深地科学论坛（第二十五讲）：深地科学前沿热点问题探究

时间：2021 年 12 月 29 日 14：30-16：00

地点：腾讯会议直播（ID 号：718 317 6634）

报告人	报告人单位	报告题目
張　鋒	日本国立大学法人 名古屋工業大学	Research on mechanical behavior of piled raft foundation subjected to vibration loads with model test and numerical test (研究震动载荷作用下桩排基础力学特征的模型实验与数值实验)

欢迎全校教师及同学参加！

深部岩土力学与地下工程国家重点实验室

深部地下工程学科创新基地

《深地科学（英文）》

江苏岩土力学与工程学会

力学与土木工程学院

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报告人简介：

Dr. Feng Zhang is the professor of Nagoya Institute of Technology (NIT, National University Association, Japan) since 2005 and is also a Concurrent Professor of Tongji University since 2006. He got Ph.D. degree from Kyoto University in 1995. He served as the head of Civil Engineering Department of NIT during 2006 to 2008 and the director of Advanced Disaster Prevention Engineering Center of NIT during 2011 to 2014. He has published more than 130 top-level journal papers and is the recipient of the awards including the Best Paper Medal of Soils & Foundations (2002, 2011) and the Best Paper Medal of Japan Society of Civil Engineers (2007). His main research fields are Soil Mechanics; Rock Engineering; Seismic Engineering (Large Category) and the detailed research topics at current time are as follow:

- Constitutive modeling for saturated/unsaturated soils, soft rock and cemented treated soils
- Seismic evaluation of earth structures, Pile foundation, and soil-structure hybrid system
- Numerical analyses in geotechnical engineering
- Geologic repository of high-level nuclear waste
- High-precision modelling for sea bed rock and mechanism of Décollement

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报告摘要：

Research on mechanical behavior of piled raft foundation subjected to vibration loads with model test and numerical test

(研究震动载荷作用下桩排基础力学特征的模型实验与数值实验)

Piled-raft foundation (PRF) has been used in high-speed railway in China. If the design and construction of the foundation is done without taking proper precautions, then the vibration loads induced by the high-speed trains may cause excessive settlement of the foundation, significantly affecting the stability and safety of trains. To carefully examine the settlement mechanisms of PRFs constructed in different grounds subjected train loads, systematic 1 g model tests were conducted. The dynamic responses of PRFs in dry loose sand, medium dense sand, and saturated medium dense sand ground, subjected to different frequencies of sinusoidal vibration loads, were investigated. Additionally, reinforcement effect of cement-treated partial ground improvement (PGI) for dry loose sand ground, a commonly used countermeasure against settlement of PRF, was also investigated via model tests. It is found that the dynamic loading frequency affected the settlement of PRF, and the pattern of PGI reinforced at different depths of pile also significantly affected the settlement. The model test also showed that load-sharing ratio between pile and raft also changed significantly during vibration loading, implying that extensive precaution should be taken in design and construction of PRFs for high-speed railway constructed in soft ground.

As to a small scale 1g model test or at shallow surface ground, confining stress of soil is usually very small (less than 50kPa), in which the stiffness is known to be much higher than that at normal confining stress state. To accurately describe the mechanical behavior of sand at different confining stresses including very small one, Cyclic Mobility model was modified based element tests of Toyoura sand, in which for loose and medium dense Toyoura sand, isotropic consolidation and unloading tests covered the stress range from very small to normal value (5kPa~700kPa), were systematically conducted. It is found from the tests that at small confining stress, the stiffness of both loose and medium dense Toyoura sands in compressive stage is about 2.5 times of that at normal confining stress, while at unloading stage, the difference of the stiffness is about 3 times. Based on the test results, Cyclic Mobility model were modified to describe the mechanical behavior of Toyoura sand at small confining stress, while the main features of the original model under normal stress state is still kept valid. In the modification, a power function relation between void ratio and confining stress was adopted. Then, the modified model was incorporated into a FEM code named as DBLEAVES to simulate 1g model tests on piled-raft foundation subjected to vibration load, in which the accuracy of the proposed numerical method can be improved dramatically compared with the calculation based on the original model.