7th ECCOMAS Thematic Conference on Smart Structures and Materials
SMART 2015
A.L. Araújo, C.A. Mota Soares, et al. (Editors)

Abstract ID-133

IMPLEMENTATION OF A SEMI-ACTIVE TUNED MASS DAMPER TO REDUCE VIBRATIONS IN A SLENDER FOOTBRIDGE

Carlos Moutinho, Álvaro Cunha, Jorge Martins De Carvalho

Faculty of Engineering of University of Porto, Portugal
moutinho@fe.up.pt ; acunha@fe.up.pt ; jmartins@fe.up.pt

Keywords: Footbridges, Vibration Problems, Structural Control, Semi-Active Systems.

Summary: The stress-ribbon footbridge located at FEUP campus is a slender structure that connects the main buildings of the university to the student's canteen. Its dynamic behaviour has been studied over the last years in several areas of the system dynamics. First, the modal parameters in terms of natural frequencies, damping ratios and modal shapes were identified, and a complex non-linear numerical model of the structure that takes into account the several construction phases was calibrated using that information. Then, a comprehensive study of the analysis of the vibration levels of the footbridge involving either regular and vandal loads was develop. This was done in the context of the European research project SYNPEX in which FEUP was one of the partners. Given the perceptible levels of vibration that frequently affect that structure, an active vibration control system was implemented for research purposes. Since 2009 a dynamic monitoring system composed by 4 accelerometers and 4 thermal sensors collets time series, enabling the Operational Modal Analysis and the Vibration-based Structural Health Monitoring of the footbridge. More recently, a Tuned Mass Damper was installed in the context of a research project related to smart inertial vibration control systems. In a first stage, this device worked passively, tuned to the critical natural frequency in terms of proneness to resonant pedestrian loads. This paper aims to describe the second phase of this work which consists of introducing a semi-active component in the functioning of the control device. The full system is described with respect to the hardware, software and control law used to reduce the footbridge vibrations. A preliminary study regarding the effectiveness of this control system over several months of operation is presented.