

Investigation of seismic performance of concentrically braced frames with zipper columns

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Abstract

Inverted-v braced frames are typical braced frame configurations which with increase of lateral loads the compressive braces buckle and plastic hinges form in the braces. Shear capacity of frame decrease as a result of compression braces' buckling. To overcome these limitations of chevron braced frames zipper braced frames have been suggested. Zipper columns are vertical members connecting the mid points of the beams above the first floor. In order to investigate the seismic behavior of zipper braced frames 3, 6, 9 and 12 story zipper braced frames was designed and modeled in ABAQUS and nonlinear time history analyses were conducted. As a consequence, the results showed that zipper columns help to improve the seismic performance by uniform damage distribution over the height of building.

Keywords: chevron brace, nonlinear time history analyses, unbalanced force, zipper strut.

1. INTRODUCTION

Chevron braced frame is one type of lateral load resisting system which has reduction of story shear resistance when subjected to severe earthquake ground motions. This behavior cause soft story mechanism in multi-story structures. As lateral displacement increase, the buckling of compression brace occurs and its axial capacity decrease, while the force in tension brace continues to increase. This causes a large vertical unbalanced force at the midpoint of the beam. [1]

In 1989 Khatib et al proposed to add zipper columns in order to connect the brace-to-beam intersection points (figure 1). [2] Zipper columns transmit vertical unbalanced force to upper floors and impose all compression braces to buckle simultaneously. As a result, the damage distributed uniformly over the building height. Though, instability and collapse can occur when the full-height mechanism form (figure 1-d). The disadvantages of a full-height zipper mechanism can be overcome by introducing suspended zipper frames as shown in figure 2. [1]

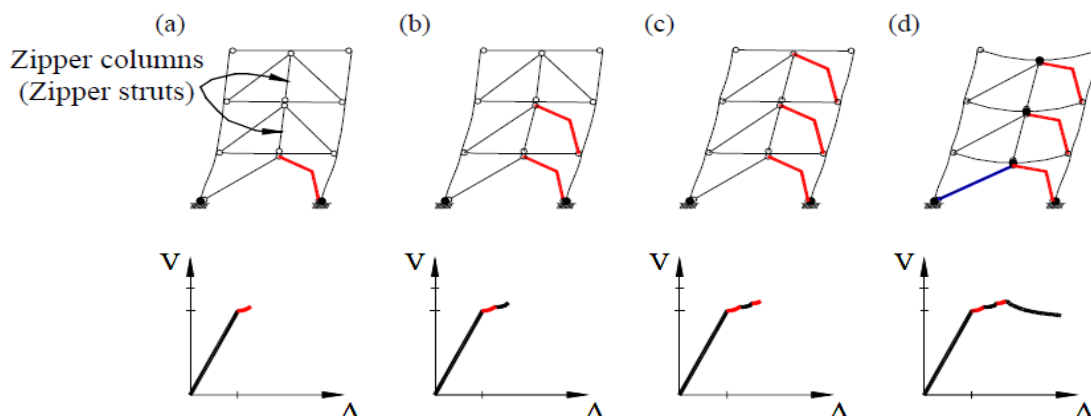


Figure 1. Full-height zipper mechanism [1]