8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

CONTINUUM MICROMECHANICS BASED UPSCALING OF VISCOELASTIC PROPERTIES OF BITUMINOUS MIXTURES

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Key Words: *Bitumen, Asphalt, Pavement, Viscoelasticity, Multiscale Model, Upscaling, Identification, Validation, FEM.*

ABSTRACT

The macroscopic behaviour of bituminous mixtures is defined by the underlying material phases, namely aggregates, air, and bitumen. In order to assess and finally optimize the performance of bituminous materials a multiscale framework of material description is proposed, allowing to explain the asphalt behavior at the so-called structural scale (*macro*scale) by means of finer-scale characteristics such as material composition and behavior of the constituents (see Figure 1) [1].

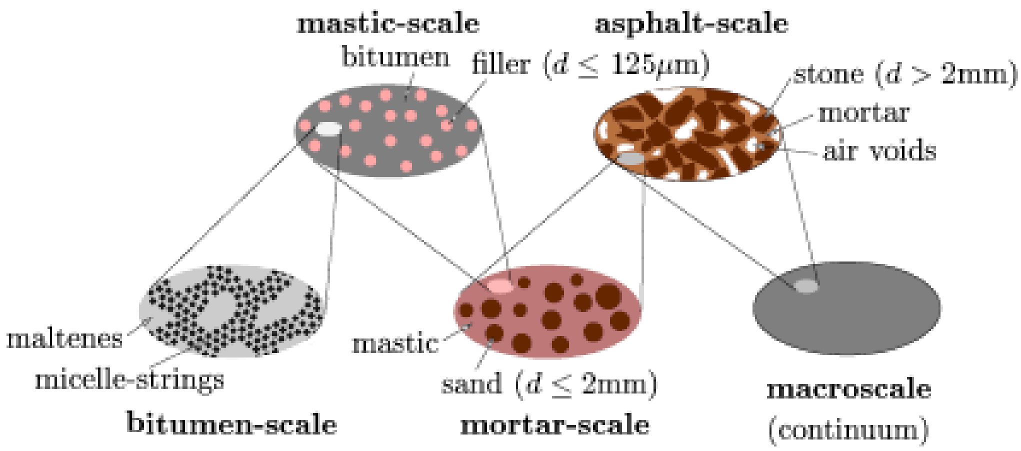

Figure 1: Multiscale model for asphalt according to [1]

As regards viscoelastic properties of bituminous mixtures, averaging schemes are used to obtain the macroscopic properties of the composite material. Hereby, the experimentally-obtained properties of the constituents at finer scales serve as input for so-called upscaling schemes. In our case, the parameters of the underlying viscoelastic model are obtained from transferring the respective parameters identified from the bitumen-scale towards the macroscale; the viscoelastic behavior of bitumen serves as input and the effect of addition of aggregates (filler, sand, stone, air,...) is investigated.

Upscaling of viscoelastic properties is performed in the framework of continuum micromechanics, employing the Mori-Tanaka scheme accounting for the matrix-inclusion morphology present in bituminous mixtures [3,2]. The proposed multiscale model provides access to the macroscopic viscoelastic properties of asphalt as a function of the asphalt mix design, used for the low-temperature assessment of flexible pavements (see Figure 2).

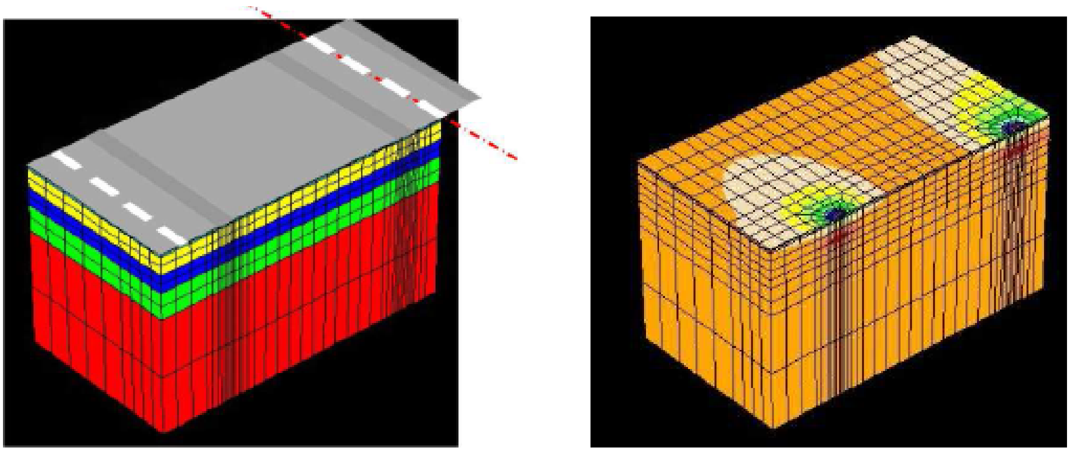

Figure 2: Numerical model for the assessment of flexible pavements and normal stress perpendicular to road axis

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