Small update on

Seismic Isolation

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Mini-Workshop on ILC Infrastructure and CFS for Physics and Detectors
2018/11/28 KEK

Technology

These pages showcase some of Toda Corporation's most important construction techniques and technologies. Toda Corp. also uses numerous technologies not listed here. Toda Corp. combines the optimal construction techniques and technologies for each client project.

Toda construction technologies

Structural technologies

High-rise RC technology, technologies for construction highly earthquake-resistant buildings, etc.

Structural technologies

Environmental technologies

Technologies born of initiatives aiming to achieve coexistence between human being and nature and creatively restore the global environment

Environmental technologies
Environmental initiatives (PDF 9.58MB)

Indoor environment technologies

Technology to analyze indoor environments, comprising aspects such as temperature, humidity, airflow, dust, chemicals, sound, and light

Indoor environment technologies

Renovation technologies

Toda Corp.'s renovation proposals and implementation bear in mind the structure's entire life cycle cost, from planning and construction, to maintenance and management, to demolition and disposal.

Renovation technologies

Civil engineering technologies

Technologies to improve infrastructure that supports more comfortable and convenient living

Civil engineering technologies

Achievements and Scope
Technology
- Structural technologies
- Environmental technologies
- Indoor environment technologies
- Renovation technologies
- Civil engineering technologies

Company Information
Investor Relations

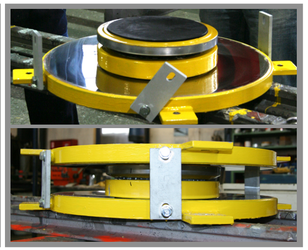
TOP of the Page

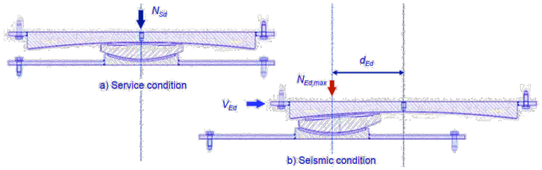
Terms of Use

Above platform isolation

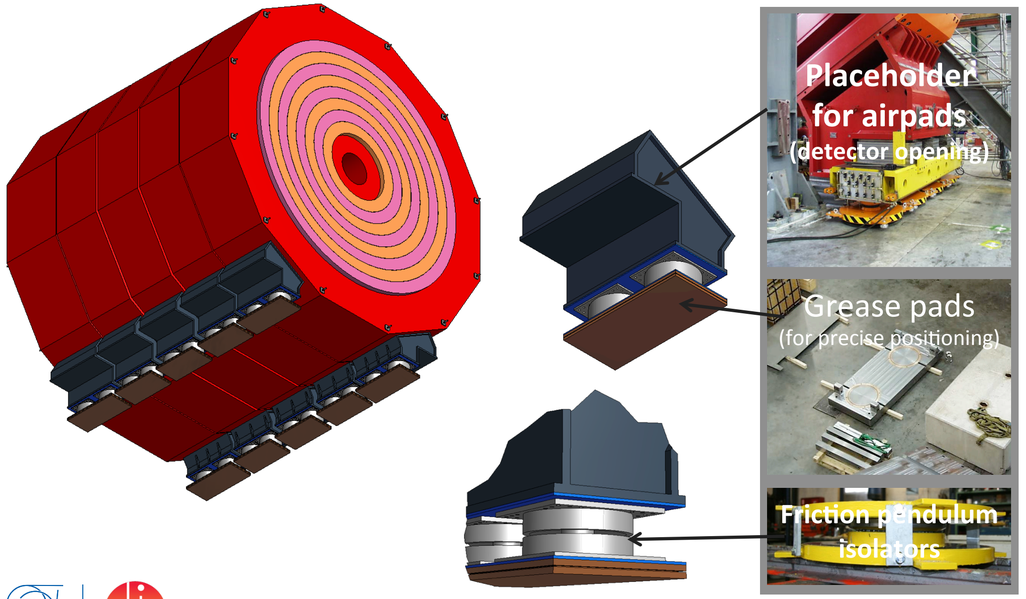
- Friction pendulum isolators beneath the detector feet;
- Reliable technology;
- No high compliance elements (e.g. rubber) improves the positioning of the detector;

Pendulum isolators



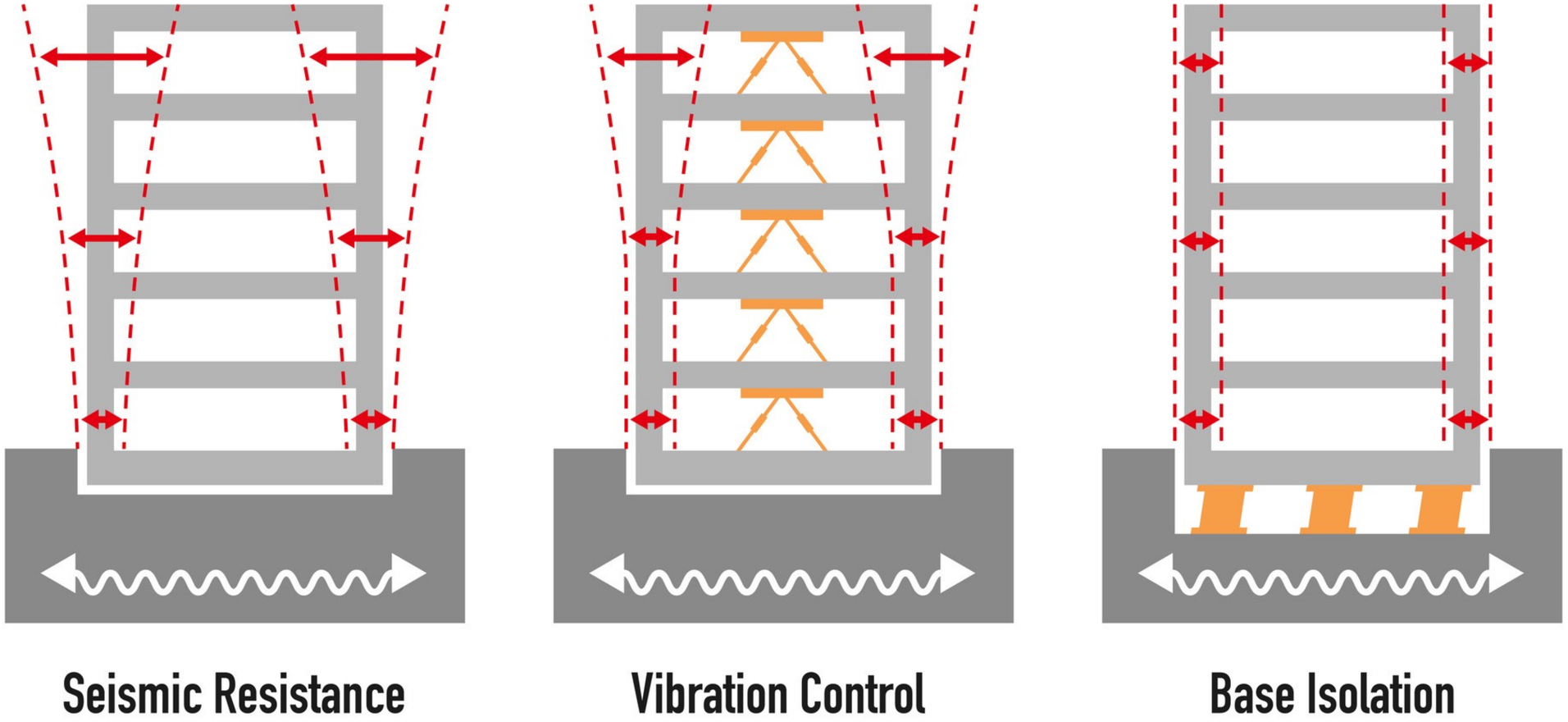


Above platform isolation



Earthquake-Resistant Building

Earthquake-Resistant Building



Base Isolation

Tohoku University, Science Complex C

Base-isolation

Science Complex C

1

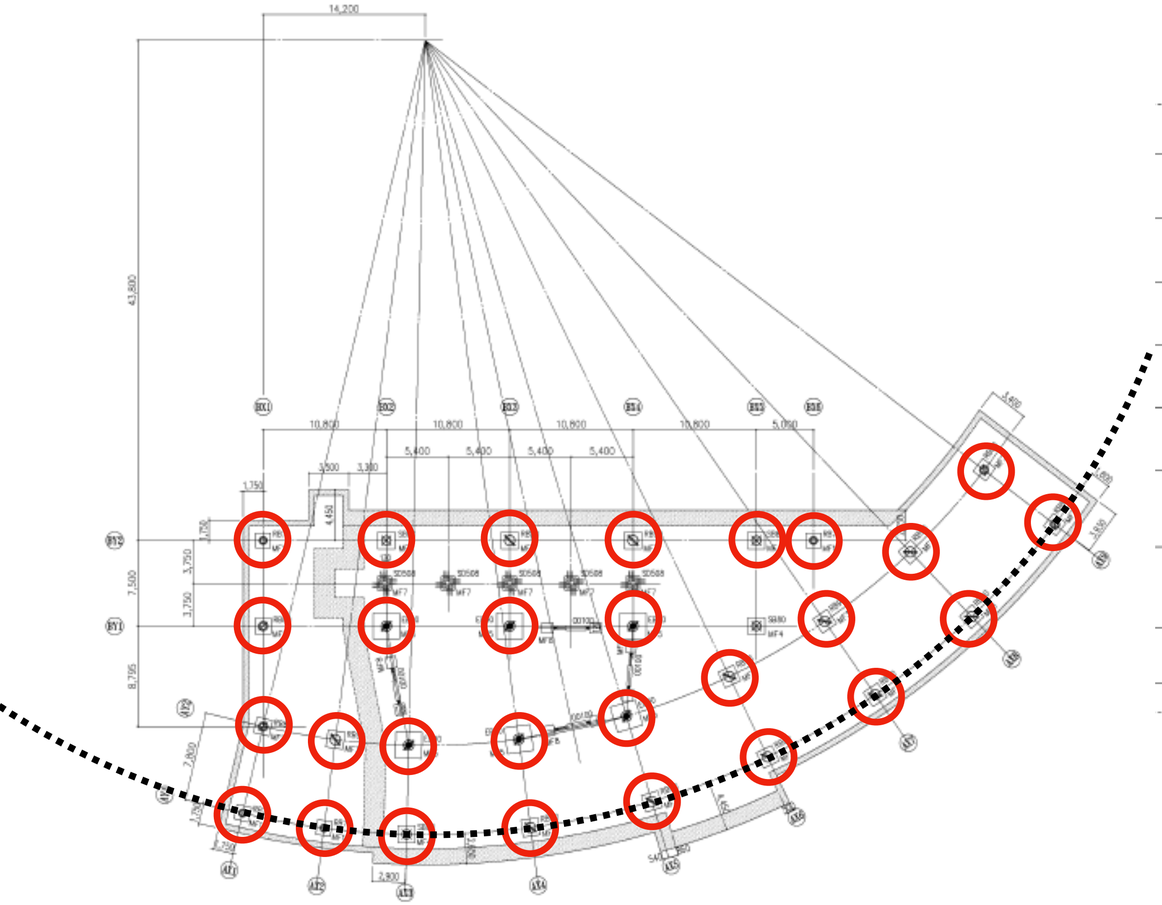
Rubber Bearing

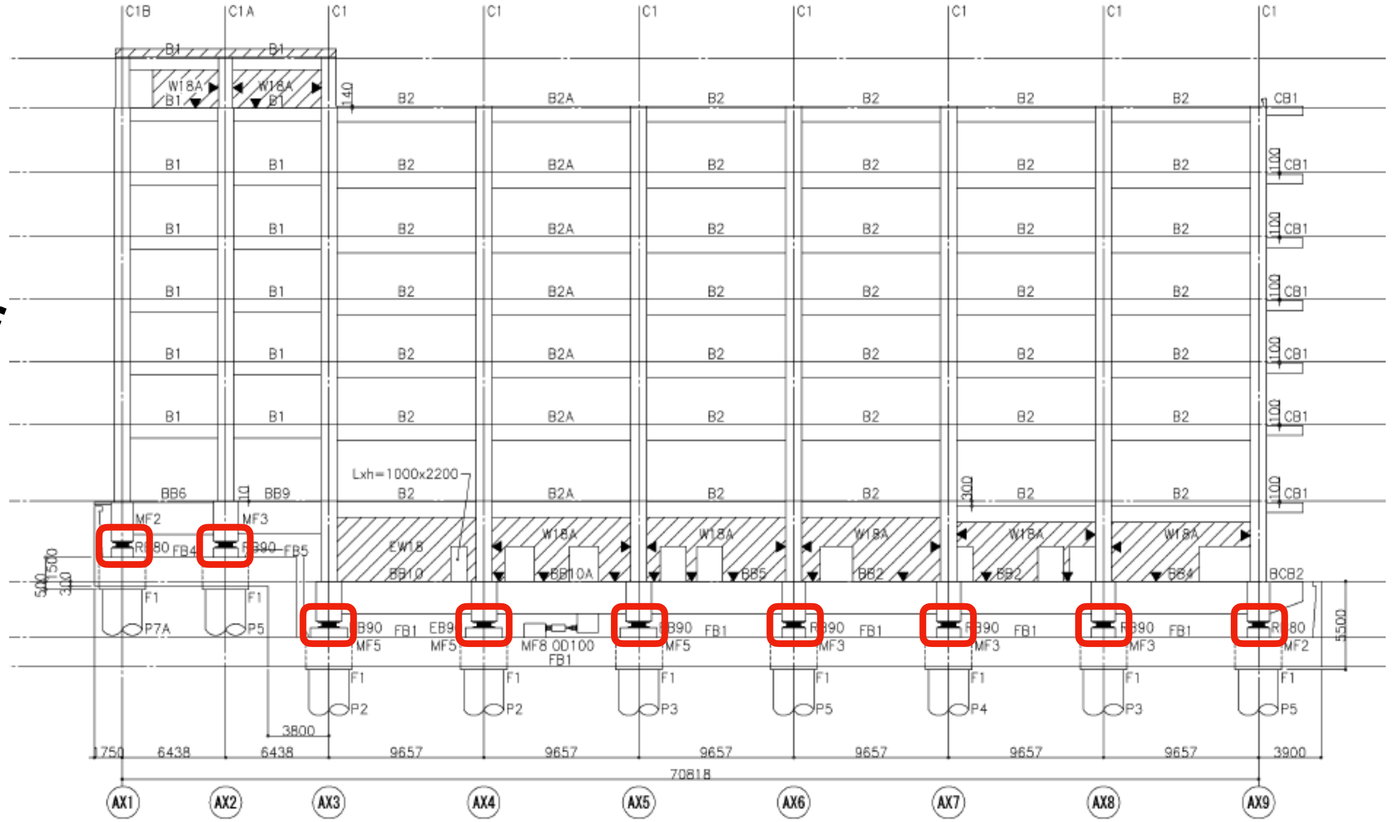
Rubber Bearing

Rubber Bearing

Rubber Bearing

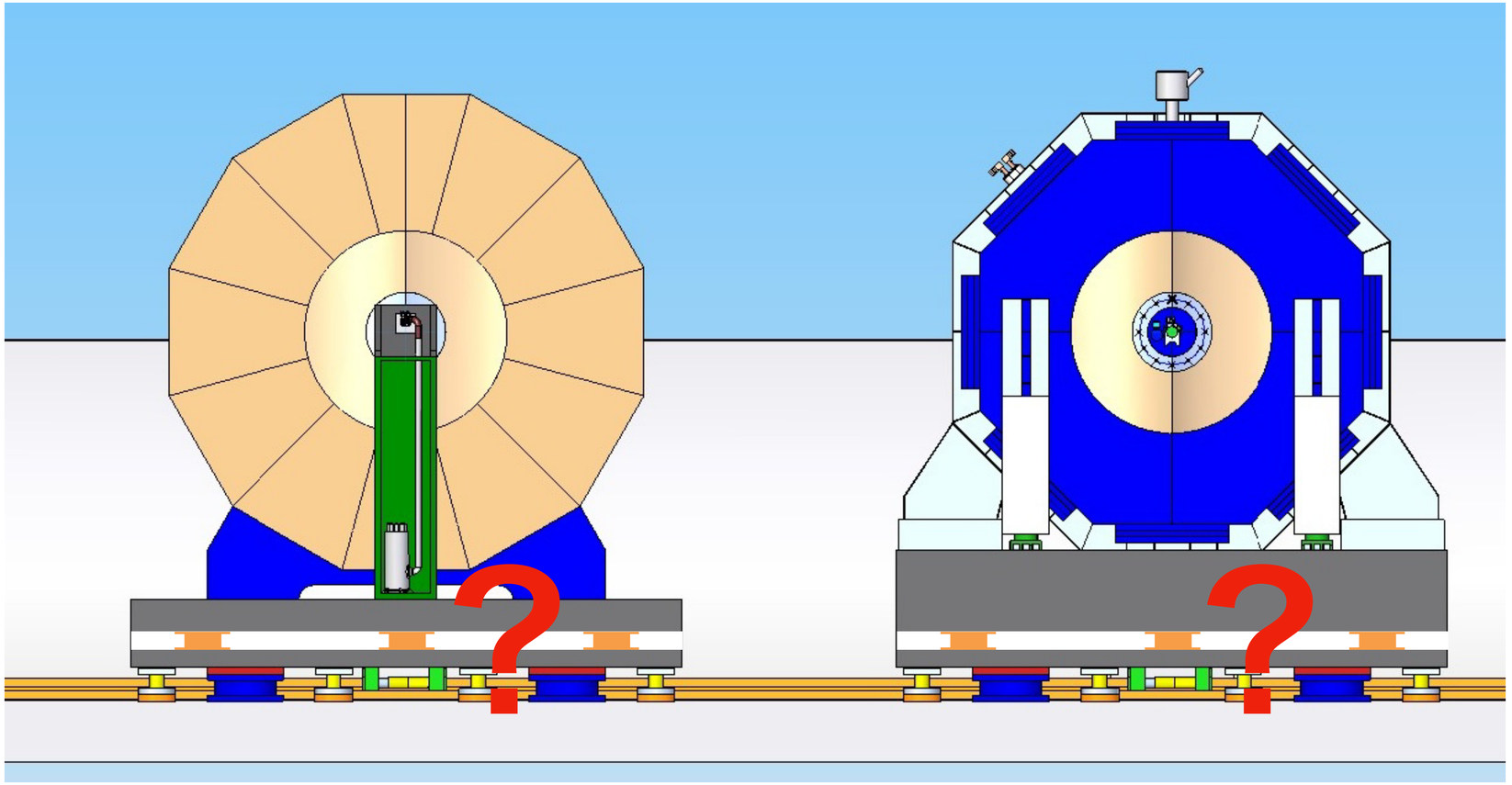
Science Complex C





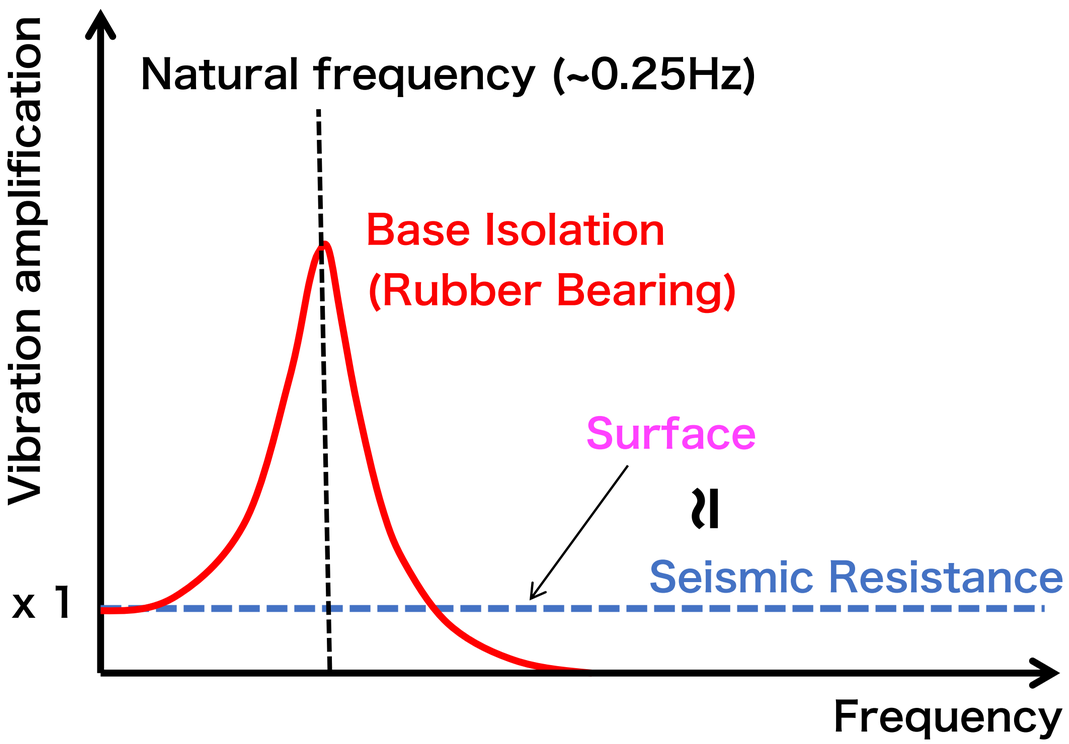
28 Legs / Rubber bearings

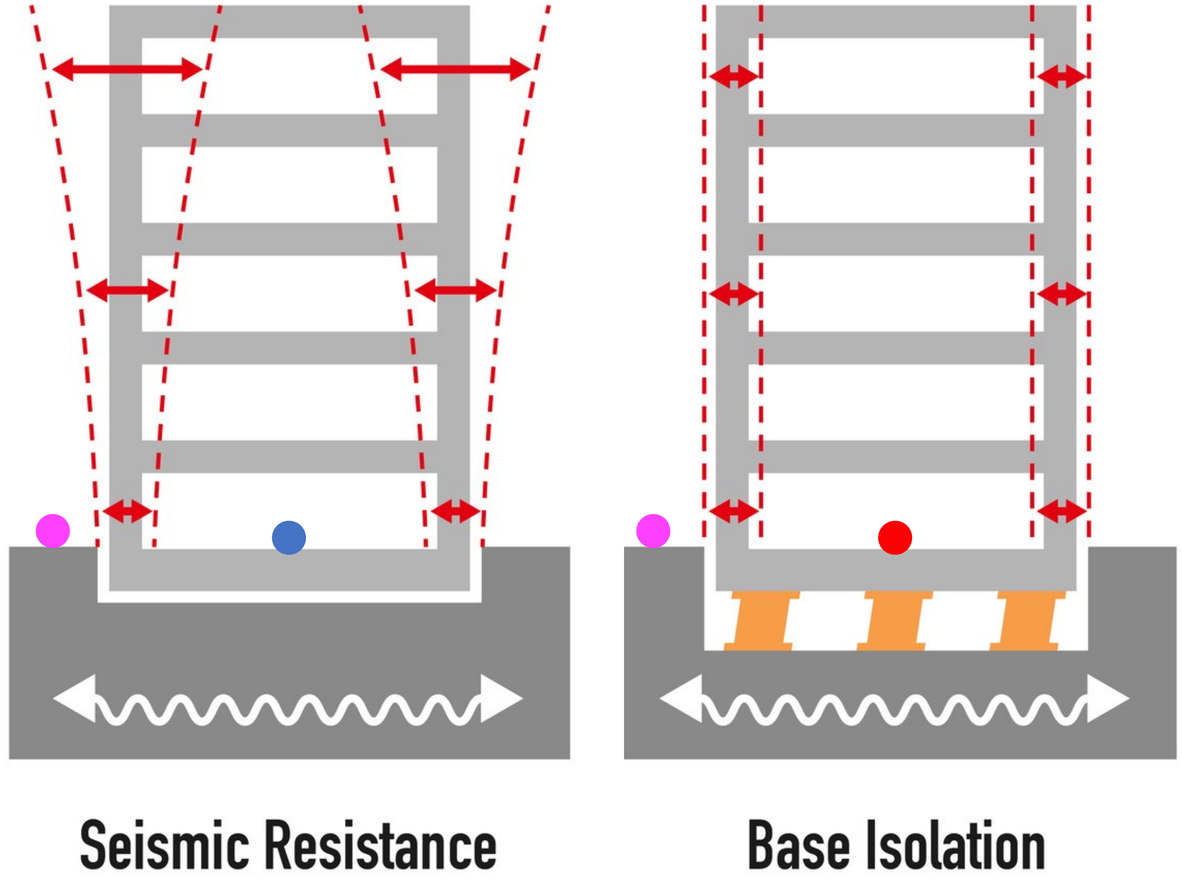
Base-isolation ?



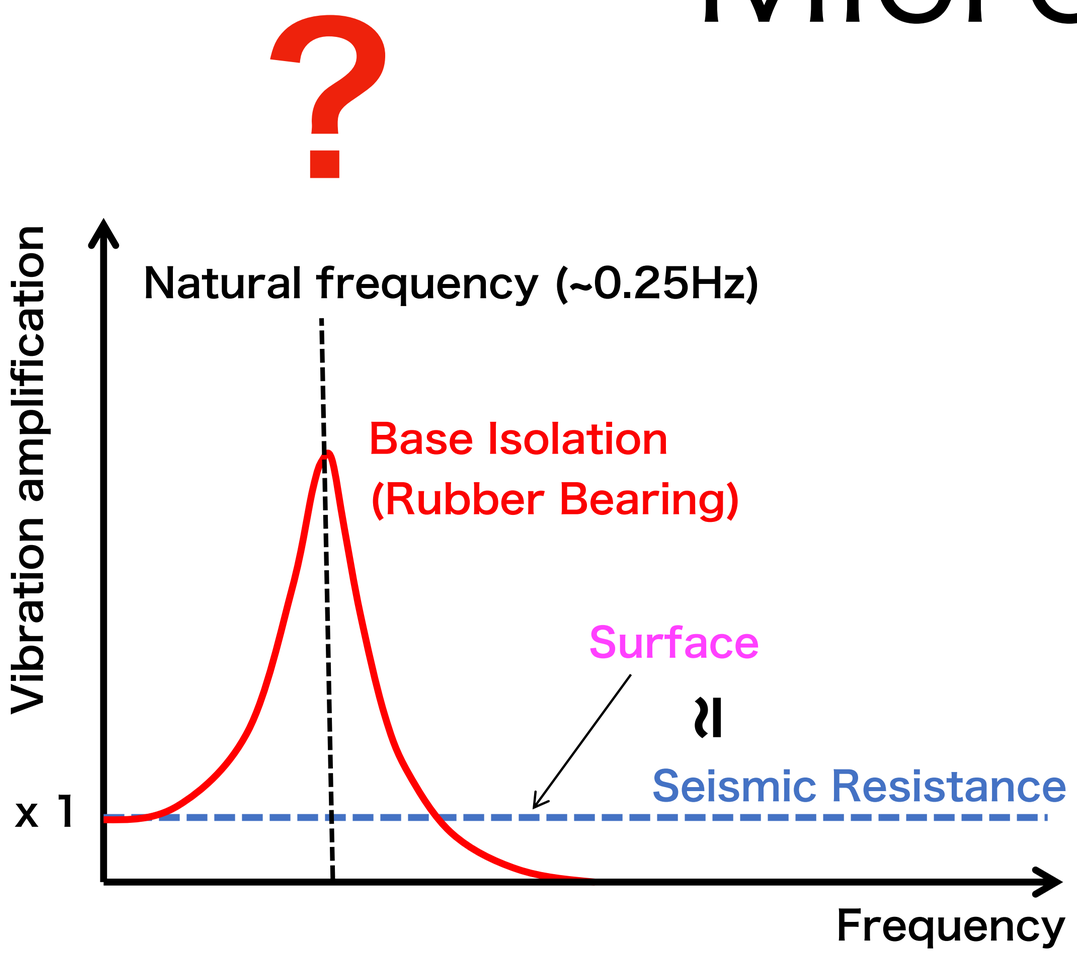
TDR

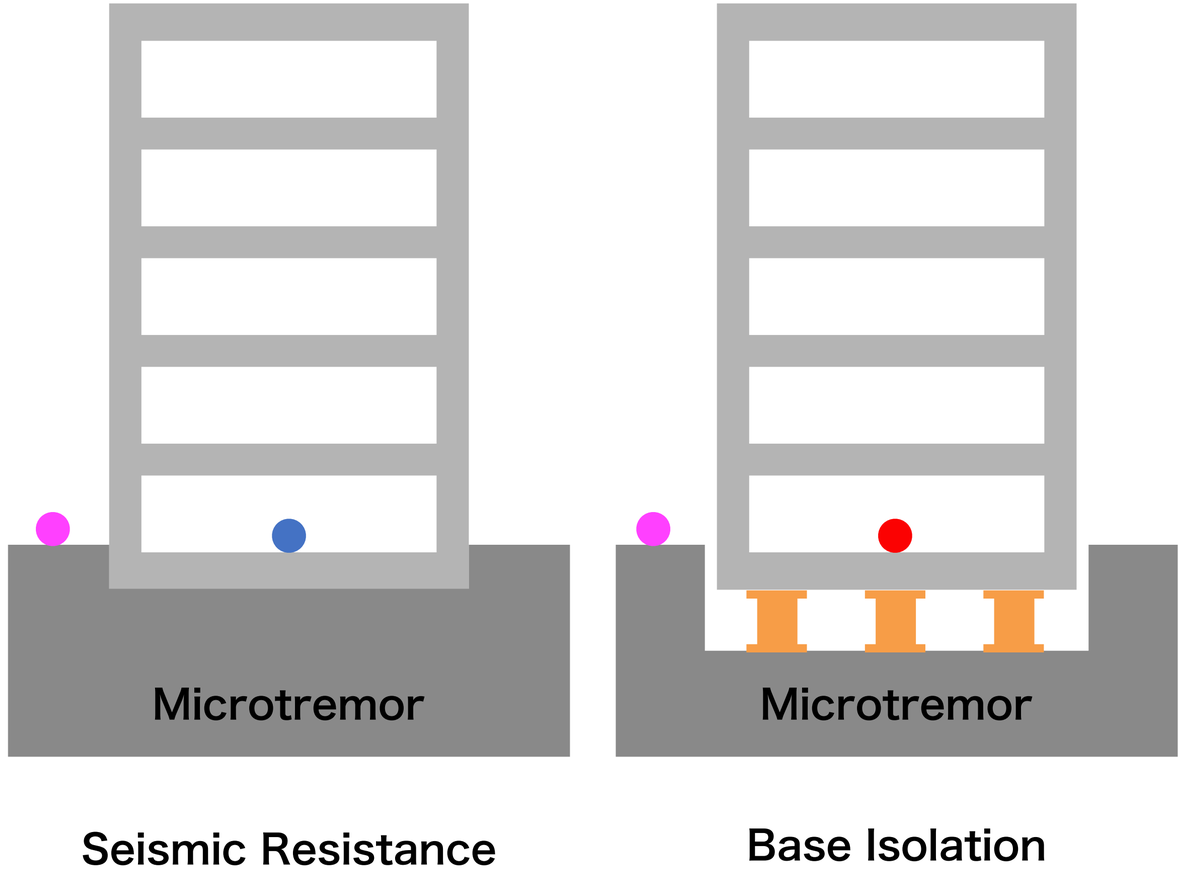
Earthquake


Vibration amplification
Natural frequency (~0.25Hz)
Base Isolation
(Rubber Bearing)
Surface
≒
Seismic Resistance
x 1
Frequency


Seismic Resistance
Base Isolation

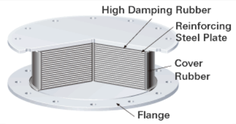
Microtremor



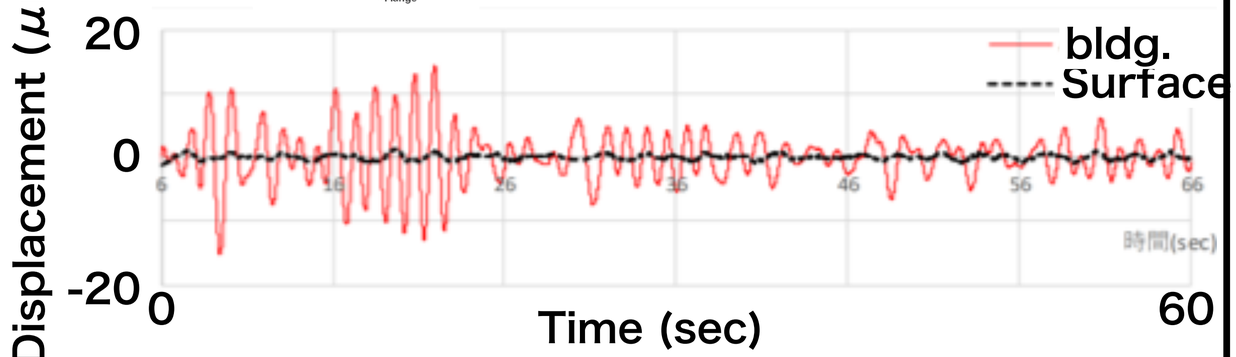


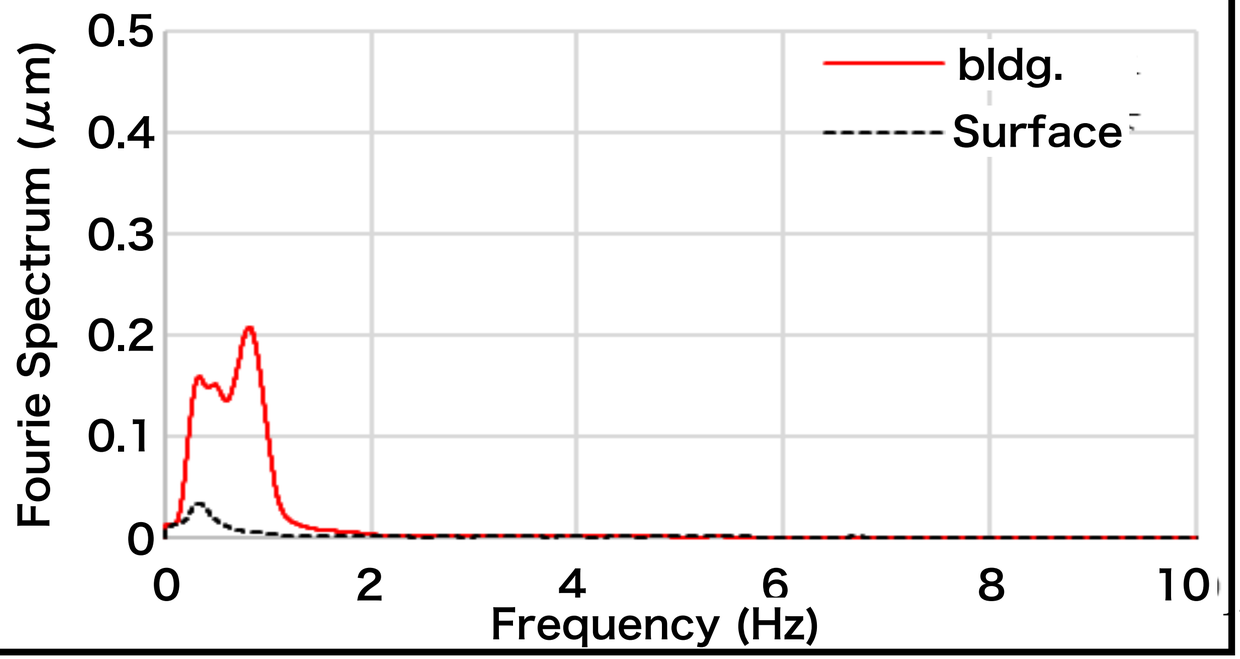
Measurement of vibration at existing buildings

Result (Microtremor)

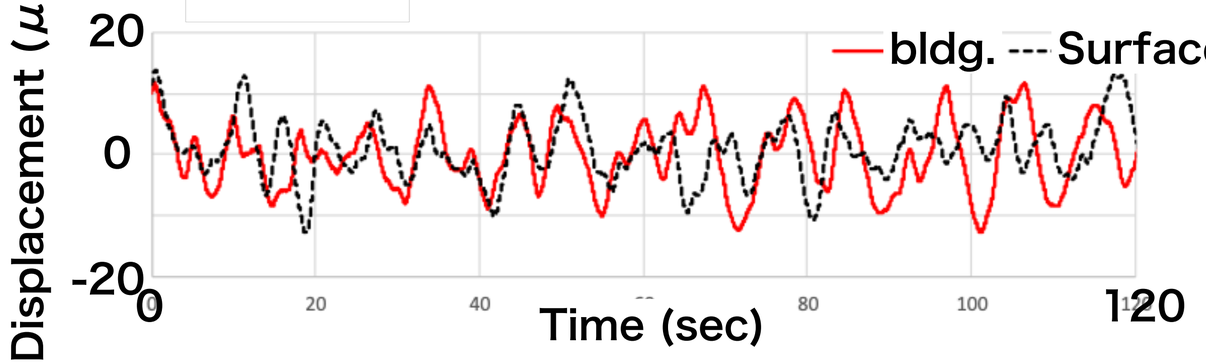


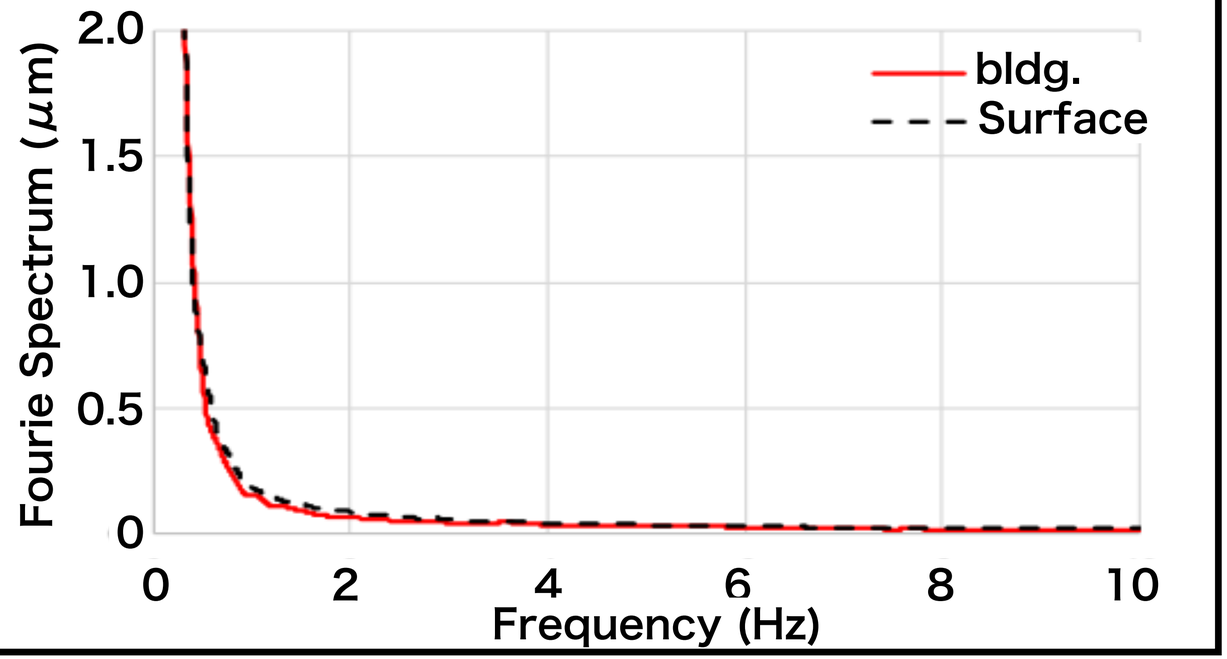
Rubber Bearing

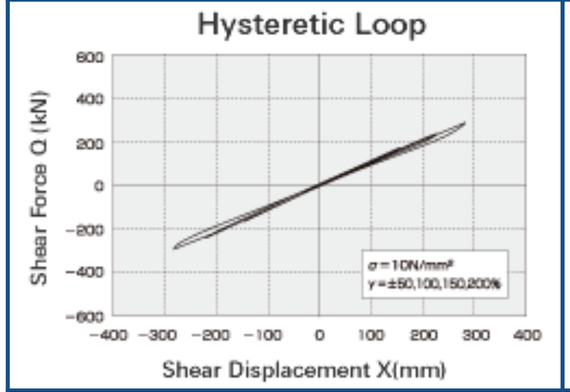
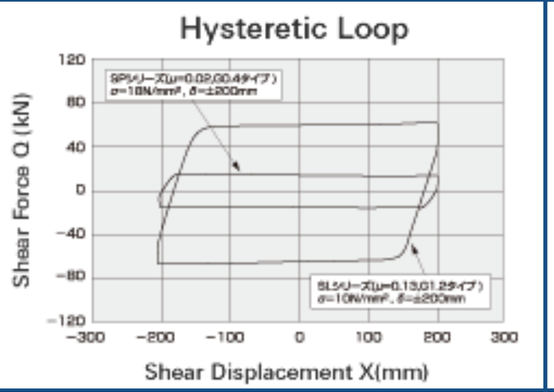
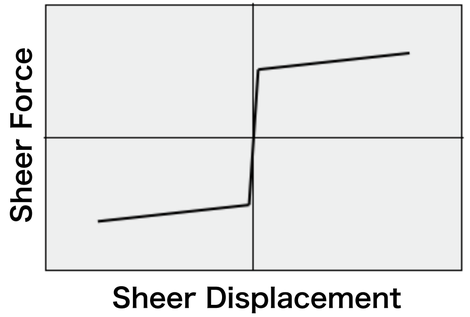
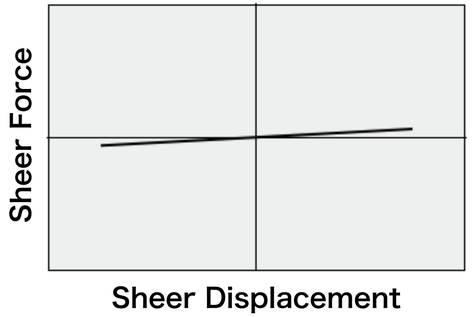
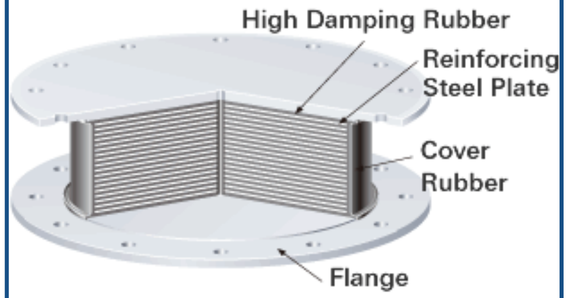
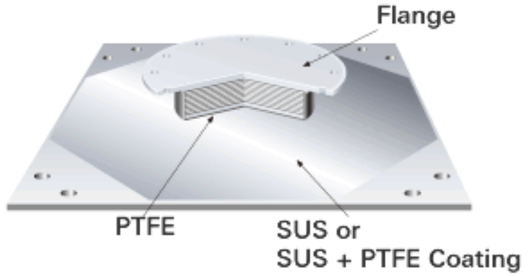
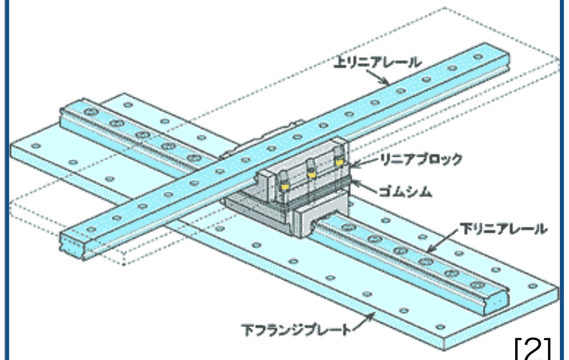




Rigid Sliding Bearing

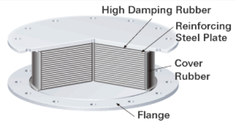




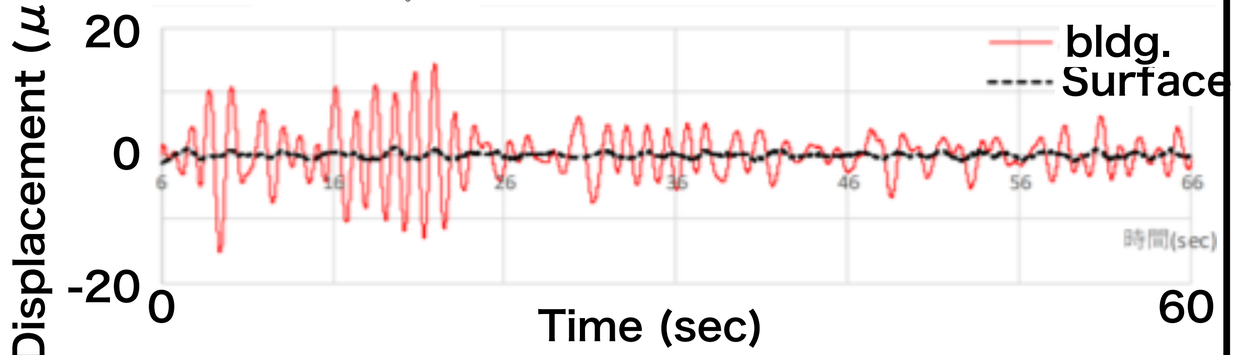
Rubber Bearing	Elastic Sliding Bearing	Rigid Sliding Bearing	Rolling Bearing
			
 [1]	 [1]		 [2]
			

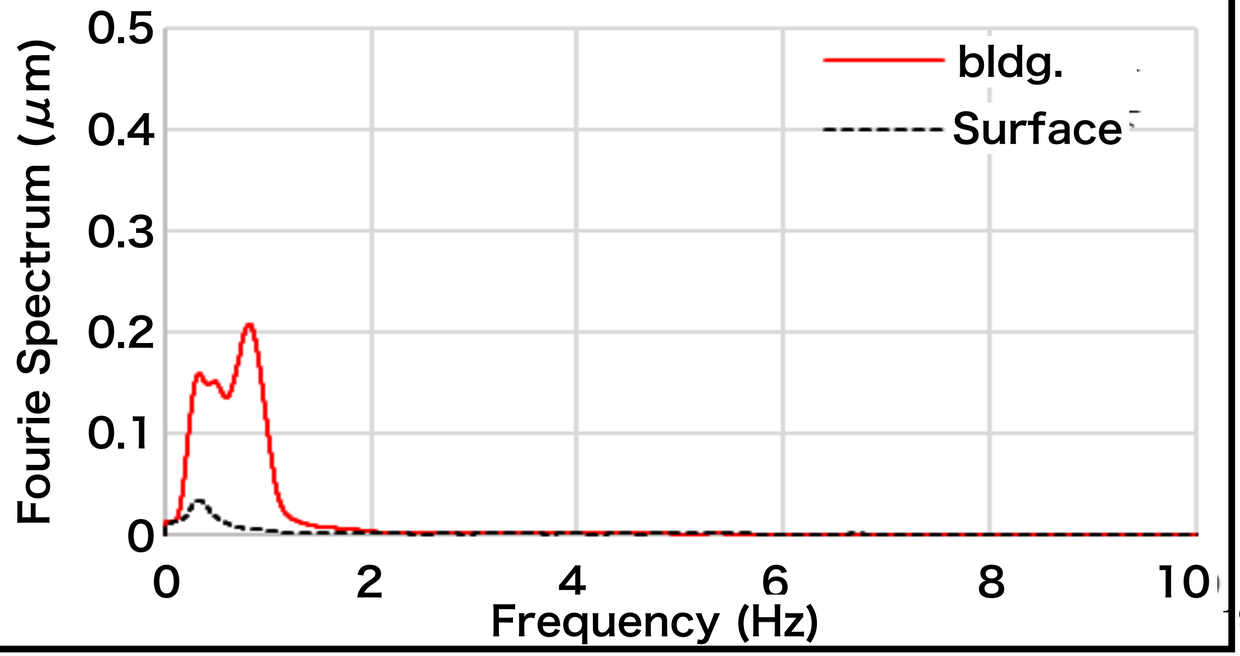
[1] https://www.bridgestone.com/products/diversified/antiseismic_rubber/product.html
[2] http://www.adc21.com/201_korogari.html

Result (Microtremor)

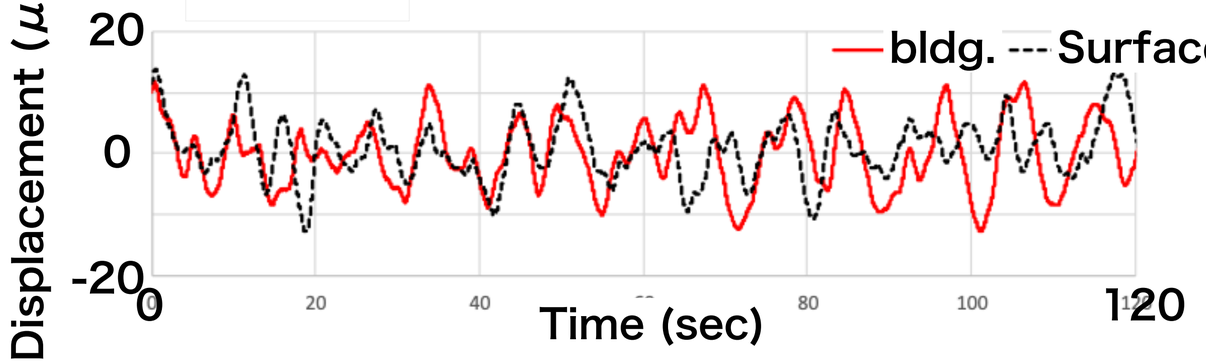


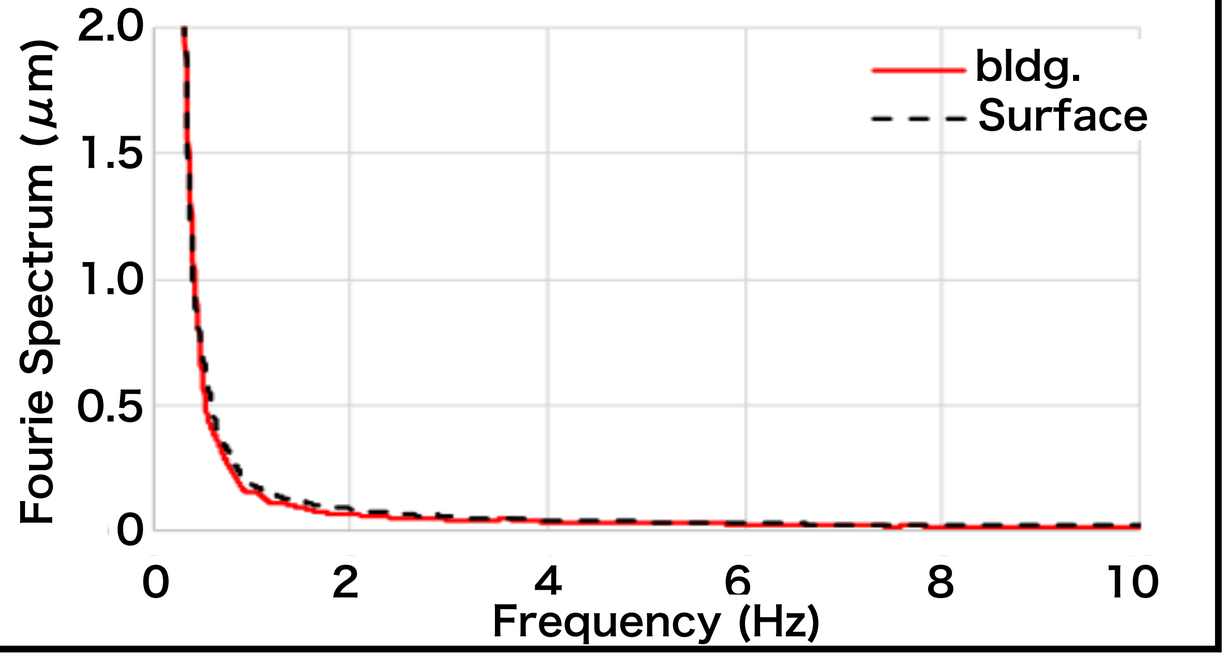
Rubber Bearing





Rigid Sliding Bearing



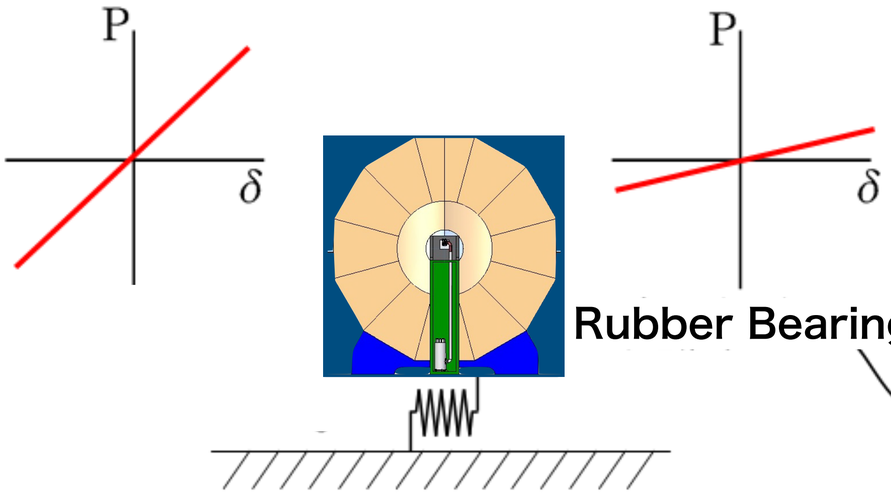


Response analysis (Microtremor/Earthquake)

Simplified model

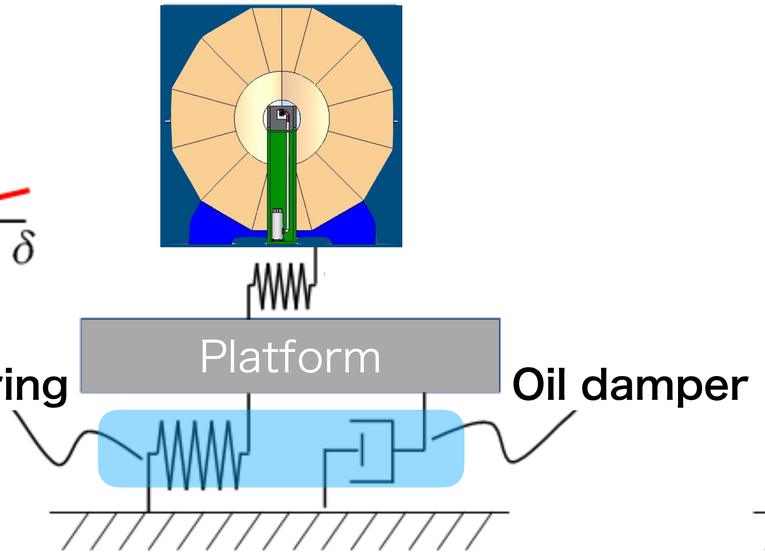
Base Isolation

Seismic Resistance



Natural period
~ 0.4 sec
(assumption)

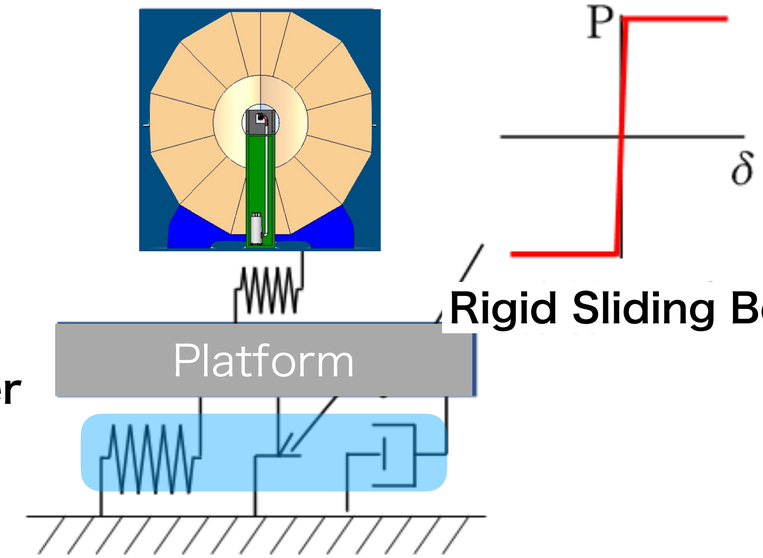
Base Isolation - 1



Rubber Bearing
+
Oil damper

Natural period
~ 4 sec

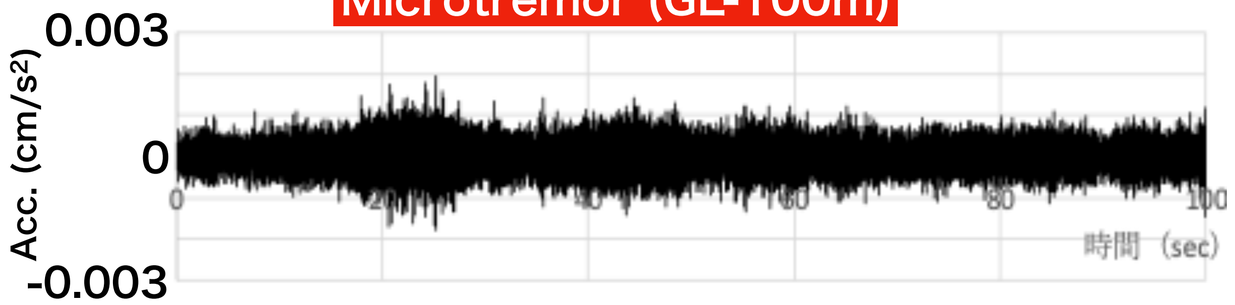
Base Isolation - 2

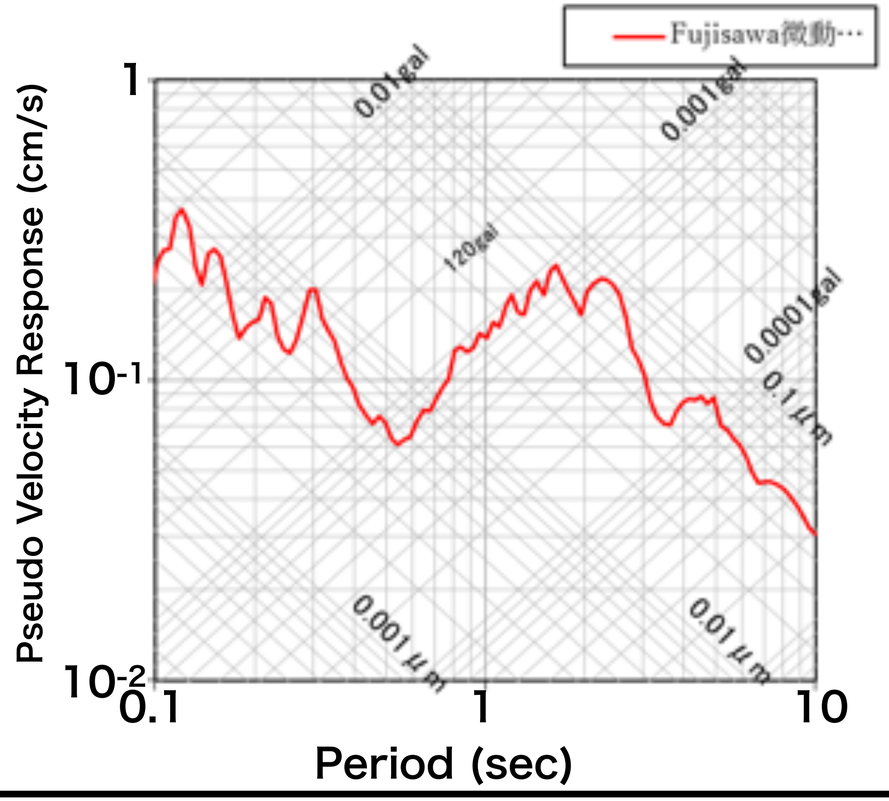


Rubber Bearing
+
Rigid Sliding Bearing
+
Oil damper

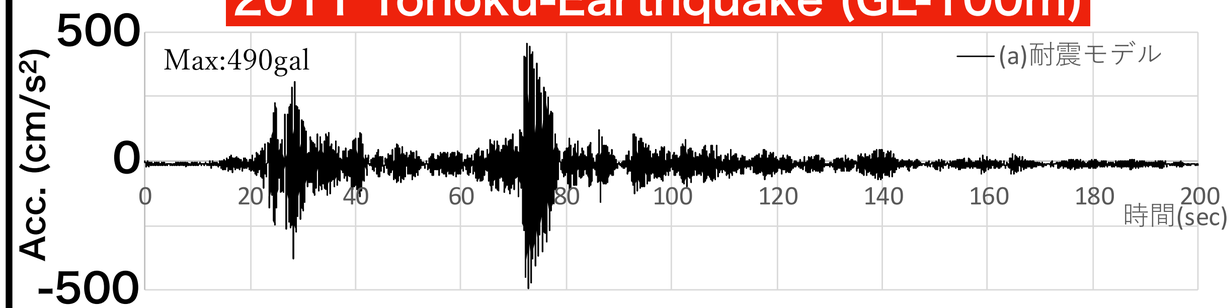
Input spectrum (Fujisawa-Sta.)

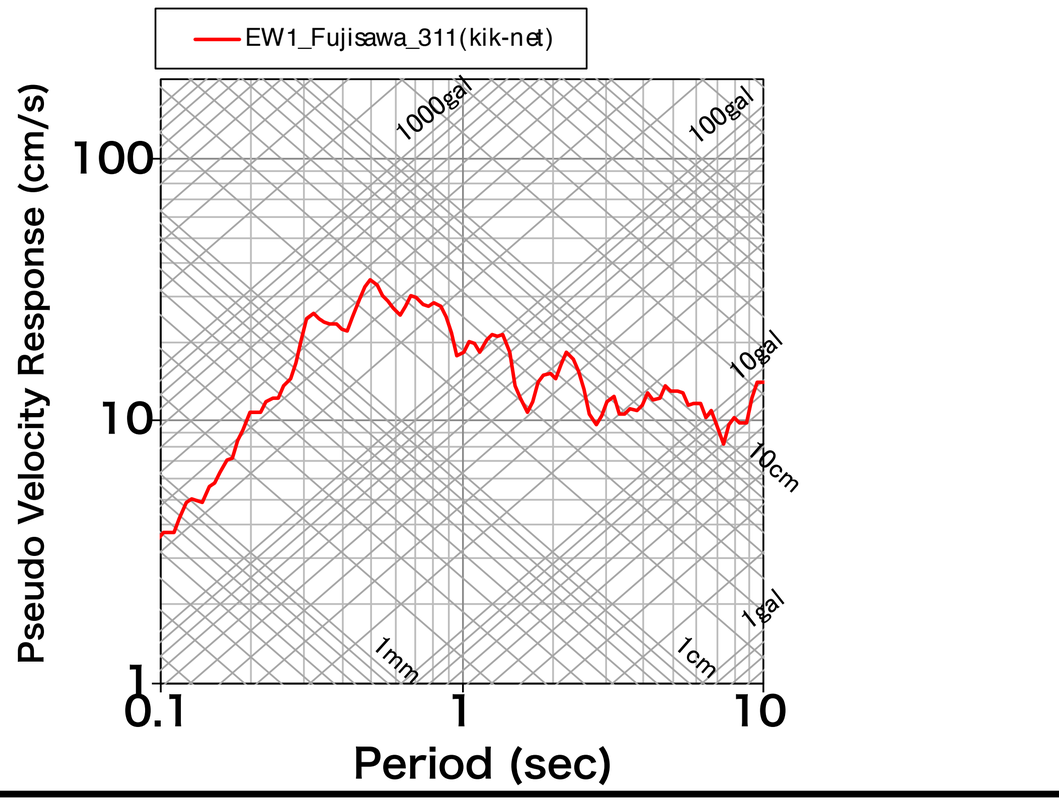
Microtremor (GL-100m)





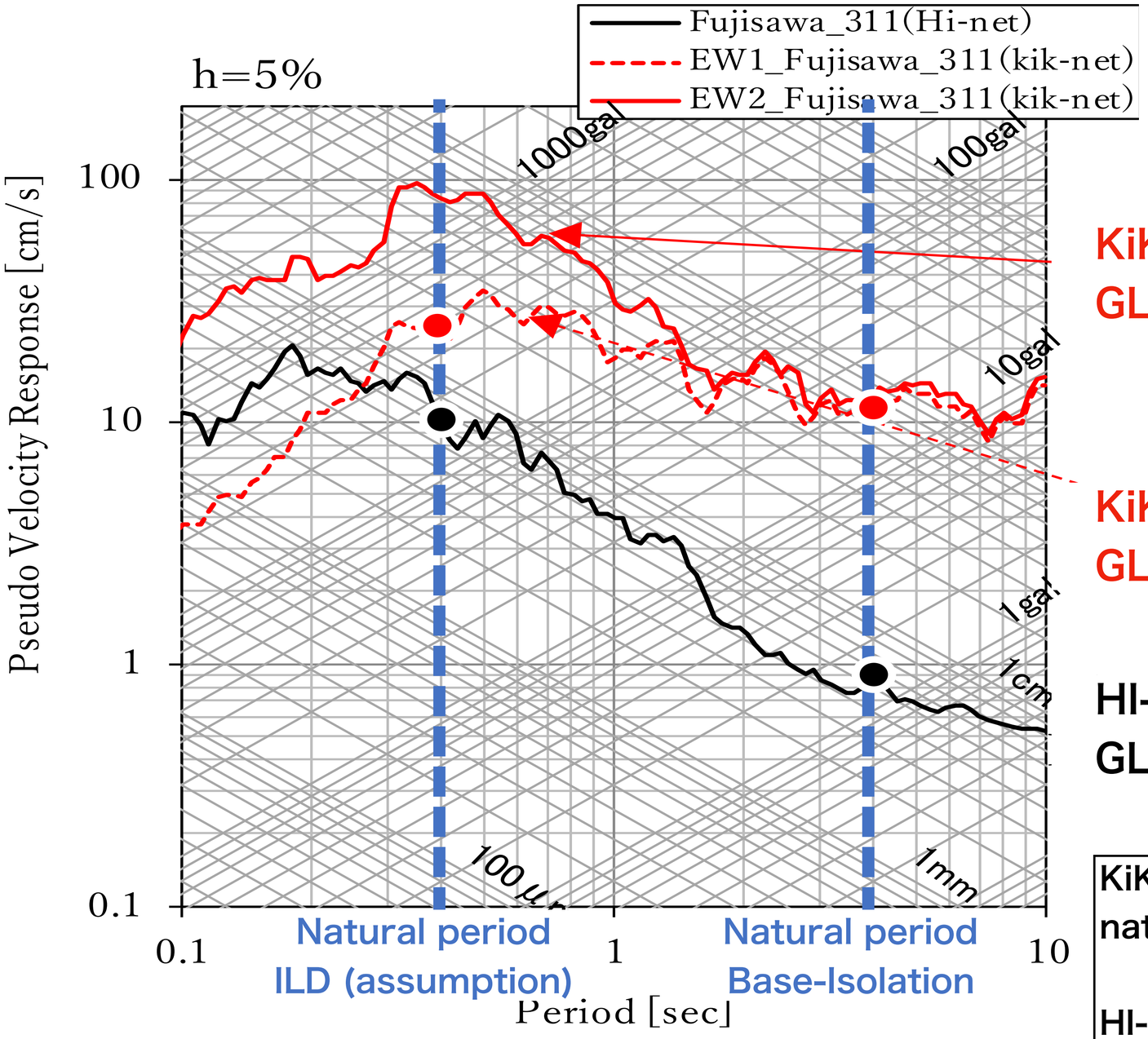
2011 Tohoku-Earthquake (GL-100m)





2011 Tohoku Earthquake

The most severe case



KiK-net (Fujisawa station)
GL

KiK-net (Fujisawa station)
GL-100m

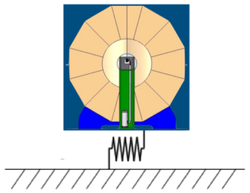
HI-net (Fujisawa station)
GL-100m

KiK-net (Kiban Kyoshin (基盤強振) network)
nation-wide strong-motion seismograph network

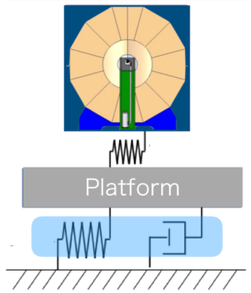
HI-NET (Hi-sensitivity Seismograph Network Japan)
nation-wide high-sensitivity seismograph network

Result (Microtremor)

Seismic Resistance

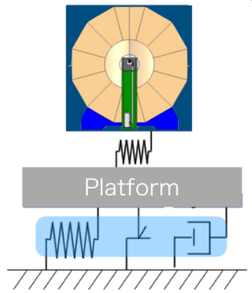


Base Isolation - 1

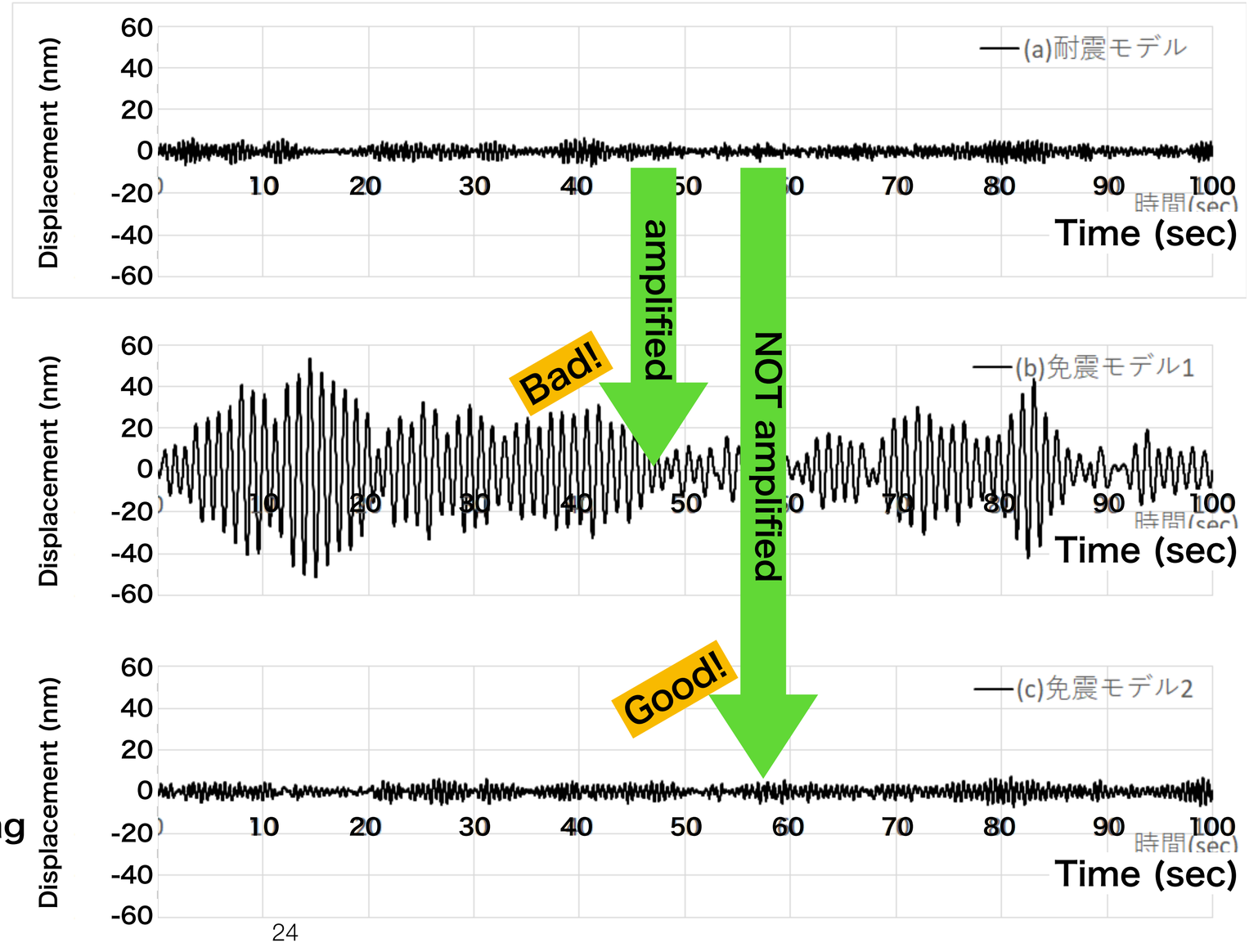


Rubber Bearing
+
Oil damper

Base Isolation - 2



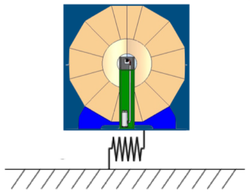
Rubber Bearing
+
Rigid Sliding Bearing
+
Oil damper



Result (2011 Tohoku Earthquake)

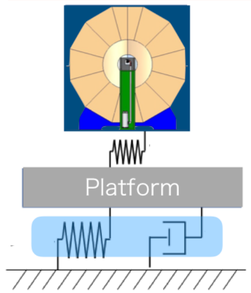
The most severe case

Seismic Resistance



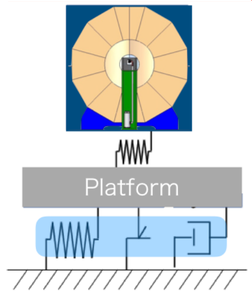
Base Isolation - 1

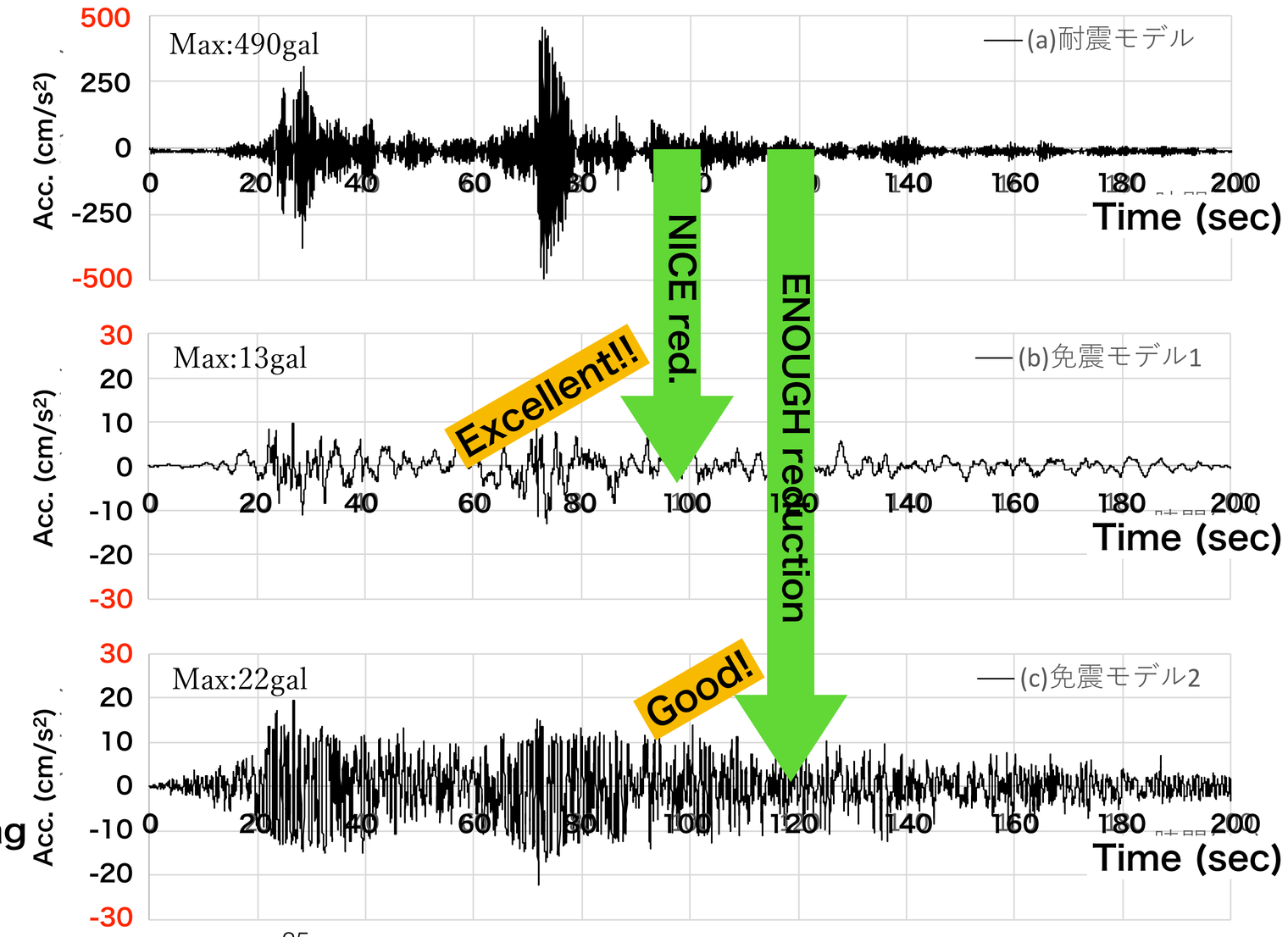
Rubber Bearing
+
Oil damper



Base Isolation - 2

Rubber Bearing
+
Rigid Sliding Bearing
+
Oil damper



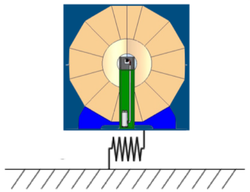


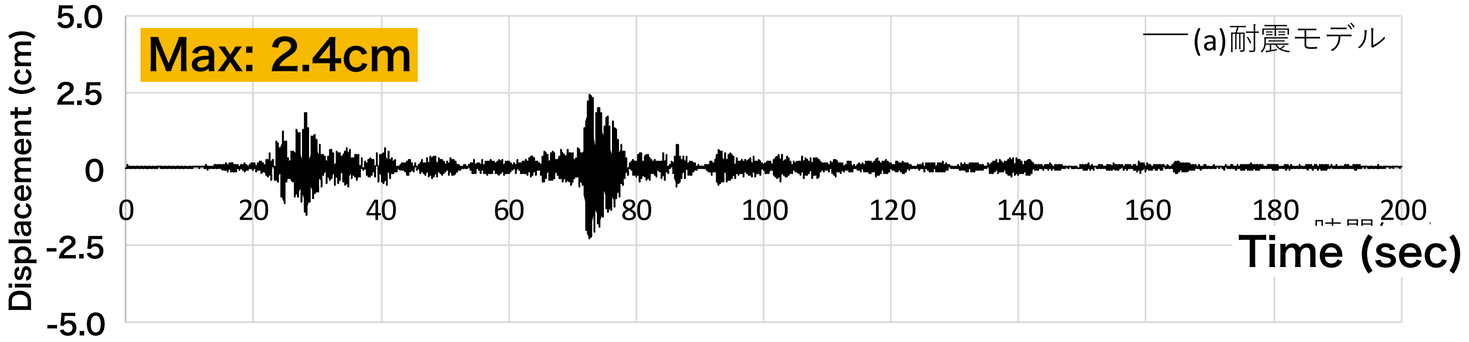
Movement / Displacement (Earthquake)

Result (2011 Tohoku Earthquake)

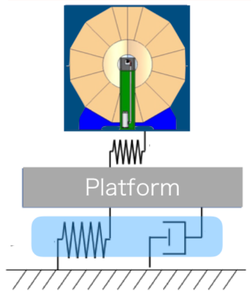
The most severe case

Seismic Resistance

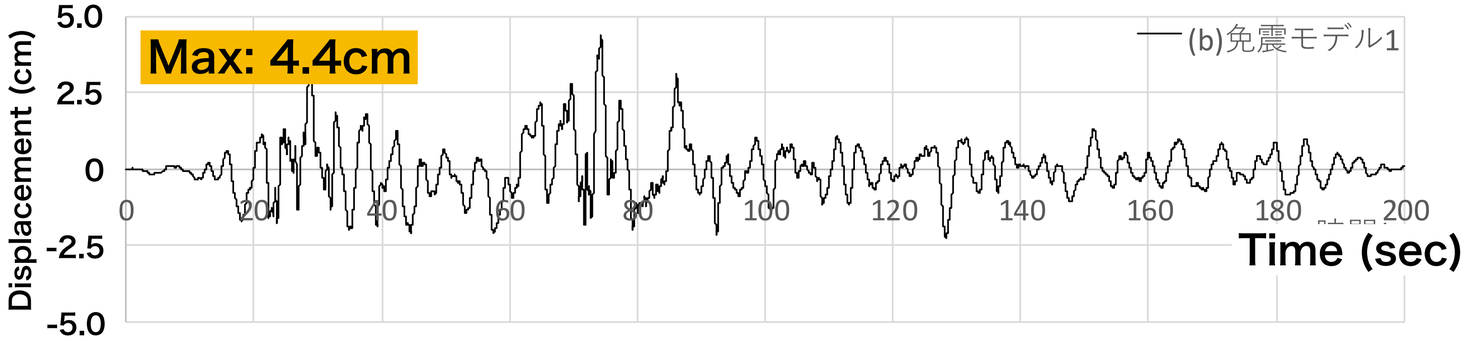




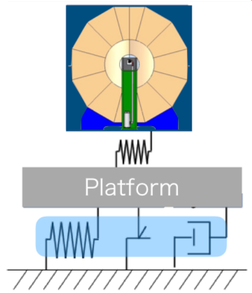
Base Isolation - 1



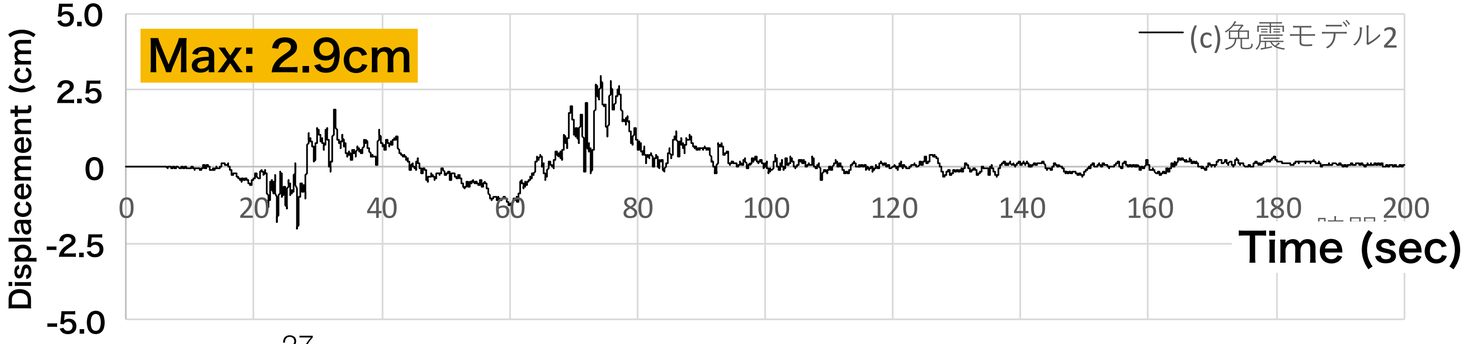
Rubber Bearing
+
Oil damper



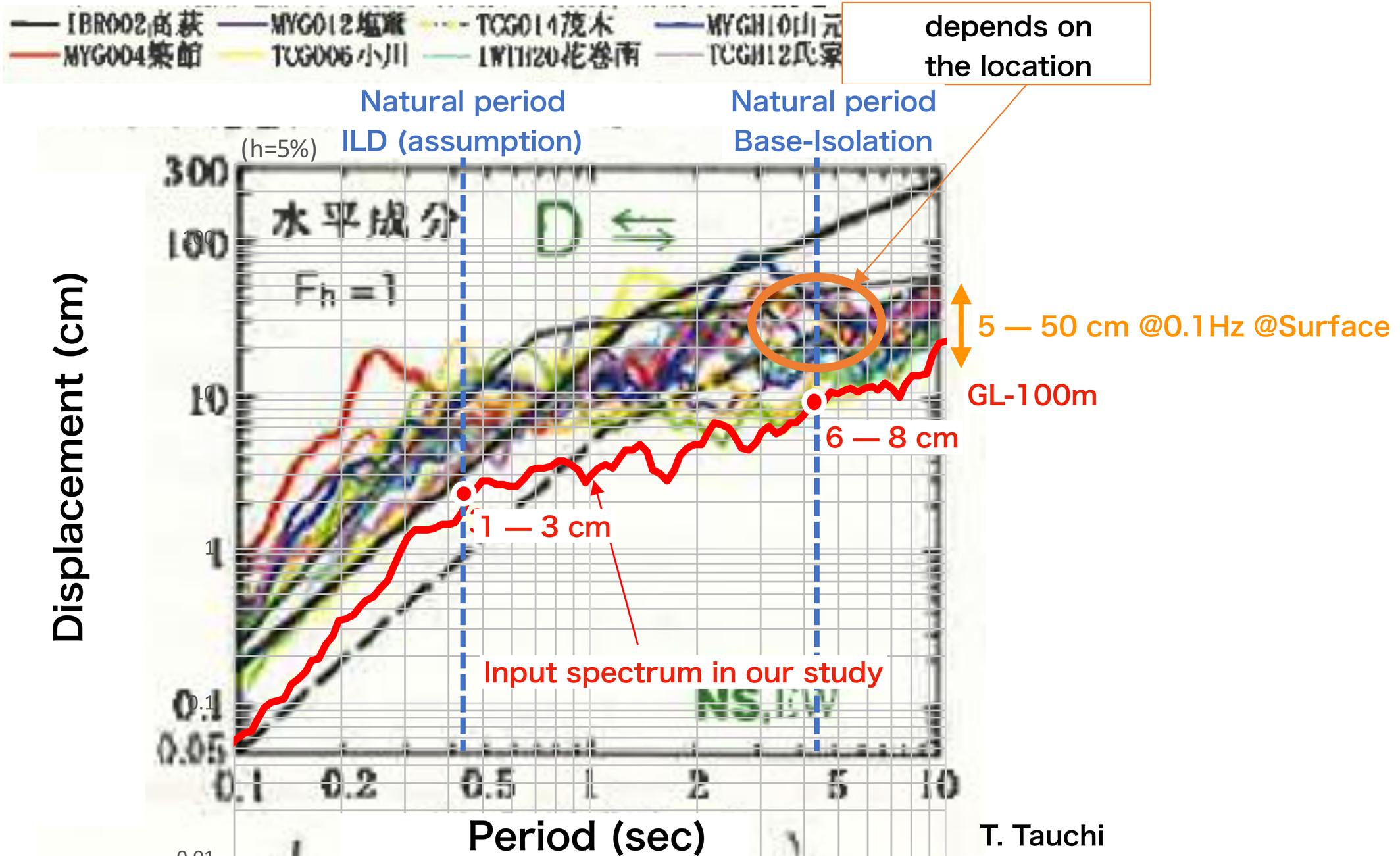
Base Isolation - 2



Rubber Bearing
+
Rigid Sliding Bearing
+
Oil damper

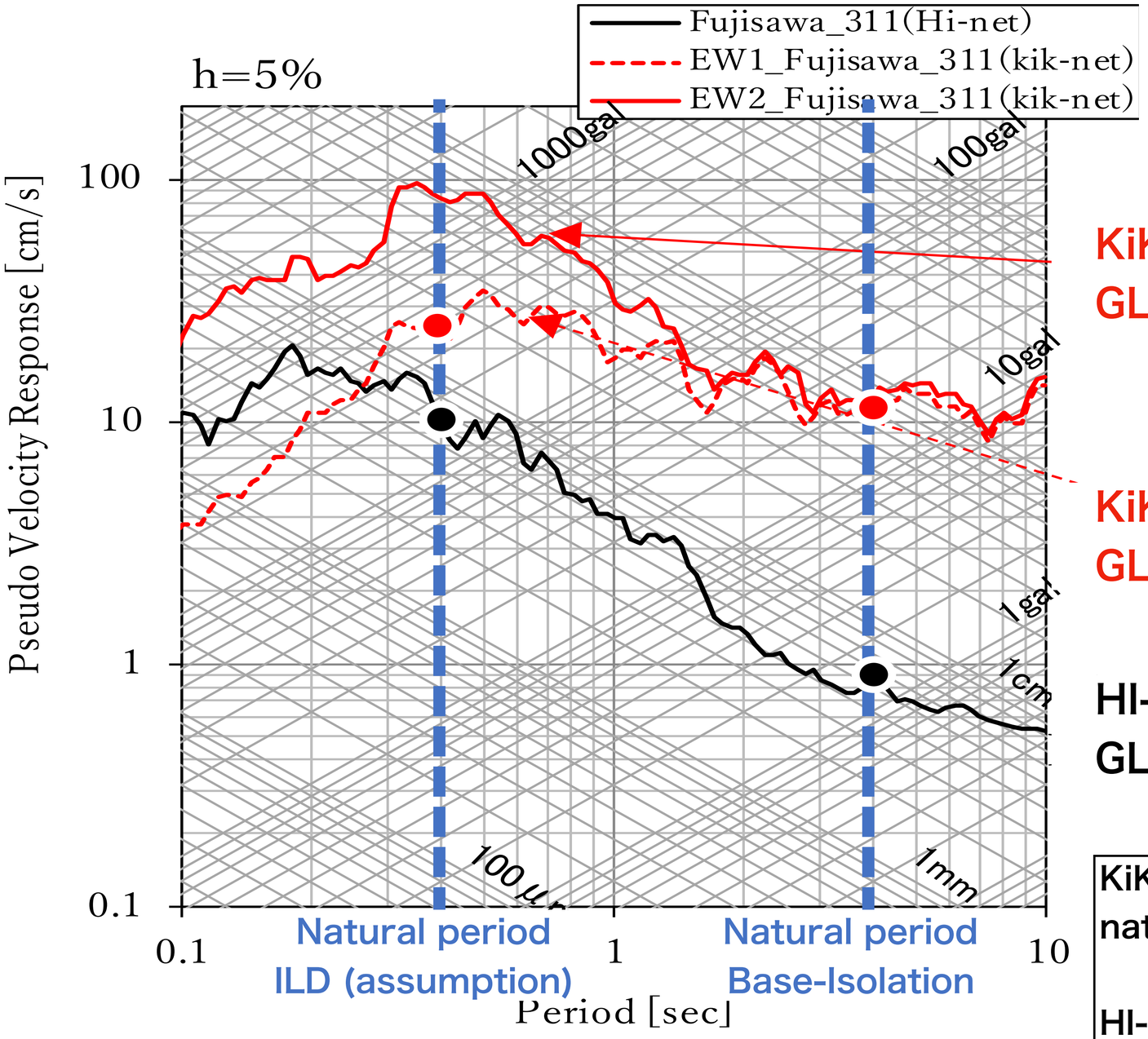


2011 Tohoku Earthquake
The most severe case



2011 Tohoku Earthquake

The most severe case



KiK-net (Fujisawa station)
GL

KiK-net (Fujisawa station)
GL-100m

HI-net (Fujisawa station)
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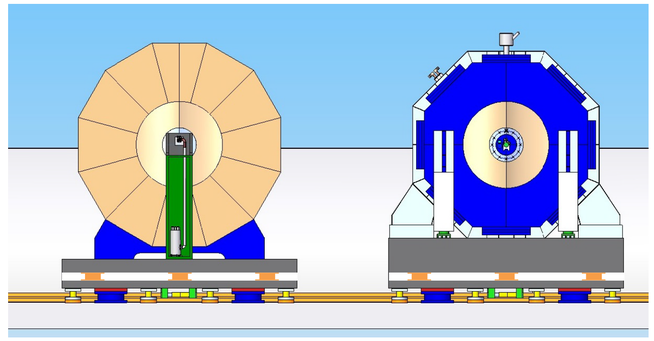
KiK-net (Kiban Kyoshin (基盤強振) network)
nation-wide strong-motion seismograph network

HI-NET (Hi-sensitivity Seismograph Network Japan)
nation-wide high-sensitivity seismograph network

Summary

- Rubber Bearing + Rigid Sliding Bearing + Oil damper shows good properties
  - Earthquake : Enough damping
  - Microtremor : No amplification



Base isolation ?

- Need natural period(s) of the ILD and the accelerator for more realistic analysis