17th U.S.-Japan-New Zealand Workshop

Vibration Control of RC High-rise Building with Soft-story

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TAISEI Corporation

Agenda

1.Background

2.Our Newly Developed System

3.Cyclic loading test

4.Shaking table test

5.Conclusion

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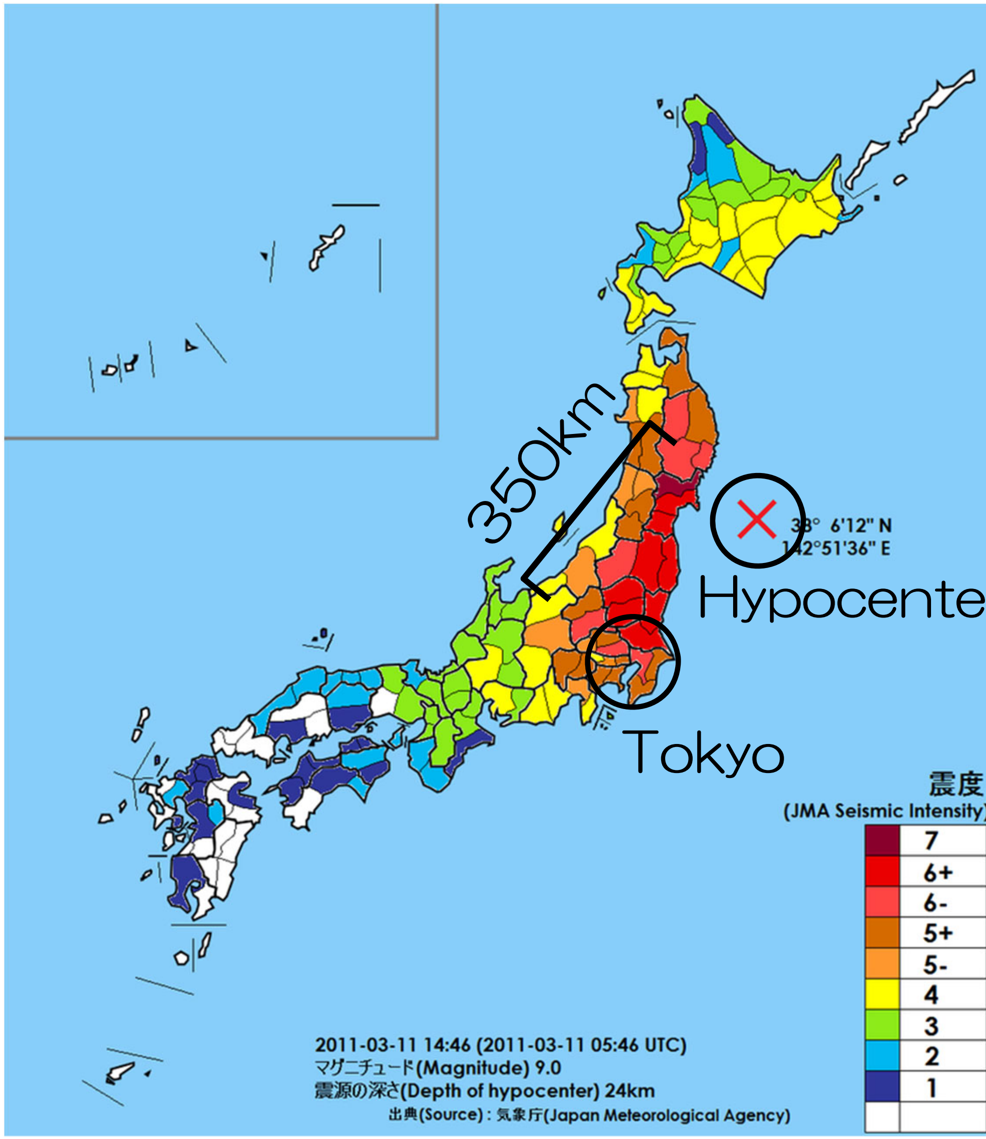
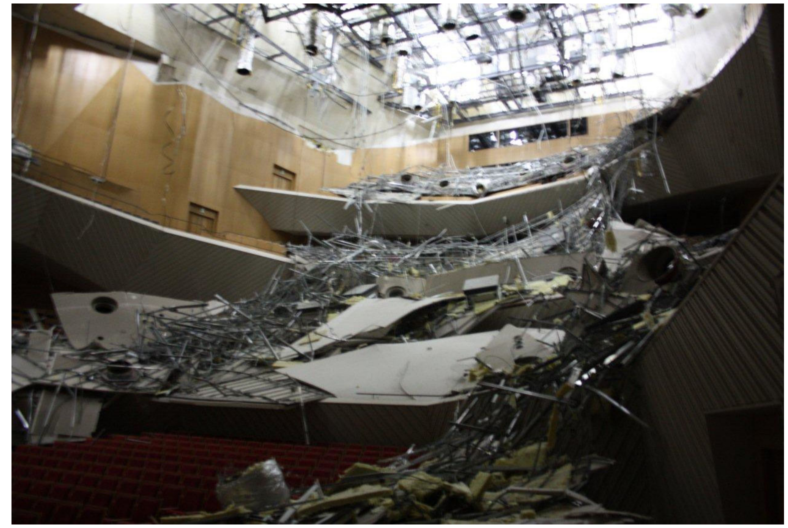
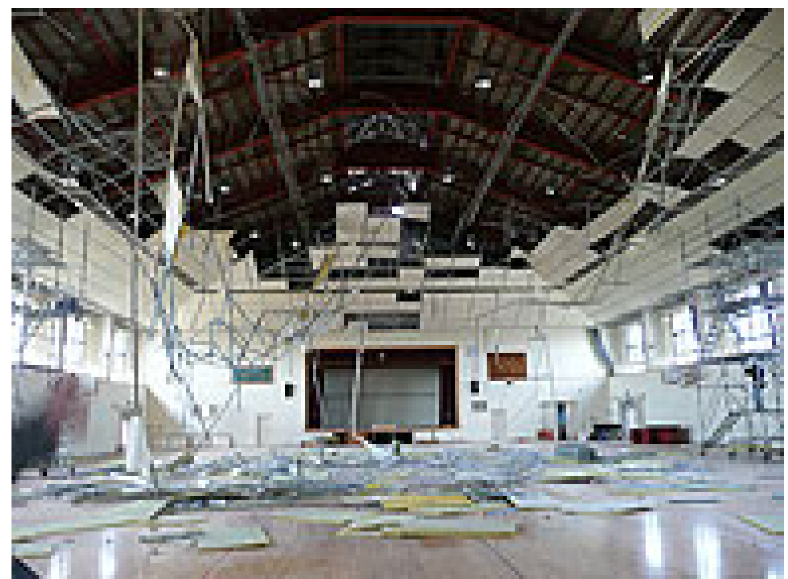
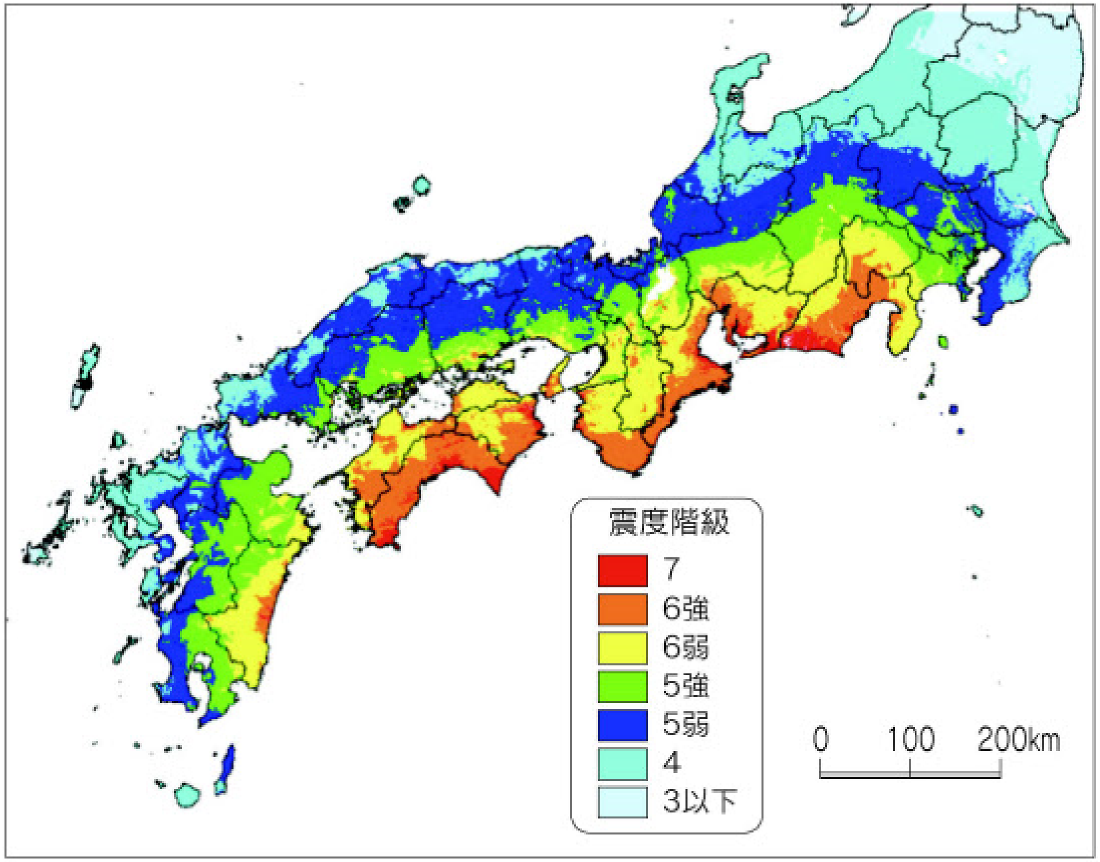
Distribution of seismic intensity of Tohoku earthquake 2011







Distribution of assumed seismic intensity of Nankai



Assumed seismic intensity of Nankai earthquake

Purpose：To provide a safety and security living environment

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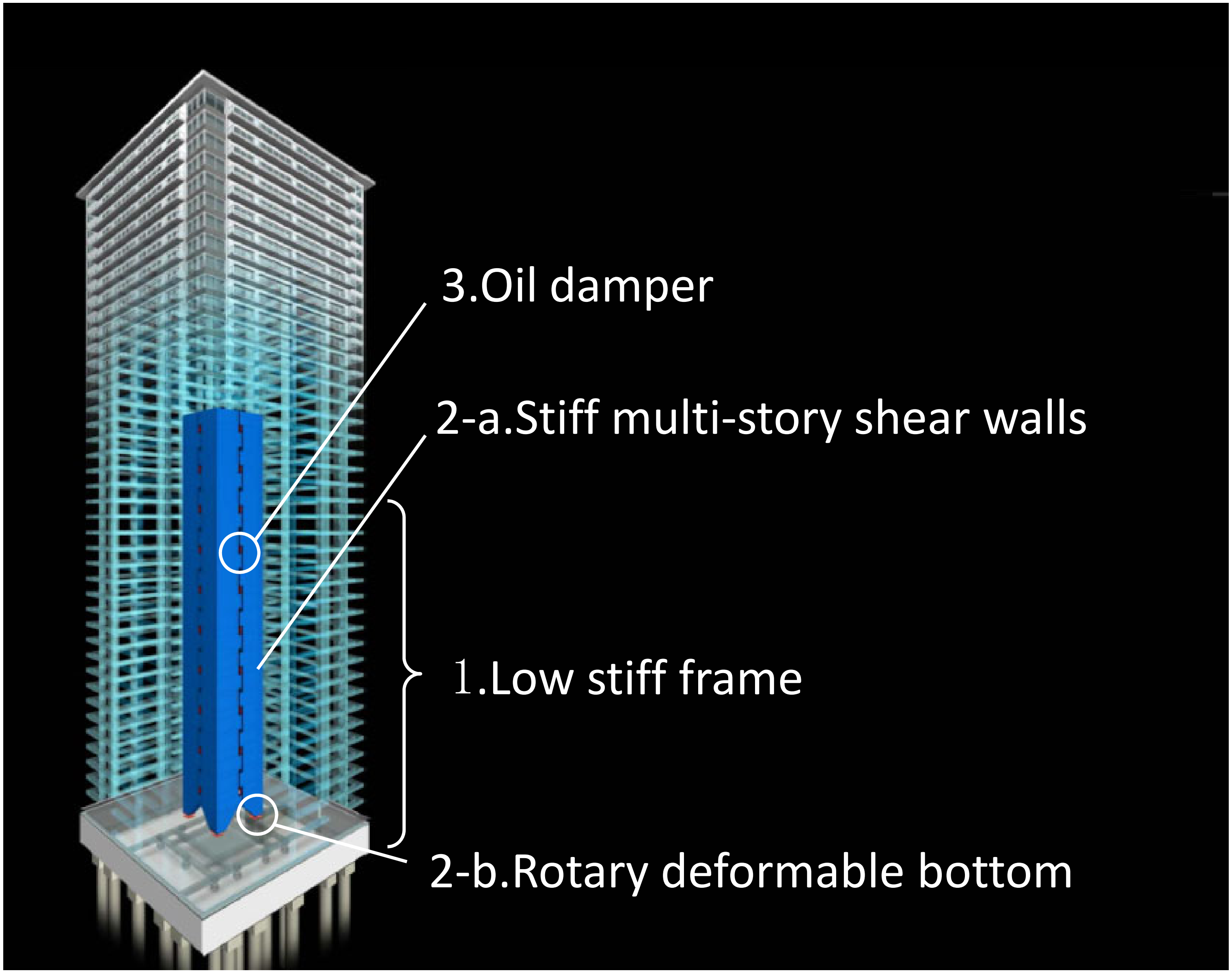
Composition of the system



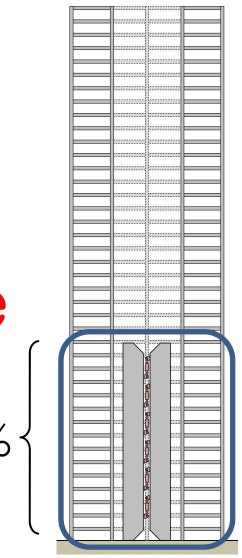
Low stiff frame

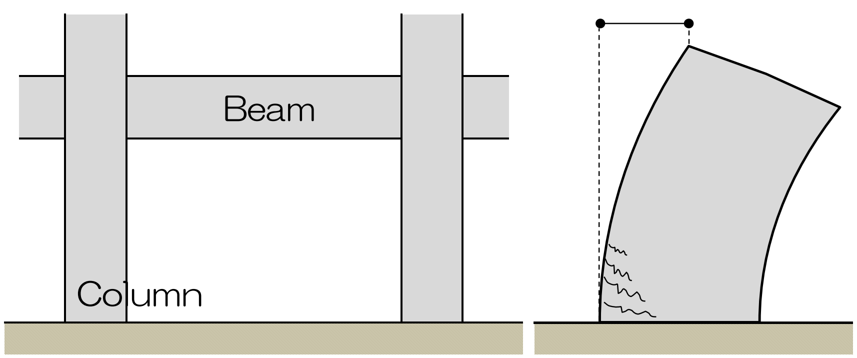
Strong material and small section

In lower stories (more than 30%)

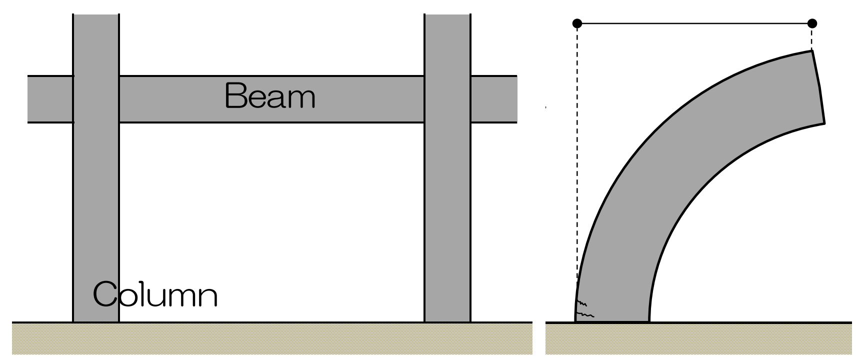
- Using strong material ⇒ Durability
- Small section ⇒ low stiffness

Flexible





ordinary



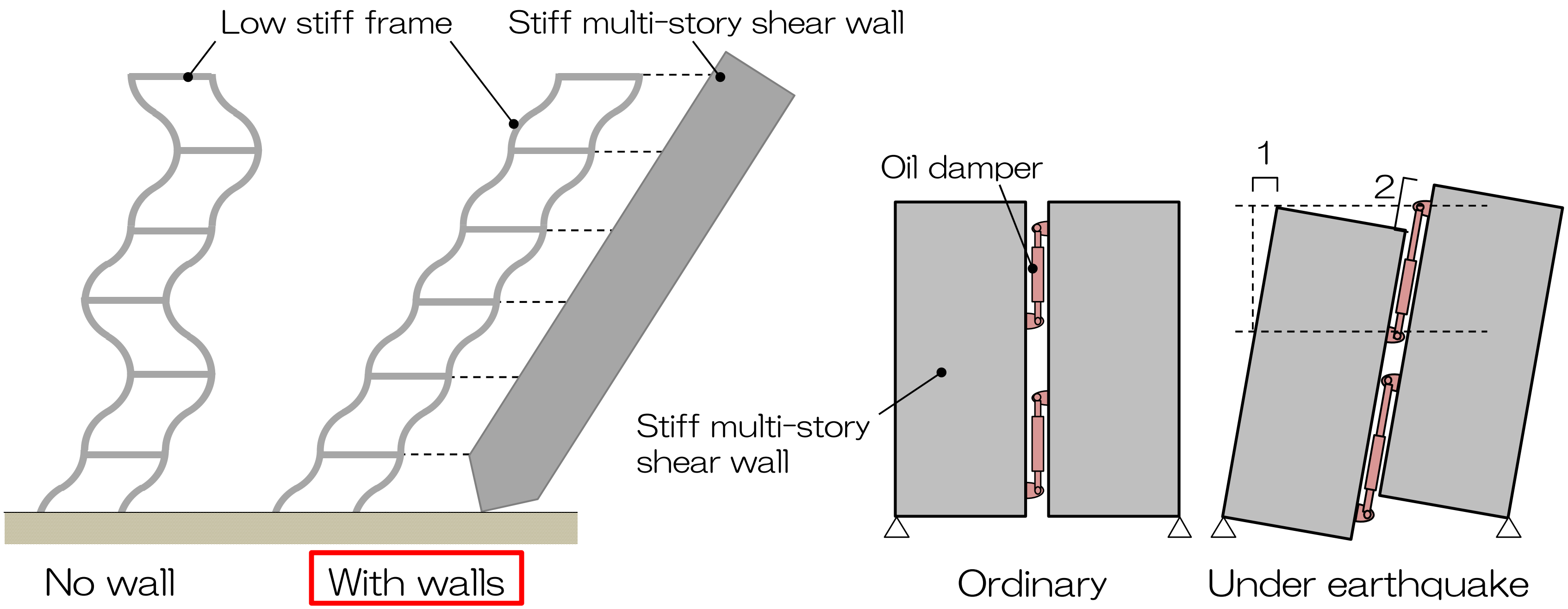
Strong material and small section

It parries earthquake effectively like base isolation

Stiff multi-story shear walls

Shin-bashira effect and leverage effect

- Shin-bashira effect ⇒ Integration of lower stories
- Leverage effect ⇒ Amplifying damper deformation



Shin-bashira effect

Leverage effect

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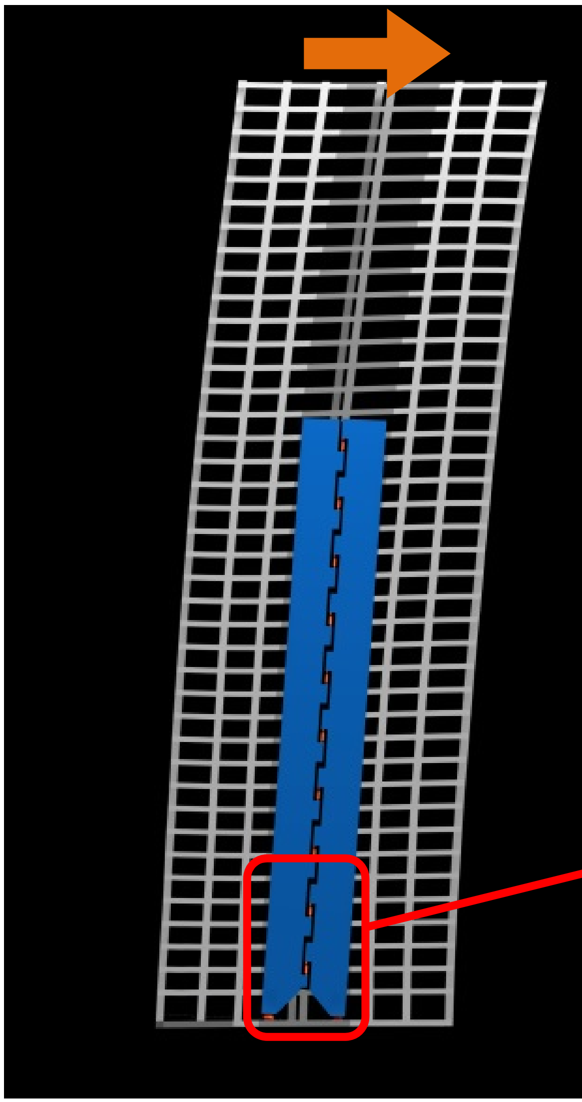
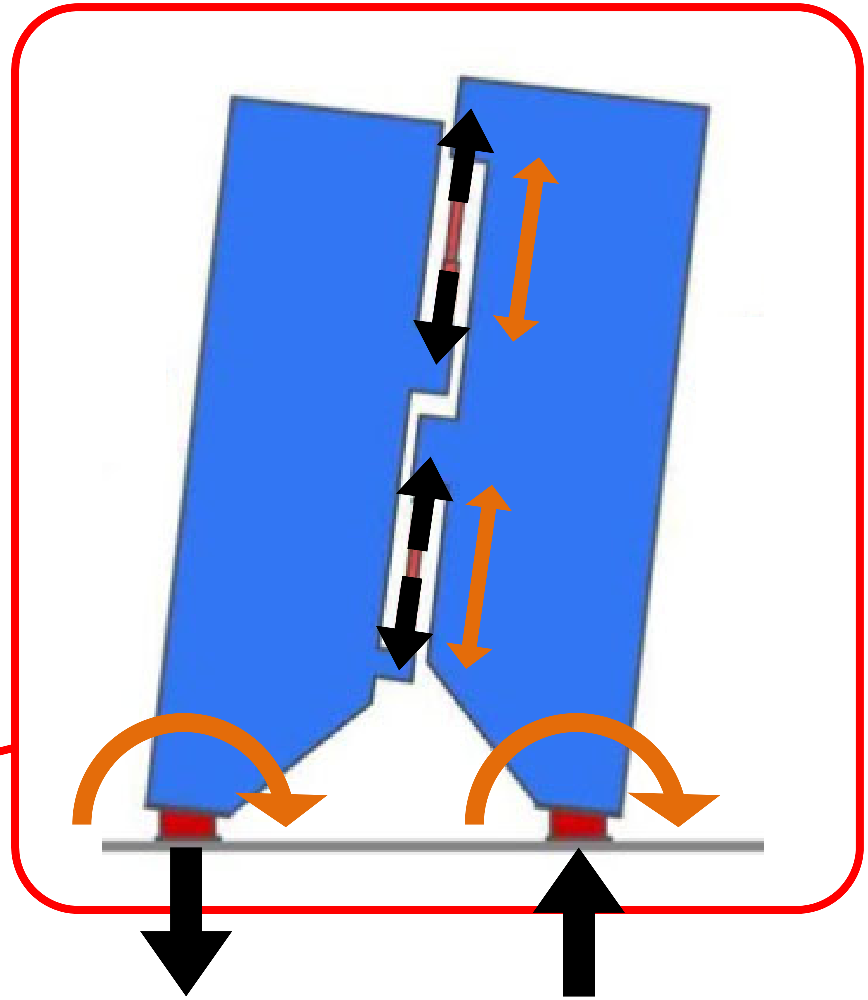
Difficult point in the design of the system

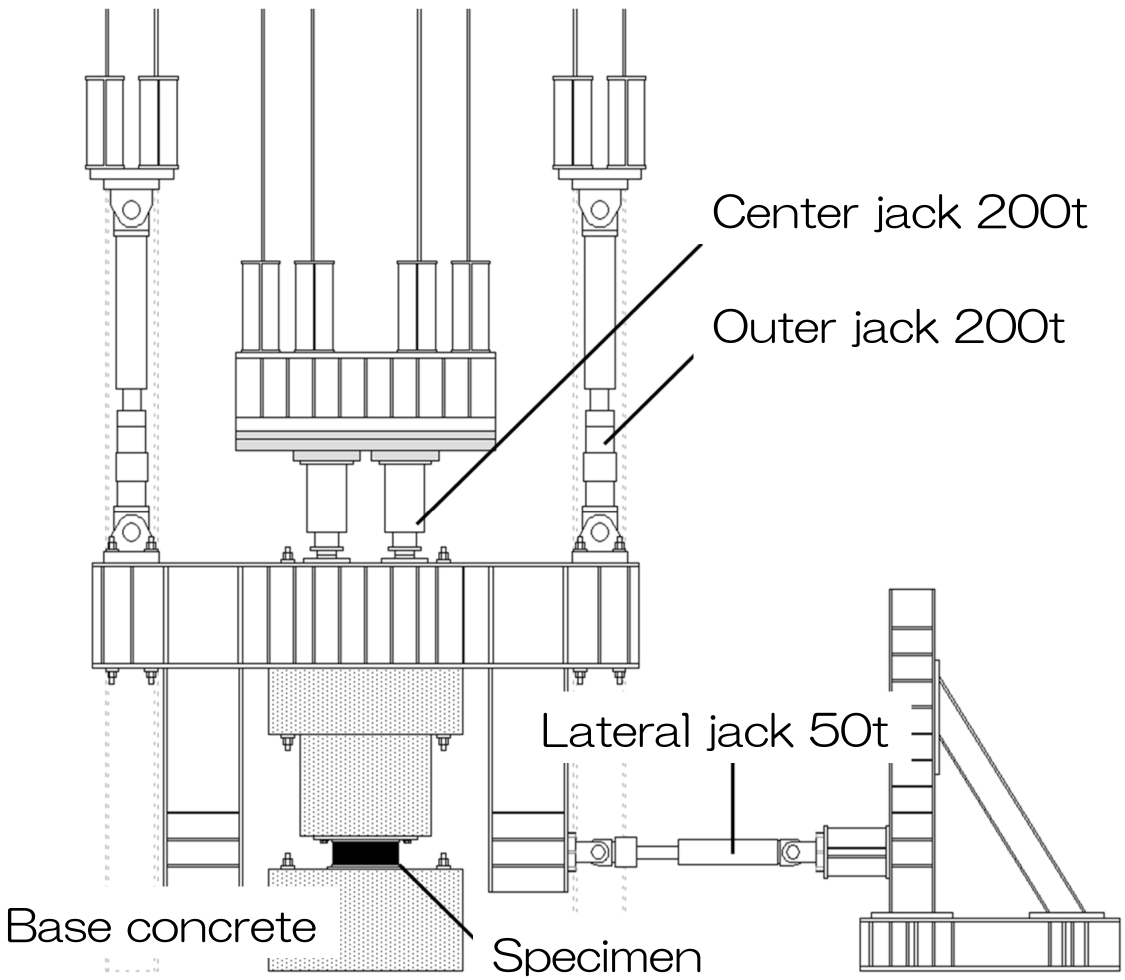
Deformation and stress of bottom of walls and dampers

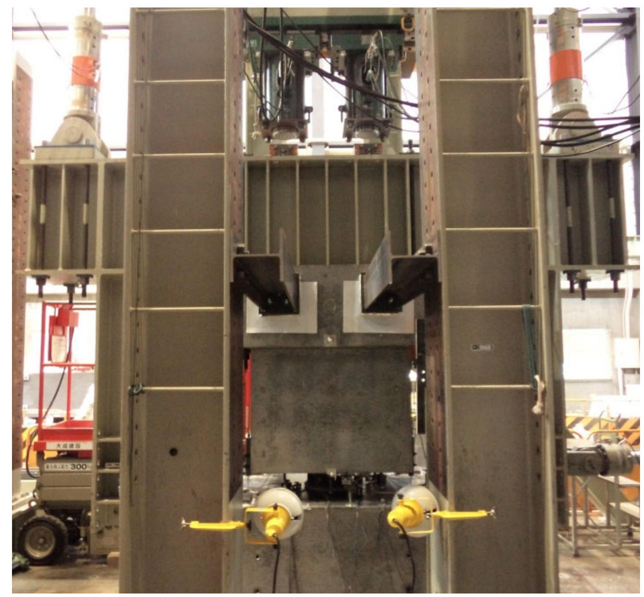




Experiment of rotary deformation of laminated rubber

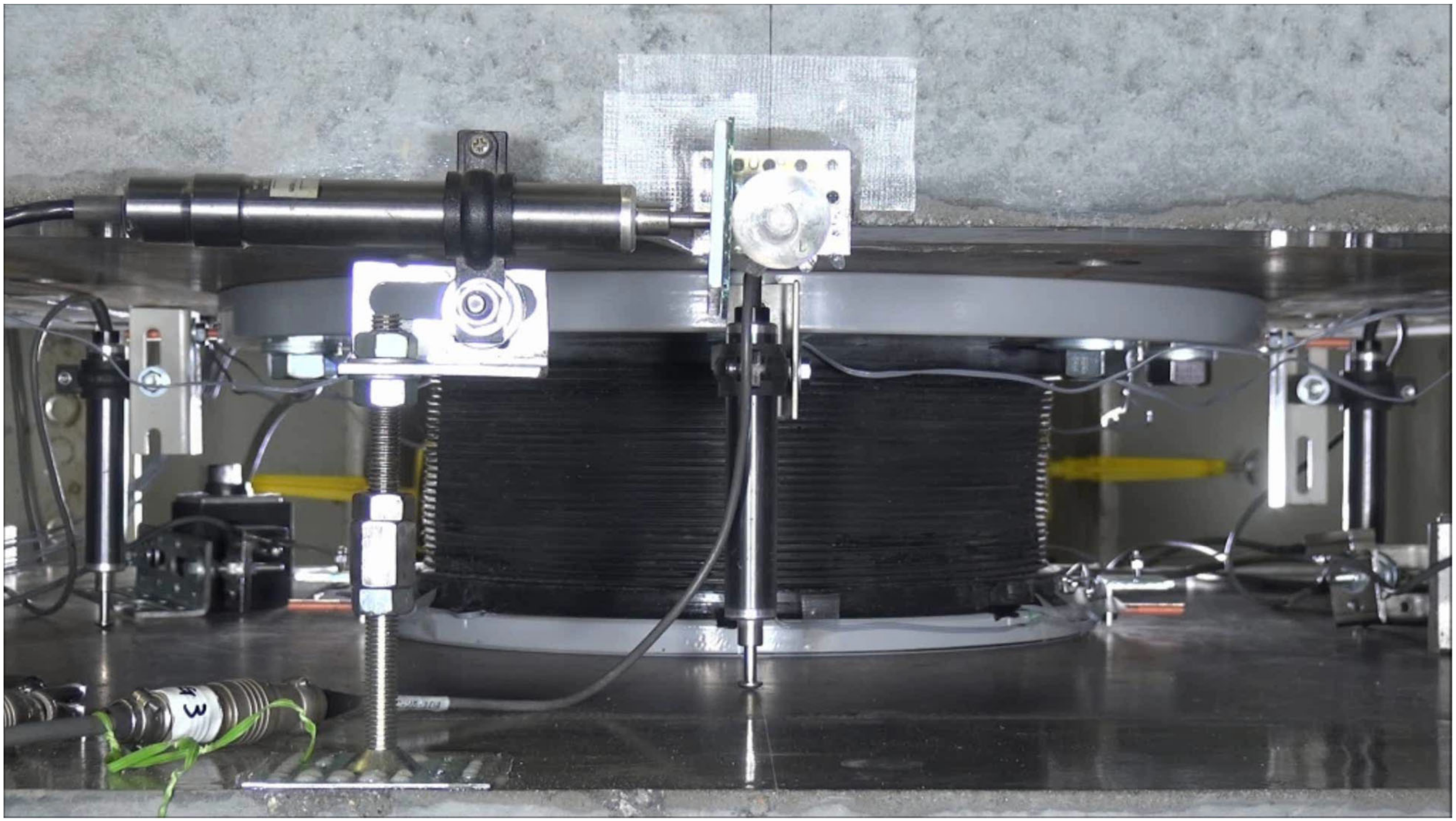
Loading equipment





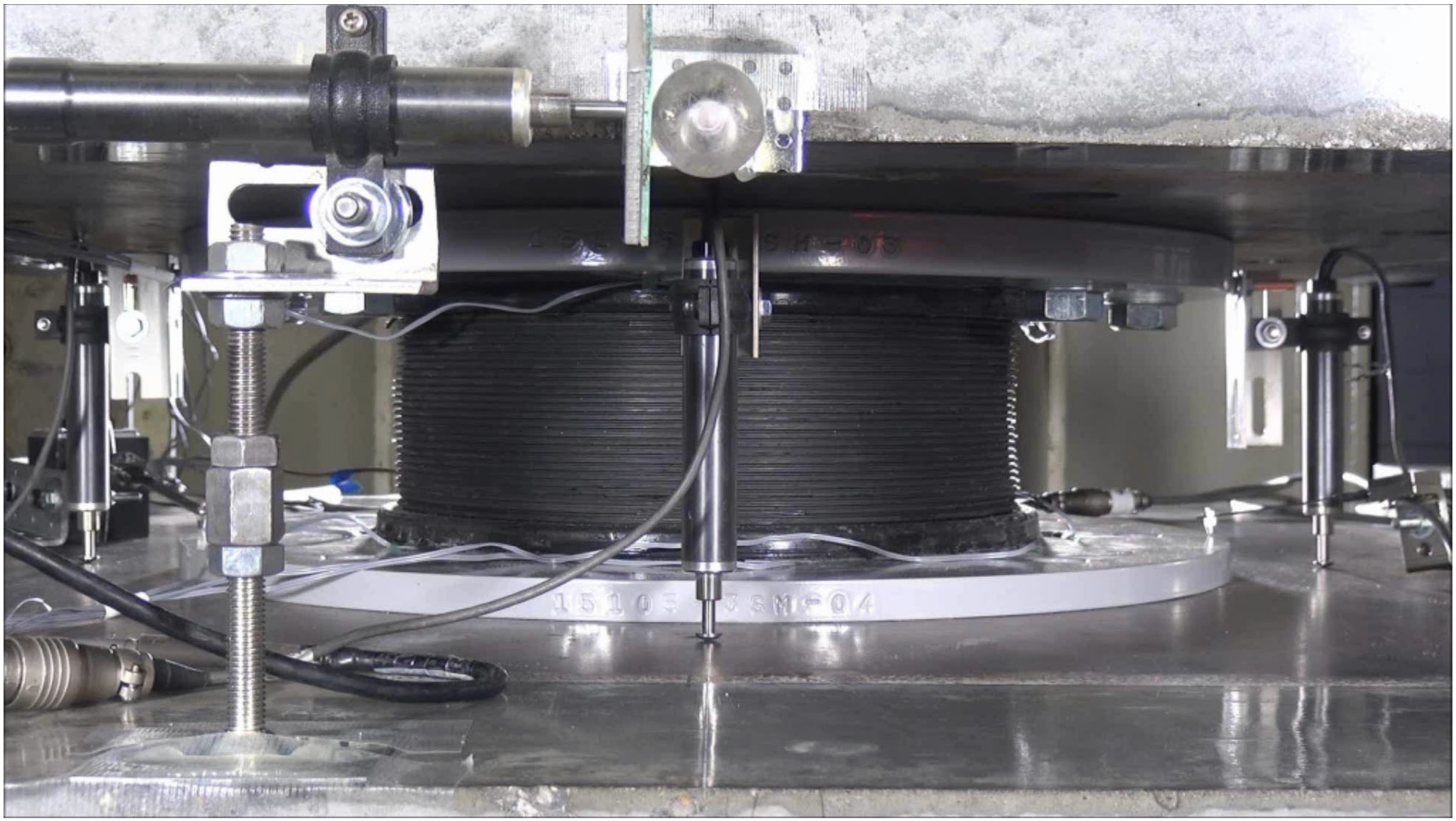
Experiment of rotary deformation of laminated rubber

Contact pressure：1MPa



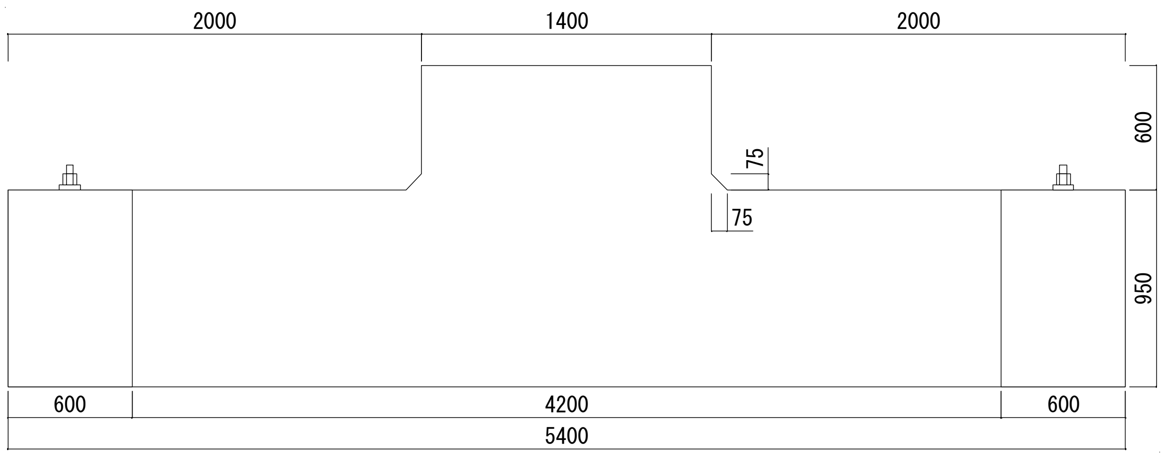
Experiment of rotary deformation of laminated rubber

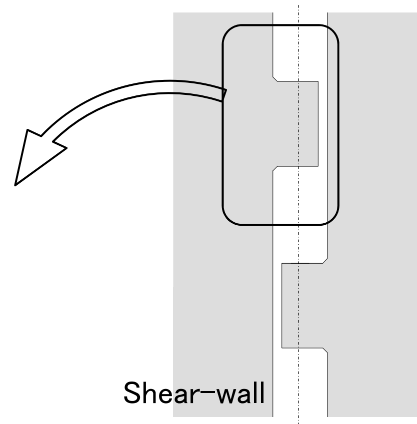
Contact pressure：30MPa



Experiment of wall-damper connection

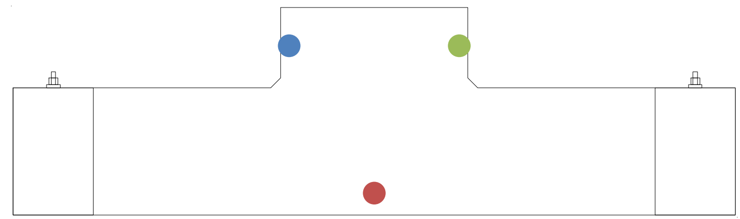
Loading equipment



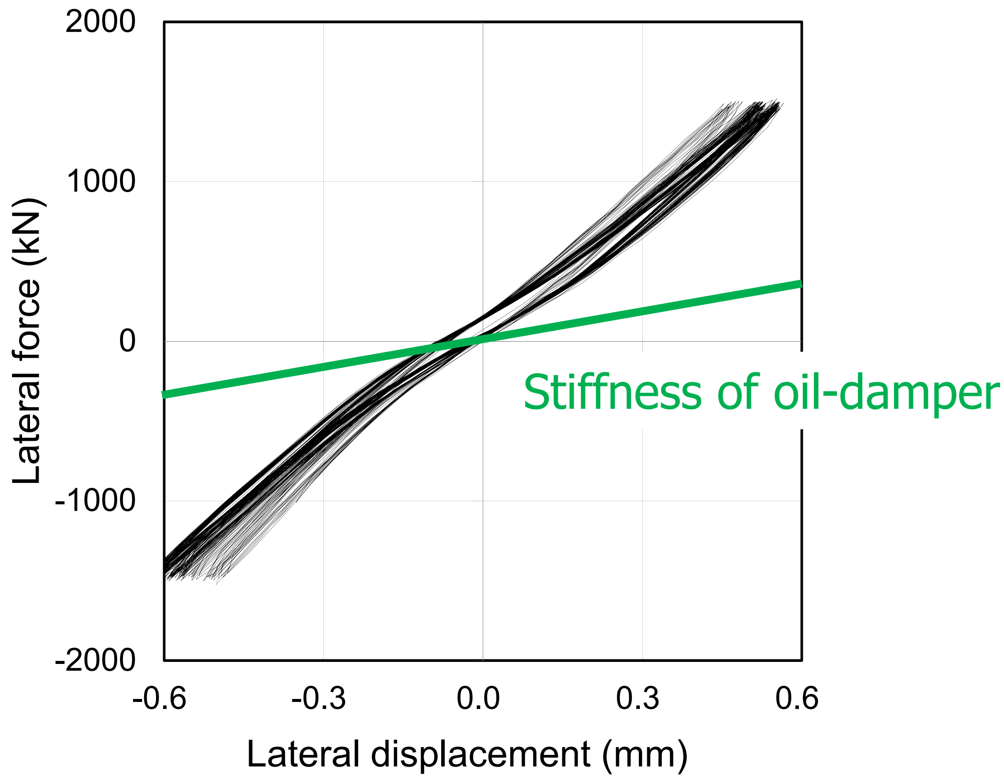


Experiment of wall-damper connection

Force-displacement relation



Lateral displacement＝(●+●)/2−●



Durability test

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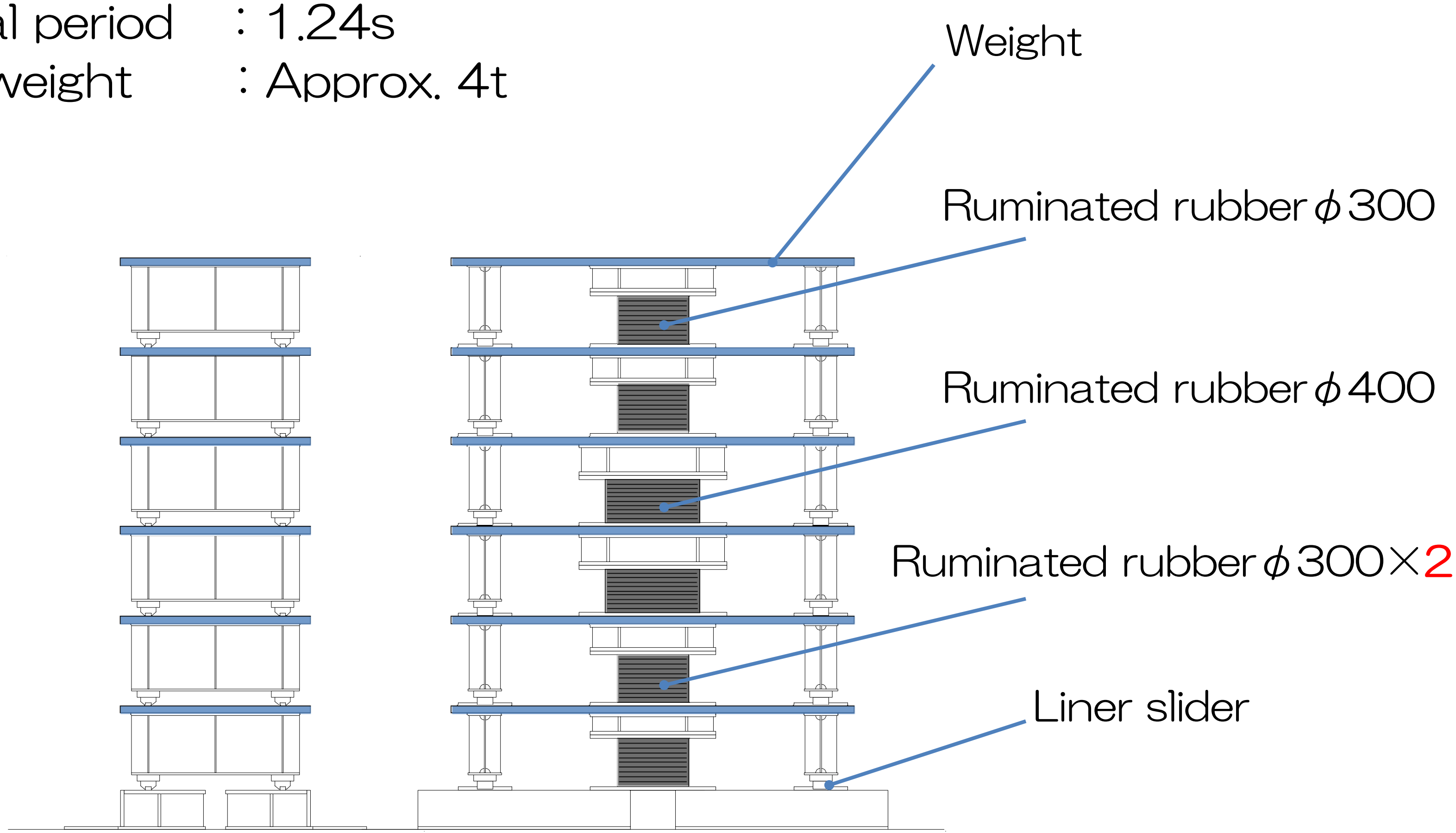
Shaking table test using simple model

Specimen 1：Normal

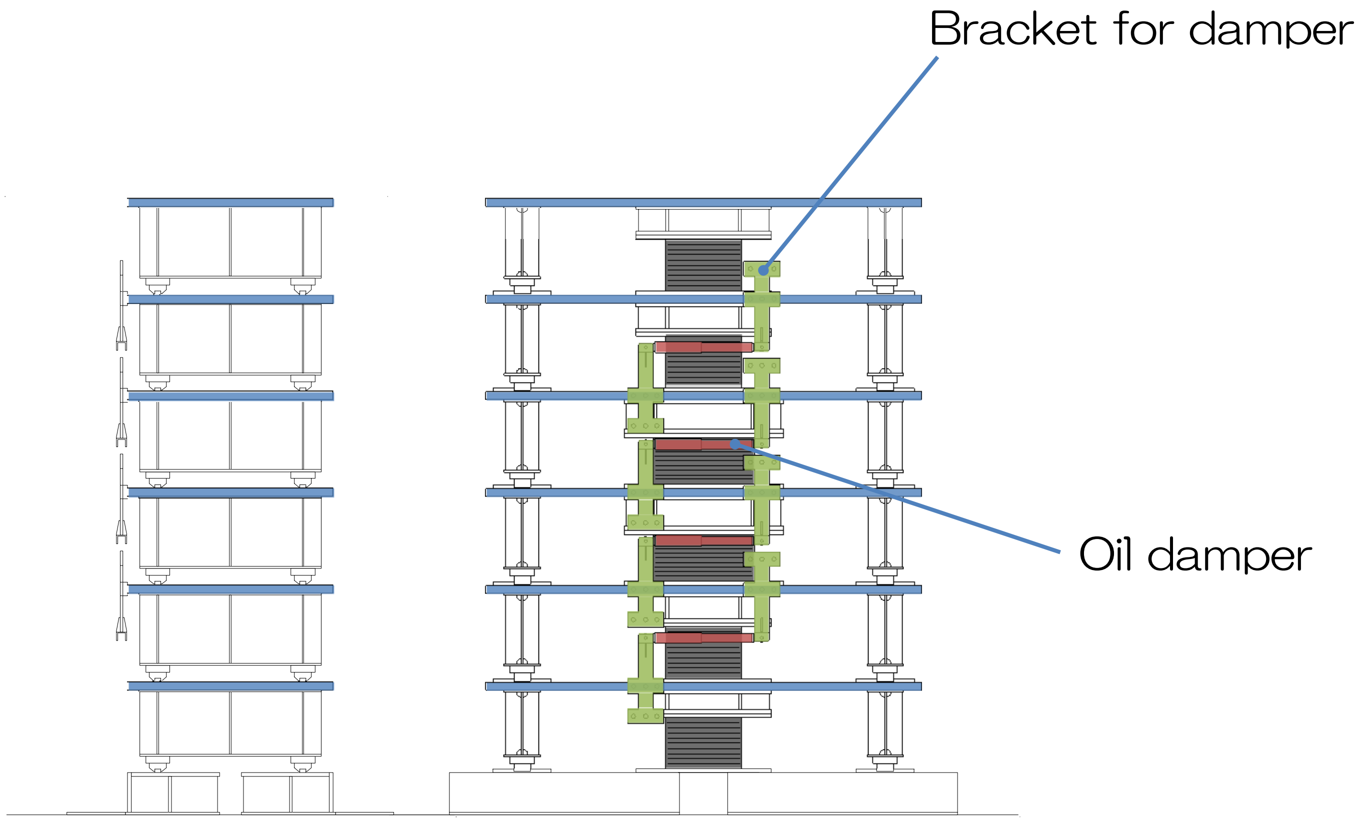
Number of story：6
Natural period　：1.24s
Total weight　　：Approx. 4t



Shaking table test using simple model

Specimen 2：Damper

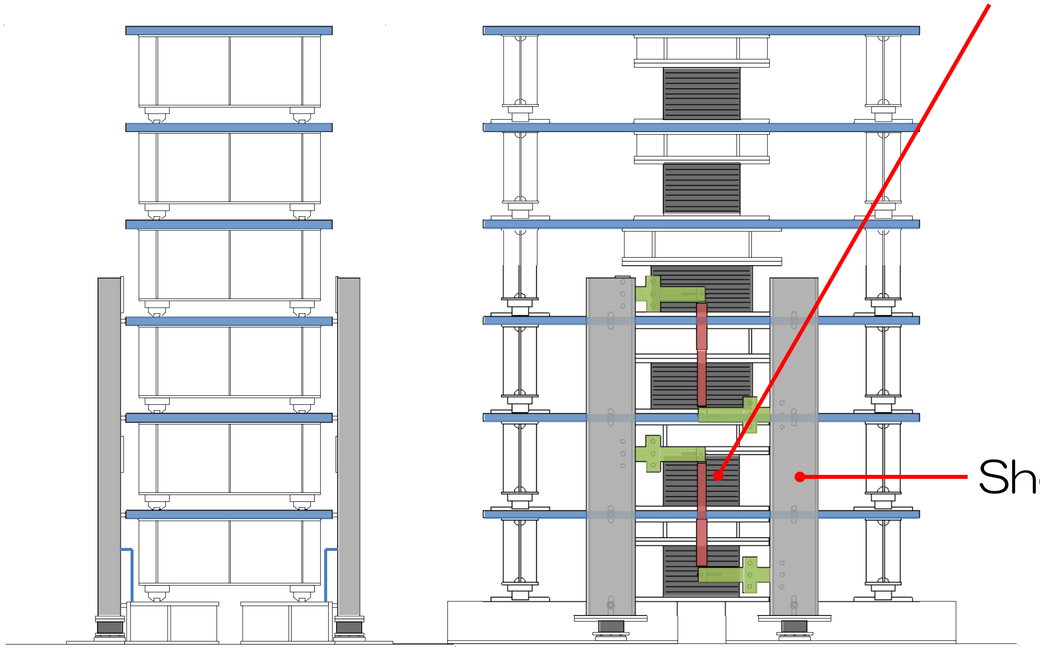
Normal model + 4 dampers
Additional damping factor：2.0%



Shaking table test using simple model

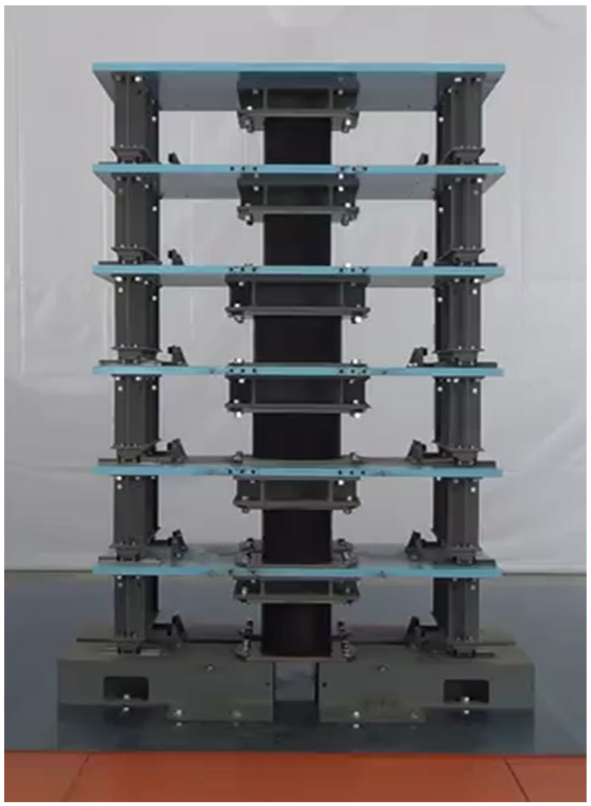
Specimen 3 : Proposed

Normal model + 4 dampers + Shear-walls - Ruminated rubber
Natural period　: 1.46s
Additional damping factor : 11.7%



Shaking table test using simple model

Input：White noise



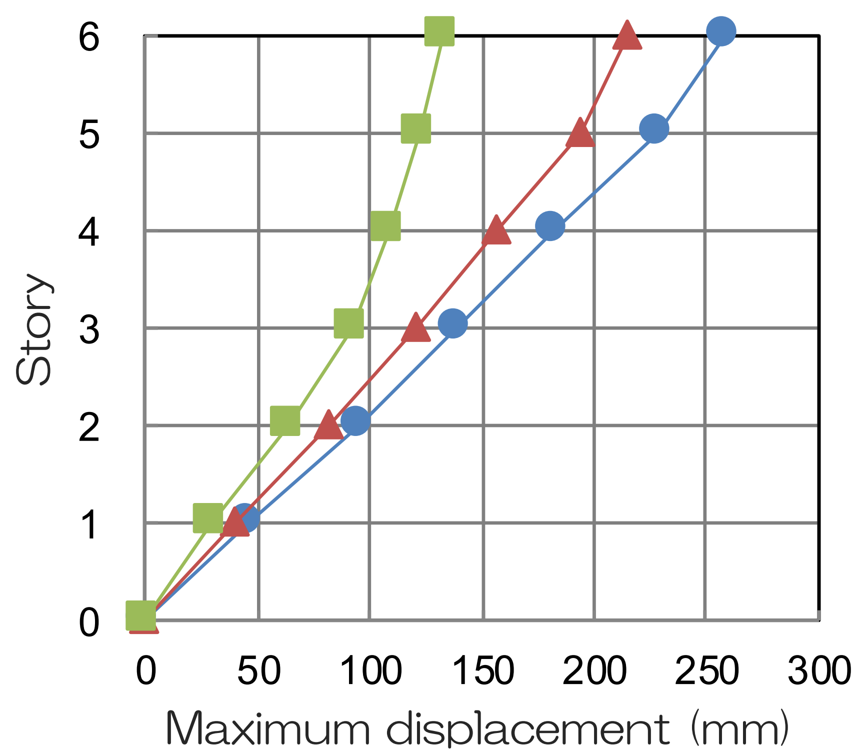
Normal

Damper

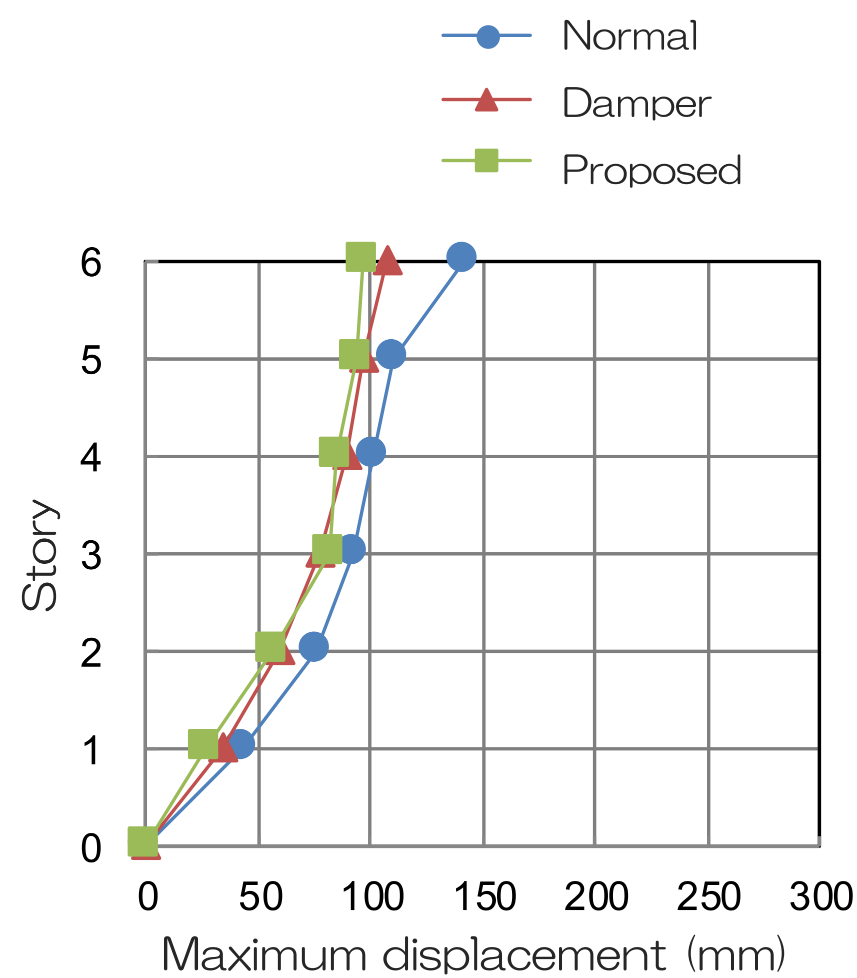
Proposed

Shaking table test using simple model

Result



Input：Nankai trough



Input：Mashiki

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Conclusion

A new vibration control system was presented

○ This system can reduce the maximum story drift In comparison with conventional vibration control building.

○ Laminated rubber bearing has a high durability against rotary deformation.

○ Wall-damper connection has a greater stiffness than oil-damper

Thank you for your attention