Optimum Structural Wall Distribution in Reinforced Concrete Buildings Subjected to Earthquake Excitations

Authors : Nesreddine Djafar Henni, Akram Khelaifia, Salah Guettala, Rachid Chebili

Abstract : Reinforced concrete shear walls and vertical plate-like elements play a pivotal role in efficiently managing a building's response to seismic forces. This study investigates how the performance of reinforced concrete buildings equipped with shear walls featuring different shear wall-to-frame stiffness ratios aligns with the requirements stipulated in the Algerian seismic code RPA99v2003, particularly in high-seismicity regions. Seven distinct 3D finite element models are developed and evaluated through nonlinear static analysis. Engineering Demand Parameters (EDPs) such as lateral displacement, inter-story drift ratio, shear force, and bending moment along the building height are analyzed. The findings reveal two predominant categories of induced responses: force-based and displacement-based EDPs. Furthermore, as the shear wall-to-frame ratio increases, there is a concurrent increase in force-based EDPs and a decrease in displacement-based ones. Examining the distribution of shear walls from both force and displacement perspectives, model G with the highest stiffness ratio, concentrating stiffness at the building's center, intensifies induced forces. This configuration necessitates additional reinforcements, leading to a conservative design approach. Conversely, model C, with the lowest stiffness ratio, distributes stiffness towards the periphery, resulting in minimized induced shear forces and bending moments, representing an optimal scenario with maximal performance and minimal strength requirements.

Keywords : dual RC buildings, RC shear walls, modeling, static nonlinear pushover analysis, optimization, seismic performance
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