
Seismic Loss Estimation For Efficient Decision Making

Seismic Fragility \u0026amp; Vulnerability for Earthquake Loss Estimation - Part 1 of 4 How to Estimate Earthquake Probability and Recurrence Time | Example and Explanation #education Seismic Fragility \u0026amp; Vulnerability for Earthquake Loss Estimation - Part 4 of 4 Seismic Fragility \u0026amp; Vulnerability for Earthquake Loss Estimation - Part 3 of 4 Seismic Fragility \u0026amp; Vulnerability for Earthquake Loss Estimation - Part 2 of 4 Ground motion variability during the 2008 M6.3 Ölfus event and its impact on seismic loss estimation A review of numerical techniques to simulate seismic cycles Seismic Analysis Lecture #3 - Dirk Bondy, S.E. How to Find Seismic Weight of A Building - Full Example SimCenter | Application Framework for Regional Earthquake Loss Estimation, September 26, 2018 UNESCO Chair Webinar - Seismic Losses Scenarios using SELENA - DAY2 OpenQuake - Scenario Damage and Loss: Hands-on exercise Earthquake rupture directivity estimation using spectra semblance OpenQuake - Event-based Risk: Theoretical Background Seismic Performance Assessment (NLTHA, Cloud, IDA, MSA) - Part 3 of 4 Performance Based Earthquake Engineering (PBEE) - Part 1 of 4 Earthquake casualty estimation Advances in Seismic Risk Assessment using Simulated Earthquake Ground Motions OpenQuake Introduction - A software for Seismic Hazard and Risk Assessment Effective seismic weight and the lumped mass at the center of each story in ETABS (Lec9)

Handbook of Seismic Risk Analysis and Management of Civil Infrastructure Systems

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Towards Seismic Resilience

Improved Seismic Monitoring - Improved Decision-Making

Structural Safety and Reliability

Seismic Vulnerability Index Assessment Framework of RC Structures

Global Changes and Natural Disaster Management: Geo-information Technologies

Assessment of Damage to Residential Buildings Caused by the Northridge Earthquake

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Safety, Reliability, Risk and Life-Cycle Performance of Structures and Infrastructures

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Soil-Foundation-Structure Interaction
SYNER-G: Systemic Seismic Vulnerability and Risk Assessment of Complex Urban, Utility, Lifeline Systems and Critical Facilities

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KENNY BRENDEN

**Handbook of Seismic Risk Analysis
and Management of Civil
Infrastructure Systems** Springer

Earthquakes affecting urban areas can lead to catastrophic situations and hazard mitigation requires preparatory measures at all levels. Structural assessment is the diagnosis of the seismic health of buildings. Assessment is the prelude to decisions about rehabilitation or even

demolition. The scale of the problem in dense urban settings brings about a need for macro seismic appraisal procedures because large numbers of existing buildings do not conform to the increased requirements of new earthquake codes and specifications or have other deficiencies. It is the vulnerable buildings - liable to cause damage and loss of life - that need immediate attention and urgent appraisal in order to decide if structural rehabilitation and upgrading are feasible. Current economic, efficient and occupant-friendly rehabilitation techniques vary widely and include the application either

of precast concrete panels or layers, strips and patches of fiber reinforced polymers (FRP) in strategic locations. The papers in this book, many by renowned authorities in earthquake engineering, chart new and vital directions of research and application in the assessment and rehabilitation of buildings in seismic regions. While several papers discuss the probabilistic prediction and quantification of structural damage, others present approaches related with the in-situ and occupant friendly upgrading of buildings and propose both economical and practical techniques to address the problem.

Expanding Underground - Knowledge and Passion to Make a Positive Impact on the World John Wiley & Sons

This book represents a significant step toward a new contribution in the process of developing the seismic vulnerability index. This is accomplished by releasing or reducing the role of the rapid visual screening that is created by the opinions and decisions of experts, which depend on observations made while investigating the vulnerability damages caused by earthquakes. Alternatively, the computational analytical technique is preferable since it can be effective in determining the seismic vulnerability index before the occurrence of an earthquake by modeling the most affected influencing parameters that regulate the building performance. In addition, the seismic vulnerability index is supported by the vulnerability curves, which describe the probability of damages and are used to estimate the economic damage grade for each building which is the topic of inquiry. In the end, this helps to establish a clear vision and sort of recommendations for engineers and specialists to follow in order to take into

consideration certain indices and factors before designing any specific structure. Because of this, the simplified work is utilized to manage and put into action measures that will protect against the effects of seismic events before an earthquake really occurs. In addition to this benefit, the work that has been done is of significant assistance to the authorities that are accountable for the restoration of the preexisting buildings and the cultural heritages.

Towards Seismic Resilience Springer Nature

The first edition of this monograph, presenting accurate and efficient simulations of seismic damage to buildings and cities, has received significant attention from the research community. To keep abreast of the rapid development in recent years, our latest breakthrough achievements have been added to this new edition, including novel resilient structural components, secondary disaster simulations, emergency responses and resilient recovery of communities after earthquake. This edition comprehensively covers a range of numerical modeling approaches, higher performance

computation methods, and high fidelity visualization techniques for earthquake disaster simulation of tall buildings and urban areas. It also demonstrates successful engineering applications of the proposed methodologies to typical landmark projects (e.g., Shanghai Tower and CITIC Tower, two of the world's tallest buildings; Beijing CBD and San Francisco Bay Area). Reported in this edition are a collection of about 60 high impact journal publications which have already received high citations.

Improved Seismic Monitoring - Improved Decision-Making Springer

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.

Structural Safety and Reliability

Woodhead Publishing

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

Seismic Vulnerability Index Assessment Framework of RC Structures Taylor & Francis US

The current state-of-the-art allows seismologists to give statistical estimates of the probability of a large earthquake striking a given region, identifying the areas in which the seismic hazard is the highest. However, the usefulness of these estimates is limited, without information about local subsoil conditions and the vulnerability of buildings. Identifying the sites where a local amplification of seismic shaking will occur, and identifying the buildings that will be the weakest under the seismic shaking is the only strategy that allows effective defence against earthquake damage at an affordable cost, by applying selective reinforcement only to the structures that need it.

Unfortunately, too often the Earth's

surface acted as a divide between seismologists and engineers. Now it is becoming clear that the building behaviour largely depends on the seismic input and the buildings on their turn act as seismic sources, in an intricate interplay that non-linear phenomena make even more complex. These phenomena are often the cause of observed damage enhancement during past earthquakes. While research may pursue complex models to fully understand soil dynamics under seismic loading, we need, at the same time, simple models valid on average, whose results can be easily transferred to end users without prohibitive expenditure. Very complex models require a large amount of data that can only be obtained at a very high cost or may be impossible to get at all.

Global Changes and Natural Disaster Management: Geo-information Technologies WIT Press

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-informatics in resource management and sustainable ecosystem.

Assessment of Damage to Residential Buildings Caused by the Northridge Earthquake WIT Press

Improved Seismic Monitoring"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.

Earthquake Disaster Simulation of Civil Infrastructures Springer

The proceedings of the conference is going to benefit the researchers, academicians, students and professionals in getting enlightened on latest technologies on structural mechanics, structure and infrastructure engineering. Further, work on practical applications of developed scientific methodologies to civil structural engineering will make the proceedings more interesting and useful to practicing engineers and structural designers.

Advances in Assessment and Modeling of Earthquake Loss Springer Science & Business Media

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 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.

National Academies Press

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 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.

Safety, Reliability, Risk and Life-Cycle Performance of Structures and Infrastructures CRC Press

Seismic Vulnerability Assessment of Civil Engineering Structures at Multiple Scales: From Single Buildings to Large-Scale Assessment provides an integrated, multiscale platform for fundamental and applied studies on the seismic vulnerability assessment of civil engineering structures, including buildings

with different materials and building typologies. The book shows how various outputs obtained from different scales and layers of assessment (from building scale to the urban area) can be used to outline and implement effective risk mitigation, response and recovery strategies. In addition, it highlights how significant advances in earthquake engineering research have been achieved with the rise of new technologies and techniques. The wide variety of construction and structural systems associated with the complex behavior of their materials significantly limits the application of current codes and building standards to the existing building stock, hence this book is a welcomed guide on new construction standards and practices. Provides the theoretical backgrounds on the most advanced seismic vulnerability assessment approaches at different scales and for most common building typologies Covers the most common building typologies and the materials they are made from, such as concrete, masonry, steel, timber and raw earth Presents practical guidelines on how the outputs coming from such approaches can be used to outline effective risk

mitigation and emergency planning strategies

SCHOOL SAFETY AND SECURITY KEEPING SCHOOLS SAFE IN EARTHQUAKES

CRC Press

This book gathers peer-reviewed contributions presented at the 3rd RILEM Spring Convention and Conference, held at Guimarães and hosted by the University of Minho, Portugal, on March 9-14, 2020. The theme of the Conference was “Ambitioning a Sustainable Future for Built Environment: comprehensive strategies for unprecedented challenges”, which was aimed at discussing current challenges and impacts of the built environment on sustainability. The present volume is dedicated to the topic “Strategies for a resilient built environment”, which covers the current and emerging approaches that lead to an optimized design and maintenance of constructions and systems. It includes the development of service life models and life cycle design, in order to maximise longevity and level of service while minimising the

environmental impact of constructions and systems. It also includes the analysis and design of larger systems, such as communities, cities or regions, aiming at reducing risk and increasing resilience. The following subtopics are included: resilience and robustness of the built environment and communities at local and global scales; risk based inspection and maintenance; life cycle analysis and service models; performance based design; improved design strategies by integrating materials and structures. Earthquake Research and Analysis Elsevier Expanding Underground - Knowledge and Passion to Make a Positive Impact on the World contains the contributions presented at the ITA-AITES World Tunnel Congress 2023 (Athens, Greece, 12 - 18 May, 2023). Tunnels and underground space are a predominant engineering practice that can provide sustainable, cost-efficient and environmentally friendly solutions to the ever-growing needs of modern societies. This underground expansion in more diverse and challenging infrastructure types or to novel underground uses can foster the changes needed. At the same time, the tunneling

and underground space community needs to be better prepared and equipped with knowledge, tools and experience, to deal with the prevailing conditions, to successfully challenge and overcome adversities on this path. The papers in this book aim at contributing to the analysis of challenging conditions, the presentation and dissemination good practices, the introduction of new concepts, new tools and innovative elements that can help engineers and all stakeholders to reach their end goals. Expanding Underground - Knowledge and Passion to Make a Positive Impact on the World covers a wide range of aspects and topics related to the whole chain of the construction and operation of underground structures: Knowledge and Passion to Expand Underground for Sustainability and Resilience Geological, Geotechnical Site Investigation and Ground Characterization Planning and Designing of Tunnels and Underground Structures Mechanised Tunnelling and Microtunnelling Conventional Tunnelling, Drill-and-Blast Applications Tunnelling in Challenging Conditions - Case Histories and Lessons Learned Innovation, Robotics and Automation BIM, Big Data and

Machine Learning Applications in Tunnelling Safety, Risk and Operation of Underground Infrastructure, and Contractual Practices, Insurance and Project Management The book is a must-have reference for all professionals and stakeholders involved in tunneling and underground space development projects. *Life-cycle Estimates of Structures Subjected to Seismic Loads* National Academies Press This book resents expert knowledge, opinions and experiences, and provides valuable insight into the scope of problems involved in protecting schools and their occupants from earthquakes.

SEISMIC FRAGILITY ANALYSIS AND LOSS ESTIMATION FOR CONCRETE STRUCTURES

CRC Press

Understanding disaster risk is an integral aspect of disaster risk management, and it is essential for efficient risk reduction investments. Regional disaster risk assessment frameworks, including seismic risk analysis, are commonly used to quantify disaster risk and inform risk reduction strategies. However, few of the

frameworks are able to quantify the full extent of disaster consequences especially as related to household recovery and the disproportionate effect on the socioeconomically vulnerable population. This dissertation proposes a set of new computational methods along various steps of the seismic risk assessment process and lays out the overall methodology for quantifying disaster impacts on the society considering the entire recovery process. This is achieved by integrating and leveraging analytical tools from other fields, namely, geostatistics, real estate investment, macroeconomics, and welfare economics. The dissertation first proposes a framework for simulating spatially distributed ground motions at multiple intensity measures. The framework allows modelers to rapidly simulate multiple realizations of earthquake ground motion intensity, which are required for regional risk assessments. Furthermore, the research investigates post-earthquake decisions on damaged commercial buildings considering the influence of real estate market conditions. An investment decision model for individual buildings that

unifies seismic performance estimation and real estate investment analysis is proposed and applied to four commercial buildings in the Los Angeles area. Results suggest that the state of the real estate market has a significant influence on decisions and recovery trajectories of commercial buildings. Finally, this dissertation integrates regional probabilistic seismic risk analysis, which quantifies asset losses, with an economic recovery model to estimate the overall economic impact of a large earthquake on the San Francisco Bay Area. In addition to quantifying changes in economic output, this approach gives insight into changes in income and employment across different economic sectors. The results of this analysis are combined with information on income, employment sector, housing values, savings, mortgage, rent, and insurance of households across the Bay Area, to calculate consumption changes throughout the recovery. Furthermore, well-being losses (i.e., changes in the utility of consumption over the recovery period) are calculated and analyzed for different socioeconomic groups. Well-being losses, unlike asset losses which use

absolute monetary values, are able to reflect the differential impact that a loss in consumption of \$1 has on a low income versus a high income household. The analysis reveals that poorer households suffer only 19% of the overall physical asset losses, but experience 41% of the well-being losses. Well-being losses also extend over a larger region than that of severe asset losses, requiring design of policies to help people recover, in addition to reducing asset losses. We evaluate several pre- and post-disaster risk reduction strategies in terms of their effect on both asset and well-being losses and examine their efficacy across different socioeconomic groups. The tools developed in this dissertation are meant to be used by researchers, practitioners, and government agencies to understand the extent of the disaster risk. They can help policymakers identify vulnerable groups within their community who might require pre- and post-disaster assistance, and design efficient investment strategies for disaster resilience considering socioeconomic characteristics and vulnerabilities of the population at risk. Improved Seismic Monitoring - Improved

Decision-Making Springer Nature

The overall objective of the current research is the development of a computationally efficient, conceptually simple, easy-to-use method providing loss estimates and other performance metrics for structural systems subjected to seismic loads. The method is based on (1) a novel probabilistic site-specific seismological model, (2) an efficient algorithm for calculating response statistics and (3) probabilistic models for life-cycle structural performance. The proposed seismic-hazard model uses earthquake records at the site of interest and the specific barrier seismological model to provide a more realistic representation of site seismic hazard. The information provided by records and the specific barrier model is aggregated in a Bayesian framework and used subsequently to simulate ground-motion samples as a function of the moment magnitude m and source-to-site distance r . Structural response statistics to simulated ground acceleration records are obtained by a novel efficient, nonintrusive method that resembles the Monte Carlo approach. Like Monte-Carlo, the method calculates

structural responses to samples of the ground-motion process. Unlike Monte-Carlo, which uses a large number of samples selected at random, the proposed method uses a small number of samples selected in an optimal way. The efficiency of the proposed method allows calculation of distributions, rather than just mean values, for downtime cost, damage, and other metrics. Probability distributions can be used in insurance applications to calculate premiums to cover cost of damage. They are also essential tools for assessing tail risk, a quantity which accounts for low-probability events with high impact, used for transferring risk to reinsurance markets. These capabilities are particularly important when dealing with extreme events. Numerical results are presented for linear and non-linear systems. Life-cycle scenarios for seismic events are simulated and used to estimate life-cycle cost and damage.

Assessing and Managing Earthquake Risk CRC Press

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

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.

Seismic Resistant Structures BoD – Books on Demand

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 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. 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.

Insights and Innovations in Structural Engineering, Mechanics and Computation
CRC Press

The New Madrid Seismic Zone (NMSZ) is described as a low probability high risk event. In case of a repetition of the 1811-1812 earthquake series, the expected consequences will cause catastrophic impacts to directly affected areas and beyond. An accurate earthquake impact assessment of the NMSZ is essential to generate an efficient response from FEMA and its associates and to educate and prepare the general population. The objective of this project is to provide scientifically defensible earthquake impact assessments with the most improved hazard, inventory, and fragility data to save lives and protect property. The study region encompasses eight states: Alabama, Arkansas, Illinois, Indiana, Kentucky, Mississippi, Missouri, and Tennessee. The implemented scenario aspires to recreate the events of 1811-1812 as accurately as possible within modeling constraints. The resulting

scenario is a 7.7 magnitude earthquake event with sequential rupture of all three segments of the NMSZ simultaneously. Hazard improvements include complete liquefaction and shaking maps, while multiple inventory datasets are incorporated and added to the existing default assets. An advanced methodology for fragility derivation is applied and improved fragility functions are included for buildings and bridges, based on

inelastic response. Additionally, secondary effects of flooding due to dam failure are analyzed. The analytical analysis is executed in HAZUS-MH MR3 developed by FEMA. Several damage criteria were developed to determine the most critically impacted counties. The results of the impact assessment are staggering, with 140 impacted counties and over 700,000 damaged buildings. Essential facilities such as schools and hospitals incur severe

damage. Transportation and utility lifelines experience serious functionality impairments. Catastrophic consequences result in nearly 86,000 casualties and approximately \$300 billion in direct economic losses. Finally, essential components of future research work are identified. The employed approaches and lesson learned in this project are applicable for worldwide earthquake impact assessments.

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