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ARTIFICIAL INCREASE OF ELASTICITY AND DAMPING FOR SEISMICALLY EXCITED STRUCTURES

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ABSTRACT
The present contribution is related to the reduction of structural responses caused by seismic demands. Incorporating helical steel spring elements and viscous dampers at different locations of a structure, the system frequency can be decreased and simultaneously, the damping ratio can be increased. Hence, seismically induced strains and stresses become smaller compared with responses of unprotected structures. Possible damage after a severe earthquake can be reduced significantly, and the behaviour of the structural members could remain in the elastic range. The corresponding design forces for the protected structures can be found in a lower range compared with a structure without any precautions. Hence, the construction costs for the lateral force resisting system would be lower regarding a similar level of safety. On the other hand, the safety could be increased and the investment would be economical when considering the necessary repair after a medium to serious earthquake.
The first part after the introduction covers general aspects for the layout of structures in seismically active regions according to common design regulations. Then, a real building is presented for which the relevant design forces are calculated. This structure is undergoing several changes concerning the arrangement of a suited spring/Viscodamper system. The corresponding design forces are calculated with the help of a proposed extension of the formulation of base shear forces. Numerical analyses in the time-domain will document the effectiveness of the presented seismic protection systems as well as the proposed design procedure. The analysis for passively controlled structures utilizing spring elements and viscous dampers is described in detail. Special aspects of the applied spring elements and damper devices as well as some economical aspects are focussed in the end of the paper.

Keywords: Earthquake-induced vibrations, Seismic protection, Passive control devices, Spring elements, Viscous dampers, Base shear

INTRODUCTION
Generally there are two different strategies for a layout of a structure in seismically active regions. The first one makes the structure as stiff as possible to withstand potential earthquake demands with the required safety against failure. This strategy causes a high input energy in the structure as the major frequency of the system may approach the resonance range of the seismic demands. Additionally the resulting structure is not economical as the