

DISPLACEMENT-BASED ASSESSMENT PROCEDURE FOR REGULAR CONFINED MASONRY BUILDINGS IN SEISMIC REGIONS

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According to its 2000 census, Mexico has close to 22 million housing units that house about 100 million Mexicans. Eighty percent of these dwellings are built with some type of masonry (unreinforced masonry or confined masonry with tie-end lightly-reinforced small-section columns and beams that surround brick masonry walls which might include or not include additional horizontal steel reinforcement placed into the mortar joints), and a large percent of those dwellings located close to seismic sources have not fared well during severe ground shaking. Thus, seismic assessment procedures to evaluate the seismic performance of masonry construction are highly valuable.

This paper presents a practical displacement-based evaluation procedure for the seismic assessment of low-height regular confined masonry buildings. First, the Coefficient Method established in several FEMA documents is adapted to obtain estimates of inelastic roof displacement demands for regular confined masonry buildings. For that purpose, a statistical study of constant relative strength inelastic displacement ratios of single-degree-of-freedom systems having hysteretic behavior representative of confined masonry buildings when subjected to earthquake ground motions recorded near the subduction zone of the Mexican Pacific coast was carried out. The inelastic displacement ratios (Figure 1) computed in this study capture the effects accounted for coefficients C_1 and C_2 included in the Coefficient Method. Second, a nonlinear simplified model is introduced to perform pushover analysis of regular confined masonry buildings whose global and local behavior is dominated by shear deformations in the masonry walls. The model employs the so-called modified wide-column for modeling the masonry panels (Figure 2), which can be applied through the use of commercial software, and it can be used to establish the capacity curve of such buildings (Figure 3, dark red line). The application of the proposed displacement-based procedure to a three-story building tested at a shaking table testing facility yielded reliable estimates of its global and local deformation demands. The displacement demands predicted by the methodology have a close correspondence to those estimated for the same building from the measurements taken on a 1:2 scale model tested on a shaking table (Figure 3, blue line). Regarding the estimation of the level of damage and structural degradation in the walls, the methodology yields conservative estimates for the damage observed during the experimental studies, but it provides a better estimation of the seismic performance on regular confined masonry buildings than that provided by traditional force-based methods (Figure 3, red dashed line).

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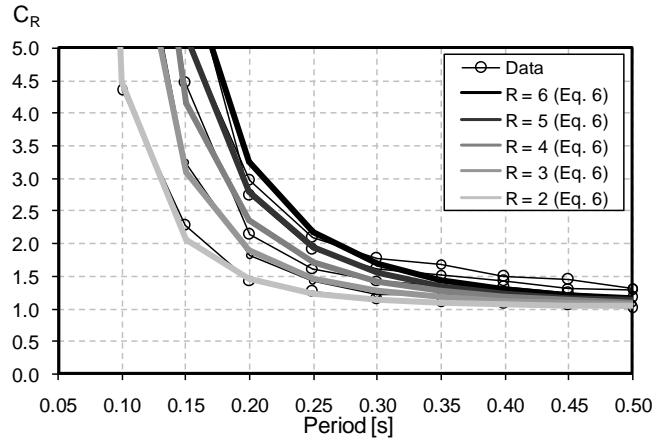


Figure 1. Comparison of central tendency (geometric mean) of inelastic displacement ratios computed in this study with those estimated from a simplified equation.

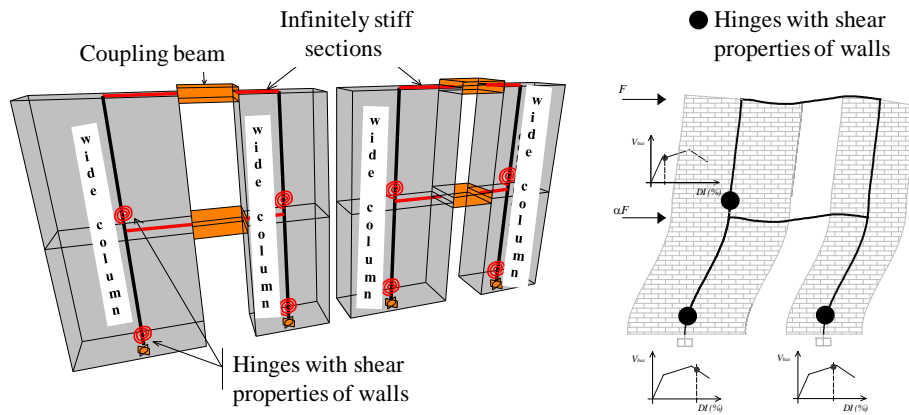


Figure 2. Modified wide-column model for Specimen 3D: a) Nonlinear model, and b) damage assessment.

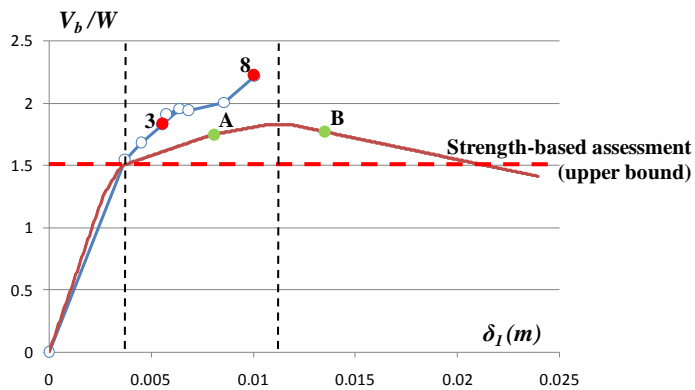


Figure 3. Performance assessments for sample building