# Response of Modified Helical Piles with a Collar Vane Subjected to Overturning Moment

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## INTRODUCTION

Roadside signs are usually supported by reinforced concrete shafts as recommended by DOTs. Constructing these elements can require different resources and it is a time-consuming process (see Fig. 1). For single-post mounted signs, DOTs often recommend shafts with diameters of 18" and 24" and lengths of 5.5' and 7', respectively.

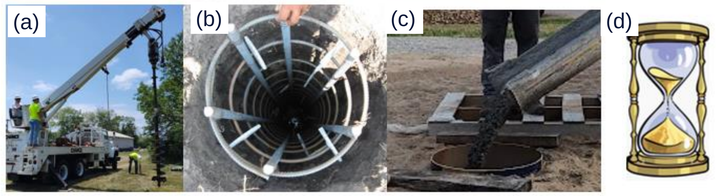


Fig. 1. Construction sequence of Typical Details.

A Helical pile (HP) is a highly efficient and cost-effective deep foundation element. Research has shown that by using a Collar Vane (CV), the lateral and torsional capacity of a HP can be increased substantially [1]. However, for sign structures, the foundation design is controlled by the wind-induced overturning moment. In this study, the response of modified HP with a CV subjected to overturning moment is explored and compared to those typical details.

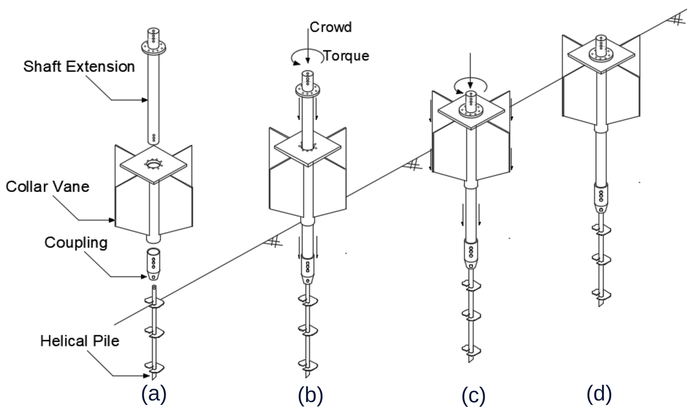


Fig. 2. Collar Vane installation sequence.

## ACKNOWLEDGEMENTS

## EXPERIMENTAL PROGRAM

- Helical piles were installed and tested in a medium-stiff clay in Centralia, MO.
- Helical piles were instrumented with five strain gauges pairs distributed along the shaft to measure bending.
- A moment arm (see Fig. 3) was used to apply a constant shear (≈6 kN) and variable moment at the pile head.
- Instruments to measure the applied load and deformations were employed as shown in Fig. 3.

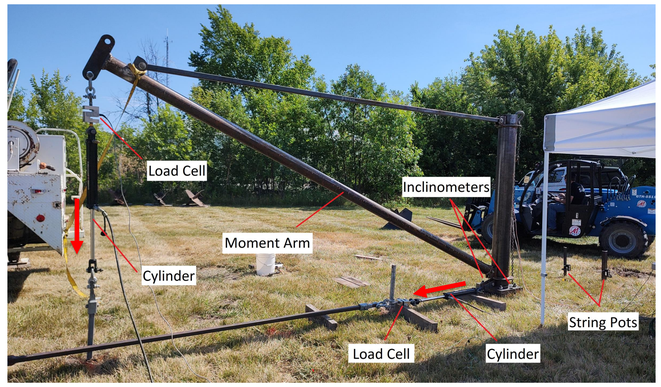


Fig 3. Moment arm and instrumentation used.

## RESULTS

- Fig. 4 shows the pile head deflection produced by the applied overturning moment of both modified HPs and typical details. The response of the HPs with CV is comparable with those of the typical details.
- Fig. 5 depicts the typical bending moment profiles on the HP shaft extension. The bending moment is substantially reduced due to the incorporation of a CV.

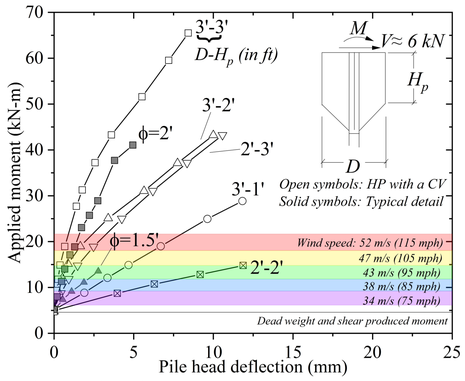


Fig 4. Pile head deflection vs moment for different CVs in clay.

- Fig. 6 compares the maximum measured bending moment on the shaft against the applied overturning moment. The capacity of the CV to reduce the bending moment on the shaft increases with its size.

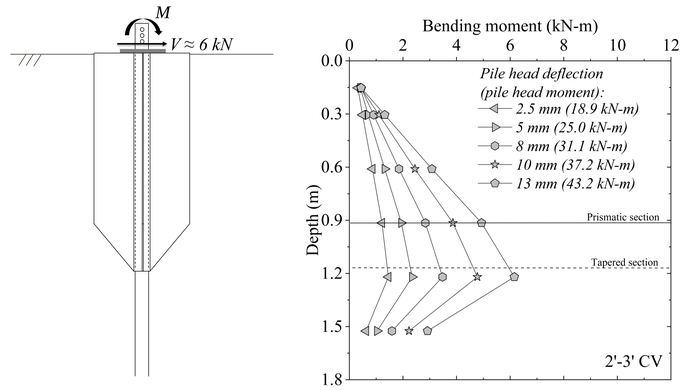


Fig 5. Typical shape of the bending moment profiles for a HP with CV.

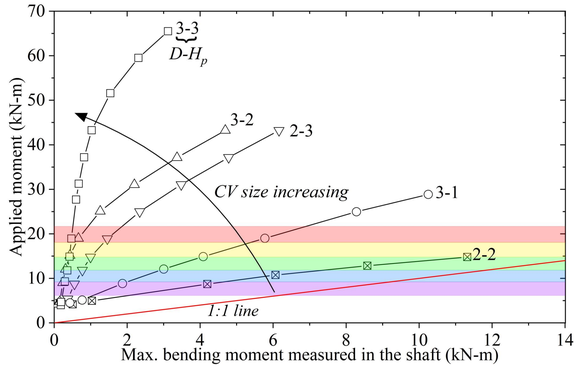


Fig 6. Max. measured bending moment vs applied moment.

## CONCLUSIONS

- Due to the advantages of helical piles and the easy installation of the Collar Vane, modified helical piles offer important practical benefits compared to typical concrete shafts.
- Modified helical piles with a Collar Vane comprise a potential alternative and solution to support roadside signs structures.
- The bending moment on the shaft is effectively reduced by the Collar Vane, even when supporting a high overturning moment.

## REFERENCES

[1] Carvajal Munoz, Juan Sebastian, "Performance of Helical Piles Retrofitted with a Novel Collar Vane Under Lateral and Torsional Loads" (2023).