ABSTRACT

This study presents a design technique for various passive dampers and an active tuned-mass damper for vibration control in high-rise buildings under wind loads. For passive dampers, the study includes tuned-mass damper (TMD), multiple tuned-mass damper (MTMD), tuned-liquid damper (TLD), and multiple tuned-liquid damper (MTLD). Firstly, the design formulas of optimal equivalent damping ratio of TMD, MTMD, TLD, and MTLD are established. Then, the wind-induced displacement and acceleration responses and equivalent static of wind loads are computed by using National Building Code of Canada 1995 with the optimal passive damper characteristic obtained in this study. Finally, three examples of high- and very high-rise buildings, namely, 183 m, 317.5 m, and 400 m high, are studied to illustrate the effectiveness of the various passive damper design. The result show that the wind-induced displacement and acceleration responses and equivalent static wind loads can be significantly reduced by applying the passive dampers. The results also indicate that for the same mass ratio, the effectiveness of dynamic dampers can be ranked as: MTMD > TMD > MTLD > TLD.

For the active tuned mass damper (ATMD), the controller is based on the complete feedback, namely, feedback of displacement, velocity and acceleration. The controller gains that minimize the variance of rooftop displacement are presented in closed form. The results show that ATMD is very effective in reducing the displacement and acceleration responses and equivalent wind load of the buildings to an extent large than those that the passive alone can achieve.