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The Effect of Increased Tip Area of Suction Caissons on the Penetration Resistance Coefficients

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Abstract : The installation process of caissons has usually been a challenging step in the design phase, especially in the case of suction-assisted installation. The engineering practice for estimating the caisson penetration resistance is primarily controlled by the resistance governed by inner and outer skirt friction and the tip resistance. Different methods have been proposed in the literature to evaluate the above components, while the CPT-based methodology has attained notable popularity among others. In this method, two empirical coefficients are suggested, k□ and kp, which relate the frictional resistance and tip resistance to the cone penetration resistance (q□), respectively. A series of jacking installation and uninstallation experiments for different soil densities were carried out in the offshore geotechnical laboratory of Aalborg University, Denmark. The main goal of these tests was to find appropriate values for empirical coefficients of the CPT-based method for the buckets with large embedment ratio (i.e., d/D=1, where d is the skirt length and D is the diameter) and increased tip area penetrated into dense sand deposits. The friction resistance effects were isolated during the pullout experiments; hence, the k□ was back-measured from the tests in the absence of tip resistance. The actuator force during jacking installation equals the sum of frictional resistance and tip resistance. Therefore, the tip resistance of the bucket is calculated by subtracting the back-measured frictional resistance from penetration resistance; hence the relevant coefficient kp would be achieved. The cone penetration test was operated at different points before and after each installation attempt to measure the cone penetration resistance (q□), and the average value of q□ is used for calculations. The experimental results of the jacking installation tests indicated that a larger friction area considerably increased the penetration resistance; however, this effect was completely diminished when foundation suction-assisted penetration was used. Finally, the values measured for the empirical coefficient of the CPT-based method are compared with the highest expected and most probable values suggested by DNV(1992) for uniform thickness buckets.

Keywords : suction caisson, offshore geotechnics, cone penetration test, wind turbine foundation
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