

PERFORMANCE OF TECHNIQUES TO MINIMISE REFLECTION CRACKING AND
ASSOCIATED DEVELOPMENTS IN PAVEMENT INVESTIGATION FOR
MAINTENANCE OF UK MILITARY AIRFIELDS

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Abstract

Resurfacing with asphalt is one of the techniques used on jointed concrete runways and taxiways in the UK in order to increase their strength, improve their profile, reduce the cost of routine maintenance or reduce the risk of foreign object damage. The thickness of the asphalt layer is often greater than that required for structural purposes alone, in order to reduce the occurrence of reflection cracking above joints and cracks in the underlying concrete. Reflection cracking is also a concern when applying a new asphalt surface to an existing asphalt overlay that already contains reflection cracks.

Trials have been carried out at a number of military airfields in the UK to assess the performance of different anti-reflection cracking systems. TRL Limited on behalf of Defence Estates (DE, UK, Ministry of Defence) is studying reinforcement grids, modified binders, alternative asphalt inlay materials and crack and seat techniques. The performances of test sections have been compared to control areas constructed with conventional Marshall asphalt overlay. Furthermore associated research has been on-going to establish how to apply the most appropriate maintenance technique once reflection cracking has occurred. This largely relates to making the correct diagnosis and as such investigation techniques have developed using detailed visual condition surveys, core sampling and most recently, application of Ground Penetrating Radar (GPR). Through these techniques, crack progression is quantified by length, depth and width of cracking, the depth of the pavement layers is established including the presence of steel reinforcement, and underlying slab sizes are detected where they are previously unknown. As a result of this research improved maintenance planning and pavement investigation is leading to improved assessment of maintenance requirements and more cost effective maintenance solutions.

This paper briefly outlines the trials of anti-reflection cracking treatments, details their performance over time, and discusses developments in pavement investigation techniques to assess the occurrence of reflection cracking and the selection of the most appropriate maintenance solution.

1 Introduction

For many years, jointed unreinforced pavement quality concrete (PQC) has been used to construct airfield runways and taxiways at RAF airbases. For UK military airfield construction, the standard practice has been single-slab construction with no load transfer dowel bars. Twin slab construction, where the joints of the top layer were offset to those of the bottom layer and a separation membrane was normally included between the two layers, was sometimes specified during the 1950s for use at airfields where heavy aircraft operated.

In areas where jet blast and fuel spillage are not a major consideration, asphalt overlays provide an economic means of restoring or improving pavement life. However, after a few years in service, reflection cracks generally start to occur in the surface of the asphalt overlay above the joints between the concrete paving slabs. This is due to the thermal movements in the underlying concrete. Reflection cracks also occur in the surface of the composite construction frequently

used on taxiways whereby a rolled concrete base layer supports asphalt surfacing. Nunn (1) has described crack initiation as occurring at the surface of the asphalt and propagating downwards to the joint or crack in a concrete layer at depth.

In the early stages of development, reflection cracks may barely be visible and are not considered to be a structural problem. However, when they propagate through the pavement, infiltration of water can weaken the foundation and fine material may be pumped to the surface, resulting in the creation of voids beneath the concrete. Traffic loading exacerbates the situation but of greater concern on airfields is the likelihood of spalling at the cracks and the potential for FOD (foreign object damage) to aircraft.

In order to inhibit the occurrence of reflection cracking, a greater thickness of asphalt overlay is often applied than is required for structural strengthening. Although this provides an added benefit of better thermal insulation to the concrete, which helps to reduce thermal movements, it increases the cost. Since 1989, trials have been conducted on runways and taxiways at six military airfields in the UK in order to assess alternative techniques for inhibiting reflection cracking in asphalt overlays on the jointed concrete pavements and these trials are described in the following sections of this paper.

Furthermore, soon after initiating research into techniques to minimise the occurrence of reflection cracking, it was identified that there is a need for detailed guidance on how to treat reflection cracking once it has occurred. It was soon apparent that construction records were not as accurate as desired and therefore there is a tendency to misdiagnose, over or underestimate the scale of the problem. TRL have therefore been developing a new maintenance planning procedure that considers appropriate site investigation and selection of treatment, once a potential reflection cracking problem has been identified. Details of this aspect of the research are also summarised in the sections below including suitable site investigation techniques and planning procedures.

2 Trials of anti-reflection cracking treatments

2.1 General

The conventional overlay material used at UK military airfields is Marshall Asphalt (MA) with or without a Friction Course (FC) surface layer and these are the materials that have been used in most of the trials. A brief description of the anti-reflection cracking methods and the materials used in the trials is given below. The types of anti-reflection cracking treatments being assessed are:

- geogrid reinforcement
- stress absorbing membrane interlayers (SAMIs)
- modified asphalt overlay
- alternative asphalt overlay materials
- crack and seat treatment to the concrete
- asphalt inlay over concrete joints

Details of all the trials are summarized in Table 1.

2.2 Geogrid reinforcement.

Reinforcing grids are designed to enhance the tensile strength of an asphalt overlay by absorbing the horizontal tensile stresses above the concrete joints and distributing them over a wider area. As a result, the stress concentrations in the asphalt above the joints, caused when the concrete contracts with reduction in temperature, should be reduced by the presence of the geogrid and hence this should reduce the initiation of reflection cracking.

Three different geogrids have been used in these trials: HaTelit 40/17 which is a polyester grid of 40mm square mesh size, Glasgrid 8501 which is a fibreglass grid with 12.5mm square grid size and Bitufor™ system that incorporates Mesh Track MT1, a galvanised hexagonal steel mesh with dimensions 80mm by 118mm and a series of transverse reinforcing strands, which is bonded to the underlying surface with a specified slurry surfacing.

The recommended installation procedures for the different types of geogrid used in the trials differ in detail. In the Bitufor™ system, the Mesh Track can be placed directly on the concrete or on an asphalt regulating course. The installation methods for both HaTelit and Glasgrid recommend that they are placed between two asphalt layers so that when an overlay is being applied to the concrete slabs an asphalt regulating or base layer is required. The HaTelit is bonded to the asphalt using a specially sprayed adhesive or bitumen emulsion and the Glasgrid is self adhesive. The Glasgrid manufacturer states that, if the asphalt has been milled, it is imperative that a new asphalt regulating layer is used.

Table 1
Design and construction details of anti-reflection cracking trials on UK military airfields

Airfield/ /Construction Date	Section	Treatment	Overlay Material	Overlay Thickness (mm)	Existing Construction	
Finningley March 1989	T1	Fibrescreed	MA+FC	120	2-layer JCP on shale Slab size: 3mx3m	
	T2	FC layer	MA+FC	140		
	T2/3	MA control	MA+FC	120		
	T3	T3	DBM layer	MA+FC	120	HRA on lean concrete
		T4	SBS MA	SBS MA	40	
		T4/5	MA control	MA	40	
		T5	Fibrescreed	MA	40	
Northolt Aug. 1993	S1	Glasgrid	MA	100	HRA on JCP on hoggin	
	S2	Control	MA	100		
July 1997	S3	BituforTM	MA	70	JCP on unbound subbase	
	S4	Control	MA	70		
Brize Norton July 1994	T1	SBR MA	SBR MA	40	MA on rolled dry lean concrete	
	T2	EVA MA	EVA MA	40		
	T6	Control MA	MA	40		
Aug. 1994	T3	Glasgrid	MA	100	The grids were installed within the overlay	
	T4	HaTelit	MA	100		
	T6	Control	MA	100		
Marham Aug. 1995	S1	Asphalt	UL-M	23	Marshall asphalt on JCP	
	S2	inlay	Safepave	21		
	S3		Slurry	5		
Coningsby Sept. 1996	S1	Control	MA	150-210	2 layer JCP on unbound granular subbase Slab size 3mx3m	
	S2	C&S (1m)	MA	150-210		
	S3	C&S (0.5m)	MA	150-210		
	S4	C&S (0.75m)	MA	150-210		
Lyneham December 1996		C&S (2m, 1.5m, 1m, 0.75m)	none		JCP on lean concrete Slab size 6mx3m	
		C&S (1.2m)	MA	170		
Sept. 1997 (full rehabilitation contract)		C&S (1.2m)	MA	170	JCP on lean concrete or asphalt Slab size 6mx6m/6mx3m	

JCP - jointed unreinforced concrete pavement; FC - Friction Course; HRA - hot rolled asphalt, MA - Marshall asphalt, C&S - crack and seat, (crack spacing), SBR – styrene-butadiene-rubber, SBS - styrene-butadiene- styrene, EVA – ethyl-vinyl-acetate.

2.3 SAMI

Stress absorbing membrane interlayers (SAMIs) generally consist of a thick layer of binder which is often modified and spread with single size chippings which are rolled in. They provide a flexible layer which is able to deform horizontally without breaking, in order to allow large movements to take place in the vicinity of the cracks or joints. They also provide a waterproofing role to protect the pavement structure and foundation should the surface of the overlay crack. Some SAMIs are applied only to the cracks thus minimising the cost of materials and installation.

Fibrescreed RC 100, the SAMI used in the trial at RAF Finningley, is a polymer modified rubberised bituminous compound containing chopped fibres, selected granite aggregate and other fillers. It is applied hot, using a screed box to fill the voids in the cracks and joints and form the membrane in one operation.

2.4 Modified asphalt

The resistance of asphalt to cracking depends mainly on the binder content and its elastic characteristics although the coefficient of expansion of the aggregate also contributes to the performance. The binder content and its characteristics affect the asphalt's ability to absorb stresses generated at cracks and its self-healing properties as well as its resistance to ageing which causes the asphalt to become brittle with time. These properties are achieved by the use of a viscous binder and high binder content; one way of achieving this is by the use of polymer modified bitumens.

Admixing SBS (styrene-butadiene-styrene), EVA (ethylene-vinyl-acetate) or SBR (styrene-butadiene-rubber) to selected bitumens produce binders which are less temperature susceptible and which have higher viscosity at ambient temperature than unmodified bitumens.

Two test sections with modified Marshall asphalt wearing course were laid at RAF Brize Norton and one at RAF Finningley. At RAF Brize Norton, one section incorporated SBR and the other an EVA modifier. At RAF Finningley, an SBS modified Marshall asphalt wearing course was laid over a badly cracked flexible composite taxiway.

2.5 Alternative asphalt overlay materials

Where the asphalt overlay comprises several layers, the lower layer can be an asphalt mix which is more flexible than a conventional Marshall asphalt. This layer should therefore help to insulate the Marshall asphalt from the horizontal tensile stresses generated by thermal movements in the concrete below.

At RAF Finningley, two sections incorporated different asphalts in the lower layers. In one section, an additional layer of airfield Friction Course was laid under the Marshall asphalt and, in another, a dense bitumen macadam basecourse was substituted for the Marshall asphalt basecourse.

2.6 Crack and seat

The crack and seat technique produces shorter slabs while retaining satisfactory structural integrity by inducing fine, vertical, transverse cracks in the unreinforced concrete to reduce the effective length of the slab between the joints. As the size of the slabs is effectively reduced, the horizontal strains resulting from thermal movements are distributed more evenly over the pavement and are therefore less likely to cause reflection cracks in the asphalt overlay. Provided that the cracks induced in the concrete are fine, load transfer between the newly formed slabs should be good, due to aggregate interlock. After cracking, the concrete is firmly seated by a heavy pneumatic tyre roller in order to ensure that there are no voids under the concrete prior to overlaying.

Although a thinner asphalt overlay on a cracked and seated pavement might be sufficient to inhibit reflection cracking, the extra cracks created in the concrete will reduce its load-spreading ability and this must be taken into account in the structural design. Cracking of the concrete reduces the effective stiffness modulus of the concrete, depending on the degree of interlock at the cracks and on the induced crack spacing. Consequently, it is necessary to establish the balance between the crack spacing, the reduction in stiffness modulus, the overlay thickness and the occurrence of reflection cracks for typical designs of airfield pavements.

Two crack and seat trials have been conducted at RAF Coningsby and RAF Lyneham and major rehabilitation works have been carried out subsequently at RAF Lyneham.

2.7 Asphalt inlay over concrete joints

Asphalt inlays are an alternative strategy that has met with some success on highways where a previously already overlaid jointed concrete pavement has suffered reflection cracking and is about to be overlaid again. The cracks in the original overlay above joints in the underlying concrete are milled out to a width of about 300mm to 500mm and infilled with asphalt before applying a new surfacing. The new infill asphalt might act like a SAMI. This technique has been used at RAF Marham under proprietary thin surfacings and a conventional slurry surfacing.

3 Performance of treatments

The in-service performance of all the trials that have been constructed is summarised in Table 2.

Table 2
In-service performance of anti-reflection cracking trials on UK military airfields

Technique	Location	Performance
Crack and seat	RAF Coningsby	No reflection cracks in test or control sections after 6 years.
	RAF Lyneham	Taxiways, 4 years since maintenance, no reflection cracks to date.
Geogrid	RAF Northolt	Glasgrid installed below 100mm new Marshall asphalt basecourse and wearing course – needs to be laid on smooth surface, significant cracking after 7 years (20-30%). The length of transverse cracking per linear metre of taxiway is the same as the control.
	RAF Northolt	Mesh Track installed between concrete and 70mm Marshall asphalt overlay, severe cracking within 6 months, not recommended. A complete bay pattern above large slabs, fewer above 3m x 3m slabs.
	RAF Brize Norton	Glasgrid and HaTelit installed, after 7 years test sections showing fewer cracks than associated controls.
Geogrid	RAF Finningley	Fibrescreed on top of new basecourse performing not better than the associated control section, though there is no detailed information available to confirm that the Fibrescreed was correctly installed. Fibrescreed joint repair under the centre-line and SBS modified Marshall asphalt work – significantly less cracks than control.
	RAF Finningley	Friction course on Marshall asphalt on DBM basecourse – slightly delays cracking compared to control. Friction course prior to regulating gives significantly better results than the control.
Asphalt inlay over joints	RAF Marham	After 5 years cracking at trench edges: full with slurry seal and partial with the thin wearing courses.
Modified asphalt	RAF Brize Norton	Brize Norton – Marshall asphalt wearing course incorporating SBR and EVA modifier, after 7 years, modified asphalt same as control, with reflection cracks.

From the in-service performance monitoring the following recommendations have been derived:

1. Consider the use of porous friction course as the surfacing material on runways.

2. Use crack and seat.
3. Look at modified wearing courses in more detail.
4. Develop a threshold thickness of overlay in relation to concrete bay size.
5. Consider an appropriate method to design and evaluate a geogrid as a maintenance option.

No longer allow steel grids placed directly on concrete from future considerations as a anti-reflection cracking treatment unless manufacturers are able to provide conclusive, validated results to a) explain the shortcomings experienced at RAF Northolt, and b) illustrate their effectiveness as a maintenance treatment.

4 Site investigation and treatment of reflection cracking

4.1 Site investigation

Once reflection cracking has been identified as a problem to be solved, a detailed site investigation is required. As much data as possible should be obtained from a desktop study of construction and maintenance inspection records. The level of site investigation required will depend on the amount of information already available versus the need to fully understand the mechanism of the development of the reflection cracking.

The initial surface defect survey will have identified surface cracking as a potential maintenance problem. Unless already ascertained, a more detailed survey is required to establish the size (length), severity (width and shape) and location of the cracks. For a typical reflection cracking problem the location of the cracks will relate to the joints or cracks in the concrete slabs at depth and will assist with confirmation of the reflection cracking deterioration mode.

Through pavement investigations carried out on behalf of DE it has been found that there can be substantial discrepancies between construction history records and actual materials present, in particular the thickness of bituminous overlays. Therefore it is important to verify the pavement construction as one of the first steps towards understanding the reason for failure. This is ascertained by taking core samples through the entire bound pavement depth to confirm the thickness of the bituminous and cementitious layers. The crossfall of the pavement should also be considered as it may have been formed in the foundation, in the concrete layer or in the surfacing material, the latter having a large effect on the thickness of the overlay. In addition, it is not unusual for the crossfall to have been altered during a pavement rehabilitation contract and this information is unlikely to be available in the construction history record.

Core samples through the cracks should also be used to determine the crack depth and the reflection initiation mechanism i.e. joint in PQC slabs, crack in reinforced concrete, natural crack in dry lean base, joint between asphalt and PQC etcetera.

Laboratory testing of the bituminous materials to ascertain compositional and structural properties may be considered necessary if the surface cracking has occurred earlier in the material's life than would reasonably be expected. This being the case, there may be cause to investigate the contract that laid the surfacing material.

It may also be appropriate to consider the load transfer capabilities of joints and cracks and the Falling Weight Deflectometer (FWD) can be used for this purpose. The FWD can be used for two separate assessment methods, firstly, to consider the load transfer characteristics of the joints or cracks and secondly to estimate the strength of the pavement layers.

All the above techniques are quite conventional as too is the use of the Ground Penetrating Radar (GPR). However, substantial technological advances in the GPR in recent years has made it a very valuable tool when assessing reflection cracking problems. Therefore, a more detailed description of the GPR and its application, with evidence is provided in the next section.

4.2 Ground Penetrating Radar (GPR)

Radar is an echo sounding method where a combined transmitter/receiver is passed over the surface at a controlled speed. Short duration pulses of radio energy are transmitted into the pavement and reflections from material boundaries and embedded features, such as rebars or voids, are detected by the receiver. Sampling is so rapid that the collected data is effectively a continuous cross section, enabling rapid assessment of thickness and condition over large areas. By assessing the strength, phase and the scatter of signals it is often possible to find cracking and changes in compaction, bond and moisture content.

This method inevitably involves the collection of a large body of information - not all of which is of engineering significance. Analysis involves identifying the main elements of the structure under investigation and establishing the characteristics of its base condition. Variations in construction and condition can then be identified, enabling significant features to be mapped.

In order to provide a reliable definition of material type and to provide a definitive calibration of radio frequency velocity, core and trial pit information is usually required. The more core information that is made available, the greater the reliability that can be expected from the results of the radar investigation.

A precise match between processed radar thickness data and core logs from the same stretch of airfield pavement is not always achievable. Typically, the accuracy to which the thickness of bound materials can be measured is approximately double that of unbound or open textured materials. In these circumstances, the likely accuracy of thickness measurements is:

- +/- 8% for bound layers
- +/- 15% for unbound layers.

As a rule, variations in moisture content and void ratio are greater in the unbound materials compared to bound materials.

4.3 Survey procedure

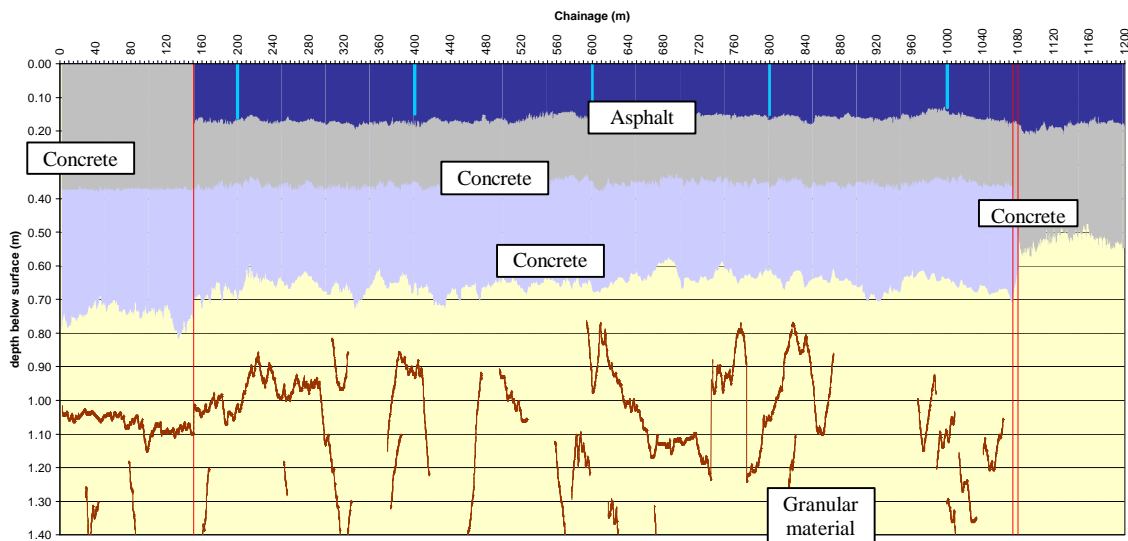
Surveys can be conducted between scheduled air traffic where necessary. The radar recording equipment. The transducers are suspended directly below the vehicle, and housed within a sled. This enables the transducers to be positioned directly on the pavement surface.

The Radar control system can be set to collect around 20 scans per metre i.e. one scan every 50mm so that small changes within the pavement can be resolved, giving greater confidence to the interpretation.

A survey wheel attached to the survey vehicle provides an independent distance measurement system linked to the radar equipment. This records the position of each individual radar scan relative to a fixed starting point. A longitudinal relocation accuracy of better than $\pm 2\%$ measured from the nearest fixed point can be expected.

An example of the construction types and thicknesses seen within the longitudinal survey along a centre line is shown in Figure 1. The extent of overlaid twin-slab construction can be clearly seen.

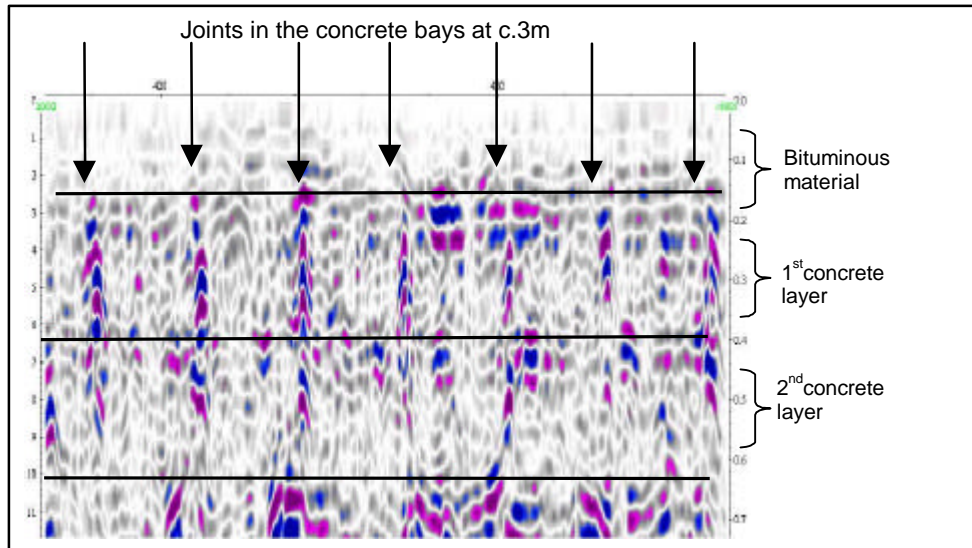
Figure 1
Cross-section of GPR dat interpretation along a runway centre-line



The radar data collected along the centre line of the runway clearly shows the boundaries associated with the reported construction types. The first radar profile was taken from the 1.5GHz transducer scanning two way travel time of 9ns (0.5m) and showed the asphalt thickness and base of the first of two concrete slabs. The asphalt layer is seen to be well controlled with little variation in depth over the surveyed area. Variation in response from the base of the asphalt may be associated with debonding of the asphalt from the underlying concrete. From information provided by cores, variations found in the data are the result of differing construction within and at the base of the asphalt layers and are not thought to be defective. The second profile was taken from the 900MHz transducer scanning a two way travel time of 19ns (1.2m). The full

construction of the runway can be clearly seen with a well-controlled layer of asphalt over twin-slab concrete. The base of the second slab appears to be variable between chainage 151m and 526m. This coincides with variations in the response from the sub-base materials. The joints between bays within the concrete slabs and the expansion joints are also clearly defined as shown in Figure 2. The joints are at regular 3m centres with usually twelve bays (36m) between expansion joints.

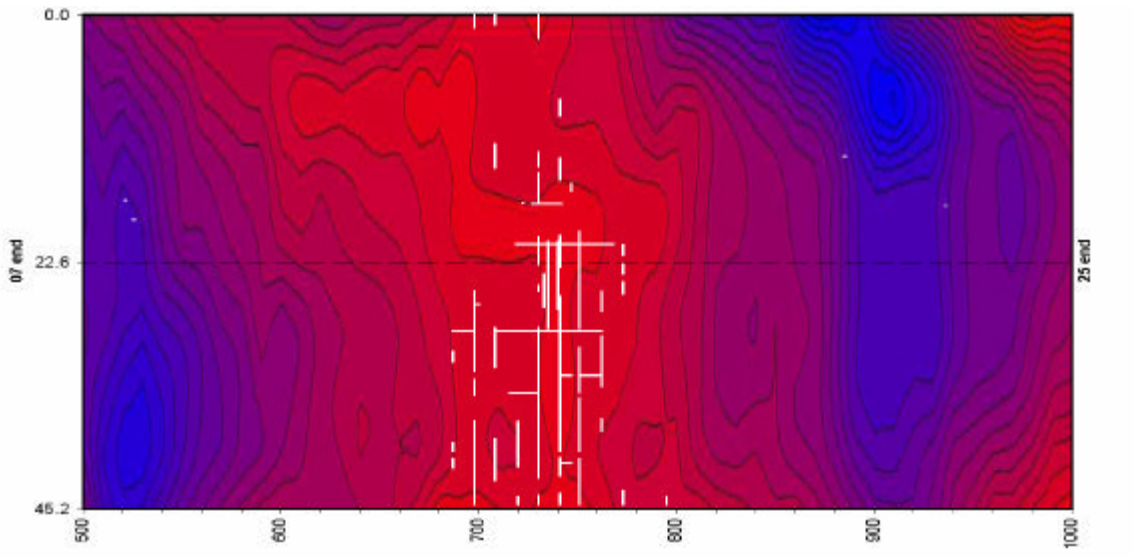
Figure 2
GPR to estimate PQC bay sizes



Particular benefits in relation to reflection cracking are clearly illustrated in Figure 3 where a visual survey of surface cracks is superimposed upon asphalt overlay thickness contour plot. The thinner areas of overlay shown in red at chainage 700-800m coincide with the observed surface crack pattern. The plot serves a two-fold purpose:

1. Illustrates the relationship between overlay thickness and occurrence of reflection cracking.
2. Identifies the variation in asphalt overlay thickness.

Figure 3
Reflection cracking visual survey superimposed on asphalt contour plot



When investigating surface cracking and establishing that reflection cracking has occurred it is important to establish the extent of the problem and the likelihood of progression based on concrete bay sizes and thickness of the overlay treatment. From Figure 2 it can be seen that treatment is only required in the critical areas of the thinner overlay thickness. This equates to large savings in asphalt quantities, and project maintenance duration.

4.4 Implications on maintenance planning procedures

The research carried out by TRL on the behalf of DE has identified that reflection cracking is a frequent problem at DE airfields that could be minimised in the future by appropriate treatment during maintenance operations. The need to consider reflection cracking when maintaining airfield pavements is essential. Historically, the phenomenon of reflection cracking was not clearly identified or understood. There was a frequent practice of applying a thin overlay and only recently has this practice changed as it is realised that a whole-life benefit can be achieved by more appropriate maintenance.

Nevertheless, the current construction of airfield pavements in the UK is such that the risk of future reflection cracking is high. Previously the routine monitoring that takes place at an airfield would not have necessarily identified the cause or the severity of the problem correctly for each individual situation. A detailed procedure is currently being prepared that will clearly state the steps required when investigating surface cracking problems on DE airfields.

4.5 Treatment of reflection cracking

Reflection cracking needs to be considered both when an original concrete pavement is to be overlaid and in the continuing maintenance of overlays where reflection cracking has already occurred. The important issues to be established once reflection cracking has been identified are:

1. Depth and extent of cracking – material properties.

2. Localised replacement plus full width (runway/taxiway) replacement.
3. Where the reflection cracking is full depth through the asphalt overlay it is recommended to consider removing the surface layer. This is then replaced with a new surfacing plus additional thickness of asphalt (perhaps including a geogrid reinforcement) otherwise the vertical discontinuity (i.e. the original reflection initiator plus the cracking already present in the existing overlay) as a percentage depth of the pavement structure will increase.
4. Where reflection cracking is just in the surfacing consider replacement of only that layer.
5. Stagger joints during partial reconstruction (as in haunch repair) to avoid deep vertical discontinuities
6. Test cores for binder hardness within the surface layer (viscosity) of surfacing compared to at depth - again highlighting the benefits of replace rather than overlay.
7. Has aircraft movement adjacent to the centreline encouraged healing or prevention of cracks?

Only by considering all these scenarios can the most appropriate option be selected. The techniques to consider when attempting to avoid the occurrence of reflection cracking when overlaying are outlined in section 3. In the UK the success of crack and seat trials on roads (Ellis et al, 2000) and on airfields has led to full-scale application of the technique on a major taxiway rehabilitation project. The technique does, however, require access to the concrete surface and may therefore not be appropriate to treat asphalt overlays where reflection cracking has already occurred.

4.6 Financial considerations

From the consideration of the technical aspects of maintenance treatments at airfields, it is important to consider the financial implications. In effect, both the unit costs for the maintenance treatments are important as well as the programme ramifications during airfield maintenance works.

5 Conclusions

Trials have been carried out successfully to evaluate a variety of treatments to inhibit reflection cracking in asphalt overlays over jointed concrete airfield pavements and in asphalt overlays over cracked flexible composite pavements.

The application of airfield Friction Course directly onto the jointed concrete pavement before overlaying with Marshall asphalt has reduced the occurrence of reflection cracking after nine years in service. Further benefit was obtained when a further porous Friction Course was applied on top.

A Stress Absorbing Membrane Interlayer applied to a cracked flexible composite pavement reduced the amount of reflection cracking by about 80 per cent and the severity of cracks compared to an equivalent control area after nine years in service.

An SBS modified Marshall asphalt wearing course overlay applied to a cracked flexible composite pavement reduced the amount of reflection cracking by about 80 per cent and the

severity of cracks compared to an equivalent conventional Marshall asphalt after nine years in service.

After 42 months in service reflection cracks, mirroring the crack pattern in the underlying surface had occurred in both SBR modified and EVA modified Marshall asphalt wearing courses.

The use of a fibreglass reinforcing grid demonstrated the importance of installing it on an asphalt regulating layer and not directly on a milled surface under an asphalt overlay.

After 7 years in service fewer reflection cracks had occurred in test sections incorporating a polyester grid or a fibreglass grid under 100mm of Marshall asphalt overlay, yet an associated control had extensively cracked.

The crack and seat technique has been applied successfully to jointed unreinforced concrete pavements with bay size between 3m x 3m and 6m x 6m.

Control sections have shown that smaller bay sizes (3m x 3m) give a significantly lower risk of reflection cracking when overlaid.

When investigating surface cracking and establishing that reflection cracking has occurred it is important to establish the extent of the problem and the likelihood of progression based on concrete bay sizes and thickness of the overlay treatment. Detailed visual inspection, core sampling and Ground Penetrating Radar are important techniques to be used to make the correct decisions and selection of treatment.

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