CONSTRUCTION SPECIFICATION FOR FULL DEPTH RECLAMATION WITH EXPANDED ASPHALT STABILIZATION

TABLE OF CONTENTS

331.01 SCOPE

This specification covers the requirements for in-place full-depth reclamation of the existing hot mix asphalt (HMA) pavement and underlying granular base; shaping and compacting the unstabilized material; adding and blending corrective aggregate or active filler or both, if required; adding and mixing expanded asphalt; and shaping and compacting the expanded asphalt mix.

331.01.01 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.

331.01.02 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.

331.02 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, and publications:

Ontario Provincial Standard Specifications, Construction

OPSS 301 Restoring Unpaved Roadway Surfaces
OPSS 310 Hot Mix Asphalt
OPSS 501 Compacting

Ontario Provincial Standard Specifications, Material

OPSS 1010 Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
OPSS 1101 Performance Graded Asphalt Cement
OPSS 1301 Cementing Materials

Ontario Ministry of Transportation Publications

MTO Laboratory Testing Manual:
LS-200 Penetration of Bituminous Materials
LS-282 Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-292 Quantitative Determination of Asphalt Cement Content by Ignition and Analysis of Remaining Aggregate from Bituminous Paving Mixtures
LS-297 Determination of Indirect Tensile Strength of Expanded Asphalt Mixes
LS-625 Sampling of Granular Materials

Ontario Traffic Manual (OTM):
Book 7 - Temporary Conditions

Wirtgen GmbH Publication

Wirtgen Cold Recycling Technology manual, 3rd edition, 2010

331.03 DEFINITIONS

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

Active Filler means substances added to the reclaimed materials that chemically alter the mix properties.

AMRL means as defined in OPSS 310.

CCIL means as defined in OPSS 310.

Corrective Aggregate means virgin aggregate or reclaimed asphalt pavement (RAP) or both added to the reclaimed materials to meet the expanded asphalt mix requirements.

Expanded Asphalt means heated asphalt cement expanded from its normal volume by the addition of water.

Expanded Asphalt Mix (EAM) means the mixture of reclaimed materials; corrective aggregate or active filler or both, if required; and expanded asphalt.

Performance Graded Asphalt Cement (PGAC) means as defined in OPSS 310.

Quality Assurance (QA) means as defined in OPSS 310.

Quality Control (QC) means as defined in OPSS 310.

Reclaimed Asphalt Pavement (RAP) means as defined in OPSS 310.

Unstabilized Material means the mixture of reclaimed existing asphalt pavement and granular base and corrective aggregate or active filler or both, if required.

331.04 DESIGN AND SUBMISSION REQUIREMENTS

331.04.01 Design Requirements

For mix design purposes, prior to commencing the work the Contractor shall obtain samples representative of the material that is produced during in-place full-depth reclamation. These samples shall be used to establish the design rate of expanded asphalt as a per cent by mass of the unstabilized material. The design rate of the expanded asphalt shall be a minimum of 2.8%. The dry tensile strength shall be a minimum of 225 kPa and the wet tensile strength shall be a minimum of 100 kPa. The tensile strength ratio shall be a minimum of 50%.

The mix design shall be carried out according to the Wirtgen Cold Recycling Technology manual using briquettes produced according to LS-297. Mix design work shall be completed by a laboratory with CCIL Type A certification or equivalent equipped to carry out expanded asphalt mix design. When the existing pavement significantly changes composition, a separate mix design shall be completed.

Each mix design shall include the following

a) Information on the grade, manufacturer, and supplier of the PGAC.

b) The per cent by mass of expanded asphalt in the mix, referred to as the design rate, and all calculations performed to determine the design rate of the expanded asphalt.

c) The recommended PGAC temperature for foaming, the half life, the expansion ratio, and the per cent water added for foaming.

d) The optimum moisture content and the mix design bulk relative density.

e) The dry tensile strength, the wet tensile strength, and the tensile strength ratio.

f) The amount of water to be added to the mix.

g) Maximum field rate adjustment allowed to the design rate without adverse affects to mix properties.

h) Recovered penetration for the binder of the existing pavement according to LS-200.

i) Type, source, gradation, and quantity of corrective aggregate, if required.

j) Type, source, and quantity of active filler, if required.

331.04.02 Submission Requirements

The mix design shall be submitted by the Contractor to the Contract Administrator a minimum of 7 Days prior to the start of the reclamation and stabilization. When more than one mix design is required, the area for which each mix design is to be used shall be clearly identified.

A new mix design shall be submitted when the expanded asphalt design rate is adjusted by 0.3% or greater. Separate or new mix designs shall be submitted if the composition or layer thicknesses or both of the existing pavement changes significantly.

331.05 MATERIALS

331.05.01 Active Filler

If required by the mix design, active filler shall be incorporated into the reclaimed material at the application rate determined in the mix design.

When used as active filler, Portland cement shall be according to OPSS 1301. No more than one per cent by mass of Portland cement shall be added to the mix.

331.05.02 Corrective Aggregate

If required by the mix design, corrective aggregate shall be incorporated into the reclaimed material at the application rate determined in the mix design. Corrective aggregate shall meet the physical property requirements of OPSS 1010 for Granular A.

331.05.03 Performance Graded Asphalt Cement

The Contractor shall select a PGAC with suitable expansion characteristics. PGAC shall be according to OPSS 1101, excluding the PGAC zone requirements.

331.05.04 Reclaimed Asphalt Pavement

RAP material shall be 100% passing the 37.5 mm sieve and 95 to 100% passing the 26.5 mm sieve after processing.

331.05.05 Water

Water shall be clean and free from oil, acid, alkali, organic matter, or other deleterious substances.

331.06 EQUIPMENT

331.06.01 Full-Depth Reclamation and Stabilization Equipment

The reclaimer-stabilizer shall be capable of reclaiming the existing asphalt pavement and underlying granular base to the depths specified in the Contract Documents, incorporating corrective aggregate or active filler or both into the mix, adding expanded asphalt in a controlled manner, and producing a uniform mix.

The reclaimer-stabilizer shall be fitted with an automatic sensor system to accurately maintain a preset depth of cut within a tolerance of 10 mm and shall have a minimum 2.0 m wide cutting drum.

The reclaimer-stabilizer shall have an asphalt cement expansion system capable of producing optimum expansion and an injection system capable of injecting and blending expanded asphalt uniformly throughout the unstabilized material. In order to mix the unstabilized material with the expanded asphalt, the reclaimer-stabilizer shall include the following features:

a) A system to control and regulate the application of expanded asphalt in relation to travel speed and mass of material within a tolerance of $\pm$ 3.0% by volume of asphalt cement.

b) A system to monitor and control all aspects of the mixing process, including per cent expanded asphalt, rate of application, and per cent water for optimum compaction.

c) A system of nozzles that provides uniform application of the expanded asphalt across the full width of treatment. The application system shall be adjustable for varying widths of treatment.

The aggregate delivery vehicle shall have a system for controlled application of the corrective aggregate.

Alternative equipment may be considered subject to approval by the Contract Administrator and demonstration of meeting the requirements of the Expanded Asphalt Trial Section subsection.

331.06.02 Placing Equipment

Placing of the expanded asphalt mix shall be carried out by means of a self-propelled mechanical paver capable of spreading the mix evenly in front of the screed in one continuous pass to the specified cross-fall and grade. The paver shall be equipped with distributing augers for the full width to be paved. The paver shall have a vibratory screed capable of vibrating the full width of mix placed.

331.06.03 Pilot Vehicle

The pilot vehicle shall be according to the requirements of the OTM, Book 7.

331.07 CONSTRUCTION

331.07.01 Operational Constraints

In-place full depth reclamation, including mixing, shaping, and compacting to final grade, shall be completed across the full pavement width prior to closing down operations each day.

The existing shoulders shall be shaped and compacted to match the adjacent lane prior to closing down operations each day.

Expanded asphalt stabilization shall not proceed during periods of rain or when the surface is in a saturated condition.

Traffic, including construction traffic, shall be kept off the freshly placed EAM until such time as it is able to carry traffic without damage. The Contractor shall be responsible for repair of damaged EAM.

The wearing surface shall not be placed on the EAM until the following requirements have been met:

a) The EAM has been allowed to cure for a minimum of 2 Days.

b) The Contractor has demonstrated that the EAM meets all the requirements of this specification.

c) All defective areas in the EAM have been repaired to the satisfaction of the Contract Administrator.

331.07.02 In-Place Full-Depth Reclamation

The existing asphalt pavement and underlying granular base shall be reclaimed to the depths and widths specified in the Contract Documents.

The graded surface of the reclaimed material, including existing shoulders, shall be according to the surface tolerance requirements of OPSS 301. Reclaimed material exceeding 50 mm in size shall be removed from the work. The material shall be compacted according to OPSS 501.

331.07.03 Expanded Asphalt Trial Section

Prior to carrying out expanded asphalt stabilization on the Contract, the Contractor shall demonstrate to the Contract Administrator the ability to successfully carry out expanded asphalt stabilization according to this specification by placing a trial section within the Contract limits.

In lieu of a trial section, the Contract Administrator may accept evidence that the Contractor has demonstrated the ability to successfully mix, handle, place, and compact EAM with the same equipment, placing crew, and methodology to meet the Contract requirements for placing EAM on any Contract within the last 12 months.

The trial section shall be a minimum of 3,500 m^2 or the equivalent of one tanker load of asphalt cement. The Contractor shall propose the location of the trial section to the Contract Administrator for approval. The Contractor shall give the Contract Administrator a minimum of 48 hours notice prior to placing the trial section.

The Contract Administrator shall allow the Contractor to continue the expanded asphalt stabilization work based on an acceptable visual assessment of the trial section according to the requirements of the Grading and Compacting the Expanded Asphalt Mix subsection. When EAM is rejected by visual assessment, the Contractor shall repeat additional trial sections until the EAM meets the requirements of this specification.

The Contractor shall be responsible for the repair, removal, or replacement of an unacceptable trial section.

331.07.04 Expanded Asphalt Stabilization

The Contractor shall stabilize to the depth and limits detailed in the Contract Documents. The overlap between successive passes of the reclaimer-stabilizer shall be a minimum of 100 mm and a maximum of 150 mm.

If required, corrective aggregate or active filler or both shall be added to the roadway prior to stabilizing.

In areas that are inaccessible to the reclaimer-stabilizer equipment, existing asphalt pavement shall be removed and replaced with a minimum 100 mm of binder course hot mix placed flush with the adjacent EAM surface.

331.07.05 Grading and Compacting the Expanded Asphalt Mix

The material shall be compacted to a minimum 97% of the target density, as determined in OPSS 501 for granular materials.

The compacted surface of the EAM shall be according to the surface tolerances specified in OPSS 301. Regrading of the EAM to correct crossfall deficiencies shall be minimized.

The compacted surface of the EAM shall be uniform in texture and free of segregation, longitudinal streaks, flushing, fat spots, oil spills, roller marks, and other surface defects.

331.07.06 Sampling

The Contractor shall be responsible for all sampling.

331.07.06.01 Corrective Aggregate

The Contract Administrator may request samples of the corrective aggregate to demonstrate conformance to the requirements of this specification. When requested, two 25 kg samples shall be taken in the presence of the Contract Administrator.

QA samples shall be taken in accordance with procedures given in LS-625 and at the time and location determined by the Contract Administrator.

Samples of corrective aggregate shall be obtained, properly labelled and identified, and delivered within 48 hours of sampling to the designated QA testing laboratory as specified in the Contract Documents.

331.07.06.02 Active Filler

The Contract Administrator may request samples of active filler to demonstrate conformance to the requirements of this specification.

331.07.06.03 Expanded Asphalt Mix

Samples of unstabilized material and EAM shall be taken at a minimum frequency of one set of samples per 5,000 m^2. To obtain a set of samples, the Contractor shall take one 15 kg sample of unstabilized material immediately following in-place full depth reclamation and from the same approximate location a second 15 kg sample of EAM, immediately following stabilization. The maximum sampling depth shall be 100 mm. The second sample may be obtained after placement and prior to compaction.

The samples shall be packaged in a non-absorptive material to protect sample integrity, sealed in waterproof containers, appropriately labelled, and delivered by the Contractor in good condition within 48 hours of sampling to the designated QA testing laboratory specified in the Contract Documents.

331.07.07 Traffic Convoy

When specified in the Contract Documents, the Contractor shall convoy traffic according to the OTM, Book 7.

The pilot vehicle shall guide one-way traffic through or around construction. The maximum speed of the convoy shall be 30 km/h. Convoying shall be maintained until such time as the expanded asphalt stabilized mat is able to carry traffic without damage.

331.07.08 Management of Excess Material

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

331.08 QUALITY ASSURANCE

331.08.01 General

Acceptance shall be based on QA testing. QA testing shall be carried out by a laboratory currently certified by CCIL with Type A or Type B certification or AMRL accredited or equivalent laboratory.

Acceptance criteria shall be based on the QA test results for each 5,000 m^2 placed.

The Contract Administrator shall reject all unacceptable material and all visually defective material, mix, or work. Defective material, mixture, and work shall not be incorporated into the finished work.

331.08.02 Acceptance of Corrective Aggregate

QA testing may be carried out to ensure that corrective aggregate to be used in the work is according to the physical property requirements of Granular A according to OPSS 1010.

331.08.03 Acceptance of the Expanded Asphalt Mix

331.08.03.01 Asphalt Cement Content

The sample of unstabilized material taken immediately following in-place full depth reclamation and the sample of EAM taken immediately after stabilization shall be tested for total asphalt cement content in accordance with LS-282 or LS-292. The total asphalt cement content of the EAM includes existing aged asphalt cement and new asphalt cement. The per cent by mass of new asphalt cement added to the unstabilized material shall be determined from the two samples at each location by subtracting the total asphalt cement content of the unstabilized material from the total asphalt cement content of the EAM.

The average new asphalt cement content of each 5,000 m^2 placed shall not be less than 0.4% or more than 0.6% of the established mix design.

331.08.03.02 Tensile Strength

Samples of EAM shall also be tested for dry tensile strength, wet tensile strength, and tensile strength ratio according to LS-297.

Dry tensile strength requirements for the sample are met when the dry tensile strength of the sample is equal to or greater than the minimum requirement of 225 kPa.

Wet tensile strength requirements for the sample are met when wet tensile strength of the sample is equal to or greater than the minimum requirement of 100 kPa.

The tensile strength ratio for the sample shall not be less than 50%.

331.08.04 Acceptance of Thickness

Thickness of the EAM shall be measured by the Contract Administrator. Measurements shall be taken by excavating along the edge of the stabilized pass with a shovel and measuring the depth of stabilization from the bottom of the EAM to the surface of the adjacent unstabilized material. Thickness requirements for each 5,000 m^2 are met when the following are satisfied:

a) At least 90% of all thickness measurements for each 5,000 m^2 are equal to or greater than the specified thickness minus 20 mm.

b) No individual thickness measurement for each 5,000 m^2 is less than the specified thickness minus 30 mm.

331.08.05 Acceptance of Compaction

Compaction measurements shall be taken by the Contract Administrator according to OPSS 501 for granular materials. Compaction requirements of the EAM placed are met when the following are satisfied:

a) The average of all compaction measurements for each 5,000 m^2 is greater than or equal to 97% of the target density.

b) No individual compaction measurement for each 5,000 m^2 is less than 95% of the target density.

331.08.06 Repairing and Re-Decisioning

With the exception of repairs for surface tolerance, the minimum width of repair shall be the full width of the reclaimer-stabilizer equipment, the minimum length shall be sufficient for the repair to be carried out, and all repairs shall be made using the same equipment as was used during initial production and placement.

To meet the specified surface tolerance, all deficient areas shall be re-profiled by grading or padding or padded with the same HMA type to be used in the overlying HMA lift.

Unacceptable EAM, including any area damaged or contaminated by traffic or by natural or added water shall be reprocessed and, if required, additional expanded asphalt added. Alternatively, the Contractor shall remove and replace damaged or otherwise unacceptable EAM with the same hot mix type to be used in the overlying hot mix lift to a minimum depth of 50 mm according to OPSS 310.

Mixes that cannot be compacted to the specified density shall be removed to a minimum depth of 50 mm and replaced by an appropriate HMA approved by the Contract Administrator. When it is determined that the compaction cannot be achieved due to poor subgrade conditions, the Owner shall be responsible for the cost of repairs.

331.09 MEASUREMENT FOR PAYMENT

331.09.01 Actual Measurement

331.09.01.01 Full-Depth Reclamation with Expanded Asphalt Stabilization

Full-depth reclamation with expanded asphalt stabilization shall be measured for payment by horizontal area in square metres.

331.09.02 Plan Quantity Measurement

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

331.10 BASIS OF PAYMENT

331.10.01 Full-Depth Reclamation with Expanded Asphalt Stabilization - 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.

The addition of corrective aggregate or active filler to the mix shall be at no extra cost to the Owner.

PGAC shall be included in the Full-Depth Reclamation with Expanded Asphalt Stabilization item.

Repair of unacceptable EAM shall be carried out at no extra cost to the Owner.

Repair of areas of EAM damaged by traffic shall be completed at no extra cost to the Owner.

Repair, removal, or replacement of an unacceptable trial section shall be completed at no extra cost to the Owner.

Appendix 331-A, November 2011
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 specify the following in the Contract Documents:

- The depths and widths for reclaiming existing asphalt pavement and underlying granular base. (331.07.02)

- The depth and limits of expanded asphalt stabilization. (331.07.04)

The designer should determine if the following is required and, if so, specify it in the Contract Documents:

- Traffic convoy requirements. (331.07.07)

Expanded asphalt mix (EAM) is a reclaimed asphalt pavement and granular base stabilized in-place by the addition of expanded asphalt and, if required, corrective aggregate and active filler.

EAM is a bound material and does not exhibit the same drainage characteristics as granular base material.

Expanded or "foamed" asphalt is created by injecting a carefully metered amount of cold water into hot asphalt cement in the mixing chamber of a pulverizer-stabilizer. The asphalt expands, reducing the viscosity of the asphalt cement and allowing easier dispersion throughout the mix.

The expanded asphalt bonds most effectively with finer aggregate particles forming a mortar to bond the coarser aggregate particles together. The stabilization process requires fines in order to be effective.

It is recommended that adequate pre-engineering be carried out on the project and that existing pavement thicknesses and composition be established. Additional investigation should be carried out when pavement composition changes, such as patched areas. Pre-engineering data should be included in the contract documentation.

The selected performance graded asphalt cement (PGAC) must have suitable expansion characteristics. Polymer modified PGAC may adversely affect the foaming process. There is no requirement for a PGAC to be selected based on climatic zones, as the stabilized layer is expected to have good fatigue properties and should not be prone to low temperature cracking.

Since EAM has a higher structural equivalency than granular base material, it is suitable for pavement strengthening purposes where aggregate availability is low or where elevation restrictions exist.

This specification requires that the EAM be paver laid, i.e., be placed by a self-propelled mechanical paver. If an Owner would like the EAM to be grader laid, i.e., to allow the use of a grader to place the EAM, a special provision to allow that option should be included in the Contract Documents.

When additional full-depth reclamation is required beyond the limits of the expanded asphalt stabilization, the depth and limits of full-depth reclamation should be clearly indicated in the Contract Documents. (331.07.02)

Appendix 331-A

When compaction is to be determined according to OPSS 501 Method B, a minimum roller size should be specified.

A minimum 2-Day curing period is recommended prior to overlaying the EAM. The EAM should be surfaced as soon as possible after curing, as the mix is susceptible to damage by traffic and rain.

A tack coat is recommended on the EAM prior to hot mix overlay.

EAM is typically overlain with hot mix asphalt. A surface treatment or slurry surfacing may be considered; however, this specification may require modification.

Contract scheduling should allow for stabilization and overlay to be completed within the hot mix temperature operational constraints.

QC requirements have been removed from this specification, as acceptance is based on QA testing. If an Owner requires Contractor QC to confirm that the work meets the specification requirements, a special provision detailing the required Contractor QC should be included in the Contract Documents.

The payment clause for this specification is all inclusive. Should an Owner desire to pay for corrective aggregate, active filler, or asphalt cement separately, separate payment items are required.

In times of volatile asphalt cement prices, on multi-year contracts, and on Contracts with greater than 1,000 tonnes of paver laid EAM material, designers may consider using the MTO PGAC price index for payment adjustment. The MTO PGAC price index is available on the Ontario Ministry of Transportation website at www.raqs.mto.gov.on.ca, by clicking on Contractor, Contract Bulletin, Asphalt Price Index. The MTO PGAC price index is only a tool for qualifying PGAC prices and is not intended as a standard asphalt cement price to be incorporated into the contract bid. The MTO PGAC price index calculation for a given month takes in the average of the 4 weeks of the month and is published on the last day of the month.

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.