INTRODUCTION

Cyclic thermal and traffic loads are the principal sources of pavement stress which contribute to crack formation and crack growth. In order to improve the serviceability and design methods of pavements, the nature of the process of crack initiation and growth must be better understood.

RESEARCH GOAL

Investigate the fracture processes in pure bitumen and idealised asphalt mixes during monotonic loading over a range of temperatures and loading rates.

METHODOLOGY FOR FRACTURE CHARACTERIZATION

1. 3-Point bend test [SE(B)].
3. Fracture mechanism maps.
4. Crack length analysis.
5. Fracture and Failure Finite Element Modelling.

EXPERIMENTAL SET-UP

Three-point bend fixture and digital image data acquisition system

EXPERIMENTAL RESULTS

J. Harvey and D. Cebon (2003)

Temperature compensated strain rate:

\[ \dot{\epsilon} = \dot{\epsilon}_0 \exp \left( \frac{Q}{RT} \left( \frac{1}{T_0} - \frac{1}{T} \right) \right) \]

DCB Specimen

Force

Adhered

Adhesive: Bitumen Film

CONCLUSIONS

A wide range of crack behaviour was observed including brittle, ductile, transition and crack arrest. These regimes can be seen clearly on the failure mechanism maps.

Crack length has been measured as a function of time. Ongoing work will evaluate the C*-integral parameter to determine the best fracture modelling approach.

ON-GOING WORK

FE Modelling with Cohesive Elements

O. Portillo and Prof. D. Cebon (2008)

Temperature-compensated crack mouth opening strain rate:

\[ \dot{E}_y = \frac{\Delta}{\Delta_0} \exp \left[ -\frac{Q}{R} \left( \frac{1}{T_0} - \frac{1}{T} \right) \right] \]

Bitumen / Asphalt Mix

Mechanism map for asphalt mix

Crack length vs. Time plot for an asphalt mix. The sample was tested at a temperature of -20 °C and displacement rate of 0.05 mm/s.