

Nondestructive Testing of PAVEMENTS and Backcalculation of Moduli

Harold L. Von Quintas

Albert J. Bush, III

Gilbert Y. Baladi

Editors

Second Volume



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*Harold L. Von Quintus, Albert J. Bush, III, and
Gilbert Y. Baladi, Editors*

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The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of these peer reviewers. The ASTM Committee on Publications acknowledges with appreciation their dedication and contribution to time and effort on behalf of ASTM.

Foreword

This publication, *Nondestructive Testing of Pavements and Backcalculation of Moduli (Second Volume)*, contains papers presented at the symposium of the same name held in Atlanta, GA on 23–24 June 1993. The symposium was sponsored by ASTM Committee D18 on Soil and Rock and its Subcommittee D4 on Road and Paving Materials. Albert J. Bush, III, of U.S. Army Corps of Engineers in Vicksburg, MS, Harold L. Von Quintus of Brent Rauhut Engineering in Austin, TX, and Gilbert Y. Baladi of Michigan State University in East Lansing, MI presided as symposium chairmen and are the editors of the resulting publication.

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Overview

In June 1988, the first International Symposium on Nondestructive Testing (NDT) of Pavements and Backcalculation of layer moduli was held. Since then, another symposium on NDT and backcalculation of layer moduli was held in August of 1991 and was sponsored by the Transportation Research Board. Both of these symposia were well attended, and showed that there was a strong interest within the transportation community in the area of NDT and the use of deflection data for evaluating and designing pavement structures. Unfortunately, these two symposia also showed that the industry was divided regarding the adequacy and use of state-of-the-art evaluation procedures for determining structural capacity of pavement structures.

As a result of the first symposium in 1988, ASTM Subcommittees D18.10 and D04.39 have been extensively involved in the preparation of standardized procedures for NDT and the evaluation of deflection data. Standardized procedures have been prepared and approved for collecting deflection data with different devices. These are listed below for reference purposes:

- D 4602 Standard Guide for Nondestructive Testing of Pavements Using Cyclic Loading Dynamic Deflection Equipment
- D 4694 Standard Test Method for Deflections with a Falling-Weight-Type Impulse Load Device
- D 4695 Standard Guide for General Pavement Deflection Measurements

The task of standardizing backcalculation procedures, however, has been more difficult, because of the diversity of opinions and procedures currently in use by the transportation industry. The first draft of a standard guide for backcalculation of layer moduli from deflection measurements was balloted in 1986. The latest draft balloted in 1992 received numerous negative ballots that were found to be persuasive. More recently, there have been numerous research projects completed by individual transportation agencies and as part of the Strategic Highway Research Program (SHRP).

With these recent advancements and the need to develop concurrence within the transportation industry to develop a standardized evaluation procedure, Subcommittees D18.10 and D04.39 suggested to the Executive Committees that ASTM sponsor the second International Symposium on Nondestructive Testing of Pavements and Backcalculation of Moduli. This Second International Symposium was held in Atlanta, Georgia in June, 1993. The attendance at this symposium exceeded 80, representing 12 different countries and 25 states in the United States. An attendance list is included at the end of this publication.

The symposium was divided into four sessions (two sessions per day) and one panel workshop or discussion on issues related to standardization of backcalculation procedures. The papers presented at this Second International Symposium focused in the area of backcalculation of layer moduli techniques and comparisons of material moduli as measured in the laboratory to values calculated from field deflection measurements. Information from these papers and discussion were used to establish whether a backcalculation procedure could be standardized based upon the current state-of-the-art technology. The format of the presentations was divided into four sessions followed by a panel discussion. Each of the sessions were subdivided into two parts as follows:

SESSION 1—Analytical Models and Techniques for Backcalculation of Layer Moduli (5 Papers).

Chairman—Dr. Albert J. Bush III, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Part 1 of Session 1: Recent Developments and Tools to be Used in the Future for Evaluating Pavements Based on Backcalculation Techniques (2 Papers).

Keynote Speaker—Dr. Jacob Uzan, Professor, Israel Institute of Technology (Technion), Israel, “Advanced Backcalculation Techniques.”

Part 2 of Session 1: Methods and Procedures Used for Backcalculation of Material and Pavement Properties (4 Papers).

SESSION 2—Measurement and Calculation Techniques in the Field and Laboratory

Chairman—Mr. Harold L. Von Quintus, President, Brent Rauhut Engineering Inc., Austin, TX.

Part 1 of Session 2: Verification of backcalculation techniques and comparisons of laboratory measured values with those calculated from field measurements or deflections (4 papers).

Part 2 of Session 2: Characterization of Pavement Materials and the Effects of Non Linearity on Backcalculation of Layer Moduli (4 papers).

SESSION 3—NDT for Pavement Structural Evaluation, Design and Rehabilitation.

Chairman—Dr. Albert J. Bush III, U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Part 1 of Session 3: Problems/errors associated with backcalculation methods in terms of pavement evaluation, and backcalculation of design parameters for concrete pavements (4 papers).

Part 2 of Session 3: Analysis of deflection measurements and effects of load distributions on pavement response (4 papers).

SESSION 4—NDT for Other Pavement Uses: Use of the Results From NDT to Determine Layer Thickness, Joint Efficiency, and Void Detection (5 Papers).

Chairman—Dr. Gilbert Y. Baladi, Professor, Michigan State University, East Lansing, MI.

SESSION 5—Panel Discussion on Backcalculation of Layer Moduli

Chairman—Dr. Gilbert Y. Baladi, Professor, Michigan State University, East Lansing, MI.

Discussion paper presented by Richard May, Asphalt Institute, Lexington, KY and Harold L. Von Quintus, Brent Rauhut Engineering, Austin, TX entitled “The Quest for a Standard Guide to NDT Backcalculation”.

Panel participants: Dr. Albert J. Bush III., U.S. Army of Engineers, Waterways Experiment Station, Vicksburg, MS. Dr. Jacob Uzan, Israel Institute of Technology (Technion), Israel; Richter, Federal Highway Administration, Turner Fairbanks, Washington, DC; Dr. Ullditz, Technical University of Denmark, Denmark, and Luckanen, Braun Intertec, Minneapolis, MN.

Papers in this STP are presented on those topics in the four sessions listed previously. These papers include examples of different backcalculation of layer moduli procedures, comparisons

between laboratory measured and field calculated values, as well as, the more common examples on the use of deflection testing to evaluate pavement structures. The papers published represent eight different countries, eleven different states, and thirteen different educational agencies. It is the hope of the organizers of this symposium that the papers presented will provide the readers with much of the latest information in the areas of pavement evaluation using NDT techniques, and application of that data for use in pavement design.

One of the goals and objectives of this symposium was to determine if the industry could find a common ground to standardize a backcalculation procedure. In specific, this was the focus of the panel discussion at the end of the symposium. This panel discussion was preceded by a paper entitled "The Quest for a Standard Guide to NDT Backcalculation" (presented by Mr. Richard May) and a presentation by Dr. Albert Bush (Symposium Cochairman and D4.39 Subcommittee Chairman) entitled "Where We Go From Here."

From the question and answers during the panel discussion, it was the general consensus that backcalculation of layer moduli from deflection measurements will definitely be used in the future for the rehabilitation design and evaluation of pavement structures. The question however, is still: what is the reliability of these values? Specifically, it was the general consensus of the panel and attendees that the accuracy of backcalculated moduli is model dependent and unknown, as well as those values measured in the laboratory because there is a diversity of opinion on the simulation of field conditions in the laboratory. For example, there is controversy within the industry on whether backcalculation procedures should be based on a dynamic or static analysis, and what values actually represent the "truth," both in the laboratory or from field measurements.

In summary, most participants, concurred that there needs to be a standard "baseline" of values from which to compare on a project, material, or pavement bases, and that one should not become paralyzed by the imperfection of the procedures. More importantly, research must be merged into practice on a consistent basis and one way to accomplish this is through the standardization process. As such, a procedure needs to be standardized and that procedure should concentrate on user oriented issues. Thus, the editors, panel, as well as most symposium participants involved in these discussions, believe that some standardized procedure should be pursued to ensure that a common set of values can be compared.

The editors wish to thank all those who participated in this symposium and who contributed to this STP. Special thanks are given to the authors, the reviewers of the papers, ASTM Committees D18 and D4 for sponsoring the symposium, and to the members of Subcommittees D18.10 and D04.39 for their valuable input and efforts. Last but not least, the editors would like to express their deep appreciation to the ASTM staff for their assistance in preparing for this symposium and in its preparation. The high professional quality of ASTM publications would not be possible without their dedicated and professional efforts.

Dr. Albert J. Bush III

U.S. Army Corps of Engineers, Waterways
Experiment Station, Vicksburg, MS; symposium
cochairman and coeditor.

Mr. Harold L. Von Quintus

President, Brent Rauhut Engineering, Austin, Texas,
symposium cochairman and editor

Dr. Gilbert Y. Baladi

Professor of Civil Engineering, Michigan State
University, East Lansing, Michigan, symposium
cochairman and coeditor

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