

Formwork Guide To Good Practices 3rd Edition

During the mid-20th century, with the rise of industrial prefabrication, precast concrete sandwich panels started being used as cladding for buildings. Since then, society and construction industry have become increasingly aware of energy efficiency in all fields, including affordability and sustainability consciousness, while maintaining the buildings' durability. As such, buildings have been subject to increasingly stringent requirements which has kept the technology of sandwich panels continually at the forefront of building envelope evolution. Nowadays, sandwich panels have reached the highest standards of functional performance and aesthetic appeal. In building construction, these sandwich panel attributes combine with the well-known advantages of prefabrication including structural efficiency, flexibility in use, speed of construction, quality consciousness, durability, and sustainability. Sandwich panels have gained more exposure, thus representing quite a significant application within the prefabrication industry and a vital component of the precast market. The fib Commission "Prefabrication" is eager to promote the development of all precast structural concrete products and to share the knowledge and experience gained, to aid with practical design and construction. By issuing this comprehensive overview, "Guide to Good Practice", a better understanding of design considerations, structural analysis, building physics, use of materials, manufacturing methods, equipment usage and field performance will be provided. This document contains the latest information currently available worldwide. The Commission is particularly proud that this document is a result of close cooperation with PCI and that it is published by both the fib and PCI. This cooperation started six years ago, first with comparing the different approaches to several issues, then progressively integrating and producing common documents, like this one, that hasn't yet been treated in a specific Guide by either body. This Guide is intended to be the reference document to all who are interested in utilising the advantages of Precast Sandwich wall panels. In conjunction with the previously published Planning and Design Handbook on Precast Building Structures, the designer will have significant resources to integrate sandwich wall panels into any applicable structure. Based on the Institute of Concrete Technology's Advanced Concrete Technology Course, these four volumes are a comprehensive educational and reference resource for the concrete materials technologist. An expert international team of authors from research, academia and industry has been brought together to produce this unique series. Each volume deals with a different aspect of the subject: constituent materials, properties, processes and testing and quality. With worked examples, case studies and illustrations throughout, the books will be a key reference for the concrete specialist for years to come. Expert international authorship ensures the series is authoritative. Case studies and worked examples help the reader apply their knowledge to practice. Comprehensive coverage of the subject gives the reader all the necessary reference material.

Since the 1980's, several buildings throughout the world have been subject to gas explosions, impact by cars or airplanes, or car bomb attacks. In many cases the effect of the impact or explosion has been the failure of a critical structural member at the perimeter of the building. After the failure, the load supported by that member could not be redistributed and part or all of the structure has collapsed in a progressive manner. The phenomenon that occurs when local failure is not confined to the area of initial distress, and spreads horizontally and/or vertically through the structure, is termed progressive collapse. Progressive collapse is a relatively rare event, as it requires both an accidental action to cause local damage and a structure that lacks adequate continuity, ductility, and redundancy to prevent the spread of damage. It is technically very difficult and economically prohibitive to design buildings for absolute safety. However it is possible to construct precast concrete buildings that afford an acceptable degree of safety with regard to accidental actions. A structure is normally designed to respond

properly, without damage, under normal load conditions, but local and/or global damages cannot be avoided under the effect of an unexpected, but moderate degree of accidental overload. Properly designed and constructed structures usually possess reasonable probability not to collapse catastrophically under such loads, depending on different factors, for example: the type of loading; the degree and the location of accidental loading in regard to the structure and its structural members; the type of structural system, the construction technology, and the spans between structural vertical members, etc. No structure can be expected to be totally resistant to actions arising from an unexpected and extreme cause, but it should not be damaged to an extent that is disproportionate to the original cause. The aim of fib Bulletin 63 is to summarize the present knowledge on the subject and to provide guidance for the design of precast structures against progressive collapse. This is addressed in terms of (a) the classification of the actions, (b) their effect on the structural types, (c) the strategies to cope with such actions, (d) the design methods and (e) some typical detailing, all supplemented with illustrations from around the world, and some model calculations.

This title provides advice on provision, specification and construction of joints in in-situ concrete construction. It aims to help structural designers make informed decisions about the provision of joints in concrete structures.

Delayed completion affects IT, process plant, oil and gas, civil engineering, shipbuilding and marine work contracts. In fact it affects all industries in all countries and the bigger the project, the more damage delayed completion causes to costs, to reputation and sometimes, even to the survival of the contracting parties themselves. In simple projects, time can be managed intuitively by any reasonably competent person, but complex projects cannot and a more analytical approach is necessary if the project is to succeed. Although much has been written about how to apportion liability for delay after a project has gone wrong there was, until recently, no guidance on how to manage time pro-actively and effectively on complex projects. In 2008, the CIOB embarked upon a 5-year strategy to provide standards, education, training and accreditation in time management. The first stage, this Guide to Good Practice in Managing Time in Complex Projects, sets down the process and standards to be achieved in preparing and managing the time model. As a handbook for practitioners it uses logical step by step procedures and examples from inception and risk appraisal, through design and construction to testing and commissioning, to show how an effective and dynamic time model can be used to manage the risk of delay to completion of construction projects.

The fourth edition of this classic book provides a comprehensive treatise on the design and construction of swimming pools, both public and private. Significantly revised, it covers planning, materials, design, construction and finishing, water circulation and treatment, energy conservation, maintenance and repairs. This is a standard book for all

This new edition of John Illingworth's popular book provides a thorough introduction to the selection of construction methods, their planning and organization on site. Thoroughly revised and updated, *Construction Methods and Planning* takes a practical, down-to-earth approach and features numerous examples and illustrations taken from real situations and sites. In Part One, the main factors which determine the planning of construction methods - site inspections, the site itself, temporary works, design, cost concepts and selection of plant and methods - are discussed. In Part Two, the application of these tools is presented, covering foundations and basements, in situ and precast concrete structures, steel frames, cladding, internal and external works, waste, methods statements, contract planning control and claims. The author provides an extension of the concept of 'buildability' and new chapters on facade retention and the refurbishment of domestic accommodation.

The FRC-2014 Workshop Fibre Reinforced Concrete: from Design to Structural Applications was the first ACI-fib joint technical event. The Workshop, held at Polytechnique Montreal (Canada) on July 24th and 25th 2014, was attended by 116 participants from 25 countries and

4 continents. The first international FRC workshop was held in Bergamo (Italy) in 2004. At that time, the lack of specific building codes and standards was identified as the main inhibitor to the application of this technology in engineering practice. Ten years after Bergamo, many of the objectives identified at that time have been achieved. The use of fibre reinforced concrete (FRC) for designing structural members in bending and shear has recently been addressed in the fib Model Code 2010. Steel fibre reinforced concrete (SFRC) has also been used structurally in several building and bridge projects in Europe and North-America. SFRC has been widely used in segmental tunnel linings all over the world. Members of ACI544 and fib TG-4.1 have been involved in writing code based specifications for the design of FRC structural members. More than fifty papers were presented at the Workshop from which forty-four were selected for this joint ACI/fib publication. The papers are organised in the document under six themes: Design guidelines and specifications, Material properties for design, Behaviour and design of beams and columns, Behaviour and design of slabs and other structures, Behaviour and design of foundations and underground components, and finally, Applications in structure and underground construction projects.

The Model Code for Concrete Structures is intended to serve as a basis for future codes. It takes into account new developments with respect to concrete structures, the structural material concrete and new ideas for the requirements to be formulated for structures in order to achieve optimum behaviour according to new insights and ideas. It is also intended as a source of information for updating existing codes or developing new codes for concrete structures. At the same time, the Model Code is intended as an operational document for normal design situations and structures.

Concrete is after water the second most used material. The production of concrete in the industrialized countries annually amounts to 1.5-3 tonne per capita and is still increasing. This has significant impact on the environment. Thus there is an urgent need for more effective use of concrete in structures and their assessment. The scope of activities of the fib Task Group 3.7 was to define the methodology for integrated life-cycle assessment of concrete structures considering main essential aspects of sustainability such as: environmental, economic and social aspects throughout the whole life of the concrete structure. The aim was to set up basic methodology to be helpful in development of design and assessment tools focused on sustainability of concrete structure within the whole life cycle. Integrated Life Cycle Assessment (ILCA) represents an advanced approach integrating different aspects of sustainability in one complex assessment procedure. The integrated approach is necessary to insure that the structure will serve during the whole expected service life with a maximum functional quality and safety, while environmental and economic loads will be kept at a low level. The effective application and quality of results are dependent on the availability of relevant input data obtained using a detailed inventory analysis, based on specific regional conditions. The evaluation of the real level of total quality of concrete structure should be based on a detailed ILCA analysis using regionally or locally relevant data sets.

The objectives of MC2010 are to (a) serve as a basis for future codes for concrete structures, and (b) present new developments with regard to concrete

structures, structural materials and new ideas in order to achieve optimum behaviour. MC2010 includes the whole life cycle of a concrete structure, from design and construction to conservation (assessment, maintenance, strengthening) and dismantlement, in one code for buildings, bridges and other civil engineering structures. Design is largely based on performance requirements. The chapter on materials is extended with new types of concrete and reinforcement (such as fibres and non-metallic reinforcements). The fib Model Code 2010 also gives corresponding explanations in a separate column of the document. Additionally, MC2010 is supported by background documents that have already been (or will soon be) published in fib bulletins and journal articles. MC2010 is now the most comprehensive code on concrete structures, including their complete life cycle: conceptual design, dimensioning, construction, conservation and dismantlement.

For a large part of the existing buildings and infrastructure the design life has been reached or will be reached in the near future. These structures might need to be reassessed in order to investigate whether the safety requirements are met. Current practice on the assessment of existing concrete structures however needs a thorough evaluation from a risk and reliability point of view, as they are mostly verified using simplified procedures based on the partial factor method commonly applied in design of new structures. Such assessments are often conservative and may lead to expensive upgrades. Although the last decades reliability-based assessment of existing concrete structures has gained wide attention in the research field, a consistent reliability-based assessment framework and a practically applicable codified approach which is compatible with the Eurocodes and accessible for common structural engineering problems in everyday practice is currently missing. Such an approach however allows for a more uniform, more objective and probably more widely applied assessment approach for existing concrete structures. Hence, in this bulletin two different partial factor formats are elaborated, i.e. the Design Value Method (DVM) and the Adjusted Partial Factor Method (APFM), enabling the incorporation of specific reliability related aspects for existing structures. The DVM proposes a fundamental basis for evaluating partial factors whereas the APFM provides adjustment factors to be applied on the partial factors for new structures in EN 1990. In this bulletin both methods are elaborated and evaluated and a basis is provided for decision making regarding the target safety level of existing structures.

Materials for Architects and Builders provides a clear and concise introduction to the broad range of materials used within the construction industry and covers the essential details of their manufacture, key physical properties, specification and uses. Understanding the basics of materials is a crucial part of undergraduate and diploma construction or architecture-related courses, and this established textbook helps the reader to do just that with the help of colour photographs and clear diagrams throughout. This new sixth edition has been completely revised

and updated to include the latest developments in materials research, new images, appropriate technologies and relevant legislation. The ecological effects of building construction and lifetime use remain an important focus, and this new edition includes a wide range of energy-saving building components.

The fib Awards for Outstanding Concrete Structures are attributed every four years at the fib Congress, with the goal of enhancing the international recognition of concrete structures that demonstrate the versatility of concrete as a structural medium. The award consists of a bronze plaque to be displayed on the structure, and certificates presented to the main parties responsible for the work.

Applications are invited by the fib secretariat via the National Member Groups. Information on the competition is also made available on the fib's website, and in the newsletter fib-news published in Structural Concrete. The submitted structures must have been completed during the four years prior to the year of the Congress at which the awards are attributed. The jury may accept an older structure, completed one or two years before, provided that it was not already submitted for the previous award attribution (Mumbai, 2014). The submitted structures must also have the support of an fib Head of Delegation or National Member Group Secretary in order to confirm the authenticity of the indicated authors. Entries consist of the completed entry form, three to five representative photos of the whole structure and/or any important details or plans, and short summary texts explaining: - the history of the project; - description of the structure; - particularities of its realisation (difficulties encountered, special solutions found, etc.). A jury designated by the Presidium selects the winners. The awards are attributed in two categories, Civil Engineering Structures (including bridges) and Buildings. Two or three 'Winners' and two to four 'Special Mention' recipients are selected in each category, depending on the number of entries received. The jury takes into account criteria such as: - design aspects, including aesthetics and design detailing; - construction practice and quality of work; - environmental aspects of the design and its construction; - durability and sustainability aspects; - significance of the contribution made by the entry to the development and improvement of concrete construction. The decisions of the jury are definitive and cannot be challenged. They are unveiled at a special ceremony during the fib Congress in Melbourne.

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.

The concept of precast segmental bridges is not new: the first application documented was from the mid-1940s, designed by Eugene Freyssinet and built over the river Marne near Luzancy in France, between 1944 and 1946. Although innovative, it also contained traditional wet concrete joints between the members. The impressive breakthrough came slightly later with the introduction of match-cast joints by Jean Muller, first for a bridge near Buffalo (USA) in 1952, and later for a bridge across the River Seine at Choisy le Roi near Paris in 1962. This opened the way for a large number of new developments in terms of design, production approaches and construction techniques, and precast prestressed concrete segmental construction became rapidly one of the most efficient and successful bridge construction methods all over the world. These developments are still evolving, but the interaction between design, production and construction is a critical factor for success: the interaction creates opportunities to optimise the scheme, but at the same time is crucial to ensure safety, especially during construction, when large weights are moved, placed and secured, frequently at substantial heights. Engineers of all disciplines involved should interact during the development and realisation of precast segmental bridge (PSB) schemes, to

conclude the optimum method statement and consequently check all the intermediate steps of the method statement in terms of stress, stiffness, stability, production and constructability. With the ongoing development of the PSB concept, and consequently moving limits in terms of dimensions, it was concluded to be appropriate to develop a Guide to good practice for the PSB construction method. The present report was developed by an integrated team of engineers with roots in design, structural engineering, production and construction, and provides a valuable source of knowledge, experience, recommendations and examples, with particular emphasis on the fib Model Code for Concrete Structures 2010 and fib Bulletins 20, 33, 48 and 75. I would like to thank all the members of Task Group 1.7, all the individual contributors from outside Task Group 1.7, and the reviewers of the Technical Council of the fib for their contribution to this Guide to good practice. In particular, I would like to thank Gopal Srinivasan and Marcos Sanchez, who, apart from their own contributions, did the final editorial work for this bulletin.

fib Bulletin 57 is a collection of contributions from a workshop on "Recent developments on shear and punching shear in RC and FRC elements", held in Salò, Italy, in October 2010. Shear is one of a few areas of research into fundamentals of the behaviour of concrete structures where contention remains amongst researchers. There is a continuing debate between researchers from a structures perspective and those from a materials or fracture mechanics perspective about the mechanisms that enable the force flow through a concrete member and across cracks. In 2009, a Working Group was formed within fib Task Group 4.2 "Ultimate Limit State Models" to harmonise different ideas about design procedures for shear and punching. An important outcome of this work was the ensuing discussions between experts and practitioners regarding the shear and punching provisions of the draft fib Model Code, which led to the organization of the Salò workshop. Invited experts in the field of shear and FRC gave 18 lectures at the workshop that was attended by 72 participants from 12 countries in 3 different continents. The contributions from this conference as compiled in this bulletin are believed to represent the best of the current state of knowledge. They certainly are of general interest to fib members and especially helpful in the finalization of the 2010 fib Model Code. It is hoped that this publication will stimulate further research in the field, to refine and harmonize the available analytical models and tools for shear and punching design.

Temporary structures are a vital but often overlooked component in the success of any construction project. With the assistance of modern technology, design and operation procedures in this area have undergone significant enhancements in recent years. Design Solutions and Innovations in Temporary Structures is a comprehensive source of academic research on the latest methods, practices, and analyses for effective and safe temporary structures. Including perspectives on numerous relevant topics, such as safety considerations, quality management, and structural analysis, this book is ideally designed for engineers,

professionals, academics, researchers, and practitioners actively involved in the construction industry.

This book provides an extensive list of factors that should be considered on all construction related projects, whilst highlighting, with the aid of worked examples, the key areas that will make the most significant contribution to success. It also provides details on the very latest UK legislation. Including the recent CDM Regulations and European Directives, it: provides a framework for the development of pro-active management of Safety, Health and Environment (SHE) in the construction industry; describes a systematic approach to construction SHE management which promotes continuing improvement in SHE performance in all construction activities; and defines the minimum She objectives to be considered during each construction activity.

To date, very little has been published on the topic of corrugated-steel-web bridges. fib Bulletin 77 offers the global engineering community a first complete overview of this fascinating technology. The shear capacity of corrugated-steel web began to be studied in Japan in 1965 and resulted in the use of corrugated steel in steel-girder webs as a replacement for web stiffeners. After Japan laid the groundwork for the technology, France built the first composite bridge with corrugated-steel webs and upper and lower concrete slabs in the 1980s. Composite bridges had already been popular in France but engineers found that concrete slab creep meant that prestressing force spread into the steel plates, causing high losses. Corrugated-steel web, which reduces axial stiffness, was welcomed as a solution to this problem and several bridges were designed and built with this technology. Building on France's composite technology, Japan began developing corrugated-web precast box-girder bridges in the 1990s and today has over 140 corrugated-web bridges, by far the largest number for any country in the world. Japanese engineers have come a long way in solving issues such as fatigue and ultimate load behaviour and have made good use of corrugated-steel web's advantages for bridge building, which include reduced self weight (of approximately 15% compared with the weight of an ordinary concrete box-girder bridge), economy and improved construction processes. fib Bulletin 77: Corrugated-steel-web bridges covers numerous examples of bridges in Japan and France as well as an in-depth case study and analysis of a large corrugated-steel-web bridge in Germany. This publication offers designers, proprietors, contractors and architects alike relevant technical and theoretical information on construction processes along with ideas for future development. fib Model Code 2010 represents the state-of-the-art 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 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.

Concrete offshore structures have been successfully delivered to the international oil and gas industry for more than 35 years. Some 50 major concrete platforms of different shapes and sizes, supporting large production and storage facilities, are currently operating in hostile marine environments worldwide and have excellent service records. After some years with little development activity, today there is a renewed interest in robust structures for the Arctic environment, for Liquefied Natural Gas (LNG) terminals and for special floating barges and vessels. Currently, concrete solutions are being considered for projects north and east of Russia, north of Norway and offshore Newfoundland, among others. Concrete is also in increasing demand in built up coastal areas for a variety of purposes such as harbour works, tunnels and bridges, cargo terminals, parking garages and sea front housing developments where durability and robustness are essential. The mandate of fib Task Group 1.5 was to gather the experience and know-how pertinent to the development, design and execution of offshore concrete structures, and to elaborate on the applicability of concrete structures for the Arctic environments. The findings of the Task Group are presented in fib Bulletin 50. The report is based on experience gained from the design, execution and performance of a number of offshore concrete structures around the world and in particular in the North Sea. Ongoing inspections have shown excellent durability and structural performance, even in structures that have exceeded their design lives, in conditions often characterized by extreme wave loads, freezing conditions, hurricane force winds and seismic actions. This forms the "background" for discussing the applicability of concrete structures for the Arctic regions. Although to a large extent dedicated to oil- and

gas-related structures, the report is also relevant to other marine applications where the same design principles, material selection criteria and construction methods apply. fib Bulletin 50 is not in itself a code, nor is it a textbook. Rather, extensive reference is made to proven and readily available design codes and construction guides, as well as relevant papers and proceedings and other fib publications.

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 "PRESSS 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.

Trevor Holroyd maintains that a substantial part of an engineer's training relates solely to the academic and the result is that engineers may be greatly disadvantaged in the commercial world. In his book, *Site management for engineers*, he presents, in concise and clear terms, the practices which an engineer must understand to become competitive commercially. The book covers good site practice and management techniques, programmes, tenders, construction methods, all types of resource procurement, health and safety, planing systems and people skills. It draws on examples from the author's extensive experience of site supervision and provides engineers with a practical working guide.

A concise introduction to formwork intended to give the engineer confidence in supervising work on site. It explains what formwork does and examines its requirements, its materials and finishes and other practical issues providing a checklist of points to consider.

With the publication of this bulletin, fib Commission 1 is initiating a new series of

documents related to the use of structural concrete in underground construction, where structural concrete plays a major and increasingly important role. The usage of underground space is more than ever a key issue of urban planning and fib decided to start addressing the issues related to the design and construction of concrete structures in this particular environment. In this context one the most significant applications of structural concrete is tunnel lining, for which the properties of reinforced concrete are particularly well suited through compressive strength, water tightness, ductility, and durability. Reinforced concrete tunnels linings have mostly been traditionally cast in situ, but the development of Tunnel Boring Machines has lead to the invention of precast concrete segmental lining technology, which is nowadays one of the most promising applications of Fibre Reinforced Concrete (FRC). Thanks to the courage and dedication of innovative designers and contractors, a number of large tunnels have already been built around the World with FRC precast linings, and this report presents the experience acquired with these projects, and also provides guidance about the way to apply 2010 fib Model Code recommendations on FRC to these structures. The main drivers of this evolution from RC to FRC are a better ductility, more durability, and easier fabrication and construction process. As Commission 1 chair, I am very grateful to Alberto Meda and to all members of this task group for opening the way to this new field of underground structures within our commission, and to have efficiently produced a document that will be useful to our members and to the construction community around the World.

Formwork a guide to good practice Formwork A Guide to Good Practice Design and Construction of Joints in Concrete Structures Thomas Telford

The third 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.

Construction projects are undertaken to meet a variety of business, service and aspirational objectives and needs. The success of a building or an element of infrastructure depends on how well it meets the owner's needs and interests or those of the users. Recent changes in owner attitudes to construction are reflected in an increasing interest in through-life costs, i.e. not only the capital costs of construction but also the operational costs associated with a structure's functional performance for a defined life span. The owner can greatly improve the likelihood of achieving the value they seek from the facility by being intimately and effectively involved in the definition of performance requirements at the start of the construction procurement process. The objective of fib Bulletin 44 is to provide guidance to owners of concrete structures on: the management of their concrete structures (buildings and infrastructure) as part of their business goals or the service objectives of their organization; best practice in the management of concrete structures; their responsibilities with respect to the management of their concrete structures; the wider context and issues of service life design; information and direction needed by the supporting professional team of architects, engineers, specifiers, contractors and others. This Guide also provides background information on topics such as deterioration processes and technical procedures used for the management of concrete structures, including reference to international standards for the protection and repair of concrete structures. These activities are illustrated by application examples/case histories and by a section addressing frequently asked questions. A brief review is made of some potential future developments.

The realization process of civil engineering structures is complicated, involving a wide variety of disciplines, each of which brings a specific contribution. It is a challenge to structure the process so that a balanced, optimized participation of the many disciplines involved is achieved. One of the critical success factors is knowledge management: each discipline should bring professional knowledge, but they should interact at interfaces as well. Temporary structures are an example of this phenomenon: they are right in the middle of a complex system of interactions between structural engineering, site engineering, work preparation, procurement, and execution. They have a significant impact on cost, construction time, construction methodology and the through-life performance of the actual structure. Formwork and falsework are among the most important elements of temporary structures for civil engineering projects. Knowledge management with respect to formwork and falsework requires engineers to share knowledge and experience in the broadest sense, as the actual performance of formwork and falsework can only be evaluated at a late stage in the realization process,

when some disciplines are no longer present. The learning circle can therefore only be closed through feedback. fib Bulletin 48 presents an overview of formwork and falsework techniques and addresses issues related to the design and application thereof. Its objective is to bridge the gap often experienced in practice by effectively feeding back state of the art knowledge and experience with regard to formwork and falsework, thus making a larger group of engineers familiar with the important issues related to the design and application of formwork and falsework. It aims to provide both structural and site engineers with information to design and use formwork and falsework in a safe, reliable, and economic way, thus achieving better interaction between the engineering disciplines involved. Bulletin 48 addresses some fundamental issues related to formwork and falsework: The appearance of the finished concrete, which is closely related to the quality of the formwork. The performance of the finished concrete in relation to durability and as part of Life Cycle Management. The need to support the concrete while it acquires enough strength and stiffness to support itself. In this context the most important issue is structural safety. The guidelines given in this document are based on the experience of site and design engineers; and most of the advice is a consequence of real problems experienced in the past. Any warnings based solely on theoretical judgment have been avoided; only recommendations based on experience have been included. fib Bulletin 48 focuses on principles only, and therefore does not address detailed design issues, for which local design codes should be applied.

A practical treatise on the processes and standards required for the effective time management of major construction projects This book uses logical step-by-step procedures and examples from inception and risk appraisal—through design and construction to testing and commissioning—to show how an effective and dynamic time model can be used to manage the risk of delay in the completion of construction projects. Integrating with the CIOB major projects contract, the new edition places increased emphasis on the dynamic time model as the way to manage time and cost in major projects, as opposed to the use of a static target baseline program. It includes a new chapter distinguishing the principal features of the dynamic time model and its development throughout the life of a project from inception to completion. Guide to Good Practice in the Management of Time in Major Projects—Dynamic Time Modelling, 2nd Edition features new appendices covering matters such as complexity in construction and engineering projects, productivity guides (including specific references to the UK, Australia, and the USA), and a number of case studies dealing with strategic time management and high-density, resource-based scheduling. Provides guidance for the strategic management of time in construction and civil engineering projects Demonstrates how to use a dynamic time model to manage time pro-actively in building and civil engineering projects Sets out processes and standards to be achieved ensuring systematic documentation and quality control of time management Integrates with the CIOB major projects contract Guide to Good Practice in the Management of Time in Major Projects—Dynamic Time Modelling, 2nd Edition is an ideal handbook for project and program management professionals working on civil engineering and construction projects, including those from contractors, clients, and project management consultants.

After an examination of fundamental theories as applied to civil engineering,

authoritative coverage is included on design practice for certain materials and specific structures and applications. A particular feature is the incorporation of chapters on construction and site practice, including contract management and control.

In the last ten to fifteen years a vast amount of research has been undertaken to improve on earlier methods for analysing the seismic reliability of structures. These efforts focused on identifying aspects of prominent relevance and disregarding the inessential ones, with the goal of producing methods that are both more efficient and easier to use in practice. Today this goal can be said to be substantially achieved. During these years scientific activity covered all of the many aspects involved in such a multi-disciplinary problem, ranging from seismology, to geotechnics, to structural analysis and economy, all of them to be consistently organised into a probabilistic framework. As the output of this research was dispersed into a multitude of technical papers, fib Commission 7 thought it worthwhile to select the essential aspects of this large body of knowledge and to present them into a coherent and accessible document for structural engineers. To this end a task group of specialists was formed, whose qualifications come from their personal involvement in the above-mentioned developments throughout this period of time. From its inception the group decided that the bulletin should have had a distinct educational character and provide a clear overview of the methods available. The outcome is a compact volume that starts by introducing the concepts and definitions of performance-based engineering, continues with two chapters on assessment and design, respectively, presenting the methods in detail accompanied by illustrative examples, and concludes with an appendix with sample programming excerpts for their implementation. It is believed that at present fib Bulletin 68 represents a unique compendium on probabilistic performance-based seismic design.

Based on the Institute of Concrete Technology's Advanced Concrete Technology Course, these four volumes are a comprehensive educational and reference resource for the concrete materials technologist. An expert international team of authors from research, academia and industry has been brought together to produce this unique series. Each volume deals with a different aspect of the subject: constituent materials, properties, processes and testing and quality. With worked examples, case studies and illustrations throughout, the books will be a key reference for the concrete specialist for years to come. * Expert international authorship ensures the series is authoritative * Case studies and worked examples help the reader apply their knowledge to practice * Comprehensive coverage of the subject gives the reader all the necessary reference material

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. Standards for specifying and ensuring the durability of new concrete structures are commonly of the prescriptive kind. fib Bulletin 76: Benchmarking of deemed-to-satisfy provisions in standards - Durability of reinforced concrete structures exposed to chlorides presents the benchmarking of a number of rules for chloride-induced corrosion as given in national codes such as European, US and Australian standards. This new benchmark determines the reliability ranges in the chloride-induced depassivation of rebar if the deemed-to-satisfy rules of different countries are taken into consideration. It does not only involve (probabilistic) calculations using input mainly based on short-term and rapid laboratory-test data but also involves input based on an independent assessment of existing structures. The reliability analyses are carried out using the probabilistic design approach for chloride-induced corrosion presented in fib Bulletin 34: Model Code for Service Life Design (2006), fib Model Code for Concrete Structures 2010 and ISO 16204:2012. The work compares the calculated reliability ranges thus determined with the target reliabilities proposed by current specifications and, based on the comparison, offers a proposal for the improvement of deemed-to-satisfy rules and specifications. fib Bulletin 76 presents and discusses in detail the input data for the examined model parameters and offers an extensive annexe documenting the values of the individual parameters used in the analyses. It thus provides a reliable database for the performance-based probabilistic service-life design of concrete structures exposed to chlorides, be they in the form of salt fog, sea water or de-icing salts.

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