Incorporation of GPR data into characterization of the bitumen filled cracks in pavements: Lab and numerical study

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Road pavements are subject to a range of problems due to traffic and temperature variations producing cracks that propagate to the pavement surface. Cracks need to be assessed to avoid deterioration and provide confidence in the functioning of the road system. Cracks are usually maintained after visual inspection by filling with bitumen as a first rehabilitation technique to avoid further deterioration and absorbing water leakages. Although this temporary solution does not extend the pavement life cycle it can help to avoid additional problems occurring within the pavement. This work is proposed to aid the development of understanding and characterization of cracks filled with bitumen in both rigid and asphalt pavements.

This study reports on the results of several laboratory experiments that were performed to explore the capability of Ground Penetrating Radar (GPR) in the assessment of bitumen-filled cracks in both rigid and asphalt pavements, respectively. These tests were focused on the analysis of cracking filled with bitumen using a GPR system equipped with a ground-coupled antenna with a 2.3 GHz central frequency, and varying the antenna orientation with respect to the crack axis.

Results showed the variation in characterization and changes in amplitude that could be expected
when analysing bitumen-filled cracks in concrete and asphalt specimens, dependent upon the antenna orientation being used; GPR B-scans were compared to images from computational models using a Finite-Difference Time-Domain (FDTD) method-based software package (gprMax2D). Additionally, a field survey carried out provided images consistent with the comparable conditions of the lab tests. The results of this work proved the capability of the GPR method to detect and characterize cracks filled with bitumen in pavements across a range of crack dimensions and pavement types.

Keywords
GPR, NDT, Rigid pavements, Asphalt Pavements, Cracks, Computational models, Target orientation,
Pavement assessment