



Post-tensioning Damper System for Micro-vibration Reduction in Houses

Takewaki-Tsuji Lab.

Outline of research

Habitability

Traffic and wind vibration

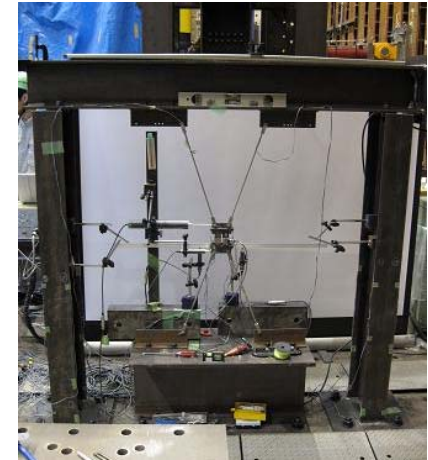
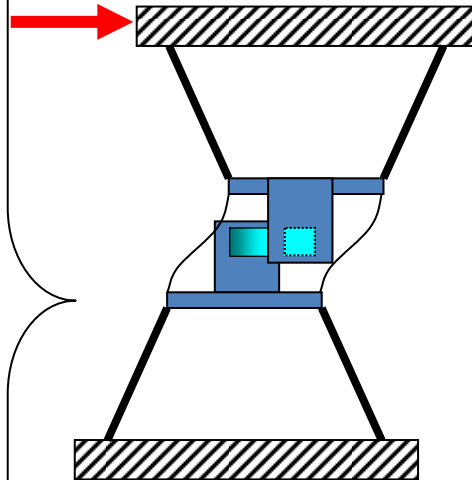


Safety

Earthquake and wind

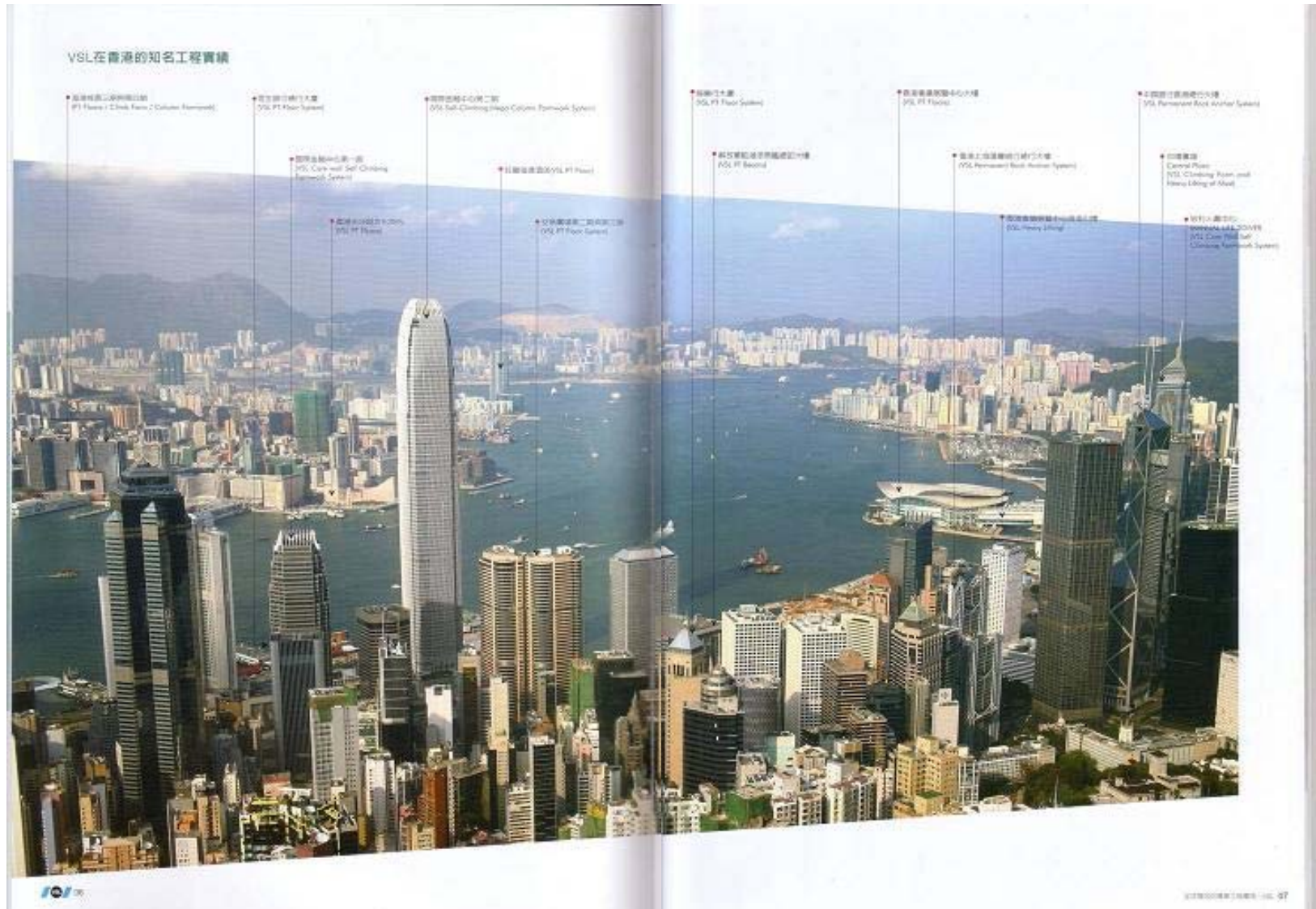


New vibration control system



Theoretical investigation
and experimental test

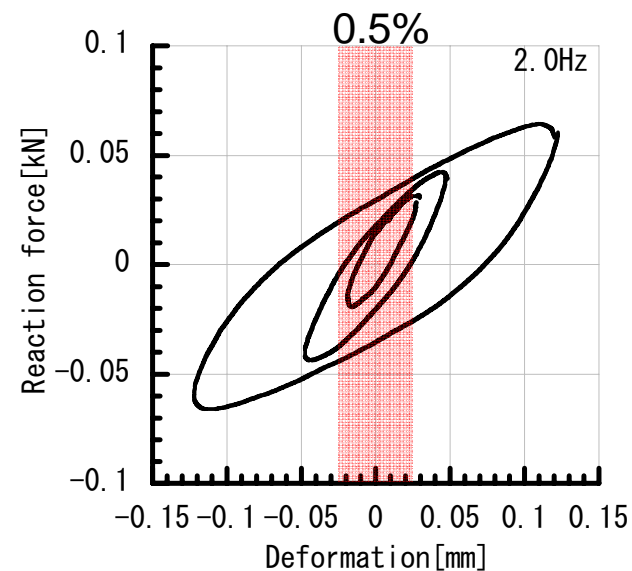
Asian Cities



Background and purpose of research

- Need of micro-vibration reduction in houses
- Proposal of low-cost and handy system
- Clarification of control mechanism
- Proposal of simple analysis model
- Experimental investigation (1/3 scale)
- Use of High-hardness rubber damper

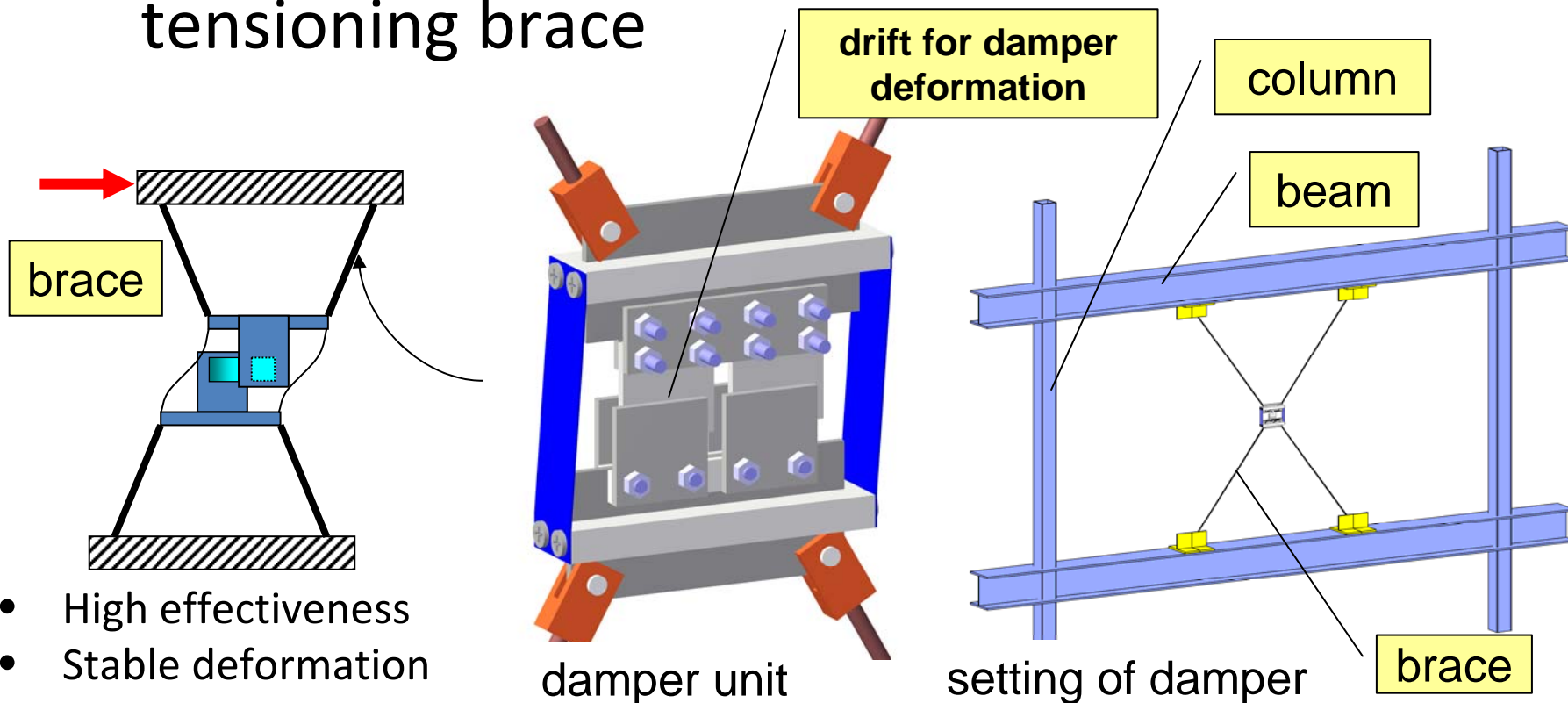
Sufficient damping even in small deformation range (shear strain of 0.5%)



Experimental results
(5mm thickness)

Proposed vibration-control system

- Sufficient damping of high-hardness rubber damper even in small deformation range
- Avoidance of mechanical looseness via post-tensioning brace

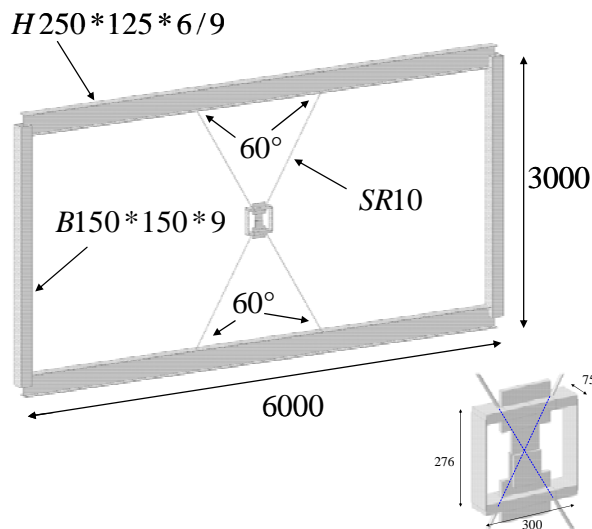


- High effectiveness
- Stable deformation

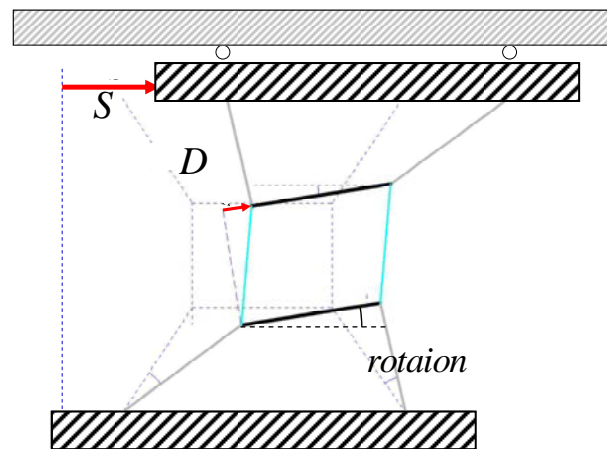
Clarification of damper mechanism

Principal parameters

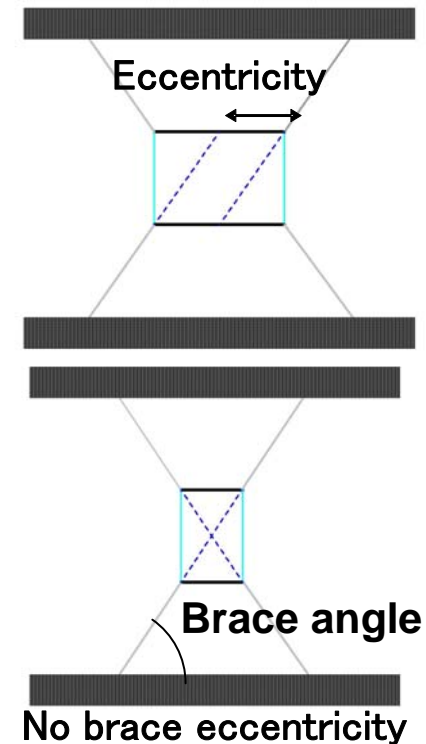
- Member stiffness
(brace and rubber damper)
- Eccentricity of brace
- Brace angle
- Post-tensioning force



Detailed model



Simple model



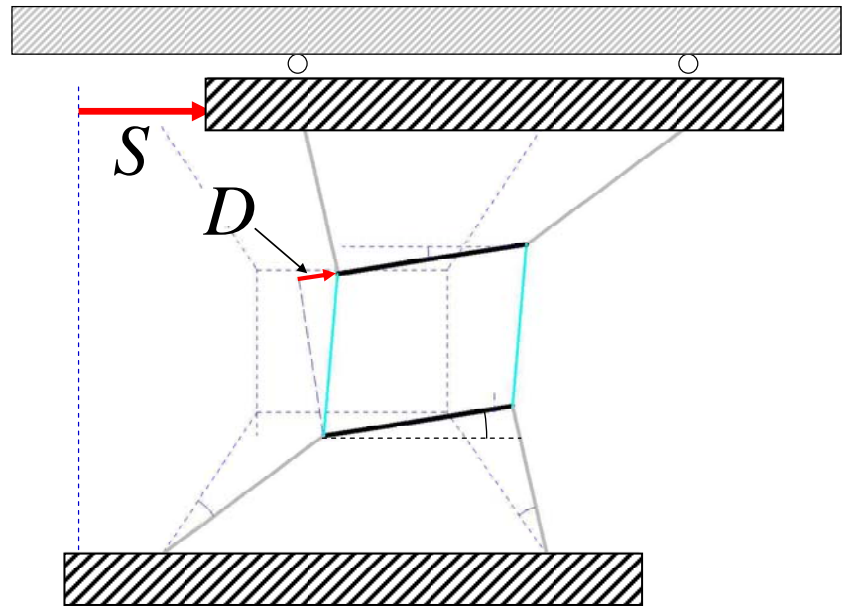
No brace eccentricity

Effective deformation ratio

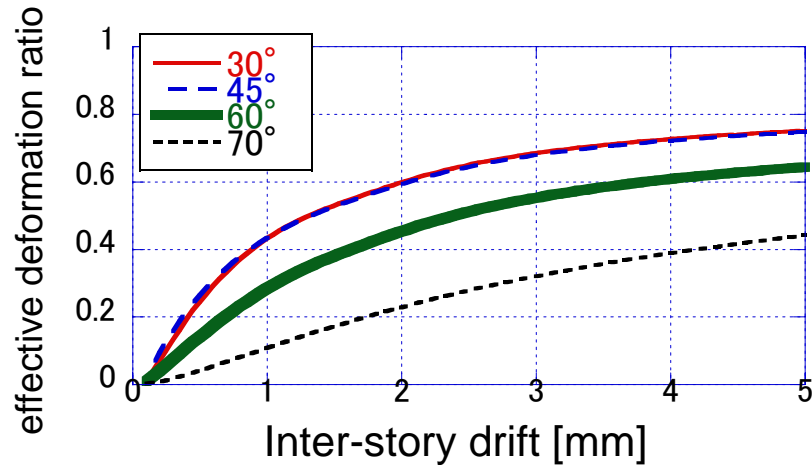
Effective deformation ratio $= \frac{D}{S}$

Damper displacement

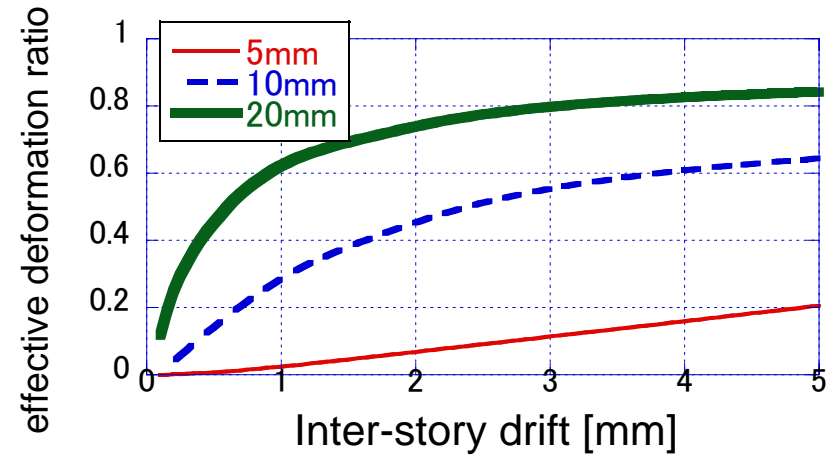
Interstory drift



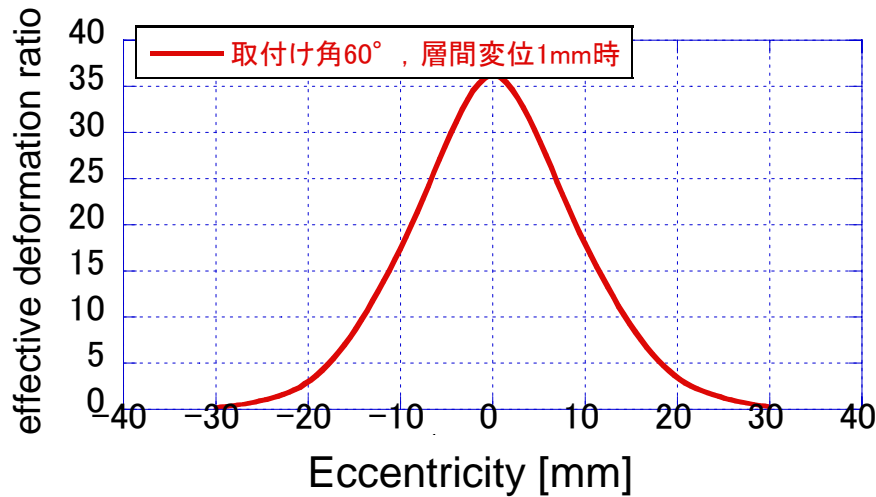
Simulation result



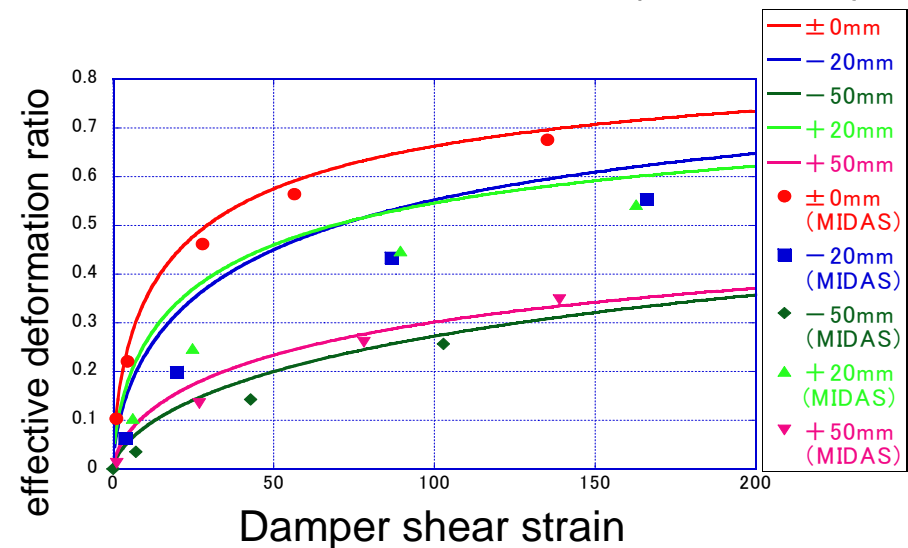
Influence of brace angle



Influence of brace size (diameter)

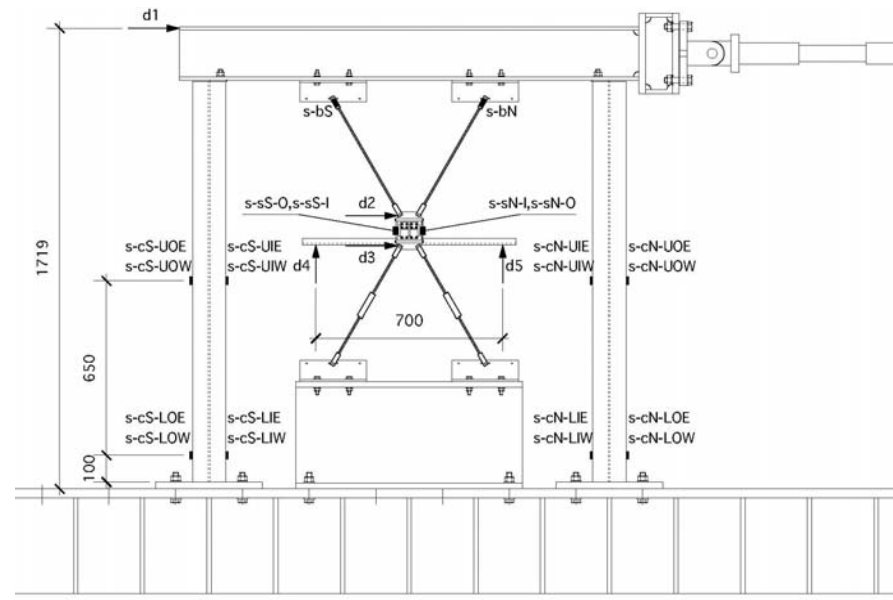
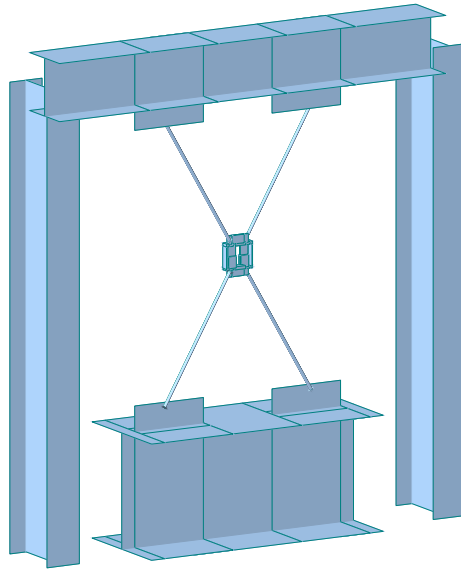


Influence of brace eccentricity



Comparison between detailed and simple model

1/3-scale experiment

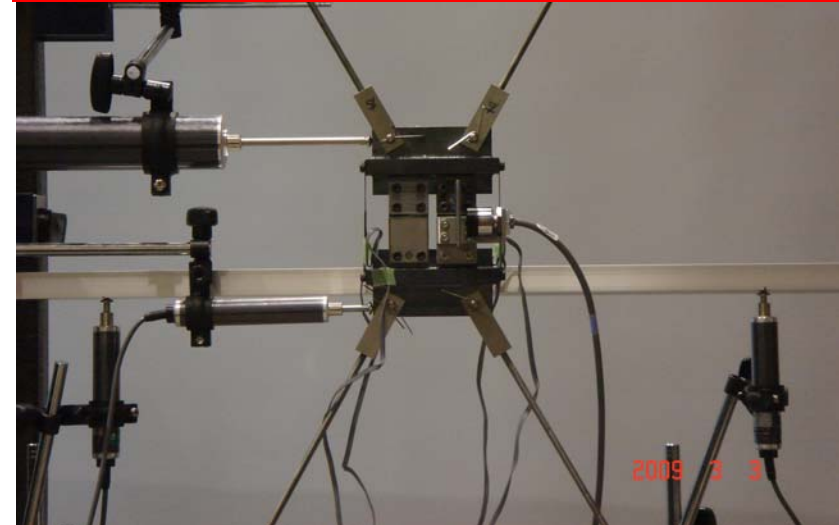


- Brace angle=60°
- Brace eccentricity=0, 30, 100mm
- Brace diameter= $\phi 6$
- Post-tensioning is determined so that compressive-side brace does not enter compressive region and tensile-side brace does not yield

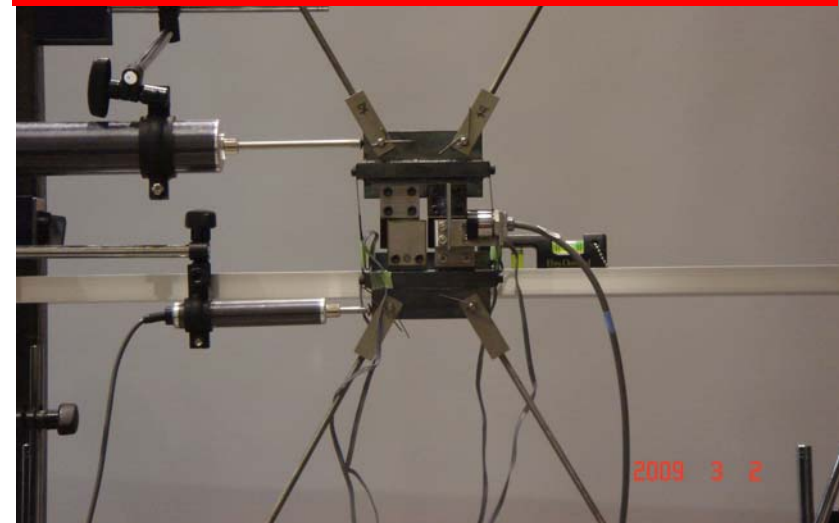
Test specimen



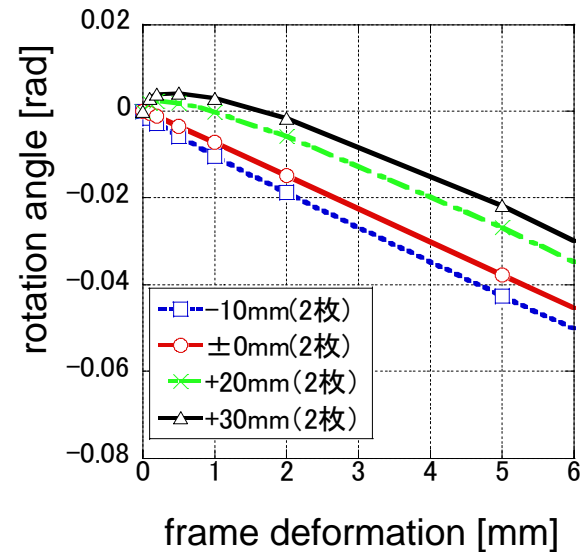
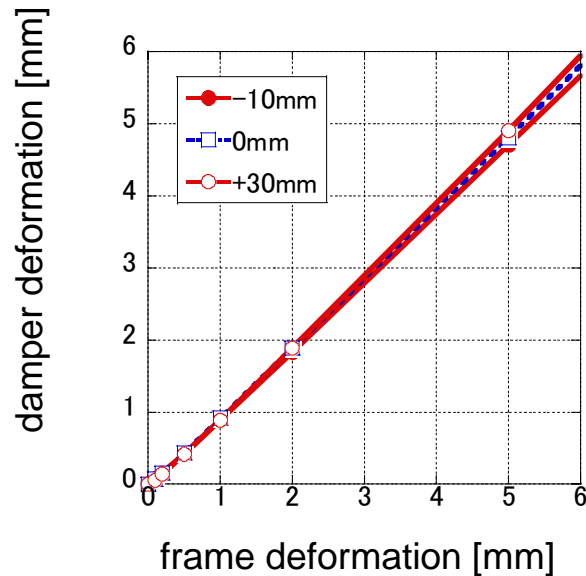
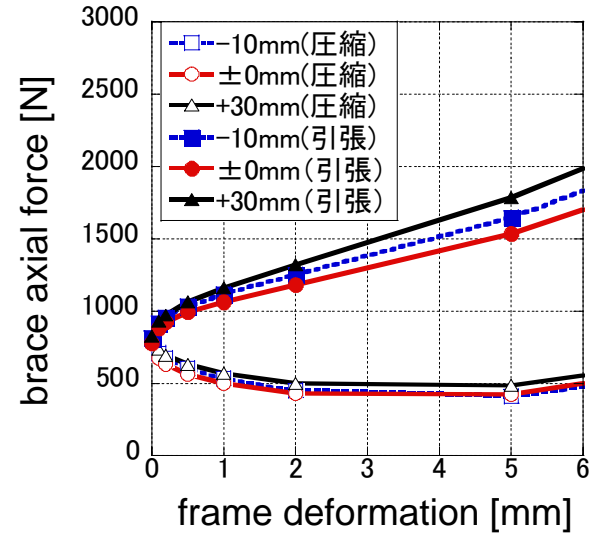
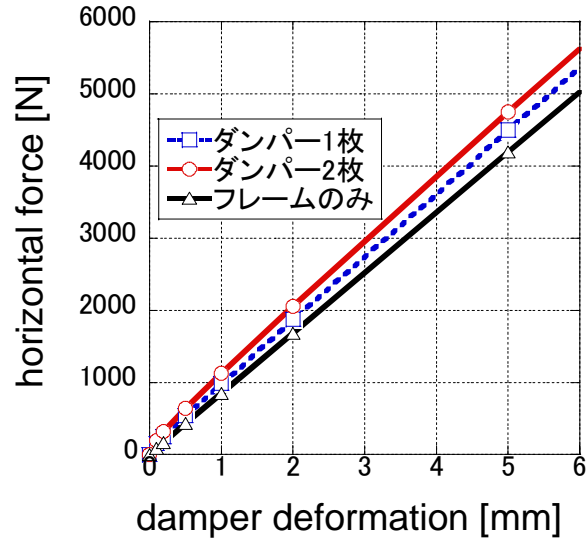
Initial state



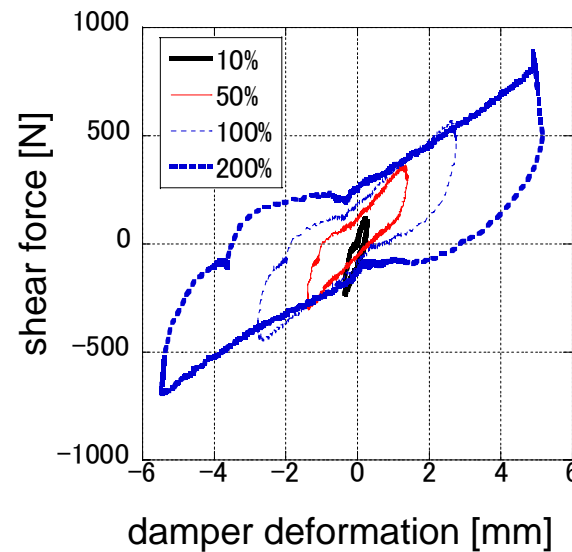
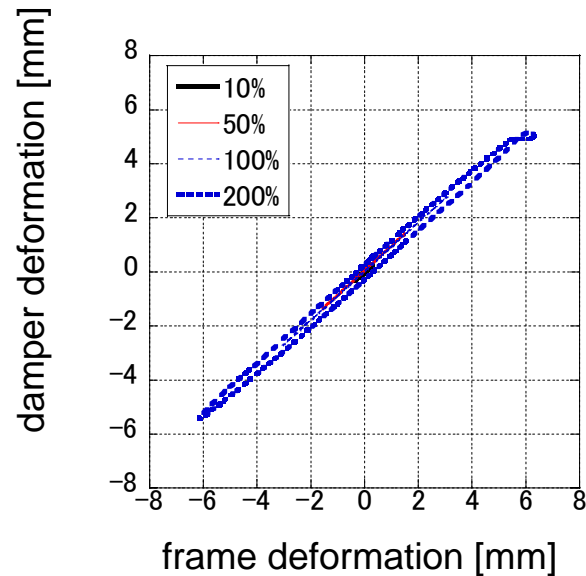
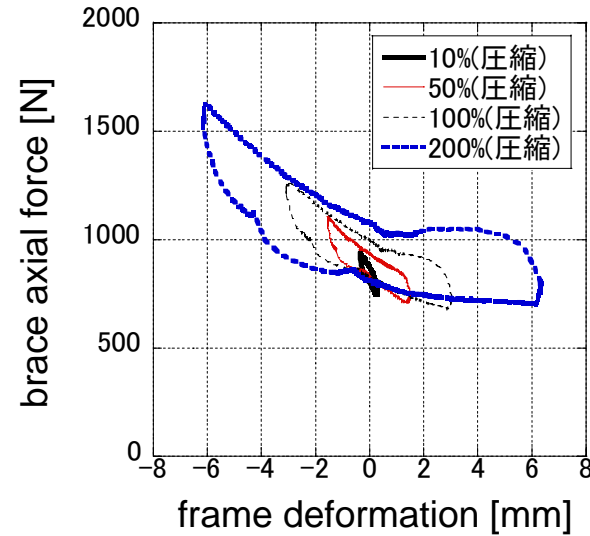
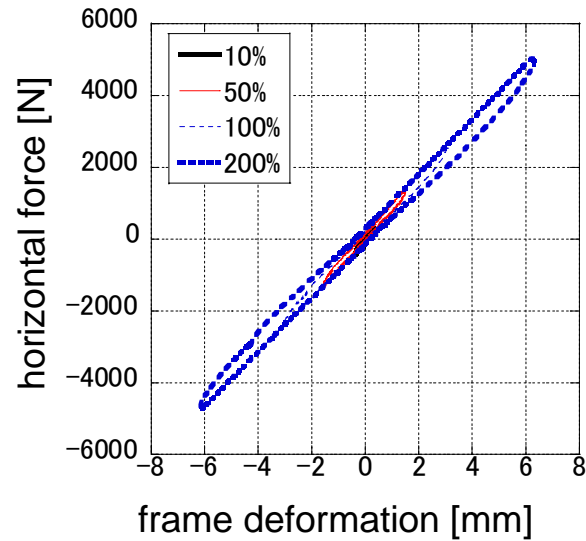
Frame displacement 3mm



Simulation result



Experimental result





Future issues

- Proposal of design method including proposed vibration control system
- Dual resistance for small and large amplitudes
Series solution
- Tensegrity solution of post-tensioning force