate or other means to prevent sinking into or damage to the deformable surface.

Cold-drawn annealed steel wire ties shall be to ASTM A1064/A1064M “Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.” All tie-wires used for the installation of galvanized reinforcing bars shall be galvanized, covered with powdered epoxy resin or acceptable alternative, or be composed of a non-metallic material accepted by the Owner’s Representative.

All reinforcing steel shall be deformed and shall conform to CSA G30.18 and CSA A23.1/A23.2, Grade 400W unless otherwise specified.

All galvanized reinforcing steel used shall be hot dipped galvanized in accordance with CSA G164 “Hot Dip Galvanizing of Irregularly Shaped Articles.” Galvanized Reinforcing Steel shall conform to ASTM A143/A143M “Standard Practice for Safeguarding Against Embrittlement of Hot Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement” and ASTM A767/A767M “Standard Specification for Zinc Coated (Galvanized) Steel Bars for Concrete Reinforcement.” Test results for embrittlement shall be provided in advance of placement.

Galvanized reinforcement shall have a minimum zinc coating 610 g/m2.

905.03.02 Fabrication, Transportation, and Storage of Galvanized Steel Reinforcement

All properties including laps, splices, hooks and bends in reinforcement, etc. shall be as per CSA S6 “Canadian Highway Bridge Design Code” and the Reinforcing Steel Institute of Canada Manual of Standard Practice. Any bends developing cracks or splits shall be rejected.

The Contractor shall submit 1 hardcopy and 1 electronic copy of a detailed reinforcing steel bar schedule to the Owner’s Representative. The schedule shall show all dimensions and bending diagrams for all the reinforcing steel in accordance with ACI 315R “Guide to Presenting Reinforcing Steel Design Details.”

The Contractor retains responsibility for correctly detailing reinforcement but the schedule must be reviewed for conformity with the design. Fabrication of reinforcing steel should not proceed until review of the schedule by the Owner’s Representative has been obtained.

Contractor shall deliver, store and handle materials in accordance with manufacturer's written instructions.

Prior to delivery to site, the Contractor shall store materials off ground and in accordance with manufacturer's recommendations in a clean, dry, well-ventilated area.

The Contractor shall deliver materials to site in original factory packaging, labelled with manufacturer's name and address. The Contractor shall transport the reinforcing steel to the site and store it on racks or platforms with adequate identification.

All dirt, grease or other foreign materials shall be removed from the steel prior to the placement.

905.03.03 Placing of Galvanized Steel Reinforcement

Field bending shall not be carried out unless authorized by the Owner's Representative and heat shall not be used for this purpose. Any bends developing cracks or splits shall be rejected.

No welding shall be carried out unless specifically authorized by the Owner's Representative and if authorized, it shall be carried out in accordance with CSA W186. Welded galvanized reinforcing steel shall have two coats of zinc rich paint applied to the areas with removed or damaged galvanizing.

If galvanized steel is to be placed in contact with stainless or black reinforcing steel, direct contact between the steels shall be prevented by non-biodegradable tape or another means. Damaged galvanizing shall be repaired by the Contractor as described below.

Damaged galvanized coatings shall be repaired using a zinc rich paint as detailed in ASTM A780M "Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings." Excessively damaged or defective components, as determined by the Owner's Representative, shall be replaced with new at the Contractor's expense.

Substitutions of different size bars must have the approval of the Engineer of Record. Splicing at locations other than those specified on the drawings must be accepted by the Engineer of Record. All Contractor's requests for splices other than those detailed on the contract drawings will be at the Contractors' expense.

Reinforcing steel shall be supported and firmly held in the required positions at all times.

Bars shall be tied at all intersections except when the bar spacing is less than 250 mm in each direction, alternate intersections shall be tied. Specified distances from forms shall be maintained by supports, spacers, or other proposed means that have been reviewed and accepted by the Owner's Representative.

If reinforcement is in position for a considerable time prior to concrete being placed, then the reinforcing steel shall be re-inspected and, where necessary, cleaned and repaired using zinc rich paint. Cleaning processes shall not damage the hot dipped galvanic coating.

Bursting and spalling reinforcement shall be placed at nominal cover.

All reinforcement to be placed at nominal cover as per of CSA S6 unless otherwise stated on the contract drawings.

905.04 STAINLESS STEEL REINFORCEMENT

905.04.01 Material

The Contractor shall supply all the reinforcing steel to be incorporated in the work.

Stainless reinforcing steel bars shall be manufactured and tested in accordance with the applicable standard(s).

The yield strength shall be determined using the offset method (0.2 %).

Supports used to maintain the specified reinforcing steel concrete cover or for separation between layers of bars shall be of adequate strength, shape and dimension, and accepted for use by the Owner's Representative.

All rebar supports, bolts, chairs, and rods shall be non-metallic (fiberglass, plastic, etc). Concrete chairs shall not be used to support stainless steel reinforcing bars.

Stainless steel supports for rebar may be utilized provided that they meet the material requirements specified in this section and achieve the clear covers identified in the project documents.

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, tie wire, bolts and

rods may be fabricated of stainless steel meeting the material requirements specified in this section. If stainless steel supports are utilized there shall be no metal within 25 mm of the concrete surface after form removal. The 25mm 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.

After stripping of forms, fiberglass ties shall be cut off/broken off and grinded flush with the concrete surface. Shims or another method shall be used around the tie to protect the finished surface from damage.

Chairs positioned on Styrofoam, evafoam, or other deformable surface shall be fitted with a baseplate or other means to prevent sinking into or damage to the deformable surface.

When Stainless Steel Reinforcement is used, all formwork supports, bars, rods, chairs, etc., shall be non-metallic (fiberglass, plastic, or accepted equal). Chairs positioned on Styrofoam, evafoam, or other deformable surface shall be fitted with a baseplate or other means to prevent sinking into or causing damage to the deformable surface.

Tie wire used to tie stainless steel reinforcing bars to stainless steel reinforcing bars, reinforcing steel bars, and shear studs, shall be Type 316 LN or Type 316L, stainless steel wire, 1.2 or 1.6 mm in diameter.

Reinforcing stainless steel bars, splice bars, tie bars, dowel bars, hook-bolt dowels, and spirals shall be according to ASTM A276M “Standard Specification for Stainless Steel Bars and Shapes” and ASTM A955M “Standard Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement”, minimum Grade 420 (Minimum yield strength of 420 MPa). Stainless steel spacers, according to ASTM A276, shall be provided with the spirals. Nominal dimensions, unit masses, and deformation requirements for metric bar sizes shall be according to CSA G30.18.

Stainless reinforcing steel shall be of the following designation as defined by the Unified Numbering System (UNS):

- S31803 (2205 Duplex)

Stainless reinforcing steel shall be shot blasted and pickled at the production mill to remove all mill scale and surface oxidation.

Unless otherwise specified, only one type of stainless reinforcing steel shall be supplied for use throughout the project.

905.04.01.01.01 Mill Tests and Material Testing Requirements

All stainless steel supplied to the project shall be accompanied by mill test reports. Mill test reports for each heat number shall be legible and provided in English to the Owner's Representative a minimum of 2 weeks prior to shipping to site. The Contractor shall maintain a tracking system and records for all reinforcing steel fabricated and installed and provide this information to the Owner's Representative upon request. Mill test reports at a minimum shall include: heat number, date, and location of production, compliance with production standards, chemical analysis, mechanical properties, and pickling process details for stainless reinforcing steel. Mill test reports shall be authenticated by the manufacturer.

Where mill test reports originate from a mill outside Canada or the United States of America, the Contractor shall have mill test reports verified by a certified laboratory in Canada by testing the material to the specified material standards, including boron content. The testing laboratory shall be certified to ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories" by an organization accredited by the Standards Council of Canada for the tests required. Samples for testing shall be collected by personnel employed by the certified laboratory. A verification letter shall be provided by the certified laboratory that includes at a minimum, the applicable mill test reports, testing standards, date of verification testing, and declaration of material compliance with Contract requirements. The verification letter shall be signed by an authorized officer of the certified laboratory.

Stainless steel utilized solely as formwork or rebar supports shall be provided with a mill test report from the manufacturer; however, verification by a Canadian laboratory is not required.

905.04.02 Fabrication, Transportation, and Storage of Stainless Steel Reinforcement

All properties including laps, splices, hooks and bends in reinforcement, etc. shall be as per CSA S6 and any addenda.

The Contractor shall submit 1 hardcopy and 1 electronic copy of a detailed reinforcing steel bar schedule to the Owner's Representative. The schedule shall show all

dimensions and bending diagrams for all the reinforcing steel in accordance with ACI 315R.

The Contractor retains responsibility for correctly detailing reinforcement but the schedule must be reviewed for conformity with the design. Fabrication of reinforcing steel should not proceed until review of the schedule has been obtained.

Fabrication facilities shall follow the guidelines as set out in ANSI/CRSI–IPG4.1 “Standard Practice for Stainless Steel Reinforcing Bar Fabrication Facilities”

All bars requiring bends shall be cold bent at the fabrication facility. Heating of bars to facilitate bending will not be permitted. Any bends developing cracks or splits shall be rejected.

Bars shall be cut by shearing or with fluid cooled saws. Torch cutting will not be permitted. Bars showing evidence of torch cutting will be rejected.

Unless otherwise specified, all hooks and bends shall be fabricated using the pin diameters and dimensions recommended in the Reinforcing Steel Institute of Canada (RSIC) Manual of Standard Practice. Bars shall conform accurately to the dimensions shown on the Drawings, and be within the fabricating tolerances detailed in the RSIC Manual of Standard Practice.

Fabrication of stainless reinforcing steel shall be carried out such that bar surfaces are not contaminated with deposits of iron or other non-stainless steels; or suffer damage due to straightening or bending. Stainless reinforcing steel fabrication facilities shall be exclusive to the fabrication of stainless reinforcing bars or in a facility that provides a permanent fixed physical barrier which fully isolates fabrication processes. Fabrication shall occur only on equipment dedicated solely to fabrication of stainless reinforcing steel bars. All machinery points that come into contact with stainless reinforcing steel bars shall consist of hardened steel (minimum of 35 Rockwell), stainless steel, or nylon. All racking shall be protected with hardened steel (minimum of 35 Rockwell), stainless steel, nylon or wood.

Reinforcing steel bars shall be fabricated without laminations or burrs.

Reinforcing steel shall be covered and protected at all times during transportation.

Lifting of stainless steel reinforcing shall be completed with nylon strapping dedicated to stainless steel reinforcing bars. Fork trucks used in the handling of coil or straight stainless

reinforcing steel shall have their forks covered with hardened steel (minimum of 35 Rockwell), stainless steel, or nylon. Stainless steel reinforcing bar bundles shall be tied with plastic strapping or stainless steel tie wire and not with carbon steel or epoxy coated carbon steel strapping.

Polyethylene wrap shall be used to fully cover all stainless reinforcing steel bars and bundles for shipping. Stainless steel reinforcing bars shall also be tarped at all times during shipping with tarps dedicated for stainless steel reinforcing bars.

Reinforcing steel of differing material types shall be stored separately. Bar tags identifying the material type shall be clearly visible and shall be maintained in-place until installation of the material.

The Contractor shall store all reinforcing steel on platforms, skids, or other suitable means of support able to keep the material above the ground surface while protecting it from mechanical damage or deterioration.

905.04.03 Placing of Stainless Steel Reinforcement

Field bending shall not be carried out unless authorized by the Owner's Representative and heat shall not be used for this purpose. Any bends developing cracks or splits shall be rejected.

No welding shall be carried out unless specifically authorized by the Owner's Representative and if authorized, it shall be carried out in accordance with CSA Standard W186.

If stainless steel is to be placed in contact with galvanized or black reinforcing steel, direct contact between the steels shall be prevented by non-biodegradable, non-electrically conductive tape or another means.

Stainless bars with surface defects due to installation shall be assessed and repaired as per Section 905.04.04.

Welding of non-stainless steel shall not be permitted in the vicinity of stainless steel. If contamination of the stainless steel occurs as described in Section 905.04.04, the steel shall be repaired or replaced at the contractor's expense.

Substitutions of different size bars must have the approval of the Engineer of Record. Splicing at locations other than those specified on the drawings must be accepted by the

Engineer of Record. All Contractor's requests for splices other than those detailed on the contract drawings will be at the Contractors' expense.

Reinforcing steel shall be supported and firmly held in the required positions at all times.

Reinforcing steel containing any loose rust, scale, dirt, paint, oil, concrete, concrete paste or other foreign materials shall be cleaned or replaced to the full satisfaction of the Owner's Representative prior to being incorporated into the Work.

Bars shall be tied at all intersections except when the bar spacing is less than 250 mm in each direction, alternate intersections shall be tied. Specified distances from forms shall be maintained by supports, spacers, or other proposed means that have been reviewed and accepted by the Owner's Representative.

If reinforcement is in position for a considerable time prior to concrete being placed, then the reinforcing steel shall be re-inspected and, where necessary, cleaned prior to placement of concrete.

Bursting and spalling reinforcement shall be placed at nominal cover.

All reinforcement to be placed at nominal cover as per CSA-S6 unless otherwise stated on the contract drawings.

905.04.04 Repair of Stainless Steel Reinforcement

Individual stainless steel bars exhibiting any of the following defects prior to concrete pouring shall be repaired or replaced by the Contractor at their expense:

- Any location of contamination from grinding or cutting slag;
- Any location of iron contamination greater than 100 mm in length;
- More than 10 discrete points(1) of iron contamination on bar deformations within any 1000 mm of bar length;
- More than 20 discrete points(1) of iron contamination on bar deformations per bar; or
- More than 5 discrete points(1) of iron contamination that are not located on bar deformations per bar.

Notes:

(1) A discrete point is defined as an area of contamination less than or equal to 5 mm^2. If any area of contamination is larger than 5 mm^2, the area shall be divided by 5 to determine the number of discrete points.

Bars exhibiting excessive staining, as determined by the Owner's Representative, shall have the contaminants identified by energy dispersive x-ray analysis (EDXA) or be removed from service. Costs associated with contaminant identification or the removal of bars from service shall be carried out by the Contractor at their expense.

Removal of non-stainless steel particles from the bar shall be completed using a wire brush with stainless steel bristles.

If the wire brush proposal detailed above is not effective or not applicable to the repair needed, the Contractor may propose an alternative method of repair. Proposals for the repair of stainless reinforcing steel bars shall be reviewed by the Owner's Representative prior to implementation. If repair cannot be completed to the satisfaction of the Owner's Representative, the bar shall be replaced at the Contractor's expense.

Stainless reinforcing steel bars exhibiting signs of mechanical damage shall be replaced at the Contractor's expense.

905.05 MEASUREMENT FOR PAYMENT

905.05.01 Measurement For Payment For Reinforcing Steel Used In Those Contract Items Where The Unit Of Measurement Is Stated In Tonnes.

For those contract items where the unit of measurement for "Black Steel Reinforcement", "Galvanized Steel Reinforcement", and "Stainless Steel Reinforcement" on the Unit Price Table is stated in tonnes, then the total length of reinforcing steel used in the construction will be measured for payment. The payment quantity shall be determined by multiplying the lengths of reinforcing bars actually placed in the structure by its weight per metre according to the following table:

BAR DESIGNATION	MASS WEIGHT KG/M
10M	0.785
15M	1.570
20M	2.355
25M	3.925

30M	5.495
35M	7.850

The total value will be converted to tonnes, calculated to two decimal places. Where substitution has occurred, the theoretical value will apply. Only that steel required by the contract drawings will be measured.

No allowance will be made for clips, wire, chairs, or other material used to fasten reinforcing steel in place. Measurement for payment purposes shall not be made for diaphragm inserts.

That reinforcing steel placed in concrete girders, double tees, or any other precast component shall not be included in the measurement for payment. Payment for this steel will be included with supply of precast component or concrete girder.

Measurement for payment purposes will not be made for lap lengths if the bars are less than 11 metres long unless the lap is specifically indicated on the contract drawings.

905.05.02 Measurement For Payment For Reinforcing Steel Used In Conjunction With Those Contract Items Where Reinforcement Is Considered Incidental To The Work.

Where reinforcement is considered incidental to the work, no reinforcing steel will be measured for payment purposes. Items where reinforcing steel is considered incidental are catch basins, manholes, toe walls, head walls for culverts not greater than 1,500 mm diameter, footings for stairs, encasements for pipes not greater than 600 mm diameter, collars for pipes or other items as defined in the contract.

905.06 BASIS OF PAYMENT

“Black Steel Reinforcement”, “Galvanized Steel Reinforcement”, and “Stainless Steel Reinforcement” shall be priced separately under the item “Supply and Place Reinforcing Steel Except in Prestressed Girders” of the Unit Price Table.

Payment at the contract price for "Black Steel Reinforcement,” “Galvanized Steel Reinforcement,” and “Stainless Steel Reinforcement,” in the Unit Price Table shall be full compensation for providing all test certificates, supplying all materials at the work site, for storing, protecting and cleaning the reinforcing steel as required, for bending, cutting and welding the reinforcing steel, for placing the reinforcing steel in the work; for supporting the reinforcing steel during the placing, compacting and setting of concrete, and for such

other work as may be required to complete the supply and placing of reinforcing steel as outlined in this section.

The supply of reinforcing steel at the work site properly stored and protected and in proper condition for incorporation into the work shall be deemed for progress payment purposes to constitute 75% of the work to be carried out under the Item "Supply And Place Reinforcing Steel Except In Prestressed Girders".

SECTION 906

PRESTRESSED CONCRETE MEMBERS

INDEX

906.01 SCOPE

This section covers all prestressed components used in bridge structures and includes both pre-tensioning and post-tensioning methods.

The Contractor shall furnish all labour, materials, equipment, plant and services specified, indicated or required to manufacture, transport, store and install the prestressed concrete and/or prestressed steel components in accordance with the plans and specifications.

906.02 GENERAL

Post-tensioning in general, post-tensioning materials, grouting, preparations for post-tensioning, application and measurement of prestressing force shall conform to CSA A23.1 “Concrete Materials and Methods of Concrete Construction.”

Cast in place concrete or optionally precast at the site shall conform to CSA A23.1.

Precast concrete and pre-tensioning operations shall conform to CSA A23.4 “Precast Concrete – Materials and Construction.”

Welding will not be permitted within 3.0 metres of any tendon without adequate protection of the prestressing steel from welding sparks. Under no circumstances shall prestressing steel be used to ground welding equipment.

906.02.01 Design Submissions

For Department provided girder designs, Contractor shall provide shop drawings meeting the requirements of 906.02.03. Drawings shall clearly indicate any Contractor specified components such as, but not limited to, hold downs, hold ups, lifting anchors, etc.

For non-Department provided girder designs, or a design which, in the Department’s opinion, has been significantly modified by the Contractor, the Contractor shall provide calculations in accordance with Section 927. In addition, the following shall apply:

1. The Contractor is responsible for all costs associated with the design and implementation of the alternate girders. This includes but is not limited to: the design and implementation of any changes to the structure that are required to accommodate the Contractor’s design, bearing details, screed elevations, haunch elevations, and abutment modifications.
2. The design live load and design reactions for the girder will be clearly stated on the shop drawings. If requested by the Owner’s Representative, the reactions for different load cases shall be provided.

906.02.02 Approvals and Casting

The Contractor shall clearly indicate at the preconstruction meeting their intention to cast the concrete members on site or at an accepted plant. The method of prestressing to be used shall be either pre-tensioning or post-tensioning as detailed on the drawings unless otherwise accepted.

Prior to construction of pre-tensioned members, the Contractor shall submit to the Owner’s Representative for review the name of the plant from which it is intended to order the members. Only members supplied from a plant, accepted by the Owner’s Representative, will be accepted for payment.

906.02.03 Prestressing Method

Prior to casting any concrete to be prestressed, the Contractor shall submit to the Owner's Representative for review 1 Hard copy and one 1 Electronic copy of: 1 set of metric design calculations and a complete set of metric drawings. These details shall outline the method and sequence of stressing and shall include but is not limited to: complete specifications and details of the prestressing steel and anchoring devices, e.g. anchorage block out dimensions and angles, anchoring stresses, elongation calculations, type of enclosures, and all other data pertaining to the prestressing steel in the members, pressure grouting materials and equipment, size and spacing of diaphragm and end block reinforcement, where applicable.

The prestress supplier shall determine the prestress anchorage bearing plate/casting as well as the spiral steel directly behind and adjacent to the same.

906.02.04 Inspection and Testing

At all times the Owner's Representative and Engineer of Record shall have the right to inspect and accept all methods, plant and materials involved. This shall include the right to momentarily stop jacking in order to measure the elongation and jacking pressure from initial to final load on as many cables as deemed appropriate by the Owner's Representative and/or Engineer of Record.

906.02.05 Member Top Flanges

Members whose top flanges become the bottom form for the deck slab shall have the flange designed to safely accommodate all temporary construction loads.

The top surface of prestressed members, against which new concrete is to be placed, shall be intentionally roughened while it is sufficiently plastic so that the depth of the indentations is at least 5 millimetres and the spacing is not greater than 15 millimetres. All concrete surfaces against which new concrete is to be placed shall be clean, sound, and free from any loose particles and laitance.

906.02.06 False work

Sound, adjustable false work in accordance with Section 907 shall be required to compensate for any settlement such that the structure, particularly the soffit, is constructed true to line and grade. The prestressed concrete is not self supporting until stressing, anchoring, grouting and proper curing have been carried out. Except as noted on the contract drawings and as outlined in the Specifications, false work may be removed after these operations have been completed. The prestressing ducts, strands and anchorages must be accurately and rigidly fixed in position before any concrete is placed.

In addition to the requirements of Section 907, forms for prestressed members shall also meet the following requirements:

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

2. Forms 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.

3. Forms used for prestressed members shall be inspected by the Owner's Representative prior to use. Formwork which is damaged, deformed or is otherwise deemed unacceptable by the Owner's Representative shall be replaced at the Contractor's expense. Examples of unacceptable formwork includes, but is not limited to, the following:

    1. Formwork which has gaps between formwork connections or is otherwise not mortar tight.

    2. Formwork surfaces or connections that have one or more forming surface deformations or inconsistencies 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 sections will not be considered acceptable.

906.03 MATERIALS

906.03.01 Concrete

All concrete work shall conform to the requirements of the Section 904, unless otherwise stated herein.

The minimum ultimate compressive strength of the concrete shall be as shown on the plans and at the time of tensioning shall be verified by the Owner's Representative from the results of the field cured test cylinders.

Care shall be taken to ensure that the test cylinders are compacted and cured under conditions similar to the conditions acting on the concrete in place. At least 3 specimens

shall be tested from each batch prior to tensioning the cables and at least 3 specimens at 28 days.

No concrete shall be deposited in the forms until the placing of reinforcing steel, enclosures, anchorages and prestressing steel has been inspected and accepted by the Owner's Representative.

An inspection and testing company may be appointed by the Owner's Representative to inspect and control quality of materials. If so, separate payment will be arranged for by the Department. The Contractor shall provide, without charge, all materials required for test purposes and give all necessary cooperation.

906.03.02 Reinforcing Steel

If the steel used in the deck is black steel reinforcement or galvanized steel reinforcement, the reinforcing steel in prestressed members shall meet the requirements of "Galvanized Steel Reinforcement" in Section 905 unless noted otherwise in the contract documents.

If the steel used in the deck is stainless steel reinforcement, the reinforcing steel in the prestressed members shall meet the requirements of "Stainless Steel Reinforcement" in Section 905 unless noted otherwise in the contract documents.

906.03.03 Prestressing Steel

All prestressing steel shall be protected against damage, rust and other corrosion and shall be free of all dirt, oil, grease and other deleterious substances when finally grouted in the deck. Splicing of prestressing steel bars only shall be permitted to manufacturers' specifications. Splicing of strands or wire is not permitted.

All prestressing steel from each manufactured reel of wire, strand or mill heat of bar to be shipped to the site, shall be assigned an individual lot number and shall be tagged in such a manner that each such lot can be accurately identified at the job site. All unidentified prestressing steel received at the site will be rejected.

The Contractor shall furnish one sample, 1500 mm long from each manufactured reel of wire, strand or mill heat of bar prestressing steel for testing purposes. The Owner's Representative will select the samples of prestressing steel from the job site and all materials for testing shall be furnished by the Contractor at their own expense.

The Contractor shall have no claim for additional compensation in the event their work is delayed awaiting review of the materials.

The approval of any material by the Owner's Representative shall not preclude subsequent rejection if the material is damaged in transit or later damaged or found to be defective.

Prestressing steel shall be high tensile strength 7-wire strand or bar as shown on the contract drawings, fabricated, sampled and tested in accordance with the requirements of ASTM A 416/A 416M "Specification for Steel Strand, Uncoated, Seven Wire for Prestressed Concrete" and ASTM A 421/A 421M "Standard Specification for Uncoated Stress Relieved Steel Wire for Prestressed Concrete" and to the satisfaction of the Owner's Representative. Storage of prestress steel and components shall be in accordance with ASTM A 416/A 416M and ASTM A 421/A 421M and the environment shall not be wet, humid or subject to the accumulation of moisture.

2 copies of the mill certificate and 2 copies of the stress-strain curves representative of the actual lots to be used shall be submitted to the Owner's Representative with samples.

Prestressing steel shall be high tensile strength 7-wire strand or bar as shown on the contract drawings, fabricated, sampled and tested in accordance with the requirements of 416/A 416M and A 421/A 421M.

Tendons shall consist of parallel wires or strands composed of the required number of high tensile, cold-drawn, low-relaxation (stabilized) strands. Positive end anchorage shall be provided on each end of the tendon after threading through the terminal hardware. The tendon shall be enclosed in mortar-tight flexible metal conduit.

The pre-assembled connection between the conduit and the end bearing assemblies shall be adequate to ensure a mortar tight enclosure from terminal to terminal. The anchor shall provide for grout passage into the tendon. The supplier of the tendons shall furnish grout fittings for attachment to the terminal hardware.

High tensile strength steel shall be from steel made by the open hearth, electric furnace or basic oxygen process to produce the desired high tensile strength. Strand shall have a nominal diameter of 15.24 millimetres, minimum ultimate tensile strength of 260.6 kN and a nominal end area of 140.0 square millimetres per strand, or as otherwise indicated on the contract drawings.

Steel grade shall be 1860 MPa unless otherwise specified on the contract drawings.

Oil tempered steel shall not be employed for use in prestressed concrete construction.

The complete stress-strain curve for the steel shall be obtained for each heat or lot of steel used in the entire project and shall be used as data for stressing of the steel of that particular heat or lot. Steel shall be clearly identified during transportation and storage.

The Contractor shall furnish one entire tendon complete with anchorages, one complete coupling device and all hardware for testing and evaluation purposes unless waived by the Department. If the tendon and/or associated hardware has not been previously used in Newfoundland and Labrador, the Contractor shall supply a sample for evaluation and testing purposes. Any components which in the opinion of the Owner's Representative, fall below the quality of the sample provided shall not be used in the works.

906.03.04 Ducts

Ducts for prestressing steel shall be made of accepted galvanized rigid or semi-rigid corrugated steel tubing with mechanical joint connections of the diameter as shown on the drawings. Rigid ducts shall have a minimum wall thickness of 0.60 millimetres and be capable of being bent to a minimum inside radius of 9 metres without distress. Semi-rigid ducts shall have a minimum wall thickness of 0.25 millimetres and be capable of being bent to a minimum inside radius of 3.5 metres without distress. The wobble friction coefficient (k) shall not exceed 0.0023 per metre and 0.0033 per metre for rigid and semi-rigid ducts respectively. The curvature friction coefficient (μ) shall not exceed 0.20 for both duct types. Rigid ducts shall be used for longitudinal tendons and semi-rigid ducts used for transverse tendons unless otherwise specified in the contract documents.

Ducts shall be watertight and of sufficient strength to withstand all forces imposed upon them during placing of concrete without denting, sagging or leaking. All ducts and anchorage assemblies shall be provided with any necessary air vents and pipes for the injection of grout after prestressing. Grouting ducts and vents shall be located at all high points and at both ends of all longitudinal tendons. For transverse tendons, grouting ducts and vents shall be located at both ends of all tendons and at all high points when the vertical distance between the lowest and highest point in the duct exceeds 400 millimetres.

906.03.05 Anchorage Assemblies

The anchorages shall be of an accepted type as indicated on the contract drawings for the size of tendons shown on the drawings complete with all required spiral reinforcement.

Anchoring hardware shall meet the minimum requirements set forth in CSA A23.1. Moreover, the anchorage components, i.e. the bearing plate, wedges, anchor head and/or casting to develop at least 100% of the ultimate tendon capacity but the prestressing steel as anchored is permitted to fail at 95% of the ultimate tendon capacity.

All reinforcement, duct work, cones and/or anchorages shall be fastened firmly so that no movement can occur when concrete is placed. Anchorages shall be held tight to the end forms so that no laitance can leak down the face of the cone or bearing plates. Enclosures shall be protected against the entrance of foreign matter prior to grouting particularly in cold weather.

The anchorages shall be placed in the position shown on the contract drawings. The axis of the anchorage must coincide with the axis of the cable passing through it. Details of end anchorages, i.e. block out dimensions and angles shall be determined by the prestress supplier in coordination with the Owner's Representative.

906.03.06 Round Void Forms

When required the type of round void form used shall be in accordance with the following table:

OUTSIDE DIAMETER OF VOID	TYPE OF ROUND VOID FORM
OVER 930 MM	1.2 MM GALVANIZED CORRUGATED METAL PIPE
630 MM - 930 MM	1.0 MM GALVANIZED CORRUGATED METAL PIPE
UNDER 630 MM	1.0 MM GALVANIZED CORRUGATED METAL PIPE OR SONOVOID TUBES, TYPE D, 100% DUROBOARD OR ACCEPTED EQUAL

Metal void forms shall have outside diameter (top of corrugations to top of corrugation) equal to the diameter of the voids shown on the drawings.

Void tubes made of fibrous material shall be protected against damage during storage and handling and shall be protected from moisture and water at all times. Adequate ventilation shall be provided to prevent damage due to humidity. The void tubes shall not be stored on the site for more than seven days before installation.

The void tubes shall be designed to withstand the forces imposed on them during concreting and until the concrete has set up, without deformation such as bulging, sagging or collapse.

Damaged tubes shall not be used.

All void tubes must be accurately placed and rigidly fixed in position before any concrete is placed. The Contractor shall pay particular attention to the buoyancy of the voids and adequate measures shall be taken to counteract the same. No concrete shall be placed until the installation of the tubes has been inspected and accepted by the Owner's Representative.

906.03.07 Other Components

Other components, including but not limited to, dowels, hold-downs, or other inserts shall be hot dipped galvanized, with the exception of threaded dowel inserts, which shall be hot dipped galvanized or painted with a zinc rich metallic paint.

906.04 DIMENSIONAL TOLERANCES

The following dimensional tolerances will be allowed:

LENGTH	= ± 10 MM
CROSS SECTION	= ± 3 MM FROM EACH DIM. (NOT CUMULATIVE)
TENDON POSITIONING	= ± 3 MM FROM EACH DIM. (NOT CUMULATIVE)
CONCRETE COVER	= ± 3 MM FROM EACH DIM. (NOT CUMULATIVE)
ALIGNMENT	= ± 3 MM MAX. IN ANY 3 M LENGTH
CAMBER DIFERENTIAL BETWEEEN ADJACENT PRESTRESSED MEMBERS	= 20 MM MAX.

In addition, camber in the prestressed members immediately after stressing or de-tensioning shall not vary more than 50% of the calculated value. Camber due to member dead load only, at the time of placing the deck slab, shall not be more than 20 millimetres greater than the initial camber without review by the Owner's Representative and Engineer of Record.

Deck slab surface under full dead load shall be to the grades indicated on the drawings. The deck slab thickness shall be constant between the top flanges of adjacent members. In order to meet these criteria the Contractor shall haunch the deck slab over the member or protrude the member a maximum of 20 millimetres into the deck slab or both, as indicated on the drawings.

For prestressed slab superstructures the deck slab surface and soffit shall be to the grades indicated on the drawings immediately after stressing, unless otherwise indicated in the contract documents.

906.05 PLACING CONCRETE, STRESSING AND GROUTING TENDONS

The minimum concrete strength at stressing shall be 30 MPa unless otherwise specified on the contract drawings.

906.05.01 Placing

Concrete must not be deposited in the forms until the Owner's Representative has inspected the placing of the reinforcement, ducts, anchorages, prestressing steel and has given their acceptance thereof.

Bar reinforcing steel and prestressing steel shall be placed accurately at the locations shown on the drawings or accepted by the Engineer of Record. The distance from the forms shall be maintained by plastic bar chairs, spacers, hangers or hold down devices. Within a 5.0 metre longitudinal distance from support locations i.e. piers and abutments, a tolerance of ± 6 millimetres will be permitted in the placing of prestressing ducts. At all other locations a tolerance of ± 12 millimetres will be permitted.

Post-tensioning ducts must be held securely at intervals of 500 millimetres or less against vertical or horizontal displacement from true alignment during the placing of concrete.

Holes shall be provided for anchor dowels and for diaphragm dowels which pass through the member, openings for connection rods, recesses for grout and holes for railing bolts in the members shall be provided in accordance with the details shown on the drawings.

Where diaphragm dowels do not pass through the member, the dowels shall be anchored in the member by embedment in the concrete or by means of accepted threaded inserts.

Where openings for diaphragm dowels are provided, these dowels shall be grouted in place after the installation of the member in the structure.

Where continuous prestressed concrete slab type construction is required, the deck shall be cast in one continuous concrete placing operation commencing at the lower end of the structure.

The concrete must be vibrated externally and can be vibrated internally as required to consolidate the concrete. The vibrating shall be done with care and in such a manner

that reinforcing steel, ducts and prestressing steel will not be displaced. Vibrators shall operate at a minimum frequency of 160 Hz for the internal type and 60 Hz for the external type.

All curing methods shall be subject to the Owner's Representative's review. Curing shall be in accordance with Section 904.05.

906.05.02 Prestressing Technician

The Contractor shall provide at their own expense a technician familiar with the type of prestressing involved, accepted by the Owner's Representative, to supervise all prestressing work. This technician shall be present at the completion of the steel installation and just prior to concreting operations, at stressing and grouting operations.

The prestressing supplier shall formally certify in writing that the stressing technician being employed on the works has sufficient knowledge and experience to undertake and successfully complete the prestressing, grouting and associated work.

906.05.03 Stressing

All prestressing steel shall be stressed by means of hydraulic jacks which shall be equipped with accurately calibrated hydraulic pressure gauges, damped from vibration, with a dial not less than 150 millimetres in diameter, to permit the stress to be computed at any time. A certified calibration curve shall accompany each jack, showing the relationship between gauge readings and stress in the ram for both ascending and descending movements of the ram. In general monostrand jacks shall not be used for stressing multi-strand tendons unless specifically accepted by the Designer. A monostrand jack shall be present on site during stressing operations or be available to the Contractor within a 48 hour delivery period should the need arise

A load cell attached to the jack will be accepted, as an alternative to the above, as a means of obtaining the force in the tendon provided the accuracy of the load cell is attested to by an authority acceptable to the Owner's Representative.

The stressing operation shall be conducted in a manner recommended by the manufacturer of prestressing material and only in the presence of the Owner's Representative or designated representative.

The supervisor in charge of the tensioning shall be provided with the required extension of the tendons and the jack pressure. The extension shall be carried out at an even rate, jack pressure and extension shall coincide with the required extension and pressure at the time of anchoring, due allowance being made for anchorage slippage at both ends of

the tendons. The permissible variation in specified prestress shall not be more than 95% to 100% of the theoretical jacking force or pressure for both longitudinal and transverse tendons. Moreover, the permissible variation in specified elongation shall not be more than ± 5% of the theoretical elongation for longitudinal tendons. For transverse tendons the permissible variation in specified elongation shall not be more than ± 5% of the theoretical elongation or ± 10 mm whichever is greater.

The stress in the tendons shall be measured by means of the extension of the tendons and shall be continuously checked by means of the pressure gauge on the jack. The accuracy of the jack pressure gauge shall be checked periodically. The zero error in the jack pressure shall be determined by plotting a few straight pressure readings against jack extension and extending the straight line back to determine the zero intercept.

The stressing shall be carried out as shown on the contract drawings. The tensioning shall not be commenced until the tests on the concrete cylinders, manufactured and cured under the same conditions as the prestressed member, indicate that the concrete of the member has attained the required compressive strength as shown on the contract drawings.

After the concrete is placed, no tensioning will be permitted until it is demonstrated, to the satisfaction of the Owner's Representative, that the prestressing steel is free and unbounded in the enclosure.

Any tendon in which the accuracy of the extension is doubted shall be de-stressed and restressed in the presence of the Owner's Representative.

Records of elongation, calibrated jack force readings and slip shall be kept by the Owner's Representative. Until such acceptance is obtained in writing, no tendons shall be grouted.

The prestressed steel shall be anchored at a stress that will result in the ultimate retention of working forces or stresses of not less than those shown on the plans, but in no case shall the steel be tensioned above 80% of the ultimate strength. Losses in stress due to creep, plastic flow, elastic flow and shrinkage of concrete plus creep of steel and sequence stressing, shall be computed in accordance with CSA S6 "Canadian Highway Bridge Design Code."

Prestressed strands which have been stressed and meet project criteria shall be cut off with a saw; a torch is not acceptable. The Contractor shall leave 25-50 millimetres of strand protruding beyond the visible end of the wedge.

906.05.04 Bonding And Grouting

906.05.04.01 General

The Contractor shall sandblast all concrete surfaces in anchorage boxout areas and fill the boxout with concrete of a quality similar to that used in the member. For anchorages without the tendon end cap, anchorage recesses or boxouts are to be sandblasted and filled with concrete before grouting operations commence.

All post-tensioned prestressing steel shall be bonded to the concrete by pressure grouting the ducts or openings. All stressing shall be completed before grouting begins. All areas around post-tensioned cables, strands, tendons or rods shall be completely filled with high early strength non-shrink grout.

The grouting procedure shall be reviewed by the Owner's Representative.

Generally this work shall be done as soon as the prestressing steel has been stressed and accepted and in no case shall any tensioned prestressing steel be left ungrouted for more than 7 days after prestressing.

In the case of post-tensioned slabs which contain both longitudinal and transverse prestressing steel, the maximum time permitted between the beginning of the stressing sequence and the grouting of the last cable shall not exceed two weeks.

Stressing and grouting sequences of longitudinal and transverse tendons shall be as outlined in the contract documents. The maximum time permitted between the beginning of stressing and grouting of the last cable shall not exceed two weeks.

All ducts or openings shall be clean and free of all foreign materials that would impair bonding of the grout. Each duct or opening shall be thoroughly blown out with compressed air immediately prior to grouting. Where it is found necessary, in the opinion of the Owner's Representative, the duct or opening shall be flushed out with water, prior to use of compressed air. The concrete shall have a temperature of at least 5 degrees Celsius at the time of grouting and shall be maintained at this temperature or higher for a period of at least 48 hours. If necessary this may include preheating the structure and maintaining protection for a period of three days after the grout is placed. The temperature of the grout at the time of injection shall be not less than 16 degrees Celsius nor more than 27 degrees Celsius.

906.05.04.02 Grout Materials and Grouting

Cementing materials shall consist of Type GU Portland cement and silica fume. The cement shall be according to OPSS.MUNI 1301 “Cementing Materials” and certified to be free from early stiffening tendency when tested according to CSA A3000 “Cementitious Materials Compendium.” Silica fume shall be according to CSA A3000 and in an uncompacted form. Silica fume shall constitute a 6% replacement by mass of cement in the dry grout mixture.

Superplasticizer shall be a non-retarding naphthalene sulphonate in powdered form. Superplasticizer shall constitute 1.5% by mass of cementing materials in the dry grout mixture.

Aluminum powder shall be according to ASTM D 962 “Standard Specification for Aluminum Powder and Paste Pigments for Paints” Type 1, Class C, and coated with 2.5 to 3.0% stearic acid. Aluminum powder shall be used in a quantity sufficient to provide the expansion specified herein.

Water for testing grout mixture shall be according to OPSS.MUNI 1302 “Water”.

The grout shall not bleed or segregate when allowed to stand for 1 hour immediately after mixing.

The grout shall expand by 6% ± 2% of its original volume when measured at 1 hour after mixing.

The time for the grout to flow through the flow cone shall be between 11 and 25 seconds when the measurements are performed immediately after the grout is removed from the mixer and shall remain between 11 and 25 seconds, when measured 30 minutes after mixing.

Cubes made from the grout shall have a minimum specified 28-Day compressive strength of 60 MPa.

Grout shall have a maximum water: cement ratio of not more than 0.36, not contain any trace amounts of chlorides, contain at least 6% of silica fume by weight, contain an accepted superplasticizer and an accepted expansive agent. Masterflow 1205 High Performance Duct Grout manufactured by Master Builders Inc. and MS Cable manufactured by King are two grouts which are accepted by the Department. Accepted equivalent grouts as determined by the Owner’s Representative may also be utilized.

The grout mix design and representative samples shall be submitted for review at least 14 days in advance of anticipated use. The mix design must be accepted by the Owner's Representative prior to grouting. The grout shall be mixed and placed as per the manufacturer's instructions and under the supervision of the Owner's Representative. The compressive strength of the grout shall be at least 40 MPa in 4 days. Strength tests shall be performed on 50 millimetre cubes, stored and tested in accordance with ASTM C109 "Standard Test Method for Compressive Strength of Hydraulic Cement Mortars."

The Contractor shall be responsible for all mix design and quality control of grout production and placing. Quality control and assurance of the grout from a testing viewpoint shall be provided by the Department.

When allowed to stand for 15 minutes, the grout shall not bleed or segregate. At the time of initial set, the grout shall exhibit an expansion of 6% (± 2%) of its original volume.

Grouting equipment shall be capable of grouting to a pressure of at least 1.5 MPa with a 19 millimetre minimum inside diameter grout hose, maximum pressure 1.7 MPa.

Alternatively, the grouting equipment shall be specifically designed for the job and accepted by the Owner's Representative.

Grout shall be mixed in an accepted mechanical mixer, that provides for straining and re-agitating the grout before it is used. Time between mixing and pumping the grout shall not exceed 40 minutes.

Retempering the grout will be prohibited.

The grout shall completely fill the duct or opening and shall be allowed to flow continuously and freely for 5 seconds at the outlet end of the duct or opening. In case the continuity of grouting is interrupted, the duct or opening shall be immediately cleaned out. A dependable high pressure air and water supply shall be on hand during grouting.

After grout has set, all exposed vents and hoses, in finished concrete surfaces are to be removed 50 millimetres from the finished surface. The resulting void or cavity must have all debris removed and be thoroughly cleaned. The void or cavity should be filled with SET 45, manufactured by Master Builders or an accepted equal. The Contractor shall follow the Manufacturer's recommendations and specifications in the mixing and placing of SET 45.

906.05.05 Concrete Finishing

Top flanges or surfaces which concrete will be poured against shall be finished as per 906.02.05.

Concrete surfaces which are to be exposed to weather, such as the outside faces of exterior girders, or as otherwise indicated in the contract documents shall be sealed as per Section 924.

906.05.06 Treatment at Ends of Members

The prestressing tendons at ends of members that are to be encased in concrete shall be cut flush with the ends of the beams.

Pretensioning tendons at the end of members that are not to be encased in concrete shall be cut back to recess the cable 25 millimetres from the end of member. The recess shall be cleaned and filled with a suitable patching material.

Concrete surfaces at the ends of the members that are not to be encased in concrete shall be coated with elastomeric coating.

906.06 HANDLING AND INSTALLATION OF PRESTRESSED MEMBERS

At least 7 days before starting work, the Owner's Representative shall be fully informed as to the method of handling, installation and the amount and kind of equipment proposed for use. The Contractor shall comply with the provisions of the Highway Traffic Act and make all necessary arrangements with the authorities for permission to transport.

The Contractor shall exercise extreme care in handling, storing, moving and erecting precast prestressed concrete members to avoid twisting, racking or other distortion that would result in cracking or damage to the members. The Contractor shall handle, transport and erect precast prestressed members in an upright position and keep the points of support during lifting, storing, transportation and erection within 600 mm of the points of support in the final structure. The Contractor shall not permit the reactions of the lifting devices to be inclined to the vertical at an angle greater than thirty degrees. Holes provided for lifting shall be filled with mortar when members have been placed.

The Contractor must decide upon the method by which they plan to lift the prestressed girders and submit design calculations signed and stamped by a Professional Engineer licensed to practice in the Province of Newfoundland and Labrador.

Prestressed concrete girders shall not be moved or transported until the grout has attained 30 MPa. False work shall not be removed from continuous prestressed concrete structures until the grout has attained 30 MPa. Loads in addition to member self-weight shall not be placed on the prestressed concrete members until the grout has attained 30 MPa. Grout samples shall be taken, field cured and tested to establish the appropriate time to move or transport girders, remove false work or apply loads to prestressed concrete structures. Grout samples shall also be obtained and tested for acceptance purposes.

906.06.01 Temporary Bracing

The Contractor is responsible for the stability of the prestressed girders during placing and until the diaphragms are in place.

Temporary bracing for members shall be designed according to CSA S6 using a wind load specific for the location and having a minimum return period of 10 years if the members are to be fabricated and permanently connected within the same construction season. Temporary bracing shall be designed by a Professional Engineer licensed to practice in Newfoundland and Labrador.

The supply and installation of the bracing, including all cast-inserts and fixings, at external girder ends shall be considered incidental to the work

It is the responsibility of the Contractor to ensure that girder stability is maintained at all times including during and after stressing, and under the weight of the wet slab, until the slab is cured. The brace, inserts, and plates as detailed on the contract plans to provide stability to the exterior girders during deck construction will be considered incidental to the supply and installation of the girders.

906.07 STORAGE OF PRESTRESSED MEMBERS

The period between stressing of a concrete member and the application of permanent dead loads shall not be greater than 6 months without the approval of the Engineer of Record. The Contractor shall be responsible for the monitoring of member(s) in storage including the monitoring of any cambers or other relevant dimensions as directed by the Engineer of Record and/or the Department.

No payment will be made until prestressed members are delivered to the installation site and accepted by the Owner’s Representative.

906.08 MEASUREMENT FOR PAYMENT

906.08.01 Prestressed Concrete Members Other than Post-Tensioned Slabs

The quantity of prestressed members supplied and erected for which payment shall be made shall be the total number of members required as shown on the plans.

906.08.01.01 Supply of Prestressing Steel and Accessories

Prestressing tendons including anchorages will be considered incidental to the cost of supplying any prestressed members other than post-tensioned slabs.

906.08.02 Prestressed Concrete In Post- Tensioned Slabs

906.08.02.01 Concrete

Measurement for payment will be by cubic metres of concrete placed based on neat lines shown on the plans. No deductions will be made from the volume of concrete for reinforcing or prestressing steel, anchorages or inserts. Deductions for any design voids will be made. The quantity shall include the volume of concrete in curbs, sidewalks, medians, parapets, including those on the wingwalls or as otherwise shown on the plans.

906.08.02.02 Supply of Prestressing Steel and Accessories

The quantity of prestressing tendons including anchorages for which payment shall be made shall be the total number of tendons required as shown on the plans. This will be considered incidental to the cost of the prestressed concrete in post tensioned slab structures.

906.08.02.03 Concrete Surface Finish

Payment for concrete surface finish on prestressed members shall be incidental to the supply of the member.

906.08.03 Concrete Sealing

Payment for concrete sealing shall be incidental to “Installation” for the concrete member.

906.09 BASIS OF PAYMENT

906.09.01 Prestressed Concrete Members Other than Post-Tensioned Slabs

Payment at the contract price for ”Prestressed Concrete Members Other than Post-Tensioned Slabs” in the Unit Price Table shall be full compensation for all materials, labour, equipment, plant and services necessary to complete the prestressed concrete work in accordance with the plans and as described herein.

In particular, no separate payment will be made for:

a) Supply of cement, aggregates and other materials, plant or equipment for producing the concrete.
b) Supply and placement of grout.
c) Form work and false work.
d) Supply and installation of void tubes including all drain tubes, air vents, bracing, non-corrosive chair supports, splices and end closures.
e) Sandblasting the construction joints.
f) Supply and apply accepted bonding adhesive.
g) Supply and installation for reinforcing steel except that in post-tensioned slabs.
h) Transporting and storing prestressed concrete members.
i) Any post construction jacking of the superstructure.
j) Supply of prestressing steel and accessories

Payment for prestressed concrete members, such as AASHTO or CPCI Girders and double tees, will be under "Prestressed Girders" “Supplied” and “Installed” as appropriate.

Payment for the supply of all materials, equipment, and labour to construct and transport these prestressed members shall be on a per unit basis as per bid under item “Supplied” under “Prestressed Girders”.

No payment will be made until prestressed members are delivered to the installation site and accepted by the Owner’s Representative.

Payment for the supply of all materials, equipment, cranes, and labour required to place the pre-stressed members and install temporary bracing shall be on a per unit basis as per bid under item “Installed” under “Prestressed Girders.”

Payment for “Installed” shall be made once the girders have been properly placed, without damage, into their final position and required temporary bracing has been installed.

906.09.02 Post-Tensioned Slabs

Payment for concrete in post-tensioned slabs will be as per “Superstructure Concrete” in Section 904, "Concrete Structures".

Payment at the contract price shall be full compensation for all materials, labour, equipment, plant and services necessary to complete the prestressed concrete work in accordance with the plans and as described herein.

In particular, no separate payment will be made for:

a) Supply of cement, aggregates and other materials, plant or equipment for producing the concrete.
b) Supply and placement of grout.
c) Form work and false work.
d) Supply and installation of void tubes including all drain tubes, air vents, bracing, non-corrosive chair supports, splices and end closures.
e) Sandblasting the construction joints.
f) Supply and apply accepted bonding adhesive.
h) Transporting and storing concrete members.
i) Any post construction jacking of the superstructure.

Payment for reinforcing steel in post-tensioned slabs shall be as detailed for the appropriate bid item in Section 905.

Payment for prestressing steel and accessories in post-tensioned slabs shall be as per 906.09.03.

906.09.03 Supply of Prestressing Steel and Accessories

When provided in the Contract Documents, payment at the contract price for "Supply Of Prestressing Steel And Accessories" in the Unit Price Table shall be full compensation for all materials, labour, services, plant and equipment necessary for the supply, delivery, installation and stressing of the tendons including all anchorages, bursting and spalling or end block steel and grouting as required in accordance with the contract drawings and this specification.

For post-tensioned slab structures, the materials, fabrication and placing, cost of bursting and spalling or end block steel shall be paid for under Section 905.

906.09.04 Concrete Surface Finish

Payment for concrete surface finish on all prestressed members shall be incidental to the cost of the member.

906.09.05 Concrete Sealing

Payment for concrete sealing shall be incidental to “Installation” for prestressed concrete members other than post-tensioned slabs.

Payment for concrete sealing shall be incidental to the cost of concrete for post-tensioned slabs.

906.09.06 Rejection

Honeycombing, distortion, warping, cracking, improper grouting or other evidence of inferior workmanship or failure to meet the requirements of these specifications shall be cause for rejection of any member.

Minor surface cavities or irregularities which are satisfactorily repaired shall not constitute cause for rejection. Repairs shall not be made until the Owner's Representative has inspected the extent of the irregularities and has determined whether or not the concrete member will be rejected.

Final acceptance of members will not be made until they have been installed in the structure. Members that have been tentatively accepted at the manufacturing plant but are damaged in transit shall be replaced by the Contractor at their own expense.

Erection by a non-accepted method may be cause for rejection.

SECTION 907

FORMWORK AND FALSEWORK

INDEX

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 1.5 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.

Form ply 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 BRIDGE RAIL END BLOCK RECESSES

When shown on the contract drawings, the Department shall supply 4 800x450x19 plywood panels, complete with Teflon 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 bridge rail 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.

SECTION 908

DOWELS

INDEX

908.01 SCOPE

The scope of this section is to cover the supply, material, fabrication and placement of dowels in substructure and superstructure where drilling and grouting of rock or existing structure is required.

Dowel is defined as a deformed coated reinforcing steel bar, reinforcing steel bar or stainless steel reinforcing bar placed into a hole of specified dimensions drilled into a concrete structure and bonded to the concrete by dowel adhesive.

Dowel Adhesive is defined as an epoxy or acrylic resin adhesive used to secure the dowel in concrete, rock or another material.

Dowel Grout is defined as a mixture of water cement, and sand used to secure a dowel in concrete, rock, or another material.

Dowel Type is defined as a dowel differentiated by bar size, embedment length, orientation of embedment and by bar material, such as 15M stainless steel reinforcing bar and 20M reinforcing steel bar.

Pull Test is defined as an in situ test consisting of the application of a specified tensile axial load for a specified time period to installed dowels selected for testing. As referenced

in Ontario Ministry of Transportation Publications: Pull Test Guide for Testing of Metallic Dowels, of Uncoated, Coated or Stainless Steel.

Lot is defined as any number of dowels installed within a 48 hour period or installed since the last round of pull testing, whichever period is shorter.

908.02 MATERIAL

The Contractor shall supply all the reinforcing steel used as dowels and dowel pins to be incorporated in the work. All reinforcing steel for dowels shall be in accordance with Section 905.

Dowels shall be new, clean, and free of deleterious material. Dowels shall be capable of sustaining the pull test loads specified in Table 1 without displacement for a time period of not less than 1 minute.

Dowel adhesive shall be epoxy or acrylic resin accepted by the Owner's Representative.

Dowel grout shall be a low slump, expansive type neat grout with a minimum compressive strength of 30 MPa in 28 days unless specified otherwise in the contract documents.

908.03 FABRICATION, TRANSPORTATION AND STORAGE

All steel shall be fabricated to sizes and shapes as shown on the drawings.

The Contractor shall transport the reinforcing steel and dowel pins to the site and shall store in an accessible place where identification checking can take place prior to placement.

All dirt, grease or other foreign materials shall be removed from the steel prior to placement.

908.04 DOWEL PLACEMENT IN STRUCTURES

Dowels shall be placed in locations as shown on the contract drawings. The Contractor shall drill holes to the required dimensions, clean holes, place dowel adhesive or grout, and properly position the dowels as specified in the contract documents. Core drilling of the dowel holes shall not be permitted.

Steel reinforcement and other existing embedment's shall not be cut or damaged by the drilling process. Prior to drilling holes, the Contractor shall locate existing steel

reinforcement using a covermeter, Utility ducts, post tensioning hardware, and any unsound concrete in the vicinity of the dowel locations. If any of the above is encountered during drilling operations, the Owner's Representative shall be notified immediately.

The Contractor's operations shall not cause spalling, cracking, or other damage to the surrounding concrete. Concrete spalled or otherwise damaged by the Contractor's operations shall be repaired in a manner acceptable to the Owner's Representative.

For doweling adhesive the Contractor shall clean the holes using compressed air to remove all deleterious material, including dust and debris, and shall dry them prior to placing the dowel adhesive.

The handling and placement of the dowel adhesive and grout shall conform to the manufacturer's written instructions. All excess dowel adhesive shall be struck-off flush with the concrete surface and removed from the surrounding concrete surface area.

Where dowels are to be grouted, the hole diameter shall be two times the nominal diameter of the dowel. The holes shall be flushed out, saturated with water and blown out with oil free compressed air immediately before the grout is injected.

Dowel holes that are started but not completed shall be cleaned and filled with an appropriate patching material.

The Contractor shall maintain dowels in the proper position during the setting of the dowel adhesive or grout and shall prevent the loss of dowel adhesive from the holes.

908.05 DOWEL PLACEMENT IN ROCK

Dowels shall be placed in locations as shown on the contract drawings. The Contractor shall drill holes to the required dimensions, clean holes, place dowel adhesive or grout, and properly position the dowels as specified in the Contract Documents. Core drilling of the dowel holes shall not be permitted.

Where dowels are to be placed in rock, holes shall be drilled to the required depth and size. Hole diameter shall be two times the nominal diameter of the dowel. Each hole shall be cleaned out, grouted and the dowel set in place.

If the hole contains water, the contractor shall remove the water otherwise a tremmie procedure accepted by the Owner's Representative shall be used to completely fill the

hole with grout. The dowel shall be forced into the hole after the grout has been placed and while it is still fresh.

Dowel holes that are started but not completed shall be cleaned and filled with an appropriate patching material.

The Contractor shall maintain dowels in the proper position during the setting of the dowel adhesive or grout and shall prevent the loss of dowel adhesive from the holes.

908.06 PULL TESTING OF DOWELS

When indicated in the contract documents, the Contractor shall complete Pull Tests of the installed dowels in accordance with the applicable sections of ASTM E488 “Standard Test Methods for Strength of Anchors in Concrete Elements.” The required number of pull tests shall be as indicated in the contract documents.

The Contractor shall not install formwork or attach anything to the dowels such as steel reinforcement and Utility ducts until the pull tests have been completed and the dowels are accepted into the work.

The Contractor shall conduct pull testing within 3 business days of installation. A Departmental Representative shall be present during the testing procedure and the Department shall select the dowels to be tested. The applicable pull test load shown in Table 1 must be sustained by the dowel, without displacement, for a time period of no less than one minute.

TABLE 1: Pull Test Loads

Dowel Size	Test Loads	
	Embedment less than 200mm	Embedment 200mm or greater
10M	20 kN	35 kN
15M	40 kN	70 kN
20M	60 kN	110 kN
25M	100 kN	180 kN
30M	140 kN	250 kN
35M	190 kN	340 kN

All dowels failing the pull test requirement shall be replaced by the Contractor by installing a new dowel in an adjacent location accepted by the Owner’s Representative.

Dowels failing the pull test requirement shall be removed and the hole filled with an appropriate patching material.

If more than one dowel fails, the lot of dowels shall be considered unacceptable and the Contractor shall complete the following:

a) Conduct pull tests on all remaining untested dowels of the lot.
b) On the subsequent lot, conduct pull tests on 10% of dowels or 20 dowels, whichever is greater. If more than one dowel fails, all remaining untested dowels of that lot shall be tested.
c) The subsequent lot shall be tested at the higher frequency until no more than one tested dowel fails.

The Contractor shall pull test all replacement dowels in the presence of the Owner's Representative. Each replacement dowel shall be accepted individually.

Dowels shall not be subjected to more than one pull test.

908.07 MEASUREMENT FOR PAYMENT

The quantity of dowels for which payment shall be made shall be the total number of (a) "Dowels in Rock" and (b) "Dowels in Concrete" which require installation as shown on the drawings.

908.08 BASIS OF PAYMENT

Payment at the contract price for "Dowels in Rock" and the "Dowels in Concrete" in the Unit Price Table shall be full compensation for furnishing all labour, tools, equipment, materials and incidental items required to supply, install, drill holes, apply adhesive/grout, and conduct pull testing on the dowels as indicated in the contract documents.

Where dowel pins are projecting through elastomeric bearing pads, the cost associated with these dowels shall be considered incidental to the supply and installation of bearing pads and separate payment will not be made for the same.

SECTION 909

TIMBER STRUCTURES

INDEX

909.01 SCOPE

This specification covers the supply of timber and all necessary fastenings, as well as the fabrication, placement, and backfilling of timber crib bridge abutments. It also includes the supply and installation of filter fabric, timber chesses, timber wheel guards, and timber raceways for timber decked bridges.

909.02 GENERAL

909.02.01 Dimensions

The Contractor shall construct and install timber crib bridge abutments, timber chesses, wheel guards, and timber raceways in accordance with the dimensions specified in the contract drawings. All site dimensions must be verified before commencing work, and any discrepancies shall be reported in writing to the Owner's Representative.

909.02.02 Protection

The Contractor shall protect completed work from damage caused by other construction activities or environmental conditions. Any damaged portions of timber construction shall be repaired or replaced as determined by the Owner's Representative at no additional cost to the Department.

909.03 MATERIALS

909.03.01 Timber

All timber materials shall be graded and stamped in accordance with applicable grading rules and standards set by associations or agencies that have been approved to grade timber by the Canadian Lumber Standards Administration Board of CSA. All lumber and timber shall be sawn.

Only Douglas Fir shall be used for timber crib bridge abutments and timber chesses; grade shall be SPF Number 1 Grade.

Douglas Fir or Eastern Hemlock shall be used for timber wheel guards and timber raceways; grade shall be SPF Number 1 Grade.

909.03.02 Grading Authority

National Lumber Grades Authority (N.L.G.A.)

909.03.03 Connections

All steel connections shall be medium structural steel conforming to CSA G40.21, "Structural Quality Steels", or the latest edition thereof. All steel connections shall be hot dip galvanized in accordance with Section 909.03.04.

a) All nails and spikes shall be in accordance with CSA B111-1974 “Wire Nails, Spikes and Staples” latest edition.
b) All bolts and nuts shall be in accordance with ASTM F3125, Grade A325M. High strength nuts and hardened washers shall be suitable for use with the types of bolts specified on the contract drawings and shall be in accordance with ASTM A563 and ASTM F436.
c) Bolts, nuts, and washers specified in the Contract Documents shall be Type 1 and shall be hot dip galvanized.
d) All drift bolts shall be made from round stock, have a diamond or wedge pointed and a button head. The length of the drift bolts shall equal to the total thickness of the timbers being fastened, minus 50mm.
e) Lag screws shall conform to CSA B34-1967 “Miscellaneous Bolts and Screws” – Table 18.
f) All lag screw washers shall conform to the CSA B19.1 "Plain Washers", for Class 2 - Common Punched Washers with wide rims.
g) Round plate washers for 13mm and 16mm diameter machine bolts shall be 6.4mm thick x 76.2mm diameter and have a hole diameter of 15mm and 18mm respectively.
h) Round plate washers for 19mm, 22mm and 25mm diameter machine bolts shall be 7.9mm thick x 76.2mm diameter and have a hole diameter of 21mm, 24mm and 27mm respectively.
i) The use of square washers is not permitted.
j) Two (2) washers shall be used with each machine bolt.

909.03.04 Galvanizing

Galvanizing shall conform to the latest edition of CSA G164-18 "Hot Dip Galvanizing of Irregularly Shaped Articles". Unless otherwise specified, the minimum weight of zinc coating shall be as stated in Table 1 of this Standard.

909.03.05 Filter Fabric

Non-woven geotextile filter fabric shall have the following minimum mechanical properties: thickness of 3.0mm, mass of 270 g/m^2, tensile strength of 550 Newtons, 100% elongation at rupture, Mullen Burst strength of 1700 kPa, Ball Burst strength of 1350 Newtons, and tear strength of 290 Newtons. These typical properties shall be as defined by CGSB CAN2 4.2.

909.03.06 Backfill

All backfill used for timber crib bridge abutments shall be in accordance with Section 902 “Select Material Compacted – Rock” unless otherwise specified.

909.03.07 Wood Preservation

All timber materials used for timber crib bridge abutments, timber chesses, and timber wheel guards shall be pressure treated in accordance with Section 590.

Timber planks used for timber raceways shall be non-treated.

909.04 CONSTRUCTION AND FABRICATION

909.04.01 Timber Crib Bridge Abutments

Timber crib bridge abutments shall be constructed as shown on the contract drawings. In general, the procedure below shall be followed:

a) Levelling Pieces: Place levelling pieces beneath bottom timbers in such a manner that they will conform to the shape of the ground. Place levelling pieces horizontally so that succeeding pieces will be solidly secured at intersections of bottom timbers and vertical posts and other levelling pieces by means of machine bolts of proper lengths.

b) Bottom Timbers: Place bottom timbers lengthwise and crosswise to form the bottom three courses of the cribs. Crosswise and lengthwise bottom timbers shall

be of one piece and spaced as shown on the drawings. Secure three courses of bottom timbers together with machine bolts at every intersection with each other and vertical posts.

c) Ballast Floor: Place ballast floor on all pockets of the bottom or middle course of bottom timbers. Secure each ballast floor timber to bottom timbers with drift bolts so that adjacent ballast floor timbers are not secured to same bottom timber.

d) Longitudinals: All longitudinals for individual cribs shall be continuous (in one length) to a depth of at least 500mm below the lowest ground elevation within the footprint of the new timber crib bridge abutment. Above this elevation, where the cribs are married, the longitudinals shall be of sufficient length to span one bay of one crib and one half bay of the adjacent crib. Where they are joined, they shall be butt joined by mid bay in the middle of a 1200mm block, the block being secured to the timber below by a drift bolt in the centre and the longitudinal to the block by drift bolts in the ends of the longitudinal, for all longitudinals, butt joints shall form a staggered pattern and adjacent longitudinals directly above or below shall not be joined in the same bay. All longitudinals shall be secured to the crossties at every intersection by a drift bolt and to the vertical post by a machine bolt every third course of longitudinals.

e) Crossties: Crossties to be in one length across cribs. Secure crossties to intersection of longitudinals by a drift bolt and to intersection of vertical posts by a machine bolt every third course of crossties. The top course shall be machine bolted as well. All machine bolts on the exterior shall be countersunk.

f) Vertical Posts: Vertical posts are to be in one length from the bottom of the cribwork to the underside of the concrete deck. One vertical post shall be located at each corner of each crib and at the intersection of the crossties with the longitudinals. Vertical posts shall be secured to the crossties and longitudinals at every third course with machine bolts of adequate length. Where two cribs are married together, one of the adjacent vertical posts may be eliminated 500mm above high water level (with climate change) as noted on the contract drawings.

g) Fillers: Blocking shall be placed in the cribwork as indicated on the drawings, and as directed by the Owner’s Representative. It shall be the exact length to completely fill the proper spaces and shall be placed under all crossties and longitudinals which are carrying the bearing weight of the deck. It shall be of the

same size and material as the crossties or longitudinals, full length, and shall be drift-bolted with two bolts into the timber immediately below it.

h) Holing: Bore holes for drift bolts 1.5mm smaller than the bolt diameter and for full length of bolt. Bore holes for machine bolts to same diameter as bolt. The inside of all drilled holes shall be thoroughly treated with one coat of wood preservative.

i) Before placement of any backfill for timber crib bridge abutments, a layer of geotextile filter fabric shall be placed to encapsulate the fill as shown on contract drawings. All joins in the filter fabric shall have a minimum overlap of 200mm.

j) Backfill: Backfill shall be placed in horizontal layers having a maximum loose lift thickness of 300 mm and each layer will be thoroughly compacted until no movement is detected, as directed by the Owner's Representative.

909.04.02 Timber Chesses

Timber chesses shall be dimensioned and installed as per contract drawings.

Timber chess sections shall be attached to a timber fastening beam at both ends with 200mm galvanized nails, two per beam. Nails shall not be placed within 50 mm of the fastening beam edge. The outer edges of all chesses shall be trimmed parallel to the bridge centre line. All cut ends and drilled holes shall be treated with two coats of wood preservative.

909.04.03 Timber Wheel Guards

Timber wheel guards shall be dimensioned and installed as per contract drawings and shall include pressure treated chocks and galvanized hardware. Timber wheel guards shall be connected to the structure and the timber fastening beams at intervals not exceeding 1500mm. Connections will be 19mm hot dip galvanized machine bolts of sufficient length including nuts and washers. All drilled holes shall be treated with two coats of wood preservative. The ends of the timber wheel guards will be tapered from top to bottom at 45 degrees. The cut ends will be treated with two coats of wood preservative.

909.04.04 Timber Raceway

Timber raceway planks shall be dimensioned and installed as per contract drawings.

Raceway planks shall be placed so that joins in adjacent runs are staggered at least 610mm. Raceway planks shall be secured to the timber chesses using 101mm

galvanized nails, two nails at each end of the timber and two nails in every second timber chess. The nailing pattern shall be staggered between adjacent runs. If required to prevent splitting of the timber, the Contractor shall pre-drill nail holes. Raceway planks shall be at least 1220mm long at the start and/or end of any run, however main run decking shall be no less than 3660mm in length. Any planing, tapering or modification of timber raceway members to accommodate bridge grades shall be considered incidental to the work.

909.05 UNASSIGNED

909.06 UNASSIGNED

909.07 UNASSIGNED

909.08 MEASUREMENT FOR PAYMENT

909.08.01 Timber Crib Bridge Abutments

Timber crib bridge abutments shall be measured in cubic meters of completed work in place, rounded to the nearest one decimal place. The cubic measurements of the cribwork shall be determined by the product of the following dimensions, measured in place:

a) The height of each crib shall be the average of the measurements taken at each vertical point, from the bottom of the lowest timber to the top of the bearing seat.

b) The width of each crib shall be the average width measured between the outside faces of the exterior longitudinals, with each width taken from the top tier of each row of crossties.

c) The length of each crib shall be measured at or near low water level along the center line of the crib, parallel to a level water surface, between the outside faces of the exterior crossties.

909.08.02 Timber Chesses

Timber chesses shall be measured in cubic metres, based on the volume of the newly installed timber chesses, rounded to one decimal place for payment purposes.

909.08.03 Timber Wheel Guards

Timber wheel guards shall be measured by the length of timber wheel guard installed, in metres, rounded to one decimal place for payment purposes.

909.08.04 Timber Raceway

Timber raceways shall be measured by the outer extents of the new timber raceway, in square metres, rounded to one decimal place for payment purposes.

909.09 BASIS OF PAYMENT

909.09.01 Timber Crib Bridge Abutments

Payment at the contracted unit price for timber crib bridge abutments shall include all preparation, equipment, filter fabric, materials, access, labour and incidentals necessary to perform the work as outlined herein or as shown on the contract drawings.

The supply and installation of backfill for timber crib abutments shall be as per Section 902 “Select Material Compacted – Rock” unless otherwise specified.

909.09.02 Timber Chesses

Payment at the contracted unit price shall include all equipment, materials, access, labour, and incidentals to install the timber chesses as outlined herein or as shown on the contract drawings.

909.09.03 Timber Wheel Guards

Payment at the contracted unit price shall include all equipment, materials, access, labour, and incidentals necessary to install the timber chesses as outlined herein or as shown on the contract drawings.

909.09.04 Timber Raceway

Payment at the contracted unit price shall include all equipment, materials, access, labour, and incidentals necessary to install the timber raceway as outlined herein or as shown on the contract drawings.

SECTION 910

STRUCTURAL STEEL

INDEX

910.01 SCOPE

This specification covers the requirements for the supply, fabrication, delivery and erection of structural steel for highway bridges including the design of all connections. The works shall be carried out in accordance with the latest version of CSA-S6 “Canadian Highway Bridge Design Code”.

910.02 DEFINITIONS

For the purpose of this specification, the following definitions apply:

Bearing Contact Area - Two planes which are in contact or have a separation between them not exceeding 0.12mm.

Erection Diagrams - drawings showing the dimensional layout of the steel structure, from which shop details are made, and which correlate to the fabricator's piece markings with the location in the structure.

Flush - a profile of weld reinforcement in which there is a smooth gradual transition between base and weld metal involving grinding where necessary. Weld reinforcement not exceeding 1mm in height, may remain on each surface, unless the weld is part of a fraying surface when all reinforcement shall be removed.

Fracture Critical Member - a member, including attachments, in a single load path structure, which is subject to tensile stress and whose failure could lead to collapse of the structure.

Primary Tension Member - a member including attachments, which are subject to tension stress.

Proposal - a Contractor's submission of changes, when engineering design is required, affecting either the original design or shipping, as stipulated in this specification.

Smooth - a profile of weld reinforcement, in which the surface finish of weld reinforcement has a sufficiently smooth gradual transition, involving grinding where necessary. Weld reinforcement not exceeding the following limits, may remain on each surface:

For plate thicknesses $\leq$ 50mm, 2mm
For plate thicknesses > 50mm, 3mm

910.03 APPROVALS

910.03.01 General

Proposals by the Contractor, connection design, shop details, bolting procedure, welding procedures, erection diagrams, alternative design calculations, drawings and procedures shall bear the seal and signature of a Professional Engineer licensed in the Province of Newfoundland and Labrador.

Work affected by these proposals, details, designs, procedures and drawings shall not proceed until the Contractor receives an accepted copy of their submission(s).

Design shall be according to CSA S6.

Welding design shall be according to CSA W59 “Welded Steel Construction.”

Welding procedures shall be according to CSA W47.1 “Fusion Welding of Steel Company Certification” and CSA W59, except where modified by CSA S6 Clause A10.1.5.

Symbols for welding and non-destructive testing shall be according to CSA W59.

910.03.02 Shop Details and Welding Procedures

Four weeks before the commencement of fabrication, the Contractor shall submit to the Owner’s Representative for review, 1 paper copy and 1 electronic copy of shop details and welding procedures, which shall include the following:

a) All necessary specifications for the materials to be used.
b) The welding process to be used, the position of welding, filler metal, the proposed method of filling the welds, flux, shielding gas, if required, joint configurations, number and size of passes, preheat and interpass temperatures (if required) sequence of passes, current, rate of pass, electrode type, thickness or size, electrical stick-out and polarity and methods of storing consumables.
c) The methods that will be used for the preparation of the edges and measures which will be taken to control the effects of distortion, shrinkage and residual stresses.
d) The proposed methods and sequence of assembling, welding, welding repair and welding equipment which will be used. The approval of the above must be obtained before commencing the work.
e) Full detail dimensions and sizes of all component parts of the structure. These dimensions shall make allowance for changes in shape due to weld shrinkage,

camber, and any other effects that cause finished dimensions to differ from initial dimensions.

f) Erection marks.
g) Identification of areas requiring special surface treatment.
h) Identification of fracture-critical and primary tension members and component parts. Attachments having a length of more than 100mm in the direction of tension and welded to the tension zone of a fracture-critical or primary tension member shall be treated as part of that member.
i) Bolt installation requirements, including number of fitting up bolts required at each connection and oversize and slotted holes.
j) Identification of material and welds requiring non-destructive testing, including the limits of the weld undergoing testing and the frequency and type of testing.
k) Temporary welds.
l) Location of shop and field splices.

When all requirements are satisfied, one (1) accepted electronic copy of the above will be returned to the Contractor.

The Fabricator shall have a copy of the shop detail drawings and welding procedures at the manufacturing plant during fabrication available at all times.

910.03.03 Erection Diagrams and Procedures

4 weeks before commencement of erection, the Contractor shall submit to the Owner's Representative for review, 1 paper copy and 1 electronic copy of the erection diagrams, drawings and procedures, including lifting point locations and details of all temporary supports.

Erection diagrams and erection procedure drawings shall include at least the following:

a) Principal dimensions of the bridge
b) Erection marks
c) Sizes of all members
d) Field welding requirements, including identification of welds requiring non-destructive testing
e) Size and type of bolts
f) Bolt installation requirements, including the number of fitting up bolts required at each connection and identification of oversize and slotted holes.
g) Bracing during erection of structural steel.
h) Treatment at faying surfaces for joints designed as slip critical.

i) Written confirmation that the diagrams and drawings have been reviewed for quality assurance, safety and environmental requirements, and is in full accordance with the contract plans and specifications.

The Contractor shall have a clean copy of the erection diagrams and the erection procedure drawings and calculations at the site during erection available at all times.

Grouting materials, equipment and procedure shall be accepted by the Owner's Representative. The Contractor shall submit their grouting proposal to the Owner's Representative at least 2 weeks in advance of required use.

When all requirements are satisfied, 1 accepted electronic copy of the erection diagrams and procedures will be returned to the Contractor. Acceptance of all or any part of the proposal does NOT indemnify the Contractor from any consequences resulting from their proposal or any consequences related to the erection that were not covered in their proposal. Acceptance does not relieve the Contractor from any conditions specified in the Contract Documents.

Work is not to commence until acceptance of the proposal has been obtained from the Owner's Representative. The Contractor's Field Superintendent and Project Manager will be required to attend a pre-job meeting prior to commencement of any field work. The Contractor is required to follow the accepted erection plan and will be required to verify and sign off, after each stage of the erection procedure, that all requirements of that stage of the procedure have been satisfied.

The Erector shall provide to the Owner's Representative a detailed survey of the substructure including the location and top elevation (i.e. underside of bearing plates) of all bearing grout pads.

Shop drawings and calculations are to cover erection of all elements of the bridge. Shop drawings showing partial details or details of some elements but not all, and/or calculations that do not cover all elements of the erection process, will not be reviewed until all details have been submitted to the Owner's Representative. The Contractor shall have, and demonstrate, their own QA procedures for review of their proposal before submittal to the Department.

The Contractor shall ensure that all conflicts with utilities have been removed or mitigated and is responsible for obtaining all permits and all monetary and time costs related to complying with the requirements of the utility owners.

910.03.04 Mill Certificates, Samples and Tests

Prior to fabrication, 1 paper copy and 1 electronic copy of mill test reports for all materials, certifying that the material meets the contract requirements, shall be submitted to the Owner's Representative.

The Owner's Representative shall have the right to call for any additional samples, specimens and tests that are, in their opinion, necessary to secure the proper quality of material and work.

Paper Copies of the mill test certificates for all material to be used in the fabrication shall be available at all times for review at the fabricating plant during fabrication. The certificates shall show that the material is according to the Contract Documents.

If the material cannot be identified by mill test certifications, coupons shall be taken and tested and these test certificates shall be submitted to the Owner's Representative.

Steel with boron content exceeding 0.0008% shall not be permitted.

Where mill test certificates originate from a mill outside Canada or the United States of America, the Contractor shall have the information on the mill test certificate verified by testing by a certified Canadian laboratory to ensure grade compliance by testing the material to the specified material standards, including boron content. This laboratory shall be certified by an organization accredited by a Canadian or American accreditation body to comply with the requirements of ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories" for the specific tests or type of tests required by the material standard specified on the mill test certificate. The accreditation body shall be a signatory to the International Laboratory Accreditation Cooperation Mutual Recognition Arrangement (ILAC MRA). Preparation and collection of samples for testing shall be directed and witnessed by or completed by personnel employed by the testing laboratory A verification letter shall be provided by the testing laboratory and include laboratory accreditation documentation, applicable mill test reports, testing standards, date of verification testing, verification testing results, and declaration of compliance with the specified material reference standards. The results of verification testing shall meet all requirements of the specified material reference standard. The verification letter shall be signed by an authorized officer of the testing laboratory.

Re-classification of steel using a mill test report or mill test report verification testing data will not be permitted.

Proof that the bolts, nuts, and washers meet the chemical composition, mechanical properties, dimensions, workmanship, and head burst as required by ASTM F3125M "Standard Specification for Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, 830MPa and 1040 MPa Minimum Tensile Strength," ASTM A563M "Standard Specification for Carbon and Alloy Steel Nuts," or ASTM F 436M "Standard Specification for Hardened Steel Washers" shall be submitted to the Owner's Representative. Verification of the acceptability of assemblage of zinc-coated bolts, nuts, and washers delivered to the job site shall also be submitted to the Owner's Representative.

The Contractor shall submit to the Owner's Representative, at least two (2) weeks in advance of the steel fabrication, a letter certifying that the stud shear connectors conform.

For bolts supplied from a manufacturer outside Canada or the United States of America, the above information shall be verified by testing by a Canadian laboratory as outlined in the Mill Test Certificates clause.

During or after fabrication of the components, and prior to erection, the Owner's Representative, or a representative nominated by the Department, shall conduct an inspection to verify that the fabrication of components has been carried out in general conformance with the shop details, welding procedures, and Contract Documents, and issue to the Contractor written permission to proceed with the work.

910.04 MATERIALS

910.04.01 Steel

Structural steel shall conform to the requirements of CSA-G40.21 "Structural Quality Steels" and shall be as specified in the Contract documents. Structural steel shall be new and previously unused or unassembled.

910.04.02 Identification of Structural Steel

Identification of structural steel shall be in accordance with the provisions of CSA S16.1 "Limit States Design of Steel Structures." In addition, fracture critical and primary tension members shall be identified such that the pieces of each member are traceable to material test reports which indicate the required toughness properties.

910.04.03 High Strength Bolts, Nuts and Washers

High strength bolts shall be supplied with heavy hex nuts and one hardened washer per bolt. The bolts shall have dimensions conforming to CSA B18; with chemistry and mechanical properties conforming to ASTM F3125M "Standard Specification for Structural

Bolts" or A490M "Standard Specification for High Strength Steel Bolts". The nuts shall be of heavy hex type conforming to CSA B18 suitable for use with ASTM F3125M or A490M bolts of the type specified. Hardened washers shall conform to ASTM F436M, suitable for use with ASTM F3125M or A490M bolts of the type specified. Bolts, nuts and washers shall be new and previously unused, and shall be shipped together as an assembly.

910.04.04 Electrodes

Electrodes shall conform to the latest edition of CSA W48.1-M, W48.3-M, W48.5-M and W48.6-M.

Filler metal shall be in accordance with Table 5-1, "Filler Metal Requirements for Exposed Bare Applications of CAN G40.21-M 350A, 350AT, 400A, 400AT, ASTM A242 and A588 Steels" of the CSA W59.

Deposited weld metal shall have a minimum Charpy Impact Energy as specified on the contract drawings.

910.04.05 Shear Connectors

Shear connectors shall be of a headed stud type in accordance with the requirements of Appendix "H" of CSA W59-M. Grade to be specified on the contract drawings.

910.04.06 Bearing Assemblies

The Contractor shall supply and install bearing assemblies as shown on the Contract Drawings or approved alternatives accepted by the Department.

Mill test reports and rotational capacity testing for fasteners shall be submitted to the Owner's Representative for review and acceptance 6 weeks prior to the commencement of erection, assembly or installation.

910.05 FABRICATION AND ERECTION

910.05.01 General

It is the Contractor's responsibility to ensure that the structure has sufficient capacity to sustain the stresses to which it will be subjected to during the erection procedure.

All fabrication shall confirm to the requirements of CSA S6 Clause A10.1.4.

Each member shall carry an erection mark for identification. Permanent marking shall be affixed in an area not exposed to view in the finished structure.

910.05.02 Welded Fabrication

910.05.02.01 General Requirements

All welding and all welding related items shall conform to the requirements of the following codes: CSA W59, ANSI/AASHTO/AWS D1.5 “Bridge Welding Code” and CSA S6 clause A10.1.5.

Qualification of welding procedures shall include weld metal and HAZ impact testing.

The fabrication weld metal requirements, base metal repairs, and repairs of weld in fracture critical and primary tension members hall be according to CSA S6 Clause 10.23.5.

Peening, when required, shall be subject to approval by the Owner’s Representative.

910.05.02.02 Qualifications of the Contractor

The company undertaking welded fabrication of bridge structures and components shall have documentation from the Canadian or American Institute of Steel Construction indicating the steel fabricator has been certified with the CISC or AISC.

The certification shall be as follows as required:

CISC Complex Steel Bridges or
AISC Advanced Steel Bridges

CISC Simple Steel Bridges, w/ fracture critical endorsement or
AISC Simple Steel Bridges, w/ fracture critical endorsement

CISC Simple Steel Bridges, w/o fracture critical endorsement or
AISC Simple Steel Bridges, w/o fracture critical endorsement

Certification shall be in effect prior to the beginning of the Work and shall be maintained throughout the period of manufacture.

910.05.02.03 Place of Fabrication

All fabrication shall be carried out in adequately covered and heated areas. The place of fabrication shall be accepted by the Owner’s Representative.

910.05.02.04 Web to Flange Fillet Welds

Where practical, web to flange fillet welds shall be made continuously by machine or automatic welding. Welds, when corrected, shall blend smoothly into the adjacent welds. When corrected by welding, a semi-automatic or manual process may be used.

910.05.02.05 Electrodes, Workmanship and Techniques

910.05.02.05.01 General

Electrodes, workmanship and techniques shall be in accordance with the provisions of CSA W59M.

910.05.02.05.02 Preparation of Material

The preparation of edges by oxygen cutting shall be done by machine whenever practical. Corner of oxygen cut girder flanges shall be chamfered 1.5 to 2.0 mm by grinding.

Plasma arc cutting shall only be done when accepted in writing by the Owner's Representative.

All cut edges which are not to be welded, shall have a roughness not greater than 1000 as defined by CSA B95 "Surface Texture Roughness, Waviness, and Lay." The provisions of CSA W59 shall also apply.

All surfaces and edges of materials to be welded shall be in accordance with the provisions of CSA W59.

910.05.02.05.03 Inspection and Repair of Planar Edge Discontinuities

Inspection and repair of planar edge discontinuities shall be in accordance with the provisions of CSA W59. For fracture critical and primary tension members, the requirements of the Owner's Representative shall apply.

910.05.02.05.04 Workmanship and Finish

Workmanship and finish shall be of the best modern general practice in bridge fabrication and construction.

Shearing, flame cutting and planing shall be done carefully and accurately.

Particular attention shall be paid to the neatness and uniformity of finish of all parts of the work exposed to view.

910.05.02.05.05 Storage of Material

Structural material, either plain or fabricated, shall be stored at the fabricating shop or elsewhere, above the ground upon platforms, skids, or other suitable supports, shall be kept free from dirt and other foreign matter and shall be protected as far as practicable from corrosion.

Long members shall be so supported as to prevent deflection.

910.05.02.05.06 Straightening Material

All steel, before being marked off or worked, must be flat and straight. If any flattening or straightening is necessary, it shall be done by methods that will not, in the Owner's Representative's opinion, injure the metal. Sharp kinks or bends in the material shall be cause for its rejection.

910.05.02.05.07 Re-Entrant Cuts

A fillet of not less than 20mm radius shall be provided at the junctions of all re-entrant cuts and the fillet shall be formed before the cuts are made.

910.05.02.05.08 Flame Cutting

Steel may be flame-cut, provided a smooth surface is secured by the use of a mechanical guide. Flame cutting by hand shall be done only when accepted by the Owner's Representative, and the surface shall be made smooth by planning, chipping or grinding.

910.05.02.05.09 Assembly

Assembly shall be in accordance with the provision of CSA W59.

In addition, the following requirements for bearing and intermediate stiffeners in plate girder and box girder bridges, shall apply:

a) Bearing stiffeners shall be vertical under full dead load.
b) Intermediate stiffeners may be either vertical or perpendicular to fabrication worklines, depending on the fabricators practice.

910.05.02.05.10 Temporary Welds

Temporary welds shall be in accordance with the provisions of CSA W59.

Temporary welds on fracture critical, primary tension members and flange material in compression shall not be used.

Extension bars, when attached to flanges, shall have the welds placed inside the joint, so that they can be welded over and fused into the final joint.

910.05.02.05.11 Groove Welds

For groove welds in butt joints, extension bars shall be used.

910.05.02.05.12 Tack Welds

Tack welds shall be in accordance with the provisions of CSA W59.

Tack welds shall not be used on fracture critical or primary tension members unless they are incorporated into the final weld.

910.05.02.05.13 Attachments

Attachments making use of tack welds which are not part of the welds shown in the contract, shall not be allowed on any portion of the girders.

910.05.02.05.14 Profile of Welds

Profile of welds shall be according to CSA W59.

910.05.02.05.15 Camber and Correction Of Shape

Webs shall be cut to the prescribed camber, with suitable allowance for shrinkage due to cutting and subsequent welding.

Mechanical means, or heat, may be used to correct the shape or straighten a welded member. If such a member is a fracture critical or primary tension member, the prior approval of the Owner's Representative is necessary. Welding corrections and repairs to fracture-critical and primary tension members shall be according to CSA S6 Clause 10.23.6.

Steel members subject to shape corrections or straightening shall be allowed to cool in still air.

910.05.02.05.16 Stress Relief - Heat Treatment

Temperature shall be recorded using thermo-couples or other accepted methods. A record of the heat treating operation, showing temperature and time data, shall be maintained and made available to the Owner's Representative upon request.

910.05.02.06 Obligations of The Contractor

Prior to commencement of welding, the Contractor shall make available to the Inspector, the Canadian Welding Bureau's transferable or non-transferable identification cards for each tacker, welder or welding operator, to be employed on the work. Such identification cards shall be currently valid and shall indicate the welding process and the positions which the personnel are qualified to weld.

910.05.02.07 Welding Repairs

Any section of weld that does not meet the acceptance standards shall be removed, rewelded, and re-examined.

Submissions of repair procedures shall be submitted to the Department a minimum of 14 days prior to commencement of work. Submissions shall comply with CWB accepted welding procedure specifications, data sheets and repair procedures, and shall be signed and sealed by a CWB certified Welding Engineer.

When making welding repairs to fracture-critical and primary tension members, the preheat requirements shall be according to CSA S6 Table 10.16. All repair procedures for these members and any others that are either listed as critical in CSA S6 clause 10.23.6.5 or are more severe than as described in CSA S6 Clause 10.23.6.4 will be submitted for approval to the Owner's Representative a minimum of 14 days prior to commencement of the work, and shall be according to CSA S6, Clause 10.23.6. Work on the repair shall not commence until the Owner's Representative has given written approval to proceed.

Non-critical repairs shall be as defined in CSA S6 Clause 10.23.6. All repair procedures for these members will be submitted for approval to the Owner's Representative a minimum of 14 days prior to commencement of the work. Work on the repair shall not commence until the Owner's Representative has given written approval to proceed.

910.05.02.08 Non-Destructive Testing of Fracture Critical Members

The Fabricator shall maintain documentation of all visual and non-destructive testing for review and confirmation by the Owner's Representative. Documentation shall be submitted to the Owner's Representative upon completion of the project.

910.05.02.09 Standards of Inspection, Certification and Acceptance

The standards of inspection and acceptance shall be in accordance with CSA W59.

Any independent organization undertaking welding testing shall be certified for testing bridges in conformance with CSA W178.1. The certification shall encompass at lest the following methods: radiographic, ultrasonic, and magnetic particle.

The independent organization's non-destructive testing technician undertaking non-destructive testing of welds under the Inspection and Testing subsection shall be certified for testing bridges in conformance with CSA W178.2. Certification shall be to either Level II or III for the methods used, as required by CGSB 48.9712 "Qualification and Certification of Nondestructive Testing Personnel."

910.05.03 Bolted Construction

910.05.03.01 General

This sub-section covers the requirements for bolted steel construction.

The design of bolted connections shall be performed by the Contractor. The design shall be in accordance with CSA S6 A10.1.6. Bolts shall be sufficiently long to exclude threads from the shear plane.

Dimensional and workmanship tolerances shall be according the CSA W59 and Annex A10.1 of CSA S6.

910.05.03.02 Assembly And Inspection

The assembly and inspection of joints, using ASTM F3125M or A490M bolts, shall be in accordance with the provisions of CSA S6 and CSA W59.

910.05.03.03 Trial Assembly

All bolted splices shall be sub-punched or sub-drilled, put together in the shop and then reamed, unless put together and drilled from the solid. All shop trial assembly requirements shall be in accordance with CSA S6 clause A10.1.6.11.

910.05.03.04 Holes Drilled Using Numerically Controlled Machines

As an alternative to the trial assembly specified above, when numerically controlled machines have prepared bolt holes the requirements of CSA S6 clause A10.1.6.12 shall apply.

910.05.03.05 Bolt Holes

All holes for bolts shall be punched or drilled. Where the thickness of the metal does not exceed 16mm, the metal may be punched or drilled 2mm larger than the nominal diameter of the fastener. Where the thickness of metal exceeds 16mm, or wherever required under Subsection 910.05.03, all the holes shall be subpunched or subdrilled 5mm smaller and after assembling shall be reamed 2mm larger than the nominal diameter of the fastener or, alternatively, shall be drilled from the solid 2mm larger than the nominal diameter of the fastener. Holes in welded members shall not be made before the welding of such member is completely finished.

910.05.03.06 Punched Holes

The diameter of the die shall not exceed the diameter of the punch by more than 2mm. If any holes must be enlarged to admit the fasteners, they shall be reamed. Holes must be clean cut, without torn or ragged edges. Poor matching of holes will be cause for rejection.

910.05.03.07 Reamed or Drilled Holes

Reamed holes shall be cylindrical, perpendicular to the member, and not more than 2mm larger than the nominal diameter of the bolt. Whenever practicable, reamers shall be directed by mechanical means. Drilled holes shall be 2mm larger than the nominal diameter of the bolt. Burrs on the outside surfaces shall be removed. Reaming and drilling shall be done with twist drills.

If required by the Owner's Representative, assembled parts shall be taken apart for removal of burrs caused by drilling.

Connecting parts requiring reamed or drilled holes shall be assembled and securely held while being reamed or drilled and shall be match-marked before disassembling.

910.05.03.08 Holes for Field Connections

The holes of those field connections which are assembled in the shop shall be reamed while assembled.

910.05.04 Shop Assembly

The exact detailed method of assembly, including points of support, dimension checks, method of trimming to length, drilling and marking of splices, is to be to the procedure submitted as per the accepted shop drawings.

All field connections in girder members (flanges and webs) shall be assembled in the shop, and there have their subsize holes reamed to specified size while assembled. The assembly, including camber, alignment and accuracy of holes, shall be accepted by the Owner's Representative before reaming is commenced.

Surfaces of metal that will be in contact shall be cleaned before assembling. The parts of the member shall be assembled, well pinned and firmly drawn together with bolts, before reaming is commenced. Assembled pieces shall be taken apart, if necessary, for the removal of burrs and shavings produced by the reaming operation. The member shall be free from twists and bends or other distortion.

Shop assembly of connections may be waived if the Contractor can demonstrate to the Owner's Representative a method of assuring accurate matching of connections in the field, and that they have had past experience. Any alternative method of matching field connections shall be subject to approval by the Owner's Representative.

In addition, the following requirements for bearing and intermediate stiffeners shall apply:

a. Bearing stiffeners shall be vertical under full dead load.

b. The bearing ends of bearing stiffeners shall be flush and square with the web and shall have at least 75 percent of this area in contact with the flanges. When bearing against a steel base or seat, all components shall fit within .010 inch (.025mm) for 75 percent of the projected area of the web and stiffeners and with no gap of 1/32 inch (0.80mm) for the remaining 25 percent of the projected area.

c. Intermediate stiffeners may be either vertical or perpendicular.

910.05.04.01 Drifting Of Holes

The drifting done during assembly shall be only such as to bring the parts into position and shall not be sufficient to enlarge the holes or distort the metal. If any holes must be enlarged to admit the fastener, they shall be reamed.

910.05.04.02 Match-Marking

Connecting parts assembled in the shop for the purpose of reaming holes in field connections shall be match-marked, and a diagram showing such marks shall be furnished to the Owner's Representative.

910.05.05 Transportation and Delivery

910.05.05.01 General

The Contractor shall perform all work necessary to ensure safe delivery and storage at the site specified in the Contract.

Structural steel shall be so loaded for shipping that it may be transported and unloaded at its destination without being excessively stressed, deformed or otherwise damaged. Girders shall be transported with their webs in a vertical plane.

Structural steel, when stored, shall be stockpiled to avoid excessive stress deformation or other damage.

Not less than 7 days before any shipping begins, the Contractor shall provide the Owner's Representative with the delivery schedule.

910.05.05.02 Oversize-Overweight Restrictions

Vehicles loaded with structural steel which are oversize or overweight are not permitted on the highways except by special permit which shall be obtained by the Contractor.

It is the Contractor's responsibility to ensure delivery of structural steel to the job site is feasible.

910.05.06 Erection

910.05.06.01 General

Structural steel erection shall not commence until all aspects of Section 910.05.06 Inspection and Testing have been fulfilled to the satisfaction of the Owner's Representative. The Contractor shall notify the Owner's Representative, in writing, of the starting date at least 2 weeks prior to the commencement of field operations and work shall not be carried out until the Inspector is on the site.

Repairs to erected material will only be permitted when the procedure is accepted by the Owner's Representative.

Welding shall not be used to fill misplaced holes.

The Contractor shall not use any of the material intended for use in the finished structure for erection or temporary purposes unless such use is provided for on the plans or authorized by the Owner's Representative. Excessive hammering, pushing, pulling, twisting, bending and the like which will injure or distort the members will not be allowed. Surfaces to be in permanent contact shall be cleaned just prior to assembly.

The Contractor shall supply all materials, tools, equipment, plant and labour necessary for the erection of the steelwork. The Contractor shall erect the structural steel in accordance with the requirements of the latest edition of the A.A.S.H.T.O. Specifications.

910.05.06.02 Methods and Equipment

So that the Owner's Representative may verify that the proposed method of erection conforms to the requirements of these specifications, the Contractor shall, before starting the work of erection, furnish the Owner's Representative with erection procedure, erection drawings, together with complete calculations of stresses in the steelwork in the various stages of erection and shall inform the Owner's Representative fully as to the method of erection they propose to use. The whole of this information shall be submitted to the Owner's Representative at least 4 weeks before the work of erection is to commence and shall be stamped by a Professional Engineer who is registered or licensed to practice in the Province of Newfoundland and Labrador.

The Owner's Representative shall have the right to inspect all equipment to be used for the erection to satisfy themself that such equipment is of good quality, and they may forbid the use of any equipment that is, in their opinion, in any way faulty.

Under no condition may stresses occurring in the members of the structure exceed the basic allowable stresses, except with the express permission of the Owner's Representative.

Release of temporary supports or temporary members, etc. must be gradual, and under no circumstances will a sudden release be permissible.

The method of erection proposed to be used shall be subject to the acceptance of the Owner's Representative, but such approval shall not relieve the Contractor of any responsibility for the safety of the proposed method of work in full accordance with the Contract. The Contractor shall not start any erection operation before this acceptance is obtained.

910.05.06.03 Falsework

The design of falsework shall be in accordance with CSA S269.1 "Falsework and Formwork."

Falsework shall also conform to Section 907.

The Contractor shall furnish, construct, erect, maintain and subsequently remove and dispose of all falsework required for the erection of the work. Falsework will include all temporary supports and foundations and shall be properly designed and substantially constructed and maintained to sustain the loads which will come upon it. Falsework drawing(s) shall be stamped by a Professional Engineer registered or licensed to practice in the Province of Newfoundland and Labrador.

910.05.06.04 Handling and Storing Materials

Material delivered to the site shall be placed on skids above ground. It shall be kept clean and properly drained. Girders and beams shall be placed upright and shored. Long members shall be supported as to prevent injury from deflection.

910.05.06.05 Damaged Material

Material which is bent, kinked, twisted or otherwise damaged shall be immediately removed from the job site and replaced with equivalent new and undamaged material.

910.05.06.06 High Tensile Bolts

Each bolt shall be tightened to provide, when all the bolts in the joint are tight, at least the minimum bolt tension shown in Table A10.1.4 of CSA-S6.

Alternatively, the "turn-of-the-nut" method may be used for tightening bolts as specified in CSA S6 clause A10.1.6.7.

The Contractor shall submit to the Owner’s Representative a detailed description of the tightening method they propose to follow, and shall be subject to approval by the Owner’s Representative. Tightening by torque control shall not be utilized.

The proposed tightening procedure shall contain controls to prevent the "over tightening" of bolts.

910.05.06.07 Connections

At the time of erection all splice plates shall be free of all contamination such as burrs, drillings, oil, dirt and paint.

Any error in shop fabrication, or any deformation resulting from handling or transportation, which prevents the proper assembly and fitting of parts shall be reported to the Owner’s Representative.

910.05.06.08 Drilling and Grouting of Anchor Bolts

When the Contract includes drilling and grouting of anchor bolts, this work shall be performed as follows:

Holes shall be drilled in the concrete, and through reinforcing steel, where encountered, by means of a core drill. From the time of drilling and until the anchor bolts have been placed and grouted, the Contractor shall prevent the entry of water and any other foreign material into the holes.

The Contractor shall place the anchor bolts, supply all necessary materials, provide necessary heating, protection, and carry out all the work required to completely fill the space around the anchor bolts.

910.05.06.09 Field Assembly

The parts shall be accurately assembled as shown on the plans, and any match-marks shall be followed. The material shall be carefully handled so that no parts will be bent, broken, or otherwise damaged. Hammering which would injure or distort the members is prohibited. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled.

Insofar as the cantilever method of erection is followed, the procedure shall be accepted by the Owner's Representative.

In all main girder field connections, 10% of the holes shall be filled with cylindrical erection pins before tightening high-strength bolts.

Cylindrical erection pins for use in shop-reamed holes shall be machined to a push fit so as to obtain an accurate matching of corresponding holes.

910.05.07 Inspection and Testing

910.05.07.01 Responsibility

It is the Contractor's responsibility to supply the material, execute, complete and maintain the works in strict accordance with the terms of the Contract. Inspection and testing of the materials and works by the Owner's Representative or their representative or that performed by the Contractor and reviewed by the Owner's Representative shall not be deemed to relieve the Contractor of any of their obligations.

910.05.07.02 Quality Control

Quality control shall be in accordance with CSA S6 clause A10.1.8. The acceptance standards of CSA W59 for dynamically loaded structures shall also apply.

In addition to quality control measures instituted by the Contractor, the Contractor shall be responsible for the quality control procedures specified throughout Specification 910.

A record for each component shall be kept to identify the material as to heat number, corresponding mill test certificate, and colour coding or other identifying markings.

910.05.07.03 Non-Destructive Testing and Inspection

Prior to commencement of fabrication the Contractor shall designate, by way of written notification to the Owner's Representative, an independent testing organisation to perform inspections and testing services. A certified non-destructive testing technician shall do the testing. Neither the technician nor the independent testing organization shall be changed without the approval of the Department. The inspections and testing services to be performed shall include:

(a) A full visual inspection of all components.
(a) All welds shall be visually inspected.
(b) Groove welding (splicing) of material for main girder members, other than splices shown on drawings, will not be permitted without express written consent of the Owner's Representative. In the event that such splices are allowed, they shall receive 100 percent radiographic or ultrasonic inspection.
(c) Web to flange fillet welds on main girder members shall be subject to magnetic particle inspection as follows:
    (1) Submerged arc welds 25 percent of length
    (2) Semiautomatic welds 50 percent of length
    (3) Manual welds 100 percent of length

(d) 25% of fillet welds for attaching gusset plates, diaphragm welds and bearing stiffeners shall be tested by magnetic particle inspection.
(e) Gusset plates and stiffeners for attaching diaphragm bracing shall be tested for 100% of the length of the mid-depth of the web to the tension flange.
(f) All transverse welds on tension flanges shall receive 100% magnetic particle inspection.

(g) Periodic inspections shall also be conducted to ensure:
    (1) Mill certificates and material identifications conform with the shop and contract drawings.
    (2) Fabrication procedures/methods conform to the Department's and project's specifications.
    (3) Weld procedures/methods conform with the Contractors weld procedures accepted for this project, the Department's and project's specifications and the requirements of CSA W59 and ANSI/AASHTO/AWS D11.5-88.

The independent testing organisation for performing the aforementioned tests shall be experienced in the type of inspection and non-destructive testing required and shall be subject to the approval of the Owner's Representative.

The independent testing organisation and the Department shall be given a minimum of 5 business days notice of when the work is ready for testing. Such notice shall include the type and quantity of work to be tested.

In the event that welding defects or deficiencies are found, either by the Department's representative or by the personnel designated to perform testing for the Contractor, then the Owner's Representative must be notified within 48 hours by the Contractor and a method of welding repair for correction of the deficiencies must be submitted in writing, for approval by the Owner's Representative. Upon approval of any proposed corrective measures the Contractor may proceed with the repair work, however, all repairs or corrective measures may be subject to 100% non-destructive testing and inspection, at the discretion of the Owner's Representative, and at the expense of the Contractor.

The personnel or organization performing non-destructive testing and inspection for the contractor shall keep a written record of all testing and inspection work performed, which shall include details of the item(s) inspected, type of inspection(s) performed, date, time and location where inspection was performed, and details of any items which did not conform with the shop or contract drawings or specifications.

The Contractor shall submit to the Owner's Representative, within one week of their execution, all inspection, testing/retesting results and records. In addition, from the time of commencement of fabrication, the Contractor shall ensure that the independent testing organisation submits to the Owner's Representative a weekly progress report describing work completed, and inspections and testing conducted, including results thereof, since the previously submitted progress report.

One week after all fabrication work is complete the Contractor's designated independent testing organisation shall submit to the Owner's Representative, in writing, certification that all inspection and testing required under the Department's Specification and the project's supplementary conditions have been performed and all items inspected, including those requiring repair or rework and re-inspection, fully conform to the shop and contract drawings as well as the Department and project specifications.

All components fabricated outside of Canada shall be shipped to a steel fabricator located in Canada that is:
1) CWB certified in accordance with CSA W47.1 to Division 1; and
2) Either CISC or AISC certified in the applicable category of steel bridges for re-inspection and testing.

The components shall be in a condition that facilitates all re-inspection and testing requirements. The re-inspection and testing shall take place at the Canadian shop and the Contractor shall also arrange for inspection by a CSA 178.2 Level III certified welding inspector accredited with W47.1/W59 to inspect:

- All components to ensure that they were undamaged during transportation; and
- Shop re-assembly of all components is required in accordance with 335.

Components shall not be shipped from the Canadian shop until all requirements have been met and the work has been reviewed and accepted. The Contractor shall have no claim against the Department resulting from delays caused by these requirements.

910.05.07.04 Inspection

The Contractor shall perform all inspection as outlined in Section 910.05.06. In all such inspections, the Contractor will be held strictly to the true intent and meaning of the specifications, drawings and other Contract Documents in regard to quality of materials, workmanship and diligent execution of the Contract. Any work done or materials used without supervision or inspection by the Owner's Representative may be ordered to be removed and replaced, at the Contractors' expense.

Inspection by the Owner's Representative may extend to all or any part of the works and to the preparation, fabrication, manufacture or erection of any or all the materials. The Owner's Representative or their representative shall be furnished by the Contractor with such information and facilities as is required to make a complete and detailed inspection and shall be allowed access to all parts and phases of the work. The Contractor shall supply electric power, scaffolding, protection from the weather, and free access for inspection and testing of material, to all aspects of the fabrication, delivery, and erection of the structural steel.

910.05.07.05 Owner's Representative

(a) A Owner's Representative will be assigned to the project to report to the Engineer on the progress of the works as a whole and the manner in which they are being performed, to secure adherence to the requirement of the Contract, to report on any failure by the Contractor to fulfil the requirements of the Contract and to direct the Contractor's attention to such failure.

(b) Testing Engineers and Inspectors may be appointed by the Engineer to fulfil duties similar to those of the Owner's Representative in connection with various aspects of the works and to carry out the testing of material and work.

(c) The Owner's Representative shall, within the limits of the written authorization given them by the Engineer, have authority to reject material or work that is not in conformity with the requirements of the Contract, but no representative of the Engineer shall have authority to revoke, alter, enlarge, relax or release any requirement of the Contract.

910.06 SURFACE PREPARATION AND COATINGS

The type of coating(s), the type of surface preparation, the method of application and drying or curing in addition to the measurement for and basis of payment shall be as defined in Section 921.

Surface touch up where necessary shall be done after the erection is complete and final.

910.07 CAMBER

Camber shall be as stated on the contract drawings.

910.08 MEASUREMENT FOR PAYMENT

Measurement for payment will be made on a lump sum basis for “Fabrication, Supply and Delivery” and “Erection.”

Measurement for payment will commence when the structural steel arrives on site and is accepted by the Owner’s Representative.

Measurement for payment will not be made for the provision of samples, specimens and testing including those tests required to be carried out in accordance with Section 910.05.06.

Measurement for payment for Surface Preparation and Coatings will be made in accordance with Section 921.

910.09 BASIS OF PAYMENT

910.09.01 Fabrication, Supply and Delivery

Payment at the contract price for "Fabrication, Supply and Delivery" in the Unit Price Table shall be full compensation for all labour, equipment, materials, plant and services to fabricate, test and inspect as outlined above, design services, supply, transport, deliver, handle and store the structural steel as outlined in this specification.

The basis of payment shall include full compensation for the provision of a storage site, the unloading, proper and orderly storage and identification of structural steel as outlined herein.

The Contractor shall bear all costs for the provision, preparation and testing of samples and specimens including those described in Section 910.05.06.

All costs, including inspection and testing, associated with the correction or repair of rejectable defects shall be the responsibility of the Contractor.

At the discretion of the Owner’s Representative, the Department may withhold a sum equal to 15% of the total lump sum price for the tender item "Fabrication, Supply and Delivery of Structural Steel", if the Contractor fails to comply with, or provide the documentation required under, Section 910.05.07. This sum may be withheld until such time as the Contractor, in the Owner’s Representative's opinion, meets the obligations set forth in the aforementioned specification.

The basis of payment shall include full compensation for the preparation of all proposals, shop details, bolting and welding design, bolting, welding and erection procedures, diagrams, calculations and drawings and submission of the same to the Owner's Representative for approval.

The costs and fees of the testing Engineer and other representatives of the Engineer shall be borne by the Department; with the exception of costs of re-inspection and retesting as associated with work not meeting these specifications, which shall be borne by the Contractor.

The basis of payment for Surface Preparation and Coatings will be made in accordance with Section 921.

The basis of payment for false work shall be in accordance with Section 907.

910.09.02 Other Inspection and Testing

If the Owner's Representative decides additional testing is necessary, the costs for electric power, scaffolding, protection from the weather and access for testing and inspection shall be included with the appropriate tender items and be borne by the Contractor.

The cost of the Engineer, their representative and all additional testing shall be borne by the Department unless due to rejectable defects or alternative design proposed by the Contractor; the cost of which will be borne by the Contractor.

910.09.03 Erection

Payment at the contract price for "Erection" in the Unit Price Table shall be full compensation for all labour, equipment, materials, plant and services to handle and erect the structural steel, site works required for erection, the drilling, setting and grouting of anchor bolts in addition to testing and inspection, all as outlined above.

SECTION 911

ICE BREAKERS

INDEX

911.01 SCOPE

The scope of this specification is to cover the supply and erection of steel ice breakers on concrete piers.

911.02 MATERIALS

The ice breaker shall be fabricated in 300W structural steel to CSA G40.21 “Structural Quality Steels”
Fabrication shall be in accordance with the detailed drawings.”

After fabrication the ice breaker shall be hot dip galvanized in accordance with CSA G164 “Hot Dip Galvanizing of Irregularly Shaped Articles.”

911.03 ERECTION

The ice breaker shall be placed in the form work prior to concrete placement. Elevations shall be accepted by the Owner’s Representative.

Any damage done to the galvanizing prior to installation shall be repaired in an acceptable manner and provide a galvanized coating comparable to that provided by CSA G164.

911.04 UNASSIGNED

911.05 MEASUREMENT FOR PAYMENT

Each ice breaker on each pier will be considered a unit.

911.06 BASIS OF PAYMENT

Payment at the contract price for “Supply and Install Icebreakers” in the Unit Price Table shall be full compensation for all labour, equipment and material to fabricate, galvanize, transport, and install the ice breakers.

For rehabilitation projects, the contract price shall also include the removal and reinstallation of the existing ice breakers as specified in the contract documents. Contractors shall replace any ice breakers damaged by their operations at their expense.

SECTION 912

BEARINGS

INDEX

912.01 SCOPE

The scope of this specification is to cover the supply, fabrication and installation of all plain and steel reinforced elastomeric bearings and pot bearings in structures. Pot bearings shall be defined as free sliding, constrained sliding and/or fixed structural

bearings consisting of a metal piston supported by a single moulded disc of unreinforced elastomer that is confined within a metal cylinder.

Bearing materials, manufacture, fabrication and installation shall comply with the latest edition of CSA-S6 “Canadian Highway Bridge Design Code” or OPSS 1202 “Bearings – Elastomeric Plain and Steel Laminated” and OPSS 1203 “Bearings – Rotational and Sliding Surface” for elastomeric and pot bearings respectively. In the event of a conflict between the two, the more severe criteria shall control.

912.02 MATERIALS

All materials shall be new and unused with no reclaimed material incorporated in the finished bearing.

912.02.01 Elastomeric Bearings

Bearings shall be fabricated from elastomeric materials. Virgin natural polyisoprene (natural rubber) or virgin polychloroprene (neoprene) shall be the only raw polymer permitted.

Internal steel plates shall be not less than 3mm thick nor greater than 5mm. Plates shall be mild steel and conform to CSA G40.21 “Structural Quality Steels”

The elastomer compound shall exhibit grade 5 low temperature behaviour. Both natural rubber and neoprene shall be either 50 ± 5 or 60 ± 5 durometer as stated on the contract drawings. The shop drawings shall indicate the low temperature behaviour grade and durometer number.

912.02.02 Pot Bearings

The Contractor shall furnish a manufacturer's certification that materials proposed for use on the project have been pretested and will meet the requirements as set forth in the manufacturer's current literature.

Elastomer and rubber components shall meet Grade 5 classification as per CSA S6.

Sliding pot bearings shall have a PTFE and stainless steel interface.

912.03 MANUFACTURE AND APPROVAL

912.03.01 Elastomeric Bearings

912.03.01.01 Manufacture

All pads shall have a smooth finish. Any steel plates shall be free from burrs and sharp edges; all laminations shall have a uniform thickness.

All elastomeric bearings shall have a minimum rotational capacity of ±0.005 radians. All elements shall be capable of maintaining its initial uniform contact at ± 0.005 radians rotation.

Steel laminated bearings shall be moulded as a single unit under pressure and heat, steel plates shall be completely bonded on all surfaces.

912.03.01.02 Approval

Bridge bearings shall be as designated in the contract or from an accepted source.

The Contractor shall submit 1 hardcopy and 1 electronic copy of the bearing shop drawings to the Department for review and allow 14 calendar days for review. These drawings shall be stamped and sealed by a Professional Engineer registered in the Province of Newfoundland and Labrador.

A copy of the bearing shop drawings shall be available on site at all times prior to and during the installation of the bearings.

Bearing materials, manufacture, fabrication and installation shall comply with the CSA-S6-14.

Bridge bearings designed from an accepted source shall also submit at least 14 calendar days prior to commencement of the bearing installation 1 hardcopy and 1 electronic copy of the design calculations for the bearings to the Department.

The shop drawings for the bearings shall clearly indicated the following as a minimum:

a) Bearing layout and orientation.
b) Dimensions and details of the bearings. Dimensions refer to length, width, diameter and thickness.
c) Details of each component of the bearing including the top or bottom plate, or both, including anchorages or dowels or both.
d) Installation details.

e) Load resistance at serviceability and ultimate limit states, including maximum compressive permanent and total loads.
f) Compression Stiffness, maximum movement capacity in shear, shear stiffness and rotation capacity.
g) Individual alphanumeric identification of each bearing.

912.03.01.03 Identification

All bearings shall be indelibly marked with the name of the manufacturer, the part number, bearing identification number, elastomer type, elastomer grade and the date of manufacture on the side visible after erection.

912.03.01.04 Quality Assurance

The manufacturer shall submit a certificate of compliance to the Owner's Representative prior to installation. The certificate of compliance shall contain the material properties, grades and relevant standards of all bearing materials. The manufacturer shall certify the bearing(s) meet the design requirements.

912.03.02 Pot Bearings

912.03.02.01 Fabrication and Manufacture

This work shall consist of the fabrication, manufacture and finishing of pot type structural bearing devices of the type shown on the plans for the locations as shown on the plans. These structural bearings shall adequately provide for all movements, loads, forces and rotations of structural members where applicable.

Bearings shall be factory set and clamped for equal expansion and contraction and plant assembled. Temporary connections shall not be removed until the bearings are set in their final positions.

The stainless steel sliding surface interface sheet shall conform to ASTM A167 "Standard Specification for Stainless and Heat Resisting Chromium –Nickle Steel Plate, Sheet, and Strip." Type 304 with a bright annealed mirror Number 8 finish on one side and continuously welded to the top plate.

All pot bearings shall have a minimum rotational capacity of ±0.02 radians. All elements shall be capable of maintaining its initial uniform contact at ± 0.02 radians rotation. The coefficient of friction between the PTFE and stainless steel plates at maximum permissible bearing load shall be 0.03 or less. Pot bearings are to be lubricated and unfilled. Exposed steel surface shall be coated with cold galvanizing compound (2 coats).

The bearing device manufacturer shall be pre-qualified with a five year proven history of successful product manufacture.

All welding shall be in accordance with CSA W59 “Welded Steel Construction.” The company undertaking welding fabrication shall be certified in Division 1 or Division 2.1 of CSA W47.1 “Fusion Welding of Steel Company Certification”

Unidirectional or constrained sliding bearings should be manufactured with a gap tolerance at the guides of 0.5 mm. All bearing surfaces of steel plates shall be finished flat within 0.25 mm. Overall manufacturing height tolerance shall be ± 3 mm.

Anchorage pins, studs and connections shall be designed and supplied by the fabricator for the maximum horizontal force and minimum/maximum vertical force indicated on the drawings.

912.03.02.02 Approval

The pot bearing manufacturer shall be as designated in the contract documents or an accepted equal. Bearings shall be accepted by shop drawings and the manufacturer shall supply the Owner’s Representative with a catalogue.

The Contractor shall submit 1 hardcopy and 1 electronic copy of the bearing shop drawings and calculations to the Department for review and allow 14 calendar days for review. These drawings shall be stamped and sealed by a Professional Engineer registered in the Province of Newfoundland and Labrador.

The shop drawings for the bearings shall clearly indicate the following as a minimum:

a) Bearing layout and orientation.
b) Dimensions of each component of the bearing including: top plate, sliding surface, bearing surface, piston, elastomeric disc, base pot, anchor pins, anchor studs and welds and the overall dimensions of the finished bearing. Dimensions refer to length, width, diameter and thickness.
c) Minimum and maximum horizontal and vertical load resistance at serviceability and ultimate limit states including maximum compressive permanent and total loads.
d) Longitudinal and transverse movement capacity.
e) Bearing rotation capacity in radians.
f) Direction and range of movement.
g) A detailed bill of materials.
h) Individual alphanumeric identification of each bearing.

912.03.02.03 Identification

All bearings shall be indelibly marked with the name of the manufacturer, the part number, bearing identification number, elastomer type, elastomer grade and the date of manufacture on the side visible after erection.

912.03.02.04 Quality Assurance

The manufacturer shall submit a certificate of compliance to the Owner's Representative prior to installation. The certificate of compliance shall contain the material properties, grades and relevant standards of all bearing materials. The manufacturer shall certify the bearing(s) meet the design requirements.

912.04 INSTALLATION

The bearings shall be protected from damage, distortion, excessive heat, and deleterious matter during the handling, transportation, storage and installation.

All welding within 3 metres of any bearing shall be specifically prohibited unless written approval is obtained from the Owner's Representative. Such approval will require specific measures to protect the bearings where so required by the Owner's Representative.

The bearings shall only be disassembled by the Contractor with the permission of the bearing supplier, The Bearing supplier's representative shall be present during disassembly and reassembly. Upon completion of the structure, the top and bottom surfaces of the bearings shall be in full contact with the structure.

Grouting operations shall be according to the manufacturer's recommendations, except that the temperature of the air, concrete and bearings shall not be less than 10 degrees Celsius at the time of grouting and shall be maintained at not less than 10 degrees Celsius for a minimum of 96 hours after grout is placed. Where pintles are specified in the Contract Documents, they shall engage the steel plate of the bearings through the entire thickness of that plate.

Temporary clamping devices shall be used to maintain correct orientation and setting and to prevent movement or separation of the bearing components during the handling, transportation, and installation. The clamping devices shall not be used for lifting or suspending the bearings. Clamping devices shall be removed after bearing is in its final position, with all permanent connections made, and after all grout and concrete in contact with the bearing have been placed.

Upon completion of the installation of the bearings on the substructure and prior to any loading on the bearings, the Owner's Representative shall conduct an interim inspection to verify that the installation has been carried out in general conformance with Contract Documents and issue the Contractor written permission to proceed.

912.04.01 Elastomeric Bearings

Bearings when received on site shall be stored in a location and under conditions accepted by the Owner's Representative and in accordance with the Manufacturer's requirements.

The bearings shall be installed in the exact location as called for in the contract. The centerline of the bearing along the direction of movement shall be parallel to the direction of movement of the bridge at that bearing location.

Tolerances of installation (including manufacturing tolerances) shall be ± 5 mm vertically and ± 3mm horizontally. A minimum of 90% of both the top and bottom surfaces of the bearing shall be in contact with the respective surfaces. Should these tolerances be exceeded the bearings may still be accepted by the Department, at the Department's discretion, if the bearing designer provides a stamped and signed as-built drawing and calculations showing the bearing is still compliant with the design code CSA S6-14.

Variation from a dead level plane shall not exceed 1mm in 500mm.

Any abnormal appearance of the bearings shall be cause for rejection.

912.04.02 Pot Bearings

The manufacturer shall ship each bearing fully assembled. The bearings are not to be disassembled prior to final installation without the knowledge of the design authority and manufacturer.

Bearings when received on site shall be unloaded and stored in accordance with the manufacturer's recommendations. The Owner's Representative shall accept the same.

The bearings shall be installed in the location and orientation as indicated on the contract drawings. Constrained sliding or uni-directional bearings shall be properly aligned to allow for the movement of the structure as indicated on the contract

drawings. The bearings shall not be installed in the field prior to the Owner's Representative's acceptance.

Where the bearings are of a guided or constrained type, the Contractor shall establish the bearing alignment using surveying instruments. The tolerance for variation in alignment, i.e. plan view, is ± 0.0067 radians (0.382 degrees) where the bearing is required to move 75 mm or less. The bearings shall have dead level bearing surfaces, i.e. top and bottom plates. Dead level shall be defined as ± 0.001745 radians (0.10 degrees), i.e. ± 1.745 mm in 1000 mm.

In positioning, the bearing centre of the base should correspond to the centre of the support. Rotation of the bearing should not be permitted to occur during concrete placing operations. The top plate shall be supported on all sides to prevent deflection of the same during the concrete placing operations.

The base plate shall be bedded by the contractor on non-shrink grout. It is of extreme importance that the final bedding be free from high or hard spots, voids, etc. The Contractor shall supply durable load bearing wedges to support all bearings when they are placed on the non-shrink grout pad. Wooden wedges are not acceptable. The bearing base plate shall be set in position using a flowable non-shrink grout unless otherwise indicated on the shop drawings. For uni-directional and multi-directional bearings, adjust the upper plate to proper setting as instructed by the Owner's Representative prior to affixing to the structure. Ensure form work is well sealed to prevent concrete from flowing onto the bearing prior to placing deck concrete.

Installation requirements shall be written on the shop drawings. Bearings are to be installed as per the manufacturer's recommendations.

912.05 MEASUREMENT FOR PAYMENT

Each individual bearing fully assembled shall be considered as one unit regardless of the bearing type, kind, size, capacity, function, location of installation in the structure or source of manufacture. Measurement for payment purposes shall be the total number of such units installed.

Bearings used against concrete creep blocks and concrete corbels shall not be included in measurement for payment and are incidental to the works.

912.06 BASIS OF PAYMENT

Payment at the contract price for "Supply And Install Bearings" in the Unit Price Table shall be full compensation for all labour, equipment, access, materials and services

required to supply, fabricate, transport to the job site, store on site, handle and install the bearings in the specified location and provide any associated design calculations. Any anchorages, grout and dowel pins required are considered incidental and no separate payments will be made.

The tendered price per each unit for "Supply and Install Bearings" shall be the average price per unit regardless of the bearing type, kind, size, capacity, function, location of installation in the structure or source of manufacture excluding bearings used against creep blocks and concrete corbels which are incidental to the works.

Any necessary engineering and adjustment shall be considered incidental to the work.

No payment will be made until a certificate of compliance has been received by the Owner’s Representative.

SECTION 913

EXPANSION JOINTS

INDEX

913.01 SCOPE

The scope of this specification is to cover the design, supply, material, fabrication and installation of expansion joint assemblies of the type as shown in the contract documents.

Typical strip seal expansion joint systems are comprised of two separate metal assemblies which hold a seal consisting of a flexible material between them. Movement in the bridge is accommodated by the flexible seal which is free to stretch and compress to a specified degree. The system also includes sealants, backer rods, caulking, foams, drainage, and metal plates used to accommodate movement in the deck, curbs, and barriers.

Typical asphalt plug expansion joints consist of a mixture of elastic material (binder) and aggregate placed over the joint between sections of the bridge. Movement in the bridge is accommodated by the binder/aggregate mix compressing and stretching to a specified degree. The system also includes sealants, backer rods, caulking, foams, and metal plates used to accommodate movement in the deck, curbs, and barriers.

Expansion joint design, materials, fabrication and installation shall comply with the latest edition of CSA S6 “Canadian Highway Bridge Design Code.”

913.02 APPROVALS

Prior to any fabrication or the purchase of materials, shop drawings must be reviewed by the Owner's Representative.

Contractor shall submit 1 hardcopy and 1 electronic copy of the shop drawings with 2 weeks required for review.

The shop drawings shall show:

a. Movement chart showing total rated movement.
b. The required setting width for temperatures in increments of 5°C within the normal setting range.
c. Grade, type and dimension of all material used.
d. Location and full details of all splices and welds.
e. Full details of anchors, clamping devices and curb details.
f. Preset shipping dimensions.
g. Site storage and installation procedures.
h. Relationship of expansion joint assembly to deck, approach slab, roadway and all adjacent reinforcement.
i. For strip seal expansion joints, confirmation from the neoprene seal manufacturer that the lubricants to be used during installation are compatible with the seal.
j. For asphalt plug expansion joints confirmation from the neoprene seal binder and aggregate plug manufacturer that all other components of the system are compatible with the plug.

913.03 STRIP SEAL EXPANSION JOINT SYSTEM

The expansion joint assembly shall be a mechanically locked joint of the type shown on the contract drawings or an accepted equivalent. It shall be capable of satisfactory operation between -35 and +40 degrees Celsius.

913.03.01 Materials

913.03.01.01 Seal

The seal shall be a neoprene seal conforming to OPSS.PROV 1210 "Material Specification for Deck Joint Assemblies" and having the following properties:

Seal Physical Requirements Preformed Seal Physical Requirements Property	Physical Requirements	Test Procedure
Tensile Strength	Minimum 13.5 MPa	ASTM D 412

		Test Method A
Ultimate Elongation	Minimum 250%	ASTM D 412 Test Method A
Hardness,	55 Shore A, + 7, -5	ASTM D 2240
Oven Aging Test, 70 h @ 100 °C Change in Tensile Strength	Maximum 20%	ASTM D 573 ASTM D 412 Test Method A
Change in Elongation	Maximum 20%	ASTM D 412 Test Method A
Change in Hardness	Maximum 10 points	ASTM D 2240
Permanent set at break	Maximum 10%	ASTM D 412 Test Method A
Low Temperature Crystallization Hardness, ShoreA 7 d @ -10 °C Change in Hardness	Maximum 15 points	ASTM D 832 ASTM D 2240
Oil Swell, ASTM Oil No. 3, 70 h @ 100 °C Weight Change	Maximum 45%	ASTM D 471
Ozone Resistance, 20% Strain, 150 pphm in air 70 h @ 40 °C	No cracks	ASTM D 1149 Method B, Procedure B1
Notes: A. All tests shall be made on specimens prepared from the preformed seals.		

Manufacturer's storage and handling requirements shall be followed. The seal shall not be exposed to ultraviolet rays for more than 3 days before installation.

913.03.01.02 Lubricant

The Contractor shall supply a suitable lubricant to facilitate the installation of the seal into the expansion joint rail. The lubricant shall be compatible with the neoprene seal and the Contractor shall provide a letter from the seal manufacturer to this effect when requested by the Owner's Representative.

913.03.01.03 Steel

All steel used in the expansion joint assembly shall conform to CSA-G40.21 "Structural Quality Steels." The steel grade shall be 300W and galvanized in accordance with 913.03.02.

Reinforcing steel shall be as specified in the contract documents and in accordance with Section 905.

If the protective galvanized coating is damaged prior to final acceptance, regardless of cause, the Contractor shall wire brush to clean the metal and hand paint with a cold

galvanizing compound accepted by the Owner's Representative. The cleaned surface shall receive one application of metal conditioner to de-oxide, degrease and phosphatise the metal surface to be treated. Pre-mixed, ready-to apply, liquid cold galvanizing compound should be applied to the prepared clean dry metal surface. The cold galvanizing compound must be of a type that imparts cathodic action against corrosion. The cold-galvanizing compound shall have a minimum 50 mm overlap of the surrounding galvanized metal. Both metal conditioner and cold galvanizing compound must be accepted by Underwriters Laboratories of Canada for component coatings (organic) and meet or exceed CGSB 1.181-99 "Ready Mixed Organic Zinc Rich Coating.". All materials must be applied in accordance with the manufacturer's instructions.

913.03.01.04 Concrete

Concrete in the expansion joint dam shall be as per "Superstructure Concrete" of Section 904.

Concrete which does not meet the specified compressive strengths shall be rejected or payment will be reduced as per Section 913.06.03.

913.03.02 Fabrication

All cut edges shall be smooth, regular and free of slag.

All holes shall be drilled and bleed holes shall be 12 millimetre diameter.

All welding shall be in accordance with CSA W59 "Welded Steel Construction." The company undertaking welding fabrication shall be certified in Division 1 or Division 2.1 of CSA W47.1 "Fusion Welding of Steel Company Certification."

The roadway part of the expansion joint shall be bent up 150 millimetres at a 45 degree angle into the curb, the neoprene seal shall extend 25 millimetres beyond the end of the joint.

Unless otherwise indicated, all joints shall be fitted with snowplow deflector plates. Snow plow deflectors shall be placed parallel to the center line of the roadway.

The steel shall be zinc metallized or hot dipped galvanized.

Zinc metalizing shall be in accordance with CSA G189 "Sprayed Metal Coatings for Atmospheric Corrosion Protection" providing a minimum metallized coating of 200µm.

Hot dip galvanizing shall be in accordance with the most recent edition of CSA G164 “Hot Dip Galvanizing of Irregularly Shaped Articles” providing a minimal galvanized coating thickness of 200µm.

The neoprene seal shall be continuous. If the seal is cut over the installation length, it shall be rejected, removed, and replaced at the Contractor’s expense. No schedule extensions shall be given for this reason.

913.03.03 Transportation and Storage

The joint assembly shall be shipped with the preset dimensions of 50 millimetres for 10 degrees Celsius unless otherwise indicated on the drawings. Care shall be taken in the shipping to prevent bending, warping or other damage.

The joint assembly shall be stored such that it is protected from rusting, dirt and distortion.

913.03.04 Installation of Strip Seal Expansion Joint Systems in New Construction

913.03.04.01 General

The Contractor shall provide a technician, accepted by the Owner’s Representative, familiar with the expansion joint assembly being installed, to supervise all works involved with its installation.

Before the placement of the expansion joint assembly, all deck concrete shall have been placed and cured for a minimum period of 3 days with enough area for the proper placement of the expansion joint assembly "boxed-out" as per detail on contract drawings.

Seals shall be continuous over their installation length. No cutting of the seal shall be permitted, except for trimming of excess length at the ends. If the seal is cut over the installation length, it shall be rejected, removed, and replaced at the Contractor’s expense. No schedule extensions shall be given for this reason.

The expansion joint installation sequence is outlined as follows:

a. Install steel expansion joint assembly. Adjustment for the prevailing temperature shall be made and clamps re-tightened.
b. Erect form work, prepare concrete surfaces, place expansion joint and dam concrete; this concrete is to be cast separately from the deck concrete. Clamps shall be removed shortly after the concrete has set.

c. Remove form work, polystyrene and debris, request inspection and approval to install seal from the Owner's Representative. The use of heat, fire, gasoline or the application of corrosive chemicals is not an acceptable means of polystyrene removal.
d. Install the seal in the expansion joint.

Concrete the same as that specified for "Superstructure Concrete" in accordance with Section 904, shall be placed around the expansion joint in the previously boxed-out area with great care being taken during consolidation that no voids are left under the steel components.

The joint assembly shall be placed precisely as called for in the drawings and such that it will remain true to elevation and grade and remain firm after the concrete has hardened. Deviation from the grade or elevation shall be cause for rejection. Rejection would mean the complete removal of the expansion joint assembly and its subsequent replacement.

After the concrete has hardened, the exposed face of the seal and structural steel shapes shall be cleaned of deleterious material. Bleeder holes and bolt holes shall be cleaned and filled with an accepted epoxy grout and any scratches in the metallizing shall be touched-up with zinc rich touch-up paint.

913.03.05 Installation of Strip Seal Expansion Joint Systems in Rehabilitation Projects

913.03.05.01 General

Where existing expansion joints on the structure(s) are to be replaced by a new strip seal expansion joint system, the expansion joint system shall be in accordance with Section 913.03.

For rehabilitation projects, areas of the deck adjacent to the expansion joints may have an undetermined degree of deterioration and it may be necessary to remove sections of the deck and backwall to accommodate the new joint system. All existing reinforcing steel in the deck and backwall is to remain intact.

All concrete to asphalt joints must be sawcut and a space provided and filled with an accepted sealant, as described on the drawings.

It will be the Contractor's responsibility to ensure that exact dimensions of the replacement joint are correct.

All deck repairs adjacent to joints and overlays must be complete prior to the installation of concrete in expansion joint dams and asphaltic plug joints.

913.03.05.02 Removal of Existing Joint

The work shall entail the removal of concrete, existing sealants and joint fillers, and water stops. The work shall be performed as detailed on the drawings. All existing formwork remaining from the original construction along with any accumulated debris on the beam seats shall be removed and disposed of to the Owner's Representative's satisfaction.

Concrete shall be removed to 300mm each side of the joint in plan view and removal shall be to a depth of 200mm in the deck and 300mm in the backwall, unless otherwise indicated on the contract drawings. If concrete is to be removed by jackhammer, the maximum hammer mass permitted is 13 kg. All tools used in concrete removal should be pointed. Existing reinforcing steel in the deck or backwall is not to be cut.

If any reinforcing steel is found to be exposed, the concrete shall be removed to a clear distance of 25mm below the underside of the reinforcement.

If any concrete is required to be removed around reinforcing steel, then the maximum hammer size permitted shall be 7 kg. The Contractor shall take care not to damage any existing steel reinforcing. Reinforcing that is damaged shall be replaced by dowelling into the existing member at the Contractor's own cost.

Existing reinforcement with a cross-sectional area that is corroded more than 10% of its original cross section shall be replaced. The Contractor shall supply and install new steel reinforcement to match the original diameter, new bars shall be spliced with the original reinforcement or dowelled into the existing member. The Owner's Representative may specify additional reinforcement in the field to ensure the expansion joint concrete is adequately tied into the existing deck.

913.03.05.03 Surface Preparation

At the edge of areas to be repaired, a neat line shall be saw cut a minimum of 30mm to preclude feather edges.

Prior to restoration of these areas, the concrete substrate and all exposed reinforcing steel shall be satisfactorily blast cleaned and painted in accordance with Section 919.06 and 919.07 until the steel is free of all rust and all loose particles of concrete. Remaining blasting medium shall be removed with oil-free jets of compressed air or water producing a minimum pressure of 6 MPa. If the substrate is wet at the time of cleaning, then it shall

be cleaned with high pressure jets of water. A pressure gauge shall be installed in the water or air lines in order to verify the specified pressure.

The deck and backwall shall then be restored as per the drawings. However, no concrete shall be placed until the prepared surface to be restored is inspected and approval in writing is given by the Owner's Representative.

Concrete substrate shall be kept damp for a minimum of 24 hours prior to placement of concrete.

Contractor shall provide and apply a bonding agent, SikaTop Armatec-110 EpoCem manufactured by Sika or an accepted equivalent, prior to pouring concrete. Bonding agents shall be applied in accordance with the manufacturer's instructions.

913.03.05.04 Supply And Placement Of Concrete

The joint assembly shall be placed precisely as called for in the drawings and such that it will remain true to elevation and grade and remain firm after the concrete has hardened. Deviation from the grade or elevation shall be cause for rejection. Rejection would mean the complete removal of the expansion joint assembly and its subsequent replacement.

All aspects of concrete supply and placement are subject to approval of the Owner's Representative. High range water reducing agents (superplasticizers) may be used at the Contractor's request if so indicated when the mix design is submitted. The Contractor must demonstrate competence and experience in their use and specific approval must be obtained.

Concrete shall meet the requirements of "Superstructure Concrete" specified in Section 904.

If superplasticizers are used, the maximum slump permitted will be 90 mm.

913.03.05.05 Finishing

Concrete must be finished immediately after strike off before the appearance of bleed water using a magnesium float. All concrete must be broom finished. The surface shall not be overworked. The Contractor shall supply a 3 m straight edge and the surface shall not deviate from the design grade by more than 8 mm.

913.03.05.06 Curing

Immediately after the concrete has been placed and finished, the Contractor shall apply the evaporation retardant “MasterKure ER 50” manufactured by Master Builders Company Ltd, SikaFilm manufactured by Sika, or an accepted equivalent. The product shall be applied as per manufacturer's instructions and recommendations.

All aspects of curing shall be in accordance with Section 904.05.

After the concrete has hardened, the exposed face of the seal and structural steel shapes shall be cleaned of deleterious material. Bleeder holes and bolt holes shall be cleaned and filled with an accepted epoxy grout and any scratches in the metallizing shall be touched-up with zinc rich touch-up paint.

913.03.06 Removal and Replacement of Expansion Joint Seal

For rehabilitation projects that only require the removal and replacement of the Neoprene Seal, the existing seal shall be removed and debris removed from the gap. The steel assembly shall be painted with a zinc-rich paint as per Section 919 before the new seal is installed.

Seals shall be continuous over their installation length. No cutting of the seal shall be permitted, except for trimming of excess length at the ends. If the seal is cut over the installation length, it shall be rejected, removed, and replaced at the Contractor’s expense. No schedule extensions shall be given for this reason.

Lubricant as specified in Section 913.03.01.02 shall be used to install the seal.

913.04 ASPHALT PLUG EXPANSION JOINTS

913.04.01 Materials

913.04.01.01 Binder and Aggregate Plug

Binder and aggregate plug shall be WABO Expandex, Prismo Thormajoint, or an accepted equal.

All components of the joint system shall be accepted, in writing, by the manufacturer of the binder and aggregate plug.

913.04.01.02 Steel

The steel grade shall be 300W and galvanized in accordance with Section 913.03.02 unless otherwise noted on the contract drawings.

New steel shall be provided for all Asphalt Plug Expansion Joints unless otherwise indicated on the drawings.

913.04.01.03 Concrete Backers

When concrete backers are specified in the contract documents the concrete shall meet the requirements of “Superstructure Concrete” in Section 904 and the reinforcing steel shall meet the requirements of the steel type specified in Section 905.

913.04.02 Installation

Installation shall be as per manufacturer’s instructions.

Asphalt or concrete adjacent to the plug joint shall be sawcut the full depth of the plug to ensure a clean joint.

For rehabilitation of existing asphalt plug joints, all components of the existing plug joint and any debris shall be removed from the joint prior to the new plug joint being installed.

For rehabilitation projects, areas of the deck adjacent to the expansion joints may have an undetermined degree of deterioration and it may be necessary to remove sections of the deck and backwall and reconstruct before installation of the plug joint. Any repairs to these areas shall be in accordance with Section 919.

913.05 TESTING

All expansion joints are to be tested once installation is complete, by the following method in the presence of the Owner’s Representative:

The area around the expansion joint shall be enclosed with sand bags, or an approved similar watertight method, to ensure that a minimum of 100mm of water is held over the full width of the joint. Water shall be left for a minimum of 1 hour. Both underneath the joint and the water level shall be monitored to ensure that no water is leaking through the joint. For bride rehabilitations where the joint is constructed in two parts, the test shall overlap the connection area a minimum of 200mm.

Any joints that are showing any water leakage shall either be repaired or replaced at the Contractor's own cost to the Owner's Representative's satisfaction.

913.06 MEASUREMENT FOR PAYMENT

913.06.01 Supply and Install Expansion Joints

Measurement for payment will be made for each expansion joint assembly installed and accepted by the Owner's Representative. The assembly shall include the preparation of the expansion joint block-out, expansion joint, neoprene seal, all related components within the boxed-out area or zone, drainage, concrete, and reinforcing steel.

Materials to protect the seal, fill gaps, and accommodate movement in the deck, curbs, sidewalks, and barriers are also included as part of the expansion joint. This includes, but is not limited to, sealants, backer rods, caulking, foams, and metal plates used to accommodate movement in the deck, curbs, and barriers.

913.06.02 Remove and Replace Expansion Joint Seal

Measurement for payment will be made for each expansion joint seal removed and installed in the works and accepted by the Owner's Representative.

Materials to protect the seal, fill gaps, and accommodate movement in the deck, curbs, sidewalks, and barriers are also included as part of the expansion joint. This includes, but is not limited to, sealants, backer rods, caulking, foams, and metal plates used to accommodate movement in the deck, curbs, and barriers.

913.06.03 Supply and Install Asphalt Plug Expansion Joint

Measurement for payment will be made for each expansion joint assembly installed and accepted by the Owner's Representative.

Asphalt plug joint thickness shall match the adjoining asphalt or as indicated on the contract drawings or as directed by the Owner's Representative. No additional payment will be made for plug joint thicknesses up to 100 millimetres. For plug joints which exceed 100 millimetres in thickness, the payment shall be prorated for the amount exceeding 100 millimetres.

Materials to protect the asphalt plug, fill gaps, and accommodate movement in the deck, curbs, sidewalks, and barriers are also included as part of the expansion joint. This includes, but is not limited to, sealants, backer rods, caulking, foams, and metal plates used to accommodate movement in the deck, curbs, and barriers.

913.07 BASIS OF PAYMENT

913.07.01 Supply and Install Strip Seal Expansion Joint System

Payment at the contract price for "Supply and Install Strip Seal Expansion Joint" in the Unit Price Table shall be full compensation for all labour, equipment, materials, plant and services required for the design, supply, fabrication, transportation to the job site, storage, handling, satisfactory preparation and installation for the expansion joint assembly of the type as indicated on the contract drawings.

The supply and application of all metal plates, drainage components, lubricants, grouts, sealants, galvanizing compound, epoxy, styrofoam, evafoam, or accepted equal, adhesive, caulking, bonding agents, evaporation retarder, and backer rods shall be incidental to the work and payment will not be made for such.

Concrete and steel reinforcement in the expansion joint block out shall be incidental to the cost of the expansion joint assembly.

The removal of all polystyrene, form work, and debris between the back face of the deck and the front face of the stem shall be incidental to the works.

For rehabilitation projects, the cost of demolition, disposal, and preparation of the expansion joint block out for the replacement expansion joint shall be incidental to the works.

Payment for repairs to the adjacent concrete deck outside of the expansion joint block out shall be as per Section 919. Additional reinforcing or reinforcing to replace existing corroded reinforcement in the deck or backwall shall be paid as per Section 905.

Concrete which does not meet the specified compressive strengths shall be rejected or penalized as per Section 913.06.03.

913.07.02 Remove and Replace Expansion Joint Seal

Payment at the contract price for "Remove and Replace Expansion Joint Seal" in the Unit Price Table shall be full compensation for all labour, equipment, materials, plant and services required for the design, supply, fabrication, transportation to the job site, storage, handling, satisfactory preparation and installation for the expansion joint seal of the type as indicated on the contract drawings.

Application of zinc-rich paint to the expansion joint steel shall be incidental to the work.

If joint seals specified in the contract are ordered and delivered to site but not used, they shall be paid at invoice price only. Unused seals shall be delivered to a Department of Transportation and Infrastructure depot as directed by the Owner's Representative.

913.07.03 Concrete Rejection and Penalties

Expansion joints constructed where the average tested 28 day strength of the concrete in the expansion joint dam is less than the specified strength but otherwise meets the specifications will be accepted at a reduced payment provided the difference between the specified strength and the average tested 28 day strength is no greater than 5 MPa. If the difference is greater then 5 MPa than the expansion joint shall be rejected. The Contractor shall remove the expansion joint dam and re-pour the concrete.

When concrete is rejected, those provisions outlined in CSA A23.1 "Concrete Materials and Methods of Concrete Construction" shall be followed to determine whether or not the concrete may remain in the work. Such work shall be done at the Contractor's expense. Notwithstanding the above, should the concrete remain in the work it shall be subject to a reduction as outlined below, for having a strength less than that specified.

If the concrete in any portion of the expansion joint is found to have a strength deficiency of less than 5 MPa than the lump sum bid price for the expansion joint will be adjusted in accordance with the following:

$$ALSP = BLSP * (SS / TS)) * (LJDC / LJ)$$

where:

ALSP = Adjusted Lump Sum Price for the Expansion Joint
BLSP = Bid Lump Sum Price per Expansion Joint
SS = Specified 28 day strength (MPa)
TS = Tested Average 28 day strength (MPa)
LJDC = Length of Joint with Deficient Concrete (m)
LJ = Length of Joint (m)

913.07.04 Supply and Install Asphalt Plug Expansion Joint

Payment at the contract price for "Supply and Install Asphalt Plug Expansion Joint" in the Unit Price Table shall be full compensation for all labour, equipment, materials, plant and services required for the design, supply, fabrication, transportation to the job site, storage,

handling, satisfactory preparation and installation for the expansion joint as indicated on the contract drawings.

The supply and application of all metal plates, lubricants, grouts, sealants, galvanizing compound, epoxy, Styrofoam, evafoam, or accepted equal, adhesive, caulking, backer rods shall be incidental to the work and payment will not be made for such.

For rehabilitation projects, the cost of demolition, disposal, and preparation of the expansion joint block out for the replacement expansion joint shall be incidental to the works.

The cost of concrete and reinforcing steel for concrete backers shall be incidental to the works. This includes the costs of any demolition of asphalt, concrete, and steel to install the backers. Payment for the joints will be reduced as per section 913.07.03 for concrete where the average tested 28 day strength of the concrete in the expansion joint dam is less than the specified strength but otherwise meets the specifications, provided the difference between the specified strength and the average tested 28 day strength is no greater than 5 MPa, any concrete less than this will be rejected.

Payment for repairs to the underlying or adjacent concrete shall be as per Section 919 “Rehabilitation of Concrete Structures.” Additional reinforcing or reinforcing to replace existing corroded reinforcement in the deck or backwall shall be paid as per Section 905.

Payment for repairs to the adjacent asphalt wearing surface shall be as per “Asphaltic Patching” in Section 332.10.2.

SECTION 914

BRIDGE DECK WATERPROOFING

INDEX

914.01 SCOPE

The scope of this specification is the preparation and treatment of the concrete bridge deck, as shown on the plans and where designated by the Owner's Representative, with

a surface conditioner, hot applied rubberized asphalt membrane, membrane reinforcement, and fiber protection board. Joint filling compound shall fill grooves adjacent to curbs, sidewalk, and barrier walls. Undiluted tack coat shall be applied to the asphalt adjacent to curbs, sidewalks and barrier walls.

914.02 GENERAL

The Contractor shall submit for approval to the Owner's Representative the following documentation:

1. Product Data Sheets and the Manufacturer's Installation Instructions for all products to be used in the water proofing system, including, but not limited to the following:
    a. Surface Conditioner /Primer
    b. Hot Applied Rubberized Waterproofing Membrane
    c. Reinforcing Material (If required)
    d. Protection Board

2. In addition to the above information, the submission shall contain:
    a. the project name and number;
    b. proposed dates of application for priming, waterproofing, and paving;
    c. the specific gravity and the weight or mass per drum of the asphalt membrane;
    d. Overview of the Contractor's and foreman's previous experience installing the proposed system or similar systems;
    e. Letter from the manufacturer of the waterproofing membrane that all components to be used in the waterproofing system are accepted for use and are compatible with their product;
    f. Letter from the manufacturer of the waterproofing membrane that the contractor applying the waterproofing membrane is accepted to install their waterproofing system.

3. A copy of the Contractor's pre-waterproofing briefing which shall include, at a minimum, the following information:
    a. Overview of the waterproofing system's components and how the components will be applied;
    b. Any relevant safety information;
    c. Required surface preparation prior to application of primer/conditioner
    d. Required air temperatures and kettle temperatures for application;
    e. Required application thickness of membrane and how the thickness will be measured during application;

f. How defects such as bubbles, pinholes, and missed areas will be corrected
g. Where and how reinforcing materials will be placed
h. How protection board will be placed and rolled including the required overlap and joint staggering distances.

The pre-waterproofing briefing will be carried out with all workers that will be involved in the waterproofing operation. Multiple briefings shall be conducted as required to ensure that all workers are fully versed in the installation procedure or how to correct any installation errors. The Owner's Representative shall be provided with 48 hours notice to be present for briefings.

The Contractor shall give the Owner's Representative a minimum of 48 hours notice prior to commencing the waterproofing application; in addition, the prepared bridge deck shall be specifically accepted by the Owner's Representative.

All concrete surfaces shall be cured in accordance with Section 904.05 and be in a dry condition before waterproofing operations may begin. Waterproofing work shall not be performed during rainy or inclement weather or on frost covered surfaces.

The Contractor shall adhere to Section 820.02 and the required procedures.

914.03 MATERIALS

The waterproofing system will include a surface conditioner/primer, asphalt membrane, membrane reinforcement (as construction details require), protection board, and tack coat emulsion. All components to be used in the overall waterproofing system shall be accepted for use by the manufacturer of the hot applied (poured) rubberized asphalt membrane for compatibility with their product.

914.03.01 Surface Primer for Asphalt Membrane

The surface conditioner shall conform to the requirements of CGSB 37-GP-9Ma "Primer, Asphalt, Unfilled for Asphalt Roofing, Damproofing and Waterproofing" and accepted by the Owner's Representative and accepted for use by the manufacturer of the asphalt membrane.

914.03.02 Asphalt Membrane

The asphalt membrane shall be as follows or an accepted equivalent accepted by the Owner's Representative:

1) Ultraseal 3750 by Craftco Inc.
2) MACSEAL BDM by McAsphalt Industries

3) Henry 790-11 MTO Grade

914.03.03 Reinforcing Materials

The rubber materials shall be as follows or an accepted equal accepted by the Owner's Representative. Any product, including those listed below shall be accepted for use by the manufacturer of the asphalt membrane:

1) SBM 63 Butyl Rubber Membrane by Stedfast
2) Ultraseal Reinforcing Fabric by Craftco Inc.
3) Henry Polyfab Reinforcing Fabric
4) Henry 990-25 Elastomeric Flashing Sheet

914.03.04 Protection Board

Protection board shall be asphalt impregnated fiberboard accepted by the Owner's Representative and accepted for use by the manufacturer of the asphalt membrane.

914.03.05 Tack Coat for Protection Board

The tack coat used in conjunction with the protection board shall be as specified in Section 320.

914.03.06 Joint Sealing Compound

Joint sealing compound shall be as per Section 914.03.02 or an accepted equal accepted by the Owner's Representative.

914.03.07 Asphaltic Concrete Sealant

The asphaltic concrete sealant shall be an undiluted tack coat as per Section 914.03.05.

914.04 INSTALLATION

914.04.01 Concrete Surface Preparation

The existing surface of the concrete shall be treated by sandblasting, bush hammering or other such methods as the Owner's Representative may accept, so as to expose solid, laitance-free concrete. All dirt and debris shall be swept off and disposed of to leave a prepared surface satisfactory to the Owner's Representative before application of the surface primer/ conditioner. Immediately prior to the application of the surface primer/ conditioner, the concrete surface shall be cleaned with a jet of oil-free compressed air to remove all dust and any other foreign material. Waterproofing shall not commence until the Owner's Representative has accepted all preparation work.

Without limiting the generality thereof, in the preparation of new concrete decks the following can be anticipated: removal of concrete and grout spills, small depressions must be filled with Portland cement mixture, areas of heavy laitance require removal, sharp projections must be ground off and honeycombed concrete requires patching.

Old decks will generally require the removal of larger expanses of old hot mix pavement and waterproofing which is not well bonded. Scaled or spalled concrete must be removed and replaced with Portland cement concrete. This will generally be considered as rehabilitation work and will be paid for separately under Section 919.

Hot mix asphaltic patching shall not be used to level a deck prior to waterproofing.

914.04.02 Surface Primer for Asphalt Membrane

Surface primers shall be applied as directed by the manufacturer.

Surface primer shall be applied with accepted equipment which will provide a uniform application at the required rate.

The surface primer shall be applied only when the concrete is dry, clean and when the air and concrete surface temperature are above 5 degrees Celsius. No traffic shall be permitted upon the surface conditioner until it has fully cured.

The surface primer shall be applied to the entire deck surface including those vertical surfaces which are to be treated with waterproofing such as the vertical faces at curbs and expansion joint dams.

Surface primer shall be applied in accordance with CGSB 37-GP-15M “Application of Asphalt Primer for Asphalt Roofing, Dampproofing and Waterproofing.”

914.04.03 Application of Asphalt Membrane

Application of hot applied, rubberized asphalt membrane for bridge deck waterproofing shall generally comply with CGSB 37-GP-51M “Application of Rubberized Asphalt, Hot Applied, for Roofing and Waterproofing.”

Cakes of hot applied rubberized asphalt membrane shall be melted in an accepted, indirect heating or double boiler type mechanically agitated heating and mixing until which shall keep the contents continuously agitated until the material can be drawn free flowing and lump free from the mixing unit at a temperature not exceeding that recommended by the manufacturer. The kettle shall be equipped with a thermometer to measure membrane temperature.

No membrane shall be applied until the surface primer has cured completely. The hot applied rubberized asphalt membrane shall be applied at the temperature recommended by the manufacturer, to the clean primer coated concrete deck, so as to form a uniform single coat having a minimum thickness of 4mm and a maximum thickness of 5mm. The average thickness shall not be less than 4.5mm.

The operation shall be such that discontinuities in the membrane are avoided and any joints lapped 150mm. The membrane shall extend up the face of curbs, dams at expansion joints and deck drains to the height of the top of the hot mix asphaltic surface course and into the chase where this has been provided.

Membrane application temperature shall be not less than 175 degrees Celsius and not greater than 212 degrees Celsius. Overheated material may gel or become stringy and shall be rejected. The membrane shall be applied in such a manner to eliminate entrapped air, be of uniform thickness and essentially free of pinholes and blisters.

914.04.04 Application of Reinforcing Materials

In the areas indicated on the drawings, at all cracks and construction joints reinforcing material shall be placed directly over the hot applied rubberized asphalt membrane while it is still tacky. The reinforcing material shall extend up the face of the curbs or barrier walls to the top of the asphaltic pavement, or into the chase where this has been provided. The reinforcing material shall then be covered with a layer of hot applied rubberized asphalt membrane as shown on the plans or as directed by the manufacturer. At the horizontal and vertical surfaces, the reinforcing material shall be shaped to fit the interface, ensuring that air is not entrapped, fish mouths shall be eliminated.

914.04.05 Application of Protection Board

Protection boards shall be laid on the asphalt membrane while the surface is still warm and tacky. Materials or substances shall not be applied to either the membrane surface or the protection board to remove the tackiness prior to installation of the protection board. Protection boards may be butt jointed. Otherwise, protection boards shall be placed with edges overlapping a maximum of 25mm both longitudinally and transversely. The overlap pattern shall be consistently applied in one direction such that the quality of paving will not be reduced. The overlap pattern shall be such as to facilitate paving operations in the downgrade direction. The protection board edge shall be within 6mm of all curbs, drain verticals and expansion joint verticals.

Protection board shall be rolled as directed by the manufacturer.

No construction traffic or equipment shall be permitted upon the hot applied rubberized asphalt membrane until the protection board has been placed and the membrane has cooled to ambient temperature. Once cooled, only construction traffic directly associated with paving of the asphalt on the waterproofing will be allowed. Any other vehicular traffic, operated either by the public or by the Contractor will not be allowed, and each occurrence will result in the application of the daily liquidated rate to payment of this item.

914.04.06 Application of Protection Board Tack Coat

The diluted tack coat material shall be applied at the rate of 0.5 litre per square metre.

Tack coat material shall be applied to the protection board cover with accepted equipment which will provide a uniform application at the required rate. The tack coat shall be applied only when the protection board cover is dry, clean and when the air temperature is above 5 degrees Celsius. The tack coat on the protection board cover shall be placed just sufficiently ahead of paving to allow for adequate curing.

914.04.07 Paving Operations

The Contractor shall schedule their operations so that paving shall be carried out as soon as the membrane has cooled to ambient temperature but no earlier than 12 hours from conclusion of the waterproofing installation.

Asphalt shall be placed within 48 hours after waterproofing is complete unless otherwise accepted by the Department. Liquidated damages will apply for each 24 hour period that this time period is exceeded. Paving equipment shall not be permitted upon the tack coat until it has fully cured. Asphaltic paving of bridge decks shall be in accordance with Section 922.

914.04.08 Forming and Filling Grooves with Joint Sealing Compound

Along each curb and for the full length of each curb, sidewalk, barrier wall, or where indicated in the contract drawings, the Contractor shall form a rectangular groove 12mm-20mm wide extending from the surface to the top of the base course of asphalt. If only one lift of asphalt is present, the groove shall extend to the top of the waterproofing membrane. This groove shall be made using asphalt impregnated strips or timber placed against the curb prior to the placing of the hot mix asphaltic concrete.

If required, the material used to form the groove shall be coated with an accepted bond breaker and shall be fully removed after the mix has been fully compacted. The Contractor may use an alternative method of forming the grooves with the approval of the Owner’s Representative.

Immediately prior to pouring the sealing compound, the groove shall be completely empty, dry and then cleaned of any dust or debris by an oil-free compressed air jet.

The joint sealing compound shall be poured in place after the asphaltic pavement reaches ambient air temperature.

Cakes of joint sealing compound shall be melted on the job site and shall be continuously agitated in the mechanically agitated heating and mixing kettle. The contents shall be continuously agitated until the material can be drawn free flowing and lump free from the mixing kettle at a temperature within the range recommended by the manufacturer.

The compound shall not be heated in excess of the pouring temperature recommended by the manufacturer. The Contractor may be required to demonstrate with the equipment proposed for use that it will consistently produce a joint sealing compound of proper pouring consistency.

Pouring shall be done by the use of hand pouring pots, mechanical methods, or any other method which will give satisfactory results. The pouring equipment shall be designed such that a minimum of time will elapse during pouring operations so the compound will be placed in a workmanlike manner. Shields shall be provided to prevent the compound from being spilled on the concrete curb and on the newly placed bituminous surface.

Sufficient compound shall be poured into the groove so that upon completion of the work the surface of the compound will be flush with the surface of the pavement when the air temperature at time of pouring is 27 degrees Celsius or over, or 5mm below the surface of the pavement when the temperature is below 27 degrees Celsius. If the compound subsides to a level below the surface of the pavement, a second pouring will be required. When more than one pouring is required to fill the groove, succeeding pours will be made immediately.

Damage such as stones embedded in the joint sealing compound by construction traffic and Contractor's operation shall be repaired by the Contractor at their expense.

Traffic will not be permitted upon the surface course during the operation of forming and filling the grooves.

914.04.09 Sealing Surface of Asphaltic Concrete Adjacent To Curbs

After the grooves at curbs have been filled and before it has become contaminated with dirt or debris, the surface shall be spray or brush painted with a uniform continuous, liberal application of undiluted tack coat specified in Section 914.03.07 at the rate as per

manufacturer's instructions, or as directed by the Owner's Representative, for a width of 600mm adjacent to all curbs, barrier walls, or where otherwise specified, to completely seal the surface. The tack coat shall extend 25mm up adjacent concrete surfaces.

914.05 SAMPLING

The Department's representatives may at their discretion require that sufficient quantities of the surface conditioner, hot poured rubberized asphalt membrane, joint sealing compound, or tack coat be obtained from the materials being used on the project as might be required for immediate analysis or future testing purposes.

914.06 MEASUREMENT FOR PAYMENT

The area treated with hot applied rubberized asphalt membrane will be measured in square metres to the nearest one decimal place and will for payment purposes be considered the product of the width of the bridge deck measured perpendicular to faces of curb and side walk and the length of the bridge measured in plan between centre lines of abutment bearings. No allowance will be made in the measurement for the turn-up at the curb line or for any overlaps.

914.07 BASIS OF PAYMENT

Payment at the contract price for "Bridge Deck Waterproofing" in the Unit Price Table shall be full compensation for the preparation of the concrete deck surface, the supply and application of surface conditioner, hot applied rubberized asphalt membrane, rubber membrane, protection boards, tack coat, joint sealing compound, the forming and filling of the grooves, the supply and application of undiluted seal coat, the handling and controlling of traffic, and for all other items incidental to the satisfactory completion of work as determined by the Owner's Representative.

SECTION 915

SUPPLY, INSTALLATION, AND SALVAGE OF BRIDGE RAIL

INDEX

915.01 SCOPE

The scope of this specification is related to the fabrication, supply, and installation of aluminum bridge railing and steel bridge railing as shown on the contract documents.

915.02 ALUMINUM BRIDGE RAIL

915.02.01 Scope

This covers the fabrication, supply, and installation aluminum bridge railing as shown on the contract documents. The number of rails on the railing shall be as per the contract documents.

915.02.02 Materials

a) The posts shall be permanent-mould cast from A444-T4 or accepted equal and be heat-treated according to ASTM B108 “Standard Specification for Aluminum-Alloy Permanent Mold Castings.”
b) The rails shall be extruded from 6061-T6, 6351-T6 or equal.
c) The rail plugs shall be cast from A356.0F or equal.
d) Type A307 or F3125 connecting bolts, nuts and washers shall be of hot dipped galvanized steel in accordance with CSA G164 “Hot Dip Galvanizing of Irregularly Shaped Articles.”
e) The set screws shall be stainless steel.
f) Type F3125 anchor bolts, nuts and washers shall be of hot dipped galvanized steel in accordance with CSA G164.
g) Black/Grey Neoprene Gaskets 50 Duro Hardness
h) Nylon Bushings
i) Miscellaneous materials shall be as noted on the contract drawings.

915.02.03 Fabrication

The railing shall be fabricated as per the contract documents. Alternative rail designs may be submitted for approval. The Department reserves the right to refuse alternative designs.

Fabrication of the railing shall be to CSA S6 “Canadian Highway Bridge Design Code.”

Before starting any work on the railing, the Contractor shall submit 1 hardcopy and 1 electronic copy of shop drawings including Bill of Materials to the Owner’s Representative for review, showing full details of the fabrication and erection of the railing.

For all bridge rehabilitation projects or as indicated on the drawings, prior to fabrication, the Contractor shall visit the site to confirm all measurements on the drawings are correct. By submitting fabrication drawings to the Owner’s Representative for acceptance, the Contractor is indicating they have visited the site to complete these measurements. No

additional payment will be made for any fabrication errors as a result of differences between the tender/construction drawings and actual site conditions.

915.02.04 Installation

For rehabilitation projects with existing aluminum rail, the aluminum rail shall be salvaged as per Section 915.04.

Unused anchor bolts or rebar from the existing bridge rail shall be removed to 70mm below the concrete surface and patched with a suitable patching material accepted by the Owner's Representative.

Railing and metal traffic barrier components shall be protected from damage and distortion during handling, transportation, storage, and installation. Aluminum alloys shall not be flame cut.

Railing shall be installed as indicated on the contract and shop drawings. Snug-tight bolts for slip joints shall be extra long and have double nuts which shall be torqued up against each other while still maintaining the slip joint.

Rail and posts shall be erected true to line and levels as shown on the drawings or as directed by the Owner's Representative. Rails are to be parallel to the top of the concrete, and the posts are to be perpendicular to the concrete.

Where shims are required for the alignment of the posts, they shall be made from fully annealed alloy known commercially as A1100 or equivalent.

Surfaces of aluminum in contact with concrete shall be given a heavy coat of alkali-resistant bituminous paint prior to the installation. The paint shall be applied as it is received from the manufacturer without the addition of any thinner.

A 6mm thick neoprene gasket shall be placed between the aluminum post and concrete. The gasket shall have pre-punched holes enabling it to properly fit over the anchors.

A prefabricated anchor insert of the type shown on the drawings or an accepted equal, shall be used to secure the bridge railing posts to the concrete.

If chemical anchors are used to secure the bridge rail posts then the anchor is to be accepted by the Owner's Representative. All chemical anchors shall be installed as per the manufacture's specifications.

Nylon bushings shall be used to prevent any electro-chemical reaction occurring between the aluminum posts and the bolts.

For accurately positioning the insert with the form, a setting template shall be furnished with the insert.

The aluminum bridge railing shall be thoroughly cleaned of all discolouration by accepted methods and all marks and scratches occurring during the fabrication shall be removed. The Contractor may at their own expense, apply a thin coat of clear non-yellowing lacquer to the cleaned surfaces, but they shall in any case ensure that the railings, when erected, have a clear surface of uniform appearance and texture.

915.03 STEEL BRIDGE RAIL

915.03.01 Scope

For new bridge construction this specification applies to the supply and installation of new steel bridge rail.

For the rehabilitation of existing structures, in addition to the supply and installation of new steel bridge rail, this specification applies the demolition of the existing concrete or metal barrier system required for installation of the new steel bridge rail.

915.03.02 Materials

Components of the Steel Bridge rail shall be as follows:

a) Rail bars. ..... HSS 350 WT, Class H
b) Rail posts and Base Plates. ..... 350 W
c) All other shapes and plates. ..... 300 W
d) Anchor studs, washers and nuts. ..... ASTM A449
e) All other bolts and nuts ..... ASTM A307
f) Black/Grey Neoprene Gasket… .....50 Duro Hardness

All steel shall be structural steels as per most recent edition of CSA G40.21.

Hot dip galvanizing shall be completed as per most recent edition of CSA G164.

All welding and weld inspection as per most recent edition of CSA W59 “Welded Steel Construction.”

Mill test reports shall be provided for all materials in English. Mill test reports shall be submitted to the Owner's Representative for review and acceptance 3 weeks prior to the commencement of fabrication.

Where mill test reports originate from a mill outside Canada or the United States of America, the Contractor shall have mill test reports verified by a certified laboratory in Canada by testing the material to the specified material standards, including boron content. The testing laboratory shall be certified to ISO/IEC 17025 "General Requirements for the Competence of Testing and Calibration Laboratories" by an organization accredited by the Standards Council of Canada for the tests required. Samples for testing shall be collected by personnel employed by the certified laboratory. A verification letter shall be provided by the certified laboratory that includes at a minimum, the applicable mill test reports, testing standards, date of verification testing, and declaration of material compliance with Contract requirements. The verification letter shall be signed by an authorized officer of the certified laboratory.

915.03.03 Fabrication

Prior to fabrication the Contractor shall submit fabrication drawings of the steel rails system for acceptance by the Owner's Representative. Drawings shall clearly indicate all information required for fabrication, the grade of components, and any other information requested by the Owner's Representative.

For all bridge rehabilitation projects or as indicated on the drawings, prior to fabrication, the Contractor shall visit the site to confirm all measurements on the drawings are correct. By submitting fabrication drawings to the Owner's Representative for acceptance, the Contractor is indicating they have visited the site to complete these measurements. No additional payment will be made for any fabrication errors as a result of differences between the tender/construction drawings and actual site conditions.

All exposed cut or sheared edges shall be broken and free of burrs. The inside weld flash of tubing shall be removed at splices and expansion joints.

All material shall be hot dipped galvanized in accordance with the most recent edition of CSA G164 with a minimum thickness of 85 micrometres. Steel shall be abrasive blast cleaned to SSPC SP-6 before galvanizing. If the protective galvanized coating is damaged prior to final acceptance, regardless of cause, the Contractor shall wire brush to clean the metal and hand paint with a cold galvanizing compound. The cleaned surface shall receive one application of metal conditioner to de-oxide, degrease and phosphatise the metal surface to be treated. Pre-mixed, ready-to apply, liquid cold galvanizing

compound should be applied to the prepared clean dry metal surface. The cold galvanizing compound must be of a type that imparts cathodic action against corrosion. The cold-galvanizing compound shall have a minimum 50 mm overlap of the surrounding galvanized metal. Both metal conditioner and cold galvanizing compound must be accepted by Underwriters Laboratories of Canada for component coatings (organic) and meet or exceed CGSB 1.181-99 “Ready Mixed Organic Zinc Rich Coating.” All materials must be applied in accordance with the manufacturer’s instructions.

Rail bars to be used on a radius of 300 m or less shall be curved before the application of any galvanizing. Bending tolerance from theoretical horizontal curvature shall be plus or minus 3 millimetres per metre and not to exceed 12 millimetres total.

Lengths of rail bar shall be attached to a minimum of 2 posts and at least 4 posts whenever possible. Rail bar expansion joints shall be provided in any rail bay spanning a superstructure expansion joint.

Rails shall be attached to posts using bolts inserted through the face of the rail bar. Bolts shall be round or dome head and may be rib neck, slotted, wrench head or tension control (TC or twist-off).

Holes in rail bars shall be field drilled and shall be coated with an accepted zinc rich paint prior to erection.

Bolts in expansion sleeves shall be tightened to a point that will still allow rail movement.

915.03.04 Transportation and Storage

Galvanized material shall be stacked or bundled and stored to prevent wet storage stain as per the American Hot Dip Galvanizers Association (AHDGA) publication “Wet Storage Stain”. Any evidence of wet storage stain shall be removed to the satisfaction of the Owner’s Representative.

Galvanized rail components shall be transported and stored in a manner that prevents the formation of wet storage stain.

Newly galvanized components shall be stored under cover in a dry and well ventilated area for a period of at least 48 hours. Components shall be raised from the ground and, if stacked, separated with untreated poplar, ash, or spruce wood spacers and spaced to allow for free air flow at all surfaces.

For outdoor storage and transportation after the initial 48 hour period, components shall be raised from the ground and, if stacked, separated with untreated poplar, ash, or spruce wood spacers and spaced to allow for free air flow at all surfaces. Components shall be inclined to ensure drainage of water.

915.03.05 Installation

For rehabilitation projects with existing aluminum rail, the aluminum rail shall be salvaged as per Section 915.04. Anchor bolts or rebar for the existing bridge rail shall be removed to 70mm below the concrete surface and patched with a suitable patching material accepted by the Owner's Representative.

Rail and posts shall be erected true to line and levels shown on the drawings or as directed by the Owner's Representative. Rails are to be parallel to the top of the concrete and the posts are to be perpendicular to the concrete.

A 6mm (1/4") thick neoprene gasket shall be placed between the galvanized steel posts and concrete. The gasket shall have the same footprint as the baseplate and have pre-punched holes enabling it to properly fit over the anchors. Neoprene shall be black or gray, specified for outdoor use, and have a duro hardness of 50A.

If, after installation, wet storage stain is present, it shall be removed to the satisfaction of the Department.

Nuts on the anchor studs shall be tightened to sung fit then given another ¼ turn. The anchor studs shall extend at least 6mm above the top of the tightened nut. Tops of the anchor studs shall not be cut or grinded in any way.

Once the nuts are tightened, the baseplate and neoprene shall be in full contact with the concrete curb. In the event that sufficient contact is not achieved, the post shall be removed and the concrete grinded to ensure full contact. The use of grouts or shims to achieve full contact is not permitted.

Washers or other items shall not be used to shim the baseplates.

915.03.06 Installation Using Chemical Anchors

For rehabilitation projects where chemical anchoring is specified, the Contractor shall measure the drilled holes to ensure the correct depth has been achieved. Anchor rods shall be a minimum of 425 mm long for an embedment depth of 350 mm, or as indicated on the Contract Drawings. Prior to installation, the anchor studs shall be measured and

the required embedment marked on them using yellow paint marker or another method accepted by the Owner's Representative.

The anchor studs shall be installed as per the chemical anchoring manufacturer's specifications using a level or another means to ensure plumb installation. A slight amount of epoxy shall come out of the drilled hole when the stud is fully inserted.

Chemical anchoring shall not be placed through the holes in the steel baseplate. Posts shall be placed onto the anchor studs until after the chemical anchor has fully cured.

The actual length of embedment shall be within 10 mm of the specified embedment. Anchor studs with embedment outside of this tolerance shall be rejected and replaced by the Contractor at the Contractor's expense.

915.04 SALVAGE OF EXISTING BRIDGE RAIL

When detailed on the contract drawings, existing bridge rail shall be salvaged.

Any rail deemed salvageable by the Owner's Representative shall be treated as per Section 901.04 and transported to the Department depot specified in the contract documents. Any materials deemed not salvageable by the Owner's Representative shall become the property of the Contractor and properly disposed of.

The Contractor is required to contact the Transportation and Infrastructure depot which will be receiving the salvaged material to be advised of the hours of operation and the location for storing salvage.

Contractor shall take care when salvaging the bridge rail and other components. Removal of the bridge rail posts will require concrete chipping at the base to expose the anchorages to a depth such that the anchorages can be cut and the posts removed without damage to the posts and their associated baseplates. Any rail components damaged as a result of the Contractor's operations shall be repaired or replaced at the Contractor's expense.

915.05 MEASUREMENT FOR PAYMENT

915.05.01 Aluminum Bridge Rail

The quantity of aluminum one-rail and four-rail bridge railing for which payment shall be made will be all railing as shown on the contract drawings and as accepted by the Owner's Representative to the nearest 0.1m.

Measurement shall be per metre of one or four-rail aluminum rail system installed and measured from end to end of the railing.

915.05.02 Steel Bridge Rail

The quantity of four-rail steel bridge railing for which payment shall be made will be all railing as shown on the contract drawings and as accepted by the Owner's Representative to the nearest 0.1 metre.

Measurement shall be per metre of steel rail system installed and measured from end to end of the railing.

915.06 BASIS FOR PAYMENT

915.06.01 Aluminum Bridge Rail

Payment at the contract price for "Supply And Install One-Rail Aluminum Bridge Rail" and "Supply and Install Four-Rail Aluminum Bridge Rail" in the Unit Price Table for shall be full compensation for all labour, equipment and materials required to fabricate, supply, deliver and install the railings, including posts, rails, rail sleeves, rail plugs, anchor inserts, nylon bushings, neoprene pads, nuts, bolts and washers and any other items required to supply and install the railing systems. Where existing concrete or metal bridge rail is to be demolished or salvaged, the cost of demolition, disposal or salvage shall be included in the unit price of the new railing.

For projects where salvaged rail is to be used, payment at the contract price shall include the supply and installation of any missing or damaged nuts, bolts, nylon bushings, bituminous paint, and neoprene pads. Costs for pick-up and delivery of the material from the Department depot specified in the contract shall be incidental to this item.

Payment will be made on delivery of all materials in good condition and with adequate storage on site up to the cost of material supplied as substantiated by invoices.

The remaining payment for installation will be made when the Owner's Representative is satisfied that installation in accordance with the contract has been carried out**.**

No additional payment will be made for any fabrication errors as a result of differences between the tender/construction drawings and actual site conditions.

915.06.02 Steel Bridge Rail

Payment at the contract price for "Supply And Install Four–Rail Steel Bridge Rail" in the Unit Price Table shall be full compensation for all labour, equipment and materials required to fabricate, supply, deliver, and install the railings, including posts, rails, rail sleeves, rail caps, neoprene gaskets, anchor inserts, nuts, bolts and washers and any

other incidental items. Where existing concrete or metal bridge rail is to be demolished or salvaged, the cost of demolition, disposal or salvage shall be included in the unit price of the new railing.

Payment will be made on delivery of all materials in good condition and with adequate storage on site up to the cost of material supplied as substantiated by invoices.

The remaining payment will be made when the Owner's Representative is satisfied that installation in accordance with the contract has been carried out**.**

No additional payment will be made for any fabrication errors as a result of differences between the tender/construction drawings and actual site conditions.

915.06.03 Salvage of Existing Bridge Rail

If existing bridge rail is to be salvaged, all costs associated with salvaging and delivery shall be included in the per metre cost of the new bridge rail to be installed on the structure.

10% of the bid price of the bridge rail shall be withheld until the bridge rail identified as salvage has been delivered as per Section 915.04.

SECTION 916

ROCK EMBEDDED CONCRETE GUTTER

INDEX

916.01 SCOPE

This specification covers the requirements for the construction of rock embedded concrete gutters on a prepared bed of granular base course.

The width, length and cross section of the gutter shall be as shown on the drawings.

916.02 MATERIALS

916.02.01 Concrete

Concrete shall meet all requirements of “Curb, Gutter, Sidewalks, Catch Basins & Weir Baffles” concrete, in accordance with Section 904.

Where gutter is to be placed on slopes it may be necessary for the concrete to have a slump of 20 millimetres in order for the wet concrete to stay in the forms while the concrete is setting.

916.02.02 Concrete Reinforcement

Concrete reinforcement shall be Black Steel Reinforcement unless Galvanized or Stainless Steel is used in the project, in which case it shall match those. In the event that multiple types are used, the steel type which has the greater quantity in the remainder of the project shall be used.

Additional testing for stainless steel originating from outside Canada is not required for steel in rock embedded concrete gutters.

916.02.03 Rock

Stones for embedding in the gutter shall consist of slab shaped, clean, hard durable rock, free of cracks. Rock subject to marked deterioration by water or weather will not be accepted.

The thickness of the individual stones shall not be less than 70 millimetres or greater than 130 millimetres and the maximum dimension shall not exceed 250 millimetres.

916.02.04 Joints

Material for forming isolation joints shall be 12 millimetre thick bituminous fibre material of depth equal to the depth of the gutter.

Material for forming control joints shall be 12 millimetre thick bituminous fibre material for the set-in-place type, or a bituminous filler material for the groove or saw-cut type.

All materials including formwork shall be supplied by the Contractor.

916.02.01 Gabions

Gabions shall be as specified in Section 601.

916.03 PREPARATION WORK

Should excavation be required prior to placing the bed for the gutter, then such work shall be carried out and paid for in accordance with Section 403.

When fill is required prior to placing the bed for the gutter, then this work shall be carried out in accordance with Section 204.

After the site has been graded, as described above, a bed shall be laid composed of Selected Granular Base Course Granular "A". The bed shall be laid by the Contractor and accepted by the Owner's Representative prior to construction.

The compacted depth of the bed should not be less than 100 millimetres. The bed shall be compacted to not less than 95% of the Standard Proctor Density (ASTM D698).

916.04 FORMWORK

Formwork shall conform to the requirements of Section 907.

Forms shall be set to provide a gutter with the dimensions indicated on the drawings and to the grades and lines accepted by the Owner's Representative prior to construction.

916.05 PLACEMENT OF CONCRETE REINFORCEMENT

Minimum cover to concrete reinforcement shall be 50mm.

Dowels shall be 1500 millimetres long and spaced at 2 metre intervals.

Placement including chairs and supports shall be as specified in Section 905.

916.06 PLACING THE CONCRETE AND ROCKS

Concrete shall be placed in accordance with the requirements of Section 904.

Reinforcing steel shall be placed in accordance with the requirements of Section 905.

As soon as the concrete has been placed and consolidated, it shall be struck off true to grade and required cross section by an oscillating movement of a template.

The surface shall then be floated with a wooden float until the mortar flushes to the top, and the entire surface presents a tight and compact appearance and the divisions between each block shall be marked, rounded and tooled with proper finishing tools in

the neatest possible manner to the satisfaction of the Owner's Representative. The jointing tool shall have a radius of 12 millimetres.

Immediately following finishing, the stones shall be moistened in water and placed in the concrete. The stones shall be placed in the concrete leaving about 20 millimetres of stone exposed. When the stones are pushed into the concrete, any resulting depression in the surface of the concrete next to the sides of the stones shall be filled and trimmed by means of hand work with a trowel, or other suitable tool.

Should the Contractor choose to use the groove or saw-cut type of control joint, as opposed to the bituminous fibre type, then at those places where control joints are to be made, care shall be taken to ensure that no stones are placed in the path of a joint.

The Contractor shall take care in placing the stones in the concrete to ensure that the exposed parts of the stones are not smeared with concrete. Should stones become smeared during placing, they shall be immediately removed, thoroughly washed and then placed back in the concrete before it sets.

Concrete at the top of the gutter shall be formed and sloped so that runoff from the road and adjacent curbs flow into the gutter without ponding.

916.07 JOINTS

When the rock embedded concrete gutter is to be constructed abutting another structure such as concrete pavement, concrete sidewalk, concrete retaining wall, or catch basin frame, then the Contractor shall construct a full length isolation joint, of depth equal to the depth of the gutter. When abutting asphaltic pavement no joint is necessary.

Isolation joints shall consist of a 12 millimetre thick bituminous fibre panel cut to such size so as to provide a full depth joint extending for the full width. The bituminous fibre panels shall be set vertical in the forms before the concrete is poured.

Panels shall be pre-cut to the shape of the joint so as to provide a 6 millimetre recess on the exposed surface. The Contractor has the option of either providing a 6 millimetre deep, 12 millimetre wide cap strip, to be removed after the concrete has hardened and not edging the joints, or carefully removing all concrete immediately above the filler material to form a 6 millimetre deep, 12 millimetre wide recess then finishing both edges of each joint to a 6 millimetres radius with a suitable short edging tool.

Control joints shall be placed at intervals of not greater than 6 metres.

Control joints may be formed using a 12 millimetre thick bituminous fibre panel cut to such size so as to provide a joint extending not less than one quarter the depth of the gutter for the full width. The bituminous fibre panel control joints shall be set vertical in the forms before the concrete is poured.

Panels shall be pre-cut to the shape of the joint so as to provide a 6 millimetre recess on the exposed surface. The methods of obtaining these 6 millimetre recesses shall be as previously stipulated for isolation joints.

Alternatively control joints may be formed by the use of a "guillotine" knife in fresh concrete or saw cutting the hardened concrete with a sufficient time of placing to prevent uncontrolled cracking. Groove or saw-cut control joints shall be of thickness between 3 and 5 millimetres, depth not less than one quarter the depth of the gutter, and width the full width of the gutter. When the concrete is dry the control joints shall be completely filled with a bituminous filler material. Immediately prior to the filling, the joint shall be thoroughly cleansed of all dust, and particles of foreign matter.

Construction joints shall be built at convenient stopping places in the placement of the concrete. They may be either butt type or isolation joints and they shall be the full depth and width of the gutter. They shall be built at the end of each day's construction or when there is a delay in the supply of concrete and cold joints might develop.

916.08 CURING THE CONCRETE

Concrete shall be cured in conformity with the requirements of Section 904. Consideration will be given to the use of white pigmented curing compounds applied in accordance with the manufacturer’s recommendations.

916.09 TRIMMING

After the removal of the forms and after the initial curing of the concrete, the Contractor shall grade and tamp adjacent other material against the exposed edges of the gutter to form stable shoulders for the gutter. These shoulders shall be made trim to sightly proportions.

916.10 GRADING OF ADJACENT GROUND

Ground adjacent to the gutter within 10 metres of the end of the expansion joint or approach slabs, if present, shall be graded so that the water drains into the gutter. Failure to properly grade the ground to the satisfaction of the Owner’s Representative shall be corrected at the Contractor’s expense.

916.11 GABIONS AND END TREATMENTS

When shown on the drawings, rock filled gabions shall be placed at the bottom of the gutter to prevent erosion from the flowing water. Gabions shall be Type 'G' unless other wise specified.

In the event that gabions are not indicated on the drawings, Class I Hydraulic Rip Rap meeting the requirements of Section 917 shall be placed. The area covered with rip rap shall be 0.5 metres thick and cover an area of approximately 1 metre by 1 metre centered in front of the end of the gutter.

916.12 MEASUREMENT FOR PAYMENT

Measurement for payment will be by the length laid, according to the instructions of the Owner's Representative in linear metres, rounded to one decimal place.

916.13 BASIS OF PAYMENT

Payment at the contract price for "Supply and Install Rock Embedded Concrete Gutter" in the Unit Price Table shall be full compensation for all labour, materials and equipment to prepare the ground and install the rock embedded gutter. This includes, but is not limited to, the supply and installation of form work, reinforcing steel, concrete, granular base course, stones, gabions, joints, joint filler, landscaping, rip rap and any other items to install the gutter.

SECTION 917

HYDRAULIC RIP RAP

INDEX

917.01 SCOPE

This specification covers the supply, delivery and installation of hydraulic rip rap protective covering placed to protect causeways and structures.

917.02 MATERIALS AND GRADING

The quality of rock must be accepted by the Owner's Representative prior to placement. The Rock supplied for placement must be clean, hard, durable and angular in shape. Field stones and boulders may be used only upon consultation and acceptance with the Owner's Representative.

The rocks supplied shall meet the following requirements:

a) Have a density of not less than 2.6 t/m^3.
b) When subjected to the Los Angeles Abrasion Test in CSA A23.2 "Test Methods and Standard Practices for Concrete" shall have a loss not greater than 35%.
c) When tested for soundness according to CSA A23.2-9A, the rock material shall have a loss not greater than 15% after five cycles.

Rip Rap material provided shall have a gradation that conforms to the following (Taken from "Guide to Bridge Hydraulics" published by RTAC):

Class I	Class II	Class III
NOMINAL 300 MM DIAMETER OR 40 KG MASS ALLOWABLE LOCAL VELOCITY UP TO 3 M/SEC. GRADING SPECIFICATION: 100% SMALLER THAN 450 MM OR 130 KG AT LEAST 20% LARGER THAN 350 MM OR 70 KG AT LEAST 50% LARGER THAN 300 MM OR 40 KG AT LEAST 80% LARGER THAN 200 MM OR 10 KG	NOMINAL 500 MM DIAMETER OR 200 KG MASS ALLOWABLE LOCAL VELOCITY UP TO 4 M/SEC. GRADING SPECIFICATION: 100% SMALLER THAN 800 MM OR 700 KG AT LEAST 20% LARGER THAN 600 MM OR 300 KG AT LEAST 50% LARGER THAN 500 MM OR 200 KG AT LEAST 80% LARGER THAN 300 MM OR 40 KG	NOMINAL 800 MM DIAMETER OR 700 KG MASS ALLOWABLE LOCAL VELOCITY UP TO 5 M/SEC. GRADING SPECIFICATION: 100% SMALLER THAN 1200 MM OR 2300 KG AT LEAST 20% LARGER THAN 900 MM OR 1100 KG AT LEAST 50% LARGER THAN 800 MM OR 700 KG AT LEAST 80% LARGER THAN 500 MM OR 200 KG

The class of rip rap to be used will be designated in the contract documents.

Location of a suitable source for the hydraulic rip rap shall be the responsibility of the Contractor.

917.03 PLACING

Where and as directed by the Owner's Representative excavation shall be performed to provide a shelf or ledge to provide adequate foundation for the bottom of the hydraulic rip rap.

Material shall be placed as shown on the plans or as otherwise directed by the Owner's Representative.

Material shall be dumped or craned into position to starting at the bottom of the slope and working upwards. Material must completely cover the area to be protected to the depth specified. The finished surface shall have a uniform appearance, free from depressions or bumps.

The Owner's Representative shall be the final and sole judge of the quantity of hydraulic rip rap required.

917.04 MEASUREMENT FOR PAYMENT

Measurement for payment shall be cubic metres of material placed to the nearest one decimal and only that material placed as directed by the Owner's Representative shall be

accounted for payment. Payment will be in cubic metres as tendered under item “Hydraulic Rip Rap” as listed in the unit price table.

Where measurement is impractical due to placement under water an estimate of that rip rap correctly placed will be made by converting the truck load into cubic metres.

Measurement for any excavation requested by the Owner’s Representative will be in accordance with Section 902.

917.05 BASIS OF PAYMENT

Payment at the contract price for “Hydraulic Rip-Rap” in the Unit Price Table shall be full compensation for all labour, materials, and equipment needed to supply and place hydraulic rip rap protection as required under the Contract.

SECTION 918

DECK DRAINS

INDEX

918.01 SCOPE

The scope of this specification is to cover the supply and installation of deck drains in both new construction and rehabilitation projects.

918.02 MATERIALS AND FABRICATION

Deck drains shall be of material supplied in accordance with CSA G40.21 “Structural Quality Steels” Grade 300W.

Drains shall be hot dip galvanized after fabrication to CSA G164 “Hot Dip Galvanizing of Irregularly Shaped Articles.”

The outlet pipe is to be supplied in accordance with ASTM A53 “Standard Specification for Pipe, Steel, Black, Hot-Dipped, Zinc Coated, Welded and Seamless.”

918.03 INSTALLATION

Drains are to be installed in the locations shown on the plans or as otherwise accepted by the Owner’s Representative.

For new deck construction, the deck drain(s) shall be put in place before the deck concrete is cast. Elevation of the deck drains shall be verified prior to the deck pour dry run.

For rehabilitation projects, the hole for the deck drain down spout shall be drilled through the concrete deck with a core bit. Breaking through the deck with a jackhammer is not permitted. The core bit shall be capable of drilling a hole of sufficient size to easily accommodate the outside diameter of the down spout. Any gap between the drilled hole and the outside of the drain down spout shall be grouted to the satisfaction of the Owner’s Representative. Any other demolition and concrete reinstatement required to install the drain properly shall be completed.

The work shall entail the removal of existing drains, the supply and installation of new drains at the location shown on the drawings and the reinstatement of concrete surrounding them. The holes left by the existing drains shall be filled with new concrete.

Care shall be taken that the top of the drain is slightly below the surrounding finished surface. Sloping of the wearing surface to accommodate deck drains shall not extend into the driving lanes.

The bottom of the down spout shall extend a minimum of 300mm below any adjacent superstructure components.

The grating shall be tack welded to the catch basin.

Incorrectly placed drains shall be cause for rejection and shall be replaced as per the direction of the Owner's Representative

918.04 MEASUREMENT FOR PAYMENT

Each individual drain shall be considered one unit. Only deck drains will be measured for payment.

918.05 BASIS OF PAYMENT

Payment at the contract unit price for "Supply and Install Deck Drains" in the Unit Price Table shall be considered full compensation for all labour, equipment, plant and materials required to supply and install deck drains, including both catch basins and drainage down spouts.

For rehabilitation contracts, payment at the contract unit price for "Supply and Install Deck Drains" in the Unit Price Table shall also include costs associated with removal of existing drains, concrete demolition, concrete rehabilitation, non-shrink grout, and asphalt removal.

Any work associated with rectifying incorrectly placed drains shall not be paid for.

SECTION 919

REHABILITATION OF CONCRETE STRUCTURES

INDEX

919.01 SCOPE

The scope of this specification is to cover the supply of materials for concrete repair, methods of repair including concrete removal, surface preparation and the placement, finishing and curing of repair materials. All work, equipment and materials shall be in strict accordance with CSA A23.1 “Concrete Materials and Methods of Concrete Construction” and the relevant sections of the Department Specification Book.

919.02 MOBILIZATION AND DEMOBILIZATION

919.02.01 General

In addition to the requirements specified in this Section, the applicable requirements specified in Division 1 shall also apply and be adhered to.

As part of Mobilization, Contractor shall remove all debris, sand, and rubbish from the bridge deck and bearing seats. Contractor shall also clean any deck drains, curbs, and

gutters to ensure they are free flowing. These items shall be cleaned again prior to demobilization if required by the Department.

If snow clearing or removal is required at any time during the work, it shall be considered incidental to Mobilization and Demobilization.

Prior to demobilization, the Contractor shall gather all debris and rubbish from the work site and adjacent areas including, the bearing seats, ditches, watercourses, and treelines. This shall include debris not due to the Contractor's activities or operations.

Any debris and rubbish shall disposed of in accordance with 919.21.

919.02.02 Contractor's Outline of Repair Procedures

After contract award, the Department may elect to have the Contractor submit their outline of repair procedures for all aspects of the contract or specific procedures. The Contractor must be specific with their repair procedures. The intention of the submissions are to determine details of the Contractor's proposed equipment, methods, materials, and key personnel to ensure general acceptability and that important aspects of work have been fully understood.

The Department reserves the right to request additional submissions of the Contractor's Outline of Repair procedures at any time during the project. Work related to the repair procedure requested shall not commence until the procedure is accepted by the Department. Additionally, payment for the work related to the requested repair procedure shall be withheld until the repair procedure is accepted by the Department.

For repair procedures requested prior to mobilization, the first 20% of the bid price for mobilization shall be withheld until the Department accepts the Contractor's repair procedures that were requested.

Acceptance of the Contractor's repair procedures by the Department shall not relieve the Contractor of their responsibility to complete the work as detailed in the Department's Specification Book or as per the manufacturer's requirements. If the Contractor plans to deviate from any procedures outlined in the Specification Book, they shall clearly request deviations in the Outline of Repair Procedures by stating what the Specification Book directs them to do and how they plan to deviate from this. The Contractor shall remain responsible for ensuring the repairs are proper and that the work will result in a high quality, proper functioning, and durable end product.

919.02.03 Payment

Measurement for payment for “Mobilization and Demobilization shall be lump-sum and shall be payment for all parts of any multi-part contracts.

Payment at the contract price for “Mobilization and Demobilization” in the Unit Price Table shall be compensation in full for all labour, supplies, materials and equipment use required to mobilize and demobilize plus the provision of storage and security required during the mobilization and demobilization phases of the work.

Contractors are advised that bid limits apply to this item. Refer to Section 157 for more information. Additional details may also be contained in the Supplementary General Conditions for the contract.

For projects which do not have “Access to Work Site” as a separate bid item, any work, equipment, materials, etc required to access the work site shall be considered incidental to “Mobilization and Demobilization”.

For each part of a project, payment for “Mobilization and Demobilization” shall be as follows:

a) 20% upon full mobilization to the site including all preparation, equipment, and materials to begin the work.
b) 20% upon full demobilization from the work site including the removal of all rubbish and the acceptance of any required documentation by the Department
c) The remainder shall be paid as a percentage of the work completed as determined by the value of progress payments.*

*Payments for interim blasting, crushing, stocking aggregate and materials on site are not considered as value of work completed on a bid item when payment for this item is calculated.

There shall be no change in the lump sum price of this item due to a change in contract scope or an extension to the contract completion date. At no time shall the total of the amounts paid to the Contractor under this item be greater than the tender’s lump sum bid price.

The payments for the lump sum price shall be full compensation for the work under this item regardless of the number of times the contractor mobilizes/demobilizes to the project location(s).

For multi-part projects, the total payment available for mobilization and demobilization of each part shall be determined using the equation below. This payment value shall be paid in the percentages specified above.

$$MD_i = LS \times (V_i / V_T)$$

Where:

MD_i = Mobilization and Demobilization payment available for Part i of a project
LS = Lump Sum bid for Mobilization and Demobilization for the entire Project
V_i = Bidded value of the work for Part i of the project
V_T = Bidden value of the work for all parts of the project

Should an entire part be removed from the contract, the lump sum amount for mobilization and demobilization shall be reduced according to the equation above.

919.03 ACCESS TO WORK SITE

919.03.01 General

The work under this items shall include the following:

a) Accessing all areas of the work site requiring work to be completed including, but not limited to, scaffolding, lifts, or any other materials/equipment the Contractor deems necessary;
b) Access to the piers and abutments;
c) Payment for any fees associated with the work;
d) Design, installation, and certification of tie off points for fall arrest or other safety gear;
e) Design, installation, and maintenance of any systems needed to work in or around water. Contractor is responsible to protect their work against any changes in water level until completion;
f) Design and installation of any systems needed to capture demolition debris; and;
g) Any other items the Contractor deems necessary to access and/or complete the work which does not fall under another item of the unit price table.

The Contractor shall supply, erect, maintain and dismantle scaffolding, swing staging, barges and/or portable lifts at all repair locations. The scaffolding, staging, barges or lifts

shall be erected in such a manner that all areas that require repairs are accessible. All equipment used for access shall conform to the latest edition of the Occupational Health and Safety Act including all amendments.

When scaffolding is used, ladders longer than 3m shall not be used without Departmental approval. Intermediate platforms or staircases shall be used where possible. For any scaffolding platforms over 4m high, staircases shall be used to access the platform.

919.03.02 Payment

Measurement for payment for "Access to Work Site" shall be made as lump-sum.

Payment at the contract price for “Access to Work Site” in the Unit Price Table shall cover all aspects of the work including full compensation for all labour, engineering, permits, training, equipment and material considered necessary.

During the entirety of the contract, the Contractor is solely responsible for the protection and maintenance of all access equipment and materials. No extra payment will be made for loss of, or damage to, any access materials and equipment due to any factors including, but not limited to, theft, weather, water, accidents etc.

919.04 MAINTENANCE OF TRAFFIC

919.04.01 General

A sign and traffic plan shall be submitted to the Owner’s Representative for review and approval before the Contractor works on the roadway. Contractors shall plan for a two-week review period by the Department.

Unless specified otherwise, one 3.2m wide traffic lane, at a minimum, shall be maintained at all times.

Signage and traffic control shall conform to relevant portions of Section 7 and the Department Traffic Control Manual.

The Contractor shall be responsible for all traffic signs, barricades and traffic control devices.

The Contractor shall pay particular attention to the flow of traffic through the construction zone. Any damage incurred to vehicles or their cargo or injury sustained to their

occupants as direct or indirect result of the Contractor's actions, procedures or negligence, shall be the sole responsibility of the Contractor.

The Contractor shall indemnify the Department with regard to claims arising from damages or injury.

The Contractor shall be responsible for the placement and maintenance of all traffic signs, barricades and other traffic control devices deemed necessary as per Division 7 and the Department Traffic Control Manual.

Contractor shall submit 1 Hardcopy and 1 Electronic copy of their traffic control plan, including drawings, for acceptance.

919.04.02 Temporary Traffic Light

For projects where two way traffic will be reduced to one lane and flag persons will not be on-site the entire period that the reduction is in effect, temporary traffic lights shall be installed and maintained at the Contractor’s expense.

Temporary traffic lights shall be a fully operational, automated traffic signal system subject to the approval of the Traffic Engineer. One set of lights is required at each end of the structure for lane traffic control. The traffic control systems shall remain the Contractor’s property upon contract completion. The Contractor shall ensure the traffic light system will operate around the clock for the entire duration of the reduced lane traffic flow. The Contractor shall have on site, at all times, one of each red, green, and amber lenses, four spare LED signal lamps and one auxiliary power source for the traffic control system. The Department’s Traffic Engineer will provide the time cycles to suit traffic flow.

If at any time due to unforeseen circumstances, a temporary breakdown occurs with the traffic light system, the Contractor shall, as a temporary measure, immediately provide appropriate radio and sign equipped flag persons to control vehicular traffic. The Contractor shall have on site, in the event of a breakdown, a set of two-way radios in good operating condition and a set of stop and slow signs. Contractors shall have in place, provisions to deal with inoperable traffic lights at any time including after work-hours, weekends, and holidays.

Failure of the temporary traffic light system in either direction greater than a 10 minute period will result in the following liquidated damages being applied:

- 2nd failure, 0.5 x liquidated damages daily rate

- 3rd failure, 1 x liquidated damages daily rate
- 4th failures, 2 x liquidated damages daily rate
- 5th or more failures, 4 x liquidated damages daily rate for each subsequent failure

No separate payment shall be made for the provision of temporary flag persons and related items and all associated costs shall be included in this contract item.

For longer duration projects, Contractors are strongly encouraged to connect the temporary traffic signals to the provincial electrical grid. However, if during the duration of the project, traffic lights connected to their own power source become inoperable six or more times due to failure of their power source, the Contractor shall connect the traffic lights to the provincial electrical grid or a suitable gasoline or diesel generation system accepted by the Department. All costs, permits, and approvals associated with connecting temporary traffic lights to the provincial electrical grid are the responsibility of the Contractor.

919.04.03 Temporary By-pass

For certain projects where a temporary by-pass will be required, it shall be stated in the Supplementary General Conditions detailing span and load carrying capacity.

If noted in the Contract Documents that the bypass shall be designed by the Contractor, The Contractor shall be responsible for the location and route of the by-pass, the hydrological, hydraulic, and structural and foundation design of the river crossing, the maintenance and upkeep, and the placement and maintenance of all traffic control devices required to ensure safe traffic flow. The hydraulic design shall be for a minimum 1 in 25 year event, however, the Contractor shall use their own judgement and select a larger design storm if appropriate. The Department will not accept a claim if a storm exceeds the 1 in 25 year event.

Section 140, "Environmental Requirements" and any other environmental requirements specified in the contract documents shall be adhered to by the Contractor. If unwatering is required, the requirements of Section 902.03 shall also be adhered to.

1 Hardcopy and 1 Electronic copy of the detailed drawings and calculations, signed and sealed by a Professional Engineer licensed to practice in the Province of Newfoundland and Labrador, shall be submitted by the Contractor for acceptance to the Owner’s Representative and shall, at a minimum, show the following:

1. The proposed route of the by-pass.

2. The structure
3. The sign and barricade layout.
4. Design and posted speed through the construction zone

All repairs to the by-pass deemed necessary by the Department shall be implemented by the Contractor immediately after written notification by the Owner's Representative. If after notification the Contractor fails to initiate repairs, repairs will be done by others. The cost of such repairs will be deducted from progress payments.

919.04.04 Traffic Resumption

Curing time required for deck concrete is wet curing for 7 days and a further 30 days for air drying, and specified design strength must be obtained,

Until the above conditions are satisfied, no traffic will be permitted on a new deck or overlay.

The area used as a route for the by-pass must be returned to its original condition as determined by the Department.

919.04.05 Payment

Measurement for payment for "Maintenance of Traffic" shall be lump sum.

The contract price for "Maintenance of Traffic" in the Unit Price Table shall cover all costs of maintenance of traffic including all labour, equipment, and material necessary to carry out all the work described.

Costs for flagperson(s) shall be incidental to "Maintenance of Traffic" unless otherwise stated in the contract documents.

20% of the bid price of "Maintenance of Traffic" shall be withheld by the Department until the Owner's Representative is satisfied that the area has been returned to its original condition.

For multi-part projects, the total payment available for "Maintenance of Traffic" of each part shall be determined using the equation below. This payment value shall be paid in the percentages specified above.

$MT_i = LS \times (V_i / LS)$

Where:

MT_i = Maintenance of Traffic payment available for Part i of a project
LS = Lump Sum bid for Maintenance of Traffic for the entire Project
V_i = Bidded value of the work for Part i of the project (excluding lump sum items that apply to all parts)

919.05 JACKING OF BRIDGE SUPERSTUCTURE FOR REHABILITATION WORKS

919.05.01 General

This section covers the requirements for raising and lowering the superstructure by the use of jacks, as required, to complete specified rehabilitation work.

Jacking Design Engineer means an Engineer retained by the Contractor qualified to provide the services specified in the Contract Documents to both design and certify the provided jacking.

Jacking System means all components required to perform the lifting and temporary support of the bridge superstructure. This includes but is not limited to; jacks, hydraulic hoses and fluid, valves, sensors, jacking systems, shims, temporary support systems, and all related appurtenances.

Survey means precise and detailed measurements and elevations taken, recorded, documented and certified by a Newfoundland and Labrador Land Surveyor or an Engineer.

919.05.02 Design

Contractor shall be responsible for the design of the jacking system. When certain aspects of a jacking system are provided in the Contract Documents, the Contractor shall incorporate these aspects into the design of the jacking system.

When jacking locations are provided in the Contract Documents, they shall be incorporated into the design of the Contractor's proposed jacking system and shall not be changed without written permission from the Owner's Representative and the Engineer of Record that specified the locations.

Where the replacement of bearings is called for in the Contract Documents, the design shall take into account the possible difference in bearings size between the new and the

original and ensure that the placement of the temporary supports does not interfere with the proper placing of bearings.

The design shall account for the structural work and condition of the structure at the time of jacking, and the stages that may interfere with temporary supports or jacking locations. It shall take into account any deterioration and/or removals prior to and during the duration of the jacking and remedial work.

The design of temporary supports shall account for articulation of the superstructure including thermal movements, as well as any potential slip in supports. Jack and support locations shall account for conflicts between structural work and temporary works designed by the Contractor.

The Contractor shall be responsible for determining an appropriate amount of pre-loading to be applied to the jacks prior to the start of displacement controlled jacking. The pre-loading amount shall be no less than 15% of the specified jacking load and shall be sufficient to account for decompression of bearings, gaps between shims (if used) and any other geometric imperfections in the proposed jacking system.

Shims and blocking used to support the jacks shall also be designed for no less than 150% of the jacking loads determined by the Jacking Design Engineer

919.05.02.01 Pre-Approved Jacking Engineers

The Department will provide a list of prequalified Jacking Design Engineers in the contract documents. Alternative engineers may be submitted for acceptance.

919.05.02.02 Jacking Drawings and Calculations

The Contractor shall submit 1 hardcopy and 1 electronic copy of the jacking drawings and calculations to the Owner's Representative 14 days prior to the commencement of the jacking operations, for information purposes only. Submissions shall bear stamped by a Professional Engineer licensed to practice in the Province of Newfoundland and Labrador.

The jacking drawings and calculations shall include the following:

a) Jacking methodology and sequence.
b) Location, number, type and capacity of the jacks to be used.
c) Description of the control system, complete with all design, schematics and equipment to be used.

d) Location and material to be used for temporary blocking and shimming.
e) Proposed pre-loading to be applied to jacks.
f) Schematic showing the configuration of all jacks, stop valves, gauges, manifolds and hydraulic pumps.
g) Current calibration certificates for all jacks, gauges, and lifting/lowering controller.
h) Full details of the temporary support system including forces to be transmitted and method of transferring the loads to the substructure or founding strata, including considerations for thermal expansion and contraction.
i) Strengthening of the existing structure where necessary.
j) Restrictions on traffic and construction traffic.
k) Calculations as per section 927.

Any required modifications to accommodate the proposed jacking system that may affect the final configuration of the bridge shall be submitted as a written proposal to the Owner's Representative prior to commencing jacking operations.

The Contractor shall have a copy of the signed and sealed jacking drawings at the site during jacking setup and operations.

When jacking design considerations or field conditions necessitate amendments to the jacking drawings, revised jacking drawings shall be submitted according to the above requirements.

919.05.03 Materials

All structural steel shall be according to CSA G40.20/G40.21 "General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel."

High strength bolts shall be according to ASTM F3125M "Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated."
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High strength nuts, and hardened washers shall be suitable for use with the types of bolts being specified and shall be according to ASTM A563M "Standard Specification for Carbon and Alloy Steel Nuts" and ASTM F436M "Standard Specification for Hardened Steel Washers."

The nuts, bolts, and washers shall be shipped together as an assembly from the manufacturer. The requirements outlined in the Test Reports for Fasteners clause found in Section 910 shall apply.

Mechanical and/or adhesive anchors shall be suitable for dynamic loads and shall be installed according to the manufacturer's recommendations.

Cement based non-shrink grout shall be supplied.

919.05.04 Equipment

A synchronized jacking system shall be used and shall consist of either a Programmable Logic Controller (PLC) controlled system or a volumetric controlled system as detailed in this section.

The system shall be capable of adjusting pressures and hydraulic volumes in order to achieve a uniform lift and/or lowering to a tolerance of not more than 1.0 mm from the leading to lagging cylinders.

When different makes and models of jacks are used, the system shall be capable of adjusting for differing amounts of fluid required at different jacks in order to comply with the specified lifting and lowering tolerances.

919.05.04.01 PLC Jacking System Requirements

A PLC controlled system shall include a central unit which continuously monitors the relative and absolute position of each individual jacking point.

919.05.04.02 Volumetric Controlled Jacking System Requirements

A volumetric controlled jacking system shall be fully calibrated and designed to precisely deliver the same volume of hydraulic oil to each individual jack at the same time when the same make and model of jacks are used at all locations.

919.05.04.03 Displacement Sensors

The synchronized jacking system shall display real-time data for each jack location showing vertical displacement, hydraulic pressure, and applied force for monitoring purposes during the jacking operation. The data shall be automatically recorded at 1 second intervals in a data log file for the entire duration of the jacking/lowering operation(s) and stop only after the bridge is firmly on the temporary supports or permanent bearings.

Each jacking location shall have either a digital displacement sensor or linear transducer accurate to 0.1mm to monitor displacements. The displacement sensors can be either

integrated into the jacking system or independently monitored such that displacement sensors, stroke sensors or calibrated volumetric control system is capable of achieving the relative lift/lowering tolerances specified in the Contract Documents. For jacks supported on temporary fixtures (such as jacking corbels), independent displacement sensors shall be used, and measurements shall be made relative to a fixed location on the adjacent bearing seat.

A data log file shall be submitted to the Owner's Representative within 7 days of any jacking operation in Microsoft Excel format (or Approved equivalent). Data log file format is to be in a table with individual columns representing each displacement sensor reading in millimetres, hydraulic pressure, and applied force at each jacking location. Individual rows shall represent the time in Hr:Min:Sec format.

919.05.05 Procedure

919.05.05.01 Pre-Construction Surveys

Prior to the start of any work related to the jacking operation, the Contractor shall carry out field measurements of all components of the existing structure that might impact the installation of the jacking system and ensure that any necessary adjustments to the jacking drawings and calculations based on these field measurements are made accordingly. The Jacking Design Engineer then determine whether any adjustments to the jacking system based on the field measurements will be required. If adjustments to the jacking drawings and calculations are required, the jacking drawings and calculations shall be resubmitted to the Owner's Representative along with a request for review.

The Contractor shall take measurements of the underside of deck or girders at bearing locations prior to jacking the structure as part of this detailed survey and shall be relative to an adjacent fixed point on the substructure which will not move during construction. This shall include a minimum of one local fixed marking on the abutment or pier immediately adjacent to each lift point and bearing location. This marking must be located such that it will not be moved or compromised by the construction operations. Measurements to the underside of each girder and lifting point shall be made relative to the corresponding fixed marking, which shall be recorded accurate to 1mm.

The Contractor shall submit these measurements to the Owner's Representative prior to jacking.

919.05.05.02 Detailed Surveys

Prior to the start of any work related to the jacking operation, the Contractor shall perform a detailed survey to establish geodetic elevations of the existing bridge deck, curb, and crown along deck joints to remain.

The Contractor shall also survey the underside of all girders to be jacked, before jacking, at all four corners of the shoe plates and all four corners of bearing pedestals, before any concrete removal and after the reconstruction, prior to the installation of the new plates or bearing pads.

The survey shall be in addition to the pre-construction survey, and the Contractor shall submit the results to the Owner's Representative prior to jacking.

All structural steel fabrication, delivery and erection shall be in accordance with Section 910. All formwork and falsework shall be in accordance with Section 907.

919.05.05.03 Jacking

919.05.05.03.01 General

The Contractor shall ensure that all existing expansion joints are free to move vertically prior to jacking. Bolts securing the bridge rail posts to the parapet walls, if present, shall be loosened to permit jacking without damaging the bridge rails.

Upon completion of the fabrication and installation of the components of the temporary works and prior to jacking, the Jacking Design Engineer shall conduct an inspection to verify that the fabrication and installation of the temporary works has been carried out according to the jacking drawings.

Traffic shall not be allowed on or below the bridge during jacking.

At no point shall the applied jacking loads exceed 200% of the jacking loads determined by the Jacking Design Engineer.

A Certificate of Conformance shall be submitted by the Jacking Design Engineer to the Owner's Representative prior to commencing each jacking operation.

A Certificate of Conformance shall be submitted by the Jacking Design Engineer to the Owner's Representative upon completion of each jacking operation.

919.05.05.03.02 Jacking Operations

The Contractor shall inform the Owner's Representative in writing at least 5 Days prior to the commencement of the jacking operations.

The lifting or lowering of the entire width of the structure shall be carried out in one uniform and synchronized operation using a synchronized jacking system. At no time during the lifting or lowering of the structure shall the elevation difference between any jacking points exceed 1.0 mm as measured at the centre line of the bearings.

Jacking operations shall be carried out under the direct supervision of the Jacking Design Engineer. Prior to the commencement of jacking operations, the accuracy of all transducer read-outs, relative to manual measurements shall be demonstrated to the Owner's Representative.

The lift and/or lowering at each jacking point shall be monitored continuously during the jacking operation from a centralized location by remote sensors or calibrated jacking system. The maximum lift for all jacking points shall be sufficient to decompress the bearings and stop 3 mm above the final jacking elevation, unless otherwise specified in the Contract Documents.

919.05.05.03.03 Temporary Supports

The bridge superstructure shall not be supported on hydraulic jacks for a period longer than permitted on the jacking drawings and in no case longer than 8 hours.

When the required lift for all jacking points has been achieved and the bearings have been released, temporary supports (such as blocking and shimming) shall be placed to support the bridge. The jacks shall then be lowered in one synchronized operation while maintaining the maximum allowable difference between any two jacking points of 1.0 mm.

The jacking loads shall be transferred to the temporary supports and then the jacks released prior to the commencement of bearing removal and bearing seat reconstruction or bearing replacement work. Unless otherwise specified in the Contract Drawings, temporary supports shall be located at the jacking points.

The superstructure shall not be left on temporary supports for more than 15 Days or as specified in the Contract Documents.

919.05.05.03.04 Post-Jacking Survey

Immediately after the structure has been placed on temporary supports and prior to the bearing seats being reconstructed (if applicable), the underside of the superstructure that will be in contact with the new bearings shall be surveyed. The survey shall include the four corners in contact with the bearings and at least one point in the middle of the bearing area. Data from the survey shall be forwarded to the Owner's Representative to determine if adjustments to the design are required.

919.05.05.03.05 Lowering of the Superstructure

Where jacking of the superstructure is accompanied by rehabilitation of bearing seats, the superstructure may be jacked again for the removal of the temporary supports only after the concrete in the bearing seats has reached the required design strength determined by the Jacking Design Engineer.

The jacks shall then be lowered in one synchronized operation, while maintaining the maximum allowable difference between any two jacking points of 1.0 mm, and the superstructure shall be placed onto the bearings.

919.05.05.03.06 Bearing Contact

The bearings shall have uniform and full contact at top and bottom. The requirements for bearing full contact as specified in Section 912 shall be met. The jacking system shall remain in place until full contact of bearings is achieved.

919.05.05.03.07 Reinstatement of Structure

The bridge deck and girders shall be reinstated to the original elevations unless new elevations are specified in the Contract Documents or as otherwise directed by the Owner's Representative.

A final continuous and smooth riding surface not exceeding 3 mm in difference across all joints, approaches and adjacent spans where bearings are replaced shall be provided. The pre-jacking elevations, proposed new elevations, new bearing thickness, elastic compression of new bearings from the manufacturer, and any other new components installed shall be assessed as part of the Work in meeting this requirement.

The Contractor shall notify the Owner's Representative when any existing conditions or components will affect the ability to meet the above requirement. Anchor holes shall be filled with non-shrink grout finished flush with the surrounding concrete with matching

color; no metal components of the jacking system shall be embedded permanently in concrete with less than 40 mm of cover.

All expansion joint and bridge rail components removed or loosened to facilitate jacking shall be reinstated.

919.05.06 Payment

Measurement for payment shall be a lump sum which will be full compensation for all jacking required to complete the work in the contract documents

Payment at the contract price for “Jacking of Superstructure for Rehabilitation Works” in the Unit Price Table shall include all design work, materials, equipment, surveying, labour, and any other items needed to complete the jacking operations.

The Contractor shall be responsible for the costs to repair any damage caused by error or negligence during the jacking operations.

Payment for the repairs to the structure undertaken during jacking operations shall be paid out as per the appropriate bid item.

Payments for jacking will be made as percentage of lifts completed and will not be paid until the lift is completed, the superstructure is lowered, and all required documentation is received for that lift. For example, if 4 lifts are required, each lift will result in a payment equal to 25% of the lump sum bid price.

919.06 BLAST CLEANING OF EXPOSED REINFORCING STEEL

919.06.01 General

Existing steel reinforcement which has been exposed during rehabilitation work and is to remain in place shall be cleaned using a vapor abrasive blast cleaning method. This operation uses a combination of pressurized water, air, and abrasive media to remove rust from the reinforcing steel.

Cleaned reinforcing steel shall be cleaned to the SSPC-SP7 definition, which is defined as:

> “A method in which all oil, grease, dirt, rust scale, loose mill scale, loose rust and loose paint or coatings are removed completely. Tight mill scale and tightly adhered rust, paint and coatings are permitted to remain.

However all mill scale and rust must have been exposed to the abrasive blast pattern sufficiently to expose numerous flecks of the underlying metal fairly uniformly distributed over the entire surface."

The equipment/materials used to complete this abrasive cleaning shall meet the following requirements:

a) Capable of producing a blast pressure of at least 100 psi; and
b) Abrasive medium shall be angular or sub-angular in shape and have a minimum hardness of 6 MOHS.

Other cleaning methods which are capable of achieving SSPC-SP7 can be submitted for acceptance by the Owner's Representative. Cleaning using only wire brushes or other unpowered hand tools will not be accepted. If alternative methods are accepted but, during the course of work, are found to not consistently meet SSPC-SP7 requirements, the Contractor shall correct the deficiencies and complete the remainder of the work using the vapour abrasive blast cleaning method outlined in this Section. No additional payment will be made for these changes.

Fine particles of cement or sand shall be removed by vacuum or with jets of oil-free compressed air.

All blast cleaned steel shall be painted with a zinc-rich primer as per Section 919.07.

919.06.02 Payment

Payment for blast cleaning shall be incidental to the work item which exposes the reinforcing steel. No additional payment will be made for equipment, materials, or labour required to complete the blast cleaning.

919.07 ZINC RICH PRIMING OF STEEL

919.07.01 General

Zinc rich primer shall be used to protect steel components that have damage to the hot dipped galvanizing layer.

Zinc rich primer shall be applied to any steel reinforcement that is used in rehabilitation projects and existing steel reinforcement which has been exposed during rehabilitation work.

Zinc rich primer is not required to be used in work which utilizes galvanic anodes unless galvanic anodes cannot be installed or as otherwise indicated in the contract documents.

919.07.02 Application of Zinc-Rich Primer

Reinforcing steel to be painted with a zinc rich primer shall be blast cleaned as per Section 919.06.

An approved zinc rich primer is Rust-Anode Primer by Galvatech 2000. Equivalent alternatives can be submitted for approval.

Zinc rich primers shall be a single component product specifically listed for use in rebar coating applications. Primer can be applied via brush or spray applications provided that the entire outer surface of the blast cleaned rebar is completely covered. Temperature of application, number of coats, and drying times shall be as per the manufacturer's directions. Contractor shall conduct the work in a manner that minimizes wastage.

919.07.03 Payment

Payment for the supply and application of primer shall be incidental to the work. No additional payment shall be made for any costs associated with zinc rich primer including, but not limited to, the supply, mixing, and application of primer.

919.08 SUPPLY AND INSTALLATION OF GALVANIC ANODES

919.08.01 General

Contractor shall install protective galvanic anodes within formed concrete repairs as indicated on the contract drawings.

Galvanic anodes shall be installed in concrete repairs when existing reinforcing steel is exposed as indicated on the Contract documents or as directed by the Owner's Representative.

Anodes shall be installed on the far side of the steel reinforcement from the nearest exposed face of concrete.

In locations where anodes are specified for use, but cannot be installed on exposed reinforcing steel, exposed steel shall be painted with a zinc rich primer as per Section 919.07.

919.08.02 Methods and Materials

Exposed reinforcing shall be blast cleaned as per Section 919.06 prior to the installation of galvanic anodes.

Galvanic anodes shall be manufactured by Vector Corrosion Technologies as listed in the Table below. Alternative products shall be submitted for approval and shall meet the following requirements:

a) be alkali activated;
b) have similar dimensions to the Vector specified product;
c) have a similar internal pH as the Vector specified product; and
d) have an equal or greater internal zinc mass when compared to the Vector specified product.

Galvanic anodes shall be installed as per the manufacturer's instructions.

Anode types shall be as follows:

Anode Type	Zinc Mass	Vector Product
Type 1	40 grams	Galvashield XP Compact
Type 2	60 grams	Galvashield XP
Type 3	100 grams	Galvashield XP2
Type 4	160 grams	Galvashield XP4

919.08.03 Payment

Measurement for payment for the supply and installation of anodes shall be on a per unit basis for each type of anode as per bid under "Supply and Installation of Galvanic Anodes" of the unit price table.

Payment at the contract price for "Supply and Installation of Galvanic Anodes" in the Unit Price Table shall be compensation for all costs associated with the supply and installation of anodes.

919.09 SUPPLY OF PORTLAND CEMENT, BONDING AGENTS AND OTHER SPECIALITY ITEMS

The Contractor is required to supply all cement, bonding agents, and other speciality items to be incorporated in the work.

All cement required shall be in accordance with Section 904.

The supply and use of all speciality items shall conform to manufacturer's instructions and recommendations, applicable governing standards and shall be subject to approval by the Owner's Representative. The Contractor shall also supply the Owner's Representative with copies of the relevant specifications for the above items.

The supply of these materials shall be considered incidental to the performance of the work and no separate payment will be made for the same.

919.10 SUPPLY AND REPLACEMENT OF REINFORCING STEEL DUE TO DAMAGE OR DETERIORATION

The following shall be considered additions or exceptions to Section 905, "Concrete Reinforcement", of the Specifications Book.

All reinforcing steel bars which are damaged by jack hammering or lost 10% of their cross-sectional area due to corrosion shall be replaced with a bar containing an equivalent cross-sectional area of steel to the original bar.

Replacement bars shall be dowelled into sound concrete using an accepted chemical adhesive or lapped along reinforcing steel in good condition. Adhesive embedment lengths shall be as per the manufacture's direction and lap lengths shall be as per the most recent edition of CSA S6 "Canadian Highway Bridge Design Code."

Replacement reinforcing steel shall be painted with a zinc-rich paint as specified in Section 919.07

The extent and exact nature of the work shall be determined by the Owner's Representative in the field.

Payment for replacement of existing deteriorated or damaged steel shall be made in accordance with Section 150 "Force Account Payment" at the unit price bid for "Black Steel Reinforcement", "Galvanized Steel Reinforcement", and "Stainless Steel Reinforcement", whichever is applicable.

Any reinforcing steel, which in the opinion of the Owner's Representative, has been damaged due to negligence of the Contractor, shall not be paid for.

919.11 CONCRETE REPAIRS WITH LATEX MODIFIED CONCRETE

919.11.01 General

Contractor shall remove damaged and deteriorated concrete as shown on the contract drawings and as directed by the Owner's Representative and repair using latex modified concrete

Any dowels or reinforcement which is damaged through negligence and cannot be reused as determined by the Owner's Representative, shall be reinstated at the Contractor's expense.

919.11.02 Removal and Surface Preparation

All existing formwork remaining from previous work along with any accumulated debris on the beam seats shall be removed and disposed of to the Owner's Representative's satisfaction.

Where fresh concrete will meet hardened concrete, a 30 mm deep sawcut shall be used, prior to jack hammering, to obtain straight clean lines and to preclude feather-edging.

The work shall entail the removal of deteriorated concrete and surface preparation. All loose, deteriorated and chloride contaminated concrete shall be removed to a minimum depth of 75 mm beyond original lines or further until sound concrete as determined by the Owner's Representative is encountered.

If any rebar is presently exposed or exposed by concrete removal, then the concrete surrounding the rebar shall be removed to a clear distance of 25 mm beyond the steel. Concrete removal shall be as detailed on the drawings and as directed by the Owner's Representative.

Concrete reinforcement exposed during repairs shall be blast cleaned as per Section 919.06. Fine particles of cement or sand shall be removed by vacuum or with jets of oil-free compressed air.

If specified in the contract documents, galvanic anodes shall be installed where existing reinforcing steel enters into the area to be repaired by latex modified concrete as per Section 919.08. If anodes are not specified, or are specified but cannot be installed, steel shall be painted with zinc-rich primer as per Section 919.07.

919.11.03 Concrete Supply and Placement

The Contractor shall inform the Owner's Representative of areas ready for new concrete or mortar placement at least 48 hours in advance of placement to allow for inspection and measurement. No concrete shall be placed until the prepared surface to be restored is inspected and acceptance in writing is given by the Owner's Representative. Acceptance does not alleviate the Contractor of responsibility for the quality of the final product.

These areas that shall then be restored to the original lines using a latex modified concrete, shall have a 28 day compressive strength of 35 MPa, maximum water:cement ratio of 0.37, 3% to 6% entrained air and maximum size aggregate of 10 mm, or an approved equal repair mortar. The latex emulsion used in the mix shall have a 46% - 49% solids content and the latex content (solids) in the concrete shall be 15 percent by weight of cement. Slump shall be suitable to properly complete the repair and completely fill the void.

All aspects of concrete supply and placement are subject to approval by the Owner's Representative.

The use of superplasticizers to ensure the proper consolidation of concrete will be permitted subject to the Owner's Representative's approval of the concrete mix design, however, the Contractor must demonstrate competence and experience in their use and specific approval must be obtained.

Latex modified concrete shall be mixed by mechanical mixer and placed within twenty minutes of batching.

Concrete for beam seats or bearing pad pedestals shall conform to section 904.04.09.

919.11.04 Curing

All aspects of curing shall be in accordance with Section 904, "Concrete Structures."

919.11.05 Payment

Measurement for payment shall be the volume in place measured in cubic metres of newly-built concrete bounded by lines pre-approved by the Owner's Representative.

The volume shall be the difference between sections of the remaining sound concrete and the face of the new concrete or mortar. The volume shall be calculated by the average end area method. Sections shall be taken at regular intervals of not more than

500 mm apart. Readings at each section shall be taken to best describe the profile of the concrete surface at that particular section. Representatives of the Owner's Representative and the Contractor shall be present when the section readings are taken.

Payment at the contract price for "Concrete Repairs with Latex Modified Concrete" in the Unit Price Table shall be full compensation for all labour, equipment and materials necessary to carry out all the work described herein.

919.12 SUPPLY AND REPLACE BEARING PADS

919.12.01 General

Existing bearing pads shall be replaced as detailed in the Contract Documents.

The work shall entail jacking up the superstructure, repair to concrete plinths, concrete bearing seats, the removal of the existing bearing pads, and the supply and placement of new bearing pads in accordance with Section 912 and as shown on the drawings.

Concrete for beam seats or bearing pad pedestals shall conform to section 904.04.09.

Bearing materials, manufacture, fabrication, and installation shall comply with Section 912.

The jacking procedure shall comply with Section 919.05.

919.12.02 Payment

Both the measurement for and basis of payment shall be in accordance with Section 912 of the Specifications Book.

Jacking of the structure, removal and disposal of the existing bearings, setting the superstructure down on the new bearings and all other labour, equipment-use, materials and services required to successfully complete the work specified shall be paid as per 919.05.

Concrete repairs shall be paid for under the appropriate concrete repair item or as specified in the Contract Documents.

919.13 REPAIR OF CONCRETE DECK BY OVERLAY

919.13.01 General

The Owner's Representative shall designate all areas to be repaired.

Deck repair by overlay shall be specified as one of two types as follows

a) Complete/Lane Repair by Overlay involves repair across an entire lane or deck width for a length specified by the Owner's Representative.
b) Partial Repair by Overlay involves repairs to parts of a lane/deck as directed by the Owner's Representative.

919.13.02 Removal

The perimeter of the designated areas shall be saw-cut to a depth of 30 mm, to the level of the rebar if less than 30 mm, or as shown on the drawings. Deteriorated concrete within the area shall be removed.

Concrete shall be removed to a minimum depth of 75mm below the existing deck elevation or until sound concrete is encountered, whichever is greater. If concrete is to be removed by jackhammer, the maximum hammer mass permitted is 13 kg. A higher hammer size up to a maximum of 23 kg may be used if the concrete is extremely hard provided approval is given by the Owner's Representative. The contractor remains responsible for any damage that occurs as a result of using the larger hammer.

Around reinforcing steel, concrete shall be removed so that there is, at a minimum, a 25mm clear distance between the rebar and remaining concrete,

All tools used in concrete removal shall be pointed to avoid damage to the existing substrate. If any reinforcing steel is exposed before or during concrete removal, the concrete shall be removed to a clear distance of 25mm below the underside of the reinforcement. If any concrete is required to be removed around reinforcing steel, then the maximum hammer size permitted shall be 7 kg. The Contractor shall take care not to damage any existing steel.

During the concrete removal and placing operations, care should be taken to keep contaminants off newly exposed surfaces.

All machinery that might leak oil should be kept off this area of deck when possible. If machinery such as a compressor has to be on this portion of the deck, plastic polyethylene sheets should be placed under it and extreme care should be taken when refuelling. Air compressors must be equipped with a functioning oil trap.

48 hours of curing shall have elapsed prior to scarifying and/or chipping on adjacent concrete within 2 metres of a newly placed overlay.

If a spill does occur, the Contractor at their own expense shall have it wiped up and the contaminated concrete chipped away immediately. The deck shall be kept clean at all times.

The exposed reinforcing steel and the remaining sound concrete must be protected when mixer trucks and other vehicles are routed over them.

919.13.03 Surface Preparation

Prior to restoration of the deck, all exposed reinforcing steel and concrete substrate shall be satisfactory cleaned of debris and rust as per Section 919.06. If the steel is not exposed, the blasting may be waived provided that the surface is cleaned with high pressure water producing a minimum pressure of 13 MPa. Fine particles of concrete, sand or rust shall be removed by vacuum or jets of oil-free compressed air or water. If substrate is wet only high pressure water shall be used. Air compressors must be equipped with a functional oil trap.

If detailed in the contract documents, anodes shall be installed on the exposed reinforcing steel as per Section 919.08. If anodes are not specified, then all exposed rebar shall be painted as per Section 919.07.

Joints shall be located as shown on the plans. If not shown on the plans, joints shall be located as accepted and/or directed by the Owner's Representative. Longitudinal joints shall be located to avoid, as much as practical, their placement in the wheel paths.

At transverse and longitudinal joints, the concrete overlay course previously placed shall be sawed to a straight and vertical edge to a depth of 30mm before the placement of the adjacent course.

At the discretion of the Owner's Representative the concrete overlay thickness may be increased beyond the thickness of the concrete which has been removed so as to maintain the required concrete cover on the reinforcing steel.

No concrete shall be placed until the prepared surface to be restored is inspected and acceptance in writing is given by the Owner's Representative.

In areas where a substantial amount of concrete is removed in excess of 100mm, the excess space shall be filled with concrete as per Section 904 prior to the placement of the overlay.

For a 24-hour period, the substrate including all vertical joints shall be kept damp. Any pools of water which have collected on the concrete shall be blown away with compressed air before application of a bonding agent such as SikaTop Armatec-110 EpoCem manufactured by Sika, MasterEmaco P124 by Master Builders Solutions, or an approved equal.

919.13.04 Concrete Supply and Placement

Concrete shall not be placed until there is an aluminum or magnesium 3 metre straight edge on site. Straight edges shall have an accuracy of 0.5mm per metre. Additional wooden straight edges may be utilized on site provided they are verified straight by comparing to the aluminum/magnesium straight edge that is on site and accepted by the Owner's Representative.

Concrete shall be as per "Superstructure Concrete" in Section 904.

If superplasticizers are used the maximum slump permitted will be 90mm.

Concrete strength shall be a minimum of 25 MPa in 48 hours.

919.13.05 Finishing

919.13.05.01 Complete/Lane Deck Repair by Overlay

A lane is considered a strip 2 metres wide or larger and the requirements of Section 904 shall apply in addition to those outlined below.

Finishing with a vibrating bridge deck finishing machine is mandatory. The machine and its operator must receive approval prior to its use. The machine shall be of the vibrating Allen screed type designed to consolidate the concrete by high frequency, low amplitude vibration. Vibration frequency shall be variable with positive control and shall be maintained at a frequency which will remove entrapped air without causing undue lateral flow, "pumping" of mortar or reduction of entrained air. The bottom face of the screeds shall not be less than 100mm wide and be metal. The screeds shall be provided with positive control of the vertical position. When more than one lane of overlay is being placed at one time, a moveable work bridge shall be supplied.

Ridges or depressions in the surface shall be removed by using a magnesium bullfloat. Areas around curbs, drains, and expansion joints shall be finished with a magnesium hand float. The surface shall not be overworked.

The Contractor shall supply an aluminum or magnesium 3m straight edge and the surface shall not deviate from the design grade by more than 8mm. Two qualified concrete finishers approved by the Owner's Representative shall be supplied to perform float and broom finishing operations.

All concrete must be broom finished. Exposed concrete bridge decks shall be given a coarse broom finish. Treated or waterproofed bridge decks shall be given a fine broom finish. The concrete deck surface shall be given a broom finish when the concrete has hardened sufficiently. The broom shall be of an approved type. The strokes shall be square across the slab, from edge to edge, with adjacent strokes slightly overlapped, and shall be made by drawing the broom without tearing the concrete but so as to produce regular corrugations not over 3mm in depth for the course broom finish. Fine broom finish shall have corrugations not exceeding 1mm in depth. The surface as thus finished shall be free from porous spots, irregularities, depressions and small pockets or rough spots such as may be caused by accidental disturbance during the final brooming of particles of coarse aggregate embedded near the surface. The Owner's Representative may decide to delete the broom finish requirements but tolerances previously stated will still apply.

919.13.05.02 Partial Deck Repair by Overlay

Finishing shall be done using hand tools and bullfloats appropriate to the size of area being repaired.

Concrete shall be vibrated using internal vibrators as required to ensure concrete is properly consolidated

The Contractor shall supply an aluminum or magnesium 3m straight edge and the surface shall not deviate from the design grade by more than 8mm. Two qualified concrete finishers approved by the Owner's Representative shall be supplied to perform float and broom finishing operations.

All concrete must be broom finished. Exposed concrete bridge decks shall be given a coarse broom finish. Treated or waterproofed bridge decks shall be given a fine broom finish. The concrete deck surface shall be given a broom finish when the concrete has hardened sufficiently. The broom shall be of an approved type. The strokes shall be

square across the slab, from edge to edge, with adjacent strokes slightly overlapped, and shall be made by drawing the broom without tearing the concrete but so as to produce regular corrugations not over 3mm in depth for the course broom finish. Fine broom finish shall have corrugations not exceeding 1mm in depth. The surface as thus finished shall be free from porous spots, irregularities, depressions and small pockets or rough spots such as may be caused by accidental disturbance during the final brooming of particles of coarse aggregate embedded near the surface. The Owner's Representative may decide to delete the broom finish requirements but tolerances previously stated will still apply.

919.13.06 Curing

Immediately after the straight edge requirements have been met, the fresh concrete shall be coated with an evaporation retardant such as "MasterKure ER 50" manufactured by Master Builders Company Ltd, SikaFilm manufactured by Sika, or an approved equivalent to preclude rapid evaporation of the bleed water.

All aspects of curing shall be in accordance with Section 904.05.

All traffic or loads of any kind must be kept off the new concrete for the entire curing period.

919.13.07 Payment

Measurement for payment for repair to the deck shall be per square metre of deck surface repaired.

The mean depth of removal is to be 100mm unless otherwise approved by the Owner's Representative. If the depth removal is approved to be greater than or less than 100mm, the payment shall be prorated. e.g., if the removal of concrete over a certain area is required to be removed to a total average depth of 125mm, then the area for payment will be adjusted by a factor of 1.25. If the depth of removal is approved to be 50mm, then payment will be adjusted by a factor of 0.50. Factors for proration shall be rounded to the nearest two decimal places.

The Department may elect to increase the thickness of the overlay by raising the top elevation of the deck. No additional payment will be made for this additional concrete up to an elevation increase of 25mm. If an elevation increase greater than 25mm is requested by the Department, any concrete above the 25mm shall be paid via force account.

If the Owner's Representative requires that the concrete overlay thickness be increased beyond the thickness of the concrete which has been removed then payment will be made for the additional concrete material as supported by invoices plus 10%. No extra payment will be made for labour, material or equipment associated with placing this additional concrete.

Any crack sealing required due to cracking occurring up to one month from pour date will be considered incidental to the work and no separate payment will be made. Method of sealing must receive prior approval by the Owner's Representative.

Payment at the contract price for "Repair of Concrete Deck by Overlay" shall be considered complete compensation for all labour, equipment, and material necessary to carry out all the work described herein.

Payment for supply and application of the evaporation retardant is considered incidental to the work and no separate payment shall be made for the same.

Formwork required due to breaking through the deck shall be considered incidental to the works.

919.14 REPAIR OF CONCRETE SURFACES

919.14.01 General

This section applies to all concrete surfaces except for the top surfaces of decks which shall be repaired by overlay as detailed in Section 919.13.

Areas designated for repairs using latex modified concrete shall be as per Section 919.11.

The Owner's Representative shall designate all areas to be repaired. The perimeter of the designated areas shall be saw cut to a depth of 30mm or to the level of the rebar if less than 30 mm or as shown on the Contract Drawings. Deteriorated concrete shall be removed.

Concrete surfaces shall be built out to achieve required depths of clear cover or as indicated in the contract documents.

919.14.02 Removal

All edges of concrete removal shall be saw cut to a depth of 30mm. Concrete shall be removed to a minimum depth of 100mm below original lines or further until sound concrete

is encountered. If concrete is to be removed by a jackhammer, the maximum hammer mass permitted is 13 kg. All tools used in concrete removal shall be pointed. If any reinforcing steel is found to be exposed, the concrete shall be removed to a clear distance of 25mm below the underside of the reinforcement. If any concrete is required to be removed around reinforcing steel, then the maximum hammer size permitted shall be 7 kg. The Contractor shall take care not to damage any existing steel. The Owner's Representative shall be the sole judge of the extent of removal required.

919.14.03 Surface Preparation

Prior to restoration of the concrete, all exposed reinforcing steel and concrete substrate shall be satisfactory cleaned of debris and rust as per Section 919.06. If the steel is not exposed, the blasting may be waived provided that the surface is cleaned with high pressure water producing a minimum pressure of 6 MPa. Fine particles of concrete, sand or rust shall be removed by vacuum or jets of oil-free compressed air or water. If substrate is wet only high pressure water shall be used.

If detailed in the contract documents, anodes shall be installed on the exposed reinforcing steel as per Section 919.08. If anodes are not specified, then all exposed rebar shall be painted as per Section 919.07.

The concrete shall be restored as per the drawings. However, no concrete shall be placed until the prepared surface to be restored is inspected and approval in writing is given by the Owner's Representative.

At the discretion of the Owner's Representative the concrete resurfacing thickness may be increased beyond the thickness of the concrete which has been removed so as to maintain the required concrete cover on the reinforcing steel or to provide a constant curb profile for rail mounting.

Concrete shall be kept damp for a minimum of 24 hours prior to placement of new material. Excess water shall be removed with compressed air before application of a bonding agent such as SikaTop Armatec-110 EpoCem manufactured by Sika or an approved equal.

919.14.04 Supply And Placement Of Concrete

Concrete shall not be placed until there is an aluminum or magnesium 3 metre straight edge on site. Straight edges shall have an accuracy of 0.5mm per metre. Additional wooden straight edges may be utilized on site provided they are verified straight by

comparing to the aluminum/magnesium straight edge that is on site and accepted by the Owner's Representative.

Concrete shall be as per "Superstructure Concrete" or "Substructure Concrete " in Section 904 as appropriate.

If superplasticizers are used, then the maximum slump shall be 90mm.

Concrete strength shall be at least 20 MPa in 48 hours. 28 Day strength of concrete shall be within ± 5MPa of the existing concrete unless otherwise specified on the contract documents.

Concrete formwork shall meet the requirements of Section 907.

919.14.05 Finishing

The concrete shall be finished immediately after strike off and before the appearance of bleed water using a magnesium float.

The surface shall not be overworked or sealed. All concrete shall be broom finished. The Contractor shall supply an aluminum or magnesium 3 metre straight edge and the surface shall not deviate from the design grade by more than 3 mm per metre up to a maximum of 8 mm over 3 metres.

Two qualified concrete finishers approved by the Owner's Representative shall be supplied to perform float and broom finishing.

919.14.06 Curing

Immediately after finishing, the Contractor shall apply the evaporation retardant "MasterKure ER 50" manufactured by Master Builders Company Ltd, SikaFilm manufactured by Sika, or an approved equivalent. The product shall be applied as per manufacturer's instructions and recommendations.

All aspects of curing shall be in accordance with Section 904.05.

919.14.07 Payment

Measurement for payment shall be the volume in place measured in cubic metres of newly-built concrete bounded by lines pre-approved by the Owner's Representative.

Payment at the contract price for “Repair of Concrete Surfaces” in the Unit Price Table shall be considered complete compensation for all labour, equipment, plant and materials used to carry out this work including, but not limited to, demolition, surface preparation, and formwork.

Any crack sealing required due to cracking, occurring up to one month from pour date will be considered incidental to the work and no separate payment will be made. Method of sealing must receive prior approval.

Payment for supply and application of the evaporation retardant is considered incidental to the work and no separate payment shall be made for the same.

Replacement of damaged or deteriorated reinforcing steel shall be paid as per Section 919.10.

New reinforcing steel shall be paid as per Section 905.

919.15 REPLACEMENT OF EXPANSION JOINTS AND ASSOCIATED WORK

The supply and installation of expansion joint systems, parts, and measurement for and basis of payment shall be as outlined in Section 913.

919.16 REMOVAL AND REPLACEMENT OF BRIDGE RAIL AND ANCHOR BLOCKS

The demolition, salvage, supply, and installation of bridge rails and measurement for and basis of payment shall be as outlined in Section 915.

The demolition, supply, and installation of anchor blocks and measurement for and basis of payment shall be as outlined in Section 904.

919.17 REPLACEMENT OF DECK DRAINS AND ASSOCIATED WORK

The demolition, supply, and installation of deck drains and associated work and measurement for and basis of payment shall be as outlined in Section 918.

919.18 REMOVAL AND DISPOSAL OF OLD ASPHALT FROM STRUCTURES

919.18.01 General

Work under this section shall include the removal of asphalt from the bridge deck, approach slabs, and approaches. The approaches shall be defined as a point 40 metres from the abutment back wall, or as indicated in the Contract Documents.

The approaches shall be saw cut transversely across the roadway as approved by the Owner's Representative. Rounded milling joints shall be cut to produce a vertical face.

The waste disposal area shall be provided by the Contractor and approved by the Owner's Representative. The Contractor shall follow all requirements of Division 8.

The Contractor shall transport the pavement debris to the waste disposal area then place and trim the debris to sightly proportions.

When traffic is maintained on the structure during repair, only one lane of asphalt shall be removed at a time until the concrete in the adjoining lane has been cured in accordance with Section 919.13.

919.18.01.01 Removal of Asphalt from Bridge Deck and Approach Slabs

For complete removal of the asphalt surface over the bridge deck and approach slabs, removal shall be completed using a smooth bladed excavator or backhoe bucket. For removal of asphalt patches, pneumatic hammers having maximum rating of 28 kg and equipped with chisel bits shall be used. Other methods of removal shall be submitted to the Owner's Representative for acceptance.

Asphalt removal from bridge decks and approach slabs shall be full depth and include the removal of any waterproofing systems.

Milling of asphalt from bridge decks and approach slabs shall not be permitted.

Removal of sand, debris from the bridge deck prior to asphalt removal shall be as per Section 919.02.

919.18.01.02 Removal of Pavement on Approaches

Pavement on approaches shall be removed to a depth of 50mm.

For situations where there is less than 50mm of asphalt, asphalt and granulars shall be excavated to a depth of 50mm from within the limits described above, removed, loaded, transported, and disposed of at a site approved by the Owner's Representative.

The cutting of old asphaltic pavement to be excavated shall be as outlined in accordance with Section 510.

919.18.02 Payment

Measurement for payment for the removal and disposal of old asphaltic pavement shall be in cubic metres rounded to one decimal place. Measurements shall be made before the removal and shall be the plan area of the pavement surface multiplied by the measured thickness of asphalt actually removed. Asphalt thickness shall be measured separately on the approaches and structure to account for different thickness. Measurement for payment regarding the cutting of old asphaltic pavement will not be made.

Payment at the contract price for “Removal and Disposal of Old Asphalt From Structures” in the Unit Price Table shall be full compensation for all labour, materials and equipment use for: saw cutting, excavation, removal, loading, and transporting the old asphalt and waste from the job to disposal site, off-loading, placing the debris and trimming to sightly proportions. The obtaining of an approved waste disposal area, the disposal of waterproofing debris, and the excavation, removal, transportation, disposal, and trimming of granular material shall be considered incidental to the work.

919.19 REHABILITATION WITH SHOTCRETE

919.19.01 General

The work will require the complete removal of old concrete, surface preparation, reinforcement, and the application of shotcrete. This work shall be carried out in accordance with ACI 506.2 "Specifications for Shotcrete" except as modified by the requirements of the project.

Nozzlepersons for shotcreting operations shall be certified as per ACI C660 “Shotcrete Nozzleman Certification Program.”

919.19.02 Removal of Deteriorated Concrete

Existing concrete shall be removed to a minimum depth of 75mm beyond original lines or as shown on the drawings. If sound concrete is not encountered, then the removal shall continue beyond the specified depth as determined by the Owner’s Representative.

Approval to proceed beyond the specified depth must be obtained from the Owner’s Representative.

If concrete is to be removed by jackhammer, the maximum hammer mass permitted will be 13 kg. All tools used in concrete removal shall be pointed. If any reinforcing steel is found to be exposed the concrete shall be removed to a clear distance of 25mm beyond

the reinforcement. If any concrete is required to be removed around reinforcing steel, then the maximum hammer size permitted shall be 7 kg. The Contractor shall take care not to damage any existing steel. All edges of concrete removal should be tapered to a 1/1 slope, to the full depth of removal, to prevent the entrapment of rebound. The Owner's Representative shall be the sole judge of the extent of removal required.

Reinforcing steel which is found to be deteriorated or damaged shall be removed and replaced as determined by the Owner's Representative.

919.19.03 Surface Preparation

Prior to restoration of the sections, the concrete substrate and all exposed reinforcing steel shall be blasted cleaned as per Section 919.06. Fine particles of concrete and sand shall be removed with oil-free jets of water or compressed air producing a minimum pressure of 6 MPa. If the substrate is wet at the time of cleaning, then it shall be cleaned with high pressure jets of water. Air compressors must be equipped with a functioning oil trap.

If detailed in the contract documents, anodes shall be installed on the exposed reinforcing steel as per Section 919.08. If anodes are not specified, then all exposed rebar shall be painted as per Section 919.07.

The Contractor shall inform the Owner's Representative of areas ready for shooting at least 24 hours in advance of shooting to allow for inspection and measurement.

The concrete substrate shall be kept damp for a minimum of 24 hours prior to shooting. Any excess water shall be removed with compressed air.

919.19.04 Materials

Materials shall comply with latest requirements of the following CSA Standards:

Cement CSA A5.1 Portland Cement - Type 10
Sand CSA A23.1 Section 5.3 Fine Aggregate
Water CSA A23.1 Clause 5.2 Water

The Owner's Representative may require samples of the materials to be used before work starts and periodically during the work to ensure quality and consistency.

919.19.05 Mix Design

The proportion of cement to sand shall be based on dry and loose volumes and shall be one part of cement to not more than 3½ parts of sand. The sand shall contain not less than 3% and not more than 5% moisture by weight. The water content of the final mixture shall be maintained at a practical minimum, but not more than 0.35 kg of water per kg of cement. The moisture content of the sand will be checked from time to time during the course of the work. The shotcrete shall have a minimum compressive strength of 35 MPa at 28 days.

The dry mix process only is deemed to be acceptable as described in ACI 506R “Guide to Shotcrete.”

Measurements of sand and cement by shovel, wheelbarrow or similar haphazard means will not be acceptable. No premixed material shall stand for more than 45 minutes prior to delivery through the hose.

919.19.06 Welded Wire Mesh

A welded, plain, WGW steel mesh with a wire spacing of 51mm (2") in each direction of 14 gauge wire shall be attached to the area to be repaired. This mesh shall be placed so that:

a) the cover to the mesh is 40mm minimum,
b) the space between the mesh and existing concrete is not less than 10mm. The mesh shall be securely fastened by approved concrete anchors embedded in the concrete on a 450mm square grid with tie wire. Wire mesh shall be lapped 1½ squares in all directions.

919.19.07 Application of Shotcrete

No shotcrete shall be applied at an air temperature lower than 8 degrees Celsius. Prior to the application, a test panel shall be shot to ensure competency of the nozzle person.

The test panel will be approximately 3 square metres, with one half vertical and the other half horizontal, in order for the nozzle person to demonstrate horizontal and overhead shooting on the same panel unit. Short reinforcing bars and wire mesh will be attached to the test panel as directed by the Owner’s Representative. This requirement may be waived if reliable references who attest to the nozzle person’s ability are supplied.

Before application of the shotcrete, the cleaned surfaces shall be washed down with water and all loose material such as rebound or over spray removed by a water or air blast. The concrete substrate at the time of shooting should be damp with no free moisture on the surface.

The shotcrete shall be pneumatically applied by a suitable apparatus, operated only by experienced and competent persons who fulfil the requirements as set out in Chapter 5 of ACI 506.66. The Contractor shall submit letters to the Owner's Representative stating the qualifications and experience of the nozzle person and the shotcrete pump operator. It is necessary to obtain acceptance from the Owner's Representative before any nozzle person is employed on the site.

The pressures applied to the materials shall be such that the water is thoroughly mixed with the sand-cement mixture with the water pressure being "0.1 MPa higher". The air and water pressures shall be uniform so that a steady continuous flow of shotcrete is applied with no surging.

The velocity of the shotcrete as it leaves the nozzle shall be maintained uniform at a rate determined for the given job conditions to produce the minimum rebound. The nozzle shall be held perpendicular to the surface at a distance between 600 and 1500mm. The rate of application and the depth of build-up of the shotcrete shall be adjusted to avoid sag or separation. In general, the maximum thickness of a single layer shall be 50mm on vertical surfaces and 25mm on overhead surfaces.

Rebound or accumulated loose material shall be removed from any surface prior to the placing of additional layers of mortar. This rebound or loose material shall not be used. The Contractor shall supply and install ground wires to control thickness and to assist the Owner's Representative's and Contractor's representatives in making the necessary measurements for payment purposes. The maximum thickness of a single vertical or horizontal layer may be increased if sagging or separation can be avoided, with approval from the Owner's Representative.

Forms shall be structurally sufficient and of such design that rebound or accumulated loose material can freely escape or can be readily removed. Shooting strips shall be used wherever necessary to form chamfers, corners, edges, and/or surfaces where it is necessary to obtain true lines, proper thickness and cover over steel. Cold joints shall be avoided wherever possible.

At the end of any period of placing shotcrete, the material shall be sloped to a thin edge. Before placing an adjacent section, this sloped portion shall be thoroughly cleaned by sandblasting or water blasting and wetting. This shall also apply when placing an additional lift atop a previously placed layer, where the shotcrete has taken final set.

For curing and subsequent testing purposes, the Contractor shall supply the Owner's Representative with test panels of the shotcrete approximately 400mm x 400mm x 100mm in size. The panels shall be supplied whenever required by the Owner's Representative throughout the project, with at least one panel supplied per 8 hour shift.

919.19.08 Finishing

The shotcrete shall have a natural gun finish unless otherwise specified. Any roughness around the edges or over spray shall be removed with a trowel.

919.19.09 Curing

All areas shall be cured first using a fog spray on the surface of the shotcrete.

After the shotcrete has set, curing with wet burlap or wet white non-woven filter fabric as per Specification 904.05.01 with a continuous sprinkling system shall begin and continue for 7 days.

919.19.10 Measurement for Payment

Measurement for payment will be based upon the volume measured in place in cubic metres of newly built shotcrete as per the appropriate item in the Unit Price Table. No payment shall be made for concrete removed or replaced beyond the specified depth or lines, unless the Owner's Representative has instructed the removal or replacement in writing.

If the Owner's Representative has instructed further removal, the following shall apply.

The volume shall be the difference between sections of the remaining concrete and the face of the new shotcrete. The volume shall be calculated by the average end area method. Sections shall be taken at regular intervals of not more than 500mm apart, readings at each section shall be taken to best describe the profile of the concrete surface at that location.

Representatives of the Contractor and the Owner's Representative shall be present when the section readings are taken.

919.19.11 Basis of Payment

Payment at the contract price for “Rehabilitation with Shotcrete” in the Unit Price Table shall represent full compensation for all labour, equipment, and materials necessary to carry out all the work described herein.

919.20 SUPPLY AND PLACE TREMIE CONCRETE

The supply of concrete materials, supply, mixing, transportation, placing and curing of concrete, measurement for and basis of payment shall be as outlined in Section 904.

Prior to tremie concrete being placed, any loose concrete shall be removed from the placement area and exposed rebar above the waterline shall be blast cleaned and painted in accordance with 919.06 and 919.07.

919.21 DEMOLITION AND DISPOSAL OF WASTE

For rehabilitation projects, the demolition and disposal of waste shall be considered incidental to the work being undertaken unless specifically noted in the contract documents.

Work to be completed includes removal and disposal of all concrete, granular material, rock, OM approach fill, guiderail, guiderail posts, gabion baskets, drainage pipe, debris from drainage, rubbish and any other material which the Owner’s Representative determines should be removed.

Waste shall be disposed of at an approved dumpsite and in accordance with applicable provincial and federal regulations.

If a significant amount of demolition debris enters the watercourse or roadway, as decided by the Owner’s Representative, the contractor’s lump sum bid price for ‘Mobilization and Demobilization’ shall be reduced by 20 percent per incident. Demolition work will be immediately stopped and not proceed until debris is cleaned, removed, and appropriate mitigation measures are in place.

SECTION 920

SLOPE PAVING

INDEX

920.01 SCOPE

This specification covers the requirements for areas to be paved with concrete and adjacent areas to be backfilled and graded as indicated herein.

The slope paving system is defined as the concrete surface, adjacent two (2) metre wide strips of erosion control blankets, and the backfill layer immediately under these areas. Erosion control outside of this area shall be carried out and paid as per the appropriate Sections of Division 600 but shall be graded to promote drainage away from the structure and to blend into the surrounding topography.

920.02 MATERIALS

The materials for construction of slope paving and related work shall conform to this specification, the contract drawings and all relevant sections of the Specifications Book as outlined herein.

920.02.01 Concrete

Concrete shall be as specified on the drawings and shall meet the requirements of Section 904.

Concrete shall meet the criteria for substructure concrete and the slump shall be of such consistency that will permit placement, consolidation and finishing on a 1.5:1 slope.

920.02.02 Concrete Reinforcement

All reinforcing steel supplied shall conform to Section 905.

920.02.03 Wood

Material utilized for wood strips is not required to be preservative treated or structural grade. The material may be of second or third use providing it is reasonably straight, sound, and meets with the approval of the Engineer.

920.02.04 Selected Granular Base Course, GRANULAR “A”

Granular bedding materials shall be Selected Granular Base Course, GRANULAR “A” and shall conform to Section 315.

920.02.05 Extra Backfill, Select Material Compacted - Granular

Extra backfill select material compacted, shall conform to "Select Material Compacted - Granular" in Section 902.04.02.

920.02.06 Extra Backfill, Compacted Ordinary Fill

Extra backfill, compacted ordinary fill, shall conform to "Compacted Ordinary Fill" in Section 902.04.04.

920.03 SLOPE PAVING AREAS

In the case of a single structure, the width of the slope paved with concrete shall be equal to the superstructure width including the superstructure overhang as shown in the contract drawings.

For twin structures, where the clear gap between the superstructures is 7 metres or less, the width of the slope paved with concrete shall extend from the outside edge of one superstructure to the outside edge of the adjacent superstructure and be continuous throughout its entirety as shown in the contract drawings. If the clear gap between

structures is greater than 7 metres, the two structures shall be treated as separate single structures.

The area paved with concrete shall be skewed to match the skew of the superstructure.

920.04 PREPARATION PRIOR TO CONCRETE PLACEMENT

The slope adjacent to the slope paving shall be graded to promote drainage away from the structure and to blend into the surrounding topography. Included in preparation is the excavation, removal and disposal of unsuitable, waste, or excess materials.

The Contractor shall supply, transport to site, handle, place, spread, and compact, Compacted Ordinary Fill to the dimensions, elevations and slopes as indicated on the contract drawings. Compacted Ordinary Fill shall be compacted to at least 90% of the Standard Proctor Dry Density (ASTM D698).

Selected granular base course, GRANULAR “A”, shall be placed in a 150mm thick, uniform layer, spread, compacted and trimmed to the Owner’s Representative’s satisfaction. GRANULAR “A” shall be compacted to at least 90% of Standard Proctor Dry Density (ASTM D698).

The placing of wood strips shall be as outlined in the contract drawings.

Reinforcing steel shall be placed at mid-depth of the slope paving and shall be securely held in position. Rebar to be offset from Vee grooves and wood strips by ± 50 mm to increase cover where possible. Adequate rebar support chairs or concrete blocks shall be utilized to prevent displacement of the reinforcing steel mat.

The Contractor shall place 10mm Styrofoam, or an approved equal, between slope paving concrete and adjacent concrete surfaces.

920.05 CONCRETE PLACEMENT AND EROSION CONTROL BLANKET

The supply, placing, consolidation, finishing and curing for concrete shall be as outlined in Section 904.

Erosion control blankets shall meet the requirements of Section 636 and shall be placed at the sides of the slope paving and extend from the bottom of the concrete slope paving to the end of the wing wall as shown in the contract drawings.

920.06 MEASUREMENT FOR PAYMENT

Measurement for payment purposes shall be in square metres rounded to the nearest 0.1 square metres.

Measurement for payment shall be the area paved with concrete as measured on site.

Measurement for payment purposes outside the area actually paved with concrete will not be made but shall be considered incidental to the work.

920.07 BASIS OF PAYMENT

Payment at the contract price for “Slope Paving” in the Unit Price Table shall be full compensation for all materials, labour, plant, equipment, and services to complete the work as described above or so indicated on the contract drawings.

The items which are considered incidental to the works include all work taken to prepare the surface under the concrete slope including, but not limited to: supply and installation of granular material, wood, concrete reinforcement, concrete, and Styrofoam. Also included in this payment are the adjacent 2 metre wide erosion control blankets.

Compacted ordinary fill underneath the area where slope paving is to be placed, will be paid as compacted fill as per appropriate item in the contract documents.

SECTION 921

SURFACE PREPARATION AND PAINTING OF STRUCTURAL STEEL

INDEX

921.01 SCOPE

This specification covers the supply of all labour, equipment and materials necessary to conduct surface preparation and paint application on structural steel work.

The Department will not supply any material required for work under this contract. All blast clean and paint work shall be fully completed by September 30th unless an extension is given by the Department.

Structural steel must be cleaned and painted for the areas listed below:

a) All areas of steel either primed or painted previously or
b) All superstructure and substructure steel exposed to the atmosphere or
c) Areas specified on the Contract drawings

921.02 SUBMITTALS

The Contractor shall submit the following to the Owner's Representative for review at least 3 weeks prior to commencement of blast cleaning or painting operations.

Details of the methods, procedures, and sequence of operation to be employed to complete the work, including Working Drawings and schedules. The procedures shall detail the equipment, application process, in-process quality control and the job control records to be used for the work.

Details of surface preparation and coating of areas that are difficult to access and the method of application.

Details of proposed method for management of spent material.

Detailed description of environmental protection to be employed, including details for enclosure, erection of the enclosure, and relocation procedure for the enclosure and equipment. Contractor's plan for environmental protection must be accepted by the Owner's Representative.

Product data sheets containing manufacturer's recommended maximum and minimum dry film thickness, mixing and thinning directions, recommended spray nozzles and pressures, recommended temperature range and acceptable humidity levels for application, minimum acceptable recoat time period for temperatures in the intervals of 5 degrees Celsius and from 0 degrees Celsius to 30 degrees Celsius.

Material certification from the coating manufacturer stating all materials supplied are as specified in the Contract Documents and the manufacturer's current product data sheets. Material certification from a laboratory certified by an organization accredited by the Standards Council of Canada stating that the abrasive media meets the material requirements specified in this specification.

The Contractor shall provide to the Owner's Representative a guarantee in writing, stating that the paint coating will perform satisfactory for a period of 5 years from the date of completion. In the event the paint coating system does not perform satisfactorily, the Contractor shall provide reapplication of blast clean and paint at no additional cost to the Department.

921.03 MATERIALS

The Department may consider alternative methods for surface preparation on request from the Contractor.

921.03.01 Sand

Sand shall be in accordance with CGSB 31-GP-421M and of a class that will yield a 1 to 3 mil steel profile.

921.03.02 Primer

The primer shall be one coat of PPG Dimetcote 302H Inorganic Zinc Rich Primer or an approved equal. Minimum dry film thickness shall be 2.5 mils or as recommended by the manufacturer, if thicker. The colour of the primer shall be green.

921.03.03 Paint

The intermediate coat shall be one coat of PPG Amerlock 2 Surface Tolerant Epoxy or an approved equal. Dry film thickness at 5.0 mils to 7.0 mils. The colour of the intermediate coat shall be white.

The finish coat shall be one coat of PPG Pitthane ultra urethane (Product code # 95-8000) supplied by Pittsburg Paints or an approved equal. Dry film thickness shall be between 3.0 mils to 4.0 mils. The colour of the finish coat shall be haze grey.

921.03.04 Solvent

Solvents must be compatible with the primer and paint being utilized.

921.04 ENVIRONMENTAL PROTECTION, SAFETY PRECAUTIONS AND DAMAGE PREVENTION

All safety equipment and devices for the protection of the operation and personnel shall be supplied by the Contractor.

No paint shall be allowed to smear the abutments or piers. If such happens, the paint stains shall be cleaned immediately with a proper solvent.

All work shall be performed in accordance with the Occupational Health and Safety Act and all amendments, and Sections 815, 820 and 825 of the Departmental Specification.

The Contractor shall take steps to ensure that debris or spray from blast cleaning and painting operations will not result in harmful effects or deposit in waterways or structures within the vicinity of the work. Any damage to abutting property, vehicles, utilities, pedestrians, animals or to any portion of the structure due to the cleaning or painting operations shall be the responsibility of the Contractor.

921.05 SURFACE PREPARATION

All areas to be painted shall first be blast-cleaned to a near white metal finish and in accordance with SSPC SP 10 “Near White Metal Blast Cleaning”, latest revision.

All accessible weld flux and spatter, rust, paint and mill scale shall be removed.

The accessible portions of partially enclosed steel members shall be blast-cleaned.

Rivet heads, cracks, crevices, lap-joints, fillet welds and re-entrant angles shall be blast-cleaned.

Loose paint, sharp edges, thick layers of rust, dried soil, and other loosely adhering foreign matter not efficiently removed by blast-cleaning shall be removed by hand or power tools and the underlying surface blast-cleaned.

Final surface preparation before paint coating application shall only be carried out when the temperature, moisture and humidity satisfy the criteria specified in SSPC PA 1 “Shop, Field, and Maintenance Coating of Metals” for coating application.

All areas that are to be painted shall be blast cleaned.

921.06 SURFACE CLEANING

After blast-cleaning operations are completed, dust or other loose matter shall be removed from the surface. If detrimental amounts of grease or oil are present, these substances shall be removed with solvent.

921.07 PAINTING

921.07.01 General

All areas listed in Section 921.01 shall receive primer, intermediate and finish coat.

All thickness measurements are to be made when the coatings are dry. Thickness of coatings must conform to Section 921.03.

Five separate spot measurements of the dry film shall be taken with a dry film thickness gauge; these readings shall be spaced evenly over each section of the structure 10 square metres in area. The average for the 5 spot measurements for each section shall not be less than the specified thickness. No single spot measurement in any section shall be less than 80% of the specified thickness.

As many applications as necessary shall be applied until the dry thicknesses specified in Section 921.03 are obtained.

921.07.02 Storage

All paint and thinner shall be stored in a separate building or room that is well ventilated and free from excessive heat, sparks, flame or the direct rays of the sun and in accordance with the manufacturer's requirements. Paints susceptible to damage from freezing shall be kept in heated storage space when necessary.

All containers of paint should remain unopened until required for use; any containers opened for longer than specified by the manufacturer shall not be used.

Paint, which has in the Department's opinion, become livered, gelled or expired as well as otherwise deteriorated during storage shall not be used.

921.07.03 Cleaning

Any oil, grease, soil, dust or foreign matter deposited on the surface after the surface preparation is completed shall be removed prior to painting. In the event that rusting occurs after completion of the surface preparation, the surface shall be again cleaned in accordance with the specified method.

Particular care shall be taken to prevent the contamination of cleaned surfaces with salt before the primer is applied and between applications of the remaining paint. Such contaminants shall be removed from the surface. The primer paint shall be applied within one hours after the surface has been cleaned. The successive applications shall be applied before contamination of the under surface occurs.

If the under surface, after the application, becomes contaminated by salt, it shall be washed off with clear fresh water.

921.07.04 Mixing and Thinning

All ingredients in any container of paint shall be thoroughly mixed before use and shall be agitated often enough during application to keep the pigment in suspension.

Paint mixed in the original container shall not be transferred until all settled pigment is incorporated into the vehicle. This does not imply that part of the vehicle can not be poured off temporarily to simplify the mixing.

Paint shall not be mixed or kept in suspension by means of an air stream bubbling under the paint surface.

Where a skin has formed in the container, the skin shall be cut loose from the sides of the container, removed and discarded. If such skins are thick enough to have a practical effect on the composition and quality of the paint, the paint shall not be used.

The paint shall be mixed in a manner which will ensure breaking up of all lumps, complete dispersion of settled pigment and a uniform composition. If mixing is done by hand most of the vehicle shall be poured off into a clean container. The pigment in the paint shall be lifted from the bottom of the container with a broad, flat paddle, lumps shall be broken up and the pigment thoroughly mixed with the vehicle. The poured-off vehicle shall be returned to the paint with simultaneous stirring or pouring repeatedly from one container to another until the composition is uniform. The bottom of the container shall be inspected for unmixed pigment.

Paint which does not have a limited pot life or does not deteriorate on standing may be mixed at any time before using, but if settling has occurred it must be remixed immediately before using. Paint shall not remain in spray pots, painter's buckets, etc., overnight, but shall be gathered into a container and remixed before use.

No thinner shall be added to the paint unless necessary for proper application and conforms to the manufacturer's recommendations. Paints to be sprayed, if not specifically formulated for spraying, may require thinning when proper adjustment of the spray equipment and air pressure does not result in satisfactory paint application. In no case shall more than five percent of thinner be added unless the paint is intentionally formulated for greater thinning. This shall also apply when painting in cold weather.

The type of thinner shall comply with the paint specification or manufacturer's instructions.

When the use of thinner is permissible, thinner shall be added to paint during the mixing process. Painters shall not add thinner to paint after it has been thinned to the correct consistency. All thinning shall be done under the supervision of one acquainted with the correct amount and type of thinner to be added to the paint. Notwithstanding the foregoing, all mixing and thinning shall be done in accordance with the manufacturer's recommendations.

921.07.05 Application

921.07.05.01 General

The Owner’s Representative must be notified by the Contractor 48 hours in advance of mixing and applying paint coating.

Paint shall be applied by brushing or spraying or a combination of these methods. Daubers or sheepskins may only be used when no other method is practicable for proper application in places of difficult access.

Paint shall not be applied when the surrounding air temperature is not within the maximum/minimum range recommended by the paint manufacturer. Paint shall not be applied to steel at a temperature that will cause blistering, porosity or otherwise will be detrimental to the life of the paint. When steel is painted in hot weather, precautions must be taken to ensure that the specified thickness of paint is obtained.

Paint shall not be applied in rain, snow, fog or mist or when the relative humidity exceeds 95 percent. Paint shall not be applied to wet or damp surfaces; paint shall not be applied on frosted or ice coated surfaces. Water or ice on the surface must be visible to prevent painting under this provision.

When paint must be applied in damp or cold weather, the steel must be painted under cover, protected, sheltered, or the surrounding air and the steel heated to a satisfactory temperature. In all such cases, the temperature and the humidity conditions specified

above must be met. Such steel shall remain under cover or be protected until dry or until weather conditions permit its exposure.

Any paint exposed to freezing, excess humidity, rain, snow or condensation, shall be permitted to dry. Damaged areas of paint shall then be removed and the surface again prepared and then repainted to the specified thickness.

All outside corners, rivets, sharp edges and weld joints shall first be given a separate brushed on stripe coat before each complete coat of primer, intermediate and finish coat is applied.

To a maximum extent practical, each application of paint shall be applied as a continuous film of uniform thickness free of pores. Any thin spots or areas missed in the application shall be repainted and permitted to dry before the next application of paint is applied.

Each undercoat of paint shall be in a proper state of cure or dryness before the succeeding application is applied. Paint shall be considered dry for recoating when an additional coat can be applied without the development of any detrimental film irregularities, such as lifting or loss of the undercoat.

921.07.05.02 Brush Application

Brush application of paint shall be in accordance with the following:

a) Brushes shall be of a style and quality that will enable proper application of paint. Round or oval brushes are generally considered most suitable for rivets, bolts, irregular surfaces and rough or pitted steel. Wide, flat brushes are suitable for large flat areas but they should not have a width over 127mm.

b) The brushing shall be done so that a smooth coat, as nearly uniform in thickness as possible, is obtained. This usually may best be accomplished by applying the paint in short strokes, depositing uniform amounts of paint in each stroke, brushing the paint into all surface irregularities and finally smoothing or levelling the paint film with longer strokes at about right angles to the direction of the first strokes allowing only enough of the tip of the bristles to drag in the paint film to smoothen the film without leaving deep or detrimental brush marks.

c) Paint shall be worked into all crevices and corners.

d) Any runs or sags shall be brushed out.

e) There shall be a minimum of brush marks left in the applied paint.

f) Surfaces not accessible to brushes shall be painted by spray, or by daubers, or by sheepskins.

921.07.05.03 Spray Application

Spray application of paint shall be in accordance with the following:

a) The equipment used shall be suitable for the intended purpose, shall be capable of properly atomizing the paint to be applied and shall be equipped with suitable pressure regulators and gauges.

b) The air caps, nozzles and needles shall be those recommended by the manufacturer of the equipment for the material being sprayed. The equipment shall be kept in satisfactory condition to permit proper paint application.

c) Traps or separators shall be provided to remove oil and condensed water from the air. These traps or separators must be of adequate size and must be drained periodically during operations. The air from the spray gun impinging against the surface shall show no condensed water or oil.

d) Paint ingredients shall be kept properly mixed in the spray pots or containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

e) The pressure on the material in the pot and of the air at the gun shall be adjusted for optimum spraying effectiveness. The pressure on the material in the pot shall be adjusted when necessary for changes in elevation of the gun above the pot. The atomizing air pressure at the gun shall be high enough to properly atomize the paint but not so high as to cause excessive fogging of paint, excessive evaporation of solvent, or loss of over spray.

f) Spray equipment shall be kept sufficiently clean so that dirt, dried paint and other foreign materials are not deposited in the paint film. Any solvents left in the equipment shall be completely removed before applying paint to the surface being painted.

g) Paint shall be applied in a uniform layer, with overlapping at the edge of the spray pattern. The spray pattern shall be adjusted so that the paint is deposited uniformly. During application, the gun shall be held perpendicular to the surface and at a distance which will ensure that a wet layer of paint is deposited on the surface. The trigger of the gun should be released at the end of each stroke.

h) All runs and sags shall be brushed out immediately or the paint shall be removed and the surface repainted.

i) Areas inaccessible to the spray gun shall be painted by brush; if not accessible by brush, daubers or sheepskins shall be used. Brushes shall be used to work paint into cracks, crevices and blind spots which are not adequately painted by spray. The foregoing notwithstanding, the Contractor shall conform to the paint manufacturer's recommendations.

921.07.06 Drying of Painted Steel

No paint shall be force-dried under conditions which will cause cracking, wrinkling, blistering, formation of pores, or detrimentally affect the condition of the paint.

No drier shall be added to paint on the job unless specifically called for in the specification for the paint.

Paint shall be protected from rain, condensation, contamination, snow and freezing until dry to the fullest extent practicable or as recommended by the manufacturer.

921.08 SUPERVISION

The Department will have a qualified painting inspector on the site at all times when work is in progress. The Contractor shall supply all safety equipment (respirator, goggles, etc.) required by the Inspector.

921.09 EXPERIENCE

The Contractor is required to submit a list of projects involving surface preparation and painting of structural steel at the preconstruction meeting.

921.10 MEASUREMENT FOR PAYMENT

Measurement for payment will be lump sum as tendered under the item “Surface Preparation and Painting of Structural Steel" as listed in the Unit Price Table. Interim

payments for the percentage of work done may be made at the discretion of the Owner's Representative.

921.11 BASIS OF PAYMENT

Payment shall be lump sum and constitute full compensation for all labour, materials, access, plant, and equipment required to complete all surface preparation and painting or repainting of structural steel as outlined in this specification.

SECTION 922

ASPHALTIC PAVING OF BRIDGE DECKS AND APPROACHES

INDEX

922.06 BASIS OF PAYMENT

922.06.01 General

922.06.02 Treated Bridge Decks

922.06.03 Waterproofed Bridge Decks

922.06.04 Reduced Payment Criteria for Bridge Deck and Approach Slab Paving

922.01 SCOPE

This specification applies to existing, rehabilitated, and new concrete bridge decks where asphaltic paving is being undertaken. The scope of the work covers the Department's requirements for the asphaltic paving of both treated and waterproofed concrete bridge decks and concrete approach slabs with hot or warm mix asphaltic concrete.

For the paving of rehabilitated bridges and their approaches, the supply, transportation, placing and compaction of selected granular base course shall form part of this work. For treated bridge decks the scope includes supply and application of tack coat.

If paving items are contained in a current or ongoing road contract, the approaches including the approach slab, where appropriate, will be paved under the road contract. Otherwise, granular and paving operations up to 40 metres from the abutment back wall, or as indicated in the Contract Documents, shall be included in the bridge contract.

The thickness of paving on decks and approach slabs shall be in accordance with the contract documents with deductions for being outside tolerance as per the Reduced Payment section.

Construction procedures for treated bridge decks is included in this section. Waterproofing of bridge decks shall be as detailed in Section 914.

Asphalt overlays of bridge decks is not permitted without the written approval of the Bridge Office, Highway Design Division for the specific bridge.

922.02 MATERIALS

922.02.01 Tack Coat for Treated Bridge Decks and Approaches

Tack coat shall conform to Section 320.

922.02.02 Selected Granular Base Course

Selected granular base course shall be of GRANULAR “A” or GRANULAR “B” gradation as required. This material shall conform to Section 315.

922.02.03 Asphaltic Concrete

If there are any direct conflicts, this specification will govern. All other requirements of Section 330, 331, 332, 333 and 337, as appropriate, of the specification are applicable.
All materials are subject to inspection, testing or rejection at any time and must be made available for sampling and testing prior to and at any point during the work at the request of the Owner’s Representative to ensure compliance with the applicable specifications.

Asphalt to be placed on a bridge deck, shall conform to the requirements of surface course asphalt, unless otherwise specified in the Contract Documents. All asphalt that will be in contact with bridge deck waterproofing must be WMA and comply with Section 337.

Asphalt for bridge deck are subject to the same price adjustments as per the applicable Section of the specification, however, samples will be taken at the following intervals:

- A loose sample shall be taken daily regardless of daily production tonnage.
- Where applicable, core samples shall be taken on both bridge approaches for each lift for asphalt.
- Additional samples may be taken at the discretion of the Owners Representative.

Asphalt Bridge decks may also be tested using a nuclear gauge as per ASTM D2590. It shall be operated in backscatter mode and percent compaction will be based on the daily MTD for the loose sample.

922.02.04 Joint Sealing Compound

Joint sealing compound shall conform to Section 914.03.06.

922.02.05 Asphaltic Concrete Sealant

Asphaltic concrete sealant shall conform to Section 914.03.07.

922.03 EQUIPMENT

For treated bridge decks only, an accepted pressure distributor may be utilized to place tack coat on the concrete deck. The distributor shall strictly conform to Section 320.03. Over spray along curbs, barriers, and expansion joint dams shall not be permitted. Soil

or gravel shall not be tracked onto the bridge unless otherwise accepted by the Owner's Representative stating the conditions of use.

Equipment for applying tack coat on bridge decks to be waterproofed shall be limited to a manually operated spray rod which shall produce a uniform fog-type spray. The lower part of the spray rod shall be bent 30 degrees to form a section of rod parallel to the deck. The pressurized container which holds the tack coat shall be equipped with a thermometer and pressure gauge.

Pavers shall be equipped with heated vibrating screeds and shall be capable of spreading the mixture, without segregation. Vibratory screeds shall be in operation for all paving on bridge deck and approach slabs.

Contractor shall submit a detailed equipment list to the Owner's Representative during the pre-construction/paving meeting.

All plant and equipment required to supply, produce, transport, place, spread and compact granulars shall conform to Section 315 for "Selected Granular Base Course."

All paving equipment and plant shall conform to Section 330; however, oscillatory rollers shall be used for all paving on bridge decks. Vibratory rollers are not permitted.

The equipment used for filling grooves and sealing the surface adjacent to the curbs/barriers and transverse joint filling with sealant at each expansion joint dam shall be accepted by the Owner's Representative.

922.04 CONSTRUCTION PROCEDURES

922.04.01 General

All concrete surfaces shall be cured in accordance with Section 904.05 and be in a dry condition before the work as described herein may commence. Work shall not be performed during rainy or inclement weather or on wet, snow or frost covered surfaces. Tack coat shall be required between each lift of asphalt

For bridge paving which requires multiple lifts, there shall be a minimum of 12 hours after final compaction between lifts. Any paving that commences before this 12 hour period has elapsed shall be subject to rejection by the Department and no payment shall be made for either lifts of asphalt, tack coat, and waterproofing (if applicable).

922.04.02 Surveying Requirements

The Contractor shall survey the approach slabs and bridge deck both before and after paving in accordance with Section 926. The preliminary survey shall not occur until after all deck repairs are complete.

Payment reductions in accordance with Section 922.06.04 shall be applied based on the results of the surveys.

The survey of the prepared bridge deck shall be accepted by the Owner's Representative before paving will be permitted to proceed.

922.04.03 Treated Bridge Decks

Treated bridge deck construction procedures shall apply to all bridge decks where waterproofing is not carried out. The treatment procedure shall be as outlined herein and shall apply to both the deck and the concrete approach slab.

922.04.03.01 Deck Cleaning and Preparation

Removal and disposal of old asphaltic pavement and deck rehabilitation by overlay shall be in accordance with Section 919.

The Contractor shall sweep the bridge deck and approach slabs either manually or with a power broom. This shall be followed by a cleaning of the deck and approach slabs with oil-free compressed air. Tack coat shall be applied in accordance with Section 320.

922.04.03.02 Granulars

Additional granular material shall be produced, supplied, transported, stored, placed, graded and compacted in accordance with Section 315. The width and thickness of the granular base course and granular shoulders shall be in conformance with the bridge approaches and the standard of roadway to which it is being applied as per the typical cross section. The length shall be in accordance with the length of existing pavement removed and disposed of.

Contaminated granular material shall be excavated and disposed of as directed by the Owner's Representative.

Suitable existing selected granular base course shall be reshaped and recompacted (100% maximum standard proctor dry density, ASTM D698) to grade as established by the Owner's Representative.

922.04.03.03 Paving

All construction procedures related to paving shall conform to Section 330, Section 332, and Section 333 as appropriate except as outlined herein.

In accordance with the Contract Documents, the deck and concrete approach slab grades shall be paved and finished to match the elevations of the concrete expansion joint dams. If the required thickness to reach the expansion joint elevation, for either the approach slab or deck, has a thickness greater than 75 mm it shall be paved in two lifts or as directed by the Owner's Representative. Prior to the commencement of paving the Contractor's surveyor shall profile the prepared surface as per Section 926, (treated or waterproofed) to determine the theoretical asphalt tonnage quantities.

Prior to commencing deck paving operations the Contractor shall cover all deck drains to prevent the entry of asphalt. The covers shall be secured to the deck drains. After breakdown rolling is complete the cover(s) shall be removed from all deck drains and any asphalt that may have infiltrated the drainage system shall be removed. Payment shall be held until the Owner's Representative has verified all asphalt has been removed from the drainage system.

The approaches to the bridge shall be paved first thus avoiding the transfer of foreign particles on the deck.

Paving operations shall proceed downgrade. Paving shall commence as soon as practical after the tack coat has adequately cured and shall not be left for longer than 12 hours.

For paving on bridges with expansion joints, the Contractor shall place a removable filler strip in each expansion joint gap along the full length of each joint. The purpose of the expansion joint filler strip is to prevent the asphalt from entering the flexible expansion joint gap(s). After paving operations are complete, the filler strip shall be removed. The Contractor shall clean the expansion joints and dispose of waste material.

The final profile of the asphalt surface shall be free from bumps and dips and considered a smooth riding surface. Pavement profiles that do not meet these requirements may be rejected at the sole discretion of the Department.

922.04.04 Waterproofed Bridge Decks

922.04.04.01 Waterproofing

The materials and treatment procedure for the concrete surface preparation, surface conditioner for asphaltic membrane, application of asphalt and rubber membranes,

protection boards and protection board tack coat, the forming and filling of grooves with joint sealing compound and sealing of the asphaltic surface adjacent to the concrete curbs and barriers shall be as outlined in accordance with Section 914.

Approach slabs shall be waterproofed unless otherwise specified in the contract documents. If waterproofing on the concrete approach slabs is not required as per the contract documents, they shall be treated as per Section 922.04.03.

922.04.04.02 Paving

All construction procedures relating to paving shall be as outlined in Section 922.04.03.03 except as outlined herein.

Paving of the bridge deck should commence as soon as practical after waterproofing operations described in Section 914 have been completed but not more than 24 hours unless otherwise accepted by the Owner's Representative. Care should be taken so as to not damage the installed waterproofing system. Displacement or puncturing of the protection board is not acceptable, and rejection may result in the removal and reapplication of the entire waterproofing system at the Contractor's expense. Turning of vehicles on the bridge deck is prohibited.

Paving operations shall be conducted downgrade in the direction of protection board overlap.

A Material Transfer Vehicle (MTV) must be used in accordance with the requirements of Section 330.07.09. Where it has been determined the MTV shall not be used for paving, trucks shall dump part of their load into the paver and then move away so that the paver does not have to push the truck. Care must be taken to remove any material from the deck that may have spilled in front of the paver's tracks or tires so that it does not perforate the membrane.

The speed of the asphalt spreader shall be kept in the range of 3 to 4 metres per minute in order to provide maximum traction.

The temperature of the asphalt placed on the waterproofed bridge deck shall cool to 115 degrees Celsius before breakdown rolling begins with a suitable oscillating roller. At higher temperatures the protection boards may shift under the roller, resulting in cracking the asphalt around the protection board perimeter if breakdown rolling is attempted too soon. Starting and stopping on the newly paved deck is not permitted.

922.04.04.03 Paving Adjacent to Expansion Joint Dams

In accordance with the contract documents the deck and approach slab grades shall match the height of the concrete expansion dams. Should the thickness of asphalt required by greater than 75mm, paving shall be completed in two lifts or as directed by the Owner's Representative.

922.04.05 Forming and Filling Grooves with Joint Sealing Compound

This operation applies to the joints created adjacent to and for the full length of each curb. The work shall be carried out in accordance with Section 914.04.08.

922.04.06 Sealing Surface Of Asphaltic Concrete Adjacent To Curbs and Barriers

This work shall be carried out in accordance with Section 914.04.09.

922.04.07 Transverse Joint Filling

The groove shall be saw cut across the width of the deck as indicated on the contract drawings and against each concrete face at each expansion joint dam.

The application of sealant or compound shall be carried out when the temperature is at or above 5 degrees Celsius and the joint is dry. Traffic shall be kept off the transverse joint until the sealant has set in accordance with the manufacturer's specification.

922.05 MEASUREMENT FOR PAYMENT

922.05.01 Treated Bridge Decks

Measurement for payment for the asphaltic paving of bridge decks, shall be as outlined in Section 330, Section 332, and Section 333 as appropriate, with the following amendments.

Measurement for payment for the asphaltic paving of bridge decks will be limited to the weighted tonnage of asphalt concrete actually placed on the bridge deck and approach slabs. However payment shall be capped at a maximum of the theoretical tonnage plus 10%. Theoretical tonnage shall be calculated from the profile data as per Section 922.04.02 and the density from the approved mix design. Additionally, asphalt payment shall be subject to the Reduced Payment Criteria as stipulated in Section 922.06.04.

Payment for bridge deck and concrete approach slab sweeping, cleaning, preparation, tack coating, forming and filling grooves with cold applied sealant or joint sealing compound, sealing the surface of asphaltic concrete adjacent to curbs and barriers,

transverse joint forming and filling, the provision for deck drain cover plates and expansion joint filler strips shall be deemed incidental to the work.

Measurement for payment for the production, supply, storage, transportation, placing, grading and compaction of selected granular base course material on new construction projects shall be in accordance with Section 315 for Selected Granular Base Course.

Payment for cutting existing asphaltic pavement, removal, transportation and disposal of old asphaltic pavement will be made in accordance with Section 919.18.

922.05.02 Waterproofed Bridge Decks

Measurement for payment for deck waterproofing shall be as detailed in Section 914.

Measurement for payment for the Asphaltic Paving of Bridge Decks shall be as outlined in Section 330, Section 332, and Section 333 as appropriate, with the following amendments.

Measurement for payment for the asphaltic paving of bridge decks will be limited to the weighted tonnage of asphalt concrete actually placed on the bridge deck and approach slabs. However payment shall be capped at a maximum of the theoretical tonnage plus 10%. Theoretical tonnage shall be calculated from the profile data as per Section 922.04.02 and the density from the approved mix design additionally asphalt payment shall be subject to the Reduced Payment Criteria as stipulated in Section 922.06.04.

Payment for concrete approach slab sweeping, cleaning, preparation, tack coating, forming and filling grooves with joint sealing compound, sealing the surface of asphaltic concrete adjacent to curbs and barriers, transverse joint forming and filling, the provision for deck drain cover plates and expansion joint filler strips shall be deemed incidental to the work.

Measurement for payment for the production, supply, storage, transportation, placing, grading and compaction of selected granular base course material on new construction projects shall be in accordance with Section 315.

922.06 BASIS OF PAYMENT

922.06.01 General

The basis of payment for the asphaltic paving of bridge decks shall be as outlined in Section 330, Section 332, and Section 333 as appropriate, with the amendments as noted herein.

922.06.02 Treated Bridge Decks

The basis of payment at the contract unit price for the asphaltic paving of bridge decks shall include full compensation for all equipment, labour, materials and plant necessary to prepare, sweep and clean the deck, supply and apply tack coat, pave the bridge deck, concrete approach slabs. Included is the forming and filling of approach slab grooves with joint sealing compound, and sealing the asphaltic concrete adjacent to curbs and barriers and transverse joint forming and filling as described above. Also included is the supply and transportation of all blending sand and asphaltic cement from the source to the mixing plant.

The production, supply, storage, transportation, placing, grading and compaction of selected granular base course shall be paid for separately under Section 315.

The basis of payment for cutting existing asphalt, removal, transportation and disposal of old asphaltic pavement on rehabilitation type projects shall be made in accordance with terms outlined elsewhere in the Section 919.18.

The covering of deck drains and expansion joints to prevent the entry of hot mix asphaltic concrete, the removal of the cover plates and filler strips, clean up and disposal of waste material shall be considered incidental to the work.

922.06.03 Waterproofed Bridge Decks

Payment for the waterproofing of bridge decks and all related work shall be as outlined in Section 914.

The basis of payment at the contract unit price for asphaltic paving of waterproofed bridge decks shall include full compensation for all equipment, labour, materials and plant necessary to prepare, sweep and clean the deck, supply and apply tack coat, pave the bridge deck and concrete approach slabs. Included is the forming and filling of approach slab grooves with joint sealing compound and sealing the asphaltic surface adjacent to the concrete curbs and barriers, and transverse joint forming and filling as described above. Also included in the basis of payment is the supply and transportation of all blending sand and asphaltic cement from the source to the mixing plant.

The production, supply, storage, transportation, placing, grading and compaction of selected granular base course shall be provided for separately under Section 315.

The basis of payment for cutting existing asphalt, removal, transportation and disposal of old asphaltic pavement on rehabilitation type projects shall be made in accordance with terms outlined elsewhere in the Section 919.18.

The covering of deck drains and expansion joints to prevent the entry of hot mix asphaltic concrete, the removal of the cover plates and filler strips, clean up and disposal of waste material shall be considered incidental to the work.

922.06.04 Reduced Payment Criteria for Bridge Deck and Approach Slab Paving

Where deviations occur over 20% of the total bridge deck and/or approach slab area, reductions will apply as per the below table:

Deviation from Specified Thickness	Reductions Applied to Bid Price
Less than 6 mm	None
6 mm to 10 mm	25% reduction
10 mm to 15 mm	50% reduction
15 mm to 20 mm	100% reduction
Greater than 20 mm	Reject and Replace

The Contractor may elect to remove and replace deficient asphalt at their own expense in an attempt to receive full payment for subsequent, properly placed asphalt.

In the event of rejection of the asphalt for either deviations from the asphalt thickness or is not considered a smooth driving surface, the Contractor shall remove and replace the asphalt at their own expense.

If the bridge deck was waterproofed and the asphalt is rejected for any reason, the waterproofing system shall be removed and replaced by the Contractor at their own expense.

Replacement asphalt shall be subject to the same requirements and reductions as stated above up to and including removal and replacement.

If insufficient time remains in the construction season to properly complete asphalt repairs, the rejected asphalt shall remain in place until the following construction season, at which time it shall be removed and replaced at the Contractor’s expense. Where asphalt is rejected on waterproofed bridge decks, the Contractor will also be responsible for the removal and replacement of the waterproofing system.

SECTION 923

WORK IN THE VICINITY OF UTILITIES

INDEX

923.01 SCOPE

The scope of this section is to cover work in the vicinity of overhead and underground utilities including, but not limited to, fiber optic cable, power distribution and transmission lines, water lines, and sewer lines.

This also applies to structures which have utilities attached to or embedded in the structure.

923.02 UTILITY LOCATES AND PROTECTION

The Contractor shall be responsible to locate and mark all utilities in the work area.

If protective measures are required by the utility owner, the Contractor shall carry these measures out to the satisfaction of the utility owner.

923.03 RELOCATION OF UTILITIES

If utilities are required to be relocated to accommodate the positioning of a permanent structure or a road diversion, the Department shall be responsible for coordinating and carrying out this work unless otherwise stated in the contract documents.

If the relocation of utilities is required accommodate equipment used in construction, it shall be the responsibility of the Contractor to complete this work. Examples include, but are not limited to, accommodation of cranes, lifting equipment, pile installation and pile driving equipment, excavators, dump trucks, and concrete pumps.

923.04 DISCONNECTION OR TEMPORARY RELOCATION OF UTILITIES

If utilities are required to be temporarily disconnected or temporary relocated to carry out construction, this shall be the responsibility of the Contractor.

923.05 MEASUREMENT FOR PAYMENT

There is no measurement for payment for this item.

923.06 BASIS OF PAYMENT

The cost of any utility locates, surveys, and protective measures to carry out the work shall be included in the contract price for “Mobilization and Demobilization” of the Unit Price Table. No additional payment shall be made for these items.

When the relocation of utilities is to accommodate the permanent structure or diversion is stated as the responsibility of the Contractor in the Contract Documents, it shall be included in the contract price for “Mobilization and Demobilization” unless specified otherwise in the Contract Documents.

When the relocation of utilities or temporary relocation/disconnection of utilities is required to accommodate Contractor’s equipment, the costs of this shall be included in the contract price for “Mobilization and Demobilization” unless specified otherwise in the Contract Documents.

SECTION 924

APPLICATION OF CONCRETE SEALER

INDEX

924.01 SCOPE

Concrete sealer shall be applied to all new structures as outlined in this specification. For rehabilitation projects, sealer shall be applied only if detailed in the Contract Documents.

In this section, exposed concrete shall refer to concrete which will be exposed to air after paving and landscaping is completed.

If concrete that will be buried is to be sealed, the application of sealer shall be completed before the component is buried and the sealer shall be given sufficient time to cure as per the manufacturer's direction. If the area requiring sealer is buried before sealer is applied or has properly cured, the area shall be re-excavated and sealer properly applied at the Contractor's expense.

If concrete sealer is to be applied after paving has been completed, the Contractor shall take precautions to protect the asphalt and other materials from the sealer as required. Damage to any materials due to exposure to the sealer shall be repaired to the satisfaction of the Engineer at the Contractor's expense which may include the complete removal and replacement of the damaged material.

Concrete sealer shall be applied to the following concrete superstructure and substructure surfaces:

a) all exposed faces of end blocks, curbs, sidewalks, and decks including the underside of bridge soffit
b) outside faces and bottom flanges of exterior girders

c) outside faces of abutment stems, frame legs, and wingwalls including areas which will be buried but are not covered by water at normal flow or normal low tide*,
d) the back wall face including areas behind any concrete members,
e) expansion joint dams
f) bearing seat and pedestals/plinths,
g) exposed piers and column surfaces
h) exposed surfaces of retaining walls

924.02 MATERIALS

Materials, surface preparation and application procedure shall be a silane coating with at least 100% silanes by weight. Siloxane based coatings shall not be used.

The durability and abrasion resistance of penetrating sealer shall make it suitable for protecting exposed horizontal and vertical surfaces. Penetrating sealer shall have excellent breathability, i.e. be permeable to water vapour, and provide protection against chloride-laden water.

The sealer shall be suitable for the age of the concrete at the time of application. Sealer shall not be applied to concrete within 28 days of pouring

The sealer and application procedure shall suit the requirements for severe/extreme environmental conditions.

Penetrating sealer shall exceed the performance criteria of the National Cooperative Highway Research Program (NCHRP) Report # 244 for protection of concrete against the intrusion of chlorides. In accordance with NCHRP Report # 244, the concrete sealer should provide a minimum 75% reduction in weight gain and chloride ion content.

Penetrating sealer shall comply with ASTM C672 “Standard Test Method of Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals” reflecting a rating of 0, i.e. no scaling after 50 cycles, the highest rating.

The VOC must comply with all federal and provincial regulations.

The material should not significantly darken or discolour concrete. The Contractor shall take special care to ensure runs or stains are not created which would be noticeable at a distance of 3 metres or more.

The Department’s pre-approved products are:

- PENTREAT 244-100 by W.R. Meadows

- Sikagard SN-100 by Sika

924.03 APPLICATION

924.03.01 Surface Preparation

All surfaces to be treated with penetrating sealer must be clean and structurally sound. New concrete and/or restoration work should be allowed to reach full 28 day cure strength prior to application.

Any other surface preparation called for by the manufacturer shall be carried out.

924.03.02 Application Procedure

Sealer shall be applied strictly in accordance with the manufacturer's instructions and guidelines as accepted by the Owner's Representative.

Surface cleanliness is critical to final appearance of penetrating sealer treated walls. All oil, grease, form release, parting agents, air pollution deposits and graffiti must be removed from substrate.

Any joint sealants shall be put in place and cured before application of the penetrating sealer unless accepted otherwise by the Department. The sealant shall be covered during the application of the penetrating sealer.

Alternatively, where sealants or caulks must be installed following application of the concrete sealer, the sealant or caulk must be compatible with the concrete sealer used.

Application of sealer shall be by means of a pressure spray unless the Contractor can demonstrate a superior method of application. The Contractor shall overlap all adjoining concrete surfaces with a 50 mm wide application of sealer.

Where holes are drilled, cuts are made, or the concrete surface is damaged after the sealer has been applied, the Contractor shall make good any damage and apply a fresh coat of penetrating sealer.

924.04 MEASUREMENT FOR PAYMENT

Measurement for payment purposes will not be made.

924.05 BASIS OF PAYMENT

The basis of payment for this work and items directly related shall be considered incidental to the concrete work pay items.

SECTION 925

INEXTENSIBLE MECHANICALLY STABILIZED EARTH (MSE) STRUCTURES

INDEX

925.01 SCOPE

This specification covers the design, supply, fabrication and construction of Mechanically Stabilized Earth (MSE) retaining walls and bridge abutments with precast concrete panels as facing elements. MSE retaining wall supplier shall be selected from a list pre-approved by the Department. All components of the MSE retaining wall system shall be sourced from one supplier. This includes but is not limited to, reinforced concrete face panels, inextensible soil reinforcement, geotextile filter fabric, and precast concrete coping caps.

In addition to the components listed above, the MSE wall structure also includes levelling pads, compacted engineered backfill, and perforated drainage pipe.

Face panels shall be cruciform or rectangular shaped.

925.02 MATERIALS

All concrete materials shall comply with CSA A23.1 “Concrete Materials and Methods of Concrete Construction” and CSA A23.2 “Test Methods and Standard Practices for Concrete.” All concrete work shall conform to the requirements of Section 904 unless otherwise stated herein.

Reinforcement for concrete face panels shall conform to the requirements of “Galvanized Reinforcing Steel” specified in Section 905.

925.03 SUBMISSION OF SHOP DRAWINGS AND DESIGN REQUIREMENTS

Prior to work commencing the Contractor shall prepare and submit to the Owner’s Representative for approval 1 electronic copy and 1 paper copy of detailed shop drawings, erection drawings and design calculations.

Design shall be in accordance with latest version of CSA S6, “Canadian Highway Bridge Design Code.” The structure shall have a design life of 100 years. Soil reinforcement shall have sufficient strength, frictional resistance and length as required by the design and as outlined in these specifications.

The Department requires a minimum of 4 weeks to review submitted documents.

Shop drawings shall contain:

a) Limits on backfilling, and compaction requirements, including gradation limits for engineered fill; Submitted drawings shall be stamped and signed by a Professional Engineer registered to practice in Newfoundland and Labrador;
b) Accommodation made to prevent buildup of hydrostatic pressure behind the wall;
c) Surcharge created by bridge structure and highway live loads if applicable;
d) Levelling pad details;
e) Type of soil reinforcement and length for each section of the MSE structure;
f) Factored and unfactored pressures applied to the MSE wall system;
g) Embankment pressures provided by the Geotechnical Engineer;
h) Precast concrete facing panel layout;
i) Precast concrete coping and top safety railing;
j) Representative typical details.

Wall panels will be laid out and sized so joints appear on a consistent multiple spacing. The Contractor must ensure all joints are visually continuous on the entire MSE wall face. The use of architectural strips may be required to give this appearance where necessary. Nominal concrete cover to reinforcing must be maintained. Shop drawings will be rejected if the MSE panel joint grid does not give an aesthetically pleasing appearance.

The maximum panel dimension permitted by the Department in a MSE structure will be 2000mm. In addition to the service loads provided by the owner, MSE structures shall be designed to support standard construction equipment. The use of heavy equipment used during construction, such as cranes or off road trucks, shall be taken in to consideration for design of MSE wall systems.

The Contractor shall not proceed with fabrication until acceptance of the Shop Drawings by the Owner’s Representative.

925.04 FABRICATION OF PRECAST CONCRETE PANEL FACING

925.04.01 General Requirements

The Contractor shall supply concrete panels constructed according to the MSE Supplier’s specifications and recommendations, including all necessary hardware for the lifting and aligning of panels. All panels shall be built in accordance with the accepted plans and shop drawings.

The fabricator for the concrete face panels must be certified as a precast yard, in accordance with CSA A23.4 "Precast Concrete - Materials and Construction". Proof of certification, as well as a detailed Quality Control Procedure, shall be provided to the Owner’s Representative prior to the construction of panels. The Contractor shall submit

a copy of test results upon completion of panel fabrication. Concrete shall conform to all relevant portions of Section 904.

925.04.02 Concrete Quality

Concrete shall be normal density and have a minimum compressive strength of 40 MPa at 28 days meeting all requirements for Substructure Concrete as per Section 904. Cement used shall be a blended Portland, fly ash, silica fume cement, Type GUb. Contractors are advised that the minimum proportion by mass of the total cementing materials for silica fume shall be 6% and a maximum of 8%. Contractors are advised that the maximum proportion by mass of the total cementing materials for fly ash is 25%.

Concrete shall be of sufficient workability, so the desired finish as specified in 925.04.03 can be achieved.

Precast units shall be considered acceptable for early placement in the wall when 7-day strengths exceed 75% of the 28 day requirements, unless local strength gain experience dictates a longer period of time.

925.04.03 Reinforcement

Panel reinforcement shall be placed as shown on the accepted shop drawings with care taken to ensure specified cover is maintained.

Reinforcement shall be steel bars meeting the requirements of Section 905. Other types of reinforcement such as welded wire mesh or FRP bars shall be submitted to the Department for review and accepted on a case by case basis.

925.04.04 Forms

Accepted fabricated steel forms are to be used for precast panels. Forms will be set on a rigid foundation. Forms are to be smooth, mortar tight, true to the required lines and grades and of sufficient strength and rigidity to resist springing out of shape or alignment. All precast units shall be manufactured within the following tolerances:

a) All dimensions within 5 mm, including diagonals measured between opposite corners.
b) Surface defects on formed surfaces shall not exceed 2.5 mm.

925.04.05 Concrete Finish

For panels being used as bridge abutments, the colour shall match that of the superstructure. The front face of all panels shall have a smooth grey finish conforming to

CSA A23.4 Section 24.2.5 Grade A. Consistency of finish shall be maintained with the use of the same concrete mix and the same type of form oil for the entire project. The rear face of the panels shall be an unformed surface finish, roughly screeded with no open pockets or distortions in excess of 6 mm.

925.04.06 Handling, Storage and Shipping

All panels shall be handled, stored, and shipped in such a manner as to eliminate the potential for damage such as chipping, cracks, fractures etc., as well as excessive bending stresses and damage to protruding or otherwise exposed components. Panels, when stacked, shall be supported on firm hardwood blocking located immediately adjacent to the tie strips to avoid bending them.

Panels shall be protected from discoloration and staining of the front face.

925.04.07 Rejection

The Owner's Representative shall be the sole judge of a panel's acceptability before it is placed. Panels will be subject to rejection in the case of failure to meet the required specified strength and concrete quality requirements. In addition, any or all of the following defects shall be sufficient cause for rejection:

a) Defects that indicate warped or imperfect molding;
b) Defects indicating honeycombed or open texture concrete;
c) Any structural crack as defined in Section 32.3.2 of CSA A23.4;
d) Lifting inserts or connecting hardware improperly set;
e) Cracking resulting from lifting and transport operations, and broken or cracked corners;
f) Exposed reinforcing steel;
g) Dimensions out of tolerance;
h) Non-uniform appearance.

925.05 SOIL REINFORCING SYSTEMS

925.05.01 General Requirements

Soil reinforcing systems material shall be inextensible galvanized steel in normal conditions. In cases where the soil PH is high and steel reinforcement corrosion is a concern, high density polyethylene geogrid is required. All reinforcing systems must be pre-approved by the Department.
For MSE walls which will be permanently submerged, the Contractor shall complete relevant testing of the watercourse and provide the results to the MSE wall supplier for consideration into their design.

925.05.02 Inextensible Strip Type Soil Reinforcing Systems

Where strip type reinforcing systems are used strips shall consist of hot rolled, shop fabricated ribbed structural steels conforming to CSA G40.21 “Structural Quality Steels” Grade 400 W or ASTM A572/A572M “Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel” grade 65 as shown on the shop drawings. Galvanizing shall follow shop fabrication and shall be in accordance with CSA G164 “Hot Dip Galvanizing of Irregularly Shaped Articles”. Strips shall be cut to length and tolerances as shown on the shop drawings.

Tie strips shall consist of shop fabricated structural steel conforming to ASTM A36 “Standard Specification for Carbon Structural Steel” or CSA-G40.21 Grade 300W and shall be galvanized in accordance with CSA G164 after fabrication. Bolt hole alignment, dimensions, and end distances shall be within the tolerances shown on the shop drawings.

All bolted connections shall be made using hot dip galvanized ASTM F3125 bolts and nuts.

Any damage done to the galvanizing prior to installation shall be repaired in an acceptable manner to the Department and provide a galvanized coating comparable to that provided by CSA G164.

925.05.03 Inextensible Mesh Type Soil Reinforcing Systems

Where mesh type reinforcing systems are used reinforcing mesh shall be shop fabricated cold drawn steel wire conforming to the minimum requirements of ASTM A1064 “Standard Specification for Steel Wire and Welded Wire, Plain and Deformed, for Concrete.”

Galvanization shall be applied after the mesh is fabricated and shall conform to ASTM A123 “Standard Specification for Zinc (Hot Dipped Galvanized) Coatings on Iron and Steel Products.”

All bolted connections shall be made using hot dip galvanized ASTM F3125 connectors, bolts, nuts and washers.

Any damage done to the galvanizing prior to installation shall be repaired as detailed in ASTM A780 “Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dipped Galvanized Coatings” Method 2.

925.06 RUBBER BEARING PADS

Panels, except for the bottom course, shall be supported on rubber bearing pads. Rubber bearing pads shall be secured into the panel below. The rubber shall be an elastomer with a Shore Hardness of 70 ± 5, as measured in accordance with ASTM D2240 "Standard Test Method for Rubber Property – Durometer Hardness."

925.07 FILTER FABRIC

Filter fabric to be placed over the joints at the back of the panels shall be a non-woven geotextile. Filter fabric shall be attached using an adhesive approved by the Manufacturer. These strips shall have a nominal width of 500mm and be placed over the inside of all joints between precast panels. Strips shall have a minimum overlap of 100mm at all lap locations. The material shall have the following minimum average roll values:

Grab Tensile Strength	530 N	(ASTM D4632)
Mullen Burst	1665 kPa	(ASTM D3786)
Permeability	0.22 cm/sec	(ASTM D4491)
UV Resistance	70%	(ASTM D4355)

925.08 PRECAST CORNER AND/OR COPING ELEMENTS

Corner and/or coping elements are required on all structures. All coping elements shall be precast unless a cast in place construction has been accepted in the tender documents. They shall be cast as shown on the Shop Drawings and in accordance with the specifications for concrete panels. Coping shall provide a continuous smooth appearance with no discontinuities or kinks visible. If they do not meet this criteria coping will be rejected. Concrete mix for face panels shall apply to the precast coping.

925.09 FRICTIONAL BACKFILL REQUIREMENTS

All MSE wall backfill shall be obtained from a single source.

The angle of internal friction for backfill material shall not be less than 35 degrees as determined by the Standard Direct Shear Test according to ASTM D3080/D3080M.

It is the Contractor's responsibility to conduct the required testing and provide exact values of unit mass and angles of internal friction to the MSE Supplier prior to the design of the structure.

The MSE frictional backfill will be a crushed blasted rock with the following gradation:

100mm	100% passing by dry weight
75mm	75- 100%
4.76mm	20-55%
1.2mm	10- 35%
0.3mm	6-20%
0.075mm	2-5%

Gradation requirements will be strictly enforced and variances to a coarser or less well graded material will not be accepted even if meeting the minimum gradation requirements of the MSE wall supplier.

The frictional backfill shall extend at least 500 mm beyond the end of soil reinforcing straps.

The backfill within the R/E volume shall be tested in accordance with AASHTO or ASTM standard methods and meet the following criteria:

ELECTRO-CHEMICAL PARAMETER	ELECTRO-CHEMICAL REQUIREMENT	TEST METHOD	
		AASHTO	ASTM
Chlorides (Cl^-)	< 100 ppm	T 291	D4327
Sulphates (SO_4^{2-})	< 200 ppm	T 290	D4327
Resistivity	> 3000 ohm-cm	T 288	G187
pH	5 - 10	T 289	D4972

At least two weeks prior to start of wall construction the Contractor shall identify the source of materials to be used for the MSE wall backfill and provide initial testing for the MSE wall backfill. This testing shall include both gradation and electrochemical testing as a minimum. A copy of these test results shall be provided to the Owner's Representative. In addition, the Contractor shall provide the Department with a letter of conformance from the MSE wall supplier stating that the backfill meets the electro-chemical and geotechnical requirements assumed in the design of the wall.

In addition to this initial testing, the Contractor shall sample and test the backfill for conformance with the gradation requirements at least once for every 250 cubic metre of material placed.

All sampling shall be carried out in the presence of the Owner's Representative. Additional gradation testing at the contractors cost maybe required if based upon visual inspection in the field it is evident to the Owner's Representative that the gradation of the backfill material has changed.

The Contractor shall use professional engineering services and a qualified testing firm licensed in Newfoundland and Labrador for all sampling and testing of the backfill.

In addition to testing done by the Contractor, one 20 kg representative sample of the backfill proposed for construction shall be submitted to the Owner's Representative for testing and approval two weeks prior to start of construction. The sample shall meet the geotechnical parameters as specified by the Supplier.

925.10 CONSTRUCTION REQUIREMENTS

925.10.01 General Requirements

The MSE structure shall be constructed in conformity with the lines, grades, details and dimensions as shown on the Contract drawings or established by the Department. Poor conformance with respect to this criteria is subject to rejection.

925.10.02 Structure Excavation

All necessary excavation for the MSE structure shall be in accordance with "Excavation for Foundations" in Section 902. Excavation shall be in close conformity to the lines and grades shown on the Drawings.

925.10.03 Foundation Preparation

The structure foundation shall be graded level for a width equal to the length of reinforcing elements plus approximately 500 mm or as shown on the Shop Drawings. Prior to wall construction, the foundation shall be proof rolled and/or compacted to the satisfaction of the Owner's Representative. Any foundation soils found to be unsuitable shall be removed and replaced with Engineered Fill. The foundation conditions shall be accepted by the MSE wall designer, the Contractor's Geotechnical Engineer, and the Owner's Representative prior to MSE wall erection.

925.10.04 Levelling Pad

Concrete footings shall be formed and poured as per relevant portions of the General Specifications Section 904. Cast-in-place concrete for the unreinforced concrete levelling pad shall have a 28 day design strength of 35 MPa or better and shall be screeded uniformly smooth with a variation of not more than 3 mm and without protrusions.

Elevation differences between steps shall not vary more than 5 mm from those shown on the drawings. Plan dimensions and step locations (if any) shall be in reasonable conformity with the drawings and shall be located such that panels will be positioned reasonably centred on the pad. The levelling pad shall be cured in accordance with CSA A23.1 or as directed by the Owner's Representative.

925.10.05 Backfill and Soil Reinforcing System Placement

Backfill placement shall closely follow the erection of each row of panels. At each soil reinforcing level, backfill shall be roughly levelled and compacted before placing and connecting reinforcing elements to the panels. Unless otherwise shown on the Erection Drawings, reinforcing elements shall be placed approximately perpendicular to the face of the wall or as directed by the MSE wall designer.

The Contractor will notify the Owner's Representative a minimum of 7 days prior to the commencement of backfilling operations.

The Contractor will be responsible for testing to establish the Standard Proctor Maximum Dry Density and will be responsible for having the compaction of each lift of backfill tested for conformance to the compaction requirements. All results will be provided to the Owner's Representative as the work progresses

The maximum backfill lift thickness shall not exceed 250 mm (compacted). Backfill shall be compacted to a minimum of 95% Standard Proctor Maximum Dry Density unless otherwise specified by the Owner's Representative or on the drawings. The Contractor shall decrease this lift thickness if necessary to obtain the specified density. The moisture content of the backfill during placement shall be such that temporary pore water pressure buildup during compaction is avoided. A moisture content of about 2% below optimum is recommended. Backfill compaction shall be accomplished without disturbance or distortion of reinforcing system and panels. Compaction in a zone 1.5 metres wide adjacent to the wall facing shall be achieved using light mechanical tampers. For bridge abutments, backfill beneath the bridge seat shall be compacted to 100% Standard Proctor Maximum Dry Density within the zone outlined on the Shop Drawings.

925.10.06 Panel Erection

The Contractor shall make use of the guidance services provided by the supplier and provide adequate notice to the supplier of the intended date for start of erection.

Precast concrete panels shall be placed with the aid of a light crane or other equipment as approved by the MSE wall designer. Panels are lifted by means of inserts (minimum

of two per panel) set into the upper edge of the panels. Panels shall be placed level in successive lifts, staggered as shown on the drawings, as backfill placement proceeds.

During backfilling operations each panel will rotate away from the fill about its lower edge as fill is placed to the top of the panel. The rotation results from initial stressing of the reinforcing elements. To allow for rotation each panel shall be inclined inward (towards the fill) by an amount equivalent to the outward rotation observed for the previously placed and completely backfilled panels.

The first panels erected shall be inclined inward as directed by the MSE wall designer. All subsequently placed panels shall be inclined inward based on the continuously monitored actual rotation. External bracing of the first level of panels will be required and shall be maintained during placement of the initial 1500 mm of fill.

Vertical (or sloped, as shown on the drawings) tolerances and horizontal alignment tolerance shall not exceed 18 mm when measured along a 3000 mm long straight edge. The overall vertical (or sloped) tolerance of the wall (measured from top to bottom) shall not exceed 12 mm per 3000 mm of wall height. If Supplier tolerances are not maintained the Contractor shall disassemble and reinstall the structure at no cost to the Department.

The Contractor will arrange for the mechanically stabilized earth company to provide experienced construction staff during commencement of the project. This technical staff will provide instruction both to the Contractor and the Owner's Representative for as long a period as required by the Owner's Representative.

The construction and erection work shall be executed under the continuous supervision and direction of a competent foreman/superintendent accepted in writing by the MSE wall supplier. This person must have experience in the construction and erection of MSE wall structures. The contractor shall provide suitable written evidence of tradesmen/supervisor qualifications if required by the Owner's Representative.

925.10.07 Drainage Pipe Installation

Perforated drainage pipe wrapped in filter fabric shall be installed to the lines and grades shown on the drawings and in accordance with the General Specifications or as directed by the Owner's Representative.

925.10.08 Traffic Barrier or Coping Placement

Precast traffic barrier or coping, on top of the concrete face panels, requires a smooth transition concrete/grout filler between the panel top and the underside of the barrier/coping. This concrete/grout filler shall be cured as per the Manufacture's

instructions and installed in accordance with the lines and grades as shown on the Drawings and General Specifications.

Ensure a uniform top of wall alignment. Traffic barrier or coping, placed on top of the concrete face panels, shall have construction/expansion joints to be spaced no greater than 2000 mm on centre or coincident with the panel joints, whichever is less. Coping shall be installed in accordance with the General Specifications and have evenly spaced joints positioned as shown on the drawings.

925.11 MEASUREMENT FOR PAYMENT

The unit of measurement for Mechanically Stabilized Earth (MSE) structures shall be per square metre of total wall face area from top of levelling pads to the top of the uppermost panels (excluding levelling pad and coping heights), based on the accepted panel areas given in the Shop Drawings.

925.12 BASIS FOR PAYMENT

Payment at the contract price for “Design, Supply and Install Mechanically Stabilized Earth Retaining Walls” in the Unit Price Table shall be full compensation for all labour equipment and materials required to construct the wall in accordance with the plans and specifications. Included will be all costs associated with the wall foundation, levelling pad, concrete panels, bearing pads, soil reinforcing system, frictional backfill, zones of non-frost-susceptible fill, geotextiles and adhesive over joints, perforated drainage pipe and precast coping.

Excavation - Other Material as required by the mechanically stabilized earth retaining wall designer for the installation of the mechanically stabilized earth retaining wall (panels, soil reinforcement, levelling slab, coping and frictional backfill) will be considered incidental to the work. If Excavation of rock is necessary to install the MSE Structure it will be paid for as Excavation for Foundations - Solid Rock. Actual quantity of rock to be removed is to be accepted by the Owner’s Representative.

If sub-excavation is required beneath the reinforced earth soil mass then it will be paid for as Excavation for Foundations - Other Material.

Placement of material behind the reinforced soil block will be paid for separately either as “Rock Fill in Place” or “Other Material in Place” in accordance with Section 204.

All work associated with soil testing by the Contractor and the preparation of shop drawings, erection drawings, erection procedures, calculations, etc. shall be considered incidental to the work. There will be no payment for MSE wall installation until all initial

testing results and the letter of conformance from MSE wall supplier for the backfill has been submitted to the Owner's Representative. Submission of the required gradation and compaction testing results on the backfill will be required as the MSE wall construction progresses prior to the approval of payment for MSE wall installation.

SECTION 926

CONSTRUCTION LAYOUT AND SURVEYING REQUIREMENTS

INDEX

926.01 SCOPE

This work consists of furnishing, placing and preserving construction layout stakes, reference marks and other controls in accordance with the Contract Documents for the construction of various elements of the Project by an independent Surveying sub-contractor. The Surveyor is to reproduce and submit field notes of all layout work to the Owner's Representative as the work progresses as described below.

This specification applies for any bridge replacement projects, or culvert replacement projects greater than 3m in span, or as noted in the Contract Documents.

926.02 GENERAL

The Contractor is responsible for having the finished Work conform to the lines, grades, elevations, and dimensions shown on the plans.

Unless noted otherwise in the contract documents all dimensional tolerances shall be +/- 5mm. The Department reserves the right to reject the work if this is exceeded, and the Contractor will be responsible for replacing the rejected item and any associated work. The Department reserves the right to hold back any monies that would be required for the Contractor to return to site and complete the replacement of the rejected work. This applies for all items of the work and is not limited to the items noted for surveying below.

The Surveyor is to use competent personnel and suitable equipment for the layout work required and is to provide a Registered Surveyor in Newfoundland to supervise the operation. The Surveyor is to be specified under Appendix B “Declaration of Sub-Contractors” in the Tender Documents.

The Department will furnish the Contractor with a benchmark from which all site dimensions shall be derived.

The Department may check the control of the work, as established by the Contractor and verified by the Surveyor, at any time as the work progresses. The Contractor will be informed of the results of these checks, but the Department by so doing in no way relieves the Contractor of responsibility for the accuracy of the layout work.

The Contractor shall correct or replace, at the Contractor’s own expense, any deficient layout and construction work which may be the result of the inaccuracies in the construction layout operations or the failure to report inaccuracies in the original conditions of the site that would lead to a layout that would not comply with the Contract Documents. If, as a result of these inaccuracies, the Department is required to make further studies, redesign, demolition, reconstruction or any combination of such, all expenses incurred by the Department due to such inaccuracies will be deducted from any monies due to the Contractor.

The Surveyor is to verify the location of the construction elements noted under section 926.03 and any others noted in the Contract Documents and provide copies of field notes and data used in the setting and referencing of stakes and other layout markings; data shall be provided in .csv files in PENZD format. Such provision of information shall be adequate for the Owner’s Representative to review the location and elevation of the reference marks. The Surveyor is required to notify the Department and the Contractor in writing or electronic communication within 24 hours discovery of the existence and the magnitude of any discrepancies, greater than what is allowed in the Contract Documents.

926.03 LAYOUT

Layout Marks, Reference Points and Dimensions to confirm any of the following elements that are part of the contract: Line and Grade, Substructure, Bearings, Superstructure, Walls, Bridge Decks.

926.03.01 Line and Grade

The Contractor shall be solely and completely responsible for the accuracy of the line and grade of all features of the work. Any errors or apparent discrepancies found in previous surveys, plans, specifications or supplementary general conditions shall be called to the Owner's Representative's attention immediately for correction or interpretation prior to proceeding with the work.

926.03.02 Substructure

Stake, reference or otherwise identify locations, orientations, and elevations necessary for placement of substructure components, including but not limited to cofferdams, pilings (including batter), drilled shafts, footings, columns, abutments, caps, cross beams, bearing devices, temporary supports or falsework, and excavations and embankments associated with the construction. Verify and document the locations, elevations and spatial relationships with adjacent substructure components. Supply a copy of such documentation to the Owner's Representative for review before the next stage of construction, or before a concrete pour if requested by the Owner's Representative.

926.03.03 Bearings

Verify and document the location, elevations and spatial relationships with adjacent sub- and super-structure. On bridges where prefabricated beams will be used, measure and document span lengths between bearing devices at each beam location as soon as practical. Supply a copy of such documentation to the Owner's Representative for review before the next stage of construction or before anchorage of the bearings if requested by the Owner's Representative.

926.03.04 Superstructure

Stake, reference or otherwise identify locations, orientations, and elevations necessary for placement of superstructure components including but not limited to beams, girders, diaphragms, earthquake restraints, deck, rails, structure mounted traffic control and illumination devices, and concrete forms, temporary supports and falsework associated with any of the above. Stake grades at each stage of construction. Supply a copy of such documentation to the Owner's Representative for review before the next stage of construction, or before a concrete pour if requested by the Owner's Representative.

Apply corrections to design grades based on the dynamics of the evolving structure within the tolerance specified by the Engineer of Record. Corrections that may be required depend upon the design of the bridge and the construction methods employed. Contractor is to provide proposed correction details to the Owner's Representative for approval by the Engineer of Record.

926.03.05 Walls

Stake, reference or otherwise identify locations, orientations, and elevations necessary for placement of the wingwalls, MSE walls, or any adjacent walls included in the Project. Walls are to be verified every 3 m in vertical height, and 3 m in the horizontal plane. A copy of such documentation is to be supplied to the Owner's Representative for review before continuation of the wall construction or before a concrete pour if requested by the Owner's Representative.

926.03.06 Bridge Decks

Bridge Decks shall be surveyed twice. The first survey shall be when the concrete deck is exposed, and all concrete repairs have been complete. The second survey shall be after the surface course of asphalt has been completed and is ready for traffic. The survey shall be on a 1 m by 1 m grid pattern, along the whole width of the bridge, and is to extend 20 m past the bridge in both directions. The survey shall include points along the joints, curbs, wheel paths, and drains.

926.04 UNASSIGNED

926.05 UNASSIGNED

926.06 MEASUREMENT FOR PAYMENT

No measurement for payment will be made.

926.07 BASIS OF PAYMENT

The work described above shall be included in the general cost of the work and no direct payment for "Construction Layout and Surveying Requirements" will be made.

The first 30% of any unit prices associated within the following specification sections within Table 1 will be withheld until the Surveyor has submitted the following field notes showing verification of their respective elements, the magnitude of any differences with the Contract Documents, and the Owner's Representative is satisfied that the layout is correct:

Table 1

Element described above	Specification Section
1. Line and Grade	157 “Mobilization and Demobilization”
2. Substructure	904 “Concrete Structures” and 903 “Piling”
3. Bearings	912 “Bearings”
4. Superstructure	904 “Concrete Structures”
5. Walls	925 “Inextensible Mechanically Stabilized Earth (MSE) Structures” and 904 “Concrete Structures”
6. Bridge Decks	922 “Asphaltic Paving of Bridge Deck and Approaches”

SECTION 927

DESIGN CALCULATIONS

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927.01 SCOPE

This work consists of procuring and submitting design calculations to the Department for any element or part of the work, temporary or permanent. This may include but is not limited to: temporary works; design, supply and install elements, and alternative designs submitted by the Contractor.

927.02 GENERAL

Design Calculations shall be stamped and signed by a Professional Engineer registered in the Province of Newfoundland and Labrador. This person shall be known as the "Engineer of Record" for the component/work which they have designed. Additionally the calculations shall be stamped with a "Permit to Practice" from Professional Engineers and Geoscientists Newfoundland & Labrador for the company that employs the Engineer of Record.

The calculations will be held on file for the length of the structure's lifetime and will be available to the public on request.

The Department will not take any responsibility for accuracy, integrity or validity of the calculations; the Engineer of Record, and the company that employs them, is to have their own review procedure in place and not assume any technical oversight from the Department. The Department reserves the right to query the Contractor and/or the

Engineer of Record and their employer at the time of submittal, on any part of the calculations.

All calculations are to be designed to the latest version of CSA:S6 “Canadian Highway Bridge Design Code”, TAC “Geometric Design Guide for Canadian Roads” and any other relevant standards, guidelines and legislation applicable at the time of construction. These are consider by the Department to be the minimum standard a designer must achieve. Any variations from these codes, standards, guidelines and legislation shall be specifically accepted by the Department before construction is commenced.

927.03 CALCULATIONS REQUIRED

Calculations required by the Department shall include but are not limited to:

a) Cover Sheet
b) Index
c) Design exceptions to S6, TAC design guidelines, and any other relevant standards, guidelines, and legislation applicable at the time of construction
d) Design Methodology - Any use of “simplified” methods, alternative codes or methods should be made clear here and in the calculations for the relevant design element.
e) Design Assumptions
f) Calculations of Loads - This should include consideration of ALL loads specified under CSA:S6 any additional loads specified by the Department. Each element shall have its minimum and maximum load, and the corresponding load case clearly noted.
g) Calculations of Superstructure - This would include but is not limited to design of deck, girders, diaphragms, bearings
h) Calculations of Substructure - This would include but is not limited to design of abutments, piers, wingwalls, foundations (shallow or deep)
i) Design Summary - This should include summaries of all design capacities and capacity/demand ratios with the critical load combination identified for each design element

Spreadsheets can be included to show calculations and summaries of calculations as long as one set of detailed calculations (relevant to this structure) per spreadsheet is submitted to show validity of the spreadsheet. The Department may waive this requirement if they consider the spreadsheet/method used to be sufficiently proven by the industry.

Calculations, that in the Department’s opinion, are not sufficiently detailed for future use by the Department to determine the structure or individual element’s ultimate and serviceability strength and serviceability shall be rejected and will require resubmittal.

Calculations shall be submitted as a single document unless agreed with the Department otherwise.

927.04 CALCULATION SUBMITTALS

For any element or part of the work requiring design calculations, the Contractor shall submit 1 electronic and 1 paper copy to the Department a minimum of 10 business days before construction of the element or part of the work commences. Electronic copies shall be submitted in PDF format unless requested otherwise. The Department may ask for a copy in native electronic format of any computer model used and referenced in the Design Calculations. Spreadsheets do not need to be submitted in native electronic formats.

Should calculations require resubmittal, the Contractor shall delay the construction of the element or part of the work a minimum of 10 business days after resubmittal of the calculations to the Department.

The Department will not accept any claims for time or cost associated with calculations that were rejected or required resubmittal.

927.05 UNASSIGNED

927.06 UNASSIGNED

927.07 UNASSIGNED

927.08 MEASUREMENT FOR PAYMENT

No measurement for payment will be made.

927.09 BASIS OF PAYMENT

The work described above shall be included in the unit price for the item requiring design calculations and no direct payment for “Construction Design Calculations” will be made.

Failure to provide design calculations acceptable to Department will result in 100% withheld of the payment for the item in the Unit Price Table for which the calculations are required.

SECTION 930

CONCRETE – MATERIALS AND PRODUCTION

INDEX

930.01 SCOPE

This specification covers the Department's requirements for all materials used in the production of concrete structures, including precast concrete. This specification also covers concrete batching, delivery, placement and sampling and testing. All work, plant, equipment and materials shall be in strict accordance with CSA A23.1 and CSA A23.2, unless otherwise specified.

930.02 REFERENCES

Reference standards shall be the latest revision at the date of Tender closing. This specification refers to the following standards, specifications or publications:

- AASHTO M182 "Specification for Burlap Cloth made from Jute or Kenaf and Cotton Mats"
- ACI PRC-211.1 "Selecting Proportions for Normal-Density and High Density-Concrete Guide"
- ASTM C171 "Standard Specification for Sheet Materials for Curing Concrete"
- ASTM C260 "Standard Specification for Air-Entraining Admixtures for Concrete"
- ASTM C309 "Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete"
- ASTM C403 "Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance"
- ASTM C457 "Standard Test Method for Microscopical Determination of parameters of the Air-Void System in Hardened Concrete"

- ASTM C494/C494M “Standard Specification for Chemical Admixtures for Concrete”
- ASTM C793 “Standard Test Method for Effects of Laboratory Accelerated Weathering on Elastomeric Joint Sealants”
- ASTM C920 “Standard Specification for Elastomeric Joint Sealants”
- ASTM C1017/C1017M “Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete”
- ASTM C1202 “Standard Test Method for Electrical Indication of Concrete’s Ability to Resist Chloride Ion Penetration”
- CRD-C 661-06 “Specification for Antiwashout Admixtures for Concrete”
- CSA A23.1 “Concrete materials and methods of concrete construction”
- CSA A23.2 “Test methods and standard practices for concrete”
- CSA A23.3 “Design of concrete structures”
- CSA A23.4 “Precast concrete – Materials and construction”
- CSA A283 “Qualification code for concrete testing laboratories”
- CSA A3000 “Cementitious materials compendium”
- CSA S6 “Canadian Highway Bridge Design Code”

930.03 DEFINITIONS

Engineer of Record: The Professional Engineer who completed and sealed the design of the specific component or system.

High Performance Concrete (HPC): Concrete that meets performance requirements (increase strength and durability) that cannot always be achieved routinely by using conventional materials and normal placing and curing practices.

Infill Concrete: A body of concrete used to fill in an excavated area or void space with dimensions large enough (thickness > 1m) for which consideration is given to temperature rise caused by the hydration of cementing materials in order to keep cracking to a minimum.

Owner’s Representative: An applicable Government employee responsible for the project or any Third Party who has been authorized by the Department to conduct work on the Department’s behalf.

Professional Engineer: An individual who is registered and in good standing with PEGNL.

Supplementary Cementing Materials (SCM): Means material that, when used in conjunction with hydraulic cement, contributes to the properties of hardened concrete through hydraulic or pozzolanic activity or both.

Tremie Concrete: Concrete deposited underwater through a pipe or tube fitted with a hopper at its upper end.

930.04 MATERIALS

All materials used in the production of concrete shall conform to the referenced standards. All materials are subject to inspection, testing or rejection at any time and must be made available for sampling and testing prior to and at any point during the work at the request of the Owner's Representative to ensure compliance with this specification.

930.04.01 Cement

All cementing materials shall be in accordance with CSA A3000.

Cement for High Performance Concrete (HPC), exposure class C-XL and bridge components, exposure class C-1, shall be a blended Portland, silica fume, fly ash or slag, Type GUb F/SF or GUb S/SF.

The minimum proportion by mass of the total Supplementary Cementing Materials (SCM) for exposure classifications C-XL and C-1 shall contain silica fume from 5% to a maximum of 8%. The minimum proportion by mass of the total cementing materials for fly ash or slag is 15%. The total mass of SCM's should not exceed 30% of the total weight of cementitious material.

Cement for all other concrete shall be Portland cement Type GU or GUL, a portion of which may be replaced by fly ash or slag up to 25% by mass of the total cementing material. Blending a combination of both fly ash and slag for incorporation into the GU or GUL cement is not permitted.

930.04.02 Aggregates

The Contractor will determine the source of the fine and coarse aggregates but all aggregates shall be normal density.

Fine and coarse aggregate stockpiles shall be stored separately and constructed to prevent segregation and contamination and such that no equipment will be operated on the piles. Fine and coarse aggregates shall conform to the grading limits as specified in Table 10.0 and Table 11.0, respectively, of CSA A23.1.

The coarse and fine aggregate test data required to be submitted with the concrete mix design shall include but not be limited to:

- CSA A23.2-30A – Standard Practice for sampling, testing and inspection of aggregate products for use in concrete for qualification and acceptance purposes.
- Annex P – Impact of sulphides in aggregate on concrete behaviour and global approach to determine potential deleterious reactivity of sulphide bearing aggregates.

All submitted test results shall be from tests completed within one (1) calendar year of submission to the Department, apart from those modified below.

A satisfactory history of testing to demonstrate the aggregate does not have the potential for deleterious expansion due to alkali reactivity shall consist of at least five (5) consecutive passing tests performed in accordance with CSA A23.2-25A or CSA A23.2-26A and/or CSA A23.2-14A over a period not to exceed ten (10) years and not less than five (5) years. For exposure classes C-2, C-3 and F-1, if the aggregate does not meet this requirement, preventive measures shall be identified in accordance with CSA A23.2-27A and must provide evidence demonstrating effectiveness as per CSA A23.2-28A. Aggregates that are identified as potentially alkali reactive in accordance with CSA A23.2-27A shall not be permitted in C-XL or C-1 concrete mixes.

The maximum size of coarse aggregate to be used for the different thicknesses of concrete shall be 20 mm unless otherwise specified by the Department. In no case shall the maximum size of coarse aggregate used be greater than either, 2/3 the clear distance between the reinforcement or 2/3 the clear distance between the exterior bars and the face of the structure. With the exception of girders where the latter criteria shall be 0.8 times the clear distance between the exterior bars and the face of the structure.

The sources and test results of all aggregate materials shall be clearly identified. The aggregate tests shall be conducted by a laboratory CCIL Certified in accordance with CSA A283 to perform the aggregate tests. The aggregate properties shall be signed and stamped by the Engineer of Record. The Engineer of Record shall attest to the validity of the material test data.

930.04.03 Water

All water shall be clear and free from deleterious substances and shall be potable. Water of unknown quality shall not be used in concrete unless the requirements of CSA A23.1 Clause 4.2.2 and Table 9.0 are met. A declaration of potability or water quality testing as per CSA A23.1 Clause 4.2.2.4 must be submitted with the concrete mix design submission.

All water used for curing shall be a minimum temperature of 10 ºC and be clean, free of chlorides, oils, dirt, other deleterious materials and any other material which would cause staining or discoloration of the concrete. The temperature of curing water shall be within 20°C of the concrete surface temperature at all times and shall not cause temperature differentials greater than those specified in Table 1.0 in Section 931.

The Contractor shall not use water of unknown quality and/or water from shallow, stagnant or marshy sources.

930.04.04 Admixtures

All concrete shall be air entrained with an air-entraining admixture conforming to ASTM C260/C260M.

For underwater concrete operations, precautions shall be taken to prevent loss of cementitious material by the washing action of water. The use of anti-washout admixtures confirming to U.S. Army Corps of Engineers CRD-C 661-06, Specification for Anti-Washout Admixtures for Concrete is mandatory.

Any other admixture, utilized in the concrete must conform to ASTM C494/C494M.

All admixtures shall be stored in accordance with the manufacturer’s recommendations and above freezing temperatures. There shall be no purposefully added calcium chloride in any admixtures.

930.04.05 Concrete Mixtures

Concrete mixtures shall conform to the requirements of CSA A23.1. Additional guidance for determining mixture proportions is provided in ACI PRC-211.1. The Concrete Supplier will be responsible for the mix design, accompanied by the trial batch mix data and quality control of concrete production. Concrete aggregate gradation analysis must also be completed on the material used for the trial mix and be included in the mix design report.

All concrete mixture design proportioning including the mix quality control operations shall be performed by a Laboratory CCIL Certified in accordance with CSA A283. All testing shall be completed by CCIL certified technicians in accordance with CSA-A23.1 and A23.2. The proposed mixture design shall be signed and stamped by the Engineer of Record who has a minimum of 5 years experience in the development of concrete mixture designs. Curriculum Vitae (CV) to be provided. The Engineer of Record shall attest to the validity of the material test data.

Concrete strengths shall be in accordance with Table 1.0, unless otherwise specified in the contract documents.

TABLE 1.0

Element[1]	Prestressed Girders/ High Performance Concrete[4]	All Bridge Components[4] and Traffic Light Foundations	Roadway[5] & Weir Baffles	Tremie Concrete[6,7,8]	Levelling & Infill Concrete
Exposure Class	C-XL	C-1	C-2	C-3[9]	F-1
Compressive Strength Within 28 or 56 Days[2]	50 MPa	40 MPa	35 MPa	30 MPa	30 MPa
Maximum Water/ Cementitious Material Ratio	In accordance with Table 2.0 of CSA A23.1				
Slump [3]	In accordance with the approved mix design and the requirements of CSA A23.1 clause 4.3.2.3.2				
Air Content, %	In accordance with the requirements of CSA A23.1 Table 4.0.				
Rapid Chloride Permeability (ASTM C1202)	<1000 Coulombs	<1500 Coulombs	N/A	N/A	N/A
Air Void Spacing Factor (ASTM C457) (average)	230 µm MAX	230 µm MAX	230 µm MAX	N/A	230 µm MAX

NOTES:
1. Cement shall be in accordance with Section 930.04.01.

2. For concrete utilizing blended Portland Cement GUb, compressive strength is tested for compliance at 56 days.
3. If High Range Water Reducer (HRWR) are used, the maximum concrete slump in a superplasticized condition shall be limited to 230 mm. The mix design shall state the design slump before and after the addition of superplasticizers along with the appropriate tolerances.
4. *Deleted Note*.
5. Roadway concrete is concrete used for sidewalk, curbs and median barriers that are not a part of a bridge structure. Where slip form concrete is utilized or required as per contract documents, then a slip form specific concrete mix design must be prepared and submitted in accordance with 930.04.05.01.
6. Air entrainment is required if the concrete will be exposed to freeze thaw conditions.
7. Tremie concrete requires the use of an anti-washout admixture.
8. The maximum water-to-cementitious materials ratio of Tremie Concrete is 0.45.
9. For seawater exposures the requirement for S-3 concrete exposure class shall also be met.

The verification of the mixture design through trial batching must meet the specified requirements in Table 1.0. Each mixture design shall have a unique mixture design code, it must be indicated on the mix design, as provided by the Concrete Supplier. This unique mixture design code must be present on the delivery ticket for all concrete placed on Department projects. In the event that an additional admixture is required (set retarder, anti-wash out, etc.) a different mixture design code is required.

High range water reducing agents (superplasticizers) may only be used if included in the original mix design submission.

Set retarding admixtures may be used as ambient and site conditions warrant. The dosage rate shall be supplied by the mix design Engineer of Record in a signed and stamped letter provided in advance of concrete placement. The letter should indicate the dosage rate and associated delay in the initial set time.

This specification incorporates material and constructability requirements that will enhance durability and serviceability with the goal to achieve sustainable concrete structures. Enhancing sustainability of concrete as a construction material requires consideration for the sourcing of raw materials, production, delivery, placing, finishing, curing, testing, acceptance, performance in service and recycling at the end of life. The Owner supports innovation in new construction and maintenance of existing infrastructure. CSA A23.1, Annex M provides information on innovative alternatives for

materials, construction methods, testing, performance specifications and decommissioning. Contractors considering to implement any of the ideas presented in Annex M or other innovative alternatives shall make a formal request to the Owner's Representative for review and approval.

930.04.05.01 Mixture Design Submittal

The Owner's Representative will not accept or pay for any concrete mixture produced and placed without written acknowledgement from the Materials Engineering Division (MED).

For a concrete mixture with a tendered quantity of more than 50 cubic metres, the mixture designs and trial test results are only considered valid for up to two years from the date of the final compressive strength results. For a concrete mix with a tendered quantity of 50 cubic metres or less the test results are considered valid for up to five years from the date of the final compressive strength results.

The Concrete Supplier must inform the Owner's Representative of any of the following:

- A change in the source of cement.
- A change in admixtures.
- A change in the source of the aggregates.
- A change in SCM proportions.

Implementation of any of the aforementioned changes will result in the requirement for the development of a new concrete mix design. Failure on the Concrete Supplier's behalf to inform the Owner's Representative of any of these changes will result in the complete rejection of all concrete, with no payment made.

930.04.05.01.01 Yearly Supplier Submittal

Suppliers may elect to submit their mixture designs yearly to MED for approval. Submission(s) are required between January 1st and March 31st.

The following information, based on actual trial mixes, is required:

- Name of the Certifying laboratory and applicable CCIL certifications.
- Identify the Engineer of Record, including their Curriculum Vitae (CV).
- Unique mixture design code. This must be indicated on the mix design.
- Concrete trial batch report containing all fresh and hardened properties test results.

- CCIL certificate of testing personnel.
- Mix slump and air content range and results, before and after addition of HRWR.
- All admixtures with dosage rates.
- Slump and air content loss over time.
- Aggregate test report as per requirements of 930.04.02.
- Source of water supply, including a declaration of potability or documentation demonstrating compliance as per Section 930.04.03.
- Estimate of the initial time of set.
- Verification that the concrete mix design yields 1 m^3.
- Type of Cement and test data showing conformance with CSA A3000.
- Documentations verifying the certified calibration of all plant scales used in the production of concrete within the last six (6) months
- Proof of current Atlantic Concrete Association (ACA) membership certificate for ready-mix concrete.
- Proof of CSA certification for the product category of precast concrete, where applicable.

Written acknowledgement will be provided by MED once all requirements are met. Concrete mixture designs shall be valid from the date of the 28 day or 56 day break results, whichever compressive strength acceptance is based upon. Suppliers will then be added to the list of prequalified concrete mixtures. **Resubmission is required for all mix designs, including those previously approved on a yearly basis**.

Any Contractor requesting to use a prequalified mixture must submit the following information at least one week (7 days) in advance of concrete placement:

- Project number and title description.
- Contractor company name with contact information.
- Ready mix or Precast Concrete Supplier.
- Unique mixture design code, intended use, approximate quantity and method of placement.

This information shall be provided on company letterhead and signed by a representative of the Contractor. Prequalification does not alleviate the Contractor of liability for the product supplied.

930.04.05.01.02 Project Specific Contractor Submittal

For concrete mix designs not on the prequalified list, the Contractor shall provide, with

the proposed mixture design, the information detailed in Section 930.04.05.01.01 Mixture Design Submittal, at least two weeks (14 days) in advance of the concrete placement.

930.04.06 Pre-Packaged Proprietary Products

In the event a pre-packaged proprietary product is selected for use as a repair material, the product shall be reviewed for the intended purpose and accepted by the Chief Bridge Engineer and MED in advance of placement.

Where possible materials should be selected that have similar material characteristics to the parent concrete and meet the minimum strength requirements as defined in Table 1.0.

Acceptance for the use of a pre-packed propriety product shall not relieve the Contractor of any performance or warranty responsibilities for the performance of the product. The Department is not obligated to accept any or all proposed products. In the opinion of the Department, demonstrated unsatisfactory performance of a product could result in product rejection.

930.04.06.01 Pre-Packaged Proprietary Products Submittals

Pre-packaged proprietary products must be submitted for use 14 days in advance of placement. The submission shall include:

- Project number and title description.
- Contractor company name with contact information.
- Product name and associated technical data sheet and material safety data sheet.
- Intended use and application type (vertical, horizontal, overhead, etc.).
- Approximate quantity, method of mixing and placement.
- Placing conditions including temperatures.
- Any variations from standard curing practices.
- Aggregate test report as per Section 930.04.02, if additional aggregate is added.
- Source of mixing water and requirements of Section 930.04.03.

930.04.07 Controlled Low Strength Material (CLSM)

Controlled Low Strength Material (CLSM) shall consist of a mixture of cement, fine aggregate, water and admixtures (as required).

Cement must be GU or GUL in conformance with 930.04.01. Aggregate, water and admixtures must meet the requirements of 930.04.02 to 930.04.04. CLSM shall have a compressive strength of 1-5 MPa at 28 days.

A theoretical mix design, completed within five (5) years from project submission, and aggregate report must be submitted 14 days in advance of placement for review by MED. The proposed mixture design shall be signed and stamped by the Engineer of Record who has a minimum of 5 years experience in the development of concrete mixture designs. Curriculum Vitae (CV) to be provided. The Engineer of Record shall attest to the validity of the material test data. The Owner's Representative will not accept or pay for any CLSM produced and placed without written acknowledgement from MED.

Only CLSM supplied from a certified concrete plant will be acceptable for use. Material that does not meet the approved mix design or strength shall be removed and replaced at the Contractor's expense.

930.04.08 Reinforcement

Reinforcement shall be in accordance with Section 905.

930.04.09 Form work and Falsework

Form work and falsework shall be in accordance with Section 907.

930.04.10 Burlap

Burlap shall conform to AASHTO M182 Class 4 and shall be free from substances that are deleterious to concrete. The burlap shall have no tears or holes.

930.04.11 Liquid Membrane-Forming Curing Compounds

Liquid membrane-forming curing compounds shall meet the requirements of ASTM C309.

A minimum of seven (7) days prior to the application of the curing compound, the following shall be submitted to the Owner's Representative, for information purposes:

- Literature stating the manufacturers recommended rate of application.
- Description of the equipment to be used.
- A statement from the manufacturer of the curing compound approving the equipment.

930.04.12 Concrete Curing Sheet Materials

Sheet materials that conform to ASTM C171, may be used as a cover to inhibit moisture loss during the concrete curing period.

930.04.13 Concrete Surface Retarders

A minimum of seven (7) days prior to the application of the surface retarder, the following shall be submitted to the Owner's Representative, for information purposes:

- Literature stating the manufacturers recommended rate of application.
- Description of the equipment to be used.

All surface retarders shall be stored and applied as per the manufactures instructions.

930.04.14 Joint Sealant

Joint sealant shall meet the requirements of ASTM C920 and must be Grade NS, minimum Class 50, use Type T and must pass the accelerated weathering test as per ASTM C793.

Joint sealant products shall be one of the following or an approved equal:

- DOWSIL 888 Silicone Joint Sealant
- TREMCO Dymeric 240

All work shall be in strict accordance with the manufacturer's recommendations.

930.04.15 Miscellaneous Materials

The supply and installation of miscellaneous materials shown on the drawings or mentioned in the Supplementary General Conditions but which have not been listed on the Unit Price Table, are considered incidental to the work and no separate payment will be made.

This shall include, but not necessarily limited to, all miscellaneous concrete accessories, evaporation retardant, abutment weep holes, drip grooves and guide rail modified end shoes.

930.05 EQUIPMENT

The Contractor shall supply the Owner's Representative, before commencement of the project, with adequate details of all equipment to be used. Equipment shall include but

not be limited to consolidation equipment such as internal or external vibrators, finishing tools, screed rails, finishing machines, spray equipment, compressor, etc. The intention is not to limit the Contractor's operation but to ensure adequate planning is undertaken.

The Contractor and Concrete Supplier shall maintain all equipment used for handling, mixing, transporting, depositing, compacting, curing and finishing the concrete in a clean condition and in proper working order.

Batch plant and mixing equipment shall be as defined in 930.06

930.06 CONCRETE PRODUCTION

930.06.01 Batch Plant Requirements

The batching of concrete, unless otherwise authorized by the Owner's Representative, shall be done in a batch plant that is certified in accordance with the requirements for certification as per the Atlantic Concrete Association (ACA) or equivalent. Precast concrete manufacturers shall be certified in accordance with the CSA A23.4.

All materials shall be stored in a manner that will prevent contamination, segregation, deterioration and intermingling. Cementing materials must be stored in suitable bins that will provide protection against dampness. Aggregates shall be separated into fine and coarse sizes as determined by the concrete mix design.

The equipment for batching shall have the capacity to produce at such a rate as to preclude cold joints in the concrete placement. In any event, equipment is subject to the approval of the Owner's Representative.

930.06.02 Measurement of Materials during Batching

All materials used in the production of concrete shall be measured by weighing. Materials shall be added to produce concrete conforming to the approved mix design prepared as per 930.04.05.

Scales and other mass-measuring devices must be accurate and meet the requirements of Table 23.0 of CSA A23.1. The Concrete Supplier shall provide standard certified test weights and/or devices for checking the accuracy of the controls. Checks shall be made as requested by the Owners Representative. Recalibration shall be performed if the batching plant is moved or any major alterations performed. The Concrete Supplier shall carry out all tests in the presence of the Owner's Representative and shall supply them with results of all tests and make any and all alterations, repairs or replacements required

to the equipment before authorization will be given to place concrete.

The volume of concrete discharged by the Concrete Supplier's equipment shall be expressed in cubic metres. All batch weights shall be recorded and made available for audit by the Owner's Representative upon request.

Cement in standard bags need not be weighed.

930.06.03 Mixing Concrete

The mixing of concrete, unless otherwise authorized by the Owner's Representative, shall be done in either a central mixer or truck mixer. The mixer shall carry the manufacturer's rating plate in a prominent position, indicating:

- The gross volume of the mixer.
- The rated maximum mixing capacity.
- The minimum and maximum mixing and agitating speeds.

The mixer must be capable of combining the ingredients of the concrete within a time or number of revolutions recommended by the manufacturer of the mixer to produce a thoroughly mixed and uniform mass.

The Owner Representative reserves the right to subject any truck used to transport concrete suspected of poor mixing to uniformity testing as outlined in CSA A23.1 Clause 5.2.4.5. If the truck in question fails the uniformity test, then the concrete and the truck shall be rejected. The truck shall not be permitted on Department sites until appropriate repairs have been completed and certified.

Concrete transported in a truck mixer, agitator, or other transportation device shall be discharged at the job and placed in its final position in the forms within 120 minutes from the time of initial mixing, except in hot weather or under other conditions contributing to quick stiffening of the concrete. Discharge shall also be extended if set retarding admixtures are used.

Any concrete truck on site that does not comply with the above shall have the entire load of concrete rejected, with no payment, and no concrete shall be placed from that truck.

930.06.04 Concrete Temperatures for Delivery

The temperature of the concrete to be placed must be within the temperature limits of Table 2.0.

TABLE 2.0

LEAST DIMENSION OF SECTION	CONCRETE TEMPERATURE[1]	
	MINIMUM ^{O}C	MAXIMUM ^{O}C
LESS THAN 0.3 M	10	32
0.3 M TO 1 M	10	30
1 TO 2 M	5	25
MORE THAN 2 M	5	20

NOTES:
1. The temperature of HPC shall not exceed 25ºC.

Where possible, concrete placement temperatures shall be kept as close as possible to the minimum temperatures shown in Table 2.0.

In cold weather, temperatures can be obtained by heating the water or the aggregate or both; water and aggregate shall then be combined in the mixer first and the temperature of the mixture shall not exceed 38 degrees Celsius when the cement is added.

At temperatures below freezing, aggregates are required to be heated prior to incorporation into the mixture. The aggregates shall be uniformly heated in the stockpiles and/or bins by steam, either injected live or circulated in coils, or by using dry heat before the aggregates are placed in the mixer. Whatever system is used, it shall be designed to give uniform heating that will avoid local overheating which may be injurious to the materials. No frozen lump of aggregate will be allowed in the concrete mix and shall be discarded before batching.

The use of salt, calcium chloride or other chemicals to lower the freezing point or accelerate the set is prohibited.

In hot weather, the aggregates and water shall be kept as cool as practicable. Aggregate stockpiles should be shaded from the sun and kept moist by sprinkling. Sprinkling should be adjusted to avoid producing excessive variations in the aggregate surface moisture content. Aggregates can also be cooled by circulated air, immersion in cold water and vacuum cooling.

Mixing water should be obtained from a cool source and stored so it is not exposed to direct sunlight. Ice can be used as part of the mixing water but must be completely melted by the time mixing is completed. The volume of ice used shall not replace more than 75%

of the total batch water and the combined amount of water and ice shall not exceed the total mixing water requirements. The ice source shall meet the requirements of Section 930.04.03 Water.

930.06.05 Pre-Packaged Proprietary Products

Small quantities of pre-packed proprietary concrete mixtures may be mixed on site, as authorized by the Owner's Representative, and must follow all preparation, mixing and placing requirements set forth by the manufacturer of the proprietary product.

Water used for the production of pre-packaged proprietary products must be in accordance with 930.04.03.

The Department will not perform QA testing on any Pre-Package Proprietary Product that does not comply with this specification nor the manufacturer's preparation, mixing and placing requirements. Any product produced and placed by the Contractor that does not comply with this specification or the manufacturer's preparation, mixing and placing requirements will be rejected and no payment will be made. Any material placed by the Contractor that was rejected by the Owner's Representative must be removed at the Contractor's expense.

930.07 SAMPLING AND TESTING

The Contractor and Concrete Supplier shall co-operate fully with the Owner's Representative in enabling quality assurance tests to be carried out. Samples for quality testing purposes will normally be taken from concrete as delivered to the site (at the point of discharge from the delivery equipment). However, depending on the method of placement, random sampling of the concrete as incorporated into the structure shall also be performed to verify the above specified properties. This process shall entail the sampling of fresh concrete as close to the point of deposit in the structure as is practicable. Coring of the in-place hardened concrete may also be performed. The Department reserves the right to designate the point of acceptance, with prior notice given to the Contractor.

Field quality assurance testing will be carried out by an Owner's Representative for acceptance purposes. If the material appears defective or it was determined there was a change in the process or product, the Department may take additional samples. The Contractor shall provide and maintain a suitable location for the storage and proper curing of compressive test specimens in accordance with CSA A23.2-3C.

Quality assurance tests carried out by the Department shall conform to the following

guidelines:

COMPRESSIVE STRENGTH ≥ 40 MPa

FRESH PROPERTIES TESTS	Each load until 5 consecutive batches meet the requirements then test every second load thereafter.
COMPRESSIVE STRENGTH SPECIMENS	At least 1 set of Laboratory cylinders per 50 cubic metres, minimum 1 set per day plus 1 set of field cures per category of concrete, if required by the Owner's Representative.

COMPRESSIVE STRENGTH < 40 MPa

FRESH PROPERTIES TESTS	Each load until 5 consecutive batches meet the requirements then test every third load thereafter.
COMPRESSIVE STRENGTH SPECIMENS	At least 1 set Laboratory cylinders per 50 cubic metres, minimum 1 set per day plus 1 set of field cures per category of concrete if required by the Owner's Representative.

A set of laboratory cylinders will consist of 3 specimens (one 7 day and two 28 day) for mixtures utilizing GU and GUL cement. A set of laboratory cylinders will consist of 5 specimens (one 7 day, two 28 day and two 56 day) for mixtures utilizing GUb cement.

If either the measured slump, air content or temperature fall outside the limits specified, a repeat test shall be made. Any adjustments made onsite shall be in accordance with 930.07.02. Failure to meet the contract requirements shall result in rejection of the concrete, at the Owner's Representatives discretion. Acceptance of the concrete will depend on the results and consistency of all the above testing results being satisfactory.

The Owners Representative will not accept or pay for any concrete placed prior to satisfactory fresh properties testing results from the Department.

The Department will perform QA verification to determine appropriate unit price adjustments and material acceptance/rejection. The Contractor may perform their own QC testing, however third party results will not replace Department QA. QC testing is solely for the Contractor's information.

930.07.01 Additional Strength Tests

Additional strength tests will be required when early indications of strength are required such as before transport, removal of falsework, backfilling structure, etc. These additional

test specimens must be cured in conditions that simulate as closely as possible the conditions under which the concrete is cured.

For precast concrete, the strength of elements at the time of transfer of prestress and stripping shall be determined by test cylinders cured under temperature and moisture conditions that simulate as closely as possible the conditions under which the concrete in the precast forms is cured.

930.07.02 Onsite Concrete Adjustments

Water shall not be added after batching for any reason.

The slump adjustment of superplasticized concrete shall be permitted but with admixture only. The amount of admixture to be added shall be supplied by the Concrete Supplier and the measured quantity shall be recorded on the delivery ticket. Remixing of concrete onsite after the addition of superplasticizer must be completed at mixing speed for at least 30 revolutions (or equivalent time limit).

The air content adjustment of air entrained concrete shall be permitted by the addition of admixture only. The amount of admixture to be added shall be supplied by the Concrete Supplier and the measured quantity shall be recorded on the delivery ticket. Remixing of concrete onsite after the addition of air entraining admixture shall ensure proper dispersion. Concrete that is adjusted onsite for air content shall be retested when 90 minutes from batching has elapsed for compliance.

930.07.03 Testing of Out of Province Precast Products

In the event, precast concrete is completed out of province and the Department cannot complete quality assurance testing, the manufacturer shall submit a project specific Quality Control Plan to the Department at least four (4) weeks prior to commencement of manufacturing.

As a minimum, the Quality Control plan shall include:

- Concrete mixture design in accordance with 930.04.05 including all fresh and hardened concrete test results (slump, temperature, total air content, mass density, compressive strength, air void parameters, chloride ion penetrability) as well as aggregate properties and cement.
- Mill certificate information from prestressing wire and reinforcing steel.
- Shop drawings for each element showing dimensions, tolerances for the completed element, concrete cover, and pretensioning stress.
- Detensioning procedures.

- Precast concrete sampling frequency of fresh and hardened concrete tests.
- Most recent fresh and hardened concrete test results (slump, temperature, total air content, mass density, compressive strength, air void parameters, chloride ion penetrability) from the proposed mix design last used for precast operations.
- Concrete Placement Plant as per Section 931.04.01.
- Curing procedures and Thermal Control Plan as per Section 931.04.01.02.
- Finishing and repair procedures.
- Storage procedures.
- Delivery procedures where the manufacturer is responsible for delivery.
- Certificate of accuracy for all scales or measuring devices used during the production of concrete, including batch scales, verified by a qualified technician employed by an authorized Scale Manufacturer or Company.
- List of Type SF CCIL Certified technicians as well as proof of certification.
- Proof of Laboratory CCIL Certification.
- Production schedule.

During production, the manufacturer shall provide the Department with weekly or monthly summary reports, depending on the production schedule. Summary reports shall include records of daily checks (temperature, etc.) and all testing conducted per individual element. This shall include the date of manufacturer and be signed off by the manufacturer.

930.07.04 Testing of Pre-packaged Products

The testing of prepackaged products shall be as determined by the Owners Representative and in accordance with the product data sheet provided by the manufacturer.

SECTION 931

CONCRETE – CONSTRUCTION

INDEX

931.01 SCOPE

This specification covers the Department's requirements for all concrete placement, finishing, curing and repairs. All work and equipment shall be in strict accordance with CSA A23.1 and CSA A23.2.

931.02 REFERENCES

Reference standards shall be the latest revision at the date of Tender closing. This specification refers to the following standards, specifications or publication:

- ACI 306 “Guide to Cold Weather Concreting”
- ACI 305 “Guide to Hot Weather Concreting”
- CSA A23.1 “Concrete materials and methods of concrete construction”
- CSA A23.2 “Test methods and standard practices for concrete”
- CSA A23.3 “Design of concrete structures”
- CSA A23.4 “Precast concrete – Materials and Production”
- CSA S6 “Canadian Highway Bridge Design Code”
- Portland Cement Association "Design and Control of Concrete Mixtures”
- International Concrete Repair Institute Technical Guideline 310.2R

931.03 DEFINITIONS

Cold Joint: An unplanned weakened plane or joint caused from premature set, excessive drying or improper consolidation between successive concrete lifts during a concrete placement.

Cold Weather Concreting: When the air temperature is at or below 5°C or when, according to meteorological forecasts, it is likely to fall below this limit within the next 24 hours, then the Contractor shall take special precautions to protect the concrete placed. This is defined as “Cold Weather Concreting”.

Construction Joint: A planned separation between two bridge elements and/or a deliberate divide within a single concrete element to promote ease of construction or for thermal control reasons. These joints can be horizontal, vertical or on a prescribed angle.

Control or Contraction Joint: A contraction joint is a sawed, formed, or tooled groove in a concrete element that creates a weakened plane to help control where a crack forms.

Engineer of Record: The Professional Engineer who completed and sealed the design of the specific component or system.

High Performance Concrete (HPC): Concrete that meets performance requirements (increase strength and durability) that cannot always be achieved routinely by using conventional materials and normal placing and curing practices.

Hot Weather Concreting: When the air temperature is at or above 27°C or when, according to meteorological forecasts, is expected to rise above this limit then special measures shall be taken by the Contractor to protect the concrete. Surface moisture evaporation must not exceed 0.50kg/m^2/hr

Infill Concrete: A body of concrete used to fill in an excavated area or void space with dimensions large enough (thickness > 1m) for which consideration is given to temperature rise caused by the hydration of cement in order to keep cracking to a minimum.

Owner's Representative: An applicable Government employee responsible for the project or any Third Party who has been authorized by the Department to conduct work on the Department's behalf.

Professional Engineer: An individual who is registered and in good standing with PEGNL.

Tremie Concrete: Concrete deposited underwater through a pipe or tube fitted with a hopper at its upper end.

931.04 CONCRETE OPERATIONS

931.04.01 Planning & Submittals

931.04.01.01 Concrete Placement Plan

At least four (4) weeks prior to the scheduled start date of any major concrete placement, the Contractor shall submit a concrete placement plan to the Owner's Representative. The Contractor shall allow two (2) weeks for the Department's review and five (5) business days for any subsequent review of the plan. Components requiring a Concrete Placement Plan are:

- All HPC
- Footings
- Abutments & Wingwalls
- Girders
- Retaining Walls
- Bridge decks
- Structural Precast

The Concrete Placement Plan shall include but is not limited too:

- Unique mixture design code of approved concrete mixture design.
- Concrete supply and delivery schedule, including number of dedicated trucks for mixing and delivery.
- Plan to deal with adverse weather conditions during placement and curing.
- Personnel identification including roles and responsibilities.
- Proof of Journeypersons Concrete Finisher status, where appliable for finishing large slabs. In lieu of Proof of a Journeyperson Concrete Finisher status, the

Department will accept a Concrete Finisher with a minimum of 5 years experience on previous Transportation & Infrastructure projects. A proof of proficiency listing all qualifications and previous projects must be submitted and signed by their employer attesting to the validity of the information provided.

- List of available tools and equipment on site, including backups.
- Pump truck manufacturer's specifications detailing pumping capacity and pressure at the required elevations.
- Plainview layout of pump truck setup (if being used and if multiple setups are required) to show reach limits within the pour.
- Concrete placing backup plan. This shall include but not be limited to what will happen in cases of pump truck breakdown, safety incident, unexpected stoppage that will permanently stop the pour, etc.
- Thermal Control Plan (if required). See 931.04.01.02.
- The use of retarders in various concrete trucks to maintain a “live” edge (if required).
- Plan for placement depths greater than 1500 mm.
- Plan to consolidate difficult areas (under embedment plates/around box girders etc).
- Plan to provide safe and necessary access to adequately consolidate all areas of the concrete placement.
- Plan for access once concrete consolidation has occurred. Rebar and other embedded items shall not be disturbed by walking, finishing machines or other means.
- Plan to prevent concrete surface drying/shrinkage cracking during the pour.
- Plan to finish the concrete as required by the drawings and specifications.
- Plan to prepare the concrete joint post concrete placement i.e. green cutting or sandblasting.
- Temperature Control Plan post-concrete placement (if required).
- Plan to cure the concrete surface.

A pre-pour concrete meeting shall be held prior to any major concrete placement to discuss all aspects of the concrete pour plan. This meeting is to be called by the Owner’s Representative; the Contractor and all others deemed necessary shall be in attendance. The Contractor shall conduct a trial run, 48 hours prior to placing concrete, to verify their equipment, methods and workmanship to meet the specifications. The Owners Representative shall be advised 48 hours in advance of the trial run.

The Contractor shall provide at least 48 hours notice (not including Saturday, Sundays, or holidays) of their intention to place concrete. Failure to notify DTI will result in rejection

of any concrete produced and placed and no payment shall be made. Third party testing results will not be accepted in place of Department QA. Before concrete is placed, forms, reinforcement, foundations, granular bases, placing procedures and materials must comply with the project specifications and CSA A23.1.

931.04.01.02 Thermal Control Plan

At least four (4) weeks prior to the scheduled start date of any major concrete placement, the Contractor shall submit a Thermal Control Plan to the Owner's Representative. The Contractor shall allow two (2) weeks for the Department's review and five (5) business days for any subsequent review of the plan. Components requiring a Thermal Control Plan are:

- All concrete that may be negatively impacted by undesirable thermal stresses
- HPC
- Girders
- Footings, Abutments & Bridge Decks
- Retaining Walls & Wingwalls
- Infill Concrete

Adequate protection of concrete shall be provided that will maintain the concrete temperature at a minimum of 10°C, a maximum of 70°C and respect the concrete temperature differentials in Table 1.0 for the duration of the required curing period. CSA A23.1 provides further guidance on developing a thermal control plan for various concrete placements.

The Temperature Control Plan shall include the following but is not limited too:

- Concrete element for which the plan applies.
- Any modification to the mixing process for temperature control purposes.
- Type of cold weather protection to be provided as per 931.08.02 (if applicable).
- Temperature Monitoring System:
    - Temperatures shall be monitored using thermocouples at:
        i. Centre of mass of each placement.
        ii. Top of the concrete element, located 50 mm from the surface.
        iii. Mid-point of an exterior corner, located 50 mm from the surface.
        iv. Ambient air temperature to provide a representative sample of the area and to the satisfaction of the Owner's Representative.
    - Temperature Data Logger(s) shall have the following minimum requirements:

i. Record the temperature, time and date at the specified locations above.
ii. High quality wires and thermocouples, recommended by the manufacturer of the data logger, and rated for the anticipated temperature range. Calibration records prior to installation shall be provided to the Owners Representative.
iii. Have at least four (4) recording channels or provide sufficient recorders to capture the required data.
iv. Provide a data point on each channel every 15 minutes or approved equal.
v. All temperatures must be accurate within ±1°C.
vi. Real time digital displays of the temperatures on each channel with at least 3 significant figures i.e. 13.2°C.
vii. Capabilities to provide temperature vs time graphs of each channel once downloaded to a computer and as per 931.04.01.02.01.

- Type of insulation and/or tarpaulins R value, and number of layers, if utilized.
- Type and layout of heaters, if utilized, by the Contractor.
- A plan to ensure concrete temperature differentials are maintained for the duration of the protection period as per Table 1.0 below. Differentials shall include but not be limited to the comparison of temperatures at various locations in a concrete element, such as, center and the surface, surface and the ambient, etc. It shall also include the Contractor's plan to complete corrective actions as identified by the Owner's Representative (if required).

TABLE 1.0

	Maximum permissible temperature differential, surface to ambient – wind up to 25 km/h °C‡				
	Length-to-height ratio of structural elements*				
Thickness of concrete (m)	**0†**	**3**	**5**	**7**	**20 or more**
< 0.3	29	22	19	17	12
0.6	22	18	16	15	12
0.9	18	16	15	14	12
1.2	17	15	14	13	12
> 1.5	16	14	13	13	12

**Length shall be the longer restrained dimension and the height shall be considered the unrestrained dimension.*
†*Very high, narrow structural elements such as columns.*

‡ *For high performance concrete, the maximum temperature differential for all structural components shall be 20°C*.
Note: *See* also Figure D.2.of CSA A23.1

- How the temperature of the concrete shall be gradually reduced, respecting the permissible temperature differentials as specified in Tables 3.0 and 4.0.
- Protection shall be gradually removed or reduced in such a manner that the maximum allowable drop of concrete temperature, as shown in Table 2.0 below, for each 24-hour period is not exceeded. The protection shall not be totally removed, nor shall the concrete be fully exposed to the air until the average concrete temperature is within 10°C of the ambient air temperature.

TABLE 2.0

Thickness	> 2.0 m	1 – 1.99 m	< 1.0 m
Maximum Allowable Drop in Concrete Temperature per 24 hours	10 °C	15 °C	20 °C

- Other applicable information as required by the Owner's Representative.

931.04.01.02.01 Contractor Temperature Monitoring

The Contractor shall continuously monitor the data loggers until there is no risk of the concrete exceeding the allowable temperature differentials. The Contractor shall take necessary action to maintain the temperature within the specified limits and remediate items identified by internal checks or the Owner's Representative immediately upon discovery.

The Contractor shall prepare a basic daily checklist, at a minimum it shall include the following information:

- Name of element curing, date poured, current date.
- Times of the daily checks and temperatures at the time.
- Comments on if temperatures were within requirements.

At the end of the temperature monitoring period the Contractor shall compile the following information for submission to the Owner's Representative:

- Project title, location, name of element curing, date poured, date temperature monitoring ended.

- Location of monitoring points within the placement on a project drawing.
- All daily temperatures including calculations of temperature differentials in accordance with Table 1.0 and 2.0.
- Temperature vs. Time Graphs of
    i. All internal temperature recorded channels graphed individually with the ambient channel and the applicable differential as per Table 1.0.
- Raw data from the data loggers.

Digital displays must be available for visual verification by the Owner's Representative. The Owner's Representative shall be provided access to verify temperature readings at all times.

931.04.01.03 Inspection Checklists

The Contractor shall complete project specific checklists at project startup depending on the specific scope of work and submit the checklists to the Owner's Representative within two (2) weeks of project startup for review. All checklists shall be completed to the satisfaction of the Owner's Representative. The Owner's Representative shall be provided with five (5) business days for subsequent reviews required by resubmittals.

The Contractor shall ensure all inspection checklists are completed and submitted to the Owner's Representative for acceptance no later than 48 hours prior to concrete placement or as agreed with the Owner's Representative. If the work applicable to the checklist is not complete, is modified in anyway, has risk for rework or movement due to other activities, the Owner's Representative has the right to reject the work.

The Owner's Representative shall be provided access to verify the items within all checklists at all times.

Specific checklists and contents shall include but not be limited to the information provided in Section 932.

931.04.02 Concrete Placement

All work and tolerances shall confirm to CSA A23.1.

931.04.02.01 General

Concrete delivered to site must conform to the temperature requirements within 930.06.04.

The pumping of concrete from the delivery vehicle to its place of final deposition will be permitted as authorized by the Owner's Representative in accordance with Section 931.04.01.01. Aluminum pipelines shall not be used.

The use of long troughs, chutes and pipes for conveying from the mixer to the forms shall be permitted only on written authority of the Owner's Representative. In case an inferior quality of concrete is produced by the use of such conveyers, the Owner's Representative may order discontinuance.

Pump priming admixtures used to prime concrete pump truck lines shall not be deposited within the formwork.

Concrete shall be placed to avoid segregation, have no adverse effects on concrete properties or displace the reinforcement. Concrete should be placed at the lowest point first. Concrete shall be deposited within 1.5 m of its final position. Concrete shall not be placed with a free fall greater than 1500 mm. When the planned concrete placement is greater than 1500mm in depth, the Contractor shall provide temporary spacing(s) between reinforcing bars to lower the placement hose. The Contractor may attach a reduction hose to fit between the bars or use a small hopper attached to a lay-flat rubber hose to reach the bottom of the forms. All temporary openings shall be re-instated as per drawings prior to encasement in concrete.

When concrete is placed in a deep beam, a wall or a column, at the same time as the slab above, the vertical section, if deeper than 1.5 m, shall be poured first and a delay between one and three hours shall be left for the concrete to settle before pouring the slab above. After this delay, the concrete must still be plastic enough to allow a complete homogeneous mix with the slab concrete through re-vibration.

During wet weather, concrete must not be placed unless suitable means, approved by the Owner's Representative, has been provided to prevent washing of freshly deposited concrete or marring of the exposed surface.

In the event of an unanticipated heavy rainfall, all water shall be pushed ahead of the concrete and not vibrated in. The water shall be drained from a hole in the forms or pumped as deemed necessary by the Contractor or the Owners Representative.

If the concrete details are such that a feather edge or thin section might be created by the sequence of placing, a bulkhead shall be introduced to maintain an edge thickness of at least 100 mm.

An adequate supply of concrete must be supplied to ensure it is placed in a continuous manner. Concrete for all elements shall be deposited uniformly in complete layers or lifts at the height and at the speed as required by the formwork design. All subsequent layers shall be stitched together as per 931.04.02.04.

If concrete placement has been temporarily discontinued but the concrete has not reached initial set or is still plastic, the concrete surface shall be prevented from dehydration by misting or fogging. If the placing of concrete is discontinued or the concrete has reached initial set or is no longer plastic, the concrete surface shall be prepared in accordance with 931.04.04.

The Contractor shall notify the Owner's Representative immediately of any interruption resulting in a cold joint.

See 931.09 for specifics surrounding defects and repairs for bridge deck concrete.

931.04.02.02 Levelling and Infill Concrete

Levelling concrete shall be used to level excavated areas underneath footings or other structures where indicated on the contract drawings. It may also be used to fill large voids between structures and underlying materials. Where levelling concrete exceeds 300 mm thickness, the Engineer of Record and Owner's Representative shall be contacted. Levelling concrete shall be placed after all unwatering operations have been made effective in maintaining dry and controlled conditions as authorized by the Owner's Representative.

If the excavated area/void requires a thickness of 1.0 m or greater of concrete it is considered infill concrete and additional requirements must be satisfied as per CSA A23.1. The Contractor must prepare a temperature control plan in accordance with 931.04.01.02 and CSA A23.1 that shall be reviewed and authorized by the Owner's Representative.

931.04.02.03 Tremie Concrete

Concrete shall not be deposited in water except with the authorization of the Owner's Representative and shall be in strict accordance with CSA A23.1 Section 7.5.5, 7.5.6 and 7.5.7.

Concrete shall not be placed in water having a temperature below 5°C.

Prior to any placing of the tremie concrete, vertical shaft reinforcing bars in the tremie area shall be securely held in proper alignment by steel templates. The lower template shall be located a maximum of 1 m above the top of the tremie. The upper template is to be positioned near the top of the cofferdam.

Concrete shall be placed underwater by use of a hopper and tremie pipe(s) or a concrete pump with a discharge line used as the tremie pipe. Still water shall be maintained at the point of discharge and the forms underwater shall be watertight to avoid localized eddies at the joints.

The tremie pipe(s) shall have a minimum diameter of eight times the maximum size of aggregate. Sections of the tremie pipe shall have flanged couplings fitted with rubber gaskets and must be watertight.

The discharge end of the tremie pipe shall be plugged at the start of the work to prevent water from filling the pipe. The tremie pipe shall be slowly filled allowing time for air pockets to escape until the tremie pipe and hopper are full. The flow of concrete shall be induced by slightly raising/jerking the discharge end removing the plug. The discharge end shall always be kept deposited within the concrete at least 300mm.

No concrete shall be allowed to spread greater than 3 m from the discharge end of the tremie pipe. All required tremie pipes shall be installed prior to beginning concrete placement and shall be placed at a maximum of 3 m centres or as authorized by the Owner's Representative. Exact spacing shall depend on the geometry of the cavity, mix design and shall be at the discretion of the Owner's Representative. All tremie pipes shall be exhausted sequentially, in a linear matter, to prevent the trapping of large air voids within the cavity. Regardless of the method, the flow of concrete shall be continuous until the work is completed.

If the tremie operation is interrupted below water level, the surface laitance shall be removed by jetting one day after placing and removed by pumping.

931.04.02.04 Consolidation

Concrete, during and immediately after depositing, shall be consolidated thoroughly and uniformly by hand-tamping tools, mechanical vibration or finishing machines. The structure shall be homogenous, free of cold joints, voids, honeycombing and large surface defects. Concrete must be in full contact with reinforcement, hardware and other embedded items.

Vibration shall be in accordance with the requirements of CSA A23.1. The Contractor shall provide a sufficient number of vibrators to ensure proper consolidation for the rate of concrete placement. Back-up vibrators shall be available on site at all times.

The Contractor shall size vibrators such that the zone of influence does not extend outside the limits of the concrete area. Vibrators shall also be selected to fit between the rebar.

Vibrators shall be inserted vertically and at intervals spaced so the zones of influence overlap. Vibrators must be sized to suit the elements dimensions. Vibrators shall project 150 mm into the preceding layer and then shall be slowly withdrawn to remove entrapped air. Vibration shall not be continued to cause segregation.

The Contractor shall provide safe and necessary access to adequately consolidate all areas of the element for concrete placement. Details of this access shall be outlined in the concrete placement plan. Once initial concrete consolidation has occurred, protruding rebar shall not be disturbed by walking, finishing machines or other means.

If galvanized reinforcement is used, vibrators shall have rubber or non-metallic vibrating heads.

The vibrator shall not come in contact with reinforcing steel or embedded items in the concrete. No vibrating shall occur in the cover zones.

The vibrator shall not be used to move the concrete laterally.

All methods of consolidation shall be subject to approval by the Owner's Representative.

931.04.02.05 Evaporation Retardant

When the concrete placement is complete and immediately after the straight edge requirements have been met for the deck concrete and the broom finish applied, the fresh concrete shall be coated with an evaporation retardant to preclude rapid evaporation of the bleed water. The Contractor must submit the material data sheets of the evaporation retardant intended to be utilized on the project prior to its use. Evaporation retardant to be MasterKure ER 50 manufactured by Master Builders Company Ltd, SikaFilm manufactured by Sika, or an equivalent satisfactory to Owner's Representative.

In some cases the film may need to be reapplied prior to the completion of the finishing operations and before the final curing conditions can be implemented. The supply and application of the evaporation retardant is deemed incidental to the placement of the deck concrete and as such, no separate payment will be made.

931.04.03 Concrete Surface Retarders & Scarification of Construction Joints

Construction joints in concrete shall be positioned at the location shown on the drawings or where otherwise approved by the Owner's Representative.

Where construction joints are planned or occur for reasons beyond the Contractor's control, the concrete interface shall have the surface film of concrete paste (mortar) removed to expose all aggregates by the process of high pressure washing while the concrete surface is sufficiently fresh (Green Cutting).

Surface retarders may be selected by the Contractor for various reasons to complete the green cutting or scarification of the concrete surface. All surface retarders shall be approved by the Owners Representative in accordance with 930.04.13.

The Contractor shall protect adjacent final finish surfaces from retarder overspray by means of plastic sheeting partitions or approved equal.

Areas slated to be sprayed with surface retarder shall be lightly finished to close air pockets and slightly depress the aggregates. Sprayed areas shall be covered in plastic sheeting (where possible) immediately after application until scarification can start. The Contractor shall not apply wet burlap to these areas until surface scarification has been completed. All other concrete surfaces shall be cured as per 931.10 at all times.

The Contractor shall monitor the set progression depth of the retarded mortar versus that of normal setting mortar. Once the retarded mortar reaches the desired depth as defined by the International Concrete Repair Institute (ICRI), and the adjacent normal setting mortar has reached a desirable strength to prevent damage, scarification/green cutting may begin. The Contractor will be required to complete field trial(s) as requested by the Owners Representative.

Final finish surfaces shall be protected during green cut operations (from water damage) by using sumps, pumps and barriers.

The Contractor shall be cautious at the formwork perimeter and other locations where the surface retarder may have penetrated deeper than intended. High pressure washing can cause cavities in these locations. All defects shall be subject to repair method(s) at the Owner's Representative discretion and at the Contractors expense.

All areas of the joint requiring future concrete placement shall be roughened to a Concrete

Surface Profile (CSP) level 7, as defined by the International Concrete Repair Institute (ICRI) including the required cover zone. Care shall be taken not to overcut or undermine the aggregates while trying to achieve the desired profile. If overcut is observed, the aggregated shall be removed and scarified using a method satisfactory to the Owner's Representative.

If the Contractor misses the timeline to green cut the required concrete area or fails to achieve the required profile, including overcutting, the Contractors shall roughen the area at their expense to meet the requirements of this specification.

Locations on precast elements to be in contact with future cast in place concrete shall be green cut or sandblasted to CSP level 7.

The Contractor shall not sandblast any construction joint which may damage galvanized, GFRP, or stainless steel rebar.

All wash water containing cementitious materials and surface retarder shall be disposed of as hazardous waste.

931.04.04 Construction Joints

A construction joint is a planned separation in a concrete placement. Bonding of the new and existing concrete is required.

Joints in concrete members shall be formed in location as shown on the plans.

931.04.05 Contraction Joints

A contraction joint is a control joint to encourage shrinkage cracking at a specific location.

Contraction joints shall extend to a depth equal to one-quarter of the member thickness. As soon as feasible the joint shall be thoroughly flushed out with compressed air and an approved flexible joint sealing compound utilized to fill the joint. The joint sealer compound shall be flexible over the extreme temperature conditions in the local area and must be approved by the Owner's Representative.

931.04.06 Sealing of Joints

Backing rod or sealant shall be applied to all contraction and expansion joint locations as indicated on project drawings.

All joints greater than 10mm in width and 25mm deep shall receive a backing rod.

Joint backing shall be a closed-cell non gaseous backer rod, such as Softrod specified by Tremco (Canada) Limited or an approved equal.

Joint backing rod diameter shall be determined after measuring the joint opening, the rod shall be 25% larger than the joint opening.

Joint sealant shall be in accordance with 930.04.14. The filler or sealant and the substrate material must have a temperature greater than 5℃ at the time of application unless otherwise specified by the manufacturer. Under no circumstances should sealant be applied to any surface which contains moisture, condensation, or frost. Joint surfaces are to be clean, free of dust, dry and free of foreign matter before application of primer and sealant.

Payment shall be considered incidental to the works associated with concrete work pay items.

931.05 SURFACE FINISHING

931.05.01 General

All tolerances and finishing methods shall conform to CSA A23.1.

All concrete surfaces that will be exposed on completion of the work shall be formed finish, with the exception of the bearing seats, deck, approach slabs, expansion joint end dams, curbs, sidewalks and tops of barriers which shall be a floated finish.

All surfaces shall be uniform in colour and texture to the satisfaction of the Owner's Representative and in accordance with Table 3.0.

The Contractor shall take special care during the planning, forming, concrete placing, curing and stripping phases to ensure defect-free surfaces.

TABLE 3.0

Concrete Element	Finish Type	Impression Depth
Concrete Approach Slabs - Exposed	Broom - Coarse	≤ 3-5 mm
Concrete Approach Slabs - To Be Water Proofed	As per Waterproofing Manufacturer[1]	-
Concrete Decks - Exposed	Broom - Coarse	≤ 3 mm

Concrete Decks - To Be Water Proofed	As per Waterproofing Manufacturer[1]	-
Sidewalks	Broom – Coarse	≤ 3 mm
Curbs	Broom – Fine	≤ 1 mm
Expansion Joints – End Dams	Broom – Coarse	≤ 3 mm

NOTES:
1. Contractor shall provide a letter from the waterproofing manufacturer indicating the recommended finish requirement of the element to be waterproofed.

Concrete bridge decks and approach slabs to be waterproofed shall have all protrusions, ridges, trowel marks and sharp edges removed by grinding so there are no areas exceeding 5 mm or depressions exceeding 10 mm.

Brooms shall be sized with the appropriate bristles to complete the finishes specified in Table 3.0. The strikes shall be square across the slab, from edge to edge, with adjacent strokes slightly overlapped and shall be made by drawing the broom without tearing the concrete but so as to produce regular corrugations.

All finished surfaces shall be free from porous spots, irregularities, depressions and small pockets or rough spots.

The Owner’s Representative may decide to delete the broom finish requirements but tolerances in CSA A23.1 will still apply.

931.05.02 Small Slabs

All finishing equipment shall be equipped and operated in accordance with the manufacturer's literature for the particular concrete and work being performed.

For (a) decks less than fifteen metres in length, (b) thin overlay strips wider than two metres finishing shall be achieved with a self-propelled air operated vibrating Allen Screed or approved equal.

For thin overlays less than two metres wide refer to Section 919.13.

Deck repairs by overlay shall also meet the requirements in Section 919.

Screed elevations shall be obtained as detailed in Section 907.

After the deck surface has been floated and any bleed water evaporated, but while the

concrete is still plastic, the Contractor shall finish using a 3 m straight edge swung from handles half the width of the slab.

The straight edge shall be held in successive positions parallel to the road centre line maintaining contact with the surface while finishing from one side of the slab to the other as necessary. Advancement along the deck shall be in successive stages of not more than one-half the length of the straight edge. Any depressions found shall be immediately filled with freshly mixed concrete, stuck off, consolidated and refinished. The straight edge testing and refloating shall continue until the entire surface is found to be free from observable departures from the straight edge and the slab has the required grade and contour, until there are no deviations of more than 8 mm under the 3 m straight edge.

931.05.03 Large Slabs

All finishing equipment shall be equipped and operated in accordance with the manufacturer's instructions for the particular concrete and work being performed

Deck repairs by overlay shall also meet the requirements in Section 919.

For a) new bridge decks and rehabilitated bridge decks where the total deck length is greater than fifteen metres, (b) wharf decks and (c) bridge approach slabs greater than 3 metres in length, finishing shall be achieved with a GOMACO 450 bridge deck finishing machine with a vibrating screed/rotating drum, reversing screw power auger and movable work bridge(s) or approved equal. Here after known as the finishing train.

The screed machine shall be set-up to match the skew of the bridge when the skew angle exceeds 10°.

The Contractor shall supply sufficient quantities of the required guides or rails to support the finishing train such that the deck finishing machine extends slightly beyond the placement area. While the finishing train is travelling the guides or rails it shall completely clear the finished surface, with the exception of the finishing drum or screed.

The rails shall be made of metal and be straight to within 3 mm in a 3 m length. Screed rail chairs/supports shall be adjustable in height, made of metal, and spaced at a maximum of 1.2 m and be placed under all rail joints. Maximum deflection of the screed rails under load shall be 2 mm in a 1.2 m length.

The finishing train shall be independently supported to prevent deflection of the rebar or any other embedded parts. Supports shall not be embedded with the concrete unless approved by the Owner’s Representative. The support system for the finishing train shall

be designed and stamped by a Professional Engineer in the Province of Newfoundland & Labrador.

The finishing train must be accompanied by a working platform with two (2) Red Seal Journeyperson Concrete Finishers assigned to the platform at all times.

The decks haunch shall be adjusted for the actual camber of pre-stressed members, deck concrete self weight as well as any other contributing loads. Screed elevations shall be obtained as detailed in Section 907.

A dry run of the finishing train over the entire deck shall be completed to insure the designed deck thicknesses, concrete cover and profiles will be attained. The Contractor shall provide the Owner's Representative at least 24 hours notice prior to starting the dry run. The dry run shall be completed at least 24 hours prior to commencing the deck concrete placement.

After the completion of screeding operations concrete shall be worked with a bull float or darby to remove any high spots, ridges or to fill voids in the concrete surface. Bull floating or darbying shall follow as close as practically possible behind the screed. If the concrete surface has the required smoothness/texture after screeding than bull floating or darbying may not be necessary.

Water from fog misting operation shall not be worked into the concrete surface or used as a finishing aid.

Screed rails and the supports for the screed rails shall not be removed until the concrete has hardened sufficiently to withstand the weight of workers and equipment used to remove them without marring the surface of the concrete.

931.05.04 Concrete Beam Seats and Bearing Surfaces

Concrete beam seats which will not have a bearing placed directly against them shall be magnesium floated to the levels and slopes as shown on the drawings and to prevent the accumulation of water.

Concrete surfaces which are used as bearing surfaces shall be dead level and finished in accordance with Section 912 and the bearing manufacturer's recommendations.

931.06 CURING

931.06.01 General

All curing work shall follow CSA A23.1. Water used for curing shall be in accordance with 930.04.03. C-XL and C-1 concrete exposure classes shall follow Type 3 curing as per Table 19.0 of CSA and requires a minimum seven day wet cure.

Curing shall begin immediately following the placing and finishing operations and provide the temperature and moisture conditions for the period of time necessary for concrete to develop the required properties, including strength and durability. The Contractor must have all necessary equipment and personal on site ready to commence curing processes prior to the placement of concrete.

Concrete temperature must be maintained at no less than 10°C, a maximum of 70°C and respect the temperature differentials in Table 1.0 throughout the curing period for a minimum of 7 days and for the time required to reach 70% of the specified strength. The concrete shall then be cooled as per the requirements in 931.04.01.02.

Curing of concrete surface shall start as soon as the concrete has hardened sufficiently to prevent damage. The following methods may be used for curing concrete surfaces:

- Ponding or continuous sprinkling of water.
- Applying water and covering with absorptive burlap as per 930.04.10.
- Curing compounds as per 930.04.11. This shall only be used on non-structural elements and for mixes that do not contain silica fume.
- Applying water and covering with polyethylene sheets as per 930.04.12.
- Forms in contact with concrete surfaces with wet curing.

All concrete must be cured by means of burlap and water unless otherwise approved by the Owner’s Representative.

All water used for curing shall be a minimum temperature of 10 ºC and be clean, free of chlorides, oils, dirt, other deleterious materials and any other material which would cause staining or discoloration of the concrete. The temperature of curing water shall be within 20°C of the concrete surface temperature at all times and shall not cause temperature differentials greater than those specified in Table 1.0.

During freezing weather, water curing of concrete shall be terminated 12 hours before the end of the protection period. Surfaces shall be free of surface water before permitted to

freeze.

931.06.02 Curing of Precast Concrete

Curing of Precast Concrete structures shall follow the requirements set forth in CSA A23.4. Temperature monitoring during the curing period shall be in accordance with 931.04.01.02.

Curing of non accelerated concrete shall be as indicated in 931.06.01.

Accelerated curing shall be achieved by as per CSA A23.4 Clause 23.2.3 and be in accordance with Table 4.0:

TABLE 4.0

Minimum holding period (delay) before application of heat and maximum concrete temperature during the holding period	3h at 30ºC or 4h at 40ºC
Maximum heating rate of concrete, ºC/h*	20
Maximum concrete temperature, ºC	70
Maximum cooling rate of concrete, ºC/h†	15

*For structural low and semi-low-density concrete, the heating rate shall be limited to 10ºC/h
†Monitoring shall continue until the concrete temperature is not more than 20ºC above the ambient temperature.

Throughout the entire accelerated curing cycle, concrete surfaces shall be protected from moisture loss ensuring that 95% relative humidity is present in the curing enclosure, by covering the surfaces with properly sealed tarpaulins, plastic sheeting, or a supply of moisture such as water spray or live steam. Proper curing shall be provided and care shall be taken to retain moisture and avoid excessively high or low ambient temperatures. Concrete shall not be exposed to combustion gasses during the accelerated curing cycle.

Protection and curing of accelerated concrete shall continue for the time necessary to achieve 70% of the specified strength. When accelerated curing methods are used, the governing maximum concrete temperatures shall be those achieved within the core of the concrete elements.

Where concrete curing has been accelerated, and detensioning is required, the detensioning shall be performed immediately following the curing period, while the concrete is still warm and moist.

931.06.03 Burlap

Burlap must be in accordance with 930.04.10. All burlap must be pre-soaked by immersing it in water for a period of at least 24 hours immediately prior to placing. Two layers of burlap must be applied to the surface of the concrete. Strips must overlap by 150 mm and must be held in place without marring the surface of the concrete.

Curing with burlap and water must be maintained for a minimum period of seven days. The burlap must be maintained in a continuously wet condition throughout the curing period by means of a soaker hose. The burlap must be covered with a layer of moisture vapour barrier within 12 hours of placing the concrete, in a manner which will prevent deformation of the surface of the concrete.

Air flow in the space between the moisture vapour barrier and the burlap must be prevented. Regardless of ambient temperature, moist curing with burlap and water must be provided at all times. During cold weather, burlap must be prevented from freezing.

931.06.04 Liquid Membrane Curing

Liquid membrane curing compounds meeting the requirements of 930.04.11, shall be used in conjunction with moist curing on vertical surfaces or as accepted by the Owner's Representative. Curing compounds are not permitted on construction joints, surfaces requiring weatherproofing sealants, bridge decks and HPC.

All liquid membrane curing compounds shall be rolled on and not sprayed unless the Contractor can prove a uniform finish satisfactory to the Owner's Representative.

931.06.05 Curing of Bridge Decks and Horizontal Surfaces

A continuous fog mist shall commence immediately behind the screeding operation until the concrete has hardened sufficiently to permit covering with burlap. Misting shall be conducted through the use of a pressure washer capable of sustaining a minimum 14 MPa pressure and equipped with an atomizing type nozzle. Water shall not be allowed to drip, flow or puddle on the fresh concrete surface during fog misting at any time before concrete has reached final set.

Water from fog misting operation shall not be worked into the concrete surface or used as a finishing aid.

The curing time required for deck concrete (including sidewalks and curbs) and bridge deck repairs is Type 3 curing as per CSA and requires a minimum seven day wet cure and a further 30 days for air drying. Also, the specified design strength must be obtained.

Until the above conditions are satisfied, the application of waterproofing and the opening of the bridge to traffic will not be permitted.

931.06.06 Improper Curing

Failure to carry out proper curing procedures, including temperature control and timelines as described within this specification shall result in the following liquidated damages:

- 1st occurrence, $1000 liquidated damages.
- 2nd occurrence, $2000 liquidated damages.
- Each occurrence thereafter, $5000 each occurrence.

An occurrence shall be defined as when an inspection by the Department or Owner's Representative reveals that a concrete surface during the curing period is not visibility wet or does not have measures in place to ensure proper curing temperatures.

If the Contractor fails to reinstate proper curing conditions within 30 minutes of notification, this will be treated as a separate occurrence. If there are two or more occurrences on the same section of concrete, it shall be removed and replaced at the Contractor's expense.

Payment for curing shall be considered incidental to the placement of Concrete.

931.07 HOT WEATHER CONCRETING

When the air temperature is at or above 27°C or when, according to meteorological forecasts, is expected to rise above this limit then special measures shall be taken by the Contractor to protect the concrete. Surface moisture evaporation must not exceed 0.50kg/m^2/hr. The rate of surface moisture evaporation can be estimated from Figure D.1 of CSA A23.1.

Hot weather placing of concrete shall not proceed without the approval of the Owner's Representative.

Concrete placed in the forms shall be maintained at or below 25°C and in accordance with the temperature limits in Table 2.0. The Contractor shall ensure all measures to achieve the temperature requirement are to the satisfaction of the Owner's Representative and in accordance with 931.04.01.02.

The temperature of the formwork, reinforcing steel, and material against which new concrete is to be placed, shall not exceed 30°C.

Exposed surfaces of concrete shall be shaded from the direct rays of the sun and sheltered from direct wind.

931.08 COLD WEATHER CONCRETING

931.08.01 General

Cold weather placing of concrete shall not proceed without the approval of the Owner's Representative.

Calcium chloride or other de-icing salts shall not be used as a de-icing agent in or around the forms. Concrete shall not be placed on or against frozen ground or any surface that will lower the temperature of the concrete in place below the minimum values shown in Table 2.0 or below 10°C.

Concrete for bridge decks (or approach slabs) shall not be placed between October 1 and May 1 unless otherwise approved by the Owner's Representative.

For additional guidance on Cold Weather Concreting see ACI 306 "Guide to Cold Weather Concreting", the Portland Cement Association publication "Design and Control of Concrete Mixtures", and "CSA A23.1 section 7.1.2 Cold Weather Concreting".

931.08.02 Protecting Placed Concrete

Protection shall be provided by means of heated enclosures, coverings, insulation, or a suitable combination of these methods. The proposed method of protection and curing must be included in the Thermal Control Plan.

If protective housing is utilized as indicated in the Thermal Control Plan it shall be reviewed and stamped by a Professional Engineer and meet the requirements of the National Building Code.

The equipment required for heating shall be of adequate capacity and be accepted, prior to installation, by the Owner's Representative. Heating equipment shall be available, installed and tested ready for use before the Owner's Representative will authorize concrete placement.

If temperatures are less than 5°C the Contractor shall preheat the area in which the concrete is to be placed. Additional heating may be necessary if large quantities of steel elements are present, however care must be taken to avoid heating elements more that 5°C above the temperature of the concrete mixture. Once temperatures are satisfactory to the Owner's Representative, the Owner's Representative will authorize the placement

of concrete provided other requirements of this specification have been met.

The Contractor is advised that insulation or supplemental heat may be required year-round in order to maintain required temperature differentials and to protect the concrete from thermal cracking. Alternative methods of keeping concrete temperatures at acceptable levels may be accepted.

The Contractor shall make suitable arrangements for any heating equipment outside normal working hours where required.

931.09 CONCRETE REPAIRS

The Contractor shall notify the Owner's Representative of all defective areas and their proposed repair method(s). Where possible, the Contractor and Owner's Representative shall complete a walkthrough and agree on the standard repairs to be completed and their repair method(s). Where repairs do not meet the general guidelines of the items below or abnormalities are encountered, the Engineer of Record shall be contacted.

All defects shall be subject to repair method(s) at the Owner Representative's discretion and at the Contractors expense. Concrete that has, in the Department's opinion, has excessive defects shall be rejected and replaced at the Contractor's expense. No time extension will be given for repairs or replacement of rejected concrete.

Concrete defects may include but is not limited too:

- Surface projections/excess paste
- Entrapped air voids
- Voids
- Cold joints
- Honeycombs
- Formwork tie rod holes
- Corner Spalls
- Cracks
- Depressions in slabs.

The Contractor shall submit all repair materials intended for use to the Owner's Representative as per 930.04.06. All mortars shall have a corrosion inhibiting compound where in contact with reinforcing steel. Curing of the mortar/compound shall follow the manufacturer's instructions.

Defective concrete shall have its edges saw cut 25 mm vertically, and be chipped to a

depth reaching sound concrete with no feathered edges, thoroughly cleaned, and be in a saturated surface dry (SSD) condition prior to patching with any repair mortar or compound.

Chipping, sandblasting and other destructive tools are prohibited around GFRP, galvanized and stainless steel rebar unless authorized by the Owner's Representative.

If rebar is exposed within a defect **OR** exposed from chipping to find sound concrete and:

- Less than 50% of the bars circumference is exposed **AND** the concrete around the bar is sound, the bar does not need to be chipped all the way around.
- Greater than 50% of the bars circumference is exposed, it must be chipped to sound concrete **AND** around the bar to a minimum of x 1.5 the maximum aggregate size.

Following the removal of forms, irregular projections, fins, offsets, streaks or other surface imperfections shall be removed from all surfaces except the surfaces which are not exposed or waterproofed. Concrete bridge decks and approach slabs to be waterproofed shall have all protrusions, ridges, trowel marks and sharp edges shall be removed by grinding so there are no areas exceeding 5 mm or depressions exceeding 10 mm.

Any air voids or bug holes less than 12mm wide and 6mm deep need not be repaired. All bug holes greater than 12mm wide, and 6mm deep and are concentrated in a local area shall have the overlying mortar removed to open the bug hole, be washed and repaired with a mortar accepted by the Owner's Representative.

All form tie elements (rod and/or plastic cones) shall be removed from the cover area, mechanically roughened, cleaned, pre-soaked to a SSD condition and repaired with a mortar accepted by the Owner's Representative.

Spalled corners/edges shall be saw cut 25 mm, chipped to sound concrete with feathered edges removed, thoroughly cleaned, pre-soaked to an SSD condition and formed or hand patched to the original profile at the discretion of the Owner's Representative.

All cracks 0.3 mm and greater in width shall be repaired within the warranty period, regardless of location, size, or cause in accordance with the following methodology:

Hairline cracks are defined as less than 0.1 mm, narrow cracks 0.1 mm to 0.3 mm, medium cracks 0.3 mm to 1 mm, and wide cracks are greater than 1 mm. Cracks less than 1 mm identified for repair shall be filled with a low viscosity epoxy resin such as Sika

Canada's Sikadur 52, Sikadur 55 SLV, or Master Builder's MasterInject 1380 or an approved equal. The resin shall be applied by pressure injection or by gravity feed into the crack and allowing the sealant to be absorbed.

Additional applications may be required, depending on the absorption and crack depth. Subsequent applications, if required by the Engineer of Record, shall be made as soon as possible after the prior application has sufficiently set. All use and placement of resin materials shall be in accordance with the manufacturer's written instructions.

Wider cracks, as identified from the survey may require a higher viscosity resin for repair. Polyurethane or other appropriate flexible sealants may be required to repair larger cracks where active movement occurs. The Contractor shall submit manufacturer's data for the proposed resin in this case for approval prior to use. Excess resin in the vicinity of the crack shall require removal by grinding and/or abrasive blast cleaning at the Engineer of Record's direction.

All voids, cold joints, wide cracks, honeycombs, and slab out of tolerances shall be discussed with the Owner's Representative for remedial action and shall be repaired on a case by case basis at the Contractors expense.

931.10 MEASUREMENT FOR PAYMENT

931.10.01 Measurement for Payment for concrete placement work where the Unit Price Table states the unit to be cubic metres

For those concrete work contract items, except infill, levelling and tremie concrete, where the unit of measurement on the Unit Price Table is stated as cubic metre, then measurement for payment will be by the volume of concrete placed, measured in cubic metres rounded to two decimal places, based on the neat lines called for in the plans.

Measurement for payment purposes for infill concrete shall be based upon cross sections measured in cubic metres to the nearest one decimal place. Prior to concrete placing and forming operations, the Owner's Representative shall establish the lateral and vertical limits for infill concrete.

Measurement for payment purposes for tremie concrete shall be made based upon the number of cubic metres of batched concrete rounded to the nearest one decimal place and incorporated into the works as accepted by the Owner's Representative. Every precaution must be taken to prevent waste of concrete, i.e. carelessness resulting in the escape of concrete from within the confines of the forms or inaccuracy in placing. In the event of such occurrence(s) an estimate of the wastage will be made by the Owner's

Representative and an appropriate deduction from the batch quantity will be made. All additional concrete required to be placed above the estimated quantity, accepted by the Owner's Representative.

No deductions will be made from the volume of concrete for:

a) Volume of reinforcement, prestressing steel or prestressing ducts.
b) Inserts of cross-sectional area of less than 0.1 square metres.

When it is specified that concrete is to be placed against undisturbed soil or set in rock, and where the excavation is made wider than the neat lines of the footings or the excavation is at a lower elevation then the footing grade, the excess amount of concrete will not be measured for payment quantities.

Where the concrete footings are placed lower than that authorized by the Owner's Representative, any excess amount of concrete will not be measured for payment quantities.

931.10.02 Measurement for Payment for concrete work where the Unit Price Table states the unit to be a unit other than cubic metres

For those concrete work contract items where the unit of measurement on the Unit Price Table is stated in some unit other than cubic metre, then the measurement for payment shall be in accordance with that stated in the appropriate specification for the item.

931.11 BASIS OF PAYMENT

931.11.01 Basis of Payment for concrete work where the Unit Price Table states the unit to be cubic metres

For those concrete work items where the unit of measurement in the Unit Price Table is stated as cubic metre, then payment at the contract price shall be full compensation for all materials, labour, equipment, plant and services necessary to complete the concrete work as outlined herein.

In particular no separate payment will be made for:

a) supply of cement, aggregates and other materials, plant and equipment-use required for producing the concrete
b) Mix design, production, mixing, transportation, placing, consolidation, curing and quality control during production

c) Formwork and falsework
d) Precautions to be taken for hot weather
e) Precautions to be taken for cold weather
f) Provisions of shipping crates for concrete test specimens

No payment shall be made for any concrete required for normal testing procedures.

Where excessive camber in girders is permitted by the Owner's Representative, the extra concrete due to the camber in excess of the specifications will not be paid for.

Concrete not placed in accordance with the provisions of 931, will not be paid for unless and until it can be established to the satisfaction of the Owner's Representative that there has been no harmful effect to the concrete. The onus for establishing this will belong to the Contractor.

931.11.02 Basis of Payment for concrete work where the Unit Price Table states the unit to be a unit other than cubic metres

For those concrete work contract items where the unit of measurement in the Unit Price Table is stated in some unit other than cubic metre, then the basis of payment shall be in accordance with that stated in the appropriate specification for the item.

Concrete not placed in accordance with the provisions of 931, will not be paid for unless and until it can be established to the satisfaction of the Owner's Representative that there has been no harmful effect to the concrete. The onus for establishing this will belong to the Contractor.

931.11.03 Concrete Acceptance Payment Criteria

A lot is defined as the quantity of concrete placed within one calendar day for the required strength class or as establish by the Owners Representative at the preconstruction meeting.

Concrete of a given strength class must meet the compressive strength requirements as per Table 1.0 of Section 930.

Concrete of a given strength class having a strength of less than that specified will be accepted into the job at a reduced payment, as per below, provided the difference between specified strength and tested strength is no greater than 5 MPa.

$ (Adjusted Concrete Unit Price) = $(Bid Concrete Unit Price) - $50 for Specified Concrete

Strength of 35MPa or less

$ (Adjusted Concrete Unit Price) = $(Bid Concrete Unit Price) - $100 for Specified Concrete Strength of greater than 35MPa.

Concrete of a given strength class having a strength of less than that specified by more than 5 MPa shall be rejected. The Department reserves the right to reject any concrete which does not meet all the requirements for the class of concrete specified. The Department also reserves the right to reject any portion of a placement if there exists evidence that this portion has a strength that is below the minimum acceptable required under this section. When the concrete is rejected, the Engineer of Record or Owner's Representative, may determine if the concrete can remain in the work. All expenses related to such determination will be at the Contractor's expense. If it is determined the rejected concrete cannot remain in the work, it shall be removed and replaced at the Contractor's expense. The new concrete will be subject to all conditions of Section 930 and 931. Should the rejected concrete remain in the work it will be subject to a reduction, as outlined below:

$ (Adjusted Concrete Unit Price) = $(Bid Concrete Unit Price) * 0.5 for strength between 5 and 8 MPa of the specified strength
***No payment will be made for strength less than 8 MPa of the specified strength that is allowed to remain in the work.*

If all strength results, for a C-1 exposure class, is maintained within 10 MPa of the required strength than the following bonus will apply. The average strength will be determined based on all lot strength results for the given strength class. If any individual lot strength result falls below the specified strength no bonus will be paid.

BA = V x ($2.0 x (SS/((AS-SS)*2)))

BA = Bonus Adjustment
V = Volume place (m^3)
SS = Specified Strength (MPa)
AS = Actual Strength (MPa)

SECTION 932

INSPECTION CHECKLISTS

INDEX

932.01 SCOPE

The Contractor shall complete project specific checklists at project startup depending on the specific scope of work and submit the checklists to the Owner's Representative within two (2) weeks of project startup for review. All checklists shall be completed to the satisfaction of the Owner's Representative. The Owner's Representative shall be provided with five (5) business days for subsequent reviews required by resubmittals.

The Contractor shall ensure all inspection checklists are completed and submitted to the Owner's Representative for acceptance no later than 48 hours prior to concrete placement or as agreed with the Owner's Representative. If the work applicable to the checklist is not complete, is modified in anyway, has risk for rework or movement due to other activities, the Owner's Representative has the right to reject the work.

The Owner's Representative shall be provided access to verify the items within all checklists at all times.

Specific checklists and contents shall include but not be limited to the information provided below.

932.02 PROJECT SPECIFIC CHECKLISTS

All Checklists must include:

- Time and date the inspection was complete.
- Element being inspected.
- Signature location for each line item on the sheet.
- Signature location at the bottom of the sheet by the Contractor's construction manager or superintendent.
- Include: "DTI Owner's Representative acknowledges the receival of this checklist (print name) _____ ". *Acknowledgement of this submittal does not alleviate the Contractor from performing the associated work as per the contract documents, Departmental Specifications, and provincial and federal regulations.*

932.02.01 PRE-CONCRETE PLACEMENT CHECKLIST

Pre-Concrete Placement Checklist (to be completed the morning of concrete placement):

- Concreting Placement Plan has been accepted by the Owner's Representative.
- Thermal Control Plan has been accepted by the Owner's Representative. Including a stamped protective housing drawing (if required). See 931.04.01.02.
- Temperature at the point of discharge of plastic concrete as per Section 930 Table 2.0.
- Incorporated any change notices, or changes to drawings.
- All items to be embedded inside the forms are clean and free of deleterious materials.
- Foundation is free of garage, saw dust and other deleterious materials.
- Hardened concrete surfaces are thoroughly saturated with water, for at least 1 hour in advance of placing concrete.
- Concrete Repair Checklist is completed and verified as required.
- Foundation Checklist is completed and verified as required.
- Reinforcement Checklist is completed and verified as required.
- Embedded Checklist is completed and verified as required.
- Formwork Checklist is completed and verified as required.
- Finishing Train Checklist (Screed Dry Run) completed and verified as required (See 931.05.03 and Section 907).
- Other checklists completed and verified as required.
- Finishing train support system installed and as per stamped drawing with verification provided.
- Surface temperatures checked and in compliance with this specification.

932.02.02 FOUNDATION CHECKLIST

Foundation Checklist (to be completed prior to rebar or formwork installation):

- Foundation at the required position and elevation.
- Soil and or rock has satisfactory bearing capacity verified by the Engineer of Record or delegate.
- Concrete scarified in compliance with 931.04.03.
- Incorporated any change notices, or changes to drawings.
- Conforms to Section 902.

932.02.03 REINFORCEMENT CHECKLIST

Reinforcement Checklist (complete progressively through installation and inspection):

- Installation compliance with IFC reinforcing steel drawings:
    - Bar type (glass fiber reinforced polymer (GFRP), carbon steel, stainless steel, galvanized).
    - Bar sizes.
    - Splices and development lengths.
    - Correct number of bars.
    - Spacing of bars.
    - Cover.
    - Correct tire wire used.
    - No dissimilar metals in contact.
    - Incorporated any change notices, or changes to drawings.
    - Conforms to Section 905.

932.02.04 EMBEDDED PARTS CHECKLIST

Embedded Parts Checklist (complete progressively through installation and inspection):

- Installation compliance with IFC embedded parts drawings:
    - Correct materials.
    - Correct dimensions.
    - No dissimilar metals in contact.
    - At least x1.5 max aggregate size around all embedded parts.
    - Location and verticality correct.
- Secured to prevent movement from concrete placement.
- Incorporated any change notices, or changes to drawings.
- Survey checks have been completed and within tolerance as per Section 926.
- Conforms to Section 918.

932.02.05 FORMWORK CHECKLIST

Formwork Checklist (complete progressively through installation and inspection):

- Installation compliance with submitted drawings:
  - Geometry, position and elevation.
  - Joint locations.
  - Correct form-ply.
  - Formwork panels in good condition.
  - Gaps in formwork panels closed.
  - Washout holes closed.
  - Formwork panel alignment.
  - Formwork built as per drawings (panel thickness, strong backs, whalers, panel stitching, formwork tie type/spacing/size/quantity etc.).
  - No dissimilar metals in contact.
  - Top of concrete markers in place.
  - Chamfer strips in place.
  - Survey checks have been completed and within tolerance as per Section 926.
  - Incorporated any change notices, or changes to drawings.
  - Approved by the formwork design engineer (if greater than 1.5m in height) with written verification provided.
  - Conforms to Section 907.

932.02.06 OTHER CHECKLISTS

Other checklists the Owner's Representative may require at project start-up may include but is not limited too:

- Dewatering, turbidity and erosion control - Complete during initial install and as required.
- Permanent material deliveries (i.e. box girders and rebar) - Complete at material arrival and after final installation.
- Pile driving and testing - Complete progressively through installation and inspection.
- Structural steel coatings - Complete at material arrival and after final installation.
- Rock Bolts - Complete progressively through installation and inspection.
- Rock Dowels - Complete progressively through installation and inspection.
- During Concrete Placement - Complete progressively through installation and inspection.
- Structural steel bolt torquing - Complete progressively through installation and inspection.

- Earthworks (material certifications/compacting/lifts etc.) - Complete progressively through installation and inspection.
- Post-Concrete Placement (defect maps) - Complete during the operation.
- Concrete Repairs - Complete progressively through installation and inspection.
- Pre-stressing operations - Complete during the operation.
- Post-tensioning operations - Complete during the operation.
- Finishing machine screed cover and deck thickness complete within 48 hours of the scheduled concrete placement.
- Riprap placement - Complete during the operation.