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3D-FE DYNAMIC ANALYSIS OF PAVEMENTS SUBJECTED TO NONDESTRUCTIVE IMPACT TESTING

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Abstract:
This paper shows the significance of the finite element method for modeling geometry, discontinuities, and layer material properties of highway and airport pavements. Nondestructive pavement testing and evaluation using a falling weight deflectometer, a nondestructive dynamic impact load test device, has emerged as a popular method for in situ structural evaluation of road and airport pavements. Effects of seasonal variability and material degradation with time can be cost-effectively evaluated using the falling weight deflectometer tests. Measured peak deflections and known layer thickness data are often used to backcalculate modulus values of pavement layers and subgrade. Compared to the laboratory resilient modulus testing, this method is faster and cheaper. Unfortunately, most of the available modulus backcalculation programs have been developed using the layered linear elastic static analysis to interpret dynamic deflection data collected on existing or constructed pavements. This paper reviews the assumptions used for analyzing deflection data, the limitations of static analysis, and the currently available and emerging dynamic analysis methods. It is shown that the use of three dimensional-finite element dynamic response analysis is imperative to calculate accurate in situ effective modulus values for concrete pavements with joints and cracks. The three dimensional-finite element dynamic analysis is also used to validate the in situ pavement modulus values backcalculated by the Pavement Evaluation based on Dynamic Deflections (PEDD) computer program for pavement nondestructive evaluation.

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