Commentary to: Prediction, testing and analysis of a 50 m long pile in soft marine clay-Journal of the Deep Foundations Institute, 13,(2) 1-7

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Commentary

This paper presents an excellent illustration of the best practice for installation and testing of a long displacement pile in soft clay to minimize installation disturbance. This loading test is also a good case study for the application of the SHANSEP-based approach described by Saye et al. (2013) and corresponding LRFD calibration of the SHANSEP-based approach by Stuedlein et al. (2020).

The site is in central Gothenburg (Goteburg), Sweden underlain by about 5 m of urban fill followed by about 90 m of nearly normally-consolidated marine clay. Edvardsson and Pettersson (2018) present an extensive profile of constant rate-of-strain (CRS) oedometer tests at the site exhibiting an over-consolidation ratio, OCR, near 1.0 at shallow depth increasing to about 1.2 at the bottom of the marine clay at a depth of about 95 m. An average OCR = 1.05 is assigned by the Discussers’ for the soils alongside the test pile.

The 275 mm square, precast, concrete pile was driven in 4 sections and nearly continuously in one day (Edvardsson and Pettersson, 2018). The first two sections penetrated the ground under the weight of the pile and hammer. Limited disturbance of the side resistance due to long delays and partial pile set up during installation would be expected.

Fellenius et al. (2019) state the test pile was allowed to set up for about 7 months before testing to achieve nearly full dissipation of excess pore water pressure induced by driving the displacement pile. This is consistent with the results of piles tested over time at the Gothenburg central railway station reported by Fellenius (1955), near the pile presently under discussion.

Fellenius et al. (2019) present two interpretations of the load transfer for this test pile: (1) load transfer discretized into four segments of unequal length with β-coefficients ranging from 0.42 to 0.19, with a corresponding weighted average calculated equal to approximately 0.25, and (2) load transfer described using a single β-coefficient of 0.19 considered by the authors as most representative for the largely homogenous, nearly normally-consolidated clay given the presence of the anticipated residual load. Based on an average OCR = 1.05, the Discussers calculate β = qs /σvo = 0.194(OCR)0.71 = 0.20 using the SHANSEP-based approach, in which qs = unit side resistance and σvo = vertical effective stress (Saye et al. 2013; Stuedlein et al. 2020) as shown in Fig. 1. Note that if the average OCR was assumed equal to 1.0, β = 0.194. Damaging effects of pile installation described by Saye et al. (2020) were not present in this pile case history, resulting in a good comparison of the test result and the calculated β = 0.2.

At 50 m, the pile is longer than most piles in the empirical record used to develop the SHANSEP relationship. The reported load test shows that an adjustment for pile length is not needed for this 50 m long pile when the SHANSEP-based approach is used. Saye et al. (2020) advocate that an adjustment to reduce the capacity of long piles such as Semple and Rigden (1984) is not merited, and further described how the β-coefficients embedded in the Semple and Rigden (1984) adjustment are related to the re-driving of segments of long test piles and load testing of incrementally longer piles than the great length of the test piles themselves.

References


Figure 1. Comparison of the β-coefficient reported by Fellenius et al (2019) to the data underpinning the revised, reliability-based SHANSEP side resistance approach proposed by Stuedlein et al. (2020) for piles installed using best practices (Saye et al. 2020).
Fellenius, B. (1955). “Results of Tests on Piles at Gothenburg Railway Station.” No. 5 Geotechnical Department, Swedish State Railways.


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