Delft Cluster

Experimental and numerical investigation into the installation of displacement piles in sand

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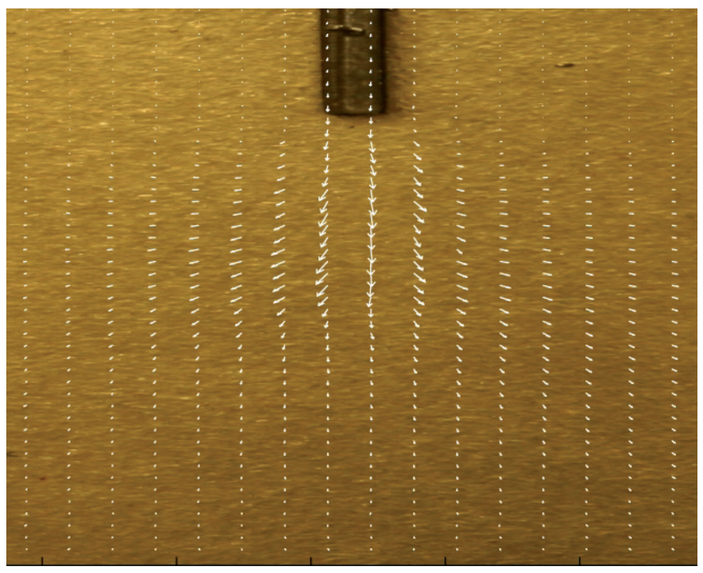
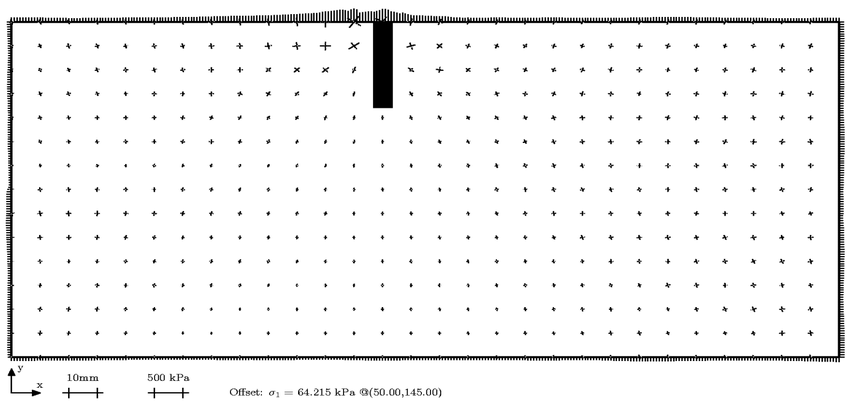
The reason for the research

With the increasing use of finite element methods for the design of pile foundations in practice, it becomes necessary to improve the accuracy of the pile bearing capacity predictions of these methods. Especially for displacement piles which distort and compact the soil surrounding the pile during the pile installation phase it is not trivial to predict the bearing capacity. In addition to the the actual pile loading phase also the pile installation phase needs to be incorporated in the numerical simulation. Therefore it is important to not only study the load-displacement behaviour of the pile head, but to also quantify the soil behaviour near the pile if current finite element analysis has to be improved and to be validated.

The plan of the project

Experimental and numerical investigation into the soil behaviour near a jacked displacement pile in sand during installation. The experimental work consists of model pile tests in a photoelastic setup in which the changes in soil density and the soil stresses can be quantified. Also a series of geocentrifuge tests will be performed in which the change in soil density is measured. These tests will lead to a better understanding of the mechanisms in the soil during pile installation. Subsequently these new insights are used to validate and improve upon current constitutive models, e.g. hypoplasticity, incorporated in a numerical framework capable of large deformations.





The results of the project

Experimental: Initial photoelastic model pile tests are performed, the first encouraging tests lead to the realisation of an improved photoelastic model setup. A series of centrifuge tests is performed in cooperation with GeoDelft which yielded novel insights in actual volumetric soil behaviour near a displacement pile during installation.
Numerical: It is shown that the combination of the Eulerian numerical framework and the hypoplastic model is feasible. Furthermore this combination yields numerical simulation capabilities never seen before in the foundation engineering practice.