

# EVALUATION OF DISPLACEMENT COEFFICIENT METHOD FOR SEISMIC ASSESSMENT OF EXISTING BUILDINGS BUILT ON SOFT SOIL SITES

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Modern performance-based seismic assessment procedures for existing structures are based on: a) the evaluation of the structure-specific lateral deformation capacity, and b) the earthquake-induced displacement demand. Several proposals to move from force-based to displacement-based assessment methodologies have been made. Among them are the linear and nonlinear static procedures (LSP and NSP, respectively) discussed in FEMA-273/274 (1997), FEMA 306 (1999), FEMA 356 (2000) and FEMA 440 (2005). Nonlinear analysis procedures have been widely used by American practicing engineers since the publication of ATC-40 (1996), and FEMA-273/274 (1997). Particularly, the nonlinear static procedures (NSP) have become popular due to their simplicity and ability to provide useful insight regarding the expected performance of earthquake-resistant structures. Among the options available to estimate target displacement demands of existing structures is the *Coefficient Method*. Recently, improvements to the Coefficient Method were recently proposed in FEMA 440 document (2005) based on extensive analytical studies. In spite of this effort, however, the application of the enhanced Coefficient Method has been focused on existing buildings built on firm soil sites since improved coefficients  $C_1$  and  $C_2$  were developed from statistical studies on the response of single-degree-of-freedom (SDOF) systems subjected to earthquake ground motions recorded on firm soil sites. Thus, there is a need of evaluating the ability of Displacement Coefficient Method for predicting the target inelastic displacement demand of existing buildings built on soft soil sites, such as the bed-lake zone of Mexico city or the San Francisco Bay Area.

The objective of the research reported in this paper is to evaluate the effectiveness of the Coefficient Method to estimate peak roof inelastic displacement demands of a family of generic reinforced concrete and steel frame buildings subjected to 40 earthquake ground motions recorded on very soft soil conditions (soil type E in NEHRP classification) such as that of found in the old lake-bed zone of Mexico city. For that purpose, the followings task will be reported in this paper: a) a review of simplified equations for evaluating coefficients  $C_1$  (Figure 1) and  $C_2$  (Figure 2) previously studied by the first author; 2) a review of transformation of equivalent SDOF displacement estimates to multi-degree-of-freedom estimates; 3) an evaluation of DCM for estimating peak roof inelastic displacement demands using proposed equations (e.g. coefficient  $C_1$ , Figure 3) through error statistics. It is believed that the results of this investigation underway will allow extending the applicability of the DCM for evaluating the expected performance of existing buildings built on soft soil sites.

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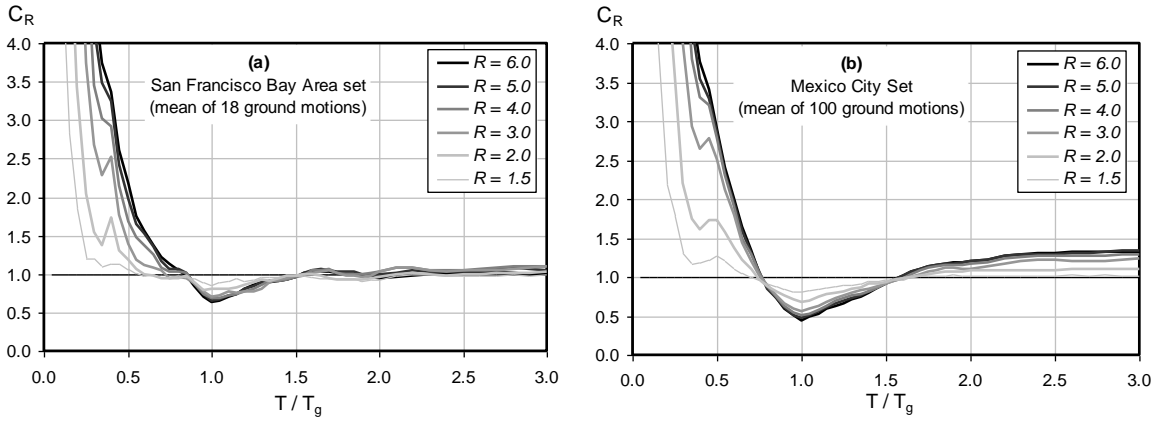


Figure 1. Mean inelastic displacement ratios computed for: (a) the San Francisco Bay Area ground motion set; and (b) Mexico City ground motion set.

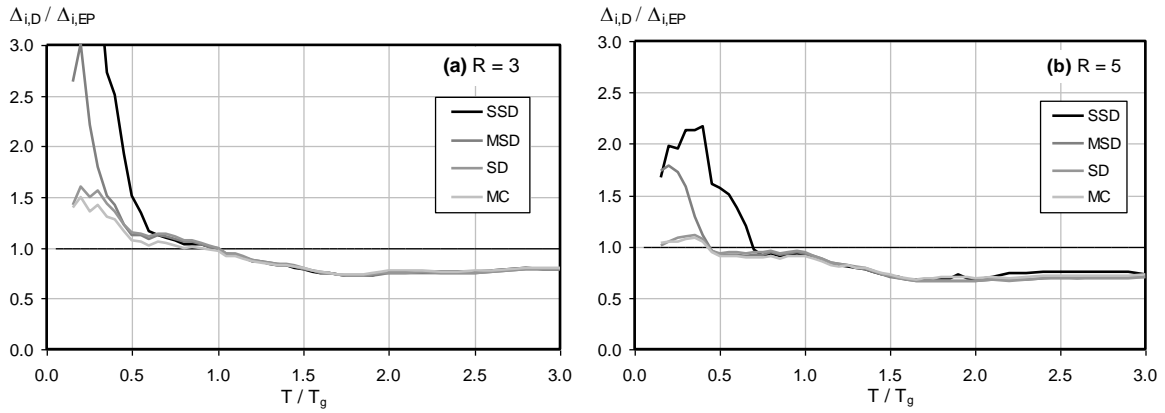


Figure 2. Degrading to non-degrading inelastic displacement ratios computed from the Mexico City set: (a)  $R = 3$ ; and (b)  $R = 5$ .

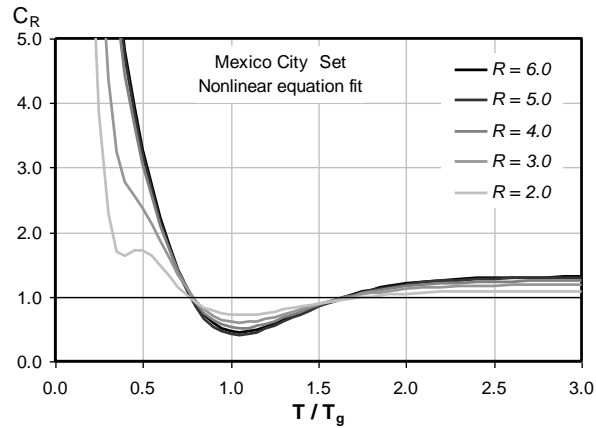


Figure 3. Mean inelastic displacement ratios (i.e. coefficient  $C_1$ ) for elastoplastic systems computed with proposed equation.