

Local Deformation Measures for RC Column Shear Failures Leading to Collapse

Mathew Leborgne

PhD Candidate, University of Texas at Austin

Wassim M. Ghannoum, PhD

Associate Professor, University of Texas at Austin

Existing nonductile reinforced concrete (RC) columns that are prone to shear failure can be classified in two groups: columns that fail in shear prior to flexural yielding, and columns that fail in shear after flexural yielding (hereafter referred to as flexure-shear-critical (FSC) columns). Shear failures in FSC column have been shown to be deformation and damage driven. Several shear failure models have been developed to estimate column lateral drift demands that produce shear failure in FSC columns. A recent dynamic collapse study (conducted by Ghannoum in 2006) of a three-bay, three-story, RC frame with FSC columns has shown that column drift may not be a good measure of damage and that a more “local” deformation measure such as column-end rotations may be more appropriate (Fig. 1 a)). This observation is somewhat intuitive considering that shear and axial failure in FSC columns occur within column end regions (Fig. 1 b)).

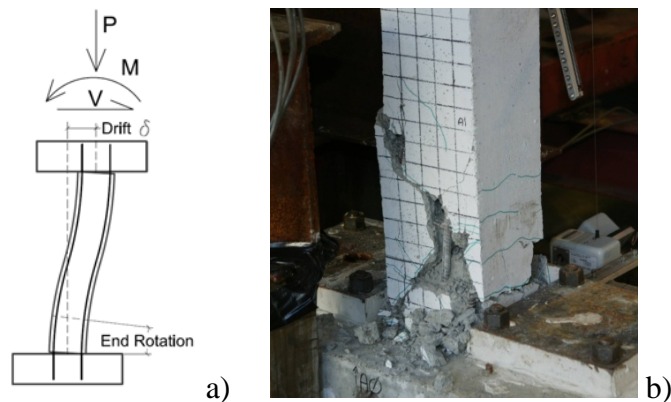


Figure 1: FSC column shear failure

A rotation based behavioral model was developed using a FSC column-test database. The model defines critical column-end rotations that generate shear failure in FSC columns. This model has been implemented in the open source analysis software OpenSEES and used to extract damage and degradation parameters past shear failure initiation from the column database. The resulting analytical model has the ability of: 1) estimating critical column-end rotations that trigger shear failure in FSC columns; and 2) modify column shear behavior once shear failure is triggered, to account for shear strength degradation caused by cyclic and in-cyclic damage. This paper presents the shear failure model as implemented in OpenSEES and compares model predictions with column-test database results.