ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

Washington Office
101 Constitution Ave., N.W.
Suite 375 East
Washington, D.C. 20001
(202) 789-7850
Fax: (202) 789-7859
Web: http://www.asce.org

Statement of Chris Poland, P.E., S.E., FSEAOC, NAE

for the hearing entitled

"*Are We Prepared? Assessing Earthquake Risk Reduction in the United States*"

Before the

Subcommittee on Technology and Innovation

of the

Committee on Science, Space, and Technology

U.S. House of Representatives

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Mr. Chairman and Members of the Committee: I am Chris Poland and I am testifying on behalf of the 140,000 members of the American Society of Civil Engineers (ASCE). At ASCE, I am Chairman of the Infrastructure and Research Policy Committee. Additionally, I serve as Chairman, Degenkolb Engineers; and I serve as Chairman of the National Earthquake Hazards Reduction Program (NEHRP) Advisory Committee.I am registered civil and structural engineer, and have worked for more than 35-years as an advisor on government programs for earthquake hazard mitigation and in related professional activities.

My professional experience includes projects of all construction types, ranging from new design to seismic retrofit and rehabilitation and historic preservation. I was the founding co-chair of the NEHRP Coalition for Seismic Safety and chaired the ASCE Standards Committee on Seismic Rehabilitation and the U.S. Department of Veterans Affairs Advisory Committee on Structural Safety. I am a member of Boards of the San Francisco Chamber of Commerce and the San Francisco Planning and Urban Research Association and elected as a member of the National Academy of Engineering in recognition of my career long work in support of Performance Based Earthquake Engineering. I served on the Board of the Earthquake Engineering Research Institute (EERI) for 10 years in two separate roles, first as the Secretary and then as the President from 2001 to 2002.

ASCE, founded in 1852, is the country's oldest national civil engineering organization representing more than 140,000 civil engineers in private practice, government, industry and academia dedicated to the advancement of the science and profession of civil engineering. ASCE is a 501(c)(3) non-profit educational and professional society. Research in civil engineering, properly conceived, conducted and implemented, should assure significant advances in the quality of life of individuals by providing essential service with minimal adverse effects on the environment by applying the principle of sustainable development and disaster resilience.

ASCE is pleased to offer this testimony before the Technology and Innovation Subcommittee on the House Science, Space and Technology Committee on the hearing, "*Are We Prepared? Assessing Earthquake Risk Reduction in the United States".*

Shift from Safety to Resilience

During my career as a Structural Engineer and Earthquake Professional, the focus and goal of seismic design work has undergone a radical change. As the result of the damage and economic impact that occurred during major earthquakes and other natural disasters over the past 20 years, the primary goal of hazard reduction has shifted from one aimed at protecting people to one that also seeks to protect the built environment to the extent necessary to allow rapid recovery. This transition brought with it the need to design portions of the built environment to be immediately usable without interruption, other portions to be usable while being repaired, and the majority to be usable after repair. This change in performance expectation is often referred to as a change from a *life safety* goal to a *resilience* goal. Achieving this goal is the focus of the current strategic plan for the National Earthquake Hazard Reduction Program (NEHRP 2008). This is new territory and the basic research, applied research, and guidelines that are needed for success are in a formative stage.

It also must be recognized that resilience is not just about the built environment. It starts with individuals, families, communities, and includes their organizations, businesses, and local governments. In addition to an appropriately constructed built environment, resilience includes plans for post event governance, reconstruction standards that assure better performance in the next event, and a financial roadmap for funding the recovery. This new style of planning and implementation must be tailored to the socioeconomic and cultural aspects of each community. Resilient communities form resilient regions and states which in turn will create a resilient nation. While the nation can promote resilience through improved design codes and mitigation strategies, implementation and response occur at the local level. Making such a shift to updated codes and generating community support for new policies are not possible without solid, unified support from all levels of government.

The federal government needs to set performance standards that can be embedded in the national design codes, be adamant that states adopt contemporary building codes including provisions for rigorous enforcement, provide financial incentives to stimulate mitigation that benefits the nation, and continue to support research that delivers new technologies that minimize the cost of mitigation, response, and recovery. Regions need to identify the vulnerability of their lifeline systems and set programs for their mitigation to the minimum level of need. Localities need to develop mandatory programs that mitigate their built environment as needed to assure recovery. (ACEHR 2009)

Are we prepared?

No.

The vast majority of our building stock and utility systems in place today were not designed for earthquake effects let alone given the ability to recover quickly from strong shaking and land movement. Earthquake Engineering is a new and emerging field and only since the mid 1980’s has sufficient information been available to assure safe designs. Design procedures that will assure resilience are just now being developed. Strong, community destroying earthquakes are expected to occur throughout the United States. In most regions outside of California, little is being done about it. While modern building codes and design standards are available, they are not routinely implemented on new construction or during major rehabilitation efforts because of the complexity and cost. Many communities do not believe they are vulnerable and if they do accept the vulnerability, find the demands of seismic mitigation unreachable.

The problem of implementation and acceptance does not just lie with the public, but also with the earthquake professionals. Because this is an emerging area of understanding, conservatism is added whenever there is significant uncertainty. Earth Science research has made great strides in identifying areas that will be affected by strong shaking. Unfortunately, each earthquake brings different styles of shaking and building performance. This leaves many structural engineers generally uncertain about what causes buildings to collapse, and unwilling to predict the extent of damage that will occur, let alone whether a building will be usable during repairs or if lifeline systems can be restored quickly enough. Resilience demands transparent performance and significant earthquake science and earthquake engineering research and guideline development is needed to bring that ability to communities.

Recommend areas that need Federally Sponsored Research

The NEHRP was originally conceived to provide the knowledge, tools, and practices needed for earthquake risk reduction and has steadily made progress toward that goal. Many argue that the research that is needed to assure safety is complete. While that is debatable, it is certainly not the case for the research and tools needed to provide resilience. The 2009-2013 NEHRP Strategic Plan represents a broad-based and comprehensive statement of what activities are needed to achieve resilience through basic research, development of cost effective measures to reduce impacts, and sponsorship of implementation programs at all levels. It was developed over a three year period with input and review by the earthquake professional community and represents consensus about what needs to be done by the Federal Government through the core Federal Agencies.

Last Week, the National Research Council of the National Academies (NRC 2011) released a study that recommends a road map of national needs in research, knowledge transfer, implementation, and outreach that will provide the tools needed to implement the NEHRP Strategic Plan and achieve its vision of a nation that is earthquake resilient in public safety, economic strength, and national security. The NRC study stands on a foundation of numerous similar reports that have been produced over the past 20 years and have persistently outlined what is needed. The list of references in the NRC report includes a complete listing of the available studies and recommendations. The list of needed activities is comprehensive, and the extent of work needing to be accomplished is long. It is an outstanding list of what can be done and what eventually needs to be done. The nation needs to continue stepping toward resilience, and the goals objectives and tasks outlined in the NEHRP Strategic Plan need to be achieved. The reauthorization of the NEHRP program is a mandatory minimum step to maintain the momentum that has been developed. Accelerating the pace of achieving the goals of that plan will bring many benefits and the value is well documented.

Key areas in need of improvement that are supported by the Federal Government

The NEHRP Strategic Plan is recognized as an appropriate plan for achieving national resilience. The NRC Road Map is a detailed assessment of what needs to be done in the next 20 years to implement the plan. As a practicing Structural Engineer and Earthquake Professional, I recognize the need for every effort and my clients will benefit significantly from the resulting work. From my perspective, they are all a part of the following four key areas that must benefit from federally supported research if we are to have the knowledge and tools to become resilient:

1. **Comprehensive worldwide monitoring and data gathering related to earthquake intensity and impact.**
   Extensive instrumentation is needed to adequately record the size and characteristics of the energy released and the variation in intensity of strong shaking that affect the built environment. We are lucky if we obtain a handful of records for entire cities but in reality thousands are needed to record the dramatic differences that occur and to understand the damage that results. In addition, the geologic changes that occur due to faulting, landslides, and liquefaction need to be surveyed, recorded, and used to understand the future vulnerability of the built environment to land movement. A network of observation centers is needed to record, catalogue and maintain information related to the impacts on society, and the factors influencing communities' disaster risk and resilience. At present, earthquake engineering is based more on anecdotal observations of damage that are translated into conservative design procedures without the benefit of accurate data about what actually happened. In my mind, expanded monitoring is the single most important area that will reduce the cost of seismic design and mitigation that will allow us to achieve greater resilience.

2. **Overarching Framework that defines resilience in terms of Performance Goals**
   Resiliency is all about how a community of individuals and their built environment weather the damage, respond and recover. It is more about improvisation and redundancy than about how any single element or system performs. Buildings and systems are designed one structure at a time for the worst conditions they are expected to experience. This approach worked well when life safety was the goal, and there was no need to consider the overall performance of the built environment. Resiliency, however, demands that performance goals and their interdependencies are set at the community level for the classes of structures and systems communities depend during the recovery process.

   Facilities providing essential services during post earthquake response and recovery must function without interruption. Electric power is needed before any other system can be fully restored. Emergency generators can only last a few days without additional deliveries of fuel. Power restoration, however, depends on access for emergency repair crews and their supplies. Community level recovery depends on neighborhoods being restored within a few weeks so the needed workforce is available to restart the local economy. People must be able to shelter in place in their homes, even without utilities, but cannot be expected to stay and work after a few days without basic utility services. To ensure that past and future advances in building, lifelines, urban design, technology, and socioeconomic research result in improved community resilience, a framework for measuring, monitoring and evaluating community resilience is needed. This framework must consider performance at various scales—e.g., building, lifeline, and community—and build on the experience and lessons of past events.

Only the Federal government can break the stalemate related to setting performance goals that if left alone will eventually cripple the nation.

3. **Social Science Research to quantify the role of improvisation and adaptation, how decisions are made at all levels and the need for rehabilitation.**
   American cities are an eclectic collection of buildings and lifeline systems built over the life of a city. The vast majority were built before adequate design codes and standards were available to assure the needed durability and performance. Achieving earthquake resilience requires a community-based, holistic approach that includes decisions and actions that are based on overarching goals, a clear understanding of the built environment, rapid and informed assessment data, and planned reconstruction and recovery.

   Communities build based on traditional standards and when affected by major earthquakes respond and recover based on intuition, improvisation, and adaptive behaviors that are drawn from the individuals available to participate. The lessons learned in one community and event rarely translate to the next community affected. In a perfect world, all buildings and systems could be rehabilitated to the needed level to assure resilience. In reality, the majority will not be rehabilitated unless financial incentives are provided. Such incentives are only appropriate and affordable when the subsequent action will contribute to a community's resilience. Only through social science research will the balance between mitigation and response be understood.

4. **Performance-Based Earthquake Engineering design tools**
   Earthquake engineering is done every day based on the available building codes, design standards, industry best practices and intuition of the nation's earthquake professionals. Engineers traditionally have not been asked to disclose how buildings will perform, only whether or not they "meet the code". For most buildings, that means nothing with regard to their safety or usability after a major event.

   For the past decade, engineers have been developing performance-based standards, but these early efforts are severely limited by insufficient data on building performance, insufficient analysis tools to predict performance, and inadequate training in the new techniques that are under development. New standards that support resiliency are needed throughout the seismic regions of the nation and need to be included in the development of national design and rehabilitation codes. Basic research, extensive full scale testing, applied research and implementation programs are needed to make the necessary seismic mitigation efforts affordable and cost effective.

Summary

In conclusion, ASCE supports research, practices and policies that identify earthquake hazards and mitigate earthquake risks, including:

- Continuance and expansion of the National Earthquake Hazards Reduction Program (NEHRP) and similar initiatives.
- The use of state-of-the-art performance standards for existing critical, essential, educational and disaster-recovery facilities, such as hospitals, schools and emergency shelters.
- Targeting buildings that are likely to collapse in major earthquakes for mandatory retrofit, reduced occupancy, reconstruction or demolition.
- Improvements of collaborative community preparedness and their related civil infrastructure with vulnerable regions so that they are economically resilient to earthquake hazards.
- Development of nationally accepted consensus-based standards for evaluation and retrofit of existing buildings;
- Development of national seismic standards for new and existing lifelines.
- Improvement of seismic mitigation applications focusing on low cost techniques; and
- Improvement of large risk mitigation programs at organizations, including at state Departments of Transportation, and at utilities.

Thank you for the opportunity to present our views, I would be happy to answer any questions you might have and to provide the Committee with further information.

References

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