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Testimony before the Congress of the United States
House of Representatives
Committee on Science, Space, and Technology

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Consulting Engineer, NIST Community Resilience Fellow
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On behalf of the
American Society of Civil Engineers

May 31, 2018
Huntington Beach, California

Summary of Testimony

Over the past 40 years, the National Earthquake Hazard Reduction Program (NEHRP) has sponsored extensive research addressing all facets of earthquake science and engineering including characterizing the prevalent seismic hazards threatening the nation, monitoring programs to determine the frequency and severity of strong shaking, sponsoring the on-going development of hundreds of design guides and standards for buildings, and assisting states with preparedness and mitigation activities. Its fundamental strength rests in its longevity, continuous funding, and the cooperative efforts of the four NEHRP agencies; the National Institute of Standards and Technology (NIST), the United States Geological Survey (USGS), the Federal Emergency Management Agency (FEMA), and the National Science Foundation (NSF). As both a leader in NEHRP and a consumer of this information in my engineering practice for over 40 years, I can say without reservation that the program is a success, fulfills a critical need, and has made great strides in advancing the science and engineering related to earthquakes. The nation is significantly better prepared to deal with the impact of strong earthquakes because of the NEHRP.

Unfortunately, the program has not yet accomplished all that was envisioned due to chronic underfunding of the four NEHRP agencies. The program has also not been reauthorized since 2004 and annual appropriations equal less than a third of the needed $306.5 million annually recommended by the National Research Council in 2011. Together, these issues have weakened the program's overall effectiveness in the recent past and going forward. This comes at a time when the nation's earthquake risk continues to grow due to population growth, urban development, and the deteriorating condition of the built environment, (ACEHR 2017).

Since the last re-authorization of NEHRP in 2004, the focus of earthquake engineering has broadened from concentrating on the design and construction of individual buildings and infrastructure systems to also include an assessment of what is needed to make communities more resilient—the ability to rapidly recover from a severe seismic shock. This broadened focus challenges NEHRP to expand its research programs to include the characterization of community specific hazards, complete our seismic monitoring capabilities, and address the socioeconomic and cultural aspects and needs of the United States. New performance-based guidelines and standards that consider the social and economic needs of communities and the performance of buildings and lifeline infrastructure systems (power, transportation, communication, water and waste water systems) needed for rapid and efficient recovery need to be developed. Congress needs to broaden NEHRP and provide sufficient funding to protect the lives, property, and prosperity of the American people (ACEHR 2010). The current bi-partisan Senate bill, S. 1768 the National Earthquake Hazards Reduction Program Reauthorization Act, includes these critical additions to NEHRP.

Founded in 1852, ASCE is our nation's oldest civil engineering organization representing more than 150,000 civil engineers in private practice, government, industry and academia. ASCE is a 501(c)(3) non-profit educational and professional society.

Written Testimony

Chairman Smith and honorable members of the committee, thank you for the opportunity to speak here today on behalf of the American Society of Civil Engineers (ASCE) about the need to re-authorize the National Earthquake Hazard Reduction Program (NEHRP). My name is Chris D. Poland. I am a licensed Civil and Structural Engineer with over 40 years of experience in structural and earthquake engineering and a NIST Community Resilience Fellow. My testimony also represents the interests of the Earthquake Engineering Research Institute (EERI) where I currently serve as the Public Policy Advisory Committee Co-chairman. EERI, ASCE, the Seismological Society of America, and others in the earthquake community were active contributors to S. 1768.

Defining and achieving a disaster-resilient nation is at the heart of my technical interests and the main focus of my endeavors related to advancing the profession. My activities are focused on public safety related to earthquakes, earthquake engineering, and community resilience. My efforts began by helping professional society committees write seismic codes for buildings and other structures, and quickly grew to include leadership positions in many of the related professional societies. In addition to my professional practice in structural engineering, I have participated in a wide variety of research projects that have led to new processes and procedures, design guidelines, and standards that are cited by building codes. Since 2004, my efforts have taken on a broader perspective that reach beyond the technical aspects of earthquake engineering to include understanding public policies aimed at disaster resilience. By working with the business community, public policy groups, and becoming a vocal advocate for disaster resilience at the local level, I helped start the conversation for how to achieve a disaster-resilient San Francisco that has led to my active participation in the NIST Community Resilience Initiative as a Community Resilience Fellow. That initiative has generalized the process so that it applies to all hazards affecting all regions of the nation.

The NEHRP now embodied in the Public Law (42 USC 7701 *et.seq*) remains a solid foundation for the continued advancement of seismic safety and resilience for the nation. It clearly recognizes the nationwide vulnerabilities, the potential for loss of life, injury, destruction of property and the need for and benefits of developing federally sponsored earthquake hazard reductions measures. The NEHRP purpose is to reduce the risks of life and property from future earthquakes. The program' objectives include educating the public, developing design and construction methods, characterizing seismic hazards, developing model building codes, disseminating methods for mitigating risks, and developing ways to assure the availability of earthquake insurance.

Through the re-authorization process, the law needs to be amended to recognize that the built environment in earthquake-prone regions of the nation has been generally designed and constructed to protect human life without consideration of the time it will take to repair and recover from the damage. The law also must recognize that authorization levels need to be set in recognition of the $306.5 million annual need established by the National Research Council Report *Strategic Plan for the National Earthquake Hazard Reduction Program* (NRC 2011). The

reauthorization should also broaden the program's objectives to focus on creating a built environment that supports community resilience through the development of performance-based design codes, guidelines and tools based on acceptable recovery times that have been established for the functions they serve.

The NEHRP programs that are now in the law need to be continued as the new demands of community resilience are added. The term "community resilience" means the ability of a community to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. Resilience starts at the local level, with individuals, families, and businesses, and the resilience of the built environment is part of the challenge. Resilience must also encompass the socio-economic and cultural aspects and needs of communities. (ACEHR 2010).

To address the broader focus on community resilience, NEHRP should be re-authorized to include the following.

1. **Identification of the gaps in seismic safety and community resilience through a nationwide risk assessment.**

   Broadening the NEHRP to address community resilience in a comprehensive way requires an enhanced level of collaboration among the NEHRP agencies. As the concepts of community resilience have developed over the past 10 years, various efforts have been added to the Agency programs, though not necessarily in a collaborative manner. To move forward in an efficient manner, a fundamental assessment of the nation's earthquake risk reduction process must be conducted to identify the gaps in knowledge, implementation, and mitigation activities that are delaying the improvement of national earthquake resilience. The assessment should be comprehensive and address the steps currently being taken by government at all levels and the private sector related to the built environment as well as efforts to address the potential social and economic impacts. This assessment will refine the direction of the program going forward, stimulate collaborative efforts between the agencies, establish the needed funding levels, and the need for additional statutory responsibilities (ACEHR 2015).

2. **Development of community based seismic hazard maps defining the potential for strong shaking, faulting, landslides, and liquefaction on a community scale.**

   Under the leadership of USGS, the earth science community has developed a scientifically defendable characterization of the seismic hazards across the United States. This is one of the most significant contributions by NEHRP to the seismic design of the built environment. This process is ongoing and needs sufficient funding to continue to refine the understanding and characterization of earthquakes. Those efforts will impact the design and rehabilitation of every element of the built environment and are needed to reduce uncertainty and improve cost expectations.

Earthquake characterizations are available now to support the work of earthquake engineers related to individual projects but generally not available to communities in map form (Geographic Information Systems (GIS) based). Community resilience planning for earthquakes is best served by understanding the seismic hazards (strong shaking, faulting, landslides, and liquefaction) in the community on a block by block basis (NIST GB 1 2016). The needed GIS databases and maps are available for strong shaking estimates but not for the other hazards. These are needed immediately and are best developed at the national level by USGS to assure consistency across community lines and access to the latest scientific findings.

3. **Completion of the Advanced National Seismic System (ANSS) Seismic monitoring network for recording earthquakes and issuing early warnings throughout the nation.**

   The Advanced National Seismic System (ANSS) is an on-going program to modernize, expand, and integrate the nations monitoring networks. It was initiated over 10 years ago, has established the backbone of its system, and has accomplished 42 percent of its instrumentation goal, but it lacks sufficient funds to be completed. All earthquake professions use information derived from seismic monitoring. Earthquake scientists focus on understanding the source and nature of strong shaking based on the strong and weak motion recordings they obtain. Structural Engineers and their related design professional colleagues use strong motion records to better understand the behavior of the built environment, determine its damage potential under strong shaking, and fine-tune their designs to meet community needs. Economists and policy analysts focus on determining the appropriate framework for evaluating the benefits and cost effectiveness of mitigation efforts. Insurance professionals and their loss estimation consultants use the information to determine the expected dollar losses that could occur (NRC 2006). The emergency management community uses it to define scenario events for planning activities and will eventually use early warning to save lives, reduce damage, economic disruption and business downtime, and reduce psychological trauma (USGS 2014).

   Completion of the Advanced National Seismic System will vastly improve the information learned from future earthquakes, reduce the uncertainly in the hazard characterizations, reduce the overall cost of achieving resilience, and complete the full development and deployment of the Earthquake Early Warning system. Additional authorization of funding and cooperation from the Secretary of Agriculture and Secretary of the Interior is needed to assist and expedite approvals for using public land for locating seismic monitoring instruments.

4. **Development of a new generation of Seismic Standards for New and Existing Construction of Buildings and Lifeline Infrastructure Systems.**

   The International Code Council publishes 15 model building codes (I-Codes) that regulate the design and construction of buildings when adopted by local jurisdictions.

They are published on a 3-year cycle and used throughout the United States. The codes are developed by the engineering professions and significant changes are added during each cycle related to resilient construction. While this is a move in the right direction, these additions are focused on improving individual building's performance and are not addressing what is needed to accelerate community-wide recovery after a significant earthquake.

While there are many codes, standards, and guidelines that govern the design and construction of lifeline infrastructure systems, their focus relates to normal day-to-day operations of the system's components and do not cover the overall system's performance during earthquakes or the dependencies that exist between systems. More emphasis on risk reduction, system restoration, and societal impacts is needed along with unified performance and restoration goals across all systems. Extensive research and a new generation of codes, standards, and guidelines are needed (ATC 2016).

In an ideal community, all buildings and infrastructure systems would recover rapidly from a strong earthquake with little interruption in services. Buildings would remain usable, infrastructure systems would remain operational, and only a few days would be needed to clean up the mess and get back to normal operations. Unfortunately, this is not the case. Buildings and infrastructure systems of any mature community have been built over generations and are subject to changing demands, retrofit or mitigation needs, and deterioration. Design codes for new buildings and retrofit codes for existing buildings do not include the performance goals needed for community resilience. Lifeline Infrastructure Systems are not regulated by national codes and are designed to performance criteria set by their owners and often without regard for the needs of the community after a strong earthquake. In addition, most existing buildings and supporting infrastructure systems do not meet current minimum code requirements and are unlikely to contribute to community resilience in their existing condition.

Fortunately, every building and infrastructure system is not immediately needed for a community to recover efficiently. Buildings only need to be usable when needed to support recovery. For example, hospitals are needed immediately to care for the injured, but recreation centers can wait until people have time to use them. Schools are immediately needed as emergency shelters. They need to reopen to students as quickly as possible, but not before the emergency response period is over, roads are open for buses, and families are settled. By setting specific return to function goals for buildings and lifeline infrastructure, communities can use their sequence of recovery activities to determine what performance levels need to be built into functional recovery-based design and planning codes. Communities can also assess their existing built environment against the goals to determine where mitigation activities are needed, and which are highest priority.

FEMA and NIST should lead the development of functional recovery-based design and planning codes from within the re-authorized NEHRP. It should be based on the work of a committee of experts from the Federal Agencies, codes and standards writing organizations, non-government organizations, disaster management professional organizations, and engineering professional organizations such as ASCE and EERI, who will set the appropriate hazard levels and performance goals for all buildings and lifeline infrastructure systems. The work products must be consistent across all elements of the built environment and aligned with the concepts in the *Community Resilient Planning Guide for Buildings and Infrastructure Systems,* published by NIST in May 2016 (NIST 2016). A rating system for easily identifying and publishing the anticipated seismic performance of individual buildings should also be developed and implemented.

NEHRP has and should continue to make Americans safer and our nation more secure, resilient, and financially stronger through research in engineering, earth and behavioral sciences, and public policy. We must also follow through with implementation of the findings through the development of design tools and assistance to States and communities with preparedness and mitigation activities. Thank you for the opportunity to share my views with the Committee regarding the National Earthquake Hazards Reduction Program, and I urge Congress to move quickly to reauthorize, with the outlined improvements, this critical program.

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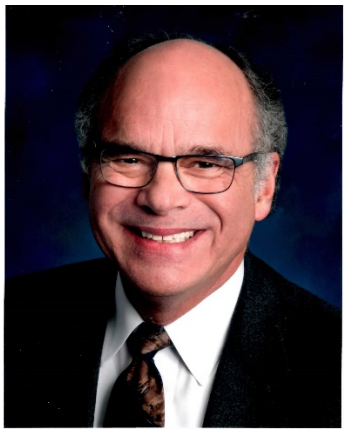

Chris Poland
Consulting Engineer
NIST Community Resilience Fellow
Chairman and CEO, Degenkolb Engineers, retired

Chris Poland is an internationally recognized authority on earthquake engineering and champion of disaster resilience. His passion for vibrant, sustainable, and healthy communities drives his consulting engineering practice. He focuses on community resilience and the buildings and systems that contribute to it. Currently, Chris is a Community Resilience Fellow in the National Institute of Standards and Technology (NIST) and member of the team of authors that are developed and are now implementing a Community Resilience Planning Guide.

Chris is a member of the National Academy of Engineering (2009) and serves on several their study committees and boards. He is a Fellow of the American Council of Engineering Companies, the Structural Engineers Association of California and the American Society of Civil Engineers Structural Engineering Institute. He is also an honorary member of the Earthquake Engineering Research Institute and the Structural Engineers Association of California.

His structural engineering career spans over 42 years and includes hundreds of projects related to the design of new buildings, seismic analysis and strengthening of existing buildings, structural failure analysis, historic preservation, as well as the development of guidelines and standards that are used worldwide. He was a Senior Principal, Chairman and CEO of Degenkolb Engineers during his 40 years with the firm from 1974 through 2014.

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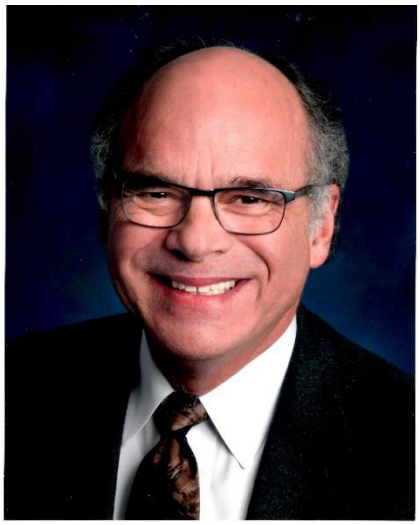

Education

B.S. Summa cum Laude, Mathematics, University of Redlands, 1972

M.S. Structural Engineering, Stanford University, 1974

Registration

California — Civil Engineer, 1977
License No. 27243
California — Structural Engineer, 1980
License No. 2336

Awards

HJ Brunier Award for Excellence in Design

2006 Alfred E. Alquist Medal

2010 Structural Engineer of the Year, *The Structural Design of Special and Tall Buildings Journal*

2017 Housner Medal

Member, National Academy of Engineering

ACEC National Awards for Various Projects

An internationally recognized authority on earthquake engineering and champion of disaster resilience, Chris Poland's passion for vibrant, sustainable, and healthy communities drives his consulting practice. He focuses on community resilience and the buildings and systems that contribute to it.

He is the past Chair of the Advisory Committee to the National Earthquake Hazards Reduction Program, and past Chairman of the Advisory Committee on Structural Safety of Department of Veterans Affairs (VA) Facilities. As Chair of the 100th Anniversary Earthquake Conference in San Francisco in April 2006, he shared the stage with California Governor Arnold Schwarzenegger and Senator Dianne Feinstein in an internationally covered event that brought the nation to think proactively about earthquake danger. He served as the Chair of the American Society of Civil Engineers Seismic Rehabilitation of Existing Buildings Standards Committee completing multiple editions both ASCE 31 and ASCE 41, standards for the evaluation and rehabilitation of existing buildings that are used worldwide.

He served on the Board of Directors for SPUR, co-chaired their Resilient City Initiative and led the publication of "The Disaster Resilient City". He is a past President, Treasurer, and Director of the Earthquake Engineering Research Instituted and is currently co-chair of the Public Policy Committee. He also served on the Board for the San Francisco Chamber of Commerce and was the founding co-chair of the San Francisco Lifelines Council with Mayor Edwin Lee from 2009 through 2014. Chris is a former Vice-Chairman of the American Council of Engineering Companies, member of the Board of Governors of the ASCE Structural Engineering Institute and was appointed to the organizing Executive Committee of the ASCE Infrastructure Resilience Division.

Currently, Chris is a Community Resilience Fellow at the National Institute of Standards and Technology (NIST) and member of the team of authors that developed a Community Resilience Planning Guide. His role is related to defining and preparing the over-arching guidance for the development of Community Disaster Resilience Plans by local communities and assisting in their implementation. That guide is the initiating document for the NIST Community Resilience Program that includes the development of Guide Briefs, analytical tools, and model guidelines for use by cities nationwide to address the natural disasters they face.

Chris was inducted into the National Academy of Engineering in 2009 and is a regular participant in Academy study committees. He is a Fellow of the American Council of Engineering Companies, the Structural Engineers Association of California and the American Society of Civil Engineers Structural Engineering Institute. He is also an honorary member of the Earthquake Engineering Research Institute and the Structural Engineers Association of California.

His structural engineering career spans over 44 years and includes hundreds of projects related to the design of new buildings, seismic analysis and strengthening of existing buildings, structural failure analysis, historic preservation, as well as the development of guidelines and standards that are used worldwide. He was a Senior Principal, Chairman and CEO of Degenkolb Engineers during his 40 years with the firm from 1974 through 2014.

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Professional Involvement

Chairman, Risk and Resilience Measurement Committee, ASCE Infrastructure Resilience Division.

Chairman, Advisory Committee on Earthquake Hazards Reduction

Chairman, Seismic Rehabilitation Standards Committee, American Society of Civil Engineers (ASCE)

Chairman, ASCE - SEI Codes and Standards Activities Division

Executive Committee Chairman, Department of Veterans Affairs Advisory Committee on Structural Safety, Washington, DC

Board of Directors, San Francisco Planning and Urban Research (SPUR)

Chairman, SPUR Seismic Hazard Mitigation Taskforce

Chairman, Council of American Structural Engineers (CASE)

Member ASCE - Structural Engineering Institute Board of Governors

Chairman of the ASCE-SEI Codes and Standards Activities Division

Member of the ASCE Infrastructure Residence Division Executive Committee

San Francisco Chamber of Commerce, Board of Directors, Executive Committee; Public Policy Committee, Land Use Planning Committee

Earthquake Engineering Research Institute (EERI) President, 2001-2002; Treasurer and Director 1994-2000; Public Policy Committee; Honorary Member, 1995

Structural Engineers Association of California (SEAOC), Fellow

Structural Engineers Association of Northern California (SEAONC), College of Fellows, 2003; Honorary Member, 2009

Relevant Experience

A representative sample of significant professional activities related to NEHRP.

Advisory Committee on Earthquake Hazard Reduction
Organizing Chair of ACEHR

Served as the organizing Chair of ACEHR and continued in that role for his entire 6 year term. Routinely set the committee agendas with the National Earthquake Hazard Reduction Program (NEHRP) Secretariat and facilitated stimulating meetings. The Advisory committee met for the first time in May 2007 and wrote their first report in May 2008. Since their organization, the committee has met every year and provided an annual report to the ICC. In those reports, the committee has made a number of recommendations that have been incorporated in the program.

ASCE 31

Actively and continuously involved in the development and standardization of ASCE 31 - Seismic Evaluation of Existing Buildings. Was the principal investigator for ATC 14, the guideline document that formed the basis for the standard, and has served in a leadership position in the three subsequent guidelines that refined and expanded the basis for this internationally used standard. He led the final standardization process for ASCE as the Chairman of their Seismic Rehabilitation of Existing Building Standards Committee. ASCE 31 was fully incorporated into the recently published ASCE 41-13 also under his leadership.

ASCE 41

Participated in the development of the guideline document FEMA 273: *Guidelines for the Seismic Rehabilitation of Buildings*, served as the ASCE Principal Investigator for the conversion of FEMA 273 to the pre-standard, FEMA 356: *Prestandard and Commentary for the Rehabilitation of Buildings*, led the subsequent effort by the ASCE Rehabilitation Standards Committee to convert the document in to a ANSI compliant standard, ASCE 41-06: *Seismic Rehabilitation of Existing Buildings*, and recently completed leading the development of the second edition, ASCE 41-13: *Seismic Evaluation and Retrofit of Existing Buildings*.

ATC-14
Principal Author

ATC-14 *Evaluating the Seismic Resistance of Existing Buildings* sponsored by the Applied Technology Council (ATC). This guideline document established a new procedure for evaluating existing buildings and is the basis for seismic evaluation documents worldwide including a national standard ASCE 31 Seismic Evaluation of Existing Buildings.

Selected Recent Publications and Presentations

Since the early 1970s, Mr. Poland has written over 40 publications and gives scores of presentations related to Structural Engineering, Earthquake Engineering, and Community Resilience each year. A listing of his most recent and significant activities follows:

Strengthening the Disaster Resilience of the Academic Biomedical Research Community: Protecting the Nation's Investment. Consensus Study Report co-authored with others. National Academies of Science, Engineering, and Medicine. Washington DC, 2017

From Resilient Infrastructure to Resilient Communities: how can emerging technologies support community efforts to become resilient? Keynote lecture at the Advanced Technologies in Structural Engineering for more Resilient Communities Workshop, The National Academies. September 2017

Insights into the New US NIST Community Resilience Planning Guide for Buildings and Infrastructure Systems. Keynote Lecture, New Zealand Society of Earthquake Engineering Annual Meeting, Christchurch, 2016

EERI Earthquake Reconnaissance Team Report: M7.8 Gorkha, Nepal Earthquake of April 25 2015 and its Aftershocks. Co-authored with others. Earthquake Engineering Research Institute, May 2016.

EERI Resilience Observatory Case Study Report: Use of Data for Measuring and Monitoring Recovery following the Canterbury Earthquake Sequence. Co-authored with others. Earthquake Engineering Research Institute, February 2016

Structural Engineer's Role in Creating Disaster Resilient Communities. ASCE Structures Congress, Portland OR, April 2015

Disaster Resilient Communities: Good for People, Good for Business. Portland Cement Association Annual Board Meeting, Scottsdale AZ, November 2014.

Resilient Communities: Growing Stronger Places. NACO County Leaders Forum, San Francisco, May 2014.

A Framework for Creating Disaster Resilient Communities. Plenary Lecture (invited), 10th US National Conference on Earthquake Engineering, Anchorage, Alaska, 2014

Creating Disaster Resilient Communities. Proceedings of the 15th World Conference on Earthquake Engineering. Lisbon, Portugal, 2012.

ASCE 41-13: Seismic Evaluation and Retrofit of Existing Buildings. Co Authored with Robert Pekelnicki. SEOAC 2012 Convention Proceedings. Structural Engineers Association of California. Sacramento California, 2012.

The 21st Century Goal for Seismic Safety: Resilient Cities. Proceedings of the 9th US National and 10th Canadian Conference on Earthquake Engineering. Curran Associates, Inc. Red Hook, New York, 2010.