

Journal of Testing and Evaluation

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Overview

The special section entitled “Advancements in the Performance Assessment of Transportation Infrastructure and Materials” includes a collection of 11 invited papers from the 3rd International Conference on Transportation Infrastructure and Materials (ICTIM), which was hosted at Jinan, China between July 2–4, 2019. The papers were subjected to the regular review procedures by the *Journal of Testing and Evaluation* (JTE) before their acceptance. The collection of these papers is roughly grouped into four major categories:

1) Characterization of soil behaviors under complex conditions

Three papers are included under this category. The paper “An Experimental Investigation on the Mechanism of Contact Erosion in Levee Foundations Considering the Characteristics of Particle Shape and Flow Field” describes an experimental study that characterized the contact erosion phenomena. The study was implemented with a custom designed testing equipment; it utilized transparent soils and computer vision to track contact erosion processes. The effects of a number of factors contributing to contact erosion were analyzed. The results showed that the flow conditions and particle shape played important roles on the initialization and development of contact erosion. The paper “Undrained Responses of Partially Saturated Sand Induced by Biogas under Dynamic Cyclic Loading” describes an experimental program that characterized the dynamic cyclic responses of de-saturated sand with denitrification bacteria. The microbial denitrification process in saturated sand created unsaturated conditions. The effects of the extent of desaturation on the improvement of soil liquefaction resistance were evaluated experimentally. Factors affecting the extent of improvements were analyzed. The paper “DEM Simulations of Energy Dissipation in Sand under Static and Cyclic Loading” describes a study that employed discrete element method (DEM) to simulate the behaviors of sand subjected to static and dynamic loads, with a focus on the energy dissipation mechanism. The study evaluated the primary modes of energy dissipation and proposed methods to calculate energy dissipation from DEM simulation results. The results showed that energy loss by friction primarily occurs in weak force network, while energy loss by viscous interactions occurred in both weak force network and strong force network.

2) Field and laboratory experiments to characterize and mitigate natural hazards

Three papers are included under this category. The paper “Experimental Study of the Performance Characteristics of Sandy Soil Debris Flow under the Effect of Artificial Rainfall” presents the details of experimental design, data acquisition and analyses to understand the mechanism triggering debris flow. The experimental system was designed to emulate rainfall events. A video based monitoring system captured the process of debris flow development. The status of soil was also monitored with pore pressure monitoring instruments. From the experimental data, major stages of debris flow development were identified. Overall, the paper provided an experimental platform and data analyses protocol that helps to understand the mechanisms for the development of debris flow. The paper “Field Tests and Three-dimensional Semi-analytical BEM Analysis of A Row of Holes as Active Barrier in Saturated Soil” describes a 3D boundary element method (BEM) model that was corroborated with field testing data to evaluate the performance of active seismic barrier via array of holes. The analyses evaluated the influence of the size, depth, and spacing of the whole array for active seismic barrier. From these,

recommendations were made to effectively design and utilize active seismic isolation. The study has practical implications in areas such as seismic isolation of dynamic foundations and protection of infrastructures from seismic events. The paper “Approximate experimental simulation of clogging of pervious concrete pile induced by soil liquefaction during earthquake” describes the experimental study that aims to evaluate the clogging behaviors of pervious concrete pile. Pervious concrete pile accelerates pore water pressure dissipation during seismic events and improves the seismic performance of the foundation. Clogging of pervious concrete pile compromises its performance. This study conducted experiments to investigate factors affecting the clogging behaviors, including the effects of magnitude and frequency of seismic shaking, porosity of the pervious concrete, and spacing between piles. From the experimental results, a clogging model was proposed to assist the design of high performance pervious concrete pile foundation.

3) Technology for Infrastructure Condition Assessment

Three papers are included in this category. The paper “Effects of Bending Radius and Fiber-Crack Angle on Polymer Optical Fiber Loss for Potential Application in Pavement Crack Monitoring” describes the experimental study that ultimately aims to develop fiber optical sensors to monitor cracks in pavement. Experiments were conducted to characterize the behaviors of polymer optical fibers, whose energy loss due to different extent of bending and cracking angles were analyzed. The results of energy loss due to bending matched established models for fiber optical energy loss. The effects of cracking angles on the energy loss in the optical fiber were also evaluated, which potentially serve as the basis for calibration of pavement crack monitoring sensors. The paper “Detection of Concrete Structural Defects Using Impact Echo Based on Deep Networks” describes the development and application of machine learning model to analyze impact echo test signals to determine the existence of damages in concrete structure. The impact echo test signals are converted to images, and subsequently fed into the inputs of a Convolutional Neural Network (CNN). The CNN model was trained with labelled data to classify the impact echo signals according to the existence/nonexistence of structural defects. The results indicated that the analyses of the impact echo signals with the CNN machine learning model achieved high accuracy in determining the existence of structural defects. Overall, this study presented a new approach for impact echo signal analyses leveraging the progress in machine learning model. The paper “Automatic Vehicle Tracking with LiDAR-enhanced Roadside Infrastructure” describes a system to track vehicles using roadside lidar technology. The primary contribution was the development and implementation of computational algorithms that allowed to analyze Lidar data and track vehicles in the real time. The results indicated the developed algorithm achieved high computational efficiency in processing Lidar data.

4) Evaluation of pavement performance

Two papers are included under this category. The paper “Damage Evaluation of Poro-Elastic Road Surface with Low Polyurethane Content” describes an experimental program that characterized the dynamic responses and damage evolution of polyurethane based pavement materials. The specimens were subjected to cyclic loads, from which the dynamic modulus and energy dissipation were obtained. The development of internal damages was also characterized with X-ray computed tomography. Sensitivity analyses were conducted that led to an optimal mixture design recipe that demonstrated high resistance to damages. The paper “Sediment Transport over a Pervious Pavement under Surface Runoff: Mesoscopic Experiment and Modeling” describes a study program that aimed to evaluate factors responsible for clogging of porous pavement. An experimental program was implemented that evaluated clogging process due to factors such as the pavement geometry and slope, flow conditions, sediment conditions, and infiltration rate, etc. From these, major factors influencing pavement clogging were identified. The study also developed a computational fluid dynamics model coupled with discrete element model to simulate the clogging phenomena.

Overall, this collection of papers covers various topics in the development and application of testing methods and data analyses, which aimed to provide better solutions towards the durability and resilience of transportation infrastructure.

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