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GUEST EDITORIAL

Advancements in the characterisation and design of asphalt materials

The need for sustainable and resilient transport infrastructure has led to the development of advanced characterisation techniques, design, and modelling methodologies for asphalt materials. Research efforts can be mainly classified into three categories: new characterisation methods aiming to better understand the molecular structure, chemical composition, rheology, mechanical properties and field performance of asphalt materials; introduction of new materials and characterisation of their behaviour and performance; and development of computational tools to investigate the mechanics and performance of composite pavement. The mechanical properties and performance of bituminous materials are the macroscopic manifestation of the material's composition and the complex interaction mechanisms across length and time scales. The material properties and the dynamics of phase interactions change with time from multiple environmentally induced physico-chemical processes, such as moisture diffusion, temperature variation, and oxidative ageing. Therefore, it is of paramount importance to develop techniques that explore the multiscale, multiphysics, and multiphase nature of the materials in order to accurately describe, to fundamentally understand, reliably predict, and – eventually – favourably control the mechanics and physics of asphalt materials.

This special issue includes articles that advance the science and understanding of characterisation and design of asphalt materials (i.e. bituminous materials, mixtures, and pavements) by bringing together individual state-of-the-art approaches. These articles describe studies in theoretical, computational, and experimental methods from subject matter experts in our field. Specifically, experimental efforts include a mechanical study to identify the early stages of initiation and growth of cavities in asphalt binders that lead to crack formation; a comprehensive evaluation of the effect of ageing on the viscoelastic characteristics of bituminous materials through the use of a variety of dynamic mechanical tests; and the chemical characterisation of an asphalt binder modified with a Warm Mix Asphalt (WMA) after subjecting the material to the combined effects of moisture and ageing processes. In terms of numerical works, this issue presents a Finite Element (FE) model analysis for evaluating the use of steel fibres and electro-magnetic induction as a polymerisation method to cure epoxy-asphalt systems; a FE method to estimate the mechanical response of an asphalt mixture after applying a grid division technique to incorporate the influence of the microstructure components of the microstructure; FE analyses to evaluate the impact of aggregate shape and percent embedment on the performance of chip seals; a new methodology to estimate the stiffness of the coarse-aggregate portion of open graded asphalt mixes through the use of the Mori-Tanaka model; and the application of Molecular dynamics (MD) models to assess the diffusion processes of different rejuvenators in aged binders that occur when rejuvenator agents are added to asphalt mixtures having reclaimed asphalt pavement (RAP).

Our goal, through this special issue, is to advance the current knowledge of bituminous materials/pavements with more fundamental aspects leading to improved practices in the materials selection, mixture design, structural design, and performance prediction.

Guest Editors for the IJPE Special Issue

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