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Numerical Assessment of the Permeability for the Pleistocene Sand Gravel Deposits Considering the Subsurface Stratigraphy of KIX

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1. Introduction

A series of elasto-viscoplastic finite element analyses is performed to assess the permeability of the Pleistocene sand gravel deposits considering the subsurface stratigraphy of KIX. The geologically genuine foundation model that has the inclined base overlain by the inclined Pleistocene deposits with irregular thickness is adopted for the numerical analysis (Fig.1). Due attention is paid to the fact that the sand gravel layers drastically change in thickness horizontally. The most serious problem originating from these sand gravel deposits is the “permeability” that controls the rate of consolidation of sandwiched Pleistocene clays. In the present study, the numerical procedure in terms of elasto-viscoplastic FEM to evaluate the long-term behavior of the Pleistocene deposits at KIX is proposed by introducing the concept of “mass permeability” and “standard hydraulic gradient”. The validity of the procedure is carefully discussed by comparing the performed results with the in-situ measured results.

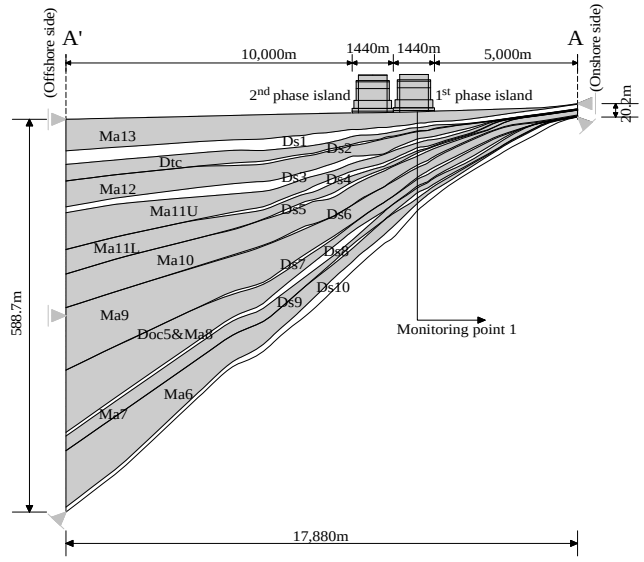

Fig.1 Geologically genuine foundation model of KIX for finite element analysis.

2. Concept of “mass permeability” and “standard hydraulic gradient”

The concept of “mass permeability” is proposed to evaluate the permeability not of each element but of the whole layer in one body. It is regarded as the macroscopic capability of permeability for the individual sand gravel layers by considering the horizontal continuity, the change in thickness and the degree of fine contents of them. On the basis of the assumption that the hydraulic gradient derived in the initially developed horizontally uniform foundation model with constant thickness is regarded as the standard one for the individual Pleistocene sand gravel layers, the evaluated mass permeability can be the representative of the capacity of permeability for the individual Pleistocene sand gravel layers at KIX. The concept of “mass permeability” is hence applied to the geologically genuine foundation model for the coupled stress-flow analysis.

3. Conclusion

The proposed numerical in terms of the coupled stress – flow analysis is found to well reproduce the representative permeable capacity of the Pleistocene sand gravel layers at KIX by comparing the calculated results. On the basis of these findings, it is expected that the representative permeable capacity of the Pleistocene sand gravel layers at KIX can be applied to the other review sections and the numerical analysis can be performed for the more simple foundation model as far as the clay layer at the monitoring point is precisely modeled.