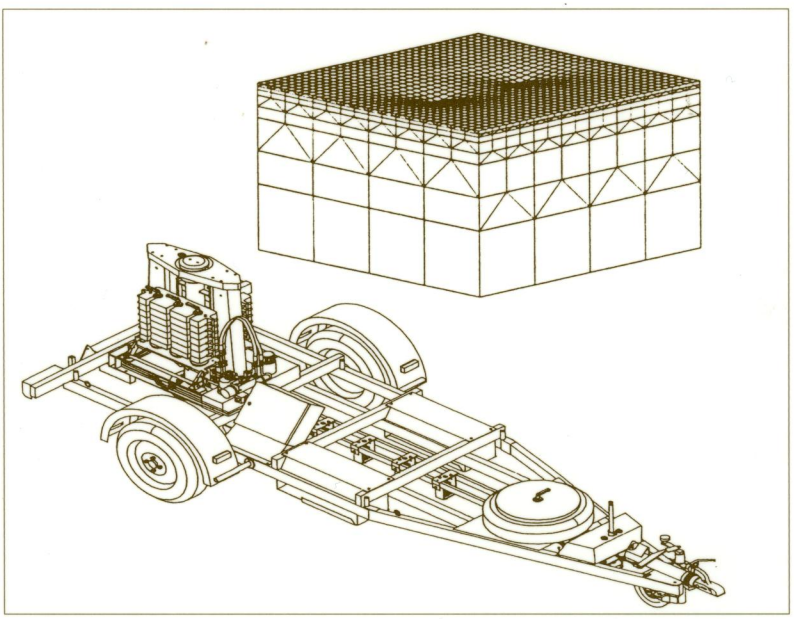
GEOTECHNICAL SPECIAL PUBLICATION

Pavement Subgrade, Unbound Materials, and Nondestructive Testing

Edited by Michael S. Mamlouk



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EDITED BY
Michael S. Mamlouk



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Abstract: This GSP contains 10 technical papers presented at the GeoDenver 2000 meeting in Denver, Colorado, in August 2000. The papers cover pavement nondestructive testing using the Falling Weight Deflectometer (FWD), High-Speed Rolling Deflectometer, and Spectral-Analysis-of-Surface-Waves (SASW). The papers also include different methods of laboratory testing such as triaxial and resilient modulus testing. The analysis methods include artificial neural network, three-dimensional finite element techniques, linear and nonlinear material response, static and dynamic analysis of material behavior, and backcalculation of layer moduli. The papers cover characterization of pavement surface, base, subbase, and subgrade layers. The depth to bedrock is considered in some papers.

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Preface

Three sessions on Pavement Subgrade, Unbound Materials, and Nondestructive Testing were held on August 7, 2000 in Denver, Colorado, as a part of the ASCE GeoDenver 2000 meeting. Ten papers were presented in these sessions covering a range of timely and important issues related to characterization of pavement subgrade and unbound materials using analytical and experimental techniques.

Each paper published in this ASCE Geotechnical Special Publication (GSP) was evaluated by two peer reviewers and the editor. The authors addressed all of the reviewers' comments to the satisfaction of the editor. The peer-reviewed papers in this publication were prepared "camera-ready" as submitted by the authors. The quality of the papers in this publication reflects not only the obvious efforts of the authors and the editor, but also the work of these peer reviewers. The ASCE Geo-Institute Pavements Committee acknowledges with appreciation the reviewers dedication and contribution of the time and effort on behalf of ASCE.

Michael S. Mamlouk
Arizona State University
Session Chair and Editor

Overview

Characterization of pavement subgrade and unbound materials using nondestructive and laboratory testing has been investigated for many years. New techniques have been recently developed in both areas of testing and analysis. This Geotechnical Special Publication (GSP) includes a contribution by some researchers representing the state-of-practice and knowledge in the area of material characterization as related to pavement and geotechnical engineering.

This GSP contains 10 technical papers presented at the GeoDenver 2000 meeting in Denver, Colorado, in August 2000. The papers cover pavement nondestructive testing using the Falling Weight Deflectometer (FWD), High-Speed Rolling Deflectometer, and Spectral-Analysis-of-Surface-Waves (SASW). The papers also include different methods of laboratory testing such as triaxial and resilient modulus testing. The analysis methods include artificial neural network, three-dimensional finite element techniques, linear and nonlinear material response, static and dynamic analysis of material behavior, and backcalculation of layer moduli. The papers cover characterization of pavement surface, base, subbase, and subgrade layers. The depth to bedrock is considered in some papers.

Mooney et al. Present detailed investigation of soft subgrade moduli via backcalculation from FWD data, triaxial testing, and pressuremeter testing. The depth to bedrock is measured through site investigation and compared to that estimated by the MODULUS backcalculation program. Andrén and Lenngren used a High-Speed Rolling Deflection Tester (RDT) to evaluate subgrade properties. The device used consists of forty laser range finders mounted on a truck, which is used to assess loaded and unloaded pavement profiles. The results of the RDT are compared to those of FWD tests. Gucunski et al. developed an artificial neural network that backcaculates pavement profiles from the SASW test collected data. The method can evaluate the thickness and elastic modulus of individual layers more accurately than previously developed methods.

Seyhan and Tutumluer present an advanced method of laboratory characterization of unbound materials to determine the stress-induced anisotropic resilient properties using a unique triaxial machine (UI-FastCell). The obtained moduli would result in higher critical pavement responses as obtained from the mechanistic analysis of a conventional flexible pavement and be associated with reduced pavement life. William and Shoukry present a mechanistic method for estimating the apparent depth to the stiff layer using the FWD data. The authors used a 3-D finite element simulation that accounts for the dynamic nature of the FWD load and the friction at the layers' interface.

Russel and Hossain show that the average ratio of the laboratory-determined to the backcalculated resilient moduli of fine-grained soils is 0.33. This conclusion corresponds to that obtained by previous studies by AASHTO. Nassar et al. present the analysis of data of FWD tests conducted at the Virginia Smart Road periodically and on top of each of the layer after it was constructed. The study found that using the surface modulus to characterize the subgrade might be misleading. Li presents the results of an experimental investigation of

nonlinear shear viscosity of subgrade soils under periodic loading. He introduces a nonlinear viscous model to describe the relation of shear stress and shear strain rate.

Chatti and Kim introduce a closed-form solution for backcalculating dynamic subgrade stiffness and damping coefficients from FWD deflection basins for rigid pavement. The solution considers the transient deflection signal of individual FWD sensors. The solution is further verified with 3-D finite element analysis and in-situ deflection testing on airfield and highway pavements. Finally, Hossain et al. present the seasonal and spatial variation of subgrade response by analyzing FWD data collected monthly on four asphalt pavement test sections for four years. The study concludes that seasonal and site variabilities can be significant. Conducting FWD tests at moderate temperatures can minimize the variability in the backcalculated subgrade moduli.

This GSP will be helpful to pavement materials and geotechnical engineers in applying innovative and effective strategies for pavement evaluation, rehabilitation, and management. Such strategies should result in pavements with higher levels of service for a longer period of time.

Michael S. Mamlouk
Arizona State University
Session Chair and Editor