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Abstract: Proper evaluation for the damage of a structural member lays the basis for the performance-based seismic design procedure. The damage in a reinforced concrete (RC) pier due to an earthquake may be three dimensional, i.e. biaxial bending with varying axial load. However, the existing damage models generally can only be applied to one dimensional cases, i.e. uniaxial bending with constant axial load. To compensate this gap, the traditional widely-used Park and Ang damage model is extended to count cases of three dimensional damages in this paper. The new developed model is based on the moment-rotation relationship. Determination of relevant variables in the proposed model is presented in detail. Two unknown parameters are determined from experimental data through two rounds of traversal search. In addition, a new set of performance levels compatible to this extended Park and Ang model is redefined. The applicability of the damage model under various one-dimensional loading paths and under spatial loadings is verified respectively. The results indicate that the extended Park and Ang damage model together with the parameters and the performance leveling criterion forms an integrated damage assessment index, which can effectively evaluate the three dimensional damage of a RC pier.

Keywords: damage model; three dimensional; performance level; performance-based seismic design