Headquartered at the State University of New York at Buffalo

The National Center for Earthquake Engineering Research

Established in September of 1986, the National Center for Earthquake Engineering Research (NCEER) is headquartered at the State University of New York at Buffalo. Funded initially by a five-year $25 million grant from the National Science Foundation (NSF) with matching funds from New York State, NCEER was awarded a second five-year grant from the NSF totaling $21 million, in May 1991. Matching funding continues to be provided annually by New York State through the New York State Science and Technology Foundation. In September 1992, NCEER received two contracts from the Federal Highway Administration totaling $14.2 million over six years, for research into the seismic vulnerability of the national highway system. NCEER also derives funding from the Federal Emergency Management Agency (FEMA), other state governments, academic institutions, public corporations, foreign governments and private industry.

NCEER's mission is to address the nationwide threat of earthquakes and to advance engineering, planning and preparedness to minimize the damaging effects that earthquakes have on buildings, civil infrastructure and socioeconomic systems. To this end, NCEER executes a systematic program that includes problem-solving research, transfer and sharing of technology and information, implementation of findings and public education. NCEER is a research consortium that annually involves approximately 100 researchers at institutions throughout the United States and the world.

RESEARCH ACCOMPLISHMENTS

1986-1994

The National Center for Earthquake Engineering Research
Headquartered at the University at Buffalo

September, 1994

National Center for Earthquake Engineering Research
State University of New York at Buffalo
Red Jacket Quadrangle, Buffalo, NY 14261

Introduction

The research accomplishments of the National Center for Earthquake Engineering Research are as numerous as they are varied. Since the Center was established in 1986 by the National Science Foundation, its mission has been to advance the state-of-the-art in earthquake engineering by conducting systematic and sustained research. The Center's strategy is to assemble multidisciplinary teams of researchers and practitioners from a broad cross-section of the earthquake hazard mitigation community. These teams pursue problem-focused studies and for the last three years have addressed the seismic evaluation and retrofit of the civil infrastructure.

Accordingly, the Center's research and implementation plan involves basic and applied research (knowledge discovery) as well as implementation activities and demonstration projects (knowledge transfer). The plan has four major Projects, one for each element of the built environment i.e. one each for buildings and their nonstructural components, lifelines, and highways (including bridges). Research teams are assembled from various disciplines and include experts in seismology, geotechnical and structural engineering, risk and reliability, and the social sciences. They are drawn from throughout the United States and overseas and comprise approximately 100 investigators from 50 institutions in 20 states and 5 countries. This consortium-approach embraces academia, private industry, professional practice and the public sector (federal, state and local government officials). In addition, the Center has contributed to knowledge transfer through its publications and information services and to education and public awareness.

Since it is not possible to describe every Center accomplishment in a report of this size, a cross-section of activities is given to illustrate the content and range of the Center's achievements. The contributions to lifeline engineering and the development of smart materials and intelligent protective systems for buildings and bridges are noteworthy. But also deserving attention is the effort to integrate social sciences with engineering and to address the socio-economic impacts of earthquakes in a logical way. Center investigators have also been effective in the code development process and have influenced the shape and direction of future codes and standards for both existing and new construction.

As noted above, this collection of technical papers is a selection of the Center's

accomplishments during the period 1986 to 1994. It has been published to inform earthquake hazard researchers, professionals and informed lay persons about the knowledge discovered and/or implemented during these past eight years. Each paper identifies the responsible research team and cooperating institutions. A list of references and related publications is included for further reading.

Recent assessments of the National Earthquake Hazards Reduction Program (NEHRP) have again recognized that a complex problem such as earthquake hazard mitigation requires a team of multi-disciplinary specialists to join forces to address the problem in a more effective way than in the past. This team should perform basic research in a variety of disciplines followed by coordinated applied studies and the transfer of results to the practicing community. The National Science Foundation established NCEER eight years ago with this objective in mind and the investment is beginning to yield dividends. The accomplishments described in this report demonstrate the validity of the multi-disciplinary, systematic approach and its importance to advancing the state-of-the-art in a timely manner.

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Buildings and Nonstructural Components

Earthquake damage to buildings and their nonstructural components can lead to significant loss of life and billion dollar losses due to property damage and business interruption. To address this problem, the Center's Building Project is directed towards two classes of buildings that are commonly found in the United States, namely the unreinforced masonry building and the lightly reinforced concrete building. Both are known to be vulnerable to even moderate or low levels of ground shaking. The objective here is to develop rational methods for evaluating these structures and to devise cost-effective methods of retrofitting them, so as to provide an adequate level of seismic resistance. Areas that have been studied include defining the seismic and geotechnical hazard, refining conventional strengthening methods, applying smart materials, developing innovative protective systems, assessing fragility functions, improving loss estimation methodologies, performing epidemiological studies, and estimating the building stock. The Nonstructural Components Project is focused on minimizing the damage to the equipment and contents of buildings using a twofold approach. First, improved methods of analysis and design have been developed and second, innovative support systems have been devised for specialized items such as computer mainframes, hospital equipment and museum artifacts. Similar areas have been studied as for the Building Project but with emphasis on risk analysis, intelligent and protective systems, and the socioeconomic impacts of damage to nonstructural components. The development of codes and standards for improving the performance of both existing and future construction is a goal of both Projects.