Light Duty Asphalt Pavements
Design, Specification and Construction

2002

AUSTRALIAN ASPHALT PAVEMENT ASSOCIATION
Cover photographs
Main photo: a smooth and aesthetically appealing pedestrian pathway in Melbourne's Botanic Gardens is strong enough to also carry occasional light maintenance vehicles.
Small photos: a functionally efficient small office car park (left), and an attractive entrance to a residential precinct.

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AAPA Implementation Guide IG-5

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While the information given in the Guide is considered to represent best practice at the time of publication, as pavement technology is in a state of continuous improvement, it will no doubt be improved upon in the future.
PREFACE

This Implementation Guide has been prepared for the advice of engineers, architects and contractors in the planning, design and construction of light-duty flexible pavements incorporating asphalt layers.

A light-duty pavement is defined as one that is predominantly subjected to low traffic volumes, lightly loaded vehicles, cycle and/or pedestrian traffic or that provides a purely architectural feature and includes:

- local access roads
- commercial building driveways and car parks other than those subjected to regular trafficking by heavy vehicles
- residential driveways
- cycleways
- footpaths and pedestrian precincts
- al fresco cafes and outdoor dining areas
- landscape architectural features.

Asphalt is a material with properties that depend on the location in which it is used, its component materials and the loads to which it is subjected. It is, therefore, not possible for the information provided in this Guide to address all aspects of a specific project, rather it provides principles that are broadly applicable.

Tables of typical pavement thicknesses for a range of light duty applications are provided as a general guide. More detailed design information can be found in the Austroads Guide to the Design of Light Duty Pavements (APRG Report No. 21). For pavements subjected to high intensity traffic or heavy wheel loads, readers are referred to AAPA Implementation Guide 6: Selection and Design of Flexible Pavements for general guidance, and are advised to seek the assistance of a specialist pavement engineer.

Part 2 of this Guide is a model specification suitable for paving with asphalt on small-scale works. Additional copies of the specification are available from AAPA. For larger asphalt projects, AAPA has also developed a model National Asphalt Specification. Advice on the availability and use of particular asphalt mixes is obtainable from asphalt producers. For further details of AAPA publications, member contacts or enquiries, contact AAPA or visit the AAPA website: www.aapa.asn.au
# CONTENTS

## PART 1  DESIGN AND CONSTRUCTION

1. AIM .................................................................................................................. 5
2. A GENERAL INTRODUCTION TO ASPHALT ...................................................... 5
3. PAVEMENT TYPES ............................................................................................ 6
4. PAVEMENT DESIGN .......................................................................................... 8
   4.1 General ......................................................................................................... 8
   4.2 Factors Affecting Design .............................................................................. 8
   4.3 Structural Design Factors ........................................................................... 9
5. TYPES OF ASPHALT MIXES AND THEIR USES ............................................... 13
   5.1 Definition and Use of Asphalt ..................................................................... 13
   5.2 Types of Asphalt ......................................................................................... 13
   5.3 Layer Thickness and Nominal Size .............................................................. 14
6. PAVEMENT THICKNESS TABLES ..................................................................... 15
   6.1 Pedestrian and Recreation Areas ................................................................. 16
   6.2 Cycleways .................................................................................................... 17
   6.3 Parking Areas and Driveways for Passenger Vehicles ..................................... 18
   6.4 Residential Streets ...................................................................................... 19
7. CONSTRUCTION ................................................................................................. 20
   7.1 Construction Sequence .............................................................................. 20
   7.2 Site Preparation ........................................................................................... 20
   7.3 Spreading and Compaction of Granular Material ........................................... 21
   7.4 Priming and Tack Coating .......................................................................... 21
   7.5 Spreading and Compaction of Asphalt ......................................................... 21
8. MAINTENANCE .................................................................................................. 22
   8.1 Prevention and Repair of Surface Damage .................................................... 22
   8.2 Resurfacing .................................................................................................. 23
9. REFERENCES ....................................................................................................... 24

## PART 2  SPECIFICATION

NOTES ON THE USE OF THE SPECIFICATION CLAUSES .................................. 25

SPECIFICATION FOR SMALL SCALE ASPHALT WORK ....................................... 28
Part 1: Design and Construction

1. **AIM**

The aim of this part of the Guide is to assist in the selection of the optimum design and construction standards needed for satisfactory performance of lightly trafficked asphalt pavements.

An essential prerequisite for satisfactory performance of asphalt pavements is the construction of an adequate foundation, which includes compaction and drainage of the subgrade and the proper selection and compaction of the layers underneath the asphalt. If the pavement structure which supports the asphalt is inadequate for its purpose, it is very difficult to construct asphalt that will have adequate resistance to deformation and cracking, and provide a smooth, durable surface.

![Figure 1: Cycle path](image)

2. **A GENERAL INTRODUCTION TO ASPHALT**

Asphalt is the world's most widely used paving material. In Australia alone, about 7 million tonnes of asphalt are produced annually and it forms the surfacing on many of the paved footpaths, cycleways, roads and freeways throughout the country, particularly in urban areas.

The widespread use of asphalt reflects its extraordinary versatility. It enables production of paving in a wide range of economical, durable forms that can be precisely tailored to the use intended and the funds available. Asphalt pavements are economical to build, maintain and rehabilitate and, when properly designed and constructed, will last for many years with appropriate and timely maintenance.

Other attractive features of asphalt surfaced pavements include the speed and ease of construction, resiliency, and dark tone that minimises glare and enables excellent visibility of traffic guidance delineation features such as linemarking.

In recent times the availability of special component materials and mixes have extended the use of asphalt to meet contemporary demands. One such innovation has been the use of polymer modified bituminous binders which provide increased resistance to permanent deformation and cracking under heavy loads. Another innovation has been the development of coloured asphalt.
While traditionally, asphalt has only been available in black, it is now possible to produce it in a range of colours either by the use of a translucent synthetic binder and/or the addition of coloured oxides in the production process or by the application of a coloured sealant to the finished asphalt surface. The coloured sealant can be applied in combination with a template which imparts a pattern to the surface of the asphalt. This innovation offers the opportunity for the increased use of asphalt in purely aesthetic applications or where visual differentiation is important to the function of the pavement.

Asphalt is also now commonly recycled, either by recycling in situ at the end of its life, or by removal and incorporation in a new mix. This provides environmental benefits by reducing the demand on raw materials.

![Figure 2: Asphalt combined with attractive landscaping in new residential estate](image)

3. PAVEMENT TYPES

Typically, there are two types of asphalt pavement appropriate for use in light traffic applications, the conventional asphalt surfaced granular pavement and the full depth asphalt pavement.

(i) Asphalt surfaced granular pavements

Conventional asphalt pavements are constructed with a granular base course and an asphalt wearing course. The wearing surface may be either dense graded or gap graded asphalt placed in one or more layers.

The granular base course normally comprises a well graded, quality controlled material with low plastic fines (for example, fine crushed rock or good quality natural gravel road base). For pavements subjected to higher levels of vehicular traffic (eg. local roads, car parks), the base should be primed to promote bonding between the base and the asphalt surfacing.

(ii) Full-depth asphalt pavements

In a full-depth asphalt pavement the pavement above the subgrade is composed entirely of asphalt layers. As asphalt is much stronger than granular material it has a much greater load spreading capacity, which means that there can be a reduction in total pavement thickness compared with the conventional asphalt pavement.

Properly designed and constructed, full depth asphalt pavements are extremely durable, requiring very little routine maintenance, although periodic renewal of the wearing course may be necessary after long periods of service.
Further advantages of full depth asphalt pavements include rapid construction, which minimises the possibility of wet weather delays or dust nuisance during dry periods, and a reduced thickness that can avoid the need to alter or relocate existing services within the area to be paved. Both of these can result in major time and cost savings.

Unless the subgrade is of sufficient strength and well drained so that it can carry construction traffic without undue deformation, it may not be possible to construct the asphalt directly on the subgrade. In that case, it is common practice to provide a working platform, over the subgrade, that typically consists of 50 mm to 100 mm of granular material. As an alternative, it may be appropriate, in some circumstances, to stabilise the subgrade with lime or cement before the construction of the full depth asphalt pavement.

<table>
<thead>
<tr>
<th>Some advantages of asphalt surfaced pavements</th>
<th>Added advantages of full depth asphalt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Speed and ease of construction</td>
<td>Reduces the thickness of the total pavement structure</td>
</tr>
<tr>
<td>Easy maintenance and rehabilitation</td>
<td>Reduces the total amount of material used in the pavement</td>
</tr>
<tr>
<td>Smooth riding surface</td>
<td>Can be built faster and with greater ease than any other pavement type</td>
</tr>
<tr>
<td>Low traffic noise</td>
<td>Enables stage construction</td>
</tr>
<tr>
<td>Good skid resistance</td>
<td>Cost effective in terms of construction, maintenance and rehabilitation</td>
</tr>
<tr>
<td>Easily strengthened if necessary</td>
<td>Minimises the ingress of water into the pavement structure</td>
</tr>
<tr>
<td>Can be used almost immediately after</td>
<td>Reduces construction delays</td>
</tr>
<tr>
<td>construction</td>
<td>Aids uniformity of compaction of layers</td>
</tr>
<tr>
<td>Minimal construction delay due to wet</td>
<td>Requires low levels of routine maintenance</td>
</tr>
<tr>
<td>weather</td>
<td></td>
</tr>
<tr>
<td>Able to be recycled</td>
<td></td>
</tr>
<tr>
<td>Line markings are easily visible</td>
<td></td>
</tr>
<tr>
<td>Range of colours</td>
<td></td>
</tr>
<tr>
<td>Surface patterns can be applied</td>
<td></td>
</tr>
</tbody>
</table>

Figure 3: Full depth asphalt pavement in hotel car park has given 30 years of low maintenance service
4. PAVEMENT DESIGN

4.1 General

For both the conventional and the full-depth asphalt pavement, the critical design parameter is the overall pavement thickness, which depends on the strength and uniformity of the subgrade and the level of traffic to which the pavement is to be subjected over its intended design life. This thickness should be sufficient to distribute the loads applied at the pavement surface to the subgrade without overstressing it and causing unacceptable deformation. In full depth asphalt pavements, the thickness must also be adequate to avoid load-induced cracking in the asphalt.

4.2 Factors Affecting Design

The three principal factors that affect the structural design of asphalt pavements are:

(a) Traffic – types and numbers of vehicles, types of axle configurations, axle loads, and prevailing road speed.
(b) Subgrade strength and uniformity.
(c) Pavement material strength and uniformity.

In contrast to more heavily trafficked pavements, the performance of lightly trafficked asphalt pavements is typically less influenced by structural design factors than by environmental factors such as:

- Ingress of moisture to the pavement or the subgrade.
- Swelling and shrinking of clay subgrades due to variation in moisture conditions.
- Hardening of the asphalt due to the ingress of air to the asphalt surfacing.
- Ambient temperatures.
- Growth of root systems of nearby trees and shrubs.

Within the pavement design procedure, however, the numerical calculations used to determine the required pavement thickness does not directly account for these environmental factors, although it defines a minimum pavement thickness that will safeguard the pavement against their worst effects. The influence of these factors on the performance of the pavement is best controlled by appropriate materials selection, the provision of adequate surface and sub-surface drainage systems and the adoption of good construction and landscaping practice.

Pavements must also be designed with adequate surface slope to shed water and avoid ponding or "bird baths" on the surface. Generally a minimum slope or crossfall of 1 in 50 is required for machine laid work to ensure effective surface drainage. Where there is significant handwork, it is preferable to increase the minimum slope to 1 in 25.

A typical residential driveway pavement is illustrated in Figure 4.

Pavement design factors are discussed in more detail in the following paragraphs.
4.3 Structural Design Factors

4.3.1 Traffic

The essence of taking traffic loading into account during design is to estimate the expected cumulative volume of vehicular traffic over the most heavily trafficked areas of the pavement throughout the design period. The design period for cumulative traffic is typically 20 years by which time the pavement may require some form of resurfacing or rehabilitation to restore surface properties.

For pavements subjected to pedestrian traffic or passenger cars only, nominal thicknesses of asphalt are proposed, as the pavement performance will be primarily governed by environmental conditions such as temperature and moisture rather than the loads applied.

For pavements subjected only to pedestrian traffic or passenger cars, nominal thicknesses of asphalt are proposed as the pavement performance will be primarily governed by environmental conditions such as temperature and moisture rather than the loads applied. The pavement thicknesses for these lightly trafficked areas, however, are adequate to support the infrequent delivery trucks in driveways, light-weight trucks in parking areas and maintenance vehicles. Increased pavement thicknesses, however, should be incorporated in the sections of passenger car parking areas regularly used by heavier trucks.

For the purposes of this guide, traffic types are listed in Table 1.
Table 1: Types of Traffic

<table>
<thead>
<tr>
<th>Application</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian Traffic</td>
<td>(a) Footpaths, school playgrounds, pedestrian precincts (Table 5)</td>
</tr>
<tr>
<td></td>
<td>(b) Al fresco dining areas* (Table 5)</td>
</tr>
<tr>
<td></td>
<td>(c) Playing surfaces such as tennis courts and basketball courts (Table 6)</td>
</tr>
<tr>
<td>Cycleways</td>
<td>(a) Cycleways (Table 7)</td>
</tr>
<tr>
<td>Parking Areas and Driveways for</td>
<td>(a) Residential driveways (Table 8)</td>
</tr>
<tr>
<td>Passenger Cars</td>
<td>(b) Passenger car parking areas up to 50 bays (Table 9)</td>
</tr>
<tr>
<td>Residential Streets</td>
<td>(a) Cul-de-sac (Table 11)</td>
</tr>
<tr>
<td></td>
<td>(b) Minor residential street (minor access) used primarily by passenger</td>
</tr>
<tr>
<td></td>
<td>cars and light trucks, with no buses and only an occasional heavy vehicle</td>
</tr>
<tr>
<td></td>
<td>(Table 12)</td>
</tr>
</tbody>
</table>

* The principal effect in these pavements is the high static point loading applied through the feet of chairs.

Figure 5: Office car parking

4.3.2 Subgrade Conditions

In determining the required thickness of pavement, consideration must be given to the on-site conditions, specifically the soil profile and sub-surface moisture conditions. The type of soil on which the pavement is to be constructed will have an overriding influence on the required pavement thickness. The presence of sub-surface moisture affects the strength of most soils and if not controlled may cause a weakening of the soil so that the pavement will not perform as required. Excessive moisture should be prevented from entering the subgrade by providing adequate surface and subsurface drainage.
Ideally, the subgrade should be tested to determine its strength. The most common form of strength testing is California Bearing Ratio (CBR) testing, from which the thickness of the pavement required to carry the anticipated loads can be estimated. (More guidance for subgrade testing can be found in A Guide to the Design of New Pavements for Light Traffic (AUSTROADS Pavement Research Group Report 21 - 1998).

When imported fill material is required, care should be taken to ensure that the imported material is of a satisfactory type, that it is placed in layers not exceeding 200 mm thick and is adequately compacted using an appropriate roller(s). When fills are constructed, care should be taken to slope the top surface of each layer so that it will drain should wet weather occur during construction.

If subgrade strength-testing is not undertaken, both the determination of pavement design thickness, and the degree and uniformity of the compaction of the subgrade, should be assessed by a competent technologist.

Table 2 provides a description of subgrade types.

<table>
<thead>
<tr>
<th>Broad Subgrade Category</th>
<th>Description &amp; Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOOD</td>
<td>Well graded, essentially granular, non-plastic soils, may contain some gravel (soils, which except for dust and smoothness would make a fair unsealed road for light traffic) CBR ≥ 10</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>Clayey gravels, firm sands with some clay, sandy clay, silty clay (material which would make a poor unsealed road when excessively wet or dry) CBR 6 to 10</td>
</tr>
<tr>
<td>POOR</td>
<td>Heavy clays, fine silts, very fine silty clays (poorly compacted soils and clays but generally capable of carrying construction traffic when dry) CBR 3 to 5</td>
</tr>
<tr>
<td>VERY POOR</td>
<td>For subgrades with CBR &lt; 3 advice should be sought from a Pavement Engineer. Such materials may require in situ stabilisation or addition of a capping layer of selected imported materials to provide adequate pavement support.</td>
</tr>
</tbody>
</table>

4.3.3 Pavement Materials

Flexible pavements typically comprise asphalt and granular materials. Section 5 discusses the various asphalt mixes that are appropriate to light duty pavements.

Granular materials should comprise good quality crushed rock or crushed natural gravel with a low fines content. Crushed rock or gravel should comply with the relevant specifications of the local road authority (eg Councils) for use as base in lightly trafficked pavements.
4.3.4 Environmental Factors

Environmental factors include rainfall, seasonal moisture variation, trees with vigorous root systems and temperature.

Rainfall

In high rainfall areas, it is particularly important to provide adequate surface and subsurface drainage to ensure that granular base materials and subgrades do not become saturated.

Seasonal Moisture Variation

Clay soils with high plasticity (termed expansive soils) undergo substantial volume change with changes in moisture content that can occur with seasonal weather conditions (eg wet winter to dry summer or vice versa). This volume change can be, and often is, a major cause of shape loss and cracking in flexible pavements but can be minimised by:

- Constructing at a time when the soil moisture content is near its long-term equilibrium value. Over-wetting of exposed subgrade soils must be avoided.

- Provision of a low permeability select fill capping layer with a minimum thickness of 150 mm or use of lime stabilisation to reduce the plasticity of the upper layer of subgrade (typically only cost effective for pavements subjected to higher levels of vehicular traffic, eg local roads, car parks).

- Ensuring that pavement drainage is adequate and that subsoil drains do not extend into expansive soils.

- Restricting planting of shrubs and trees close to the edge of the pavement.

Tree roots

Trees with vigorous root systems should not be planted close to lightly trafficked pavements. Some State Road Authorities publish guides (VicRoads, 1987) on suitable species for planting in these locations and plant nurseries can provide further advice.

Temperature

The temperature regime will influence the stiffness of full depth asphalt pavements. Harder grades of binder or multigrade bitumen are used to provide additional stiffness in hot climates. Softer grades of binder are used in cold climates to improve flexibility and resistance to cracking at low temperatures.

Figure 6: Recreational path
5. TYPES OF ASPHALT MIXES AND THEIR USES

5.1 Definition and Use of Asphalt

The term asphalt refers to a mixture of aggregate and bituminous binder. Typically, this is produced hot in a mixing plant, transported to the construction site, and spread and compacted while still hot (90°C to 140°C). Unlike concrete pavements that require a curing period, asphalt can be opened to traffic immediately after compaction and cooling to ambient temperature. In addition, asphalt has the advantage over sprayed bituminous surfaces in that there are no loose stones on the newly laid work.

5.2 Types of Asphalt

Asphalt can be produced in a range of types. The two most common forms used in light duty pavements are dense graded and fine gap graded asphalt. Further types of asphalt include open graded asphalt and stone mastic asphalt, which are primarily used for surfacing of more heavily trafficked pavements although the latter is becoming more widely used in light duty applications. Asphalt may also be coloured or patterned in some applications.

The objective of the design and placing of an asphalt mix is to obtain a pavement of sufficient strength, uniformity and flexibility to withstand the expected traffic loads over a long period without deforming or cracking. When required, the mix should also aim to provide a suitable surface texture such as fine texture for pedestrian use or a coarse texture to provide adequate skid resistance for vehicles.

It is recommended that advice on the selection of appropriate mixes be sought from AAPA Members in the project area.

(i) Dense Graded Asphalt (Asphaltic Concrete)

Dense graded mixes of various nominal sizes are made from uniformly graded aggregates and bitumen. They rely primarily on grading, aggregate particle shape and density for their strength. This is the type of asphalt most commonly used in Australia in both structural and wearing course applications.

(ii) Fine Gap Graded Asphalt

Fine gap graded asphalt is similar to dense graded asphalt but with some of the intermediate asphalt aggregate sizes replaced by finer sizes. Use of this type of mix is generally confined to wearing course in residential streets where a fine surface texture and improved workability characteristics (ie more easily compacted) are required, leading to a smooth, dense and durable surface.

(iii) Stone Mastic Asphalt

Stone mastic asphalt (SMA) has a high proportion of coarse aggregate to provide a strong aggregate skeleton that is filled with a mastic of bitumen, filler and fine aggregate to achieve a durable mix with good surface texture and good deformation resistance. SMA is generally used as heavy duty wearing course, although small nominal sizes can also be used in lightly trafficked situations, at marginally higher cost due to higher binder content.

(iv) Coloured and patterned asphalt surfaces

Coloured pigments may be added to all asphalt types to provide a modified appearance, particularly the addition of iron oxide to produce an earthy red colour. For a wider range of
colours and more brilliant colour effects, synthetic binders are used in conjunction with different coloured pigments. A particular innovation is the use of a coloured surface coating in conjunction with a pattern that is stamped into the asphalt surface while still hot (Figure 7). Other coloured surface coatings may also be applied. These are particularly used on tennis courts and other recreational pavements.

![Coloured patterned asphalt surface](image)

**Figure 7: Coloured patterned asphalt surface**

5.3 **Layer Thickness and Nominal Size**

The nominal size of a mix is denoted by the largest aggregate size used and should be related to the thickness of the layer. Usually, the larger the aggregate size, the lower the cost of the mix and the higher its strength.

To make the spreading easier, and reduce any tendency of the material to tear during laying, the compacted layer thickness should not be less than 2.5 times and, preferably not less than 3 times, the nominal size of mix. Where the surface to be overlaid is uneven, it may be necessary to either increase the asphalt layer thickness or reduce the nominal mix size to achieve the optimal value of layer thickness over high points in the underlying surface. In cases of excessive unevenness, it may be desirable to place a corrective course or courses.

Table 3 may be used as a guide to satisfactory practice for dense graded asphalt.

**Table 3: Typical Layer Thickness as a Function of Nominal Mix Size**

<table>
<thead>
<tr>
<th>Nominal Mix Size</th>
<th>Compacted Layer Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 mm</td>
<td>15–20 mm</td>
</tr>
<tr>
<td>7 mm</td>
<td>20–30 mm</td>
</tr>
<tr>
<td>10 mm</td>
<td>25–40 mm</td>
</tr>
<tr>
<td>14 mm</td>
<td>35–55 mm</td>
</tr>
<tr>
<td>20 mm</td>
<td>50–80 mm</td>
</tr>
</tbody>
</table>
Common applications of different nominal size mixes are generally as follows. All mixes may not be produced at some locations and their availability should be checked with the local supplier before completing pavement designs or works specifications.

5 mm  Fine textured mix used where very thin layers (15–20 mm) are required. Generally only applicable to pedestrian areas and minor residential street applications as a resurfacing layer or in conjunction with another underlying asphalt layer.

7 mm  Common dense graded asphalt mix used as surfacing for pedestrian traffic, recreational applications, residential streets, driveways, al fresco dining areas and minor passenger car parking areas.

10 mm  Common dense graded asphalt mix for use as surfacing where a thicker layer (30–35 mm) is required for greater resistance to traffic in residential streets and larger passenger car parking areas. 10 mm nominal size fine gap graded mixes may be used in similar applications to 7 mm dense graded mixes.

14 mm  Generally used as wearing course on heavy duty pavements but may also be used as intermediate or base course on light duty pavements.

20 mm  Common base layer suited to asphalt layer thicknesses of 50 mm or more.

6. PAVEMENT THICKNESS TABLES

The following Tables can be used as a guide for the selection of the compacted thickness of the sub-base, base and wearing courses for the given subgrade soil conditions and the estimated traffic. The thicknesses indicated are the suggested minimum values for average conditions in each case and greater thicknesses may be required in some instances. Where difficulties are apparent with unusual subgrade, drainage or loading conditions, advice should be sought from an experienced Pavement Engineer. Thicknesses less than those shown may be used where experience has proved them to be completely adequate.

| Layering |
| All dimensions are in millimetres (mm) |

Asphalt thicknesses greater than 30 mm may require to be placed in a number of layers. A general guide to selection of asphalt nominal size and layer thickness is provided in section 5.3, above. Table 4 indicates combinations of asphalt layers suitable for the pavements described in this Guide.
Table 4: Asphalt Layering

<table>
<thead>
<tr>
<th>Total Compacted Thickness of Asphalt</th>
<th>Asphalt Layers</th>
<th>Base Course</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wearing Course</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nominal Size</td>
<td>Thickness</td>
</tr>
<tr>
<td>25</td>
<td>5 or 7</td>
<td>25</td>
</tr>
<tr>
<td>30</td>
<td>7 or 10</td>
<td>30</td>
</tr>
<tr>
<td>35</td>
<td>10</td>
<td>35</td>
</tr>
<tr>
<td>50&lt;sup&gt;1&lt;/sup&gt;</td>
<td>5 or 7</td>
<td>25</td>
</tr>
<tr>
<td>75</td>
<td>5 or 7</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>30</td>
</tr>
<tr>
<td>100</td>
<td>5 or 7</td>
<td>25</td>
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<td></td>
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<td>125</td>
<td>5 or 7</td>
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<td>10</td>
<td>35</td>
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<tr>
<td>160</td>
<td>5 or 7</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>35</td>
</tr>
</tbody>
</table>

Notes:
1. Tennis courts only (Table 6)
2. Placed in two equally thick or approximately equally thick layers

6.1 Pedestrian and Recreation Areas

Table 5: Footpaths, Pedestrian Precincts, Al Fresco Dining & School Playgrounds

<table>
<thead>
<tr>
<th>Subgrade</th>
<th>Full Depth Asphalt Pavement</th>
<th>Conventional Pavement</th>
<th>Granular Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOOD</td>
<td>75</td>
<td>25</td>
<td>75</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>75</td>
<td>25</td>
<td>100</td>
</tr>
<tr>
<td>POOR</td>
<td>100</td>
<td>25</td>
<td>150</td>
</tr>
</tbody>
</table>

Figure 8: Footpath and al fresco dining
Table 6: Playing Surfaces Requiring High Standards of Surface Shape
(Tennis Courts etc.)

<table>
<thead>
<tr>
<th>Subgrade</th>
<th>Full Depth Asphalt Pavement</th>
<th>Conventional Pavement</th>
<th>Granular Base</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Asphalt Wearing Course</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>501</td>
<td>75</td>
</tr>
<tr>
<td>GOOD</td>
<td>75</td>
<td>501</td>
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</tr>
<tr>
<td>MEDIUM</td>
<td>75</td>
<td>501</td>
<td>100</td>
</tr>
<tr>
<td>POOR</td>
<td>100</td>
<td>501</td>
<td>150</td>
</tr>
</tbody>
</table>

Notes:
1. An increase in thickness to 50 mm is recommended to enable the asphalt surface layer to be placed in two layers to assist in achieving close tolerance of surface shape.

Figure 9: Asphalt tennis court with coloured surface

6.2 Cycleways

Table 7: Cycleways

<table>
<thead>
<tr>
<th>Subgrade</th>
<th>Full Depth Asphalt Pavement</th>
<th>Conventional Pavement</th>
<th>Granular Base</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Asphalt Wearing Course</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>25</td>
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</tr>
<tr>
<td>GOOD</td>
<td>75</td>
<td>25</td>
<td>150</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>75</td>
<td>25</td>
<td>200</td>
</tr>
<tr>
<td>POOR</td>
<td>100</td>
<td>25</td>
<td></td>
</tr>
</tbody>
</table>

Figure 10: Cycleway
6.3 Parking Areas and Driveways for Passenger Vehicles

Table 8: Residential Driveways

<table>
<thead>
<tr>
<th>Subgrade</th>
<th>Full Depth Asphalt Pavement</th>
<th>Conventional Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Asphalt Wearing Course</td>
</tr>
<tr>
<td>GOOD</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>POOR</td>
<td>125</td>
<td>25</td>
</tr>
</tbody>
</table>

Figure 11: Residential driveway

Table 9: Passenger Car Parking Areas up to 50 bays

<table>
<thead>
<tr>
<th>Subgrade</th>
<th>Full Depth Asphalt Pavement</th>
<th>Conventional Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Asphalt Wearing Course</td>
</tr>
<tr>
<td>GOOD</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>100</td>
<td>25</td>
</tr>
<tr>
<td>POOR</td>
<td>125</td>
<td>25</td>
</tr>
</tbody>
</table>
Table 10: Passenger Car Parking Areas, 50–500 bays

<table>
<thead>
<tr>
<th>Subgrade</th>
<th>Full Depth</th>
<th>Conventional Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asphalt Pavement</td>
<td>Asphalt Wearing Course</td>
</tr>
<tr>
<td>GOOD</td>
<td>100'</td>
<td>30'</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>125'</td>
<td>30'</td>
</tr>
<tr>
<td>POOR</td>
<td>150'</td>
<td>30'</td>
</tr>
</tbody>
</table>

Notes:
1. Access roadways, particularly areas used by commercial delivery vehicles, may require a greater thickness and advice should be sought from an experienced Pavement Engineer.

Figure 12: Large car park

6.4 Residential Streets

Table 11: Cul de Sac

<table>
<thead>
<tr>
<th>Subgrade</th>
<th>Full Depth</th>
<th>Conventional Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asphalt Pavement</td>
<td>Asphalt Wearing Course</td>
</tr>
<tr>
<td>GOOD</td>
<td>75</td>
<td>30</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>100</td>
<td>30</td>
</tr>
<tr>
<td>POOR</td>
<td>125</td>
<td>30</td>
</tr>
</tbody>
</table>

Figure 13: Cul de sac
Table 12: Minor Residential Street (no buses)

<table>
<thead>
<tr>
<th>Subgrade</th>
<th>Full Depth Asphalt Pavement</th>
<th>Conventional Pavement</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Asphalt Wearing Course</td>
</tr>
<tr>
<td>GOOD</td>
<td>100¹</td>
<td>35</td>
</tr>
<tr>
<td>MEDIUM</td>
<td>120¹</td>
<td>35</td>
</tr>
<tr>
<td>POOR</td>
<td>180¹</td>
<td>35</td>
</tr>
</tbody>
</table>

Notes:
1. Major residential streets with significant through traffic, bus routes or light/industrial commercial areas require greater thicknesses and advice should be sought from an experienced Pavement Engineer.

7. CONSTRUCTION

7.1 Construction Sequence

The normal sequence of activities for the construction of a new pavement is as follows:

- clear vegetation and topsoil
- install drains, as necessary
- check influence of tree roots
- excavate to the required subgrade depth
- identify the location and cause of any soft spots in the subgrade, improve drainage if necessary, and replace soft spots with better quality material
- apply weed killer, if required
- compact subgrade to a smooth, free draining, even slope
- form concrete kerbs or pavement edging of concrete, brickwork or timber
- place and compact granular material to provide an even and compacted surface of the correct thickness (conventional asphalt pavements only)
- place and compact hot mix asphalt base (full depth asphalt pavements only)
- spray bituminous primer or tack coat on compacted granular material (conventional asphalt pavement only)
- place and compact asphalt wearing course.

For the surfacing of an existing granular pavement or resurfacing of an existing asphalt pavement, the construction typically will involve only the last two of these activities.

7.2 Site Preparation

Clearing

For new pavements, the area should first be stripped of any vegetation and topsoil then the underlying soil or rock removed to a sufficient depth to enable the required thicknesses of crushed rock and/or asphalt to be placed. Heavy clay subgrades should be treated as described in Section 4.3.4.
Drainage

The surface on which the pavement is to be constructed should be graded and compacted to a smooth, free-draining, even slope free of depressions.

In all cases the finished asphalt surface should be sloped at least at 1 in 50, without depressions, to provide for surface water run-off. Where there is significant handwork, the minimum slope may need to be increased to 1 in 25 to ensure that there is no ponding of surface water.

Weed Growth

Some weeds or natural grasses, such as nut grass, kikuyu, couch grass, buffalo grass and bracken fern or seeds from trees can grow through an asphalt pavement when conditions are favourable. Where vegetation is present, the subgrade should be grubbed of all roots and a comprehensive soil sterilising agent or herbicide applied.

7.3 Placing and Compacting Granular Material

Granular material should be placed in layers at least 75 mm thick but not exceeding 150 mm in thickness. If the layer is too thin it may compact under the initial pass of the roller but will tend to loosen again with subsequent passes, while if it is too thick the roller will be unable to achieve a uniformly high density throughout the layer.

Prior to compaction the moisture content of the layer should be approximately 1% below the optimum moisture content. For some materials this will require the contractor to add water to the material although, for crushed rock material it is common for suppliers to add water at the quarry. This material, known as "wet mix", is delivered at a moisture content close to optimum.

Granular material should be compacted to a minimum density of 95% of the Maximum Dry Density as determined in accordance with Australian Standard AS1289.6.2.

7.4 Priming or Tack Coating

Where required, priming of the finished surface of a granular base should be carried out using a cutback bitumen conforming to the requirements of the Australian Standard AS2157 "Cutback Bitumen". The grade and application rate of the prime depends on the texture of the base surface; the more open textured the surface is, the heavier the grade of prime and the higher the application rate. For this reason the decision on an appropriate prime and application rate should to be made at the time of priming, although typically application rates vary between 0.8 l/m² to 1 l/m².

7.5 Spreading and Compaction of Asphalt

Where practicable, asphalt should be spread by a self-propelled asphalt paver and compacted with smooth, steel-wheeled rollers to a uniform dense finish. On larger works, pneumatic-tyred, multi-wheeled rollers may be used to supplement the steel-wheeled rollers to achieve the required standards of asphalt density. In areas inaccessible to rollers, and other small works, vibrating plate compactors and hand ramming methods may be employed.

Where it is impractical to use an asphalt paver then hand spreading methods must be used. Asphalt spread by hand should be placed in full shovelfuls and not cast or thrown over the area to be paved or newly placed and compacted asphalt. Generally, a slight excess of material is placed, that is then screeded to level, but excessive working of the surface leads to separation of coarse materials, and should be avoided. All surface correction should be completed prior to commencing compaction.
Wooden lutes are most commonly used for hand screeding because their light weight enables smooth screeding of hot materials. Where practicable, the screeding should be done with a head of material in front of the lute, and using a single pass that leaves a uniform surface of fresh asphalt.

The work should be carried out in a competent and careful manner with a workforce of suitable size and skill so that operations will be rapid and co-ordinated and the mix will not become unduly cold or segregated. When hand spreading it is essential to complete the work as quickly as possible to avoid excessive cooling of the asphalt. Coarse segregated materials resulting from handwork must be completely removed from the surface along with any other excess material. Attempting to avoid wastage and clean-up of surplus asphalt is false economy if it results in inferior quality in the finished work.

When matching the levels to an adjoining surface, with either paver laying or hand spreading, there must be an excess of asphalt at or beyond the edge that enables the forming of a vertical face of fresh asphalt. Generally, an excess of material should be initially placed, or carefully pulled back to the edge, and subsequently screeded away from the edge using a head of material on the lute. Dragging the minimum amount of material to barely fill to an edge, particularly at corners of patches or transverse joints, will almost certainly result in segregated material against the edge and poor density.

Cold weather, particularly cool winds or rain, will cause asphalt to cool more rapidly, making it more difficult to achieve high standards of compacted density and surface finish. Generally, placing of asphalt in such conditions should be avoided, especially when placing thin surface layers. For further information refer to Austroads/AAPA Work Tip No.12 Compaction of Asphalt.

8. MAINTENANCE

8.1 Prevention and Repair of Surface Damage

Asphalt surfaces tend to be more susceptible to minor surface damage in the first year or so of service until surface bitumen is worn or weathered away and additional hardening of the asphalt occurs. In the first one or two summers, damage can be minimised by:

- Not placing sharp objects or concentrated loads, such as outdoor furniture, on the surface.
- Avoiding tight turns in vehicles with power steering during hot weather.
- Avoiding oil and petrol spills that tend to dissolve the bitumen in the asphalt. If accidental spillage does occur, then dust with lime or flush gently with water to dilute the spill.
- Not tracking clay onto the surface from the wheels of vehicles or construction equipment.
- Avoid planting trees or shrubs with vigorous root systems close to the edges of the pavement, as root systems can cause the pavement edging to move and crack. Also, in clay soils, root systems can increase the moisture loss in periods of dry weather, causing cracking of the pavement.

Routine maintenance of asphalt surfaces includes repair of surface damage by patching with hot mix or high quality asphalt cold mix maintenance patching material and sealing of cracks appearing in the surface. Thicker layers of asphalt, particularly full depth asphalt pavements, are less susceptible to surface damage and cracking.
8.2 Resurfacing

If correctly placed and maintained, an asphalt surfacing on a light-duty pavement can be expected to last 15 to 25 years with minimal maintenance. Provided that there is no significant cracking or shape loss, the life of the pavement can be extended for a further similar period by resurfacing with a thin layer of asphalt or other suitable thin bituminous surfacing treatment. A guide to selection of alternative surfacing types is provided in the Austroads Guide to the Selection of Road Surfacings.

Renewal of the surface should consider:

- condition and strength of existing base and surface
- drainage deficiencies of existing pavement
- presence of weeds or grass growing requiring chemical treatment
- damage to existing pavement and surfacing from tree and shrub roots or expansive subgrade.

Resurfacing with hot-mix asphalt is carried out by applying a tack coat of bitumen emulsion to the prepared surface followed by laying and compacting the asphalt whilst hot. If necessary, edges may be milled and the new asphalt tapered to match the existing edge levels.
9. REFERENCES

Australian Asphalt Pavement Association Information Booklet IB-7 – Driveways, tennis courts and coloured asphalt.


Part 2: Specification

NOTES ON THE USE OF THE SPECIFICATION CLAUSES

(a) Scope

The specification is intended for use as a basis for obtaining quotations and undertaking minor works such as parking areas, driveways, bicycle paths, footpaths and other pedestrian precincts and recreational and alfresco dining areas. For more extensive works, the use of the AAPA National Asphalt Specification, which provides details of design, manufacture, process control and placing of asphalt mixes for a full range of asphalt applications may be more appropriate. For works on public roads, local government authorities or road agencies may require that pavements be constructed to the relevant specifications of that authority.

(b) Specification and Design Criteria for Asphalt Mix Types

Supplier Members of the Australian Asphalt Pavement Association produce asphalt mixes in accordance with AS2150 – Asphalt (Hot-Mixed) and the specifications of the Local Authorities, State Road Authority or other public authorities in the State where they operate.

Asphalt mixes may be designed using either Marshall compaction as specified in AS2150, or gyratory compaction. A guide to design criteria for specific application follows.

1. Marshall Compaction

<table>
<thead>
<tr>
<th>Application</th>
<th>Criteria</th>
<th>Mix Type and Size</th>
</tr>
</thead>
<tbody>
<tr>
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<td>AC5</td>
</tr>
<tr>
<td>Wearing course for foot and light vehicle traffic (35-blow or 50-blow*) (Tables 4, 5, 6 and 7)</td>
<td>Air voids – target (%)</td>
<td>4.5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3-6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stability – minimum (kN)</td>
</tr>
<tr>
<td>Wearing course for increased vehicular traffic and base in full depth asphalt (50-blow) (Tables 8, 9, 10 and 11)</td>
<td>Air voids – target (%)</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Air voids – production range (%)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stability – minimum (kN)</td>
</tr>
</tbody>
</table>

* Note: If 50-blow Marshall compaction is used, air voids targets should be decreased by 1% and minimum stability increased by 1kN.
2. Gyratory compaction

<table>
<thead>
<tr>
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<th>Criteria</th>
<th>Mix Type and Size</th>
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</thead>
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<tr>
<td></td>
<td></td>
<td>AC5</td>
</tr>
<tr>
<td>Wearing course for foot and light vehicle traffic (50-cycle or 80-cycle*)</td>
<td>Air voids – target (%)</td>
<td>4.5</td>
</tr>
<tr>
<td>(Tables 4, 5, 6 and 7)</td>
<td>Air voids – production range (%)</td>
<td>3-6</td>
</tr>
<tr>
<td>Wearing course for increased vehicular traffic and base in full-depth asphalt (80-cycle)</td>
<td>Air voids – target (%)</td>
<td>4.0</td>
</tr>
<tr>
<td>(Tables 8, 9, 10 and 11)</td>
<td>Air voids – production range (%)</td>
<td>3-6</td>
</tr>
</tbody>
</table>

* Note: If 80-cycle gyratory compaction is used, air voids targets should be decreased by 1%.

(c) Type and Class of Binder

Class 170 bitumen complying with AS2008 is generally used in cooler regions and Class 320 in warmer regions or heavier traffic applications. Class 600, multigrade bitumen or polymer modified binders are not generally used in the applications described in this Guide.

(d) Prime and Tack Coat

A prime is the application of a bituminous material to the surface of a granular base layer and is intended to both waterproof the granular layer and to provide a bond to the asphalt surfacing. While a prime is not essential on pavements subject to little or no vehicular traffic (e.g., cycleways, driveways), it is highly desirable on pavements subject to regular vehicular traffic if the pavement is to achieve its optimal performance.

Typically a primer consists of a 50/50 mix of bitumen and a more volatile hydrocarbon (cutter), which is sprayed using a mechanical sprayer. The cutter enables the bitumen to penetrate into the granular material and evaporates over time. A typical application rate of cutback on a dense, well-compacted crushed rock surface is about 1 l/m² but higher rates and/or a heavier prime (i.e., a higher proportion of bitumen in the cutback) are necessary where the surface is more open and porous.

Tack coat is the application of bitumen emulsion to an existing asphalt surface to provide a bond to a new asphalt surface. The emulsion used is a cationic rapid set (CRS) emulsion and is applied at a rate of 0.2 l/m² to 0.3 l/m² of residual bitumen. A tack coat is sometimes used as an alternative to a cutback prime on granular materials but it may not achieve penetration into the base and is liable to “pick up” by vehicle tyres and paving equipment. It should not be used as an alternative to a prime on granular materials.

(e) Testing and Quality Control

To ensure that asphalt mixes comply with specification requirements, supplier members of the Australian Asphalt Pavement Association maintain testing and laboratory control at their respective plants.

On small projects it is not usual to require specific testing to assess the nature of the subgrade or pavement materials or the level of compaction achieved in the as-constructed
pavement. If the client/owner requires such testing then the type and frequency of testing should be specified so that it can be costed into the price tendered for the work.

Testing may also be required in the event of a dispute regarding the quality of the work provided by the Contractor in which case the testing and the allocation of the associated costs will have to be agreed between the Client/Owner and the Contractor at the time.

(f) **Layer Thicknesses**

The selection of the appropriate layer thickness for an asphalt mix is important to achieving a dense smooth surface, particularly for machine laid work. For this type of work, the layer thickness depends on the nominal size of the mix. A layer thickness less than about 2.5 times the nominal size is likely to result in the mix being dragged by the paver causing a variable surface texture and poor compaction. A thickness greater than about 4 times the nominal size can cause the layer to deform under the rollers, resulting in a poor surface shape. For handwork the minimum thickness criterion is not as important although a thickness less than 2 times the nominal size should be avoided.

The other factor in considering layer thickness is the rate at which the layer will cool, which is dependent on the temperature of the mix and the prevailing weather conditions. The rate of cooling will determine whether there is sufficient time to achieve a well compacted layer as the compaction process has to be completed before the temperature of the asphalt falls below about 90°C. For further information refer to Austroads/AAPA Work Tip No.12 *Compaction of Asphalt*.

(g) **Cover Rates for Asphalt:**

In order to estimate quantities of mix required or to convert a rate per tonne to a rate per square metre, the following table may be used as a guide. However, it should be emphasised that actual coverage rates obtained will depend on surface texture, profile, cross-section and density of raw materials, etc.

<table>
<thead>
<tr>
<th>Thickness (mm)</th>
<th>Compacted Spread Rate (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>48</td>
</tr>
<tr>
<td>25</td>
<td>60</td>
</tr>
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<td>30</td>
<td>72</td>
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<td>96</td>
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<td>120</td>
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<td>60</td>
<td>144</td>
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<tr>
<td>75</td>
<td>180</td>
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<td>100</td>
<td>240</td>
</tr>
<tr>
<td>125</td>
<td>300</td>
</tr>
<tr>
<td>150</td>
<td>360</td>
</tr>
</tbody>
</table>

*Note: The table above is based on 24 kg/m² for each 10 mm thickness.*
SPECIFICATION FOR SMALL SCALE ASPHALT WORK

1 Scope

This specification is intended for use on projects involving very lightly trafficked asphalt pavements such as small car parks, residential driveways, cycleways, footpaths, alfresco dining areas and pedestrian precincts or where asphalt is being used for purely aesthetic purposes. It is not intended for use on pavements subjected to regular commercial vehicle traffic. (Note: for pavements subjected to regular commercial vehicle traffic the AAPA National Asphalt Specification should be used.)

The specification includes requirements for site preparation, placing and compacting of granular base, priming, tack coating and the spreading and compaction of asphalt. It does not include requirements for the construction of concrete kerb or kerb and channel or for the installation of surface and sub-surface drains.

2 Description of Works

The Works to be carried out under this Specification comprise the construction of a (Insert type of facility eg driveway, car park) at (Insert location)...

The Works shall include any or all of the following items as specified in Schedule A.:

- Site clearing including excavation and removal of vegetation and topsoil.
- Excavation of soil or rock to a depth consistent with the specified pavement thickness and finished pavement surface levels.
- Excavation and removal from site or stockpiling on site of existing granular material.
- Preparation of subgrade including the sterilisation for weed growth.
- Installation of sub-surface drains and connection to existing stormwater pit(s) or drains.
- Installation of kerb and channel.
- Installation of masonry or timber edging strips.
- Installation of grated surface drains.
- Supply, spread and compact of granular material.
- Supply, place and compact asphalt base.
- Supply, place and compact asphalt surfacing.

The Works shall be constructed in accordance with this specification and any plans and/or written instructions provided by the Owner to the Contractor prior to the commencement of the Works.

3 Equipment and Labour

The Contractor shall provide all equipment and labour to complete the work in accordance with this specification and any plans and written instructions provided by the Owner.
4. Materials

a) Bitumen  Bitumen shall conform to the requirements of Australian Standard AS2008 "Residual Bitumen for Pavements".

b) Cutback Bitumen  Cutback bitumen shall conform to the requirements of AS 2157.

c) Bitumen Emulsion  Bitumen emulsions shall conform to the requirements of AS 1160.

d) Granular Material  Granular material shall conform to the requirements of the Local Government or State Road Authority specification for 20 mm nominal maximum size base or sub-base.

e) Asphalt  Asphalt shall conform to the requirements of Australian Standard AS2150 "Asphalt (hot-mixed)".

5. Site Clearing

The area to be paved shall be cleared of all vegetation and topsoil to the limits shown on the drawing or as defined in Schedule A of this specification.

Any existing trees, shrubs or bushes outside the area to be cleared that are to be protected shall be identified by the Client/Owner and notified to the Contractor prior to the commencement of the Works. The Contractor shall put in place appropriate measures to safeguard such vegetation from damage for the duration of the Works.

Vegetation and soil contaminated with weeds shall be removed from the site and disposed of at a location and in a manner conforming with State Regulations and Local By-laws. Clean topsoil shall be stockpiled on site unless otherwise specified in the Schedule A.

6. Subgrade Preparation

6.1 New Pavements

For new pavements, the Contractor shall excavate and remove so much of the underlying soil and/or rock as is necessary to achieve subgrade levels consistent with the specified pavement thickness and finished surface levels. All excavated material shall be removed from the site.

Any areas, which are excessively wet and/or soft shall be excavated to a firm base and infilled with suitable material to the level of the surrounding subgrade. Suitable fill material, other than topsoil, may be obtained from agreed excavations on-site or may be imported. The Contractor shall not proceed with the removal and replacement of soft subgrade without the express consent of the Owner/Client.

Following the removal and replacement of any soft material, the subgrade shall be compacted to 95% of the Maximum Dry Density as determined in accordance with Australian Standard AS1289.6.1 and graded to provide a smooth, free draining surface.

6.2 Existing Unsealed Pavements

For existing unsealed pavements, where it is necessary to remove the existing granular material due to either its unsuitability or a requirement to further excavate the subgrade in
order to meet pavement thickness and finished surface level requirements, the subgrade shall be prepared and compacted as for a new pavement.

Granular material deemed unsuitable for re-use in the pavement shall be removed from the site. Granular material, which conforms to the requirements of this specification shall be stockpiled on site in a location and in a manner which avoids contamination.

6.3 Sterilisation

For new pavements and for existing unsealed pavements, where the existing granular material has been removed the subgrade shall be treated with an appropriate herbicide to prevent weed growth. The herbicide shall be applied strictly in accordance with the manufacturer’s instructions in a manner which ensures a total and uniform coverage of the area to be paved.

The Contractor shall take appropriate measures to ensure that the manner of application does not result in damage to vegetation beyond the area to be paved or in the herbicide entering any stormwater drainage system.

6.4 Sub-surface Drainage

Where required, sub-surface drains shall be installed at a minimum depth of 300 mm below the subgrade or to such other depth as specified in the Schedule A and shall be provided with a free outlet to a stormwater collection pit, drain or channel.

The drains shall be either 80 mm earthenware pipes placed with suitable gaps or 100 mm slotted PVC pipe or slotted flexible polyethylene pipe and shall be laid in trenches of a minimum width of 200 mm, which shall be backfilled to the level of the subgrade using 7 mm nominal size screenings.

7. Edge Restraint

If there is no other edge constraint, such as a kerb or kerb and channel, the perimeter of the area to be paved shall be provided with an edge restraint such as timber or masonry edging as specified in Schedule A.

Timber edging shall comprise red gum or treated pine slabs having a minimum thickness of 50 mm and a minimum width equal to the minimum compacted thickness of granular material and/or asphalt. The edging shall be fixed securely to the subgrade so that it will not move laterally or rotate under the action of rollers during the construction of the pavement.

Masonry edging shall be laid in a mortar bed placed on the compacted granular base material and constructed in accordance with good practice for masonry construction.

8. Granular Base

8.1 New Pavements

Where required, the base material shall be supplied, spread to the required thickness as specified in Schedule A, graded to level and compacted. The minimum compacted density of the material shall be 95% of the Maximum Dry Density as determined in accordance with Australian Standard AS1289.6.2.
The finished surface of the base at any point shall not be above nor more than 10 mm below the level required to meet both the minimum thickness of asphalt surfacing and the finished pavement level at that point.

8.2 Existing Pavements

For existing unsealed pavements, where the existing granular material is of adequate quality and thickness, the surface shall be graded to level and compacted in accordance with the requirements for new pavements. Where the existing granular material comprises a limestone aggregate or other material with natural cementing properties, the layer shall be tyne prior to regrading and re-compaction to break the cementitious bonds and allow a better bond with the overlying asphalt.

Where the existing granular material is of adequate quality but inadequate thickness and finished pavement levels allow the placement of an additional layer of granular material, the Contractor shall tyne the existing pavement prior to placing additional material to promote bonding of the two materials. The new granular material and the existing material shall then be compacted as a single layer in accordance with the requirements for new pavements.

9. Prime

Where required in accordance with Schedule A, the Contractor shall prime the finished surface of the base prior to placing asphalt. The prime shall be a cutback bitumen sprayed at a rate of 1 l/m² unless otherwise specified in Schedule A or determined by the Contractor on site at the time of priming.

An emulsion tack coat may be used in place of a cutback prime on pavements subject to limited vehicular traffic, such as driveways, or to pedestrian traffic only.

10. Tack Coat

Tack coat shall only be applied to the existing asphalt surfaces, which have been thoroughly cleaned of all soil, weed growth and other contamination. Tack shall consist of a 60/40 CRS emulsion and shall be applied at a rate of 0.2 l/m² to 0.3 l/m² of residual bitumen.

11. Asphalt

11.1 General

Asphalt shall be supplied, placed and compacted to the minimum thicknesses specified in Schedule A in accordance with the Australian Standard AS2734 except as noted herein.

Where the asphalt is to be machine laid, it shall be discharged from the delivery vehicle into the hopper of the paver and spread and compacted in a continuous operation.

Where the asphalt is to be hand spread, it shall be stockpiled on the pavement at a rate consistent with the rate at which it is being spread and compacted. Individual stockpiles should contain no more material than is required to cover an area of 15 m² to the minimum thickness specified in the Schedule. Asphalt stockpiles shall be spread using wooden lutes or the backs of rakes to avoid segregation of the mix and at such a rate that ensures that the asphalt temperature after spreading is adequate to achieve the specified level of compaction. Any segregated or cold mix shall be removed from site and not re-incorporated in the asphalt. Asphalt shall not be thrown or scattered over the finished surface prior to compaction.
11.2 Base

Where specified, asphalt base shall comprise a dense graded asphalt of the nominal size specified in the Schedule A. The asphalt shall contain Class 320 bitumen and shall meet the requirements shown in Schedule A for a 50-blow Marshall design or 80-cycle gyratory design.

The asphalt shall be compacted using a vibrating steel-wheeled roller to a mean density of 94% of the laboratory compacted density.

11.3 Surfacing

The asphalt surfacing shall comprise a fine gap graded or dense grade asphalt of the maximum nominal size shown in Schedule A. The mix may contain either a Class 320 or a Class 170 bitumen and shall meet the requirements shown in Schedule A for a 35-blow or 50-blow Marshall design or 50-cycle or 80-cycle gyratory design.

The asphalt shall be compacted using a vibrating steel-wheeled roller to achieve a mean density of 96% of the laboratory compacted density.

11.4 Finished Surface

The finished surface shall conform to the required levels within +/-5 mm and shall not deviate from a 3 m straightedge placed on the surface by more than 7 mm for machine-laid work and more than 10 mm for manually placed work.

12. Testing and Quality Control

The Contractor shall undertake or arrange to be undertaken all testing as specified herein. The testing shall be undertaken by a laboratory certified by NATA for the specified test or tests. The type and frequency of testing shall be as specified in Schedule A and results shall be provided to the client/owner within 7 days of the test being completed.

13. Schedule and Terms of Payment

The contract shall be for a lump sum fixed price as quoted in Schedule B. Any variations to the work as described in Schedule A of this specification shall be agreed by the owner and the contractor before any work is carried out. The cost of such variations shall be determined from the quantity of additional work and the rate for such work as provided in the attached schedule. The scheduled rates shall be provided by the contractor as part of their quote for the work.

14. Defects Liability Period

The Contractor shall make good any defect in materials or workmanship provided under the contract for a period of 12 months, or such longer period as stipulated in the Schedule at no cost to the client.

This requirements does not include defects arising from:
- excessive use of the pavement by heavy vehicles,
- deep-seated soil movements as a result of soil moisture variation,
- the ingress of tree roots beneath the pavement, the ingress of moisture into or beneath the pavement, unless sub-surface drains were installed as part of the contract,
- fuel or oil spills or
- other factors for which the pavement was not designed.
### SCHEDULE A

**Description of the Works**

The Client or Owner is to complete this Schedule by indicating in the appropriate box which items form part of the Works and where required to nominate layer thickness and asphalt type and nominal maximum size.

1. Site Clearing - Excavation and removal of vegetation and topsoil  
   - Limits of site clearing - as shown on drawings  
   - 0.3 m beyond the area to be paved  
   Yes ☐ No ☐

2. Excavation of soil or rock  
   Yes ☐ No ☐

3. Excavation and removal or stockpiling of existing granular material  
   Yes ☐ No ☐

4. Preparation of subgrade including the sterilisation for weed growth  
   Yes ☐ No ☐

5. Installation of sub-surface drains  
   Yes ☐ No ☐

6. Installation of kerb and channel  
   Yes ☐ No ☐

7. Installation of masonry or timber edging strips  
   Yes ☐ No ☐

8. Installation of grated surface drains  
   Yes ☐ No ☐

9. Supply, spread and compact of granular material  
   Compacted thickness: _______ mm  
   Yes ☐ No ☐

10. Prime/Tack Coat *(strike out whichever is not applicable)* prepared base  
    Yes ☐ No ☐

11. Tack coat existing sealed surface  
    Yes ☐ No ☐

12. Supply, place and compact asphalt base  
    Mix Type and Size: _______  
    Compacted Thickness: _______ mm  
    Design: ☐ Marshall  
    ☐ Gyratory  
    Target Voids _____ %  
    Production Voids Range _____ %  
    Stability _____ kN minimum  
    Target Voids _____ %  
    Production Voids Range _____ %

13. Supply, place and compact asphalt surfaceing  
    Mix Type and Size: _______  
    Compacted Thickness: _______ mm  
    Design: ☐ Marshall  
    ☐ Gyratory  
    Target Voids _____ %  
    Production Voids Range _____ %  
    Stability _____ kN minimum  
    Target Voids _____ %  
    Production Voids Range _____ %

14. Undertake testing of materials and finished pavement layers  
    Yes ☐ No ☐

    **Type of Test:**  
    ☐ Grading & PI of granular base  
    ☐ Density of compacted granular base  
    ☐ Grading & bitumen content of asphalt  
    ☐ Density of compacted asphalt  
    Frequency  
    1 per _____ m³  
    1 per _____ m²  
    1 per _____ tonne  
    1 per _____ m²
SCHEDULE B

Pricing of the Works

This schedule is to be completed and signed by the Contractor. The Client/Owner should delete any items which do not form part of the Works.

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Unit</th>
<th>Quantity</th>
<th>Rate</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Site Clearing</td>
<td></td>
<td>m²</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Excavation and removal of soil</td>
<td>m³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Excavation and removal of rock</td>
<td>m³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Sterilisation of subgrade</td>
<td>m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Preparation and compaction of smooth, free-draining subgrade</td>
<td>m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Sub-surface drainage, incl. trench excavation, supply and lay pipe, backfill with granular material</td>
<td>m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Edge Strips – supply and install</td>
<td>m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8. Surface Drains – supply and install</td>
<td>m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Tyne existing granular pavement</td>
<td>m²</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>10. Crushed rock – supply, spread and compact</td>
<td>m³</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Asphalt Base Course – supply, place and compact</td>
<td>m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Asphalt Surfacing – supply, place and compact</td>
<td>m²</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Testing</td>
<td>Item</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TOTAL LUMP SUM PRICE $___________

Contractor Name: 

Business Address: 

Signed ___________________________ Date _______________

35