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Non-linear dynamic modelling and design procedure of FV spring-dampers for base isolation

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Abstract

A viable non-linear dynamic design procedure for fluid viscous spring-dampers used in base-isolation systems of building structures is presented herein. The procedure consists of a preliminary design phase developed for a single-degree-of-freedom idealisation of the structural system, and in a final verification phase. The damping coefficient values ensuring achievement of the basic performance levels hypothesised in the design problem are estimated at the first stage. An explicit relationship interpolating the damping coefficient demand curves traced out as functions of damper loss factor, and dynamic input frequency composition and amplitude, is proposed as the basic design equation to this aim. This relationship, derived from previous analytical studies, is further validated herein against the results of experimental forced-vibration tests conducted on a steel frame mock-up. A first demonstrative application of the procedure is then carried out on a simple building with very stiff superstructure. Doubled calibration of the damping coefficient under normative-generated and pulse-type input ground motions, and evaluation of the influence of the pre-stress load imposed on several types of fluid viscous devices in the manufacturing process, are included. Selected case studies are discussed in the accompanying paper.