ISSMGE TC 202, 1st China-Japan Mini Workshop

High Speed Railway Geotechnics

December 14, 2015

Multifunctional Hall, 3rd floor, Hongguoyuan Campus Hotel

Beijing Jiaotong University, Beijing, China

PROGRAM

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北京交通大學 Beijing Jiaotong University

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SCHEDULE

December 14, Monday, (45min for presentation, 15min for discussion)

Timetable	**Chairs**	**Presenters**	**Affiliation**	**Topic**
8:30am-8:45am	**Opening Address, Dean of the School of Civil Engineering Prof. Dingli Zhang, Chair: Prof. Jiankun Liu**			
Session 1: Cold Region Geotechnics				
Time	Chair	Presenter	Organization	Topics
8:45am-9:30am	Prof. Kimitoshi Hayano	Prof. Tatsuya Ishikawa	Hokkaido University	Addresses from TC202; Advanced lab tests on granular materials for transportation facilities in cold regions
8:45am-10:30am		Prof. Satoshi Akagawa	Hokkaido University	Frost Heaving in Ballast Railway Tracks
10:45am-11:00am	Coffee Break, Group photo			
11:00am-11:45pm	Prof. Kimitoshi Hayano	Prof. Jilin Qi	Beijing University of Civil Engineering and Architecture	Creep of Frozen Soils
12:00 Lunch at Hongguoyuan Hotel, 2nd Floor				

Session 2: High Speed Railway Geotechnics				
2:30pm-3:15pm	Prof. Jilin Qi	Dr. Yoshitsugu Momoya	Japan Railway Technical Research Institute	Geotechnical issues around ballasted track and slab track in Japan
3:30pm-3:45pm	Coffee Break			
3:45pm-4:30pm	Prof. Jilin Qi	Prof. Qianli Zhang	China Railway Academy	Design and Construction of Ballastless High Speed Railway in China
4:45pm-5:30pm		Prof. Kimitoshi Hayano	Yokohama National University	Lateral Resistance Characteristics of Sleepers in Railway Ballasted Tracks from Laboratory Model Tests
5:45pm-6:00pm	**Closing remarks, Prof. Tatsuya Ishikawa**			

INVITED DISTINGUISHED LECTURES

Professor Tatsuya ISHIKAWA, Hokkaido University
E-mail: t-ishika@eng.hokudai.ac.jp
Research interests: Unsaturated soil, Frost heaving, Granular material
Topic: Advanced laboratory tests on granular materials for transportation facilities in cold regions
Abstract: This research presents an experimental study to evaluate the synergistic effects of traffic loads and environmental conditions on the mechanical behavior of granular geomaterials like gravel and sand in order to examine the mechanism of cyclic plastic deformation of railroad ballast and roadbed subjected to cyclic moving wheel loads at a ballasted track in cold regions. The objectives of this research are as follows: (a) To examine the change in the mechanical behavior of granular base caused by freeze-thawing and concurrent seasonal fluctuations in water content, (b) To evaluate the effects of water content on the mechanical behavior of coarse granular materials subjected to moving wheel loads with high loading rate. For these purposes, in this study, three types of laboratory element tests were mainly performed with gravel and sand under unsaturated condition and/or saturated condition: (a) medium-size triaxial compression tests, (b) multi-ring shear tests (a torsional simple shear test), (c) freeze-thaw CBR tests. By comparing the results of the above-mentioned tests with those of small-scale model tests, the applicability to a laboratory element tests of granular geomaterials subjected to moving wheel loads, fluctuation in water content, and freeze-thaw history was examined. Furthermore, based on the test results, the influences of principal stress axis rotation, loading rate, water content, and freeze-thaw history on the deformation-strength characteristics of geomaterials were examined. As the results, it was revealed that change in water content as well as freeze-thawing seriously influences the bearing capacity of coarse granular materials, and that the synergistic effects of principal stress axis rotation and water content strongly influence cyclic plastic deformation of granular materials. Besides, it was shown that the loading rate has a strong influence on the deformation-strength characteristics of coarse granular materials in unsaturated condition. These findings lead to the conclusion that when developing a theoretical model for predicting the mechanical behavior of transportation facilities like railroad ballast and roadbed in cold regions and evaluating the long-term performance, it is important to give a

special consideration to the influence of water content, freeze-thaw history, loading rate, and principal stress axis rotation on the deformation-strength characteristics.

Professor Satoshi AKAGAWA, Hokkaido University
E-mail: akagawa@eng.hokudai.ac.jp
Research interests: Frozen soil
Topic: **Frost Heaving in Ballast Railway Tracks**
Abstract: Frost heave is a well-known phenomenon in cold regions. It may happen in the wet clayey ground in winter. The railway track upheaval which happens in cold regions during winter is generally understood as frost heaving in subgrade layer. However, it has been confirmed that the upheaval due to frost heaving sometimes happens in the ballast layer. This understanding has been observed in active railways in northern Japan. Samples have been collected from ballast and subgrade layers have been examined for their frost heave susceptibilities along with X-ray diffraction analysis and confirmed that ballast layers, which contain clayey minerals but fines consist of crushed ballast may heave. In other words, frost heaving of ballast layer happens not by fines originated by crushed rock forming minerals of ballasts. In this lecture the expansion mechanism of the ballast layer, which contains varying amount of fines, is discussed with frost heave tests results along with ice lens formation properties in ballast pores.

Professor Jilin QI, Beijing University of Civil Engineering and Architecture
E-mail: qijilin@lzb.ac.cn
Research interests: Geotechnical engineering in cold regions
Topic: Creep of Frozen Soils
Abstract: Creep is one of the most characteristic features for frozen soils. This work firstly examines the factors influencing creep of frozen soils, in comparison with creep of unfrozen soils. Field investigation to creep of warm frozen soils in embankments of the Qinghai-Tibetan highway has been carried out. State-of-the-art on constitutive modeling is demonstrated. It is suggested that the constitutive modeling on frozen soils is rather open. The authors and his colleagues have long pursuit on this task, including: a mechanical element model, a hypoplastic model as well as an attempt on a model based pre-consolidation pressure.

Dr. Yoshitsugu MOMOYA, Japan Railway Technical Research Institute
Research interests: Railway Track Structures
Topic: Geotechnical issues around ballasted track and slab track in Japan
Abstract: Design and construction of roadbed and subgrade supporting the railway track are important factor to maintain the track in the good condition. However, before the design standard was established in 1978 in Japan, the importance of the stability of subgrade and roadbed was not sufficiently recognized. Therefore, most of the existing lines do not have stiff roadbed and subgrade. As a result, in many places in Japan, we still have the problem in the maintenance of ballasted track such as excessive settlement or mud pumping. To overcome those issues, some new improving methods were developed to reduce the maintenance work of ballasted track. By contrast, for the new lines which were designed and constructed based on the design standard, asphalt roadbed became the standard structure for

the ballasted track. The asphalt roadbed effectively reduces the maintenance work of ballasted track. Regarding the slab track, it was firstly applied for Sanyo-Shinkansen opened in 1975. It was originally applied only on the viaducts or in the tunnels. However, by prescribing the performance of the subgrade and roadbed, it became possible to apply also on the embankment. Slab track on the earth structure was firstly applied extensively for Hokuriku-Shinkansen opened in 1997. Now the slab track became the standard track structure for the high speed line in Japan. In this presentation, the design method and some issues around roadbed and subgrade for ballasted tracks and slab tracks are introduced.

Professor Qianli ZHANG, Railway Construction Research Institute, China Railway Academy
E-mail: zhql@rails.com.cn
Research interests: Railway Engineering
Topic: Design and Construction of Ballastless High Speed Railway in China
Abstract: The design parameters for subgrade structure are analyzed the research history of HSR in China are summarize, experimental results of field test for subgrade state are presented also, base improvement method and its pile-net structure analysis are conducted, the quality control indexes of subgrade construction are compared and correlated, recommendations are made for practical use. The speedup history of the existing railway and the improvement measures are also summarized.

Professor Kimitoshi HAYANO, Yokohama National University
E-mail: hayano@ynu.ac.jp
Research interests: Geotechnical engineering Civil engineering materials
Topic: Lateral Resistance Characteristics of Sleepers in Railway Ballasted Tracks from Laboratory Model Tests
Abstract: Railway ballasted track sleepers have the important function of providing sufficient lateral resistance to prevent lateral movement of the rails. If the lateral force induced by the thermal expansion of the steel rails overcomes the lateral resistance of the sleepers, rail buckling may occur. More attention has been paid to this lateral stability problem since the introduction of continuous welded rails. However, there is a high degree of uncertainty in the prediction of the lateral resistance of sleepers. In view of the foregoing, a series of laboratory model tests were conducted on 1/5-scale models to evaluate the lateral resistance of the sleepers. At first, single-sleeper pullout tests and track panel pullout tests were conducted on different types of concrete sleepers. The results of the pullout tests revealed the effects of the sleeper shape and number of sleepers on the lateral resistance. Based on the above-mentioned results, as a second stage of research, angular folding of ballasted tracks at structure boundaries were physically simulated in sleeper pullout tests to see effects of folding on the lateral resistance of the sleepers. The test results showed that the angular folding at structure boundaries induced local displacements in the ballasted tracks so that the lateral resistance of the sleepers was decreased. The results also proved that the lateral resistance was depending on the conditions such as the folding angles and the number of folding.