Young Members Column

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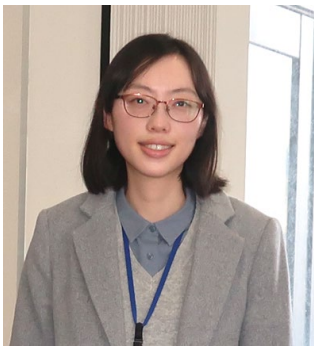

I am Xi Xiong from China. After graduating from Tongji University in Shanghai, I became a master's student at the same university. When I was in my first year of the Master's course, I came across an opportunity for a double degree program between Tongji University and Nagoya Institute of Technology. This became the moment for me to study in Japan. After graduation, I chose to continue my doctoral studies at Nagoya Institute of Technology.

During my study at Nagoya Institute of Technology, my research was focused on modelling the mechanical properties of unsaturated soil and its application to geotechnical problems. Generally, most geomaterials in surface ground are at the unsaturated state. This means that the grounds closely related to human activities are basically unsaturated grounds. The mechanical and hydraulic properties of unsaturated soil are considered to be much more complicated than those of saturated soil. However, after conducting many element tests on unsaturated soil, I realized that though the mechanical properties of unsaturated soil are complicated, they can still be described by a unified constitutive model. Using the unsaturated soil constitutive model, I found geotechnical problems, such as slope stability subjected to rainfall and seepage stability of a landslide dam, could be properly solved. Therefore, I believe unsaturated soil mechanics can be applied to a wider range of geotechnical problems.

Now I am working at Kanazawa University, Japan. Modelling of unsaturated soil is still an important research direction of mine. In addition to this, I have started to study the bearing capacity of pile foundations. Sheet piles are commonly used for retaining walls, land reclamation, and underground structures such as car parks and basements to provide temporary or permanent earth support. In recent years, efficient installation methods of piles have been developed, such as Silent Piler and Gyro Piler etc. Using these technologies, sheet piles can be installed with high accuracy and high-quality. To show the possibility to use sheet piles for permanent piled raft foundations, a series of model tests were conducted by my research group. And we found that a piled raft foundation supported by sheet piles would be a promising alternative to a conventional pipe pile foundation, especially in highly-seismic areas. The Second International Conference on Press-in Engineering 2021 held by IPA gave me a very valuable opportunity to present this work.

I began to think about the relevance of my different research directions. For a friction pile, shaft and base resistance together constitute its bearing capacity. The performance of a friction pile is a problem of structure-soil interaction. For the rational design of pile foundationss, not only the properties of the piles but also the mechanical behavior of soil is important. At present, pile foundations are normally designed to extend principles of saturated soil mechanics assuming fully drained conditions. As I mentioned above, the grounds closely related to human activities are basically unsaturated grounds and part or all of the pile foundations are in the unsaturated ground. In some regions, the fluctuation of groundwater table in a year is very significant, which means the changes in the mechanical behavior of soil are also significant. The performance of piles installed in the unsaturated ground could be also influenced by the fluctuation of the groundwater table. Therefore, using saturated soil mechanics to design a pile foundation could overestimate or underestimate its bearing capacity. To investigate how the properties of unsaturated soils influence the performance of pile foundations, I recently started a new research project. I hope my work can promote the application of unsaturated soil mechanics in geotechnical engineering, and provide a reference for the design of pile foundations in the future.