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Use of Integrated Viscous Dampers to Control Wind Induced Vibrations in Tall Buildings

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1 Abstract

The tall building world is seeing a trend pushing building heights and slenderness ratios to levels previously unseen. The design of these buildings for both strength and serviceability is typically governed by the dynamic response of the building to wind. Comfort of building occupants during relatively low return period wind events is a key challenge, and engineers are increasingly turning to damping technologies to limit building accelerations rather than adding stiffness or mass. Large tuned mass dampers (TMDs) are a commonly used solution.

This paper suggests that integrating viscous dampers within a tall building's structure can deliver a cost-effective alternative to TMDs, delivering high performing buildings with additional benefits in terms of robustness and space efficiency.

Two case studies are presented. Firstly, measured data from a tower in New York with viscous dampers integrated into the structure is provided, comparing design stage predictions to real-life performance. Furthermore, a case study for a super-slender tower is described, demonstrating the potential for enhanced performance and significant cost and space savings using integrated damping.

Keywords: Tall buildings, viscous dampers, integrated damping, wind engineering, accelerations

2 Introduction

The beginning of the 21st century has seen a surge in the number of supertall buildings being constructed around the world. According to CTBUH's skyscraper database [1], eighteen buildings over 300m were completed in 2018 alone. This is set to more than double in 2019. Scarcity of prime real estate and demand for luxury residential apartments has also seen increases in the slenderness of towers (the ratio of a tower's height to its base). Ratios of 10:1 were once thought to be pushing the limits of engineering feasibility, now towers under construction are set to exceed ratios of 20:1.

The design of supertall and super-slender buildings bring some unique challenges, in particular relating to the dynamic behavior of the structure under wind loading. Keeping tower deflections and accelerations within acceptable limits tends to drive the design. As buildings became taller, more slender and therefore more dynamically sensitive, controlling building drifts and accelerations by adding stiffness or mass becomes impractical and

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