February 8, 2005

RESEARCH SUBJECTS OF JAPAN SIDE AND POSSIBLE COLLABORATION WITH U.S.

I. Research Subjects of Japan Side

Key subjects EB, VB, MT, TT, and AS below correspond mostly to those commented by Nakashima and Kasai in San Francisco, June 18th, 2004. Each subject will be presented in the next meeting, February 10th and 11th (6 to 8 min. per subject).

Existing Buildings (EB):

Collapse of a moment frame built in 1981-1998 (EB1, 4-story, full*& reduced scales, 3D tests).
Verification of retrofit scheme (EB2, 4-story, full* & reduced scales, 3D tests), design methods.
Behavior of slab-girder, beam-column and base plate connections, material & weld, effects on collapse.
Behavior of non-structural components (furniture, equipment, cladding, partitions, etc.).
*E-Defense shaking table will be used.

Value-added Buildings (VB):

Verification of damage control* (5- or 6-story, full* & reduced scale, 3D test bed*), design method.
Characterization of devices** (large deformation ranges, realistic loading and boundary conditions)
Behavior of slab-girder, device or brace connections such as gusset plate, loss of device deformation.
Behavior of non-structural components (furniture, equipment, cladding, partitions etc.).
* E-Defense shaking table will be used.
** steel, viscous, viscoelastic, and oil dampers, possibly natural rubber isolators*** etc.
*** long period ground motions for the building model with isolators.

Measuring Techniques (MT)

Displacement sensor (low cost, long stroke, high precision, contact and non-contact types)
Data acquisition system (efficient interface, such as rapid data check, and transmission through IT*)
Health monitoring and condition assessment* (network and algorithms, application of SensorGrid).
* Planned collaboration with Prof. Mita's IT group

Testing Techniques (TT):

Distributed hybrid testing by Internet linkage.
Hybrid simulation between numerical analysis and physical test.
3D testing of subassembly by predetermined dynamic loading and/or pseudo-dynamic loading

Analysis and Simulation (AS):

High-fidelity collapse simulation for EB (modeling members, connections, slabs, etc).
High-fidelity damage control simulation for VB (using displacement- or velocity-dependent devices).
Verification and comparison (OpenSees, commercial program, simplified program, and others).
Blind performance prediction for EB and VB (prior to E-defense shaking tests and others).
Efficient algorithm and process (user-interface*, parallel computing, structural optimization, etc.)
* Planned collaboration with Prof. Mita's IT group

II. Possible Collaborations with U.S. Researchers

These are suggested by the Japanese members, and more would come out from the discussions between US and Japan sides in SF.

Correlative collapse experiments using reduced-scale specimens, see 1980's US-Japan research on 1/12 model by Krawinkler, and 1/3.3 model by Bertero.
Performance of heavy rolled sections and welds in US (short to tall bldgs.) and Japan (tall bldgs.).
Failure of column base plate and its effect on collapse.
Comparative study on details, materials, and design of short buildings.

Validation/calibration of OpenSees, commercial programs, and others for simulating collapse.
Comparative study and assessment on accuracies of various computer programs.
New simplified analysis methodology for simulating collapse for design purpose.
Detailed and simplified analysis methods for slab-girder interaction.

Internet-based collaboration for analysis and testing by using Japanese analysis programs.
Development of parallel-processing computation scheme for structural analysis and hybrid testing.
Detailed and simplified analysis of passive control device as well as system.
Incorporation of passive device elements into general-purpose analysis software.

Optimization of damper distributions throughout the building height based on simplified analysis.
Performance-based design of passively controlled or base-isolated buildings.
Long-term cost performance study of VB, nonstructural component responses.
Effect of long-period ground motion on tall buildings or base-isolated structures.
Accurate estimation for damping provided by energy dissipative members considering its deformation loss caused by flexibility of connection and/or supporting members.
Monitoring and identification of damping ratio, vibration period, and damage of nonlinear structures with or without supplemental energy dissipation (typically non-classical damping)
Performance assessment for velocity-dependent dampers against frequently occurring minor shaking.
Device and connection testing with 3-D motion and realistic B.C.

Three-dimensional displacement-measurement devices and techniques of low cost and accuracy (contact and non-contact types)
Efficient data-processing and checking procedures for a large number of records.
Real-time transfer and off-site monitoring of full-scale test data of a large size.

Pre-test analysis competition for simulating instability and collapse of a simple cantilever column.
Pre-test analysis competition for simulating connection failure and collapse of full-scale frame.
Pre-test analysis competition for simulating responses of retrofitted moment resisting frames
Pre-test analysis competition for simulating damping and responses of passively controlled buildings
Pre-test analysis competition for simulating responses of various non-structural components.