Editorial

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fib is an umbrella organisation for the concrete community worldwide. Among its ambitions is the development of new concepts and methodologies, and to get these implemented in the industry. The most efficient way of implementation is through international, regional and national standardisation. *fib*'s role in this context is at the level of pre-standardisation.

Among the achievements of *fib*, the Model Codes from 1978 and 1990 represent major contributions to the development of operational codes on structural design of concrete structures. The Model Code is presently under revision and will be extended with new aspects like construction, service life design and sustainability.

The integrated efforts in *fib* and the International Organization for Standardization (ISO) to sort out the 'traffic rules' for how to design sustainable concrete structures was described in the June editorial of this journal by Professor Koji Sakai¹ who is the driving force on this very important issue in both organisations.

Closely related to sustainability is service life.

I had the personal privilege to serve on *fib* Task Group 5-6 that prepared the 2006 *fib* Model Code for Service Life Design (Bulletin no 34 – *fib* MC SLD).² This document provides the methodology for treating deterioration of concrete structures according to the same principles of reliability and limit states as used for traditional structural design.

This summer ISO TC-98 published ISO 13823, *General Principles on the Design of Structures for Durability*.³ This document addresses all structural materials and basically repeats that service life should be designed according to the same methodology as given in ISO 2394, *General Principles on Reliability for Structures*.⁴ ISO 2394 is the 'mother document' for modern reliability and limit-state based standards like the European Eurocodes.

fib and ISO have therefore reached a common platform on this matter.

Today, in all operational standards, service life design of concrete structures is performed by primarily obeying some predefined criteria on concrete composition and cover to the reinforcement. These prequalified deemed-to-satisfy solutions are the result of (hopefully) successful in-field experience and the personal judgement of the experts in that particular code committee.

Why cannot such a design method be continued? Why do some academics try to impose sophisticated and complex procedures on the industry when the old way of handling this is generally accepted by most stakeholders?

The reason for my motivation for exploring, developing and implementing this new philosophy is based on two pillars.

In my home-country, Norway, like many other parts of the world, we have experienced shortage of Portland cement in the last few years. We therefore have to go for blended cements, and we have to import cements for which we have no domestic long-term field experience and for which it is not obvious that well-established relationships between w/c ratio and quality are still valid. This trend towards new blended cement compositions is further enhanced by society's demand for sustainability as described by Professor Sakai. Production of cement clinker is by far the single biggest contributor to greenhouse gases from our industry.

The second reason for my concern about the present regime is the observations I have made on how these deemed-to-satisfy criteria actually work in today's operational standards.

It is thought-provoking to notice that a well defined exposure regime like submerged reinforced concrete in sea water (Atlantic and Pacific rim) for the same cover ends up with requirements on w/c ratio ranging from 0.40 to 0.55.

For those of us training the next generation of our trade's workforce, we indeed have a pedagogical problem in giving a rational explanation for these peculiar differences. To demonstrate a humble attitude to this, I never claim that that the technical expertise of the

Norwegian code committee (which I chaired and which ended with 0.40) is that much better than our colleagues in another European marine superpower that prescribes a requirement of 0.55. The only explanation must be that the different code committees are considering different definitions of the end of service life (limit states) and that they consider different levels of reliability for failing to stand this period.

If code committees are not able to communicate with a common set of definitions, how can the industry then communicate this important performance in a transparent way to the building owner?

The international reactions to the principles given in *fib* MC SLD and later in ISO 13823 have been two-fold.

A great many of the academics in our community have indeed embraced this new method with enthusiasm. Unfortunately, this enthusiasm has sometimes filtered out some important sentences like 'uncertainties associated with models and test methods shall be considered' and 'uncertainty of models and parameters will normally influence the result of SLD to a greater degree when used for design of new structures than when assessing remaining service life of existing structures'. Since the full-probabilistic method in the *fib* document is by far the most complicated and sophisticated, many of the readers by reflex also have considered it as the most accurate. This was not the intent of the authors, and it is not based on the actual text in the document.

fib MC SLD clearly states that the other three methods to verify the design, in addition to the full-probabilistic method (partial-factor method, deemed-to-satisfy method and avoidance of deterioration) should also be calibrated and be reliability and limit state based.

Some reports have appeared around the world over the last few years giving examples on service life design according to *fib* MC SLD based on material properties derived from accelerated testing of young concrete. To extrapolate the structural performance after 50–100 years based on test results obtained after only a few months requires much more

accurate models than those available today. Some of these examples have therefore yielded results that are regarded as unrealistic by greater parts of our community. These sceptics therefore often tend to judge the whole approach as false, like a modern example of the story of the Emperor's new clothes. All use of tools like 'statistics' and 'modelling' are discredited by these critics.

To bridge the gap between the enthusiasts and the sceptics and to advance from the present deadlocked position, ISO TC-71 has appointed a group, SC-2/WG-4, to implement the principles of *fib* MC SLD into practical ISO documents for service life design of concrete structures. I have the demanding and privileged position of convening this group of experts.

My vision for this working group is that we will be able to reach international consensus on the definitions and the general parts of methodology given in *fib* MC SLD. Such a common language will definitely in itself foster a more concise dialogue between experts and make communication to the rest of the stakeholders more transparent. As an example, the present definition of 'service life' in ISO and other operational standards is neither qualitative nor quantitative.

The extension given by *fib*: definition of a relevant limit state, a number of years and a

level of reliability, will in itself be a major step forward. As already stated in the *fib* document, I foresee that the 'deemed-to-satisfy' and 'avoidance' methods will be by far the most used approaches for design of new structures in the future. However, the code committees have to calibrate these requirements.

As close to none of the cements on the market today have 50 or 100 years of records, the experts must base their decisions on extrapolation. In this exercise some type of modelling or reasoning is unavoidable. The full-probabilistic approach might then be very well suited to extrapolate long-term performance based on assessments of medium-term field-exposed structures. Then the influence of uncertainties in data and models will be reduced dramatically.

In this way the code committees might indicate to the users both what limit state and also the level of reliability for achieving this, they had in mind.

I also foresee that we will stress what is already embedded in *fib* MC SLD: that lack of representative data and model uncertainties will normally make the full-probabilistic method unsuited for design of new structures. This is fully in line with what is the case for structural design. ISO 2394, like the European Eurocode-0, describes the full-probabilistic method

for structural design. Actually, it is the reference for the partial-factor method used by all designers. The partial-factor method would be an absurdity without the qualitative description of the full-probabilistic method. Nevertheless, hardly any structural design has ever been carried out according to this method due to lack of representative data.

My ambition and vision is therefore to: foster the use of *fib* MC SLD as a reference document by code-writers world-wide, embed the definitions and methodology of the *fib* MC SLD in ISO documents under the auspices of ISO TC-71 'Concrete', and standardise some deterioration models and supporting test procedures, for which international consensus is achievable.

References

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