CONSTRUCTION SPECIFICATION FOR REPAIRING CONCRETE PAVEMENT AND CONCRETE BASE WITH PRECAST CONCRETE SLABS

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363.01 SCOPE

This specification covers the requirements for repairing concrete pavement and concrete base with precast concrete slabs using either the Fort Miller Super-Slab® Method or the Michigan Method. The work may include both continuous and intermittent slab repairs.

363.02 REFERENCES

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

Ontario Provincial Standard Specifications, Construction

OPSS 350	Concrete Pavement and Concrete Base
OPSS 366	Repairing Concrete Pavement and Concrete Base
OPSS 369	Sealing or Resealing of Joints and Cracks in Concrete Pavement and Concrete Base
OPSS 510	Removal
OPSS 904	Concrete Structures
OPSS 929	Abrasive Blast Cleaning - Concrete Construction

Ontario Provincial Standard Specifications, Material

OPSS 1002	Aggregates - Concrete
OPSS 1301	Cementing Materials
OPSS 1302	Water
OPSS 1303	Admixtures for Concrete
OPSS 1350	Concrete - Materials and Production
OPSS 1355	Precast Concrete - Materials and Production
OPSS 1440	Steel Reinforcement for Concrete
OPSS 1441	Load Transfer Assemblies
OPSS 1442	Epoxy Coated Reinforcing Steel Bars for Concrete

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:

LS-407	Compressive Strength of Moulded Cylinders
LS-449	Method of Test for Load Transfer Test of Concrete Pavement Using a Falling Weight Deflectometer
LS-602	Sieve Analysis of Aggregates
LS-619	Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus
LS-704	Plastic Limit and Plasticity Index of Soils

Designated Sources of Materials (DSM)

MTO Forms:

PH-CC 322 Concrete Construction Report

CSA Standards

A23.2-3C	Making and Curing Concrete Compression and Flexural Test Specimens*
A23.2-1D	Moulds for Forming Concrete Test Cylinders Vertically*
A3000	Cementitious Materials for Use in Concrete**
A3004-C2	Test Method for Determination of Compressive Strengths**

* [Part of A23.1:24/A23.2:24 - Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete]
** [Part of A3000:23 - Cementitious Materials Compendium]

ASTM International

C939-10 Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)

363.03 DEFINITIONS

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

Bedding Grout means a thin non-structural grout pumped into the grout distribution system that is cast in the bottom of the Fort Miller Super-Slab® Method to fill voids beneath the slabs to provide uniform support to the slab.

Concrete Base means a rigid pavement structure, which is overlaid with asphaltic concrete, and may include concrete shoulders.

Concrete Pavement means a rigid pavement structure with an exposed concrete surface and may include concrete shoulders.

Continuous Slab Repair means the continuous replacement of multiple consecutive slabs of concrete pavement or concrete base with inter-connecting precast concrete slabs.

Diamond Grinding means altering the profile and texture of a concrete pavement surface by using grinding equipment that employs diamond tip blades.

Flowable Fill means a mixture of cementing materials, fine aggregate, water and admixtures, used as a leveling material with the Michigan Method.

Intermittent Slab Repair means a 2 to 4.5 m long repair of concrete pavement or concrete base carried out using a single precast concrete slab.

Micro-grinding means the process of removing a thin layer (< 5 mm) of the treated base surface by grinding.

Slabs means precast concrete elements used to repair concrete pavement or concrete base. Where requirements for concrete base and concrete pavement slabs differ, the terms precast concrete pavement slabs and precast concrete base slabs are used, respectively.

363.04 DESIGN AND SUBMISSION REQUIREMENTS

363.04.01 Design Requirements

363.04.01.01 General

The design of the precast concrete slabs shall be either:

a) Fort Miller Super-Slab® Method, or

b) Michigan Method.

363.04.01.02 Flowable Fill Mix Design - Michigan Method

For flowable fill used as a levelling material, the mix shall be designed to provide adequate strength and durability for its intended use.

363.04.01.03 Bedding Grout Mix Design - Fort Miller Super-Slab® Method

For bedding grout, the mix shall be designed to provide adequate strength and durability for its intended use.

363.04.01.04 Proprietary Patching Materials

The proprietary patching material (PPM) selected for use shall be suitable for the application.

PPM shall be used to fill the dowel slots for the Michigan Method and the inverted dovetail slots for the dowel and tie bars for the for the Fort Miller Super-Slab® Method.

The PPM selected for use for the Fort Miller Super-Slab® Method shall be a non-shrink grout capable of being pumped into and completely filling the inverted dovetail slots to encompass dowels or tie bars completing the structural connection between slabs.

363.04.02 Submission Requirements

363.04.02.01 Precast Concrete Slab Repair Plan

At least 2 weeks prior to the start of the trial or start of the work if the trial is not required, the following shall be submitted to the Contract Administrator:

a) Method of precast concrete slab repair for intermittent and continuous slab repairs. If an alternative continuous precast method is proposed, the following supporting documentation shall be submitted for acceptance by Owner:

   i. Demonstration and documentation of good field performance under similar conditions, such as precast, prestressed concrete, and
   ii. Design details.

b) Details of fabrication, transportation, and installation of precast concrete slab repairs.

c) Details on the method of removal of existing pavement (i.e., sawcutting, removal, equipment, and disposal).

d) Details on the method of base preparation.

e) Details on the method of installing precast concrete slab.

f) Details on the method of grouting or placement of proprietary patching material (including equipment to be used for mixing and installing).

g) Details of joint forming and sealing.

363.04.02.02 Flowable Fill Mix Design - Michigan Method

When flowable fill is used as a levelling material, a concrete mix design for flowable fill, according to the Mix Design subsection of OPSS 1350, shall be submitted to the Contract Administrator at least 2 weeks prior to the start of the trial or start of the work if the trial is not required.

363.04.02.03 Proprietary Patching Materials - Product Details

363.04.02.03.01 General

At least 2 weeks prior to the start of the trial or start of the work if the trial is not required, the name of the PPM selected for use and the manufacturer's specifications and recommendations for placement and the strength gain charts shall be submitted to the Contract Administrator. The submission shall also include documentation verifying the suitability of the product for the application and evidence of successful performance in a similar application. The PPM and supporting information provided shall be acceptable to the Owner.

363.04.02.03.02 Strength Gain Charts

Strength gain charts for the PPM shall be developed to determine the rate of strength gain. The minimum length of time for the strength gain chart shall be the period of lane closure specified in the Contract Documents.

The size, preparation and testing of grout cubes shall be according to Testing for Early Strength of PPM section of this specification.

For the development of the strength gain chart, a minimum of six sets of cubes shall be tested for compressive strength. The Contractor is responsible for the timing and frequency of the testing of the cubes.

The PPM strength gain chart shall be developed and submitted to the Contract Administrator at the time of submission of the mix design for PPM.

The above data shall be accompanied by a covering letter, signed by an Engineer, identifying the curing method and test method, and detailing the development of the strength gain chart.

All supporting test data shall not be more than 12 months old at the time the PPM product detail and mix design is submitted to the Contract Administrator.

If the ambient air temperature at time of placement differs from the ambient air temperature during the development of the strength gain charts by more than 10 °C, new strength gain charts shall be submitted.

In the event that field performance or conditions are no longer representative of the conditions under which the submitted strength gain charts were developed, a new mix design and charts shall be resubmitted prior to proceeding with precast concrete slab repairs.

363.04.02.04 Bedding Grout Mix Design - Fort Miller Super-Slab® Method

When bedding grout is used, a concrete mix design for the bedding grout, according to the Mix Design subsection of OPSS 1350, shall be submitted to the Contract Administrator at least 2 weeks prior to the start of the trial or start of the work if the trial is not required.

363.04.02.05 Chipping Hammer

At least 7 Days prior to commencement of the work, a copy of the manufacturer's published specifications on the chipping hammers to be used shall be submitted to the Contract Administrator.

363.04.02.06 Test Results for the Trial Precast Concrete Slab Repair

Test results from the trial precast concrete slab repair shall be submitted to the Contract Administrator, as they become available, and shall include the following:

a) Test results for 28-Day compressive strength of flowable fill, if used.

b) Test results for compressive strength of PPM at the anticipated time of opening of the repair to traffic.

c) Test results for 28-Day compressive strength of PPM.

d) Test results for 12-hour compressive strength of bedding grout, if used.

363.05 MATERIALS

363.05.01 Admixtures

Air entraining and chemical admixtures for flowable fill, bedding grout and bonding agent shall be according to OPSS 1303.

363.05.02 Bedding Grout - Fort Miller Super-Slab® Method

Bedding grout shall be a mixture of cementing materials, fine aggregate, water and admixtures.

The bedding grout shall have a flow rate of 17 to 22 seconds when measured according to ASTM C939.

The compressive strength of the bedding grout shall be a minimum of 2.0 MPa at 12 hours.

363.05.03 Bond Breaker for Dowel Bars

Dowel bars shall be coated with RC-250, Tectyl 506, or an alternative type of material acceptable to the Owner.

363.05.04 Bonding Agent

Bonding agent shall consist of Portland cement, Type GU or Portland limestone cement, Type GUL. Sand shall be according to OPSS 1004. Cementing material shall be according to OPSS 1301.

363.05.05 Cementing Material

Cementing materials for flowable fill, bedding grout and bonding agent shall be according to OPSS 1301.

363.05.06 Epoxy Adhesives

Epoxy adhesives shall be of the type approved for horizontal dowel applications and mixed in the nozzle (cartridge). Epoxy adhesive shall be from the DSM list. Cementitious grouts shall not be permitted for this application.

363.05.07 Expansion Caps for Dowel Bars

Caps shall be tight-fitting and made of compressible, non-absorptive, closed cell polyethylene that will allow approximately 6 mm movement at the end of the dowel bar.

363.05.08 Fine Aggregate for Base Preparation - Fort Miller Super-Slab® Method

Fine aggregate for base preparation shall be produced from a quarry or talus only, with a plasticity index of 0%, when tested according to LS-703 and LS-704 and a maximum micro-Deval abrasion loss of 35, when tested according to LS-619. Fine aggregate means that portion of aggregate material passing the 4.75 mm sieve when tested according to LS-602. Recycled materials shall not be permitted.

363.05.09 Flowable Fill - Michigan Method

Flowable fill shall consist of cementing materials, fine aggregate, water and admixtures.

Fine aggregate for flowable fill shall be according to OPSS 1002.

The compressive strength of the flowable fill mixture shall not be less than 0.5 MPa or greater than 1.0 MPa at 28 Days.

363.05.10 Joint Sealing Compound

Joint sealing compound shall be according to OPSS 369.

363.05.11 Precast Concrete Slabs

Precast concrete slabs shall be according to OPSS 1355 with the following additions:

a) The minimum compressive strength of concrete at 28 Days shall be 30.0 MPa.

b) The nominal maximum size of coarse aggregate shall be 19 mm.

c) For precast concrete pavement slabs and precast concrete base slabs, after all finishing operations are completed and before curing and protection of the concrete, the plastic surface of the concrete shall receive an initial texturing. The initial texturing shall be performed with a longitudinal burlap drag to produce a uniform textured surface. The burlap shall be kept in a clean and damp condition, free from tears and encrusted mortar. Burlap shall not add excessive water to the concrete surface.

d) Precast concrete pavement slabs and precast concrete base slabs that will be exposed to traffic shall receive a final texturing while in a plastic state using equipment manufactured to produce longitudinal tines 3 mm ± 1 mm wide on 16 mm ± 3 mm centres with a tine depth of 4 mm ± 1 mm. Tining shall not extend within 75 mm ± 15 mm of the pavement edge. The surface of the concrete shall be free in all cases from displaced aggregate particles and local projections.

e) Slabs shall be full lane width and shall be 2 to 4.5 m in length. Prior to fabrication, the concrete pavement or concrete base thickness at each repair location shall be determined. Slabs may be cast a maximum of 15 mm thinner than the existing concrete to be repaired to accommodate the bedding material.

363.05.12 Proprietary Patching Materials

Proprietary patching material used for the Michigan Method shall be from the Owner's List of Acceptable Concrete Patching Materials. The list of proprietary patching materials shall be obtained from the Contract Administrator.

Proprietary patching material used for the Fort Miller Super-Slab® Method shall be a product recommended for use by Fort Miller Co., Inc.

The minimum compressive strength of the PPM prior to opening to traffic shall be 20 MPa.

The minimum compressive strength of the PPM at 28 Days shall be 30 MPa.

363.05.13 Tie Bars and Dowel Bars

Tie bars and dowel bars shall be according to OPSS 1440. Tie bar and dowel bars shall be epoxy coated according to OPSS 1442.

363.05.14 Water

Water used for flowable fill, PPM, bedding grout, bonding agent and proprietary patching materials shall be according to OPSS 1302.

363.06 EQUIPMENT

363.06.01 Air Compressor

The compressor for air blasting shall have a minimum capacity of 3.5 m^3/min. The compressed air shall be free from oil and other contaminants.

363.06.02 Chipping Hammer

Chipping hammers shall be hand-held and have a maximum weight of 9.0 kg prior to any handle modification, where applicable, and a maximum piston stroke of 102 mm. All hammers shall have the manufacturer's name and part or model number engraved on them by the manufacturer. All information shall be clearly legible. The manufacturer's published specifications shall be the sole basis for determining weight and piston stroke.

363.06.03 Consolidating Equipment

Internal vibrators used to consolidate the PPM in the dowel bar slots shall have a maximum diameter of 25 mm and shall have a resilient covering that will not damage the epoxy coated dowels during use.

363.06.04 Gang Drill

Gang drills shall consist of not less than three independently powered pneumatic drills. The gang drill shall be capable of drilling through steel and shall not damage adjacent concrete.

363.06.05 Gang Saw

The gang saw shall have gang-mounted diamond saw blades and shall be capable of cutting at least 3 parallel slots simultaneously at a slot spacing of 300 mm within a tolerance of 3 mm.

363.06.06 Screeding Device for Base Preparation

The screeding device used for fine grading for base preparation shall be laser or otherwise mechanically controlled and shall be capable of fine grading fully compacted fine aggregate or flowable fill to a tolerance of 3 mm.

363.06.07 Straight Edges

Straight edge shall be commercially made of metal, and 3 m long.

363.07 CONSTRUCTION

363.07.01 General

Precast concrete slab repairs shall be carried out at the locations identified in the Contract Documents. The work may include both continuous and intermittent slab repairs.

The work may include the following acceptable methods of slab repairs:

a) Intermittent Slab Repair - the Fort Miller Super-Slab® Method and the Michigan Method, as modified by the requirements of this specification; and

b) Continuous Slab Repair - the Fort Miller Super-Slab® Method, as modified by the requirements of this specification, or an alternative continuous precast method with demonstrated and documented good field performance under similar conditions, such as precast, prestressed concrete that is acceptable to the Owner.

Precast concrete slab repairs shall have a load transfer efficiency of greater than or equal to 70%, when testing using a falling weight deflectometer (FWD).

363.07.01.01 Fort Miller Super-Slab® Method

For the Fort Miller Super-Slab® Method, the work shall consist of fabricating precast concrete slabs (i.e., Super-Slab®), sawcutting and removing the existing concrete pavement or concrete base, repairing and compacting the existing underlying material as necessary, placing and grading fine aggregate base material, drilling holes and inserting and securing dowel bars and tie bars, placing precast concrete slabs, installing PPM in inverted dovetail slots, installing bedding grout beneath the slabs, and sealing of joints.

363.07.01.02 Michigan Method

For the Michigan Method, the work shall consist of fabricating precast concrete slabs with dowel bars, sawcutting and removing the existing concrete pavement or concrete base, repairing and compacting the existing underlying material as necessary, constructing dowel bars slots in adjacent existing concrete, placing of flowable fill levelling material, placing precast concrete slabs, installing PPM in dowel bar slots, and sealing of joints.

363.07.02 Trials

363.07.02.01 Proprietary Patching Material Strength Gain Charts

For precast concrete repairs, strength gain charts shall be developed for the purpose of determining the rate of strength development of the PPM. Strength charts shall be developed prior to commencement of the trial precast concrete slab repair. If a trial area is not required, strength gain charts shall be developed prior to construction of the precast concrete slab repair.

363.07.02.02 Trial Precast Concrete Slab Repair

Prior to carrying out the precast concrete slab repair, the ability to successfully carry out the slab repair according to this specification shall be demonstrated to the Contract Administrator by completing a trial precast concrete slab repair within the Contract limits, including all material testing required by specification.

The trial slab repair shall include both intermittent slab and continuous slab repairs. The location of the trial slab repair shall be proposed to the Contract Administrator for approval. The Contract Administrator shall be given a minimum of 48 hours notice prior to the trial slab repair.

The strength gain chart for the PPM strength versus time, according to this specification, shall be verified during the trial.

The Contract Administrator shall allow the slab repair work to continue based on an acceptable visual assessment of the trial and acceptable test results. When the slab repair is rejected, additional trial slab repairs shall be performed until the trial slab repair meets the requirements of this specification.

Unacceptable trial precast concrete slab repairs shall be removed and replaced.

A trial slab repair is not required if the Contractor has demonstrated successful placement of a slab repair using the same equipment, placing personnel and methodology, meeting all specification requirements, within the last 12 months on another MTO Contract.

363.07.03 Operational Constraints

The Contract Administrator shall be notified in writing of the intent to repair the concrete pavement or concrete base 7 Days prior to the commencement of the repairs.

Vehicles shall not be permitted to drive on areas where the concrete pavement or concrete base has been removed, in whole or part.

Perimeter sawcutting of the removal area shall not be carried out more than 7 Days in advance of the expected date of repair.

Placement of bedding grout and PPM shall be carried out as soon as possible after the installation of the precast concrete slab.

The temperature of the flowable fill mixture used for the Michigan Method, as manufactured and delivered, shall be a minimum of 10 ºC. Placement of flowable fill shall not be allowed if the anticipated air temperature will be 2 ºC or less in the 24 hour period following the proposed time of placement.

The PPM shall not be placed when the air temperature is outside the manufacturer's recommended temperature range or is likely to fall or rise outside the range throughout the duration of the material placing operation. Prior to placing the PPM, it shall be demonstrated to the Contract Administrator that the existing concrete temperature in the repair area meets the manufacturer's requirements by measuring and recording the substrate temperatures using a contact thermometer or infrared thermometer with an accuracy of ± 1ºC.

Construction vehicles, equipment, or traffic shall not be permitted to travel on the precast repair until the PPM has attained a minimum compressive strength of 20 MPa.

Repairs at each location shall be completed within the time period specified in the Contract Documents. If the repair is not progressing at a rate that will permit the full restoration of traffic within the allowable time period, appropriate measures acceptable to the Contract Administrator shall be undertaken to allow opening of the road to traffic. Full depth precast concrete slab repairs, according to the Repairs clause of this specification, shall replace the above temporary work during the next scheduled closure.

363.07.04 Removals

Repair areas shall be as specified in the Contract Documents or as demarcated by the Contract Administrator.

A template shall be used to precisely delineate the limits of the areas to be repaired within a tolerance of 12 mm. Repairs shall be the full width of the lane and full depth of the concrete pavement or concrete base.

Concrete removal shall be carried out according to OPSS 510. The outer limits of the concrete removal area shall be sawcut full depth. Where exposed concrete pavement or concrete base conditions are sufficient to support traffic loading, advanced sawcutting is permitted up to 7 Days in advance of the expected date of removal. Sawcuts shall extend no more than 100 mm into existing adjacent concrete that is to remain in place. Sawcuts in concrete that are to remain in place shall be filled with an epoxy resin acceptable to the Owner.

Concrete removal shall be by a lift-out method rather than breaking in place. Adjoining concrete, asphalt and underlying base shall remain undisturbed. Heavy breaking equipment such as hoe rams shall not be used in the removal operation. The concrete pavement or base shall not be broken in place.

If during the removal, the underlying material below the concrete pavement or concrete base is disturbed, removed, or damaged, the underlying materials shall be repaired and/or replaced at no additional cost to the Owner.

When the underlying material is open graded drainage layer (OGDL), repair and/or replacement shall be with Granular O meeting the requirement of OPSS 1010 or 100% crushed 9.5 mm clear stone meeting the requirement of OPSS 1004.

When the underlying material is granular, the material requirements shall be according to OPSS 1010. Compaction of the granular materials shall be by means of:

a) A plate tamper with a minimum mass of 80 kg, or

b) A self-propelled (walk-behind) single or tandem steel drum with a minimum static mass of 500 kg used in vibration mode.

If the concrete removal operation causes damage, cracks or displacement of the adjacent concrete or asphalt:

a) Corrective action shall be taken immediately; and

b) The damaged concrete or asphalt shall be repaired according to the Repairs subsection of this specification.

363.07.05 Base Preparation

363.07.05.01 General

Levelling material shall be either a flowable fill for the Michigan Method or fine aggregate for the Fort Miller Super-Slab® Method meeting the requirements of this specification.

Micro-grinding of the existing treated base is recommended if minor adjustment for the base level is required.

363.07.05.02 Flowable Fill - Michigan Method

The batching equipment shall have devices designed to measure the specified quantities of each component material and mixing shall be of sufficient duration to ensure uniform consistency of the flowable fill. Water content shall be maintained so that compressive strengths are achieved and a uniform, flowable mixture is developed that is self-levelling when placed.

363.07.05.03 Fine Aggregate - Fort Miller Super-Slab® Method

Fine aggregate shall be compacted then fine graded using a screeding device capable of grading the fully compacted bedding material to the required tolerance.

363.07.06 Precast Concrete Slab Installation - Michigan Method

363.07.06.01 Sawcutting Dowel Bar Slots

Dowel bar slots shall be created using gang saws. The slots shall be 65 mm wide by 450 mm long and to a maximum depth to allow the dowel bar to be placed at mid-depth of the slab with 12 mm cover under the bar. The slots shall be parallel to the centreline of the roadway with a maximum tolerance of 3 mm from a parallel line. Over-cutting dowel bar slots shall not be permitted.

Equipment shall not cause damage to the existing pavement. Immediately after the sawing operation, slots and joints shall be flushed with water under pressure in one direction to remove the slurry. All slurry from the sawcutting operation shall be removed from the slot and pavement.

363.07.06.02 Concrete Removal in Dowel Bar Slots

Chipping hammers shall be used to remove concrete within the slots. Concrete shall be removed to ensure the bottom of the slot is level and in such a manner as to prevent damage to the concrete remaining in place. The chipping hammers shall not be permitted to break through the concrete.

If the concrete removal operation causes damage, cracks or displacement of the adjacent concrete or asphalt:

a) Corrective action shall be taken immediately; and

b) The damaged concrete or asphalt shall be repaired according to the Repairs subsection of this specification.

363.07.06.03 Slot Cleaning

All concrete surfaces within the slot shall be solid, free from loose or unsound fragments. All concrete surfaces shall be abrasive blast cleaned according to OPSS 929 and all dust and loose material shall be removed from the prepared surface by using compressed air.

363.07.06.04 Precast Concrete Slab Installation

The installation of precast concrete slabs shall not damage the adjacent concrete or asphalt.

Immediately prior to placement of each slab, bond breaker shall be applied to the vertical face of the transverse joints of the existing concrete.

The use of pry bars or wedges in joints for alignment purposes shall not be permitted.

The vertical differential between adjacent pavement shall be less than 6 mm. If the vertical differential is greater than 6 mm, the surface shall be brought to the required tolerance by diamond grinding.

The maximum allowable transverse joint width shall be 12 mm and the maximum allowable longitudinal joint width shall be 20 mm.

363.07.06.05 Placing the PPM in Dowel Bar Slots

All concrete surfaces within the slot shall be prepared according to the PPM manufacturer's requirements. The slot shall be clean and free of standing water immediately prior to placement of the bonding agent, if used, and PPM. Standing water shall be removed from the slots using compressed air.

A bonding agent shall be used to treat the existing concrete surface when required by the PPM manufacturer.

The bonding agent and PPM shall be mixed, placed and finished according to the requirements of the PPM manufacturer with the following exceptions or additions:

a) A metering or measuring device shall be used to establish the correct amount of mixing water for the PPM;

b) All batches of the PPM shall be consistent;

c) The temperature of the plastic PPM at the time of discharge from the mixer, shall be between 10 and 25°C;

d) The PPM shall be vibrated to consolidate the material into the slot and around the dowel;

e) The PPM shall be finished flush with the surface of the concrete and all excess material removed immediately;

f) Moist curing using wet burlap according to OPSS 904 to maintain 100% relative humidity shall be immediately applied after finishing of the PPM and shall be maintained for at least 24 hours or until the time of opening to traffic;

363.07.07 Precast Concrete Slab Installation - Fort Miller Super-Slab® Method

363.07.07.01 Dowel Bar and Tie Bar Installation

Tie bars and dowel bars shall be installed as specified in the Contract Documents. Tie bars are only required for continuous repairs.

Gang drills shall be used to drill holes in the existing concrete for insertion of dowel bars and tie bars. Where existing dowel bars are encountered, the gang drill shall be used to drill through the steel. The diameter of the drill holes shall be no more than 5 mm larger than the diameter of the dowel bars or tie bars. Drill holes shall be thoroughly cleaned using a wire brush and compressed air from the back of the drill hole outwards. Drilling equipment shall be used in a manner to ensure adjacent pavement is not damaged.

Dowel bars and tie bars shall be secured into the existing concrete with an epoxy adhesive. The epoxy adhesive shall be injected into the back of the cleaned drill hole and the dowel bar or tie bar with grout retention disks attached, and shall be inserted to ensure the bars are completely encased with epoxy adhesive for the full depth of the hole.

363.07.07.02 Precast Concrete Slab Installation

Immediately prior to placement of each new slab, bond breaker shall be applied to the vertical face of the transverse joint of the previously placed slab or existing concrete and dowels that protrude from it. Precast concrete slabs shall be guided into position during installation using guide bars inserted in bedding grout port holes to align slabs during setting. The use of pry bars or wedges in joints for alignment purposes shall not be permitted. The installation shall not damage the adjacent concrete or asphalt.

The vertical differential between adjacent slabs shall be less than 6 mm. If the vertical differential is greater than 6 mm, the slab shall be removed, the base re-graded, and the slab reset until the differential is less than 6 mm prior moving on to the next slab.

The maximum allowable longitudinal and transverse joint widths shall be 12 mm for continuous repairs. For intermittent slab repair, the maximum allowable transverse joint width shall be 12 mm and the maximum allowable longitudinal joint width shall be 20 mm.

If precast concrete slabs are to be opened to traffic before they are grouted, incompressible shims shall be placed at approximate ¼ points in both the transverse and longitudinal joints to maintain horizontal alignment of the new precast slabs until they are grouted.

If un-grouted slabs are vertically displaced so that the vertical differential is greater than 6 mm as described above, the slab shall be removed, the base re-graded, and the slab reset prior to grouting, or the surface shall be brought to the required tolerance by diamond grinding.

363.07.07.03 Placing the Proprietary Patching Material

Foam grout dams shall be installed at the open ends of the transverse joint to be grouted to prevent PPM from escaping during the installation.

PPM shall be mixed according to the instructions provided by the manufacturer. The volume of water shall be measured accurately for each batch by weighing the batch water or by using calibrated pails that are perforated at a level to ensure the correct amount of water is mixed with each bag of grout. PPM shall be pumped in the back port of each dowel slot until it comes out the second port in the same slot. Foot shall be placed over the second port and pumping shall be continued until the grout flows along the joint to the next slot. The same procedure shall be repeated for the back port of the next slot. The PPM level in the previously filled ports shall be continually monitored to ensure the PPM is flush with the slab. PPM shall be pumped into the ports, as necessary to ensure the level of the PPM in the joints and slots is even with the top of the slab.

363.07.07.04 Placing the Bedding Grout

Bedding grout shall be placed after the PPM has been installed. Bedding grout shall be pumped in the lowest port of the slab until it comes out the corresponding port at the other end of the slab. While filling the remaining ports in the slab, the grout level shall be continually monitored in previously filled ports and grout added, as required, to keep the grout level in the ports even with the top of the slab. The head pressure shall be adequately maintained during the grouting operation to ensure the bedding grout fills all voids under the slab.

Before the bedding grout fully sets, the top 50 ± 5 mm of bedding grout in each port shall be removed and replaced with PPM, mixed and cured according to the Placing the Proprietary Patching Materials clause. The PPM in all ports shall be finished flush with the surface of the concrete and all excess material removed immediately.

363.07.08 Tolerances

363.07.08.01 Dowel Bar and Tie Bar Tolerances

Dowel bars shall be installed mid-depth of the concrete slab in a plane with the pavement or base surface and parallel to the centreline of the road. Tie bars shall be installed mid-depth of the concrete slab in a plane with the pavement or base surface and perpendicular to the longitudinal lane edge sawcut face. The tolerance for the alignment of dowel bars and tie bars shall be ± 15 mm along the length of the bar in both the vertical and horizontal planes of the pavement or base and parallel to the direction of traffic.

363.07.08.02 Surface Tolerances

The surface of the precast concrete slab repair shall join flush with the existing concrete pavement or concrete base.

The surface of intermittent slab repairs slabs shall be such that when tested with a 3 m long straight edge placed in any direction, there shall be no gap greater than 6 mm between the bottom of the straight edge and the surface of the pavement.

The surface of continuous slab repairs shall be such that when tested with a 3 m long straight placed in any location and direction, including the edge of pavement, except across the crown or drainage gutters, there shall be no gap greater than 6 mm.

363.07.09 Joint Sealing

All longitudinal and transverse joints shall be sealed according to OPSS 369.

363.07.10 Material Sampling and Testing

363.07.10.01 General

Field sampling and testing shall be performed by a person certified according to the Testing of Plastic Concrete clause of OPSS 1350.

All samples shall be accompanied by a copy of the completed MTO form PH-CC-322, Concrete Construction Report.

363.07.10.02 Compressive Strength of Flowable Fill

One set of two 150 x 300 mm cylinders per lot shall be cast, cured and transported according to CSA A23.2-3C, for 28-day compressive strength testing by the Owner.

All concrete test cylinders shall be cast in moulds. The moulds shall be single use moulds according to CSA A23.2-1D and made of plastic with a lid. The lids shall be chemically and physically compatible with the concrete and shall provide watertight closure for the moulds.

The air temperature immediately adjacent to the cylinders shall be continuously recorded and monitored during the field-curing period. The maximum time interval for recording the temperature shall be every 15 minutes.

363.07.10.03 Bedding Grout

363.07.10.03.01 Flow Rate

The bedding grout shall be sampled and tested for the flow rate according to ASMT C939. The bedding grout shall acceptable if the flow rate is between 17 and 22 seconds. Unacceptable bedding grout shall not be used in the work.

363.07.10.03.02 Compressive Strength

Sets of cubes for 12-hour compressive strength determination of the bedding grout shall be prepared.

Testing of the 12-hour compressive strength shall be done by the Owner and the stainless steel molds shall be provided by the Contract Administrator.

Determination of the 12-hour compressive strength shall be according to CSA A3004-C2, with the following amendments:

a) A set of cubes shall consist of 6 test specimens for the determination of compressive strength at 12-hours.

b) The specimens shall be stored on site at a temperature between 15 °C and 25 °C until transportation to the designated laboratory.

c) The specimens shall be cured on site for as long as possible and transported to the laboratory in the moulds, immediately prior to testing at 12-hours.

The test specimens shall be accompanied by a transmittal form and MTO Form PH-CC-322, Concrete Construction Report.

363.07.10.04 Compressive Strength of Proprietary Patching Material

363.07.10.04.01 General

Sets of cubes for early strength determination of the PPM, in addition to the cubes required for determination of strength at 28 Days, shall be prepared.

Testing of early strength shall be done by the Contractor and the stainless steel moulds shall be provided by the Contractor. Testing of 28-Day strength shall be done by the Owner and the stainless steel moulds shall be provided by the Contract Administrator.

Determination of compressive strength shall be according to CSA A3004-C2, with the following amendments:

a) A set of cubes shall consist of 6 test specimens for the determination of compressive strength for each test age.

b) The specimens shall be stored on site at a temperature between 15 °C and 25 °C and shall not be moved prior to demoulding.

c) For early strength determination, the Contractor shall be responsible for the timing of demoulding and transportation of the test specimens to the designated laboratory.

d) For 28-day strength determination, the specimens shall be demoulded and transported to the designated laboratory within 24 hours ± 4 hours.

e) For 28-day strength determination, the test specimens shall be demoulded on site and shall be paced in a sealed white opaque plastic bag containing at least 250 ml of water and maintained at a temperature between 15 °C and 25 °C, for transportation to the designated laboratory.

The test specimens shall be accompanied by a transmittal form and MTO Form PH-CC-322, Concrete Construction Report.

363.07.10.04.02 Early Strength

Prior to early loading and opening to traffic, it shall be demonstrated that the PPM has attained a minimum compressive strength of 20 MPa.

The laboratory conducting the early compressive strength tests shall be certified as a concrete testing laboratory by the Canadian Council of Independent Laboratories (CCIL) that has successfully participated in the MTO correlation program.

A minimum of two sets of six cubes shall be cast from the final repair area of each closure.

The test results shall be immediately provided to the Contract Administrator prior to opening the repair to traffic.

363.07.10.04.03 28-Day Compressive Strength

Two sets of 6 cubes shall be cast per lot, one set for acceptance testing and one set for referee testing, if invoked. The Contract Administrator shall randomly select the batch from which the acceptance and referee samples are taken.

363.07.11 Repairs

Precast concrete slabs that do not meet the surface tolerance requirements shall be removed and replaced, or repaired by diamond grinding. Diamond grinding shall be according to OPSS 350.

Concrete pavement or concrete base adjacent to precast concrete slab repairs, that is damaged, cracked or displaced during removals or installation of the precast concrete slab shall be removed and replaced with new concrete. The damaged concrete shall be cut back full depth to sound concrete and repaired according to OPSS 366.

Asphalt surfaces damaged during the removal process shall be repaired at no additional cost to the Owner.

All repairs shall be at no additional cost to the Owner. A repair proposal shall be submitted to Contract Administrator for approval. Repairs shall not proceed until written acceptance of proposal has been received.

363.07.12 Access for Quality Assurance

Electrical power, scaffolding, protection from the weather, and unhindered access for inspection and testing of all the work, including assessment of repairs, shall be provided to the Contract Administrator or Owner's representative.

Any debris and obstructions shall be removed to allow access for the purposes of inspection.

363.07.13 Management of Excess Material

Management of excess material shall be as specified in the Contract Documents.

363.08 QUALITY ASSURANCE

363.08.01 Field Inspection

The Contract Administrator will inspect the precast concrete slabs prior to and after installation to determine if the work contains any of the following defects:

a) Cracking, voids, honeycombing, delaminations or spalling of the concrete or PPM.

b) Unrepaired sawcuts in the adjacent pavement or base from the removal process.

c) Rocking or lack of support of precast concrete slab.

d) Precast concrete slabs that do not meet the specified surface tolerance.

e) Tining that does not meet the requirements of this specification.

f) Any other defects and deficiencies, not meeting the requirements of this specification.

Any work that does not meet the requirements of this specification and contains defects or deficiencies shall be deemed rejectable.

363.08.02 Acceptance of Water, Admixtures, and Cementing Materials

Acceptance of water, admixtures and cementing materials shall be according to OPSS 1350.

363.08.03 Acceptance of 28-Day Compressive Strength of Flowable Fill

A lot shall consist of all the flowable fill from one Day's placement. One set of two 150 x 300 mm cylinders shall be tested for 28-day compressive strength per lot to determine the acceptance of the lot. The compressive strength of a lot shall be the average of the set of the 2 acceptance cylinders.

Compressive strength shall be determined according to LS-407, with the exception that specimens shall be air cured in their moulds until they are tested.

Compressive strength shall be considered acceptable when the lot strength is not less than 0.5 MPa or greater than 1.0 MPa.

Unacceptable flowable fill shall be deemed rejectable.

363.08.04 Acceptance of Compressive Strength of Bedding Grout

A lot shall consist of all the bedding grout from 4 hours of production or if the production period is less than 4 hours, all the bedding grout from one Day's placement. One set of six cubes shall be tested for 12-hour compressive strength per lot to determine the acceptance of the lot. The compressive strength of a lot shall be the average of the set of the 6 cubes.

Compressive strength shall be determined according to CSA A3004-C2.

Compressive strength shall be considered acceptable when the lot strength is greater than or equal to 2.0 MPa at 12 hours.

Unacceptable bedding grout shall be deemed rejectable.

363.08.05 Acceptance of 28-Day Compressive Strength of Proprietary Patching Material

A lot shall consist of all the PPM from 4 hours of production or if the production period is less than 4 hours, all the PPM from one day's placement. One set of six cubes shall be tested for 28-day compressive strength per lot to determine the acceptance of the lot. The compressive strength of a lot shall be the average of the set of the 6 cubes.

Compressive strength shall be determined according to CSA A3004-C2.

Compressive strength shall be considered acceptable when the lot strength is greater than or equal to 30.0 MPa at 28 days.

Unacceptable PPM shall be deemed rejectable.

363.08.05.01 Referee Testing

The referee testing process for proprietary patching material compressive strength is based on duplicate cubes cast at the same time as the acceptance cubes.

Referee testing of compressive strength for a lot may only be invoked by the Contractor within 3 Business Days of receiving the test results for that lot.

The referee laboratory shall be designated by the Owner. Referee test results shall be forwarded to the Contractor as they become available.

If the difference between the referee test result and the acceptance test result is less than or equal to the confirmation value, then the acceptance test result is confirmed, and the acceptance test result shall be used in the determination of acceptance for the proprietary patching material. If the difference between the referee test result and the acceptance test result is greater than the confirmation value, the acceptance test result is not confirmed, and the acceptance test result shall be disregarded and the referee results shall be used in the determination of acceptance. The confirmation value for confirming the acceptance test result shall be the greater of 10% of the specified strength or 10% of the strength of the acceptance cubes, expressed to one decimal place.

363.08.05.01.01 Referee Testing Cost

The cost of compressive strength referee testing shall be as specified in the Contract Documents.

When the referee result confirms the acceptance test result, the Contractor shall be charged the cost of compressive strength referee testing. When the referee result does not confirm the acceptance test result, the Owner shall bear the cost.

363.08.06 Falling Weight Deflectometer Acceptance Testing

Falling weight deflectometer (FWD) testing shall be carried out on the approach and leave joints of each precast concrete slab to determine the load transfer efficiency across the transverse joints according to OPSS 366.

The new joint shall be acceptable if FWD test results for both the approach and leave slabs indicate load transfer efficiency of 70% or greater. The new joint with a load transfer efficiency less than 70% shall be deemed rejectable.

363.09 MEASUREMENT FOR PAYMENT

363.09.01 Actual Measurement

363.09.01.01 Precast Concrete Slab Repair

Measurement of the precast concrete slab repair placed shall be by area in square metres. The total area shall be calculated to the nearest 0.1 m^2.

363.09.02 Plan Quantity Measurement

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

363.10 BASIS OF PAYMENT

363.10.01 Precast Concrete Slab Repair - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, and Material to do the work, subject to payment adjustments according to OPSS 1355.

Measures taken to permit full restoration of traffic within the allowable time period shall be at no additional cost to the Owner.

Precast concrete slabs rejected by the Contract Administrator shall be removed and replaced with new concrete as specified elsewhere in the Contract Documents at no additional cost to the Owner.

Concrete adjacent to and damaged by the removal or installation process shall be repaired at no additional cost to the Owner.

Repairs, including grinding, shall be at no additional cost to the Owner.

Asphalt surfaces damaged during the removal or installation process shall be repaired at no additional cost to the Owner.