

# M-S Department Physics 505 Group

## TUNED MASS DAMPER ~resist earthquake with technology~

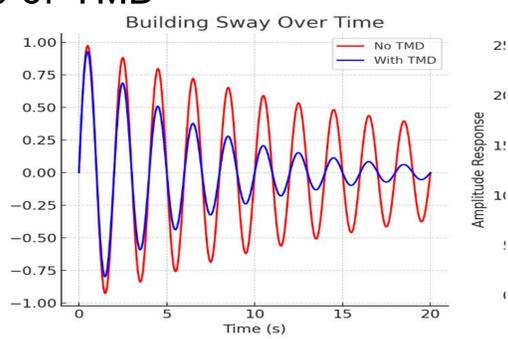
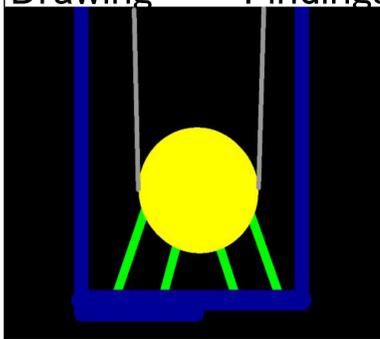
Member ©Yuito Miyara, Shu Uehara, Haru Hiejima  
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### Motivation for research

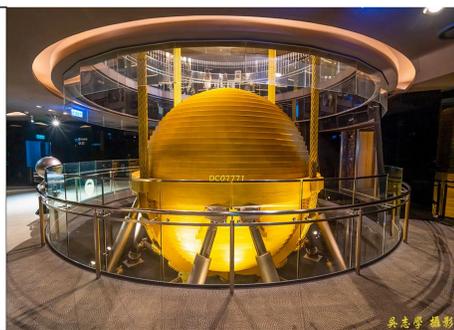
On April 3rd, 2024, there was an earthquake of seismic intensity 6 upper in Taiwan. Then, the earthquake caused big damages to all the buildings in Taipei city, except for "Taipei 101", which is the highest building in Taiwan. That news sparked our interest in seismic technology.

### TMD (Tuned Mass Damper) Simplified

Drawing Findings of TMD

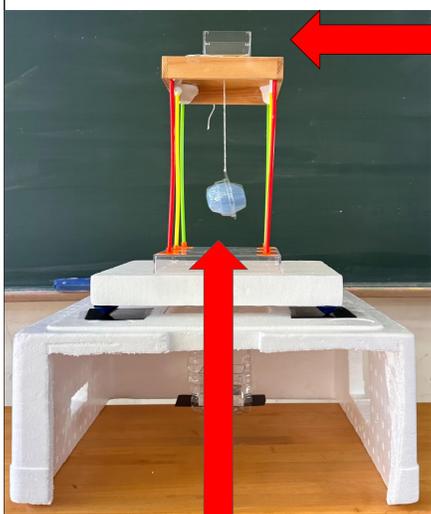


The TMD which is actually in Taipei101 →  
 diameter: 5.5m  
 weight: 660t  
 About 0.1% of the whole  
 High 80% of the full length of the building

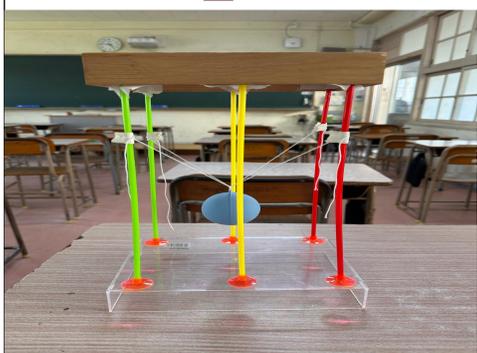


### Experiment

The model which we made



Visualization of shaking  
 Using water and oil emulsions  
 Measure the amount of oil mixed



#### Reproduction of TMD

- Use a bow toy sold at a 100 yen store to reproduce the bending.
- Reproducing a pendulum with a kite string and a ball

#### Reproduction of shaking

- Using ball casters and stand
- Electronic metronome BPM 100 fixed

### Experimental Results

When the length of thread is 5 cm

Weight of the sphere	0 g	30 g	60 g
Shaking reduction rate	0%	20%	30%

When the length of thread is 11 cm

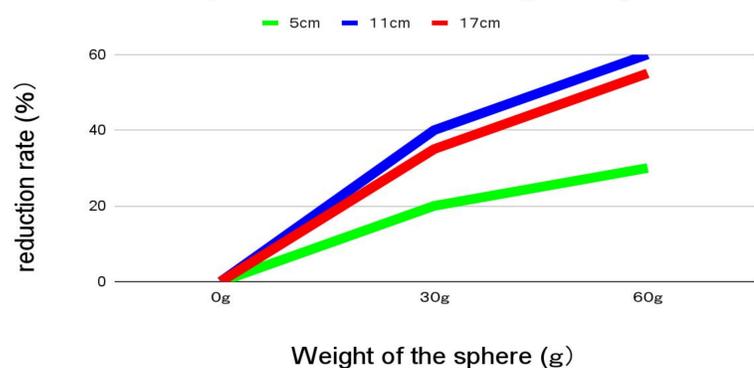
Weight of the sphere	0 g	30 g	60 g
Shaking reduction rate	0%	40%	60%

When the length of thread is 17 cm

Weight of the sphere	0 g	30 g	60 g
Shaking reduction rate	0%	35%	55%

※ Shaking reduction rate =  $\frac{\text{Oil height after experiment (1cm)}}{\text{Initial height of oil (1cm)}}$

Variation of sway reduction rate with weight and position



### Consideration

- The heavier the weight of the ball, the higher the rate of reduction.
- The most appropriate → The TMD is designed not to resonate with the natural frequency of the building, so it moves at the opposite phase to the building. → When the length of thread is 11 cm

### References

- <https://toyokeizai.net/articles/-/747269>
- <https://www.cnn.co.jp/style/architecture/35218359.html>