VISUALIZATION OF PILE RESPONSE UNDER LATERAL LOADING

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The response of pile under lateral loading is a very important concern for engineers to design offshore structure platforms, secant-pile walls, and pile-supported bridge abutments, etc. Hetenyi [1] derived the differential equations for the beam-column on a foundation, which was then used by engineers to analyze the pile response under lateral loading. This was also the basis for implementation of p-y method developed later. There have been many experiments performed on full-sized piles, where strain gauges were bonded to the pile along its length to measure the deformation and bending moment. These curves were then differentiated or integrated to get experimental p-y curves. But since the soil is opaque, the real response of pile under lateral loading can not be visualized. If the real response of a pile can be visualized, this will provide the researchers and engineers a clear view how the pile behaves under lateral loading.

In this paper, we designed an experiment to visualize the response of pile under lateral loading using image analysis and transparent soil model. Transparent soil is made of silica gel and appropriate pore fluid. It has been studied by Iskander and his colleagues ([2], [3], [4], and [5]). Their testing data proved that silica gel has the similar characteristics as natural sand. In our experiment, transparent soil was put into a 1ft $\times$ 1ft $\times$ 1.5ft Plexiglas container. A 3/4-inch diameter aluminum pile was installed into the transparent soil model. Lateral load was applied to the pile head through a force meter.

We studied the response of the pile during the process of applying the static lateral load first and then releasing the load. Digital camera was used to capture the image of the model in this experiment. The images were analyzed by the cross-correlation method. The deflection of the pile was obtained from the image analysis. In order to transform the displacement from the image to the object coordinates, a simple camera calibration algorithm was also presented in this paper.

References

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