

# Reinforced Concrete Design International Edition Wang Salmon

This textbook describes the basic mechanical features of concrete and explains the main resistant mechanisms activated in the reinforced concrete structures and foundations when subjected to centred and eccentric axial force, bending moment, shear, torsion and prestressing. It presents a complete set of limit-state design criteria of the modern theory of RC incorporating principles and rules of the final version of the official Eurocode 2. This textbook examines methodological more than notional aspects of the presented topics, focusing on the verifications of assumptions, the rigorousness of the analysis and the consequent degree of reliability of results. Each chapter develops an organic topic, which is eventually illustrated by examples in each final paragraph containing the relative numerical applications. These practical end-of-chapter appendices and intuitive flow-charts ensure a smooth learning experience. The book stands as an ideal learning resource for students of structural design and analysis courses in civil engineering, building construction and architecture, as well as a valuable reference for concrete structural design professionals in practice.

Foundation Engineering is of prime importance to undergraduate and postgraduate students of civil engineering as well as to practising engineers. For, there is no construction - be it buildings (government,

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commercial and residential), bridges, highways, or dams - that does not draw from the principles and application of this subject. Unlike many textbooks on Geotechnical Engineering that deal with both Soil Mechanics and Foundation Engineering, this text gives an exclusive treatment and an indepth analysis of Foundation Engineering. What distinguishes the text is that it not merely equips the students with the necessary knowledge for the course and examination, but provides a solid foundation for further practice in their profession later. In addition, as the book is based on the Codes prescribed by the Bureau of Indian Standards, students of Indian universities will find it particularly useful. The author is specialized in both Soil Mechanics and Structural Engineering; he studied Soil Mechanics under the guidance of Prof. Terzaghi and Prof. Casagrande of Harvard University - the pioneers of the subject. Similarly, he studied Structural Engineering under Prof. A.L.L. Baker of Imperial College, London, the pioneer of Limit State Design. These specializations coupled with over 50 years of teaching experience of the author make this text authoritative and exhaustive. Intended as a text for undergraduate (Civil Engineering) and postgraduate (Geotechnical Engineering and Structural Engineering) students, the book would also be found highly useful to practising engineers and young academics teaching the course.

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One of the most pressing problems facing the construction industry globally is the deterioration of major concrete infrastructure in marine and other chloride-containing environments. While recent advancements in concrete technology have made it easier to control the negative impact of deteriorating processes such as alkali-aggregate reaction, freezing and thawing and chemical attack, chloride-induced corrosion of embedded steel continues to pose the biggest threat to structure durability and performance. The second edition of *Durability Design of Concrete Structures in Severe Environments* focuses on enhancing the durability and service life of concrete structures. The text describes field experience and deteriorating processes of concrete structures in severe environments, and includes current data based on extensive field investigations. It presents a durability design based on calculation of corrosion probability, and outlines additional protective strategies and measures. The text also describes procedures for performance-based concrete quality control and quality assurance with documentation of achieved construction quality and compliance with specified durability. The text further covers calculation of life cycle costs and life cycle assessment, and includes some new recommended job specifications. What's New in the Second Edition: This second edition delivers more results and experience from practical applications of the probability-based durability design and the performance-based concrete quality control. It includes recent commercial projects both for Oslo Harbor KF and Nye Tjuvholmen KS in Oslo, and contains some preliminary results from the

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more comprehensive research program "Underwater Infrastructure and Underwater City of the Future" at Nanyang Technological University in Singapore. The book serves as an essential guide both for the owners and the consulting and construction engineers involved in new and major concrete infrastructure design and construction.

An exploration of the world of concrete as it applies to the construction of buildings, Reinforced Concrete Design of Tall Buildings provides a practical perspective on all aspects of reinforced concrete used in the design of structures, with particular focus on tall and ultra-tall buildings. Written by Dr. Bungale S. Taranath, this work explains the fundamental principles and state-of-the-art technologies required to build vertical structures as sound as they are eloquent. Dozens of cases studies of tall buildings throughout the world, many designed by Dr. Taranath, provide in-depth insight on why and how specific structural system choices are made. The book bridges the gap between two approaches: one based on intuitive skills and experience and the other based on computer skills and analytical techniques. Examining the results when experiential intuition marries unfathomable precision, this book discusses: The latest building codes, including ASCE/SEI 7-05, IBC-06/09, ACI 318-05/08, and ASCE/SEI 41-06 Recent developments in studies of seismic vulnerability and retrofit design Earthquake hazard mitigation technology, including seismic base isolation, passive energy dissipation, and damping systems Lateral bracing concepts and gravity-resisting systems Performance based design trends Dynamic

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response spectrum and equivalent lateral load procedures Using realistic examples throughout, Dr. Taranath shows how to create sound, cost-efficient high rise structures. His lucid and thorough explanations provide the tools required to derive systems that gracefully resist the battering forces of nature while addressing the specific needs of building owners, developers, and architects. The book is packed with broad-ranging material from fundamental principles to the state-of-the-art technologies and includes techniques thoroughly developed to be highly adaptable. Offering complete guidance, instructive examples, and color illustrations, the author develops several approaches for designing tall buildings. He demonstrates the benefits of blending imaginative problem solving and rational analysis for creating better structural systems.

This fourth edition of a bestselling textbook has been extensively rewritten and expanded in line with the current Eurocodes. It presents the principles of the design of concrete elements and of complete structures, with practical illustrations of the theory. It explains the background to the Eurocode rules and goes beyond the core topics to cover the design of foundations, retaining walls, and water retaining structures. The text includes more than sixty worked out design examples and more than six hundred diagrams, plans, and charts. It suitable for civil engineering courses and is a useful reference for practicing engineers.

Innovative Shear Design presents a new, rational and economical design procedure that offers increased protection against shear for all types of structures. The

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first part of the book describes the internal forces imposed on any flexurally bent member, and goes on to describe how these can interact with external loading forces to cause failure. The author then details the new design approach, and explains how its implementation can prevent cracking and failure for a given load. The book contains numerous practical examples describing optimum design techniques for all types of structure. Innovative Shear Design is an essential reference for structural designers, architects, academics, and researchers. It will also be a key reference text for students of structural design.

Concrete will be the key material for Mankind to create the built environment of the next millenium. The requirements of this infrastructure will be both demanding, in terms of technical performance and economy, and yet be greatly varied, from architectural masterpieces to the simplest of utilities. Innovation in Concrete Structures: Design and Construction forms the proceeding of the three day International Conference held during the Congress, Creating with Concrete, 6-10 September 1999, organised by the Concrete Technology University. Topics discussed include civil engineering structures, sub-structures, high-rise structures, deep basements, precast concrete construction and housing. This Book Systematically Explains The Basic Principles And Techniques Involved In The Design Of Reinforced Concrete Structures. It Exhaustively Covers The First Course On The Subject At B.E./ B.Tech Level.Important Features: \* Exposition Is Based On The Latest Indian Standard Code Is: 456-2000. \* Limit State Method

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Emphasized Throughout The Book. \* Working Stress Method Also Explained. \* Detailing Aspects Of Reinforcement Highlighted. \* Incorporates Earthquake Resistant Design. \* Includes A Large Number Of Solved Examples, Practice Problems And Illustrations. The Book Would Serve As A Comprehensive Text For Undergraduate Civil Engineering Students. Practising Engineers Would Also Find It A Valuable Reference Source.

This second edition of Concrete Pavement Design, Construction, and Performance provides a solid foundation for pavement engineers seeking relevant and applicable design and construction instruction. It relies on general principles instead of specific ones, and incorporates illustrative case studies and prime design examples to highlight the material. It presents a thorough understanding of materials selection, mixture proportioning, design and detailing, drainage, construction techniques, and pavement performance. It also offers insight into the theoretical framework underlying commonly used design procedures as well as the limits of the applicability of the procedures. All chapters have been updated to reflect recent developments, including some alternative and emerging design technologies that improve sustainability. What's New in the Second Edition: The second edition of this book contains a new chapter on sustainability, and coverage of mechanistic-empirical design and pervious concrete pavements. RCC pavements are now given a new chapter. The text also expands the industrial pavement design chapter. Outlines alternatives for

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concrete pavement solutions Identifies desired performance and behavior parameters Establishes appropriate materials and desired concrete proportions Presents steps for translating the design into a durable facility The book highlights significant innovations such as one is two-lift concrete pavements, precast concrete pavement systems, RCC pavement, interlocking concrete pavers, thin concrete pavement design, and pervious concrete. This text also addresses pavement management, maintenance, rehabilitation, and overlays. This book provides an extensive coverage of the design of reinforced concrete structures in accordance with the current Indian code of practice (IS 456: 2000). As some of the Indian code provisions are outdated, the American code provisions are provided, wherever necessary. In addition, an attempt is made to integrate the provisions of IS 456 with earthquake code (IS 13920), as more than 60% of India falls under moderate or severe earthquake zones. The text is based on the limit state approach to design and covers areas such as the properties of concrete, design of various structural elements such as compression and tension members, beams & slabs, and design for flexure, shear torsion, uni-axial and biaxial bending and interaction of these forces. Each chapter features solved examples, review questions, and practice problems as well as ample illustrations that supplement the text. An exhaustive list of references as well as appendices on strut-and-tie-method, properties of soils, and practical tips add value to the rich contents of book.

Designed primarily as a text for undergraduate students of Civil Engineering for their first course on Limit State Design of Reinforced Concrete, this compact and well-organized text covers all the fundamental concepts in a highly readable style. The text conforms to the provision of the latest revision



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of Indian Code of Practice for Plain and Reinforced Concrete, IS : 456 (2000). First six chapters deal with fundamentals of limit states design of reinforced concrete. The objective of last two chapters (including design aids in appendix) is to initiate the readers in practical design of concrete structures. The text gives detailed discussion of basic concepts, behaviour of the various structural components under loads, and development of fundamental expressions for analysis and design. It also presents efficient and systematic procedures for solving design problems. In addition to the discussion of basis for design calculations, a large number of worked-out practical design examples based on the current design practices have been included to illustrate the basic principles of reinforced concrete design. Besides students, practising engineers would find this text extremely useful.

This work gives an overview of significant research from recent years concerning performance-based design and quality control for concrete durability and its implementation. In engineering practice, performance approaches are often still used in combination with prescriptive requirements. This is largely because, for most durability test methods, sufficient practical experience still has to be gained before engineers and owners are prepared to fully rely on them. This book, compiled by RILEM TC 230-PSC, is intended to assist efforts to successfully build the foundation for the full implementation of performance-based approaches through the exchange of relevant knowledge and experience between researchers and practitioners worldwide.

Although the use of composites has increased in many industrial, commercial, medical, and defense applications, there is a lack of technical literature that examines composites in conjunction with concrete construction. Fulfilling the need for a comprehensive, explicit guide, Reinforced Concrete Design with FRP Composites presents

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specific informat

This detailed guide is designed to enable the reader to understand the relative importance of the numerous parameters involved in seismic design and the relationships between them, as well as the motivations behind the choices adopted by the codes.

This book analyses the current knowledge on structural behaviour of RC elements and structures strengthened with composite materials (experimental, analytical and numerical approaches for EBR and NSM), particularly in relation to the above topics, and the comparison of the predictions of the current available codes/recommendations/guidelines with selected experimental results. The book shows possible critical issues (discrepancies, lacunae, relevant parameters, test procedures, etc.) related to current code predictions or to evaluate their reliability, in order to develop more uniform methods and basic rules for design and control of FRP strengthened RC structures. General problems/critical issues are clarified on the basis of the actual experiences, detect discrepancies in existing codes, lacunae in knowledge and, concerning these identified subjects, provide proposals for improvements. The book will help to contribute to promote and consolidate a more qualified and conscious approach towards rehabilitation and strengthening existing RC structures with composites and their possible monitoring. The main outcomes of RILEM TC-226-CNM are summarized in this book. Key input was provided by researchers from countries that are main contributors in the R&D, design, construction, operation, and regulation of waste nuclear reinforced concrete facilities. Nuclear power plants and many of the facilities and structures used for the management of radioactive waste materials generated by the fuel cycle use concrete in their construction. RILEM TC 226 CNM covered several areas including functional and performance

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requirements for concrete structures; degradation processes; phenomenological modelling, field experiences, tests approaches, instrumentation and monitoring methods dedicated to performance assessments; service-life models; aging Management of Nuclear Power Plants, repair techniques; codes and standards specific to radioactive waste facilities.

This introduction to the principles of concrete mechanics and design focuses on the fundamentals - from very basic, elementary to the very complicated concepts and features an easy-to-follow yet thorough step-by-step design methodology.

\*emphasizes basic principles of the mechanics aspects of concrete design and avoids explanations of the detail requirements which can be found in the ACI Code and Commentary. \*surveys modern design philosophies and features an amply illustrated tour of the world of concrete.

\*carefully lays out the various design procedures step-by-step - for flexural design, shear design, column design, etc, prepares and encourages students to program procedures for computer solution. Instructors, at their own discretion, can suggest follow-up coding assignment. \*goes beyond the traditional description of materials to provide substantive coverage of concrete, current concrete technology, and the durability of materials - especially since many engineers will find themselves repairing, rehabilitating, and strengthening existing structures, rather than designing new ones. \*explores the interrelationship between design and analysis - a typical problem area for students, especially in relation to statically indeterminate structures, reviews some structural analysis methods for continuous beams and frames, especially those methods that designers will find useful for checking purposes - e.g., moment distribution, explains how the behavior of structures can be controlled through design decisions.

\*includes sections on basic plate theory and yield line theory

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as supplements to the common design procedures of the ACI Code. \*contains important optional topics that students can master through self-study after understanding the basics such as torsion, slab design, footings, and retaining walls.

\*includes many easy-to-follow examples worked out in great detail. \*contains a large number of illustrations. \*features very carefully designed problem sets that require students to think and appreciate various physical aspects of what they are doing. \*contains a comprehensive glossary of terms common in concrete engineering and the construction industry.

Definitions are based largely on The Cement and Concrete Terminology Report of ACI Committee 116.

Comprehensive coverage of durability of concrete at both material and structural levels, with design related issues Links two active fields in materials science and structural

engineering: the durability processes of concrete materials and design methods of concrete structures Facilitates

communication between the two communities, helping to implement life-cycle concepts into future design methods of concrete structures Presents state-of-the-art information on the deterioration mechanism and performance evolution of

structural concrete under environmental actions and the design methods for durability of concrete structures Provides

efficient support and practical tools for life-cycle oriented structural design which has been widely recognized as a new

generation of design philosophy for engineering structures The author has long experience working with the topic and

the materials presented have been part of the author's current teaching course of Durability and Assessment of Engineering

Structures for graduate students at Tsinghua University The design methods and approaches for durability of concrete

structures are developed from newly finished high level research projects and have been employed as recommended

provisions in design code including Chinese Code and

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## Eurocode 2

This conference proceedings brings together the work of researchers and practising engineers concerned with computational modelling of complex concrete, reinforced concrete and prestressed concrete structures in engineering practice. The subjects considered include computational mechanics of concrete and other cementitious materials, including masonry. Advanced discretisation methods and microstructural aspects within multi-field and multi-scale settings are discussed, as well as modelling formulations and constitutive modelling frameworks and novel experimental programmes. The conference also considered the need for reliable, high-quality analysis and design of concrete structures in regard to safety-critical structures, with a view to adopting these in codes of practice or recommendations. The book is of special interest to researchers in computational mechanics, and industry experts in complex nonlinear simulations of concrete structures.

The theory of reinforced concrete design is presented as a direct application of the laws of statics and behavior of reinforced concrete. This book emphasizes that a successful design must not only satisfy the design equations, but practical construction aspects as well. Covering basic undergraduate level concepts and more advanced topics, this book includes detailed treatments of flexure, shear, development and columns at a level suitable for undergraduate use, as well as the more difficult areas of strain compatibility solutions of beams, P-(Delta) analyses of frames, strut-and-tie models, and design for earthquake resistance. The

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numerous examples are all worked out completely, step-by-step.

The second edition of the Structural Concrete Textbook is an extensive revision that reflects advances in knowledge and technology over the past decade. It was prepared in the intermediate period from the CEP-FIP Model Code 1990 (MC90) to fib Model Code 2010 (MC2010), and as such incorporates a significant amount of information that has been already finalized for MC2010, while keeping some material from MC90 that was not yet modified considerably. The objective of the Textbook is to give detailed information on a wide range of concrete engineering from selection of appropriate structural system and also materials, through design and execution and finally behaviour in use. The revised fib Structural Concrete Textbook covers the following main topics: phases of design process, conceptual design, short and long term properties of conventional concrete (including creep, shrinkage, fatigue and temperature influences), special types of concretes (such as self compacting concrete, architectural concrete, fibre reinforced concrete, high and ultra high performance concrete), properties of reinforcing and prestressing materials, bond, tension stiffening, moment-curvature, confining effect, dowel action, aggregate interlock; structural analysis (with or without time dependent effects), definition of limit states, control of cracking and deformations, design

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for moment, shear or torsion, buckling, fatigue, anchorages, splices, detailing; design for durability (including service life design aspects, deterioration mechanisms, modelling of deterioration mechanisms, environmental influences, influences of design and execution on durability); fire design (including changes in material and structural properties, spalling, degree of deterioration), member design (linear members and slabs with reinforcement layout, deep beams); management, assessment, maintenance, repair (including, conservation strategies, risk management, types of interventions) as well as aspects of execution (quality assurance), formwork and curing. The updated Textbook provides the basics of material and structural behaviour and the fundamental knowledge needed for the design, assessment or retrofitting of concrete structures. It will be essential reading material for graduate students in the field of structural concrete, and also assist designers and consultants in understanding the background to the rules they apply in their practice. Furthermore, it should prove particularly valuable to users of the new editions of Eurocode 2 for concrete buildings, bridges and container structures, which are based only partly on MC90 and partly on more recent knowledge which was not included in the 1999 edition of the Textbook.

fib Model Code 2010 represents the state-of-the-art

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of code-type models for structural behaviour of concrete. It comprises constitutive relations and material models together with the most important explanatory notes. However the underlying normative work, i.e. the fundamental data as well as the considerations and discussions behind the formulas could not be given within the Model Code text. Based on various experiences gained after the publication of Model Code 1990 this lacking background information will lead in the following to numerous questions arising from Model Code users. Consequently the present bulletin claims to conquer this general weakness of codes in a way to guard against any future misunderstandings of the Model Code 2010 related to its chapter 5.1 (Concrete). It discusses the given formulas in connection with experimental data and the most important international literature. The constitutive relations or material models, being included in MC1990 and forming the basis and point of origin of the Task Group's work, were critically evaluated, if necessary and possible adjusted, or replaced by completely new approaches. Major criteria have been the physical and thermodynamical soundness as well as practical considerations like simplicity and operationality. This state-of-the-art report is intended for practicing engineers as well as for researchers and represents a comprehensible summary of the relevant knowledge available to the members of the



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fib Task Group 8.7 at the time of its drafting. Besides the fact that the bulletin is a background document for Chapter 5.1 of MC2010, it will provide an important foundation for the development of future generations of code-type models related to the characteristics and the behaviour of structural concrete. Further it will offer insights into the complexity of the normative work related to concrete modelling, leading to a better understanding and adequate appreciation of MC2010.

Now updated to reflect the latest ACI 318-05 Building Code, this cutting-edge book analyzes the design of reinforced concrete members through a unique and practical step-by-step trial and adjustment procedure. Supplements narrative with flow charts to guide readers logically through the learning process. Provides ample photographs of instructional testing of concrete members to decrease the need for actual laboratory testing. Uses Strain Limits Design Method in all design examples as mandated in the new code, using the new load factors and strength reduction factors. Updates chapter on seismic design of buildings to comply with the major changes to the ACI 318 Code and the new International Building Code provisions on seismic design. Adds chapter on the LRFD design of bridge deck structures in accordance with AASHTP 2002, including a summary of the various pertinent load and design provisions and equations. Offers an

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expanded section on the strut-and-tie modeling for the design of reinforced concrete deep beams. A useful construction reference for engineers.

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