

Seismic Retrofit of Ductile Concrete Moment Frames with Innovative Pin-Supported Walls

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Background

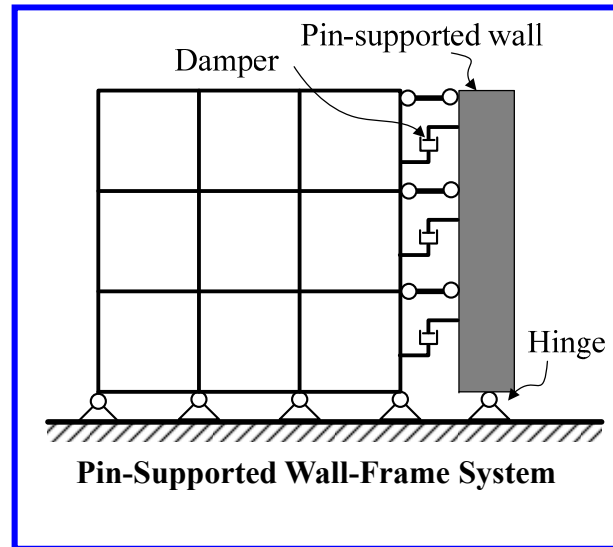
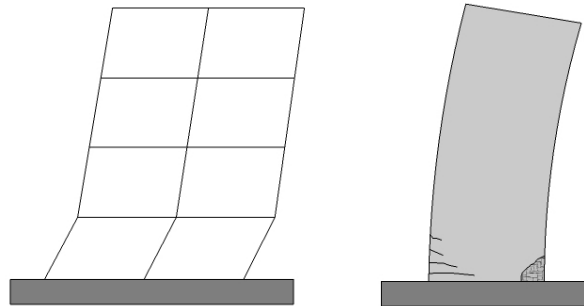
Moment Frame



Kobe city hall after 1995 Kobe EQ



RC frame after 2008 Wenchuan EQ

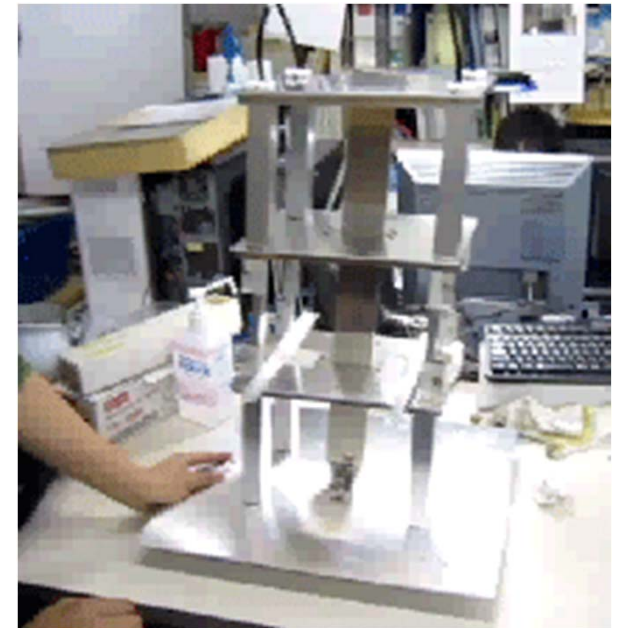
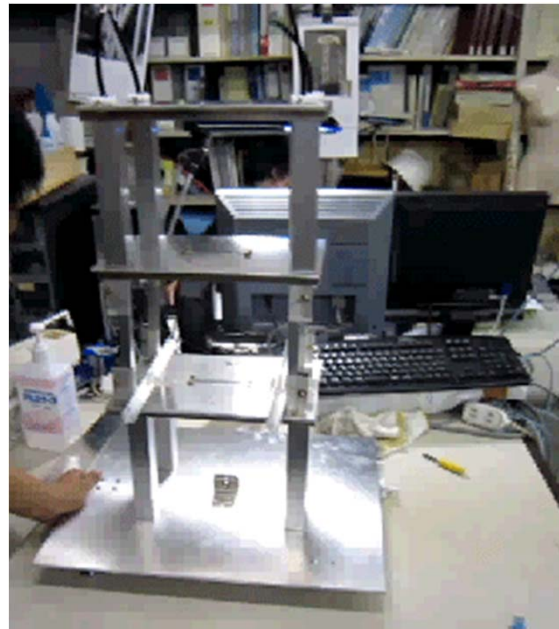
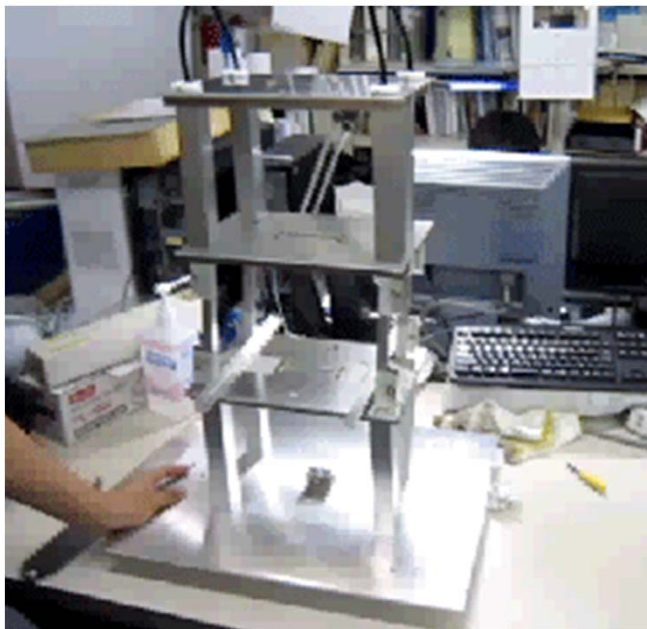
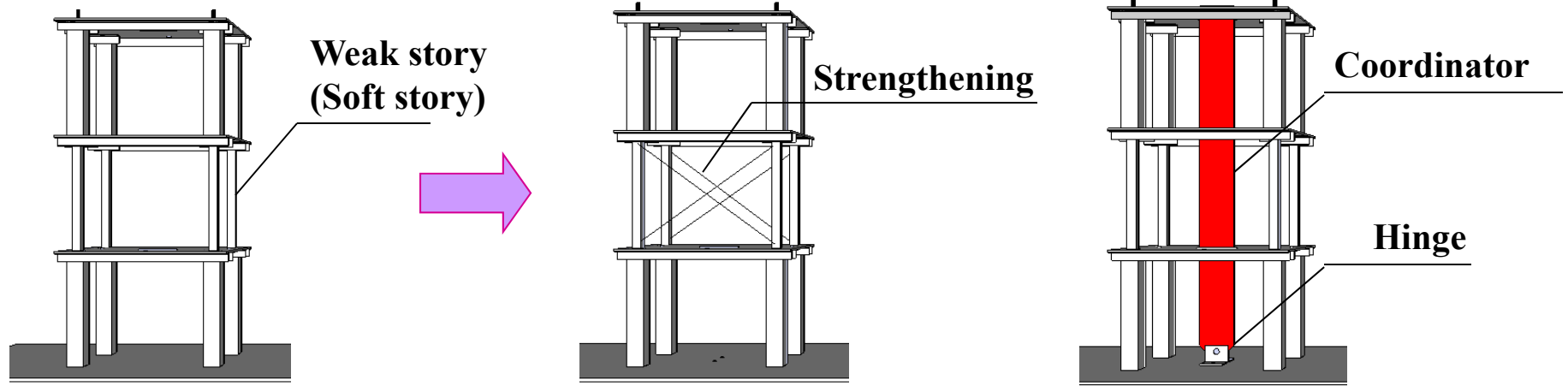


Shearwall

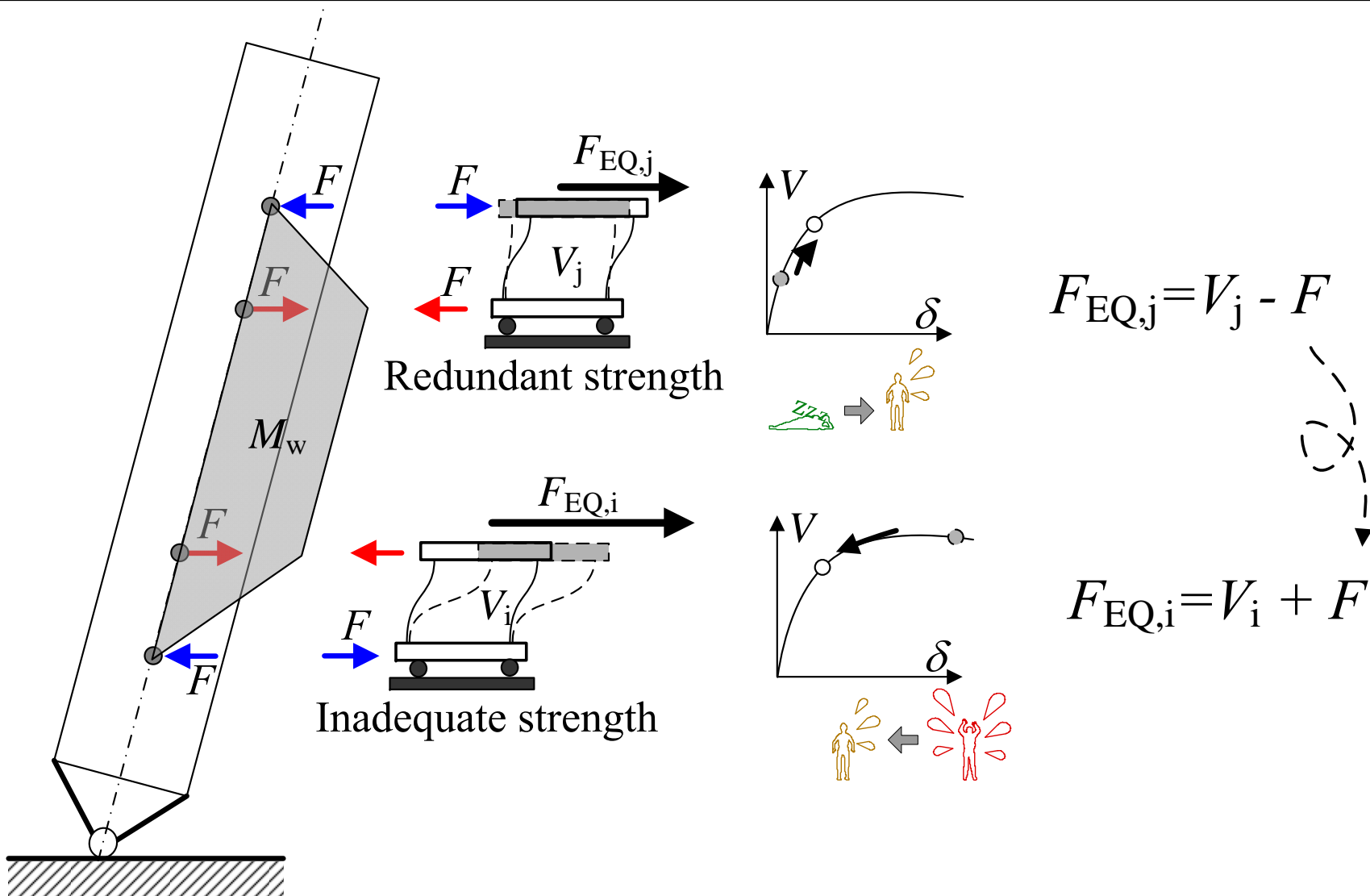


Shearwall damage in 2010 Chili EQ (EERI, 2010)

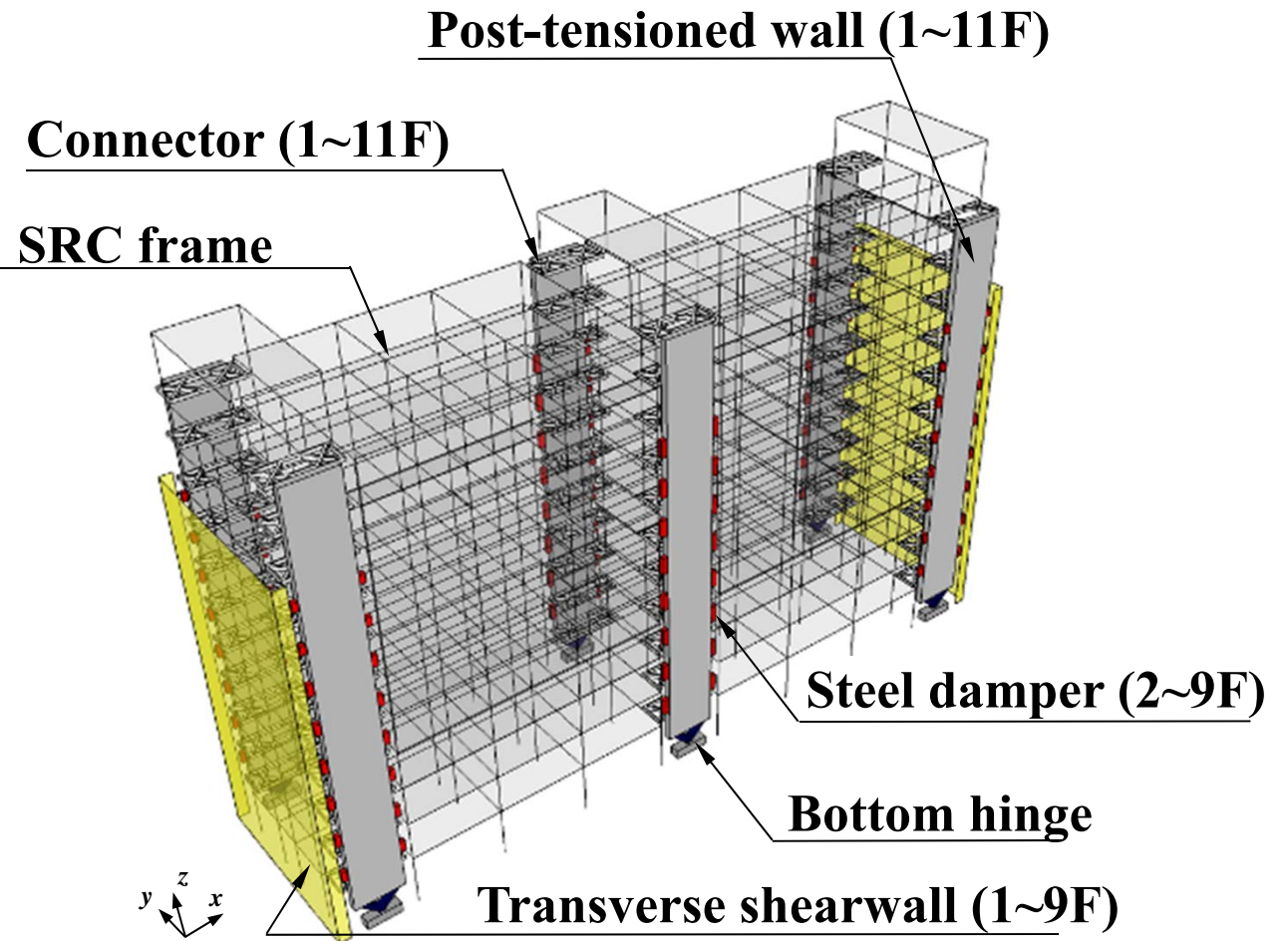
Pin-Supported Walls



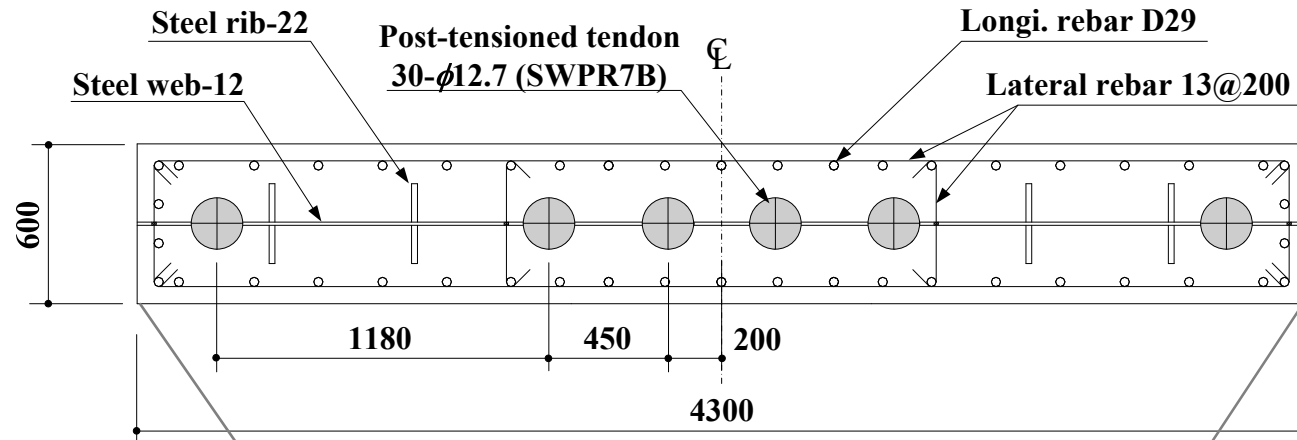
Pin-Supported Walls



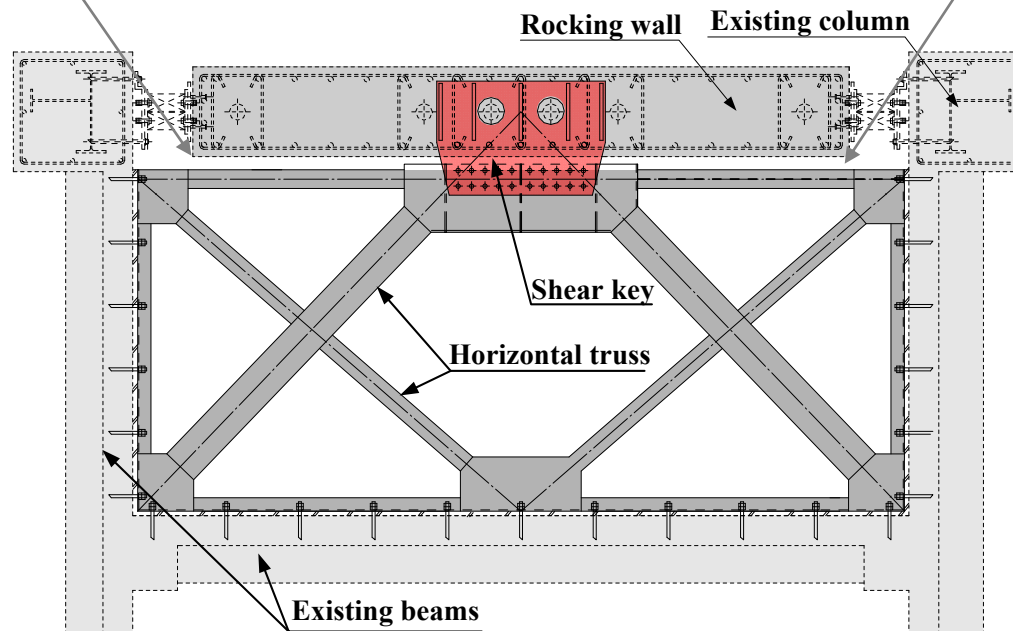
G3 Building in Tokyo Tech



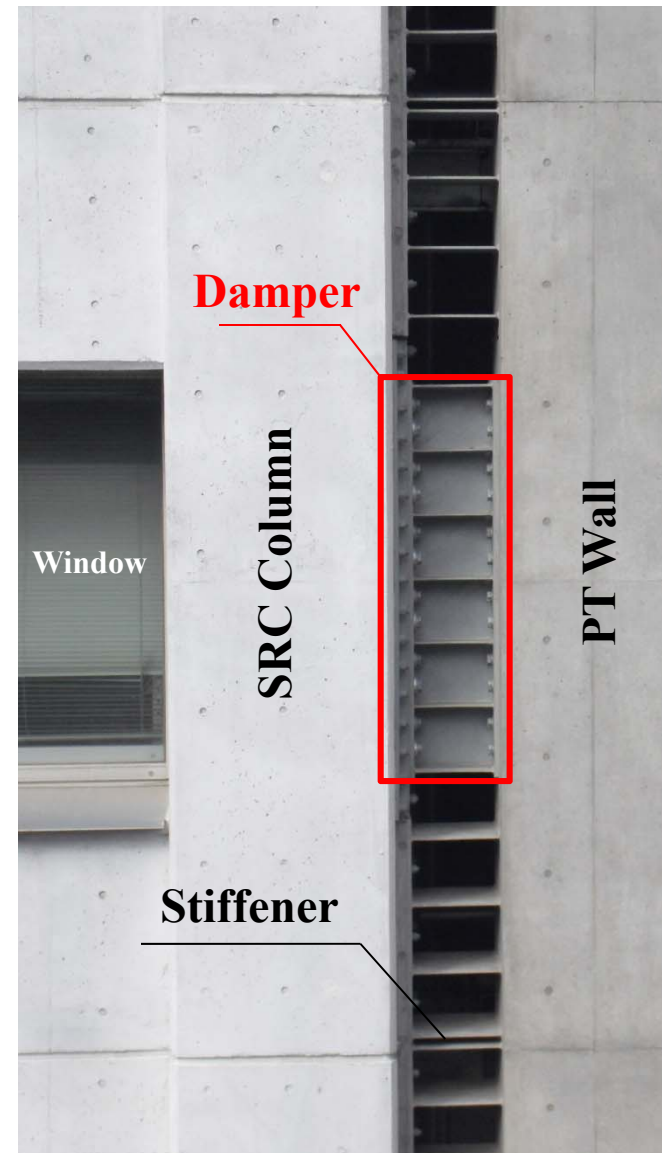
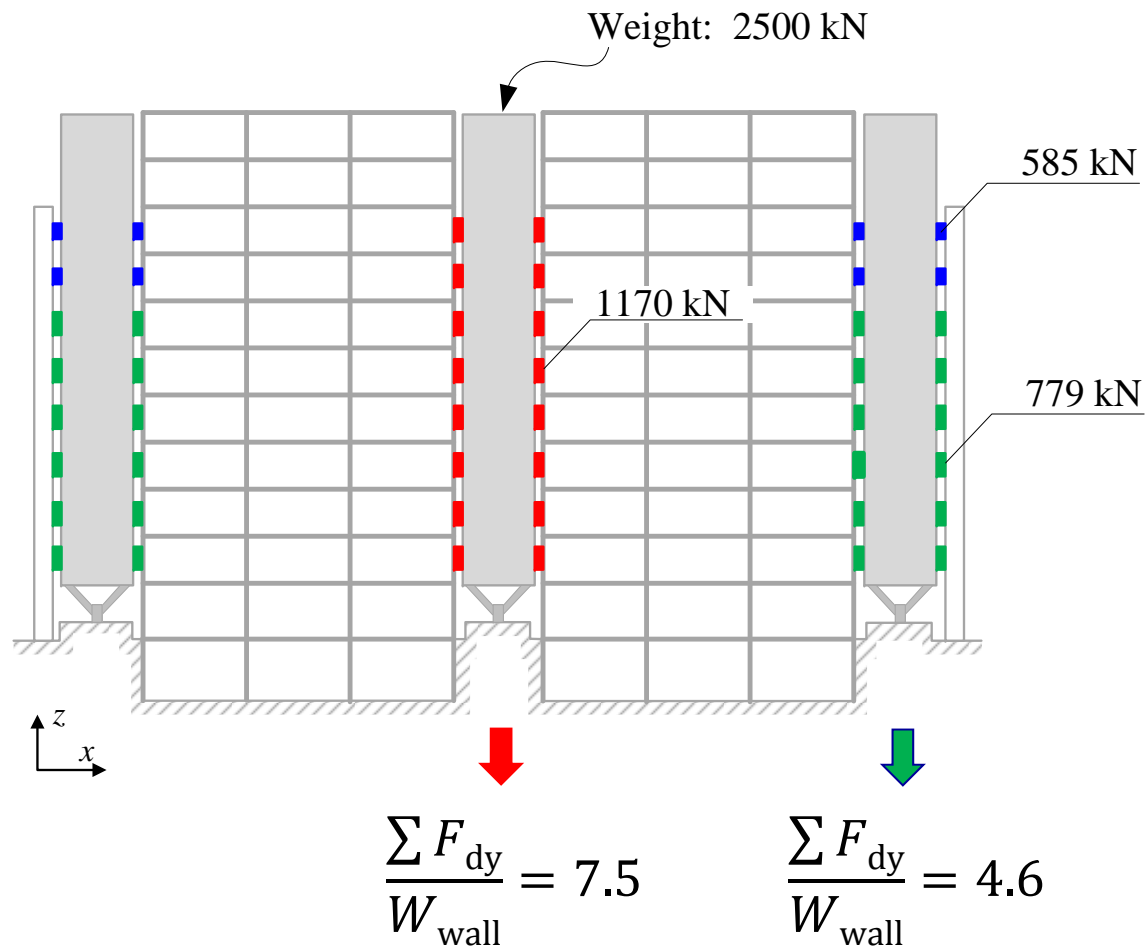
Post-Tensioned Wall and Connector



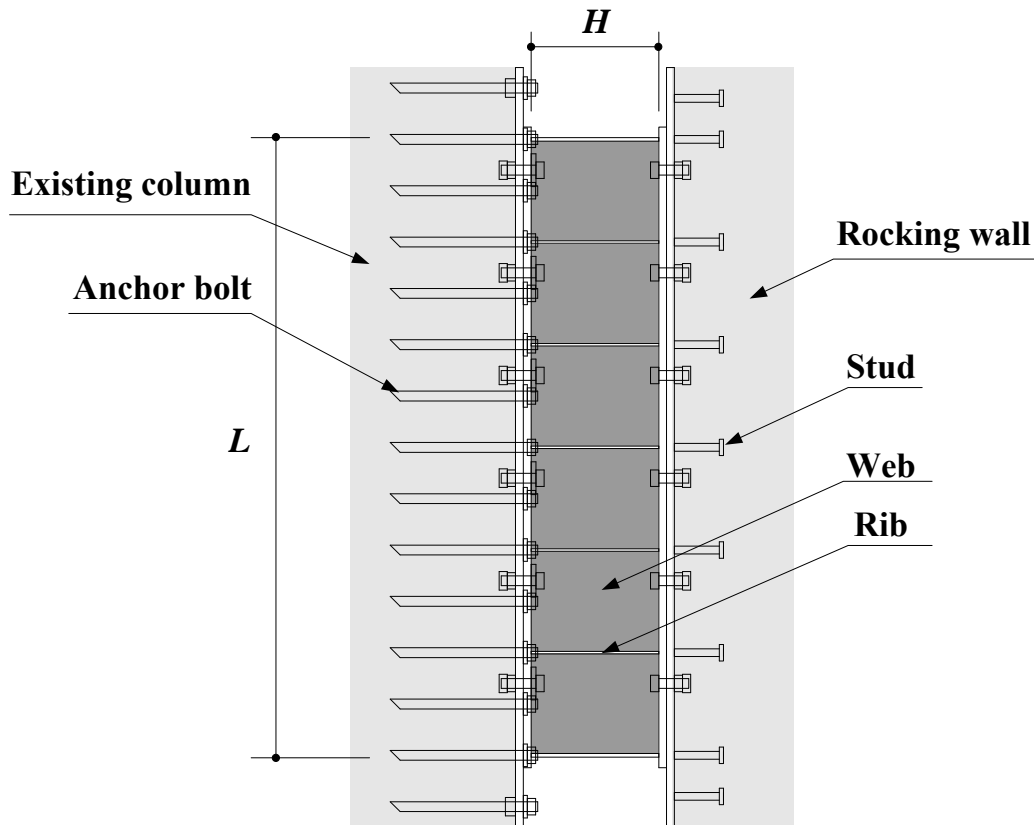
$$P_{\text{con}} = 0.68P_y$$
$$\sigma_{\text{cp}} \approx 7 \text{ MPa}$$



Steel Damper

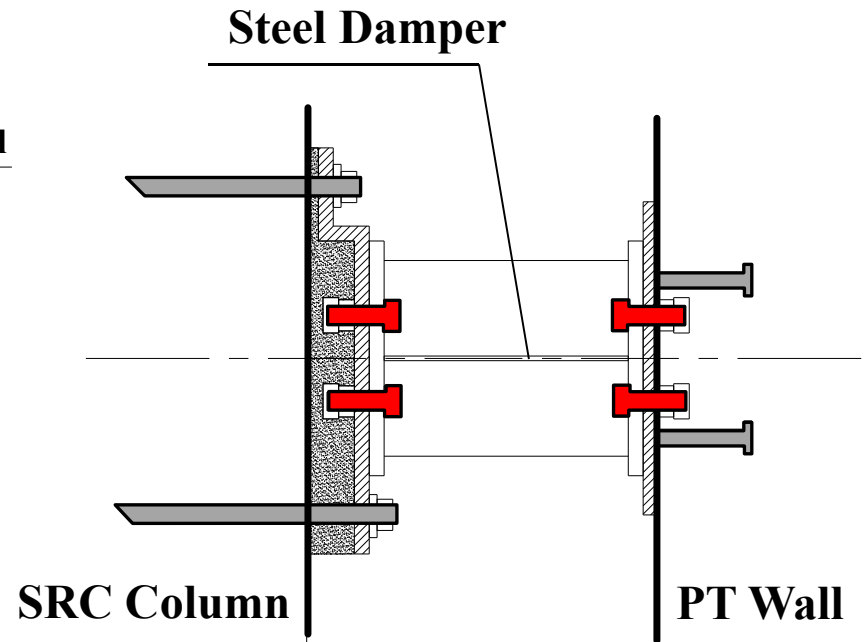


Steel Damper



Web: PL-6, SLY225
Flange: PL-19, SN400B
Rib: PL-6, SS400 at 250mm spacing

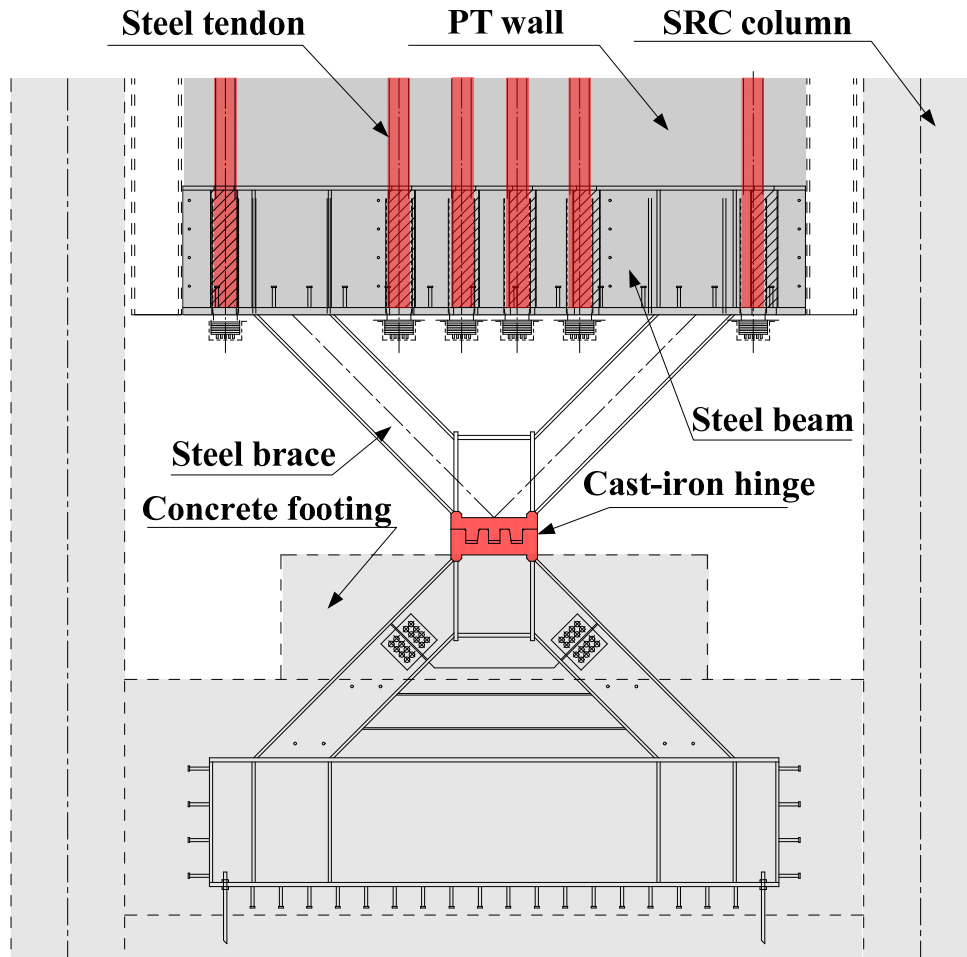
Web height $H = 312\text{mm}$
Total length $L = 750\sim 1500\text{mm}$



Plan View

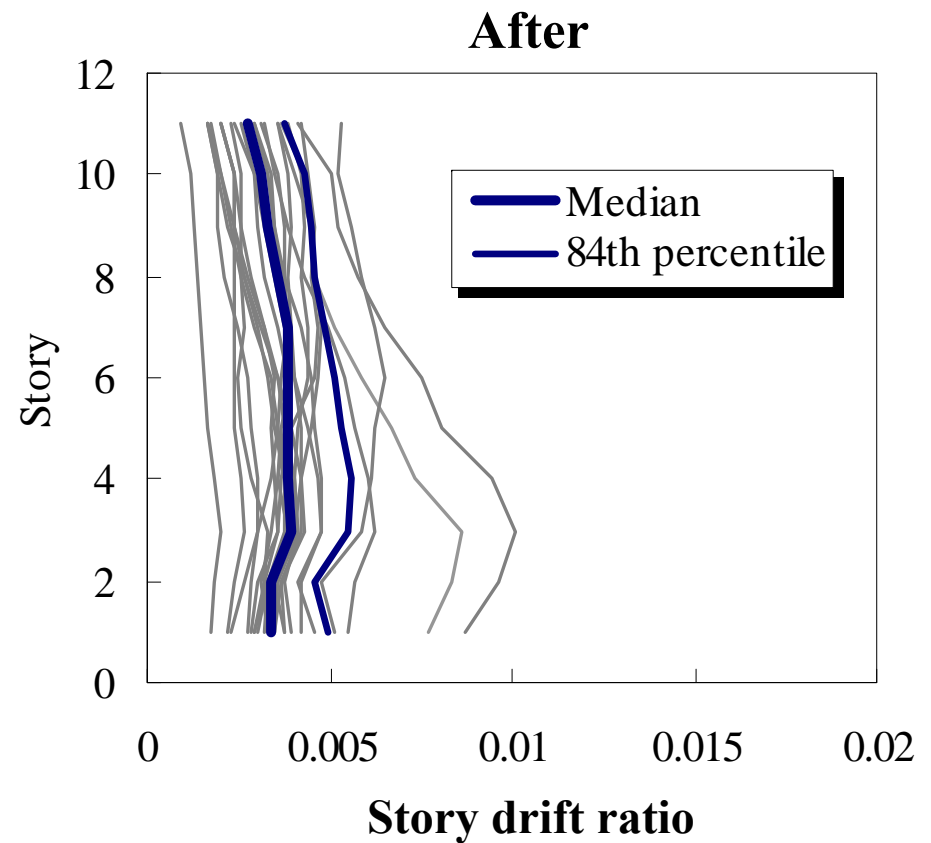
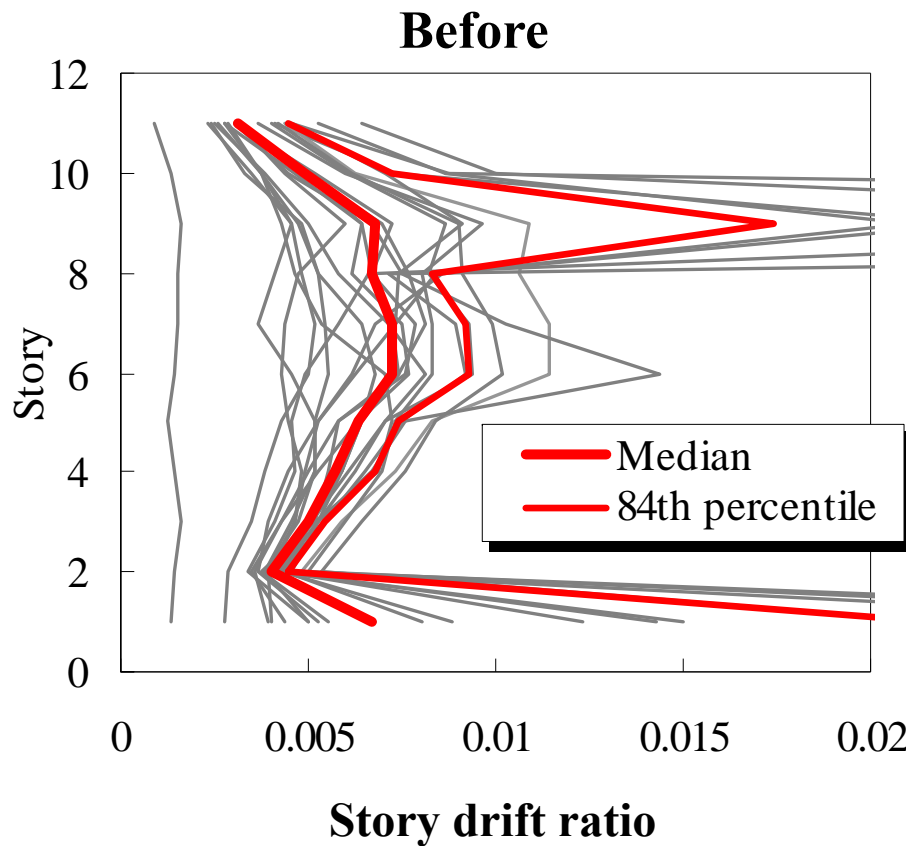
Two sets of fasteners to make dampers **replaceable**

Bottom Hinge

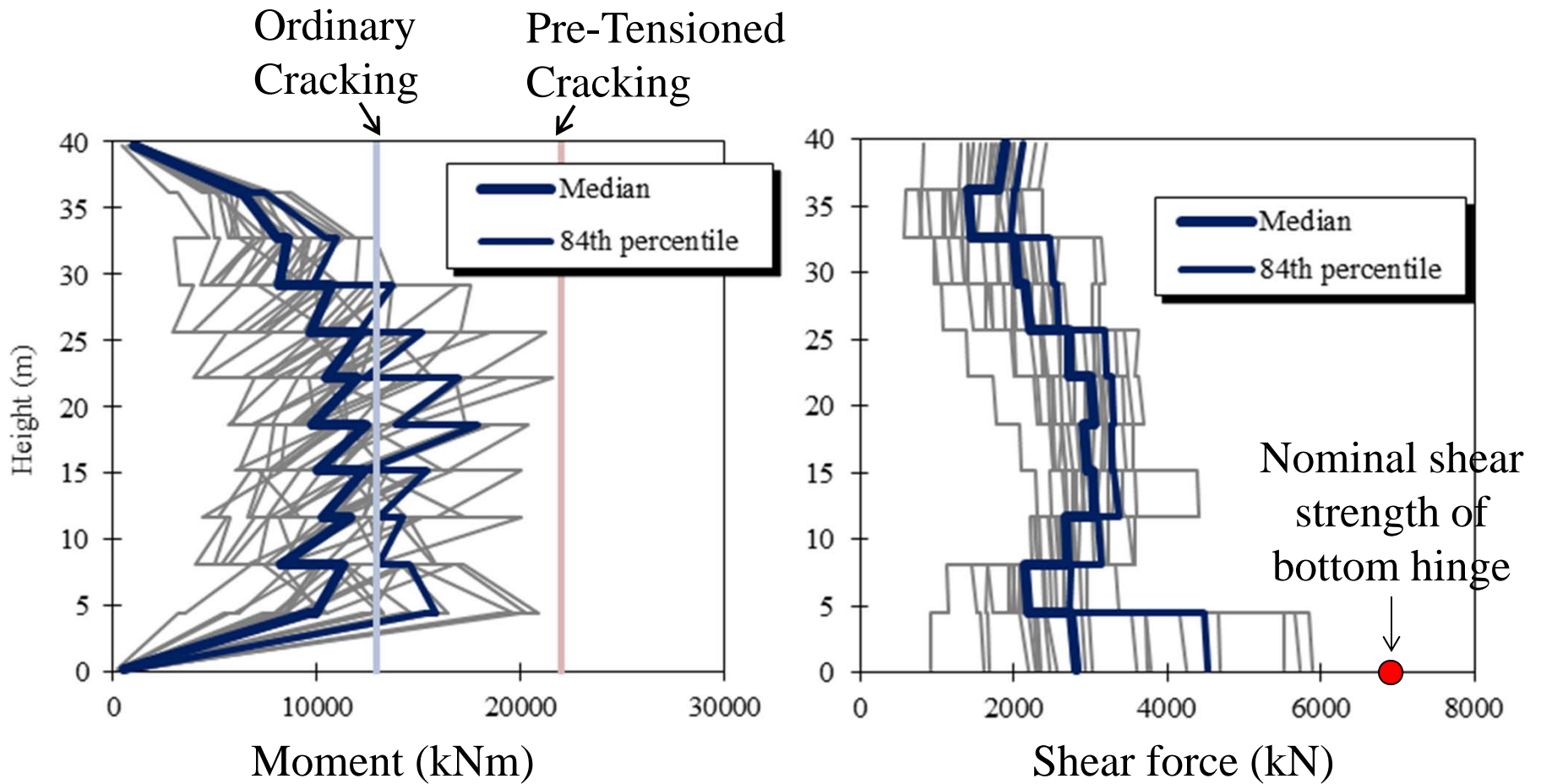


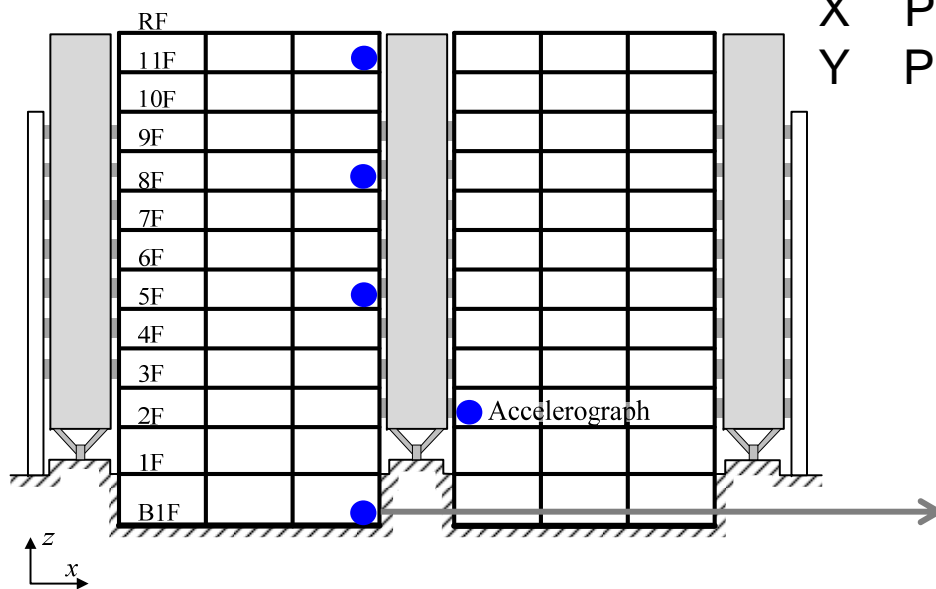
Numerical Evaluation

- **Nonlinear Time History Analysis**
- **Fiber-sectioned beam elements in ABAQUS**
- **22 Ground Motions (scaled to PGV = 50 cm/s)**

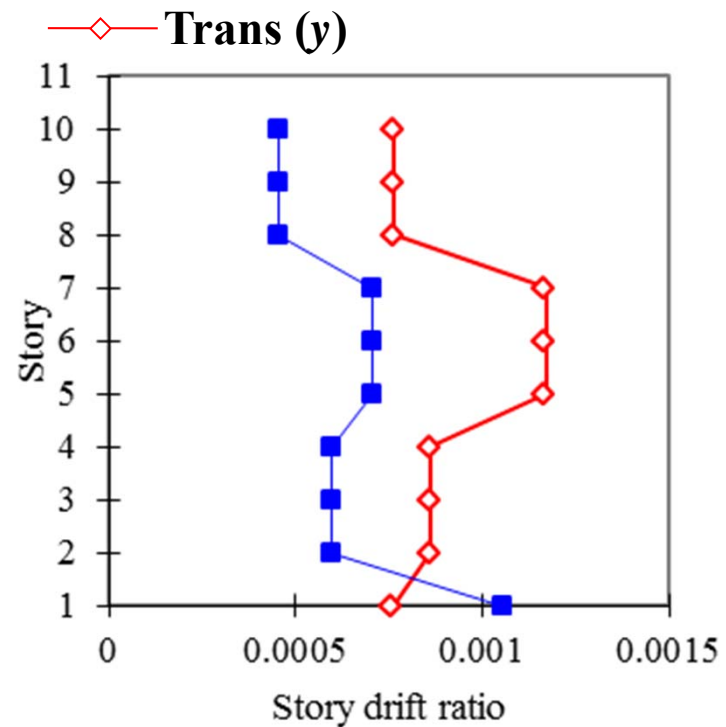
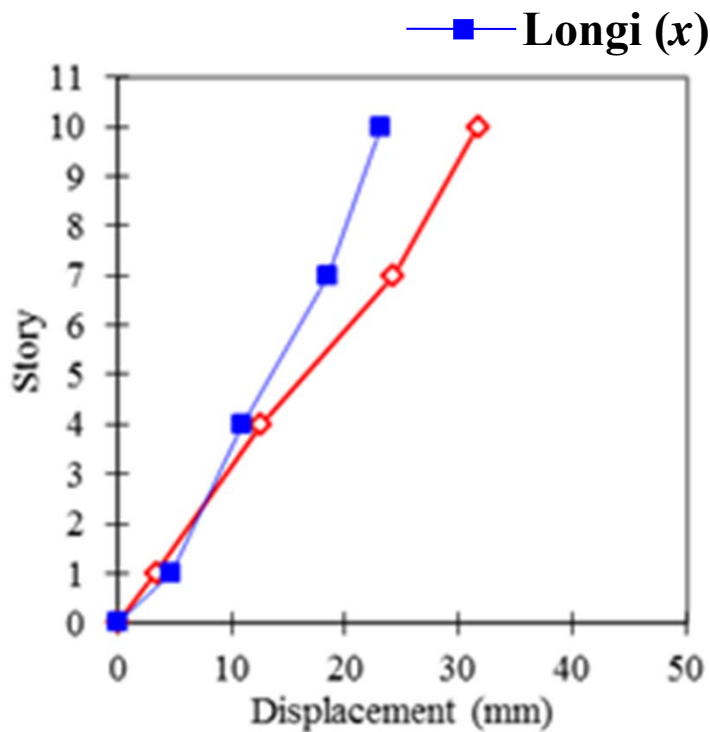
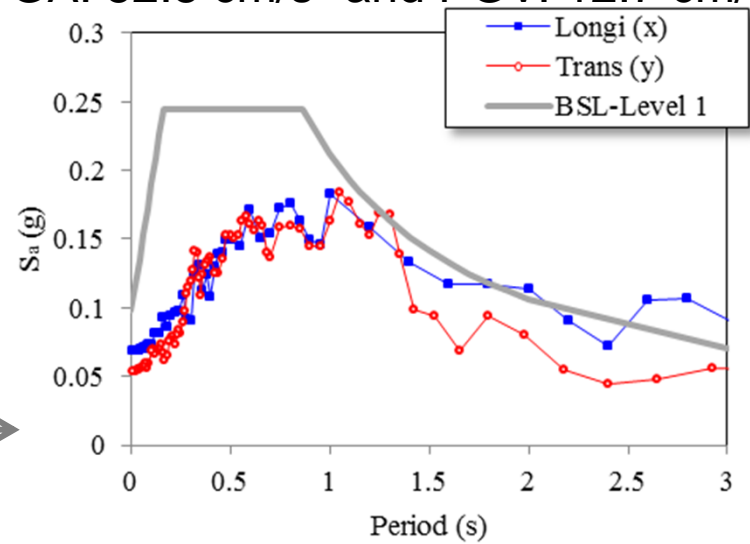


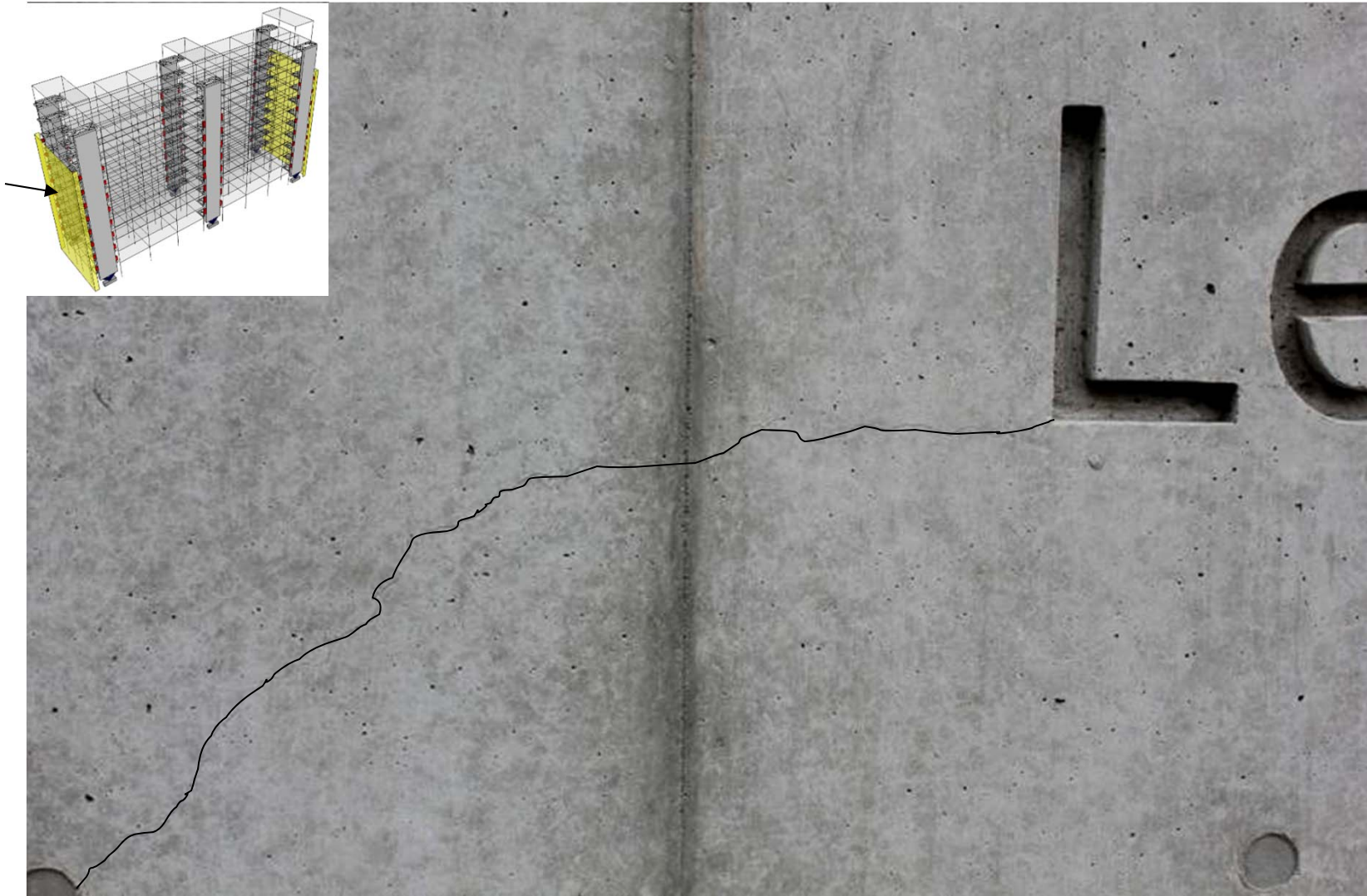
Numerical Evaluation





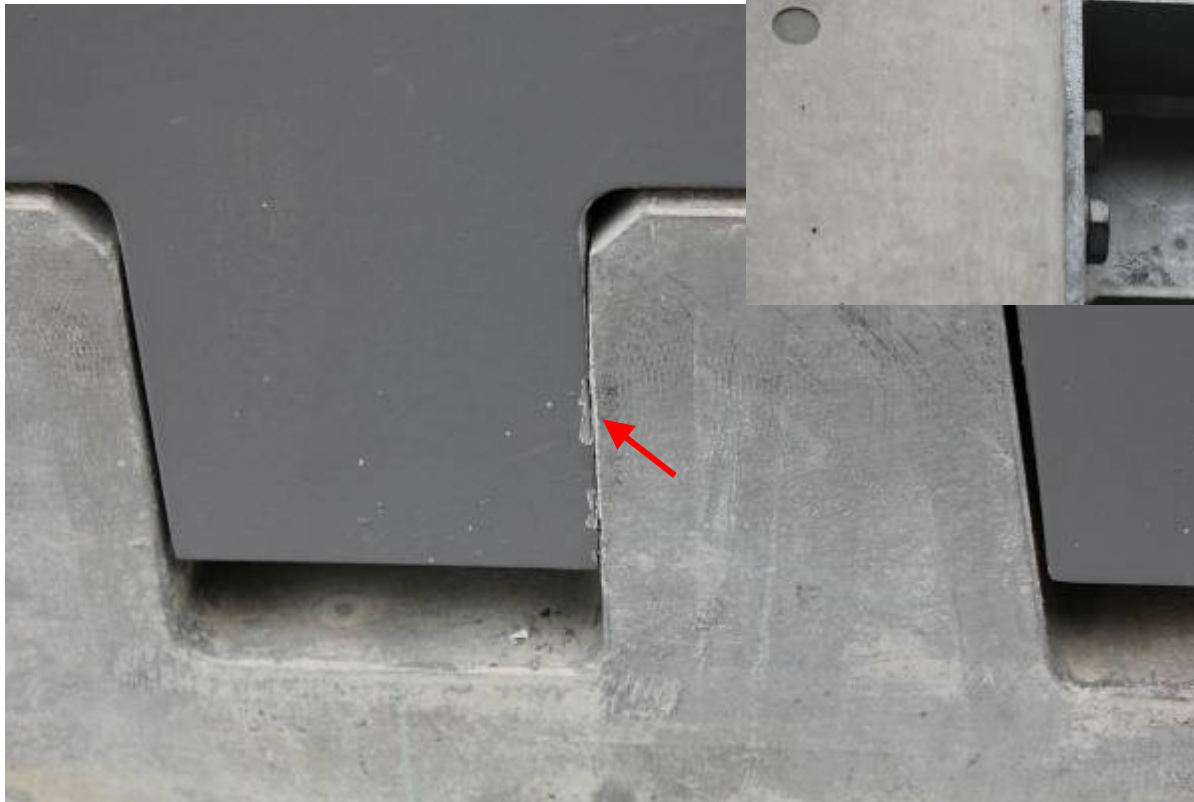
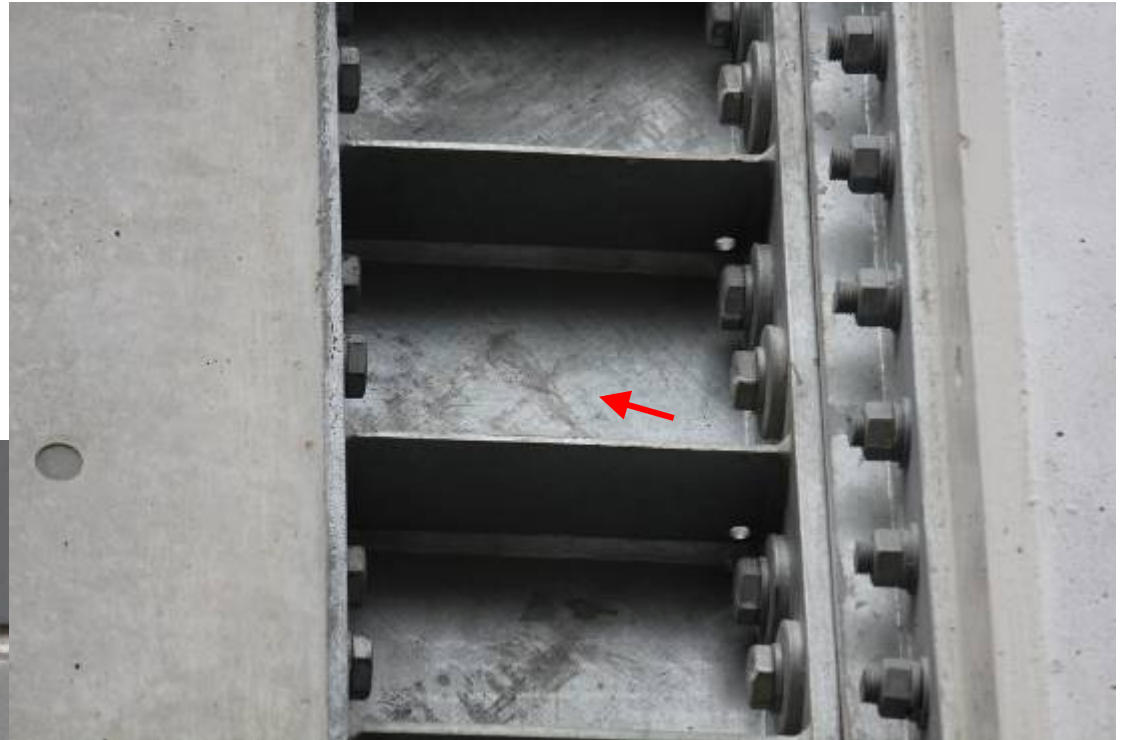
X PGA: 67.3 cm/s² and PGV: 14.4 cm/s
 Y PGA: 52.8 cm/s² and PGV: 12.7 cm/s





Diagonal cracks on transverse shear walls during 2011 Tohoku EQ

**Diagonal rust
on steel damper**



**Protective coating peeled
off at bottom hinge**





Thanks for your attentions!