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Editorial:

Towards safe and comfortable high-speed transportation infrastructure

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In the past decades, we have witnessed the rapid development of high-speed transportation infrastructure, such as high-speed railways, urban subways, expressways, and airfields worldwide. As a major effort in transportation infrastructure development, China plans to build 20 000 km of high-speed rail network by the year of 2020 with design speed up to 500 km/h. With such a fast pace, ensuring the safe and comfortable high-speed transportation presents major technical challenges to the design, construction, and maintenance of high performance infrastructure.

To achieve safe and comfortable high-speed transportation systems, innovations are necessary to further advance geotechnical engineering theory and technology. The uniqueness of high-speed transportation requires further advancements in vehicle-infrastructure-ground interaction theory, infrastructure settlement and control standard, ground improvement technologies, infrastructure health monitoring technologies, aseismatic performance of infrastructure, etc.

To address these challenging issues, the First International Symposium on Geotechnical Engineering for High-Speed Transportation Infrastructure (IS-GeoTrans) will be hosted in Hangzhou, China, from October 26 to 28, 2012, to provide a platform for international exchange of information and expertise. The theme of IS-GeoTrans2012 is "Safe and Comfortable High-Speed Transportation Infrastructure". It intends to provide a venture to discuss the challenges and critical issues in the development and maintenance of high-speed transportation infrastructure, and aims to catalyze the advancement in geotechnology and to prompt scholarly exchange.

We received many papers from experts all over the world. The contents of these papers include theory of vehicle-subgrade interaction, settlement of high-speed transportation infrastructure, environmental vibration induced by high-speed transportation, ground improvement technologies for settlement control, theory of shield-ground interaction, monitoring, evaluation and maintenance of infrastructure serviceability, and many other topics of interest. All papers were subjected to peer review to be published in the Proceedings of the IS-GeoTrans2012. In addition, high quality papers were selected and recommended, upon authors' consent, to be included in special issues of two international journals, namely *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)* and *Acta Geotechnica*. Nine high quality papers have been included in the special issue of the former. The following provides a brief highlight of major contribution of these papers.

Environmental vibration, maintenance, repair, and operations of high-speed rails

Four papers in the current special issue deal with high-speed ballast railways in USA, UK, Belgium,

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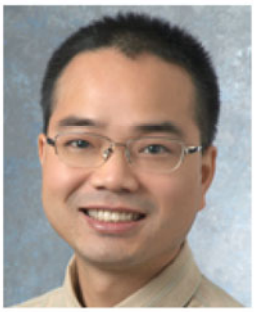

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and Finland from different aspects. Topics covered by these papers include environmental vibrations, long-term behaviors of ballast, railway bridge approaches, and maintenance methods for track geometry, which are among the most pressing issues in high-speed railway research.

Prof. DEGRANDE (Katholieke Universiteit Leuven, Belgium) introduces a hybrid prediction technique for estimating the environmental vibration caused by high-speed railways. In this method, the transfer functions are obtained from the in-situ experiments, and the track-soil system is modeled by means of a coupled 2.5D finite element-boundary element model. The input data for numerical predictions are extracted from experimental results such as the transfer functions, to reduce errors due to models and input data. This hybrid method was proved to greatly improve the accuracy in vibration prediction. Dr. BIAN (Zhejiang University, China) also developes a 2.5D finite element model to investigate the interaction between the underground tunnel and surrounding soils. The accuracy of the proposed analysis method is verified by a semi-analytical solution of moving rectangular load inside soil stratum.

The railway bridge approach tends to cause problem for high-speed rail operation such as the "bump" at the transition. High-speed railways set a high requirement on track smoothness. Optimal consideration of factors related to ballast and sub-ballast materials, dimensioning and design are necessary. To this end, Prof. TUTUMLUER (University of Illinois at Urbana-Champaign, USA) presents the research framework and initial instrumentation plan of an ongoing research that aims to identify different factors contributing to the development of differential movements at the bridge approaches. In their research, many instruments were installed under the ground layers and on the rails. The data will be used to develop new design methods to mitigate the differential movement problem at such transition. Prof. NURMIKOLU (Tampere University of Technology (TUT), Finland) presents an overview on the wide-range of rail track structures studied at TUT that deal with key aspects of track geotechnics, including ballast degradation (fouling), sub-ballast degradation and dimensions, and frost action in railway tracks. Note worthily, it was observed that the frost action can cause severe problems for the railway track. Besides, maintenances of railway to ensure comfort and safety were found to be costly and time-consuming. Prof. WOODWARD (Heriot-Watt University, UK) describes the application of in-situ polyurethane polymers, termed XiTRACK, to stabilize and reinforce ballasted railway track. Case studies are given on how this technique can be used to solve these types of long-standing issues at two typical critical sites, i.e., a junction and a transition onto concrete slab-track.

Soil improvement and embankment settlement control

The control of post-construction settlement is critical in the design of the embankment for high-speed traffic. Pile-supported embankment is widely used in express ways and high-speed railways over soft soils, to reduce the embankment settlement. However, there are very few researches on the improvements of soil consolidation by rigid piles. Dr. ZHOU (Macau University, China) presented a semi-analytical method for the analysis of pile-supported embankments in consolidating soils. It is found that it takes longer time for soil to consolidate for embankment supported with floating piles compared with that supported with end-bearing piles. Prof. PUPPALA (The University of Texas at Arlington, USA) studied two major types of distresses associated with ground deformation and their formation mechanisms. The remedial measures for addressing distresses to transportation infrastructure caused by ground settlement and heave are discussed.

Frost actions on transportation infrastructure

Frost actions can cause serious problems on transportation infrastructure. The design of high-speed infrastructure in cold region is very challenging. Prof. NURMIKOLU (TUT, Finland) introduces the experiences in cold region railway design in Finland and also presents a simple method for determining the frost-susceptibility of materials. Prof. YU (Case Western Reserve University, USA) studies the effects of frost action in accelerating traffic caused fatigue damages of pipelines. A multi-physics simulation model has been developed and extended to analyze the interactions between pipe-soil systems, especially when subjected to frost actions. The frost effects were found to have detrimental effects in accelerating fatigue crack initialization in pipes.

Ground settlement caused by shield tunneling

Ground settlement caused by shield tunneling always presents environmental concerns. Prof. HE (Southwest Jiaotong University, China) presents the field and model tests to investigate the surface settlement caused by shield tunneling in sandy cobble strata. Discrete element method (DEM) analyses are conducted to study the factors which can affect the forming of ground arch in sandy cobble strata at the microscopic level. Results show that the shape of the surface settlement curve due to tunneling in sandy cobble strata is different from that in the soft soil. The buried depth and clear spacing between two tunnels have significant impacts on the forming of ground arch.

Acknowledgements

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On behalf of the organizing committee, we appreciate all the supports from the keynote speakers, presenters, and symposium sponsors. These are indispensable for us to deliver a successful symposium. Thank you and we look forward to your participation at IS-GeoTrans2012.

Papers related to this editorial

Verbraken, H., Lombaert, G., Degrande, G., 2012. Experimental and numerical prediction of railway induced vibration. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, **13**(11):802-813. [doi:10.1631/jzus.A12ISGT8]

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Woodward, P.K., El Kacimi, A., Laghrouche, O., Medero, G., Banimahd, M., 2012. Application of polyurethane geocomposites to help maintain track geometry for high-speed ballasted railway tracks. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, **13**(11):836-849. [doi:10.1631/jzus.A12ISGT3]

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He, C., Feng, K., Fang, Y., Jiang, Y.C., 2012. Surface settlement caused by twin-parallel shield tunnelling in sandy cobble strata. *Journal of Zhejiang University-SCIENCE A (Applied Physics & Engineering)*, **13**(11):858-869. [doi:10.1631/jzus.A12ISGT6]