E02

A feasibility study on performance of X-shaped steel links in slitted steel shear walls as a means of structural condition assessment

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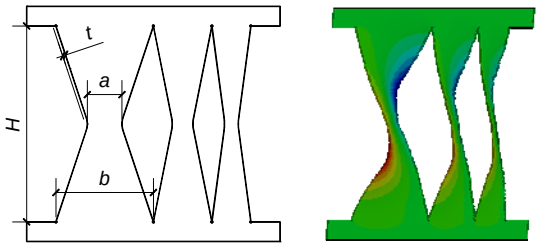
1. Introduction

A post-earthquake survey for building damage needs quantitative information to enhance its reliability and objectivity. An X-shaped steel link is developed as a novel structural component that is capable of recording the maximum experienced deformation to estimate the level of deformation in the story where the link is installed.

2. Basic concepts

A schematic of a steel plate slitted wall with X-shaped links is illustrated in Fig. 1(a), where *b*, *a*, *H* and *t* denote the link end section width, middle section width, height, and thickness, respectively. Under in-plane shear deformation, the links yield and buckle involving out-of-plane deformation. The shear deformation at the onset of buckling can be controlled by changing the shape of the links. Accordingly, a combination of the links with different configurations can provide quantitative information on the deformation that is experienced by the slitted wall.



(a) (b)

Fig. 1 Schematic diagram of slitted wall with X-shaped links: (a) links with various widths; (b) deformed shape with buckling

The X shape of the link is intended to control the location of plastic hinge formation away from the end section and middle section. The ratio of end section width to middle section width, *b*/*a*=3, yields the plastic hinge location at one-quarter height of the link. After the formation of plastic hinges, the central part between the two hinges rotates out-of-plane as a rigid body involving local buckling of the link. The rotation angle (*R*) of the middle section is taken as the indicator of out-of-plane buckling.

3. Numerical results

With finite element software ABAQUS, X-shaped link models with different aspect ratios (*H*/2*a*) were studied. The buckling phenomena were independent of the thickness-to-height ratio, which was a strong sign of local buckling. Fig. 2 shows the results of the parametric study for various width-to-thickness ratios (2*a*/*t*). The links with similar width-to-thickness ratios exhibited similar buckling behavior while the links with different width-to-thickness ratios buckled apart as indicated by the increase of rotation angle *R* at different drift ratios. Therefore, a combination of X-shaped links with different width-to-thickness ratios is promising as a maximum drift indicator for visual inspection.

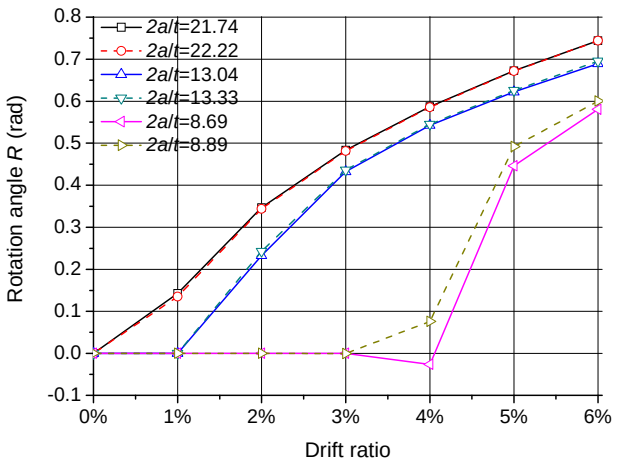


Fig. 2 Link rotations for different width-to-thickness ratios