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Investigation of Influences of Modeling of the Panel Zone in the Vierendeel Frames

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Abstract

Vierendeel frames are widely used in building construction. Panel zone is one of the most important parts of the frame which plays significant role in the stability of it. Modeling the frames based on centerline dimensions of the beams and columns always will not give realistic results in the panel zone region. Therefore, Different linear and nonlinear models with panel zone have proposed to better simulate their performances. In this paper, a 3-story vierendeel frame is modeled using centerline dimensions of the elements without panel zone as well as different linear and nonlinear models with panel zone. OpenSees software is used in order to evaluate of this frame behavior under cyclic loading and Pushover loading. Then the seismic parameters of the frame such as ductility, energy dissipation, and strength are obtained. Furthermore the joints with different rigidities are evaluated based on displacement control.

Keywords: Vierendeel Frame, panel zone, Cyclic Loading, Pushover Loading

1. Introduction

In the vierendeel frames the behavior of the panel zone plays significant role in the stability of it. Structural analysis based on line elements alone will not be sufficient in itself to provide the values of design forces in the panel zone region. The depths of the internal members and chords must be taken into account to find the force values in the panel zone. Under seismic loading the panel zone region is considerably subjected to unbalanced moments and considerable shears. So resulted deformations in this region must to be calculated and controlled.

OpenSees software is used in order to evaluate this frame behavior under cyclic loading and Pushover loading. A 3-story vierendeel frame is modeled using centerline dimensions of the elements without panel zone as well as different models with panel zone. Then the seismic parameters of the frame such as ductility, energy dissipation, and strength are obtained. Furthermore the joints with different rigidities are evaluated based on displacement control.

2. Proposed analytical models in modeling of the panel zone

2-1- Linear and nonlinear centerline models without panel zone

A linear elastic model with centerline dimensions is acceptable for design of the frames when beam moments be checked at the location of intersection of the beam and column. Even though this model gives adequate results for design, but it will not give always good estimates of the distribution of shears, moments and axial forces throughout the building under dynamic loads.

Models that allow yielding in the beams and columns are more realistic than linear models. Most common used methods for modeling this nonlinear behavior are done by placing a nonlinear flexural spring at the ends of elastic beam and column members. It should be assigned to springs more high stiffness than beams and columns. The spring behavior and member plus spring behavior are shown in Fig. 1 [1].