



Mid-America Earthquake Center

University of Illinois at Urbana-Champaign (lead institution)

Reducing earthquake losses through research and education

Though earthquakes in the eastern and central United States are infrequent, they are indeed possible and their consequences can be quite severe. A sequence of three earthquakes from December of 1811 until February of 1812 near the town of New Madrid, Missouri, represented the most violent shaking in the history of recorded seismicity in the contiguous United States. The estimated economic loss from a repeat of one of these events is projected to be in the range of \$200 billion. Research and educational programs of the Mid-America Earthquake (MAE) Center are directed at strategies and techniques that will reduce the potential loss from extreme seismic events as well as less-intense, but more probable, earthquakes. Thrust areas of the MAE Center focus on reducing economic losses and improving human safety across community-wide systems and national networks of the existing infrastructure. Parallel center research is directed at improving the understanding of seismic hazards in Mid-America.

Research

The goals of the MAE Center are consistent with those of the National Earthquake Hazards Reduction Program. They are focused on reducing losses through improved evaluations of the seismic hazard in the central and eastern United States, and on creating innovative retrofit strategies for communities in Mid-America and the national transportation networks that serve the region. Research programs are structured to:

- Improve engineering of the built environment
- Improve data for construction standards and codes
- Continue development of seismic hazards and risk assessment tools
- Develop an understanding of societal impacts and responses related to earthquake hazard mitigation.

MAE Center projects aim specifically at a systematic seismic risk reduction plan to reduce losses to communities and networks. Research addresses barriers related to: understanding of earthquake effects and how structures respond to them, estimating anticipated losses both locally and nationally, assessing economic impact of retrofit solutions, and implementing measures to improve seismic safety.

Functionality of vulnerable bridges and essential buildings is studied in the context of projected losses to a community or a national network. Research is also directed at technologies needed to enable system-wide loss reductions, and includes development of: particular types of retrofit methods, more accurate hazard maps that better depict the risk in Mid-America, software for evaluating seismic response of retrofitted structures, and guidelines for enhanced rehabilitation of buildings and bridges.

Projects of the MAE Center are organized to provide team integration, but are limited to those that will make

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Partner Institutions:

- Georgia Institute of Technology
- University of Memphis
- MIT
- St. Louis University
- Texas A&M University
- Washington University



Damage from the 1886 Charleston, SC, earthquake

a difference with regard to the Mid-America earthquake problem. Seismological studies are directed at the New Madrid seismic zone and will broaden to other areas east of the Rockies as the center grows. Geotechnical investigations are germane to foundation and soil problems relevant to the geology of the eastern and central states. Structural engineering studies are limited to evaluation and retrofit of existing construction typically found in lower seismic exposures. Social and economic studies concentrate on problems associated with the occurrence of infrequent, but high-consequence earthquakes in the urban centers of Mid-America.

Sample communities and transportation networks, as well as actual building and bridge retrofit projects, are used as proof-of-concept testbeds to confirm research results and enhance their implementation potential.

Education

One of the key challenges in reducing earthquake losses in the eastern half of the country is to make people aware of their level of seismic risk and what they should be doing to mitigate effects of a damaging earthquake. Education is promoted by the Center to several groups ranging from students and teachers at primary and secondary schools, undergraduate and graduate students, engineering practitioners and other decision makers, and the general public. The education program is actively sponsoring workshops, symposia, and conferences on earthquake topics related to Mid-America, as well as development of instructional aides for K-12, software and equipment to enhance undergraduate education of earthquake effects on structures, graduate teaching modules to improve the presentation of advanced technological aspects of earthquake engineering, and innovative museum displays and virtual reality demonstrations to enhance public awareness of future seismic hazards and ways to mitigate their effects.

By working together with faculty in multi-institutional, cross-disciplinary teams, student researchers assist in developing

practical solutions to earthquake problems. Graduate research assistants from each institution join together at an annual symposium, take part in planning of research with end users of their research at program coordination meetings, have a voice in Center activities through a student leadership council, and may participate in an industry internship program. A goal-setting awards program sends top graduate research assistants to Europe each year to visit post-earthquake sites. A summer program, Research Experiences for Undergraduates (REU), enables exceptional students from across the United States to conduct research in the Center laboratories.

Industrial Collaboration/ Technology Transfer

The Business, Industry and Government Partnership program provides interaction between Center investigators and practitioners. Potential end users of the Center's research actively participate in program coordination meetings of each of the three thrust areas as well as in Center-sponsored seminars, workshops, and conferences. A subscription service provides preferred access to the Center's products and permits interested industry and government affiliates to become a part of the MAE Center family. A direct sponsored research program is in place to solve specific earthquake-related problems of industry.

Facilities

Distributed among seven core institutions, the Center operates as a virtual center where researchers are separated geographically but linked via electronic means to research problems in coordinated teams. The MAE Center central administrative offices are located in the Newmark Civil Engineering Laboratory at the University of Illinois at Urbana-Champaign. Testing facilities include shaking tables and large-scale reactions walls for structural engineering research, centrifuges and mobile test facilities for geotechnical engineering, and seismological test equipment including a network of ground motion instrumentation in the New Madrid seismic zone.

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