

Revised for the 2010 Report

Chris Poland

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Resilience

General

The National Earthquake Hazard Reduction Program (NEHRP) has been committed since its inception in 1977 to protecting lives through pre-event planning and mitigation of risks. Many tools, such as seismic monitoring and mapping, building code development, risk mitigation, and emergency preparedness provide a solid framework for community development and disaster planning. Yet, serious gaps exist. For example, the vast majority of the existing physical infrastructure was constructed to inadequate standards, well below current standards for new construction; even the new standards focus on life safety and are not sufficient to achieve resilience. Most buildings will suffer costly damage in a major earthquake, and critical lifelines (*e.g.*, highways, ports, water supply systems, electricity grids, and telecommunications networks) will not provide their intended services immediately after such an earthquake.

There is a rapidly growing recognition that communities need to be more than safe and prepared to stand alone for 72 hours. They need to be able to quickly recover, that is, be disaster resilient. Disaster-resilient communities must have credible response plans that recognize their inherent abilities to recover, and include places and plans to govern after a major disaster. Power, water, and communication networks need to resume operations shortly after a disaster. Residents need to be able to stay in their homes, travel to where they need to be, and resume fairly normal living routines within weeks, so they can restore their community within a few years. Businesses need to understand and plan around the expected usefulness of their facilities and have plans for their restoration.

While the contemporary national model building code has been adopted by some communities in every state and is effective for safeguarding life and protecting first responders, state and local adoption is neither universal nor comprehensive. There is an enormous diversity in the way codes are implemented that ranges from full attainment, to limited adoption, to areas that strip out disaster-resisting provisions, to communities that actually prohibit the application of building codes to homes. Building codes are of little use if they are not adopted and enforced by well-qualified building departments and their inspectors.

Furthermore, a major earthquake striking a U.S. city that was constructed in *full compliance* with current building codes would cripple the city's ability to recover quickly, because its buildings and lifeline systems have not been designed for post-disaster performance. They have only been designed to safeguard life, and, in some cases, support emergency response.

There is no such thing as a fully modern code-compliant city, because every city is filled with older buildings and antiquated lifeline systems that were designed to earlier, now outdated, building codes or no codes at all. There is always a subset of "killer" infrastructure that is extremely vulnerable to collapse, which would cause the deaths of many building occupants and users of transportation systems, while impeding recovery for years. Many of our major urban centers are "catastrophes waiting to happen."

Issues and Challenges

Resilience starts at the local level, with individuals, families, and businesses. Everyone in the country has a stake in creating resilience. Further, resilience of the built environment is only a part of the challenge. Resilience must also encompass the socioeconomic and cultural aspects and needs of communities.

Resilient cities form resilient regions, which in turn build a resilient Nation. While the Nation can promote resilience through improved design codes and mitigation strategies, implementation and response must occur at the local level. The Nation cannot achieve resilience without motivating and supporting local measures that achieve resilience. Support for such activities is currently lacking.

If national resilience is to be achieved, the Nation must enact legislation that empowers cities to build resilience neighborhood by neighborhood. State grants that support the identification and retrofit of “killer” buildings are required. Resources are needed to develop the human infrastructure for responding to and recovering from natural hazards. Understanding and planning for effective lifeline response after extreme events is a key part of developing community resilience. Building codes need to move towards performance-based earthquake engineering so that resilience, beyond “life safety,” is the primary objective¹.

Many of the tools and procedures needed to create disaster-resilient cities exist and are continually being refined. Achieving resilience nationwide, however, will require a different approach than currently exists. Modifications to current building codes, alignment of diverse lifeline systems around common performance objectives, and strong community support for adopting policies that foster resilience are needed. Deficient buildings and systems need to be mitigated, and new buildings and systems need to be designed to the performance levels needed.

Shifting to building codes focused on resilience and adopting new policies to strengthen communities are not possible without solid, unified support from all levels of government. The federal government should set performance standards that can be embedded in the design codes; be adamant that states adopt contemporary building codes and include provisions for rigorous enforcement; provide financial incentives to stimulate mitigation that benefits the Nation; and continue to support research that delivers new technologies that encourage cost-effective mitigation, response, and recovery. Through state and local governments, regions should identify the vulnerabilities of their lifeline systems and enact programs for their mitigation to the minimum levels of need to ensure resilience. Localities should expand their preparedness planning and develop mandatory programs that mitigate their built environment, as needed, to assure survival.

Recommended Actions to be Taken at the Federal Level

The federal government must play a central role in promoting resilience, giving visibility to the multi-dimensional and multi-sector aspects of the challenge, and encouraging the various sectors to join the resilience movement.

Key NEHRP-specific earthquake resilience actions that are required immediately include (listed in order of decreasing priority):

1. Support state and local governments and the private sector by providing increased and targeted incentives to adopt and enforce resilience-focused building codes, fix “killer” buildings, and

¹ The response of a “life safe” building in an earthquake may not result in deaths to its occupants, but the building may be too badly damaged to be repaired or reused. True resilience would support rapid reuse of buildings and other components of infrastructure following earthquakes within the anticipate design envelope for a given region.

develop more effective mitigation, response, and recovery programs. Some programs exist, such as the FEMA State Hazard Mitigation Grants, but they are too small and need to be funded at meaningful levels.

2. Promote and incentivize resilient and reliable lifeline services during extreme events to deliver critical resources and support community restoration.
3. Establish a policy that provides adequate funding of programs that implement knowledge in all hazard areas through national codes, standards, training, education, guidance materials, and technical and continuing education. The National Institute of Standards and Technology (NIST) and the Federal Emergency Management Agency (FEMA) have the responsibility to transfer research into practice, but they are critically underfunded for this work. The required level of funding is comparable to that supporting fundamental NEHRP research if we are to put into practice the knowledge we have gained over the past several decades.
4. Foster cross-agency communication, collaboration, and coordination on community resilient programs.
5. Have independent agencies conduct two studies, validated by OMB and CBO, to determine the costs and benefits of investing in resilience. The first study should focus on private sector investments in facilities mitigation. The second study should focus on both public and private sector investment in critical infrastructure and lifelines. These studies would provide private sector companies with the bottom line justification needed to make investments in long-term resilience.

Key earthquake resilience actions that apply more broadly than the NEHRP agencies alone but are also required immediately include:

1. Require federal agencies with disaster-response missions to interact in a coherent and consistent way with individual states. In the long term, effective local resilience depends on enabling individuals and educators under state and local programs.
2. Estimate the cost to strengthen the federal infrastructure and develop a plan to address those areas of greatest vulnerability to ensure that government functions are resilient² — that they function effectively after a major disaster, with minimal disruption, so that the impact on government operations is not itself a contribution to the problem.

² The ACEHR is aware that Executive Order 12941 required the federal agencies to estimate such costs for their existing building earthquake risks but is unaware that such an estimate has ever been developed and released.