# Innovative Tuned Liquid Damper System

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## Abstract

This paper introduces a damper system developed by Thornton Tomasetti in collaboration with NASA to mitigate wind-induced vibrations in buildings. The system relies on multiple masses of water contained in separate pipes that can be tuned individually to resonate at different frequencies. Each pipe is tuned with an air spring that controls both the stiffness and damping of the water mass, allowing for substantial adjustments of the system properties after installation and throughout the lifetime of the building. In addition to being more flexible than traditional tuned-mass dampers, the proposed system can be made of low-cost components and offers a number of practical advantages, such as having a distributed mass that results in lower loads imposed on the building structure. A prototype of the system is being implemented on a 32-story residential building in New York.

**Keywords:** Damping; Wind; Serviceability; Tuned; Liquid; Damper.

## 1 Introduction

Supplemental damping is becoming increasingly common as there is an expanding need to control building accelerations in high-rise and even medium-rise buildings. Modern buildings are being designed and constructed in increasingly slender and complex forms while also employing lighter construction materials, making them ever more susceptible to wind-induced accelerations. There is also an increasing number of tall buildings that include residential floors, where the comfort limits on acceleration are more stringent than in office buildings.

The use of traditional tuned mass systems for mitigating building accelerations is not always the most practical and cost-effective option. It is well known that a traditional tuned-mass damper (TMD) employs a high mass ratio with minimal stroke to mitigate accelerations and is most effective only for a narrow range of frequencies centered on a target mode. A heavier TMD is effective on a broader range of frequencies but generally correlates with a higher cost for the TMD itself as well as additional costs for strengthening the structural system of the building to support the weight of the TMD. Alternatives to the TMD are the tuned sloshing damper (TSD) and tuned liquid column damper (TLCD), but those systems require rigid and therefore heavy water tanks to ensure proper tuning. TSD and TLCD tanks are typically made of concrete and often experience leaks over time.

A novel damper system is being developed and implemented by Thornton Tomasetti in collaboration with NASA to mitigate wind-induced accelerations in buildings without the disadvantages of traditional TMDs. The system is described in this paper, along with the prototype designed for a building in Brooklyn.



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