

# Lateral and Torsional Resistance of Helical Piles using a Novel Collar Vane

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## INTRODUCTION

A Helical pile (HP) is a deep foundation element designed to support axial loads. However, due to its limitation to support lateral and torsional loads, it cannot be used to support structures like mast arm traffic signs or signal poles. To overcome this limitation, a Collar Vane (CV) is attached near the head of the HP to increase torsional and lateral passive resistance.

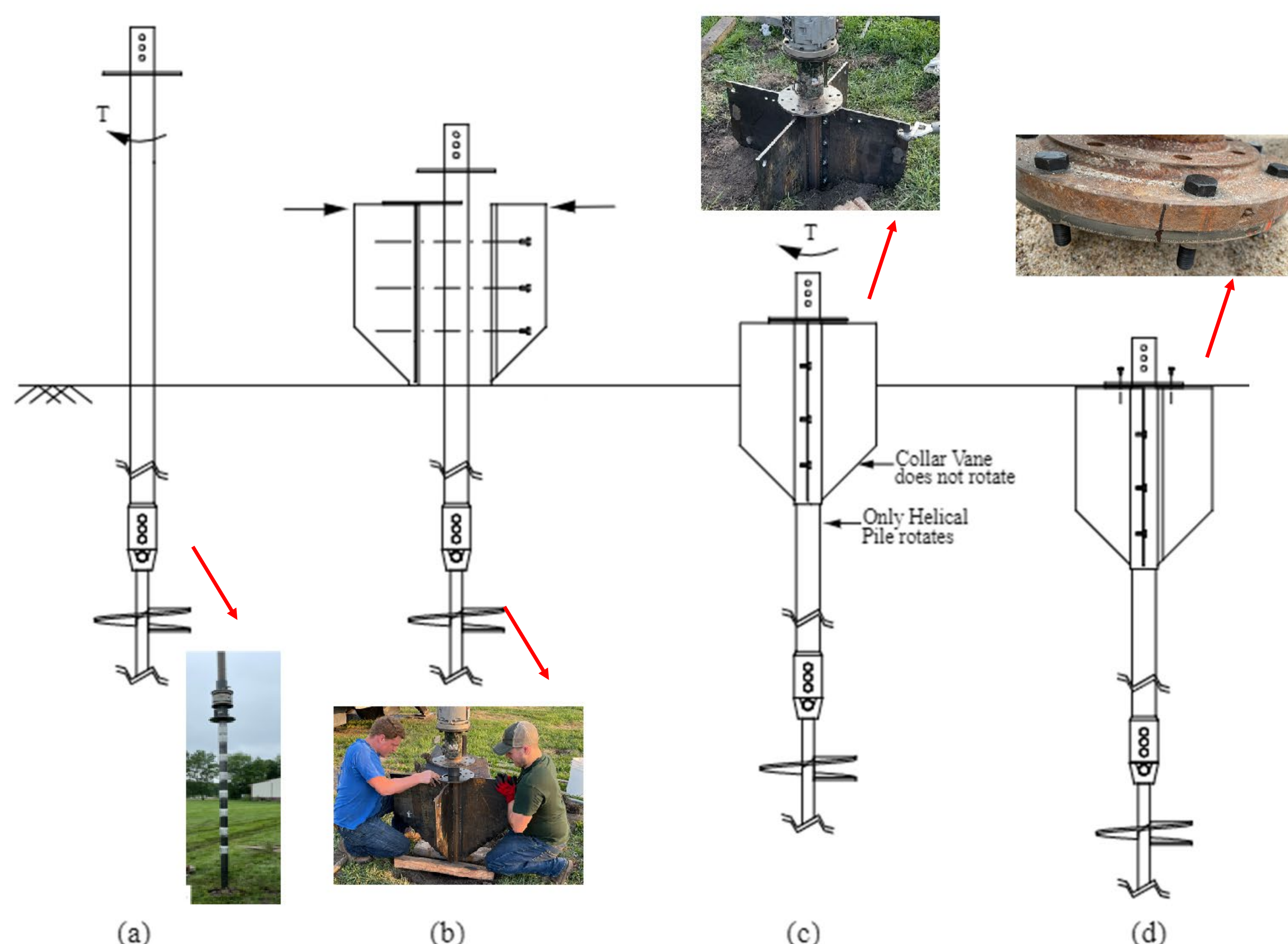


Fig. 1. CV installation sequence into HP

## EXPERIMENTAL PROGRAM

- Helical pile was installed and tested in a medium-stiff clay in Centralia, MO.
- A quick load procedure was used to complete the testing program in a timely manner.
- Helical pile was instrumented with eight strain gauges locations along the shaft to measure bending.
- A 3-m long loading arm was used to apply pure torsional loads as shown in Fig. 2.

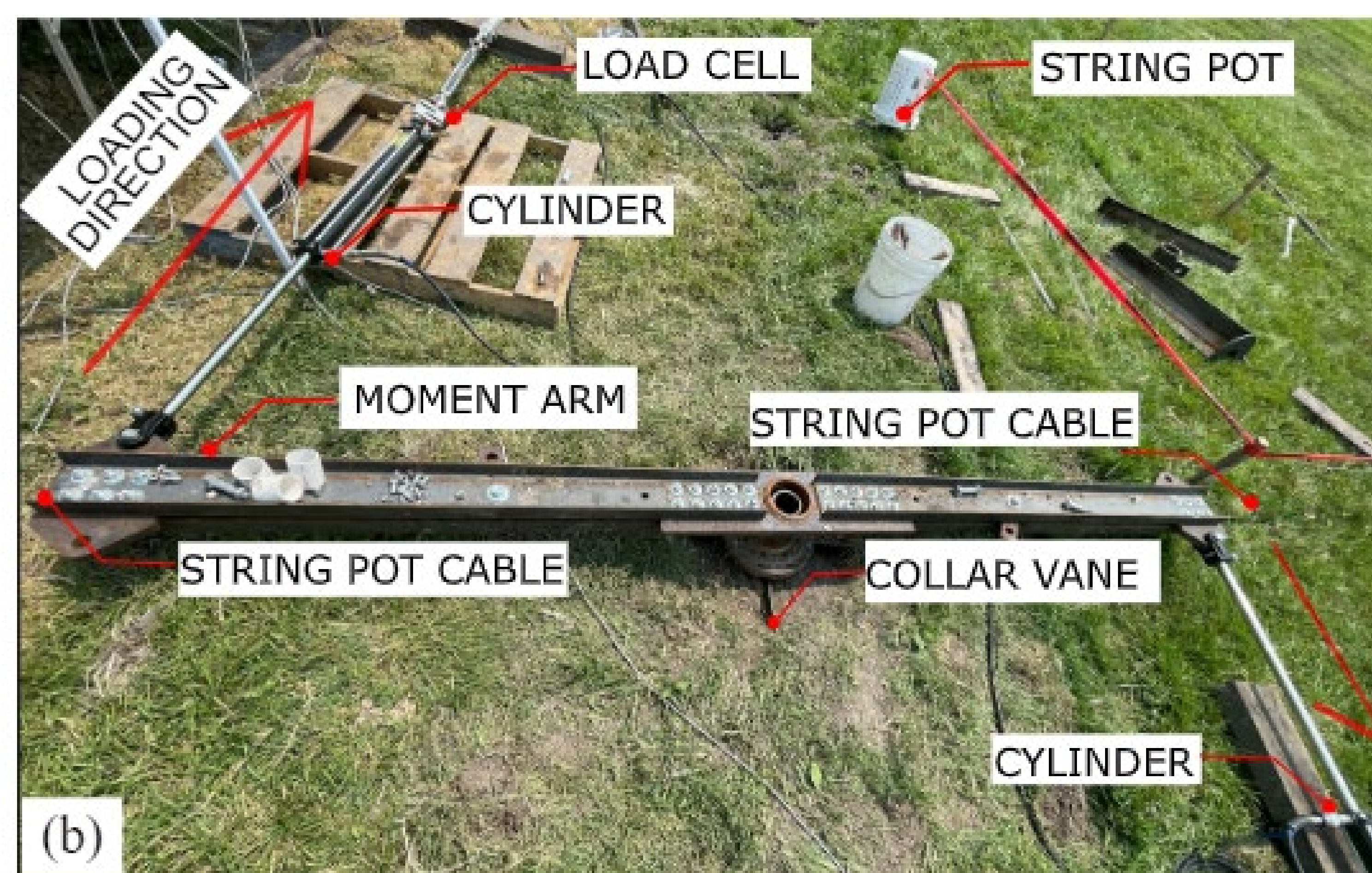


Fig. 2. Loading arm used in torsion test program.

## RESULTS AND ANALYSIS

- Fig. 3a. shows lateral-deflection response. As CV size increases, it is required to apply more force to displace pile due to increment in lateral passive resistance.
- Fig. 3b. shows normalized force required to displace HP 10 mm.

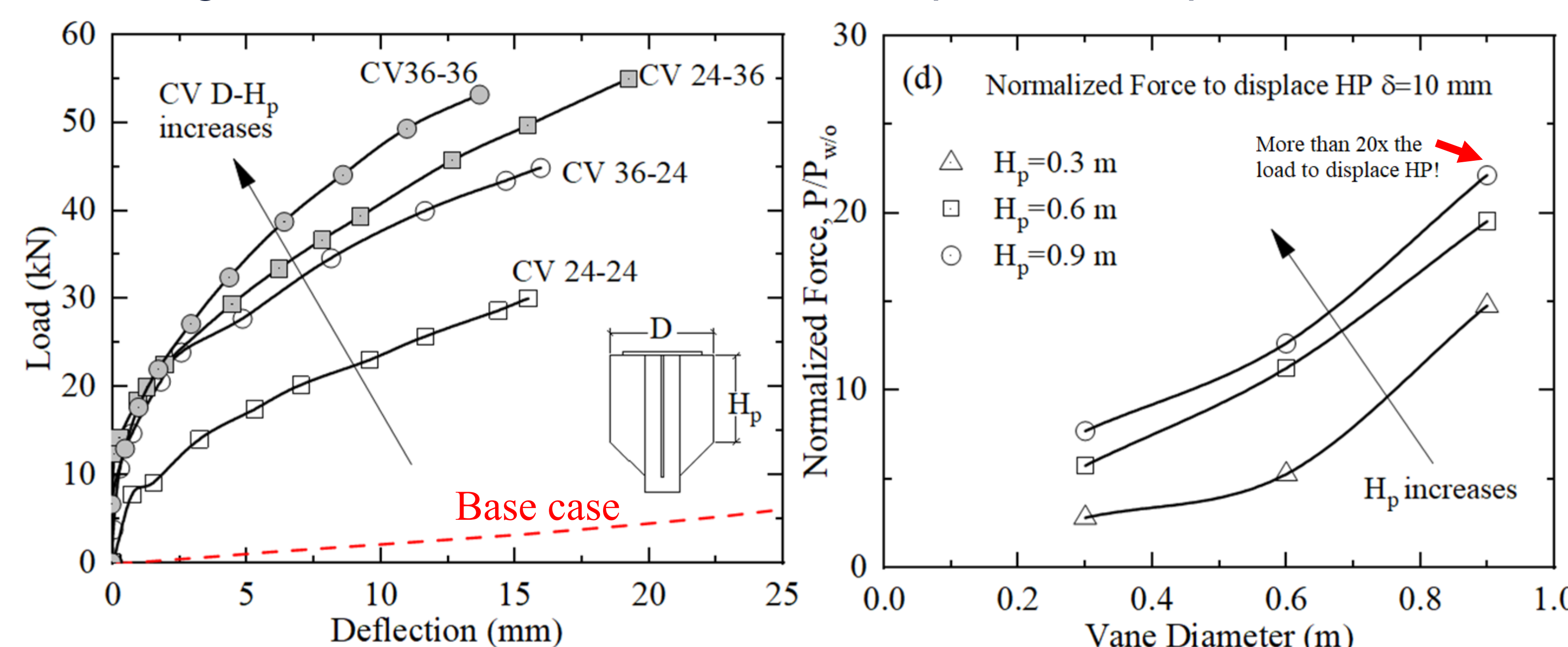


Fig. 3. Bending moment profile for two Collar Vanes. Reduction in moment observed

- Reduction in bending moment (Fig. 4) values due to CV was observed by limiting the pile displacement and thus, eliminating the need of shafts with bigger diameters.
- The torsional capacity of HP is effectively increased by the CV as shown in Fig. 5. Due to the increment of torque required to mobilize shear resistance around CV.

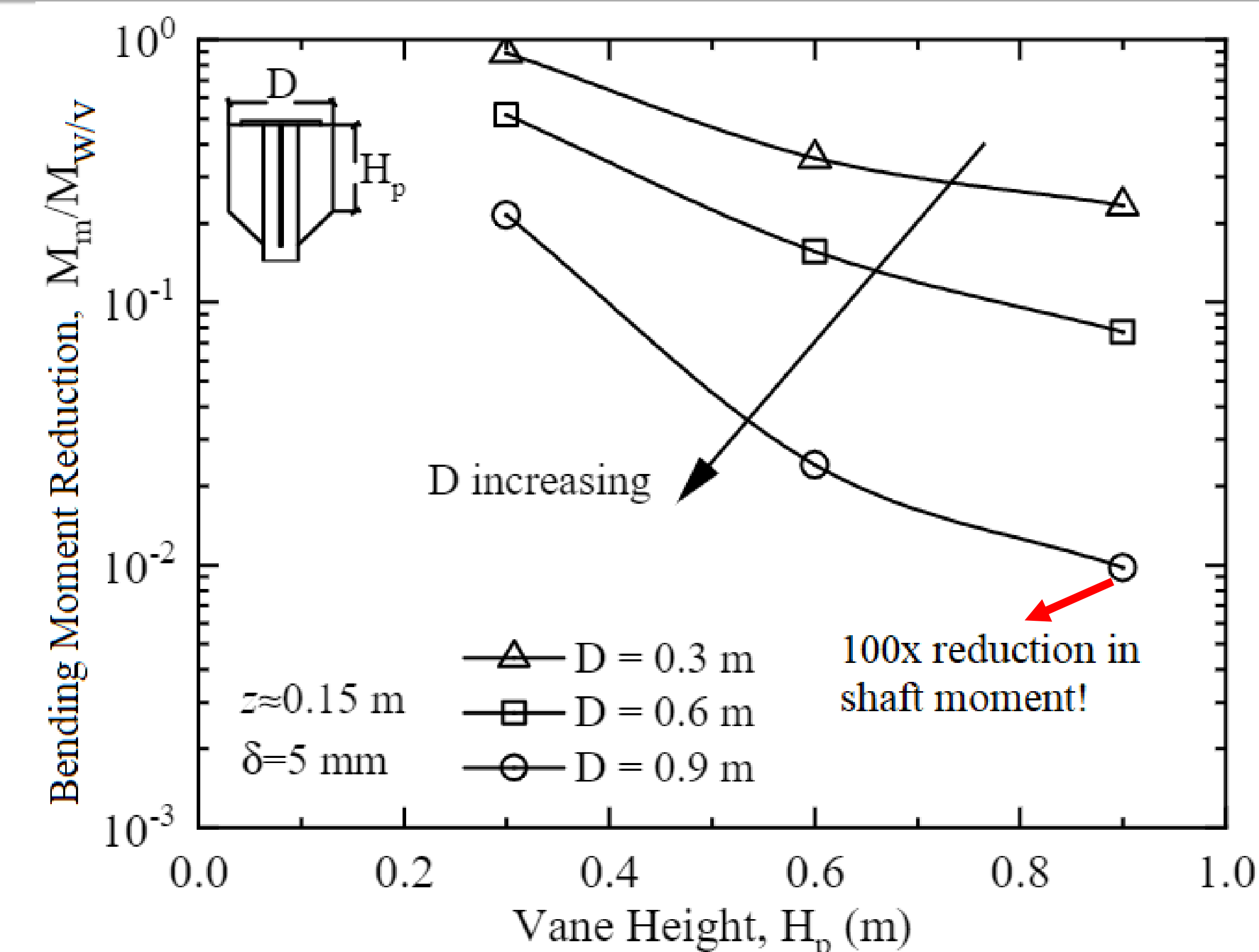


Fig. 4. Vane Resistance in CV 3-3 (36x36in) carrying 85% of the load at 15 mm displacement.

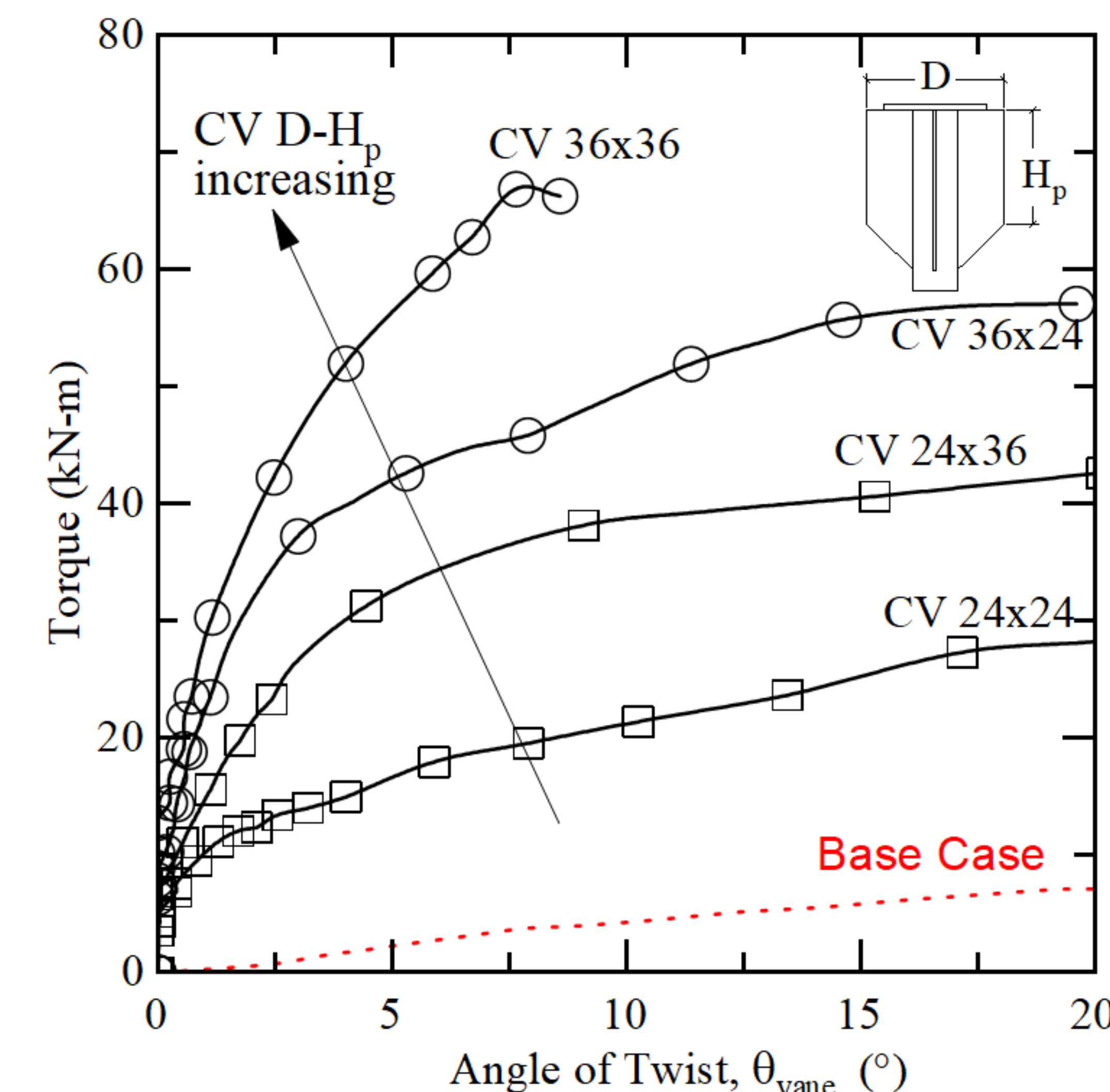


Fig. 5. Torsional resistance vs Rotation for different diameters.

## CONCLUSIONS

- Usage of HP provides construction and design advantages (inexpensive, easy to install).
- Resistance is transferred through the flange; reducing shaft moments and giving more efficient pile properties.
- Vane located at shallow depths where piles mobilize most lateral resistance: more efficient pile design.

## ACKNOWLEDGEMENTS



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