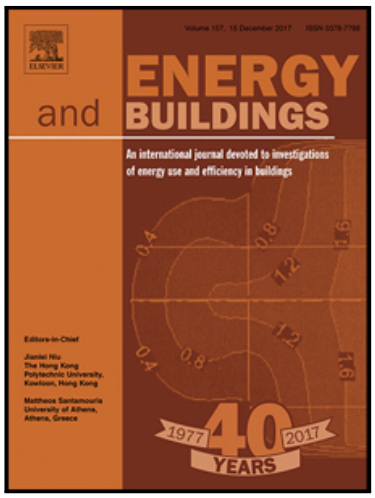

Low-energy Structures Embedded With Smart Dampers

Quang Ha, Sayed Royel, Carlos Balaguer

PII: S0378-7788(18)31024-7
DOI: https://doi.org/10.1016/j.enbuild.2018.08.016
Reference: ENB 8752

To appear in: *Energy & Buildings*

Received date: 30 March 2018
Revised date: 9 July 2018
Accepted date: 8 August 2018

Please cite this article as: Quang Ha, Sayed Royel, Carlos Balaguer, Low-energy Structures Embedded With Smart Dampers, *Energy & Buildings* (2018), doi: https://doi.org/10.1016/j.enbuild.2018.08.016

Low-energy Structures Embedded With Smart Dampers

Quang Ha*, Sayed Royel, Carlos Balaguer

University of Technology Sydney, 15 Broadway, Ultimo NSW 2007, Australia

Universidad Carlos III de Madrid, Calle Madrid, 126, 28903 Getafe, Madrid, Spain

Abstract

Building structures, subject to dynamic loadings or external disturbances, may undergo destructive vibrations and encounter different degrees of deformation. Modeling and control techniques can be applied to effectively damp out these vibrations and maintain structural health with a low energy cost. Smart structures embedded with semi-active control devices, offer a promising solution to the problem. The smart damping concept has been proven to be an effective approach for input energy shaping and suppressing unwanted vibrations in structural control for buildings embedded with magnetorheological fluid dampers (MRDs). In this paper, the dissipation energy in MRD is studied by using results from induced hysteretic effect of structural vibrations while the fluid is placed under a controlled magnetic field. Then, a frequency-shaped second-order sliding mode controller (FS2SMC) is designed along with a low-pass filter to implement the desired dynamic sliding surface, wherein the frequency responses of the hysteretic MRD is represented by its magnitude and phase describing functions. The proposed controller can thus shape the frequency characteristics of the equivalent dynamics for the MRD-embedded structure against induced vibrations, and hence, dissipate the energy flow within the smart devices to prevent structural damage. Simulation results for a 10-floor building model equipped with current-controlled MRDs, subject to horizontal seismic excita-

*Corresponding author

Email addresses: quang.ha@uts.edu.au (Quang Ha), sayed.royel@uts.edu.au (Sayed Royel), balaguer@ing.uc3m.es (Carlos Balaguer)