Velocity Factor Determination Test of Pneumatic Fenders

Shigeki Sakakibara, Shuu Yamada,
Industrial Products Technical Department, The Yokohama Rubber Co., Ltd.
Hiratsuka, Kanagawa, Japan

ABSTRACT

The pneumatic fender roles an energy absorber for safe ship berthing and mooring in the usage of ship-to-ship oil and gases transfer operations at offshore and ship-to-jetty in harbor basin. In this paper, the velocity factor in performance and its determination procedures are demonstrated by conducting dynamic and static compression tests.

KEY WORDS: Pneumatic fender; performance; velocity factor; ship berthing; ship-to-jetty; ship-to-ship; dynamic compression.

INTRODUCTION

A Pneumatic fender, which is filled with a pressurized air inside the fender body, is used as an energy-absorbing device and a spacer to keep a proper stand-off distance for ship-to-ship transfer operation at offshore (OCIMF(Oil companies international marine forum); 1995, 2005) and for ship-to-jetty usages during ship berthing and mooring at ports and harbors. The pneumatic fenders are basically composed by outer rubber, reinforcement synthetic tire cords and inner rubber. The synthetic-tire-cords layer is designed to have enough strength to achieve the minimum endurable pressure and the rated performance. There are two kinds of pneumatic fenders, floating type pneumatic fender and fixed type one. For the floating type pneumatic fenders, the ISO code, ISO17357 that specified the material, performance (reaction force and energy absorption/ minimum endurable pressures), dimensions and inspection methods was issued in 2002 to keep the quality of the fenders ( ISO17357; 2002, S.Sakakibara and et al; 2003), and is referred to the OCIMF guidelines (OCIMF; 2005). On the other hand, a guideline for the design of fenders systems was also published by PIANC (International Navigation Association) in 2002 (PIANC; 2002). The guideline describes the recommended procedures for testing, reporting and verifying the performance. Velocity and temperature factors were added to the previous edition in 1984 as the main revised points to evaluate the performance based on the actual usages of the fenders. The compression velocity for establishing the rated performance data (RPD) was 0.0003-0.0013 m/s (2-8cm/s) in constant-slow in the previous edition, however that was changed to be 0.15m/s at the initial deflection velocity under linearly-decreasing or sinusoidally decreasing deflection velocity, except for the cases of ship-to-ship operation and/or spacer purpose between ship and ship or jetty because the velocity factor was considered to be comparatively small in the actual vessel berthing conditions. On the other hand, the performance of pneumatic fenders for temperature variations is stable when the initial internal air pressure is set to be the specified rated pressure.

Repeatedly the effect of velocity factor for the pneumatic fenders is described in the PIANC guideline that all pneumatic fender performance, except for ship-to-ship operation and/or spacer purpose, shall be defined under linearly-decreasing or sinusoidally decreasing deflection velocities to simulate actual vessel-berthing conditions. However the procedures to determine the velocity factors are not mentioned in details. So we conducted the velocity factor determination tests for the floating type pneumatic fenders and the fixed ones. In this paper, the velocity factors and its determination procedures for pneumatic fenders are demonstrated. Furthermore the property of the velocity factors is investigated. The description and discussion is mainly demonstrated for the floating pneumatic fenders due to the limitation of the space, but same investigation was done for the fixed type pneumatic fenders.

TEST METHOD AND PROCEDURES

Basic Construction and Performance of Pneumatic Fenders

The floating type pneumatic fenders are composed by outer rubber, reinforcement synthetic tire cords and inner rubber as shown in Fig.1.