Commission 8

Structural service life

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Pielstick	Eisman & Russo	USA

Co-Deputy Chairs:

McKenna	Halcrow Group Ltd, a CH2M HILL Company	Ireland
Papworth	BCRC	Australia

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Stipanovic Oslakovic	University of Twente	Netherlands

Members:

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Bartholomew	CH2M HILL	USA
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Kobayashi	Gifu University	Japan
Leon	Univ. Politecnica de Madrid	Spain
Linger	Vinci Construction - Grands Projets	France
Markeset	TDK, Institutt for bygg- og energiteknikk	Norway
Matthews	Building Research Establishment	United Kingdom
Matthys	Ghent University	Belgium
Miyagawa	Kyoto University	Japan
Paeglitis	Riga Technical University	Latvia
Rahimi	Federal Waterways Engineering and Research Institute	Germany
Ramezanianpour	Amirkabir Univ. of Technology	Iran
Sgobba	Italcementi Group	Italy
Smith	Atkins	United Kingdom
Solgaard	Cowi AS	Denmark
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Subbarao	Construma Consultancy Pvt. Ltd.	India
Tikalsky	University of Utah	USA
Ueda	Hokkaido University	Japan
Vimmr	STÚ - K, a.s.	Czech Republic
Vogel	Karlsruher Institut für Technologie (KIT)	Germany
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Alipour	University of Massachusetts	USA
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Francois	National Institute of Applied Sciences	France
Frangopol	Lehigh University	USA
Ferreira	VTT Techn. Research Centre of Finland	Finland
Hamilton	University of Florida	USA
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Marano	Politecnico di Bari	Italy
Meda	University of Rome “Tor Vergata”	Italy
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Otieno	University of Cape Town	South Africa
Randl	Carinthia Univ. of Applied Sciences	Austria
Rinaldi	University of Rome “Tor Vergata”	Italy
Safi	KTH Royal Institute of Technology	Sweden
Sandeford	GHD Pty. Ltd	Australia
Siriviatnanon	Cement Concrete & Aggregate Australia	Australia
Straub	TU München	Germany
Ueda	Tokushima University	Japan
van der Horst	Delft University of Technology	Netherlands
Vennesland	NTNU	Norway
Wigum	Mannvit Reykjavik	Iceland

(*fib* members are listed in **bold**)

Recent meetings:

Copenhagen (May 2015)

Recent publications:

fib Bulletin 76: **Benchmarking of deemed-to-satisfy provisions in standards** (State-of-the-art report prepared by T8.6, published 2015)

Terms of reference

Background and scope

The overall motivation of *fib* Commission 8 (COM8) is to provide rational procedures to obtain an optimal technical-economic performance of concrete structures in service and to ensure that sustainability, whole-life cost and associated through-life perspectives are taken into account as part of the process by which experience gained from practice is fed back to the design, execution, maintenance and rehabilitation stages.

The scope and objective of COM8 work is to effectively address the structural service life aspects of individual structures with rational strategies, procedures and criteria for design, assessment, maintenance and remediation. This work includes modified methods for the determination of inspection frequencies as well as methods based on sound engineering principles that will provide efficiencies as well as cost savings. These methods are reliability-based to ensure cost optimal and sustainable through-life management strategies.

The procedures and processes under review by COM8 begin at the initial planning and design phase utilizing slightly modified designs parameters, and improved materials and construction methods which can include active and passive methods of corrosion protection specific to the location, climate and structural characteristics of the structure. The durability limit state (DLS) is defined as the minimum acceptable value of performance or the maximum acceptable value of degradation of a reinforced concrete element or structure under physical, chemical and biological loads.

The determination of the DLS has led to the further development of a structural "Birth Certificate" (Through Life Management) for individual components of each structure. The Birth Certificate has been defined as a document, report or technical file containing engineering information formally defining the form and the condition of the structure after construction.

General areas of interest:

- Development and validation of deterioration mechanisms on meso and macro level, profiting from micro level research, considering the structure-environment interaction.
- Probabilistic performance based service life design.
- Inspection, assessment and validation of structural performance including performance monitoring.
- Service life management and cost optimisation on object level (e.g. bridges) and on network level (e.g. transport lines as road systems), taking due account of environmental aspects of the creation and maintenance of concrete structures.
- Maintenance, repair and strengthening materials including materials performance and co-action with the base material and parent structure.
- Re-evaluation and reliability updating
- Identification of the main influences of current design and execution procedures being non-optimal to subsequent performance, and provide feedback of experience gained.
- Develop rational strategies, procedures and criteria for assessment, maintenance and remediation of concrete structures, including reliability based methods, to ensure cost optimal and sustainable structures, by considering:
    - Selection of durability and structural performance criteria based on residual life cycle costing and sustainability considerations
    - Assessment and residual service life evaluation of maintained and repaired structures
    - Maintenance, repair, strengthening and performance upgrading methods, and selection of materials and systems for the effective management of structures. Execution of maintenance, repair and strengthening, including procedures for quality assurance
- Disseminating, lecturing and teaching activities on an international scale.

Description of workflow and timeline

COM8 has continued to formulate and deliver an active working program based on a four-year cycle. Members of COM8 were very active in the development of the *fib* Model Code for Concrete Structures 2010 (*fib* MC2010) and have now re-focused work in the established working task groups. As each task group completes their respective assignment they will recommend or develop training material such as PowerPoint presentations available to the *fib* and then be disbanded and utilized for new task groups. New task groups are developed taking into account new topics and coordinated with other technical bodies.

Collaboration with other groups

COM8 continues to reach out to foster partnerships with groups such as RILEM, ISO, ACI- Committee 201, CEN, IABSE, TRB as well as other commissions within *fib*.

Target audience

Authorities/governmental agencies, practicing engineers/consultants, academia, material suppliers, contractors, students.

Expected outcome and delivery dates

Anticipated publications include:

- Task Group 8.1: Technical Report: “Model technical specification for repairs and interventions”, expected autumn 2015
- Task Group 8.2: Technical Report: “Birth and re-birth certificate & through-life management aspects” expected end of 2015
- Technical Report: “Calibration of code – Deemed-to-satisfy provisions” expected autumn 2014
- Task Group 8.3: Technical Report “Operational document to support Service Life Design” expected autumn 2015
- Task Group 8.4: Technical Report “Life Cycle Cost (LCC) - Design life and/or replacement cycle” expected autumn 2017
- Task Group 8.5: Technical Report “Durability of Post-Tensioned Systems” expected autumn 2017

Other activities of this group

Training Workshop: "Service Life Design of Concrete Structures", 14-15 November 2011, New Delhi, India.

Task Group 8.1 Model technical specification for repairs and interventions

Convener:

McKenna	Halcrow Group Ltd, a CH2M HILL Company	Ireland

Secretary:

Leon	Univ. Politecnica de Madrid	Spain

Members:

Anstice	GHD Pty. Ltd	Australia
Appleton	A2P Consult	Portugal
Bartholomew	CH2M HILL	USA
Bevc	ZAG Ljubljana	Slovenia
Branco	University of Coimbra	Portugal
Cairns	Heriot-Watt University	United Kingdom
Dias-da-Costa	University of Sydney	Australia
Edvardsen	Cowi A/S	Denmark
Ikeda	Hybrid Research Inst. Inc.	Japan
Julio	Technical University of Lisbon	Portugal
Kobayashi	Gifu University	Japan
Miyagawa	Kyoto University	Japan
Paeglitis	Riga Technical University	Latvia
Papworth	BCRC	Australia
Pielstick	Eisman & Russo	USA
Ramôa Correia	Technical University of Lisbon	Portugal
Sandeford	GHD Pty. Ltd	Australia
Sena Cruz	University of Minho	Portugal
Smith	Atkins	United Kingdom
Subbarao	Construma Consultancy Pvt. Ltd.	India
Ueda	Tokushima University	Japan
Valença	Polytechnic Institute of Coimbra	Portugal
Veludo	Polytechnic Institute of Leiria	Portugal

(*fib* members are listed in **bold**)

Terms of reference

Background and scope

Task Group 8.1 is preparing a technical report on the subject of the requirements for a model specification for repairs and interventions with the goal of achieving publication as an *fib* bulletin. Consideration will be given as to whether this work should later be taken forward as a future Guide to Good Practice.

Description of workflow

A first draft report is under development. It has been decided to further develop the approach employed in a Norwegian document containing model technical specifications for a number of rehabilitation methods and align them to the Eurocode convention. In so doing it is envisaged that this report will deliver a model technical specification for a range of rehabilitation methods, each underpinned by their principles. Topics and techniques being considered for inclusion include: Concrete removal, concrete reinstatement, patch repair; surface treatments and coating; cathodic protection; chloride extraction; realkalisation; crack sealing; physical protection / barriers; cladding; inhibitors; electro–osmosis; sacrificial anode (in patch repair); strength; external reinforcement; jacketing; external pre-stressing and replacement and reconstruction of elements. These topics will be preceded by chapters covering the investigation of defective concrete from inspection and testing to monitoring.

To ensure the document has relevance to the end user methods presently may be supported with by a suitable case study.

Description of workflow and timeline

The work started in November 2007 and is expected to be finished by autumn 2015.

Collaboration with other groups

The members are active on other international committees.

Target audience

Owners, engineering consultants, contractors

Expected outcome and delivery dates

Technical Report: “Model technical specification for repairs and interventions”, expected in autumn 2015.

Task Group 8.2 Birth and re-birth certificates & through-life management aspects

Convener:

Bartholomew	CH2M HILL	USA

Secretary:

McKenna	Halcrow Group Ltd, a CH2M HILL Company	Ireland

Members:

Bevc	ZAG Ljubljana	Slovenia
Cairns	Heriot-Watt University	United Kingdom
Edvardsen	Cowi A/S	Denmark
Leon	Univ. Politecnica de Madrid	Spain
Marano	Techn. Univ. of Bari,	Italy
Paeglitis	Riga Techn. Univ	Latvia
Pielstick	Eisman & Russo	USA
Subbarao	Construma Consultancy Pvt. Ltd.	India

(*fib* members are listed in **bold**)

Terms of reference

Background and scope

Task Group 8.2 (T8.2) is preparing a technical report on the subject of birth and re-birth certificates & related through-life management aspects.

The goal of the technical report is to develop a template for the rational approach to the assessment of a "Life Rating" for individual structures. The template will organize and analyze design parameters and as-built data in an effort to predict the type and frequency for in-service inspections. This information will then provide a mechanism for owners and engineers to optimize the inspection frequency providing a cost saving over time.

It is planned to take of the following points into account:

- Development of concepts for birth and re-birth certificates evolving into "Life Rating" of new and existing structures. This work will include recording data and environmental conditions as well as technical information required for through-life management of concrete structures.
- Consideration of the wider issues associated with the through-life management of concrete structures – with reference to technical, functional, economic, and sustainability issues (i.e. the wider framework).
- Development of a framework for documentation of:
    - the parameters used in a service life design,
    - measurements of actual parameters achieved during construction,
    - and measurements of the actual in-service behaviour against predicted behaviour.
- Development of a conservation plan for structures, including plans for routine maintenance and in-service inspection.

Description of workflow and timeline

The work started in May 2008 and is expected to be finished by the end of 2015.

Collaboration with other groups

The members are active on other international committees.

Target audience

Owners, engineering consultants and specifiers

Expected outcome and delivery dates

Technical Report: “Birth and re-birth certificate & through-life management aspects”, expected at the end of 2015.

Task Group 8.3: Operational document to support Service Life Design

Convener:

Andrade	Instituto Eduardo Torroja	Spain

Secretary:

Gulikers	Rijkswaterstaat Centre for Infrastructure	Netherlands

Members:

Bartholomew	CH2M HILL	USA
Cremona	SETA/CTOA	France
Edvardsen	Cowi A/S	Denmark
Ferreira	VTT Techn. Research Centre of Finland	Finland
Kobayashi	Gifu University	Japan
Linger	Vinci Construction	France
Markeset	TDK, Institutt for bygg- og energiteknikk	Norway
Matthews	Building Research Establishment	United Kingdom
Miyagawa	Kyoto University	Japan
Papworth	BCRC	Australia
Pielstick	Eisman & Russo	USA
Rabade	CISDEM (UPM-CSIC)	Spain
Sgobba		Italy
Stipanovic Oslakovic	University of Twente	Netherlands
Subbarao	Construma Consultancy Pvt. Ltd.	India
Vimmr	STú - K, a.s.	Czech Republic

(*fib* members are listed in **bold**)

Recent meetings:

Copenhagen (May 2015)

Terms of reference

Background and scope

The motivation of *fib* Task Group 8.3 (T8.3) is the need to introduce the advanced probabilistic approach in the design of service life and durability. The *fib* MC2010 has incorporated a performance approach for the durability design that is not known and experienced by current engineers. A document is needed that explains in detail and with examples the procedure and the meaning of designing by performance.

The objective of T8.3 is to develop a technical report that will provide operational guidance to support the practical implementation of *fib*/ISO Service Life Design codes and standards with the goal of achieving publication as a bulletin (following the publication of relevant service life design codes and standards).

The report will cover the following topics:

- review/clarification of limit states – meaning and use in practical management of structures;
- criterion dependency on limit states selected;
- threshold levels initiating deterioration;
- design approach: simple to complex needs for particular situations, considering approaches ranging from e.g. deterministic to probabilistic;
- models issues: what simplifications can be made, what would be adequate for general practical users: critical review/limitations, range of application of models, etc.;
- generic top frame to define broader issues and with examples of corrosion to explore aspects or issues in depth;
- cracks/influences upon deterioration;
- statistical quantification of the input parameters / implications for output / sensitivity;
- implication of models used – review – initiation – propagation, etc. – relationship to the limit states;
- inter-relationships of parameters adopted in service life design codes and standards;
- application to design / assessment of existing structures.

Description of workflow and timeline

The work started in January 2010 and is expected to be finished by end of 2015.

The final draft of the document is in preparation with the following chapters:

Chapter 1: Introduction and scope of report – Part of life cycle analysis

Chapter 2: Reliability concepts

- Durability limit state
- Probability of corrosion
- Reliability indices
- Consequence, design supervision and maintenance classes
- Reliability and cost

Chapter 3: Review of corrosion initiation and Propagation in MC2010

Chapter 4: Practical application of MC2010 models

- Carbonation induced corrosion
    - Full probabilistic
    - Partial safety factor
- Chloride induced corrosion
    - Full probabilistic
    - Partial safety factor
- Identification of gaps and limitations in above

Chapter 5: Operational guidance

- Flow chart (four methods of design)
- Case studies

Chapter 6: Future developments

- Discussion of chloride and carbonation profiles as opposed to fronts

Appendix A: Corrosion initiation models in other relevant codes of practice

Appendix B: Other deterioration processes

Collaboration with other groups

The members are also active in RILEM and in other international committees related to the subject of service life prediction.

Target audience

Primarily design engineers but also consultants, academia, prescribers, testing laboratories, materials producers.

Expected outcome and delivery dates

A technical report providing operational guidance on the procedure for service life design according to MC2010, expected spring 2015.

Task Group 8.4: Life Cycle Cost (LCC) - Design life and/or replacement cycle

Convener:

Edvardsen	Cowi A/S	Denmark

Secretary:

Campos e Matos	Minho University	Portugal

Members:

Akiyama	Waseda University	Japan
Almeida	Polytechnic Institure of Guarda	Portugal
Arangio	Sapienza University of Rome	Italy
Bernard	Oxand Switzerland	Switzerland
Caprani	Monash University	Australia
Casas Rius	Tech. Univ. of Catalunya, Civ. Eng. Dpt.	Spain
El-Dieb	United Arab Emirates University	UAE
Ferreira	VTT Techn. Research Centre of Finland	Finland
Frangopol	Lehigh University	USA
Gulikers	Rijkswaterstaat GPO	Netherlands
Kong	Korea University	Korea
Landolfo	Università degli Studi di Napoli Federico II	Italy
Linneberg	COWI A/S	Denmark
Masovic	University of Belgrade	Serbia
McKenna	Halcrow Group Ltd, a CH2M HILL Company	Ireland
Neves	Nottingham University	United Kingdom
Novak	Technical University of Brno	Czech Republic
Okasha	University of Hail	Saudi Arabia
Orlowsky	Technische Universität Dortmund	Germany
Pandey	University of Waterloo	Canada
Papworth	BCRC	Australia
Petraschek	OBB-Infrastruktur AG	Austria
Ruan	Tongji University	China
Safi	KTH Royal Institute of Technology	Sweden
Sanchez-Silva	Universidad de Los Andes	Colombia
Smith	Atkins	United Kingdom
Solgaard	Cowi A/S	Denmark
Stang	Techn. University of Denmark DTU	Denmark
Stewart	The University of Newcastle	Australia
Stipanovic Oslakovic	University of Twente	Netherlands
Strauss	Universität für Bodenkultur	Austria
Viviescas Jaimes	Universidad Industrial de Santander	Colombia
Yücemen	Middle East Technical University	Turkey

(*fib* members are listed in **bold**)

Recent meetings:

Copenhagen (May 2015)

Terms of reference

Evaluate reinforced concrete structures through design for life cycle cost by considering cost models (replacement/rehabilitation and user costs) and maintenance strategies. Address strategies and risks to optimize a life cycle cost design. Summarize existing models for structural costs. Establish a flowchart for life cycle cost analysis. Provide examples and case studies with narrative and consequences. Provide awareness to designer, owners, contractors, university, financial institutions and engineers in LCC impact.

Background and scope

In the past, structural design aimed to minimize initial (construction) costs and solutions with the lowest initial costs were favoured. This selection criterion has, however, been subject to debate, since infrastructure managers have become aware that costs during operation of the structure are significant, e.g. costs for operation, maintenance and repair.

As an example, concrete bridges are subject to natural degradation during operation, requiring maintenance and/or repair such as substitution of edge beams or repair of cracks in the concrete. Such interventions result in direct costs, i.e. the costs of the actual work and in some cases also indirect costs, e.g. delay to traffic. Bearing this in mind, infrastructure owners and managers have felt the need for a different approach to decision-making – an approach that considers costs related to the whole life of the structure. Asset management, lifecycle assessment and whole life costing are all similar approaches which apply several tools and systematic procedures to achieve this aim. More specifically, these approaches seek to reduce the costs of a structure during various phases of the structure's 'life', such as design, construction, operation, and decommission. Additionally, they may be used to extend the service life, minimizing decommissioning and replacement expenditures of the structure. Nowadays the most developed lifecycle systems incorporate three fundamental modules: database, performance/prediction models, and optimization strategies. The use of these systems for management of the infrastructure has grown over the past years. However, constant research for development of modules is required, to ensure that they are relevant and practical.

Future infrastructure projects should integrate economical and technical concepts in a global framework including public welfare, environmental protection and intergenerational responsibility. This can be taken into account with procedures for life cycle optimization considering the actual planning and design of the structures maintenance and inspection etc. The overarching aim of this procedure is to provide guidelines for management of concrete structures considering Life Cycle Costs (LCC) and to provide awareness to owners, contractors, universities, financial institutions, and engineers on the long-term LCC impact.

The work of T8.4 comprises the preparation of a state-of-the-art report on LCC including the following:

- A flow chart for life cycle cost analyses;
- Examples and/or case studies concerning life cycle cost evaluations of design strategies, including narratives and consequences of the favoured strategy;
- A risk analysis covering costs and benefits;
- Identification of hazard scenarios (weak points);
- Discussion on the value added by the LCC analyses including:
    - Design;
    - Inspection;
    - Testing;
    - Monitoring;
    - Birth Certificate;
    - Inspectability;
    - Interventions.
- Reference to relevant *fib* documents;

Description of workflow and timeline

The work started in January 2014 and is expected to be finished by the end of 2016.

Collaboration with other groups

fib Commission 7

fib Task Group 7.4, "Sustainable civil structures

fib Task Group 8.1, "Model Technical specification for repairs and interventions"

fib Task Group 8.2, "Birth and re-birth certificates & through-life management aspects"

Target audience

Owners and the owners' designers, engineering consultants, design companies, contractors, financial institutions and universities

Expected outcome and delivery dates

The expected outcome of this task group is a technical report (state-of-the-art) covering the work described above regarding LCC. The deadline of this technical report is by the end of 2017.

Task Group 8.5: Durability of post-tensioning systems

Convener:

Pielstick	Eisman & Russo	USA

Members:

Corven	Corven Engineering	USA
McKenna	Halcrow Group Ltd, a CH2M HILL Company	Ireland
Bartholomew	CHM2 Hill	USA
Ganz	GTI	Switzerland
Hunsicker	Consultant	USA
Krauser	VSL	USA
Theryo	PB	USA
Vejoda	PTI	USA

(*fib* members are listed in **bold**)

Terms of reference

Background and scope

Task Group 8.5 (T8.5) will produce an update of Bulletin 33, “Durability of post-tensioning tendons” (Recommendation published in 2005). This update will include a title change to address the ever changing post-tensioning systems and the advancement of tendon protection systems to include pre-packaged grouts and wax systems.

Expected outcome and delivery dates

A technical report providing operational recommendations and information on the latest developments to assure better durability of post-tensioned systems.

Description of workflow and timeline

The first task group meeting was held in October 2014 with draft reviews to begin spring of 2017

Collaboration with other groups

Work will be coordinated with PTI, ASBI as well as Euro standards.

Target audience

Owners, engineering consultants, contractors

Expected outcome and delivery dates

Autumn 2017

Task Group 8.6: Calibration of code deemed-to-satisfy provisions for durability

Convener:

Gehlen	TU München	Germany

Secretary:

Gulikers	Rijkswaterstaat Centre for Infrastructure	Netherlands

Members:

Andrade	Instituto Eduardo Torroja	Spain
Bartholomew	CH2M HILL	USA
Edvardsen	COWI A/S	Denmark
Ferreira	VTT Techn. Research Centre of Finland	Finland
Helland	Skanska Norge AS	Norway
Markeset	TDK, Institutt for bygg- og energiteknikk	Norway
Papworth	BCRC	Australia
Pielstick	Eisman & Russo	USA
Rahimi	Federal Waterways Engineering and Research Institute	Germany
von Greve-Dierfeld	TU München	Germany

(***fib*** members are listed in **bold**)

Recent publications:

fib Bulletin 76: **Benchmarking of deemed-to-satisfy provisions in standards** (State-of-the-art report prepared by T8.6, published 2015)

Terms of reference

Background and scope

The objective of Task Group 8.6 is to give an overview of the current deemed-to-satisfy rules and of the corresponding levels of reliability regarding durability in order to give suggestions on how current deemed-to-satisfy rules can be improved.

The group should undertake a review of the background of deemed-to-satisfy options for concrete mixes for specified service life situations. The work involves a calibration of the reliability levels provided by current deemed-to-satisfy options.

Description of workflow and timeline

The work started in May 2010 and is expected to be finished by 2015.

Collaboration with other groups

As this task is strongly related and dependent on the work to be undertaken in Task Group 8.3 on the identification and definition of appropriate limit states, modelling of relevant degradation processes and the associated input parameters, ongoing interaction between these TGs is considered essential.

CEN/TC104/SC1 and CEN/TC250/SC2/JWG/Ad hoc durability

Target audience

Academia, consultants, authorities/governmental institutions, producers (concrete), contractors

Expected outcome and delivery dates

Technical Report: “Procedure for Benchmarking of Deemed-to-satisfy Provisions in Standards – Durability of Concrete Structures Exposed to Chlorides”, to be delivered in Spring 2015.