



## Optimal Design of Toggle Brace Dampers for the Wind Resistance Design of Super Tall Buildings

Haojia Ma

*Department of Structural Engineering, Tongji University, Shanghai, CHINA*

Xin Zhao

*Department of Structural Engineering, Tongji University, Shanghai, CHINA*

*Tongji Architectural Design (Group) Co., Ltd., Shanghai, CHINA*

Contact: [22zx@tjadri.com](mailto:22zx@tjadri.com)

### Abstract

With the increase of building height, the story drift induced by wind load become increasingly prominent for the structural design of super tall buildings. Viscous dampers with motion amplification device, for example toggle brace damper system, have been proved to be an effective device to absorb and dissipate large amounts of energy from wind loads or earthquake actions with a small deformation. In this paper, a new optimal design method to find the optimal placement, number and damping coefficient of viscous dampers for the wind resistance design of super tall buildings is proposed. It addresses the problem of minimizing the number and damping coefficient of viscous dampers subject to the additional damping ratio, maximum power, and maximum damping force constraints. The theoretical basis and design process for finding optimum geometry parameter of the toggle brace damper system are also developed. A real 250 meter super tall residential building project will be employed to illustrate the effectiveness and applicability of the proposed optimal design method of toggle brace dampers for the wind resistance design of super tall buildings.

**Keywords:** viscous dampers; toggle brace; wind resistance design; additional damping ratio ;super tall buildings.

### 1 Introduction

With the increase of building height, modern super tall buildings become more and more slender, and the structural natural frequency becomes closer to the predominant frequency of strong wind. The story drift induced by wind load become increasingly prominent for the structural design of super tall buildings. For the wind resistance design of super tall buildings, it is

obviously uneconomical to improve the stiffness performance of super tall buildings by enlarging section and stiffness of structure members. With the rapid development of the energy dissipation technology, structural engineers increasingly look to the energy dissipation technology for the wind resistance design of super tall buildings.

Viscous damper have been proved to be one of the most efficient devices to absorb and dissipate