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Multi-Scale Model for Low-Temperature Creep of Asphalt

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The increase of service time of flexible pavements requires to optimization of the complex thermo-rheological behavior of asphalt, consisting of bitumen, aggregate, and air voids. Basically, three different modes of optimization are distinguished: (i) variation of mixture characteristics, (ii) change of constituents used, and (iii) allowance of additives. In order to account for the wide range of asphalt mixtures, resulting from the variations of the different constituents, a multiscale model is proposed by introducing five observation scales, reaching from the bitumen-scale to the macro-scale. This model is used to predict low-temperature creep properties of asphalt by assigning the temperature dependence of creep to the bitumen phase only, and using homogenization schemes to incorporate the effect of the filler. The good agreement between the material properties obtained via homogenization and the respective experimental results suggests that only the volume content of the filler affects the creep properties of asphalt, explaining phenomena and problems recently encountered in asphalt pavement engineering.

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