



# SEISMIC DESIGN OF REINFORCED AND PRECAST CONCRETE BUILDINGS

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# Seismic Design Of Reinforced And Precast Concrete Buildings

**FIB - International Federation for  
Structural Concrete**



## **Seismic Design Of Reinforced And Precast Concrete Buildings:**

**Seismic Design of Reinforced and Precast Concrete Buildings** Englekirk, P. C. Jordan, 2003-02-01      **Seismic Design of Reinforced and Precast Concrete Buildings** Robert E. Englekirk, 2003-03-10 Presents the basics of seismic resistant design of concrete structures Provides a major focus on the seismic design of precast bracing systems      Seismic Design of Reinforced and Precast Concrete Buildings Robert E. Englekirk, 2003-03-10 Presents the basics of seismic resistant design of concrete structures Provides a major focus on the seismic design of precast bracing systems      Seismic Design of Precast Concrete Building Structures fib Fédération internationale du béton, 2003-01-01 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      *Precast-concrete buildings in seismic areas* FIB - Féd. Int. du Béton, 2016 This document has a broad scope and is not focussed on design issues Precast construction under seismic conditions is treated as a whole The main principles of seismic design of different structural systems their behavior and their construction techniques are presented through rules construction steps and sequences procedures and details that should lead to precast structures built in seismic areas complying with the fundamental performance requirements of collapse prevention and life safety in major earthquakes and limited damage in more frequent earthquakes The content of this document is largely limited to conventional precast construction and although some information is provided on the well known PRESS technology jointed ductile dry connections this latter solution is not treated in detail in this document The general overview contained in this document of alternative structural systems and connection solutions available to achieve desired performance levels intends to provide engineers architects clients and end users in general with a better appreciation of the wide range of applications that modern precast concrete technology can have in various types of construction from industrial to commercial as well as residential Lastly the emphasis on practical aspects from conceptual design to connection detailing aims to help engineers to

move away from the habit of blindly following prescriptive codes in their design but instead go back to basic principles in order to achieve a more robust understanding and thus control of the seismic behaviour of the structural system as a whole as well as of its components and individual connections

**Design of Connections for Precast Prestressed Concrete Buildings for the Effects of Earthquake** D. P. Clough, 1986      *Displacement-based Seismic Design of Reinforced Concrete Buildings* fib Fédération internationale du béton, 2003

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 7 Seismic design a truly international team of experts representing the expertise and experience of all the important seismic regions of the world In October 2002 the final draft of the Bulletin was presented to the public during the 1st fib Congress in Osaka It was also there that it was approved by fib Commission 7 Seismic Design

**Guide to Emulating Cast-in-Place Detailing for Seismic Design of Precast Concrete Structures** Joint ACI-ASCE Committee 550, American Concrete Institute, 2009 This guide provides information for detailing precast concrete structures that should meet building code requirements for all seismic design categories by emulating cast in place reinforced concrete design This guide also explains how emulative precast concrete structures can address the provisions of ACI 318 08 including those of Chapter 21 if special attention is directed to detailing the joints and splices between precast components

**Design of Reinforced Concrete Buildings for Seismic Performance** Mark Aschheim, Enrique Hernández-Montes, Dimitrios Vamvatsikos, 2019-04-05 The costs of inadequate earthquake engineering are huge especially for reinforced concrete buildings This book presents the principles of earthquake resistant structural engineering and uses the latest tools and techniques to give practical design guidance to address single or multiple seismic performance levels It presents an elegant simple and theoretically coherent design framework Required strength is determined on the basis of an estimated yield displacement and desired limits of system ductility and drift demands A simple deterministic approach is presented along with its elaboration into a probabilistic treatment that allows for design to limit annual probabilities of failure The design method allows the seismic force resisting system to be designed on the basis of elastic analysis results while nonlinear analysis is used for performance verification Detailing requirements of ACI 318 and Eurocode 8 are presented Students will benefit from the coverage of seismology structural dynamics reinforced concrete and capacity design approaches which allows the book to be used as a foundation text in earthquake engineering

**Seismic Design of Reinforced Concrete Buildings** Jack Moehle, 2014-10-06 Complete coverage of earthquake resistant concrete building design Written by a renowned seismic engineering expert this authoritative resource discusses the theory and practice for the design and evaluation of earthquakeresisting reinforced concrete buildings The book addresses the behavior of reinforced concrete materials components and systems subjected to routine and extreme loads

with an emphasis on response to earthquake loading Design methods both at a basic level as required by current building codes and at an advanced level needed for special problems such as seismic performance assessment are described Data and models useful for analyzing reinforced concrete structures as well as numerous illustrations tables and equations are included in this detailed reference Seismic Design of Reinforced Concrete Buildings covers Seismic design and performance verification Steel reinforcement Concrete Confined concrete Axially loaded members Moment and axial force Shear in beams columns and walls Development and anchorage Beam column connections Slab column and slab wall connections Seismic design overview Special moment frames Special structural walls Gravity framing Diaphragms and collectors Foundations

**EARTHQUAKE RESISTANT DESIGN OF STRUCTURES** AGRAWAL, PANKAJ ,SHRIKHANDE, MANISH ,2006-01-01

This comprehensive and well organized book presents the concepts and principles of earthquake resistant design of structures in an easy to read style The use of these principles helps in the implementation of seismic design practice The book adopts a step by step approach starting from the fundamentals of structural dynamics to application of seismic codes in analysis and design of structures The text also focusses on seismic evaluation and retrofitting of reinforced concrete and masonry buildings The text has been enriched with a large number of diagrams and solved problems to reinforce the understanding of the concepts Intended mainly as a text for undergraduate and postgraduate students of civil engineering this text would also be of considerable benefit to practising engineers architects field engineers and teachers in the field of earthquake resistant design of structures

**Proceedings fib Symposium in Athens Greece** FIB – International Federation for Structural Concrete,2003-05-01 **Structural Concrete Textbook, Volume 4** fib Fédération internationale du béton,2010-06-01 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 for Concrete Structures 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 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

**Seismic Performance of Concrete Buildings** Liviu Crainic, Mihai Munteanu, 2012-12-10 This book examines and presents essential aspects of the behavior analysis design and detailing of reinforced concrete buildings subjected to strong seismic activity Seismic design is an extremely complex problem that has seen spectacular development in the last decades The present volume tries to show how the principles and methods of earthquake

*Externally applied FRP reinforcement for concrete structures* FIB – International Federation for Structural Concrete, 2019-05-01 In December 1996 CEB established a Task Group with the main objective to elaborate design guidelines for the use of FRP reinforcement in accordance with the design format of the CEB FIP Model Code and Eurocode2 With the merger of CEB and FIP into fib in June 1998 this Task Group became fib TG 9.3 FRP Reinforcement for concrete structures in Commission 9 Reinforcing and Prestressing Materials and Systems Finally as a result of the restructuring of fib's Commissions and Task Groups at the end of 2014 the Task Group became fib T5.1 FRP Reinforcement for concrete structures chaired by Stijn Matthys at Ghent University in Commission 5 Reinforcements The work of former TG 9.3 and current T5.1 was performed by two working parties WP one of which is Externally Applied Reinforcement EAR which produced fib bulletin 14 Externally bonded FRP reinforcement for RC structures in July 2001 Following a number of years of relatively slow activity the WP on externally applied reinforcement was reactivated and started working on an update of bulletin 14 The result of this work is summarised in the present technical report which aims to give design guidelines on the use of externally applied FRP reinforcement both externally bonded and near surface mounted for concrete structures An attempt has been made to present some of the topics in a Eurocode compatible format so that the material covered may form the basis for the introduction of composites in the next version of Eurocode 2 and for the updating of the text on seismic retrofitting with composites in the next version of Eurocode 8 All persons who participated in the preparation of this Bulletin are mentioned in the copyright page Further acknowledgements are due to Jos e Bastien Canada Hans Rudolf Ganz Switzerland and Luc Taerwe Belgium for revision of the document To all members of the working party on externally applied reinforcement our sincere thanks are expressed for

the high quality and extensive work brought in on a voluntary basis      **Structural Concrete, Volume 2** fib Fédération internationale du béton, 2010-01-01 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 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      *Guidelines for Design of Low-Rise Buildings Subjected to Lateral Forces* Ajaya Kumar Gupta, Peter James Moss, 2020-11-25 *Guidelines for Design of Low Rise Buildings Subjected to Lateral Forces* is a concise guide that identifies performance issues concerns and research needs associated with low rise buildings The book begins with an introduction that discusses special problems with low rise buildings subjected to wind and earthquakes Chapter 2 examines probabilistic methods and their use in evaluating risks from natural hazards It also addresses the characteristics of wind and seismic forces and levels of risk implied by building codes Wind forces are covered in more detail in Chapter 3 with discussions of wind force concepts and wind structure interactions Chapter 4 is devoted to earthquake forces and traces the



development of building codes for earthquake resistant design Chapter 5 describes the main framing systems used to resist lateral forces and discusses the code requirements for drift control The designs and requirements for connections between building elements are addressed in Chapter 6 It includes examples along with several illustrations of suitable connections The performance of non structural elements during wind and earthquake forces is also examined in detail This book serves as an important reference for civil engineers construction engineers architects and anyone concerned with structural codes and standards It is an excellent guide that can be used to supplement design recommendations and provide a design basis where there are no current requirements

**Brick and Block Masonry - From Historical to Sustainable Masonry** Jan Kubica, Arkadiusz Kwiecień, Łukasz Bednarz, 2020-07-06 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 Krak w 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

NEHRP Recommended Provisions: Design Examples ,

**Fibre Reinforced Concrete** FIB - International Federation for Structural Concrete, 2022-11-01 Fibre Reinforced Concrete FRC is a composite material characterized by an enhanced post cracking tensile residual strength due to the capacity of fibres to bridge the crack faces by means of pull out mechanism Due to a better knowledge of FRC and the recent developments worldwide of guidelines for structural design the fib Special Activity Group 5 who prepared the new fib Model Code decided to introduce some sections on new materials and in particular on FRC structural design At that time working Groups TG 8 3 Fibre reinforced concrete and TG 8 6 Ultra high performance fibre reinforced concrete of fib prepared these sections of the new fib Model Code concerning FRC design rules for providing a guidance to engineers to properly and safely design FRC structural elements both at serviceability and at ultimate limit states based on the state of the art knowledge This bulletin was written with the aim to share the main framework used by the two groups to introduce these two sections and to describe the many aspects already known but not yet introduced in the Model Code Even though the basic principles introduced in the two sections are mainly obtained from research on steel fibre reinforced concrete the Model Code is open to every type of fibres following a performance based design approach The bulletin represents a wide effort made by the

people of the Task Group 4 1 and 4 2 to trace the knowledge on FRC and aims to be helpful for structural designers when using this new material in the practice

## Whispering the Techniques of Language: An Psychological Quest through **Seismic Design Of Reinforced And Precast Concrete Buildings**

In a digitally-driven world where displays reign supreme and immediate transmission drowns out the subtleties of language, the profound strategies and psychological subtleties hidden within phrases usually move unheard. Yet, situated within the pages of **Seismic Design Of Reinforced And Precast Concrete Buildings** a interesting literary treasure pulsating with organic emotions, lies an exceptional quest waiting to be undertaken. Penned by a talented wordsmith, that marvelous opus attracts readers on an introspective journey, delicately unraveling the veiled truths and profound impact resonating within ab muscles cloth of each and every word. Within the mental depths of the emotional review, we can embark upon a honest exploration of the book is key themes, dissect its charming publishing style, and fail to the effective resonance it evokes deep within the recesses of readers hearts.

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