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BITUMINOUS SURFACINGS FOR PAVEMENTS ON AUSTRALIAN AIRPORTS

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SYNOPSIS

The paper reports on survey and research into the performance of bituminous surfacings on airports by the Australian Airports Association Technical Working Group. Bituminous surfacings (seals and asphalt) are used at most airports in Australia for surfacing runways, taxiways and aprons. The Australia design philosophy is to design lower cost pavements with thinner surfacings. This means savings which flow directly to airport charges and ticket costs. For regional airports, they can flow to the very viability of the airport itself. A comparison of pavement designs from different authorities shows the extent of saving using the Australian philosophy. However the lower cost design philosophy means getting the most out of materials, and encountering some problems along the way. The research into bituminous surfacings on airports found some problems with the performance of surfacings. Rather than opt for more expensive designs, the AAA Technical Working Group embarked upon their 2004/5 research programme to investigate these problems and develop solutions.

For seals, airport seal design is being increasingly derived from roads practice, which has led to some problems with seal design and maintenance. The problems manifested are too little bitumen being used at construction to hold the stone, and not enough rolling. Loss of stone (stripping), followed by bleeding in the subsequent summer has been experienced at some airports. The design differences between airports and roads are presented.

For asphalt surfacings, problems were identified at certain airports with groove closure, groove edge breaking, and other unsatisfactory performance. A national coring programme found stripping of asphalt on airport pavements was more widespread than previously thought. The focus moved to the binder with issues such as viscosity, temperature susceptibility, polymer modification, and quality control being considered. A new programme of direct airport binder quality control was introduced on some major airport projects. The AAA TWG is undertaking the development of a new airport binder (or binders) with properties such as good asphalt mixture stiffness at slow loading times and across the service temperature range, and good resistance to stripping. Expressions of interest were sought in mid-2005 from binder manufacturers and a preliminary evaluation of products has been completed. A short list of binders will be selected for further investigation and airport trials.

INTRODUCTION

Use of bituminous surfacings on Australian airports

Both bituminous seals and asphalt are used on pavements at Australian airports. Seals are predominantly double seals, used on civil pavements for light to medium aircraft pavements (up to Boeing 737/717 size). Asphalt is predominantly dense graded asphalt wearing courses, usually used on civil pavements for medium to heavy aircraft pavements (from the Boeing 737/717 size upwards) and widely used on military airports.

The binder used in seals and asphalt for many years has been unmodified paving grade bitumen (note that the terms binder and bitumen are used somewhat interchangeably; bitumen is the unmodified product and binder can be modified or unmodified). Airports have historically used Class 320 bitumen for asphalt and Class 170 bitumen for seals.

Both Class 170 and Class 320 bitumen have given good service at many airports across Australia. For seals, reports of stripping/bleeding have increased in recent years. For asphalt, softness or rutting has generally not been a problem at airports. Some of the major airports found that asphalt made with Class 320 bitumen was stripping (the asphalt would degrade and loosen, leaving only a thin intact crust). This would fail, particularly in hot and wet weather, and significant and repeated patching was required. Asphalt made with the AB6/A10E grade of SBS polymer modified bitumen, for whatever reason, was found not to strip nearly as badly, and so this was adopted at several major airports. It should be noted that many other airports are still using Class 320 bitumen in asphalt without experiencing serious problems.

Design philosophy for airport pavements in Australia

The use of surfacings is inter-related to the pavement design philosophy. The Australian approach is to design lower cost pavements, with lighter surfacings, thinner layers, thinner surfacings, and less capable materials. This is in common with South African and New Zealand practice, and differs from USA practice. Seals are used instead of asphalt where possible. Thin asphalt is used instead of thick asphalt, if possible. And thick asphalt is used instead of concrete. The design philosophy for lower cost pavements has been successful, and is a reflection of our relatively benign climate, a willingness to stretch designs (reduce reliability), a high local capability for inspection and maintenance (to repair failures), and less intense trafficking.

The cost implication of design philosophy was found here by comparing designs according to different philosophies (Table 1). The cost of the pavement structure for a runway for a Boeing 737-800 design aircraft was calculated for:

- two Australian designs (one with a sealed surface and one with 50mm of asphalt, both on crushed rock basecourse),
- American FAA design (with their thicker asphalt and a cement stabilised basecourse), and
- American FAA concrete slab design.

Each of these designs has their advantages and disadvantages, and their suitability and applicability will vary by location.

Table 1 Comparison of pavement design philosophy costs

Design philosophy	Surfacing	Structure	Cost/sq.m.	2500m runway
Australian	Seal	S2/250G2/300G5	$ 102	$ 11,500,000
Australian	Asphalt	G/50A/200G2/300G5	$ 115	$ 13,000,000
USA	Asphalt	G/125A/200C3/200G5	$ 147	$ 16,600,000
USA	Concrete	G/400conc/150C3	$ 255	$ 28,700,000

Notes: design aircraft: unlimited 737-800 @ MTOW. Subgrade CBR 10. ACN/PCN 45. Runway 2500m x 45m. Non-critical area thickness adjustment omitted. Costs are for pavement and surfacing only, for 2005, including supervision and testing. All non-pavement, subgrade and earthworks costs excluded. Structure codes are: G = grooving, S2 = double seal, 50A = 50mm asphalt, 200G2 = 200mm crushed rock basecourse, 300 G5 = 300mm subbase, 150C3 = 150mm 3% cement stabilised. Australian costs include paver laid crushed rock and Macro proof rolling.

The difference in cost is very evident. Similar exercises have been done in the past for roads, and the same order of cost difference between different design philosophies was found. The Australian philosophies mean savings which flow directly to airport charges and ticket costs. For regional airports, they can flow to the very viability of the airport itself. However the lower cost design philosophy means getting the most out of materials, and encountering some problems along the way. The survey and research into bituminous surfacings by the Australian Airports Association found some problems with the performance of surfacings at some airports. Rather than opt for more expensive designs, the AAA Technical Working Group embarked upon their 2004/5 research programme to investigate these problems and develop solutions.

BITUMINOUS SURFACING DESIGN FOR AIRPORTS

Seal design on Australian airports

The seal design is increasingly derived from local road authority or Austroads practice (Austroads, 2001); design has often moved substantially from the old Department of Civil Aviation specifications. This reflects advances in design, but has led to some problems with seal design and maintenance when the difference between roads and airports has not been properly addressed. These differences include:

- Risk of stone damage to aircraft which limits the maximum stone size to 10mm (roads often use 14mm stone).
- Traffic levels on most airports are extraordinarily low by road standards, which means that there is insufficient traffic to roll the stone into the bitumen just after construction, thus re-orienting the stone to lie flat.
- The amount of loose stone tolerated on an airport surfacing is close to zero, which is far less than roads.

Most road design methods have mechanisms to design suitable seals for very low traffic roads (which is the equivalent to airports), but all too often a design for a nearby highway is used instead. This leads to too little bitumen to hold the stone. The amount of rolling at construction is also often based on road experience where much less is required than at an airport. Since the airport does not have enough traffic to roll the stone into the bitumen, the stone sits up above the bitumen and is easily lost if not rolled enough at construction. The phenomenon is loss of stone (stripping), leading to loose stone and sometimes the entire seal is compromised. In the subsequent summer, it might also lead to what seems to be bleeding; this is simply the bitumen, now uncovered by the lost stone, being hot and sticky, and adhering to tyres.

Designs for road and airport seals are compared here to illustrate the differences. These are for a 10mm/7mm double seal (Table 2). A number of common assumptions are made about surface texture, ALD, stone absorption, etc. The recommended practice for airports is shown the last column, which is Austroads – very low traffic road design + enough rolling for an airport.

Table 2 Comparison of seal designs

Bitumen application rate (l/m^2 @ 15 ^{o}C)	Historic Department Civil Aviation	Austroads – rural highway	Austroads – very low traffic road + rolling for airport
10mm first layer	1.35	1.1	1.5
7mm second layer	1.2	1.0	1.35
Total binder	2.55	2.1	2.85
Roller hours for a 2000mx30m runway	340	75	300

Notes: traffic for airport = 50-100 v/l/d. Rural highway = 2500 vehicles/lane/day.

The binder in use for seals on airports is usually Class 170 bitumen. The more viscous (stiffer) Class 320 bitumen has been used in semi-tropical climates with success to cope with higher aircraft stresses. However Class 320 (which is not dissimilar to Class 170 + 1½% cutter) has given some problems in hot/dry climates, especially if constructed during cool weather without sufficient cutter and rolling being applied.

Asphalt design on Australian airports

Asphalt mix design for Australian airports is done in accordance with the Marshall design method using 75 blows per face. The design is based on maximising the bitumen content consistent with achieving the specified design air voids content and the minimum Marshall stability. The philosophy is for good compactability, long durability given very low trafficking, and low permeability. Stripping evaluation of the design mix is done using Austroads Method AST 02 – Stripping Potential of Asphalt – Tensile Strength Ratio. The optional freeze- thaw cycle is not conducted, and the Tensile Strength Ratio should not be less than 80%. A typical specification for asphalt used on runways and on [untrafficked] shoulders is shown in Table 3.

Table 3 Typical specification for Australian airport asphalt

Property	Runway	Shoulder
Nominal Mix Size	14mm	10mm
AS Sieve Size(mm)	Target % Passing (by volume)	
13.2	100	
9.5	82	100
6.7	70	82
4.75	60	70
2.36	44	50
1.18	33	37
0.600	25	27
0.300	16	17
0.150	10	10
0.075	5	5
Filler Content (% of aggregate by mass)	1.5% hydrated lime	
Bitumen Content (% total Mix by mass)	5.8	6.1
Marshall stability (min, kN)	12	8
Marshall flow (max, mm)	3	4
Marshall air voids target (%)	4	4
Voids filled with bitumen target (%)	75	80

The design/specification used for asphalt for airports in Australia differ from the road arena in several respects. They are Marshall based designs rather than the performance designs common on roads today. Indeed, if the airport mix specification was assessed for roads usage, it would raise concerns over rutting. The airport mix has high binder content, the grading is very close to the maximum density line, and the voids filled with binder are high. This must be set off against the airport functional properties demanded. In service, rutting of asphalt mix usually has not proved a problem. Australian airport asphalt practice has been benchmarked against international airport practices in a separate exercise several years ago and found to be comparable. However the change in loads with the new Airbus and Boeing aircraft (Table 4) means that the airport asphalt mix specification now needs review again.

Table 4 Increasing aircraft loads

Aircraft	Mass/tyre (tonnes)	Tyre pressure (kPa)	Period in Australian service
Historical and present loads			
Boeing 727-200	22.6	1170	1960s onwards
Boeing 737-400	16.2	1440	1970s onwards
Boeing 747-400	23.6	1400	1980s onwards
Boeing 777-200	20.8	1400	1999 onwards
New loads			
Boeing 777-300ER	26.9	1533	2003 onwards (limited so far)

Airbus A340-600	29.1	1610	2003 onwards (limited so far)
Airbus A380-800	26.6	1500	2007+

AAA TECHNICAL WORKING GROUP RESEARCH 2004/5

Scope of AAA TWG research

The AAA Technical Working Group (TWG) undertook a study to provide an overview of how bitumen's are produced in Australia and how they are performing on airports. The study was divided into three packages. Package A sought to ascertain what problems airports were facing with bituminous products by means of a survey and limited inspections. In addition, it sought information on closure of grooves in asphalt, groove edge breakage, premature aging of asphalts and soft behaviour of bituminous surfacings generally in hot weather. Package B covered project investigations into some aspects of bitumen and its performance, done in conjunction with actual construction projects. Cores were taken from runways around Australia and examined closely to see how the surfacing had performed. The concept of a new airport binder arose in this package. Package C was a technical survey of how bitumen and modified bitumen is produced for Australia, and how the products had changed over time. The detailed reports of these are available through the AAA.

The problems discussed in this study need to be kept in perspective. Bituminous surfacings on Australian airports have a long history of good performance. Modified bitumen binders have been used for airports in other countries with reported success, and asphalt is widely used internationally as an airport surfacing. Asphalt and bituminous binders continue to be a product used by Australian airports, and the challenge ahead is to refine the system to improve performance.

Survey and inspection

The AAA TWG undertook a written survey of the performance of runway surfacings on Australian airports in 2004. Returns from 38 civilian and military airports, covering 62 runways and the main Australian airports, were analysed (Kubu Australia, 2005). The survey covered a range of runways.

Runway surfacing types

The survey responses included runway surfacing types such as concrete ends/asphalt, all asphalt, asphalt ends/seal, all seal, and other (which were unsurfaced gravel or grass). Cross-tabulating these by runway length gives an overview of the numbers of each type of runway surfacing in use, in the figure below.

RWY length group * SURFACE Crosstabulation

Count

		SURFACE					
		Concrete ends + asphalt	All asphalt	Asphalt ends + seal	Seal	Other	Total
RWY length group	<= 1000m		1		3	1	5
	1001-1500m		1		5	1	7
	1501-2000m	1	8	1	8	2	20
	2001-2500m	2	9	1	2		14
	2501-3000m	1	4				5
	3001-3500m	5	3				8
	3501-4000m	2	1				3
Total		11	27	2	18	4	62

Runway friction treatments

The friction treatment is provided to meet requirements for wet weather friction and texture (the two parameters are not the same, although they are to some extent related). A bitumen seal surface almost always meets the ICAO requirements in terms of skid resistance and texture depth; it is a friction treatment in itself. An asphalt surfacing might have reasonable skid resistance, but is inherently smoother and does not provide enough macrotexture which is the main thing governing wet weather skid resistance above 80 kph. So asphalt surfaces need a friction treatment. An overlay of open graded asphalt (sometimes called popcorn mix) was historically used as a friction treatment, but the economics of grooving have proved more attractive in Australia since the 1980s. Cross-tabulating these by runway length gives an overview of the numbers of each type of friction treatment in use, in the figure below. The runways listed as having “nil” friction treatment in the figure below are either ungrooved dense-graded asphalt (usually on military airports) or grass or unsurfaced gravel.

RWY length group * FRICTION Crosstabulation

Count

		FRICTION				
		Grooved	Porous asphalt	Seal	Nil	Total
RWY length group	<= 1000m			2	3	5
	1001-1500m			5	2	7
	1501-2000m	5		8	7	20
	2001-2500m	6	2	3	3	14
	2501-3000m	3			1	4
	3001-3500m	4			4	8
	3501-4000m	3				3
Total		21	2	18	20	61

Aircraft type by surfacing

The heaviest aircraft type using the airport (at a frequency of more than 1/month) has been cross-tabulated by runway surfacing. Because of the diversity of aircraft, they have been grouped with similar aircraft to simplify the table, and only the main groups are reported in this paper. The groupings used were:

Aircraft group	Aircraft types
Widebody jet	Boeing 747, 747-400, 747-400F, Galaxy C5, MD-11
Narrowbody jet	Boeing 737-800, 737-400, Airbus A320
Regional	Saab 340, Dash 8, Brasilia
GA	General aviation, PC-9

Cross-tabulating these by surfacing gives an overview of the numbers of each type of runway surfacing in use by the different aircraft, in the figure below.

Surfacing	GA	Regional	Narrowbody jet	Widebody jet
Concrete ends/asphalt			1	5
Asphalt	2	2	8	8
Asphalt ends/seal		1	1	
Seal	7	7	2	
Unsealed	4			

As expected, the lighter aircraft operate on bitumen seals and the heavier aircraft on asphalt and asphalt/concrete runway ends. The midpoint is the Boeing 737 aircraft, which operates on both. The largest aircraft that can operate on bituminous seals is the Boeing 767/DC-10 size, but this requires certain techniques in design and operation (discussed more fully in Emery and Caplehorn, 1993).

Asphalt groove closure problems

The survey found groove closure problems in the asphalt at some airports surveyed (Table 5). Groove closure appears to be directly related to slow moving (and heavy) aircraft. As soon as the aircraft speed increased, the groove closure stopped. Where a taxiway crossed the runway, and the geometry was such that slow taxying would occur, there was groove closure right across the runway as the aircraft taxied across and directly in the wheeltracks.

Table 5 Survey of groove related asphalt problems

Grooving problems	Asphalt binder			
	PMB (A10E)	C320	Multigrade	HiPar
Yes	3	6	1	2
No	1	6		

A team of airport engineers then inspected certain airports where problems had been identified with groove closure and unsatisfactory surfacing performance. The early stage of groove closure was evidently plastic flow of the asphalt into the grooves, and sometimes stone at the edge of grooves had rotated slightly. The inspection and discussions with other airport engineers found that groove closure typically occurs in the first 1-3 years of a new surfacing, but not after that (for new surfacings, grooving is routinely delayed some weeks to allow initial hardening). It is logically related to a property of the surfacing that changes with time, and that is probably aging and hardening of the bitumen. This in turn is related to bitumen viscosity. It also found that groove closure occurred in the warmer months, and that must be related to a property of the surfacing that changes with temperature. Logically that is stiffness of the binder and asphalt, and again viscosity of the binder.

The mechanism of groove closure is thought to be viscous flow. Examination under the microscope of asphalt which had been pushed/flowed into the groove, shows binder still covering stones and suggests a problem with stiffness/cohesion rather than adhesion.

Given the pattern of occurrence, closure has to be related to a property of the surfacing that changes with aircraft speed (i.e. loading time). For bituminous surfacings, the stiffness modulus of the bitumen and the stiffness modulus of the asphalt are known to vary with loading time. Bitumen stiffness also depends on bitumen viscosity, which also varies with age. Since the airport mix specification has a moderate rut potential and is relying heavily on the viscosity of the mastic for its rut resistance, binder viscosity is a key issue.

Asphalt groove edge break

The inspections and survey also found groove breaking/crumbling in asphalt, which is not the same as groove closure. Asphalt at the edges of grooves breaks off. Groove breaking is probably caused by horizontal stresses from aircraft tyres allied to insufficient cohesion. Tyres, it seems, do not just exert their load downwards. Research by De Beer et al (1999) on tyre/pavement contact stresses has shown significant horizontal stresses due to the tyres. De Beer used the Vehicle-Road Surface Pressure Transducer Array (VRSPTA) system to measure contact stresses under moving loads, i.e. Stress-In-Motion (SIM). An aircraft tyre for a Boeing 747-100 was tested as part of the research (46 x 16, 30 ply rating at 1448 kPa inflation; loaded in testing to 20-50 kN).

The VRSPTA, at right angles to the direction of travel for the free-rolling smooth tyre, clearly indicated *inward shear* towards the tyre centre. From this it was postulated that the pavement surface is experiencing a tensile stress *outside* the tyre edge and a state of compression towards the tyre centre. Other horizontal stresses were found in the direction of travel. For the Boeing 747 tyre, the measured maximum contact stresses were:

- transverse contact stresses of 261 - 502 kPa
- longitudinal contact stresses of 137 - 279 kPa
- vertical contact stresses of 2057 - 2240 kPa

These horizontal stresses are significant but less than the typical tensile strength of many types of asphalt, although low tensile strength cannot be discounted for some asphalt. Along the edge of a groove where the asphalt is unsupported, the horizontal stresses might be sufficient to cause edge breaking of some asphalt and especially those made with A10E PMB binder.

Asphalt stone loss

The inspections and survey also found stone loss in some asphalt, which could be due to the same horizontal forces causing groove edge break (note that no sealed runways were inspected in this year's programme – such inspection would have shown many issues with stone loss from seals). Examination under the microscope of stones (5-10mm diameter) that had been freshly plucked from asphalt shows that they still have bitumen adhering to the stone. The asphalt was made with A10E SBS PMB and the failure/break appears to be in the binder. This suggests a problem with cohesion rather than adhesion.

The asphalt of another runway made with A10E was giving off "dust" or "grit" from the whole surface of the runway. This started shortly after construction and continues several years later. Runway sweeping currently picks up approximately 12kg of "dust" every two weeks. Examination of the dust under the microscope showed a mixture of binder coated and uncoated grains in the size range 0.3-1.5 mm.

Stone loss (and groove breakage) creates a significant foreign object damage (FOD) hazard. While part of the airport FOD risk management strategy is frequent inspection and sweeping, surfacings that generate FOD are unacceptable in an airport environment.

Jet blast erosion

There has been jet blast erosion of an asphalt runway surfacing (made with A10E) at one airport. Jet blast erosion occurs in a wide swath underneath each of the engines, which includes areas both inside and outside the wheeltracks. The pattern of erosion indicates that it is four-engine aircraft causing most of it, and logically this is the Boeing 747 aircraft. The mechanism for this blast erosion is uncertain but might be related to cohesion of the asphalt at this airport.

Soft binder

At one airport, the asphalt runway surfacing (made with A10E) was reportedly unusually soft in hot weather (summer), and capable of being penetrated to over 25mm depth by a screwdriver pushed in by the groundsman. By contrast in cool weather it was hard. This is unusual behaviour. The use of a screwdriver like this is not a standard test, however it is not dissimilar to the common ball penetration test for sealed surfacing design. Typical ball penetration test values in dense graded asphalt would be 1-3mm, and it is a concern that the screwdriver penetrations were much higher. The groundsman monitored the penetration over time in an informal process. The screwdriver penetration remained very high in hot weather, although is decreasing some 3 years after construction. The full length of the runway was affected. Despite this softness, no rutting of the asphalt was observed or reported which meant that the softness has not led to the mix deforming. The penetration is related to the temperature of the surfacing (Figure 1). The slight lag between penetration and surfacing temperature is probably the result of temperature gradients within the asphalt layer.

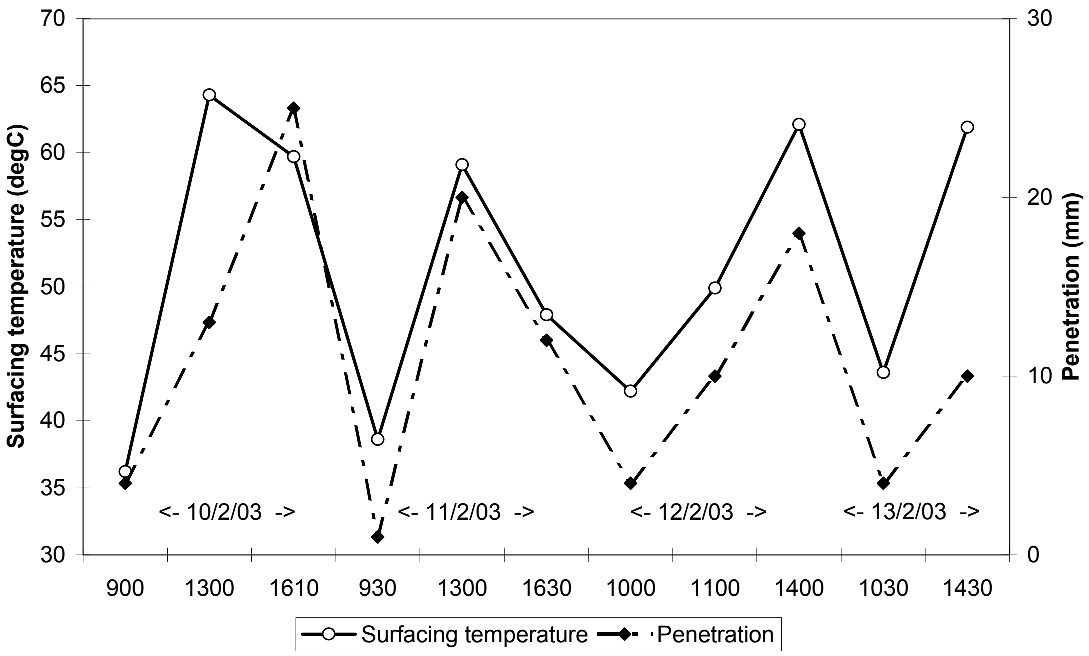

Figure 1 Airport M : screwdriver penetration vs surfacing temperature (Feb 03)

Coring programme

A coring programme was undertaken by AAA TWG in 2005 to determine the extent of the “stripping” problem in asphalt around Australian airports and the potential relationship to binders and traffic. Cores were taken from a number of asphalt pavements of different ages, different binder types, and different trafficking. The programme is close to completion, but the early results are clear that stripping is widespread.

Bitumen stripping occurs when the bitumen loses its adhesion to aggregates in the asphalt mix. Stripping usually occurs with the presence of moisture in the asphalt layer and is worsened when traffic loading causes high pore pressures within the asphalt surfacing. Under saturated conditions, all asphalt mixes may fail as a consequence of cyclical hydraulic stress physically scouring the asphalt binder from the aggregate (Kandhal and Rickards, 2001). This mechanism undoubtedly explains the stripping in some airport pavements.

However there is stripping on airports in areas where there is no traffic, although it is more severe in the wheeltracks (Table 6). In some cases, the water table is not near the surface. There are probably mechanisms present other than physical scouring, and investigations continue.

Table 6 Core stripping results

Stripping of coarse aggregate	Binder type		
	C320	Multigrade	A10E PMB
Minimal	8%	25%	4%
Moderate	70%	40%	93%
Serious	22%	35%	4%
Total number of cores	54	20	28

Stripping of coarse aggregate	Location	
	In wheeltracks	Outside wheeltracks
Minimal	9%	11%
Moderate	66%	85%
Serious	25%	4%

Note 1: Stripping was by RTA assessment.
Note 2: The same trend was evident for stripping of fine aggregate

Programme for testing of binder during construction

The AAA TWG established a programme for direct testing of binder by the airport during construction on selected projects in 2004/2005. This is in addition to the usual quality control procedures of the bitumen industry. The survey and inspection had found bitumen quality during construction to be a problem on some airports. There were problems with contamination of binder used for asphalt (this phrase is used here to include the wrong grade or wrong binder being supplied). Preliminary bitumen audit protocols were set out for airports to sample bitumen during construction. The programme has been applied to several projects, covering C320, multigrade, and A10E binders. The early results are supportive of the value of this testing. Figure 2 shows the results of viscosity testing, where one sample (which would correspond to approximately $70,000 of asphalt) was well below specification.

This programme is expected to lead to a recommended set of direct sampling and testing practices for airports undertaking bituminous surfacing works.

New airport binder

The problems with binders found during the survey and inspection led the AAA TWG to consider the development of an improved airport binder(s) with properties relevant to airports. The engineering properties for bituminous binders for airport asphalt were derived from discussions within the AAA Technical Working Group and a review of engineering fundamentals. The airport environment is characterised by:

- Much less traffic over the design period compared to highways,

- Generally stiff pavements,
- Some longer and slower loading times than highways,
- Higher tyre pressures (typically 2x highway) and wheel loads (typically 10x highway wheel loads),
- Night construction work requiring easy compaction of asphalt at the lower end of the temperature limits.

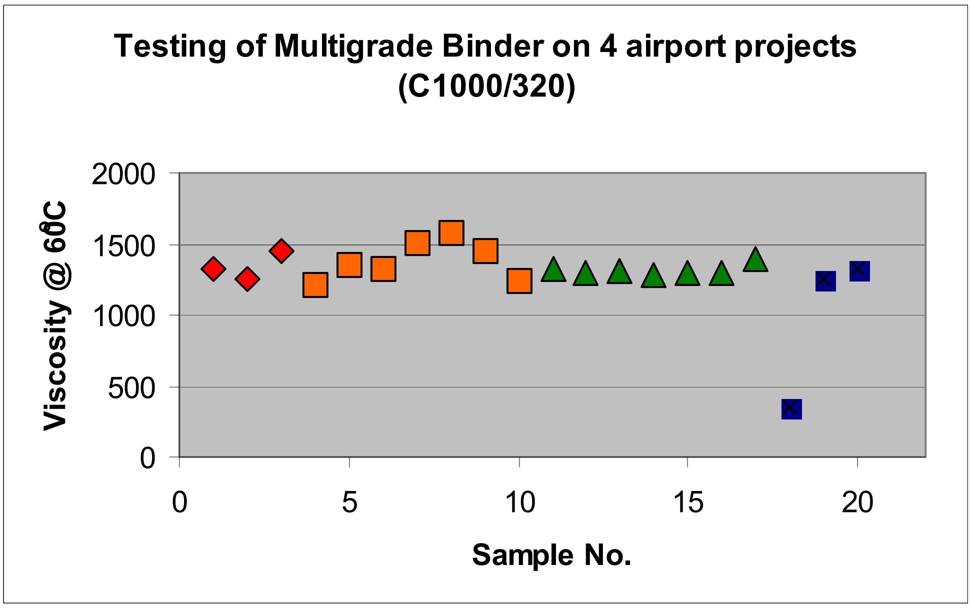

Figure 2 Binder testing programme - viscosity

Some of these attributes are found on roads as well, but it is the particular combination that characterises airports. The engineering properties sought for a new bituminous binder(s) for airport asphalt, relative to Class 320 bitumen, are the following:

- Good asphalt mixture stiffness at slow loading times and across the service temperature range
- Higher mixture resistance to viscous deformation
- Higher resistance to stripping
- Constructible
- Robust and reliable

These requirements apply to asphalt for trafficked areas. Other parts of the airport such as runway edges, shoulders and blast areas will have different requirements, eg. durability, oxidation of bitumen, erosion of surface.

The AAA TWG have embarked on a co-operative approach with industry to jointly develop a suitable solution. Expressions of interest were sought in mid-2005 from those existing modified binder manufacturers likely to be able to service all of Australia. Manufacturers were asked to submit one or more products, which could be products that are currently available and/or new products specially developed to meet the assessment criteria. The product could be a binder or an additive to the asphalt mix. A preliminary evaluation of these products has been completed, and a very short list will be selected for further investigation and airport trials. The submitted binders included elastomeric (6), elasto/plastomeric (2), multigrade/high viscosity (4), crumb rubber (1), and other (complex binders not classified elsewhere) (6).

This programme is being actively pursued, and is likely to lead to one or two 'airport' binders to add to the multigrade, C320 and C170 binders already in use. The next steps are:

- Completion of laboratory testing to characterise the binder(s),
- Asphalt mix designs using new binder(s),
- Australian wheeltracking and stripping tests, including comparative testing of multigrade, A10E and C320 binders,
- Accelerated loading trials using the MMLS under various conditions of saturation and temperature. Overseas, some airports are doing performance testing of mixes for major projects using this (Molenaar et al, 2004).
- Full-scale trial sections on airports.

FUTURE AAA TWG TRAINING PROGRAMME

The AAA binder research programme showed up a clear need of airports for training in the supervision of the construction of all types of surfacings. Training is needed to cover specification, design, construction, supervision and quality control. Various models are under consideration. While there are some surfacing courses already being run in Australia (such as the valuable ones run by Australian Asphalt Paving Association), the airport needs are for an expansion of the airport specifics, together with a greater hands-on content. It would particularly seek to capture the experience of the most senior airports engineers who are retiring over the next few years.

One model is a 'live-in' short course (5 days) to coincide with an airport construction project. It would offer classroom training in the day, and on the job training at night on the airport construction. Sleep would be optional. Such a course could still link with existing Training Centres, and would have useful commonality with training in road surfacing construction. A trial of this course is being considered for 2006.

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