Performance Improvement Of Pendulum Tuned Mass Damper With Rigid Auxiliary Ring

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Due to the advantage of being able to alter the frequency by adjusting the pendu-lum length, pendulum tuned mass dampers (P-TMD) are widely used. In fact, as the pendulum's swing amplitude increases, the nonlinear phenomenon of P-TMD becomes more obvious. According to the tuning control principle, keeping the frequency consistent with the natural vibration frequency of the structure can minimize the response. As a result, in the current practical engineering, it is usual-ly to increase the damping mechanism to consume too much energy to limit the swing of the pendulum. The nonlinear dynamic behavior of the pendulum could be used in the process of structural vibration control to make up for the lack of energy consumption. In order to improve the vibration control effect of P-TMD under large amplitude, P-TMD with a rigid auxiliary ring (R-P-TMD) is pro-posed in this paper, which enhances the nonlinear effect of the pendulum and eliminates the need for extra damping mechanisms to reduce the cost. To begin, the structural 2-DOF model is established, and the theoretical equations are in-ferred. The primary structure's parameters are obtained from the benchmark building (Elias and Matsagar, 2015). The passive control device's mass ratio to the primary structure is appropriately set to 0.02. On this basis, the optimal fre-quency ratio and damping ratio are determined according to the closed optimal tuning criterion in damped structures (Den Hartog, 1956). Then, the frequency-domain-analysis is carried out by the EIHB method. By comparing the displace-ment response of the primary structure installed with a translational linear TMD (L-TMD) and a P-TMD, it is found that the responses are consistent under small amplitude vibration. However, the nonlinearity of the pendulum is enhanced and the damping effect is weakened under large amplitude vibration. The amplitude-frequency response results show that R-P-TMD can effectively improve the con-trol effect and work effectively in a wider frequency band. The time-domain-analysis is performed simultaneously by using the Runge-Kutta method, it is found that the structural amplitude installed with R-P-TMD is reduced more and the swing amplitude of the pendulum is greater obviously, which confirmed that the pendulum absorbs more energy to reduce the response of the primary struc-ture. Further, the phase diagram trajectories of the Runge-Kutta method and the EIHB method are consistent.