

## **Performance Evaluation Of Three-Element Passive Vibration Control For Stay Cables**

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The theory and technology of three-element passive mitigation of structural vibration, based on a damping element, a stiffness element, and an inertial mass element, is developed and applied to significantly enhance cable vibration control performance in this paper. At present, the control performances on cable vibration mitigation were studied for five different inerter-based damping devices, namely the parallel-connected viscous mass damper (PVMD), series-connected viscous mass damper (SVMD), parallel-connected viscous mass damper paralleled with stiffness (PVMD-PS), tuned inerter dampers (TID) and tuned viscous mass damper (TVMD). First, the optimum configuration mechanism and energy dissipation capability improvement of these dampers were derived by investigating the displacement distribution and evolution of each element in these dampers. Subsequently, the single-mode and multi-mode cable vibration control analyses were conducted for these dampers through both theoretical analyses and numerical simulations, thus the maximum attainable modal damping ratios of the cable-damper system and corresponding optimum damper parameters were obtained. Then, practical prototypes of the PVMD and PVMD-PS were developed, namely eddy-current inertial mass damper (ECIMD) and magnetic stiffness eddy-current inerter damper (MSECID), and experimental investigations were carried out to evaluate the control performance of a scaled model cable with the ECIMD or MSECID. Finally, experimental results were compared with the numerical simulation results to verify the applicability of several theoretical analysis models of the cable-damper system, and the optimal designs of ECIMD and MSECID were proposed for cable multi-mode vibration control. The results show that all the five inerter-based damping devices significantly outperform the viscous damper (VD) for single-mode vibration control. Additionally, PVMD and PVMD-PS can achieve superior multi-mode vibration control performance to VD. Key Words: Stay cable, vibration control, inerter, eddy-current damping, multi-mode vibration.