Analysis and Design of Steel Structures Equipped with Pressure-Adjustment Fluid Viscous Dampers for Wind-And-Seismic Double-Excitation Vibration Mitigation

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Abstract

Fluid viscous dampers have been successfully and extensively adopted in both existing and new structures to improve structural performance under external excitations, namely wind and seismic excitations. During excessively large excitations, the failure of fluid viscous dampers can affect the structural dynamic performance as the supplementary damping is reduced significantly or completely. This study introduces a pressure-adjustment fluid viscous damper (PA-FVD, hereafter) consisting of pressure-adjusting devices to limit generated axial force and potentially prevent failure associated with its high axial force. Steel structures equipped with traditional FVDs and PA-FVDs is presented to compare important structural performance indices including acceleration, velocity, and displacement time history; additional damping ratio; and maximum structural internal forces under wind and seismic excitations. The analytical results have shown a substantially better structural response when the structure is equipped with PA-FVDs.

Keywords: pressure-adjustment fluid viscous damper; fluid viscous damper; dynamic performance; large earthquake; building structure.

1 Introduction

A variety of revolutionary technologies has been developed to meet the constantly challenging demands to provide structures with better performance under lateral loads, namely seismic and wind loads, and the application of passive energy dissipating devices into the structures is one of the main solutions [1] as the inherent damping ratio of structure is limited and qualitatively small [2]. The following sections briefly discuss the

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