Proceedings of the Eighteenth (2008) International Offshore and Polar Engineering Conference
Vancouver, BC, Canada, July 6-11, 2008
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ISBN 978-1-880653-70-8 (Set); ISBN 1-880653-68-0 (Set)

Use of Suction Piles for Temporary Mooring of Immersed Tunnel Elements

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ABSTRACT

An underwater vehicular tunnel is currently being built in southern Korea with immersed pre-cast concrete elements. The pre-cast tunnel elements will be left floated until they are ready for permanent installation. Suction piles will be used to temporarily moor these concrete tunnel elements. The design, construction, installation, and proof testing of pre-cast concrete suction piles are briefly described.

KEY WORDS: immersed tunnel, temporary mooring, suction piles; pile installation.

INTRODUCTION

An immersed vehicular tunnel, 3.24 km long, is currently being built in southern Korea as part of a new 8.2 km highway connecting Busan, the second largest city in Korea, and Geojedo, an island that is home to two major shipyards. Fig. 1 shows a bird's eye view of the entire highway. The tunnel section of the highway is located at the far right end. The underwater tunnel will consist of 18 immersed pre-cast concrete elements with each element being 180 m long. Each tunnel element will have eight segments that will be constructed separately and joined later. Each segment has a width of 26.4 m, length of 22.5 m, and height of 10 m. A total of 144 segments are therefore necessary to complete the immersed tunnel.

The tunnel elements are constructed on-shore and left floated (six tunnel elements at a time) until they are ready to be installed. Figs. 2 and 3 show photos of tunnel element being built in a dry dock and being towed to be moored. Therefore, temporary mooring of these six tunnel elements is inevitable. Initially, embedded deadweight concrete anchors with its top surface being flush with the seafloor surface were considered to provide the necessary resistance against the mooring line tension. However, due to environmental concerns associated with the potential contamination and damage that may be caused by underwater excavation or dredging to nearby aqua farms, it became evident that an alternative foundation system needed to be introduced. The alternative foundation system should not include seafloor soil excavation and could be retrieved later after the completion of the entire tunnel construction. Since suction piles could satisfy these requirements, they were chosen as the foundation system to provide necessary resistance against the mooring line tensions. Fig. 4 shows how the six tunnel elements will be moored to 14 suction piles.

Fig. 1 Geoga Highway with Two Bridges and Immersed Tunnel

This paper briefly describes the design, construction, installation, and proof-testing of the pre-cast concrete suction piles that provide necessary resistance for the mooring of immersed tunnel elements.

SOIL CONDITIONS

The seafloor consists of predominantly silty clay extending to an average thickness of 7 meters. Below the silty clay layer, 1.0 – 1.7 m thick sandy gravel underlain by weathered rock exists. The properties