PAVEMENT REHABILITATION
Summary

Steps required in evaluating pavement:

• Search for pavement history/subsoil drain register/ recorded maintenance work
• Visual inspection
• Level of serviceability testing
• Assessment of Pavement Condition
• Pavement Testing for Structural Response to load (deflection survey)
• Determination of traffic pattern and past traffic
• Analysis of test data
• Verification of the pavement to ensure the condition of the pavement consistent with measured level of deflections.
Structural Assessment - Beyond Deflection Testing

If the deflection response does not correspond to the pavement distress, the following properties should be determined:

- Layer density
- Insitu subgrade stiffness
- Thickness of insitu stiffness of pavement
- Grading, m/contents & plasticity of s/grade and pavements
Extent of patching = light colour
Checklist for Solutions
Solutions - Strengthening

- Selective digout & reseal
- Overlays
  - granular
  - Asphalt
- Base course stabilisation
- Drainage
  - table drains
  - shoulder seal
  - subsurface drains
  - crossfall & flow path regulation
  - remove low permeability barriers
Solutions - Shape Corrections

- Asphalt
- Slurry seals
- Hot or Cold recycling
Solutions - Crack Repairs & Water Proofing

• Patching
• Crack infilling
• Hot/cold recycling
• SAM’s or SAMI’s
• Geotextiles
Solutions - Skid Resistance Improvements

- Open graded asphalts
- Grooving of asphalts
- Rejuvenators
- Reseal
Extent of patching = light colour

OWP ruts

Shoving
Treatments for Flexible Pavements

Strengthening treatments
If existing pavement is structurally inadequate for anticipated traffic, possible strengthening treatments include:

• structural overlays (granular, asphalt, concrete)
• insitu or plant-mixed stabilisation
• major patchings
• reconstruction
Insitu stabilisation
Granular Overlay
Asphalt Overlay
Design Issues

1. Widening to accommodate future overlay
2. Consider the merits and demerits of one side widening as against both sides. – Alignment
3. Boxing point – to avoid wheel path.
4. Improvement of existing subgrade if lime treatment is specified
   Issues – Suitability of lime – Capillary Rise
5. Strength of the existing pavement – lack of depth, poor quality
6. Selection of the subgrade strength both in the widening and under the existing pavement
7. Structural assessment using deflection/overlay design/Back Analysis
8. Case studies
9. Traffic issues – Tyre Pressure, ESA/CV
10. Overlay issues
11. Boxing to provide effective cover over expansive subgrade i.e.. 700-800mm above the untreated subgrade.
12. Seal design – Provide a full width seal as against only over the widening
13. Design to avoid crushed rock pavement on impermeable sub base.
Construction Issues

1. Shape correction  scarify or rut fill – avoid bird baths.
2. Subgrade improvement with lime stabilisation / rock fill – issues
3. Construction under traffic – particularly granular overlay
4. Construction traffic
5. Extension of culverts and drainage structures
Specification/ Material Issues

1. Widening material to be ‘compatible’ with the existing material to avoid box type issues
2. Material specification local availability, Pore Pressures/DOS issues
3. Overlay material to be suitable for stabilisation
Maintenance & Rehabilitation Issues

1. ‘Boxed’ type design relies on the seal integrity – seal maintenance or resealing pavement

2. Insitu stabilisation
Design and Construction Considerations

Road Geometry
consider the effect of possible treatments on road geometry

• Examples:
  ⇒ a thick overlay may involve additional costs for raising the level of shoulders, adjacent verges, relocating guardrails & drains
  ⇒ a widening may involve increasing embankment width, consider costs
Design and Construction Considerations

Construction under traffic

need to consider traffic management required for different treatment options

• Detours
• Night work
• Benefits – i.e. soft spots
• Risks - ravelling
Transverse Crack (CT)

Possible Causes

• Reflection of a shrinkage crack or joint in an underlying base (commonly port-land cement concrete or cemented materials)

• Construction joint or shrinkage crack (due to low temperature or bitumen hardening) in asphalt surfacing

• Structural failure of portland cement concrete base
Block Cracking and Pumping
Joint and crack sealing

Method:
• clean cracks, then
• fill with rubberised bitumen emulsion or
• hot-poured polymer-modified bitumen

Appropriate use:
• temporary treatment to inhibit moisture ingress
• widely-spaced block cracking, longitudinal or transverse

Inappropriate use:
• closely spaced cracks
Section through repaired pavement.
Fabric SAMI Western Freeway
Paving Geotextiles

- Road rehabilitation and some new works
- Asphalt or chip seals
- Isotropic
- Non-woven, needle punched
- Heat resistant
- Absorb/become impregnated with bitumen
The effective use of geotextiles in bituminous surfacings
Materials

- Polyester and polypropylene most common
- Polypropylene cheaper
- Polypropylene affected more by temperature
Why use them?

• To retard environmental cracking
• Reduce permeability of wearing course
• Increase pavement life/performance by preventing ingress and egress of water
• Roads are aging therefore rehabilitation increasingly important
• Lightly trafficked, clay pavement chip seals
Treatments for Flexible Pavements

Treatments to correct shape
If pavement ride quality or shape needs to be improved, possible treatments include:

• remove and replace existing surfacing
• asphalt overlay, with and without regulation layer
• slurry surfacing
• asphalt or sprayed seal surfacing in combination with granular overlay
• reconstruction

Need to ensure check that pavement is structurally adequate for these treatments
Slurry seals and microsurfacing

Appropriate uses:
- non-structural overlay
- correct minor shape loss
- lower noise compared to sprayed seal
- for low speed skid resistance

Inappropriate uses:
- pavements with inadequate structural capacity
- pavements rut depth >15 mm and heavy traffic

Rut filling and correction
A section of the Landsborough Highway
Slurry Seal as a “holding” Treatment
Insitu stabilisation of granular pavements

• stabilisation provides a long-term increase in its load bearing properties
• stabilisation methods:
  ⇒ granular (mechanical)
  ⇒ cementitious
  ⇒ lime
  ⇒ bitumen
  ⇒ other chemical agents
Guide to selecting method of stabilisation

Table 5.1 Guide to selecting a method of stabilisation (Austroads, 1998)

<table>
<thead>
<tr>
<th>Plasticity Index</th>
<th>MORE THAN 25% PASSING 75µm</th>
<th>LESS THAN 25% PASSING 75µm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PI ≤ 10</td>
<td>10 &lt; PI &lt; 20</td>
</tr>
<tr>
<td></td>
<td>PI ≤ 6</td>
<td>PI x %</td>
</tr>
<tr>
<td></td>
<td>passing 75µm ≤ 60</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>PI ≤ 10</td>
</tr>
</tbody>
</table>

Form of stabilisation

- Cement and cementitious blends
- Lime
- Bitumen
- Bitumen/cement blends
- Granular
- Miscellaneous chemicals*

Key

- Usually suitable
- Doubtful
- Usually not suitable
Treatments to Improve Drainage

- Drainage and moisture control is of fundamental importance
- Safety to road users
  - Aquaplaning/skid
  - Spray/visibility
  - Reduced width/vehicle stability
- Pavement performance
  - may mean difference between sound/failed
  - requires expedient corrective action
Drainage Condition

- Shallow Table Drains
- Blockage of subsurface drainage due to widening
- Permeable shoulders and medians
- Pumping rigid pavements
- Impermeable aggregate drainage layers
- Reduction in drainage capacity of kurbed pavements due to overlays
- Water seepage into pavement adjacent to median
Drainage Condition

• Pockets of unstable subgrade
• Broken and clogged pipes and pipe outlets
• Pavement failures due to permeable shoulders
• Water ponding on the surface due to surface irregularities and due to incorrect surface crossfall
• Water ponding against the edge of the pavement
• Moisture infiltration from a cutting.
• Moisture infiltrating through the cracks, joints and other discontinuities in the pavement.
• Moisture infiltration through permeable surfaces and build-up of moisture at changes of pavement type, thickness or patches occurring on longitudinal grades.
## Treatments to Improve Drainage

- List of treatment options for drainage deficiencies

<table>
<thead>
<tr>
<th>Condition</th>
<th>Treatment Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shallow and/or silting table drains</td>
<td>De-silt or deepen drains</td>
</tr>
<tr>
<td>Moisture ingress from elevated shoulders and medians</td>
<td>Install subsurface drainage at the edge of pavement closest to the point of moisture ingress</td>
</tr>
<tr>
<td></td>
<td>Seal shoulders and place impermeable material in median</td>
</tr>
<tr>
<td>Impermeable shoulders caused by boxed construction</td>
<td>Install subsurface drains through the permeable shoulders</td>
</tr>
<tr>
<td>Water ponding in hollows in the pavement surface</td>
<td>Correct pavement shape</td>
</tr>
<tr>
<td>Infiltration from cuttings</td>
<td>Install sub-surface and surface interceptor drains at the base of the cut slope</td>
</tr>
<tr>
<td></td>
<td>Provide a drainage blanket under pavement</td>
</tr>
<tr>
<td>Accumulation of moisture in sag curves</td>
<td>Improve crossfall in the low point of the sag</td>
</tr>
<tr>
<td>Moisture accumulation at changes of pavement type or thickness</td>
<td>Install subsurface drains along the junction to connect with edge drains</td>
</tr>
</tbody>
</table>
Drainage improvements

surface drainage systems
- de-silt, deepen table drains
- remove blockages
- overlays to correct shape, crossfall
- improve capacity of system
- raise grade line
Drainage improvements

subsurface drainage

common practice in wetter areas & heavy traffic to construct subsurface drainage systems to:

- drain subgrade
- drain pavement materials
- intercept ground water
Asphalt overlays

- application of a layer of asphalt to existing pavement
- prior to overlay may need to crack seal, cold plane or patch localised areas
Asphalt overlays

Appropriate uses:
- pavements requiring shape correction
- pavements requiring strengthening
- improve noise or skid resistance

Inappropriate uses:
- over unstable bases/subbases
- where pavement levels cannot be increased, unless combined with cold planing
Open graded asphalt surfacings

- OGA is a coarse, gap graded mix, 18-23% air voids
- OGA has superior noise reducing and spray reducing properties
- as OGA is very permeable, not waterproof, if existing pavement is cracked need a seal or SAMI under the OGA
Ultra thin asphalt surfacings

Two major types

• thin OGA placed with a modified asphalt paver that applies a tack coat ahead of the asphalt
• modified, small sized, dense graded asphalt mixes
Ultra thin asphalt surfacings

Appropriate uses:
- minor shape correction of structurally sound pavements
- on cracked pavements in combination with a geotextile SAMI treatment
- to obtain reduction in noise and spray

Inappropriate uses:
- on pavements that require strengthening
- areas of high shear forces
Asphalt recycling

Plant Mixed Recycling

removal of asphalt and its re-use in new asphalt
Asphalt recycling

Hot In-Place Asphalt Recycling (HIPAR)

In a single pass, HIPAR equipment:
- heats and mills the surface
- mixes the millings with new aggregate, binder and rejuvenating agent to form a recycled mix
- lays and compacts the mix back onto the pavement
Asphalt recycling

HIPAR appropriate uses:
- rehab substantial lengths of major roads which are structurally sound
- restore surface shape, skid resistance
- rejuvenation of oxidised asphalt

HIPAR inappropriate uses:
- to treat reflection cracking in asphalt overlying a bound cementitious layer
- asphalt containing tars, some types of PMB or geotextiles
Concrete Pavement Treatments

- surface treatments
- joint treatments
- strengthening treatments

More fully discussed in RTA NSW *Guide to Maintenance of Concrete Pavements*
Crack and Seat with Overlay

- involves cracking pavement into 0.5m to 1m square sections, then rolling to push the cracked slabs into a stable position
- the C&S pavement is then strengthened with an asphalt overlay
- process creates blocks sufficiently small to inhibit thermal movement and hence reflection cracking, yet still retains some aggregate interlock
Slab stitching

process is used to retain aggregate interlock across joints, thereby maximising load transfer

its effectiveness relies on it being completed before the crack or joint has opened sufficiently to compromise load transfer

Figure 16: Typical section of a stitched crack.
Full depth concrete patching

- involves removal of distressed concrete by full depth saw cuts
- installation of dowel bars to achieve load transfer across sawn joints
- placing & compacting concrete
Grade Line Restrictions

Limitation on modifying grade line is a major influence on treatment selection

- maintain bridge clearances
- urban kerb and channel levels, or intersecting roads

Level constraints may require treatments like:

- mill and replace existing asphalt
- thin surfacings
- in situ stabilisation
- reconstruction
Design and Construction Considerations
Shoulder Sealing

• safety and pavement performance significantly enhanced by sealing shoulders
• Shoulders must be structurally adequate
Design and Construction Considerations

Availability of Plant, Personnel and Material

- some treatments require specialised items of plant operated by skilled staff
- availability may influence viability of treatment
- testing and process control
- Establishment costs
Note:--

* Cost includes administrative oncosts
* Excludes pretreatment measures

Types of Rehabilitation

- Chip Seal
- Asphalt
- Thin Treatments (<50mm)
- Thick Treatments (>50mm)
Overlays

1. Grade Controlled Overlays:
   1.1 Graded to High Spots
   1.2 Cut/Fill
   1.3 Full Cut

2. Non-Grade Controlled Overlays

3. Treatment of Existing Surface:
   3.1 Scarify and Reshape
Overlays - Grade Controlled

1.1 Graded to High Spots
Overlays - Grade Controlled

1.1 Graded to High Spots

Advantages:
- Relatively simple design
- Minimal pretreatment

Disadvantages:
- Relatively poor rideability
- Excessive wastage of imported pavement
- Ponding
Overlays - Grade Controlled

1.1 Graded to High Spots

Applications:

- High traffic
- Reasonable existing shape
- Conservative design where there may be considerable existing pavement thickness variations
Overlays - Grade Controlled
1.1 Graded to High Spots

Drawn cross sections are a crucial part of the design process.
Overlays - Grade Controlled

1.2 Cut/Fill
Overlays - Grade Controlled

1.2 Cut/Fill

Advantages:
- Minimal wastage
- Allows good rideability

Disadvantages:
- Extensive pre-treatment
  - Profiling
  - Stabilizer
- Traffic sensitive
- Frequent grade changes
Overlays - Grade Controlled

1.2 Cut/Fill

Applications:
- Existing pavement out of shape
- High traffic (rideability)

Other Comments:
- Detailed knowledge of existing pavement thickness
Overlays - Grade Controlled
1.3 Full Cut
Overlays - Grade Controlled

1.3 Full Cut

Advantages:
- Uniform working platform → leads to good rideability

Disadvantages:
- Expensive
- Wastage of existing pavement
- Traffic
Overlays - Grade Controlled
1.3 Full Cut

Applications:
- Inadequate existing pavement quality
- Height restrictions
  - Kerb and channel
  - Bridge and clearance
  - Rail Crossing
- Minimal increased cover required
Overlays – Non-Grade Controlled

2. Non-Grade Controlled
Overlays – Non-Grade Controlled

2. Non-Grade Controlled

Advantages:
- Minimal pretreatment
- Minimal wastage

Disadvantages:
- Lack of control
- Poor rideability
Overlays – Non-Grade Controlled

2. Non-Grade Controlled

Applications:

- Good existing vertical alignment
- Low traffic roads
Overlays – Treatment of Existing Surface

3.1 Scarify and Reshape
Overlays –
Treatment of Existing Surface
3.1 Scarify and Reshape

Advantages:
- Maximum use of existing pavement
- Provides uniform full width pavement

Disadvantages:
- Uncertainty of reshaped pavement thickness → conservative design
- Traffic control
- May require mixing with imported material to allow minimum thickness
Overlays –

Treatment of Existing Surface

3.1 Scarify and Reshape

Applications:

- Best under side track
- Better suited to non-grade control