

TG 22 - Environmental Design Methods in Materials and Structural Engineering

TG22 has completed its work and has held its wrap-up meeting. Its Coordinator Prof. Asko Sarja sums up the position and suggests what the next stage might be.

Final Meeting

What was the final meeting of TG22 took place in Espoo, Finland on 24th May 2000. Right at the top of the Agenda was to discuss the third draft of the final report and the possible creation of a new TG. Beside these subjects, the connection of TG22 to the CIB Compendium Project on Performance Based Building Standards was discussed following an introduction by Dr. Foliente, the Coordinator of the Compendium Project.

For Life Cycle Design (LCD) the entire design process must be renewed, thus integrating the different aspects together. Traditional economy is expanded into life cycle monetary and environmental economy (ecology). Controlled technical performance and serviceability over the design service life are guaranteed by mechanical (static, dynamic and fatigue) design, service life planning and optimisation, durability design, optimal energy economy and hygrothermal design; all of them being based on the life cycle performance principle. Health is protected by methods of building physics, including hygrothermal, chemical and biological aspects. Design for recycling is a special area. The selection of final solutions from alternative structural systems, materials and products can be made by applying the methods of multiple-attributes optimisation and decision-making and related methods. For this task we need to include multiple calculation methods in which life cycle principles are added to all viewpoints. All these subjects are incorporated in the TG22 Report.

TG22 Draft Report

The draft report of TG22: "Guide for Integrated Life Cycle Design of Materials and Structures" was discussed, and the requirements for completion were identified. The report is divided into Parts A and B. Part A features a comprehensive description of the Framework, Process and Methods of Integrated Life Cycle Design (LCD). Part B includes specific descriptions of design for recycling, integrated life cycle design of materials, and systematising the procedures of environmental structural design. It was agreed that the authors: Prof. Asko Sarja, Mr. Julian Kümmel, Mr. Christoph Müller, and Dr. Toshio Fukushima will once more review their texts for the final manuscript, and send the checked parts to Asko Sarja before mid July, who will do the editing work after that. The aim is to send the manuscript to the publisher in September for printing. It is anticipated that the printed report will be available in the Spring of 2001.

Plans for new TG

It was stated that the RILEM/CIB/ISO Symposium: Integrated Life Cycle Design of Materials and Structures, ILCDES 2000, May 22 - 24, which was created by TG22, was very successful and was pointing the way towards Life Cycle Design (LCD).

A Report on ILCDES 2000 follows this Article.

Alongside a general increase in interest in performance based principles in building and civil engineering this success supports the earlier plans to continue the work of TG22 with a new subject TG, having a preliminary title: Performance Based Design of Structures. The objectives of the new TG could be to concretise selected design methods into a prestandard level, applying mathematical methodology and

methods, and to plan and organise a Second ILCDES Symposium 2003. This work would continue the tradition of structural design, where the scientific methods of mathematics and physics have effectively been applied.

It was agreed that Asko Sarja, will commence an investigation into the possibility of a joint CIB/RILEM/IABSE Working Group on Performance Based Design of Structures.

All individuals who are interested in joining and planning this future work on Performance Based Design of Structures are asked to contact Asko Sarja without delay.

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RILEM/CIB/ISO International Symposium on Integrated Life-Cycle Design of Materials and Structures (ILCDES 2000)

Prof. Asko Sarja looks back at ILCDES 2000.

Background

Reference was made in the foregoing report to ILCDES 2000.

In fact the initiative for this Symposium came from CIB TG22 (also RILEM TC 172 EDM), chaired by Professor Dr. Tech Asko Sarja. Subsequently contacts were established with ISO TC 98 - Basis for Design of Structures and to ISO TC 59/SC14 - Buildings - Service Life Planning. Co-sponsorship was forthcoming from IABSE - International Association for Bridge and Structural Engineering and ECCE - European Council of Civil Engineers. The international Scientific Committee was made up of scientists and practitioners in related fields of research and practice from all over the world. We are indeed highly appreciative for all this important co-operation.

The basic idea underlying the Symposium was that design of materials and structures is a key factor in the development towards a sustainable building and civil engineering practice. It was claimed that a high life cycle quality - including functionality, technical performance, economy, ecology, safety, health and comfort - can be achieved only through integrated life cycle design. The term "integrated" means the introduction of all requirements into design. The term "life cycle" means the introduction of a time span over generations into all calculations, evaluations and decisions.

Participation and Technical Programme

The total number of registered participants was 163 originating from 29 countries. In total 102 reports had been selected from 147 submitted abstracts for presentation at the Symposium. 60 of them were in the form of oral reports of 20 minutes duration and 42 in short 5 to 10 minute oral introductions in combination with posters during specific poster sessions. Both the oral and poster reports are printed each in 5 pages in the ILCDES 2000 Symposium Report which is published as RILEM Proceedings PRO

14 by RILEM Publications, 549 p. (ISBN 951-758-408-3, ISSN 0356-9403). The report can be ordered either from the RILEM Publishers or from the Local Organiser (address is below).

The following keynote papers were presented:

- Prof. Dr Christer Sjöström, Sweden, Past President of CIB: Challenges of Sustainable Construction in the 21st Century
- Prof. Dr. Asko Sarja, Finland, Chair of RILEM TC 172 EDM / CIB TG 22: Integrated Life-Cycle Design as a Key Tool for Sustainable Construction - RILEM TC 172/CIB TG22 Approach
- Dr. Hywell Davies, United Kingdom, Member ISO TC 59 / SC 14: Service Life Planning: ISO and DuraCrete Approaches
- Prof. Dr. Andrzej Brandt, Poland, Chairman of ISO TC 98: Bases for Design of Structures: Bases for Design of Structures; ISO Technical Committee 98

Two other Plenary Sessions were: Framework and Process of Integrated Life Cycle Design and Concluding Plenary Session.

In between the Plenary Sessions the Symposium was structured in two Parallel Sessions:

1. DESIGN with the Themes:

- Procedures, Methods and Guides of Life-Cycle Design
- Life-Cycle Accounting, Optimisation and Decision-Making
- Design for Recycling and Reuse
- Computer Applications and Software Tools for Life-Cycle Design
- Examples of Life-Cycle Design

2. MODELLING AND ANALYSIS with the Themes:

- Life-Cycle Assessment
- Durability Design and Prediction Models for Life-Cycle Performance
- Examples of Life-Cycle Design

Concluding remarks were presented in two reports:

- Dr. Carl-August Günther: Ecological Viewpoints of Life Cycle Building and Civil Engineering
- Prof. Dr. Asko Sarja: Integrated Life Cycle Design: Current State and Future Needs for Development

Conclusions

In drawing conclusions and in the final discussion, the following statements were made:

- ILCDES 2000 Symposium has demonstrated a fairly good state of current research results.
- Many research works are on similar lines and are compatible.
- Research is perhaps too dominantly analysis and assessment oriented.
- Need for more design process and methods-orientation to fill the gaps but avoiding overlapping with earlier works!
- Generic models are required, followed by local applications
- The minimising of material and water consumption as well as the minimising of pollution into air, water and of construction waste going to landfills should become a top priority of architects, construction engineers and industries and environmental legislation, to the advantage of our nature.
- Clients should be willing to pay for Life Cycle Design (LCD); they will derive profit from it!
- In some areas international standardisation is going on (e.g. in ISO and EN).
- Life Cycle Maintenance Planning is closely connected to Life Cycle Design (LCD).

- New design process and design method-oriented standardisation are needed.

At the end, the question arose: Do we want to have ILCDES 2003? In an instant Gallup Poll approximately 2/3 of participants expressed their support for the idea. It will be developed further by the ILCDES 2000 Organisers, and the outcome will be notified next year.

Short Summary of Integrated Life Cycle Design (LCD)

Structural and materials engineering is a profession, in which the scientific methods of mathematics and physics have effectively been applied. In introducing the principles of life cycle engineering into structural and materials design the excellent tradition of scientific methods can be applied into praxis. For this task we need to include multiple calculation methods in which life cycle principles are added to all viewpoints. The traditional economy is expanded into a life cycle monetary economy and into an economy of nature (ecology). Controlled technical performance, safety and serviceability over the design service life are guaranteed by mechanical (static, dynamic and fatigue) design, service life planning and optimisation, durability design, optimal energy economy, acoustic and hygrothermal design; all of them grounded on the principle of Asko Sarja life cycle performance. Health is protected by methods of building physics, including hygrothermal, chemical and biological aspects. Design for recycling and reuse is a special area. The selection of final solutions from alternative structural systems, materials and products can be made by applying the methods of multiple -attributes optimisation and decision-making and related methods. We have also to rethink the entire design process, thus integrating different aspects together. The methodology of integrated life cycle design can be used in the design of individual buildings or other structural facilities, as well as in the development of new materials and structures or structural systems.



Representatives of international organisations and local organisers
(from left to right):

Managing Director Mr. Yrjö Matikainen (RIL), Dr. Hywel Davies
(ISO), Prof.Dr. Asko Sarja, Symposium Chair (CIB and RILEM),
Prof.Dr. Andrzej Brandt (ISO) and Dr. Carl-August Günther
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