Asphalt Reinforcement Systems

Advantages of Fortifix steel-based Asphalt Reinforcement System

creative geosynthetic engineering

Technical Note

Introduction

Asphalt is the most commonly used material for road construction due to its relative affordability and ease of installation. The low tensile strength of asphalt means it can be easily damaged by a number of factors however; including settlement, fatigue, temperature fluctuations and vehicle loadings.

Reflective cracking is the most common failure mechanism, caused by the reflection of cracks from within the road base layer through to the surface (see Figure 1). Damage arising from reflective cracking results in potholes and broken surfaces that cause discomfort to road users, vehicle damage and increased maintenance costs for the operators of the paved area. Furthermore, cracks enable the penetration of water through the surface, leading to further deterioration of the overall road structure.

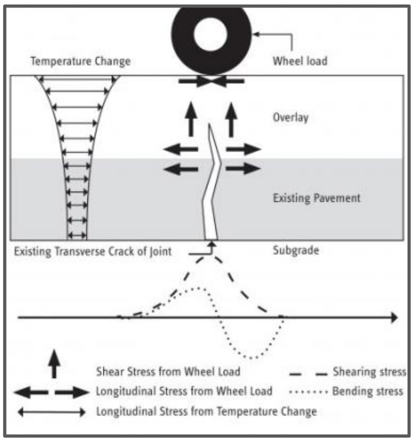

Fig. 1 - Mechanism of Reflective Cracking

Optimal asphalt reinforcement

To maximise overlay lifetime, anti-reflective cracking interlayers are widely used for the rehabilitation of damaged asphalt and concrete pavements, but not all materials provide equal reinforcement.

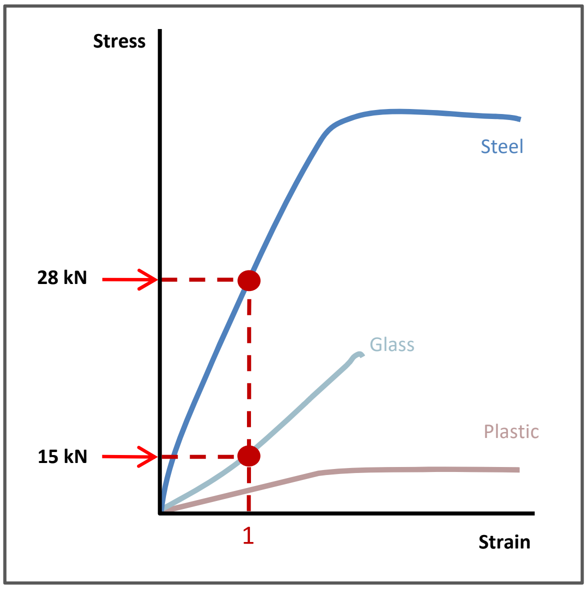

Fig. 2 - Stress strain curve of different reinforcement materials with similar cross sections

The most important criteria to deliver superior anti-cracking performance are "stiffness" EA (material cross section A * material modulus E) and the adhesion of the reinforcement interlayer within the pavement, including the existing surface and the overlay.

The high strength, low strain properties provided by the twisted steel-cord structure of Fortifix reinforces asphalt to achieve a long lasting, durable road surface.

Fortifix has a high Young's modulus of 190 GPa (a measure of stiffness that defines the relationship between stress / force per unit area and strain / proportional deformation, as shown in Figure 2) is 50 times greater than that of asphalt. It also offers a far more effective reinforcement solution compared to glass fibre grids that have a Young's Modulus of 70 GPa.

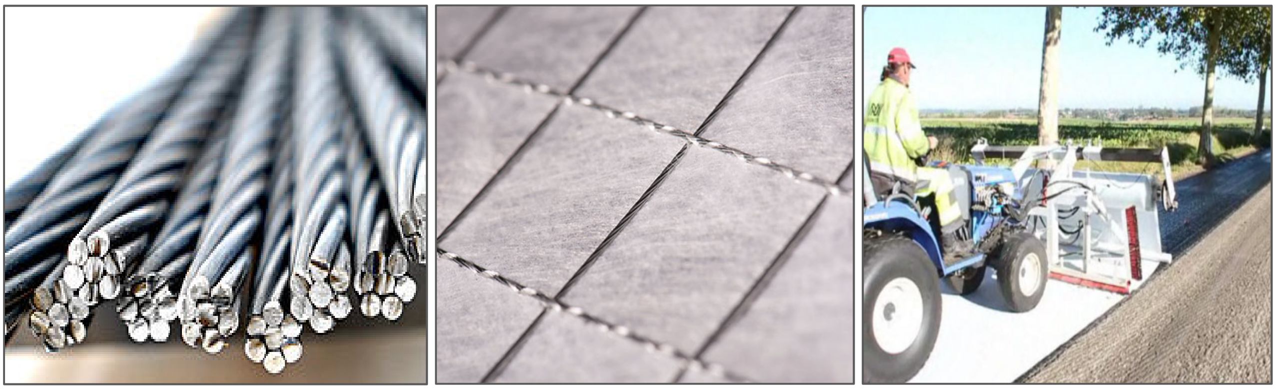

Fig. 3 - Fortifix is made using flexible, high strength twisted steel-cord that is stitched into position onto a non-woven geotextile. Application rates of between 5,000-10,000 sq m per day are typical using mechanical installation.

abg ltd. E7 Meltham Mills Rd, Meltham, West Yorkshire, HD9 4DS
UK t 01484 852096 **e** highways@abgltd.com **www.abgltd.com**

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Reflective Cracking Tests

The other most important performance measure for an anti-cracking interlayer is for the material to achieve excellent adhesion with the receiving surface and the overlay material. Bond strength is measured using Leutner shear tests and Fortifix meets bond strength requirements when applied on both planed and regulated surfaces. Thermal plate testing (as shown in Figure 4) is also used to simulate reflective crack formation and the performance of different interlayers under the effects of thermal expansion.

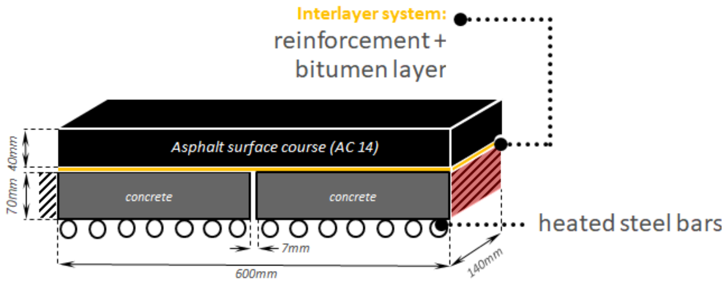

Fig. 4 - Thermal plate test setup with concrete/asphalt composite.

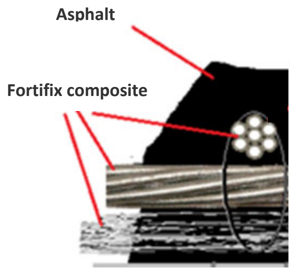

Fig. 5 - Fortifix steel-cord grid anchored into overlay to provide improved stiffness & bond

During the test, a notch in the road sample base is opened and closed by 1 mm at a very slow rate, controlled by the thermal expansion of the steel bars holding the sample. The crack propagation is recorded as a function of the number of expansion cycles and the total testing time (results shown in Figure 6). The testing demonstrates that the Fortifix steel-cord interlayer provided enhanced anchorage and reinforcement within the asphalt and concrete build-up. The outer surface area of the twisted steel-cords embeds into the overlay to provide active reinforcement (as shown in Figure 5), whilst the smaller aperture grids only adhere to the asphalt via the coating, and therefore do not achieve the same composite bond strength and delaminate more easily. In addition, the larger Fortifix grid opening size of 40mm x 30mm facilitates increased contact and absorption of the bond coat through the geotextile carrier.

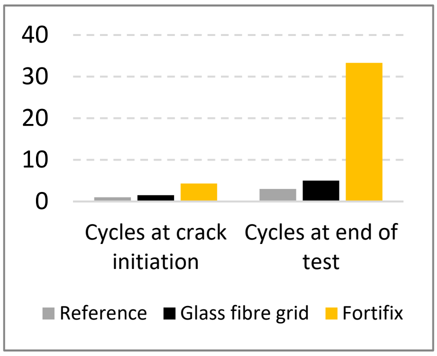

Fig. 6 - Maximum load and number of cycles to crack initiation and at the end of the test. Averaged results of the different anti-cracking systems expressed in number of cycles.

	Cycles at crack initiation	Cycles at end of test	Remarks
Reference	1	3	Crack
Glass fibre grid	2	5	Crack & delamination
	1	5	Crack
	1.5	**5.0**	**Average value**
Fortifix	2	30	Crack
	1	20	Crack
	10	50	Crack initiation
	4.3	**33.3**	**Average value**

Summary

Fortifix provides a light-weight and easy to install interlayer. Although there is an increase in the initial road construction cost as a result of installing Fortifix, the expected surface life is increased three fold (from 5 to 15 years) and the cost of the installation over the lifetime of the road is approximately half that of an unreinforced overlay when this extended maintenance interval is taken into account (see Figure 7).

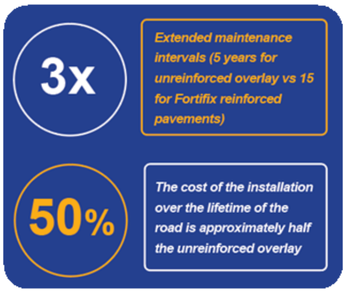

Fig. 7 - Extended asphalt overlay maintenance intervals & cost life savings

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