Commission 4

Concrete and concrete technology

Chair:			
	Dehn	MFPA Leipzig GmbH	Germany
Deputy Chair:			
	Martius-Hammer	SINTEF	Norway
Members:			
	Beushausen	University of Cape Town	South Africa
	de Schutter	Ghent University	Belgium
	Ferrara	Politecnico di Milano	Italy
	Grünewald	Delft University of Technology	Netherlands
	Helland	Skanska Norge AS	Norway
	Justnes	NTNU	Norway
	Lohaus	Leibniz Universität Hannover	Germany
	Mechtcherine	TU Dresden	Germany
	Müller	Karlsruhe Institute of Technology	Germany
	Vandewalle	Catholic University Leuven	Belgium
	Walraven	TU Delft	Netherlands
Corresponding Members:			
	Geiker	NTNU	Norway
	Ueda	Hokkaido University	Japan

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

Terms of reference

Background and scope

The overall motivation of *fib* Commission 4 (COM4) is to make theoretical and practical developments in the field of concrete technology, and to present these developments in an understandable and code-type formulated manner. COM4 positions itself at the forefront of new technologies and techniques by considering both fundamental research and practical issues.

The aim of COM4 is to collect and to validate information on the properties and behaviour of concrete for structural applications subjected to various types of loading and environmental conditions. The commission focuses its attention both on traditional types of concrete, in particular under unusual conditions, and on new types of concrete and cementitious composites under all types of loadings and conditions. The properties of the concrete types considered should be formulated in such a way that it is possible to derive behavioural models and design recommendations for practical applications.

COM4's areas of technical work and interest are:

- Durability and deterioration of concrete and cementitious composites
- Traditional cements and blended binders, concrete admixtures and additions, supplementary cementitious materials
- Alkali-activated binders and concretes
- Geopolymers
- Constitutive laws and code-type models for traditional and new types of concrete
- Time- and temperature dependent concrete properties
- Concrete properties under multiple loading
- Concrete with recycled materials
- Properties and behavioral modeling of UHPC, LWAC, SCC, FRC, SCM concretes

- Aspects of mixing, execution and curing;
- Performance-based specifications for concrete;
- Cement-based repair and retrofitting materials and composites.

One of the major objectives for the future activities in COM4 is to attract more members from the industry by promoting the benefits of participating in the work of COM4 or one of its task groups.

Description of workflow and timeline

COM4 has formulated and planned its working programme for a four-year term. Task groups in COM4 are focusing on the preparation of bulletins which cover the above-mentioned interests. If new Task Groups will be developed, coordination with technical bodies is targeted (e.g. RILEM, ACI, ACF).

Collaboration with other groups

Commission 1, Commission 2, Commission 6, Commission 7, Commission 8

COM4 has made considerable efforts to foster its relationship with the corresponding technical committees of RILEM and ACI. Besides this, COM4 is in close contact with RILEM and ACI in order to coordinate future activities.

Target audience

Academia, consultants, authorities/governmental institutions, producers (concrete, admixtures, concrete additions/extenders, cement, aggregates), contractors.

Expected outcome and delivery dates

Provision of background documents for respective chapters in the *fib* Model for Concrete Structures 2010: T4.1, *Fibre-reinforced concrete*, (expected delivery date: beginning of 2015).

Provision of bulletins: T4.2, *Ultra high performance fibre-reinforced concrete* (expected delivery date: mid-2015), T4.2, *Structural design with flowable concrete* (expected delivery date: mid 2015), T4.4, *Aesthetics of concrete surfaces* (expected delivery date: beginning of 2015), T4.5, *Performance-based specifications of concrete* (expected delivery date: mid 2016), T4.6, *Constitutive laws for concretes with supplementary cementitious materials* (expected delivery date: mid 2016).

Task Group 4.1: Fibre-reinforced concrete

Convener:		
Vandewalle	Katholieke Universiteit Leuven	Belgium
Secretary:		
Vitt	Bekaert s. a.	Belgium
Members:		
Balázs	Budapest Univ. of Techn. & Economics	Hungary
Banthia	University of British Columbia	Canada
Barragan	OCV Chambery International	France
Barros	Universidade do Minho	Portugal
Boshoff	University of Stellenbosch	South Africa
Dancygier	Technion - Israel Instit. of Technology	Israel
Dehn	MFPA Leipzig GmbH	Germany
Destree	Consultant ArcelorMittal	Belgium
di Prisco	Politecnico di Milano	Italy
Falkner	Ingenieurbüro Dr. Falkner GmbH	Germany
Gettu	Indian Institute of Technology Madras	India
Kanstad	Norwegian Univ.of Science & Technology	Norway
Kusterle	Universität Innsbruck	Austria
Löfgren	Arup Materials Consulting	United Kingdom
Massicotte	Ecole Polytechnique de Montréal	Canada
Minelli	University of Brescia	Italy
Moro	BASF Construction chemicals Italia Spa	Italy
Parmentier	Belgian Building Research Institute	Belgium

Plizzari	University of Brescia	Italy
Rossi	IFSTTAR	France
Serna Ros	Univ. Politecnica de Valencia	Spain
Soetens	University of Ghent	Belgium
van den Bos	TNO DIANA bv	Netherlands

Corr. Members:

Mobasher	Arizona State University	USA
Parra-Montesinos	University of Wisconsin	USA

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

Recent meetings:

Leuven (March, September, November 2015)

Terms of reference

Background and scope

Fibre concrete is more than 50 years old and the design rules have undergone developments over the years. T4.1 will make theoretical and practical developments in the field of fibre-reinforced concrete materials technology, rheology and materials characterization and models and to present these developments in code-type formulations. For steel fibre concrete, the group continues the work of the RILEM technical committee TC 162-TDF Test and Design Methods for Steel Fibre Reinforced Concrete. The task group collects and validates information on the behaviour of fibre-reinforced concrete materials, subjected to various types of loading and environmental conditions.

Description of workflow and timeline

T4.1 is currently finalising a bulletin on the background to the design rules in MC2010.

Collaboration with other groups

Collaboration with WP1.4.1 (Tunnels in fibre-reinforced concrete), T2.2 (Ultimate limit state models), T4.2 (Ultra high performance fibre-reinforced concrete) and ACI Committee 544 (FRC)

Target audience

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

Expected outcome and delivery dates

The delivery of the bulletin is expected in 2016.

Task Group 4.2: Ultra high performance fibre-reinforced concrete

Convener:

Walraven	Delft University of Technology	Netherlands

Members:

Aarup	CRC Technology ApS	Denmark
Behloul	Lafarge	France
Bunje	IBB Fehling & Jungmann GmbH	Germany
Dehn	MFPA Leipzig GmbH	Germany
Denarie	EPF Lausanne	Switzerland
di Prisco	Politecnico di Milano	Italy
Fehling	IBB Fehling + Jungmann GmbH	Germany
Frettlöhr		Germany
Gambarova	Politecnico di Milano	Italy
Graybeal	PSI/FHWA Structures	USA
Greiner	Bilfinger + Berger AG	Germany
Grünewald	Delft University of Technology	Netherlands
Katagiri	Taiheiyo Cement Corporation	Japan
Leutbecher	Universität Kassel	Germany
Marchand	IFSTTAR	France
Redaelli	Perreten et Milleret	Switzerland
Reineck	Universität Stuttgart	Germany
Resplendino	Setec TPI	France
Rossi	IFSTTAR	France
Sato	Hokkaido University	Japan
Schmidt	Universität Kassel	Germany
Simon	Eiffage TP	France
Skazlic	University of Zagreb	Croatia
Thibaux	Eiffage	France
Toutlemonde	IFSTTAR	France
Tue	Technische Universität Graz	Austria

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

Terms of reference

Background and scope

Task Group 4.2 (T4.2) will make theoretical and practical developments for concretes with strength > 120 N/mm2 in the field of fibre-reinforced concrete materials technology, rheology and materials characterization and models to present these developments in code-type formulations. Work is applicable to concrete with fibres of various types, such as steel, polyacrylic, polypropylene, etc., or combinations thereof.

Collaboration with other groups

The work of T4.2 is coordinated with the work of *fib* T4.1 (Fibre-reinforced concrete) that develops recommendations for conventional fibre-reinforced concrete. Through common memberships there is also coordination with the work of the RILEM Technical Committee on High Performance Fibre-Reinforced Cementitious Composites (TC HFC).

Target audience

Universities, research institutes, design engineers and consultants, producers and contractors.

Expected outcome and delivery dates

A complete draft will be discussed in the task group in the beginning of 2015. It is expected that the final bulletin will be published during the summer of 2015.

Task Group 4.3: Structural design with flowable concrete

Conveners:

Grünewald	Delft University of Technology	Netherlands
Ferrara	Politecnico di Milano	Italy

Members:

Barragan	OCV Chambery International	France
Barros	Universidade do Minho	Portugal
Behloul	Lafarge	France
Beitzel	Inst. für Bauverfahrens- und Umwelttechnik	Germany
Bertram	Grawe & Bertram	Germany
Billberg	CBI Betonginstitutet	Sweden
Cairns	Heriot-Watt University	UK
Dehn	MFPA Leipzig GmbH	Germany
den Uijl	Delft University of Technology	Netherlands
di Prisco	Politecnico di Milano	Italy
Domone	UCL Centre for Materials Research	United Kingdom
Fischer	Technical University of Denmark	Denmark
Freytag	Technische Universität Graz	Austria
Geiker	NTNU - Trondheim Norwegian Univ.	Norway
Gettu	Indian Institute of Technology Madras	India
Kanstad	The Norwegian Univ.of Science & Tech	Norway
Laranjeira	Univ. Politecnica de Catalunya	Spain
Leemann	EMPA Dübendorf	Switzerland
Martinie	IFSTTAR	France
Martius-Hammer	SINTEF Building and Infrastructure	Norway
Nunes	University of Porto	Portugal
Obladen	Strukton Group	Netherlands
Roussel	IFSTTAR	France
Sato	Hokkaido University	Japan
Schmidt	Federal Institute for Material Research	Germany
Sonebi	Queen's University Belfast	Ireland
Spangenberg	Technical University of Denmark	Denmark
Stähli	Concretum Construction Science AG	Switzerland
Stang	Techn. University of Denmark DTU	Denmark
Taylor	Queen's University Belfast	UK
Vandewalle	Catholic University Leuven	Belgium
Walraven	Delft University of Technology	Netherlands
Zilch	TU München	Germany

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

Recent meetings:

Zürich (May 2015)

Terms of reference

Background and scope

Flowable concrete (highly flowable, self-compacting and/or self-levelling) has evolved from a special type to a commonly applied building material. *fib* Task Group 4.3 (T4.3) considers three aspects of flowable concrete (FC) for structural design: material properties, production effects and structural boundary conditions. The flow of concrete (initiated by some vibration and/or the weight of concrete) can affect the structural characteristics of hardening or hardened concrete. The mixture composition has to be adjusted and optimized in order to obtain a high flowability. T4.3 aims at promoting the application of flowable concrete, improving and adapting the concrete design and the production technology and its implementation in guidelines and codes.

The technical work of T4.3 considers the following aspects:

- mechanical /structural characteristics;
- local effects;
- effects of orientation/segregation due to the flow/vibration;
- mixture composition;
- production technique.

Research findings will be compiled and analyzed in order to provide guidance for designers and users of concrete structures with FC. Areas of structural design where FC differs from traditional vibrated concrete (TC) have to be identified.

Description of workflow and timeline

The work of T4.3 is divided into three phases:

Phase 1 – Orientation

Phase 2 – Compilation and comparison

- study of research findings;
- synthesis of findings from research and practice;
- stimulation of research and application of FC.

Phase 3 – Translation

Comparison of findings with existing codes

Collaboration with other groups

fib Task Group 4.1, “Fibre-reinforced concrete”

fib Task Group 4.2, “Ultra high-performance fibre-reinforced concrete”

RILEM Technical Committee "Mechanical Properties of Self-Compacting Concrete", relating activities with ACI Committee 544 'FRC'

RILEM Technical Committee "High Performance Fibre Reinforced Cementitious Composites"

Target audience

Academia, design engineers, concrete producers, contractors

Expected outcome and delivery dates

State-of-the-art report completed and ready for printing at the end of 2015

Recommendation on “flowable concrete” planned for printing in mid-2017

Task Group 4.4: Aesthetics of concrete surfaces

Convener:			
	Lohaus	Leibniz Universität Hannover	Germany
Secretary:			
	Fischer	Leibniz Universität Hannover	Germany
Members:			
	Barragan	OCV Chambery International	France
	Boska	TU Darmstadt	Germany
	Casals Roige	Oficina tecnica d’enginyeria civil	Spain
	Cauberg	WTCB-CSTC-BBRI	Belgium
	De Weerdt	SINTEF Building and Infrastructure	Norway
	Dehn	MFPA Leipzig GmbH	Germany
	Goldammer	DBV	Germany
	Hierlein	FDB - Fachvereinigung	Germany
	Hofstadler	Institut für Baubetried und Bauwirtschaft	Austria
	Karman	Ecoratio	Netherlands

Motzko	TU Darmstadt	Germany
Østnor	SINTEF Building and Infrastructure	Norway
Pacios Alvarez	ETS Ingenieros Industriales - UPM	Spain
Reinisch	Doka Industrie GmbH	Austria
Tadros	Speco Engineering Ltd.	Canada
van de Riet	Ecoratio	Netherlands

Corr. Members:

Gjerde	Victoria University of Wellington	New Zealand

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

Terms of reference

Background and scope

The notion of exposed concrete is subjective and varies according to the viewer. The motivation of *fib* Task Group 4.4 (T4.4) is to show possibilities how to category and evaluate visible concrete surfaces and to point out technical factors of influence.

In order to have a basis for the work of T4.4, it is necessary to limit the requirements regarding the appearance of concrete surfaces. Because exposed concrete has been established in recent years by well-known architects as having a homogenous and smooth appearance, the work will be focused on this kind of visible concrete surface. An exposed concrete surface is observed within the context of the surfaces of the whole building. The resulting impression depends considerably on the viewing distance and lighting conditions. Therefore the utilization of the building is important when evaluating a concrete surface. The realization of an exposed concrete surface is influenced by many different factors, including concrete technology, concrete formwork and formwork material, the application of a releasing agent, the method of operation on-site, logistical conditions during transportation of the concrete and concreting, as well as climatic influences and the coordination of all persons involved in the building process.

T4.4 will formulate a state-of-the-art technical report on how exposed concrete is defined and built. The final aim is to create a generally accepted recommendation or guideline for exposed concrete with a homogenous appearance. This generally accepted recommendation or guideline will be characterized by classifying exposed concrete in different categories. The limit of its objective performance will be considered as well as the consequences on the effort on-site and the planning of structural framework.

Description of workflow and timeline

The working programme is planned over a four-year term. During the first phase, it will be necessary to collect and evaluate test results and practical experience with exposed concrete. From these results, the influences on the appearance of a visible surface should be discussed and distinguished as to how far they can be controlled in the planning process and during the execution. The results will be summarized in a state-of-the-art-report.

Based on the parameters resulting from phase one as well as already existing national regulations and recommendations, categories for exposed concrete surfaces with a homogenous and smooth appearance will be developed in the second phase. The kind of publication of this guideline has to be discussed, possibly as a technical report for the classification of attractive concrete surfaces.

Target audience

Academia, consultants, contractors, producers (concrete, admixtures, concrete additions, cement), authorities, institutions

Expected outcome and delivery dates

The delivery of the bulletin is expected at the beginning of 2015

Task Group 4.5: Performance-based specifications for concrete

Conveners:		
Beushausen	University of Cape Town	South Africa
Dehn	MFPA Leipzig GmbH	Germany
Secretary:		
Herrmann	Leipzig University	Germany
Members:		
Alexander	University of Cape Town	South Africa
Altmann	Ingenieurbüro Altmann	Germany
Baroghel-Bouny	IFSTTAR	France
Bigaj-van Vliet	TNO Built Environment + Geosciences	Netherlands
Coufal	TBG Metrostav S.R.O.	Czech Republic
De Belie	Ghent University	Belgium
de Schutter	Ghent University	Belgium
di Prisco	Politecnico di Milano	Italy
Fennis	Delft University of Technology	Netherlands
Ferrara	Politecnico di Milano	Italy
Freitas Goncalves	LNEC Laborat. Nacion. de Engenh. Civil	Portugal
Geiker	NTNU - Trondheim Norwegian Univ.	Norway
Grünewald	Delft University of Technology	Netherlands
Gulikers	Rijkswaterstaat Centre for Infrastructure	Netherlands
Haist	Karlsruhe Institute of Technology (KIT)	Germany
Hooton	University of Toronto	Canada
Juhart	Graz University of Technology	Austria
König	Leipzig University	Germany
Martius-Hammer	SINTEF Building and Infrastructure	Norway
Mechtcherine	Technical University Dresden	Germany
Müller	Karlsruhe Institute of Technology	Germany
Rougeau	CERIB	France
Strauss	Universität für Bodenkultur	Austria
Tauscher	Federal Highway Research Inst. BASt	Germany
Torrent	Holcim Group Support Ltd	Switzerland
Walraven	Delft University of Technology	Netherlands
Wendner	Universität für Bodenkultur	Austria
Ye	Delft University of Technology	Netherlands

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

Terms of reference

Background and scope

Traditional requirements for constituent materials, limiting w/b-ratios and cement contents are often not applicable for modern construction and modern types of concretes. With the advancement of testing methods for fresh and hardened concrete properties, a performance-based design and specification of concrete and concrete structures is approaching and already frequently applied. However, an independent overview is still missing on how a performance-based approach can be generalized – for both mechanical and durability aspects. In a first step *fib* Task Group 4.5 (T4.5) intends to provide further information in addition to the new *fib* Model Code for Concrete Structures 2010 (MC2010) and how performance-based specifications can be adopted for the given models and design rules.

Scope and objective:

Provision of concrete technological background and posing of practical questions.

Provision of concrete technological and structural expertise.

Development of (new) design concepts for performance-based concretes/constructions and transfer of the concepts into practice.

Provision of supplementary information on performance-based specifications for concrete in addition to MC2010.

Description of workflow and timeline

T4.5 has formulated and planned its working programme over a four-year term. Within the next two years T4.5 will focus on the collection of available testing data and national and international (prenormative and normative) literature (e.g. from CEN, ACI, etc.).

Collaboration with other groups

RILEM TC 230-PSC

Target audience

Academia, consultants, authorities/governmental institutions, producers, contractors.

Expected outcome and delivery dates

The delivery of the bulletin is expected in mid 2016.

Task Group 4.6: Constitutive laws for concretes with supplementary cementitious materials

Conveners:

Martius-Hammer	SINTEF Building and Infrastructure	Norway
Justnes	SINTEF Building and Infrastructure	Norway

Members:

Andrade	Instituto Eduardo Torroja	Spain
Bier	TU Bergakademie Freiberg	Germany
Brameshuber	RWTH Aachen	Germany
de Schutter	Ghent University	Belgium
Dehn	MFPA Leipzig GmbH	Germany
Denarie	EPF Lausanne	Switzerland
Helland	Skanska Norge AS	Norway
Hooton	University of Toronto	Canada
Lagerblad	Swedish Cement and0 Concrete Research Institute	Sweden
Pade	Danish Technological Institute	Denmark
Visser	TNO Built Environ. & Geosciences	Netherlands
Vollpracht		Germany
Ye	Delft University of Technology	Netherlands

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

Terms of reference

Background and scope

The use of Supplementary Cementitious Materials (SCM) as binder in concrete is increasing, mainly driven by the need of the concrete industry to make concrete more environmentally friendly and in particular to meet official requirements for lower CO_2 emissions. Here, it is to replace considerable amount of the high emitting Portland cement with low emitting SCM. The *fib* Model Code for Concrete Structures 2010 (MC2010) covers the use of SCM, but limits which materials and amount of SCM. The overall motive of *fib* Task Group 4.6 (T4.6) is to prepare the basis for an extension of the MC2010, which includes assessment of less known SCM also, and with larger replacements.

T4.6 aims to prepare a state-of-the-art report addressing the items in chapter 5.1 *Materials – Concrete* in the MC2010. The constitutive relations can be formulated as in, and assessed in relation to compliance with those given in MC2010.

The subchapters may contain an assessment of the validity of material laws in the two above-mentioned chapters in the MC2010 for SCM, based on existing knowledge. If not valid, modifications

may be suggested based on an overview of work to develop or modify material laws for SCM. This may lead to the results: 1) MC2010 models are valid, 2) Other existing laws specially made for SCM are valid. 3) Material laws have to be further investigated or developed.

The work will include a review of literature and ongoing research in the field, codes and recommendations, as well as already-existing constitutive relations and models. If possible, the goal is also to give guidance to ongoing research among the members to get best possible results.

Description of workflow and timeline

The target duration is four years (from autumn 2011 to autumn 2015), and to hold two meetings per year. The members will be recruited from both academia and industry focusing on experience and knowledge about the influence of SCM on mechanical properties and durability. The planned schedule is as follows:

- Start-up meeting in October 2011 with an introduction of members, suggestion of new members, overview of members' competences and experiences, discussion of definitions and limitations, plan of activities and subsequent milestones
- Join RILEM TG SCM-meeting (the first was on 3 July 2011), discuss cooperation.
- Second meeting organised as an internal workshop with the goal of preparing an overview of competence and of the soundness and reliability of the known material laws/models relevant for the MC2010, as the basis for planning further work in the TG. And to prepare a list of STAR-content including authors.
- Biannual meetings to present and discuss new knowledge as prepared in draft chapters.
- Intermediate reporting in *fib* and/or other journals/conferences
- Final publication as a bulletin (state-of-art-report), and other journals/conferences

Collaboration with other groups

fib Task Group 4.5, *Performance based specifications for concrete*

fib Task Group 8.3, *Operational document to support Service Life Design*

RILEM committee "TC SCM Hydration and microstructure of concrete with supplementary cementitious materials"

Target audience

Code authors, designers, contractors, researchers

Expected outcome and delivery dates

State-of-the-art report addressing the items in chapter 5.1, *Materials – Concrete* in the *fib* MC2010. The constitutive relations can be formulated as in, and assessed in relation to compliance with those given in the *fib* MC2010.

The delivery of the bulletin is expected in mid-2016.

Other activities of this group

Joint meetings and workshops with RILEM committee "TC SCM Hydration and microstructure of concrete with supplementary cementitious materials".