INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: A Study on Response and Capacity of Monopod Bucket Foundations Supporting Offshore Wind Turbines in Sandy Soils

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SHORT ABSTRACT

With the increasing demand for renewable and environment friendly energy, wind turbine farms are moving seaward due unavailability of suitable land locations, noise pollution produced, visual impact on the natural environment, and availability of stronger and stable wind speeds. Offshore wind turbine foundations are subjected to large lateral forces arising from wind forces and water currents and the vertical self-weight loading is substantially lesser.

This thesis presents the results of three-dimensional finite element analyses of bucket foundations embedded in medium dense and very dense sandy seabeds, considering the non-linear behaviour of the soil. Under vertical compressive loading, the response of bucket foundation was investigated for three diameters (12, 15 and 18 m), each having three aspect ratios (0.5, 0.75 and 1.0). The effects of skirt length and soil plug of the bucket foundation were investigated by comparing the vertical response with that of surface circular foundation and embedded solid foundation, respectively. Based on the results, predictive equations have been proposed for the bucket foundation to determine the ultimate vertical bearing capacity and settlement under superstructure load.

Under lateral loading, same geometries of bucket foundation were analysed under lateral loads. The superstructure load ranged from 5 to 15 MN. The hub height was taken as 100 m and the lateral loading height was varied from 0 to 100 m. For a given loading height and superstructure load, the ultimate lateral capacity is observed to increase with increasing value of either bucket diameter or skirt length. Increasing bucket diameter shows greater influence on the ultimate lateral capacity as compared to skirt length. The influence of superstructure load on ultimate lateral capacity keeps on decreasing with an increase in bucket skirt length. Interaction diagrams of lateral load and overturning moment capacity at various loading heights have been represented graphically for serviceability limit state, fatigue limit state, worst expected transient load limit state, and ultimate limit state. Finally, predictive expressions have been proposed for the depth of point of rotation, initial stiffness, ultimate lateral capacity and allowable capacity of bucket foundations in medium and very dense sands.