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Editorial

Pavement Analysis and Design by Multiphysics

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Reliable and sustainable pavement infrastructure is critical for present economic and environmental challenges. The complexity of pavement analysis and design stems from diverse pavement materials, heavy traffic, and changing climate. The reliability of a pavement design depends on the extent of representation of this complexity in the prediction of various forms of distress that limit the effective service life of the pavement. The pavement materials need to be treated as they actually are, and the analysis should take into account the actual coupled behaviors of materials, structures, traffic, and environmental conditions.

From a physical point of view, prediction of pavement performance is a multiphysics problem. Questions still remain about appropriate representation and characterization of each physical process and integration of multiple physical processes to predict pavement material deterioration and structural distresses as an analysis and design platform.

Thus, this special issue provides a collection of presentation and discussion of applications of multiphysical concepts and approaches to characterize pavement materials and predict pavement responses as well as performance. It includes a variety of pavement materials such as asphalt, concrete, soils, and recycled materials.

A. H. Albayati et al. discussed the application of the recycled concrete aggregate in warm mix asphalt and how to improve the moisture susceptibility of the mixture. The replacement of the original aggregates with the recycled concrete aggregate had shown a significant improvement in moisture susceptibility. A paper by K. Hossain and Z. Hossain provides a synthesis of computational and experimental approaches to characterize chemical, physical, and mechanical properties for asphalt binders. A paper by D. Wang et al. presents an algorithm to construct virtual asphalt mixtures using the discrete element method and predicts the mechanical responses of the mixture. Y. Sun et al. conducted laboratory investigations of relaxation damage properties of high-viscosity asphalt sand and used the modified generalized Maxwell model to simulate coupled viscoelasticity and damage. The results showed that the proposed approach could effectively predict the relaxation damage process and provide a theoretical support for crack control of asphalt pavements. A review paper by X. Qu et al. presents a comprehensive view of the development, establishment, and application of molecular dynamics to simulate the behaviors of asphalt materials.

A paper by J. Zhang et al. presents a method to measure and predict the degree of compaction of fine-grained subgrade using a light dynamic penetrometer. A prediction equation was developed that contained the penetration ratio and the numerically calculated water content of subgrade. J. Zhang et al. developed a method to estimate the soil water characteristic curve of cohesive soils using a simple test with methylene blue. A paper by F. Zhou et al. presents an equal-strain model for the radial consolidation of unsaturated soils by vertical drains. The solutions were verified, and parametric studies regarding the drain resistance effect were graphically presented. T. Tang et al. investigated the thermal cooling effects of reflective-resistant-ventilated coupling structure in permafrost zones. It was recommended that such a structure could be used as a protective measure to improve the thermal stability of wide embankment.

Q. Tang et al. investigated the possibility of using bottom ash from the incineration of municipal solid waste as partial aggregate alternative. The laboratory test results indicated that bottom ash is suitable to be used as road base materials. X. Wang et al. studied the mechanisms of premature deterioration of concrete at joints in cold weather regions and carried out experimental work to verify the hypothesis. It was found that interfacial transition zone could be the weak point for cracking. Y. Zhou et al. applied the bipotential theory to the Drucker–Prager model and proposed dual constitutive cones with five forms of the bipotential function. The accuracy and stability of the developed algorithm was verified for civil engineering applications.

F. Han et al. studied the dynamic amplification factor due to surface roughness of bridge deck pavements. The roughness of the bridge deck pavement and the vehicle speed are two main factors that affect the dynamic amplification factor, which is closely related to driving comfortableness and service life of deck pavement. A paper by Z. Ye et al. presents a numerical model to analyze pavement vibration due to the dynamic load of passing vehicles. The vibration signals reflected the level of road roughness, the stiffness of the pavement materials, and the integrity of pavement structure, which could provide recommendations for early warning and timely maintenance of pavements.

Conflicts of Interest

The editors declare that there are no conflicts of interest regarding the publication of this special issue.

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