

3D FINITE ELEMENT MODEL FOR ASPHALT CONCRETE RESPONSE SIMULATION

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ABSTRACT

An extensive experimental, analytical and numerical investigation on the response of asphalt concrete is currently in progress at Delft University of Technology. The objectives of this Asphalt Concrete Response (ACRe) project are: (a) the formulation and finite element implementation of a 3-dimensional, strain rate sensitive, temperature and loading history dependent constitutive model, (b) the development of the necessary experimental set-ups, testing procedures and data-analysis methods for determination of the model parameters.

These objectives are strongly interrelated: on the one hand the model dictates what should be measured in a test, while on the other hand, the response observed in the tests sets the requirements for the model. As a result, model development/verification and experimental testing have been progressing in parallel throughout the project. In this contribution both, the finite element and the experimental aspects of the project will be presented.

The constitutive model has been implemented in the finite element system INSAP. The system has been used to simulate the initiation and propagation of damage in two flexible pavement structures due to repeated loading. The simulations illustrate the influence of geometry and material characteristics on the development of damage.

Key words: 3D, material model, response simulation, material parameter determination

1 INTRODUCTION

Most of the design procedures that are used in road engineering are based on linear elastic multi-layer analysis and simple laboratory tests. Unfortunately, design life and material degradation, which are essential issues in estimating the life time of a pavement, can not be addressed by linear elasticity. In the damage accumulation process the complex nature of asphalt concrete is essential and accurate performance predictions are possible only when that nature is modelled. This means that, besides the temperature and strain rate dependency, the state of stress dependency of the material response must be also taken into account. So far, this is often neglected although it is well known that the strength of asphalt concrete increases with increasing confinement. When it comes to failure predictions, this aspect of the material behaviour can no longer be neglected. The multitude of states of stress caused by a wheel load results in a multitude of different material strengths. As a result, the damage accumulation process is highly complex, since it depends not only on the material characteristics but also on the state of stress.

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