Capacity Assessment of Existing RC Buildings Using a 3-D Adaptive Pushover Procedure

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ABSTRACT

Structural capacity assessment of an existing structure under an earthquake excitation is a phenomenon in earthquake engineering. In recent years, performance-based design methods which rely on nonlinear static analysis procedures (NSP) have been started to use widely among the structural engineers. Although, nonlinear time history analysis has been accepted as the most accurate way to determine the structural demand, it needs more expertise and effort in computation process. This made researchers to focus on developing much more simple procedures while estimating the inelastic performance under seismic excitation. Pushover and adaptive pushover analysis might be classified as the result of these efforts.

Since torsion is assessed by the fundamental mode shape under an earthquake excitation, most conventional pushover programs are usually designed for two dimensionally analysis neglecting torsional effects. It is a well-known fact that, conventional pushover analysis cannot predict torsional response accurately. That is the main reason why the dynamic response history analyses are assumed to be more appropriate methods in estimating the response of an asymmetric building due to its time consuming property.

In this study, the aforementioned three-dimensional adaptive pushover procedure, which is represented in PEER 2011 [1], is implemented on three existing irregular reinforced concrete (RC) buildings, one of which is the SPEAR building. The other two buildings are selected from the database of Istanbul Earthquake Master Plan 2003 project with in a concept of Zeytinburnu Pilot Region, for previously determined 7 earthquake records.

As a result, it can be stated that, the conventional pushover analysis overestimates the capacity results of irregular RC buildings. Studies have shown that adaptive results of the drift profiles are much closer to the nonlinear time history analysis results for these types of buildings.

[1] Oyguc, R., Boduroglu, M., Seismic Risk Management in Urban Areas**,** Proceedings of a U.S.-Iran-Turkey Seismic Workshop December 14-16, 2010, Istanbul, Turkey, PEER Report 2011/07, pp 303-314.

Key Words: 3-D adaptive pushover, capacity assessment, existing RC buildings, torsional effects.

1 INTRODUCTION

As a well-known fact, nonlinear static procedures are based on converting the multi degree of freedom system (MDOF) to an equivalent single degree of freedom system (SDOF). They produce estimates of the maximum displacement, story drifts and other structural components. Structural capacity is determined by the pushover or capacity curve that was used to generate the equivalent SDOF model. In pushover analysis the static forces are distributed along the height of the structure until a predefined target displacement is reached. If the lateral load pattern is kept constant through the analysis, the method is called as conventional pushover and if the load pattern is constantly updated through each analysis step in the inelastic range, then the analysis method is called as adaptive pushover method.