



## 4<sup>th</sup> ICTG Workshop on Sustainability & Climatic Effects in Mechanistic based Designs of Road Infrastructure Systems

May 24, 2021

**Moderators:** Halil Ceylan, Chair, ASCE Geo-Institute Pavements Committee

Hasan Ozer, Chair, ASCE T&DI Highway Pavements Committee

### Workshop Program

Introductory comments by the moderators about the workshop (~15 minutes)

- We aim to allocate one full hour for each presentation/topic, 35-40 mins for the presentation followed by 20-25 minutes for the discussion. Our goal is to discuss each topic in detail so that the audience has the opportunity to ask plenty of questions and learn more about the topics covered during the workshop.
- The workshop is scheduled to start at 9 am CDT and we will wrap it up by 4:30 pm CDT (including a 15 min break after the 3<sup>rd</sup> presentation)
- Presentations will be delivered via live/synchronous Zoom meeting connection

#### **Presenter 1**

Dr. Claudia Zapata, Arizona State University, [czapata@asu.edu](mailto:czapata@asu.edu)

Dr. Xiong (Bill) Yu, P.E., Case Western Reserve University, [xyy21@case.edu](mailto:xyy21@case.edu)

#### **Multiscale Multiphysics Processes in Frozen Soils: Incorporating Frost Actions into Pavement Design**

Frost heave and thaw weakening leads to change of pavement IRI and compromise pavement performance. This presentation will firstly introduce the theoretical framework that aims to understand the multi-physics processes in frozen soils and its influence on the pavement. The

coupling phenomena is described with continuous finite element model as well as a random finite element model that allows holistic simulation of frozen soil behaviors, including the effects of phase transition and the consequent internal stress and volume changes. The performance of the model is firstly validated with laboratory experiments. The model is implemented to simulate the effects of frost action on pavement. The coupled thermal-mechanical actions including the mechanical responses of subgrade soils subjected to freezing temperature and its effects on the pavement structure are analyzed. The results show that the frost action and expansion of ice lenses change the interaction modes between pavement layers, and that the detrimental effects of frost heave on the pavement structure can be mitigated by increasing the thickness of base layer, use of thermal insulation layer or improve drainage in the subgrade layer.

For implementation in the pavement design and performance prediction, a simplified model is formulated to estimate the frost depth and frost heave. The results are evaluated and calibrated with data from instrumented sites. The calibrated model identifies the critical factors on frost heave and thaw weakening as well as the change in pavement IRI due to seasonal freezing-thawing processes. It will allow to predict the effects of climate on the long-term pavement performance.

### **Presenter 2**

Dr. Raul Velasquez, P.E., Geomechanics Research Engineer, Minnesota Department of Transportation, [raul.velasquez@state.mn.us](mailto:raul.velasquez@state.mn.us)

#### ***Climatic Effects on Performance of Recycled Bases in MnROAD***

This presentation summarizes on-going geotechnical research at MnROAD related to environmental impacts on the performance of recycled aggregate bases (including RCA and RAP). Emphasis is placed on the effect of drastic temperature changes on the response of recycled pavement foundation. Furthermore, the importance of the relative shallow groundwater condition present at research facility is discussed.

### **Presenter 3**

Andrew Dawson, Chair, TRB AKM80 Aggregates Technical Committee  
[andrew.nottingham@aol.com](mailto:andrew.nottingham@aol.com)

#### ***Climate Change and Its Impact on Transportation Pavements/Tracks and Their Foundations***

Break (15 minutes)

### **Presenter 4**

Dr. Guangming Wang, P.E., State Pavement Performance Engineer, FDOT State Material Office  
Florida Department of Transportation  
[Guangming.Wang@dot.state.fl.us](mailto:Guangming.Wang@dot.state.fl.us)

## ***FWD-Based Decision Matrix for Flood Inundated Roadways: Florida Case Study***

### **Abstract:**

Flooding can not only cause significant damage to roadway assets but also pose a safety threat to the road users. Thereby, flooded pavements are closed to traffic to restrict further deterioration of pavements and to ensure safety of the traveling public. However, when the flood waters recede, the pavements are structurally vulnerable and may lead to structural and functional failures if traffic is allowed immediately onto the roadway. Therefore, a well-informed and sound methodology is required to determine the structural adequacy of the pavement to carry vehicular traffic post flooding. For this purpose, Florida Department of Transportation (FDOT) initiated a study that resulted in a practical and easily understood decision matrix based on Falling Weight Deflectometer (FWD) data for opening roadways to traffic after flood events. The decision matrix considers pavement performance parameters such as subgrade modulus, truck traffic, and the present flood condition to determine whether the roadway is safe to be re-opened to traffic. In this presentation, a brief overview of the decision matrix methodology along with a case study where the tool was successfully employed is presented.

Dr. Wang is a Florida registered professional engineer with more than 10 years of experience in pavement engineering. He graduated from the University of Florida with Ph.D. degree in Civil Engineering in 2009. After graduation, he joined Quality Engineering Solutions and had been working as a pavement/geotechnical engineer and project manager for more than 5 years before he joined FDOT in 2015. His areas of expertise include pavement non-destructive testing, pavement design and analysis, pavement marking management (PMM) and pavement modeling.

Dr. Wang currently works as State Pavement Performance Engineer and manages several statewide programs including FWD, GPR, PMM, high friction surface treatment (HFST) and green colored pavement markings (GCPM).

### **Presenter 5**

Brian Moore, Secondary Roads Research Engineer, Iowa County Engineers Association Service Bureau (ICEASB)

[brian.moore@iceasb.org](mailto:brian.moore@iceasb.org)

### ***Challenges Faced with Unpaved and Local Road Infrastructure Systems in Iowa***

Iowa is the United States leader in corn, soybean, and pork production. The network of over 72,000 miles of granular unpaved roads is the backbone of Iowa's agricultural and manufacturing economy that help feed the world. Local road owners spend millions of dollars annually on the maintenance of this system. The presentation will highlight the challenges faced by local road owners and research solutions put into practice to help maintain the network.

### **Presenter 6**

Bora Cetin, Associate Professor, Michigan State University

[cetinbor@msu.edu](mailto:cetinbor@msu.edu)

***Long-Term Seasonal Assessment of Pavement Base Aggregates Using Recycled and Natural Materials***

In this presentation long term performance of seven pavement test sections built with various base materials, including recycled Portland cement concrete (RPCC), reclaimed asphalt pavement (RAP), commonly used natural aggregates that are classified as MnDOT (Minnesota Department of Transportation) Class 3 through Class 6, and blended aggregates with recycled and natural materials along with aggregate base section stabilized with 14% fly ash. Each test site was monitored for 7-10 years via conducting falling weight deflectometer (FWD), international roughness index (IRI), rutting tests. Results of FWD, IRI, and rutting tests will be presented and discussed.

**Panel Discussion (60 minutes)**

**Discussion questions**

**We will share a list of discussion questions with the panelists ahead of the workshop. Please e-mail us any questions that you have in mind to be discussed during the workshop and panel session**

**Each presenter will be asked at least one question during the panel discussion**