7th National Congress on Civil Engineering, 7-8 May 2013
University of Sistan and Baluchestan, Zahedan, Iran

Progressive collapse in asymmetric RC moment frame buildings

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Abstract

The present paper deals with nonlinear assessment of progressive collapse in low-rise three-dimensional (3D) reinforced concrete (RC) frame buildings with mass irregularities in plan. To this end, 3 story 3D frame buildings, with 0%(symmetrical), 10% and 20% mass eccentricity in plan and designed based on the provisions of the Iranian seismic code of practice (Standard No.2800), were modeled using strength and stiffness degrading material models adopted in FEMA P-695. Then incremental dynamic analyses (IDA) were performed to quantify the frames performances from linear elastic through the overall collapse level of response along with assessing the IDA curve of each record. The results show that response of asymmetrical frames are quite different from the symmetrical ones. Also, it is observed that irregularities in plan may cause a very irregular pattern of progressive yielding in critical sections of all asymmetric structures, especially in frames located on the flexible side of the plan. Such a poor response is shown to be intensified with increasing eccentricity.

Keywords: nonlinear analysis, Progressive collapse, mass irregularity, reinforced concrete, performance assessment

1. INTRODUCTION

The definition of progressive collapse has evolved over time and in different codes but essentially it is a phenomenon in which an initial local failure spread from element to element and eventually results in the collapse of the whole structure or to an extent disproportionate to the original failure. Some researchers also distinguish between the terms of progressive collapse and disproportionate collapse [1].

The cause of progressive collapse phenomena can be due to human-made hazards (blast or explosion, vehicle impact, fire, etc.) or natural hazards such as earthquakes. Earthquake loading can generate strong lateral forces and stress reversals. These load effects can overload structural members which result in the loss of one or more load-carrying members, which may then lead to failure of additional structural members in other parts of the system and the unzipping effect of progressive collapse of the