INTRODUCTION

Efforts to solve problems associated with pile foundations have been made over the past century. Such advances include the use of corrosion protective coatings on piles used in marine environment and usage of micropiles in areas where conventional piles are impractical. However, there are still challenges that need to be overcome. This study dwells on one of such challenges; down-drag on piles caused by negative skin friction (NSF).

1. Background

NSF occurs when the soil adjacent the pile moves downward relative to the pile. The downward movement of the soil causes friction within the pile-soil interface. This induces a dragload force to the pile, which if huge enough, causes a downdrag and subsequent failure of the pile. An instance where NSF occurs due to a compressible fill causing the adjacent soil to consolidate is illustrated in figure 1.

2. Objective and Scope

The need for good predictions of downdrag forces is to ensure safer designs of piles. In this study, researched techniques were used to predict the downdrag force to be experienced on a pile in a group. The predicted values were then assessed against the actual values recorded on a test site in Bothkennar, Scotland. The test site was a group of nine friction piles driven into soft clay upon which a compressible fill was later overlain. The predictions were made for the profile of force with depth a year after setup of the piles. To aid in the prediction of downdrag, the following were also predicted:

- Initial pore pressure response
- Initial settlement of the ground surface
- Excess Pore Pressure distribution a year later
- Consolidation Settlement a year later

3. Prediction Technique

The initial pore pressure was predicted using the Boussinesq’s solution while the initial settlement was obtained by applying Hooke’s law after obtaining a modulus for the soil. The excess pore pressure and consolidation settlement were predicted using the Terzaghi’s one dimensional consolidation theory. From the results of the predictions above, the downdrag forces were obtained by multiplying the effective stress by a skin friction factor. A reduction factor was then used to take into account the group effects.

Owing to the shortcomings of the first four predictions, the downdrag forces predicted were not accurate. The prediction for the downdrag forces were recalculated using values closer to the observed values of the initial four predictions. The results of both predictions and the analysis are shown in figure 2.

4. Conclusion and Recommendations

The prediction overestimated the downdrag forces. This was more pronounced at the 13.2 m depth with overestimations of 72 % and 88 % for the initial and recalculated predictions respectively.

The following are recommended for further study:

- Application of this prediction technique after studying the possible reduction of effective stress due to pile group effects
- Development of other analysis to predict downdrag forces more accurately

References: