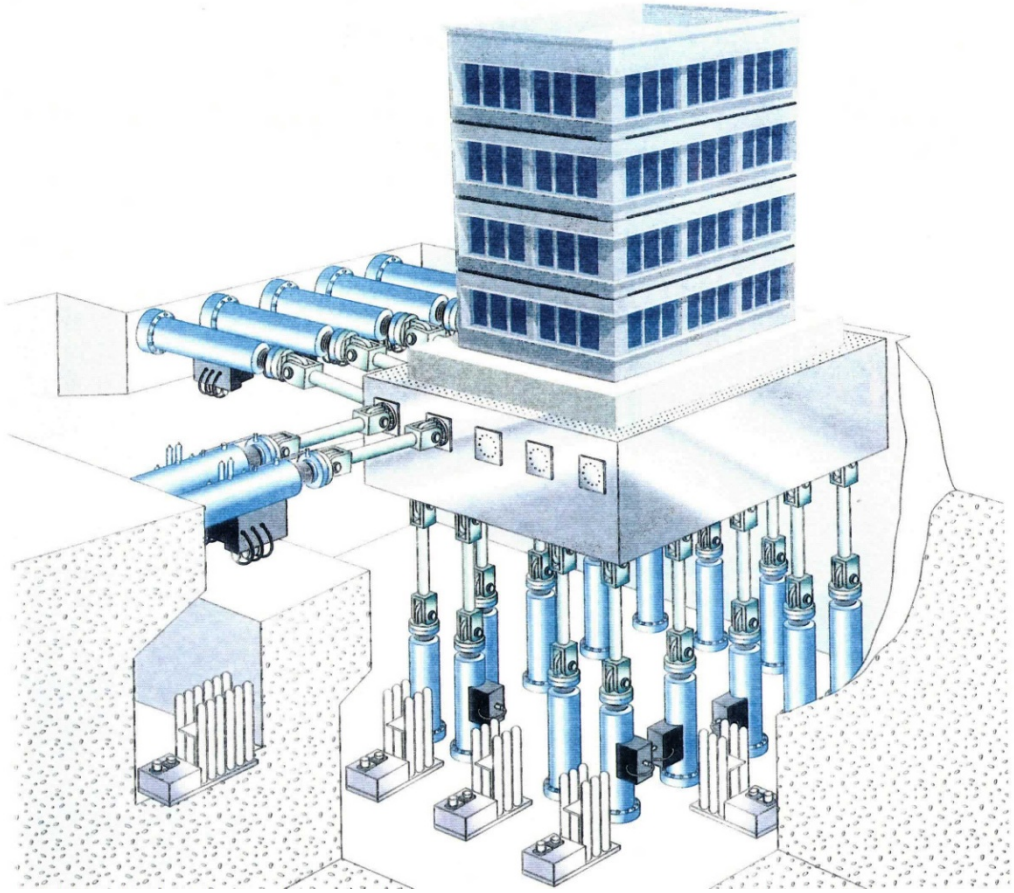
Today's Topics

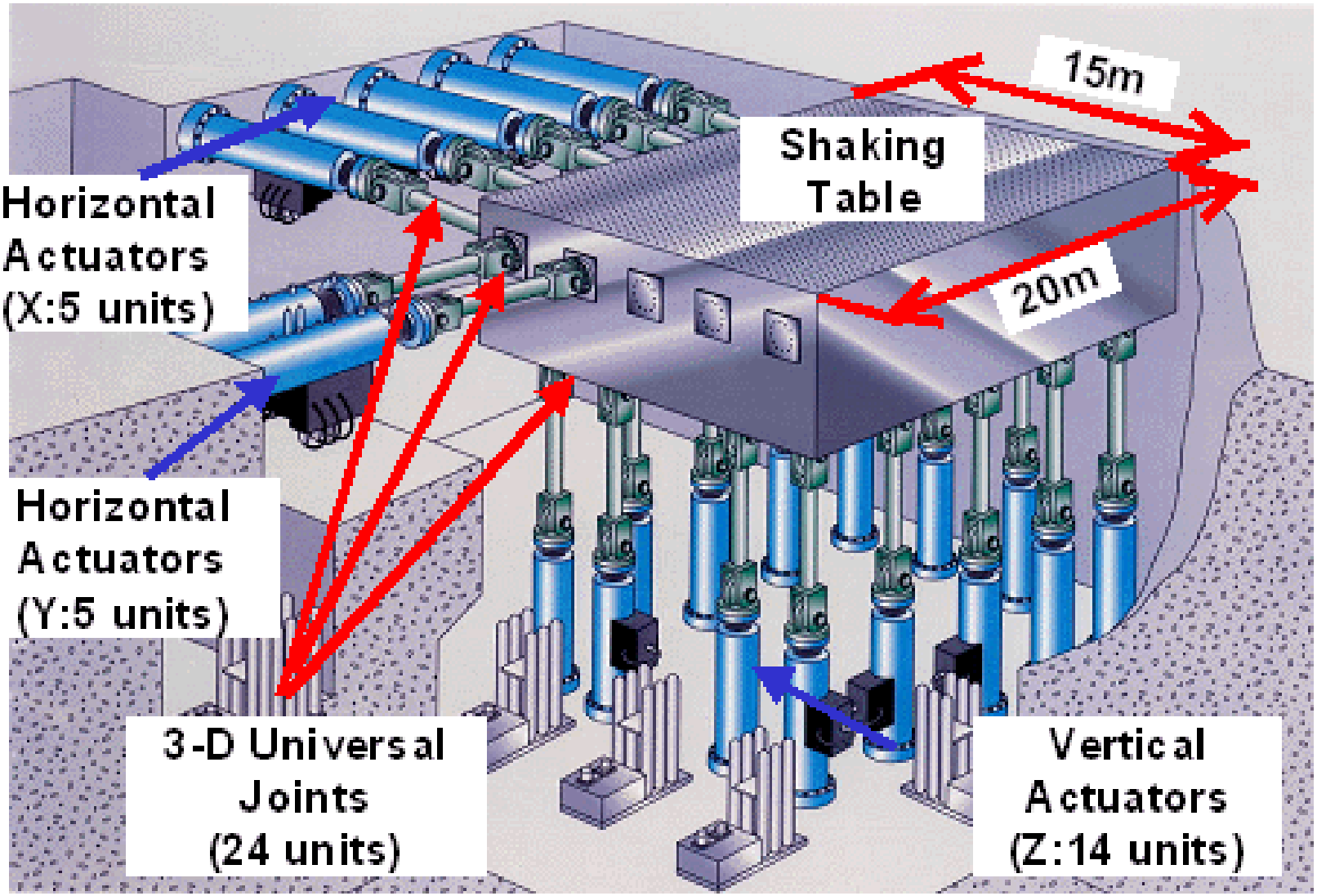
- Some Lessons of the 2011 Tohoku Earthquake
- **Past Research using Large-Scale Testing Facilities**
- A New Project on Condition Assessment and Collapse Quantification

What is E-Defense?



It is a jumbo shaking table
of 20 m by 15 m in plan, activated in 3D
Owned by National Research Institute for Earth Science and Disaster Prevention and open in 2005.

Shaking Table and Actuator System



Specifications of Shaking System

3D Full-Scale Earthquake Testing Facility		
Payload	12 MN (1,200 tonf)	
Size	20 m x 15 m	
Driving Type	Accumulator Charge Electro-Hydraulic Servo Control	
Shaking Direction	X & Y Horizontal	Z Vertical
Max. Acceleration (at Max. Loading)	>9 m/s/s	>1.5 m/s/s
Max. Velocity	2 m/s	0.7 m/s
Max. Displacement	1 m	0.5 m
Max. Allowable Moment	Overturning Moment 150 MN x m	Yawing Moment 40 MN x m

Activities of E-Defense

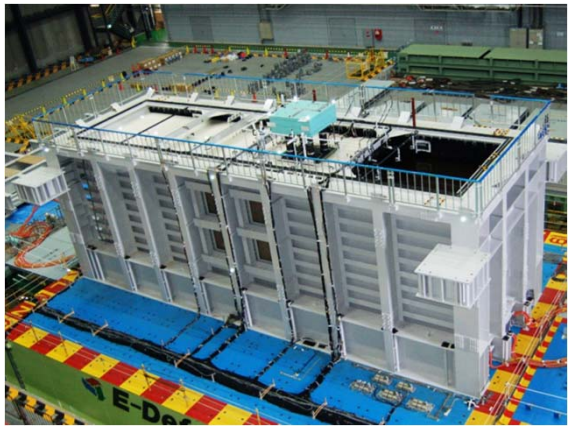
Since 2005, E-Defense has completed forty some full-scale (or large-scale) tests for various structures.

Four-story Base-isolated Hospital

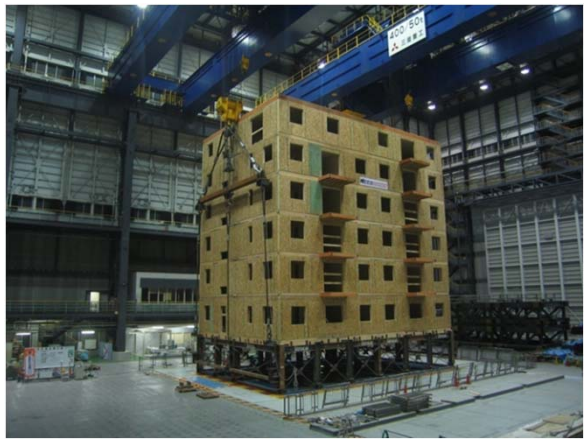
Six-story RC Frame

Two-Story Wooden House

Four-story Steel Frame

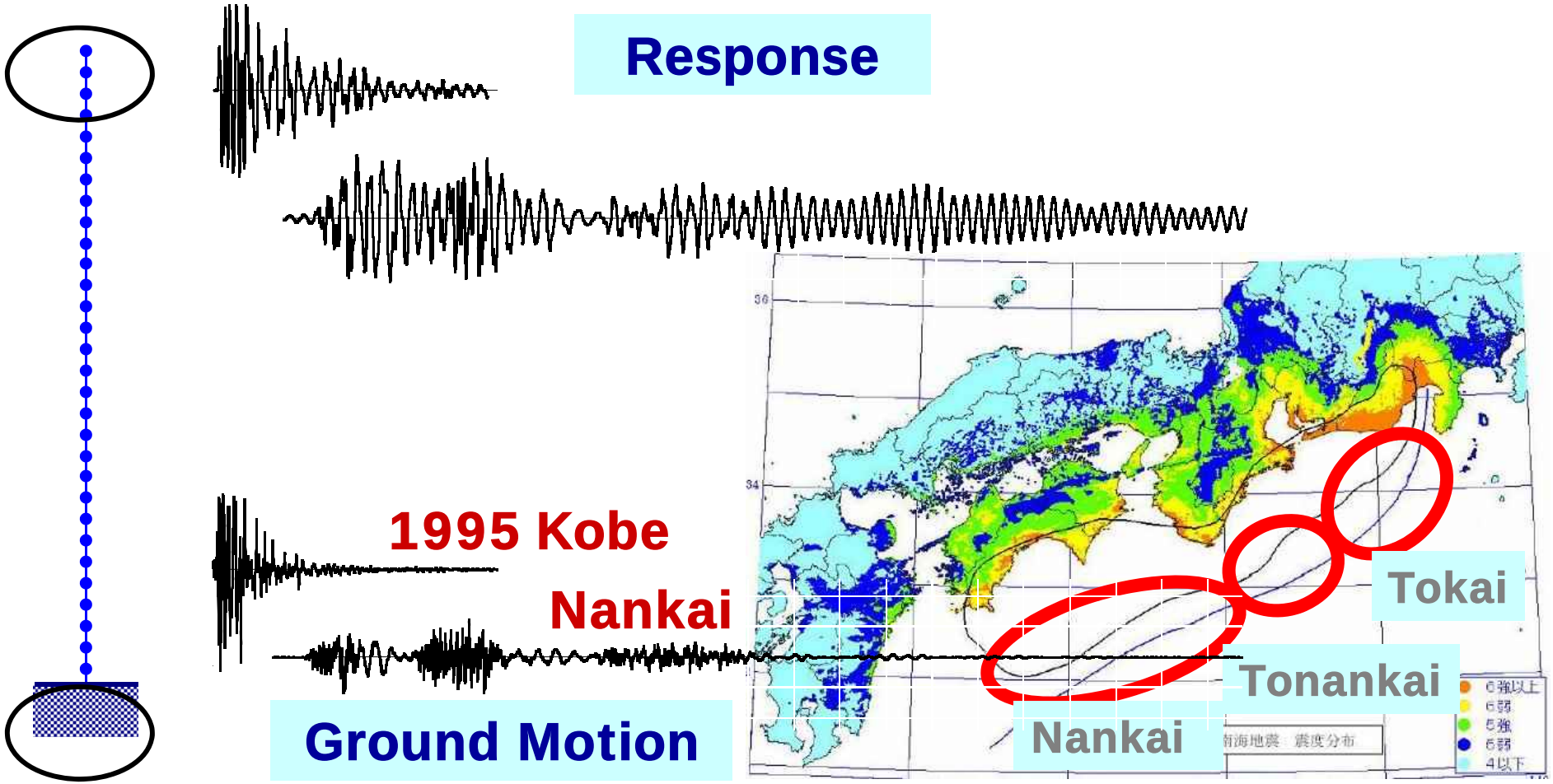


Pile Foundation

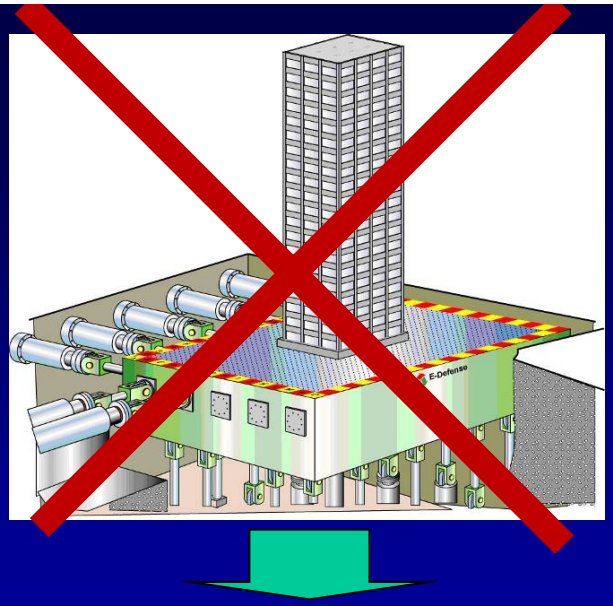


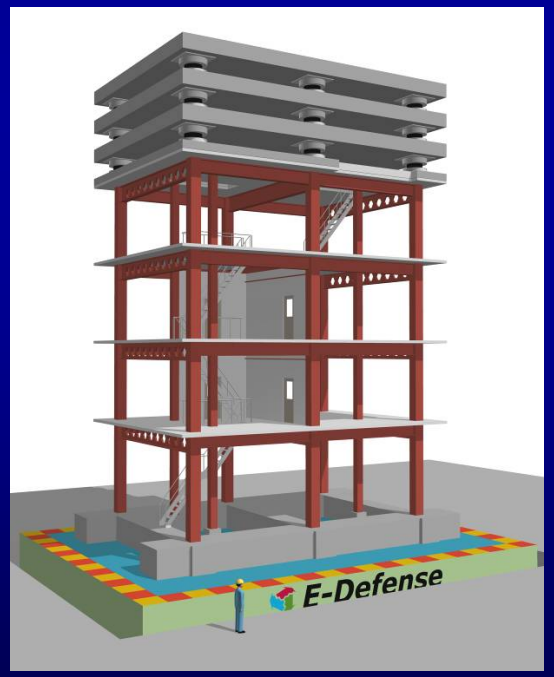
Six-story Wooden House

Performance and Damage of High-Rise Buildings Subjected to Long-Period Ground Motion



Substructure Model for High-Rise Steel Building





Me1

Me1

Me1

Me2

Concrete Mass

Damper

Rubber Bearing

Ke3

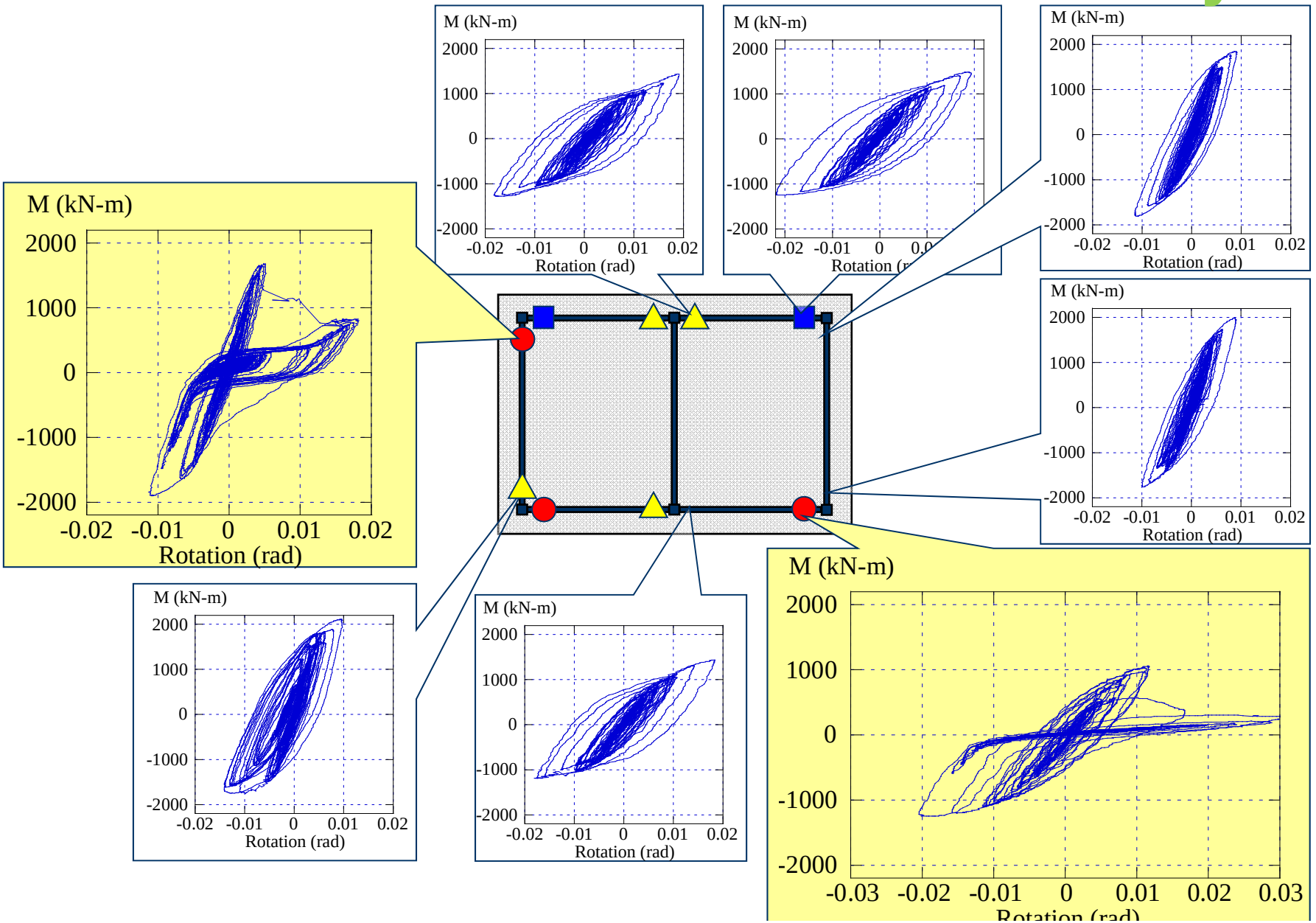
Ke2

Ke1

Mass

Stiffness

Moment-Rotation Relationships of Beam-to-Column Connections in Third Story



Today's Topics

- Some Lessons of the 2011 Tohoku Earthquake
- Past Research using Large-Scale Testing Facilities
- **A New Project on Condition Assessment and Collapse Quantification**

Special Project for Reducing Vulnerability for Urban Mega Earthquake Disasters (2012 – 2016)
Budget for 2012: 6 million USD

Objective/Scope: Based on lessons learned from 2011 Tohoku earthquake, urgent, comprehensive research is to conduct for minimizing loss of urban disasters against large ocean ridge earthquakes along Nankai Trough and near fault earthquakes that would hit metropolitan regions. To carry out this research, a trans-disciplinary research team has been formed, consisting of earth science, structural engineering, and social sciences.

Prediction
(I) Prediction of earthquake damage to metropolitan regions

Responses
(III) Advancement of capacity for urban disaster responses

Prevention
(II) Maintenance and recovery of functionality in urban infrastructures

Problem Statement and Research Needs

Lessons from 2011 Tohoku – answers that earthquake engineering shall supply

(1) Response to earthquakes beyond what is considered in structural design

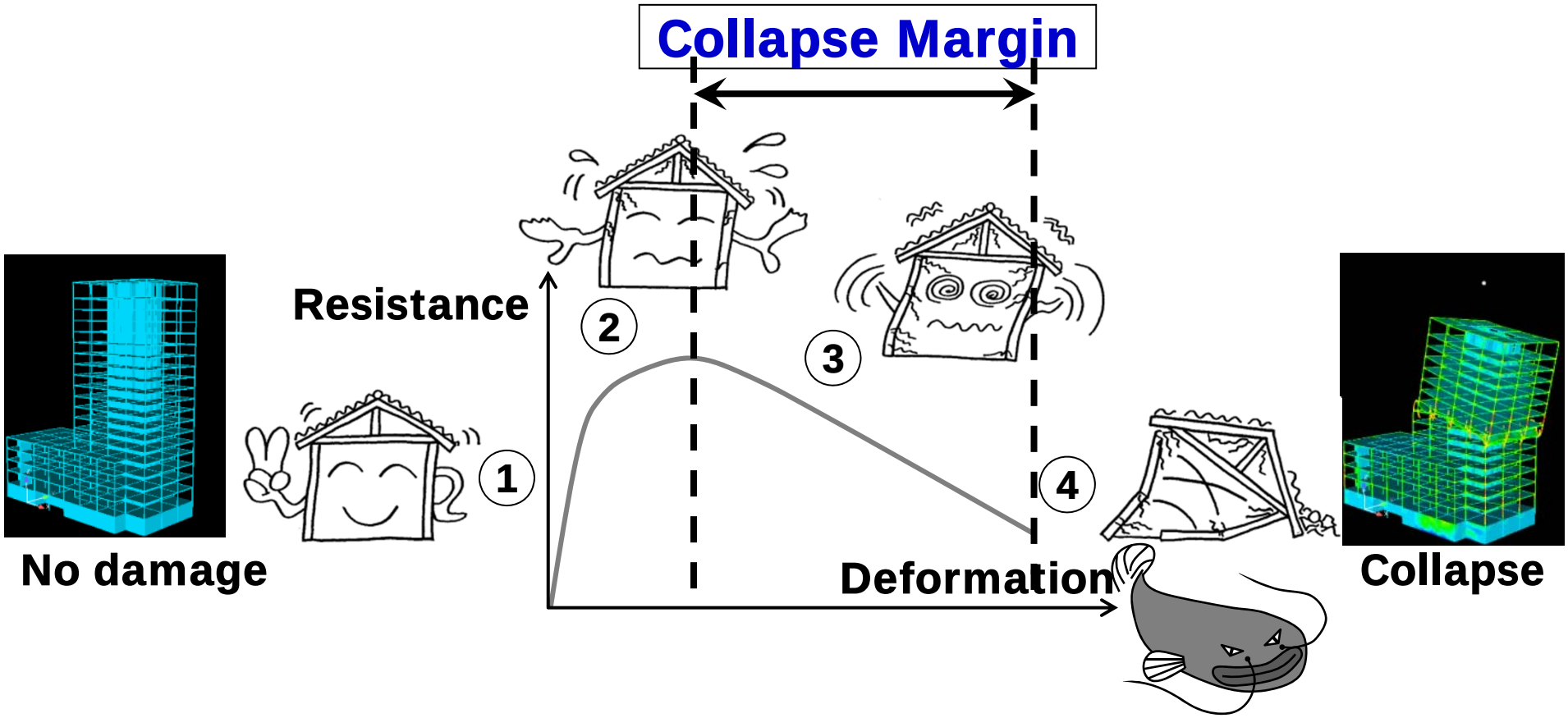
(2) Continuing business and prompt recovery

Research needs in light of 2011 Tohoku lessons:

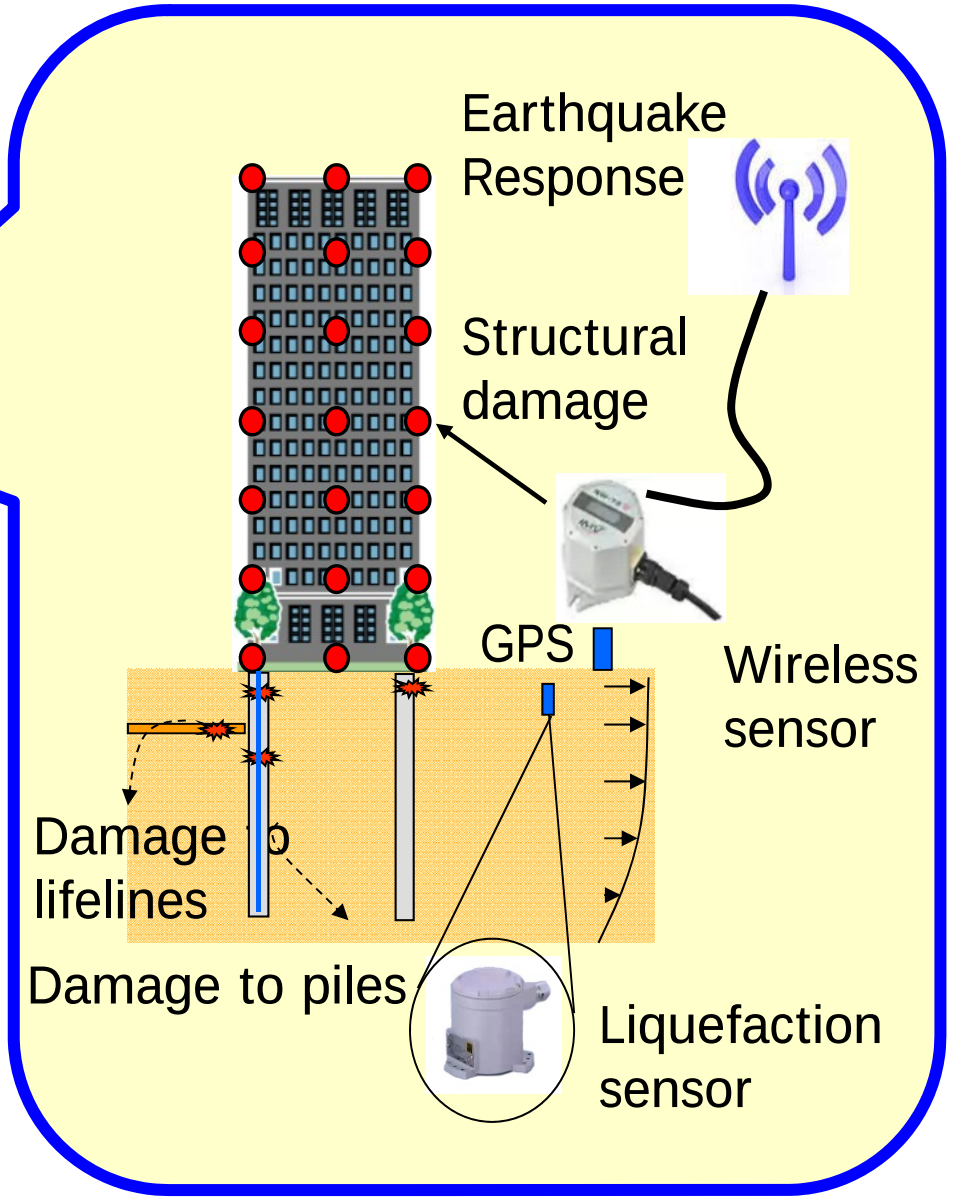
(A) Quantification of collapse margin of high-rise buildings

(B) Monitoring and prompt condition assessment of buildings

Quantification of collapse margin of high-rise buildings



Monitoring and prompt condition assessment of buildings



Research Objectives

Objectives of Research:

① Quantification of collapse margin of urban buildings

①－1: Steel high-rise; ①－2: RC medium-rise

② Monitoring and condition assessment of buildings

②－1: Superstructure; ②－2: Soil and underground; ②－3: Interactive SSI system

③ Monitoring and response evaluation of SSI

③MeSO-net observation

Experiences on “Special Project for Earthquake Disaster Mitigation in Tokyo Metropolitan Area (2007-2011）”

Trans-disciplinary research team that considers “national interest”, “advanced research”, and “timely transfer to practice”

Research Team

Oversight Committee

緑川光正(北大)、西山功(国総研)、北村春幸(東理大)、壁谷澤寿海(東大)、西谷章(早大)、福和伸夫(名大)、中井正一(千葉大)、翠川三郎(東工大)、金箱温春(JSCA)、伊藤優(JSCA)、杉山義孝(建防協)

Headquarters

- DPRI, Kyoto U.
(M. Nakashima, PI)
- E-Defense, NIED
(K. Kajiwara, Vice-PI)
- Kobori Institute
(N. Koshika, Secretary)

Research Team

①-1:S造高層余裕度
責任機関:鹿島（高橋元美、項目代表）
協力機関:清水建設、小堀研、京都大学(吹田啓一郎、部会主査)、防災科技研

①-2:RC造余裕度
責任機関:大林組（勝俣英雄、項目代表）
協力機関:清水建設、京都大学(西山峰広、部会主査)、防災科技研

②-1:モニタリング上部
責任機関:清水建設（斎藤知生、項目代表）
協力機関:鹿島、大林組、名古屋大学(飛田潤、部会主査)、京都大学、防災科技研

②-2:モニタリング地盤
責任機関:大成建設（藤井俊二、項目代表）
協力機関:小堀研、京都大学(田村修次、部会主査)、防災科技研

②-3:モニタリング連成システム
責任機関:小堀研（岡野創、項目代表）
協力機関:京都大学、清水建設、大成建設、竹中工務店、横浜国立大学(楠木浩一、部会主査)、防災科技研

③:MeSO-net観測
責任機関:竹中工務店（小林喜久二、項目代表）
協力機関:東京大学地震研究所(酒井慎一、部会主査)、京都大学、防災科技研

Research Team

Oversight Committee

緑川光正(北大)、西山功(国総研)、北村春幸(東理大)、壁谷澤寿海(東大)、西谷章(早大)、福和伸夫(名大)、中井正一(千葉大)、翠川三郎(東工大)、金箱温春(JSCA)、伊藤優(JSCA)、杉山義孝(建防協)

Head-quarters

・京都大学・防災研究所
(中島正愛、研究代表)
・(独)防災科学技術研究所
(防災科技研)・
兵庫耐震工学研究センター
(梶原浩一、研究副代表)
・(株)小堀鐸二研究所
(小鹿紀英、全体幹事)

①-1: Steel collapse

PI: Kajima (M. Takahashi)
Co-PIs: Shimiz, Kobori, Kyoto U. (K. Suita), E-Defense

①-2: RC collapse

PI: Obayashi (H. Katsumata)
Co-Pis: Shimiz, Kyoto U. (M. Nishiyama), E-Dfense

②-1: Monitoring superstructure

PI: Shimiz (T. Saito)
Co-PIs: Kajima, Obayashi, Nagoya U. (J. Tobita), E-Defense

②-2: Monitoring soil-foundation

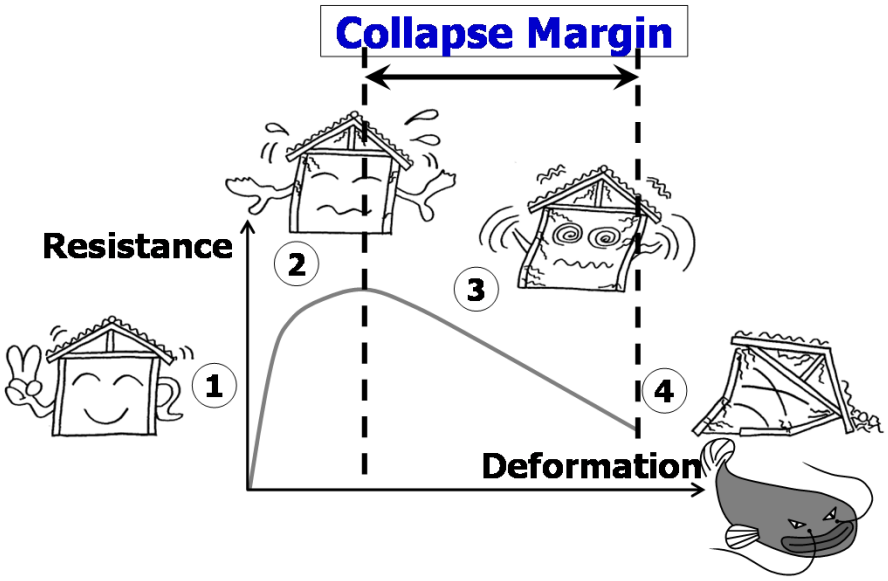
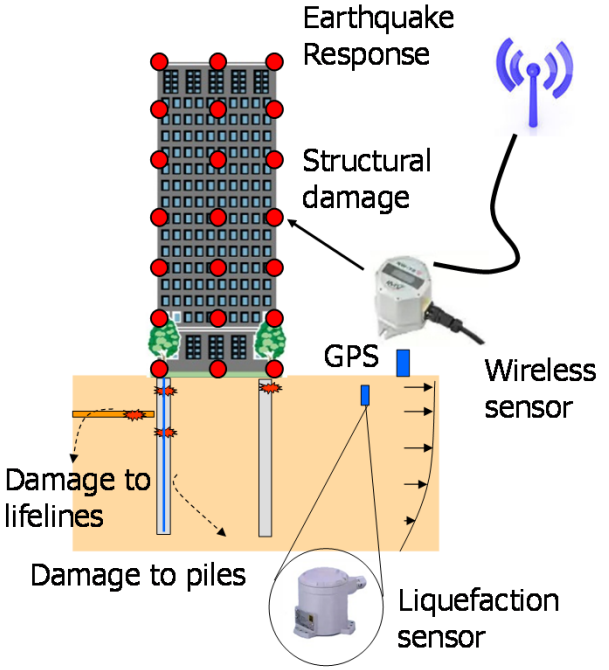
PI: Taisei (S. Fujii)
Co-Pis: Kobori, Kyoto U. (S. Tamua), E-Defense

②-3: Monitoring SSI System

PI: Kobori (H. Okano)
Co-Pis: Kyoto U. Shimiz, Taisei, Taeknaka, Yokohama U. (K. Kusunoki), E-Defense

③: MeSO-net

PI: Takenaka (K. Kobayashi)
Co-PIs: Univ. Tokyo (S. Sakai), Kyoto U., E-Defense

Closure

Japanese earthquake engineering research community tries its best for the protection of human lives from various disasters and the establishment of a safer, securer, and more resilient society by ceaseless exercises of its missions.