nehrp SeismicWaves
How the National Earthquake Hazards Reduction Program Is Advancing Earthquake Safety
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Hazards, Risks, and Opportunities in the Nation's Heartland

This is the first of two articles about developments in the New Madrid Seismic Zone, where activities are commemorating the 200th anniversary of the great earthquakes that rocked the region in 1811 and 1812.

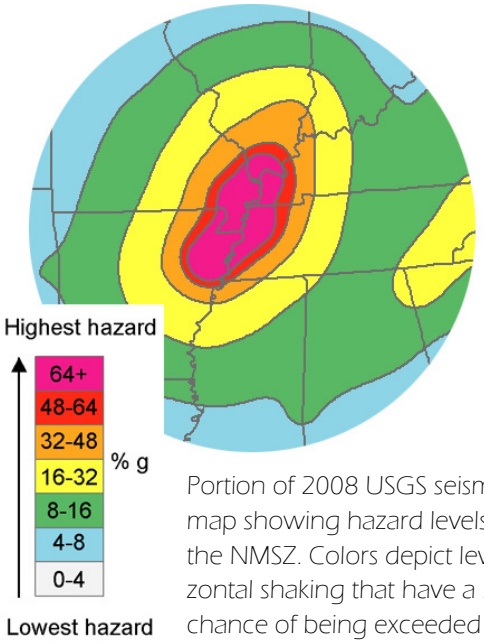
A series of three large earthquakes and many smaller ones shook the central United States two centuries ago, striking in an area now known as the New Madrid Seismic Zone (NMSZ). Ever since, there have been questions about the implications of those events for the region. The questions have become more consequential as ongoing development has increased the people and property that are potentially at risk, and as more has been learned about how to reduce seismic risks. In recent years, with the approach of the New Madrid earthquake bicentennial, the questions have attracted greater attention.

The National Earthquake Hazards Reduction Program (NEHRP) is responding to these questions by clarifying the seismic hazards and risks present in the NMSZ and by promoting commensurate hazard preparedness and risk mitigation. This approach was articulated late last year in a written statement issued by the NEHRP Advisory Committee on Earthquake Hazards Reduction (ACEHR) in recognition of the bicentennial.[1]

Acknowledging Local Concerns

At a meeting in Memphis in November 2010, ACEHR heard about developments in the NMSZ not only from the NEHRP agencies, but also from many local and regional earthquake scientists and seismic design professionals. Some participants voiced long-standing disagreements and concerns over how seismic hazards and risks in the NMSZ should be characterized and interpreted. The committee explored these issues and their implications for earthquake safety and resilience, building code adoption and enforcement, building design and construction, and economic development in the region.

In its subsequent New Madrid bicentennial statement, ACEHR urged the NEHRP agencies and others with a stake in earthquake safety in the central United States to take advantage of the opportunities afforded by the bicentennial. They were advised to reexamine seismic hazards and risks in the NMSZ and to learn about, evaluate, and enhance associated preparedness and mitigation efforts.



Portion of 2008 USGS seismic hazard map showing hazard levels surrounding the NMSZ. Colors depict levels of horizontal shaking that have a 2-in-100 chance of being exceeded in a 50-year period, expressed as percentages of *g* (*g* is the acceleration of a falling object due to gravity). Courtesy of USGS.

Reexamining the Hazard

The U.S. Geological Survey (USGS) promptly brought ACEHR's statement to the attention of the National Earthquake Prediction Evaluation Council (NEPEC), a committee established by Congress to advise the USGS Director on issues related to earthquake prediction and forecasting. NEPEC convened a panel of independent experts to evaluate and report on "the level of hazard posed by future large earthquakes in the NMSZ."[2] The panel met in Memphis in March 2011 to interview scientists and engineers from the region, and reviewed many written communications submitted by government and university scientists, state agencies, private firms, and business groups.

The panel's report acknowledges the uncertainties that still affect seismic hazard estimates in the NMSZ, including insufficient knowledge about the physical processes that govern earthquake recurrence in the central United States. Nevertheless, the panel concluded that

[1] ACEHR, *NEHRP Bicentennial Statement*, Feb. 11, 2011, http://www.nehrp.gov/pdf/ACEHR_bicentennial.pdf.

[2] John Vidale et al., *Report of the Independent Expert Panel on New Madrid Seismic Zone Earthquake Hazards*, Apr. 16, 2011, NEPEC's Charge to the Panel, 20, http://earthquake.usgs.gov/aboutus/nepec/reports/NEPEC_NMSZ_expert_panel_report.pdf.

the NMSZ "is at significant risk for damaging earthquakes that must be accounted for in urban planning and development," and that the method used to assess and characterize NMSZ hazards, through the periodic development of new USGS national seismic hazard maps, is "the best means available to refine hazard estimates."[3]

The current versions of the USGS hazard maps were issued in 2008 following a multiyear, consensus-based development and review process. The best available science was incorporated through workshops, meetings, and analyses involving hundreds of scientists, engineers, and policy makers from government agencies, academic institutions, and private-sector groups.[4]

Advancing and Promoting Codes and Standards

As the NEPEC panel noted in its report, USGS hazard maps are the basis for, but are not the same as, the design maps that are included in the model building codes used by states and localities nationwide. With support from USGS and the Federal Emergency Management Agency (FEMA), the Building Seismic Safety Council[5] used the 2008 hazard maps to develop new design maps for the 2009 edition of the *NEHRP Recommended Seismic Provisions for New Buildings and Other Structures* (FEMA P-750), a preeminent source of improved seismic provisions for model building codes and associated design standards. The design maps were subsequently adopted into the 2010 edition of the American Society of Civil Engineers (ASCE) national standard for seismic design in new buildings (ASCE/SEI 7-10), and into the next (2012) edition of the *International Building Code* (IBC).

The ACEHR bicentennial statement notes that the design maps were developed using a new, "risk-targeted" method that resulted in design criteria for the NMSZ that are less stringent than those found in earlier maps. To further address local concerns about the costs of implementing the latest codes and standards, the National Institute of Standards and Technology recently initiated a research project that will analyze the incremental costs required to design and construct buildings using the new design maps. Researchers will produce three alternative designs (using no seismic requirements, requirements from current local codes, and requirements from FEMA P-750 and ASCE/SEI 7-10) for each of up to eight commercial and residential buildings typical of those being constructed in the NMSZ, and will compare estimated design and construction costs for these alternatives.

ACEHR's statement urges state and local governments around the NMSZ to adopt and enforce the latest model building codes and standards applicable to new buildings (2009 IBC and ASCE/SEI 7-10) and existing structures (ASCE/SEI 31-03 and 41-06). This is advocated as a fundamental step toward mitigating the potential effects of the earthquake hazards present in the region. In a recent analysis, FEMA found that in the counties most at risk in states in and around the NMSZ, adoption of current national model building codes with full seismic-resistant provisions has been spotty. Just 10 percent of local jurisdictions in this area were found to have adopted such codes for new commercial and residential buildings, and 2.2 million people were residing in jurisdictions where neither commercial nor residential construction was regulated by such codes.[6]

Planning for Earthquake Resilience

ACEHR's bicentennial statement strongly emphasizes the need for planning. Mitigation planning, such as charting how to improve code adoption and enforcement or how to strengthen vulnerable building stocks, is needed to reduce the damaging effects of future earthquakes in the region. Preparedness planning is needed to help individuals and organizations respond to and recover from those effects more efficiently and successfully.

With strong support from FEMA and USGS, states and localities in the NMSZ are using the occasion of the bicentennial to make a substantial down payment on these planning needs. Their accomplishments will be described in a forthcoming issue.

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[3] Vidale et al., *Report of the Independent Panel*, Executive Summary, 1.

[4] Mark D. Petersen et al., *Documentation for the 2008 Update of the United States National Seismic Hazard Maps*, USGS Open-File Report 2008–1128, Introduction, 1–2, http://pubs.usgs.gov/of/2008/1128/.

[5] The BSSC is an independent, voluntary membership body that fosters improved seismic safety provisions for use by the building community (http://www.nibs.org/index.php/bssc).

[6] FEMA, *Building Codes in the New Madrid Seismic Zone*, Building Science Branch, March 2011, http://www.iccsafe.org/gr/Documents/AdoptionToolkit/nmsz_building_code_adoption.pdf.