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The Finite-Difference Modelling of Earthquake Motions The Finite-Difference Modelling of Earthquake Motions The Finite-Difference Modelling of Earthquake Motions The spectral character of earthquake motions Practices and Procedures for Site-Specific Evaluations of Earthquake Ground Motions Industry Practices in Specifying Earthquake Motions Ground Motion Seismology Seismic Ground Motion In Large Urban Areas Stochastic Model for Earthquake Ground Motion Using Wavelet Packets Earthquake Source Asymmetry, Structural Media and Rotation Effects Ground Motions and Soil Liquefaction During Earthquakes Strong Ground Motion Seismology Earthquakes and Other Earth Movements Fundamentals of Earthquake Engineering Earthquake Ground Motion Final Task Report on the Characteristics of Earthquake Ground Motions for Seismic Design Earthquakes and Other Earth Movements Relative Magnitude of the Preliminary and the Principal Portions of Earthquake Motions Final Task Report on the Characteristics of Earthquake Ground Motions for Seismic Design Estimation of Design Earthquake Motions for New Zealand Critical Aspects of Earthquake Ground Motion and Building Damage Potential Analog Simulation of Earthquake Motions Forward Simulation and Linear Inversion of Earthquake Ground Motions The Characteristics of Earthquake Ground Motions for Seismic Design: Task H-1 : characteristics of earthquakes response spectra in Southern California Simulated Earthquake Motions Soil-bridge Interaction During Long-duration Earthquake Motions The Characteristics of Earthquake Ground Motions for Seismic Design Fundamental Concepts of Earthquake Engineering Nonstationary Analysis and Simulation of Earthquake Ground Motions Characterizing the Rotational Components of Earthquake Ground Motion Design of Multistory Reinforced Concrete Buildings for Earthquake Motions Spectrum-compatible Earthquake Motions and Active-damper Isolation Interpretation of Earthquake Strong Ground Motion and Implications for Earthquake Mechanism Analog Simulations of Earthquake Motions : with Discussion and Author's Closure Final Task Report on the Characteristics of Earthquake Ground Motions for Seismic Design Basic Earthquake Engineering A Study of Possible Amplification by Soil Profile of Earthquake Motions at Maysville, Kentucky Critical Earthquake Response of Elastic-Plastic Structures Under Near-Fault or Long-Duration Ground Motions: Closed-Form Approach via Impulse Input Seismic Motion, Lithospheric Structures, Earthquake and Volcanic Sources Directions in Strong Motion Instrumentation

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"Earthquakes and Other Earth Movements" by John Milne. Published by Good Press. Good Press publishes a wide range of titles that encompasses every genre. From well-known classics & literary fiction and non-fiction to forgotten−or yet undiscovered gems−of world literature, we issue the books that need to be read. Each Good Press edition has been meticulously edited and formatted to boost readability for all e-readers and devices. Our goal is to produce eBooks that are user-friendly and accessible to everyone in a high-quality digital format. "In this project, procedures are derived to extract rotational components of ground motion from recorded translational data. Two categories of procedures are developed: Single Station Procedure (SSP) and Multiple Station Procedure (MSP). One of the newly developed MSPs, the Surface Distribution Method (SDM), enabled the development of a design procedure for dense seismic arrays, whose primary purpose is to extract rotational ground motions. Design criteria are proposed to determine the length of the array, the number of recording stations and their spatial distribution. An improved definition of accidental eccentricity is proposed for building design and studied for a wide range of one-story elastic systems, and nonlinear isolation systems. A preliminary investigation of the effect of rotational ground motions on the response of several types of structures is performed, and it is found that rotational components of ground motion significantly affect structural response"--Page iii. Strong ground motion measuring and recording instruments play a major role in mitigation of seismic risk. The strong ground motion near the source of an earthquake describes the effects that endanger our built environment, and is also the most detailed clue concerning the source mechanism of the earthquake. The range of complexity that engulfs our understanding of the source parameters of a major earthquake (extent of the source mechanism, stress drop, wave propagation patterns) and how buildings and other works of construction respond to ground-transmitted dynamic effects may be overpowered by improved direct observations. Strong motion seismographs provide the information that enables scientists and engineers to resolve the many issues that are intertwined with practical problems of building safe communities worldwide. They may be installed as arrays close to major fault zones, consisting of many instruments arranged in some geometrical pattern, or in the vicinity and mounted on buildings. This book, which contains papers by invited authorities, represents a unique interaction between seismologists and earthquake engineers who examine issues of mutual concern in an overlapping area of major interest. The papers have been grouped around three major areas. -Seismic Hazard and Extreme Motions -Engineering Uses of Strong Motion Seismograms -Arrays and Observations. Proceedings of the NATO Advanced Study Institute, Ankara, Turkey, June 10-21, 1985 Fundamentals of Earthquake Engineering: From Source to Fragility, Second Edition combines aspects of engineering seismology, structural and geotechnical earthquake engineering to assemble the vital components required for a deep understanding of response of structures to earthquake ground motion, from the seismic source to the evaluation of actions and deformation required for design, and culminating with probabilistic fragility analysis that applies to individual as well as groups of buildings. Basic concepts for accounting for the effects of soil-structure interaction effects in seismic design and assessment are also provided in this second edition. The nature of earthquake risk assessment is inherently multi-disciplinary. Whereas this book addresses only structural safety assessment and design, the problem is cast in its appropriate context by relating structural damage states to societal consequences and expectations, through the fundamental response quantities of stiffness, strength and ductility. This new edition includes material on the nature of earthquake sources and mechanisms, various methods for the characterization of earthquake input motion, effects of soil-structure interaction, damage observed in reconnaissance missions, modeling of structures for the purposes of response simulation, definition of performance limit states, fragility relationships derivation, features and effects of underlying soil, structural and architectural systems for optimal seismic response, and action and deformation quantities suitable for design. Key features: Unified and novel approach: from source to fragility Clear conceptual framework for structural response analysis, earthquake input characterization, modelling of soil-structure interaction and derivation of fragility functions Theory and relevant practical applications are merged within each chapter Contains a new chapter on the derivation of fragility Accompanied by a website containing illustrative slides, problems with solutions and worked-through examples Fundamentals of Earthquake Engineering: From Source to Fragility, Second Edition is designed to support graduate teaching and learning, introduce practising structural and geotechnical engineers to earthquake analysis and design problems, as well as being a reference book for further studies. This book explains the physics behind seismic ground motions and seismic waves to graduate and upper undergraduate students as well as to professionals. Both seismic ground motions and seismic waves are terms for “shaking” due to earthquakes, but it is common that shaking in the near-field of an earthquake source is called seismic ground motion and in the far-field is called seismic waves. Seismic ground motion is often described by the tensor formula based on the representation theorem, but in this book explicit formulation is emphasized beginning with Augustus Edward Hough Love (1863 – 1940). The book also explains in depth the equations and methods used for analysis and computation of shaking close to an earthquake source. In addition, it provides in detail information and knowledge related to teleseismic body waves, which are frequently used in the analysis of the source of an earthquake. "Numerical simulation is an irreplaceable tool in earthquake ground motion research. Among all the numerical methods in seismology, the finite-difference (FD) technique is the most widely-used, providing the best balance of accuracy and computational efficiency. Now, for the first time, this book offers a comprehensive introduction to this method and its applications to earthquake motion"-- This breakthrough book is the first to examine the rotational effects in earthquakes, a revolutionary concept in seismology. Existing models do no yet explain the significant rotational and twisting motions that occur during an earthquake and cause the failure of structures. The rotation and twist effects are investigated and described, and their consequences for designing tall buildings and other important structures are presented. This book will change the way the world views earthquakes. TRB’s National Cooperative Highway Research Program (NCHRP) Synthesis 428: Practices and Procedures for Site-Specific Evaluations of Earthquake Ground Motions identifies and describes current practice and available methods for evaluating the influence of local ground conditions on earthquake design ground motions on a site-specific basis. While successfully preventing earthquakes may still be beyond the capacity of modern engineering, the ability to mitigate damages with strong structural designs and other mitigation measures are well within the purview of science. Fundamental Concepts of Earthquake Engineering presents the concepts, procedures, and code provisions that are currently being used to make structures as earthquake-resistant as is presently feasible. The book begins by describing the purpose, main aspects, and historical development of earthquake engineering and provides an overview of the type and extent of damage an earthquake can produce. It then introduces the concepts of seismology, the mechanisms of earthquake generation and propagation, and the difference between the various scales used to quantify the size of an earthquake and its potential to cause damage. The book also discusses the response spectrum and the different ways earthquake ground motions may be characterized and how local soil conditions may affect ground motion characteristics. Later chapters examine the design spectrum, conventional methods used to calculate the response of structures, soil-structure systems, and nonstructural components to earthquake ground motions. This comprehensive resource is certain to advance the knowledge of those tasked with taking preemptive action against the devastating effects of major, catastrophic earthquakes. The specialty section Earthquake Engineering is one branch of Frontiers in Built Environment and welcomes critical and in-depth submissions on earthquake ground motions and their effects on buildings and infrastructures. Manuscripts should yield new insights and ultimately contribute to a safer and more reliable design of building structures and infrastructures. The scope includes the characterization of earthquake ground motions (e.g. near-fault, far-fault, short-period, long-period), their underlying properties, their intrinsic relationship with structural responses, and the true behaviors of building structures and infrastructures under risky and uncertain ground motions. More specific topics include recorded ground motions, generated ground motions, response spectra, stochastic modeling of ground motion, critical excitation, geotechnical aspects, soil mechanics, soil liquefaction, soil-structure interactions, pile foundations, earthquake input energy, structural control, passive control, active control, base-isolation, steel structures, reinforced concrete structures, wood structures, building retrofit, structural optimization, uncertainty analysis, robustness analysis, and redundancy analysis. This eBook includes four original research papers, in addition to the Specialty Grand Challenge article, on the critical earthquake response of elastic-plastic structures under near-fault or long-duration ground motions which were published in the specialty section Earthquake Engineering. In the early stage of dynamic nonlinear response analysis of structures around 1960s, a simple hysteretic structural model and a simple sinusoidal earthquake ground motion input were dealt with together with random inputs. The steady-state response was tackled by an equivalent linearization method developed by Caughey, Iwan and others. In fact, the resonance plays a key role in the earthquake-resistant design and it has a strong effect even in case of near-fault ground motions. In order to draw the steady-state response curve and investigate the resonant property, two kinds of repetition have to be introduced. One is a cycle, for one forced input frequency, of the initial guess of the steady-state response amplitude, the construction of the equivalent linear model, the analysis of the steady-state response amplitude using the equivalent linear model and the update of the equivalent linear model based on the computed steady-state response amplitude. The other is the sweeping over a range of forced input frequencies. This process is quite tedious. Four original research papers included in this eBook propose a new approach to overcome this difficulty. Kojima and Takewaki demonstrated that the elastic-plastic response as continuation of free-vibrations under impulse input can be derived in a closed form by a sophisticated energy approach without solving directly the equations of motion as differential equations. While, as pointed out above, the approach based on the equivalent linearization method requires the repetition of application of the linearized equations, the method by Kojima and Takewaki does not need any repetition. The double impulse, triple impulse and multiple impulses enable us to describe directly the critical timing of impulses (resonant frequency) which is not easy for the sinusoidal and other inputs without a repetitive procedure. It is important to note that, while most of the previous methods employ the equivalent linearization of the structural model with the input unchanged, the method treated in this eBook transforms the input into a series of impulses with the structural model unchanged. This characteristic guarantees high accuracy and reliability even in the large plastic deformation range. The approach presented in this eBook is an epoch-making accomplishment to open the door for simpler and deeper understanding of structural reliability of built environments in the elastic-plastic range The best way to minimize damage from earthquakes is to predict their location and effects and reinforce against those possible effects. Toward that end, this book presents prediction methods useful for the design of earthquake-resistant structures. In the first of two parts, the book deals with issues relating to the characterisation and the rational definition of seismic input. It begins with a study of earthquake records that leads to the identification of their damage potential parameters, such as the peak ground acceleration and the strong motion duration. Subsequent chapters concern themselves with the deterministic and probabilistic methodologies for producing seismic inputs. Further chapters are dedicated to the generation of artificial seismic input on the basis of stochastic or probabilistic approaches. The second part of this volume deals with the effects of ground motion on foundation elements and structural integrity. Particular emphasis is given to the interaction of foundation piles with vibrating soils, homogeneous or heterogeneous. The final two chapters are concerned with the possible connection between soil structure interaction (SSI) and structural damage. In both instances records of actual earthquake induced motion are used for such assessments. Among all the numerical methods in seismology, the finite-difference (FD) technique provides the best balance of accuracy and computational efficiency. This book offers a comprehensive introduction to FD and its applications to earthquake motion. Using a systematic tutorial approach, the book requires only undergraduate degree-level mathematics and provides a user-friendly explanation of the relevant theory. It explains FD schemes for solving wave equations and elastodynamic equations of motion in heterogeneous media, and provides an introduction to the rheology of viscoelastic and elastoplastic media. It also presents an advanced FD time-domain method for efficient numerical simulations of earthquake ground motion in realistic complex models of local surface sedimentary structures. Accompanied by a suite of online resources to help put the theory into practice, this is a vital resource for professionals and academic researchers using numerical seismological techniques, and graduate students in earthquake seismology, computational and numerical modelling, and applied mathematics. Geophysicists use seismic signals to image structures in the Earth's interior, to understand the mechanics of earthquake and volcanic sources, and to estimate their associated hazards. Keiiti Aki developed pioneering quantitative methods for extracting useful information from various portions of observed seismograms and applied these methods to many problems in the above fields. This volume honors Aki's contributions with review papers and results from recent applications by his former students and scientific associates pertaining to topics spawned by his work. Discussed subjects include analytical and numerical techniques for calculating dynamic rupture and radiated seismic waves, stochastic models used in engineering seismology, earthquake and volcanic source processes, seismic tomography, properties of lithospheric structures, analysis of scattered waves, and more. The volume will be useful to students and professional geophysicists alike. The accelerated, and often uncontrolled, growth of the cities has contributed to the ecological transformation of their immediate surroundings. Factors contributing to the urban vulnerability include: lowering or rising of the water table, subsidence, loss of bearing capacity of soil foundations and instability of slopes. Recent catastrophic earthquakes highlight the poor understanding by decision makers of seismic related risk, as well as the tendency of some builders to use the cheapest designs and construction materials to increase short-term economic returns on their investment. Losses from earthquakes will continue to increase if we do not shift towards proactive solution. Disaster reduction is both an issue for consideration in the sustainable development agenda and a cross-cutting issue relating to the social, economic, environmental and humanitarian sectors. As location is the key factor, which determines the level of risk associated with a hazard, land-use plans and mapping should be used as tools to identify the most suitable usage for vulnerable areas. Earthquake engineering analyses are often performed using shallow, crustal earthquake motions (e.g., 1940 El Centro). However, large areas of the world are subject to subduction zone earthquake motions (e.g., the Pacific Northwest). A subduction zone earthquake motion is characterized by its long duration (e.g., strong shaking lasts for more than a minute). Observations of unexpected bridge damage following the recent subduction zone earthquakes in Chile and Japan highlight the importance of understanding soil-bridge interaction during long-duration earthquake motions. Accordingly, the main objective of this thesis is to report the seismic response of a soil-bridge system during long-duration earthquake motions. The soil-bridge system was created within the nite-element framework OpenSees. The pile foundation was modeled using fiber-section elements (representing a reinforced concrete pile), and the pile was attached to a soil continuum, which was specified as a dense, non-liquefiable sand, by using calibrated soil springs. The bridge column was modeled using force-based fiber-section elements attached to the linear elastic bridge deck. A double span bridge was considered herein. Gap elements were used at the ends of the bridge deck to represent back ll response. The soil-bridge system was subjected to seven selected subduction zone earthquake motions and seven selected shallow, crustal earthquake motions. For each earthquake motion, the number of inelastic excursions was based on the yield rotation, [theta][subscript y], corresponding to the curvature at the point of first yield of the moment-curvature analysis. The number of inelastic excursions was plotted with five earthquake intensity measures: peak ground acceleration (PGA), cumulative absolute velocity (CAV), significant duration (D595), Arias intensity (I[subscript A]), and spectral acceleration (S[subscript a]). Results show a definite distinction between the two types of earthquake motions and long-duration earthquake motions are more damaging to soil-bridge systems than shallow, crustal earthquake motions with similar amplitudes and frequency contents because of the increased number of cycles of loading. This book provides senior undergraduate students, master students and structural engineers who do not have a background in the field with core knowledge of structural earthquake engineering that will be invaluable in their professional lives. The basics of seismotectonics, including the causes, magnitude, and intensity of earthquakes, are first explained. Then the book introduces basic elements of seismic hazard analysis and presents the concept of a seismic hazard map for use in seismic design. Subsequent chapters cover key aspects of the response analysis of simple systems and building structures to earthquake ground motions, design spectrum, the adoption of seismic analysis procedures in seismic design codes, seismic design principles and seismic design of reinforced concrete structures. Helpful worked examples on seismic analysis of linear, nonlinear and base isolated buildings, earthquake-resistant design of frame and frame-shear wall systems are included, most of which can be solved using a hand calculator. For performance-based design, nonlinear dynamic structural analysis for various types of input ground motions is required. Stochastic (simulated) ground motions are sometimes useful as input motions, because unlike recorded motions they are not limited in number and because their properties can be varied systematically to study the impact of ground motion properties on structural response. This dissertation describes an approach by which the wavelet packet transform can be used to characterize complex time-varying earthquake ground motions, and it illustrates the potential benefits of such an approach in a variety of earthquake engineering applications. The proposed model is based on Thr´ainsson and Kiremidjian (2002), which use Fourier amplitudes and phase differences to simulate ground motions and attenuation models to their model parameters. We extend their model using wavelet packet transform since it can control the time and frequency characteristic of time series. The time- and frequency-varying properties of real ground motions can be captured using wavelet packets, so a model is developed that requires only 13 parameters to describe a given ground motion. These 13 parameters are then related to seismological variables such as earthquake magnitude, distance, and site condition, through regression analysis that captures trends in mean values, standard deviations and correlations of these parameters observed in a large database of recorded strong ground motions. The resulting regression equations then form a model that can be used to predict ground motions for a future earthquake scenario; this model is analogous to widely used empirical ground motion prediction models (formerly called "attenuation models") except that this model predicts entire time series rather than only response spectra. The ground motions produced using this predictive model are explored in detail, and are shown to have elastic response spectra, inelastic response spectra, durations, mean periods, etc., that are consistent in both mean and variability to existing published predictive models for those properties. That consistency allows the proposed model to be used in place of existing models for probabilistic seismic hazard analysis (PSHA) calculations. This new way to calculate PSHA is termed "simulation-based probabilistic seismic hazard analysis" and it allows a deeper understanding of ground motion hazard and hazard deaggregation than is possible with traditional PSHA because it produces a suite of potential ground motion time histories rather than simply a distribution of response spectra. The potential benefits of this approach are demonstrated and explored in detail. Taking this analysis even further, this suite of time histories can be used as input for nonlinear dynamic analysis of structures, to perform a risk analysis (i.e., "probabilistic seismic demand analysis") that allows computation of the probability of the structure exceeding some level of response in a future earthquake. These risk calculations are often performed today using small sets of scaled recorded ground motions, but that approach requires a variety of assumptions regarding important properties of ground motions, the impacts of ground motion scaling, etc. The approach proposed here facilitates examination of those assumptions, and provides a variety of other relevant information not obtainable by that traditional approach.