EVALUATION OF NONLINEAR STATIC PROGRESSIVE COLLAPSE IN IRREGULAR CONCRETE STRUCTURES

Ardeshir GHADAMIAN
M.Sc. Student, Department of Civil Engineering, Malayer Branch, Islamic Azad University, Malayer, Iran
ardeshir_6868@yahoo.com

Mehdi ALIREZAEI
Department of Civil Engineering, Malayer Branch, Islamic Azad University, Malayer, Iran
M.Alirezaei@iiees.ac.ir

Keywords: Progressive Collapse, Nonlinear Static Analysis, Alternate Load Path Method

Progressive collapse is a catastrophic structural phenomenon that can occur because of human demolition and natural hazards. The mechanisms that are used in order to create progressive collapse can be immensely impacted by the smallest fraction of failure that may cause a significant deformation in the structural capabilities of the building. Therefore, inevitably is leading to the collapse of the structure. The current customs in progressive collapse analyses and design generally focus on preventing progressive collapse due to varying gravity and blast loads. Behavioral characteristics of the progressive collapse due to uniform load pattern and triangular load pattern have been evaluated. The aim of this study is to investigate irregular reinforced concrete buildings in plan such as: moment resisting frames that are designed based on specific procedures with the inclusion of damaged units and the overall ability of the structure to resist progressive collapse under earthquake scenarios. For this purpose, nonlinear static analysis was utilized on 3-D structures using "OpenSEES" software. The results of the behavioral components was conducted with the progressive collapse potential of 3,6 and 10 story buildings by applying alternate load path methods proposed on GSA2003 and UFC2009. The results of the following analysis consisted of capacity curves, procedure of creating plastic hinges, story drift and also residual shear capacity index. The results significantly depend on variables such as, location of column removal and the number of stories.

Hinge rotation limitation is the most important part of guidelines that is available for progressive collapse assessment of structures (Tavakoli et al., 2012; Kim and Kim, 2009). As mentioned later, UFC (2009) guideline presented hinges rotations in collapse prevention (CP) performance level for the beam as a limit state. In GSA2003, this is limited to 0.105 radians. If the beams above of the lost column, exceed this limited the structures have high potential of progressive collapse. Rotation of the hinges investigated in target displacement (Tavakoli et al., 2012). The target displacement shall be calculated in accordance with FEMA356. Figure1 show the location of plastic hinges and their performance level and rotation of beams, when c1 removed.

The results show that when c1 is removed in 3 story buildings have high potential of progressive collapse but with increase stories the structure is capable to absorb element loss.

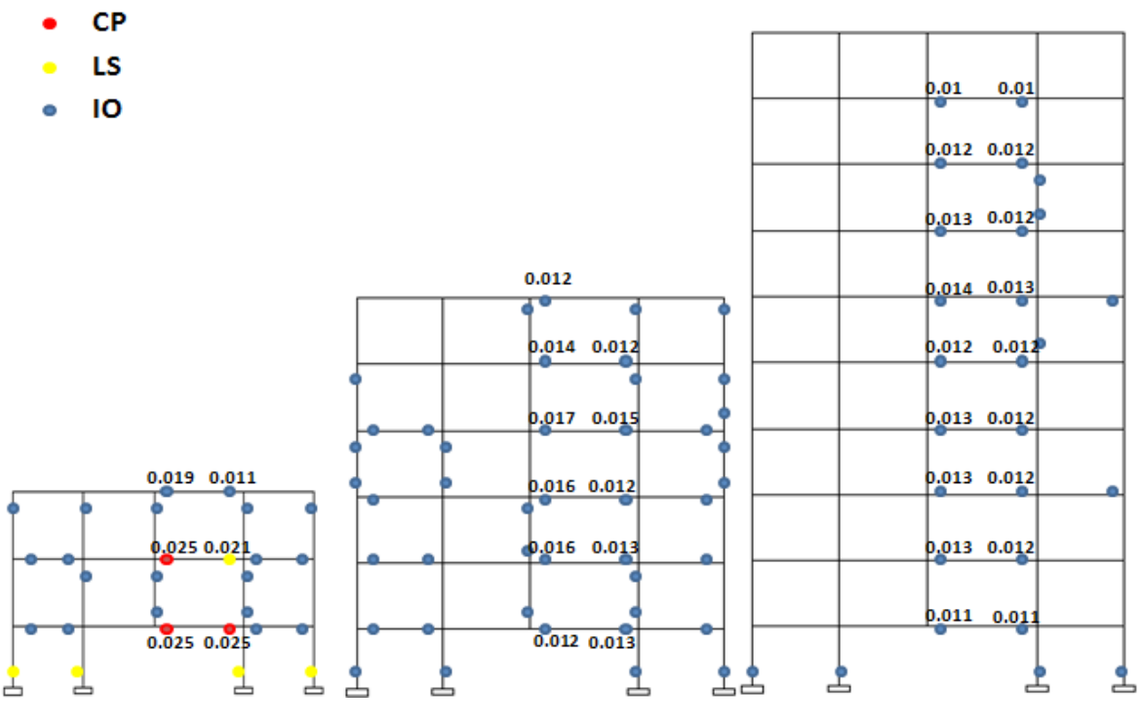

Figure 1. Formation of hinges when c1 is removed under triangular load pattern

REFERENCES

Kim J and Kim T (2009) Assessment of progressive collapse-resisting capacity of steel moment frame, *Journal of Constructional Steel Research*, 65, 169-179

Tavakoli HR, Rashidi Alashti A and Abdollahzadeh GR (2012) 3-D Non Linear Static Progressive Collapse Analysis of Multi-Story Steel Braced Building, *15 WCEE Lisboa*

Unified facilities criteria (UFC) (2009) Design of buildings to resist progressive collapse, Department of Defence, The U.S. General Services Administration; GSA (2003), Progressive collapse analysis and design guidelines for new federal office buildings and major modernization projects