

Research on Urban Earthquake Engineering at Tokyo Tech. - Earthquake Disaster Mitigation -

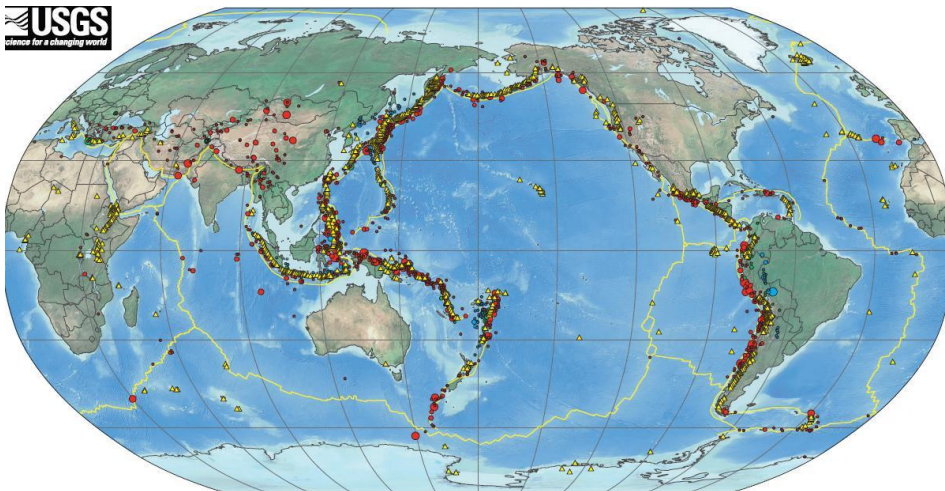
- The 2011 Tohoku Earthquake (M9)
- Anticipated Tokyo Earthquake
- Technologies for Earthquake Disaster Mitigation

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Center for Urban Earthquake Engineering
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Japan is one of the most
earthquake-prone countries.



Epicenters of Large Earthquakes

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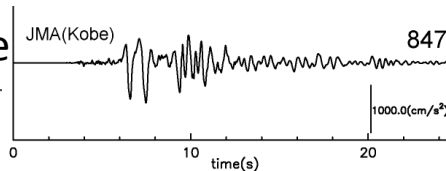
Damage Earthquakes with more than 1,000 Fatalities in Japan since Meiji era

1894	Nobi Earthquake M8.0	7,300
1896	Sanriku Tsunami M8.3	22,000
1923	Kanto Earthquake M7.9	105,000
1927	Kita-Tango Earthquake M7.3	2,900
1933	Sanriku Tsunami M8.1	3,100
1943	Tottori Earthquake M7.2	1,100
1944	Tonankai Earthquake M7.9	1,000
1945	Mikawa Earthquake M6.8	2,000
1946	Nankai Earthquake M8.0	1,400
1948	Fukui Earthquake M7.1	3,800
1995	Kobe Earthquake M7.3	6,300
2011	Tohoku Earthquake M9.0	19,000



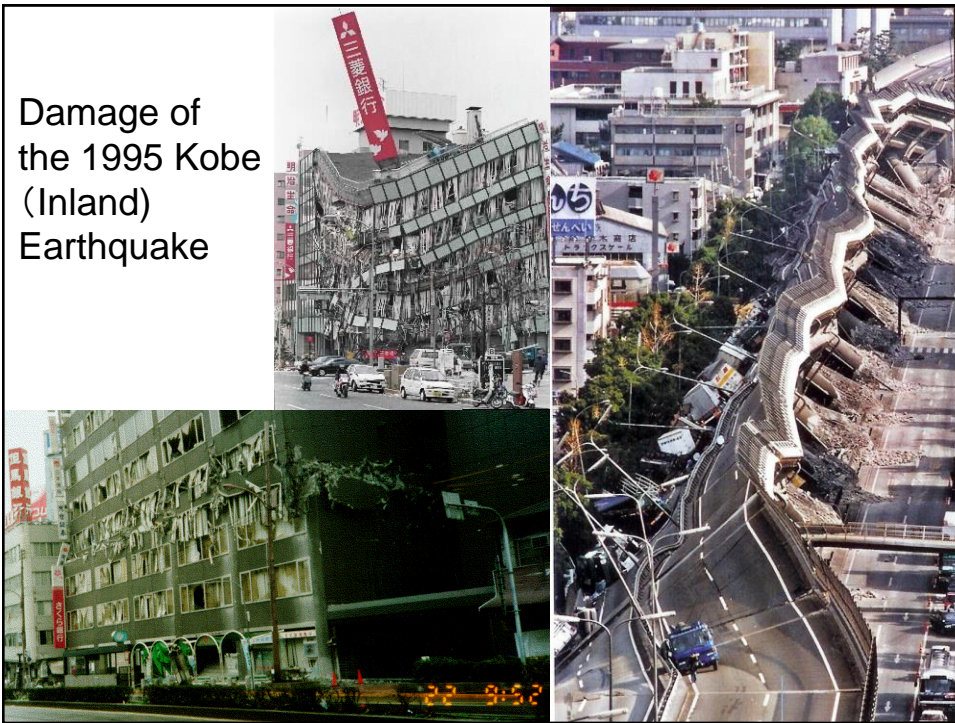
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Strong Shaking during the 1995 Kobe Earthquake



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Damage of
the 1995 Kobe
(Inland)
Earthquake



The 2011 off the Pacific coast of Tohoku
Earthquake

Origin Time: 14:46, March/11/2011

Magnitude: M_w 9.0

Number of dead and missing: 19,000

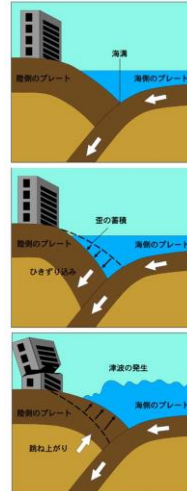
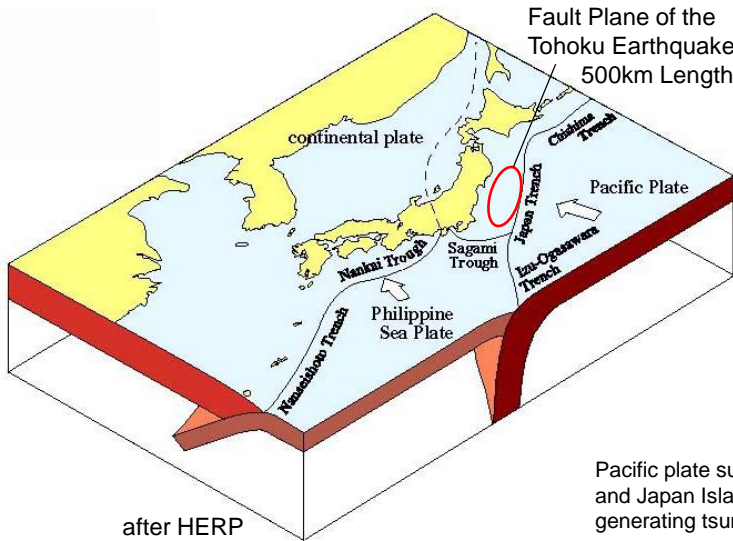
Number of displaced people: 300,000

Number of damaged houses: 1,000,000

Direct monetary loss: 200 billion US\$



Tectonic Plates in the Japanese archipelago and surrounding areas



Pacific plate subducts Japan Islands, and Japan Islands spring up generating tsunami and shaking.

Video of Tsunami in Sendai



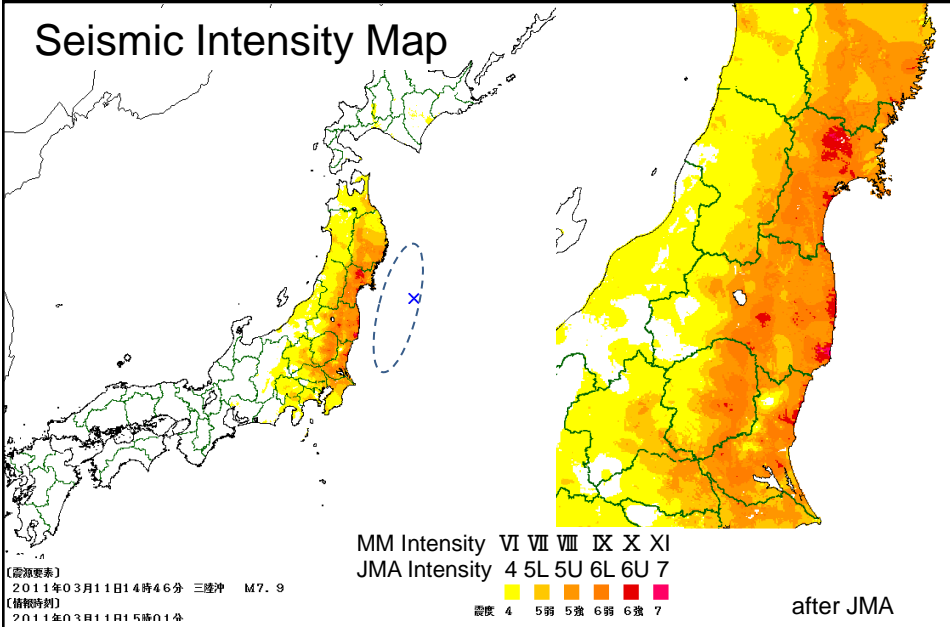
pipeline numbers for Chinese who are injured or distressed are: 090-7835-268

From You Tube

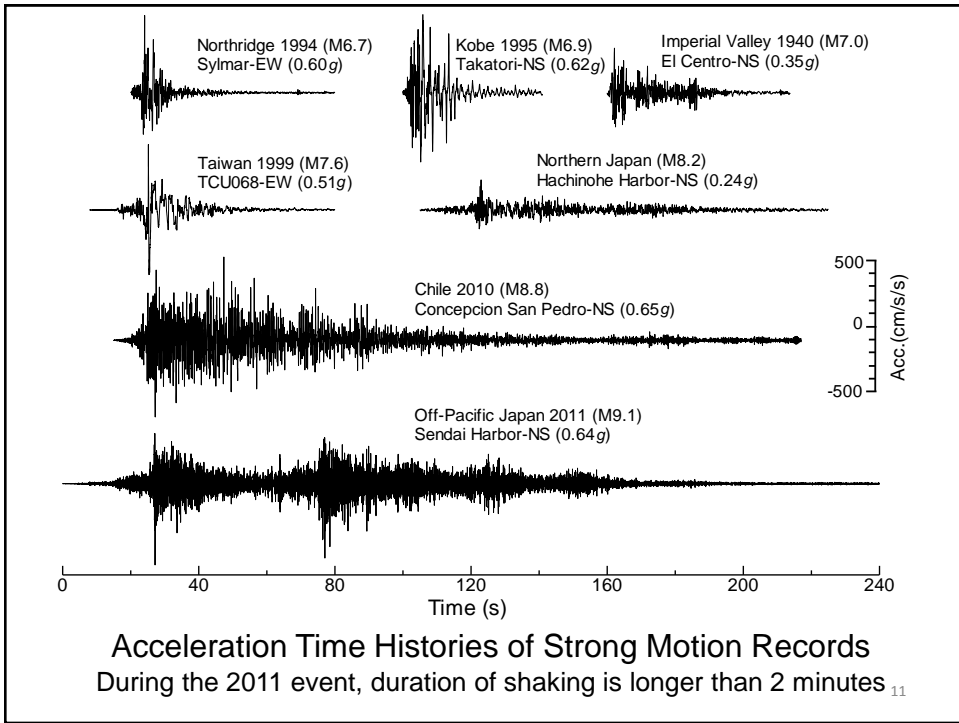
Onagawa



Seismic Intensity Map



The area of intensity 5 upper (MMI 8) or greater is approx. 35,000 km².



Video of Earthquake Motion
at Apartment House in Sendai (Intensity IX)

2011.3.11
東日本大震災
(M9.0)

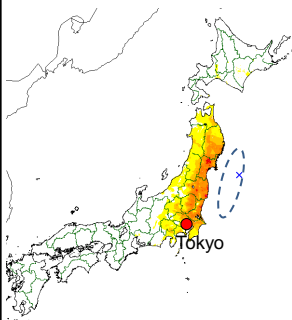
仙台青葉区
camera: SONY DSC-WX5

From YouTube

Building Damage at Lowland of Sendai City



Video of Strong Shaking in Tokyo Intensity 5 lower or 5 upper in JMA scale Intensity VII to VIII in M.M. Scale



(2011年)
2011年03月11日14時46分 震度 M7.9
(震源地)
2011年03月11日14時46分

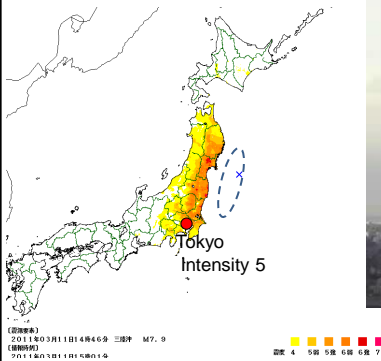
震度 4 5 6 7

Long-period Ground Motion in Tokyo

approx. 150km far from the epicentral area



Displacement of 0.5 to 0.7 m was observed at the top of high-rise buildings. Many people felt fear, and operation of elevators was stopped.



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Damage of Ceiling in Tokyo Area



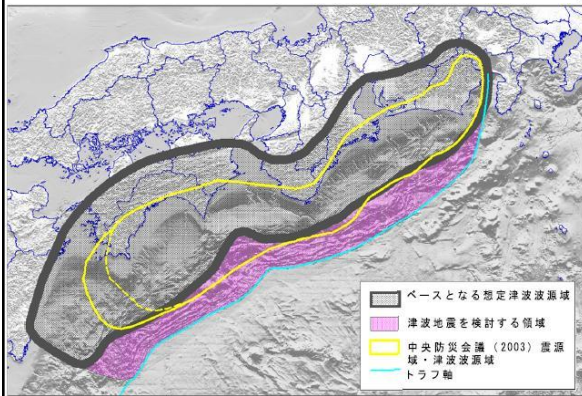
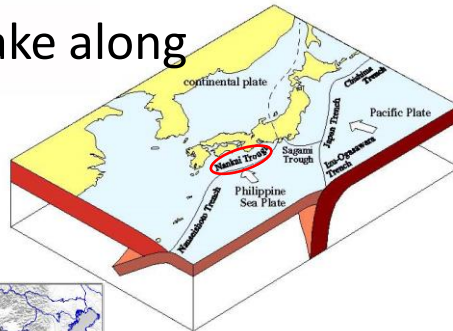
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Soil Liquefaction in Tokyo

A phenomenon whereby a saturated or partially saturated sand soil substantially loses strength and stiffness in response to earthquake shaking, causing it to behave like a liquid.



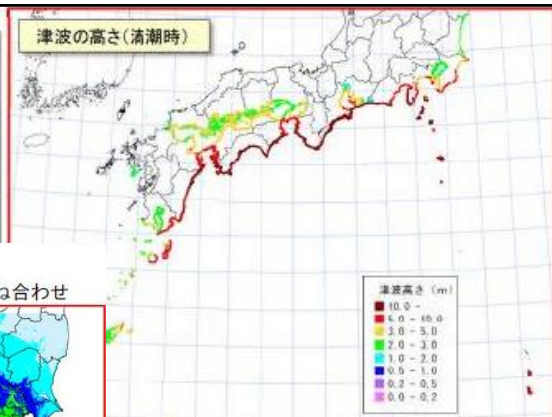
Anticipated Mega-quake along Nankai Trough (M9)



The Central Disaster Management Council of Japanese Government revised quake-tsunami estimates along Nankai trough. They estimate a tremendous earthquake striking in the 750-km Nankai Trough running from Honshu to Kyushu as the worst-case scenario.

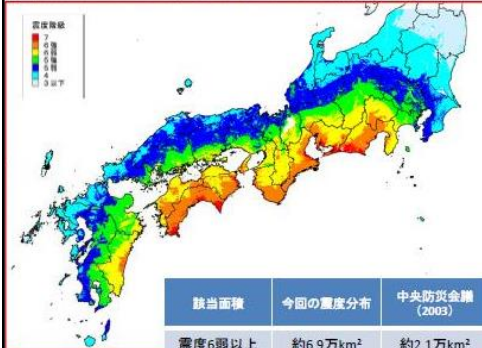
図 V. 3 新たな想定津波波源域

Estimated Tsunami Height (Hmax >30 m)



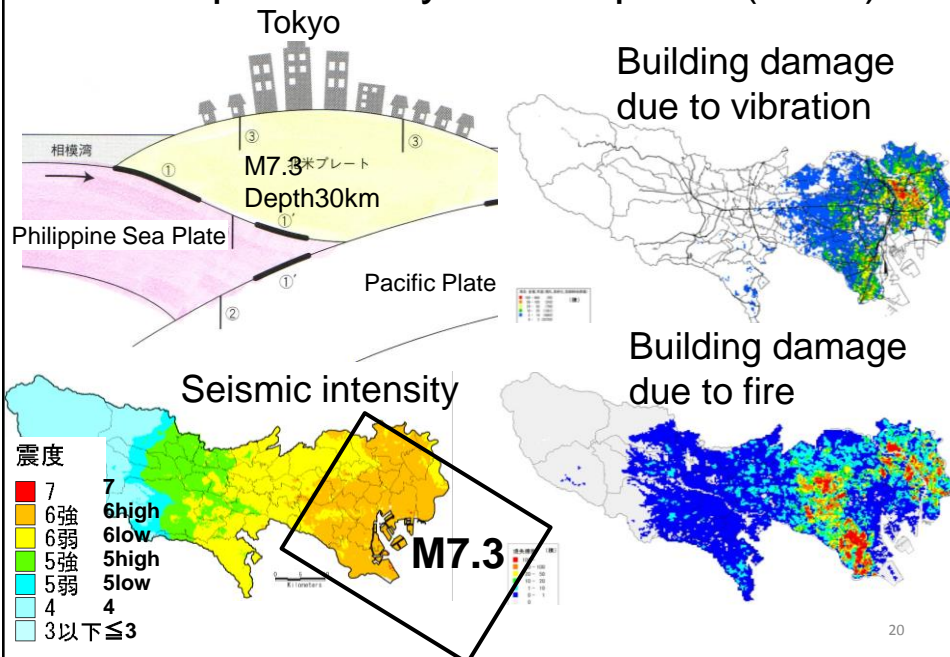
【最大クラスの震度分布】

強震波形4ケースと経験的手法の最大震度重ね合わせ



Estimated Seismic Intensity (area of intensity IX or greater is 70,000 km²)¹⁹

Anticipated Tokyo Earthquake (M7.3)



Threat of Earthquake Disaster



Necessity of Preparedness



Development of Countermeasures with
New technologies

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Center for Urban Earthquake Engineering Center at Tokyo Tech.

City of high earthquake resilience

Three Major Research Areas

**Advanced
Technology for
Earthquake Disaster
Mitigation**

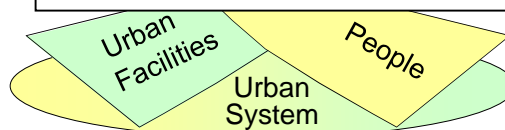
Seismic Hazard & Risk Simulation Technology
Earthquake Disaster Information System
Intelligent Vibration Control of Buildings

**Renovation
Technology for Urban
Earthquake Resilience**

Seismic Retrofit Technology
Seismic Evaluation of Lifeline

**Strategic Plan for
Urban Seismic Risk
Reduction**

Performance-based Design, Earthquake
Education, Investment Strategy

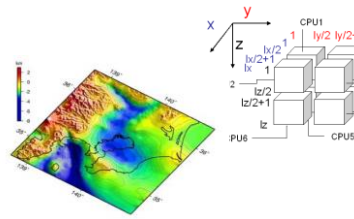
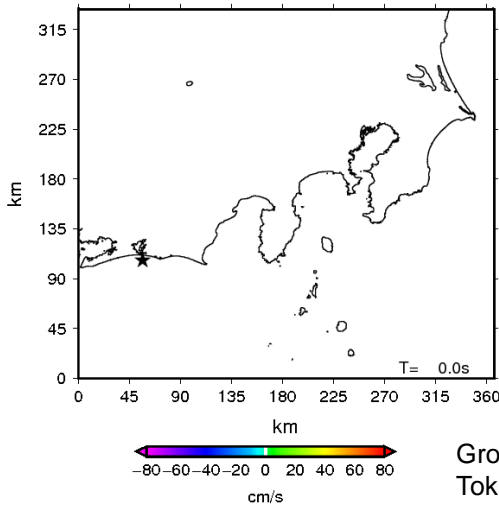


About 50 faculty members in six departments in three Graduate Schools of Tokyo Tech are working for this program. Various research topics are conducted for earthquake disaster mitigation.

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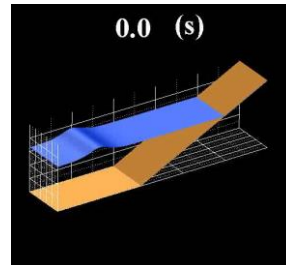
Advanced Seismic Hazard Simulation

By using our supercomputer TSUBAME, sophisticated earthquake ground motion simulation is conducted.

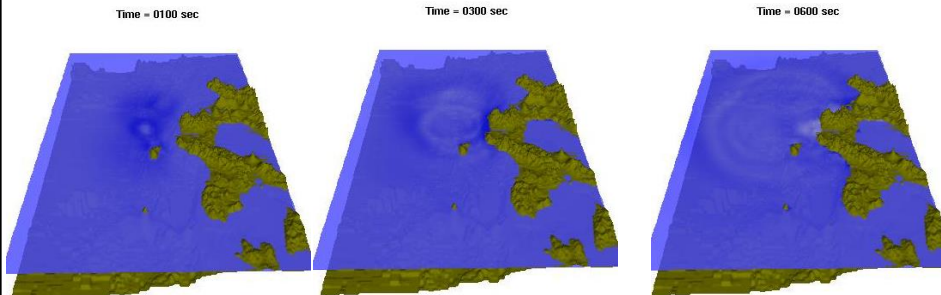


Ground Motion Simulation for Tokai Earthquake

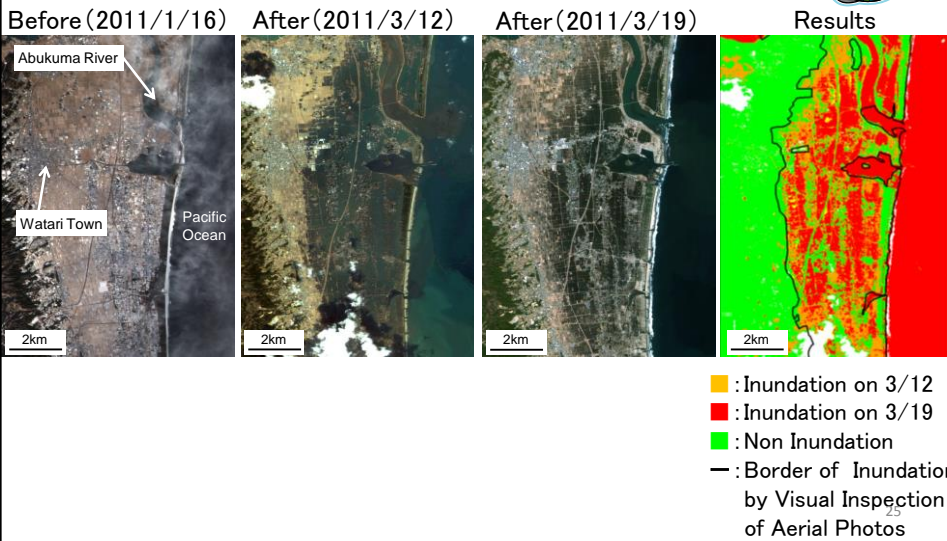
Dynamic Tsunami Simulation



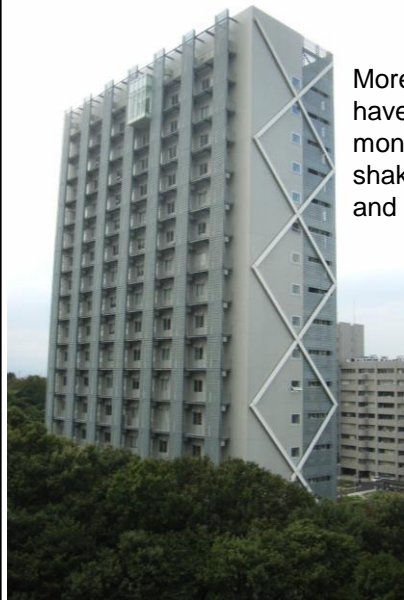
Tsunami Run-up Simulation



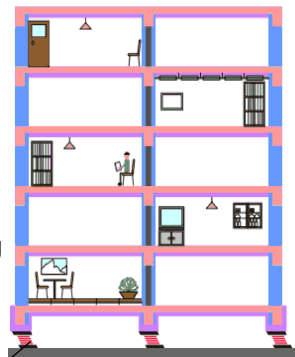
Automated Detection of Inundation Area from Satellite Images (FORMOSAT-2)



Base-Isolation Building at Suzukake-dai Campus



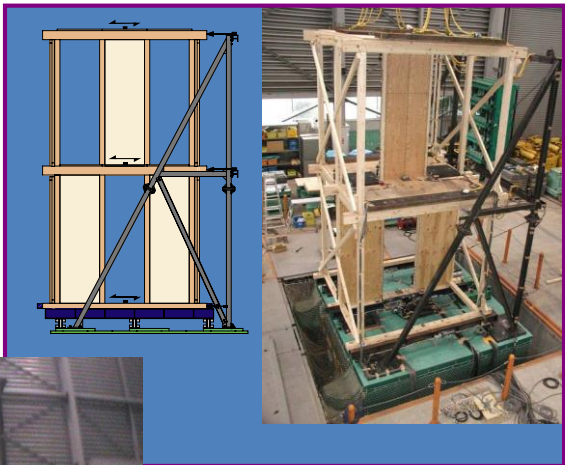
More than 100 sensors have been installed to monitor response during shaking due to quake and wind



Rubber Bearing to Absorb Seismic Energy



Damper System to Reduce Vibration of Wooden House



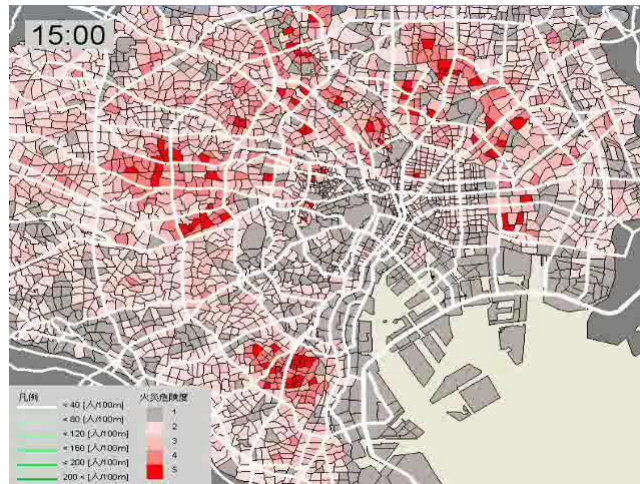
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Evaluation of Indoor Safety during Earthquake by Shaking Table Test and Numerical Simulation



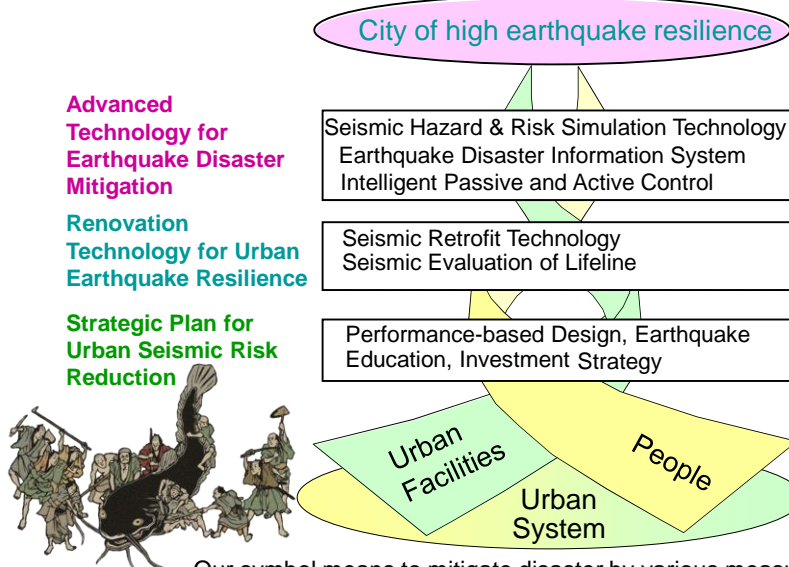
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Simulation of Stranded People after Earthquake to Plan for Disaster



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Our Goal is to construct Earthquake Resilient Society.



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