NOTES TO THE SPECIFICATION FOR ASPHALTIC CONCRETE

These notes are for guidance and are not to be included in the contract documents.

1. SCOPE

The scope provides a definition of dense graded asphaltic concrete, as distinct from other dense graded mixtures such as Stone Mastic Asphalt or Hot-Rolled Asphalt, and open graded mixtures. It also establishes that the specification only covers the component materials and the physical and mechanical properties of the Asphaltic Concrete mixtures.

The specification is largely an editorial review of previous versions, and is interim only until a fundamental review incorporating recent advances in mix design and testing is completed. It does however contain one significant change:

1. The incorporation of clauses related to the addition of Reclaimed Asphalt Pavement (RAP)

2. RELATED DOCUMENTS

Specifications and test procedures referred to in the main body of the specification are defined in this section, to remove any possible ambiguity. The most recent version of any related document is defined as current and hence must be used.

3. DEFINITIONS

Explicit or implicit definitions from previous versions of the specification have been grouped together for clarity. Job Mix Formula is defined with the proviso that the particle size distribution acceptance limits based on the Job Mix Formula may fall outside of the Specified Mix Envelopes. This is acceptable provided suitable results for binder content and VMA are obtained in accordance with Tables 5.1 or 5.2, and, Stability, air voids and Flow in accordance with Table 5.3.
4. MATERIALS

Requirements relating to the aggregate, filler and binder components of the Asphaltic Concrete mixture have been grouped together in this section. Reference to aggregate Polished Stone Value is included. Minimum Polished Stone Value will be defined by specific contract requirements and depend on site conditions, but should not fall below 45.

Where the mix is to be used as a base then there will not normally be a PSV requirement.

Minimum Crushing Resistances for Coarse Aggregates and crushed Fine Aggregates have not been changed from previous versions of this specification, but the 200 kN minimum requirement is conservative and reduction may be justified in the future. Where aggregate resources are limited, consideration should be given to allowing material with lower Crushing Resistance to be used, but the Surfacing Engineer, Transit New Zealand Head Office should be consulted.

A minimum of 85% by mass of the coarse aggregate fraction is required to comply with minimum specified Polished Stone Value. The intention of this requirement is to accommodate a small quantity of aggregate particles coarser than 4.75mm that may be present in “all-in” aggregates used primarily for the fine aggregate fraction, e.g. “PAP 7”. The clause is not intended to permit the use of whole coarse aggregate components of Polished Stone Value less than that specified by the contract document. This requirement will also allow the use of RAP where the PSV of the aggregate used in the RAP will probably not be known.

The use of the artificial aggregate such as steel slag is acceptable provided the steel slag’s properties and special requirements meet the requirements of TNZ M4 2005 as detailed in the section on Regional Variants (excluding the grading requirements as the correct grading is that appropriate for the asphalt mix).

Other innovative asphalt mixes including or otherwise the inclusion of crushed glass, higher percentages of RAP and other waste or industrial by-products that are not acceptable under this specification can be submitted to Transit New Zealand’s Engineering Policy Manager for consideration of approval for use. Generally, the new mix will need to have been developed following proper mix design procedures as detailed by Austroads (ie. APRG 18) together with on road performance results and/or performance test results such as wheel track rutting and fatigue tests. Transit New Zealand may assist in the development of mixes that show benefits of consuming waste material that would otherwise be sent to landfill. This will be considered on a product by product basis. A list of those already approved is attached as Appendix 1 to these notes.

Prior to using any artificial aggregates or waste products approval is required from the local Regional Council, whom are concerned about the potential for leachates entering waterways.
Bitumen complying with TNZ M/1 specification is referenced, but the option of using modified or alternative binder materials is not excluded. In this instance, sufficient evidence in the form of rheological data, or detailed analysis of the mixture should be provided to substantiate the improved performance.

This edition of M/10 specifically allows up to 15% of RAP to be used in the asphaltic concrete. The specification permits this to be used in any mix. If the Contractor wishes to use higher percentages then these can be used subject to specific design. This specific design would include appropriate tests for assessing the overall hardness or modulus of the mix and tests on the consistency of the RAP. Approval of Transit New Zealand Engineering Policy Manager is required for the use of RAP at percentages greater than 15%.

RAP shall be processed to produce a free flowing product with a consistent grading and that has homogeneous properties. This may require processing RAP in batches. Further information on using RAP can be found in the Austroads publications AP - T02 "Framework Specifications for Asphalt Recycling" and AP 44 / 97 "Asphalt Recycling Guide. 1997"

5. MIX DESIGN

Design particle size distribution limits are amended from early versions of M/10 by the addition of extra sieve sizes to control the amount of coarse aggregate in the mixtures. In addition, intermediate mixture sizes have been added: Mix 25 and Mix 15.

Compaction of test specimens in the laboratory (“Marshall blocks”) is in accordance with ASTM D1559 except that powered compaction apparatus (i.e. mechanical compaction) is specifically allowed for reasons of safety and consistency. This recognises current normal practice.

75-blow compaction is specified, as has been the practice in the past. Where traffic counts are low or loading is light, reducing the compaction effort to 50 blows per side of the specimens may be considered.

A requirement for minimum Voids in the Mineral Aggregate (VMA) for the mixtures is included. The limits are based on the Asphalt Institute MS-2 publication. The minimum VMA helps to ensure that there is a minimum binder volume. This is used by pavement designers to estimate modulus and fatigue properties of the mix.

Because the laboratory determination of aggregate specific gravity is operator dependent, VMA results can vary between laboratories. A recommended test of the reliability of a VMA result follows:

\[
\text{Volume of binder} = \frac{\text{Compacted Density of Mix} \times \text{Binder Content}}{\text{Density of Binder}}
\]

\[
\text{VMA}_{\text{effective}} = \text{Volume of Binder} + \text{Air Voids}
\]

The hierarchy of results is:

\[
\text{VMA}_{\text{apparent}} > \text{VMA}_{\text{effective}} > \text{VMA}_{\text{bulk}}
\]
Where apparent, effective and bulk refer to the Asphalt Institute Manual MS2 definitions of aggregate specific gravity

If the VMA_{effective} does not fall approximately midway between the VMA_{apparent} and the VMA_{bulk} results, then results should be reviewed in detail.

The intention of including minimum limits on the VMA is to ensure sufficient binder in the Job Mix Formula for adequate mixture durability. This may also be empirically quantified by calculation of the binder film thickness but this criterion should be viewed with caution due to the assumptions made during the calculation. More information may be found in MS-2 and in APRG 18.

Two 10mm SMEs are given: Mix 10 (Table 5.1) and Mix 10 TS (Table 5.2). While they are both classified as levelling or wearing, Mix 10 TS was developed as an alternative to Mix 10 to provide greater macrotexture. It differs from Mix 10 by allowing a higher ratio of coarse aggregate to fine aggregate, thus providing greater aggregate interlock and a coarser, more open texture on the constructed pavement.

Because the Marshall procedure uses nominal 100mm moulds for the manufacture of laboratory compacted specimens, the coarse particles present in Mix 40 can give rise to highly variable results. For this reason an alternative procedure for specimen preparation is given, as has been normal practice for some years in New Zealand. Experience shows that this procedure gives a close approximation of the final mix, but a field trial is recommended for final design adjustment and confirmation.

Alternative design procedures for Mix 40 using impact compaction (modified Marshall) or gyratory compaction (Austroads) with 150mm moulds may be considered. The advice of the Surfacing Engineer, Transit New Zealand Head Office should be sought in these instances.

6. PRODUCTION

Aggregates are required to be stored in such a manner that they are not contaminated with materials from other stockpiles, wind blown detritus or loss of material (e.g. fines) due to rain.

Limits are placed on binder storage temperatures, but no differentiation is made between grades of bitumen. Bitumen that is heated above 175° C is subject to testing to show compliance with M/1 specification. Minimum testing should be Penetration and Viscosity.

Note that if bitumen from alternative sources, or modified binders are used, the mixture production temperatures and limits may need to be changed.
7. TESTING

Production quality testing is limited to bitumen content and particle size distribution analysis to confirm that the plant is producing mixtures in accordance with the Job Mix Formula established in the laboratory.

The Marshall method is a method of mix design and is thus not intended that specimens compacted in the laboratory using plant-produced mixtures is used as a method of quality control. Whilst producers may elect to manufacture these specimens, assessment of production quality should be by bitumen content and aggregate particle size distribution only. Note that if volumetric and mechanical testing is performed on mixture samples drawn from production, results may not exactly replicate data obtained in the laboratory during the design procedure. This is expected and acceptable.

Because of health and safety reasons, mix sampling is only to occur at the plant. In situ testing of the mat by, for example, air voids content may be used to control construction techniques. If in situ testing shows a problem then construction techniques are to be reviewed. Problems can arise for a variety of reasons including segregation, poor compaction or low mix texture.

Particle size distribution results for produced mixtures must be compared to the Job Mix Formula particle size distribution, with the results expected to fall within the JMF limits of Table 7.1. Individual results may fall outside the particle size distribution design limits of Tables 5.1 or 5.2; this is acceptable provided they are within the JMF limits.

When the air voids content of the compacted mix in the field is to be determined, Maximum Theoretical Specific Gravity and Density testing of the actual mix (ASTM D2041) is required. This test is sensitive to changes in mix binder content, is reproducible and rapid, thus it is recommended as a means of monitoring production quality, in conjunction with binder content and particle size distribution analysis.

Alternative methods of determining bitumen content to ASTM D2172 are permitted. Provided these methods have been validated, or in the case of the ignition furnace suitable calibration offsets have been established, alternatives are fully acceptable. Other methods such as nuclear methods may also be used if validated.
Approved Innovative Asphalt Mixes utilising non standard Aggregates

Other innovative asphalt mixes including or otherwise the inclusion of crushed glass, higher percentages of RAP and other waste or industrial by-products that are not normally acceptable under this specification but which have been approved by Transit New Zealand’s Engineering Policy Manager are as follows:

None Approved to date, 15 April 2005.