SEISMIC EVALUATION OF RC FRAMES USING DISPLACEMENT-BASED ADAPTIVE PUSHOVER METHOD

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Keywords: Adaptive Pushover, Higher Modes, Nonlinear Time History, Seismic Demands

Static pushover analysis has been widely studied during the last decadeas an alternative method for nonlinear dynamic analysis in seismic evaluation of structures. This procedure amplifies the lateral forces distributed over structure's height following a specified pattern.The amplification starts with small values and continues until a prescribed target displacement is reached. Conventional nonlinear static procedures use a constant load pattern for the entire analysis irrespective of the behavioural regime the structure is acting within. This sort of load pattern poses a limitation on this procedure accuracy because of the nonlinearity changes that occur during the analysis and change the conditions according to which the initial load pattern was selected (Chopra and Goel, 2003). These conditions include mainly the principal mode shape of the structure and the inelastic stiffness matrix. To overcome this drawback, advanced static pushover methods have been proposed that incorporate higher mode effects and adaptive load patterns (Abbasnia et al., 2013).

Several advanced pushover procedures have been proposed recently among which adaptive pushover method proposed by Pinhoetal is the most practically applicable (Antoniou and Pinho, 2004). Two types of this method including displacement and force-based procedures are available. Incorporating the Displacement-based Adaptive Pushover (DAP) method in estimating seismic demands (displacement and inter-story drift) of reinforced concrete (RC) moment frames is the main purpose of this research. In order to perform inelastic analyses, four intermediate RC moment resisting frames with 10, 15 and 20 stories were designed in accordance with AISC-05 that were 5-span wide. These structures were subjected to the conventional and DAP analysis procedures as well as the Nonlinear Time History Analysis (NTHA) method. The latter method has been regarded as an accurate benchmark for assessing the precision of the two former methods.

The NTHA has been performed using a set of 10 ground motion records. In order to alleviate the discrepancies caused by record-to-record uncertainties in the NTHA results, the selected records have been scaled so that their average spectrum matched the standard 2800 spectrum at the natural period of the structure under consideration. In performing pushover analyses, the target displacement has been calculated according to FEMA356 suggestions (FEMA, 2000). Nonlinear modelling and analysis of the frames have been conducted using the OpenSees software (OpenSees, 2008). Since the OpenSees software does not provide for adaptive nonlinear procedures, a MATLAB program has been developed by the authors to run the DAP procedure.

The NTHA results averaged over all ground motion records as well as those obtained via conventional and DAP pushover methods are compared in the following figure that shows the story displacements obtained for 20-story model.

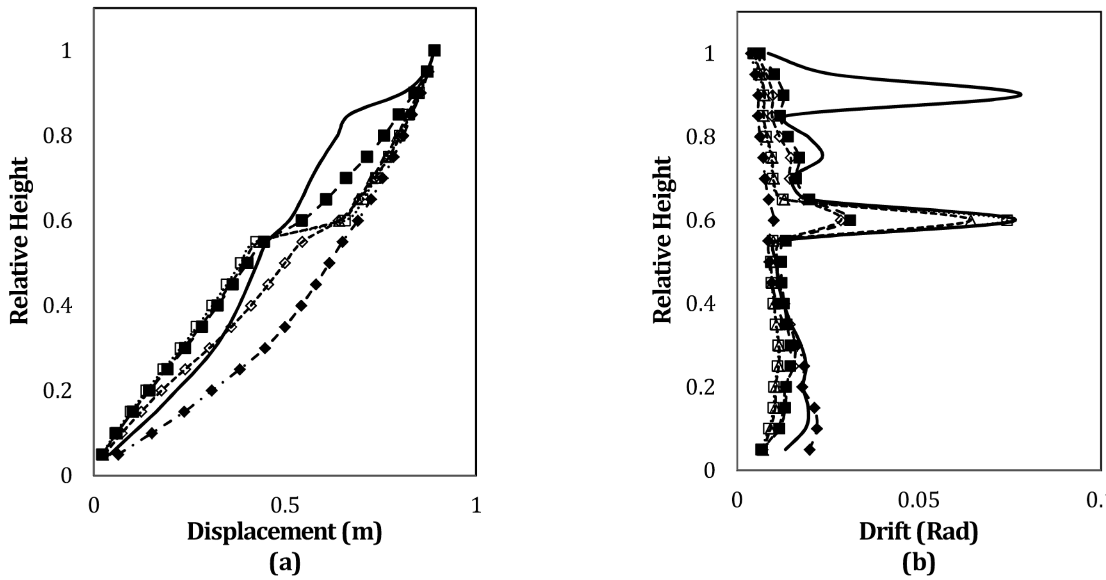

Figure 1. a) Story displacement profile, 20-story, b) The variation of inter-story drift, 20-story structure

These results and those obtained for other structures show that DAP method can superlatively estimate the displacement demand and interstory drift especially for high-rise buildings. Also it is able to consider higher mode effects in tall buildings. With increase of structure's height, the accuracy of DAP methods increases in comparison with conventional pushover.

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