Proceedings of the Eighteenth (2008) International Offshore and Polar Engineering Conference
Vancouver, BC, Canada, July 6-11, 2008

ISBN 978-1-880653-70-8 (Set); ISBN 1-880653-68-0 (Set)

Application of Grouting the Sea-Crossing Bridge foundation in the Busan-Geoje Fixed Link

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ABSTRACT

During construction of a sea-crossing bridge grouting was used to fill densely the space between the bottom of caisson and the ground. This grout mixture was mixed with anti-washout admixture after locating accurately the pre-cast caisson on three concrete landing pads. This method differs significantly from the costly conventional method, for bridge foundations offshore, where concrete is placed in situ after excavating inside of a temporary concrete coffering wall. To verify the grouting method in advance, the full-scale field tests were performed twice on land. After identifying the fluidity of the grout material to be filled, finding some possible problems with the main construction and

revising the original design, the main construction has been continuing successfully with 20 caissons completed to date. The purpose of this paper is to introduce for the first time in Korea the grouting method including the automatic and the manual monitoring system based on the main construction of the caisson foundation. This method is expected to be used in the near future for a similar construction projects.

KEY WORDS: Full-scale field test, Caisson Foundation, Mortar grout, Self-Leveling, Monitoring System.

INTRODUCTION

The Busan-Geoje Fixed Link, total length of 8.2km, in extension of the 58th local rode connected Gaduk island, Busan to Jangmokmyon Geoje, Gyongnam Province, consists of a cable stayed bridge and an immersed tunnel. The bridge, total length of 4,219.5m, consists of a cable stayed bridge, which is planed to be built between primary temporary sea route LOT2, second temporary sea route LOT1 and a junction bridge as shown in Fig.3. Beside the main tower, all parts (caisson, pier, upper slab etc) were planed to be pre-cast on land and to be moved to the site and then assembled step-by-step. As showed in Fig 4 and Fig.5, 23 caissons (LOT1 for 12, LOT2 for 11) were located on three landing pads and the space beneath the caisson was filled with the anti-washout grout to unify the caisson and the space.

SELECTION OF FOUNDATION TYPE

Concrete caisson foundation were selected based on the site conditions and the illustrations and were designed to transfer all upper load to the ground through the caisson and to place three of concrete pads due to a rough ground surface made by excavating. The space between the bottom of caisson and the bedrock would need to be filled completely with an anti-wash grout placed underwater to transfer enough the upper load to the bedrock through it.
The caisson slab size ranges from 11m x 17.5m to 41.0m x 20.25m in 11 different types. The biggest caisson, shown in Fig.1, LOT2-P5, was planed to be filled the maximum space of 65cm, in the range of +20cm to –30cm of the planed excavating level, with the grout based on the final design depth, as shown in Fig.2.

MIXING DESIGN AND TESTS

To be satisfied simultaneously durability and constructability of the grout for filling of beneath the caisson, it has been designed to be mixed a slag cement with the anti-washout agent and the AE water reduction agent to resist segregation and to make better filling.
For the mixing design, it was evaluated target strength based on Korea Concrete Standard and defined design strength by the equation as the following and then laboratory test was performed and considered 90days design strength as 28days strength for safety

$$F_{28}=(15/0.8) \times 1.25 = 23.4(MPa) \quad (1)$$

The specified mixing design in the laboratory tests for the grout was reproduced in the batch type plant and it was checked the physical properties and the physical alteration in time. The results of tests for a basic quality of grout, such as strength, air contents, pH, turbidity, slump flow, in each agent with different companies, are shown in Fig.6. Variation of slump flow was displayed in a little difference with different companies but maintenance effect of slump flow until 5 hours was suitable. Also turbidity and pH were displayed less 50mg/l and 12.
And also 5.5% of initial maximum air content was higher than the standard. Generally the grout with an anti-washout agent shows the reduced initial strength due to the retarded setting time and the reduced mature unconfined strength due to segregation during placing it in the water.