

MCEER HIGHWAY RESEARCH

RESEARCH ADDRESSES SEISMIC VULNERABILITY OF HIGHWAYS NATIONWIDE

HIGHWAY RESEARCH EXTENDED UNDER 6-YEAR, \$10.8 MILLION FHWA CONTRACT

MCEER's 6-year, \$10.8 million contract from the Federal Highway Administration (FHWA) calls on the Center to extend its research on the seismic vulnerability of the national highway system. Studies are intended to build on MCEER advancements made under previous and current FHWA contracts.

Awarded in September of 1998 and authorized under the federal government's Transportation Equity Act for the 21st Century, the contract focuses on several special issues critical to the nation's highway infrastructure. These include:

- Development of formal loss estimation methodologies for highway systems — extending work done by MCEER on a system-wide highway seismic risk assessment methodology.
- Development of a seismic design and retrofit manual for long-span bridges — to complement a three-volume seismic retrofit manual for typical highway bridges and structures, currently being prepared by MCEER for FHWA (see "Manual Aids Highway Engineers ...").
- Development and improvement of "smart" or "intelligent" earthquake protective systems, including bearings and dampers, specialty materials, and other passive and hybrid semi-active systems.
- Studies related to foundation design and soil behavior and response, including large pile group

behavior, long period ground motions, and improvements in ground remediation technologies.

The contract also calls for special studies on the development of post-earthquake non-destructive technologies to assess condition of previously retrofitted bridge components; support for NCHRP Project 12-49 (see "MCEER-ATC ..."); and the design and installation of a system to record seismic free field and structural response data from the Cape Girardeau, Missouri cable-stayed bridge, currently under construction across the Mississippi River.



MCEER highway research seeks to develop tools and methods for seismic design and retrofit of our nation's highway system.

MCEER HIGHWAY RESEARCH - SELECTED PROJECTS

The MCEER Highway Project consists of research studies and contract work. All focus on the evaluation or reduction of the seismic vulnerability of highway systems and components in the United States. Most address both existing transportation infrastructure and new and future highway construction. Representative projects and sponsors include:

SAFEGUARDING OUR NATION'S HIGHWAYS

Improving the seismic performance and reliability of the nation's highway system is the overall aim of MCEER's Highway Project. The project was initiated in the fall of 1992 with two Federal Highway Administration (FHWA) contracts totaling more than \$14 million. In 1998, MCEER received an additional 6-year, \$10.8 million FHWA contract to expand on work begun in 1992 (see "Highway Research Extended ..."). Research is augmented by additional contracts from FHWA and other agencies.

The project uniquely examines the impact of earthquakes on the highway system as an integrated network, rather than a collection of individual roads, bridges, embankments, tunnels, etc. Projects seek to ensure the usability of highways following earthquakes, by improving performance of all interconnected components.

Overall goals are to improve understanding of the seismic hazards to highways and to improve and develop analysis methods, screening procedures and additional tools, retrofit technologies, design criteria, and other approaches to reduce seismic vulnerability of existing and future highway infrastructure.

Studies examine:

- seismic hazards and ground motion
- soils and foundations
- structural systems and components
- performance criteria
- analysis and design issues
- intelligent and protective systems

In all, MCEER highway research involves more than 40 investigators from over 20 institutions throughout the United States.

■ Revised Seismic Design Specifications and Commentary for AASHTO "Standard Specifications for Highway Bridges" (NCHRP Project 20-7/45, 1990-1993)

■ Seismic Vulnerability of New Highway Construction (FHWA Project 112, 1992-1998)

■ Seismic Vulnerability of Existing Highway Construction (FHWA Project 106, 1992-2000)

■ Seismic Hazard Assessment of the Queensboro Bridge (New York City DOT, 1993-1994)

■ Bridge Seismic Vulnerability Screening Procedure (New York State, 1994-1995)

■ Seismic Performance of Timber Highway Bridges (FHWA, 1996-1999)

■ Comprehensive Specifications for the Seismic Design of Bridges (NCHRP Project 12-49, 1998-2001)

■ Seismic Vulnerability of the Highway System (FHWA, 1998-2004)

HIGHWAY PROJECT HIGHLIGHTS

Below are some examples of contributions that MCEER's Highway Project has made to improving the seismic performance of the national highway system.

CODES & STANDARDS

■ AASHTO Standard Specifications for Highway Bridges - Division I-A, Seismic Design — updated and revised seismic design specifications for highway bridges, adopted in 1994.

■ AASHTO Commentary on Standard Specifications for Highway Bridges — commentary to the above, adopted in 1997.

■ New York State DOT Bridge Safety Assurance - Seismic Vulnerability Manual — developed seismic vulnerability screening and ranking procedures, published in 1995.

DESIGN CRITERIA AND METHODS

■ Seismic Design Criteria for Bridges and Other Structures (MCEER 97-0002) — prepared for MCEER by the Applied Technology Council (ATC). Contains a review of national and international approaches and criteria used in the seismic design of bridges, tunnels, and retaining structures.

TOOLS FOR EVALUATION AND ANALYSIS

■ Screening Guide for Rapid Assessment of Liquefaction Hazard at Highway Bridge Sites (MCEER 98-0005) - (see "Screening Guide...").

■ IDARC Bridge — A Computational Platform for Seismic Damage Assessment of Bridge Structures - detailed in MCEER 98-0011.

RETROFITTING TOOLS & TECHNOLOGIES

■ Seismic Retrofitting Manuals for Highway Systems (see "Manual...").

■ Earthquake Protective Systems — studies have addressed optimizing the design and performance of various earthquake protective systems. Results have been incorporated into the newly-issued AASHTO Guide Specifications for Seismic Isolation Design (2nd Edition, 1999).

SYSTEM PERFORMANCE AND SOCIETAL IMPACTS

■ Queensboro Bridge Seismic Evaluation (1994) — establishment of the site-specific seismic response spectra and time histories at the foundation level for each of the major structures comprising the Queensboro Bridge, one of the five major bridges linking Manhattan and Queens in New York City.

■ Seismic Risk Assessment (SRA) Methodology — a formal seismic risk assessment methodology evaluating an earthquake's impact on a city, county or regional highway system or network (see "Manual...").

CURRENT RESEARCH PARTNERS

Applied Technology Council
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SPONSORS

Federal Highway Administration
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