Accuracy and Efficiency in Progressive Collapse Analysis: Real Structures vs. Successively Reduced Substructures

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Abstract

Due to the fact that the behavior of reinforced concrete structures is complex (nonlinear behavior) when they are subjected to gravitational or lateral loads, the computational cost when the entire model is considered is significant.

Thus, the aim of the present study is to show a relation between a full modeled structure and several types of reduced substructures in terms of accuracy and cost efficiency (time, work volume) when the progressive collapse potential is assessed The considered structure has three stories and is placed in a low seismic area (a_g = 0.08g). The design is made for a medium ductility class in accordance with the Romanian seismic code P100-1/2006. To evaluate the progressive collapse potential, only the corner column case specified in GSA (2003) Guidelines is considered.

Three types of analysis are used. When the linear static analysis based on the GSA (2003) Guidelines is performed the concept of DCR (**D**emand **C**apacity **R**ation) is applied. In this case, if the DCR value exceeds the allowable value of 2.0 for structural elements these are considered to be severely damaged.

On the other hand, when the nonlinear static/dynamic analysis is used, the ultimate plastic hinge rotation will be compared with the allowable value specified in DoD2009 for this type of analysis (0.0035 rad). If this value is exceeded the structural element is considered to be collapsed.

As a final conclusion, a lower limit of model simplification will be drawn so that the accuracy of the results to be maintained in an acceptable tolerance.

Keywords: progressive collapse, nonlinear analysis, corner column.

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