

Performance of a Mono Bucket Foundation – A Case Study at Dogger Bank

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This paper presents the results from the measurements of a mono bucket foundation supporting a met mast at Dogger Bank, which is the location of a future wind farm. The foundation is installed at a water depth of 23 meters and in soil conditions with layers of dense sand and stiff clay. The mono bucket foundation has a diameter of 15 meters and a skirt length of 7.5 meters. The presented data are the water surface elevation, the inclination of the bucket lid, and the generation of excess pore pressure inside the bucket, which contain data from a half year of measurements. The measurements show that the structure has been exposed to more than one severe storm. This paper describes the behaviour of the mono bucket foundation in terms of rotation and excess pore pressure generation. The measurements are used to identify the general behaviour of the full-size mono bucket foundation and show evidence of the presence of suction pressures generated during impact loads, which creates undrained moment and uplift forces.

INTRODUCTION

In September 2013 a mono bucket foundation was installed at Dogger Bank, supporting a meteorological measuring mast, which in the industry is referred to as a met mast (see Fig. 1). The purpose of the erection was to collect data concerning the environmental conditions at the location, which is used in the design of a wind farm.

A mono bucket foundation consists of three parts: the skirt on the bottom, the lid in the middle, and the shaft on top, as shown in Fig. 2. A platform was mounted on top of the shaft, on which the met mast was fixed. In order to document the behaviour of the foundation, various transducers were installed on the mono bucket foundation and platform. Only the transducers from which measurements are used in this paper will be presented here: wave radar, pressure transducers, inclinometers, and accelerometers. The location of the pressure transducer is shown in Fig. 2.

The wave radar is mounted on a platform at the top of the shaft and measures the distance to the water surface. The pressure transducers, inclinometers, and accelerometers, from which data are presented, are all mounted on the lid of the foundation. The pressure transducers are mounted below the lid in order to measure the pore pressure in the soil inside the mono bucket foundation. The inclinometers and accelerometers are all installed on the top side of the lid. The accelerometers are mounted on both the lid and the platform.

On September 23, 2013 data collection of the measurements of all transducers started, and the results shown in this paper are from the first half year after installation.

THE PROJECT AREA

Dogger Bank is a sand bank in between Great Britain to the west and Denmark to the east (see Fig. 1). The water depth or



Fig. 1 Location of Dogger Bank. West of Dogger Bank is Great Britain and east is Denmark.

lowest astronomical tide (LAT) at the location is measured to 23 meters. The soil conditions were investigated by Cone Penetration Test (CPT), and at the position of the mono bucket foundation are layers of very dense sand and stiff clay (see Table 1).

The installed mono bucket foundation has a diameter of 15 meters and a skirt length of 7.5 meters; therefore, the skirt tip is located in stiff clay. After installation, the foundation is fully sealed, which implies that dissipation of excess pore pressure can occur only through the soil.

The water surface elevation is measured by the wave radar. The measured surface elevation is depicted in Fig. 3. The data shows a 12-hour tidal variation in the water surface elevation. By the removal of the tidal effects a clearer picture of the wave conditions is obtained, and the surface elevation without tidal variation is given in Fig. 4. From these figures it is possible to detect storm events, and such events occurred in October and December 2013. From the October storm the surface elevation ranges from approximately -5 meters below the mean water level to +15