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Parametric Non-Linear Analysis of Reinforced Concrete Frames with Supplemental Damping Systems

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Abstract : This paper focuses on parametric analysis of reinforced concrete structures equipped with supplemental damping braces. Practitioners still luck sufficient data for current design of damper added structures and often reduce the real model to a pure damper braced structure even if this assumption is neither realistic nor conservative. In the present study, the damping brace is modelled as made by a linear supporting brace connected in series with the viscous/hysteretic damper. Deformation capacity of existing structures is usually not adequate to undergo the design earthquake. In spite of this, additional dampers could be introduced strongly limiting structural damage to acceptable values, or in some cases, reducing frame response to elastic behavior. This work is aimed at providing useful considerations for retrofit of existing buildings by means of supplemental damping braces. The study explicitly takes into consideration variability of (a) relative frame to supporting brace stiffness, (b) dampers’ coefficient (viscous coefficient or yielding force) and (c) non-linear frame behavior. Non-linear time history analysis has been run to account for both dampers’ behavior and non-linear plastic hinges modelled by Pivot hysteretic type. Parametric analysis based on previous studies on SDOF or MDOF linear frames provide reference values for nearly optimal damping systems design. With respect to bare frame configuration, seismic response of the damper-added frame is strongly improved, limiting deformations to acceptable values far below ultimate capacity. Results of the analysis also demonstrated the beneficial effect of stiffer supporting braces, thus highlighting inadequacy of simplified pure damper models. At the same time, the effect of variable damping coefficient and yielding force has to be treated as an optimization problem.

Keywords : brace stiffness, dissipative braces, non-linear analysis, plastic hinges, reinforced concrete frames
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