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

Special Provision No. PVMTXXXX

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 DRSM 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 $DRSM_z$, $\triangle_z$, and σ_z 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, with a smooth transition where crossfall transitions are required. 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 top of 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

A geodetic horizontal and vertical control network shall be established within the highway corridor.

The vertical control component shall be established with reference to CGVD28 and in accordance with *MTO Vertical Survey Control Specifications* and meeting an accuracy of **2nd Order**, i.e., maximum vertical misclosure of forward and backward runs and overall of no more than 8 mm*√km, where km represents the distance in kilometres. General Specifications (Section 3) and particular specifications must be met, with the following modifications:

a. Stability checks of primary benchmarks at both ends of the project are not required where measured height differences are within 2nd Order tolerance and elevations conform to the most recent topographical survey data.
b. Where there are no existing primary benchmarks within 7 km of either end of the project, new geodetic benchmarks may be established by GNSS means.
c. Existing primary benchmarks or newly established benchmarks should be checked and reported on for conformity with the most recent MTO topographical survey data.
d. The geodetic control monuments shall be sufficiently distant from construction operations to be protected from disturbance.
e. Iron bar benchmarks need not be capped with bronze or brass castings but must be sufficiently stable and precisely measurable to suit the control survey specifications.

Horizontal control points shall be distributed along the route at a maximum spacing of 500 m and integrated with any existing primary horizontal control to local accuracy of 2 cm using the NAD83(CSRS) reference system. The adjustment epoch must match that of any already established by the design project.

Survey registration points shall be established at an interval not exceeding 150 m along the edge of pavement. The registration points shall have a horizontal accuracy of 30 mm with respect to horizontal control and a vertical accuracy of 1 mm established with respect to the vertical geodetic control network at 95% confidence.

Full documentation of the geodetic control and registration point must be provided to show that the method of establishment and resulting accuracy meets the MTO specification.

A high-density survey of the existing asphalt pavement surface area using shall be used to collect a minimum of 500 measured points / m^2 and referenced to geodetic control.

Quality control measurements shall be sampled within sections of pavement independently of the high-density survey by using a total station midway between registration points. Total station positions will be confirmed by no fewer than three Face1/Face2 observations to control or registration points with residual errors no worse than 2 mm vertical and 20 mm horizontal. Each section will measure 5 m long x (the width of highway). The number of swath samples shall be 12 locations evenly distributed along the length of the removal of asphalt pavement. Each sample section will comprise four cross-section lines spaced two metres apart. Each cross-section line shall comprise 3D survey point measurements spaced laterally at not more than 100 mm.

Quality control sample swaths and survey registration point measurements shall be submitted to the Contract Administrator within 2 Days of being recorded. Cross-section comparisons and statistical analyses shall be provided in list and graphical formats.

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 swath measurement points:

a) The DRSM elevation, $DRSM_z$, at the same x,y location as the swath measurement point shall be determined by TIN interpolation.

b) The elevation difference between the $DRSM_z$ elevation and the field measured elevation by total station, $\triangle_z$, shall be calculated in mm.

The average of the calculated elevation differences for all the points in each swath shall not exceed 2 mm and the standard deviation of the differences, σ_z, shall not exceed 3 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 / or 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 shall have total station measurements made by an Ontario Land Surveyor of the top of the milled surface to verify the ±5 mm tolerance is met. The total station shell be used mainly for measuring longitudinal and transverse profiles, which can be fully or partially milled. The relative height differences between any two measured points on this measured profile shall correspond to the height differences of the same points calculated from the DDM and/or DRSM within a tolerance of ± 5 mm. The cross-fall calculated from the measured points on this measured profile shall correspond to the cross-fall calculated from the DDM within a tolerance of +/-0.15 %.

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.