

# Seismic Loss Estimation For Efficient Decision Making

The mitigation of earthquake-related hazards represents a key role in the modern society. The main goal of this book is to present 9 scientific papers focusing on new research and results on earthquake seismology. Chapters of this book focus on several aspect of seismology ranging from historical earthquake analysis, seismotectonics, and damage estimation of critical facilities.

This two volume set (CCIS 398 and 399) constitutes the refereed proceedings of the International Conference on Geo-Informatics in Resource Management and Sustainable Ecosystem, GRMSE 2013, held in Wuhan, China, in November 2013. The 136 papers presented, in addition to 4 keynote speeches and 5 invited sessions, were carefully reviewed and selected from 522 submissions. The papers are divided into 5 sessions: smart city in resource management and sustainable ecosystem, spatial data acquisition through RS and GIS in resource management and sustainable ecosystem, ecological and environmental data processing and management, advanced geospatial model and analysis for understanding ecological and environmental process, applications of geo-

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informatics in resource management and sustainable ecosystem.

Geographic Information Research is a broad discipline, and is being actively pursued world-wide. A group of researchers in both North America and Europe have come together as contributors to this volume as a way of combining their expertise. The emphasis is on matters of political, strategic and organizational importance, rather than on technology or systems, and covers the theory and social and political practice which goes hand-in-hand with GIS.

This collection focuses on the development of novel approaches to address one of the most pressing challenges of civil engineering, namely the mitigation of natural hazards. Numerous engineering books to date have focused on, and illustrate considerable progress toward, mitigation of individual hazards (earthquakes, wind, and so forth.). The current volume addresses concerns related to overall safety, sustainability and resilience of the built environment when subject to multiple hazards: natural disaster events that are concurrent and either correlated (e.g., wind and surge); uncorrelated (e.g., earthquake and flood); cascading (e.g., fire following earthquake); or uncorrelated and occurring at different times (e.g., wind and earthquake). The authors examine a range of specific topics including methodologies for vulnerability assessment of structures, new techniques to reduce the system demands through control systems;

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instrumentation, monitoring and condition assessment of structures and foundations; new techniques for repairing structures that have suffered damage during past events, or for structures that have been found in need of strengthening; development of new design provisions that consider multiple hazards, as well as questions from law and the humanities relevant to the management of natural and human-made hazards.

TCLEE Monograph 16 presents more than 100 papers from the Fifth U.S. Conference on Lifeline Earthquake Engineering, held in Seattle, Washington, August 12-14, 1999.

Damage assessment, rehabilitation, decision-making, social consequences, repair and reconstruction; these are all critical factors for considerations following natural disasters such as earthquakes. In order to address these issues, the United States of America and the Peoples Republic of China regularly organize bilateral symposia/workshops to investigate multiple hazard mitigation, particularly with respect to earthquake engineering. This book contains state-of-the-art reports presented by world-renowned researchers at the US/PRC Symposium Workshop on Post-Earthquake Rehabilitation and Reconstruction held in Kunming, Yunnan, China, May 1995. The following key areas are addressed: damage assessment of structures after earthquakes; lessons of post-

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earthquake recovery, rehabilitation and reconstruction, including public policy, land use options, urban planning, and design; issues in and examples of decision-making, and implementation of rehabilitation and reconstruction plans and policies; repair, strengthening, retrofit and control of structures and lifeline systems, post-earthquake socio-economic problems covering issues of relief and recovery; human and organizational behavior during emergency response, and strategies for improvement; real-time monitoring of earthquake response and damage.

This book presents a simplified approach to earthquake engineering by developing the fragility curve for regular and irregular moment-resisting frames based on different types of structural material, height, and ground motion records. It examines six sets of concrete and steel frames, which vary in terms of their height (3-, 6- and 9-storey) and include regular and irregular frames. Each structure frame was designed based on Eurocode 2 and 3 with the aid of Eurocode 8 for earthquake loading. The SAP2000 software was used as the main tool for the pushover analysis and incremental dynamic analysis. Readers are first provided with background information on the development of nonlinear analysis in earthquake engineering. Subsequently, each chapter begins with a detailed explanation of the collapse of the structures and the application in

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nonlinear analysis. As such, the book will greatly benefit students from both public and private institutions of higher, particularly those who are dealing with the subject of earthquake engineering for the first time. It also offers a valuable guide for Civil Engineering practitioners and researchers who have an interest in structural and earthquake engineering.

This dissertation is a collection of research studies that address challenges in Performance-based Earthquake Engineering (PBEE) and provides solutions to issues of concern to practicing engineers, researchers, city planners, and the insurance industry alike in implementation of PBEE for building structures. Contributions made within this research are four fold: i) An applied solution is provided to reduce the number of ground motion records required to reliably estimating Intensity Measure-Engineering Demand Parameters (IM-EDP) relationship used for building loss estimation. This solution employs classical linear modal analysis to develop a first estimate (i.e. a priori) of IM-EDP relationships, followed by utilizing Bayesian statistics to update these estimates using a small number of nonlinear response history analyses of a detailed model of the building (i.e., posterior). ii) An applied hazard based Regional Seismic Loss Assessment (RSLA) method for buildings is formulated. In contrast to previous research in this field, the proposed RSLA method utilizes a regional rapid seismic hazard disaggregation tool and is computationally efficient and sufficient. iii) A new seismic design methodology is formulized and presented. A set of preliminary

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Performance-based Seismic Design (PPBSD) tools are developed for four-story reinforced concrete moment-resisting frame (RC-SMRF) office buildings, located in Los Angeles at 475 year ground motion return period by which stakeholders can make informed decisions with regards to the potential risk they may adopt against future earthquakes. iv) An earthquake loss rating system is provided that maps a building's seismic performance to a rating value/index. This outcome can transfer seismic risk metrics to non-engineers in an effective communicative way.

Diagrids are becoming an increasingly popular structural system in high rise design and construction. Little research has been performed on the seismic performance of Diagrids and how it integrates with seismic loss estimation. A motion based design scheme can facilitate the seismic design of Diagrids with the ultimate goal of reducing upfront costs and repair costs. In this thesis we analyze Diagrids with varying locations, aspect ratios, diagonal angles, and motion design parameters to understand the relationship between the geometric design parameters of a Diagrid and the design costs and estimated losses. We use a static seismic design procedure and analyze various period estimation techniques to evaluate their validity when used with Diagrids. We develop a simple loss estimation scheme focused on interstory drift and content replacement. We then analyze which Diagrids are most cost effective for a given set of design parameters, and briefly discuss additional methods of reducing seismic damage to buildings. Our analysis uses Matlab and Microsoft Excel for the development of our

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analytical models and for the manipulation and organization of data. Keywords: Diagrid Structures, Seismic Design, Seismic Damage, Loss Estimation

The United States will certainly be subject to damaging earthquakes in the future. Some of these earthquakes will occur in highly populated and vulnerable areas. Coping with moderate earthquakes is not a reliable indicator of preparedness for a major earthquake in a populated area. The recent, disastrous, magnitude-9 earthquake that struck northern Japan demonstrates the threat that earthquakes pose. Moreover, the cascading nature of impacts-the earthquake causing a tsunami, cutting electrical power supplies, and stopping the pumps needed to cool nuclear reactors-demonstrates the potential complexity of an earthquake disaster. Such compound disasters can strike any earthquake-prone populated area. National Earthquake Resilience presents a roadmap for increasing our national resilience to earthquakes. The National Earthquake Hazards Reduction Program (NEHRP) is the multi-agency program mandated by Congress to undertake activities to reduce the effects of future earthquakes in the United States. The National Institute of Standards and Technology (NIST)-the lead NEHRP agency-commissioned the National Research Council (NRC) to develop a roadmap for earthquake hazard and risk reduction in the United States that would be based on the goals and objectives for achieving national earthquake resilience described in the 2008 NEHRP Strategic Plan. National Earthquake Resilience does this by assessing the activities and costs that would be required for the nation to achieve

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earthquake resilience in 20 years. National Earthquake Resilience interprets resilience broadly to incorporate engineering/science (physical), social/economic (behavioral), and institutional (governing) dimensions. Resilience encompasses both pre-disaster preparedness activities and post-disaster response. In combination, these will enhance the robustness of communities in all earthquake-vulnerable regions of our nation so that they can function adequately following damaging earthquakes. While National Earthquake Resilience is written primarily for the NEHRP, it also speaks to a broader audience of policy makers, earth scientists, and emergency managers.

Current knowledge and state-of-the-art developments in topics related to the seismic performance and risk assessment of different types of structures and building stock are addressed in the book, with emphasis on probabilistic methods. The first part addresses the global risk components, as well as seismic hazard and ground motions, whereas the second, more extensive part presents recent advances in methods and tools for the seismic performance and risk assessment of structures. The book contains examples of steel, masonry and reinforced concrete buildings, as well as some examples related to various types of infrastructure, such as bridges and concrete gravity dams. The book's aim is to make a contribution towards the mitigation of seismic risk by presenting advanced methods and tools which can be used to achieve well-informed decision-making, this being the key element for the future protection of the built environment against earthquakes. Audience: This book will be of interest to

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researchers, postgraduate students and practicing engineers working in the fields of natural hazards, earthquake, structural and geotechnical engineering, and computational mechanics, but it may also be attractive to other experts working in the fields related to social and economic impact of earthquakes.

The main objective of this study is to develop a methodology to assess seismic vulnerability of concrete structures and to estimate direct losses related to structural damage due to future seismic events. This dissertation contains several important components including development of more detailed demand models to enhance accuracy of fragility relationships and development of a damage assessment framework to account for uncertainties. This study focuses on concrete structures in the Mid-America region where a substantial seismic risk exists with potential high intensity earthquakes in this geographic region. The most common types of concrete structures in this area are identified based on the building inventory data and reinforced concrete (RC) frame buildings and tilt-up concrete buildings are selected as case study buildings for further analysis. Using synthetic ground motion records, the structural behavior of the representative case study buildings is analyzed through nonlinear time history analyses. The seismic performance of the case study buildings is evaluated to describe the structural behavior under ground motions. Using more detailed demand models and the corresponding capacity limits, analytical fragility curves are developed based on appropriate failure mechanisms for different structural parameters including different

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RC frame building heights and different aspect ratios for tilt-up concrete structures. A probabilistic methodology is used to estimate the seismic vulnerability of the case study buildings reflecting the uncertainties in the structural demand and capacity, analytical modeling, and the information used for structural loss estimation. To estimate structural losses, a set of damage states and the corresponding probabilistic framework to map the fragility and the damage state are proposed. Finally, scenario-based assessments are conducted to demonstrate the proposed methodology. Results show that the proposed methodology is successful to evaluate seismic vulnerability of concrete structures and effective in quantifying the uncertainties in the loss estimation process. In order to assess the seismic risk for Switzerland, and particularly for the city of Basel, a joint project on the subject of "Earthquake Scenarios for Switzerland" was launched by the Swiss Seismological Service (SED) and the Institute of Structural Engineering (IBK) at the ETH Zurich. The goals of the study are to improve the assessment of seismic hazard, to investigate the vulnerability of the built environment and finally, to combine the results to elaborate risk scenarios as the first fundamental step in the mitigation process. The objective of this work is the evaluation of the seismic vulnerability of existing buildings with a focus on the residential building stock in the city of Basel. Since no major damaging earthquake has occurred in Switzerland in recent times, vulnerability functions from observed damage patterns are not available. A simple evaluation method based on engineering models of the building structures

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suitable for the evaluation of a larger number of buildings is therefore proposed ... CSIE 2011 is an international scientific Congress for distinguished scholars engaged in scientific, engineering and technological research, dedicated to build a platform for exploring and discussing the future of Computer Science and Information Engineering with existing and potential application scenarios. The congress has been held twice, in Los Angeles, USA for the first and in Changchun, China for the second time, each of which attracted a large number of researchers from all over the world. The congress turns out to develop a spirit of cooperation that leads to new friendship for addressing a wide variety of ongoing problems in this vibrant area of technology and fostering more collaboration over the world. The congress, CSIE 2011, received 2483 full paper and abstract submissions from 27 countries and regions over the world. Through a rigorous peer review process, all submissions were refereed based on their quality of content, level of innovation, significance, originality and legibility. 688 papers have been accepted for the international congress proceedings ultimately.

While numerous advanced statistical approaches have recently been developed for quantitative trait loci (QTL) mapping, the methods are scattered throughout the literature. Statistical Methods for QTL Mapping brings together many recent statistical techniques that address the data complexity of QTL mapping. After introducing basic genetics topics and statistical principles, the author discusses the principles of quantitative genetics, general statistical issues of QTL mapping,

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commonly used one-dimensional QTL mapping approaches, and multiple interval mapping methods. He then explains how to use a feature selection approach to tackle a QTL mapping problem with dense markers. The book also provides comprehensive coverage of Bayesian models and MCMC algorithms and describes methods for multi-trait QTL mapping and eQTL mapping, including meta-trait methods and multivariate sequential procedures. This book emphasizes the modern statistical methodology for QTL mapping as well as the statistical issues that arise during this process. It gives the necessary biological background for statisticians without training in genetics and, likewise, covers statistical thinking and principles for geneticists. Written primarily for geneticists and statisticians specializing in QTL mapping, the book can also be used as a supplement in graduate courses or for self-study by PhD students working on QTL mapping projects.

Improved Seismic Monitoringâ€"Improved Decision-Making, describes and assesses the varied economic benefits potentially derived from modernizing and expanding seismic monitoring activities in the United States. These benefits include more effective loss avoidance regulations and strategies, improved understanding of earthquake processes, better engineering design, more effective hazard mitigation strategies, and improved emergency response and

recovery. The economic principles that must be applied to determine potential benefits are reviewed and the report concludes that although there is insufficient information available at present to fully quantify all the potential benefits, the annual dollar costs for improved seismic monitoring are in the tens of millions and the potential annual dollar benefits are in the hundreds of millions.

Fragility functions constitute an emerging tool for the probabilistic seismic risk assessment of buildings, infrastructures and lifeline systems. The work presented in this book is a partial product of a European Union funded research project SYNER-G (FP7 Theme 6: Environment) where existing knowledge has been reviewed in order to extract the most appropriate fragility functions for the vulnerability analysis and loss estimation of the majority of structures and civil works exposed to earthquake hazard. Results of other relevant European projects and international initiatives are also incorporated in the book. In several cases new fragility and vulnerability functions have been developed in order to better represent the specific characteristics of European elements at risk. Several European and non-European institutes and Universities collaborated efficiently to capitalize upon existing knowledge. State-of-the-art methods are described, existing fragility curves are reviewed and, where necessary, new ones are proposed for buildings, lifelines, transportation infrastructures as well as for

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utilities and critical facilities. Taxonomy and typology definitions are synthesized and the treatment of related uncertainties is discussed. A fragility function manager tool and fragility functions in electronic form are provided on [extras.springer.com](http://extras.springer.com). Audience The book aims to be a standard reference on the fragility functions to be used for the seismic vulnerability and probabilistic risk assessment of the most important elements at risk. It is of particular interest to earthquake engineers, scientists and researchers working in the field of earthquake risk assessment, as well as the insurance industry, civil protection and emergency management agencies.

The official proceedings of the 10th world conference on earthquake engineering in Madrid. Coverage includes damage in recent earthquakes, seismic risk and hazard, site effects, structural analysis and design, seismic codes and standards, urban planning, and expert system application.

This Special Issue was created to collect the most recent and novel research on seismic performance evaluation of building structures. This issue includes three important topics on seismic engineering for building structures: (1) seismic design and performance evaluation, (2) structural dynamics, and (3) seismic hazard and risk analysis. To protect building structures from earthquakes, it is necessary to conduct seismic performance evaluations on structures with reliable methods and

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to retrofit these structures appropriately using the results of the seismic performance evaluation.

Issues in Land and Water Engineering / 2013 Edition is a ScholarlyEditions™ book that delivers timely, authoritative, and comprehensive information about Coastal Engineering. The editors have built Issues in Land and Water Engineering: 2013 Edition on the vast information databases of ScholarlyNews.™ You can expect the information about Coastal Engineering in this book to be deeper than what you can access anywhere else, as well as consistently reliable, authoritative, informed, and relevant. The content of Issues in Land and Water Engineering: 2013 Edition has been produced by the world's leading scientists, engineers, analysts, research institutions, and companies. All of the content is from peer-reviewed sources, and all of it is written, assembled, and edited by the editors at ScholarlyEditions™ and available exclusively from us. You now have a source you can cite with authority, confidence, and credibility. More information is available at <http://www.ScholarlyEditions.com/>.

Safety, Reliability, Risk and Life-Cycle Performance of Structures and Infrastructures contains the plenary lectures and papers presented at the 11th International Conference on STRUCTURAL SAFETY AND RELIABILITY (ICOSSAR2013, New York, NY, USA, 16-20 June 2013), and covers major

aspects of safety, reliability, risk and life-cycle performance of str  
Soil-Foundation-Structure Interaction contains selected papers presented at the International Workshop on Soil-Foundation-Structure Interaction held in Auckland, New Zealand from 26-27 November 2009. The workshop was the venue for an international exchange of ideas, disseminating information about experiments, numerical models and practical en  
COST is an intergovernmental framework for European Cooperation in Science and Technology, allowing the coordination of nationally-funded research on a European level. Part of COST was COST Action C26Urban Habitat Constructions Under Catastrophic Events which started in 2006 and held its final conference in Naples, Italy, on 16-18 September 201  
This book presents ongoing research and ideas related to earth observations and global change, natural hazards and disaster management studies, with respect to geospatial information technology, remote sensing, and global navigation satellite systems. Readers will discover uses of advanced geospatial tools, spatiotemporal models, and earth observation systems. Chapters identify the international aspects of the coupled social, land and climate systems in global change studies, and consider such global challenges as agriculture monitoring, the smart city, and risk assessment. The work presented here has been carefully selected, edited, and peer reviewed in order to advance research and development, as well as to encourage innovative applications of Geomatics technologies in global change studies. The book will appeal not only to academicians, but also to professionals, politicians and decision makers who wish to learn from the very latest and most innovative, quality research in this area of global change and natural disaster management. /divContributions are drawn from revised submissions based on state-of-the-art papers from the 7th GiT4NDM - 5th EOGC, 2015 event.

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Large-scale earthquake hazards pose major threats to modern society, generating casualties, disrupting socioeconomic activities, and causing enormous economic loss across the world. Events, such as the 2004 Indian Ocean tsunami and the 2011 Tohoku earthquake, highlighted the vulnerability of urban cities to catastrophic earthquakes. Accurate assessment of earthquake-related hazards (both primary and secondary) is essential to mitigate and control disaster risk exposure effectively. To date, various approaches and tools have been developed in different disciplines. However, they are fragmented over a number of research disciplines and underlying assumptions are often inconsistent. Our society and infrastructure are subjected to multiple types of cascading earthquake hazards; therefore, integrated hazard assessment and risk management strategy is needed for mitigating potential consequences due to multi-hazards. Moreover, uncertainty modeling and its impact on hazard prediction and anticipated consequences are essential parts of probabilistic earthquake hazard and risk assessment. The Research Topic is focused upon modeling and impact assessment of cascading earthquake hazards, including mainshock ground shaking, aftershock, tsunami, liquefaction, and landslide.

Natural Hazards - Risk, Exposure, Response, and Resilience demonstrates advanced techniques to measure risks, exposures, responses, and solutions to hazards in an array of communities. Eleven original research reports by international scholars on hazard assessment and management are organized into four sections: studies assessing risk using in-depth modeling and technological detection to provide insight into problems associated with earthquakes, torrential rains, and nuclear power plant safety; studies revealing the spatial distributions of exposure and impacts from an assortment of hazards; studies examining

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human response to increased awareness of the patterns of hazard; and a study demonstrating assessment of resilience of sociotechnological systems to natural hazards. This volume contributes new conceptual and practical commentaries to assess, mitigate, and plan for disasters.

This text details the proceedings of the 11th European Conference on Earthquake Engineering. CD-ROM contains full text of the 650 papers in printed form. This would have been 6 volumes of 1000 pages each. Topics covered: are: Engineering seismology; Experimental aspects for soils, rocks and construction material; Computational aspects for materials, structures and soil-structure interaction; Civil engineering projects; Active and passive isolation; Industrial facilities, lifelines and equipment; Vulnerability, seismic risk and strengthening; Site effects and spatial variability of seismic motions; Reliability analyses and probabilistic aspects; Design criteria, codes and standards; Eurocode 8 and national applications; Seismic risk in the Mediterranean basin; Post earthquake investigations; Huge economic losses from natural disasters, including nearly 100 000 fatalities world wide in 1999 alone, gave rise to a renewed recognition by government, industry and the public that national governments and international agencies cannot simply go on as they have in the past. Changes in financial cover, better enforcement procedures for building standards, better business contingency planning, and well developed emergency response were demanded from all sides. In this volume an international group of experts present recent research on the variety of approaches adopted by different countries to assess natural hazard risks and the incentives for mitigating and financing them, the particular focus being in earthquake risks. The volume also presents an in-depth summary of recent reforms in Turkey related to seismic risks,

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with comparative research from many other countries. Linkages are emphasised between science and engineering infrastructure, insurance and risk management, and public policy. Developing a Rapid Seismic Performance Based Rating System in Safety Assessment of Buildings

Throughout the past few years, there has been extensive research done on structural design in terms of optimization methods or problem formulation. But, much of this attention has been on the linear elastic structural behavior, under static loading condition. Such a focus has left researchers scratching their heads as it has led to vulnerable structural configurations. What researchers have left out of the equation is the element of seismic loading. It is essential for researchers to take this into account in order to develop earthquake resistant real-world structures. Structural Seismic Design Optimization and Earthquake Engineering: Formulations and Applications focuses on the research around earthquake engineering, in particular, the field of implementation of optimization algorithms in earthquake engineering problems. Topics discussed within this book include, but are not limited to, simulation issues for the accurate prediction of the seismic response of structures, design optimization procedures, soft computing applications, and other important advancements in seismic analysis and design where optimization algorithms can be implemented. Readers will discover that this book provides relevant theoretical frameworks in order to enhance their learning on earthquake engineering as it deals with the latest research findings and their practical implementations, as well as new formulations and solutions.

An increasing number of large-scale natural disasters have affected millions of people in recent years. Major earthquakes, floods, And hurricanes, have caused great destruction of property

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and loss of life, while forest fires, pipeline failures, and bombings have created equally devastating affects on a smaller scale. The increased threats are the topic of the Third International Conference on Disaster Management and Human Health Risk, convened so that experts on public health, security, and disaster management could share information. This book contains the papers presented at the conference. Topics covered include Disaster analysis; Disaster monitoring and mitigation; Emergency preparedness; Risk mitigation; Risk and security; Safety and resilience; Socio-economic issues; Biological threats; Learning from disasters.

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