

## Design Of Floor Diaphragms In Multi Storey Timber Buildings

Why another textbook on the design of wood sets this book apart is its inclusion of "struc structures? In many years of teaching structural tural planning. " Most textbooks show only the design in wood, the authors have used virtually selection of member proportions or number of every textbook available, as well as using only connectors in a joint to satisfy a given, com a code and no textbook at all. The textbooks pletely defined situation. This book, on the used have included both the old and the rela other hand, shows the thinking process needed tively modem; some have been fairly good, but to determine whether or not the member is re in our opinion each has deficiencies. Some quired in the first place. Following this, the books have too few solved examples. Others spacing and continuity of the member are de omit important material or have an arrange cided, its loads are determined, and finally its ment making them difficult to use as formal shape and size are selected. teaching tools. By writing this book, we intend We believe that illustrating structural plan to correct such deficiencies. ning as well as detailed member and connec The prime purpose of this book is to serve as tion design is of considerable value in helping a classroom text for the engineering or archi the student make the transition from the often tecture student.

"The use of untopped hollow core slabs as diaphragms in seismic prone regions may be a practical and economical construction alternative due to the optimum use of materials, slenderness of the construction, environmental friendliness and reduction on the self-weight of the floors. However, the use of untopped precast diaphragms in high seismic regions remains largely unexplored and lacks experimental evidence. A study on the seismic performance of untopped hollow core floor diaphragms of buildings where all the vertical elements (walls and columns) are part of the lateral force resisting system was conducted to provide analysis and design parameters for the potential use of this diaphragm system in seismic zones corresponding to Seismic Design Category D." -- Tomado del Formato de Documento de Grado.

Floor and roof systems are designed to carry gravity loads and transfer these loads to supporting beams, columns or walls. Furthermore, they play a key role in distributing earthquake-induced loads to the lateral load resisting systems by diaphragm action. In reinforced concrete buildings, the in-plane flexibility of the floor diaphragms is often ignored for simplicity in practical design (i.e., the floor systems are frequently treated as perfectly rigid diaphragms). In recent building standards (ASCE-7, 2005), it is acknowledged that this assumption can result in considerable errors when predicting the seismic response of reinforced concrete buildings with diaphragm plan aspect ratio of 3:1 or greater. However, the influence of floor diaphragm openings (typically for the purpose of stairways, shafts, or other architectural features) has not been considered. In order to investigate the influence of diaphragm openings on the seismic response of reinforced concrete buildings; several 3-story reinforced concrete buildings are designed as a Building Frame System according to the International Building Code (2006). Each building is assumed to be in the Saint Louis, Missouri area, and it's analyzed using IDARC2, a non-commercial program capable of conducting nonlinear analysis of RC buildings with rigid, elastic, or inelastic floor diaphragms, under both static lateral loads (pushover) and dynamic ground motions (time-history), where a suite of three well-known earthquakes is scaled to model moderate ground motions in the Saint Louis region. The comprehensive analytical study conducted involves placing different opening sizes (none, 11%, 15% and 22% of total floor area) in various floor plan locations with respect to the location of the shear walls (located at end frames or at the interior frames), where three types of floor diaphragm models (rigid, elastic, and inelastic) are assumed. Building floor plan aspect ratios of 3:1 and 4:1 are investigated. IDARC2 is enhanced by modifying the fiber model (strain compatibility) computation routine involved in obtaining the idealized moment-curvature curves of floor slabs with openings (symmetric and nonsymmetric). Also, a new option is added so that the user can over-ride IDARC2 idealized moment-curvature curves for slabs with openings and by defining their own. The results are then presented and discussed. It is concluded that in order to capture the seismic response of reinforced concrete buildings with floor diaphragm openings accurately; it is necessary to use an inelastic diaphragm model for floor diaphragm aspect ratio of 3:1 or greater. Thus, using a rigid diaphragm assumption, as specified by ASCE7-05 for buildings concrete floor diaphragms with aspect ratio of 3:1, and elastic diaphragm assumption, as allowed by ASCE7-05 for floor diaphragm with aspect ratio of 4:1, can result in significant underestimations of the lateral loads resisted by the interior building frames and building maximum frame displacements, particularly when the diaphragm openings are located in the middle two-thirds of the building plan. The base shear redistribution due to inelastic slab deformations increases the load subjected to the interior frames significantly. Hence, the influence of inelastic inplane diaphragm deformations due to floor openings cannot be overlooked in such buildings. Simple design recommendation is given for determining proper diaphragm chord reinforcement to prevent in-plane floor slab yielding when openings are present.

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 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.

In 1994 fib Commission 6: Prefabrication edited a successful Planning and Design Handbook that ran to approximately 45,000 copies and was published in Spanish and German. Nearly 20 years later Bulletin 74 brings that first publication up to date. It offers a synthesis of the latest structural design knowledge about precast building structures against the background of 21st century technological innovations in materials, production and construction. With it, we hope to help architects and engineers achieve a full understanding of precast concrete building structures, the possibilities they offer and their specific design philosophy. It was principally written for non-seismic structures. The handbook contains eleven chapters, each dealing with a specific aspect of precast building structures. The first chapter of the handbook highlights best practice opportunities that will enable architects, design engineers and contractors to work together towards finding efficient solutions, which is something unique to precast concrete buildings. The second chapter offers basic design recommendations that take into account the possibilities, restrictions and advantages of precast concrete, along with its detailing, manufacture, transport, erection and serviceability stages. Chapter three describes the precast solutions for the most common types of buildings such as offices, sports stadiums, residential buildings, hotels, industrial warehouses and car parks. Different application possibilities are explored to teach us which types of precast units are commonly used in all those situations. Chapter four covers the basic design principles and systems related to stability. Precast concrete structures should be designed according to a specific stability concept, unlike cast in-situ structures. Chapter five discusses structural connections. Chapters six to nine address the four most commonly used systems or subsystems of precast concrete in buildings, namely, portal and skeletal structures, wall-frame structures, floor and roof structures and architectural concrete facades. In chapter ten the design and detailing of a number of specific construction details in precast elements are discussed, for example, supports, corbels, openings and cutouts in the units, special features related to the detailing of the reinforcement, and so forth. Chapter eleven gives guidelines for the fire design of precast concrete structures. The handbook concludes with a list of references to good literature on precast concrete construction.

A Complete Guide to Solving Lateral Load Path Problems The Analysis of Irregular Shaped Structures: Diaphragms and Shear Walls explains how to calculate the forces to be transferred across multiple discontinuities and reflect the design requirements on construction documents. Step-by-step examples offer progressive coverage, from basic to very advanced illustrations of load paths in complicated structures. The book is based on the 2009 International Building Code, ASCE/SEI 7-05, the 2005 Edition of the National Design Specification for Wood Construction, and the 2008 Edition of the Special Design Provisions for Wind and Seismic (SDPWS-08). COVERAGE INCLUDES: Code sections and analysis Diaphragm basics Diaphragms with end horizontal offsets Diaphragms with intermediate offsets Diaphragms with openings Open front and cantilever diaphragms Diaphragms with vertical offsets Complex diaphragms with combined openings and offsets Standard shear walls Shear walls with openings Discontinuous shear walls Horizontally offset shear walls The portal frame Rigid moment-resisting frame walls--the frame method of analysis

Structural Steel Design, Third Edition is a simple, practical, and concise guide to structural steel design – using the Load and Resistance Factor Design (LRFD) and the Allowable Strength Design (ASD) methods -- that equips the reader with the necessary skills for designing real-world structures. Civil, structural, and architectural engineering students intending to pursue careers in structural design and consulting engineering, and practicing structural engineers will find the text useful because of the holistic, project-based learning approach that bridges the gap between engineering education and professional practice. The design of each building component is presented in a way such that the reader can see how each element fits into the entire building design and construction process. Structural details and practical example exercises that realistically mirror what obtains in professional design practice are presented. Features: - Includes updated content/example exercises that conform to the current codes (ASCE 7, ANSI/AISC 360-16, and IBC) - Adds coverage to ASD and examples with ASD to parallel those that are done LRFD - Follows a holistic approach to structural steel design that considers the design of individual steel framing members in the context of a complete structure.

Addresses the Question Frequently Proposed to the Designer by Architects: "Can We Do This? Offering guidance on how to use code-based procedures while at the same time providing an understanding of why provisions are necessary, Tall Building Design: Steel, Concrete, and Composite Systems methodically explores the structural behavior of steel, concrete, and composite members and systems. This text establishes the notion that design is a creative process, and not just an execution of framing proposals. It cultivates imaginative approaches by presenting examples specifically related to essential building codes and standards. Tying together precision and accuracy—it also bridges the gap between two design approaches—one based on initiative skill and the other based on computer skill. The book explains loads and load combinations typically used in building design, explores methods for determining design wind loads using the provisions of ASCE 7-10, and examines wind tunnel procedures. It defines conceptual seismic design, as the avoidance or minimization of problems created by the effects of seismic excitation. It introduces the concept of performance-based design (PBD). It also addresses

serviceability considerations, prediction of tall building motions, damping devices, seismic isolation, blast-resistant design, and progressive collapse. The final chapters explain gravity and lateral systems for steel, concrete, and composite buildings. The Book Also Considers: Preliminary analysis and design techniques The structural rehabilitation of seismically vulnerable steel and concrete buildings Design differences between code-sponsored approaches The concept of ductility trade-off for strength Tall Building Design: Steel, Concrete, and Composite Systems is a structural design guide and reference for practicing engineers and educators, as well as recent graduates entering the structural engineering profession. This text examines all major concrete, steel, and composite building systems, and uses the most up-to-date building codes.

The primary objective of the dissertation work is to examine the capacity of precast concrete diaphragms. This work is part of a multi-university research effort to develop a new seismic design methodology for precast/prestressed concrete floor diaphragms. To accomplish this, two-dimensional finite element (FE) models of precast floor diaphragms are created, including new elements to match the response of reinforcing details under combined forces. Using these models, nonlinear static "pushover" analyses are performed by applying body forces in the plane of the floor. The analyses are composed of three major parts: (1) Parametric studies to determine the required diaphragm shear strength relative to design (flexural) strength, termed "shear reinforcement overstrength", to promote a ductile mechanism in precast diaphragms. The performance of precast diaphragms with different shear reinforcement overstrength is examined. Appropriate shear reinforcement overstrength design factors are proposed to produce certain performance targets, in terms of a number of key parameters related to diaphragm geometry and the properties of the diaphragm reinforcing details. (2) Parametric studies to examine the effects of "secondary" diaphragm elements (spandrels, internal beams) on precast diaphragm behavior. Though not directly counted in design to participate diaphragm action, the secondary elements and their connections to the main diaphragm may modify the strength, stiffness and deformation capacity of the diaphragm. Analytical studies are performed to examine their effect on the global characteristics and local demands of precast floor diaphragms. The parameters evaluated include the characteristics of the connection details, the seismic hazard level used in design, diaphragm geometry, and layouts of spandrels and internal beams. (3) Development of a rational method for calculating the service stiffness and yield strength of precast concrete diaphragms. The method involves input of diaphragm geometry and reinforcing details. The method is verified analytically through comparisons to a set of FE analyses for an idealized diaphragm representation (regular single span diaphragm idealized with simple end supports). The method verified for a single set of diaphragm reinforcement details is used to estimate the properties over a range of untopped and topped diaphragm systems. Consideration of spandrel and internal beams in the method is discussed.

This book presents the selected peer-reviewed proceedings of the International Conference on Recent Trends and Innovations in Civil Engineering (ICRTICE 2019). The volume focuses on latest research and advances in the field of civil engineering and materials science such as design and development of new environmental materials, performance testing and verification of smart materials, performance analysis and simulation of steel structures, design and performance optimization of concrete structures, and building materials analysis. The book also covers studies in geotechnical engineering, hydraulic engineering, road and bridge engineering, building services design, engineering management, water resource engineering and renewable energy. The contents of this book will be useful for students, researchers and professionals working in civil engineering. This book is intended to serve as a textbook for engineering courses on earthquake resistant design. The book covers important attributes for seismic design such as material properties, damping, ductility, stiffness and strength. The subject coverage commences with simple concepts and proceeds right up to nonlinear analysis and push-over method for checking building adequacy. The book also provides an insight into the design of base isolators highlighting their merits and demerits. Apart from the theoretical approach to design of multi-storey buildings, the book highlights the care required in practical design and construction of various building components. It covers modal analysis in depth including the important missing mass method of analysis and tension shift in shear walls and beams. These have important bearing on reinforcement detailing. Detailed design and construction features are covered for earthquake resistant design of reinforced concrete as well as confined and reinforced masonry structures. The book also provides the methodology for assessment of seismic forces on basement walls and pile foundations. It provides a practical approach to design and detailing of soft storeys, short columns, vulnerable staircases and many other components. The book bridges the gap between design and construction. Plenty of worked illustrative examples are provided to aid learning. This book will be of value to upper undergraduate and graduate students taking courses on seismic design of structures.

This is arguably the most comprehensive book on the subject of architectural-structural design decisions that influence the seismic performance of buildings. It explores the intersection between the architecture and the structural design through the lens of earthquake engineering. The main aim of this unique book, written by renowned engineer M. Ljunji, is to explain in the simplest terms, the architecture and structure of earthquake-resistant buildings, using many practical examples and case studies to demonstrate the fact that structures and buildings react to earthquake forces mainly according to their form, configuration and material. The purpose of this book is to introduce a new perspective on seismic design, a more visual, conceptual and architectural one, to both architects and engineers. In a word, it is to introduce architectural opportunities for earthquake resistant- buildings, treating seismic design as a central architectural issue. A non-mathematical and practical approach emphasizing graphical presentation of problems and solutions makes it equally accessible to architectural and engineering professionals. The book will be invaluable for practicing engineers, architects, students and researchers. .More than 500 illustrations/photographs and numerous case studies. Seismic Architecture covers: • Earthquake effects on structures • Seismic force resisting systems • Advanced systems for seismic protection • Architectural/structural configuration and its influence on seismic response • Contemporary architecture in seismic regions • Seismic

response of nonstructural elements • Seismic retrofit and rehabilitation of existing buildings • Seismic architecture.

Timber construction is one of the most prevalent methods of constructing buildings in North America and an increasingly significant method of construction in Europe and the rest of the world. Timber Engineering deals not only with the structural aspects of timber construction, structural components, joints and systems based on solid timber and engineered wood products, but also material behaviour and properties on a wood element level. Produced by internationally renowned experts in the field, this book represents the state of the art in research on the understanding of the material behaviour of solid wood and engineered wood products. There is no comparable compendium currently available on the topic - the subjects represented include the most recent phenomena of timber engineering and the newest development of practice-related research. Grouped into three different sections, 'Basic properties of wood-based structural elements', 'Design aspects on timber structures' and 'Joints and structural assemblies', this book focuses on key issues in the understanding of: timber as a modern engineered construction material with controlled and documented properties the background for design of structural systems based on timber and engineered wood products the background for structural design of joints in structural timber systems Furthermore, this invaluable book contains advanced teaching material for all technical schools and universities involved in timber engineering. It also provides an essential resource for timber engineering students and researchers, as well as practicing structural and civil engineers.

Developments in the Formulation and Reinforcement of Concrete, Second Edition, presents the latest developments on topics covered in the first edition. In addition, it includes new chapters on supplementary cementitious materials, mass concrete, the sustainability of concrete, service life prediction, limestone cements, the corrosion of steel in concrete, alkali-aggregate reactions, and concrete as a multiscale material. The book's chapters introduce the reader to some of the most important issues facing today's concrete industry. With its distinguished editor and international team of contributors, users will find this to be a must-have reference for civil and structural engineers. Summarizes a wealth of recent research on structural concrete, including material microstructure, concrete types, and variation and construction techniques Emphasizes concrete mixture design and applications in civil and structural engineering Reviews modern concrete materials and novel construction systems, such as the precast industry and structures requiring high-performance concrete

This second edition of Precast Concrete Structures introduces the conceptual design ideas for the prefabrication of concrete structures and presents a number of worked examples that translate designs from BS 8110 to Eurocode EC2, before going into the detail of the design, manufacture, and construction of precast concrete multi-storey buildings. Detailed structural analysis of precast concrete and its use is provided and some details are presented of recent precast skeletal frames of up to forty storeys. The theory is supported by numerous worked examples to Eurocodes and European Product Standards for precast reinforced and prestressed concrete elements, composite construction, joints and connections and frame stability, together with extensive specifications for precast concrete structures. The book is extensively illustrated with over 500 photographs and line drawings.

Reflecting the historic first European seismic code, this professional book focuses on seismic design, assessment and retrofitting of concrete buildings, with thorough reference to, and application of, EN-Eurocode 8. Following the publication of EN-Eurocode 8 in 2004-05, 30 countries are now introducing this European standard for seismic design, for application in parallel with existing national standards (till March 2010) and exclusively after that. Eurocode 8 is also expected to influence standards in countries outside Europe, or at the least, to be applied there for important facilities. Owing to the increasing awareness of the threat posed by existing buildings substandard and deficient buildings and the lack of national or international standards for assessment and retrofitting, its impact in that field is expected to be major. Written by the lead person in the development of the EN-Eurocode 8, the present handbook explains the principles and rationale of seismic design according to modern codes and provides thorough guidance for the conceptual seismic design of concrete buildings and their foundations. It examines the experimental behaviour of concrete members under cyclic loading and modelling for design and analysis purposes; it develops the essentials of linear or nonlinear seismic analysis for the purposes of design, assessment and retrofitting (especially using Eurocode 8); and gives detailed guidance for modelling concrete buildings at the member and at the system level. Moreover, readers gain access to overviews of provisions of Eurocode 8, plus an understanding for them on the basis of the simple models of the element behaviour presented in the book. Also examined are the modern trends in performance- and displacement-based seismic assessment of existing buildings, comparing the relevant provisions of Eurocode 8 with those of new US prestandards, and details of the most common and popular seismic retrofitting techniques for concrete buildings and guidance for retrofitting strategies at the system level. Comprehensive walk-through examples of detailed design elucidate the application of Eurocode 8 to common situations in practical design. Examples and case studies of seismic assessment and retrofitting of a few real buildings are also presented. From the reviews: "This is a massive book that has no equal in the published literature, as far as the reviewer knows. It is dense and comprehensive and leaves nothing to chance. It is certainly taxing on the reader and the potential user, but without it, use of Eurocode 8 will be that much more difficult. In short, this is a must-read book for researchers and practitioners in Europe, and of use to readers outside of Europe too. This book will remain an indispensable backup to Eurocode 8 and its existing Designers' Guide to EN 1998-1 and EN 1998-5 (published in 2005), for many years to come. Congratulations to the author for a very well planned scope and contents, and for a flawless execution of the plan". AMR S. ELNASHAI "The book is an impressive source of information to understand the response of reinforced concrete buildings under seismic loads with the ultimate goal of presenting and explaining the state of the art of seismic design. Underlying the contents of the book is the in-depth knowledge of the author in this field and in particular his extremely important contribution to the development of the European Design Standard EN 1998 - Eurocode 8: Design of structures for earthquake resistance. However, although Eurocode 8 is at the core of the book, many comparisons are made to other design practices, namely from the US and from Japan, thus enriching the contents and interest of the book". EDUARDO C. CARVALHO

This book contains papers presented in the 6th International Conference on Civil, Offshore & Environmental Engineering (ICCOEE2020) under the banner of World Engineering, Science & Technology Congress (ESTCON2020) will be held from 13th to 15th July 2021 at Borneo Convention Centre, Kuching, Sarawak, Malaysia. This proceeding contains papers presented by

academics and industrial practitioners showcasing the latest advancements and findings in civil engineering areas with an emphasis on sustainability and the Industrial Revolution 4.0. The papers are categorized under the following tracks and topics of research: 1. Resilient Structures and Smart Materials 2. Advanced Construction and Building Information Modelling 3. Smart and Sustainable Infrastructure 4. Advanced Coastal and Offshore Engineering 5. Green Environment and Smart Water Resource Management Systems

A user-friendly reference on the design and technology of building structures. The authors provide a holistic approach to structural design by covering all of the primary structural materials (steel, wood, reinforced concrete, and masonry) and combining architectural form, spatial organization, and load configurations.

Brick and Block Masonry - From Historical to Sustainable Masonry contains the keynote and semi-keynote lectures and all accepted regular papers presented online during the 17th International Brick and Block Masonry Conference IB2MaC (Kraków, Poland, July 5-8, 2020). Masonry is one of the oldest structures, with more than 6,000 years of history. However, it is still one of the most popular and traditional building materials, showing new and more attractive features and uses. Modern masonry, based on new and modified traditional materials and solutions, offers a higher quality of life, energy savings and more sustainable development. Hence, masonry became a more environmentally friendly building structure. Brick and Block Masonry - From Historical to Sustainable Masonry focuses on historical, current and new ideas related to masonry development, and will provide a very good platform for sharing knowledge and experiences, and for learning about new materials and technologies related to masonry structures. The book will be a valuable compendium of knowledge for researchers, representatives of industry and building management, for curators and conservators of monuments, and for students.

The Analysis of Irregular Shaped Structures Diaphragms and Shear Walls McGraw Hill Professional

This overview of the analysis and design of buildings runs from basic principles and elementary structural analysis to the selection of structural systems and materials, and on to foundations and retaining structures. It presents a variety of approaches and methodologies while featuring realistic design examples. As a comprehensive guide and desk reference for practicing structural and civil engineers, and for engineering students, it draws on the author's teaching experience at The City College of New York and his work as a design engineer and architect. It is especially useful for those taking the National Council of Examiners for Engineering and Surveying SE exam.

This book comprises select proceedings of the International Conference on Smart Technologies for Energy, Environment, and Sustainable Development (ICSTEESD 2018). The chapters are broadly divided into three focus areas, viz. energy, environment, and sustainable development, and discusses the relevance and applications of smart technologies in these fields. A wide variety of topics such as renewable energy, energy conservation and management, energy policy and planning, environmental management, marine environment, green building, smart cities, smart transportation are covered in this book. Researchers and professionals from varied engineering backgrounds contribute chapters with an aim to provide economically viable solutions to sustainable development challenges. The book will prove useful for academics, professionals, and policy makers interested in sustainable development.

The aim of this state-of-art report is to present current practices for use of precast and prestressed concrete in countries in seismic regions, to recommend good practice, and to discuss current developments. The report has been drafted by 30 contributors from nine different countries. This state-of-art report covers: state of the practice in various countries; advantages and disadvantages of incorporating precast reinforced and prestressed concrete in construction; lessons learned from previous earthquakes; construction concepts; design approaches; primary lateral load resisting systems (precast and prestressed concrete frame systems and structural walls including dual systems) diaphragms of precast and prestressed concrete floor units; modelling and analytical methods; gravity load resisting systems; foundations; and miscellaneous elements (shells, folded plates, stairs and architectural cladding panels). Design equations are reported where necessary, but the emphasis is on principles. Ordinary cast-in-place reinforced concrete is not considered in this report. This fib state-of-the-art report is intended to assist designers and constructors to provide safe and economical applications of structural precast concrete and at the same time to allow innovation in design and construction to continue. This Bulletin N° 27 was approved as an fib state-of-art report in autumn 2002 by fib Commission 7, Seismic design.

A brief summary of the history of seismic design as given in chapter 1, indicates that initially design was purely based on strength or force considerations. When the importance of displacement, however, became better appreciated, it was attempted to modify the existing force-based approach in order to include considerations of displacement, rather than to totally reconsider the procedure on a more rational basis. In the last decade, then, several researchers started pointing out this inconsistency, proposing displacement-based approaches for earthquake engineering evaluation and design, with the aim of providing improved reliability in the engineering process by more directly relating computed response and expected structural performance. The main objective of this report is to summarize, critically review and compare the displacement - based approaches proposed in the literature, thus favouring code implementation and practical use of rational and reliable methods. Chapter 2 Seismic performance and design objectives of this report introduces concepts of performance levels, seismic hazard representation, and the coupling of performance and hazard to define performance objectives. In fact, for displacement analysis to be relevant in the context of performance-based design, the structural engineer must select appropriate performance levels and seismic loadings. A critical review of some engineering limit states appropriate to the different performance levels is therefore proposed. In chapter 3 Conceptual basis for displacement-based earthquake resistant design, the fundamental principles associated with displacement of the ground during an earthquake and the effects, in terms of displacement, in the structure, are reviewed. The historical development guides the presentation with a review of general linear and nonlinear structural dynamics principles, general approaches to estimate displacement, for both ground and structure, and finally a general presentation of the means to measure and judge the appropriateness of the displacements of the structure in section. Chapter 4 Approaches and procedures for displacement-based design can be somehow considered the fundamental part of the report, since a critical summary of the displacement - based approaches proposed by different researchers is presented there. Displacement - based design may require specific characterization of the input ground motion, a topic addressed in Chapter 5 Seismic input. In general, various pertinent definitions of input motion for non-code format analysis are included, while peak ground parameters necessary for code base shear equations are only addressed as needed for the definition of motion for analysis. Chapter 6 Displacement capacity of members and systems addresses the fundamental problem of evaluating the inelastic displacement capacity of reinforced concrete members and realistic values of their effective cracked stiffness at yielding, including effects of shear and inclined cracking, anchorage slip, bar buckling and of load cycling. In Chapter 7 Application and evaluation of displacement-based approaches, some of the many different displacement based design procedures briefly introduced in Chapter 4 are applied to various case studies, identifying and discussing the difficulties a designer may encounter when trying to use displacement based design. Results for five different case studies designed in accordance with eight different displacement based design methods are presented. Although in general case studies are considered a useful but marginal part of a state of the art document, in this case it has to be noted that chapter 7 is possibly the most innovative and fundamental part of the whole report. The conclusions of chapter 7 are the fundamental and essential conclusions of the document and allow foreseeing a bright future for displacement - based design approaches. The state-of-art report has been elaborated over a period of 4 years by Task Group 7.2 Displacement-based design and assessment of fib Commission

