Acknowledgements

Thanks for the work of the contributing members from the roading industry, especially from Roading New Zealand, consultants and New Zealand Transport Agency.
## Record of amendments

<table>
<thead>
<tr>
<th>Amendment no.</th>
<th>Detail of amendment/s</th>
<th>Effective date</th>
<th>Updated by</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rebrand and format, after industry development, and publish as NZ Transport Agency document</td>
<td>7/9/12</td>
<td>Joanna Towler</td>
</tr>
<tr>
<td>2</td>
<td>Clarify flowchart and text Step 1.</td>
<td>20/2/13</td>
<td>Joanna Towler</td>
</tr>
<tr>
<td>2.1</td>
<td>Edit Acknowledgements section</td>
<td>25/3/13</td>
<td>Joanna Towler</td>
</tr>
<tr>
<td>3</td>
<td></td>
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</tbody>
</table>
# Table of contents

Guidelines for surfacing treatment selection .................................................................................................................... 5
Manual management plan ......................................................................................................................................................... 6
Introduction .............................................................................................................................................................................. 7
Notes to the flow charts ............................................................................................................................................................. 9
Step 1. Existing pavement forensics .................................................................................................................................... 9
Step 2. Surfacing selection ..................................................................................................................................................... 10
Step 3. Asphalt considerations ............................................................................................................................................. 12
Step 4. Bonding the surface to the substrate and sealing the surface .............................................................................. 14
References ..................................................................................................................................................................................... 15
Flow charts .................................................................................................................................................................................... 16
Guidelines for surfacing treatment selection

In this section

This section contains the following topics:

<table>
<thead>
<tr>
<th>Topic</th>
<th>See Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual management plan</td>
<td>6</td>
</tr>
<tr>
<td>Introduction</td>
<td>7</td>
</tr>
</tbody>
</table>
Manual management plan

Purpose

This manual management plan outlines the updating and contact points for the NZ Transport Agency Asphalt Surfacing Treatment Selection Guidelines.

Document information

<table>
<thead>
<tr>
<th>Manual name</th>
<th>Asphalt Surfacing Treatment Selection Guidelines</th>
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<tbody>
<tr>
<td>Manual no.</td>
<td>SP/M/035</td>
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<tr>
<td>Availability</td>
<td>This manual is located in electronic, PDF format on the NZTA website at: <a href="http://www.nzta.govt.nz/resources/results.html?catid=43">http://www.nzta.govt.nz/resources/results.html?catid=43</a></td>
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<tr>
<td>Manual sponsor</td>
<td>National Manager Professional Services, NZTA National Office</td>
</tr>
<tr>
<td>Manual owner</td>
<td>Operations Manager, NZTA National Office</td>
</tr>
<tr>
<td>Manual contact person</td>
<td>Operations Engineer, NZTA National Office</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:nzta.specifications@nzta.govt.nz">nzta.specifications@nzta.govt.nz</a></td>
</tr>
<tr>
<td>Manual Steering Group</td>
<td>Roading New Zealand’s Pavement &amp; Asphalt Committee: Asphalt Working Group</td>
</tr>
</tbody>
</table>

Amendment and review strategy

- All suggested changes to this manual should be sent to the manual contact person, and will be acknowledged by him/her.
- Amendments to the manual will comply with this management plan and will be detailed in the Record of amendments section of this document.

<table>
<thead>
<tr>
<th>Comments</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amendments (of a minor nature)</td>
<td>Minor updates to information in this manual will be incorporated after they have been approved by the manual sponsor and ratified.</td>
</tr>
<tr>
<td></td>
<td>As required.</td>
</tr>
<tr>
<td>Review (major changes)</td>
<td>Amendments fundamentally changing the content or structure of this manual will be incorporated after appropriate consultation by the manual sponsor and approval by the ratification group.</td>
</tr>
<tr>
<td></td>
<td>12 months after issue then every 5 years.</td>
</tr>
<tr>
<td>Notification</td>
<td>All users that have registered their interest by email to <a href="mailto:nzta.specifications@nzta.govt.nz">nzta.specifications@nzta.govt.nz</a> will be advised by email of amendments and reviews.</td>
</tr>
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<td></td>
<td>Immediately.</td>
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</tbody>
</table>

Other information

There will be occasions, depending on the subject matter, when proposed amendments to this manual will need to be considered by the NZTA and the industry, before an amendment is approved. This may cause some variation to the above noted timeframes.

Distribution

The Manual Management Plan is included in the manual and sent to Information Management.
Introduction

Purpose

These Guidelines for Surfacing Treatment Selection have been written for Asset Managers, Surfacing Engineers and Pavement Designers. They aim to guide the reader in the engineering decision making and processes that need to occur in selecting a treatment.

Status of manual

This manual is a guideline as it is impossible to define surfacing solutions suitable for all the different pavement types, traffic levels and environments found in New Zealand.

Flow charts

The Guidelines are in the form of four flow charts with accompanying notes. The flow charts guide the practitioner through:

- Step 1. Existing pavement forensics, for new surfacing on existing pavements
- Step 2. Selection of preferred surfacing type for new or existing pavements
- Step 3. Asphalt considerations that influence preferred surfacing type
- Step 4. Bonding of surfacing to substrate, sealing the surface

The flow charts and explanatory notes will guide pavement and surfacing designers through analysis of existing pavement performance and other factors to be considered that will potentially lead to a surfacing performing as expected for all relevant criteria.

Asset management

Guidance in the area of asset management techniques for pavement management is also included in the flow charts. This includes first questioning whether asphalt is required and consideration of alternatives to asphalt, as well as considerations, other than pavement engineering, in the decision process.

Communication

Emphasis is placed on communicating asphalt performance objectives with the local asphalt producer and supplier during the treatment selection phase, to ensure that locally available mixes are selected. Discussion with Clients and suppliers to manage expectations and work with available products is emphasised.

Any concerns the Client has with material properties, whether bitumen or aggregate, should be communicated to the Contractor. The Contractor may demonstrate to the Client their quality systems that are designed to detect and address any quality issues prior to asphalt being laid.

Specification principles

In an ideal world, the client would specify the desired asphaltic concrete performance and the contractor would design and construct the asphaltic mix to suit.

However, asphaltic concrete is usually specified in a method-based contract environment. Therefore the pavement designer selects from currently available mixes using available aggregates and chooses the binder in negotiation with the client and advice from the contractor.
### Specification
Specifications continue to evolve to give choice in asphalt selection and achieving performance. Both prescriptive type specifications and performance based specifications exist. It is recommended that:

- Performance type specifications be adopted if innovation and product development to achieve an end performance requirement is desired
- Using both performance based specifications and prescriptive specifications on a project is avoided, if possible, because misunderstanding and confusion in demonstrating compliance of the asphalt can occur.

### Inventory
It is extremely important to have good inventory data in order to answer all the flowchart questions satisfactorily and get maximum benefit from these guidelines.

### Other related documents
This is a high level document and links to various other documents such as Austroads guides and *Chipsealing in New Zealand* to provide further detail.
Notes to the flow charts

Step 1 Existing pavement forensics

Aims
The aim of this section is to discover why an existing surfacing has reached the end of its useful life.

Pavement forensics
In this step pavement forensics is introduced to aid designers in understanding the reasons for premature failure and to enable any required corrective actions to be undertaken prior to resurfacing, to avoid a repeat of poor performance.

Failure mechanisms and reasons
A range of failure mechanisms are listed; two or more of these may occur simultaneously:
- Cracking
- Ravelling
- Rutting
- Shoving
- Flushing
- Macrotexure Loss
- Microtexture Loss
- Delamination

Step 1 then introduces potential reasons for the failure mechanism(s):
- Issues below the surfacing such as layer weakness, inadequate pavement thickness, utility services trenches, tree roots, cracked pavements, ground movement
- Drainage issues, causing water to pond in the pavement, reducing layer shear strength
- Changes in road use, which could be type, magnitude, frequency or duration of load
- Deficient construction quality such as mix production issues, layer bonding, jointing, voids or compaction issues
- Inappropriate specification of asphalt type or pavement material components
- Other issues such as chemical spills, accident damage, flood inundation during loading
- Other issues identified during the forensic investigation

Pavement surfacing premature failure may be a result of a combination of reasons for failure and number of failure mechanisms. For guidance on pavement layer weakness, refer Step 3.

Analysis
It is important that pavement forensic investigations consider multiple failure mechanisms, as addressing only one, and not considering other failure mechanisms that may exist, could result in repeated early failure.
Step 2 Surfacing selection

Aims
The aim of this section is to choose the most appropriate surfacing treatment that delivers the optimal whole of life solution in terms of value for money.

Treatment selection
For surfacing treatment selection, it is important to consider a full range of options and associated conditions or issues. The New Zealand Supplement to Austroads pavement design guideline (Transit New Zealand, 2007) requires whole of life analysis, with and without risk, to be considered as one of the inputs to pavement type considerations. As this document is primarily about surfacing treatment selection, the whole of life analysis of pavement types is not covered, and is assumed to be a separate exercise.

In New Zealand, the first surfacing engineering criteria to consider is whether a chipseal, asphalt or other surfacing type should be used. The Treatment Selection Chart from Chipsealing in New Zealand (Transit New Zealand, 2005), Figure 6.3, should be followed for guidance on this, unless chipseal has been precluded for technical or Client Road Controlling Authority (RCA) specified reasons.

If Chipsealing in New Zealand, Figure 6.3, suggests asphalt is required, a recommended guide for designers is the Austroads surfacing selection guideline Guide to the Selection of Road Surfacings (Austroads, 2003). Surfacing types and their relevant ranking for differing properties are well covered by this document.

A last check for chipsealing suitability is to ask ‘Will chipsealing give an acceptable surfacing life?’ In some specific low traffic sites, a combination of factors (e.g. temperature, longitudinal gradient, turning vehicles, infrequent loading) may change a surfacing selection recommendation to asphalt, or an alternative such as slurry seal, Cape Seal, or other proprietary surfacing. For alternative surfacing types, seek local Contractor or other specialist advice for availability and any potential risk or quality issues that may be identified.

Selection of Asphalt
If asphalt is selected as the preferred treatment, Step 2 guides the designer through a process of selecting asphalt types to satisfy other engineering criteria:

- low texture for certain users (cyclists or pedestrians): fine gap graded asphalt (FGGA)
- low noise: open graded porous asphalt (OGPA) or stone mastic asphalt (SMA)
- macrotexture (refer NZTA T/10): OGPA or SMA
- water spray suppression: OGPA or SMA

Pedestrian considerations
Some low volume, low speed, roads in city or town centres may have a high demand for midblock pedestrian crossing. A fine asphalt or slurry seal surface may be used for this.

Pavement considerations
A key issue for all asphalt surfacings is whether the underlying pavement can adequately support the asphalt to allow the intended life to be achieved. This issue is addressed in Step 3, Asphalt Considerations, ensuring that this issue is addressed by the designer.
After selection of asphalt type it is necessary to determine which specification should be used. In New Zealand there is a choice of method based (prescriptive) or performance based (outcome) specifications for asphalt production.

Specifications are continually evolving in response to industry initiatives with new products, changes in physical properties of material supply or material types, to encourage innovation and maintain intellectual property in supplier products that may offer performance advantages. Due to specification evolution a list is not included here.

Client requirements may define the specifications to be used for a particular project. Where this decision is the responsibility of designers the project context needs consideration. If particular surfacing performance requirements are required and traditional method based specifications do not require the performance as an outcome, it may be better to give the asphalt supplier the responsibility for providing a mix that will achieve these outcomes. An example of this is very heavy duty asphalt surfacing, where polymer addition to the asphalt binder is required to provide high rut resistance or tensile fatigue resistance. Another example might be where an ultra thin surface is required, with a surface texture, on a relatively flexible pavement.
# Step 3 Asphalt considerations

<table>
<thead>
<tr>
<th>Aims</th>
<th>The aim of this section is to ensure practitioners have considered issues for asphalt surfacings that may or may not be referenced in standard specifications or Client project specifications.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pavement considerations</strong></td>
<td>The designer should first ask ‘Is the pavement structure suitable for asphalt support?’ Step 3 guides the designer in investigation and potential remedies to structural deficiency. An option of accepting reduced surfacing life is shown should funding preclude improving the pavement structure. This may be acceptable provided the Client accepts such a reduced life for the surfacing. A temporary solution could be adopted until funding is available, or default to chipseal might occur. Preparing a whole of life cost analysis for options can assist Clients with decision making around capital investment today to incur lower maintenance costs during the life of the pavement. Pavement curvature, measured by Falling Weight Deflectometer (FWD) or Benkelman Beam (expressed as FWD curvature $D_{0}-D_{200}$) is a good measure of a pavement structure’s ability to support thin asphalt surfacing and resist fatigue cracking.</td>
</tr>
<tr>
<td>Auckland experience</td>
<td>NZTA Auckland Region has good correlation of motorway open graded porous asphalt life with deflection curvature. For traffic levels greater than 10 million Equivalent Standard Axles (ESAs) a pavement curvature of less than 0.15 mm FWD curvature, $D_{0}-D_{200}$ is sought to achieve 8 to 10 years OGPA life before ravelling occurs.</td>
</tr>
<tr>
<td>FWD surveys</td>
<td>For existing pavements where asphalt overlay or new asphalt surfacing is proposed, the designer can carry out FWD surveys and model the pavement to determine whether the deflection curvature is suitable or not. For new pavements, the pavement can also be modelled to predict the deflection curvature and determine whether it is suitable or not.</td>
</tr>
<tr>
<td>Crack mitigation</td>
<td>Step 3 reminds designers to consider the potential negative effects of a bound (cemented) layer underneath the surfacing and offers crack/warping risk mitigation options.</td>
</tr>
<tr>
<td><strong>Loading and binder considerations</strong></td>
<td>Magnitude of loading is considered along with pavement support in selection of binder type and additives. For stiffer pavements where tensile fatigue at the top or bottom of the surfacing is not a primary failure mechanism relatively stiffer bitumen binders are recommended (to resist asphalt shoving). For more flexible pavements, a polymer addition to the bitumen binder is recommended. For guidance on polymers and their use, refer to Austroads document AP-T42/06: Guide to the Selection and Use of Polymer Modified Binders and Multigrade Bitumens (Austroads 2006), and seek local asphalt producer and constructor advice.</td>
</tr>
<tr>
<td>Stability in high stress situations</td>
<td>The designer should consider structural asphalt or other very stiff pavement for supporting asphalt surfacings in very high stress areas, for example areas with heavy traffic turning and braking.</td>
</tr>
</tbody>
</table>
### Binder considerations - performance based

When performance based specifications are used, or where the Contractor designs the pavement, it is recommended that project specifications do not specify the binder. In order to aid asphalt performance, it is preferable that the choice of appropriate binder and additives is left with asphalt producers and suppliers who best understand their binder products. Provision of design traffic information and site geometric characteristics in lieu of binder type will greatly assist the asphalt producer to develop the optimum binder properties. The selection of an appropriate binder should then be discussed between the Contractor and the Engineer (pavement designer).

### Binder considerations - method based

For prescriptive type specifications the Engineer (pavement designer) will usually specify the binder type. However, the Engineer should be open to the contractor suggesting a different binder for a given set of reasons, and this should be discussed with the pavement designer. Therefore it is appropriate to provide design traffic information and site geometric characteristics, for the asphalt producer to take into consideration, even when specifying a binder in a method-based contract.

### OGPA considerations

OGPA may be required for spray or noise suppression. Where traffic volumes of 500 or more heavy commercial vehicles per lane per day and pavement FWD curvature, $D_0-D_{200}$ (modelled or measured) is greater than the limits shown in Figure E-A3.4 (Austroads, 2009), polymer modified binder is recommended.

High void (30%) OGPA (e.g. PA HV as specified in TNZ P/11:2007) may be used for high spray suppression or surface drainage purposes. This mix should not be used in high stress areas.

### Skid resistance considerations

Skid resistance is an important safety consideration for all surfacings including asphaltic surfacings.

The basic requirements are that the specified levels of microtexture and macrotexture are retained throughout the life of the surfacing. Further details are contained inNZTA T10 specification.

### RAP considerations

If local asphalt producers are utilising millings (reclaimed asphalt pavement, or RAP) in new asphalt surfacing on relatively flexible pavements, it is worthwhile to consider the effects this may have on the performance of the surfacing.

RAP typically increases mix stiffness modulus due to the stiffness of the existing binder in the RAP material. For thin surfacings tolerant to deflection, the effects are likely to be minor. For asphalt surfacing types with lower binder contents, that are less tolerant to pavement curvature (FWD curvature $D_0-D_{200}$), the addition of RAP may shorten surfacing life when constructed on a more flexible pavement.

### Other issues

Other issues referenced in Step 3:

- Local asphalt producer asphalt type options
- Local quarry aggregate characteristics
- Using the right asphalt type for the project location
- Better performance where minimum asphalt thickness is 3 times nominal stone size for dense graded and open graded porous asphalt and 4 times for stone mastic asphalt
- Provision of adequate water resistance under the asphalt layers, introduction to Step 4
### Step 4 Bonding the surface to the substrate and sealing the surface

<table>
<thead>
<tr>
<th>Aims</th>
<th>The aim of this section is to effectively bond the asphalt surfacing to the pavement below whilst accounting for water resistance requirements.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inputs</td>
<td>Inputs to decision making are:</td>
</tr>
<tr>
<td></td>
<td>- the thickness of the surfacing</td>
</tr>
<tr>
<td></td>
<td>- the upper pavement layer types</td>
</tr>
<tr>
<td></td>
<td>- the various surfacing types</td>
</tr>
<tr>
<td></td>
<td>- traffic demands and suggested response</td>
</tr>
<tr>
<td>Pre-leveling before applying OGPA</td>
<td>Prior to applying bonding layers, pre-levelling with a scrub coat of fine asphalt mix may be required on existing surfaces (rut fill) to prevent water ponding under OGPA overlay, and to give surfacing layer thickness consistency to avoid differences in compaction density.</td>
</tr>
<tr>
<td>Bonding methodology</td>
<td>Suggested bonding methodology is provided and, where required, degree of water resistance, reported as suggested layer configurations with minimum residual binder applications.</td>
</tr>
<tr>
<td>Membrane seals</td>
<td>For membrane seals, primer seal with emulsion will penetrate a damp surface but not a dry, dusty, surface, and not a cemented aggregate with cement laitance remaining on the surface. Cemented stabilised aggregate surfaces need to be well broomed, before cement setting, to provide a textured interface for membrane seals and asphalt bonding. The flow chart indicates relatively high residual binder contents for membrane seals under asphalt surfacings on unbound granular pavements:</td>
</tr>
<tr>
<td></td>
<td>- In heavy traffic areas 2 l/m² residual binder under dense grade or stone mastic asphalt</td>
</tr>
<tr>
<td></td>
<td>- In all traffic areas 3 l/m² residual binder under OGPA is recommended</td>
</tr>
<tr>
<td></td>
<td>These residual binder rates have been derived from successful applications aimed to provide as much water resistance as possible under asphalt on new unbound granular basecourse, where it has not been possible to traffic with a chip seal for 2 years before asphalt laying.</td>
</tr>
<tr>
<td></td>
<td>Generally, for membrane seals, there should be just enough binder to provide water resistance to the pavement and just enough chip spread to stop it being carried off by traffic.</td>
</tr>
<tr>
<td>Is the underlying pavement foamed bitumen stabilised?</td>
<td>In accordance with Roading New Zealand's Technical Note No 002: First Coat Sealing on a Stabilised Basecourse, when first coat sealing foamed bitumen stabilised basecourse, first calculate the binder application rate as per normal, then reduce by 15%.</td>
</tr>
</tbody>
</table>
References


Step 1 - Existing Pavement and Surfacing Forensics

1. Is it an existing pavement?
   - Yes
     - Problem identified, go to STEP 2
   - No
     - Why did it fail?

2. Was the surfacing life acceptable?
   - Yes
     - Fix pavement structure
   - No
     - Consider what else may have happened – chemical spills, flood inundation, accident damage

3. Why did it fail?
   - Cracked (crocodile, transverse, longitudinal, block or crescent) failed prematurely?
     - Yes
       - Is there a strength issue in the layers? Check deflection and/or curvature, excavate test pits.
     - No
       - Is there a drainage issue? Check pavement for water, video primary and subsoil drainage

4. Ravelled, failed prematurely?
   - Yes
     - Fix drainage system
   - No
     - Rutted, failed prematurely?

5. Rutted, failed prematurely?
   - Yes
     - Is there a change in road use?
   - No
     - Shoved, failed prematurely?

6. Shoved, failed prematurely?
   - Yes
     - Is there a surfcacing construction quality issue (layer bonding, jointing, voids, compaction)?
   - No
     - Flushed, failed prematurely?

7. Flushed, failed prematurely?
   - Yes
     - Is the mix type, modulus, or component(s) inappropriate for the environment and use?
   - No
     - Texture, failed prematurely?

8. Texture, failed prematurely?
   - Yes
     - Consider what else may have happened – chemical spills, flood inundation, accident damage
   - No
     - Skid resistance failure

9. Skid resistance failure
   - Yes
     - Delamination failure
   - No
**Asphalt surfacing treatment selection guidelines**

**STEP 2: Determine what is required.**

1. **Engineering Criteria**
   - Chipseal or Asphalt?
     - Use Chipsealing in NZ. Treatment Selection Chart, Figure 6.3, to choose.

2. **Chipsealing.** Follow guidelines in Chipsealing in New Zealand and seek local knowledge.
   - Use Austroads APG 63/03 Surfacing Selection Guidelines and Specifications used in New Zealand.

3. **Asphalt.** Use Austroads APG 63/03 Surfacing Selection Guidelines and Specifications used in New Zealand.

**Other criteria**

1. **Does the RCA require asphalt?**
   - No
     - Use asphalt.
   - Yes
     - Go to STEP 3 – Surfacing Selection.

2. **Will chipseal give an acceptable life?**
   - No
     - Use asphalt.
   - Yes
     - Go to STEP 3 – Surfacing Selection.

3. **Is slurry seal, Cape seal, or proprietary surfacing an option?**
   - No
     - Use asphalt.
   - Yes
     - Seek Contractor or other specialist advice.

4. **Is there a low texture need for pedestrians?**
   - No
     - Use fine mix asphalt or, if available, slurry seal as an alternative option (refer specialist advice for slurry).
   - Yes
     - Use fine mix asphalt or, if available, slurry seal as an alternative option (refer specialist advice for slurry).

5. **Is there a low noise pavement required?**
   - No
     - Use SMA, OGPA, high strength OGPA, or specialist low noise mixes.
   - Yes
     - Use SMA, OGPA, high strength OGPA, or specialist low noise mixes.

6. **Is there a minimum texture requirement that precludes dense graded asphalt (DGA)?**
   - No
     - Use SMA, OGPA, high strength OGPA, or other specialist texture mixes.
   - Yes
     - Use SMA, OGPA, high strength OGPA, or other specialist texture mixes.

7. **Is the site high stress?**
   - No
     - Depending on traffic level and location, use SMA, DGA, high strength OGPA, Polymer may be required.
   - Yes
     - Use SMA, OGPA, high strength OGPA, or other specialist texture mixes.

8. **Determine current specifications suitable for use.**
Asphalt surfacing treatment selection guidelines

**Step 3 – Asphalt Considerations**

1. Model pavement and determine likely asphalt behaviour. RCA may have delection criteria to be met. Curvature prediction from model can be used to determine behaviour of surfacing. Aeroasphalt Guides to Pavement Technology, Part 5, Appendix A3, has plots of curvature for traffic level to help determine acceptable curvature limits.

   Is curvature or deflection considered too high?
   - No: Proceed or seek further advice.
   - Yes: Correct pavement structure or deflection to provide adequate support. Options:
     1. Infill or grade stabilization or modification such as cement, foamed bitumen, cement/lime, cement/KOM, other pre-stabilized blend.
     2. Structural asphalt.
     4. If funding not available to fix structure, then accept reduced asphalt life or use chip seal.

2. Consider crack/wrapping risk mitigation:
   - Removing existing bound layer, particularly if it is fatigue cracked.
   - Granular or modified layer between bound layer and under surfacing (plan ensure good drainage of layer is provided).
   - For new bound layers, pre-crack after 2 to 5 days curing.
   - Drain deflecting membrane under surfacing (single or double coat chip seal, polymer in second coat) and/or polymer or other additive in binder.

3. Is there a bound layer underneath that will possibly cause reflective cracking due to thermal and/or moisture movement? (Check wrapping or fatigue cracking?)
   - Yes: yes.
   - No: Continue.

4. Is traffic very heavy or heavy with braking and/or turning? (Check for reflective cracking due to thermal and/or moisture movement?)
   - Yes: Consider:
     1. Improving pavement structure.
     2. Polymer or other additive in binder.
     3. High PSV aggregate to resist polishing.
   - No: Proceed to next step.

5. Is OGPA required?
   - Yes: Consider:
     1. High strength OGPA with polymer or SMA in higher stress areas – check drainage needs.
     2. Polymer in binder in OGPA heavy traffic zones may extend life by 25 to 35%.
     3. Larger mix thicker OGPA for better drainage on 5% longitudinal grades, thick OGPA can have binder film/durability issues – use polymer and/or fibre in mix to resist binder drain down.
     4. Double layer OGPA (scanner in lower layer) for better noise suppression and drainage.
     5. 25% - 30% void OGPA is an option in TNZ P11:2007 specification.
   - No: Proceed to next step.

6. Does NZT T/R 510 slide resistance apply?
   - Yes: Calculate requirements, analyse crash history (if present), assess geometric changes possible effects – document process. If local aggregates with PSV required are not available, discuss cost implications with Client. If PSV greater than 64 is required, discuss and agree with Client, possibly decide to lower PSV slag aggregates or other synthetic products.
   - No: Proceed to next step.

7. Will recycled asphalt (RAP) be used?
   - Yes: NZTA specs allow up to 15% RAP. RAP increases mix stiffness. Check if asphalt supplier(s) are using RAP. If so, request volumetrics (JMF) and ITT modulus and check modulus will not affect fatigue performance of asphalt layers. On more flexible pavements with thin surfacing, a stiffer mix may shorten surfacing life due to fatigue cracking occurring sooner.
   - No: Proceed to next step.

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**What is local asphalt producer capability?** If more familiar with a particular type of asphalt, e.g., DGA rather than SMA or OGPA, and there is less risk with this approach, then design to include this factor. Polymer or other additive could be added to improve a local mix.

**What are local quarry aggregates like?** Success of mixes depends on local aggregate types, particularly in the stone on stone mixes (e.g., SMA, OGPA). Discuss with Aggregate and Quarry Association of NZ or Reading NZ if double arises.

**Horses for Courses** approach. Be wary of coarse graded mixes with larger binder content in collier areas due to potential for fatigue cracking. Use finer graded, higher bitumen mix in this situation.

**Design thickness** should be at least 3 times (DGA/OGPA) and 4 times (SMA), mix nominal size (i.e., sizes 90% of aggregate passes) to allow for construction thickness tolerances.

**Thin asphalt** is permeable. Ensure water resistance of layer below. For air void aggregate and bluster into aggregate and/or base layers of chip seal, refer Step 4.
Step 4 – Bond and Seal

**STEP 4. Bonding the surfacing to the substrate**

Refer notes for pre-leveling of existing surfaces

Is the surfacing being laid on an asphalt base > 40mm thick, or a cemented base?

Yes

Apply a tack coat with 0.2 to 0.7 l/m² residual bitumen prior to surfacing. Use little or no cutback, or emulsion. May need to be higher rate if water resistance is needed on older surfaces.

No

Tack and blind layer prior to surfacing. Use emulsion or no cutback in binder.

Is the surfacing considered to be ‘waterproof’? E.g. AC14 or SMA10 > 40 mm thickness

Yes

Will the underlying layer be trafficked prior to surfacing?

No

Apply a tack coat with 0.2 to 0.7 l/m² residual bitumen prior to surfacing.

Yes

Tack and blind or single coat membrane seal with 1 l/m² bitumen little or no cutback (<2%). 150 m²/m³ spread rate.

No

Water resistance is required

No

Is the traffic high or high stress?

Yes

Two coat membrane seal required, with cutback <5% (if > 10 days to surfacing). For <10 days to surfacing use little or no cutback (<2%).

No

Single coat membrane seal required, 1 l/m² bitumen with cutback <5% (if > 10 days to surfacing). 150 m²/m³ spread rate.

Is the underlying pavement unbound granular material?

Yes

Membrane chip seal(s) required. In addition, as part of overall treatment, consider emulsion added to the basecourse during compaction or primerseal with emulsion to penetrate basecourse.

No

Is the proposed surfacing OGPA?

Yes

Total treatment to achieve minimum 2 l/m² (high traffic) or 1.3 l/m² (low traffic) residual binder below DGA/SMA.

No

Total treatment to achieve a minimum 1 l/m² residual binder below OGPA surface.

Is the traffic short term?

Yes

Traffic speed restriction of 30 km/h with cones periodically shifted during curing period of at least 48 hours.

No

Is the surfacing being laid on an asphalt base > 40mm thick, or a cemented base?

Yes

Single coat grade 4 chip seal required to achieve a minimum 1 l/m² residual binder below surfacing.

No

Single coat grade 4 chip seal to achieve a minimum 1 l/m² residual binder below surfacing in low stress areas. In higher stress areas a 2 coat chip seal should be considered.

Is the foamed bitumen stabilised?

Yes

Will the foamed bitumen be trafficked prior to asphalt surfacing?

No

Single coat grade 4 chip seal required to achieve a minimum 1 l/m² residual binder below surfacing.

Yes

Consider adequate texture for bonding and crack mitigation requirement, e.g. power brooming of the cemented base before curing to remove fines and laitance, use of emulsion primer for bonding followed by PMB seal for crack mitigation and maintaining a seal over cracks.

Is the underlying pavement modified granular with little cracking potential?

Yes

Seek advice on suitable bonding system type and application methodology

No

Is the underlying pavement cement stabilised granular?

Yes

No

Consider adequate texture for bonding and crack mitigation requirement, e.g. power brooming of the cemented base before curing to remove fines and laitance, use of emulsion primer for bonding followed by PMB seal for crack mitigation and maintaining a seal over cracks.