National Earthquake Hazards Reduction Program

... a research and implementation partnership

Program Overview

Opening Plenary Session
25 July 2010

9th US National and 10th Canadian Conference on Earthquake Engineering: Reaching Beyond Borders

Toronto, July 25-29, 2010

9ième Conférence Nationale Américaine et 10ième Conférence Canadienne de Génie Parasismique: Au delà des Frontières
Presentation Outline

- Overview (Background, Agency Roles, Budgets)
- Agency Overviews
- Strategic Plan
- National Research Council Roadmap Study
- Recent Activities
- Q&A (if time permits …)
National Earthquake Hazards Reduction Program
A Statutory Multi-Agency Partnership
Overview

• National program first authorized by U.S. Congress in 1978.

• Overall purpose: “…to reduce the risks of life and property from future earthquakes in the United States…”

• NEHRP has been re-authorized on 2 – 5 year cycles following formal U.S. Congressional hearings. New re-authorization now in process (HR 3820). Meanwhile, agencies continue their Program activities.

• Program has no authority to establish or enforce codes and regulations, or to conduct post-earthquake response and recovery operations.
Major Statutory NEHRP Activities

- Conduct interdisciplinary research on earthquakes and earthquake effects on communities, structures, buildings, homes, and lifelines. (NSF, USGS, NIST)

- Monitor earthquake activity and characterize hazard. (USGS)

- Develop earthquake-resistant design and construction practices. (NIST, FEMA)

- Develop and promote adoption of effective model building codes and practices for earthquake resilience. (FEMA, NIST)

- Public education on earthquake risks and mitigation. (All)
## 2005-2011 NEHRP Agency Budgets

### Enacted Agency NEHRP Budgets ($M)

<table>
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<tr>
<th>FY</th>
<th>FEMA</th>
<th>NIST</th>
<th>NSF</th>
<th>USGS</th>
<th>NEHRP Total</th>
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<td>2005</td>
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<td>0.9</td>
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<td>2007</td>
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<td>1.7</td>
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<td>2008</td>
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<td>1.7</td>
<td>53.6</td>
<td>58.1</td>
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<td>2009</td>
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<td>4.1</td>
<td>55.0</td>
<td>61.2</td>
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<tr>
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<td>4.1</td>
<td>55.3</td>
<td>62.8</td>
<td>131.2</td>
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</tbody>
</table>

### Requested Agency NEHRP Budgets ($M)

<table>
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<tr>
<th>FY</th>
<th>FEMA</th>
<th>NIST</th>
<th>NSF</th>
<th>USGS</th>
<th>NEHRP Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>9.0</td>
<td>4.1</td>
<td>53.8</td>
<td>62.3</td>
<td>129.2</td>
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</tbody>
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### Notes:
1. ARRA funds are not included.
2. Information shown is for internal NEHRP use only. Authorized budgets will not be publicly reported with requested budgets.
NSF: NEHRP’s Primary Basic Research Arm

- **Directorate for Geosciences (GEO)**
  - Incorporated Research Institutions for Seismology (IRIS)
  - Southern California Earthquake Center (SCEC)
  - Fundamental Research on Earthquakes (Unsolicited Proposals)
  - EarthScope Facility (Related non-NEHRP activity)

- **Directorate for Engineering (ENG)**
  - George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES) Facility - Operations and Research
  - Unsolicited Proposal Research Programs
    - Hazard Mitigation and Structural Engineering
    - Geotechnical Engineering
    - Infrastructure Management and Extreme Events
    - Natural Hazards Center

- **Post-earthquake reconnaissance (GEO and ENG)**
NEES for the Engineering Community

NEEShub Cyberinfrastructure
- Data repository
- Telepresence
- Simulation tools
- Hybrid simulation
- Collaborative tools
- Cybersecurity

NEES Headquarters at Purdue University (NEEScomm)

Oregon State University
University of Nevada, Reno
University of Minnesota
University of Buffalo
Cornell University
Rensselaer Polytechnic Institute
Lehigh University
University of Illinois at Urbana-Champaign
University of California, Davis
University of California, Berkeley
University of California, Santa Barbara
University of California, San Diego
University of Texas at Austin
University of California, Los Angeles
Next-Generation Earthquake Resistant Structural Systems: Performance-Based Seismic Design Philosophy for Mid-Rise Wood Frame Construction

Benchmark two-story town house woodframe tests using University at Buffalo NEES dual shake tables (2006)

New design approach using test results (2007-2008)

Validate methodology with capstone full-scale, six story woodframe building tests using E-Defense shake table in Miki, Japan (June and July 2009)

Direct Displacement Design (DDD) Procedure

NEES dual shake table tests

E-Defense shake table test

(Graphics: John van de Lindt, PI)
Combined in-house and extramural program has six primary focus areas, consistent with “Roadmap:”

- Technical support for building code development
- Performance-based seismic design development
- National design guidelines development
- Evaluated technology dissemination
- Development of improved evaluation and strengthening for existing buildings (increased future focus)
- Enhanced design productivity and interoperability development (future focus)

NIST goal: ~ 50/50 in-house/extramural split
Recent NIST Publications

NIST GCR 09-917-2
Research Required to Support Full Implementation of Performance-Based Seismic Design

NIST GCR 09-917-1
Seismic Design of Reinforced Concrete Special Moment Frames: A Guide for Practicing Engineers

NIST GCR 09-917-3
Seismic Design of Steel Special Moment Frames: A Guide for Practicing Engineers

NEHRP Seismic Design Technical Brief No. 2
NEHRP Seismic Design Technical Brief No. 1

National Earthquake Hazards Reduction Program
FEMA’s NEHRP Contributions

Building Science for Disaster-Resilient Communities

- Research/New Knowledge
- Lessons Learned Research to Practice
- Reduced Disaster Losses
- Guidance and Tools Development
- Outreach and Implementation Technology Transfer
- Building Codes and Standards Disaster Resistance

Mitigation Works

NEHRP - National Earthquake Hazards Reduction Program
FEMA’s NEHRP Activities

- Guidance Development (new and existing buildings)
- Building Codes and Standards
- Training (current, planned and future strategy)
- Outreach (strategic communication)
- State and Local Coordination (NETAP, EMPG, State Assistance)
- Partnerships (consortia, EERI)

Research ➔ Practice
The USGS Role in NEHRP

- Provide earthquake monitoring and notifications,
- Assess seismic hazards, and
- Conduct targeted research needed to reduce the risk from earthquake hazards nationwide.
USGS provides rapid information on earthquakes worldwide
USGS seismic hazard assessments: National, regional, urban

U.S. National Seismic Hazard Maps

Uniform California Earthquake Rupture Forecast

Seattle urban hazard map
USGS & FEMA: Translating USGS national hazard maps into model building codes

Recommended Provisions, ASCE 7, and International Building Code based on the USGS national seismic hazard map
Putting Down Roots in Earthquake Country

Utah Seismic Safety Commission
American Red Cross, Pacific Gas & Electric and many more…

Putting Down Roots for the Central US (coming soon)
California-wide public preparedness drill

The Great Southern California ShakeOut

October 15, 2009

national earthquake hazards reduction program
FEMA National Level Exercise 2011
Based on New Madrid earthquake

Scenario ShakeMap and PAGER prepared for SONS07 emergency response exercise
NEHRP Strategic Plan

A national vision for the future:

A nation that is earthquake-
resilient in public safety,
economic strength, and
national security.
2003 EERI Report

- Developed 20-yr research & outreach plan for earthquake engineering, with broad discussion of national needs, listing of broad task/activity areas, & rough estimation of costs for tasks/activities

Post-2003

- Advances have occurred
- Pace of change may not have matched that envisioned in EERI report
- Costs have changed
- New NEHRP Strategic Plan is seen by earthquake professionals as addressing broad national needs

Study Purpose:

- Provide an independent technical roadmap to implement strategic goals, objectives, outcomes, and priorities identified in the NEHRP Strategic Plan, to be used by the NEHRP agencies as an informational reference document in program planning
Recent Activities

• FEMA completed the 2009 *Recommended Provisions for Seismic Regulations* to support the development of revised building codes.

• USGS has initiated major instrumentation upgrades to the Advanced National Seismic System (ANSS), supported with ARRA funding.

• NSF awarded new operations cooperative agreement to Purdue University for the Network for Earthquake Engineering Simulation (NEES) (known as NEEScomm).

• NIST increased its research efforts in support of performance-based seismic engineering and proceeded with staff buildup activities.
Recent Activities (continued)

- Proposed 2011 NIST initiative, *Disaster-Resilient Buildings and Infrastructure*, will support post-earthquake reconnaissance and database management.

- FEMA and NIST initiated a formal interagency process to develop closely coordinated research and knowledge transfer activities.

- NIST & NSF made additional research grant awards under ARRA.

- NEHRP co-sponsored Chile earthquake structural engineering meeting with ASCE and PEER (June 2010).
Once Again Pushing the Envelope

Since it was first published in 1985, the NEHRP Recommended Seismic Provisions for New Buildings and Other Structures (the Provisions) has always sought to push the envelope of earthquake safety by advancing the efficiency and acceptance of seismic design standards. Early on, the envelope was empty and easily pushed, because seismic design provisions were largely absent from industry standards and from the model building codes adopted by states and localities.

Successive editions of the Provisions, published by the Federal Emergency Management Agency (FEMA), began to fill the envelope with code-ready design requirements. The envelope swelled further as industry groups such as the American Concrete Institute and the American Institute of Steel Construction incorporated seismic measures into their national design standards. By the early 2000s, the envelope bulged with the addition of the increasingly complete seismic requirements included in Minimum Design Loads for Buildings and Other Structures (ASCE/SEI 7), the preeminent U.S. structural design standard maintained by the American Society of Civil Engineers (ASCE).

FEMA found the envelope harder to push on Provisions updates because preoccupied with the congruence between the Provisions and ASCE/SEI 7. This led to a major change in the 2000 edition of the Provisions (FEMA P-746). By adopting the latest (2000) edition of ASCE/SEI 7 as the reference standard to be updated in the 2000 Provisions, instead of revising the previous (2000) edition of the Provisions, the developers of FEMA P-746 enabled the Provisions to again push the envelope and “assume its role as the resource for introducing new knowledge, innovative concepts, and design methods to improve national seismic standards and codes.”

A Collaborative and Voluntary Tour De Force

In 2008, FEMA contracted with the Building Seismic Safety Council (BSSC) through the council’s parent organization, the National Institute of Building Sciences, to develop the 2008 Provisions. A unique national resource established in 1979, the BSSC is a voluntary council of representatives from more than 90 organizations interested in the seismic safety of the built environment. BSSC members include organizations representing the building materials industry, trade and professional groups, code authors, code developers, public agencies, researchers, and other interests.

By 2008, the BSSC had recruited more than 200 national experts to assist in updating the Provisions. These volunteers were organized into the 2008 Provisions Update Committee (PUC) and a dozen associated technical subcommittees and ad hoc issue teams. It was these volunteers, working with the BSSC’s Board of Directors, member organizations, and staff, as well as with personnel from FEMA and NEHRP, who developed the 2008 Provisions. “Amateurs unfortunate enough to experience the earthquake that will inevitably occur in the future will owe much, perhaps even their lives, to the contributions and dedication of these individuals.”

Consensus on the Provisions was achieved through ballots conducted at subcommittee, PUC, and BSSC-member levels.

Visit the NEHRP web site at www.nehrp.gov.