DISCUSSION

Reply to the discussion by Mesri on "Field study of pile – prefabricated vertical drain (PVD) interaction in soft clay"[1]

Dongli Zhu, Buddhima Indraratna, Harry Poulos, and Cholachat Rujikiatkamjorn

The authors appreciate the Discusser for his comments, suggestions, and interest in this research. In this Reply, the Authors would like to provide clarifications regarding the points mentioned by the Discusser (Mesri 2021).

Clarification regarding the meaning of the straight dashed line in Fig. 3

The Authors agree that the meaning of the straight dashed line in Fig. 3 is not entirely clear. As pointed out by the Discusser, Mesri (1975) proposed eq. R1 to estimate the undrained shear strength of soft clay based on preconsolidation pressure.

$$(R1) \qquad S_{u(mob)} = 0.22\sigma'_p$$

This equation has been widely accepted in geotechnical engineering practice to establish a lower bound of undrained shear strength for normally consolidated soil. By comparing the lower bound of undrained shear strength based on eq. R1 and the interpreted undrained shear strength based on cone penetration test (CPT) results, a verification check can be performed on the interpretation of the undrained shear strength. In addition, the offset between the interpreted and the lower bound of undrained shear strength can be used to qualitatively assess the overconsolidation ratio of the soft soil.

Clarification regarding the meaning of "interpreted undrained shear strength"

The interpreted undrained shear strength profiles from CPTs conducted at six different locations were employed to produce the average interpreted undrained shear strength profile shown in Fig. 3.

The undrained shear strength profiles were interpreted based on eq. R2 recommended by Lunne et al. (2002)

$$(R2) \qquad S_u = \frac{q_t - \sigma_{vo}}{N_{kt}}$$

where S_u is the undrained shear strength; q_t is the corrected CPT cone resistance; σ_{vo} is the vertical overburden stress; N_{kt} is the bearing factor for net tip resistance, for which a value of 16.5 was used then calibrated against the field vane test results reported by Zhu et al. (2020) and Kelly et al. (2014) at the same site.

The typical undrained shear strength estimated by Mesri and Kane (2018) at 6 m depth is approximately 15 kPa, which reasonably agrees with the average interpreted undrained shear strength profile plotted in Fig. 3.

It is worth noting that the interpreted average undrained shear strength is less than the lower bound of the undrained shear strength predicted by eq. R1 (the straight dashed line in Fig. 3) between 11 and 12 m below ground surface. This can be attributed to the increasing organic content at this depth.

Clarification regarding the preconsolidation profile

Based on the CPT test data and eq. R3 recommended by Lunne et al. (2002), the overconsolidation ratio can be calculated as

$$(R3) \qquad OCR = k\left(\frac{q_t - \sigma_{vo}}{\sigma'_{vo}}\right)$$

where OCR is the overconsolidation ratio; k is an empirical factor typically ranging from 0.2 to 0.5; q_t is the corrected CPT cone resistance; σ_{vo} is the vertical overburden stress; σ'_{vo} is the effective vertical overburden stress.

The equivalent average preconsolidation pressure between 2 and 12 m below ground surface ranges from 45 to 75 kPa. At 6 m below ground surface level, the average estimated preconsolidation pressure is 63 kPa, which agrees with the value of 64 kPa assessed by Mesri and Kane (2018).

References

Kelly, R.B., O'Loughlin, C.D., Bates, L., Gourvenec, S.M., Colreavy, C., White, D.J., et al. 2014. In situ testing at the National Soft Soil Field Testing Facility, Ballina, New South Wales. Australian Geomechanics Journal, **49**(4): 13–26.

Lunne, T., Powell, J.J., and Robertson, P.K. 2002. Cone penetration testing in geotechnical practice. CRC Press.

Mesri, G. 1975. New design procedure for stability of soft clays. Journal of Geotechnical and Geoenvironmental Engineering, **101**(4): 409–412.

Mesri, G. 2021. Discussion of "Field study of pile – prefabricated vertical drain (PVD) interaction in soft clay". Canadian Geotechnical Journal. [In this issue.] doi:10.1139/cgj-2020-0368.

Mesri, G., and Kane, T. 2018. Discussion of site characterisation of the Ballina field testing facility. Géotechnique, **68**(5): 459–462.

Zhu, D., Indraratna, B., Poulos, H., and Rujikiatkamjorn, C. 2020. Field study of pile – prefabricated vertical drain (PVD) interaction in soft clay. Canadian Geotechnical Journal, **57**(3): 377–390. doi:10.1139/cgj-2018-0873.

D. Zhu. Golder Associates, North Sydney, NSW 2060, Australia.

B. Indraratna.* Transport Research Centre, University of Technology Sydney, NSW 2007, Australia; ARC Training Centre for Advanced Technologies in Rail Track Infrastructure (ITTC-Rail), University of Wollongong, NSW 2522, Australia.

H. Poulos. Coffey Services Australia, 799 Pacific Highway, Chatswood, NSW 2067, Australia.

C. Rujikiatkamjorn. School of Civil and Environmental Engineering, University of Technology Sydney, NSW 2007, Australia; ARC Training Centre for Advanced Technologies in Rail Track Infrastructure (ITTC-Rail), University of Wollongong, NSW 2522, Australia.

Corresponding author: Buddhima Indraratna (email: buddhima.indraratna@uts.edu.au).

*B. Indraratna served as an Associate Editor and C. Rujikiatkamjorn served as an Editorial Board Member at the time of manuscript review and acceptance; peer review and editorial decisions regarding this manuscript were handled by G. Siemens.

[1]Appears in the Canadian Geotechnical Journal, **58**(5): 747 (2021) [dx.doi.org/10.1139/cgj-2020-0368].