Comparative Assessment of Irregular Distribution Steel Bracings According to The Internal Forces in Plates Method

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Abstract. This study examines the maximum permitted inter-story drift ratio (IDR) for 15 stories RC building as specified by ASCE7-16 and evaluates the structural integrity of different building models with irregular and regular configurations by considering plastic deformations. Models 4 and 8 exhibit complete adherence to allowable restrictions, thanks to well-placed bracings, particularly those inclined along the building's face. On the other hand, models 2, 3, 5, and 6 show departures from permissible Inter-storey Drift Ratio (IDR) values because of inadequate distribution of bracing. This leads to uneven distribution of stress, poor dissipation of energy, and plastic deformations, especially in the columns on the ground level. In order to tackle these problems, it is essential to ensure that bracing is evenly distributed across all levels and sections. The study employs SAP2000 software to model seismic loads and determine the most effective places for bracing. The free-vibration analysis is used to calculate the natural periods of each model, while nonlinear time history analysis is performed to investigate the dynamic behavior. The findings emphasize the need of appropriately distributing bracing to reduce drift and plastic deformation, which is essential for enhancing structural resilience against seismic stresses.

Keywords: steel bracings, concentric, irregular, drift ratio, plastic hinges.

INTRODUCTION

Given the unpredictable and unavoidable nature of earthquake occurrences, implementing measures to mitigate damage and safeguard communities becomes paramount. Numerous seismic construction designs and technologies have been developed to mitigate the impact of earthquakes on structures [1].

Reinforced concrete (RC)-framed buildings frequently use concrete bracing, while steel structures commonly utilize steel bracing (Br). Over the last twenty years, several papers have shown the successful application of steel Br in RC frames. RC buildings first used steel bracing as a retrofitting technique to improve the structural integrity of earthquake-damaged buildings or to increase the load-bearing capacity of existing structures Historically, bracing methods can be categorized into exterior and internal bracing.

The process of retrofitting existing structures involves the addition of a steel bracing system to the outer frames of the external bracing system. Sekiguchi, Del Valle Calderon et al. [2], and Badoux and Jirsa [3] have provided documented examples of practical retrofitting that make utilize this approach.

Previous studies mostly focused on assessing the behavior of nonductile RC buildings retrofitted with bracing elements, which restricts the application of steel bracing in new RC construction.

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