National Science Foundation
Statutory Implementation Activities
National Earthquake Hazards Reduction Program

Presentation
to the
NEHRP Advisory Committee on Earthquake Hazard Reduction
October 23, 2007

Joy M. Pauschke, Ph.D., P.E.   Eva Zanzerkia, Ph.D.

Program Director   Program Director

Directorate for Engineering   Directorate for Geosciences

jpauschk@nsf.gov   ezanzerk@nsf.gov

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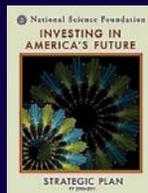
NSF Mission, Vision, and Strategic Goals
Investing in America's Future
Strategic Plan FY 2006 – 2011
http://www.nsf.gov/pubs/2006/nsf0648/nsf0648.jsp

- Mission
    - *To promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense (NSF Act of 1950)*
- Vision
    - *Advancing discovery, innovation and education beyond the frontiers of current knowledge, and empowering future generations in science and engineering.*
- Strategic Outcome Goals
    - Discovery
    - Learning
    - Research Infrastructure
    - Stewardship

At NSF, NEHRP operates within the context of the NSF Strategic Plan

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National Science Foundation Organizational Chart

	Office of Cyberinfrastructure
	Office of Equal Employment Opportunity Programs
	Office of the General Counsel
	Office of Integrative Activities
	Office of International Science & Engineering
	Office of Legislative & Public Affairs
	Office of Polar Programs

National Science Board (NSB)

Director / Deputy Director

Office of the Inspector General (OIG)

Primary NEHRP Activities

- Biological Sciences (BIO)
- Computer & Information Science & Engineering (CISE)
- Engineering (ENG)
- Geosciences (GEO)
- Mathematical & Physical Sciences (MPS)

- Social, Behavioral & Economic Sciences (SBE)
- Education & Human Resources (EHR)
- Budget, Finance & Award Management (BFA)
- Information & Resource Management (IRM)

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Program Responsibility: Encourage prompt dissemination of significant findings, sharing of data, samples, physical collections, and other supporting materials, and development of intellectual property so research results can be used by appropriate organizations to mitigate earthquake damage

Recent and ongoing activities that support this Program Responsibility

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Grantee Dissemination

- NSF Award Administration Guide
- NSF Grant Proposal Guide
- NSF and community data sharing policies
- Research community databases
- Publications, workshops, meetings, and seminars
- Technology transfer with practitioners/industry

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From the ***NSF Award Administration Guide*** – **applicable to NSF grants and cooperative agreements**
http://www.nsf.gov/pubs/policydocs/pappguide/nsf08_1/aag_6.jsp#VID4:

"4. Dissemination and Sharing of Research Results

a. Investigators are expected to promptly prepare and submit for publication, with authorship that accurately reflects the contributions of those involved, all significant findings from work conducted under NSF grants. Grantees are expected to permit and encourage such publication by those actually performing that work, unless a grantee intends to publish or disseminate such findings itself.

b. Investigators are expected to share with other researchers, at no more than incremental cost and within a reasonable time, the primary data, samples, physical collections and other supporting materials created or gathered in the course of work under NSF grants. Grantees are expected to encourage and facilitate such sharing. Privileged or confidential information should be released only in a form that protects the privacy of individuals and subjects involved. General adjustments and, where essential, exceptions to this sharing expectation may be specified by the funding NSF Program or Division/Office for a particular field or discipline to safeguard the rights of individuals and subjects, the validity of results, or the integrity of collections or to accommodate the legitimate interest of investigators. A grantee or investigator also may request a particular adjustment or exception from the cognizant NSF Program Officer.

c. Investigators and grantees are encouraged to share software and inventions created under the grant or otherwise make them or their products widely available and usable.

d. NSF normally allows grantees to retain principal legal rights to intellectual property developed under NSF grants to provide incentives for development and dissemination of inventions, software and publications that can enhance their usefulness, accessibility and upkeep. Such incentives do not, however, reduce the responsibility that investigators and organizations have as members of the scientific and engineering community, to make results, data and collections available to other researchers."

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"**E. Publication/Distribution of Grant Materials**

1. NSF Policy

NSF advocates and encourages open scientific and engineering communication. NSF expects significant findings from research it supports to be promptly submitted for publication, with authorship that accurately reflects the contributions of those involved.

2. Costs

Cost of documenting, preparing, publishing, disseminating and sharing research findings and supporting material are allowable charges against the grant. (See AAG Chapter V.B.7.)

3. Responsibilities

Unless otherwise provided in the grant, preparation, content, editing, identification of authorship and submission for publication of significant research findings are the responsibility of the investigators, consistent with such policies and procedures as the grantee may prescribe."

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"**(iii) Results from Prior NSF Support**

If any PI or co-PI identified on the project has received NSF funding in the past five years, information on the award(s) is required. Each PI and co-PI who has received more than one award (excluding amendments) must report on the award most closely related to the proposal. The following information must be provided:

(a) the NSF award number, amount and period of support;

(b) the title of the project;

(c) a summary of the results of the completed work, including, for a research project, any contribution to the development of human resources in science and engineering;

(d) publications resulting from the NSF award;

(e) a brief description of available data, samples, physical collections and other related research products not described elsewhere; and

(f) if the proposal is for renewed support, a description of the relation of the completed work to the proposed work.

Reviewers will be asked to comment on the quality of the prior work described in this section of the proposal. Please note that the proposal may contain up to five pages to describe the results. Results may be summarized in fewer than five pages, which would give the balance of the 15 pages for the Project Description."

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Other NSF and community data sharing policies, e.g.,

- Geosciences Directorate, Earth and Atmospheric Research Division, Data Sharing Policy

  http://www.nsf.gov/geo/ear/EAR_data_policy_204.pdf

- NEES Data Sharing Policy

  http://www.nees.org/Governance/Policies/20050511_NEESinc_DSAPG.pdf

Major NSF-supported databases, e.g.,

- Incorporated Research Institutions for Seismology (Global Seismic Network)

  http://www.iris.edu/about/DMC/dms.htm

- UNAVCO (GPS, LIDAR, INSAR, etc.)

  http://facility.unavco.org/data/data.html

- NEES (earthquake engineering experimental data)

  http://it.nees.org/software/central/index.php

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Dissemination of significant findings through technology transfer activities; NSF-funded researchers choose their own dissemination methods, e.g.,

- Journals, e.g., ASCE Journals, *Bulletin of the Seismological Society of America*, *Earthquake Engineering & Structural Dynamics*, EERI *Earthquake Spectra*, *Journal of Geophysical Research*, *Nature, Science,…*

- Conference Proceedings and Professional Meetings, e.g.,

  8NCEE, 13WCEE, ASCE Structures Congress and GeoCongress, American Geophysical Union Fall/Spring meetings and Chapman Conferences, Seismological Society of America meetings, ACES (APEC Cooperation for Earthquake Simulation) meetings, Center annual meetings

- Professional society magazines, e.g., ASCE *Civil Engineering*

- Workshop reports, e.g., NSF-funded workshops, NEHRP-funded workshops, etc.

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Dissemination of significant findings through technology transfer activities through active practitioner/industry and other agency involvement on projects, e.g.,

- MCEER – Earthquake Engineering to Extreme Events
  http://mceer.buffalo.edu/partnerships/spn/default.asp
- Mid-America Earthquake Center
  http://mae.cee.uiuc.edu/projects/industry_partner_projects.html
- Pacific Earthquake Engineering Research Center
  http://peer.berkeley.edu/bip/current_members.html
  http://peer.berkeley.edu/bip/technology_transfer.html
- NSF unsolicited and NEES research awards
- NSF 07-522 Grant Opportunities for Academic Liaison with Industry (GOALI)
  http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf07522
  e.g., GOALI: Development of a Seismic Design Methodology for Precast Floor Diaphragms (NSF Awards 0623952 and 0324522)

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NEHRP Seismic Waves Articles and NEES Webinars
htp://www.nehrp.gov/plans/index.htm#success
http://www.nees.org/Education/Webinars/

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Program Responsibility: In addition to supporting individual investigators, support university research consortia and centers for research in geosciences and in earthquake engineering

Recent and ongoing activities that support this Program Responsibility
(Also see May 2007 ACEHR slides)

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- Directorate for Geosciences
  - Incorporated Research Institutions for Seismology (consortium)
    http://www.iris.edu
  - Southern California Earthquake Center (center) co-funded w/USGS
    http://www.scec.org
  - Fundamental Research on Earthquakes (individual investigators(s))
  - EarthScope (Related non-NEHRP activity) (consortium)
    http://www.earthscope.org

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Related Non-NEHRP Activities

earthscope

San Andreas Fault Observatory at Depth (SAFOD)

- 2007 - Scientists drill into earthquake zone 10,000-plus feet beneath Earth's surface
- Location about 23 miles NE of Paso Robles near Parkfield
- http://www.nsf.gov/news/news_summ.jsp?cntn_id=110106

Drilling rig used to retrieve samples of rock from the San Andreas Fault.

Credit: *EarthScope*
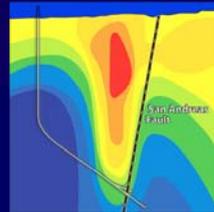
Credit: *Zina Deretsky, National Science Foundation*

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- Directorate for Engineering
  - Earthquake Engineering Research Centers (three centers)
    - MCEER-Earthquake Engineering to Extreme Events
      http://mceer.buffalo.edu
    - Mid-America Earthquake (MAE) Center
      http://mae.cee.uiuc.edu
    - Pacific Earthquake Engineering Research (PEER) Center
      http://peer.berkeley.edu
  - EERI's *Learning from Earthquakes* Program (multi-organizational investigators)
    http://www.eeri.org/lfe.html
  - National Hazards Center (center)
    http://www.colorado.edu/hazards/
  - George E. Brown, Jr. Network for Earthquake Engineering Simulation Operations (consortium)
    http://www.nees.org
  - George E. Brown, Jr. Network for Earthquake Engineering Simulation Research (individual investigators & consortia)
  - Fundamental Research on Earthquake Engineering (individual investigator(s))
  - Fundamental Research on Social Science and Public Policy Aspects of Disasters (individual investigator(s))

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NSF NEES Research Grand Challenge Projects

Consortia: involve researchers from multiple institutions, private companies, and professional organizations

- *NEESR-GC: Seismic Risk Mitigation for Port Systems*
  NSF Award 0530478
- *NEESR-GC: Mitigation of Risk Collapse of Vulnerable Concrete Buildings*
  NSF Award 0618804
- *NEESR-GC: Simulation of the Seismic Performance of Nonstructural Systems*
  NSF Award 0721399

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Program Responsibility: Work closely with the United States Geological Survey to identify geographic regions of national concern that should be the focus of targeted solicitations for earthquake-related research proposals

Recent and ongoing activities that support this Program Responsibility

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Directorate for Geosciences
- Southern California Earthquake Center (SCEC) – co-funded with USGS
- Coordination of awards with USGS external grants program
  - Continental Dynamics
    http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf04512
  - Geomorphology and Land Use Dynamics
    http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf06564
  - Geophysics
    http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf06546
  - Tectonics
    http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf06544
- USGS researchers involved in related non-NEHRP EarthScope activities

Directorate for Engineering
- Pacific Earthquake Engineering Research Center works with SCEC
- Mid-America Center works with USGS in Memphis
- EERI's *Learning from Earthquakes* Program coordinates with USGS

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Program Responsibility: Support research that improves the safety and performance of buildings, structures, and lifeline systems using large-scale experimental and computational facilities of the George E. Brown Jr. Network for Earthquake Engineering Simulation and other institutions engaged in research and the implementation of the National Earthquake Hazards Reduction Program

Recent and ongoing activities that support this
Program Responsibility

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Programs that fund seismic performance of buildings, structures, and lifelines:

- Earthquake engineering research centers
- Annual NEES research (NEESR) program solicitations
- Unsolicited proposal programs in the Division of Civil, Mechanical, and Manufacturing Innovation, e.g.,
  - Structural Systems and Hazard Mitigation of Structures
  - Geoenvironmental Engineering and GeoHazards Mitigation
  - Infrastructure Management and Hazard Response
- Other NSF programs

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MCEER Selected Research Accomplishments
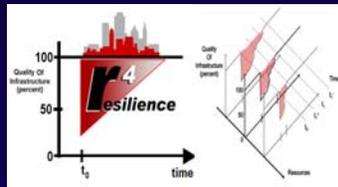
Community seismic resilience:
- Robustness
- Redundancy
- Rapidity
- Resourcefulness
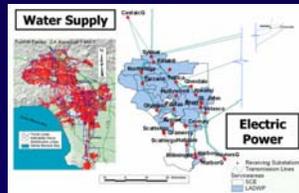
Lifeline facilities
LADWP Decision Support System – interactions between electric power and water distribution systems and heavily damaged network modeling

(Graphics courtesy of M. Bruneau, SUNY Buffalo)

Acute care facilities
- Base isolation
- Passive Dampers
- Decision-Support Tools
- Nonstructural systems

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MAE Center Selected Research Accomplishments

- Traffic Flow Models for Impact Assessment ⋯⋯▶

- NMSZ source models and attenuation
  Experimental (deep hole explosions) attenuation ⋯⋯▶
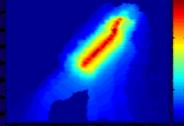
- DEEPSOIL: State-of-the-Art Site Response Analysis

- Uniform Reliability Fragility Relationships
  (85% of US bridges and 90% of US buildings

- Hazard-Independent Social-Economic Impact Models
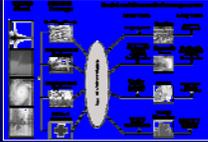
- MAEviz: Web-based open-source modular risk ⋯⋯▶
  assessment

(Graphics courtesy of A. Elnashai,
University of Illinois, Urbana-Champaign)

MAEViz
Mid-America Earthquake Center Seismic Loss Assessment System

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PEER Selected Research Accomplishments

Terashake2.1-Surface Cumu Vel Magnitude (250S)
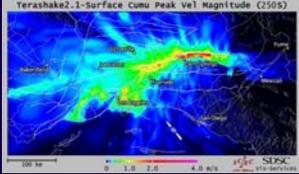
Collaborative research with SCEC and
earth sciences for ground motion
characterization
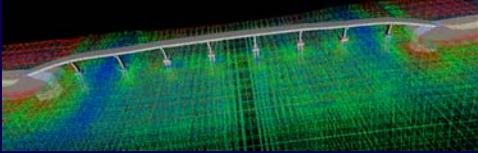
Advanced simulation and visualization for PBEE

Products include
- Loss estimation methodologies for structures
- Open System for Earthquake Engineering Simulation (OpenSees)
- Structural performance database for reinforced concrete columns
- BiSpec - Linear and Nonlinear spectra of earthquake records
- Next Generation Attenuation
- PEER Strong Motion Database

(Graphics provided by J. Moehle, University of California, Berkeley)

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NEES Research Program

- NEES Research Awards (4 program solicitations; 43 awards to date)
  - Grand Challenge (3)
  - Small Group (19)
  - Individual Investigator (11)
  - Payload (9)
  - Simulation Development (1)
  - Five awards underway to jointly use NEES and E-Defense facilities
- Examples of topical areas funded
  - Structural systems: Steel, reinforced concrete, composite, wood, masonry, port, bridges
  - Nonstructural: Plumbing, facade, ceiling-piping-partition
  - Geotechnical: Site characterization, liquefaction, foundations, lifelines/pipelines
  - Tsunami: Generation, modeling, performance based engineering
- NEES Workshops
  - Seismic Vulnerability of Existing Buildings (ATC, NSF Award 0702355)
  - World Forum (2006 San Francisco, 2007 Italy, 2008 China planned)

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Other examples of research funded

- Structural Systems and Hazard Mitigation of Structures
  - *A Comprehensive Approach for Incorporating the Effects of Near-Fault Directivity into Design Criteria (NSF Award 0726684)*
- Geoenvironmental Engineering and GeoHazards Mitigation
  - *Biomineralization within Soil to Mitigate Seismic-Induced Liquefaction (NSF Award 0700918)*
- Infrastructure Management and Hazard Response
  - *Investment Planning for Regional Natural Disaster Mitigation (NSF Award 0555738)*
- NSF 07-559 Accelerating Discovery in Science and Engineering through Petascale Simulations and Analysis (PetaApps)
  - *Towards Petascale Simulation of Urban Earthquake Impact* (NSF Award 0749227)
  - *Enabling Earthquake System Science Through Petascale Calculations (Petashake) (NSF Award 0749313)*

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Program Responsibility: Emphasize, in earthquake engineering research, development of economically feasible methods to retrofit existing buildings and to protect lifelines to mitigate earthquake damage

Recent and ongoing activities that support this Program Responsibility

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Retrofit techniques for existing buildings, e.g.,

- MCEER-Earthquake Engineering to Extreme Events
  - ➢ Seismic Retrofit of Acute Care Facilities
- Collaborative Research: Development of Innovative, Replaceable Coupling Beam Systems for Damage Mitigation in Coupled Walls (NSF Award 0653920)
- NEESR-GC: Mitigation of Collapse Risk in Vulnerable Concrete Buildings (NSF Award 0618804)
- NEESR-SG: Development of Performance Based Tsunami Engineering (NSF Award 0530759)
- NEESR-SG: Seismic Performance Assessment and Retrofit of Non-Ductile RC Frames with Infill Walls (NSF Award 0530709)
- NEESR-SG: Innovative Applications of Damage Tolerant Fiber-Reinforced Cementitious Materials for New Earthquake-Resistant Structural Systems and Retrofit of Existing Structures (NSF Award 0530383)

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Lifelines

- Pacific Earthquake Engineering Research Center
  - Over 110 lifeline projects
    - Primarily funded by California Department of Transportation, California Energy Commission, & Pacific Gas & Electric Company
    - *http://peer.berkeley.edu/research/lifelines.html*
  - Bridges and Transportation Systems
    - *http://peer.berkeley.edu/research/thrust_area_2.html*
- MCEER-Earthquake Engineering to Extreme Events
  - With Los Angeles Department of Water and Power
  - *http://mceer.buffalo.edu/research/lifelines/default.asp*
- Mid-America Earthquake Center
  - Transportation and other infrastructure systems
  - *http://mae.cee.uiuc.edu/projects/research_projects.html*
- Tri-Earthquake Engineering Research Centers
  - Transportation systems – REDARS and MAEviz
  - Electric power systems

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Lifelines (continued):

- NEES facilities capable of lifelines testing, e.g.,
  - Cornell's large displacement facility (http://nees.cornell.edu)
  - University of Nevada, Reno's triple bi-axial shake tables (http:/nees.unr.edu)
- NEES research awards, e.g.,
  - NEESR-SG: Damage Detection and Health Monitoring of Buried Pipelines after Earthquake-Induced Ground Movement (NSF Award 0724022)
  - NEESR-SG: Evaluation of Ground Rupture Effects on Critical Lifelines (NSF Award 0421142)
  - NEESR-SG: Soil Improvement Strategies to Mitigate Impact of Seismic Ground Failures via Novel Integration of Experiment and Simulation (NSF Award 0723697)
  - SGER: Large-Scale Validation of Seismic Performance of Bridge Columns (NSF Award 0738014)
  - NEESR-SG: Seismic Simulation and Design of Bridge Columns under Combined Actions, and Implications on System Response (NSF Award 0530737)
  - NEESR-SG: Seismic Performance of Bridge Systems with Conventional and Innovative Materials (NSF Award 0420347)
  - NEESR-II: Dynamic Passive Pressure on Full-Scale Pile Caps (NSF Award 0421312)

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Lifelines (continued):

- Unsolicited proposals to NSF Programs
    - Interdependent Response of Complex Urban Infrastructures Subjected to Multiple Hazards
      (NSF Award 0728040)
    - Travel Grant for First U.S.-Italy Seismic Design of Bridges Workshop
      (NSF Award 0731707)
    - Partial Support of the U.S.-Japan Panel on Wind and Seismic Effects
      (NSF Awards 0745730, 0647347)
    - Time-Dependent Instability in Rock Masses: Understanding, Prediction and Prevention
      (NSF Award 0653942)
    - SGER: Soil-Structure Interaction of Bridge Columns in Frozen Environments
      (NSF Award 0502117)

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NEESR-SG: Seismic Performance of Bridge Systems with Conventional and Innovative Materials
(NSF Award 0420347)
http://nees.unr.edu/4-spancebridges/

February 2007 test

- University of Nevada, Reno NEES Site – Three Shake Tables

- 100-ft long, 15-ft tall, 4-span bridge model

Two more bridges to be tested over next two years

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Program Responsibility: Support research that studies the political, economic, and social factors that influence the implementation of hazard reduction measures

Recent and ongoing activities that support this Program Responsibility

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Earthquake Engineering Research Centers, e.g.,
- MCEER, e.g.,
  - http://mceer.buffalo.edu/research/remote_sensing/default.asp
  - http://mceer.buffalo.edu/research/Response_and_Recovery/default.asp
- Mid-America Earthquake Center, e.g.,
  - http://mae.cee.uiuc.edu/software_and_tools/maeviz.html
- Pacific Earthquake Engineering Research Center, e.g.,
  - http://peer.berkeley.edu/research/funded_projects_c.html
- Tri-center
  - *Natural Hazards Review*, May 2004 "Deciding What's Safe"
  - FEMA-funded "Promoting Seismic Safety - Guidance for Advocates"

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- NEESR Grand Challenge Research Awards
- Natural Hazards Center
- EERI's *Learning from Earthquakes* program
- EERI's *Future of Interdisciplinary Research* Workshop, September 2007
- NSF Engineering unsolicited awards
  - Seven SGER awards to study the 2005 Hurricane Katrina
  - Prevalence and Preparedness for Conjoint Natural and Technological Disasters (NSF Award 0750166)
  - Investment Planning for Regional Natural Disaster Mitigation (NSF Award 0555738)
  - Measuring Cross-Community Disaster Preparedness and Resiliency: Theoretical and Practical Application Development (NSF Award 0408856)
- NSF Human and Social Dynamics Priority Area
  - Six SGER awards to study the 2004 Indian Ocean tsunami
  - DRU: Modeling Community Response and Economic Impacts of Risk Amplification Following a Terrorist Strike (NSF Award 0728934)
  - DRU: Designing Resilience for Communities at Risk: Decision Support for Collective Action under Stress (NSF Award 0729456)
  - DRU: Analysis of Current HAZMAT Response Capabilities and the Impact of Human Robot Interaction on Risk Mitigation (NSF Award 0623083)

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Program Responsibility: Include to the maximum extent practicable diverse institutions, including Historically Black Colleges and Universities and those serving large proportions of Hispanics, Native Americans, Asian-Pacific Americans, and other underrepresented populations

Recent and ongoing activities that support this Program Responsibility

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NSF Merit Review Process – NSB-approved merit review criteria
http://www.nsf.gov/bfa/dias/policy/meritreview/

> What is the intellectual merit of the proposed activity?
> What are the broader impacts of the proposed activity?
- How well does the activity advance discovery and understanding while promoting teaching, training, and learning?
- **How well does the proposed activity broaden the participation of underrepresented groups (e.g., gender, ethnicity, disability, geographic, etc.)?**
- To what extent will it enhance the infrastructure for research and education, such as facilities, instrumentation, networks, and partnerships?
- Will the results be disseminated broadly to enhance scientific and technological understanding?
- What may be the benefits of the proposed activity to society?

NSF Proposals are evaluated against these two merit review criteria

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- Summer Research Experiences for Undergraduate Students Sites
  - Southern California Earthquake Center (SCEC/UseIT)
  - MCEER – Earthquake Engineering to Extreme Events
  - Mid-America Earthquake Center
  - Pacific Earthquake Engineering Research Center
  - NEES Consortium, Inc. (NEESreu)
  - REU Site on Development of Enhanced Materials and Structural Assemblages for Seismic Performance Evaluation Studies (NSF Award 0552786)
- NSF Supplements - Research Experiences for Undergraduates
- NSF Education and Human Resource Directorate Programs
  - Deployment and Integration of Instructional Shake Tables Using the NEES Cyberinfrastructure (NSF Award DUE-0618605)
- NSF Office of Cyberinfrastructure - Cyberinfrastructure-Teams (CI-Team) http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=12782&from=fund
  - CI-TEAM Implementation Project: Using Cyberinfrastructure to Develop Next Generation Civil Infrastructure (NSF Award 0636300)
  - CI-TEAM Demonstration: Tsunami Shelter Challenge (NSF Award 0636286)
  - Advancement of Cyberinfrastructure Careers through Earthquake System Science (ACCESS) (NSF Award 0636438)

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Tri-EERC Collaborations
Selected Education Accomplishments

- Tri-Center REU Program
- Tri-Center Student Leadership Council
- Tri-Center Student Field Missions
  - 2006 New Zealand
  - 2005 Greece
  - 2004 Japan
  - 2003 Italy
  - 2002 Taiwan
- Tri-Center Student Seminars
- Tri-Center Teaching Modules

Photos from
http://mceer.buffalo.edu

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NEES Research Program Solicitations - Eligibility Criterion
(NSF 06-504, NSF 07-506, NSF 08-xxx)

Research team: The project team for Individual Investigator, Small Group, and Grand Challenge proposals must include one of the following two options in the research activities:

1. Faculty and students involved in the research activities from a predominantly undergraduate institution, women's college, Historically Black College or University, Hispanic-Serving Institution, Indian Tribally Controlled College or University, Alaska Native-Serving Institution, or Native Hawaiian-Serving Institution.

2. A partnership to integrate the proposed research activities into an existing NSF-funded Louis Stokes Alliance for Minority Participation (LSAMP), Alliance for Graduate Education and the Professoriate (AGEP), or Center of Research Excellence in Science and Technology (CREST) project. Information on LSAMP, AGEP, and CREST programs and awards made by these programs may be found on the NSF web site for the Division of Human Resource Development in the Directorate for Education and Human Resources (http://www.nsf.gov/div/index.jsp?div=HRD)

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Program Responsibility: Develop, in conjunction with the Federal Emergency Management Agency, the National Institute of Standards and Technology, and the United States Geological Survey, a comprehensive plan for earthquake engineering research to effectively use existing testing facilities and laboratories (in existence at the time of the development of the plan), upgrade facilities and equipment as needed, and integrate new, innovative testing approaches to the research infrastructure in a systematic manner

Recent and ongoing activities that support this Program Responsibility

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Timeline for NEES development and construction

Ref: "Setting Priorities for Large Research Facility Projects supported by the National Science Foundation," The National Academies, 2004, Table C-9

- 1995: EERI workshop co-funded by NSF and NIST - "*Assessment of Earthquake Engineering Research and Testing Capabilities in the United States*," EERI Publication WP-01
- FY 1996-FY 1998: Additional planning workshops and meetings
- FY 1999: National Science Board approves inclusion of NEES in FY 2000 budget
- FY 2000-FY 2004: NSF NEES Major Research and Facilities Construction
  - 15 equipment sites (2 NSF program solicitations)
  - System integration (1 program solicitation)
  - Consortium development (1 program solicitation)
- FY 2005 – FY 2014: NSF NEES Operations and Research

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NEES Infrastructure – 15 experimental facilities and cyberinfrastructure

- Large to full scale testing, e.g.,
  - Structures, geostructures, subassemblages
  - Multi-span and long span systems
  - Lifeline/pipeline/utility/buried systems
  - Nonstructural components
  - Soil-foundation-structure interaction
  - Site characterization, liquefaction, and lateral spreading
  - Tsunami modeling
  - Hybrid simulation (e.g., geographically distributed/multiple sites)
  - Telepresence
- Research projects utilize multiple NEES facilities
- Data curated and archived in NEES central data repository
- Partnership with Japan's E-Defense shake table facility

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Research Needs Reports Referenced in NSF NEES Research Solicitations

- Preventing Earthquake Disasters: The Grand Challenge in Earthquake Engineering – A Research Agenda for the Network for Earthquake Engineering Simulation (NEES) *http://www.nap.edu/catalog/10799.html?ec_44*

- Securing Society Against Catastrophic Earthquake Losses: A Research and Outreach Plan in Earthquake Engineering http://www.eeri.org/cds_publications/securing_society.pdf

- *Research Needs Report,* Building Seismic Safety Council *http://www.bssconline.org*

- *ATC-EERI NEHRP Workshop on Meeting the Challenges of Existing Buildings,* San Francisco, CA September 2007 to be referenced in NSF 08-xxx (co-funded with FEMA and NIST)

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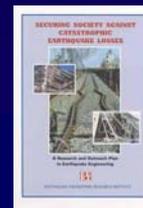
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Japan's Earth-Defense (E-Defense) Shake Table
National Research Institute for Earth Science and Disaster Prevention (NIED)
Hyogo Earthquake Engineering Research Center
Miki, Hyogo Prefecture, Japan (Kobe, Japan)
http://www.bosai.go.jp/hyogo/ehyogo/

Full-scale earthquake simulation test on reinforced concrete building structure using E-Defense on January 2006. The test was part of five-year national research project - DaiDaiToku. The specimen was a 6-story wall-frame structure, 2 by 3 bays. NSF has agreement w/MEXT and NEESinc has agreement w/NIED for joint utilization of NEES and E-Defense facilities.

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Planned U.S. NEESR Projects to use E-Defense
(6th NEES/E-Defense Planning Meeting 9/27-29/2007)

SGER: Large-Scale Tests of a Bridge Column Using the E-Defense Shaking Table
NSF Award 0738014
PI: Stephen Mahin, University of California, Berkeley – Winter 2008

NEESR-SG: NEESWood: Development of a Performance-Based Seismic Design Philosophy for Mid-Rise Woodframe Construction
NSF Award 0529903
PI: John van de Lindt, Colorado State University – Fall 2008

NEESR-SG: Controlled Rocking of Steel-Framed Buildings with Replaceable Energy Dissipating Fuses
NSF Award 0530756
PI: Gregory Deierlein, Stanford University – Summer 2009

NEESR-SG: International Hybrid Simulation of Tomorrow's Braced Frame Systems
NSF Award 0619161
PI: Charles Roeder, University of Washington – Summer 2009

NEESR-SG: TIPS: Tools to Facilitate Widespread Use of Isolation and Protective Systems, a NEES/E Defense Collaboration
NSF Award 0724208
PI: Keri Ryan, Utah State University - TBA

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NEES Distributed Bridge Testing - UIUC, RPI, and Lehigh
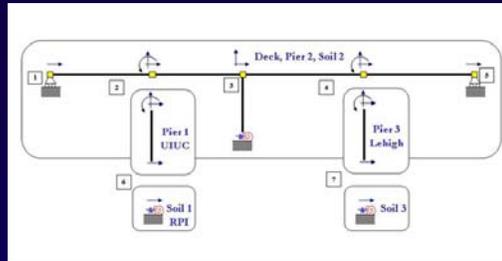
Substructuring
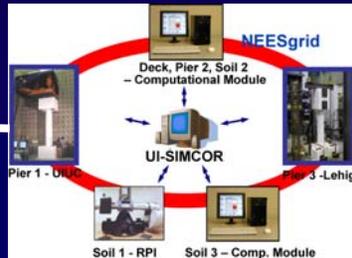
Distributed Hybrid Simulation Test

(Graphics courtesy of A. Elnashai, UIUC)

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