Title of Thesis : Development of a Rigid Pavement Backcalculation Program—Elastic Solid Foundation

Total Pages : 148

Name of Institute : Graduate Institute of Civil Engineering, Tamkang University

Graduate Date : June, 1997 Degree Conferred : Master

Name of Student : Chao-Tsung Lee Advisor : Dr. Ying-Haur Lee

Abstract :

This study will first perform comprehensive and in-depth investigations on the primary factors affecting pavement surface deflection measurements, such as various Nondestructive Deflection Testing (NDT) devices, locations of loading plate (interior, edge, and corner of the slab), and finite slab size. Thus, the study strives to minimize the major limitations and deficiencies of traditional backcalculation procedures by modifying the most widely-used AREA deflection basin concept. A modified closed-form deflection ratio backcalculation procedure was introduced and implemented in a user-friendly computer program (TKUBAK) for the backcalculation of jointed concrete pavements.

The major research approach of this study include: (1)theoretical investigations and validations of the closed-form Westergaard and Losberg deflection equations through the use of PowerStation IMSL libraries for the integration of Bessel functions for infinite slab conditions: (2)discussions of the limitations and deficiencies of AREA deflection basin concept, ILLI-BACK deflection ratio concept, and traditional backcalculation procedures: (3)the analyses and applications of ILLI-SLAB finite element (F.E.) program to more realistically account for practical slab situations: (4)the incorporation of dimensional analysis, the identification of dominating mechanistic variables, as well as the development of backcalculation databases through a series of F.E. factorial runs over a wide range of pavement designs: (5)the application of Projection Pursuit Regression (PPR) technique for the development of prediction models using S-PLUS statistical package: (6)the introduction of a modified deflection ratio backcalculation procedure: (7)the development of a user-friendly program (TKUBAK) to facilitate instant modulus backcalculation using the IMSL libraries and Visual Basic 4.0 software package.

Since all the mechanistic variables used (e.g., normalized load radius, normalized radial distance, normalized slab sizes) in the proposed models and modified deflection ratio backcalculation procedures are dimensionally correct, both English and metric (SI) unit systems can be used by the program. The main features of the program include: the traditional AREA deflection basin backcalculation procedure, the ILLI-BACK closed-form deflection ratio backcalculation procedure, as well as the proposed modification to the deflection ratio backcalculation procedure. Furthermore, this study also enhanced the applicability of the deflection ratio concept by the fact that any different NDT loading radius, sensor locations, and finite slab sizes could be analyzed by the proposed approach.

Keywords : Concrete (Rigid) Pavements, Backcalculation, Nondestructive Deflection Testing, Wheel Loading, Deflection, Finite Element Analysis, Dimensional Analysis, Regression Analysis, Prediction Model.