NARC RESEARCH STUDENSHIP # 4

CAMBRIDGE UNIVERSITY
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Title: ***Fracture Mechanics of Asphalt Mixes***

Description:

Cracking in flexible asphalt pavements is the source of loss of bending stiffness which ultimately causes surface deformation and degradation. Repeated thermal and traffic loads are the principal sources of pavement stress, which contribute to crack formation and crack growth. A significant obstacle to improving the durability of asphaltic materials used in roads and predicting road lives accurately is the current lack of fundamental understanding of the micromechanics of crack initiation and growth in asphalts. Hence, the principal focus of the research is to develop a fundamental understanding of the fracture behaviour of asphalt mixes.

The study of fracture behaviour of bitumen and idealised asphalt mixes under monotonic loading is a helpful first step is to understand the fatigue cracking of asphalt mixes. Once the monotonic response has been characterised, understanding the cyclic (fatigue) behaviour of realistic mixes becomes more tractable.

Objectives:

The overall objective of this project is to investigate the micromechanical processes that lead to fracture of bitumen and asphalt mixes.

- The first step in this study is to conduct systematic 3-point bend tests on bitumen and idealised asphalt mix specimens in order to develop fracture mechanism maps classifying the brittle, ductile and transition response of the materials as a function of load rate and temperature.
- The next step in this research work is to develop micromechanical models and Finite Element models of the cracking process in the 3-point bend specimens.

This project is heavily based on previous research into constitutive modelling of bitumen and asphalts in the CUED and extensive literature review in this topic will be conducted. Analysis of experimental data of 3-point bend tests will be carried out in terms of the stress intensity factor, K_{IC}, fracture energy, G_{IC}, and J-integral, J_{IC}. Experimental work will involve conducting crack length measurements as a function of time, enabling the C^*-Integral to be evaluated. The aim is to identify the most suitable metric of fracture performance of asphalt. Fracture characterization parameters obtained from this experimental program will be compared to other test data reported in the literature and in previous research in the CUED.