

BEYOND SEPTEMBER 11TH

AN ACCOUNT OF POST-DISASTER RESEARCH

A cooperative project of the

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ACKNOWLEDGMENTS

Beginning in the early afternoon of September 11, 2001, the Natural Hazards Center, like many other organizations, focused all of its efforts on doing what it could to contribute to the response to and recovery from the terrorist attacks of that day. In our case, it was to use our expertise, under the foresighted leadership of Mary Fran Myers, Co-Director, to mobilize as many teams of scholars as possible to conduct field investigations in the immediate aftermath of the events. These investigations were essential, we believed, in order to collect data, witness what was happening, and capture the lessons that were sure to emerge.

We gratefully acknowledge all of those who responded to the call, as well as the National Science Foundation, which provided us additional funds to support the work of the scholars in the field. Further, we acknowledge the ready willingness of both the Public Entity Risk Institute and the Institute for Civil Infrastructure Systems to offer financial support to ensure that the findings of the research could be published together in this volume and widely distributed.

The production of this book was made possible with the usual invaluable input and support of every member of the Hazards Center staff and especially Mary Fran Myers, Lori Peek, and Laura Musser. The Hazards Center gratefully acknowledges the grant received from the National Science Foundation through its Research Experience for Undergraduates program, which made it possible for Musser to participate in the production of the book. Helpful substantive, editorial, and other input on various aspects of the book's development was received from Diane Adams, David Butler, Mike Campbell, Andre Filiatrault, Sarah Michaels, JoAnne Monday, and Rae Zimmerman.

Earlier drafts of this volume were improved as a result of the efforts of more than 40 anonymous reviewers, all of whom were generous with their time, critical in their thinking, and judicious with their suggestions.

The Hazards Center extends its appreciation to the authors whose work is represented here. Throughout the production process they were cooperative, cheerful, and patient.

Finally, we offer our sincere thanks to the many citizens and government officials of New York, Washington, D.C., and Pennsylvania, who allowed the authors of these papers to observe and question them during what was likely the most traumatic time of their lives.

— Jacquelyn L. Monday
Editor

PREFACE

Disasters affect our built environment as well as our social, political, economic, and cultural systems. The threats from most disasters can never be eliminated. Hazards, many of which are natural geophysical and meteorological phenomena, will always be with us. Therefore, combined with our efforts at implementing structural and non-structural mitigation measures, it is our preparedness for the known and our agility in handling the unknown that will determine the extent of damage, loss, and destruction that our systems suffer. When disaster strikes, then, it is imperative to utilize the event to inform research aimed at the mitigation of, preparedness for, response to, and recovery from hazardous events that are extreme enough to cause disaster. Our aim must be to design our physical and social structures to be “disaster resilient.”

The Division of Civil and Mechanical Systems (CMS) in the Directorate for Engineering of the National Science Foundation (NSF) has a long history of responding to requests for rapid reconnaissance and research in the wake of natural and technological disasters. For over 25 years, CMS, as a key player in the National Earthquake Hazard Reduction Program, has funded both Small Grants for Exploratory Research (SGER) and long-range strategic research on the impacts of earthquakes, landslides, hurricanes, tornados, tsunamis, floods, releases of toxic materials and technological accidents, and other hazards to the built environment and those social systems governing mitigation, preparedness, emergency response, and recovery. NSF’s SGER program and the University of Colorado–Boulder’s Natural Hazards Research and Applications Information Center’s (NHRAIC’s) Quick Response (QR) program provide support for researchers to collect “perishable” data during the immediate post-impact period of disasters. The NSF-sponsored “Learning from Earthquakes” program administered through the Earthquake Engineering Research Institute has played an important role in undertaking these investigations for decades.

On September 11, 2001, each of these disaster response mechanisms was put to a new test, as were the emergency response capabilities of New York, Washington, D.C., Pennsylvania, and the rest of the nation. Key CMS Program Directors reflected on that day.

Miriam Heller, IIS Program Director—

The traffic in Alexandria, Virginia, seemed purposeful in keeping me from the workshop I helped to support, “Mitigating the Vulnerability of Critical Infrastructures to Catastrophic Failures.” The workshop represented some of NSF’s targeted efforts to translate and expand research from natural disasters’ effects on the built environment to critical infrastructure protection. At 8:45 a.m., the words on my radio did not clearly register in my mind, “We interrupt our regular broadcast . . . a plane appears to have crashed into the north tower of the World Trade Center.” Within 30 minutes of my arrival, another workshop sponsor from the Office of Science and Technology Policy

received a phone call explaining that the Pentagon had been attacked. We were unaware that the workshop's main topic, infrastructure interdependencies and cascading failures, was playing out in New York and the Washington, D.C. metropolitan area as each of the eight critical infrastructures was disrupted. With all air travel suspended and phone lines jammed, we managed to ensure that stranded workshop participants would have lodging. We cancelled the remainder of the workshop to head to our respective zones of safety.

The Gujarat and Nisqually earthquakes would normally have presaged imminent SGER requests. Yet, getting to my family and finding my way home amidst road closures leading to the Capitol and emergency routes to the Pentagon displaced all thoughts of work. When I reached home at 3:00 p.m., I was jarred into action with the first request for additional support for QR grants from Mary Fran Myers at NHRAIC. I immediately contacted the CMS Program Officers who were in town, Joy Pauschke and Rick Fragaszy, to find how to respond. It was the end of the fiscal year and my budget was spent. Over the next two weeks, the NSF system moved with remarkable swiftness to match that of the proposing investigators, finding monies, reviewing proposals, and making awards. By September 26, pertinent information on the awardees was compiled and sent off to the Institute for Civil Infrastructure Systems in New York, whose assistance had been enlisted in the coordination of the researchers.

Joy Pauschke, NEES Program Director—

My family in Chicago contacted me via phone as soon as the first World Trade Center tower was hit. For the next hour or so, most of the NSF staff stood in front of the television to watch the tragic events of the day unfold. About mid-morning, there was collective uncertainty as to whether downtown Washington, D.C. and/or suburban Virginia had also been hit. (The Pentagon is about 8 miles from NSF). Finally, around 10:30 a.m., the Office of Personnel Management dismissed all federal employees for the day. The next day was a federal unscheduled leave day.

Making the NSF SGER rapid response awards between September 11 and 30, 2001, was the result of the great *esprit de corps* and teamwork across all of NSF. As the acting Division Director for CMS, I attended the Engineering Management Group meeting on September 12 and explained the inquiries about rapid response SGER requests that NSF had already received. Since the divisional programs at NSF were already spent out by mid-August, any remaining fiscal year 2001 NSF funding was at the Engineering Directorate or Office of Director levels. The Directorate for Engineering and the Office of the Director, through the Budget Division, quite expediently transferred \$100,000 and \$200,000, respectively, to CMS and to Engineering Education and Centers Divisions for rapid response awards. CMS Program Officers immediately processed the rapid response proposals submitted through

FastLane. Thanks to the commitment by the Division of Grants and Agreements to process all the rapid response awards, NSF was able to make these awards by September 30, 2001.

Richard Fragaszy, GGH Program Director—

I was in my office on September 11 when Joy Pauschke burst in to tell me about the first airplane crashing into the World Trade Center. My first thought was that she was pretty convincing, but it must be a joke. The next hours were spent watching the news and still not really believing what had happened. As a native of Manhattan, I was very familiar with the World Trade Center area, and had many friends and relatives in the city. Fortunately, it turned out they were all safe. The next day at work we all had the same response to the disaster—what can we do? Under Joy’s leadership, resources became available and we began talking with researchers about immediate needs for data collection. We were all amazed, and proud, of the speed at which everyone at NSF worked together to fund a significant number of awards and supplements. When reading this volume, it should be kept in mind that there was no solicitation, no time to do in-depth literature reviews, no time to think and plan quietly. The work reported here was done by a dedicated group of investigators who dropped everything to do the best they could under very trying times. It is a tribute to them that so much valuable work was accomplished so quickly.

Priscilla Nelson, CMS Division Director—

I was attending U.S. Nuclear Waste Technical Review Board meetings in Las Vegas when the first plane hit. Actually, the meetings hadn’t started yet, but when I came down the elevator and saw a large group of people gathered around a television, I was quickly informed as to what was happening. The initial thinking was that the first crash was an isolated occurrence—an accident. This perspective soon gave way to the horrible realization that this was not an accident, and that the world had changed. I tried to call in to NSF, but couldn’t get a phone line; couldn’t send an e-mail.

The meeting in Las Vegas actually started and covered most of the agenda. Presenters were in shock, and no one was focusing well on the business at hand. The rest of the day, the major topic of conversation was how to leave Las Vegas. Questions about whether “it” was over continued, and made me realize that the knowledge that something was “over” was incredibly important in determining when recovery could begin.

The next day, I was finally able to connect to NSF and with my extended family. The family were shaken but well, and the NSF program officers were superb— finding the resources for awards (the leadership at NSF really came through on that), coordinating with the Division of Grants and Agreements to get awards out quickly. The Civil and Mechanical Systems Division operated

like a system of talented people running with smoothness, calmness, and efficiency. Joy, Rick, and Miriam did a superb job.

Ultimately, I connected with a small group of Board members and we rented a car and drove back eastward, finally arriving in Washington, D.C., early Sunday morning, September 16.

Within two weeks of the attacks, NSF and NHRAIC researchers were at Ground Zero and other September 11th disaster sites. A grand total of eight NSF SGER and supplements and seventeen NHRAIC QR awards were being finalized or under discussion to support natural hazards researchers in contributing their skills and expertise toward a disaster of a *different nature*. This was a human-initiated disaster, intentionally targeting one of the densest concentrations of people and infrastructure on earth.

This disaster, by necessity, included the involvement of law enforcement and military officials, which demanded some overarching management of the research. The Institute for Civil Infrastructure Systems (ICIS) offered proximity to the site, links to local agencies, and was the natural solution. Under the direction of Dr. Rae Zimmerman, ICIS provided a point of contact for officials to verify researcher activity as well as for researchers trying to make connections with city personnel. In December 2001, ICIS also convened a workshop to bring together the researchers and government officials engaged in responding to the events to exchange experiences, findings, and data with the goal of identifying further research pursuits. After this workshop, a briefing was held for Congressional staff. The briefing included a visit to the World Trade Center site and the New York City Emergency Response Center. NSF staff, city workers, and a few NSF-supported investigators discussed their activities and answered questions posed by the Congressional staff.

This book consists of selections written by many of the researchers who received QR or SGER grants to investigate questions that arose in the September 11th disaster. Each takes a distinct view of the disaster; their topics span engineering, information technology, and behavioral sciences. We believe that the findings, lessons, and recommendations collected herein will be a worthwhile contribution to the further exploration and dissemination of information to help people, localities, and organizations make risk-informed decisions. The book should also stimulate thinking and identify areas in which additional investigation is needed to build resiliency in the face of risks from natural, technological, and malevolent causes.

Readers should note that the initial response of NSF was followed by strong interest in World Trade Center and related research from all across the

Foundation. By the end of fiscal year 2002, CMS had awarded 27 proposals for a total of \$2.5 million. NSF-wide, 77 awards were made totaling approximately \$24 million. More detailed information on these awards, which are listed in the Appendix of this volume, can be found at the NSF website, <http://www.nsf.gov>. More information about the QR awards is available on NHRAIC's website at <http://www.colorado.edu/hazards>.

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