Selection and design of wind and earthquake double-excitation vibration mitigation system using fluid viscous dampers for steel residential towers.

Bingjie Du

Tongji Architectural Design (Group) Co., Ltd., Shanghai, China

Xin Zhao*

Structural Engineering Department, Tongji University, Shanghai, China

Tongji Architectural Design (Group) Co., Ltd., Shanghai, China

Yang Wang, Yi Huang

China Overseas Property Group Co., Ltd., Shenzhen, China

Contact:22zx@tjad.cn

Abstract

Fluid viscous dampers can be utilized to control structural vibration as well as to meet the requirements of structural stiffness and strength under both wind and seismic excitations. As they can operate with a wide range of excitation frequencies, a double-excitation vibration mitigation system is introduced. Moreover, various deformation amplification devices, double dampers configurations, and fluid viscous damper parameters are comprehensively analyzed for the system selection for wind and seismic excitations. Using the sensitivity analysis method, structural optimization with the proposed system is demonstrated in the case study of a tall steel residential building.

Keywords: A double-excitation vibration mitigation system; fluid viscous damper; structural optimization; tall steel structure

1 Introduction

The steel structure has the characteristics of long period and weak stiffness, and the wind vibration excitation is often the control load that affects the overall performance of the structure. With the continuous development of vibration reduction technology, the shock absorption design under earthquake excitation must be considered in the design process. As an effective vibration damping device, viscous damper can realize multi-excitation and multi-performance vibration damping of structures, improve the comfort, stiffness and strength of structures under wind excitation, and provide additional damping ratio for structures under earthquake excitation.

At present, the viscous damping technology under single excitation of earthquake or wind vibration has been fully studied. However, there is a lack of comprehensive discussion on the design of wind

https://doi.org/10.2749/manchester.2024.1067
Distributed by structurae