Service life of asphalt materials for asset management purposes
MPA Asphalt is part of the Mineral Products Association (MPA) - the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar, and silica sand industries and is the sectoral voice for mineral products. Its membership also includes companies manufacturing road construction and quarrying plant and equipment and UK producers of petroleum bitumen.

“The value of the local road network to both authorities and society cannot be underestimated – practically every journey starts and ends on a road and they are essential to safe and timely transport of people, goods and services. Having an accurate picture and understanding of that value and its deterioration is key to the successful implementation of Highways Asset Management Plans. The joint working group from MPA and ADEPT members is to be commended for its efforts in providing this tool to assist Asset Managers.”

Alan Mackenzie, Chairman, MPA Asphalt

ADEPT is the Association of Directors of Environment, Economy, Planning and Transport.

The Association of Directors of Environment, Economy, Planning & Transport is an umbrella organisation representing local authority county, unitary and metropolitan Directors responsible for 'Place based' services. Our remits include economic development, transport and communications, planning and housing and the environment.

“I am delighted that ADEPT and MPA have joined together in this initiative to establish the service life of various asphalt materials. It is an excellent example of collaboration as Highway Authorities travel the road of Whole Government Accounting. To depreciate the network it is essential that Authorities, at the outset, have a guideline for asset managers as to how long asphalt materials should be expected to last.”

Heather Barnes, President, ADEPT

Whilst every care is taken to ensure the accuracy of the general information and advice offered herein or given by staff of the Mineral Products Association and ADEPT, no liability or responsibility of any kind can be accepted by the Mineral Products Association, the ADEPT or their staff.

Cover photography courtesy of Aggregate Industries
## Contents

<table>
<thead>
<tr>
<th>page</th>
<th>item</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Executive Summary</td>
</tr>
<tr>
<td>5</td>
<td>Introduction</td>
</tr>
<tr>
<td>5</td>
<td>Methodology</td>
</tr>
<tr>
<td>6</td>
<td>Surface Course</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td>Service Life</td>
</tr>
<tr>
<td>6</td>
<td>Binder Course and Base</td>
</tr>
<tr>
<td></td>
<td>Description</td>
</tr>
<tr>
<td></td>
<td>Service Life</td>
</tr>
<tr>
<td>7</td>
<td>Guidance to follow to achieve life</td>
</tr>
<tr>
<td>7</td>
<td>Key compromising factors</td>
</tr>
<tr>
<td>8</td>
<td>Failure modes</td>
</tr>
<tr>
<td>9</td>
<td>Recommendation</td>
</tr>
<tr>
<td>10</td>
<td>References</td>
</tr>
<tr>
<td>10</td>
<td>Bibliography</td>
</tr>
<tr>
<td>10</td>
<td>Glossary</td>
</tr>
<tr>
<td>11</td>
<td>Working Group Members</td>
</tr>
</tbody>
</table>
Executive Summary

Service life is defined as the period of time for which asphalt materials after first installation are fit for purpose and as such can be used for asset management purposes. The 'life' of a pavement is the time at which significant maintenance becomes necessary. On any given road the materials may have a greater or lesser life depending upon circumstances. Treatments to extend service life are also addressed.

A sound basis for understanding the service life of asphalt materials used in highway maintenance and construction is an essential element of lifecycle planning for the highway practitioner with regard to asset management and the requirements for depreciation, valuation and Whole of Government Accounts (WGA).

The work undertaken by a joint working group of ADEPT and MPA representatives has provided a guideline for asset managers on service life values for use by Highway Authorities. They are recommended to the Chartered Institute of Public Finance and Accountancy (CIPFA) and the Highway Asset Management Financial Information Group (HAMFIG) as the service life values to be used unless other specific performance data is available to justify alternative figures.

The following summarises the service life figures:

<table>
<thead>
<tr>
<th>PAVEMENT LAYER</th>
<th>MATERIAL</th>
<th>MATERIAL SERVICE LIFE IN DESIGNED ROADS</th>
<th>MATERIAL SERVICE LIFE IN EVOLVED ROADS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface course</td>
<td>Asphalt concrete HRA Thin surface course system SMA a) Low texture b) Other</td>
<td>8 years 20 years 15 years 20 years 15 years</td>
<td>6 years 20 years 10 years 20 years 10 years</td>
</tr>
<tr>
<td>Binder course</td>
<td>Asphalt concrete EME 2 HRA SMA</td>
<td>All 30 years</td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>Asphalt concrete EME 2 HRA</td>
<td>All 40 years</td>
<td></td>
</tr>
</tbody>
</table>
Introduction

All Highway Authorities should be producing lifecycle plans for their assets in order to calculate the annual depreciation of those assets; this will be reported in Whole of Government Accounts (WGA) as required by DfT. A key part of any lifecycle plan is understanding what the asphalt material options are and how long they will last.

In the absence of robust, long-term records based on actual performance, which few authorities currently have, the service lives identified in this document should only be used to allow the production of Lifecycle plans.

All Highway Authorities are encouraged to collect and analyse data as part of their asset management in order to provide feedback to future reviews of this document. This will enable them to verify that the service lives quoted are valid for their situation or to enhance the information from actual data.

It is recommended that authorities use the figures published in this report where relevant in producing lifecycle plans to support WGA financial reporting unless, or until, robust local data is available that demonstrates a different level of performance on their roads.

This document has been recommended to HAMFIG (Highway Asset Management Financial Information Group) and CIPFA (Chartered Institute of Public Finance and Accountancy) as the way forward and the basis for lifecycle planning and asset valuation regarding these asphalt materials.

Methodology

A group consisting of members of MPA Asphalt Technical Panel together with members of ADEPT Soils & Materials Design & Specification Group representing materials technical specialists met in workshops to discuss service life. The aim of the workshops was to seek agreement as to the expected service life of asphalt materials used in highway maintenance and construction. The output was subsequently reviewed by both parties and refined at joint meetings.

The “service life” of an asphalt material, after first installation, is its expected lifetime following which it is no longer fit for purpose.

The Group reached consensus on the service lives that pavement layer materials will attain if design and construction are undertaken in accordance with required practice. The sections below on “Guidance to follow to achieve service life” and “Key compromising factors” give advice on such practice.

Each pavement layer material is considered against the following headings:

- Description/Definition
- Service life
- Guidance to follow to achieve service life
- Key compromising factors
- Failure modes (surface course only)

The Group considered the issue of “designed” and “evolved” roads. Designed roads are those that were constructed following a pavement structural design process whereas evolved relates to those roads that have been historically treated in some way over time without any formal initial design. Different service lives are provided for materials in both designed and evolved types.
Surface course

DESCRIPTION

What is included?

The use of asphalt material as a surface course in highway maintenance is a long established and proven technique. This report considers the following:

- Asphalt concrete – a continuously graded mixture of mineral aggregate, filler and bituminous binder which forms an interlocking structure.
- Thin surface course system – paver laid surface course materials installed between 15 and 50mm thick.
- SMA – a very high stone content, gap-graded mixture with high binder content.
- HRA – a dense mixture of mineral filler, sand and bitumen into which a coarse aggregate is added. It is a gap-graded material and the mechanical properties are dominated by the mortar. Coated chippings may be applied to achieve texture.

If specific proprietary materials are used from suppliers Authorities should seek performance information related to those products as it may be different to the lives proposed in this document.

Which roads are included?

- All classes of road, from single track, unclassified roads to national high speed motorways can, and have had asphalt materials successfully applied.

SERVICE LIFE

The Group gave due consideration to service life on carriageways when designed and constructed correctly based on standard pavement design. It is anticipated that the characteristic life across the whole network in the appropriate application will reflect these service lives.

Binder course and base

DESCRIPTION

Binder course – provides a well-shaped surface upon which the surface course is laid, contributes to structural strength and waterproofing

Base – main structural layer that takes designed loading over the life of the pavement

What is included?

The following asphalt materials are included as binder course material:

- Asphalt concrete
- EME 2
- HRA
- SMA

SERVICE LIFE

BINDER COURSE

When the pavement and materials are correctly designed and installed, binder course materials will have a service life of 30 years.

BASE

When the pavement and materials are correctly designed and installed, base materials have a service life of 40 years.

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>MATERIAL SERVICE LIFE IN DESIGNED ROADS</th>
<th>MATERIAL SERVICE LIFE IN EVOLVED ROADS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt Concrete e.g.</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>Hot Rolled Asphalt (HRA)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Thin Surface Course Systems</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>(TSCS) e.g. CI 942</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stone Mastic Asphalt (SMA)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>a. Low texture</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>b. Other</td>
<td>15</td>
<td>10</td>
</tr>
</tbody>
</table>

NOTE: HRA and ‘low texture’ SMA are more able to accommodate the variability of evolved roads.

It is recognised that various Highway Authorities around the UK utilise asphalt materials on footways providing similar life to carriageways however the Group did not address footways and this may be rectified in the future.
Guidance to follow to achieve life

- Design to standards and specifications and with supply chain involvement
- Client competence
- RN42 applies
- Importance of bond coat
- Pre-surfacing requirements to be determined e.g. pre-patching, raising ironwork
- Determine specification
- Contractors must be certified to and compliant with National Highway Sector Scheme (NHSS) 16
- Trained workforce – contractors must demonstrate their workforce competency is up to date
- Service life assumes sound substrate
- Consideration of available flexibility or stiffness of existing substrate
- Drainage of whole pavement structure
- Maintenance of drainage
- Material selection
- Surfacing conditions – cold/ wet – winter night to hot/dry – summer day

Key compromising factors

The key compromising factors are the factors most likely to affect the service life figures quoted above and will not be an issue if the guidance is followed. Such factors may include:

- Night work
- Wrong material in wrong place
- Use of non-Sector Scheme registered contractor
- Incorrect preparation of works
- Inclement weather conditions
- Surface conditions (note 8)
- Application to planed surface
- Compaction
- Segregation
- Poor substrate
- Poor finish / longitudinal profile
- Incorrect bond coat

Each of these factors can have a significant effect and increased risk of reduction in life and the total effect will be cumulative. Any single factor could have a reducing effect of 5% whilst cumulative effects could total as much as 75% in extreme circumstances.
Failure modes

The following are failure modes that can occur in the surface course. Different materials will have different modes of failure:

- Polishing of aggregate
- Loss of texture
- Chipping loss/stripping
- Rutting
- Joints / ravelling
- Fatting up
- Cracking
- Bleeding
- Tearing
- Fretting

NOTES

1. Consider road hierarchy related to traffic levels.

2. Determine the reason to apply new surface – ensure it is the correct solution.

3. Failure can be a result of a change in site circumstance e.g. channelized traffic loading resulting in rutting.

4. Correct binder type and quantity is essential to achieve life.

5. Consider suitability of substrate condition/affinity to sub-grade.

6. Need to apply at the right time as this affects maintenance planning and contract preparation to ensure all the necessary sites can be included. HRA gives a good indication of future failure hence time to plan whereas SMA can be more instant and will require patch and hold pending work at the appropriate time.

7. Consider drainage at site location i.e. whether the defect is a consequence of water ponding or flowing over the surface or in the pavement structure or sub-grade. This will need attention prior to surfacing if it is to survive the service life.

8. Surface conditions must be right such as no standing water, no residual salt, no detritus, and vegetation free.

9. Materials to be laid at the most advantageous time of year; in general terms this means March to November, although some products are designed to be laid outside this working window.
Recommendation

All Highway Authorities are recommended by ADEPT and the MPA to use the service life for asphalt as stated in the following table when producing lifecycle plans for asset management and to support WGA financial reporting unless, or until, robust local data is available that demonstrates a different level of performance on their roads for the pavement materials used:

<table>
<thead>
<tr>
<th>PAVEMENT LAYER</th>
<th>MATERIAL</th>
<th>MATERIAL SERVICE LIFE IN DESIGNED ROADS</th>
<th>MATERIAL SERVICE LIFE IN EVOLVED ROADS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface course</td>
<td>Asphalt concrete</td>
<td>8 years</td>
<td>6 years</td>
</tr>
<tr>
<td></td>
<td>HRA</td>
<td>20 years</td>
<td>20 years</td>
</tr>
<tr>
<td></td>
<td>Thin surface</td>
<td>15 years</td>
<td>10 years</td>
</tr>
<tr>
<td></td>
<td>course system</td>
<td>20 years</td>
<td>20 years</td>
</tr>
<tr>
<td></td>
<td>SMA</td>
<td>15 years</td>
<td>10 years</td>
</tr>
<tr>
<td></td>
<td>a) Low texture</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>b) Other</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Binder course</td>
<td>Asphalt concrete</td>
<td>All 30 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EME 2 HRA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Base</td>
<td>Asphalt concrete</td>
<td>All 40 years</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EME 2 HRA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

NOTE: HRA and ‘low texture’ SMA surface courses are more able to accommodate the variability of evolved roads.

The above has been recommended to HAMFIG and CIPFA by ADEPT as the way forward and the basis for lifecycle planning and asset valuation regarding these asphalt materials.
References

Road Note 42 (2008), published by TRL
NHSS 16 – National Highway Sector Scheme for the Laying of Asphalt Mixes
MCHW Volume 1 Specification for Highway Works
BS EN 13108 Bituminous mixtures – Material specifications

Bibliography

Design Manual for Roads and Bridges (DMRB) (Vols 0-15)
PD 6691 Guidance on the use of BS EN 13108 Bituminous mixtures – Material specifications
BS 594987 Asphalt for roads and other paved areas. Specification for transport, laying, compaction and type testing protocols.
LR1132 The Structural Design of Bituminous Roads, TRL 1984
Well Maintained Highways a Code of Practice for highway maintenance, UKRLG, updated 2013
CSS ENG/6-94 Pavement Design Manual
Code of Practice on Transport Infrastructure Assets, CIPFA, 2013

Glossary

ADEPT Association of Directors of Environment, Economy, Planning and Transport
CIPFA Chartered Institute of Public Finance & Accountancy
CSS County Surveyors Society (now ADEPT)
DfT Department for Transport
EME 2 Étobe à module élevé
EN European Norm (Standard)
HAMFIG Highways Asset Management Financial Information Group
HRA Hot Rolled Asphalt
MPA Mineral Products Association
NHSS National Highway Sector Scheme
RN42 Road Note 42
SMA Stone Mastic Asphalt
SMDS ADEPT Soils & Materials Design & Specification
TRL Transport Research Laboratory
WGA Whole of Government Accounts
Working group members

ADEPT representatives
Steve Betteridge  Secretary, SMDS Group
John Booth  Member, SMDS Group
Stephen Child  Chairman, SMDS Group
Bob Noakes  Member, SMDS Group
David O’Farrell  Member, SMDS Group
Ian Walsh  Member, SMDS Group
Chris Allen Smith  Asset Management

MPA representatives
John Bradshaw-Bullock  MPA
Robert Gossling  MPA
John Lay  MPA
David Markham  MPA
Paul Phillips  MPA
John Richardson  MPA
Malcolm Simms  MPA
Iain Simpson  MPA
Chris Southwell  MPA
MPA Asphalt is part of the Mineral Products Association, the trade association for the aggregates, asphalt, cement, concrete, dimension stone, lime, mortar and silica sand industries.

© MPA Asphalt June 2015