

Japanese practices for the long-period ground motion issue and earthquake early warning

Long-period ground motion issues in Japan

2003 Tokachi-oki EQ

A fire occurred to a petroleum tank due to “sloshing” caused by a long-period ground motion.



2004 Niigata Chuetsu EQ, 2007 Niigata Chuetsu-oki EQ

Suspension wires for elevators in a high-rise building in Tokyo were damaged due to a long-period ground motion.

2011 Tohoku EQ

Many high-rise buildings in Tokyo were damaged by long-period ground motions.

A high-rise building at Osaka (256 m high, 55 storeys), located 800 km away from the epicentre, were also largely shaken for about 10 minutes, causing extensive damage to the building.



Large shaking table experiments in Japan

Shake table tests on high-rise buildings are difficult to conduct due to the large scale. However, some tests have been conducted at one of the world's largest shake tables (E-Defence, NIED).

2008/9

Seismic resistance of the lower part of a high-rise building

Height: 22 m
Weight: 1200 t



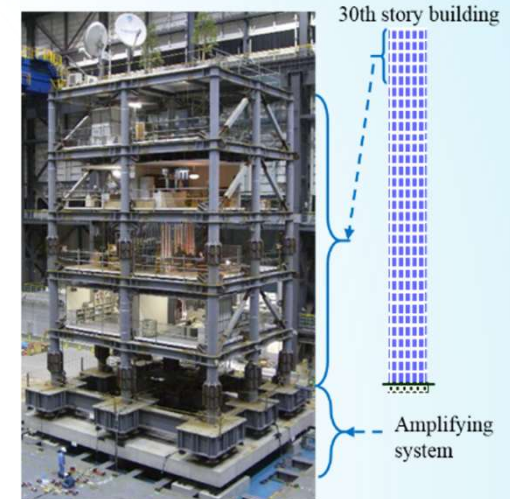
Physical model of top floors

Lower four floors.

2008

Safety in a high-rise building.

Height: 22.5 m
Weight: 750 t



2013

Seismic resistance of a tall building

Height: 25 m
Weight: 420 t



1/3 reduced model.

Practices against long-period ground motions

Shinjuku Mitsui Bbuilding

超大型
制震装置TMD

1800 tonnes TMD



Oil damper for
long-period
movement



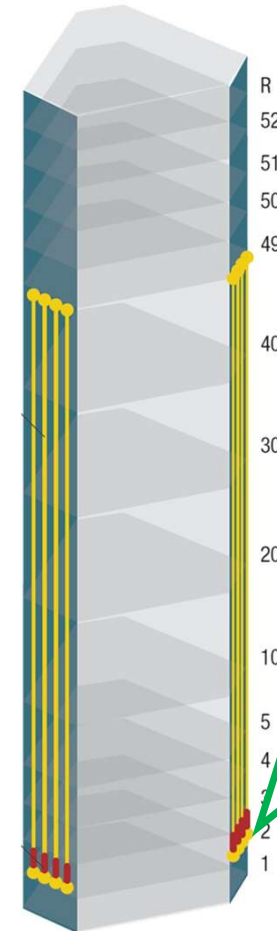
オイルダンパー

Sumitomo Shinjuku Building

iRDT damper developed
by Prof. Ikago's group
(Tohoku U).



A huge weight like a
TMD is unnecessary for
the similar performance.



From Nikkei Architecture.

Early Earthquake Warning at 2024 Noto peninsula EQ: Anamizu (44 km from the epicentre)

The warning arrived 15 seconds ahead of the main shaking.



<https://www.youtube.com/watch?v=6nar0ZwHrJc>

MBS News

Earthquake Early Warning at 2024 Noto peninsula EQ: Suzu (7 km from the epicentre)

The warning arrived about 5 seconds ahead of the main shaking.



<https://www.youtube.com/watch?v=wYMJCernT0U&t=19s>

ANNnewsCH

- **The issue of long-period ground motion and high-rise buildings has been addressed in Japan since the 2000s.**
- **There are several high-rise buildings equipped with protection devices against long-period ground motions.**
- **The effectiveness of EEW has been demonstrated in Japan.**
- **Additional studies will be required for those applications in Thailand, depending on the expected performance and cost.**