B313 - HOT MIX ASPHALT (OPSS 313)

313.1 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 details about hot mix asphalt can be found in the MTO's Pavement Design and Rehabilitation Manual.

The hot mix asphalt courses are paid either by the square metre or by tonnage, as appropriate. Hot mix asphalt (HMA) measured by the square metre is paid based on the horizontal area of the hot mix lift placed. Payment is decreased when lifts on average are placed thinner than the specified lift thickness. There is no incentive for HMA courses placed thicker than what was specified in the Contract Documents as overruns for square metre items are not possible unless there is a change or error in the plan quantity. Payment by square metres is an effective alternative to tonnage that should be considered for contracts that do not require tolerance corrections in the HMA courses or provide the contractor with an opportunity to make tolerance corrections under a separate operation.

313.1.1 Traffic Categories

Superpave material and mix design specifications are based on the anticipated project traffic level in the design lane over a 20-year period. This is regardless of the actual design life of the roadway. Superpave identifies five levels of traffic in terms of Equivalent Single-Axle Loads (ESALs), which MTO has designated as "A, B, C, D or E", as follows:

MTO Traffic Category	Design ESALs (millions)
A	< 0.3
B	0.3 to < 3
C	3 to < 10
D	10 to < 30
E	> 30

Some MTO pavement design documents use the annual design traffic count in the design lane. Data such as the Annual Average Daily Traffic (AADT) and percent trucks can be used to estimate the design ESALs. Traffic can also be characterized by the type of facility (e.g., urban freeway, rural freeway, etc.).

For MTO contracts, the traffic category for Superpave mixes is specified by SSP 111F06 amending OPSS 1151 as recommended by the Regional Geotechnical Section based on project specific pavement design report. Traffic category should not be specified for SMA mixes. Since the traffic category determines the selection of materials that will be used in Superpave mixes and, more critically, the mix design compaction criteria, design ESALs should be determined using the appropriate protocols for seasonal variation, traffic growth, truck factors, etc. Further details on selecting the traffic category can be found in the MTO's Directive PHM-C-001 and the Pavement Design and Rehabilitation Manual.

Projects may include features or facilities with different traffic categories. For example, a secondary highway forming part of the contract may carry a significantly lower traffic volume than the main project highway. The decision to identify and isolate the various traffic categories within a project can impact the mixes being used and related material specifications. Careful consideration should therefore be given when breaking up the project into different traffic categories in order to balance the economics and the technical merits of the outcome.

313.1.2 Superpave Mixes

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

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

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

c) **Superpave 19.0** is a binder course mix for all traffic categories.

d) **Superpave 12.5** is a surface course mix for Traffic Category A, B and C roads where premium rutting and skid performance is not warranted.

e) **Superpave 12.5FC 1** is a surface course mix for Traffic Category C and D roads that provides superior rutting and skid resistance through the use of premium coarse aggregate.

f) **Superpave 12.5FC 2** is a surface course mix for Traffic Category D and E roads. It provides better rutting and skid resistance than Superpave 12.5FC 1 due to the requirement for both premium coarse and fine aggregates.

g) **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** is a fine surface or levelling course mix used for miscellaneous applications.

313.1.3 Stone Mastic Asphalt Mix

SMA is to be selected, in accordance with Directive PHM-C-001. All SMA placed requires the application of a hot grit coated with asphalt cement (about 1%) during mix placement to increase early age friction. There are currently three designations of SMA mixes:

a) **SMA 19.0** is a premium binder course mix with enhanced rutting resistance.

b) **SMA 12.5** A premium surface course with enhanced rutting resistance, water spray reduction, and potential noise reduction.

c) **SMA 9.5** A premium surface course with enhanced rutting resistance, water spray reduction, and potential noise reduction. The smaller nominal maximum size results in a tighter surface texture and may also make it suitable where a thinner lift is desired.

313.1.4 Hot Mix Asphalt Miscellaneous

The mix type for hot mix asphalt miscellaneous shall be either Superpave or SMA. The tender item

"Hot Mix Asphalt Miscellaneous" will only apply when areas, which require hot mix paving, cannot be performed by a machine and require manual placement.

Local conditions, the type and the amount of Hot Mix Asphalt Miscellaneous paving required should be taken into consideration to justify the use of this item.

313.1.5 Surface Course Type

The selection of the surface course mix type shall be according to Directive PHM-C-001.

313.2 REFERENCES

- Highway Corridor Management Manual
- Directive PHM-C-001, The Use of Surface Course Types on Provincial Highways
- Designated Sources for Material (DSM) - Prequalified Products List - MTO
- TAC Geometric Design Guide for Canadian Roads - Chapter 3 and 4, June 2017
- MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads - Appendix 4 - Cross Section Elements, April 2020
- MERO-033, Construction of Longitudinal Joints in Flexible Pavements - Design Guidelines
- Pavement Design Report - project specific
- Pavement Design and Rehabilitation Manual, MTO, March 2013
- MTO LS-307, Design Procedure for Recycled Hot Mix Asphalt

313.3 TENDER ITEMS

Item Code	Title	Col Type	U.O.M.	PQP
0313-1369	Superpave 4.75	Variation	t	N
0313-1370	Hot Mix Asphalt Miscellaneous	Normal	m2	Y
0313-1372	Superpave 9.5	Variation	t	N
0313-1373	Superpave 12.5	Variation	t	N
0313-1374	Superpave 12.5FC 1	Variation	t	N
0313-1375	Superpave 12.5FC 2	Variation	t	N
0313-1376	Superpave 19.0	Variation	t	N
0313-1377	Superpave 25.0	Variation	t	N
0313-1378	Superpave 37.5	Variation	t	N
0313-1385	Superpave 19.0	Variation	m2	Y
0313-1390	Superpave 12.5 - Warm Mix	Variation	t	N
0313-1391	Superpave 12.5FC 1 - Warm Mix	Variation	t	N
0313-1392	Superpave 12.5FC 2 - Warm Mix	Variation	t	N
0313-1393	Superpave 19.0 - Warm Mix	Variation	t	N
0313-1394	Superpave 25.0 - Warm Mix	Variation	t	N
0313-1410	SMA 9.5	Variation	t	N
0313-1415	SMA 12.5	Variation	t	N
0313-1420	SMA 19.0	Variation	t	N

0313-1421	SMA 19.0 - 50 mm Lift Thickness	Variation	m2	Y
0313-1422	SMA 19.0 - 60 mm Lift Thickness	Variation	m2	Y
0313-1423	SMA 19.0 - 70 mm Lift Thickness	Variation	m2	Y
0313-1425	SMA 9.5 - 25 mm Lift Thickness	Variation	m2	Y
0313-1426	SMA 9.5 - 30 mm Lift Thickness	Variation	m2	Y
0313-1427	SMA 9.5 - 35 mm Lift Thickness	Variation	m2	Y
0313-1430	SMA 12.5 - 40 mm Lift Thickness	Variation	m2	Y
0313-1431	SMA 12.5 - 50 mm Lift Thickness	Variation	m2	Y
0313-1432	SMA 12.5 - 60 mm Lift Thickness	Variation	m2	Y
0313-1530	Superpave 9.5 - 25 mm Lift Thickness	Variation	m2	Y
0313-1531	Superpave 9.5 - 30 mm Lift Thickness	Variation	m2	Y
0313-1532	Superpave 9.5 - 35 mm Lift Thickness	Variation	m2	Y
0313-1535	Superpave 12.5 - 40 mm Lift Thickness	Variation	m2	Y
0313-1536	Superpave 12.5 - 50 mm Lift Thickness	Variation	m2	Y
0313-1537	Superpave 12.5 - 60 mm Lift Thickness	Variation	m2	Y
0313-1540	Superpave 12.5FC 1 - 40 mm Lift Thickness	Variation	m2	Y
0313-1541	Superpave 12.5FC 1 - 50 mm Lift Thickness	Variation	m2	Y
0313-1542	Superpave 12.5FC 1 - 60 mm Lift Thickness	Variation	m2	Y
0313-1545	Superpave 12.5FC 2 - 40 mm Lift Thickness	Variation	m2	Y
0313-1546	Superpave 12.5FC 2 - 50 mm Lift Thickness	Variation	m2	Y
0313-1547	Superpave 12.5FC 2 - 60 mm Lift Thickness	Variation	m2	Y
0313-1551	Superpave 19.0 - 50 mm Lift Thickness	Variation	m2	Y
0313-1552	Superpave 19.0 - 60 mm Lift Thickness	Variation	m2	Y
0313-1553	Superpave 19.0 - 70 mm Lift Thickness	Variation	m2	Y
0313-1610	Superpave 25.0 - 80 mm Lift Thickness	Variation	m2	Y
0313-1611	Superpave 25.0 - 90 mm Lift Thickness	Variation	m2	Y
0313-1612	Superpave 25.0 - 100 mm Lift Thickness	Variation	m2	Y
0313-1613	Superpave 25.0 - 110 mm Lift Thickness	Variation	m2	Y
0313-1620	Superpave 12.5 - Warm Mix - 40 mm Lift Thickness	Variation	m2	Y
0313-1621	Superpave 12.5 - Warm Mix - 50 mm Lift Thickness	Variation	m2	Y
0313-1622	Superpave 12.5 - Warm Mix - 60 mm Lift Thickness	Variation	m2	Y
0313-1625	Superpave 12.5FC 1 - Warm Mix - 40 mm Lift Thickness	Variation	m2	Y
0313-1626	Superpave 12.5FC 1 - Warm Mix - 50 mm Lift Thickness	Variation	m2	Y
0313-1627	Superpave 12.5FC 1 - Warm Mix - 60 mm Lift Thickness	Variation	m2	Y
0313-1630	Superpave 12.5FC 2 - Warm Mix - 40 mm Lift Thickness	Variation	m2	Y
0313-1631	Superpave 12.5FC 2 - Warm Mix - 50 mm Lift Thickness	Variation	m2	Y
0313-1632	Superpave 12.5FC 2 - Warm Mix - 60 mm Lift Thickness	Variation	m2	Y
0313-1635	Superpave 19.0 - Warm Mix - 50 mm Lift Thickness	Variation	m2	Y
0313-1636	Superpave 19.0 - Warm Mix - 60 mm Lift Thickness	Variation	m2	Y
0313-1637	Superpave 19.0 - Warm Mix - 70 mm Lift Thickness	Variation	m2	Y
0313-1640	Superpave 25.0 - Warm Mix - 80 mm Lift Thickness	Variation	m2	Y
0313-1641	Superpave 25.0 - Warm Mix - 90 mm Lift Thickness	Variation	m2	Y

0313-1642	Superpave 25.0 - Warm Mix - 100 mm Lift Thickness	Variation	m2	Y
0313-1643	Superpave 25.0 - Warm Mix - 110 mm Lift Thickness	Variation	m2	Y

When the unit of measure is square metre, the tender item name will include a reference to the design lift thickness specified for all hot mix included under that tender item. When more than one design lift thickness is specified for a square metre hot mix type, the mix quantity will be split into different tender items to reflect the quantities for each design lift thickness.

Some items include the term “Warm Mix”. These are mixes that require the use of warm mix technology in production. This technology allows the mix to be produced at a lower temperature and provides environmental, safety, and performance benefits compared to conventional hot mix asphalt. The warm mix items are used when recommended by the Regional Geotechnical Section on a specific project.

The design, estimating, and documentation requirements for the various mix type items also apply to the equivalent warm mix item e.g., the requirements for Superpave 12.5 item also apply to the Superpave 12.5 - Warm Mix item.

313.4 SPECIFICATIONS

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

313.5 SPECIAL PROVISIONS

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

313.6 STANDARD DRAWINGS

The designer must base their work on highway engineering standards pertaining to the above tender items. Pavement design related standards are contained in the 500 series of the Ontario Provincial Standards Drawings (OPSD) and 500 series of the Ministry of Transportation Ontario Drawings (MTOD). Cross section elements are illustrated in the 200 series of the OPSD and 200 series of the MTOD.

313.7 DESIGN

313.7.1 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 PHM-C-001, 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 both 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.

313.7.2 Optimizing the Number of Mix Types

Superpave has the potential to specify mix requirements that are tailored to the anticipated traffic loading and environment for a given location. While this is a significant merit of Superpave, in an effort to be technically correct in specifying mix criteria, a designer shall try to avoid too many mix types. Given the time frame and cost of preparing designs and the economics of producing different aggregates (especially when quantities are small) and the cost of PGAC tankage, it is recommended that consideration be given to design features which will optimize the number of mix types in a project.

Possible considerations include:

a) If more than one traffic category is warranted for a given mix type in different locations on the project (or contract), consider using one mix type with the higher traffic category throughout. This is especially recommended for single traffic category differentials (e.g., consider using Category E for Category D).

b) Do not create a separate mix type if the only difference between applications is a different grade of PGAC. Example: Superpave 19.0 lower binder may require a PG 58-28 and upper binder may require PG 64-28. The same mix type with the higher requirement (i.e., PG 64-28) can be used.

c) When quantities of binder course are very small in comparison to surface course, consider using the surface course mix as the binder course.

d) When more than one binder course measured in square metres is used, try to use the same mix type and lift thickness (and therefore same item) in order to eliminate an additional unnecessary item and allow a single combined measurement and payment of multiple binder lifts.

e) Consider eliminating the use of small quantities of a padding mix if milling is an option.

f) Consider using Superpave 25.0 and capping it with a surface course. This may eliminate the need for Superpave 19.0.

313.7.3 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.

313.7.4 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 determined 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.

313.7.4.1 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.

313.7.5 Paving of Commercial Entrances

Commercial entrances should be paved according to the “Highway Corridor Management 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 the Hot Mix Miscellaneous item may be used.

313.7.6 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 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.

313.7.7 Padding

Padding of the existing roadway is sometimes required to restore the roadway or superelevation or 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 determined by the Regional Geotechnical Section. Actual depths are determined by design cross-sections during detailed design.

313.7.8 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 “TAC Geometric Design Guide for Canadian Roads - Chapter 4 as amended by MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads - Appendix 4”.

313.7.9 Paved Shoulders

The warrant and design of fully or partial paved shoulders are documented in the “TAC Geometric Design Guide for Canadian Roads - Chapter 4 as amended by MTO Design Supplement for TAC Geometric Design Guide for Canadian Roads - Appendix 4”.

When fully paved shoulders are warranted, the following shoulder mix types may be used based on the surface course selected on the mainline as shown below and in consultation with Regional Geotechnical Section

Surface Course Selected on the Mainline	**Surface Course Type on the Shoulder**
Superpave 12.5 or Surface Treatment	Superpave 12.5 or Surface Treatment
Superpave 12.5FC 1	Superpave 12.5FC 1 or Superpave 12.5
Superpave 12.5FC 2	Superpave 12.5FC 2, FC 1 or Superpave 12.5
SMA 12.5	SMA 12.5 or Superpave 12.5FC 2, FC 1
Concrete	Concrete or hot mix as retrofit - SMA 12.5, Superpave 12.5FC 2, FC 1

The selection of surface course mix type and lift thickness for fully paved shoulders should be made with the following technical considerations:

a) MTO Surface Course Directive PHM-C-001, including the traffic category consideration, when the paved shoulder may be exposed to mainline traffic for a considerable period of time;

b) Future construction or emergency traffic staging requiring the use of the shoulder for traffic diversion;

c) Geometric design, in particular the presence of curves, ramps or entrances where there may be frequent wandering from the mainline wheel-path and encroachment of vehicles on to the shoulder; Example: inner fully paved shoulder of a loop ramp can be paved with the same surface mix type as the ramp lane.

d) Collision statistics, including the incidence of skid related events and evidence of frequent encroachment onto the shoulder;

e) Continuity of the pavement mix type and lift thickness; Example: The top two asphalt lifts could be extended over the shoulder.

f) Whether plan quantity of the fully paved shoulder justifies the use of a more cost effective mix type;

The depth and width of paved shoulders should be clearly shown on a typical section or in a table.

313.7.10 Asphalt Cement

The Pavement Design Report and/or recommendation by the Regional Geotechnical Section should be referenced for the selection of performance graded asphalt cement (PGAC) grade(s). Superpave designates asphalt cement in the manner PG 58-34 for example. This particular performance grade (PG) is expected to provide performance up to a design high pavement temperature of 58 °C down to a low design pavement temperature of -34 °C.

For the purpose of PGAC grade designation, Ontario has been divided into three zones:

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, includes Manitoulin Island, and is north of a line from Honey Harbour, to Longford, Taylor Corners, Cavan, Campbellford, and Mallorytown.

Zone 3: The area south of Zone 2.

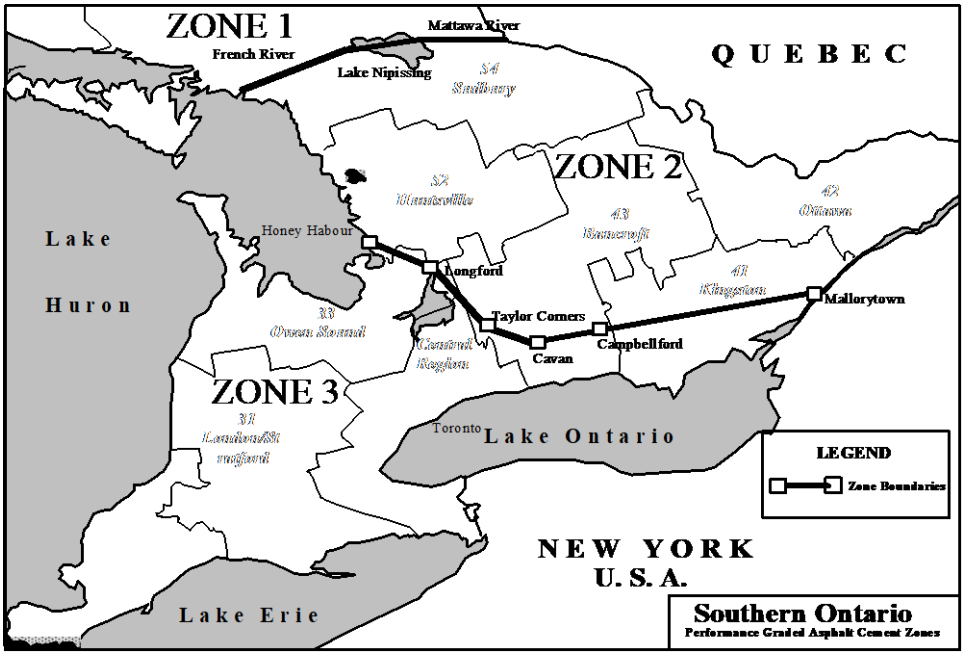

Figure 1: PGAC Zones for Ontario

The zones were delineated on the basis of temperature contours from available weather data, and with due regard for the relationship between pavement and air temperatures as established by the Long Term Pavement Performance (LTPP) studies. Table 1 provides the basic performance grades for each Ontario zone. Note that MTO currently specifies % binder replacement and therefore grades are only provided for 0 to 20 % binder replacement. If the contractor is permitted and chooses to modify the composition of the mix by including more recycled content, MTO LS-307 specifies how grade selection is also modified.

Table 1 - Grade Selection for Ontario

	PGAC Zones		
	Zone 1	**Zone 2**	**Zone 3**
New Hot Mix or up to 20% Binder Replacement	52 - 34	58 - 34	58 - 28

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) Upgrades for heavy commercial traffic, frequent starts and stops, and vehicle speeds in consultation with Regional Geotechnical Section. See Table 2.

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

Highway Type	**Increase from Standard**	**Optional Additional Grade Increase (Note 2)**
Urban Freeway	2 Grades	N/A
Rural Freeway Urban Arterial	1 Grade	1 Grade
Rural Arterial Urban Collector	Consider increasing by one grade if heavy commercial traffic is greater than 20% of AADT.	1 Grade
Rural Collector Rural Local Urban/Suburban Collector	No Change	1 or 2 Grades

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 (1 grade for average speed range of 20 to 70 km/h and 2 grades for average speed less than 20 km/h), frequent stops and starts, and historical concerns with instability rutting.

For the low temperature grade, it is possible that the generalization given in Tables 1 and 2 results in the avoidance of “micro-climates”. If this is considered important for a given project, the LTPPBind software Version 3.1 can be used to more accurately determine the cold temperature grade.

For the high temperature grade, it is recommended that for any major project, the grade selected using the guidelines should be confirmed using LTPPBind software Version 3.1. If there is disagreement between LTPPBind and Tables 1/2, the higher requirement should govern, but with due regard to the economics of the grade selection.

The degree of reliability in LTPPBind should normally be set at 98 percent. A lower reliability (not less than 90%) may be considered based on judgement, economics, and availability of certain PGAC grade.

313.7.11 Anti-stripping Treatment

For East, Central, and West Regions; the Regional Quality Assurance Section shall be contacted, and the mandatory anti-stripping treatment requirements special provision option shall only be included on the recommendation of Regional Head of Quality Assurance.

For East, West, and Central Regions; the Regional Head of Quality Assurance will consider adding the option 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 mandatory option is not normally chosen.

313.7.12 Lift Thicknesses

A suitable lift thickness for hot mix asphalt layer is primarily dependent on two factors: 1) the mix type, since this results in a different nominal maximum aggregate size, and 2) whether the mix is coarse graded (CG) or fine graded (FG). In general terms, the smaller the nominal maximum aggregate size and the finer the mix gradation is, the thinner a lift can be constructed satisfactorily. The recommended lift thickness range for various Superpave mix types are provided in Figure 2. The recommended minimum lift thickness is based on constructability and is generally set as three times the nominal maximum aggregate size. For any lift thickness below recommended minimum, the designer shall consult with the Regional Geotechnical Section.

With respect to Figure 2, the default gradation for Superpave 12.5 (including FC 1 and FC 2) is fine-graded. The use of coarse graded mixes is invoked by special provision SSP 111F06 amending OPSS 1151.

Once the structural pavement design has been completed and the total thickness of new hot mix asphalt established, layer thicknesses can be specified using the information in Figure 2. Every project generally has its own unique features that, in conjunction with past experience, will ultimately determine the most suitable mix types and layer thicknesses. The Regional Geotechnical Section should be consulted for such recommendations.

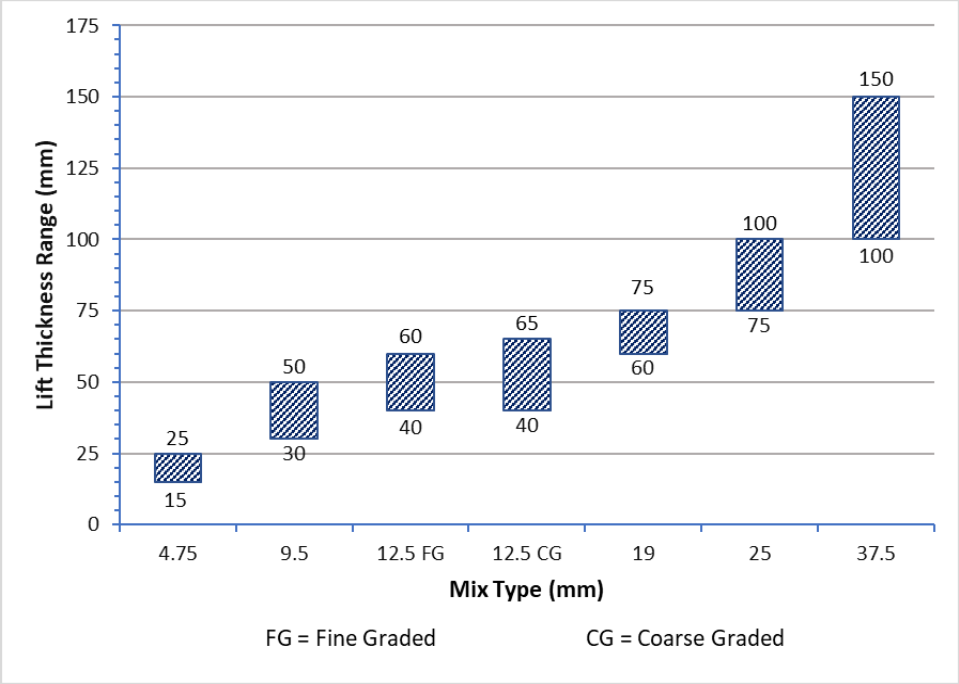

Figure 2: Recommended Lift Thickness Ranges for Superpave Mixes Only (not applicable to SMA)

Typical lift thickness for SMA mixes are as follows:

a) SMA 9.5 is typically specified at 30 or 40 mm
b) SMA 12.5 is typically specified at 40 or 50 mm
c) SMA 19.0 is typically specified at 50, 60, or 70 mm

313.7.13 Paving in Echelon

Paving in echelon shall be as recommended by the designer in consultation with the Regional Geotechnical Section and the Regional Operations Office. The “Construction of Longitudinal Joints in Flexible Pavements - Design Guidelines, MERO-033” is a valuable resource for the designer on when echelon paving is suitable and how to maximize the opportunities for paving in echelon and when it is not an option.

The fill in statement specifies 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.

313.7.14 HMA Tender Items with Small Quantities

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

In most of Northeast and Northwest Regions and parts of East Region there are no commercial hot mix asphalt plants and contractors commonly use portable plants instead. In these areas, mix designs for small items are costlier and time consuming. The search for a suitable aggregate source in some areas in these regions can pose a 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 Asphalt Pavement Council website www.onasphalt.org and in consultation with the Regional Geotechnical Section and the Regional Quality Assurance 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) 1000 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 two small tender items into one item when the combined item will satisfy the pavement design requirement for the project. MERO-033, “Construction of Longitudinal Joints in Flexible Pavements - Design Guidelines” provides information to the designer on the benefits of optimizing the number of mix types.

Exceptions where small tender items are appropriate:

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

313.7.15 Surface Smoothness

Acceptance criteria for surface smoothness, which includes payment adjustments, is included in the smoothness special provision. The designer shall include this special provision in all hot mix asphalt contracts according to its warrant. The warrant includes a list of situations where the smoothness specification should not be included.

313.7.16 Measurement by Square Metres

Multiple courses of HMA or surface course may be measured by square metres rather than by tonnage. The decision to measure an HMA course by square metres is based upon the direction of the Regional Operations Office in consultation with Regional Geotechnical Section. Preferably, the decision to measure by square metre should be considered at the 30 % design review stage. It is to be considered for contracts that include an additional underlying machine pass completed on the same contract that is not measured under a HMA square metre item. For example, one or more of the following should underlay the HMA square metre item:

- milled pavement,
- concrete pavement,
- full depth reclamation,
- graded granular base,
- in-place recycling processes (HIR, CIR, CIREAM), or a
- binder course or levelling course measured by tonnes.

Measurement by square metres is not recommended for the following cases:

- when HMA is to be placed directly on an existing surface (may be considered if the surface is not older than 3 years or is in good condition and resurfacing is not to correct for surface tolerances or crossfall issues),
- the HMA will be required to correct for crossfall,
- the HMA will be required to correct existing poor pavement surface tolerance,
- the HMA will be used for padding,
- hot mix placed at an unspecified thickness,
- for Superpave 4.75 or Superpave 37.5 courses, or
- the contract consists mainly of HMA that cannot be cored (e.g., bridge decks).

The designer should consider measurement by square metres separately for the surface course and underlying binder courses. A decision should be made for the surface course first. When the decision is made for the surface course to be measured by square metre, the designer should determine what lower most course may also be measured by square metre and that course and all overlying hot mix courses shall be measured by square metres. The designer may consider not using square metre items when the design lift thickness varies or changes throughout the contract.

313.7.17 Transverse Joints at Limits of Paving

The designer shall provide details of the transitions between new and existing pavements in the Contract Drawings. Transition requirements for transverse joints at limits of paving are specified in OPSS 313. If existing pavement needs to be removed, partially or fully, the appropriate removal item and quantities shall be included in the Contract Documents.

313.7.18 Hot Mix Asphalt Miscellaneous

The Geotechnical Section should be contacted to specify an appropriate Superpave or SMA mix type for hot mix asphalt miscellaneous which should be shown on the Contract Drawings and indicated in the Quantity Sheets. The work of "Hot Mix Asphalt Miscellaneous" may include the paving of the following areas.

a) Ditches and side slopes

b) Raised medians and commercial entrance islands

c) Channelization islands up to a maximum of 1.50 m width from face to face of curb and gutter

d) Raised medians on expressways and high volume arterials are treated the same way as channelization islands.

e) Behind the bullnose on converging and diverging lanes on secondary highways, high volume arterials and expressways as indicated in the Engineering Standard Drawings.

f) Paved boulevards behind curb and/or curb and gutter up to a maximum of 1.50 m in width.

g) The paving of areas unsuited to mechanical paving due to utility poles, hydrants, signs, narrow widths etc.

If the total area of miscellaneous paving on a contract is 100 m² or less, a separate tender item for Hot Mix Asphalt Miscellaneous is not warranted. These small areas to be paved should be included in other appropriate hot mix items, by the use of a non-standard special provision.

313.7.19 Crossfall

On contracts where crossfall is being reinstated to design standards or is being newly constructed and design is done based on lidar or equivalent surveys, the typical tangent cross sections in the Contract Drawings shall specify the design cross slope, typically 2%.

On contracts with design speeds of 130 km/h and where crossfall is being reinstated to acceptable tolerances and existing crossfall information is limited (i.e., no digital terrain model is used in preparation), typical tangent cross sections in the Contract Drawings shall specify a crossfall range of 2.0% to 2.2%.

On other contracts with design speeds of less than 130 km/h, and where crossfall is being reinstated as described in the above paragraph, typical tangent cross sections in the Contract Drawings shall specify a range corresponding to what is prescribed in Chapter 3 of the TAC Geometric Design Guide for Canadian Roads (TAC GDG) for the design speed, with that range reduced by 0.3% at the upper limit and increased by 0.3% at the lower limit. For example, if the TAC GDG specified range is 1.5% to 2.5% the specified crossfall range in the typical tangent cross sections would be 1.8% to 2.2%.

The decision to reinstate an existing pavement to design cross slope or acceptable tolerances, and the decision to include the cross slope tolerance special provision must be informed by sufficient information pertaining to the existing condition of the roadway. Knowing existing cross slope and pavement thickness is essential to determine the appropriate course of action. Cross slope information should ideally be obtained using a smart level on lower volume highways where such measurement are practical and safe to obtain. On higher volume highways, ARAN or lidar measurements should be obtained to determine existing cross slope. The greater the depth of

pavement removal and placement, the more feasible correction of cross slope will be in construction while still achieving thickness and smoothness requirements. 3-D milling may also be considered as part of a strategy to incorporate cross slope correction.

Where the cross slope tolerance special provision is included in a contract, design cross sections for tangent and all superelevated curves, including station limits, shall be included in the Contract Drawings, showing required cross slope or superelevation as appropriate. Information on existing cross slope should be provided with the contract documents for information purposes.

313.8 COMPUTATION

313.8.1 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.

313.8.2 Method of Calculation

The unit of measurement for hot mix types is either the tonne or the square metre. Each type of hot mix asphalt used on a project will be administered by a separate tender item.

When the unit of measurement is the tonne, use the following formula to compute the tonnage for each mix type:

Tonnage = Area × lift thickness × Density

Where,
Area = calculated area of paving in m^2
Lift thickness in metre
Density = Recommended mix density from table below

The applicable mass in $kg/m^2/mm$ 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 (PQP) 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.

Hot Mix Asphalt Miscellaneous is a Plan Quantity Payment item. The areas to be calculated are usually scaled from the plans. The basic unit of measurement for Hot Mix Asphalt Miscellaneous tender item is square metre.

To determine quantities for a lane that adjoins existing paving which is outside of the scope of the contract, the designer should add 50 mm to the width of paving to account for offsetting the lane demarcation 50 mm from the longitudinal joint.

313.8.3 Recommended Mix Densities for Determining Tender Tonnages

Hot Mix Asphalt Type	**Recommended Mix Densities unless otherwise specified by the Regional Geotechnical Section $kg/m^2/mm$ deep (tonnes/m^3)** (see Note 1)

Superpave 4.75	Contact Regional Geotechnical Section
Superpave 9.5	2.410
SMA 9.5	2.480
Superpave 12.5	2.460
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 and North Regions
Superpave 19.0	2.460
Superpave 25.0	2.500
Superpave 37.5	Contact Regional Geotechnical Section
SMA 19.0	Contact Regional Geotechnical Section
Notes: 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.	

313.9 DOCUMENTATION

The type of each hot mix used and the recommended depths (thickness) of the appropriate paving course shall be indicated on typical sections.

The areas of Hot Mix Asphalt Miscellaneous are to be indicated on the contract plans using the miscellaneous paving hatch pattern as specified in OPSD 103.011. The type of Hot Mix used for miscellaneous paving and the depth of application shall be indicated on the contract plans on a typical section.

When the unit of measure is square metres, each hot mix type will require a different tender item for each depth (lift thickness) specified. The tender item name will include a reference to the thickness specified for the lift of the hot mix type to be placed.

When padding 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)
- Interchange Ramps
- Channelization Legs
- Side Roads
- Detours
- Paving Under Guiderails
- Commercial Entrances
- Private Entrances
- Patrol Yards
- Fully Paved Shoulders
- Medians, Islands

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 "Quantities - Hot Mix and Granular Sheet":

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

The calculated quantities are recorded on the “Quantities - Hot Mix and Granular” Sheets in the applicable unit of measurement, and totalled.

313.9.1 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.