

Centrifuge testing for the design of ship impact protection of Incheon Bridge Project

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ABSTRACT

For the protection of the bridge against ship impact, 20~30m diameter circular cells (dolphin) are considered in design for Incheon Bridge Project. To analyze the dynamic behavior of dolphins during impact, 3D dynamic FEM analysis is carried out. Centrifuge testing is applied for the verification of these FEM analyses. Total 31 number of Centrifuge tests were successfully carried out with the variations in model diameter, relative density of infilling material, velocity of ship impact and position of impact. The paper describes the experimental model test plan, the results of the tests and comparisons of test results as well.

KEY WORDS: Centrifuge; ship impact protection; dolphin.

INTRODUCTION

The Incheon Bridge is 12km long bridges to connect Yongjong Island and Songdo-city(main land), consists of approach bridge, viaduct bridge and 800m span length cable stayed bridge which crosses the navigational channel to Incheon Harbor. The significant ship traffic to the harbor will pass the bridge alignment through the main span and this exposes the bridge structures to the risk of ship impact (100,000 tons DWT).

Incheon Bridge includes external ship impact protection of the 8 piers on the main bridge closest to the navigational span. The protection consists of an arrangement circular sheet pile cofferdam-denoted dolphins- deeply embedded in the seabed, filled with crushed rock and closed at the top with a robust concrete cap (Fig. 1~2). The dolphins are sacrificial structures that will be partly or fully destroyed in a severe ship impact. The verification of the stopping capability of the dolphins is the key of the design, involves consideration of significant

deformations and non-linear FEM modeling has been used to document the dissipation capability of the structures together with experimental verification of FEM modeling. Experimental model tests for large deformations were carried out by a series of 31 centrifuge tests in the Geocentrifuge of Geodelft.

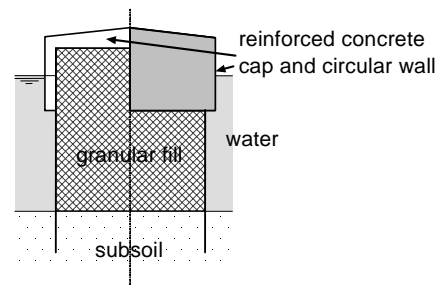


Fig. 1. Schematic cross-section of a dolphin.

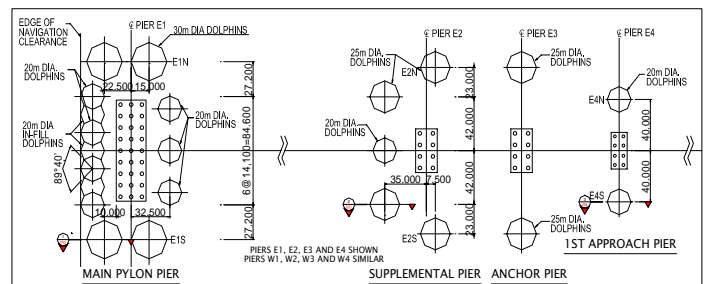


Fig. 2. Plan of ship protection arrangement for eastern part of the bridge (illustrative arrangement for Tender).