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DETERMINATION OF LATERAL CAPACITY OF TWO-STORY-X BRACED FRAMES CONSIDERING HYSTERESIS BEHAVIOUR OF CONNECTIONS

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Special concentrically braced frame systems are one of the resistant systems for seismic loads which because of resisting lateral loads and limiting relative lateral deformations have increasingly come to the attention of designers. These systems are a special class of concentric braced frames which because they provide connection details and special seismic requirements, they maximize relative nonlinear lateral displacement capacity. Nowadays, appropriate performance of nonlinear static analysis is used to determine realistic displacement capacity and to estimate demand displacements. Due to the fact that in the past two decades, seismic codes have moved from strength-based design toward ductility-based design, the main objective of this paper is to determine seismic lateral capacity of special concentrically two-story-x braced frame systems for response in roof drift, inter story drift, base shear and frame fracture-index using displacement-based method. In the end, the numerical results were compared with AISC code. When cyclic strength degradation of 15% occurs, the seismic capacity and fracture-index of systems are determined demonstrated in Figure 1 (FEMA P440A). For nonlinear static cyclic analysis, recommended FEMA461 loading history was applied and for analytical modeling of SCBFs OpenSEES software was used (FEMA 461).

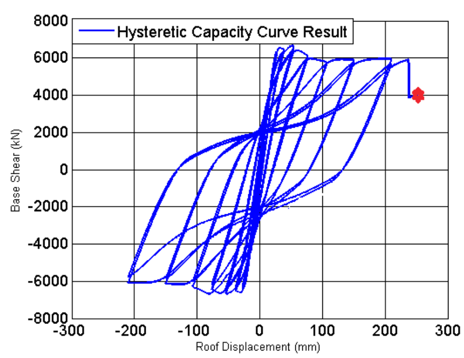

Figure 1. Force-displacement capacity curve

Therefore, in this study, in order to have a thorough investigation of frame regularity, eight SCBFs were designed based on AISC seismic provision to represent different values for response reduction factor, R with identical plans and elevations. The buildings were based on the model buildings in the SAC Steel Project, adopting the basic floor plan, story height, and gravity loads (FEMA, 355c). All the connections have been designed according to a balanced design procedure to balance desired yielding mechanisms as much as possible (Roeder et al., 2011). In addition to modeling hysteresis behavior of gusset plate connections, shear tab connections were also considered (Hsiao et al., 2012). Therefore, for validating of this, a three-story one-bay tested in NCREE in Taiwan was particularly used. To monitor strain range limit to identify brace fracture and to calculate frame fracture-index, equation 1 has been used (Hsiao et al., 2012).

$$Max.\varepsilon_{range,pred.} = 0.1435(\frac{w}{t})^{-0.4}(\frac{KL}{r})^{-0.3}(\frac{E}{F_y})^{0.2} \quad (1)$$

Brace fracture depends on the width–thickness ratio of the cross-section (w/t), the slenderness ratio of the bracing member (KL/r) and the ratio of the elastic modulus to the yield strength of the steel (E/Fy).

Due to the lack of fracture expression implementation in the OpenSEES framework based on maximum strain range limit, fracture material integrated with steel02 constitutive material model was imported with a .dll format file in the program with the ability of being open-source in OpenSEES. For modeling the brace fracture based on strain range limit, Figure 2 has been presented.

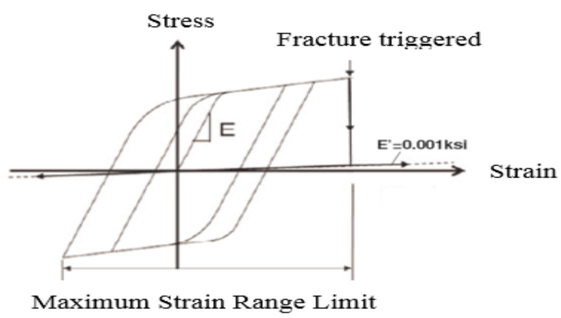

Figure 2. Schematic of the fracture material model (Hsiao et al., 2012)

Moreover, for validation of hysteresis behaviour of brace failure beyond brace fracture, a one-story one-bay tested in University of Washington was used.

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