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Strategic Shear Wall Arrangement in Buildings under Seismic Loads

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Abstract : Reinforced concrete shear walls are pivotal in protecting buildings from seismic forces by providing strength and stiffness. This study highlights the importance of strategically placing shear walls and optimizing the shear wall-to-floor area ratio in building design. Nonlinear analyses were conducted on an eight-story building situated in a high seismic zone, exploring various scenarios of shear wall positioning and ratios to floor area. Employing the performance-based seismic design (PBSD) approach, the study aims to meet acceptance criteria such as inter-story drift ratio and damage levels. The results indicate that concentrating shear walls in the middle of the structure during the design phase yields superior performance compared to peripheral distributions. Utilizing shear walls that fully infill the frame and adopting compound shapes (e.g., Box, U, and L) enhances reliability in terms of inter-story drift. Conversely, the absence of complete shear walls within the frame leads to decreased stiffness and degradation of shorter beams. Increasing the shear wall-to-floor area ratio in building design enhances structural rigidity and reliability regarding inter-story drift, facilitating the attainment of desired performance levels. The study suggests that a shear wall ratio of 1.0% is necessary to meet validation criteria for inter-story drift and structural damage, as exceeding this percentage leads to excessive performance levels, proving uneconomical as structural elements operate near the elastic range.

Keywords : nonlinear analyses, pushover analysis, shear wall, plastic hinge, performance level
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