Commission 3

Environmental aspects of design and construction

Chair:	Sakai (Kagawa Univ., Japan)
Deputy-Chair:	Hájek (Czech Technical Univ. in Prague, Czech Republic)
Secretary:	Noguchi (The Univ. of Tokyo, Japan)
Members:	Ajdukiewicz (Silesian Technical Univ., Poland), Desmyter (BBRI, Belgium), Glavind (Danish Technological Institute, Denmark), Hisada (Tohoku Univ., Japan), Jäger (Peter Jäger & Partner Bauingenieure AG, Switzerland), Kawai (Hiroshima Univ., Japan), Kjepso (Olav Olsen a.s., Norway), Mizuguchi (Univ. of Tokushima, Japan), Öberg (NCC, Sweden), Stepánek (Brno Univ. of Technology, Czech Republic), Tamura (Metropolitan Univ., Japan), van Breugel (Delft Univ. of Technology, The Netherlands)
Corr. Members:	Bleiziffer (The Univ. of Zagreb, Croatia), Buhr Jensen (COWI, Denmark), Piscaer (Univerde, The Netherlands), Poon (Polytechnic Univ., Hong Kong), Schiessl (Techn. Univ. of Munich, Germany)
Recent Meetings:	Delft (Mar. 03), Brussels (Oct. 03), Avignon (Apr. 04), Oslo (Oct. 04), Cairo (Apr. 05), Kassel (Oct. 05), Naples (June 06), Cavtat (May 07), Amsterdam (May 08), London (May 09)
Recent Bulletins:	***fib*** Bulletin 21: ***Environmental issues in prefabrication*** (State-of-art report prepared by former TG3.1, published 2003) ***fib*** Bulletin 23: ***Environmental effects of concrete*** (State-of-art report prepared by former TG3.4, published 2003) ***fib*** Bulletin 28: ***Environmental design*** (State-of-art report prepared by former TG3.3, published 2004) ***fib*** Bulletin 47: ***Environmental design of concrete structures - general principles*** (Technical report prepared by former TG3.6, published 2008)

Terms of reference

Scope

The main aim of the Commission is to deal with the interaction between the environment and concrete structures. The main areas are:

- sustainable development;
- impact of concrete structures on the environment;
- best available technologies for sustainable design and construction of concrete structures;
- capability of concrete structures to protect the environment from hazards.

Areas of interest

Background

The design and execution of the whole building activity should be reoriented on the basis of the following fundamental rules:

- The rate of depletion of renewable resources shall not exceed the rate of their regeneration.
- Non-renewable resources shall only be used to the extent that an equivalent replacement is made available.
- The release of substances to the environment shall be dictated by the capacity of the environmental media, and all functions shall be taken into consideration when assessing the load limits.
- The longevity of structures shall be long and wastes shall be reused or recycled so as not to affect the environment.

The task of the Commission is to develop guidelines and methods for the practical application of the above concept and rules in the field of building in general and concrete structures in particular. In addition to the above rules, the aesthetics as well as social and cultural aspects of structures shall be considered.

In addition to structural design, environmental design also needs to be an integral part of the overall design process. For environmental design, the input and output of natural resources and wastes shall be taken into account, as well as the impact of the building process and the building itself on the environment, during the whole service life.

Specific areas

- development of new conceptual thinking in which the decision is not only governed by economical and social interests but is also taking account of ecological costs based on life cycle design;
- establishment of:
  - operative rules for life cycle design (guiding the design with respect to sustainability) and
  - quantitative rules to control nature consumption i. e. life cycle analysis (LCA) (to measure the environmental impact and compare the impact sensitivity of different designs;
- development of methods and data bases for the quantification of ecological aspects (environmental impact, costs);
- development of data bases for best available technologies to reduce the environmental impact by consideration of regional and local conditions;
- pre-normative studies for the proposal of international directives and standards concerning sustainable development and life cycle analysis in building construction;
- dissemination.

Specific topics

A Sustainable construction:
- environmental design: development of operative and quantifying design guidelines based on flexibility and adaptability for housing, office and commercial buildings, bridges, etc.;
- life cycle analysis (LCA): use of waste and recycled material (benefits, risks and limits), ecological assessment methods;
- demountable structures, recycling concepts in concrete construction, strengthening, demolition, recycling;
- best available technologies (BAT): green concrete technologies to reduce the environmental impact of building activities throughout their whole life-cycle;
- case studies of environmental design in harmonization with structural design and durability design.

B Environmental compatibility of concrete structures:
- emission of hazardous substances from concrete structures (leaching, radiation, gaseous emissions); modelling of release rates and of the diffusion around the structure;
- assessment of environmental consequences.

C Protective structures:
- the potential of concrete and concrete structures to protect man and environment;
- specific protective structures.

D Energy conservation in building construction:
- methods for evaluation of conservation measures and determination of limiting values.

Working programme

see Task Groups 3.5 to 3.9

Task Group

TG 3.5 Protective concrete structures

Convener: van Breugel (Delft Univ. of Technology, The Netherlands)

Members: Dancygier (Israel Institute of Technology, Israel), Hauser (DUCON GmbH, Germany), Jäger (Peter Jäger & Partner Bauingenieure AG, Switzerland), Kiefer (Schöck Bauteile GmbH, Germany), Reymendt (Technical Highschool Frankfurt, Germany), Schlüter

(IIBW, Karlsruhe, Germany), Weerheijm (TNO, The Netherlands)

Corr. Members: Buhr Jensen (COWI, Denmark), Ronde (ARCADIS Bouw/infra, The Netherlands),

Recent Meetings: Brussels (Oct. 03), Karlsruhe (Apr. 04), Karlsruhe (Mar. 05), Kassel (Oct. 05), Karlsruhe (Feb. 07)

Terms of reference

The scope of the activities of the task group is to document the ability of concrete structures to protect people and environment against hazards. The activities started already in the former FIP Commission 8. It is intended to continue the work published in ***fib*** Bulletin 5 *Protective systems against hazards* by modeling extreme hazardous loads and the structural response (Working title: "Hazard actions and guidance for structural design solutions"), and by later publishing examples of protective structures used in industrial plants.

Future activities may include the application of the above to specific protective structures in areas such as avalanche protection, breakwater protection, nuclear power plants, electromagnetic and radiation protection, tunnel fires. As a first step in these fields, state-of-the-art reports need to be drafted.

Task Group TG 3.7 Integrated life cycle assessment of concrete structures

Convener: Hájek (Czech Technical Univ. in Prague, Czech Republic)

Members: Ajdukiewicz (Silesian Technical Univ., Poland), Broukalova (Czech Technical Univ. in Prague, Czech Republic), Buhr Jensen (COWI, Denmark), Desmyter (BBRI, Belgium), Fiala (Czech Technical Univ. in Prague, Czech Republic), Nielsen (Danish Technological Institute, Denmark), Nitivattananon (Aisian Institute of Technology, Thailand), Noguchi (The Univ. of Tokyo, Japan), Öberg (NCC, Sweden), Stepánek (Brno Univ. of Technology, Czech Republic)

Corr. Members: Hisada (Tohoku University, Japan), Sirivivatnanon (CSIRO, Australia)

Recent Meetings: since 2003 together with Commission 3, also Prague (Oct. 06), Bangkok (Dec. 07), Copenhagen (Oct. 08)

Terms of reference

The scope of the activities of the task group is to define the methodology for integrated life-cycle assessment of concrete structures covering main essential aspects of sustainability such as: environmental aspects, economic aspects, reliability, safety, durability, maintainability and repairability throughout the whole life of the concrete structure. The general aim is to set up basic specifications, boundary conditions and data needed for development of design tools focused on high performance and environmental quality assurance within the whole life cycle of concrete structure.

The target conceptual model for integrated life-cycle design will be based on LCA principles (according to ISO 14000 and CEN/TC350 prEN 15804). The model will include LCC principles as well as a LCO (Life-Cycle-Optimisation) approach.

The topics to be treated are for example:

- framework of integrated life cycle assessment of concrete structures;
- specifics of concrete structures related to integrated life cycle assessment;
- specification of life-cycle performance strategies of concrete structures;
- environmental impact evaluation of concrete structures;
- environment based optimization of concrete elements and structures;
- life-cycle cost of concrete structure including cost for maintenance and repair;
- integrated life-cycle optimization of concrete structure.

The objective is to optimize concrete design in order to reduce negative environmental impacts of concrete structures, while considering technical, economical as well as other sustainability aspects throughout the whole expected life.

Task Group
TG 3.8 Green concrete technologies for life-cycle design of concrete structures

Convener:	Glavind (Danish Technological Institute, Denmark)
Secretary:	Nielsen (Danish Technological Institute, Denmark)
Members:	de Spot (EcoSmart Concrete Project, Canada), Kawai (Hiroshima University, Japan), Müller (VDZ, Germany), Noguchi (The Univ. of Tokyo, Japan), Öberg (NCC, Sweden), Sakai (Kagawa Univ., Japan), Small (CELSA, Spain)
Corr. Members:	Bleiziffer (The Univ. of Zagreb), Buhr-Jensen (COWI, Denmark), Desmyter (BBRI, Belgium), Piscaer (Univerde, The Netherlands)
Recent Meetings:	Copenhagen (Nov. 06), Cavtat (May 07), Lillehammer (Sept. 07), Amsterdam (May 08)

Terms of reference

The scope of the task group's activities is to prepare a practice-oriented guideline on Best Available Technologies (BAT) to reduce the environmental impact of concrete structures throughout their full life-cycle. The term 'green concrete' was invented in connection with a large Danish R&D project in 1998 – 2002 and the experiences from these activities will be included. Due consideration will be given to constituent materials, concrete production, structural design, execution and operation and maintenance. Furthermore, aspects of demolition and recycling will be included.

There have been similar activities going on in various national and international groups and networks over the last decade. For example, ***fib*** Bulletin 28 presents the state-of-the-art on the subject. More recently, a Nordic project on CO_2 uptake of concrete during its full life-cycle has been finished. Likewise, the European network ECOserve has just ended its activities with and overview of best available technologies for the construction industry. Therefore, it is expected that TG 3.8 can combine the findings of these previous efforts into a catalogue of practical applications and case-studies from different countries. Task Group members from all over the world have been invited who are closely linked with these previous activities.

It is a fact that concrete is considered as an almost identical building material worldwide, but when it comes to assessing its environmental impact, the methods differ significantly. Due to the local conditions in the place of use, these differences may originate from:

- material availability and price for cementitious materials, admixtures and aggregates;
- competition between various structural materials (timber, steel, concrete, natural stone, etc.);
- type of industrial residual material available (various types of ashes and slags);
- type of energy resources (nuclear, hydro, coal, mineral oil, gas, etc.);
- need for recycling due to dense population or scarce natural resources;
- building traditions and legislation (green codes, labelling schemes, precast vs. ready-mix, taxes on landfill and sewage, etc.).

Therefore, it is beneficial for the concrete producers, structural designers and specifiers if green concrete technologies are well described and understood. The best way of getting the message of green concrete across is to describe it in simple terms and to illustrate it by means of basic examples and case-studies, taking the full life-cycle into account and following principles to be developed within Task Group 3.9.

The guidelines are expected to be a source of inspiration to specifiers and code writers when in future implementing a system of environmental performance standards for constructions. The Task Group includes members of both, CEN and ISO, work groups on such standards.

Task Group

TG 3.9 Application of environmental design to concrete structures

Convener:	Kawai (Hiroshima University, Japan)
Members:	Boulfiza (Univ. of Saskatchewan, Canada), de Spot (EcoSmart Concrete Project, Canada), Glavind (DTI, Denmark), Hájek (Czech Techn. Univ. Prague, Czech Rep.), Nitivattananon (Aisian Institute of Technology, Thailand), Sakai (Kagawa Univ., Japan), Sugiyama (Hokkaido Univ., Japan), Sukontasukkul (King Mongkut Institute of Technology, Thailand), Tamura (Tokyo Metropolitan Univ., Japan), Teichmann (Univ. Kassel, Germany)
Corr. Members:	Bleiziffer (The Univ. of Zagreb), Desmyter (BBRI, Belgium)
Recent Meetings:	Copenhagen (Nov. 06), Cavtat (May 07), Bangkok (Dec. 07), Amsterdam (May 08)

Terms of reference

The scope of the Task Group's activities is to show application procedures of environmental design to concrete structures in order to promote sustainable construction. The guideline for environmental design, currently under development in Task Group 3.6, will cover the life cycle of concrete structures including manufacturing of materials, transportation, execution, maintenance, demolition, disposal and recycling. In an actual concrete structure, however, the requirements for structural and durability performance in addition to environmental performance must be satisfied in a well-balanced manner. Since the quantitative evaluation method of environmental aspects in the design and construction of concrete structures is still under development, a manual-like document is required to foster the incorporation of environmental aspects into the design and construction of concrete structures. Based on the document, various case studies will be conducted.

In the *Guidelines for environmental design of concrete structures* prepared by Task Group 3.6, the environmental design is conducted with the performance-based design method. Performance parameters associated with environmental aspects are verified and inspected in the planning stage and implementation stage. The verification and inspection, however, should be essentially carried out in terms of structural and durability aspects together with environmental aspects. In cases where criteria for low environmental impact conflict with performance or durability requirements, methodologies of optimisation will be investigated. From these viewpoints, the methodologies of environmental design within the whole design of concrete structures need also to be examined.

When environmental aspects are considered in concrete structures, there are various technologies for reducing the environmental impact. These will be dealt with in Task Group 3.8 from a practical viewpoint, whereas Task Group 3.9 endeavours to establish general methodologies for evaluating environmental impact more theoretically. Therefore, both Task Groups will closely collaborate.

The output of the task group's activities will give practical guidance for the environmental design of concrete structures by showing examples including the following:

- the concept of environmental design in the whole design process;
- the general methodologies to harmonize structural, durability and environmental performance of concrete structures;
- the procedure of environmental impact evaluation of concrete structures, including the necessary data collection and inventory analysis;
- case studies of environmental design of concrete structures.

Regarding the procedures of integrated evaluation of environmental impact and inventory analysis, examples will be given, together with the general concepts.

Task Group

TG 3.10 Recycling of demolished structures

Convener:	Noguchi (Univ. of Tokyo, Japan)
Members:	Members to be invited.
Recent Meetings:	

Terms of reference

The Task Group will investigate the following:

- current state/future prospects of the country-by-country output/recycling ratio of demolished concrete lumps,
- current state of recycling technology and the uses and laws/standards for recycled concrete lumps,
- quality/performance of concrete and concrete structures made of recycled aggregate, and
- environmental loads caused by recycling of demolished concrete lumps.