313-1 HOT MIX ASPHALT - OPSS.PROV 313

313-1.1 GENERAL

Hot mix asphalt consists of several mix types, which are grouped into two categories: Stone Mastic Asphalt and Superpave as detailed below. The type of hot mix asphalt and location is recommended in the Pavement Design Report and/or by the Regional Geotechnical Section. Further design information for SMA and Superpave is available in the Superpave and SMA Design Guide.

313-1.1.1 Stone Mastic Asphalt Mix

Stone Mastic Asphalt (SMA) is a heavy-duty gap-graded hot mix asphalt with a relatively large proportion of stones and an additional amount of mastic-stabilized asphalt cement. The SMA mixture has an aggregate skeleton with coarse aggregate stone-on-stone contact to withstand loading due to heavy commercial traffic loads. SMA is considered for use on Traffic Category D and E roads.

The additional amount of asphalt cement binder is required primarily to provide increased durability and resistance to aging and cracking to a mix. The use of durable aggregates and the gap-gradation provide superior rutting resistance. The stabilization of the extra asphalt cement and in particular, prevention of binder draindown during construction, are achieved by: 1) an increase in fines and filler, 2) addition of organic or mineral fibre, 3) polymer-modification, or 4) a combination of all three.

SMA designates hot mix types by the Nominal Maximum Aggregate Size, which represents the sieve size, in mm, through which at least 90% of the aggregate passes. There are currently three designations of SMA mixes.

a) SMA 19.0

SMA 19.0 is a premium binder course mix with enhanced rutting resistance for Traffic Category D and E roads.

b) SMA 12.5

SMA 12.5 is a premium surface course with enhanced rutting resistance, water spray reduction, and potential noise reduction for Traffic Category D and E roads. It is the most common SMA surface course type on Ontario highways.

c) SMA 9.5

SMA 9.5 is a premium surface course with enhanced rutting resistance, water spray reduction, and potential noise reduction for Traffic Category D and E roads. The
smaller nominal maximum size results in a tighter surface texture and may also make it suitable where a thinner lift is desired.

313-1.1.2 Superpave Mixes

The Superpave methodology incorporates a performance-based asphalt materials characterization system to improve the long-term pavement performance under diverse environmental conditions.

Superpave designates hot mix types by the Nominal Maximum Aggregate Size, which represents the sieve size, in mm, through which at least 90% of the aggregate passes. The following Superpave mixes are specified:

a) Superpave 37.5

Superpave 37.5 is a large stone binder course mix for use when thicker binder lifts are required.

b) Superpave 25.0

Superpave 25.0 is a large stone binder course mix for use when thicker binder lifts are required.

c) Superpave 19.0

Superpave 19.0 is a binder course mix for all traffic categories. It has replaced HL 4, HL 8, and HDBC mixes.

d) Superpave 12.5

Superpave 12.5 is a surface course mix for Traffic Category B and C roads. It has replaced HL 3, HL 3 Fine and HL 4 mixes.

e) Superpave 12.5FC 1

Superpave 12.5FC 1 is a surface course mix for Traffic Category C roads that provides superior rutting resistance and skid resistance through aggregate selection. It has replaced HL 1 mix.

f) Superpave 12.5FC 2

Superpave 12.5FC 2 is a surface course mix for Traffic Category D and E roads which replaces DFC mix. It provides better rutting and skid resistance than Superpave 12.5FC 1 due to the requirement for premium coarse and fine aggregate.

g) Superpave 9.5
Superpave 9.5 is a fine surface course mix for Traffic Category A and B roads and driveways. It can also be used as a padding or levelling course for all traffic category roadways.

h) Superpave 4.75

Superpave 4.75 is a fine surface or levelling course mix used for miscellaneous applications.

i) Temporary Hot Mix

This mix is used for seasonal asphalt applications, usually on secondary highways/temporary detours, and not to be used on freeways.

313-1.2 REFERENCES

Pavement Design Report
Directive PLNG-C-003, The Use of Surface Course Types on Provincial Highways
MTO Designated Sources for Material (DSM) Manual
Commercial Site Access Policy and Standards Manual
Geometric Design Standards for Ontario Highways Manual, Chapter D
OPSS.PROV 1151, Material Specification for Superpave and Stone Mastic Asphalt Mixtures
Superpave and SMA Design Guide

313-1.3 TENDER ITEMS

SMA 9.5, SMA 12.5, and SMA 19.0
Superpave 4.75, Superpave 9.5, Superpave 12.5, Superpave 12.5FC 1, Superpave 12.5FC 2, Superpave 19.0, Superpave 25.0, and Superpave 37.5

313-1.4 SPECIFICATIONS

Details of the work of production, placing and compaction of Hot Mix are contained in OPSS.PROV 313 and OPSS.PROV 1151.

313-1.5 SPECIAL PROVISIONS

The designer should refer to Chapter “E” of this manual to review the special provisions applicable to these tender items.

313-1.6 STANDARD DRAWINGS

The designer must base his work on highway engineering standards pertaining to the above tender items. Pavement design related standards are contained in the OPSD 500 series. Cross section elements are illustrated in the 200 series.
313-1.7  DESIGN

313-1.7.1  Surface Courses

The policy to ensure consistent application of standards for selecting surface course types for all highway improvement projects in Ontario is outlined in Directive PLNG-C-003, The Use of Surface Course Types on Provincial Highways.

Under the Superpave system, the most common surface course type on Ontario highways is expected to be a Superpave 12.5 mix. The Ministry has added two premium mix types to the Superpave suite of mixes: Superpave 12.5FC 1 and Superpave 12.5FC 2. The "FC" stands for friction course. The "1" requires that the coarse aggregate fraction for this mix type must be obtained from a Designated Sources for Materials (DSM) list. The "2" requires that the coarse and fine aggregates for this mix type must be obtained from a source listed on the DSM. In addition to Superpave mixes, there are two SMA surface courses: SMA 9.5 and 12.5 are premium mixes that require the coarse and fine aggregates for the mix to be obtained from a source listed on the DSM.

313-1.7.2  Non-Driving Pavement Asphalt Applications

In addition to the use of mixes in the pavement structure, some of the above-mentioned types of hot mixes are also employed for the paving of shoulders and ditches and median strips, construction of asphalt curb and gutters, gutter outlets, spillways, sidewalks and repairs to, or patching of, the existing pavement.

313-1.7.3  Paving of Private Entrances and Side Roads

The limits of paving of entrances and side roads shall be established by the designer, and the depth of paving as specified in the Pavement Design Report and/or by the Regional Geotechnical Section.

Previously paved private entrances are to be restored to their former condition.

Gravel entrances in urban areas are paved between the curb and gutter and sidewalk.

In rural areas where curb and gutter is used, gravel entrances may be paved at the discretion of the designer.

313-1.7.3.1  Policy of Local Municipality

The designer shall contact the local Municipality with regard to local established policies on paving of private entrances.

The Ministry will normally apply the policy of that Municipality provided the extent of the work does not exceed the normal Ministry cost.
If the Municipality insists on the application of their policy and standards, then they must agree to accept any additional costs before the work is carried out.

313-1.7.4 Paving of Commercial Entrances

Commercial entrances should be paved according to the “Commercial Site Access Policy and Standards Manual” and should be approved by the designer and Regional Geotechnical Section. The limits of paving will sometimes be determined by alignment, grade and cross-section. For paving of entrances behind curb and gutter refer to section 313-10 “Hot Mix Miscellaneous”.

313-1.7.5 Deferral of Hot Mix Paving Operations

Hot Mix pavement is not to be placed before it is required for vehicular traffic because:

a) the pavement is vulnerable to be damaged by construction vehicles,

b) capital is tied up unnecessarily,

c) hot mix pavements depreciate in the absence of traffic.

On contracts where the fine grading is completed but the roadway will not be placed into service for some time, no paving operation shall commence until needed.

A note on the plans on complex freeway staging work or direction by special provision is necessary to prevent the premature paving operation.

313-1.7.6 Padding

Padding of the existing roadway is sometimes required to restore the roadway or superelevation crossfall or to remove other pavement distortions prior to resurfacing. Pavement types and maximum lift thicknesses are recommended in the Pavement Design Report and/or by the Regional Geotechnical Section. Actual depths are determined by design cross-sections during detailed design.

313-1.7.7 Pavement Widening on Curves

An additional amount of Hot Mix is to be considered when calculating the required paving on curves. The widths and details of the pavement widening on curves are to be obtained from the “Geometric Design Standards for Ontario Highway” Manual, Chapter “D”.

313-1.7.8 Paved Shoulders

The warrant and design of fully or partial paved shoulders are documented in the Geometric Design Manual Chapter “D”. The depth and width of paved shoulders should be clearly shown on a typical section or in a table.
313-1.7.9 **Asphalt Cement**

The Pavement Design Report and/or by the Regional Geotechnical Section should be referenced for the selection of PGAC grade(s).

The designer should be aware that for the purpose of PGAC grade designation, Ontario has been divided into three zones as follows:

Zone 1: The area north of the boundary formed by the French River, Lake Nipissing, and the Mattawa River.

Zone 2: The area south of Zone 1, and north of a line from Honey Harbour, to Longford, Taylor Corners, Cavan, Campbellford, and Mallorytown.

Zone 3: The area south of Zone 2.

For design purposes, the designer shall ensure:

a) Towns located along a zone boundary line are to be included in the zone south of the boundary line.

b) Projects located within 10 km of zone boundary lines may be included in either zone at the discretion of the designer so that they may be considered within one zone only.

The designer shall consider the following when selecting PGAC grades:

a) The location of the Contract, i.e., the geographical zone in which it is located, noting that some discretion is allowed.

b) The type of hot mix, new versus recycled hot mix.

c) Upgrades for heavy commercial traffic, frequent starts and stops, and vehicle speeds. See Table 2.

Table 1 provides the basic performance grades for each Ontario zone. Two basic PGAC grades are specified for each zone, one for new hot mix or mix containing up to 20% recycled asphalt pavement (RAP), and the other for mixes containing 21 to 40% RAP. Recycling ratios in excess of 40% should be addressed on a Contract specific basis.
Table 1
OPSS.PROV 1101 - Grade Selection for Ontario

<table>
<thead>
<tr>
<th>PGAC Zones</th>
<th>Zone 1</th>
<th>Zone 2</th>
<th>Zone 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>New Hot Mix or up to 20% RAP</td>
<td>52 – 34</td>
<td>58 - 34</td>
<td>58 - 28</td>
</tr>
<tr>
<td>21 to 40% RAP</td>
<td>52 – 40</td>
<td>52 - 40</td>
<td>52 - 34</td>
</tr>
</tbody>
</table>

Table 2
OPSS.PROV 1101 - Guidelines for the Adjustment of PGAC High Temperature Grade Based on Roadway Classification and Traffic Conditions

<table>
<thead>
<tr>
<th>Highway Type</th>
<th>Increase from Standard</th>
<th>Optional Additional Grade Increase (Note 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Freeway</td>
<td>2 Grades</td>
<td>N/A</td>
</tr>
<tr>
<td>Rural Freeway</td>
<td>1 Grade</td>
<td>1 Grade</td>
</tr>
<tr>
<td>Urban Arterial</td>
<td>Consider increasing by 1 grade if heavy commercial traffic is greater than 20% of AADT</td>
<td>1 Grade</td>
</tr>
<tr>
<td>Rural Arterial</td>
<td>No Change</td>
<td>1 or 2 Grades</td>
</tr>
<tr>
<td>Urban Collector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural Collector</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural Local</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban/Suburban Collector</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes:
1. Upgrading of the high temperature grade is recommended for use in both surface and top binder courses, i.e., top 80 to 100 mm of hot mix.

2. Consideration should be given to an increase in the high temperature grade for roadways which experience a high percentage of heavy truck or bus traffic at slow operating speeds, frequent stops and starts, and historical concerns with instability rutting.

313-1.7.10 Anti-stripping Additives

The requirement for anti-stripping additives in HMA is documented in OPSS.PROV.1151. The “Anti-Stripping Additive Requirements” special provision should be included for all North Region. For East, Central and West Region, the Regional Quality Assurance Section shall be contacted and the Anti-Stripping Additive Requirements special provision shall only be included if the Regional Head
of Quality Assurance in that region recommends that it be included. The Regional Head of Quality Assurance in East, West and Central Region will consider adding the special provision if there is limited information available to contractors prior to contract tender opening on the moisture sensitivity of mixes containing aggregates that may be selected by the contractor for use on the contract. This is generally the case where the hot mix aggregate source(s) for the contract is **NOT** likely to be an active commercial source(s). This is generally not the case for the East, West and Central Regions and the special provision is not normally inserted.

If all mix on the contract will require the use of hydrated lime as an anti-stripping additive, the Regional Head of Quality Assurance will consider recommending that the Anti-Stripping Additive Requirement Special Provision not be included.

### 313-1.7.11 Temporary Hot Mix Pavement

Whenever a temporary hot mix pavement (detours, widenings, etc.), which is intended to be removed within the same construction season, is included into a contact package, the use of the special provision for Temporary Hot Mix Pavement should be considered. This special provision offers the Contractor the option to construct and repair hot mix used for Temporary Hot Mix Pavement which is not subject to the normal payment adjustments for asphalt cement content, aggregate gradation and pavement compaction. It is inserted into a contract package in consultation with the Regional Contracts Office, and should not be used for detours or other temporary placement if it is expected that the time frame for the temporary pavement will extend beyond the same construction season. The Regional Geotechnical Section is to be consulted in the selection of the type of mix for the temporary hot mix pavement from the following mix types:

- Superpave 12.5 and Superpave 19.0

### 313-1.7.12 Minimum Lift Thicknesses

A suitable lift thickness for hot mix asphalt layer is primarily dependent on two factors: the mix type, since this results in a different nominal maximum aggregate size, and on whether the mix is coarse-graded or fine-graded. In general terms, the smaller the nominal maximum size and the finer the mix gradation is, the smaller the lift thickness which can be constructed satisfactorily. Recommended lift thicknesses for various mix types are provided in the Superpave and SMA Design Guide.
313-1.7.13 Paving in Echelon

Paving in echelon shall be as recommended by the designer in consultation with the Regional Geotechnical Section and the Regional Contracts Office. A special provision fill in statement shall specify whether paving in echelon shall not be used, shall be used, or may be used at the Contractor’s option. Wording shall also be provided to describe the extent of paving in echelon such as the entire contract, contract specific limits, specific lanes, or staging.

313-1.7.14 HMA Tender Items with Small Quantities

In many cases, it is desirable to eliminate tender items with small estimated quantities.

In most of North Region and parts of East Region there are no commercial hot mix asphalt plants. Contractors commonly use portable plants. In these areas, mix designs for small items are more costly and time consuming. They can result in a search for a suitable aggregate source with potential to delay the contract. Producing small quantities of aggregates will have a large unit cost.

Commercial hot mix plants serve most of Central and West Regions. Areas served by commercial plants can be determined by reviewing hot mix plant locations shown on the Ontario Hot Mix Producers Association website www.ohmpa.org and in consultation with the Regional Geotechnical Section.

In all regions, there is a considerable amount of QC/QA paperwork and administrative work associated with each different source, aggregate and mix design.

To determine if a tender item is required, review the potential tender items with less than:

a) 2000 tonnes for contracts not in areas served by commercial hot mix plants, and
b) 500 tonnes for contracts in areas served by commercial hot mix plants.

A reasonable haul distance to anticipate supply from a commercial plant would be 100 km.

The above quantities are considered to be the dividing line between “large” and “small” hot mix tender items.

If the potential small tender item is for a binder course and there is a larger quantity hot mix tender item, combine the quantity with the larger quantity item except when the larger quantity item is Superpave 12.5FC 2 or SMA.

If the potential small tender item is for a surface course, and there is a large tender item for a surface course with equivalent or better quality combine the quantity with
the surface course tender item with equivalent or better quality, except when the large tender item is SMA.

Combine 2 small tender items into one item when the combined item will satisfy the pavement design requirement for the project.

Exceptions where small tender items are appropriate:

- Small tender items for binder course mix when there is no other binder course tender item and the surface course is Superpave 12.5 FC2 or SMA.
- Small tender items for surface course when the other surface course tender item is Superpave 12.5FC 2 or SMA.
- Superpave 12.5FC 2 and SMA items where these mix types are required by MTO surface course policy.
- Non-Standard Tender Items for trial areas of new/innovative mixes.
- Contracts such as:
  1) Bridge rehabilitation contracts where the only HMA is for paving the approaches and deck
  2) Culvert/sewer replacement contracts where the only HMA is for paving at the culvert/sewer location
  3) Intersection improvement, electrical contracts and other contracts where the only HMA is used for paving small areas.
  4) patching contracts where the surface friction must be similar to the existing surface for safety reasons.

313-1.7.15 Surface Smoothness

Acceptance criteria for surface smoothness, which includes payment adjustments, is included in special provision 103F31. The designer shall include this special provision in all hot mix contracts according to its warrant. In those situations when surface smoothness criteria does not apply and special provision 103F31 is not warranted, the designer shall insert special provision 103S50 which removes the requirement to test for surface smoothness. At no time shall both special provisions 103F31 and 103S50 be included in the same contract.

313-1.8 COMPUTATION

313-1.8.1 Source of Information

All paving requirements with respect to hot mix types and depths including the paving of shoulders are as recommended in the Pavement Design Report and/or by the Regional Geotechnical Section.
313-1.8.2 Method of Calculation

The unit of measurement for hot mix types is the tonne unless the Regional Contracts Office recommends that square metre measurement be used. Each type of hot mix asphalt used on a project will form a separate tender item.

When the unit of measurement is the tonne, the computed tonnage for each mix type is the product of the calculated area of paving in square metres, the depth in millimetres and the mix density in kg/m²/mm; divided by 1000 kg/t. The applicable mass in kg/m²/mm for the various mix types is shown in the following table “Recommended Mix Densities for Determining Tender Tonnages”.

The tender items are Plan Quantity Payment (P.Q.P.) items when the unit of measurement is the square metre. When the unit of measurement is the square metre, the computed area of paving for each mix type is the product of the lengths and widths of paving detailed in the contract drawings.

313-1.8.3 Recommended Mix Densities for Determining Tender Tonnages

<table>
<thead>
<tr>
<th>Hot Mix Asphalt Type</th>
<th>Recommended Mix Densities unless otherwise specified by the Regional Geotechnical Section kg/m²/mm deep (see Note 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superpave 4.75</td>
<td>Contact Regional Geotechnical Section</td>
</tr>
<tr>
<td>Superpave 9.5</td>
<td>2.410</td>
</tr>
<tr>
<td>SMA 9.5</td>
<td>Contact Regional Geotechnical Section</td>
</tr>
<tr>
<td>Superpave 12.5</td>
<td>2.460</td>
</tr>
</tbody>
</table>
| Superpave 12.5FC 1, Superpave 12.5FC 2, and SMA 12.5 | 2.390 for East Region  
                        | 2.530 for West Region  
                        | 2.520 for Central, North Region |
| Superpave 19.0       | 2.460                                                                                                          |
| Superpave 25.0       | 2.500                                                                                                          |
| Superpave 37.5       | Contact Regional Geotechnical Section                                                                          |
| SMA 19.0             | Contact Regional Geotechnical Section                                                                          |

Note 1. The above densities are based on local coarse and fine aggregates except for SMA mixes, Superpave 12.5FC 1, and Superpave 12.5FC 2, which are based on typical aggregates used in that region.

313-1.9 DOCUMENTATION

The type of each hot mix used and the recommended depths of the appropriate paving course must be indicated on the profiles or typical sections. It is necessary to ensure that this information is indicated for all asphalt paving to be carried out on a project.
When padding, temporary hot mix pavement or superelevation correction is required for a project, the locations and required quantities for each location where this work is to be carried out must be indicated in the contract drawings. In the case of superelevation correction, the rate of proposed superelevation must also be shown.

The hot mix quantities computed for the various parts of a project are summarized on the “Quantities – Hot Mix and Granular” sheet with separate entries under the appropriate Hot Mix heading as follows:

- Roadway (incl. Partial Paved Shoulders) - Commercial Entrances
- Interchange Ramps - Private Entrances
- Channelization Legs - Patrol Yards
- Side Roads - Fully Paved Shoulders
- Detours - Temporary Hot Mix, or alternative.
- Medians, Islands - Longitudinal Pavement Ramp Downs
- Paving Under Guiderails

When any of the following tender items are being used on a project, the asphalt material designated for this work must be calculated in the applicable unit of measurement and indicated under the appropriate Hot Mix item as a separate line entry on the Quantity Sheet.

- Asphalt Curb and Gutter
- Asphalt Surfacing of Gutter
- Asphalt Spillways
- Asphalt Gutter Outlets
- Asphalt Sidewalks
- Sidewalk Resurfacing
- Crack Repair
- Miscellaneous Hot Mix

The calculated quantities are recorded on the “Quantities – Hot Mix and Granular” Sheets in the applicable unit of measurement, and totalled. This total is the tender total and is transferred to the Tender Document.

313-1.9.1 Documentation Accuracy

Calculated hot mix quantities are recorded in tonnes or square metres to the nearest whole number. Stations are recorded to the nearest whole metre.