Pavement Structural Analysis Tool to Predict Structural Capacities of Iowa County Pavements

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Abstract

Many Iowa county pavement systems have multi-layer pavement structures having multiple cycles of pavement construction and renewal history. Such complex pavement structures challenge Iowa county engineers to estimate the structural capacities of in-service pavements to develop cost-effective decision-making strategies for the management, maintenance, and rehabilitation of county pavement systems. This challenge, however, creates a need to establish reliable and accessible methods and tools for Iowa county engineers in routine pavement analysis, design, and asset management applications. Thus, this study focuses on developing a structural analysis tool for Iowa county roads. In this study, artificial neural network-based models that predict critical pavement responses such as strains and deflections are developed to be used as a surrogate layer elastic analysis tool (e.g., MatLEA), and these models are trained by the synthetic database developed for multilayered pavement systems. The outcomes from the developed models are employed to develop a computation algorithm for estimating structural capacities of in-service Iowa county pavements, which is characterized by a mechanistic-based pavement design approach using an allowable number of load repetitions (Nf) and an empirical pavement design approach using a structural number (SN) concept. Finally, a prototype Excel Spreadsheet-based "Pavement Structural Analysis (PSAT) Tool" is developed and presented in this work to incorporate the predictions of critical pavement responses and structural capacities into estimating the remaining service life of pavements and also designing overlay thickness if needed; so that Iowa county engineers can benefit from this tool to allocate their resources properly considering the entire network pavement system.