

**Fiftieth Anniversary Symposium
of National Science Foundation (NSF) Tokyo Regional
Office**

**An Overview – US-Japan Joint Research
Earthquake Engineering**

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A Partial History of US-Japan on Earthquake Engineering for Past Forty Years

**US-Japan joint Program Utilizing Large Scale Testing Facilities (1975 – 2000)
(Sponsors: NSF and Japanese Ministry of Construction)**

RC buildings (Phase I), steel buildings (Phase II), masonry buildings (Phase III), pre-cast buildings (Phase IV), composite structures (Phase V), and smart structures (Phase VI).

**NEES/E-Defense Project (2005 – 2009)
(Sponsors: NSF and MEXT)**

Two Distinguished Leaders to Initiate and Promote US-Japan joint Program



Joe Penzien
UC Berkeley

Damaging Quakes

1964 Niigata
1968 Tokachi-oki
1971 San Fernando
1978 Miyagiken-oki

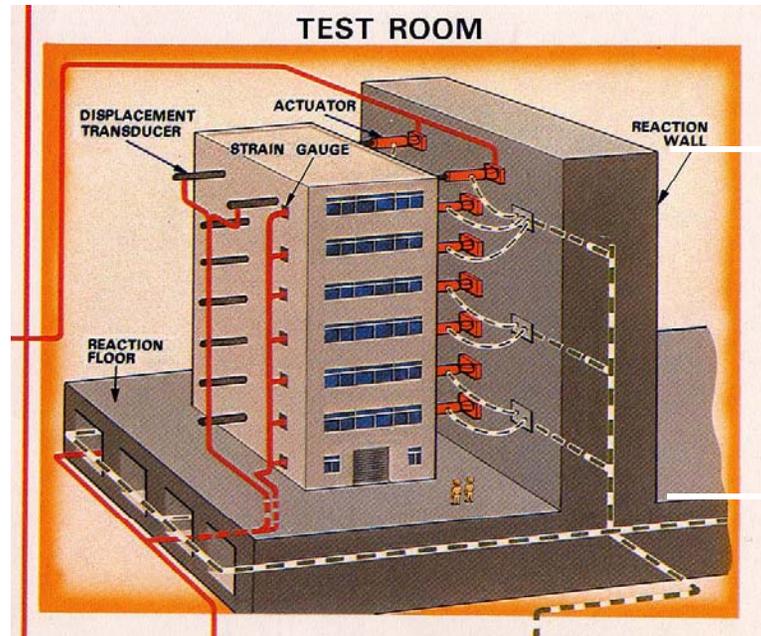


Hahime Umemura
Univ. of Tokyo

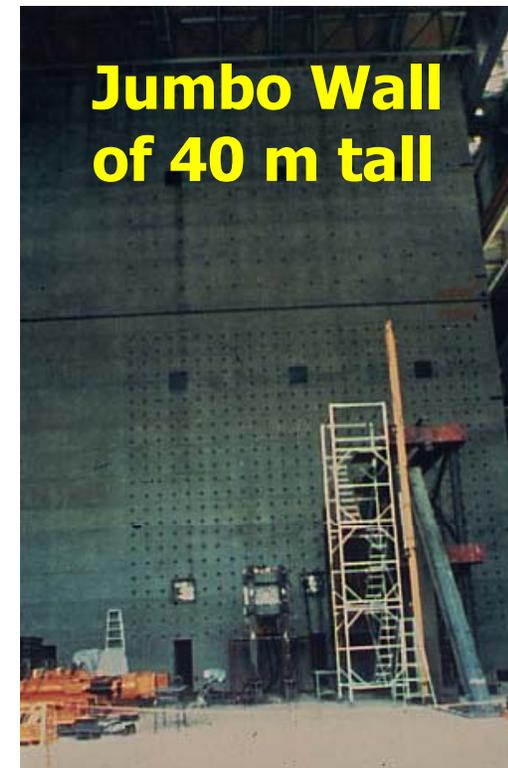
“Ume-san” & “Joe-san” friendship and mutual-trust over many years (with much *Sake*) was the source of US-Japan collaboration.



US-Japan joint Program Utilizing Large Scale Testing Facilities (1975 – 2000)



40 m



Jumbo Testing Facilities at Building Research Institute (built in 1980)

My Juvenile Reminiscence

JTCC (Joint Technical Coordinating Committee) Meeting at Tsukuba



Serious Damage Disclosed in Urban Regions

1994 Northridge



Highways

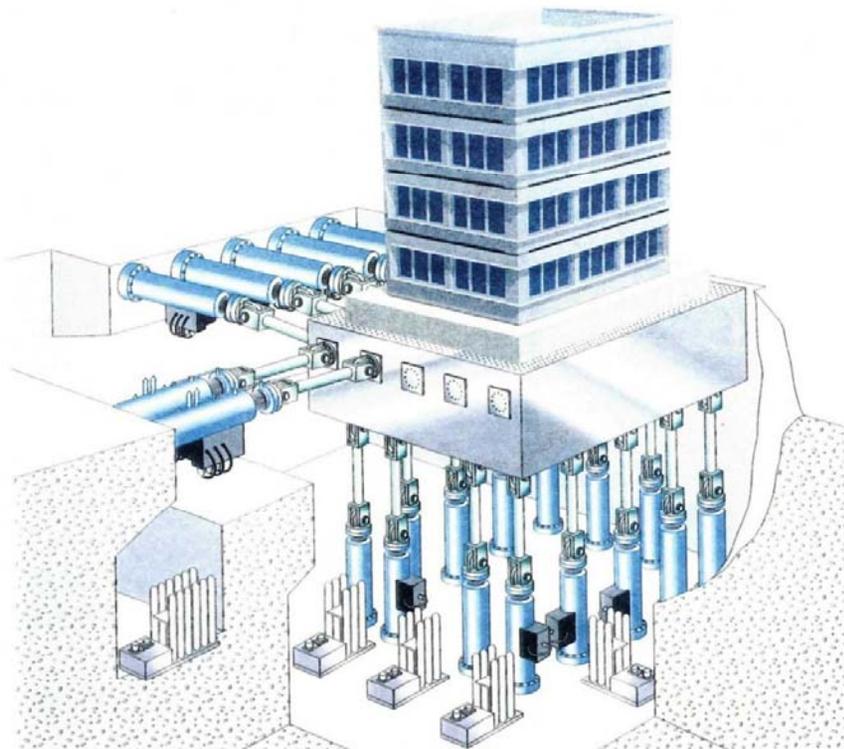
1995 Kobe



Buildings



Construction of Large-Scale Experimental Facilities for Earthquake Engineering Research



E-Defense
Ready in April, 2005



NEES
Ready in October, 2004

NEES/E-Defense Collaboration Memorandum of Understanding (MOU)

**MEXT & NSF (National Science Foundation) :
Research Collaboration on Disaster Mitigation
NIED & NEES (J. Brown Jr. Network for Earthquake
Engineering Simulation) :
Collaboration on Joint Research Using NEES/E-Defense**

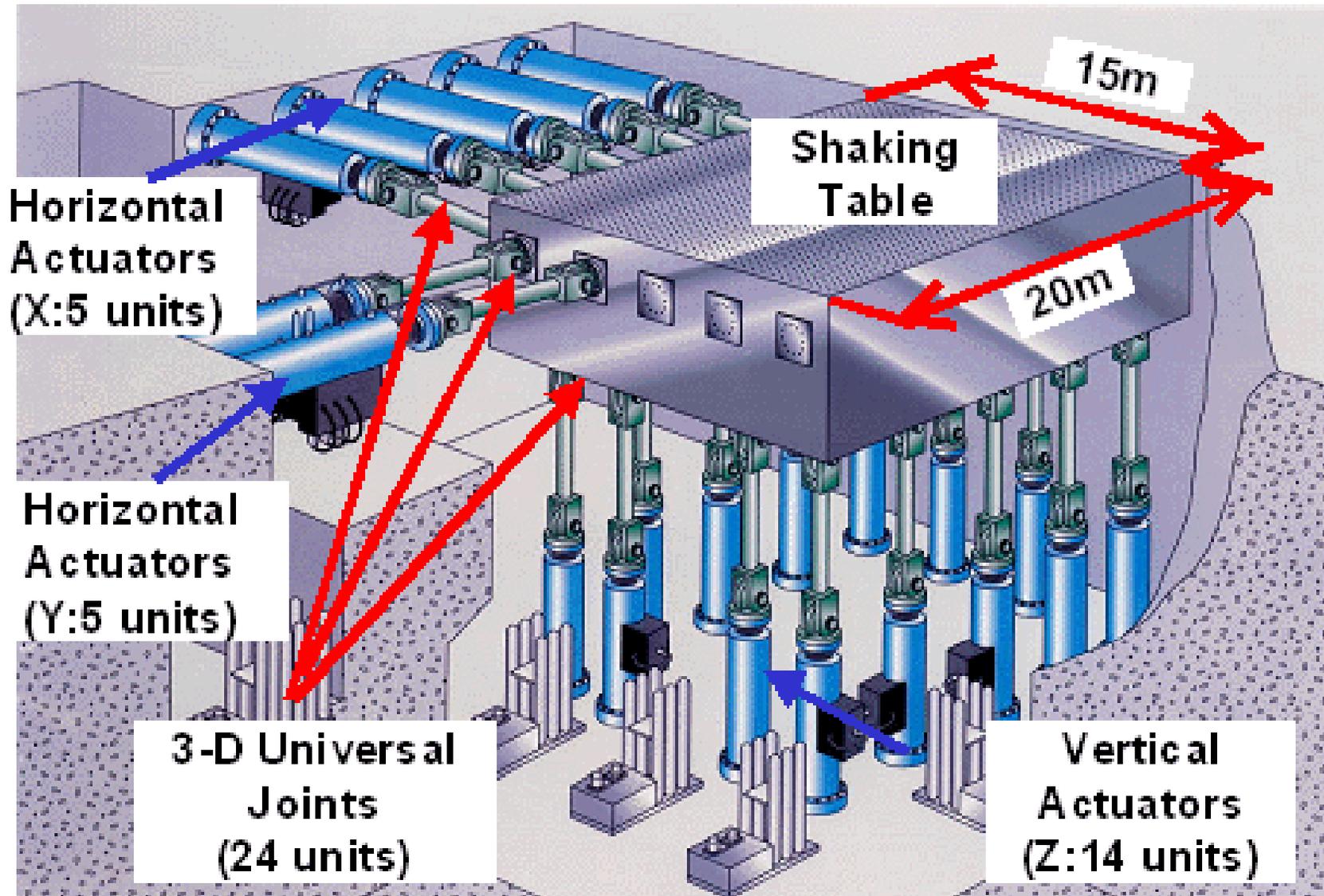


NIED-NEES, August 3, 2005

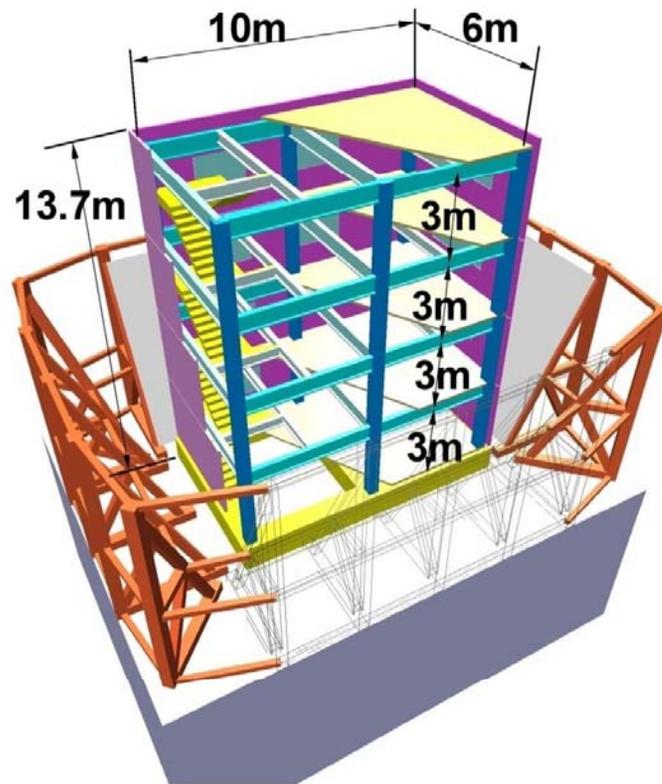


MEXT-NSF, Sept 13, 2005

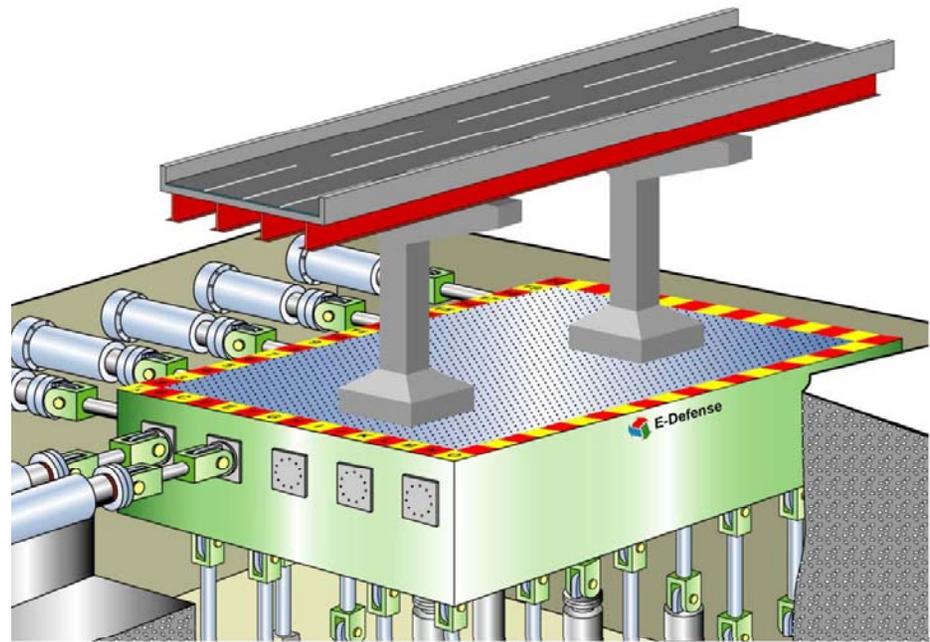
E-Defense Shaking Table and Actuator System



Phase I NEES/E-Defense Collaboration Major Focuses

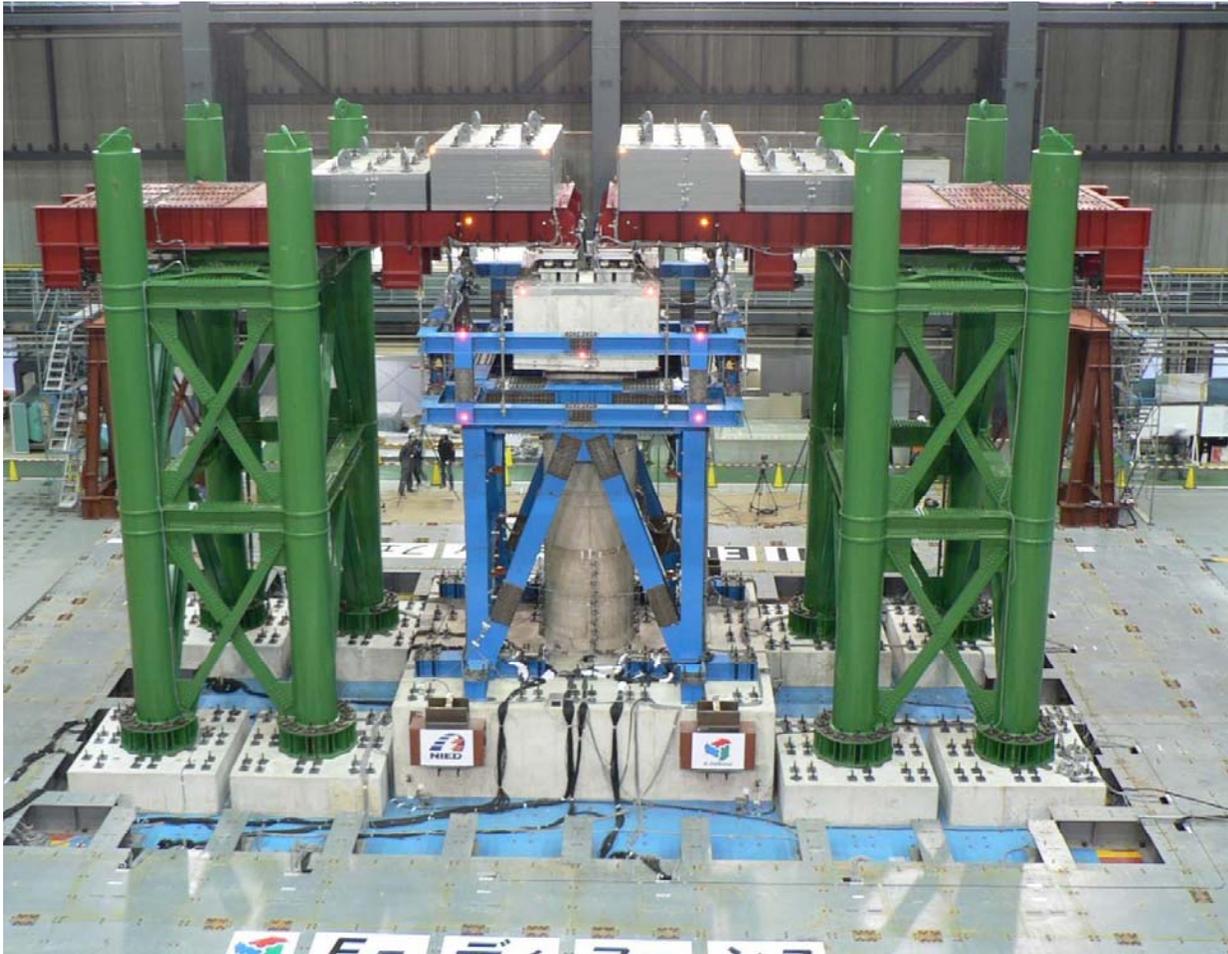


Steel



Bridges

Full-Scale RC Bridge Pier Test

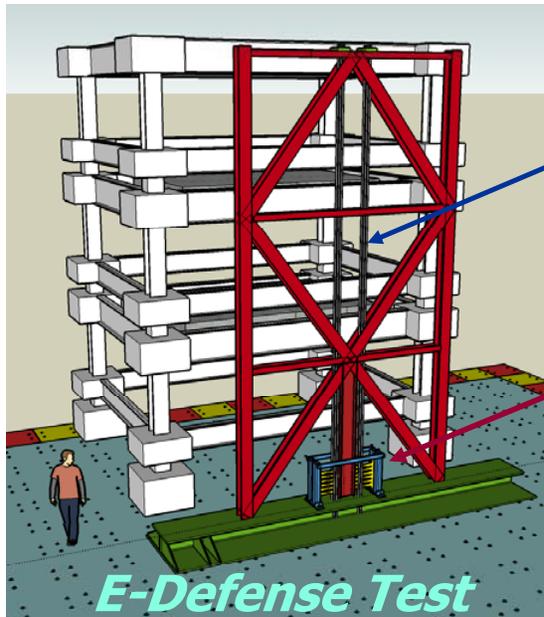


Specimen
Diameter = 1.8 m
Height = 7.5 m
Total Height
= 12 m

C1: old practice, shear

C1: closer view

NEESR: Controlled Rocking Frame System Lead by Greg Deierlein of Stanford Univ.



Active
post-
tensioning

Energy
Dissipati
ng Fuse

- Large-Scale Validation
 - fuse/rocking frame interaction
 - PT, fuses, and rocking details
- Proof-of-Concept
 - constructability
 - design criteria
- Performance Assessment
 - nonlinear computer simulation
 - life-cycle benefit cost analysis

Develop a new structural building system that employs *self-centering rocking* action and *replaceable** fuses to provide safe and cost effective earthquake resistance.

****Key Concept – design for repair***

Lessons Learned from Joint Work

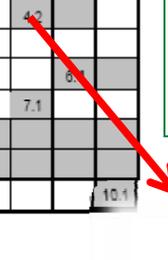
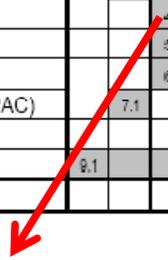
- **Innovative topic that fostered collaboration**
- **Shared institutional commitment and financial support** (NSF, MEXT)
- **Team committed to collaboration**
 - Stanford, UIUC, NIED/E-Defense, Tokyo Inst. of Tech., Hokkaido Univ., and Kyoto Univ., Practicing engineers
- **Extensive student involvement**
- **Fantastic NIED Project Manager (*MVP: T. Hikino*)**
- **Trust, patience and attention to details**



NEESWood: Development of Performance-Based Seismic Design Philosophy for Mid-Rise Woodframes (PI: John W. van de Lindt)

Task	Year 1	Year 2	Year 3	Year 4
1. Numerical Analysis Tools (SAPWOOD)	1.1			
2. Seismic Protection Systems	2.1	2.2		
3. PBD Philosophy	3.1			
4. Testing		4.1	4.3	4.2
5. Societal Risk / Decision Making		5.1		
6. Payload Projects		6.1		6.1
7. Professional Advisory Committee (PAC)	7.1		7.1	7.1
8. International Cooperation				8.1
9. Outreach/Education	9.1			
10. Annual NEES Awardee Meetings		10.1	10.1	10.1

- Full-scale, 17000 sq ft living space
- 4 retail shops at level 1
- 13 families of four (13 two-bedroom units)
- 10 couples or single occupants (10 one-bedroom units)
- 18, 20-ton containers shipped from West Coast to Japan



Validate methodology with Capstone Tests at E-Defense (2009)

**Benchmark Tests
University at Buffalo (2006)**



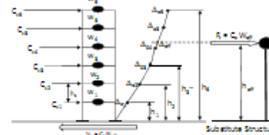
Develop new design approach using results (2007-2008)

Direct Displacement Design (DDD) Procedure

Design Base Shear

$$V_b = C_d W_{eff}$$

$C_d =$ DDD Base Shear Coefficient
 $W_{eff} = 85\%$ of the total weight
 $h_{eff} = 85\%$ of the total height

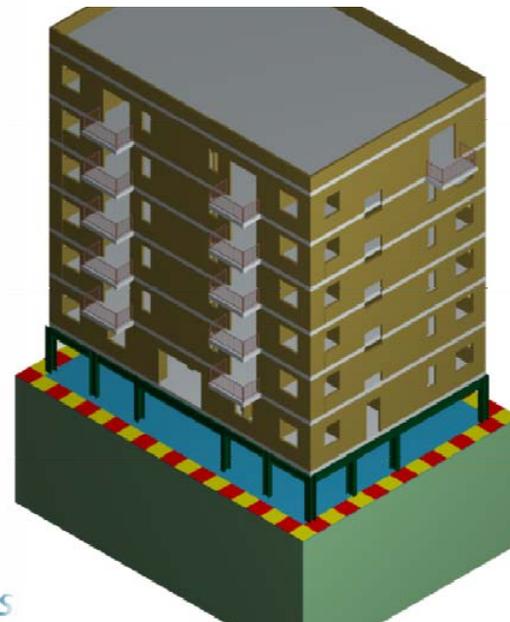
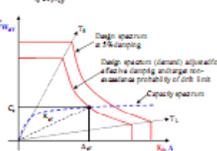


Design Base Shear-to-Total Weight Ratio

Hazard Level	C_d	V_b/W	h_{eff}/H
1	0.140	0.113	n/a
2	0.272	0.221	0.164
3	0.518	0.428	n/a

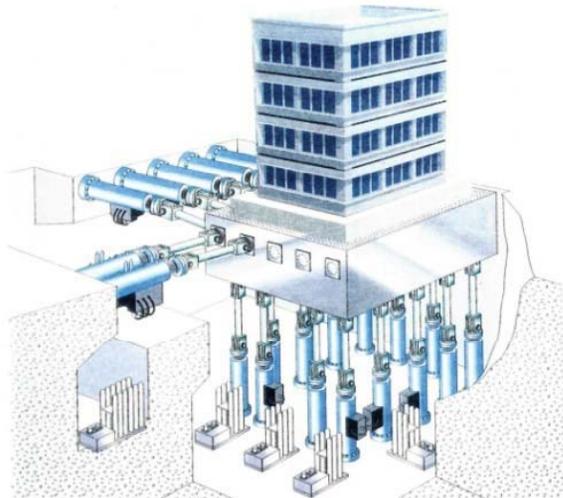
$C_d = 0.81$

NEESWood 00.01.R.0000



Toward Genuine Complementary Efforts Under a Common Umbrella

Resilient City as a Common Meta-Theme



Test on large-scale
theme structures
for final verification



A variety of tests
for examinations into basic
mechanisms and accumulation
of fundamental knowledge

Eighth NEES/E-Defense Planning Meeting September 17 and 18, 2010



**34 participants from the US
32 participants from Japan**



On behalf of the NEES/E-Defense research community, I promise that:

We will continue to work together for many more years for the earthquake disaster mitigation in the US, Japan, and the rest of the world.