Tuesday 3/14/2017

1:15–2:45 p.m.

Roadway Materials, Monitoring and Testing 3

Chairs: Burak Tanyu, George Mason University; Bora Cetin, Iowa State University

Characterization of Geo-environmental Properties of Untreated or Cement Treated Recycled Base Materials in Pavement Base Layer Applications

Mohammad Faysal, Md. Sahadat Hossain, Saif B. Salah, and Sangeeta Bhattercharjee, University of Texas at Arlington; Boon Thian, Texas Department of Transportation; Md. Sadik Khan, Jackson State University

The use of Recycled flex-base materials such as Recycled Crushed Concrete Aggregate (RCCA) and Reclaimed Asphalt Pavement (RAP) are increasing considerably nowadays in pavement base layer applications. Increased use of these materials address the issues of depletion of natural resources and provide solution to the adverse effect on environment. The recycled materials utilized in this study was collected from the Texas Department of Transportation (TxDOT) approved sources. The properties of recycled base materials depend solely on the sources and their environmental aspects of using as base material needs to be analyzed. A comprehensive laboratory evaluation of geo-environmental properties of RCCA and RAP in untreated or cement treated condition were conducted in this study. The amount of RAP and RCCA varied from 0%-100% in the combination at 50% interval with cement content varying from 0% to 6% at 2% interval. The specimens were prepared at optimum moisture content and maximum dry density obtained from the test results. The geo-environmental tests included permeability and leaching tests. Leaching tests included pH, total and volatile dissolved solids, total and volatile suspended solids, turbidity and Chemical Oxygen Demand (COD). Tests results were compared with the requirements of different environmental protection agencies. The comparison of tests results indicated that the recycled base materials were environmentally sound alternative to regular virgin aggregates and can be used in pavement base or sub-base layer.

The Effect of Crushing of Unbound Granular Materials Forming Part of Flexible Pavement Systems

Luis Vallejo, University of Pittsburgh; Zamri Chik, University of Malaysia; Sebastian Lobo-Guerrero, AGES

Due to loading, granular materials forming the base of asphalt pavements experience crushing. After crushing, the fines produced in the granular materials move into their voids and causes an increase on the bearing capacity of the base. However, when the volume of the voids is decreased due to this fines migration, the hydraulic conductivity of the crushed material decreases. This change in the hydraulic conductivity of the material with time, may lead to failure of the pavement. Compression induced crushing and hydraulic conductivity tests were conducted on small gravels. In this study, the level of fragmentation of two kind of gravels (smooth and angular) was analyzed using fractal theory. The fractal dimension concept was used to evaluate the level of fragmentation of the gravels and it was correlated with their hydraulic conductivity values. The level of crushing in the gravels was also visualized using DEM.

Evaluating Railroad Ballast Degradation Trends Using Machine Vision and Machine Learning Techniques

Benjamin L. Delay, Maziar Moaveni, John M. Hart, and Erol Tutumluer, University of Illinois at Urbana–Champaign; Phil Sharpe, AECOM
Recently, Automatic Ballast Sampling (ABS) methods have been introduced to the railroad industry to obtain a sample of ballast and underlying layers. Currently, manual-visual classification methods are used by experts to identify fouling conditions and degradation trends in the collected ballast samples. This paper presents an innovative approach developed for objective classification of ballast degradation using the combination of machine vision and machine learning techniques. Initially, various computer vision algorithms were used to generate features associated with images of ballast cross sections at different degradation levels. Next, the generated features were used alongside a visual classification database provided by experts to develop, train, validate, and test a feedforward Artificial Neural Network (ANN) using a supervised learning method. This work was further extended by implementing Convolutional Neural Networks (CNNs) to serve as automatic feature generators. The findings of this study showed that the proposed CNNs with an optimized topology could successfully classify ballast fouling in an effective and repeatable fashion with reasonable error levels. Further improvement of this technology holds the potential to provide a tool for consistent and automated ballast inspection and life cycle analysis intended to improve the safety and network reliability of US railroad transportation system.

Interfacial shear properties of geosynthetic interlayered asphalt overlays

Vinay Kumar V., Sireesh Saride, and Pranav R.T. Peddinti, Indian Institute of Technology, Hyderabad
Hot mix asphalt (HMA) overlays are the most common and cost effective rehabilitation technique available to restore the serviceability of existing distressed pavement surfaces. It is often observed that within a short span of placing HMA overlays, the distress in the existing pavement surface reflect to the new overlay surface and this process is termed as reflective cracking. To reduce the effect of reflection cracks and to improve the performance of HMA overlays, the geosynthetic interlayers are placed at the interface of old and new pavement layers. The current study aims to understand the interfacial shear properties of geosynthetic interlayered HMA overlays placed on a distressed pavement surface. The interfacial shear properties are determined in the laboratory using a large scale interface shear test apparatus. The geosynthetic interlayers used in the current study are biaxial geogrids with varying material properties and aperture sizes and a geo-jute mat. The results indicate a reduction in the interfacial bond strength (shear) between the old and new pavement layers with the inclusion of geosynthetic interlayers at the interface zone. Among different types of geosynthetic interlayers used, the polymer modified polyester grid has shown least reduction (17%) in the interface bond strength. The maximum reduction of 46% in the interface bond strength was observed in the geo-jute mat interlayers.