

Online testing of a three story steel frame with slit walls

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1. Introduction

A new type of earthquake-resisting element, consisting of a steel plate shear wall with vertical slits (SW hereafter) has been recently introduced. In this research, the slit design was modified, concentrating wider slits near the center of the plate, to include condition assessment capabilities to the SW.

In the framework of this research, a 3 story steel frame featuring SW was tested using an online test procedure; the structure was divided into two substructures: the backup frame was modeled numerically and analyzed in OpenSEES. The span featuring SW, was tested experimentally (Fig. 1) to study the influence of the frame in the SW behavior and verify the viability of using modified slit designs.

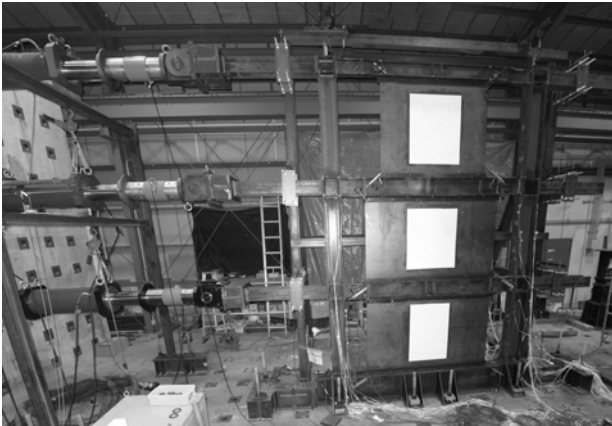


Figure 1: Experimental Setup

2. Experimental Procedure

The frame is designed with the objective of sustaining a 40% of the base shear force with the SW. The specimen was fabricated in a 1:2.4 scale to the original prototype design. JIS SS400 steel was used for the SW and the surrounding frame.

Loading procedure consisted of three online tests

for 10 seconds of JR Takatori Station record on 1995 Kobe earthquake at scales of 10%, 20% and 40%.

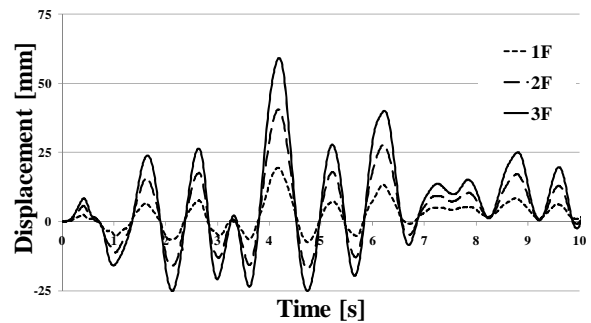


Figure 2: 40% JR Takatori response

3. Experimental Results

Figure 2 illustrates the displacement response for for JR Takatori 40%. Maximum drift angles were 1.7%, 1.9% and 1.6% for the first, second and third stories. The maximum base shear in the experimental setup was 412 kN. The participation factor of the SW (β) was 32%, 36% and 42% for each story, achieving the design goal.

The hysteretic loops of the SW show a stable behavior (Fig. 3) without evidence of slip for drift angles below 2%. Experimental results suggest that non-linear behavior starts at drift angles below 0.5% for all the SW. Out-of-plane behavior was only localized in the centermost (wider) slits. No plate out-of-plane deformation was observed.

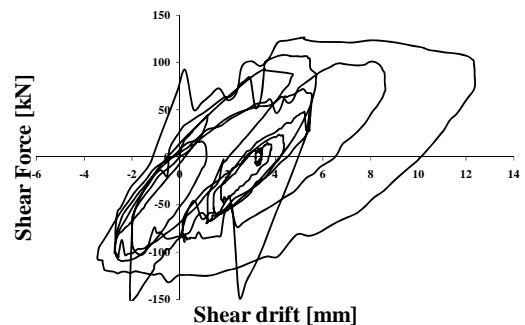


Figure 3: First story SW hysteresis (JR Tkt. 40%)