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AASHTO Guide Specifications for LRFD Seismic Bridge Design Seismic Design and Retrofit of Bridges Performance-based Seismic Bridge Design Seismic Bridge Design and Retrofit -- Structural Solutions Bridge Engineering Seismic Design and Assessment of Bridges Correlation of Shear Design Between AASHTO LRFD Bridge Design Specifications and AASHTO Guide Specifications for the LRFD Seismic Bridge Design Bridge Engineering Handbook, Second Edition Guide Specifications for Seismic Isolation Design Application of Bridge Specific Fragility Analysis in the Seismic Design Process of Bridges in California Comprehensive Specification for the Seismic Design of Bridges Bridge Engineering Bridge Engineering Handbook AASHTO Guide Specifications for LRFD Seismic Bridge Design AASHTO Guide Specifications for LRFD Seismic Bridge Design Bridge Engineering Handbook, Second Edition Bridge Engineering Seismic Design Aids for Nonlinear Pushover Analysis of Reinforced Concrete and Steel Bridges Performance-Based Seismic Bridge Design Seismic Design of Buildings and Bridges Innovative Bridge Design Handbook Theory of California Seismic Bridge Design and Analysis for the Beginner Seismic Bridge Design Applications Design Examples Proposed AASHTO Guidelines for Performance-based Seismic Bridge Design AASHTO Guide Specifications for LRFD Seismic Bridge Design AASHTO Guide Specifications for LRFD Seismic Bridge Design Seismic Design of Non-conventional Bridges Improved Seismic Design Criteria for California Bridges LRFD Bridge Design Seismic Bridge Design and Retrofit Seismic Design of Bridges Simplified LRFD Bridge Design LRFD Seismic Analysis and Design of Bridges Seismic Design Criteria for Bridges and Other Highway Structures Seismic Design of Bridges, Design Example Application of Bridge Design Program to Seismic Design and ASD Steel Bridge Design Civil & Structural Engineering Seismic Bridge Design According to Eurocode 8 and SIA 160 Seismic Design and Assessment of Bridges

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In AASHTO LRFD, three different importance categories are presented as "Critical," "Essential" and "Other" bridges to be considered in seismic design. These classifications are mainly based on the serviceability requirement of bridges after a design earthquake. The bridge's overall performance during a given seismic event cannot be clearly described. Serviceability requirements specified for a given importance category are assumed to be assured by using different response modification factors (R-factors). Although R-factor is directly related with strength provided to resisting column, it might be correlated with selected performance levels including different engineering response measures. Within the scope of this study, 27216 single circular bridge column bent models designed according to AASHTO LRFD and having varying column aspect ratio, column diameter, axial load ratio, R-factor and elastic design spectrum data are investigated through a series of analyses. Three performance levels such as "Fully Functional," "Operational" and "Delayed Operational" are defined in which their criteria are selected in terms of column drift measure corresponding to several damage states. The California Department of Transportation (Caltrans) seismic bridge design process for an Ordinary Bridge described in the Seismic Design Criteria (SDC) directs the design engineer to meet minimum requirements resulting in the design of a bridge that should remain standing in the event of a Design Seismic Hazard. A bridge can be designed to sustain significant damage; however it should avoid the collapse limit state, where the bridge is unable to resist loads due to self-weight. Seismic hazards, in the form of a design spectrum or ground motion time histories, are used to determine the demands of the bridge components and bridge system. These demands are compared to the capacity of the components to ensure that the bridge meets key performance criteria. The SDC also specifies design detailing of various components, including abutments, foundations, hinge seats and bent caps. The expectation of following the guidelines set forth by the SDC during the design process is that the resulting bridge design will avoid collapse under anticipated seismic loads. While the code provisions provide different analyses to follow and component detailing to adhere to in order to ensure a proper bridge design, the SDC does not provide a way to quantitatively determine whether the bridge design has met the requirement of no-collapse. The objectives of this research are to introduce probabilistic fragility analysis into the Caltrans design process and address the gap of information in the current design process, namely the determination of whether the bridge design meets the performance criteria of no-collapse at the design hazard level. The motivation for this project is to improve the designer's understanding of the probabilistic performance of their bridge design as a function of important design details. To accomplish these goals, a new bridge fragility method is presented as well as a design support tool that provides design engineers with instant access to fragility information during the design process. These products were developed for one specific bridge type that is common in California, the two-span concrete box girder bridge. The end product, the design support tool, is a bridge-specific fragility generator that provides probabilistic performance information on the bridge design. With this tool, a designer can check the bridge design, after going through the SDC design process, to determine the performance of the bridge and its components at any hazard level. The design support tool can provide the user with the probability of failure or collapse for the specific bridge design, which will give insight to the user about whether the bridge design has achieved the performance objective set out in the SDC. The designer would also be able to determine the effect of a change in various design details on the performance and therefore make more informed design decisions. Covers seismic design for typical bridge types and applies to non-critical and non-essential bridges. Approved as an alternate to the seismic provisions in the AASHTO LRFD Bridge Design Specifications. Differs from the current procedures in the LRFD Specifications in the use of displacement-based design procedures, instead of the traditional force-based R-Factor method. Includes detailed guidance and commentary on earthquake-resisting elements and systems, global design strategies, demand modeling, capacity calculation, and liquefaction effects. Capacity design procedures underpin the Guide Specifications' methodology; includes prescriptive detailing for plastic hinging regions and design requirements for capacity protection of those elements that should not experience damage. With chapters culled from the acclaimed Bridge Engineering Handbook, Bridge Engineering: Substructure Design focuses on the various components comprising and affecting bridge substructures. These include bearings, piers and columns, towers, abutments and retaining structures, footings and foundations, and bridge hydraulics. For each component, the The book focuses on the use of inelastic analysis methods for the seismic assessment and design of bridges, for which the work carried out so far, albeit interesting and useful, is nevertheless clearly less than that for buildings. Although some valuable literature on the subject is currently available, the most advanced inelastic analysis methods that emerged during the last decade are currently found only in the specialised research-oriented literature, such as technical journals and conference proceedings. Hence the key objective of this book is two-fold, first to present all important methods belonging to the aforementioned category in a uniform and sufficient for their understanding and implementation length, and to provide also a critical perspective on them by including selected case-studies wherein more than one methods are applied to a specific bridge and by offering some critical comments on the limitations of the individual methods and on their relative efficiency. The book should be a valuable tool for both researchers and practicing engineers dealing with seismic design and assessment of bridges, by both making the methods and the analytical tools available for their implementation, and by assisting them to select the method that best suits the individual bridge projects that each engineer and/or researcher faces. Innovative Bridge Design Handbook: Construction, Rehabilitation, and Maintenance, Second Edition, brings together the essentials of bridge engineering across design, assessment, research and construction. Written by an international group of experts, each chapter is divided into two parts: the first covers design issues, while the second presents current research into the innovative design approaches used across the world. This new edition includes new topics such as foot bridges, new materials in bridge engineering and soil-foundation structure interaction. All chapters have been updated to include the latest concepts in design, construction, and maintenance to reduce project cost, increase structural safety, and maximize durability. Code and standard references have been updated. Completely revised and updated with the latest in bridge engineering and design Provides detailed design procedures for specific bridges with solved examples Presents structural analysis including numerical methods (FEM), dynamics, risk and reliability, and innovative structural typologies Over 140 experts, 14 countries, and 89 chapters are represented in the second edition of the Bridge Engineering Handbook. This extensive collection highlights bridge engineering specimens from around the world, contains detailed information on bridge engineering, and thoroughly explains the concepts and practical applications surrounding the subject. Published in five books: Fundamentals, Superstructure Design, Substructure Design, Seismic Design, and Construction and Maintenance, this new edition provides numerous worked-out examples that give readers step-by-step design procedures, includes contributions by leading experts from around the world in their respective areas of bridge engineering, contains 26 completely new chapters, and updates most other chapters. It offers design concepts, specifications, and practice, as well as the various types of bridges. The text includes over 2,500 tables, charts, illustrations, and photos. The book covers new, innovative and traditional methods and practices; explores rehabilitation, retrofit, and maintenance; and examines seismic design and building materials. The fourth book, Seismic Design contains 18 chapters, and covers seismic bridge analysis and design. What's New in the Second Edition: Includes seven new chapters: Seismic Random Response Analysis, Displacement-Based Seismic Design of Bridges, Seismic Design of Thin-Walled Steel and CFT Piers, Seismic Design of Cable-Supported Bridges, and three chapters covering Seismic Design Practice in California, China, and Italy Combines Seismic Retrofit Practice and Seismic Retrofit Technology into one chapter called Seismic Retrofit Technology Rewrites Earthquake Damage to Bridges and Seismic Design of Concrete Bridges chapters Rewrites Seismic Design Philosophies and Performance-Based Design Criteria chapter and retitles it as Seismic Bridge Design Specifications for the United States Revamps Seismic Isolation and Supplemental Energy Dissipation chapter and retitles it as Seismic Isolation Design for Bridges This text is an ideal reference for practicing bridge engineers and consultants (design, construction, maintenance), and can also be used as a reference for students in bridge engineering courses. "This report presents the analytical study of the shear capacity of reinforced concrete columns using both the AASHTO LRFD bridge design specifications and the AASHTO guide specifications for the LRFD seismic bridge design. The study investigates various levels of axial load, transverse reinforcement and longitudinal reinforcement to determine who the two specifications compare. The AASHTO guide specifications for the LRFD seismic bridge design permits the designer to use the AASHTO LRFD bridge design specifications or equations within the AASHTO guide specifications for the LRFD seismic bridge design with predetermined values. [...] A parametrical study was extended to conventional full-scale columns, using both the AASHTO LRFD bridge design specifications and the AASHTO guide specifications for the LRFD seismic bridge design to predict shear strength in order to analyze the direct effects of the parameters on the shear strength predictions."--Abstract This book examines and explains material from the 9th edition of the AASHTO LRFD Bridge Design Specifications, including deck and parapet design, load calculations, limit states and load combinations, concrete and steel I-girder design, bearing design, and more. With increased focus on earthquake resiliency, two separate chapters– one on conventional seismic design and the other on seismic isolation applied to bridges– will fully address this vital topic. The primary focus is on steel and concrete I-girder bridges, with regard to both superstructure and substructure design. Features: Includes several worked examples for a project bridge as well as actual bridges designed by the author Examines seismic design concepts and design details for bridges Presents the latest material based on the 9th edition of the LRFD Bridge Design Specifications Covers fatigue, strength, service, and extreme event limit states Includes numerous solved problems and exercises at the end of each chapter to illustrate the concepts presented LRFD Bridge Design: Fundamentals and Applications will serve as a useful text for graduate and upper-level undergraduate civil engineering students as well as practicing structural engineers. "TRB's National Cooperative Highway Research Program (NCHRP) Synthesis 440, Performance-Based Seismic Bridge Design (PBSD) summarizes the current state of knowledge and practice for PBSD. PBSD is the process that links decision making for facility design with seismic input, facility response, and potential facility damage. The goal of PBSD is to provide decision makers and stakeholders with data that will enable them to allocate resources for construction based on levels of desired seismic performance"--Publisher's description. AASHTO has issued proposed interim revisions to the AASHTO Guide Specifications for LFRD Seismic Bridge Design (2009). This packet contains the revised pages. They are not designed to replace the corresponding pages in the book but rather to be kept with the book for fast reference. This work offers guidance on bridge design for extreme events induced by human beings. This document provides the designer with information on the response of concrete bridge columns subjected to blast loads as well as blast-resistant design and detailing guidelines and analytical models of blast load distribution. The content of this guideline should be considered in situations where resisting blast loads is deemed warranted by the owner or designer. Over 140 experts, 14 countries, and 89 chapters are represented in the second edition of the Bridge Engineering Handbook. This extensive collection highlights bridge engineering specimens from around the world, contains detailed information on bridge engineering, and thoroughly explains the concepts and practical applications surrounding the subject. Published in five books: Fundamentals, Superstructure Design, Substructure Design, Seismic Design, and Construction and Maintenance, this new edition provides numerous worked-out examples that give readers step-by-step design procedures, includes contributions by leading experts from around the world in their respective areas of bridge engineering, contains 26 completely new chapters, and updates most other chapters. It offers design concepts, specifications, and practice, as well as the various types of bridges. The text includes over 2,500 tables, charts, illustrations, and photos. The book covers new, innovative and traditional methods and practices; explores rehabilitation, retrofit, and maintenance; and examines seismic design and building materials. The fourth book, Seismic Design contains 18 chapters, and covers seismic bridge analysis and design. What's New in the Second Edition: Includes seven new chapters: Seismic Random Response Analysis, Displacement-Based Seismic Design of Bridges, Seismic Design of Thin-Walled Steel and CFT Piers, Seismic Design of Cable-Supported Bridges, and three chapters covering Seismic Design Practice in California, China, and Italy Combines Seismic Retrofit Practice and Seismic Retrofit Technology into one chapter called Seismic Retrofit Technology Rewrites Earthquake Damage to Bridges and Seismic Design of Concrete Bridges chapters Rewrites Seismic Design Philosophies and Performance-Based Design Criteria chapter and retitles it as Seismic Bridge Design Specifications for the United States Revamps Seismic Isolation and Supplemental Energy Dissipation chapter and retitles it as Seismic Isolation Design for Bridges This text is an ideal reference for practicing bridge engineers and consultants (design, construction, maintenance), and can also be used as a reference for students in bridge engineering courses. Developed to comply with the fifth edition of the AASHTO LFRD Bridge Design Specifications [2010]—Simplified LRFD Bridge Design is "How To" use the Specifications book. Most engineering books utilize traditional deductive practices, beginning with in-depth theories and progressing to the application of theories. The inductive method in the book uses alternative approaches, literally teaching backwards. The book introduces topics by presenting specific design examples. Theories can be understood by students because they appear in the text only after specific design examples are presented, establishing the need to know theories. The emphasis of the book is on step-by-step design procedures of highway bridges by the LRFD method, and "How to Use" the AASHTO Specifications to solve design problems. Some of the design examples and practice problems covered include: Load combinations and load factors Strength limit states for superstructure design Design Live Load HL- 93 Un-factored and Factored Design Loads Fatigue Limit State and fatigue life; Service Limit State Number of design lanes Multiple presence factor of live load Dynamic load allowance Distribution of Live Loads per Lane Wind Loads, Earthquake Loads Plastic moment capacity of composite steel-concrete beam LRFR Load Rating Simplified LRFD Bridge Design is a study guide for engineers preparing for the PE examination as well as a classroom text for civil engineering students and a reference for practicing engineers. Eight design examples and three practice problems describe and introduce the use of articles, tables, and figures from the AASHTO LFRD Bridge Design Specifications. Whenever articles, tables, and figures in examples appear throughout the text, AASHTO LRFD specification numbers are also cited, so that users can cross-reference the material. Mitigating the effects of earthquakes is crucial to bridge design. With chapters culled from the best-selling Bridge Engineering Handbook, this volume sets forth the principles and applications of seismic design, from the necessary geotechnical and dynamic analysis background to seismic isolation and energy dissipation, active control, and retrofit Nonlinear static monotonic (pushover) analysis has become a common practice in performance-based bridge seismic design. The popularity of pushover analysis is due to its ability to identify the failure modes and the design limit states of bridge piers and to provide the progressive collapse sequence of damaged bridges when subjected to major earthquakes. Seismic Design Aids for Nonlinear Pushover Analysis of Reinforced Concrete and Steel Bridges fills the need for a complete reference on pushover analysis for practicing engineers. This technical reference covers the pushover analysis of reinforced concrete and steel bridges with confined and unconfined concrete column members of either circular or rectangular cross sections as well as steel members of standard shapes. It provides step-by-step procedures for pushover analysis with various nonlinear member stiffness formulations, including: Finite segment–finite string (FSFS) Finite segment–moment curvature (FSMC) Axial load–moment interaction (PM) Constant moment ratio (CMR) Plastic hinge length (PHL) Ranging from the simplest to the most sophisticated, the methods are suitable for engineers with varying levels of experience in nonlinear structural analysis. The authors also provide a downloadable computer program, INSTRUCT (INelastic STRUCTural Analysis of Reinforced-Concrete and Steel Structures), that allows readers to perform their own pushover analyses. Numerous real-world examples demonstrate the accuracy of analytical prediction by comparing numerical results with full- or large-scale test results. A useful reference for researchers and engineers working in structural engineering, this book also offers an organized collection of nonlinear pushover analysis applications for students. AASHTO has issued interim revisions to AASHTO Guide Specifications for LRFD Seismic Bridge Design, Second Edition (2011). This packet contains the revised pages. They are not designed to replace the corresponding pages in the book but rather to be kept with the book for quick reference. Because of their structural simplicity, bridges tend to beparticularly vulnerable to damage and even collapse when subjectedto earthquakes or other forms of seismic activity. Recentearthquakes, such as the ones in Kobe, Japan, and Oakland,California, have led to a heightened awareness of seismic risk andhave revolutionized bridge design and retrofit philosophies. In Seismic Design and Retrofit of Bridges, three of the world's topauthorities on the subject have collaborated to produce the mostexhaustive reference on seismic bridge design currently available.Following a detailed examination of the seismic effects of actualearthquakes on local area bridges, the authors demonstrate designstrategies that will make these and similar structures optimallyresistant to the damaging effects of future seismicdisturbances. Relying heavily on worldwide research associated with recentquakes, Seismic Design and Retrofit of Bridges begins with anin-depth treatment of seismic design philosophy as it applies tobridges. The authors then describe the various geotechnicalconsiderations specific to bridge design, such as soil-structureinteraction and traveling wave effects. Subsequent chapters coverconceptual and actual design of various bridge superstructures, andmodeling and analysis of these structures. As the basis for their design strategies, the authors' focus is onthe widely accepted capacity design approach, in which particularlyvulnerable locations of potentially inelastic flexural deformationare identified and strengthened to accommodate a greater degree ofstress. The text illustrates how accurate application of thecapacity design philosophy to the design of new bridges results instructures that can be expected to survive most earthquakes withonly minor, repairable damage. Because the majority of today's bridges were built before thecapacity design approach was understood, the authors also devoteseveral chapters to the seismic assessment of existing bridges,with the aim of designing and implementing retrofit measures toprotect them against the damaging effects of future earthquakes.These retrofitting techniques, though not considered appropriate inthe design of new bridges, are given considerable emphasis, sincethey currently offer the best solution for the preservation ofthese vital and often historically valued thoroughfares. Practical and applications-oriented, Seismic Design and Retrofit ofBridges is enhanced with over 300 photos and line drawings toillustrate key concepts and detailed design procedures. As the onlytext currently available on the vital topic of seismic bridgedesign, it provides an indispensable reference for civil,structural, and geotechnical engineers, as well as students inrelated engineering courses. A state-of-the-art text on earthquake-proof design and retrofit ofbridges Seismic Design and Retrofit of Bridges fills the urgent need for acomprehensive and up-to-date text on seismic-ally resistant bridgedesign. The authors, all recognized leaders in the field,systematically cover all aspects of bridge design related toseismic resistance for both new and existing bridges. * A complete overview of current design philosophy for bridges,with related seismic and geotechnical considerations * Coverage of conceptual design constraints and their relationshipto current design alternatives * Modeling and analysis of bridge structures * An exhaustive look at common building materials and theirresponse to seismic activity * A hands-on approach to the capacity design process * Use of isolation and dissipation devices in bridge design * Important coverage of seismic assessment and retrofit design ofexisting bridges The Principles and Application in Engineering Series is a series of convenient, economical references sharply focused on particular engineering topics and subspecialties. Each volume in this series comprises chapters carefully selected from CRC's bestselling handbooks, logically organized for optimum convenience, and thoughtfully priced to fit ever Everything civil and structural engineers in California need to prepare for the seismic design topics of the Special Civil Engineering Exam and California Structural Engineering Exam. This guide emphasizes methods that lead to the quickest and simplest solution to any problem. TRB's National Cooperative Highway Research Program (NCHRP) Synthesis 532: Seismic Design of Non-Conventional Bridges documents seismic design approaches and criteria used for "non-conventional" bridges, such as long-span cable-supported bridges, bridges with truss tower substructures, and arch bridges. Design of conventional bridges for seismic demands in the United States is based on one of two American Association of State Highway Transportation Officials (AASHTO) documents: the AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications (AASHTO BDS) (1) or the AASHTO Guide Specifications for LRFD Seismic Bridge Design (Guide Spec) (2). The stated scope of these documents for seismic design is limited to conventional bridges. Non-conventional bridges outside the scope of these two AASHTO documents, such as cable-supported bridges and long-span arch bridges, are typically high value investments designed with special project criteria. There is no current AASHTO standard seismic design criteria document specific to these non-conventional bridges. Seismic design criteria for these non-conventional bridges are typically part of a broader project-specific criteria document that addresses the special character of the bridge type. Everything you need to pass the test! Seismic Design of Buildings and Bridges: 2002-2003 Edition by Alan Williams, Ph.D., S.E., C. Eng., a leading structural engineering author · Written for civil and structural engineers preparing for the: Special Civil Engineering Exam--California National Structural Engineering I and II Exams California Structural Engineering Exam · Includes more than 100 problems and step-by-step solutions from recent exams · Offers 18 HP-48G calculator programs for frequently occurring calculations in the appendix · Contains an 8-page summary of useful equations · Reflects current publications of SEAOC and FEMA · Conforms to the 1997 edition of the UBC · Updated based on the latest AISC and ACI standards · Provides comprehensive clarification of applicable Building Codes and Standard Specifications · Uses provisions of the 1999 SEAOC bluebook, 1999 FEMA Advisory No. 2, 2000 FEMA 350 Design of Steel Moment Frame Buildings, and 1997 AISC Seismic Provisions · Cites extensive reference publications that reflect current design procedures Other Engineering Resources Available from Oxford University Press For the PE Exams Civil Engineering License Review, Fourteenth Edition, Donald G. Newnan, P.E. (1-57645-029-5) Civil Engineering: Problems and Solutions, Fourteenth Edition, Donald G. Newnan, P.E. (1-57645-030-9) Civil Engineering Problem Solving Flowcharts, Second Edition, Jorge L. Rodriguez, P.E. (1-57645-038-4) Structural Engineering License Review, Problems and Solutions, 2002-2003 Edition, Alan Williams, S.E. (0-19-515916-0) Design of Reinforced Concrete Structures, Second Edition, Alan Williams, S.E. (1-57645-051-1) Civil Engineering: Bridge Structures, Alan Williams, S.E. (1-57645-041-4) Civil Engineering: Building Structures, Alan Williams, S.E. (1-57645-040-6) Civil Engineering: Foundations and Retaining Structures, Alan Williams, S.E. (1-57645-042-2) Civil Engineering: Seismic Design, Alan Williams, S.E. (1-57645-043-0) For an Introduction to MATLAB Getting Started with MATLAB 5: A Quick Introduction for Scientists and Engineers by Rudra Pratap (0-19-512947-4) Getting Started with MATLAB, Version 6: A Quick Introduction for Scientists and Engineers by Rudra Pratap (0-19-515014-7) For Background on the Engineering Profession Fundamentals of Ethics for Scientists and Engineers by Edmund G. Seebauer and Robert L. Barry (0-19-513488-5) Engineers and Their Profession, Fifth Edition, by John D. Kemper and Billy R. Sanders (0-19-512057-4) Being Successful as an Engineer by W. H. Roadstrum (0-910554-24-2) Money Back Guarantee--Pass the test or get your money back. See details inside! For more information and a complete list of FE and PE Exam review books available from Engineering Press at Oxford University Press visit www.engineeringpress.com. The book focuses on the use of inelastic analysis methods for the seismic assessment and design of bridges, for which the work carried out so far, albeit interesting and useful, is nevertheless clearly less than that for buildings. Although some valuable literature on the subject is currently available, the most advanced inelastic analysis methods that emerged during the last decade are currently found only in the specialised research-oriented literature, such as technical journals and conference proceedings. Hence the key objective of this book is two-fold, first to present all important methods belonging to the aforementioned category in a uniform and sufficient for their understanding and implementation length, and to provide also a critical perspective on them by including selected case-studies wherein more than one methods are applied to a specific bridge and by offering some critical comments on the limitations of the individual methods and on their relative efficiency. The book should be a valuable tool for both researchers and practicing engineers dealing with seismic design and assessment of bridges, by both making the methods and the analytical tools available for their implementation, and by assisting them to select the method that best suits the individual bridge projects that each engineer and/or researcher faces. Covers seismic design for typical bridge types and applies to non-critical and non-essential bridges. Approved as an alternate to the seismic provisions in the AASHTO LRFD Bridge Design Specifications. Differs from the current procedures in the LRFD Specifications in the use of displacement-based design procedures, instead of the traditional force-based "R-Factor" method. Includes detailed guidance and commentary on earthquake resisting elements and systems, global design strategies, demand modeling, capacity calculation, and liquefaction effects. Capacity design procedures underpin the Guide Specifications' methodology; includes prescriptive detailing for plastic hinging regions and design requirements for capacity protection of those elements that should not experience damage. This manual is intended to provide a technical resource for bridge engineers responsible for seismic analysis and design. It serves as a reference manual for use with the 5-day National Highway Institute (NHI) 130093 course “LRFD Seismic Analysis and Design of Bridges”, and the 3-day 130093A course “Displacement-Based LRFD Seismic Analysis and Design of Bridges”. The manual covers fundamental topics such as engineering seismology; seismic and geotechnical hazards; structural dynamics (Single-Degree-of-Freedom (SDOF) and Multiple-Degree-of-Freedom (MDOF)); and methods for modeling and analyzing bridges subject to earthquake ground motions. It also presents the principles of capacity design; applications of capacity design to piers, foundations, superstructures and connections; and discusses the requirements and recommendations of the seismic provision in each of the AASHTO LRFD Bridge Design Specifications and AASHTO Guide Specifications for LRFD Seismic Bridge Design, and their common features. Lastly, the manual addresses seismic isolation design in accordance with AASHTO Guide Specifications for Seismic Isolation Design, and retrofitting strategies in accordance with the 2006 Federal Highway Administration (FHWA) Seismic Retrofitting Manual for Highway Structures. Bridge structures can give the impression that they are rather simple structural systems, whose seismic responses can be easily predicted. On the contrary, however, many bridges did not perform well in recent earthquakes, showing a need for increased research to understand various potential problems and collapse mechanisms. Indeed, progress has been made lately in design and assessment procedures around the world, and consequently many practices have changed. In this context, the objective of fib Bulletin 39 is to present, discuss and critically compare structural solutions for bridge seismic design and retrofit that have been developed and are now used all over the world, ten years after the publication of the last comprehensive manual on the subject. It is the result of the work of an international team of experts that collaborated intensively for over three years. The first four chapters of the Bulletin present a regional review of design choices, compare and discuss international design practices, and indicate their relative merits and potential problems. Current developments are treated in the next three chapters, with particular emphasis on design for enhanced damage control, for spatial variation of ground motion and for fault crossing. The last part presents a summary of current issues related to existing bridges. Extensive technical developments have been taking place in the last two decades with the goal of making bridges an important transportation infrastructure with limited damage during earthquakes. Realising this goal depends on regional seismicity, transportation systems, seismic performance goals, local cultures, and a wide range of design and construction practices, which are presented and discussed in this Bulletin. Performance-based seismic design (PBSD) for infrastructure in the United States is a developing field, with new research, design, and repair technologies; definitions; and methodologies being advanced every year. The TRB National Cooperative Highway Research Program's NCHRP Research Report 949: Proposed AASHTO Guidelines for Performance-Based Seismic Bridge Design presents a methodology to analyze and determine the seismic capacity requirements of bridge elements expressed in terms of service and damage levels of bridges under a seismic hazard. The methodology is presented as proposed AASHTO guidelines for performance-based seismic bridge design with ground motion maps and detailed design examples illustrating the application of the proposed guidelines and maps. Supplemental materials to the report include an Appendix A - SDOF Column Investigation Sample Calculations and Results and Appendix B - Hazard Comparison. This edition is based on the work of NCHRP project 20-7, task 262 and updates the 2nd (1999) edition -- P. ix. First Published in 1999: The Bridge Engineering Handbook is a unique, comprehensive, and state-of-the-art reference work and resource book covering the major areas of bridge engineering with the theme "bridge to the 21st century."