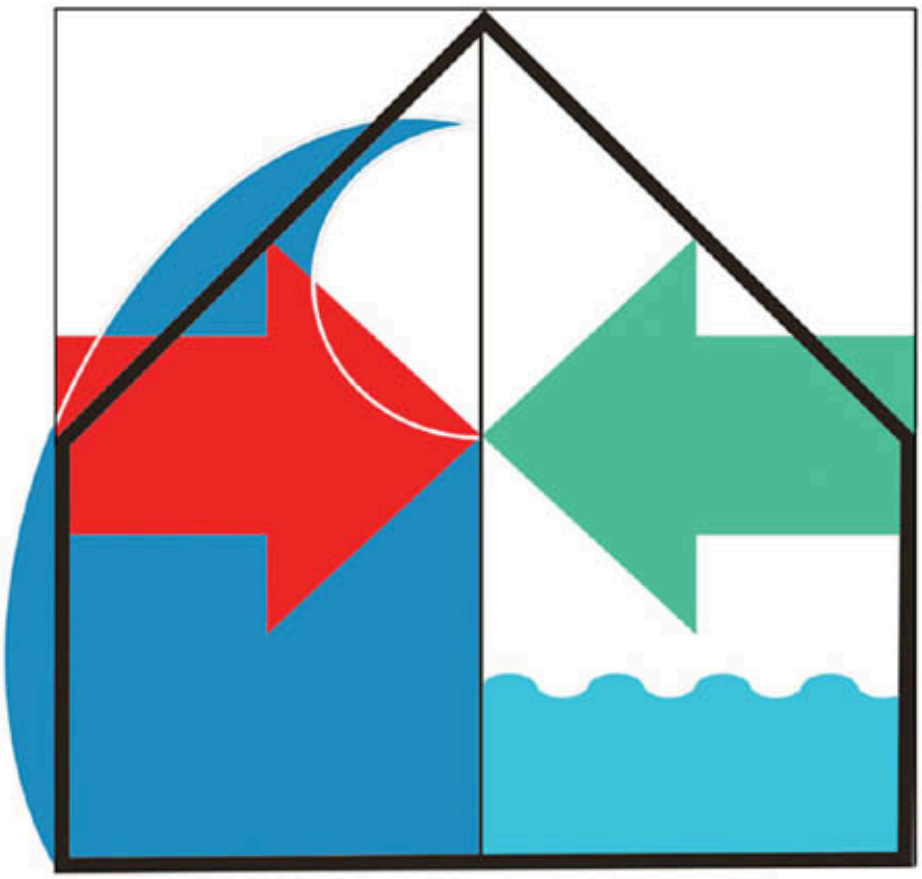
WIND STORM AND STORM SURGE MITIGATION

Edited by Nasim Uddin, Ph.D., P.E.



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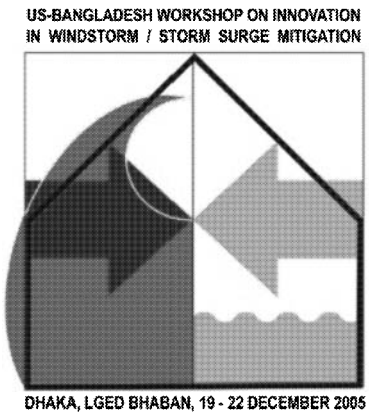
Introduction: Wind Storm and Storm Surge Mitigation



This introduction and executive summary covers the following topics:

- the origins of this monograph as a sequel to the three previous monographs generated by ASCE CDRM members and other volunteers;
- brief synopses of the papers included in this monograph; and

The Monograph as a sequel

This monograph, produced by the Council on Disaster Risk management (CDRM), is a sequel to a four previous monographs, *Acceptable Risk Processes: Lifelines and Natural Hazards* (2002) and ASCE CDRM Monograph No. 1 titled *Infrastructure Risk management Processes: Natural, Accidental and Deliberate Hazards* (2006), both edited by Craig Taylor and Erik VanMarcke, *Disaster Risk Assessment and Mitigation* (2008) edited by Nasim Uddin and Alfredo Ang, and *Multihazard Issues in the Central United States (2008)* edited by James Beavers.

The First Monograph

The first monograph contained mainly technical papers that evaluated procedures used in the acceptable risk processes in lifelines against natural hazards. Considering all the advances in probabilistic seismic hazard analysis during more than three decades, David Perkins elaborated a number of remaining issues having the effect that uncertainties may be significantly higher than the well-developed models indicate. Armen der Kiureghian presented a paper explaining how to apply Bayesian methods to obtain seismic fragility models for electric power components. Stuart Werner and Craig Taylor presented issues arising when constructing seismic vulnerability models for transportation system components. Adam Rose dealt with the complex issue of validating models to estimate higher-order economic losses.

A persistent problem is how to develop prescriptive criteria that provides guidance and goals for acceptable risk procedures. In the previous monograph, Keith Porter reviewed and evaluated available life-safety criteria; Daniel Alesch, Robert Nagy, and Craig Taylor addressed available financial criteria.

Because technical procedures do not comprise the full scope of acceptable risk processes, additional papers cover communication, administration and regulation issues. From an owner's and an engineer's perspective, Dick Wittkop and Bo Jensen addressed challenges in communicating risk results. Frank Lobedan, Thomas La Basco, and Kenny Ogunfunmi discussed the administration of the major wharf embankment and strengthening program

at the Port of Oakland. And Martin Eskijian, Ronald Heffron, and Thomas Dahlgren discussed the regulatory process for designing and implementing the engineering standards for marine oil terminals in the State of California.

The Second Monograph

The first monograph covered many broad topics pertaining to acceptable risk processes for lifelines and natural hazards. However, in the early stages of developing the second monograph, it became clear that many important topics were not treated. The first monograph's coverage focused on earthquake risks, a field that has shown quantitative sophistication for almost 40 years. In spite of remaining uncertainties in estimating earthquake risks, especially to (spatially distributed) infrastructure systems, the degree of quantitative sophistication for these risks is not matched by number of other natural hazard risks. (see American Lifelines Alliance, 2002). Also, accidental and malicious threats were at best an afterthought to members of CDRM until September 2001. In an effort to fill the apparent gaps, the second monograph covered broad topics including hazard issues, system evaluation issues, risk criteria issues, and systems management issues.

Under the broad topic of hazard issues, only one paper is included. Here Steven Harmsen extends a topic discussed by David Perkins in the previous monograph. Probabilistic seismic hazard analyses (PHSA) based estimates are used in major seismic codes and have a significant bearing on many professional, governmental, engineering, and financial activities. Most importantly, PHSA-based estimates are used in risk studies, but often without sufficient regard to the uncertainty in these estimates. This paper illustrates the quantitative sophistication in developing inputs for estimates of earthquake hazard and risk and resulting uncertainties and presages further quantitative development in seismic risk evaluation of infrastructure systems. For purpose of evaluating and expressing uncertainties resulting from diverse inputs source and attenuation models and assumptions, Harmsen, following USGS (Frankel et al. 2002), has developed a logic tree formulation that represents the broadest features of the input alternative at every phase. Instead of accumulating exceedence probabilities at a fixed ground motion level, however, he computes ground motions at a fixed exceedence probability model. Harmen uses the input models and weights found in the USGS 2002 national hazard mapping work. To supplement this USGS 2002 input information, he adds a preliminary representation of uncertainties in rates of occurrence from known faulting systems and an estimated range of uncertainty for areal source rate and b-values. Results of these logic-tree models are expressed, for instance, in terms of probability density functions of strong ground motion values for a specific return period. These findings can thus be used not only to guide future research but also to express more fully the range of uncertainties in earthquake hazard and risk evaluation as a result of its quantitative sophistication.

In "System Evaluation Issues," Jose Borrero, Sungbin Cho, James E. Moore II, and Costas Synoloakis explore tsunamis and transportation system analysis and discuss a multi-disciplinary project employing expertise in tsunamis generation and run-up analysis, transportation system analysis, and higher order economic analysis. Beverly J. Adams and Charles K. Huyck cover how remote sensing can assist in both pre- and post-disaster planning. Dorothy Reed, Jane Preuss, and Jaewook Park focus on the electric power distribution system affects of four major Pacific Northwest storms and the 2002 Nisqually earthquake. This focus provides initial data for estimating outage times and for assessing local vegetation management polices and practices.

Under "System Management Issues" Mihail Popescu and Manoochehr Zoghi provide a comprehensive account of the state-of-the-art-practice in assessing, evaluating, and managing land slide risks. Yumei Wang and Amar Chaker probe the vulnerability to multiple natural hazards in the Pacific Northwest, a region with diverse geologic settings. The authors examine the complex relations among different modes of transportation (highways, rail lines, and river navigation) and geologic hazards, and assess their importance for the community and the regions. The study results indicate that geologic hazards in the Columbia River Transportation Corridor can have severe, long lasting impacts on the Oregon economy, affect productive capacity, and slow the pace of economic growth and development. Le Val Lund and Craig Davis use a historical approach to explain how the Los Angeles Department of Water and Power Water System has coped with natural hazards as well as with emergency preparedness and homeland security. Balancing these risks reduction activities and resources needed to effect specific risk-reduction objectives requires well defined but flexible plans-of-action.

The Third monograph

The first two monographs covered many broad topics pertaining to acceptable risk processes for lifelines and natural hazards. The board topics addressed were technical issues, risk criteria issues, communication, administration, and regulation issues. In the second monograph, the broad topics covered are hazard issues, system evaluation issues, risk criteria issues, and system management issues.

Some of the papers included in this monograph cover significant technical features of integrated risk evaluations for natural disasters, whereas others deals with the complex personal, organizational, institutional, regulatory, and risk communication features of acceptable risk management.

The recent devastating earthquakes, tsunami, and hurricanes resulted in an international human tragedy affecting over a dozen countries. The white paper "Surviving Nature's Forces: Can Civil Engineers Build Safe Communities?" by Yumei Wang and Erik Vanmarcke, prompted by this human tragedy, considers that civil engineers were much involved in building the infrastructure of the communities that were destroyed.

The fundamentals for the systematic and quantitative assessment of risk, with particular emphasis for hazard mitigation, are summarized. Besides the assessment of the best estimate measure of a pertinent risk, the assessment of the uncertainty underlying the calculated risk is equally important. These are illustrated with a quantitative assessment of the risks (for a 20-year period) associated with the occurrence of a Category 4 hurricane in New Orleans on the assumption that the assessment was performed in 1990 (15 years prior to the occurrence of Katrina in 2005).

Another key feature is administering an acceptable risk evaluation program. In the paper entitled "Port Of Los Angeles Risk Management Strategies," Tony Gioiello, and Richard C. Wittkop outline how a major port has so far administered the very comprehensive acceptable risk evaluation of potential threats for ports.

In light of the port's importance to the local and national economy, the port has risk management strategies already in place. The port will also undertake the completion of a risk reduction plan to identify those facilities and systems that may be vulnerable to seismic or other events and identify ways to mitigate the port's risks in those areas. This approach is based on the premise that, no matter what level of risk reduction is implemented, there is always some residual risk of damage;

it is not possible to achieve zero risk. Even with sound preventive measures, there remain residual risks, which are sometimes extremely large and grave. A natural hazard is an unexpected or uncontrollable natural event that usually results in widespread destruction of property or loss of life. In "Surviving Natural Forces from Taiwanese Civil Engineers Perspective," Edward H. Wang, Hsieh Yuen Chang, and Ming-Hsi Hsu expand this discussion by offering perspectives on life-safety efforts in Taiwan.

The role of civil engineers was written in all phases of activities related to the recent disasters. As unfortunate as these disasters are, they offer tremendous opportunities for civil engineers to learn from the previous short falls and ensure public safety going forward. In the paper titled "Surviving Natural Disasters: Lessons Learned From the December 26, 2004 Sumatra Quake and Tsunami," Yumei Wang, Curt Edwards, Amar Bhogal, and Anat Ruangrassamee review the investigation findings in coastal Thailand and discusses some of the lessons learned from this tragedy. Findings clearly indicate that structures and lifelines require sound engineering design and construction, including tsunami-resistant buildings (at least for more important structures). In addition, tsunami education for communities and regional tsunami warning systems are needed. The paper "Achievements and Challenges of China Construction," by Xila Liu proves the complex relations among construction and natural hazards and assesses their importance for the community and the region. China is beginning an accelerated urbanization process. A great number of infrastructure projects and residences are under construction. This paper briefly introduces construction achievements and discusses construction challenges. Finally, as the key point for further development, it emphasizes construction quality and safety. Finally, there are many features of the acceptable risk processes and mitigation beyond the technically-oriented integrated systems evaluation. One such key feature is risk communication to policymakers. In the paper "Preparing for the Big One," Swaminathan Krishnan discusses the importance of constantly engaging governments in discussion to ensure that the quality of our infrastructure is maintained. Failure to do so could be catastrophic as was witnessed in New Orleans when the storm surge from hurricane Katrina (August 29, 2005) breached or overtopped the aging levees.

The Fourth Monograph

Education, planning, and mitigation are all required to reduce losses from natural and technological hazards in the United States. The U.S. Congress took the right step in establishing the DMA in 2000. However, it is just a first step. As another step in education, planning, and mitigation, ASCE's Council on Disaster Risk Reduction held a symposium in Chicago, IL, on October 18, 2006 in concert with the ASCE's annual meeting. The symposium was titled "Multihazard Hazard Issues in the Central United States." The remaining papers in this monograph highlight some specifics issues of mutihazards related to education, planning, and mitigation. At the symposium held at the Westin Chicago River North Hotel on October 18, 2006, some 12 speakers presented invited papers. These papers, purposely broad in coverage, dealt with various aspects of natural multihazard issues and to a lesser extent with technology (man) generated issues. The papers outlined some of the more important issues that should be addressed in developing comprehensive national and state hazard planning and action scenarios. Following is a brief overview of the principal points addressed in the full papers presented at the symposium and included in this monograph.

W. Hall in his paper titled "Keynote Paper: A Changing Perspective—Major Challenges" focuses briefly on four principal topics: (1) the multihazards (natural and man-made), (2) observations on risk assessment and risk coverage, (3) mitigation measures, and (4) education and training. He presents a brief discussion of issues that must be addressed to make significant improvements in our ability to plan, design, and construct/develop mitigation measures for the noted hazards in the

years ahead. In the paper "The Context for Successful Loss Reduction from Natural and Technological Hazards as Applied to the Central and Eastern U.S." by W.P. Graf, the author discusses such issues as (1) incremental improvements in new construction, (2) rehabilitation, (3) loss reduction programs, and (4) risk analysis and the importance to various constituencies, along with imbedded tasks of importance in each case. This paper relates the issue descriptions to current federal guidelines and points to requirements for stakeholders and other constituencies. The paper titled "U.S. Flood Policy 13 Years After the 1993 Flood" by Paul A. Osman briefly describes the 1993 flood of the Mississippi River in the Midwest. Even though the 1968 federal flood control act had been in place for years, few applications within the act's framework had been undertaken. This changed with the serious 1993 flood, and the author points out the great changes in application that arose with that flood. It is interesting reading, indeed, about what can actually take place in flood mitigation measures. N. Uddin in his paper "Thermopastic Composite Structural Insulated Panels (CSIPS) for Building Construction" reported on some of the latest research on structural insulated panels as might be used in special construction. In these studies thermoplastic skins were employed and showed overall significant strength enhancement with three-point loading, although some face sheet components experienced cracking. Clearly more research is needed for this valuable product to meet distortion standards, which might be needed for major disaster protection.

The paper "Proposal for the Tennessee Multihazard Mitigation Consortium (TMMC)" by James E. Beavers describes the planning and formation of the Tennessee Multihazard Mitigation Consortium (TMMC), a model not only for Tennessee but other states as well. Approved in principle at many levels, the TMMC awaits state legislative authorization and appropriation status. The institute coordinates the activities initially of three institutions but is expected to grow so as to be a major resource and formal action center for disasters of many kinds in the state of Tennessee. This document describes how a fully focused institute that is broad in scope can be developed and serve as the focal point for mitigation action. In the paper "How Communities Implement Successful Mitigation Programs: Insights From the Multihazard Mitigation Council (MMC) Community Study" by Elliott Mittler, Linda Bourque, Michele M. Wood, and Craig Taylor, the authors describe the findings of an ATC congressionally mandated study on successful mitigation efforts by nine U.S. communities of various sizes. For each city the authors describe what mitigation measures were addressed and how leadership factored into the effort. It contains valuable information on subsidizing mitigation measures and the final result. Richard G. Little in his thought-provoking paper "Achieving Risk Reductions in Critical Infrastructure Systems" discusses risk reduction from the broad perspective of the string of critical infrastructure that must be operative to maintain our economy. The theory is simple and expressed in understandable terms, but more importantly, the author discusses of the consequences of non-functional infrastructure.

The Unknown Seismic Hazard in East Tennessee and Potential Losses *by Christine A. Powell and James E. Beavers* presents a mini history of the seismicity in Tennessee (major earthquakes in 900, 1450, and 1811-1812) with particular attention to eastern Tennessee. The authors point out that eastern Tennessee is quite active seismically, and that such seismicity needs more attention by those responsible for national, state and local codes and regulations to mitigate potential damage through economical means. In the paper titled "Frequency of Hailstorms and the Resulting Damage in the Central United States" b*y Douglas L. Dewey and Rosemarie G. Grant, a*uthors Douglas Dewey and Rosemarie Grant have prepared a landmark summary contribution on the hazard of hailstorms and the damage potential (risk) associated with it. Among other valuable discussions contained therein is a section on the true impact of hail, which provides interesting insights on current insurance coverage of wind and hailstorm damage. The paper also discusses resistance parameters and case histories.