CONSTRUCTION SPECIFICATION FOR STRUCTURE REHABILITATION - CONCRETE PATCHES AND OVERLAYS

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930.01 SCOPE

This specification covers the requirements for the surface preparation, and the placing, finishing, texturing, and curing of concrete and latex modified concrete used in structure rehabilitation.

930.01.01 Specification Significance and Use

This specification is written as a municipal-oriented specification. Municipal-oriented specifications are developed to reflect the administration, testing, and payment policies, procedures, and practices of many municipalities in Ontario.

Use of this specification or any other specification shall be according to the Contract Documents.

930.01.02 Appendices Significance and Use

Appendices are not for use in provincial contracts as they are developed for municipal use, and then, only when invoked by the Owner.

Appendices are developed for the Owner's use only.

Inclusion of an appendix as part of the Contract Documents is solely at the discretion of the Owner. Appendices are not a mandatory part of this specification and only become part of the Contract Documents as the Owner invokes them.

Invoking a particular appendix does not obligate an Owner to use all available appendices. Only invoked appendices form part of the Contract Documents.

The decision to use any appendix is determined by an Owner after considering their contract requirements and their administrative, payment, and testing procedures, policies, and practices. Depending on these considerations, an Owner may not wish to invoke some or any of the available appendices.

930.02 REFERENCES

When the Contract Documents indicate that municipal-oriented specifications are to be used and there is a municipal-oriented specification of the same number as those listed below, references within this specification to an OPSS shall be deemed to mean OPSS.MUNI, unless use of a provincial-oriented specification is specified in the Contract Documents. When there is not a corresponding municipal-oriented specification, the references below shall be considered to be the OPSS listed, unless use of a provincial-oriented specification is specified in the Contract Documents.

This specification refers to the following standards, specifications, or publications:

Ontario Provincial Standard Specifications, Construction

OPSS 904	Concrete Structures
OPSS 905	Steel Reinforcement for Concrete
OPSS 919	Formwork and Falsework
OPSS 928	Structure Rehabilitation - Concrete Removal
OPSS 929	Abrasive Blast Cleaning - Concrete Construction

Ontario Provincial Standard Specifications, Material

OPSS 1002	Aggregates - Concrete
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1305	Moisture Vapour Barrier
OPSS 1306	Burlap
OPSS 1312	Latex Modifiers for Use in Concrete
OPSS 1350	Concrete - Materials and Production

CSA Standards

C22.2 No. 211.2-M1984	Rigid PVC - Unplasticized Conduit
G 30.5-M 1983	Welded Steel Wire Fabric for Concrete Reinforcement
CAN/CSA G 164-M92	Hot Dip Galvanizing for Irregularly Shaped Articles

ASTM International

A 53-90b Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
D 4285-83-1988 Method for Indicating Oil or Water in Compressed Air

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS601-89 Materials Finer Than 75 μm Sieve in Mineral Aggregates by Washing
LS607-89 Determination of Percent Crushed Particles in Processed Coarse Aggregate

930.03 DEFINITIONS

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

Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

Hardwood means wood with a degree of hardness equal to species such as hard maple, oak, or beech.

Layer - Reinforcing Steel means two or more reinforcing bars placed in a plane parallel to a concrete face.

Mat - Reinforcing Steel means transverse and longitudinal layers of reinforcing steel tied together.

Rehabilitation means any modification, alteration, or improvement to a structure or its components that is designed to correct defects or deficiencies.

Structure means any bridge, culvert, tunnel, retaining wall, wharf, dock, guideway, or any part thereof.

Proposal means a Contractor's submission of changes when engineering design is required affecting the original design as stipulated in this specification.

930.04 DESIGN AND SUBMISSION REQUIREMENTS

930.04.01 Design Requirements

930.04.01.01 Proposals

930.04.01.01.01 General

Proposals by the Contractor shall bear the seal and signature of an Engineer.

Three sets of the proposal shall be submitted to the Owner 3 weeks prior to commencement of the work.

930.04.01.02 Screed Rails

An alternative screed rail system to that specified in the Finishing Equipment - Overlays clause may be used. At least 4 weeks prior to the commencement of placing screed rails, 3 complete sets of Working Drawings detailing the proposal shall be submitted to the Contract Administrator. These drawings shall include: type, dimensions of the rails to be used, spacing of screed rail chairs, details of the finishing machine, and the calculations showing the design deflection in the system. One set of these drawings shall be returned marked to indicate required changes. Eight sets of these drawings revised where necessary shall be resubmitted.

When all Owner requirements are satisfied, 2 sets of the Working Drawings shall be returned.

930.04.02 Submission Requirements

930.04.02.01 Cement Certification

Prior to using the cement in the latex modified concrete mix, one copy of the cement supplier's certificate stating that the cement is certified free from early stiffening tendencies shall be submitted to the Contract Administrator.

930.04.02.02 Mix Design

930.04.02.02.01 Concrete and Latex Modified Mortar Mix

The Contractor shall be responsible for designing the mix.

930.04.02.02.02 Latex Modified Concrete

The Contractor shall only design the mix when specified in the Contract Documents.

930.04.02.02.03 Concrete, Latex Modified Concrete, and Latex Modified Mortar Mix

When the Contractor designs the mix, the Contractor shall submit the mix proportions to the Contract Administrator at least 3 weeks prior to production of the concrete.

930.04.02.03 Certificate of Calibration for the Latex Modified Concrete Mixing Plants

A certificate of calibration shall be provided to the Contract Administrator for each of the following:

a) Cement feed meter indicating the cement meter register count and discharge time for 42.64 kg of cement for each mixing unit. The method of test shall be according to the field calibration of cement feed meter specified in the equipment manufacturer's instructions. The minimum quantity of cement for each test run shall be 50 kg.

b) Latex rate of flow and totalizer meters. The meters shall be calibrated according to the tolerances specified in the Latex Modified Concrete Mixing Plant clause. A minimum quantity of 1,000 litres of latex shall be discharged during the calibration of the meters.

c) The water totalizer meter shall be calibrated according to the tolerances specified in the Latex Modified Concrete Mixing Plant clause or a minimum quantity of 1,000 litres.

Each certificate shall be signed by an independent testing agency and shall be dated within 90 Days prior to each use of the specific mixing unit on the Contract. Aggregate gate openings and pointer adjustments, as well as the general operating condition of equipment shall also be checked by the independent testing agency according to the manufacturer's instructions.

The Contract Administrator may require recalibration of the cement feed meter.

930.04.02.04 Certification of Superplasticizer

Prior to using the superplasticizer, one copy of a certificate from the superplasticizer manufacturer stating that the superplasticizer is certified compatible with the cementitious materials and admixtures being used shall be submitted to the Contract Administrator.

930.05 MATERIALS

930.05.01 Cement

The cement shall be according to OPSS 1301.

930.05.02 Concrete and Latex Modified Concrete

930.05.02.01 General

The concrete shall be according to OPSS 1350 and as shown in Table 1.

930.05.02.02 Aggregates

930.05.02.02.01 General

Aggregates including sand for the bonding agents shall be according to OPSS 1002 and the requirements specified herein.

930.05.02.02.02 Aggregates for Overlays

Coarse aggregate shall consist of a minimum of 60% crushed particles when tested according to LS-607. Except for latex modified concrete, aggregates shall have 1.00% by mass maximum passing the 75 μm sieve when tested according to LS-601.

Coarse aggregate for overlays that form the bridge deck riding surface shall be composed of at least 80% siliceous igneous and metamorphic rocks and minerals.

930.05.02.02.03 Aggregates for Latex Modified Concrete Overlays

Aggregates shall have 0.50% by mass maximum passing the 75 μm sieve when tested according to LS-601. All aggregates, estimated quantities required for completion of each stage of the latex modified concrete overlays, shall be stockpiled within the Contract limits or at a site approved by the Contract Administrator at least 3 weeks prior to placing the overlay in that particular stage. The fine aggregate stockpile shall be covered to prevent variation of moisture content in the pile.

When additional aggregate is required, the material shall be similar and come from the same source.

930.05.03 Latex Modifier

The latex modifier shall be according to OPSS 1312 and shall be delivered to the job site in sealed containers with the trade name and date of manufacture affixed to the containers by the manufacturer.

The latex modifier shall be maintained above 5 °C and below 30 °C at all times. Sufficient latex modifier to complete the work shall be delivered to the job site prior to the commencement of the testing of the continuous concrete mixing plant and at least 7 days prior to commencement of the work in which the latex modifier shall be used.

The latex modifier shall be agitated immediately prior to use according to the manufacturer's instructions.

930.05.04 Burlap

Burlap shall be according to OPSS 1306.

930.05.05 Water

Water shall be according to OPSS 1302.

930.05.06 Bonding Agents

930.05.06.01 Cement-Sand

Cement-sand bonding agent shall consist of Portland cement and sand in the ratio of 1:1 by volume mixed with sufficient water to form a stiff mixture. The consistency of the mixture shall be such that it can be applied with a stiff brush to the existing concrete in a thin even coating that shall not run or puddle.

930.05.06.02 Latex Modified

Latex modified bonding agent shall consist of Portland cement, latex modifier, and sand in the ratio of 1.0:0.5:2.0 by volume mixed with sufficient water to produce a consistency such that when applied with a stiff brush to the existing concrete in a thin even coating it shall not run or puddle.

930.05.07 Welded Steel Wire Fabric

The welded steel wire fabric shall be welded galvanized steel and shall be according to CSA G 30.5. Galvanizing shall be according to CAN/CSA G164.

930.05.08 Anchorage Inserts

Anchorage inserts for the attachment of the welded steel wire fabric to the concrete surface shall be galvanized according to CAN/CSA G 164 and be of adequate length and strength to resist a pull-out force of 1.0 kN.

930.05.09 Tie Wire

Tie wire shall be according to OPSS 905.

930.05.10 Moisture Vapour Barrier

The moisture vapour barrier shall be polyethylene film, opaque, white pigmented, according to OPSS 1305, and shall not be less than 100 μm thick.

930.05.11 Drainage Tubes

Rigid PVC drainage tubes shall be according to CSA C22.2 No. 211.2. Galvanized steel drainage tubes shall be according to ASTM A53. Galvanizing shall be according to CSA G.164.

930.05.12 Latex Modified Mortar Mix

The Portland cement and fine aggregate, dry basis, proportions of the mix shall be designated by mass. The latex modifier to cement ratio by mass shall be one part latex modifier to three parts cement.

The water to cement ratio, by mass, shall not be greater than 0.35 which shall include the water in the latex modifier and in the fine aggregate. The latex modifier shall not be diluted. Fine aggregates shall be according to OPSS 1002 and shall contain not less than 3% and not more than 5% moisture by mass.

930.05.13 Superplasticizer

Superplasticizer shall be according to OPSS 1350.

930.06 EQUIPMENT

930.06.01 Mixers

930.06.01.01 General

The equipment used for mixing concrete shall be according to OPSS 1350, except as specified herein for latex modified concrete mixing plant and stationary mixers.

930.06.01.02 Latex Modified Concrete Mixing Plant

Mobile continuous concrete mixing plant shall be used for latex modified concrete and shall not be less than 5 m^3 capacity and shall be equipped with:

a) A storage tank for the latex modifier equipped with a mechanical agitator.

b) Two meters to measure the discharge of latex modifier; one shall record the rate of flow to an accuracy of $\pm$ 0.5 litre per minute and the other shall record the total volume discharged to an accuracy of $\pm$ 1.5%.

c) A meter that records the total quantity of water used in the concrete to an accuracy of $\pm$ 1.5%.

d) A meter, visible at all times with a ticket printout and capable of positive measurement of cement being introduced into the mix.

e) A positive control for the flow of water being introduced into the mix, coordinated with the cement and aggregate feeder mechanisms, and adjustable for minor variations in aggregate moisture.

930.06.01.03 Stationary Mixers

Stationary mixers for the mixing of cement-sand and latex modified bonding agents shall be power driven and capable of uniformly mixing the materials.

930.06.02 Compressor - Air Blasting

The compressor for air blasting shall have a minimum capacity of 3.5 m^3/minute. The compressed air shall be free from oil when tested according to ASTM D4285.

930.06.03 Sawing Equipment - Overlays

The sawing equipment shall be self-propelled and capable of sawing the overlay concrete full depth in one pass.

930.06.04 Work Bridges

A work bridge, riding on the screed rails behind the finishing machine with a working platform not higher than 1.5 m above the finished surface shall be provided to facilitate hand finishing work, concrete inspection, texturing, and placing of curing material. On placements longer than 40 m or wider than 10 m, a second work bridge shall be provided. When two work bridges are required, the trailing work bridge shall ride on the screed rails and shall be used for the purpose of placing the curing material and shall have sufficient clearance to allow for their proper placement.

930.06.05 Straight Edge

The straight edge shall be 3 m long and commercially made of metal.

930.06.06 Finishing Equipment - Overlays

930.06.06.01 Finishing Machine

The finishing machine shall be self-propelled, and travel on rails. It shall be fitted with a rotating cylinder screed, capable of finishing the surface without subsequent hand finishing, an adjustable powered screw auger and a vibrator plate or roller mounted in front of the rotating cylinder screed and behind the power screw auger. It shall be capable of forward and reverse movement under positive control. There shall be provision for raising all screeds to clear the screeded surface and for accurately repositioning the screeds. It shall have adjustable legs fitted with locking devices.

930.06.06.02 Screed Rails

The screed rails shall be straight to within 3 mm in 3 m. The maximum deflection of the screed rails under load shall be 1 mm in a 1.2 m length.

930.06.06.03 Screed Rail Chairs

Screed rail chairs shall be adjustable in height and made of metal. At locations where metal chairs cannot be accommodated, hardwood may be used to support the rail.

930.06.07 Buggies

Buggies used for transporting and placing the concrete may be hand operated or motorized. Motorized concrete buggies shall not be greater than 0.5 m^3 capacity.

930.06.08 Scales

The scales used for the calibration of the mobile continuous concrete mixing plant shall have a minimum capacity of 200 kg with an accuracy of $\pm$ 1 kg in 200 kg. Proof of the accuracy of the scales is required prior to each calibration.

930.06.09 Consolidating Equipment

Consolidating equipment shall be according to OPSS 904.

930.06.10 Hand Finishing Equipment

Only magnesium or wood floats shall be used. Bull floats shall be magnesium.

930.07 CONSTRUCTION

930.07.01 Modification of Deck Drains

Modification of deck drains shall be made prior to waterproofing the deck.

930.07.02 Drainage Tubes in Deck

Installation of drainage tubes shall be done prior to waterproofing the deck.

930.07.03 Place Concrete Overlay
Place Latex Modified Concrete Overlay

930.07.03.01 Operational Constraints

The Contract Administrator shall be notified of the intent to place the overlay 1 Business Day prior to the commencement of the placement of the overlay. The work shall not proceed until the surface preparation has been inspected by the Contract Administrator.

Only the finishing machine and buggies used to place concrete shall be allowed on the abrasive blast cleaned portion of the deck.

Areas of reinforcing steel and concrete prepared for concrete overlay shall be protected at all times during placing operations from the dropping of the bonding agent or concrete from placing equipment or other sources, except at the intended point of discharge. Any such material shall be immediately removed.

Equipment transporting concrete and runways used by equipment transporting concrete shall not be supported by deck reinforcing steel.

Placement of concrete shall not begin until the trial run procedure as specified is complete and permission to place concrete has been given in writing by the Contract Administrator. In the case of unexpected interruptions during placing operations, a construction joint shall be formed by either chopping or sawcutting at the direction of the Contract Administrator and all new concrete shall be covered with polyethylene film. Portions of the concrete overlay with incomplete or unsatisfactory consolidation or finishing shall be removed.

Overlay concrete shall not be placed when the air or deck temperature is below 10 °C or likely to fall below 10 °C or is above 30 °C or likely to rise above 30 °C during the duration of the placing operations.

Longitudinal construction joints shall be permitted only where specified in the Contract Documents.

Concrete shall not be placed adjacent to longitudinal joints in concrete overlay less than 36 hours old. At temperatures less than 10 °C, the Contract Administrator may extend this time requirement.

Neither construction traffic nor highway traffic shall be permitted on the finished surface of the overlay concrete until the curing period has elapsed.

Prior to seasonal shutdown, operations shall be scheduled in such a manner to ensure that the overlay is placed in all areas where concrete removal has commenced.

930.07.03.02 Minimum Thickness of Overlay

The minimum thickness of the overlay shall be 35 mm for the latex modified concrete overlay and 45 mm for the concrete overlay.

930.07.03.03 Surface Preparation

When anode mesh is not used, immediately prior to wetting the deck surface, all dust and loose material shall be removed from the prepared surface of the existing deck concrete by compressed air.

When anode mesh is used, within 4 hours prior to application of the overlay the concrete surface, with anode mesh in place shall be pressure washed with water using a pressure not less than 1.4 MPa to remove debris resulting from drilling of anchor holes and other accumulated dirt adhering to the anode or concrete surfaces.

The deck surface shall be maintained in a wet condition for a period of one hour prior to the application of the bonding agent. Excess water shall be removed from the surface using compressed air, immediately prior to application of the bonding agent.

930.07.03.04 Longitudinal Construction Joints

Lumber with a thickness of 10 to 15 mm less than the nominal thickness of the overlay shall be affixed to the deck to permit the concrete to spread no less than 75 mm and no more than 125 mm beyond the construction joint.

Polyethylene, asphalt, saturated felt, or other suitable debonding material shall be secured beneath the lumber and extended to within 25 mm of the sawcut line.

930.07.03.05 Placing of Screed Rails

Screed rails for the finishing machine shall be supported on screed rail supports at intervals not to exceed 1.0 m.

Supports for the screed rails shall be placed outside the finished concrete, where possible.

The screed rails shall be continued beyond the deck at each end to a length that will enable the finishing machine to be driven beyond the end of deck.

930.07.03.06 Trial Run

A trial run shall be made prior to each placing operation to ensure that the minimum thickness of the overlay is achieved. Where the trial run indicates that an unsatisfactory thickness will result, the screed rails shall be adjusted in order to obtain the minimum thickness and the trial run repeated in the area of screed rail adjustment.

930.07.03.07 Placing

A thin coating of the bonding agent, cement-sand for concrete and latex modified bonding agent for latex modified concrete shall be brushed into the prepared surface. All vertical and horizontal surfaces against which the overlay will be placed shall receive a thorough even coating with no excess of bonding agent in any areas. Excess fine aggregate separated from the bonding agent mixture after application shall be removed from the deck surface. The rate of application of the bonding agent shall be such that the brushed material does not become dry prior to being covered with overlay. At no time shall the bonding agent be placed more than 2 m in front of the overlay placement. Bonding agent not used within 30 minutes after mixing shall not be used.

The overlay shall be placed on the deck and struck off slightly above final grade using concrete rakes.

In the event of an interruption in the placing of the overlay, the exposed edge of the overlay shall be covered immediately with wet burlap. If the delay in placing exceeds 10 minutes, the bonding agent already applied to the deck shall be removed.

When undue delays occur, all overlay material ahead of the deck finishing machine shall be removed and a joint formed.

The overall combination of labour and equipment for proportioning, mixing, placing and finishing the overlay shall be capable of finishing a minimum of 4 m^3 of overlay per hour and shall be arranged that not more than 20 minutes elapses between discharge of the overlay from the mixer and the final finishing.

930.07.03.08 Remedial Work

Debonded and honeycombed areas shall be removed and replaced. Cracks shall be treated according to the requirements shown in Table 2.

930.07.04 Finish and Cure Concrete Overlay
Finish and Cure Latex Modified Concrete Overlay

930.07.04.01 Surface Finish

The overlay shall be mechanically consolidated by the finishing machine and struck off to the final grade. The surface finish shall be free from open tears, plucked aggregates, and local projections. Areas adjacent to the curb that cannot be machine finished and areas not meeting the surface finish requirements shall be finished with hand finishing equipment.

The use of water or other material to aid in finishing shall not be permitted.

The inability to produce a uniform closed surface to the overlay shall be cause for rejection of the overlay in the affected area. Overlay rejected shall be removed and new overlay placed using methods approved by the Contract Administrator.

930.07.04.02 Surface Tolerance

Except across the crown, the surface of the overlay after finishing and prior to any required texturing shall be such that when tested with a 3 m long straight edge placed anywhere in any direction on the surface there shall be no gap greater than 6 mm between the bottom of the straight edge and the surface of the concrete. Where the gap exceeds 6 mm, the overlay shall be either removed and new overlay placed or the overlay shall be refinished so that the requirement for surface tolerance is satisfied.

930.07.04.03 Surface Texture

Where the surface of the overlay forms the wearing surface of the bridge deck, the following surface texturing shall be carried out.

When a tight uniform surface has been achieved, the surface shall be given a texture with a wire broom or comb having a single row of tines. The required texture shall be transverse grooves that may vary from 1.5 mm width at 15 mm centres to 4.5 mm width at 20 mm centres with a groove depth varying from 3.0 to 4.5 mm. The texture shall extend uniformly to within 300 mm of the curb, but no closer than 150 mm.

930.07.04.04 Cure Concrete Overlay

Two layers of wet burlap that have been presoaked by immersion in water for a period of 24 hour immediately prior to placement shall be placed on the concrete overlay within 2 to 4 m from the finishing operation. Strips shall overlap 150 mm and shall be held down without marring the surface of the concrete. The burlap shall be covered with a layer of moisture vapour barrier as soon as the moisture vapour barrier can be applied without deforming the surface of the concrete. The moisture vapour barrier shall be lapped a minimum of 150 mm. Air flow in the space between the moisture vapour barrier and the burlap shall be prevented by holding the moisture vapour barrier down at the edges and all laps. The burlap shall be kept continuously wet during the curing period.

Except as specified in the Sawcutting Construction Joints in Overlays clause, labour and Equipment shall not be allowed on the overlay for 12 hours after placement. The surface shall receive a wet burlap cure for not less than 96 hours. The curing material shall then be removed and the overlay permitted to air dry for not less than 72 hours prior to any application of waterproofing.

930.07.04.05 Curing Latex Modified Concrete Overlay

One layer of wet burlap that has been presoaked by immersion in water for a period of 24 hours immediately prior to placement shall be placed on the surface of the concrete overlay within 2 to 4 m from the finishing operation. Strips shall overlap 150 mm and shall be held down without marring the surface of the concrete. The burlap shall be covered with a layer of moisture vapour barrier as soon as the moisture vapour barrier can be applied and held in place without deforming the surface of concrete. The moisture vapour barrier shall be lapped a minimum of 150 mm. Air flow in the space between the moisture vapour barrier and the burlap shall be prevented by holding the moisture vapour barrier down at the edges and all laps.

Except as specified in the Sawcutting Construction Joints in Overlays clause, labour and Equipment shall not be allowed on the overlay for 12 hours after placement. The surface shall receive a wet burlap cure for not less than 24 hours. The curing material shall then be removed and the overlay permitted to air dry for not less than 72 hours prior to any application of waterproofing. At temperatures less than 10 °C, the Contract Administrator may extend the curing period.

930.07.04.06 Sawcutting Construction Joints in Overlays

As soon as the overlay is able to withstand the weight of the sawcutting equipment without damage and the overlay has sufficient strength to be sawcut without plucking of the aggregate, all free edges shall be sawcut for the full depth of the overlay. A minimum width of 75 mm of overlay shall be removed at each sawcut.

Excess overlay shall be removed using hand tools or chipping hammers. Burlap may be rolled back in areas where excess overlay has to be removed. The overlay shall not be exposed longer than 1 hour.

930.07.04.07 Testing of Continuous Concrete Mixing Plant for Latex Modified Concrete Overlay

930.07.04.07.01 Aggregate Discharge Test

An aggregate discharge test shall be conducted on each mixing unit in the presence of the Contract Administrator. The mixing unit shall be available for this work for 1 Day prior to the first concrete placing operation. A test shall be conducted prior to the first placement of overlay and whenever the aggregate sources are changed or the mixer recalibrated.

930.07.04.07.02 Test for Flow Rate of Latex Modifier

The flow rate of latex modifier shall be determined by the Contractor. The test shall be conducted immediately prior to each placement of overlay and at other times as directed by the Contract Administrator. The tests shall be done in the presence of the Contract Administrator as follows:

a) The flow meter for the latex modifier shall be adjusted to produce a flow rate of 122 $\pm$ 3 kg of latex per cubic metre of concrete. The latex modifier shall be discharged over a period of two minutes into a container that is free from contaminants and provided by the Contractor solely for this purpose. The container shall be weighed on approved scales. The weight of the container shall then be deducted from this figure. The procedure shall be repeated and the flow rate of the latex modifier calculated as the average of the two tests.

b) The flow procedure shall be repeated, as necessary, until the flow rate is adjusted to yield the prescribed quantity of latex modifier.

930.07.04.07.03 Yield Test

A yield test shall be carried out immediately prior to each placement of overlay and at other times, as directed by the Contract Administrator. The yield test shall be carried out by the Contractor in the presence of the Contract Administrator after the mixing units have been loaded with the required aggregates, cement, water, and admixtures or latex modifier. With the cement meter set at zero, the mixer portion of the unit set at an angle of 20 degrees and all controls set for the desired mix, concrete with the specified air content and slump shall be discharged into a 0.2 m^3 container provided by the Contractor. When the container is full, the cement meter shall display a value indicating a discharge of 78 kg of cement.
Where the specified yield is not produced, adjustments shall be made in the aggregate proportions and the test repeated until such time as the yield is within 1.0% of the required yield.

930.07.05 Concrete Patches - Formed Surface
Concrete Patches - Unformed Surface
Latex Modified Mortar Patches
Concrete Refacing

930.07.06.01 General

Typical locations and areas of repair are as specified in the Contract Drawings; however, the actual locations and extent of repair shall be as determined during the layout of the repair area according to OPSS 928.

930.07.06.02 Operational Constraints

The Contract Administrator shall be notified of the intent to place patching material or refacing materials or both 1 Business Day prior to commencement of placing the patching material or refacing materials or both. The work shall not proceed until the surface preparation has been inspected by the Contract Administrator.

Concrete patching shall not be carried out when the air or existing concrete surface temperature is below 10 °C or likely to fall below 10 °C, or is above 30 °C or likely to rise above 30 °C during the placing operation.

Patching operations shall be suspended during rain which, in the opinion of the Contract Administrator, may adversely affect the quality of the work, and portions of the concrete patch with incomplete consolidation or finishing shall be removed.

Construction equipment shall be permitted on the bridge deck and other concrete components subject to the following conditions:

a) Contamination by oil or other deleterious substances shall be prevented.

b) Equipment transporting concrete and runways used by equipment transporting concrete shall not be supported by deck reinforcing steel.

c) Concrete mixing equipment and trucks shall not be placed on or travel over abrasive blast cleaned areas of concrete.

Patching operations shall be scheduled in such a manner to ensure that patching is completed in all areas where concrete removal has commenced, prior to seasonal shutdown.

930.07.06.03 Access to Work Areas, Work Platform and Scaffolding

Adequate access shall be provided to facilitate placement of the patch material, inspection, and measurement by the Contract Administrator.

930.07.06.04 Surface Preparation

Where the new concrete or mortar is to extend over the existing concrete surface, that portion of existing surface shall be roughened by scabbling, chipping or bush hammering. The concrete surfaces receiving new concrete or mortar shall be abrasive blast cleaned to an extent according to OPSS 929.

Abrasive blast cleaned areas shall have the subsequent treatment applied within 36 hours of patching or refacing or shall be reblasted.

All dust and loose material shall be removed from the prepared surface of the repair area by compressed air prior to the application of the bonding agent.

930.07.06.05 Placement of Welded Steel Wire Fabric

When welded wire fabric is required, it shall not be placed until after blast cleaning the existing concrete surface.

The edges of adjoining welded steel wire fabric shall be overlapped by two wire spacings plus 100 mm. The wires shall be kept clean of any substance which may reduce the bond of the repair material to the wire surface.

The welded steel wire fabric shall be securely fastened to the exposed reinforcing steel by ties placed at not more than a 300 mm square grid.

When the exposed reinforcing steel is not capable of providing rigid support for the wire fabric, anchorage inserts shall be used.

Where there is no existing reinforcing steel, the wire fabric shall be fastened to the concrete with anchorage inserts placed at not more than a 300 mm square grid and the minimum clearance between the wire fabric and the existing concrete shall be 20 mm.

Each anchorage insert shall be installed to resist a pull out force of at least 1.0 kN.

930.07.06.06 Formwork and Falsework

The erection and removal of formwork and falsework shall be according to OPSS 919 and shall be placed to provide the specified cover to reinforcing steel or wire mesh or both as specified in the Contract Documents. When this results in over building of the existing concrete surface, a 1H:1V slope shall be provided to meet the existing surface at the edge of the repair area.

930.07.06.07 Concrete Patches - Formed Surface
Concrete Patches - Unformed Surface
Concrete Refacing

930.07.06.07.01 Superplasticizer

Superplasticizer shall only be used when specified in the Contract Documents or approved by the Contract Administrator. When used, it shall be added according to OPSS 1350. The slump of the concrete shall be increased to 150 $\pm$ 30 mm by the addition of the superplasticizer. The superplasticizer shall be added to the concrete on the job site and in strict conformance with the manufacturer's written instructions. The concrete shall be tested for air content after the addition of superplasticizer.

930.07.06.07.02 Construction Joints

Construction joints in concrete shall only be permitted at the locations specified on the Contract Drawings and shall be according to the placing requirements of OPSS 904.

Prior to the placement of concrete, the concrete surfaces to be patched shall be maintained in a wet condition for a period of not less than one hour. Excess water shall be removed from the surface using compressed air immediately prior to application of the bonding agent and the surface shall be coated with a thin brush coating of the cement-sand bonding agent with no excess in any area. The rate of application of the bonding agent shall be such that the brushed material does not become dry prior to being covered with the patching material.

Where the concrete surface to be repaired is inaccessible for the application of bonding agent due to formwork the area to be repaired shall be maintained in a wet condition for a period of one hour and air blasted to remove excess water immediately prior to the placing of concrete.

The placement of concrete shall be according to the construction requirements of OPSS 904.

930.07.06.07.04 Surface Finish

The surface finish of formed surfaces and unformed surfaces shall be according to the construction requirements of OPSS 904.

930.07.06.07.05 Curing Concrete - Unformed Surfaces

Two layers of wet burlap shall be placed on the surface of the concrete as soon as the surface will support it without deformation. Burlap shall be presoaked by immersion in water for a period of 24 hours prior to placing. A layer of moisture vapour barrier shall be placed immediately on the wet burlap.

The concrete shall be cured using the wet burlap covered with moisture vapour barrier for a minimum period of 96 hours. The curing material shall then be removed and the concrete permitted to air dry for not less than 72 hours prior to any application of waterproofing.

Traffic shall not be permitted on the finished surface until the curing period has elapsed.

930.07.06.07.06 Curing Concrete - Formed Surfaces

Curing shall be according to the following:

a) If the formwork is left in place for 96 hours or more, no additional curing shall be required.

b) Where the formwork is removed in less than 96 hours, the concrete shall be cured as specified for unformed surfaces for the remainder of the 96 hour curing period.

930.07.06.08 Latex Modified Mortar Patches

930.07.06.08.01 Placing

Prior to the placement of the mortar, the area to be patched shall be maintained in a wet condition for a period of one hour. Excess water shall be removed from the surface using compressed air immediately prior to the placement of the bonding agent. The surface shall be coated with a thin brush coating of the latex modified bonding agent with no excess in any area. The rate of application of the bonding agent shall be such that the brushed material does not become dry prior to being covered with the mortar. The mixing of the latex modified mortar shall be carried out using mechanical mixers. The latex modified mortar for patching not used within 30 minutes after mixing shall not be used. The latex modified mortar shall not be retempered. The mortar shall be placed and consolidated in the repair area and screeded to the desired level. The surface shall be finished to a smooth and level surface immediately after placement.

The surface shall be closed with no tears or cracks. The inability to produce a uniform closed surface to the patch shall be cause for rejection of the latex modified mortar in the affected area.

930.07.06.08.02 Curing

Latex modified mortar shall be cured according to the requirements of the Curing Latex Modified Concrete Overlay clause. Neither construction traffic nor highway traffic shall be permitted over the patch until the curing period has elapsed.

930.07.07 Remedial Work

Debonded and honeycombed areas shall be removed and replaced. Cracks shall be treated according to the requirements as shown in Table 2.

The method of removal and repair shall be submitted to the Contract Administrator prior to commencement of the work.

930.07.08 Management of Excess Material

Management of excess material shall be according to the Contract Documents.

930.08 QUALITY ASSURANCE

930.08.01 Concrete and Latex Modified Concrete Overlays
Concrete Patches
Latex Modified Mortar Patches
Concrete Refacing

930.08.01.01 Testing

930.08.01.01.01 Sampling, Delivery and Testing of Specimens

Sampling, delivery, and testing of specimens shall be according to OPSS 904. Samples and tests for slump and air content of the concrete shall be made as specified in the Contract Documents.

930.08.01.02 Inspection After Curing

The Contract Administrator shall inspect the work to determine if the completed work contains:

a) areas of debonding.

b) honeycombed areas.

c) cracks.

930.08.02 Testing of Continuous Concrete Mixing Plant for Latex Modified Concrete Overlay

930.08.02.01 General

Tests shall be conducted according to the requirements for testing specified in the Testing of Continuous Concrete Mixing Plant for Latex Modified Concrete Overlay clause of the Construction section.

930.08.02.02 Latex Modifier

Tests shall be performed on the latex modifier.

930.09 MEASUREMENT FOR PAYMENT

930.09.01 Overlays - General

For all types of overlays there shall be no measurement for the following:

a) Concrete discharged prior to the yield test.

b) Concrete produced in excess of that required for the placing operation.

c) Concrete placed on the deck more than 125 mm from the finished edge, after sawcutting of the overlay.

d) Quantity of bonding agent.

930.09.02 Actual Measurement

930.09.02.01 Modification of Deck Drains

For measurement purposes, a count shall be made of the number of deck drains modified.

930.09.02.02 Drainage Tubes in Deck

For measurement purposes, a count shall be made of the number of drainage tubes placed.

930.09.02.03 Place Concrete Overlay

Measurement shall be of the volume of concrete placed in cubic metres by delivery ticket. When their quantities are included on the delivery ticket, deductions shall be made for concrete produced in excess of that required for the placing operation and for that concrete placed on the deck more than 125 mm from the finished edge after sawcutting of the overlay. The total volume shall be calculated to the nearest cubic metre.

930.09.02.04 Place Latex Modified Concrete Overlay

Measurement shall be by volume in cubic metres and shall be calculated from the mixing unit meter register ticket and calibration certificate. A copy of the meter register ticket showing the meter reading at the commencement of the yield test and the completion of each placing operation shall be submitted to the Contract Administrator.

When their quantities are included on the meter register ticket deductions shall be made for concrete produced in excess of that required for the placing operation and for that concrete placed on the deck more than 125 mm from the finished edge, after saw cutting of the overlay.

The total volume shall be calculated to the nearest 0.1 m^3.

930.09.02.05 Concrete Patches, Formed Surface
Concrete Patches, Unformed Surface
Concrete Refacing

930.09.02.05.01 By Area

Measurement shall be by area of the concrete placed in square metres to the depth as specified in the Contract Documents.

The total area will be calculated to the nearest 0.1 m^2.

930.09.02.05.02 By Volume

Measurement shall be of the volume of concrete placed in cubic metres.

The total volume shall be calculated to the nearest 0.01 m^3.

930.09.02.06 Latex Modified Mortar Patches

930.09.02.06.01 By Area

Measurement shall be by area of the mortar placed in square metres to the depth as specified in the Contract Documents.

The total area shall be calculated to the nearest 0.1 m^2.

930.09.02.06.02 By Volume

Measurement shall be by volume of the mortar placed in cubic metres. The volume of in place latex modified mortar shall be calculated to the nearest 0.01 m^3.

930.09.03 Plan Quantity Measurement

When measurement is by Plan Quantity, such measurement shall be based on the units shown in the clauses under Actual Measurement.

930.10 BASIS OF PAYMENT

930.10.01

Modification of Deck Drains - Item
Drainage Tubes in Deck - Item
Place Concrete Overlay - Item
Place Latex Modified Concrete Overlay - Item
Finish and Cure Concrete Overlay - Item
Finish and Cure Latex Modified Concrete Overlay - Item
Concrete Patches, Formed Surface - Item
Concrete Patches, Unformed Surface - Item
Latex Modified Mortar Patches - Item
Concrete Refacing - Item

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment, and Material to do the work.

TABLE 1
Concrete and Latex Modified Concrete Overlay

	Concrete Overlay, Patches and Refacing	**Latex Modified Concrete Overlay**
Cement Content	OPSS 1350	390 ± 6 kg/m^3
Maximum Nominal Size of Coarse Aggregate	13.2 mm	13.2 mm
Slump	70 mm ± 20 mm	180 mm ± 40 mm *
Air Content	OPSS 1350	6.5% maximum *
Chemical Admixture	OPSS 1303	N/A
Latex Modifier	N/A	122 ± 3 kg/m^3
Nominal Minimum 28 Day Strength	30 MPa	30 MPa
* Five minutes after mixing.		

TABLE 2
Treatment of Cracks

	Maximum Width of a Crack mm	**Depth mm**		
		≤ 15.0	> 15.0 < Full Depth	Full Depth
Overlays and Patches to be Waterproofed and Paved	≥ 1.00	Repair	Repair	Repair
Exposed Facings, Overlays, and Patches	> 0.30	Repair or if the linear measurement of crack per m^2 is 20 m or greater, remove and replace concrete.	Repair or if the linear measurement of crack per m^2 is 10 m or greater, remove and replace concrete.	Repair or if the linear measurement of crack per m^2 is 5 m or greater, remove and replace concrete.

Appendix 930-A, November 2014
FOR USE WHILE DESIGNING MUNICIPAL CONTRACTS

Note: This is a non-mandatory Commentary Appendix intended to provide information to a designer, during the design stage of a contract, on the use of the OPS specification in a municipal contract. This appendix does not form part of the standard specification. Actions and considerations discussed in this appendix are for information purposes only and do not supersede an Owner's design decisions and methodology.

Designer Action/Considerations

The designer should ensure that the General Conditions of Contract and the 100 Series General Specifications are included in the Contract Documents.

Related Ontario Provincial Standard Drawings

No information provided here.