Comparison between Pushover Methods for Seismic Analysis High-Rise RC Dual System Buildings

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Abstract. Seismic design of RC high-rise buildings is commonly performed with simplified pushover strategies. The conventional pushover methods have added great acceptance and have become a standard tool for seismic assessment in many codes. However, for high-rise buildings, the high-mode effect is so substantial that the conventional method does not estimate the seismic demand fairly. Therefore, several modal and adaptive pushover methods have been proposed. This paper aims to compare nine representative Non-linear Static Procedures (NSP) with Nonlinear Time-History Analyses (NLTHA) for high-rise RC dual system buildings and propose modifications oriented to improve their use in this type of structure. In seismic design, dual systems are commonly used to resist the lateral load, being composed of shear walls and frames, these are convenient because of the possibility of controlling the drift at both top and bottom stories, their high structural redundancy, and several architectural advantages.

Introduction

According to previous studies [1] the conventional nonlinear static procedures [2] are somehow unable to consider the higher mode effects. To overcome these limitations and deficiencies, numerous multi-mode pushover analysis methods have been developed: Modal Pushover Analysis [3], N2 [4], Consecutive Modal Pushover Analysis [5], Adaptive Pushover Analysis [6], and Spectrum-based Pushover Analysis [7], among others. Previous studies [2-4,6] have shown that the applicability of such methods, which are preliminarily developed for frame structures, is not guaranteed for other structural configurations. However, only few studies have investigated the accuracy and applicability of pushover analysis in the quick seismic demand calculation of shear wall and wall-frame structures [6]. Furthermore, most of these multi-mode pushover methods cannot efficiently estimate the seismic demands of frame structures with sufficient accuracy. Hence there is still a need for developing an accurate and efficient method for predicting the seismic demand of high-rise dual system buildings. In the current study, four prototype dual system 30 and 45-storey buildings (B30A, B30B, B45A, B45B), are designed for the site location of Delhi; they are modelled in OpenSees software.

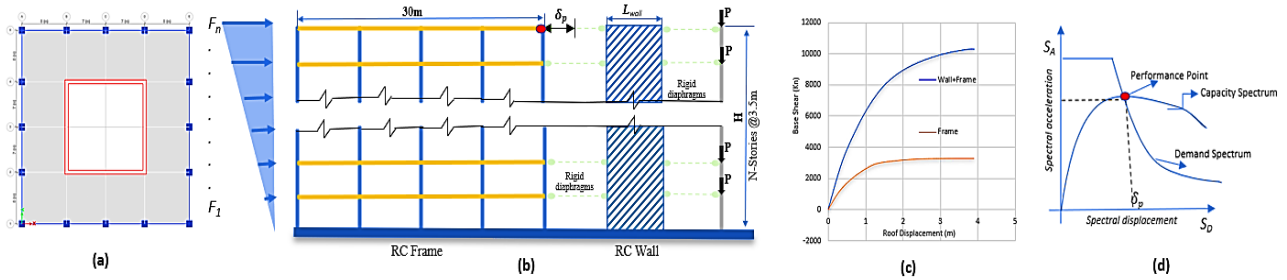

Fig. **a**. Plan layout of the prototype buildings, **b.** 2D Dual wall-frame system on the right of the RC wall, the leaning column is shown, **c.** Pushover curve for the B45A prototype building, **d.** Determination of a performance point.

Results and discussion

This paper presents a numerical study about the reliability of pushover analyses (conventional, modal, and adaptive) for high-rise RC dual system buildings. The study consists of comparing the results of four 30 and 45-storey representative prototype dual system buildings with nonlinear dynamic analyses for several representative seismic records. Although Modal Pushover and Adaptive Pushover methods perform better than the conventional pushover methods, there are still some concerns regarding high-rise dual system buildings.

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