

**Nondestructive  
Testing of**

**Pavements and  
Backcalculation  
of Moduli**

**Third Volume**

**Shiraz D. Tayabji and  
Erland O. Lukanen, editors**



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*Shiraz D. Tayabji and Erland O. Lukanen*

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# Foreword

This publication, *Nondestructive Testing of Pavements and Backcalculation of Moduli: Third Volume*, contains papers presented at the symposium of the same name held in Seattle, Washington, on 30 June and 1 July, 1999. The symposium was sponsored by ASTM Committees D18 on Soil and Rock and D4 on Road and Paving Materials. The symposium co-chairmen were Shiraz D. Tayabji, Construction Technology Laboratories, Inc., and Erland O. Lukanen, Braun Intertec Corporation.

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# Overview

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This proceedings represents the papers presented at the Third International Symposium on Nondestructive Testing of Pavements and Backcalculation of Moduli, June 30–July 1, 1999, Seattle, Washington. The Third Symposium carried on the tradition established by the two previous symposia on the same subject—the 1998 symposium held in Baltimore, Maryland and the 1993 symposium held in Atlanta, Georgia. As with the previous two symposia, the Seattle Symposium presented the advances in nondestructive testing (NDT) of pavements using conventional falling weight deflectometer (FWD) technique and other promising techniques such as ground penetrating radar (GPR), rolling weight deflectometer (RWD) testing, and seismic techniques. In addition, topics presented included dynamic analysis of deflection data, the use of neural network analysis and the use of dynamic cone penetrometer (DCP) testing.

The FWD technique has matured over the past ten years. Field procedures have been reasonably well established and significant progress has been made in backcalculation techniques. However, gaps still remain in achieving comprehensive, bias-free, backcalculation methodologies for asphalt concrete (AC) and hydraulic cement concrete (HCC) pavements that rationally account for depth to bed-rock, water-table effects, and slab curling effects.

The FWD testing is playing an important role in evaluating the structural condition of existing pavements and in understanding the effects of seasonal variations on pavement response (and subsequently on pavement performance). The RWD, when fully developed, will significantly change the manner in which we perform deflection testing. Similarly, it is expected that in the near future, the more rapid GPR and seismic techniques will become more established tools for pavement evaluation. All these developments promise an exciting next decade for pavement evaluation.

The papers presented at the Seattle Symposium represent an international effort in both the practical as well as the developmental aspects of NDT of pavements. As included in these proceedings, the papers cover a broad range of topics that will be of interest to practitioners as well as researchers. The topics presented at the symposium and included in these proceedings are as follows:

The proceedings section is divided as follows:

- Session 1—Keynote presentations
- Session 2—Deflection Testing and Backcalculation of AC Pavements
- Session 3—Deflection Testing and Backcalculation—Seasonal Variations
- Session 4—Dynamic Cone Penetrometer Testing
- Session 5—Deflection Testing and Backcalculation of PCC Pavements
- Session 6—GPR and Newer NDT
- Session 7—Dynamic Analysis of Deflection Data
- Session 8—Rolling Weight Deflectometer

A total of twenty-nine papers were presented at the Seattle Symposium which are included in this proceedings. Also included in this book are three additional papers which were not presented. The symposium was attended by over 120 engineers from several countries.

The presentations and discussions at the symposium indicate that although the FWD field testing protocols appear to be fairly well standardized, there is still a need to bring the various backcalculation techniques into a standard format to ensure consistency of results from one technique to another. This problem is somewhat complicated by the fact that there is lack of agreement among researchers



on how to establish the ground truth for the layer moduli, especially if non-linearity and other material characterization issues are considered.

The geographic diversity of the presenters and attendees at the symposium indicate the continuing growth in the acceptance of NDT for pavement evaluation. The combination of the growth in usage of NDT and the continuing development of new techniques emphasize the need for continuation of development of standard guidelines, practices, and test methods.

The editors wish to thank all those who participated in the Seattle Symposium, those who contributed to this Special Technical Publication (STP) and importantly the many peer reviewers who provided important feedback to the authors. The editors also wish to thank ASTM Committees D18 and D04 for sponsoring the symposium, the members of Subcommittees D18.10 and D04.39 for supporting the symposium and the ASTM staff for their assistance with the planning for the symposium and for preparation of this STP. Specifically, the assistance of Ms. Dorothy Fitzpatrick, Ms. Hanna Sparks, Ms. Annette Adams, and the editorial staff at ASTM is gratefully acknowledge. The high quality of the symposium and this STP would not have been possible without their dedicated and professional effort.

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# **Keynote Presentations**