



NEESR-GC: Simulation of the Seismic Performance of Nonstructural Systems
Kick-off meeting, February 18, 2008
University of Nevada, Reno

ANSWERS TO THE QUESTIONS SUBMITTED TO THE PROJECT ADVISORY BOARD

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1. The project team is aware of the need and has planned to collaborate with the ATC 58 Nonstructural Performance Product (NPP) team in order to produce fragility data. What other *needs and opportunities* exist such that research results from this project will improve the current practice in the area of ceilings, piping and partition seismic performance?

In addition to ATC-58 there is a good opportunity for this project to have an impact on seismic provisions of ceilings, piping and partition systems. In particular, results from this project could serve to significantly improve NEHRP provisions and from there to ASCE-7. Results from this project can also have a direct impact on OSPHD practice with hospitals in California, especially for projects related to the SB 1953.

Important needs: defining current design/practice (UBC, IBC, NFPA-13, etc.) for both as-built and for new construction, development of code detailing requirements for partition walls,

Other unique opportunities exist in the area of improving public awareness and public policy (e.g., extension of SB 1953 in California to hospitals in other states and to federally owned, other essential facilities, and other public buildings).

2. The research plan has flexibility to allow testing of a variety of details and configurations for both the subsystem and system experiments, within the allocated budget. Since the subsystem experiments will begin soon, are there specific configurations and/or details of ceilings, pipes and partitions that the board recommend be considered for testing?

I believe it is particularly important to start out by characterizing the mechanical characteristics of components/hardware used to connect these systems to the structure (bolts, anchors, wires, hangers, rods, struts, trapezes, etc) and well as the mechanical characterization of components used to build the ceilings, piping and partition systems (e.g., cold formed steel studs, T-bars, pipes, sprinkler heads, etc.). A second stage could be independent systems (ceilings alone, partitions alone, piping systems alone). A third could involve the combined systems to look at their interaction.

Ceiling system test should be as complete as possible considering the many subsystems that are typically involved (HVAC ducts, lighting, sprinklers, cables ducts,

drainage/plumbing, dampers with breakaway connectors, etc.). These should consider evaluation of prescriptive limits (elements requiring bracing, short lengths not requiring bracing, pipe sizes, ceiling area, minimum weights, spans between bracings, requirements of heavy duty grid systems, etc) and their impact on fragility. There is an increasing use of isolated wall systems (rubber on top of the upper track) for sound isolation purposes. We know nothing about their seismic performance.

It is important to also look at partitions that stop at ceiling level.

Before finalizing piping systems to be tested it is important to review prior testing/work (EPRI/SQUG, DOE/National Labs such as Savannah River).

3. Are there any recommendations on how the planned Public Policy studies can further improve the impact they will have on the implementation of the project results?

In terms of public policy and public awareness it is particularly important to look into the importance of inspection and adequate implementation of standards and the social implications of not doing it. Improving current practice on the adequate installation of these systems could be a huge contribution of this project.

Examining current distribution of cost, responsibility and liability in the design, installation and maintenance of these systems is important as well as to examine improve schemes as well as incentives to improve current practice and enforcement (perhaps through changes in insurance practice?).

What is the current “standard of care”?

Examine how to change the current culture and practice of design and delivery of nonstructural components.

There should be some independent evaluation of level of enforcement of various levels of government other than self-reported levels/quality of enforcement through interviews.

Identification of good practices of improved enforcement (e.g., creation of checklists). For example, City of St. Louis. Examine the role of Fire Marshalls in enforcement of NFPA requirements of fire sprinklers as compared to enforcement of building code requirements by building inspectors.

4. Can the board provide recommendations regarding the analytical modeling of ceiling, piping and partitions that will be undertaken in this project (e.g. level of sophistication, linear or nonlinear modeling, interaction with structural systems, etc.)?

The current description in the proposal is very brief, so I do not know a lot of the details. With that in mind, I believe that the mechanical characterization of components/hardware used to connect these systems to the structure (bolts, anchors, wires, hangers, rods, struts, trapezes, etc. obtained from simple experiments (mentioned above in question 2) could provide the basis for developing new elements in OpenSees using a combination of existing and new materials. These new elements could then facilitate the simulation of these systems.

The modeling should be as simple as possible to capture the essence of the behavior.

The analytical modeling should be able to answer questions such as “How much do we decrease/modify the fragility by adding this brace?, by making this connection stronger, by changing the type of connection, etc?”

5. Are there elements of the simulation-visualization tools related to Ceiling/Piping/Partition modeling that the advisory board feels would be particularly useful for practice?

It would be particularly useful to develop practical elements and tools (say in OpenSees, Matlab, etc) that in the future can be implemented in conventional structural analysis tools (Etabs, SAP, etc).

To integrate BIM-type tools (3D visualization models) to possibly identify interaction (gaps/pounding) in ceiling/piping/partition (the petrochemical industry has been using BIM-type models for 20 years).

6. In the view of the advisory board, what is the “biggest breakthrough” that can be created in this the project?

Bringing the importance of nonstructural components to a higher level in the building industry (structural engineers, architects, manufacturers, subcontractors, owners, insurance industry, governments, etc.). A particular important aspect is the definition of the role/responsibility of design and installation of nonstructural components, changing the current culture and practice. In current practice, the professionals involved in seismic design of buildings (structural engineers) are typically either not involved or only have a very limited role in design of nonstructural components or on their anchorage to the structure. The project could result in: improved codes, improved cost-effectiveness, improved standard of care, better enforcement of codes, better installation, better loss estimation, resulting in more resilient buildings, communities, metropolitan areas.