INTRODUCTION

It is well known that tendon fatigue is due to high-frequency tensions being generated by the high-frequency resonant motions of the platform. Ringing occurs similarly at the high resonance frequencies, but appears to be extremely bursting and transient. This particular behavior is understood to be due to impulsive horizontal force (Natvig, 1994). From extensive experimental studies (Zou and Kim, 1996; Kim et al., 1997a; Kim et al., 1997b) we found that the impulsive load can be generated only by strong asymmetric waves. And the impulsive forces including other measured forces have force amplitudes of significant size in the high-frequency region, while the second-order wave forces have negligibly small amplitudes.

The transient waves are evidently strong asymmetric, and generate the horizontal impact and ringing (Kim et al., 1997). However, the above transient data do not provide a long enough time history for statistical analyses. Hence we have generated a storm sea 27 min long containing a strong asymmetric wave, and measured the forces of the ISSC TLP model.

The study follows 4 steps, i.e., generate a strong asymmetric wave in the irregular wave train; measure the wave forces including impact of the TLP model; simulate the nonlinear response of the coupled TLP system due to the measured forces; statistically analyze the tether tensions.

The waves, winds and currents are the environmental elements on the TLP system. However, the present investigation considers only the wave loads in order to compare the effects of both theoretical and experimental wave loads. We employ the second-order theoretical forces (Liu et al., 1995) to compare the responses to those of measured forces in the sea of equivalent energy spectrum.

The analysis reveals that the strong asymmetric wave in a storm sea causes a weak impact and ringing, while the weak asymmetric waves in the other storm seas create only springing. The second-order theoretical wave force produces springing only, and the maximum high-frequency tension is about 4% of that due to the measured forces in the equivalent sea.

ABSTRACT

A strong asymmetric wave is generated by a control in an irregular wave train of a laboratory high sea. The measured forces of the ISSC TLP model due to such asymmetric waves, and second-order theoretical forces, are used to simulate nonlinear responses including springing and ringing. Statistical analyses reveal that springing is due to weak asymmetric waves while ringing is due to the strong asymmetric wave. The second-order force produces springing only, and its maximum high-frequency tension is about 4% of that due to the measured forces in the equivalent sea.

Ringing of ISSC TLP Due to Laboratory Storm Seas

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