Commission 9

Reinforcing and prestressing materials and systems

Chair:	Bastien (Univ. Laval, Canada)
Deputy-Chair:	Neff (Post Tensioning Institute, USA)
Secretary:	Schaaf (TNO, The Netherlands)
Members:	Balázs (Budapest Univ. of Technology and Economics, Hungary), Boitel (Freyssinet, France), Bowsher (UK CARES, United Kingdom), Brand (Dywidag Systems Intl., Germany), Chabert (LCPC, France), Chandoga (Slovak Univ. of Technology, Slovakia), Clark (Gifford and Partners Ltd., United Kingdom), Creton (BN Acier, France), de Oliveira Almeida (Sao Paolo Univ., Brazil), Elices (Univ. Politecnica de Madrid, Spain), Feng (China Academy for Building Research, China), Forsström (Sweco International AB, Sweden), Galvez Ruiz (Univ. Politecnica de Madrid, Spain), Ganz (VSL International, Switzerland), Grujic (Serbia), Gutsch (Technische Univ. Braunschweig, Germany), Hagberg (Standard Norge, Norway), Kasuga (Sumitomo Mitsui Construction Co. Ltd., Japan), Krauser (General Technologies, Inc., USA), Lu Guanglu (Tongji Univ., China), Madatjan (NIIZhB, Russia), Manjure (Freyssinet Prestressed Concrete Co., India), Mikami (Japan), Mizoguchi (Neturen Co. Ltd., Japan), Mutsuyoshi (Saitama Univ, Japan), Niki (Sumitomo (SEI) Steel Wire Corp., Japan), Nürnberger (Univ. Stuttgart, Germany), Piekarski (BBR Polska, Poland), Piron (Ministère Wallon de l'équipement et des Transports, Belgium), Pompeu Santos (LNEC, Portugal), Poser (BBR VT international Ltd., Switzerland), Poston (Whitlock Dalrymple Poston & Assoc., USA), Prevedini (Tensacciai S.P.A., Italy), Ramirez (Mekano4, Spain), Salas (USA), Schokker (Univ. of Minnesota, USA), Shirahama (Shinko Wire Company Ltd., Japan), Sruma (CBZ, Czech Republic), Taerwe (Ghent Univ., Belgium), Theryo (Parsons Brinckerhoff Quade & Douglas, Inc., USA), Turner (M. D. Turner Consulting Pty Ltd, Australia), Valentini (Siderurgica Latina Martin S.p.A., Italy), van Beurden (Nedri-Spanstaal B.V., The Netherlands), Weiher (Techn. Univ. München, Germany), West (Univ. of Waterloo, Canada),
Corr. Members:	Bagg (Consultant, Buenos Aires, Argentina), Della Vedova (Italferr, Italy), Katergarakis (Scaw Wire and Strand, South Africa), Leivestad (Berdal Strømme a.s., Norway), Windisch (Dywidag Systems Intl., Germany), Winkler (Nik Engineering, Switzerland)
Recent Meetings:	Stockholm (June 03), Quebec (June 04), Lednice (June 05), Naples (June 06), Shizuoka (May 07), Madrid (May 08)
Recent Bulletins:	***fib*** Bulletin 26: ***Influence of material and processing on stress corrosion cracking of prestressing steel – case studies*** (Technical report prepared by Task Group 9.5, published 2003) ***fib*** Bulletin 30: ***Acceptance of stay cable systems using prestressing steels*** (Recommendation prepared by former Task Group 9.2, published 2005) ***fib*** Bulletin 33: ***Durability of post-tensioning tendons*** (Recommendation prepared by Commission 9 in co-operation with former Task Group 5.4, published 2005) ***fib*** Bulletin 40: ***FRP reinforcement in RC structures*** (Technical report prepared by Task Group 9.3, published 2007)

Terms of reference

Scope

The scope of the Commission is to promote the technology for reinforcing and prestressing materials and systems and to improve their quality. This includes aspects from design, production, testing, up to the installation and final use of these materials and systems. The scope also includes maintaining and improving dialogue between producers, specifiers, and users of these materials and systems. Finally, the Commission shall encourage new research and developments within its scope.

Areas of interest

- reinforcing and prestressing steels;
- reinforcing and prestressing systems;
- non-metallic reinforcement, tendons, and systems;
- quality and protection systems for materials and systems;
- testing of materials and systems;
- stay cable systems;
- ground anchor systems;
- execution/installation of the above mentioned materials and systems (in co-operation with Commission 10).

Working programme

Prestressing materials and systems

P2 Preparation of design guidelines for concrete structures reinforced, prestressed or strengthened with non-metallic FRP (Fibre Reinforced Polymers) reinforcement.

P3 Collection of durability problems (case studies) of both, prestressing materials and systems, and reinforcing materials and systems. From time to time, the collected case studies should be presented in a Technical Report along with recommendations and conclusions.

P4 Review the damage tolerance of prestressing materials, i. e. what size of defect may cause failure of the stressed material. A Technical Report for a standard assessment of damage tolerance properties may result.

P5 Preparation of a Manual for prestressing materials and systems. The Manual should be a collection, and where necessary an extension, of existing individual FIP reports, presented in one document in a coherent and systematic manner. It should serve as a reference for specifying bodies, for Model Codes, and as a textbook for professionals interested in these materials. The Manual may later be up-dated from time to time.

P6 Collect, assess, and disseminate information on the methods available to confirm the integrity of prestressing steels and tendons inside structures. Summarise suitable information in ***fib*** Technical reports.

P7 Contributions to the preparation of the New Model Code.

Reinforcing materials and systems (to be co-ordinated with TG 9.7)

R1 Preparation of a Technical Report on existing reinforcing systems, and their testing and qualification. The report should include model specifications which can be used by specifiers/ users.

R2 Preparation of a Technical Report on available corrosion protection systems for reinforcing materials. The report should include model specifications for the protection of materials and systems which can be used by specifiers and users.

R3 Preparation of a Manual for reinforcing materials and systems. Content and style similar to the manual (P5) under preparation for prestressing materials and systems.

R4 Contributions to the preparation of the New Model Code.

Task Group

TG 9.3 FRP (Fibre Reinforced Polymer) reinforcement for concrete structures

Convener: Matthys (Ghent Univ., Belgium)

Secretary: Guadagnini (Univ. of Sheffield, United Kingdom)

Members: Balázs (Budapest Univ. of Technology and Economics, Hungary), Basler (Basler Engineering & Consulting, Zürich, Switzerland), Blaschko (Bilfinger & Berger AG, Munich, Germany), Borchert (Technische Univ. München, Germany), Burgoyne (Cambridge Univ., United Kingdom), Ceriolo (IUAV Venezia, Italy), Ceroni (Univ. del Sannio, Italy), Clénin (SIKA Services AG, Switzerland), Czaderski-Forchmann (EMPA, Dübendorf Switzerland), De Lorenzis (Univ. of Lecce, Italy), Denton (Parsons

	Brinckerhoff Ltd, United Kingdom), Di Tommaso (IUAV Venezia, Italy), Füllsack-Köditz (Halfen Group, Germany), Hansen (SINTEF, Norway), Hole (Norsk Hydro a.s., Norway), Hordijk (TU Eindhoven, The Netherlands), Klamer (TU Eindhoven, The Netherlands), Kotynia (Techn. Univ. of Lodz, Poland), Kriekemans (Fortius, Belgium), Manfredi (Univ. di Napoli Federico II, Italy), Modniks (Riga Technical Univ., Latvia), Monti (Univ. di Roma La Sapienza, Italy), Oller Ibars (Techn. Univ. of Catalonia, Spain), Pascale (Univ. di Bologna, Italy), Pecce (Univ. del Sannio, Italy), Pilakoutas (Univ. of Sheffield, United Kingdom), Pisani (Politecnico di Milano, Italy), Prota (Univ. di Napoli Federico II, Italy), Taerwe (Ghent Univ., Belgium), Täljsten (Denmark Techn. Univ., Denmark), Tamuzs (Riga Technical Univ., Latvia), Taranu (TU Iasi, Romania), Tepfers (Ralejs Tepfers Consulting, Sweden), Thorenfeldt (SINTEF Structures and Concrete, Norway), Triantafillou (Univ. of Patras, Greece), Winistörfer (EMPA, Switzerland), Zehetmaier (Technische Univ. München, Germany), Zilch (Technische Univ. München, Germany)
Corr. Members:	Barros (Univ. do Minho, Portugal), Borgmeier (Beltec Industrietechnik, Germany), Buyle-Bodin (MGC, Ministère de l'Equipement, France), Carolin (Luleå Univ. of Technology, Sweden), Chabert (LCPC, France), Chen (Edinburgh Univ., United Kingdom), Clarke (Concrete Society, United Kingdom), Curbach (Technische Univ. Dresden, Germany), Doghri (Freyssinet International, France), Donchev (Kingston Univ., United Kingdom), Duckett (Gifford and Partners Ltd), Fuzier (Freyssinet International, France), Gerritse (Gerritse Consultancy, The Netherlands), Gremel (Hughes Brothers, USA), Hamelin (Université Lyon I, France), Harik (Univ. of Kentucky, USA), Hegger (RWTH Aachen, Germany), Ibell (Univ. of Bath, United Kingdom), Juvandes (Univ. do Porto, Portugal), Koch (Hughes Brothers, USA), Leeming (Mouchel Consulting Ltd, United Kingdom), Maruyama (Nagaoka Univ. of Technology, Japan), Matthews (BRE, United Kingdom), Melo (Univ. de Brasilia, Brazil), Meier (EMPA, Switzerland), Mutsuyoshi (Saitama Univ., Japan), Nanni (Univ. of Missouri-Rolla, USA), Niewels (RWTH Aachen, Germany), Norling (STO Scandinavia AB, Sweden), Ospina (Berger/Abam Engineers Inc., USA), Pahn (Univ. of Kaiserslautern, Germany), Pantazopoulou (Demokritus Univ. of Thrace, Greece), Renaud (Owens-Corning, Belgium), Rizkalla (North Carolina State Univ., USA), Tadros (ISIS Canada), Teng (Hong Kong Polytechnic Univ., China), Vago (Sireg S.p.A., Italy), Vervuurt (TNO, The Netherlands), Weber (Schöck Bauteile GmbH, Germany)
Recent Meetings:	Corfu (June 02), Budapest (Nov 02), Ghent (Jan 05), Lyon (July 05), Cyprus (Jan. 06), Naples (June 06), Dübendorf (Jan. 07), Patras (July 07), Porto (Apr. 08)
Recent Bulletins:	***fib*** Bulletin 40: ***FRP reinforcement in RC structures*** (Technical report, published 2007)

Terms of reference

The group aims to elaborate design guidelines for, and to stimulate, the use of non-metallic (FRP) reinforcement in reinforced concrete, prestressed concrete and strengthening. Important input is needed in form of material characterisation related to standard testing methods, and to this purpose links to other international initiatives have been established. The format of the design guidelines will follow the new CEB-FIP Model Code presently under preparation. The group meets mostly twice a year, preferably in connection with other events.

Two Working Parties are currently active:

1. Material testing and characterisation (MT&C in RC and PC, conveners Taerwe and Pilakoutas)
2. Externally bonded reinforcement (EBR, conveners Triantafillou and Matthys)

Through its meetings, extensive use of internet and e-mail, contacts with the industry, linking with research groups, networks and committees in Europe, North-America and Japan, all information available is collected with the aim to develop and verify calculation models and to formulate design

guidelines. Examples are the European Training and Mobility of Researchers (TMR) network 'ConFibreCrete – Development of guidelines for the design of concrete structures, reinforce, prestressed or strengthened with advanced composites 1998 – 2002 (co-ordinator Pilakoutas) and a Marie Curie Research Training Network ENCORE (European Network for Composite Reinforcement 2005 – 2008 (co-ordinator Pilakoutas).

In preparation are a progress report on externally bonded FRP reinforcement for Reinforced Concrete (RC) Structures and an updated edition of ***fib*** Bulletin 14 published in October 2001. Based on its contents, several successful short courses were organised in May 2003 in Athens (Greece), in June 2005 in Ankara and Istanbul (Turkey) and in May 2006 in Mexico.

Task Group

TG 9.5 Durability of prestressing materials

Convener:	Elices (Univ. Politecnica de Madrid, Spain)
Secretary:	Galvez Ruiz (Univ. Politecnica de Madrid, Spain)
Members:	Chabert (LCPC, France), Lu Guanglu (Tongji Univ., China), Mizoguchi (Neturen Co. Ltd., Japan), Nürnberger (MPA Stuttgart, Germany), Pompeu Santos (LNEC, Portugal), Pontiggia (Tensacciai S.P.A., Italy), Ramirez (Mekano4 S. A., Spain), Sandberg (W.R.W. Grace Construction, USA), Theryo (Parsons Brinckerhoff Quade & Douglas, Inc., USA), Valentini (Siderurgica Latina Martin S.p.A., Italy), Virmani (Federal Highway Administration, USA), West (Univ. of Waterloo, Canada), Windisch (Germany)
Recent Meetings:	St. Petersburg (June 99), London (Sept. 2000)

Terms of reference

The Group will consider durability questions of prestressing materials, and prestressing steel in particular. It has three main objectives:

- first, it will collect information on durability problems with prestressing steel, evaluate them, and publish from time to time summary report on these problems (durability case studies, their assessment and lessons to be learned);
- second, it will prepare guidelines for the assessment of damaged prestressing materials. Input is needed in form of the characterisation of possible damage of prestressing materials during manufacturing, transport, storage, installation, and maintenance of prestressed structures. Recommendations for the maximum tolerable damage on different types of prestressing materials and components shall be developed;
- third, it will review existing stress corrosion test methods, and, assessing them, make recommendations on their effective use.

Working programme

Intended Working Parties:

- damage tolerance for prestressing steel tendons and anchorages;
- durability case studies;
- stress corrosion test methods.

The work being done mostly by correspondence; the group meets preferably in connection with a meeting of the Commission.

Task Group

TG 9.7 Reinforcing steels and systems

Convener:	Bowsher (UK CARES, United Kingdom)
Members:	Bastien (Univ. Laval, Canada), Breedijk (Netherlands), Chabert (LCPC, France), Creton (BN Acier, France), Elices (Univ. Politecnica de Madrid, Spain), Ganz (VSL International, Switzerland), Guitonneau (France), Hagberg (Standard Norge, Norway), Hollebecq (AFCAB, France), Kenel (Hochschule Rapperswil, Switzerland), Krauser (General Technologies, Inc., USA), Lu Guanglu (Tongji Univ., China), Madatjan (NIIZhB, Russia), McCabe (Univ. of Kansas, USA), Nürnberger (Univ. Stuttgart, Germany), Piron (Ministère Wallon de l'équipement et des Transports, Belgium), Pompeu Santos (LNEC, Portugal), Theryo (Parsons Brinckerhoff America, Inc., USA), Turner (Turner Consulting, Australia), Windisch (Germany)
Recent Meetings	Quebec (June 2004), Madrid (May 08)
Recent Bulletins:	***fib*** Bulletin 49: ***Corrosion protection of reinforcing steels*** (Technical report, published 2009)

Terms of reference:

The Task Group will consider all aspects related to reinforcing steels and systems from design to manufacturing, testing and final installation, use and maintenance. It will initially address several topics considered high priority. The Task Group will create sub-groups to work on particular subjects.

Areas of interest:

- review of the reinforcing steel grades available on the market (strength, ductility, bond, fatigue, durability properties) and relevant concrete structure design codes;
- manual for reinforcing materials and systems;
- technical report on fabrication of reinforcement;
- state of the knowledge on the bond properties of reinforcing steels;
- state of the knowledge on the fatigue resistance properties of reinforcing steels.

Task Group

TG 9.9 Manual for prestressing materials and systems

Conveners:	Bastien (Univ. Laval, Canada), Chabert (LCPC, France)
Members:	Boitel (Freyssinet, France), Bringer (Freyssinet, France), Neff (Post Tensioning Institute, USA), Poston (Whitlock Dalrymple Poston & Assoc., USA), Ramirez (Mekano4, Spain), West (Univ. of Waterloo, Canada), Windisch (Dywidag-Systems Intl., Germany)
Recent Meetings:	Berlin (June 02), Paris (Feb. 03), Stockholm (June 03), Quebec (June 04)

Terms of reference

The Task Group undertook to prepare a compact manual for prestressing materials and systems. It may contain, but is not limited to, items as specifications, recommendations for prestressing tendons for post-tensioning, analysis and design of post-tensioned structures, and possibly helpful suggestions to overcome specific problems in installation and use. The document should not be, however, a text book on basic principles and theory of prestressed concrete. Where appropriate, the user will be referred to available text books. Because of the rapidly changing technology it might become necessary to review and up-date that manual from time to time (every 4 to 8 years).

Task Group

TG 9.11 Testing the bond capacity of tendon anchorages

Convener:	Galvez Ruiz (Univ. Politecnica de Madrid, Spain)
Members:	Bruggeling (The Netherlands), Hagberg (Standard Norge, Norway), Siccardi (ETH Zürich, Switzerland), and others, to be invited
Corr. Members:	Fernández Gómez (Laboratorio Central INTEMAC, Spain), del Pozo Vindel (PROES Ingenieros Consultores S.A., Spain), and others, to be invited

Terms of reference

Test methods are needed for the exact determination of the transmission of prestress into a concrete structure. This concerns not only the transmission length but also the development of bond stresses along this length. The safety against slipping upon release also needs consideration. Test methods should give significant information regarding pretensioned tendons, damaged post-tensioned cables and ground anchors. Non-ordinary concretes as self-compacting concrete, fibre reinforced concrete and light weight concrete need to be taken into account.

Working programme

Practical applications based on scientific solutions need to be developed by the group. Members from industry, end users, consulting offices and research need to be incorporated.

As a short-term goal, a state-of-art report needs to be elaborated reviewing the existing problems of the industry and the solutions found so far, and detecting gaps in the present knowledge and in standardisation. The review should be made as large as possible, in any case incorporating all countries in ***fib***.

In a medium-term range, investigations need to be encouraged and assessed, on the most important parameters involved (for ex. concrete properties, geometry of tendons and wires, influence of substances like oxides or phosphates, interfering on the bond between steel and concrete. In a long-term range it is envisaged to propose simple and inexpensive standard test methods to replace the current RILEM standard test RPC 6 (RPC 14) for the determination of the tendon transmission length and bond properties of prestressing tendons.

Task Group

TG 9.12 Ground anchors

Convener:	Niki (Sumitomo Electric Industries Ltd, Japan)
Secretary:	Kido (Sumitomo (SEI) Steel Wire Corp., Japan)
Members:	Barley (Single Bore Multiple Anchor Ltd., UK), Boitel (Freyssinet International, France), Bruce (Geosystems, L.P., USA), Cavill (VSL, Australia), Chabert (LCPC, France), Ericson (Sweco VBB AB, Sweden), Forster (RTA, Australia), Neff (PTI, USA), Prevedini (Tensacciai S.P.A., Italy), Ripoll Garcia-Mansilla (Ripoll Consulting, Spain), Schmidt (Dywidag Systems International, Germany), von Matt (Dr. Vollenweider AG, Switzerland), Yamada (Nittoc Construction Co., Ltd., Japan)
Recent Meetings	London (Nov. 07)

Terms of reference

Up-dating former FIP publications (such as the 1982 recommendation "*Recommendations for the design and construction of prestressed concrete ground anchors*", the 1986 state-of-art-report "*Corrosion and corrosion protection of prestressed ground anchorages*", the 1996 recommendation "*Design and construction of prestressed ground anchorages*"), the group will aim to issue and maintain guidelines on prestressed ground anchors, that can support any country in issuing or re-issuing their own standards, recommendations, or guidelines.

Working programme

To elaborate guidelines starting from past experience, applications and approval systems, and dealing with relevant issues as system acceptance, corrosion protection, design, execution, testing, monitoring, maintenance and assessment of existing anchors. To cover this broad range it is intended to invite also geotechnical professionals to join the group. Publication of the ***fib*** Recommendations is scheduled prior to the ***fib*** Congress 2010.

Task Group

TG 9.13 External tendons for bridges

Convener:	Theryo (Parsons Brinckerhoff America, Inc., USA)
Secretary:	Weiher (Techniche Univ. Munchen, Germany)
Members:	Boitel (Freyssinet, France), Chabert (LCPC, France), Chandoga (Projstar PK, Slovakia), Della Vedova (Itaferr, Italy), Kasuga (Sumitomo Mitsui Construction Co. Ltd, Japan), Kuilboer (Bouwdienst Rijkswaterstaat, The Netherlands), Matt (Consulting Engineer, Switzerland), Niki (Sumitomo (SEI) Steel Wire Corp., Japan), Piekarski (BBR Polska, Poland), Ramirez (MeKano4, Spain), Schokker (Univ. of Minnesota, USA), Sruma (Czech Concrete Society, Czech Republic), Windisch (Germany), Xu (Tongji Univ., China), Zhu (OVM, China)
Corr. Members:	Bastien (Univ. Laval, Canada), Hsuan (Drexel Univ., USA)
Recent Meetings	Shizuoka (May 07), Madrid (May 08)

Terms of reference

As a result of durability issues with bonded internal tendons, external tendons in bridge construction become more popular in several countries. External tendons are now widely used throughout the world. While many of the technological aspects of external tendons look similar to internal bonded tendons, there are significant differences between the two, e.g. in term of corrosion protection, design approach, tendon deviation blocks, tendon curvature and lay out, tendon replaceability, tendon force transfer to the structure, etc. These differences merit the amendment of existing specifications, or the preparation of new specifications for external tendon design, testing, installation, duct durability, corrosion protection, maintenance and eventual replacement.

Working programme

The Task Group intends to prepare a report to cover these aspects specific to external tendons. The Task Group will learn and exchange practical experiences, design, specifications, problems and research reports from all over the world. The initial focus of this Task Group is on external tendons in bridges. However, other applications such as external tendons in buildings may be added at a later stage.

Task Group

TG 9.14 Extradosed tendons

Convener:	Mutsuyoshi (Saitama Univ. Japan)
Secretary:	Brand (DSI, Germany)
Members:	Almeida (Sao Paulo Univ., Brazil), Annan (VSL, Switzerland), Bastien (Univ. Laval, Canada), Brand (DSI, Germany), Chabert (LCPC, France), Chandoga (Projstar PK, Slovakia), Curran (Gifford, UK), Gläser (Techn. Univ. Munchen, Germany), Kasuga (Sumitomo Mitsui Construction Co. Ltd., Japan), Mizoguchi (Neturen Co. Ltd., Japan), Neff (Post Tesioning Institute, USA), Niki (Sumitomo Steel Wire Corp., Japan), Piekarski (BBR Polska, Pliamd), Poston (Whitlock Dalrymple Poston & Assoc., USA), Ramirez (Mekano4, Spain), Schlack (Deutches Institut für Bautechnik, Germany),

	Shirahama (Shinko Wire Company Ltd., Japan), Theryo (Parsons Brinckerhoff Quade & Douglas, Inc., USA), Weiher (Techn. Univ. Munchen, Germany)
Corr. Members:	Goodyear (T.Y. Lin International, USA), Windisch (Germany)
Recent Meetings:	Madrid (May 08)

Terms of reference

An extradosed prestressing concept is a new type of structural system in which the tendons are installed outside and above the main girder and deviated by short towers located at supports. This type of bridge is placed between cable-stayed bridges and ordinary girder bridges with internal or external tendons. Extradosed PC bridges have several positive characteristics. The girder height may be smaller than that of ordinary girder bridges, thus reducing self-weight of structures. Because of a lower main tower in extradosed bridges, vertical loads are partly resisted by main girders and stress variations in stay cables produced by living loads are smaller than those in cable-stayed bridges. It has been recommended that the safety factor for the stayed cables in extradosed bridges under design loads shall be taken as 1.67 (0.6 fpu : fpu = tensile strength of tendons), which is same as that for tendons in ordinary girder bridges. For cable-stayed bridges, this value is specified to be 2.5 (0.4 fpu). However, the recent design idea shows that there is no clear difference between extradosed bridges and cable-stayed bridges.

Working programme

The Task group will survey the present situation of design and construction for extradosed bridges including cable-stayed bridges. The work will be done in conjunction with Commission 1 (Structures).

Task Group

TG 9.15 Behaviour under cryogenic conditions

Conveners:	Poser (BBR, Switzerland), Gutsch (TU Braunschweig, Germany)
Members:	Caballero (BBR, Switzerland), Chabert (Consultant, France), Elices (Univ. Politecnica de Madrid, Spain), Gnägni (VSL, Switzerland), Kaminsiki (Freyssinet, France), Krauser (GTI, USA), Niki (Sumitomo Electric Industries Ltd., Japan), Traute (DSI, Germany)
Recent Meetings:	