

SECTION 919

REHABILITATION OF CONCRETE STRUCTURES

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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 = Bidden 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, Contractor's 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 = Bidden value of the work for Part i of the project (excluding lump sum items that apply to all parts)

919.05 JACKING OF BRIDGE SUPERSTRUCTURE 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."

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 handrail posts to the parapet walls, if present, shall be loosened to permit jacking without damaging the handrails.

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 handrail 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 satisfactorily 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 coarse 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 coarse 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 \pm 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 HANDRAIL AND ANCHOR BLOCKS

The demolition, salvage, supply, and installation of handrails 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 slighty 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.