Application Research of Viscous Damping Outrigger in Seismic Design of Super High-rise Buildings

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Abstract

In the super high-rise frame-core tube structural system, outrigger and belt members can significantly improve the lateral structural stiffness and decrease the lateral deflection. However, they will bring adverse effects, such as mutations of structural stiffness and internal force. In order to take advantages of both rigid outrigger truss and viscous damper, viscous damping outrigger(VDO) is raised. Based on a super high-rise building, this paper introduces working principle and seismic energy dissipating mechanism of VDO. The discussion will firstly focus on how the outrigger truss stiffness influence on decreasing amplitude ratio, and then, the optimal position of VDO in a super high-rise building is analyzed in detail. At the final part, the application of VDO in structural seismic design of a super high-rise building in China will be clearly verified based on their feasibility, economy and safety.

Keywords: viscous damper; outrigger truss; super high-rise building; seismic design

1 Introduction

The traditional frame-core tube structural system is widely applied in the super high-rise building. However, the lateral stiffness of this structural system is relatively low, and core tube bears more seismic force compared with outer frame columns. It is insufficient to exert the function of outer frame columns to resist lateral load. By setting the rigid strengthened layer (outrigger truss and belt truss) between core tube and outer frame columns, the axial stiffness of columns can be utilized to resist overturning moment and significantly increase the lateral stiffness of the structure, which can contribute to the decrease of lateral deformation and tensile strength of wall at the bottom of the structure. The change of overturning moment of core tube is shown in Fig.1. But the rigid strengthened layer will lead to some problems in seismic design, including:

(1) It could enlarge structural stiffness, shorten vibration period and increase seismic response;

(2) It could cause sudden changes in shear bearing capacity and lateral stiffness;

(3) The energy dissipation capacity of structural members of outrigger system is weak, so the main energy dissipation depends on core tube coupling beams and walls.

In order to solve these problems, the authors propose that viscous damper(VD) should be involved in the outrigger truss to form Viscous

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