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Parametric optimization of TLCD-Main Structure Coupled System subject to seismic excitations

Juliano Ferreira Martins, Marcus Vinicius Girão De Morais, Suzana Moreira Ávila

Abstract: The vibration levels in slender structures, such as walkways, bridges, high towers, and wind turbines, are receiving more importance with span increase. On preserving the structure lifespan, it is necessary to study additional mechanical devices capable of reducing the vibrational level of the main structure. These absorbers are essential for structural health. Tuned Liquid Column Damper (TLCD) is a kind of passive absorber composed by a U-shaped tube filled with liquid, commonly, water. In the last thirty years, this device has been researched by several researchers as an alternative to vibration reduction. TLCD is a non-linear mechanical system due to turbulent head-loss in oscillatory conditions. To avoid solving nonlinear simultaneous equations, solutions such as statistical linearization and parameter optimization have been proposed in previous works. Yalla and Kareem derived a closed-form solution for the optimized TLCD damping ratio and head loss coefficient for white noise. Alkmin et al present optimal parameters of mass and aspect ratio to control the main structure subjected to several kinds of wind random excitations. The equipment is also an object of study for seismic excitations. This study performs a parametric optimization using response maps to obtain TLCD optimum parameters to arbitrary seismic excitations. First, optimum parameters of TLCD coupled to the main structure using response maps were compared to the analytical solution. Finally, the same procedure was reproduced to obtain optimal parameter for seismic excitations.

[1)] Juliano Ferreira Martins, B.A. (M.Sc. student): University of Brasilia, Av Pq Aguas Claras lt3824, ap 606. Brasilia - DF, 71930000, Brazil (BR), juliano.martins@hotmail.com, the author presented this contribution at the conference in the special session "Innovative strategies for vibration control and mitigation" organized by G. Failla and R. Santoro.

[2)] Marcus Vinicius Girão De Morais, Associate Professor: University of Brasilia, Universidade de Brasília - Campus Darcy Ribeiro Departamento de Engenharia Mecânica - Bloco G Sala 1-10/08, Brazil (BR), mumorais@gmail.com.

[3)] Suzana Moreira Ávila, Associate Professor: Univeristy of Brasilia, Universidade de Brasilia, Campus Gama, Brazil (BR), suzana.avila@gmail.com.