

Various methods for permeability evaluation of Edogawa layer in Tokyo

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Many Japanese cities are located in alluvial lowlands and diluvial uplands. Abundant groundwater in permeable soils, such as sand and gravel, is a serious challenge in deep excavation works. Cut-off walls and dewatering methods have been commonly used to overcome the difficulty in such situations.

It is necessary to examine depth of cut-off wall in deep excavations. Groundwater is drained out of the excavation area in dewatering method so that the excavated bottom is stabilized. Dewatering cost and environmental impacts increase with quantity of groundwater drained out of excavation area.

Selection of appropriate dewatering methods and equipments, and their influence area is directly linked with soil permeability. Therefore, permeability evaluation is the most important step before the selection. Soil permeability is evaluated at site using pumping test with two or more wells, and single borehole permeability test.

Although, pumping tests require higher cost and longer time, they are the most reliable ones since spatial permeability values are obtained from them. The single borehole permeability test can be easily carried out in ground investigation, but the results are inferior in case of comparatively high permeable soils.

Standard penetration test is carried out at every meter depth in ground investigation, and various methods are used for permeability evaluation using particle size data of the obtained soil samples. Creager method (Creager et al., 1945), which applies relation between 20% particle diameter (D₂₀) and permeability, is often used in construction field. In spite of the simplicity of this method, its accuracy is reported to be same as that of single borehole permeability test.

Excavation works exceeding 30-m depth have increased in central Tokyo area. There could be many cases in dealing with Edogawa layer in this area and this tendency is not expected to change. The authors used the above-mentioned various methods until now to evaluate permeability of the Edogawa layer (sand bed) in central Tokyo area, and the following results were obtained:

- (a) Permeability of Edogawa layer using pumping test was in the order of 10⁻³ cm/s.
- (b) Permeability values obtained from single borehole pumping test were one order smaller than that from pumping tests.
- (c) Permeability values of four soil layers obtained from pumping tests and Creager method were compared. The differences in values were about 20% for soil samples at 1-m depth. The differences decreased with the accuracy of sampling points.
- (d) Out of the four soil layers mentioned above, Multi-layer pumping test method (Kohsaka and Miyake, 2000), which has been considered the best method for multi-layered soil, was adopted for three soil layers out the four mentioned above. The average N values of the Edogawa layer was about 100.

References

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