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)

Experimental Study on Ship Equipments Vibration Reduction Based on Magnetorheological Damper

Zhongchao Deng; Dagang Zhang; Xiongliang Yao
Deepwater Engineering and Technology Research Center, Harbin Engineering University.
Harbin, Heilongjiang, China.

ABSTRACT

The equipment vibration on ship is a disadvantage for the operation and safety. It should be reduced to as small as possible. To address this problem, a vibration reduction isolator system based on magnetorheological damper (MR damper) was proposed in this paper. And its experiment was carried out. The vibration experiment was designed using MTS hydraulic loading system. Many load cases were applied in the experiment with different mass of the model, exciting forces, and controllable current of MR dampers. The experiment results indicated that this isolator system has a good performance on vibration reduction of ship equipments, especially near the natural frequency of the system.

KEY WORDS: MR damper; vibration reduction; Steel rope spring; Ship vibration.

INTRODUCTION

The vibration of ship equipment is a disadvantage for ship working environment and safety. It should be reduced to as small as possible. For example, when the engines and generators are working, it may generate some vibration to the platform and make the working environment untolerable. This vibration should be controlled. To solve this problem, a new type of isolator system was presented in this paper. This kind of isolator is composed of steel rope springs and MR (magnetorheological) dampers. The MR dampers and steel rope springs were in parallel position. The concept sketch of this system is shown in Fig. 1. This isolator system uses the advantages of the high and variable damping property of MR damper to make the ship equipments have a good vibration reduction performance.

Over the years, many research results on MR and its application were carried out. That the MR fluid effect is often characterized by Bingham Plastic model and its application on vehicle seat was discussed by Sireteanu. A new kind of MR fluid with high yield stress of 100 kPa was reported by Phule and Ginder. Carlson and Weiss reported that as well as iron-cobalt alloys, iron-nickel alloys in ratio ranging from 90:10 to 99:1 showed a significant increase in the yield stress of MR fluids. The non-linear model proposed by Ginder and co-workers, they determined the static yield stress as the maximum shear stress which was modeled as tensile component in the shear direction of the linear infinite single chains of spherical particles. Spencer reported the phenomenological model for MR damper. Jinping Ou and Xinchun Guan did experiment for optimizing configuration of MR damper. Duan and Ni researched the rain-wind-induced cable vibration control on the cable-stayed Dongting Lake Bridge. Dyke and Spencer studied the seismic protection of civil structure using MR damper. Several MR fluid devices have been developed for commercial use by the LORD Corporation.

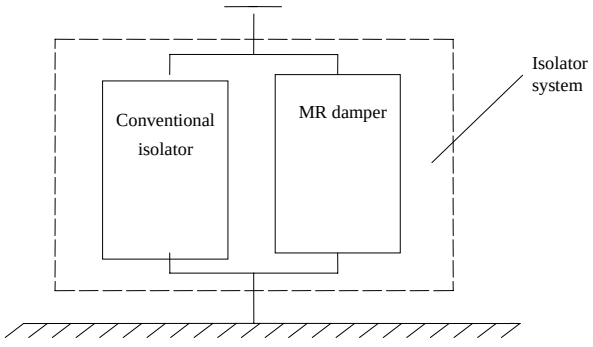

Fig. 1 Concept scatch of the isolator system

SUMMARY OF MR DAMPER AND STEEL ROPE SPRING

This experiment model was designed with two main components: MR damper and steel rope spring.

Magnetorheological fluids comprise of a carrier fluid, magneticresponsive particles and surfactants or suspension agents. The particles become polarized in the presence of an applied magnetic field, and organized into chains of particles within the fluid, which increase the apparent viscosity of the fluid. The particles return to an unorganized state when the magnetic field is removed, which lowers