CONSTRUCTION SPECIFICATION FOR
COLD RECYCLED MIX

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334.01 SCOPE

This specification covers the requirements for a cold mix paving process incorporating reclaimed asphalt pavement (RAP) from stockpiles. The process includes production and processing of RAP, design and testing, placement and compaction.
334.01.01 Significance and Use of Appendices

Appendices are not a mandatory part of this specification and must be invoked by the Owner.

Appendix 334-A: is a commentary appendix to provide designers with information on the use of this specification in a Contract.

334.02 REFERENCES

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

Ontario Provincial Standard Specification, General:

OPSS 102 Weighing of Material

Ontario Provincial Standard Specification, Construction:

OPSS 309 Cold Mixed, Cold Laid, Open and Dense Graded Bituminous Pavement

Ontario Provincial Standard Specification, Materials:

OPSS 1102 Liquid Asphalt
OPSS 1103 Emulsified Asphalt

Ministry of Transportation, Ontario Publications:

MTO Laboratory Testing Manual:

LS-282 Quantitative Extraction of Asphalt Cement and Analysis of Extracted Aggregate from Bituminous Paving Mixtures
LS-291 Quantitative Extraction of Asphalt Cement and Mechanical Analysis of Extracted Aggregate from Bituminous Paving Mixtures - Ontario Procedure
LS-300 Preparation of Marshall Specimens for Cold-In-Place Recycled Mixtures

334.03 DEFINITIONS

For the purposes of this specification, the following definition applies:

Cold Recycled Mix (CRM): means a mix of processed RAP and asphalt emulsifier modifier produced through a cold mixing process.

334.04 SUBMISSION AND DESIGN REQUIREMENTS

Prior to commencing the work, for mix design purposes, the Contractor shall obtain RAP samples that are representative of the material to be processed.

The Contractor is responsible to design the mix to account for the variability of the RAP material. The asphalt modifier by mass of RAP shall be 2.3% ± 0.5%.
A minimum of 10 Working Days prior to the start of CRM operations, information on the type, manufacturer and supplier of the asphalt modifier, and a copy of the mix design and all calculations performed to determine the mix design shall be submitted in writing to the Contract Administrator.

334.05 MATERIALS

334.05.01 Reclaimed Asphalt Pavement

The processing operation shall ensure that 100% of the RAP aggregate passes the 26.5 mm sieve. The amount of RAP aggregate passing the 75 µm sieve shall not exceed 15% by mass. Adequate measures must be taken to manage the RAP source to ensure consistency and prevent contamination.

334.05.02 Asphalt Modifier

The asphalt modifier shall be an emulsified asphalt or a liquid asphalt.

Emulsified asphalt shall meet the requirements of OPSS 1103 and be either a mixing grade polymer modified high float emulsified asphalt or a mixing grade high float emulsified asphalt, as specified in the Contract Documents.

Liquid asphalt shall be according to OPSS 1102.

334.06 EQUIPMENT

334.06.01 Production and Processing Equipment

Crushing or milling equipment, and screening equipment shall be used to generate and process the RAP to the size specified in the mix design. Crushed material shall be handled in such a way as to prevent recompaction of the material before mixing takes place.

334.06.02 Mixing Equipment

The mixing unit shall be capable of producing a uniform thoroughly blended CRM consisting of RAP and asphalt modifier. The RAP feed system to the mixing unit shall be equipped with a means of determining the mass of material being deposited into the mixing unit prior to the addition of the asphalt modifier. The mixing unit shall be capable of continuously maintaining the amount of asphalt modifier added within ± 0.2% by weight of the RAP. All measuring devices shall be calibrated according to the manufacturer's specifications at the start of the Contract and whenever deemed necessary by the Contract Administrator.

The asphalt modifier supply system shall be equipped with a flow meter and a total delivery meter.

334.06.03 Placing Equipment

Placing of the CRM shall be carried out by means of a self-propelled mechanical paver equipped with distributing augers capable of spreading the material evenly in front of the vibratory screed.

334.06.04 Compaction Equipment

Appropriate compaction equipment shall be selected to achieve the required compaction.
334.06.05  Drying Unit

The drying unit shall be specifically designed to provide radiant heat to the CRM mat. No open flame heating is to be used. The entire heater assembly shall be designed to be raised or lowered by a single control and shall be adjustable in width from 3.0 to 4.1 m.

334.06.06  Pilot Vehicle

The pilot vehicle shall be equipped with an amber rotating light and a sign mounted with clearance not less than 1 metre above the road. The sign shall be at least 1.5 m in width and 0.75 m in height, orange with black lettering and shall display the words: "Pilot Vehicle, Do Not Pass".

334.07  CONSTRUCTION

334.07.01  Operational Constraints

The placing of cold recycled mix shall not be carried out when the ambient temperature is less than 10°C or when the overnight low is forecast to be less than 2°C. After September 1st, written approval must be obtained from the Contract Administrator prior to CRM paving.

The placing of CRM shall be carried out when the roadway is free of water.

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

a) the CRM mix has been allowed to cure for a minimum of 14 Days;

b) the average in situ moisture content of the CRM is 2% or less with no test value greater than 3% immediately prior to placing the wearing surface;

c) the specified density has been achieved; and

d) all defective areas in the CRM mat have been repaired to the satisfaction of the Contract Administrator.

The wearing surface must be placed within 14 Days once the CRM mat meets these requirements.

334.07.02  Compaction

The compacted CRM surface shall be uniform and satisfy the crossfall and grade requirements as specified in the Contract Documents. After compaction, the surface of the CRM mat shall be free from deviations exceeding 6 mm as measured in any direction with a 3 m straight edge.

The CRM shall be compacted to a minimum of 96% of the laboratory bulk relative density as determined by the submitted mix design, according to LS-300.

CRM which cannot be compacted to the required density shall be removed and replaced with new CRM.

After initial compaction, the CRM shall be opened to traffic and allowed to cure for a minimum of 14 Days.
After initial compaction, a minimum of three samples of the compacted CRM shall be obtained by the Contractor, at random locations as determined by the Contract Administrator, for each full day or partial day of production. These samples shall be used for density testing.

Samples shall be removed intact from the pavement in sufficient quantities to carry out testing according to the MTO Laboratory Testing Manual. The samples shall be packaged to protect sample integrity, appropriately labelled, and delivered by the Contractor in good condition to the designated testing laboratory within 24 hours. If a sample condition is found to be unsuitable for testing by the laboratory, the Contractor will be notified immediately by the Contract Administrator to resample that location.

**334.07.03 Moisture Content**

The moisture content shall be determined in accordance with LS-282 or LS-291. Duplicate samples of the CRM shall be obtained by the Contractor for each 0.5 lane-km of production. The Contractor shall test one of the duplicate samples and the other shall be delivered to the Owner designated testing laboratory.

Each sample shall be dry cut 150 x 150 mm and removed intact from the pavement. It shall be packaged to protect sample integrity, appropriately labelled, and delivered by the Contractor in good condition to the designated testing laboratory within 24 hours of sampling. If a sample condition is found to be unsuitable for testing by the laboratory, the Contractor will be notified immediately by the Contract Administrator to resample that location.

**334.07.04 Drying**

Prior to the placement of the wearing surface, the Contractor may elect to use a drying unit. Overheating or burning of the CRM shall not be allowed.

**334.07.05 Protection of Work and Traffic Control**

Traffic, including construction traffic, shall be kept off the freshly placed CRM mat until such time as it is able to carry traffic without damage.

**334.07.06 Repair of Unacceptable Material**

CRM material that is unacceptable due to Contractor workmanship shall be removed and replaced with CRM, at no additional cost to the Owner. Removal shall be for the full depth of the CRM and the lane width of pavement.

**334.07.07 Traffic Convoy**

Traffic shall be convoyed when specified in the Contract Documents.

A pilot vehicle with an operator shall be used to guide one-way traffic through or around construction. The maximum speed of the convoy shall be 30 km/h and the convoying shall be maintained until such time the CRM mat is able to carry traffic without damage.
334.08 QUALITY ASSURANCE

334.08.01 Sampling of Asphalt Modifier

Samples of the asphalt modifier used in the mix, shall be obtained, labelled, properly identified and delivered within 5 Working Days of sampling to the Owner designated testing laboratory. Each sample of material shall be a minimum of two full 4 litre containers.

Samples shall be taken at the job site from each tanker load of material. Each sample shall be taken after a minimum of 4000 kg has been drawn from the tanker, from a sampling spigot on the transfer line, if available, or from the end of the transfer line.

The sample containers as supplied by the Contractor shall be triple tight epoxy lined pails or suitable leak-proof plastic containers which can be closed to prevent leakage. The sample labels will be supplied by the Contract Administrator.

334.08.02 Compliance

The supplied emulsified asphalt and liquid asphalt samples shall meet the requirements of OPSS 1103 and OPSS 1102, respectively, for the particular type and grade when tested in conformance to the designated test methods.

334.09 MEASUREMENT FOR PAYMENT

334.09.01 Actual Measurement

334.09.01.01 Asphalt Modifier

Asphalt modifier shall be measured for payment by mass in kilograms according to OPSS 102.

334.09.01.02 Cold Recycled Mix

Measurement of the area of CRM placed shall be made in square metres.

334.09.02 Plan Quantity Measurement

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

334.10 BASIS OF PAYMENT

334.10.01 Asphalt Modifier - Item
Cold Recycled Mix - Item
Traffic Convoy - Item

Payment at the contract price for the above items shall be full compensation for all labour, equipment, and material to do the work.

No additional payment will be made for the replacement of unacceptable materials due to Contractor's workmanship.
Appendix 334-A: Commentary for OPSS 334, November 2000

Note: This appendix does not form part of the standard specification. It is intended to provide information to the designer on the use of this specification in a Contract.

Designer Action/Considerations

Cold recycled material mitigates both reflection and thermal cracking.

CRM is susceptible to moisture intrusion and raveling, and must be sealed with a wearing surface. Typically, cold recycled mix is overlain with a surface treatment or single lift hot mix overlay. For higher traffic volume application, multiple lifts of hot mix may be considered.

Due to the variability of RAP, field adjustment of the quantity of asphalt modifier may be required.

Currently, there is no standardized mix design methodology for CRM.

Specify type of wearing surface.

Designer should address the issue of RAP ownership and quality of RAP during the preparation of contract specifications. Identify who owns the RAP and who is responsible for RAP quality.

CRM contracts should be tendered to allow for placement in warm summer months to achieve proper curing of the CRM mat.

A single contract incorporating placement of CRM and wearing surface is recommended.

Since payment for the CRM is by the square metre, the designer should ensure that grade preparation is part of the CRM contract.

The designer shall specify the nature of the asphalt modifier required. (334.05.02)

When specifying liquid asphalts, the designer should consider the environmental aspects of the product.

When traffic convoy is required, the designer shall specify the traffic convoy requirements.

Contract Documents shall indicate the need for cross-fall correction.

Significant Clauses

After September 1st, written approval must be obtained from the Contract Administrator prior to Cold Recycled Mix paving. (334.07.01)

Related Ontario Provincial Standard Drawings

None.