ENHANCED CONSTRUCTABILITY OF UNBOUND GRANULAR PAVEMENTS FOR THIN SURFACINGS

1. PAVEMENT DESIGN

ISSUE	COMMENT	ACTION	STATUS
1.1 What is the traffic volume limit beyond which satisfactory performance of sprayed seals cannot be guaranteed	The upper limit of traffic volume has not been established. It should be noted that the limit is not only dependent on traffic volume. Other factors affecting performance include: • urban or rural situation • accuracy of seal design • dryback at time of sealing, • weather at time of sealing • construction standard achieved (pavement and seal) • maintenance during life of seal Although good performance has been evidence on the Hume Freeway in rural Victoria carrying 18,000vpd including approx 6000 heavy vehicles per day , parts of other recently constructed rural roads carrying heavier traffic (50,000 vpd including 7500 hvpd) have had varied success. Clearly, as traffic increases, more care is required to ensure all factors are addressed. Cost of surfacing type is another factor which should be assesses against the risk of not accounting for all factors.	Road Authorities to investigate and report on the good and poor performance of sprayed seals on newly constructed heavily trafficked rural roads to establish any correlation between traffic volumes and seal performance which IS/ IS NOT influenced by other factors	Current best practice for selection of appropriate surfacing including where sprayed seals should or should not be used – refer Austroads publication " Guide to Pavement Technology Part 3: Pavement Surfacing (AGPT03 – 09)"

1.2 Should the geometry of the road (tight corners, roundabouts, steep grades, intersections) determine the type of pavement adopted	Unbound granular pavements constructed to high but achievable standards of construction do perform in these situations. The question is what surfacing type should be used? In urban areas, asphalt surfacing is preferred. In rural areas, sprayed seals should be used except at roundabouts and intersections involving heavy turning traffic where a thin asphalt surfacing is commonly used.	Improved guidance is required in the selection of surfacing type based on the geometry of the road.	The current best practice for the selection of appropriate surfacing – refer to Austroads publication" Guide to Pavement Technology Part 3: Pavement Surfacings (AGPT03-09)" Austroads publication "Update of the Austroads Sprayed Seal Design Method (AP-T68-06)" is being further updated to provide improved guidance in the selection of spayed seals for varying traffic conditions based on climate, small radius curves, roundabouts, turning lanes and vertical grades greater than 5%. NOTE: The Austroads publication "Guide to Road Design Part 3: Geometric Design (AGRD03-10)" provides limits for vertical grades but is not related to surfacing type.
1.3 Access to accurate traffic counts is rarely available for spray seal design purposes	Feedback from AAPA training courses suggests that traffic data for design of seals varies from being up to date to being out of date by 5 and more years or is not representative of the area being treated. It is most important to get an accurate estimate/actual count if possible, of the total traffic volume and its composition. In particular, the heavy and large heavy vehicles as these will have significant influence on potential embedment and	Road Authorities are to be encouraged to provide accurate traffic counts to designers. Estimates or guesswork of traffic data is to be avoided.	Feedback is required from Contractors where lack or unreliable traffic data was provided.

	design rates of application of binder (e.g. busy rural highways and freeways). It is also important to note traffic distribution on multi-lane roads which carry the higher traffic volumes All Road Authorities are in the best position to provide the best available traffic data at time of tender.		
1.4 Should double double PMB initial treatment seals be adopted in heavy traffic situations	Yes in most situations. The Current Austroads Technical Report on "Update of the Austroads Sprayed Seal Design Method (AP-T68/06)" provides advice on the use of double double seal treatments. However refinements to the design method are needed.	Improved guidance is required for design of double double seals the higher traffic categories and in high and extra high stress situations	A recommendation updating to double double seal design method is being prepared for consideration by the Austroads Pavement Technology Reference Panel in May 2011.
1.5 Is there a limit on tyre type, axle configuration and axle load beyond which satisfactory surfacing performance cannot be guaranteed	A significant deficiency of the existing Performance Based Specification for vehicle design is that there is no standard to assess the impacts of changes in horizontal tyre forces. In addition, the horizontal tyre forces applied to various pavement surface types by new configurations and loadings of freight vehicles are not currently known. Aggregate embedment and loss of surface texture may also be related to the increasing heavy vehicle traffic volume comprising all types of tyre and axle configurations.	Research is required to investigate the effect of horizontal shear forces on surfacing's from new generation freight vehicles.	Austroads are currently undertaking a project: "Understand the impact on pavement surfaces from next generation freight vehicles and developing practical network prediction models and responses (AT1540)". Refer first output recently reported in 2011(AP-T174/11). Performance of the double/double seal under ALF testing is also being monitored and analysed to determine whether there is an apparent difference between rates of surface texture reduction between single

			axle, tandem axle and tri-axle loadings.
1.6 Should accreditation of personnel involved in seal design accredited seal be mandated	All personnel involved in seal design should have demonstrated experience in seal design. However anecdotal evidence exists that there is a lack of understanding on how to use the Austroads Seal Design Method (AP –T68/06).	Road Authorities should review their requirements to ensure competent designers are employed in the design of sprayed seals.	Queensland has introduced a requirement to assess competence and for Contractors to nominate a prequalified designer. Victoria had adopted a more performance based approach requiring Contractors to guarantee the performance of the seal for 2 years.
1.7 Is the Austroads Sprayed Seal Design Method providing satisfactory results	Generally yes but there is evidence that Road Authorities and Contractors are making minor changes to the design method to accord with their experience. A concern also exists that the cheapest treatment is sometimes adopted rather than the most appropriate and economic treatment.	Feedback is required where evidence exists of unsatisfactory seal performance can be attributed to the design procedure or inappropriate treatment selection.	Ongoing refinements are being made to the design method to address concerns and continued feedback on good and poor performance is encouraged. A suggestion has been made to more clearly describe the procedure for "design of reseals" in a future update of the Austroads seal design method.

2. PAVEMENT MATERIALS

ISSUE	COMMENT	ACTION	STATUS
2.1 Pavement base courses must be cohesive if surfaced with sprayed seals on heavily trafficked roads	Agree. VicRoads has adopted a minimum PI of 2 with a maximum of 6 (Class 1crushed rock) as follows: • Traffic 1 to $7x10^6$ (approx. 50 to 350 HVPD – top 100mm of base course. • Traffic > $7x10^6$ – full depth base course.	Road Authorities should confirm that their base course specifications include the requirement for cohesion or advise on alternative approach	Responses from other Road Authorities still to be sought
2.2 High performing durable crushed rock is required for heavily trafficked unbound pavements with thin surfacing	Agree. Less durable crushed rock and other softer naturally occurring pavement materials have reduced lives requiring more frequent rehabilitation to correct roughness, rutting and distress. In remote areas, use of less durable pavement material with proven experience may be economically viable but may need to be supported by more robust seals	For traffic less than 50 heavy vehicles per day, use of less durable crushed rock or softer naturally occurring road making material with adequate strength (soaked CBR > 60) may be acceptable.	Current best practice is contained in: Austroads Guide to Pavement Technology Part 4 – Pavement Materials (AGPT04-07)
2.3 Sprayed seals perform better than thin asphalt surfacing over weaker pavements	Well-constructed unbound granular pavement should routinely be very stiff at the time of initial sealing with a characteristic deflection around 0.5mm. Any new pavement constructed to higher levels of	New pavements should not be sprayed sealed or thin asphalt surfaced if weak. The cause should first be identified and then addressed and the problem identified and rectified.	VicRoads specifications do not require strength testing at the time of initial sealing. Reliance is placed on other tests (proof rolling, density, dryback, etc.)

	deflection at the time of sealing is likely to have performance issues. Thin asphalt surfacing 30mm to 50mm in thickness and designed with an appropriate binder is an option to sprayed seals over weak pavements; however both treatments are likely to have reduced life. The key factor here is the relative cost of the treatment.	Road authorities should confirm their requirements for strength testing prior to applying a new surfacing. NOTE: Guidance for the selection of an appropriate treatment over an existing weak sealed pavement is provided in the Austroads "Guide to Pavement Technology Part 5: Pavement Evaluation and Treatment Design (AGPT05-09)". This guide is currently being re-fomatted.	Deflection testing is a valuable input when considering major rehabilitation of an existing distressed and probably weak pavement.
2.4 There appears to be inherent risks with the use of emulsion seals	Emulsions have the advantage of applying viscous bitumen at comparatively low ambient temperatures. When used in place of cutback bitumen, emulsions use less cutter oil and hence help reduce emissions of volatile hydrocarbons into the atmosphere. The main concern with emulsions is the lack of penetration into the pavement surface compared to hot cutback bitumen. However the use of emulsion technology in cooler weather is the preferred approach. There a many do's and don'ts with the use of emulsions in sprayed seal work and care is required if satisfactory performance is to be achieved.	Continued promotion of the use of emulsion sealing is required which includes information on best practice, risks and challenges in the use of this treatment. NOTE: AAPA conducts training courses in emulsion sealing technology.	Current best practice is contained in the following guides: • Austroads Guide to Pavement Technology Part 3 – Pavement Surfacings (AGPT03-09) • Austroads publication "Update of the Austroads Sprayed Seal Design Method (AP-T68-06)" • Austroads Environmental Assessment of Emulsions (AP – R153) • Austroads (2002). Guide to the Selection and Use of Bitumen Emulsions (AP-G73/02). • Austroads Guide to Pavement Technology Part 9: Pavement Work Practices (AGPT09-08).

3 PAVEMENT CONSTRUCTION

ISSUE	COMMENT	ACTION	STATUS
3.1 Sealing pavements in the colder wetter months of the year often leads to poor performance	Agree. Sealing of pavements should be restricted to the warmer drier months of the year where pavement temperatures are above 10^0C. Cooler and damp conditions require shorter sprayer runs, rapid aggregate cover and additional rolling. Priming of new pavement followed by sealing is the preferred approach in the warmer months. If rain is imminent, sealing should be deferred.	Sealing should desirably be programmed to be carried out in the warmer months of the year. Where sealing is unavoidably carried out in cooler periods, use of emulsion primersealing reduces the risk of poor performance provided final sealing is undertaken after an appropriate curing period.	Current best sealing practice is contained in: • Austroads "Guide to Pavement Technology Part 4K: Seals (AGPT04K-09)" • Austroads Technical Report on "Update of the Austroads Sprayed Seal Design Method (AP-T68/06)".
3.2 Where possible, use traffic to assist in the preparation of pavements for surfacing should be used.	Agree. Such trafficking will locate weak areas in the pavement which have been missed by testing or inspection. However in most "green fields" situations, it is not possible to manoeuver traffic onto the newly constructed pavement before sealing. In these situations attention to quality control including proof rolling and dryback is critical. Care needs to be exercised when	Contractors are encouraged to plan their construction activities to include trafficking wherever practical including moving traffic over the whole surface area.	For construction under traffic, speed restrictions are advisable during both day and overnight use to reduce ravelling in the green pavement surface.

	leaving “green pavements” unattended when opened to traffic.		
3.3 For untried pavement materials and work methods, trials should be undertaken to determine best practice	Agree although laboratory testing should first be undertaken to establish possible acceptable or unacceptable risks prior to undertaking any trial. Generally suitable work methods are established during construction of the trial but pavement performance would require at least 12 to 24 months of trafficking before considering adoption.	Road Authorities should confirm their requirements for trailing untried pavement materials	• VicRoads requires trails for any pavement material in excess of 40mm maximum size.
3.4 Sufficient time should be allowed for the pavement to harden when preparing pavements for sealing	Agree. The importance of pavement hardening (dryback) is critical to the success of unbound granular pavements with thin bituminous surfacings. In favourable weather conditions, dryback can be achieved in 1 to 3 days; longer in colder wetter conditions	Roads Authorities should provide feedback on the success or otherwise of their dryback requirements.	• VicRoads introduced dryback requirements into specification in July 2009. Performance is being monitored.
3.5 Excessive slurrying of the base course surface during preparation for sealing leads to poor surfacing performance	Agree. This practice is sometimes used to correct hungry, boney or ravelled pavement surfaces. It draws “fines” from the underlying pavement material leaving the layer weaker and likely to deform and become rough	Road Authorities should confirm their requirements restricting the use of excessive slurrying during preparation for sealing	• VicRoads does not permit excessive slurrying although multi-tyred rolling over a dampened surface assists in kneading loose stones into the surface after completion of compaction.

	prematurely. Note: Addition of fine material to address hungry or boney surfaces should also be avoided.		
3.6 Use of cementitious binder in base courses while assisting with pavement stability will result in cracking reflecting through the surfacing	Agree. Even small percentages of cementitious binder (less than 1%) can stiffen the pavement sufficient to induce cracking under relative heavy trafficking (> 350HVPD). In addition, the risk of variable concentrations of added binder is likely leading to variable levels of compaction.	Road Authorities should confirm their requirements restricting the use of cementitious binders in base course construction.	• VicRoads does not permit the use of cementitious binders in base course crushed rock in new pavement construction.
3.7 Segregation in pavement materials must be avoided during construction	Agree. The practice of delivering wetmixed pavement material and dumped directly onto the roadbed for grader spreading to level in the quickest possible time prior to commencement of compaction has high risk of segregation being built into the pavement layer during construction. Segregation leads to variable moisture contents and variable compaction results. (See also Issue 4.8 below). The spreading process should involve	Road Authorities should provide feedback on their requirements and methods to avoid segregation	• VicRoads introduced requirements to avoid segregation into specifications in June 2008

	turning pavement material over to remove any evidence of segregation. Pockets of deep segregated pavement material must be removed and replaced with homogenous material before completion of compaction.		
3.8 Why is there no benchmarking of achieved construction standards across Austroads	No project has been proposed to investigate such benchmarking and therefore does not have much priority.	Austroads should be approached to gauge interest in conducting such a benchmarking exercise.	No progress. NOTE: Best practice pavement construction is contained in Austroads "Guide to Pavement Technology Part 8: Pavement Construction (AGPT08-09)".

4 TESTING

ISSUE	COMMENT	ACTION	STATUS
4.1 Is Ball Embedment testing an appropriate method to determine a pavements suitability for sealing	If used correctly and at the appropriate time, it is a subsidiary method which utilises the same equipment specified for seal design. The principal method should be Moisture Content or Degree of Saturation testing.	Road Authorities should be canvassed to ascertain if there is any interest in promoting the use of the Ball Embedment testing as a means of determining pavements suitability for sealing in marginal cases of dryback.	• VicRoads has included Ball Embedment testing into its Preparation for Sealing specification (Section 310). Monitoring is continuing to confirm requirements.

4.2 Is proof rolling without visible deflection sufficient to test a pavements stability	A pavement layer should be stable and pass proof rolling without visible deflection (less than 2mm) before proceeding with construction of a subsequent layer. However proof rolling in no substitute test for compaction testing.	No action required	Pavement layers should pass both proof rolling and compaction testing prior to any acceptance of the layer.
4.3 Which test is best for use in determining moisture in the pavement - % of OMC or Degree of Saturation	The majority of Road Authorities prefer % of OMC due to reduced cost of testing. The OMC value is available from previous compaction testing however the Apparent Particle Density value required for DoS testing is an additional test. The value of % OMC currently being used by a number of Road Authorities is 60.	Roads Authorities should be encouraged to adopt a consistent approach to measuring dryback and the level of dryback required to satisfy stability requirements for a given traffic and pavement material condition.	The specified value for % OMC is still being confirmed.
4.4 What frequency of testing should apply to ensure a balance between cost of testing and minimising risk of poor pavement performance	There is no set frequency as performance is dependent on: • History of material performance • Contractor performance • Quality of testing • Cost of community inconvenience during repair	Road Authorities could be approached in a benchmarking exercise aimed at determining the optimum balance between frequency of testing and risk of poor pavement performance	No progress
4.5 Who should bear responsibility for post compaction requirements – Supplier or Constructor	This depends on whether the Supplier has complied with their obligations for Supply. Suppliers should clarify with the Contractor whether their	Supply contractors are advised to clarify their obligations for post compaction requirements prior to entering into Agreements	Supply contractors are encouraged to raise concerns with Road Authorities should unfair conditions be imposed.

	obligations cease at the gate (i.e. not responsible for post compaction requirements) or whether they guarantee post compaction requirements will be met irrespective of the Contractors construction methods including any reworking of failed lots .		
4.6 What is the appropriate compaction standard for pavement materials – Modified or Standard	Experience has shown that Standard Compaction best represents the moisture content for achieving the specified density in earthwork construction and Modified Compaction best applies to pavement materials.	All Roads Authorities should be encouraged to adopt Modified compaction testing for pavement materials.	Most Roads Authorities specify modified compaction for testing pavement materials
4.7 Concern exists that a high level of variability in compaction results are being accepted, albeit meeting specified requirements.	Agree Variability in pavement material (grading, moisture content, segregation, layer depths, etc.) produces higher standard deviations (SD's greater than 2) in compaction results and risks longer term ride quality deficiencies. A well-constructed pavement should achieve standard deviations in compaction results less than 1.	Consideration should be given to specifying a limit on standard deviation in compaction testing results to encourage uniformity in construction.	No progress.

5 SPECIFICATION

ISSUE	COMMENT	ACTION	STATUS
5.1 Is a national approach to pavement construction possible?	Pavement performance is dependent on the materials that are economically available, the traffic loading carried by such materials and the environment which exists where the materials are used. Construction standards will vary dependent on all these factors.	Contractors should raise concern with their respective Road Authority where inconsistent approach es are being adopted to pavement construction.	Current best practice is contained in Austroads Guide to Pavement Technology Part 8: Pavement Construction (AGPT08-09).
5.2 Are more Hold Points required before proceeding with sealing	No. One HP should be sufficient which requires the Contractor and the Superintendent to agree that the pavement is fit for sealing. This should include ensuring all construction requirements have been satisfied and all preparation works have been satisfactorily completed. In marginal cases, any risks in proceeding with sealing should be clearly understood by both sides.	Road Authorities to be contacted to ascertain their approach to hold points prior to sealing.	• VicRoads specifications include one hold point prior to sealing proceeding.
5.3 Should a minimum PI be adopted in base courses surfaced with sprayed seals or thin asphalt surfacing's	Yes. Base courses with no PI lack cohesion and will not withstand the correct treatment when preparing pavements for sealing. Refer also to Issue 2.1 above	Road uthorities to be contacted to ascertain their approach to specification of minimum PI in base courses	• VicRoads requires a minimum PI of 2 with maximum of 6 for base courses used on roads carrying more than 7 x10^6 ESA's (approx. 350 heavy vehicles per day) which are to be surfaced with sprayed seals or thin asphalt surfacings.

5.4 Should specifications require Contractors to use the latest developments in equipment aimed at achieving higher standards in construction	Keeping abreast with latest equipment is expensive and contractors are in the best position to determine their approach. What is important is that specified (not higher) standards must be met and if existing equipment cannot consistently achieve these standards, then the cost of rework and delays to completion of work will become an important cost factor for contractors.	Ascertain if there is good information available to contractors on construction plant and applicability to achieving specified standards – level control, compaction, ride quality. Note: Desirably with performance based specifications, Road Authorities should not specify equipment to be used.	No progress

6 TRAINING

ISSUE	COMMENT	ACTION	STATUS
6.1 There is a loss of expertise in the construction of unbound granular pavements with sprayed seal surfaces	Not necessarily so. However it is clear that knowledge transfer from departing and experienced practitioners to new and inexperienced staff does not regularly occur.	Road Authorities and Industry should work together to promote existing training courses or develop new training courses in the field of unbound granular pavement construction. Existing practitioners should be encouraged to documents their experience; both good and bad, for input into Austroads document AGPT08-09 (see Issue 5.1 above).	No progress
6.2 Field training (boot camp) specifically aimed at constructing unbound granular pavements with sprayed seal surfacing's is lacking	Agree in principal. However this requires a big effort to identify the site, supply materials and equipment, and select appropriate	Roads Authorities and industry need to work together to arrange field trials aimed at improving the skills in constructing unbound granular pavements.	No progress

	timing to suit likely attendees will be a challenge.	Note: While examples of this cooperation may have occurred in the past, more promotion and reporting of these events is required.	
6.3 There is a need to facilitate the transfer of pavement construction knowledge from experienced practitioners to learners. Refer also to Issue 6.1 above.	Agree. Road Authorities and the construction industry should join together to establish a group of accredited mentors who would be willing provide a service at reasonable cost to organisations, businesses and individuals covering all aspects of pavement construction.	Working group to be established aimed at establishing a pool of mentors.	No progress
6.4 There is a need to improve the standard of understanding of testing requirements by Materials Testing Officers	Agree. There is clear anecdotal evidence that testing officers do not fully understand the requirements of test methods and/or they produce results which are not representative of the standard of construction achieved. A testing officer accreditation system needs to be established as well as the NATA laboratory accreditation system.	A project proposal was submitted to Austroads aimed at identifying the required competencies and development of course material for road construction materials testing for use by educational institutions in offering certificate qualification to Materials Testing Officers as required by NATA policy circular 26 issued in December 2009.	Due to other competing priorities, the proposed Austroads project was not considered for funding in 20011/12. Note: The RTA NSW in partnership with the Hunter Institute of TAFE is offering a dedicated Certificate IV course in Laboratory Techniques.
6.5 A program of work placements exchanging staff between Road Authorities and contractors would enhance adoption of best practice processes.	Agree. Note: The use of Alliance contracting brings Road Authority, designers and contractor construction staff closer together in delivering projects.	Roads Authorities and Industry need to work together to establish staff exchange programs.	• Such a program exists between VicRoads and Fulton Hogan.

6.6 A grouping of mentors should be established who would be available for shadowing during all phases of construction activity	Agree. Refer also to Issue 6.3 above	Refer to Issue 6.3 above	No progress
6.7 Training of Superintendents is required to ensure their skills in administering contracts are sufficient to perform the task	Agree. Many Superintendents come from backgrounds which has not included adequate experience in administering pavement construction contracts.	Roads Authorities need to consider the warrant for developing and conducting such Superintendent training.	No progress
6.8 There is a lack of awareness within the education system of careers in the pavement construction industry	Agree CPEE offer training and tertiary qualifications in all aspects of pavement engineering. The task of improving awareness of careers in the pavement industry needs to be better promoted through Road Authorities and industry in general.	Road Authorities and industry need to better encourage graduates to undertake the CPEE units of education as a means of enhancing their career prospects. Road Authorities and industry need to ensure their supervisors and other technical staff undertake appropriate courses and achieve certificate qualification in pavement construction. There is also a need to develop teaching material for schools to encourage students to pursue a career in the road industry.	Unknown

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