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Machine Learning Approach in Predicting Cracking Performance of Fiber Reinforced Asphalt Concrete Materials

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Abstract : In recent years, fibers have been successfully used as an additive to reinforce asphalt concrete materials and to enhance the sustainability and resiliency of transportation infrastructure. Roads covered with fiber-reinforced asphalt concrete (FRAC) require less frequent maintenance and tend to have a longer lifespan. The present work investigates the application of sasobit-coated aramid fibers in asphalt pavements and employs machine learning to develop prediction models to evaluate the cracking performance of FRAC materials. For the experimental part of the study, the effects of several important parameters such as fiber content, fiber length, and testing temperature on fracture characteristics of FRAC mixtures were thoroughly investigated. Two mechanical performance tests, i.e., the disk-shaped compact tension [DC(T)] and indirect tensile [ID(T)] strength tests, as well as the non-destructive acoustic emission test, were utilized to experimentally measure the cracking behavior of the FRAC material in both macro and micro level, respectively. The experimental results were used to train the supervised machine learning approach in order to establish prediction models for fracture performance of the FRAC mixtures in the field. Experimental results demonstrated that adding fibers improved the overall fracture performance of asphalt concrete materials by increasing their fracture energy, tensile strength and lowering their 'embrittlement temperature'. FRAC mixtures containing long-size fibers exhibited better cracking performance than regular-size fiber mixtures. The developed prediction models of this study could be easily employed by pavement engineers in the assessment of the FRAC pavements.

Keywords : fiber reinforced asphalt concrete, machine learning, cracking performance tests, prediction model
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