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Effectiveness of distributed mass damper systems for lightweight superstructures
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Abstract
Distributed mass damper (DMD) systems are discussed as a method of suppressing lateral motions of superstructures during wind storms and earthquakes. Potentially, DMD systems are a technology that is economical enough for widespread application to buildings or other structures. Focus is placed on lightweight superstructures as a reflection of the trend toward the use of ultra-lightweight floor slabs in high-rise buildings. Results of model-scale experiments are presented that show that tuned mass damper (TMD) systems that add between 1.3 and 2% to the total superstructure gravitational mass are effective methods of increasing damping in superstructures and reducing peak lateral accelerations during forced vibration events. In those experiments, tuned sloshing dampers (TSDs) were employed in conjunction with floor and roof plates that simulated ultra-lightweight slabs constructed from cross-laminated timber (CLT), which is a new material option in North America. The use of TSDs was a surrogate for TMDs in general, but such devices are expected to be economic and can easily be tuned to match free vibration frequencies of superstructures. A concept for incorporating DMD arrays as parts of multimaterial ultra-lightweight floor slabs is presented in the context of high-rise building superstructures having moment-resisting frameworks made of steel, reinforced concrete, or other materials that work in conjunction with the slabs and shear walls to form superstructures. The main conclusion is that DMDs are a practical and potentially economic approach for suppressing undesirable motions of lightweight high-rise superstructures. Continuing work is focused on developing and optimizing low-cost TMDs and design of DMD systems for specific buildings or other structures. © 2014 American Society of Civil Engineers.

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