ASPHALT REINFORCEMENT WITH POLYESTER GRIDS: PRACTICAL EXPERIENCE IN ROADS & AIRFIELDS

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1 Introduction

This paper will demonstrate the service life of a pavement can be extended by incorporating polyester asphalt reinforcement technology in both roads and airfield applications. The paper will focus on laboratory results from Dynamic Fatigue and Post Installation Tensile tests, showing the key factors required for an effective asphalt reinforcement material (e.g. residual tensile strength after paving procedures, and bond-strength).

Furthermore, following 40 years' of practical experience with using polyester asphalt reinforcement, this paper will present the evaluation of long-term performance in the field, typical applications as well as limitations associated with the use of asphalt reinforcement in rehabilitation of deteriorated roads and pavements.

The findings presented will concluded that the extended service life of the pavement achieved by the use of this technology reduces both construction disruption to road traffic together with airfield operations and the associated maintenance costs to asset owners, in addition to making a positive contribution to the environment.

2 Methods

Dynamic Fatigue Tests
In order to determine the influence of the polyester asphalt reinforcement in reflective cracking applications in the traditional rehabilitation process of asphalt concrete overlay, dynamic fatigue tests were conducted on two asphalt concrete beams. The test setup consists of two beams represent the base layer and the overlay, resting on an elastic base. The base layers were pre-cracked with openings of 3mm, 6mm and 9mm, in order to simulate a cracked pavement in an asphalt overlay. The polyester asphalt reinforcement was placed directly over the pre-crack opening and between the two asphalt concrete beams. Both bending and shear modes were investigated under dynamic fatigue loading conditions.

Influence of Installation Damage on Asphalt Reinforcing Geosynthetics
In order to determine the influence of installation damage on asphalt reinforcing geosynthetics, a detailed research study was carried out by RWTH Aachen University to analyse and quantify the residual tensile strength after construction. Site tests were performed using two asphalt reinforcement products made from different raw materials (polyester and glass fibre). Each material was installed and subjected to typical construction loads experienced during an asphalt concrete overlay. Installation damage caused by way of truck loads, roller compaction loads and a combination both of truck and roller compaction loads were analysed.

Salgado Filho Airport, Porto Alegre, Brazil
In 2001 the access to an aircraft maintenance hangar used by aircraft such as the Boeing 777 had to be resurfaced after more than 40 years of service. The rehabilitation involved the placement of an asphalt corrector layer first over existing concrete slabs. In order to prevent the propagation of the expansion joints from the concrete slabs into the new overlay, a high modulus polyester asphalt reinforcement was installed over the corrector course, prior to the placement of a 50mm asphalt wearing course.

Rehabilitation of the Runway 06 at Perth Airport, Australia
In 2009, the extensively cracked Runway 06 Threshold at Perth Airport in Australia required resurfacing to restore its serviceability. Due to the severity and prevalence of the cracks in the existing pavement, rehabilitation by way of a thin asphalt overlay would not be expected to resist the propagation of these existing cracks, nor the propagation of expansion joints in the concrete slabs, into the new asphalt overlay. To effectively retard reflective cracking and extend the fatigue life of the rehabilitated pavement, a bitumen-coated high-modulus polyester (PET) asphalt reinforcement was used. The rehabilitation procedure involved texturing of the existing asphalt surface, construction of a 25mm asphalt layer, followed by the installation of the polyester asphalt reinforcement, and a 40mm asphalt overlay.

3 Findings and Argument

Dynamic Fatigue Test Results
Overall, the results demonstrate that the bitumen coated high modulus polyester asphalt reinforcement considerably delayed the reflective crack generated due to shear and bending stresses. Compared to the unreinforced material, the asphalt layer reinforced with the high modulus polyester asphalt grid was exposed to up to 6 times the number of dynamic loading cycles before the initial crack reached the surface in beams with a 3mm pre-crack. The crack pattern clearly shows that the polyester grid reinforcement interrupts and distributes the cracks caused by shear and bending stresses. Further the computer modelling provided additional understanding of the crack propagation mechanism observed in the laboratory experiments. The polyester asphalt reinforcement grid was able to absorbs part of the applied load, interrupting the propagation of the reflective crack.

Research into the Influence of Installation Damage on Asphalt Reinforcing Geosynthetics
The results showed, that the level of installation damage on asphalt reinforcement materials can vary depending upon the raw material used. The glass fibre grid showed a loss of tensile strength of up to 90% after loading from truck passes and roller compaction. In contrast the polyester asphalt reinforcing grid lost a maximum of 30% of its tensile strength after the same loading. It was concluded that glass fibre grids can be damaged significantly more compared to a polyester grid during the construction of an asphalt overlay.

Salgado Filho Airport, Porto Alegre, Brazil
Approximately 8 years after the rehabilitation, a detailed evaluation was undertaken, this involved crack activity measurement as well as the extraction and examination of core samples from both polyester asphalt reinforced and unreinforced sections of the rehabilitated pavement. The evaluation showed in comparison to the section rehabilitated using only the 50mm overlay without the polyester asphalt reinforcement, the crack propagation was interrupted at the polyester reinforcement level below the 50mm overlay due to the reduction in horizontal and vertical relative movements of the crack walls based on crack measurement and the extracted samples.

Rehabilitation of the Runway 06 at Perth Airport, Australia
In 2017, approximately 8 years after its rehabilitation, the runway pavement was found to be in an extremely good condition, without the propagation of the existing cracks and joints, well exceeding expectation and original 5 years design life.

4 Conclusions
The presented laboratory tests as well as case studies have shown that asphalt reinforcement grid made from high modulus polyester can be a highly effective solution against reflective cracking in asphalt overlays. Under laboratory conditions polyester based asphalt reinforcement was able to withstand a greater number of cycles compared to unreinforced asphalt concrete beams during dynamic fatigue testing. Polyester grid was also shown to retain a significantly higher residual tensile strength compared to glass fibre grid after a combination of truck passes and asphalt compaction loads were applied.

The long term case studies showed that the use of a polyester grid has significantly delayed the propagation of reflective cracking from expansion joints and cracks through the new asphalt overlay in both airfield pavements. However, before choosing the appropriate repair solution, it is important to understand the structural condition of the existing pavement and to treat any excessive vertical movements or weak subgrade. In the presented case studies, vertical and horizontal relative movements of existing concrete slabs were addressed by way of sub-base corrections prior. Based on the observed performance, it is possible to conclude that a high modulus polymer asphalt reinforcement is an effective treatment against reflective cracking in asphalt overlays, resulting in an extension of the service life of a rehabilitated asphalt and concrete pavements.

5 References

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