Abstract

Long-life pavements are designed and built to last for over 50 years without needing major structural rehabilitation or reconstruction. Reported benefits of such pavements include low life-cycle cost, less frequent repair and/or rehabilitation, lower user-delay costs and lower environmental impact. Several approaches exist to design long-life pavements, all of which are based on mechanistic-empirical principles. While designing long-life pavements, deep structural distresses (e.g., bottom-up cracking) are designed to never develop, by limiting the maximum critical stresses and strains. Only surficial distresses (e.g., top-down cracking, rutting etc.) are allowed to occur, but they are managed via periodic maintenances (e.g., mill and overlay). Several states in the US have built long-life pavements by enhancing structural design methods, using better materials, improving specifications and construction practices. In Michigan, four
pilot long-life pavement sections were constructed between 2017 and 2019; two rigid and two flexible pavements. Each pilot project included a long-life and an accompanying standard (control) section constructed on the same highway. Modifications to standard designs and materials were made to extend their service life. The focus of this dissertation is on the two flexible projects. The scope of the study included as-built evaluation of these pilot long-life projects to determine their potential for meeting the intended design and service lives. MDOT performed numerous field tests and collected material samples from these projects. Extensive analysis of the field data and numerous laboratory tests were conducted to characterize the material properties. As-constructed material properties were used in different mechanistic-empirical (ME) design software to estimate the expected performance of all the pilot projects. Based on the detailed laboratory and field testing and the mechanistic-empirical performance predictions, recommendations were made in structural design, material selection, construction, and quality control and quality assurance procedures. The main objective of this study is to perform a thorough analysis of the pilot flexible long-life projects which were designed based on state-of-the-practice methods and enhance the mechanistic-empirical design of these pavements and propose alternative design approach for long life pavements to potentially reduce life cycle cost and improve their performance.