# Airfield and Highway Pavements 2021

Pavement Materials and Sustainability

Selected Papers from the Proceedings of the International Airfield and Highway Pavements Conference 2021

>> June 8-10, 2021



Edited By Hasan Ozer, Ph.D. <u>Iohn F. Rushina. Ph.D.. P.E</u>



TRANSPORTATION & DEVELOPMENT INSTITUTE

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SPONSORED BY The Transportation & Development Institute of the American Society of Civil Engineers

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### Preface

Airfield and highway pavements are critical components of our transportation infrastructure. Increasing demand on these assets creates a unique challenge for researchers and practitioners to find sustainable solutions to managing their life-cycle. The airfield and highway pavements specialty conference is a unique setting where the world's foremost experts in pavement design, construction, maintenance, rehabilitation, modeling, management, and preservation meet and present most recent developments in the pavement engineering area. Building on the success of our past conferences, the 2021 International Airfield and Highway Pavements Conference of ASCE's Transportation and Development Institute (T&DI) displayed the adaptive nature of our profession as we held our first completely virtual event from June 8-10, 2021.

The 2021 virtual conference was designed to feature plenary sessions and panel discussions on important topics facing government agencies and industry. Technical breakout sessions allowed researchers and practitioners to present deeper technical content on breakthrough practices and technologies. The virtual poster session allowed "on-demand" access to cutting edge research.

The proceedings of the 2021 International Airfield and Highway Pavements Conference have been organized into three publications and are described as follows:

### Vol I: Airfield and Highway Pavements 2021: Pavement Design, Construction, and Condition Evaluation

This volume includes papers concerning mechanistic-empirical pavement design methods and advanced modeling techniques for highway pavements, construction specifications and quality monitoring, accelerated pavement testing, rehabilitation and preservation methods, pavement condition evaluation, and network-level management of pavements.

### Vol II: Airfield and Highway Pavements 2021: Pavement Materials and Sustainability

This volume includes papers describing laboratory and field characterization of asphalt binders, modifiers and rejuvenators, asphalt mixtures and modification, recycled and waste materials in asphalt mixtures, unbound base/subgrade materials and stabilization, pavement life-cycle management, interactions of pavements and their environment, and recent advances in cementitious materials characterization and concrete pavement technology. In this volume, we also included papers introducing cutting edge innovative and sustainable technologies used in pavement applications.

#### Vol III: Airfield and Highway Pavements 2021: Airfield Pavement Technology

This volume includes papers on recent advances in the area of airfield pavement design, construction, and rehabilitation methods, modeling of airfield pavements, use of

accelerated loading systems for airfield pavements, and airfield pavement condition evaluation.

The papers have undergone a rigorous peer review by at least two to three international highway pavement and airfield technology experts and a quality assurance process before becoming a publication of ASCE – the world's largest publisher of Civil Engineering content.

The success of the conference is a tribute to the incredible efforts of the leadership team consisting of Conference Co-Chairs (Hasan Ozer, John Rushing, and Zhen Leng) and Advisory Board (Imad Al-Qadi and Scott Murrell) along with an outstanding Conference Steering Committee (Amit Bhasin, Rick Boudreau, Zeijao Dong, Jeffrey Gagnon, Tom Harman, Andreas Loizos, Geoffrey Rowe, Injun Song, Leif Wathne, and Richard Willis) and terrific support from ASCE T&DI staff. The efforts of the Conference Scientific Committee are graciously acknowledged for their role in reviewing papers and providing critical feedback to the authors.

We thank everyone who attended the virtual conference and hope to see everyone again in 2023!

Hasan Ozer, Ph.D., A.M.ASCE, University of Illinois at Urbana-Champaign John Rushing, Ph.D., P.E., M.ASCE, U.S. Army Engineer Research and Development Center Zhen Leng, Ph.D., M.ASCE, Hong Kong Polytechnic University

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#### The Improvement of Thermal Cracking Resistance and Fatigue Life of RAP-Incorporated Asphalt Mixtures with the Aid of Epoxidized Methyl Soyate (EMS)

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#### ABSTRACT

In this study, an asphalt binder was modified with epoxidized methyl soyate (EMS) that was engineered at Iowa State University. The binder modification was accomplished in an asphalt terminal, and the resulting binder was used for reversing the undesired effects of reclaimed asphalt pavement (RAP) in a mixture containing 30% of this reclaimed material. The modified mixture was produced in an asphalt plant for a pavement demonstration project that occurred in November 2017. The EMS-modified mixture with 30% RAP and a control mixture containing only 18% RAP were used for paving a 7-mile stretch of a high-volume roadway in O'Brien County, Iowa, U.S. About 6.6 miles of the roadway were paved with the control low RAP mixture that is traditionally used for paving roadways in Iowa, and the remaining 0.33 miles were paved with the high RAP EMS-modified mixture. To predict the field performance of the mixtures, the low-temperature cracking and fatigue cracking resistance of the mixtures were evaluated using disc-shaped compact tension (DCT) and push-pull fatigue tests, respectively. The results revealed that the EMS restorative reactive modifier (RRM) used in this study results in reversing the undesired effects of RAP and improving the low-temperature cracking and fatigue resistance of the asphalt mixture containing 30% RAP.

#### **INTRODUCTION**

Sustainability in the context of pavements refers to achieving the design goals; preserving/restoring the surrounding ecosystems; using human, financial, and environmental resources in an economical fashion; and meeting the basic human needs (Van Dam et al. 2015). Pavement sustainability is an aspirational goal, as it is unlikely that a fully "sustainable" pavement will be constructed in the near future; therefore, the sustainability should be viewed as progressive movement toward achieving this ultimate goal. In the context of asphalt pavements, the use of reclaimed asphalt pavement (RAP) aggregates and bio-renewable modifiers can increase the speed to achieve a high level of sustainability, if not the ultimate goal. RAP when incorporated into asphalt mixtures decreases the depletion rate of virgin aggregates and reduces the amount of virgin asphalt binder needed for producing mixtures. Bio-renewable modifiers, i.e., the modifiers made of organic materials with recent biological origin, when used in asphalt binders obviate the need for using analogues obtained from petroleum resources.