Tuned rolling-ball dampers for vibration control in wind turbines

With wind turbines growing in size and cost, it is necessary to reduce their dynamic responses and improve their fatigue lifetime. A passive tuned-mass damper (TMD) is a very efficient solution for vibration control in structures subjected to wind excitations. In this study, a tuned rolling-ball damper characterized by single or multiple steel balls rolling in a spherical container is proposed to be mounted on the top of wind turbines to reduce the wind-induced vibration. A 1/20 scale shaking table model was developed to evaluate the control effectiveness of the damper. The wind-induced dynamic responses of the test model with and without TMD were obtained from the shaking table tests. The test results indicated that the rolling-ball dampers could effectively suppress the wind-induced vibration of wind turbines. The damper with three balls in one container had better control effectiveness than that with only one ball because of the impact effect and the rolling friction. The control effectiveness of the damper cannot be improved further when the number of balls is increased beyond a certain point.