**Removal of Asphalt Pavement, Partial-Depth - Item No.**

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| Special Provision |

**Amendment to OPSS 510**

**510.03 DEFINITIONS**

OPSS 510.03 is amended by the addition of the following definitions:

**Automatic Machine Guidance** means equipment mounted with instruments containing project specific digital data to remotely establish position and control equipment operation to accurately perform construction work to the specified line and grade.

**Digital Levelling** means the use of an electronic laser to scan a level rod and obtain accurate elevation readings.

**DWG** means a proprietary binary file format for storing design data and metadata in the native format for several computer aided design (CAD) computer software applications.

**DXF** means an acronym for Drawing Interchange Format and is a CAD file format commonly used for “AutoCAD” computer software applications.

**Ontario Land Surveyor** means an individual licensed by the Association of Ontario Land Surveyors to practice in the Province of Ontario.

**Survey Registration Point** means a point on the ground with its position precisely determined for use as a reference by other measurement and guidance instruments.

**Total Station** means an optical surveying instrument that combines the functions of a theodolite and electronic distance meter to measure angles and distances and calculate coordinates to a high level of accuracy.

**XML** means an acronym for Extensible Markup Language, a text-based file format that uses custom tags to define objects and the data within each object.

**510.04 DESIGN AND SUBMISSION REQUIREMENTS**

OPSS 510.04.02 of OPSS 510 is amended by the addition of the following clause:

**510.04.02.01 Digital Road Surface and Design Models**

Digital road surface model (DRSM) and digital design model (DDM) files meeting the requirements of this specification shall be submitted to the Contract Administrator seven Days prior to commencement of removal of asphalt pavement, partial-depth work according to OPSS 510. The DRSM and DDM shall be submitted in DXF, DWG, and XML format with any measurement units corresponding to those used by the Contract Documents.

The DSRM shall be digitally sealed and signed by an Ontario Land Surveyor or Engineer with specialist training in Geomatics. The DDM shall be digitally signed and sealed by an Engineer. The submission shall be accompanied by a technical report that includes the following:

a) Description of road surface survey methodology.

b) DRSM creation software and method.

c) A list of all quality control cross section measurement locations and points in three dimensions, and the DRSMz, △z, and σz for each location

d) Analysis of water drainage.

e) Method of optimizing the DDM as specified.

f) Certification the DDM meets the requirements of the Contract Documents, including crossfall.

**510.07 CONSTRUCTION**

Clauses OPSS 510.07.06.04 and OPSS 510.07.06.04.01 are deleted in their entirety and replaced by the following:

**510.07.06.04 Removal of Asphalt Pavement, Partial-Depth**

**510.07.06.04.01 General**

The work shall include the use of road surface survey, digital modelling, and automatic machine guidance for high accuracy partial depth asphalt removal by milling. Milled material shall be managed as specified in the Contract Documents.

**510.07.06.04.02 Operational Constraints**

Prior to commencing removal operations, all debris, deleterious material, and existing windrows shall be removed from the roadway surface, including material beyond the theoretical roadway width to provide positive drainage.

The surface remaining after removal shall have a constant and continuous crossfall matching the specified surface course crossfall. The surface remaining after removal shall have an even texture and be free of significantly different grooves and ridges in all directions.

Removed asphalt pavement material shall not remain on the roadway after completion of the Day's operation. Placing of the material on grade other than a bituminous surface prior to hauling to a stockpile shall not be permitted.

After partial depth removal, the gap between the top of milled surface and the bottom of a 3 m straightedge placed anywhere in any direction on the milled surface shall not exceed 6 mm.

Prior to opening the lane to traffic after partial-depth pavement removal, adjacent granular shoulder material shall be reshaped and compacted to ensure proper drainage of the milled surface and adjoining shoulders.

Partial-depth asphalt pavement removal operations and the resulting surfaces from partial-depth asphalt removal operations shall not be permitted between November 16th and June 1st, unless approved by the Contract Administrator.

**510.07.06.04.03 Road Surface Survey**

The road surface survey does not require the monumentation and surveying specified in the Ontario Specification for GPS Control Surveys or MTO Vertical Survey Control Specifications. Survey control work shall be sufficient to achieve the specified accuracy requirements.

Survey registration points shall be established at an interval not exceeding 150 m along the edge of pavement in both directions. The registration points shall have a horizontal accuracy of 30 mm and a vertical accuracy of 4 mm established by digital differential leveling with respect to existing geodetic control at 95% confidence.

The survey registration points shall be referenced to the Owner’s geodetic control and benchmarks at the limits of the removal of asphalt pavement, partial depth. The geodetic control and benchmarks used shall be sufficiently distant from construction operations to be protected from disturbance.

A high-density survey of the existing asphalt pavement surface area using high accuracy methods shall be used to collect a minimum of 1000 measured points / m2 or of higher density as required to meet the standard deviation requirements specified herein. Each point shall be measured in three dimensions. The high-density survey shall be registered to the surveyed registration points.

Quality control cross section measurements using total station at 12 locations or 1 location per km, whichever is greater, evenly distributed along the length of the removal of asphalt pavement, partial depth work shall be obtained independent of the high-density survey. At each location, the pavement cross section shall be surveyed in three dimensions with a survey point spacing of not more than 100 mm, including a survey point at all grade breaks.

The quality control cross section measurements shall be recorded separately from the high-density survey data. The location of survey registration points within 150 m of each cross section survey location shall also be measured and recorded in three dimensions using the total station.

Quality control cross section and survey registration point measurements shall be submitted to the Contract Administrator within 2 Days of being recorded.

**510.07.06.04.04 Digital Modelling**

A digital road surface model (DRSM) of the existing asphalt pavement surface area shall be prepared from the high-density survey. The maximum spacing of the DRSM triangulated irregular network (TIN) shall be 150 mm.

For each of the quality control cross-section measurement points:

a) The DRSM elevation, DRSMz, at the same x,y location as the cross section measurement point shall be determined by TIN interpolation.

b) The elevation difference between the DRSMz elevation and the field measured elevation by total station, △z, shall be calculated in mm.

The standard deviation of the calculated elevation differences for all the points at each cross section location, σz, shall not exceed 8 mm.

In the event the specified standard deviation is not met at all quality control locations, the pavement surface shall be resurveyed where required according to the Road Surface Survey clause, including new independent quality control cross section measurements, a new DRSM created, and the standard deviations recalculated with the new independent quality control point measurements replacing the old. This process shall continue until the specified standard deviation requirement is met at all locations.

A DRSM meeting the standard deviation accuracy requirement shall be used to create a digital design model (DDM) of the milled surface resulting from the removal of asphalt removal, partial depth work, and the subsequent layer(s) of asphalt materials to be placed.

The DDM milled surface design shall:

a) minimize the need for asphalt padding or levelling course;

b) meet all crossfall and super-elevation (transverse profile) requirements as specified in the Contract Documents;

c) provide for a smooth longitudinal profile in all traffic lanes with changes in longitudinal gradient, exclusive of gradient changes due to vertical alignment curvature, not exceeding \*\*H:1V;

d) match the elevation of fixed appurtenances including curbs, manholes, catchbasins, barrier walls, and intersecting roadways and entrances;

e) maintain positive drainage of the roadway surface to outlets; and

f) maintain a minimum \*\*\* mm remaining asphalt pavement thickness after the removal of asphalt pavement, partial-depth work.

Existing asphalt pavement thicknesses are specified in the Contract Documents.

The DDM shall not deviate from the requirements of the Contract Documents, except with the approval of the Contract Administrator. Proposed deviations shall be submitted to the Contract Administrator with a rationale and shall not proceed without the Contract Administrator’s written approval.

**510.07.06.04.05 Automated Machine Guidance**

An automatic machine guidance (AMG) system shall be installed on the milling equipment used for the work of removal of partial depth asphalt pavement removal. The AMG system shall be capable of precise three-dimensional control of equipment movement using satellite and local referencing.

The DRSM and DDM shall be used to prepare a digital machine control file for upload to the AMG system.

The AMG system and digital machine control file shall automatically control the milling equipment such that the existing asphalt pavement is partially removed over its entire surface to match the vertical dimension of the DDM milled surface to within a ±5 mm tolerance.

The Contract Administrator will carry out total station measurements of the milled surface to verify the ±5 mm tolerance is met.

**510.07.06.04.06 Temporary Ramping**

As part of the work of partial-depth pavement removal, at the end of each completed portion and prior to opening to traffic, temporary transverse ramping shall be constructed at a slope not steeper than 120H:1V. The temporary transverse ramping shall be removed as part of continuing the removal of asphalt pavement, partial-depth operation from the ramping location or prior to placing pavement materials at the ramping location.

If, due to unforeseen circumstances, partial depth pavement removal cannot be completed to the same station for the full pavement width prior to shut down at the end of the day, then as part of the work of partial-depth pavement removal, temporary longitudinal ramping, when permitted, shall be constructed at a slope not steeper than 10H:1V prior to opening to traffic. The temporary longitudinal ramping shall be removed within 1 Day or as agreed to by the Contract Administrator in the event of weather or access restrictions.

Temporary longitudinal ramping shall not be permitted when either of the following conditions exist:

a) the ramping height would be greater than 50 mm, or

b) the pavement slope would cause water to accumulate at the edge of the ramping and extend onto an adjacent lane or shoulder that will be open to traffic.

All costs associated with temporary ramping, including ramping material, shall be deemed to be included in the item price for Removal of Asphalt Pavement, Partial Depth.

INSTRUCTIONS TO DESIGNERS:

\*\* Replace \*\* with 400 for freeways, 300 for arterial highways, and 200 for collector and local highways.

\*\*\* Specify the minimum thickness of asphalt pavement to remain after milling, giving consideration to the depths of pavement necessary to be removed to achieve geometric requirements.

**WARRANT:** Always with this tender item on selected Contractor milled surface design trial projects in full consultation with the Geotechnical Section, Geomatics, and Contract Delivery, with thorough consideration of the following:

* Higher benefits achieved for mill/pave of rutted, distorted, rough pavement requiring extensive (~80% of road section) crossfall correction
* Higher benefits for multi-lane pavements with turn lanes, tapers, etc and projects with staged pavement rehabilitation
* Sufficient pavement depth to limit risk of “punch-through” to granular base by variable depth / optimized milling
* Not appropriate for projects with more than nil / minimal padding expected
* Close coordination between Contract Administrator and project design staff is required, to confirm design requirements met
* Potential for contamination of reclaimed asphalt pavement, on projects with premium quality surface course

 Not to be used in combination with NSSP PVMTXXXX.