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Evaluation of anti-reflective cracking systems using geosynthetics in the interlayer zone

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ABSTRACT

The purpose of this study is to evaluate the durability of anti-reflective cracking systems that have a geosynthetic, geotextile or SAMI layer in the interlayer zone. For this purpose, a dynamic test has been designed that simulates the passing of traffic loads on the road surface. Stresses are applied to a two-layer test piece, which represents the pavement structure, with an anti-crack reflection system between the lower part, which is to be reinforced, and the upper part, which is the new pavement. In the lower layer, a longitudinal groove has been made that simulates an initial crack. All interlayer systems delay crack reflection. The test procedure is sensitive to the kind of interlayer system and helps to determine the optimal dosage of tack coat. Moreover, it has been verified that geogrids show higher resistance to repeated loading cycles, and geogrids with a higher stiffness modulus show better behaviour.

1. Introduction

One of the main problems that administrations in charge of road maintenance and rehabilitation face is overlaying cracked asphalt pavements.

Cracks appearing on the new asphalt surface placed over a cracked pavement correspond to an upward extension of the cracks in the lower layer. The main causes of cracking are: fatigue, shrinkage, consolidation processes, construction joints and age.

Nunn (1989) pointed out the three mechanisms that start this reflection: fatigue due to thermal action (which produces expansion and contraction movements in the old layer), fatigue due to thermal shrinkage (because of the thermal gradient variations throughout the pavement) and fatigue caused by the action of traffic. However, De Bondt (1999) states that there are other reflective cracking catalysts due to differential consolidation and/or ground contraction.

Kim and Buttlar (2002) stated that in the reflective cracking process, traffic loads help to spread cracks. Loads produce high tension and deformation levels in the new layer, just above the existing crack in the pavement below. This discontinuity reduces the bending strength of the rehabilitated section and creates an area of stress concentration. When these stresses exceed the new pavement's fracture resistance, the crack appears and spreads.

As the loads increase, the magnitude of movement also becomes greater, increasing crack growth, which is reflected quickly in the pavement surface (Cleveland et al., 2002).

Three cracking mechanisms can contribute to the fracture: mechanism I or tensile mechanism, in which the stress is perpendicular to the plane of the crack; mechanism II or shear mechanism, in which the stress is parallel to the crack plane and perpendicular to its front; and mechanism III or torsion mechanism, in which the stress is parallel to the crack plane and to the front plane, applied to longitudinal cracks. Traffic loads produce a combined effect between the displacement mechanisms, I and II (Lytton, 1989). This is because when a vehicle wheel comes close to the surface, a vertical pavement displacement is started before reaching the crack (mechanism II). Later, there is a horizontal displacement at the moment the wheel is on the crack borders (mechanism I), and a new vertical displacement when the load passes the crack (mechanism II). Mechanism III appears, as Colombier (1997) states, when a vehicle passes just beside an existing longitudinal crack.

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