Editorial

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The December issue of *Construction Materials* provides six papers that have been taken from submissions presented to the CIB World Building Congress held in Lowry, Salford Quays, UK in May 2010. These submissions were offered to a special track organised by the CIB working commission W080 on Prediction of Service Life of Building Materials and Components. Hence the selected set of papers from this track focuses on issues related to the durability of construction materials and provides a broad range of topics that encompass durability design of and corrosion in concrete, utilisation of additives to concrete to enhance durability, degradation of wood cladding, and more generic studies on predicting the service life of construction materials and components.

The validation of a service-life-oriented design of reinforced concrete structures is the topic of the initial contribution by Bertolini *et al.* (2011a). The International Federation of Concrete (FIB) probabilistic approach has recently been proposed as a suitable model to describe the initiation and subsequent propagation of corrosion of reinforced concrete structures. The FIB design procedure was applied to 30-year-old industrial buildings (built in the 1970s) and the information derived from the model predictions was compared with actual conditions on the extent of corrosion of reinforcement in building components as obtained from a field inspection. A significant difference was observed between results obtained from the model and those that arose from field inspection. These results show that the application of the model underestimated the percentage of reinforcement no longer in a passive state by a factor of two. The authors suggest that the differences may be due to the reliability of inspection results, uncertainty in the model parameters or the values of parameters chosen when applying the model in respect to the carbonation resistance or the thickness of concrete cover. Given the level of uncertainty of results derived from the model, the authors rightly propose further studies to provide additional insight into the use of the model and the importance of the values of the different parameters in obtaining useful results.

The durability of concrete may be enhanced by the inclusion of different mineral additions that retain pozzolanic activity, as indicated in the paper by Bertolini *et al.* (2011b). It is well known that pozzolanic additions, used for partial replacement

of Portland cement, can improve the strength and durability of concrete structures. However, there has been increasing interest in the study of the behaviour of materials that potentially retain pozzolanic activity due to the higher resistance of concrete to chloride penetration offered when incorporating such materials in concrete. An experimental study is described in which the effects of different additions – such as silica fume, fly ash and ground glass, as well as natural pozzolans – to cement- and lime-based mortars are evaluated in respect to the performance characteristics of these mixes. Results show that pozzolanic additions, such as silica fume or coal fly ash, can significantly improve the resistance of mortars to chloride penetration and sulfate attack; this is not new information but helps substantiate previous work in this area. Natural pozzolanas were shown to have a lower reactivity as compared to silica fume or fly ash, but nonetheless increased the degree of impermeability of the mortar mixes. Interestingly, excellent pozzolanic behaviour was observed for finely ground glass.

The prediction of service life of concrete structures in service is the focus of the paper by Yang and Li (2011). In practice, concrete crack width is one of the most important criteria for the assessment of the serviceability of concrete structures. It is therefore desirable to have knowledge of the growth of the crack width over time so that better-informed decisions can be made concerning the repairs due to concrete cracking. A numerical method to predict corrosion-induced concrete cracking and crack width for corrosion-affected concrete structures is provided in this paper. A cohesive crack model for concrete is presented and direct tension tests on concrete were undertaken to determine accurate concrete properties. A comparison is made between numerical results and those derived analytically on the basis of worked examples and it is suggested that the numerical method can predict corrosion-induced concrete cracking and crack width with reasonable accuracy. It would now be useful for the results of this method to be compared to that of the probabilistic-based model for the corrosion of reinforced concrete structures as adopted by the FIB.

A general overview of the complexities that arise when predicting the service life of buildings and components is presented by Cole and Corrigan (2011). The generic problem of service life prediction, as posed by the authors, relates to how a

wide variety of differing information sources on service life such as historic data, survey information, modelling and expert opinion, can be used to generate information useful to estimating the life of components or structures. Various methods to estimate component life on the basis of different classifications of information are provided, together with examples of their application to estimating the life of roofs and roofing components, metal components in buildings and reinforced concrete. A detailed case study is also provided towards the application of a holistic process model for the life prediction of metal components. In such instances, the need for substantial and detailed information is perhaps a barrier to its implementation. It is evident from this paper that there is an on-going challenge to obtain the necessary level of useful and validated information required in estimating the service life of construction materials and components.

The utilisation of geopolymeric waste materials such as fly ash, silica fume and microwave-incinerated rice husk ash to replace Portland cement is the motivation for the work of Nuruddin *et al.* (2011). This research study was based on the complete replacement of ordinary Portland cement (OPC) in concrete with suitable additives and that could achieve 28-day cube strength in a range of 40–50 MPa. Compressive strength and flexural strength tests were conducted and scanning electron microscopy photomicrographs were taken to characterise the mechanical and microstructural changes in the concrete over time. Results indicated that the different geopolymeric-based concrete mixes that were tested achieved a compressive strength at 28 days equal to that of OPC concrete; as well, the flexural strength of geopolymeric concrete was comparable to that of OPC concrete.

Finally, in the paper presented by Gupta *et al.* (2011), the interest is on determining the degradation and expected service-life of wooden cladding materials. There is an apparent lack of data on the behaviour of wooden claddings when subjected to natural weathering conditions or indeed to an accelerated ageing environment and the means to characterise each of these effects. Accordingly, different types of wood were exposed to natural outdoor and accelerated laboratory conditions for selected periods of time. Following exposure, their surfaces were visually examined and analysed using infrared spectral analyses, for which the resulting Fourier transform infra-red spectra were useful for chemical characterisation of the wooden surfaces. One can determine those chemical groups that characterise the respective wood types and the effects of deterioration and ageing. In comparing the results obtained from outdoor and laboratory exposure it was

possible to estimate the durability of the respective wood specimens on the basis of surface concentration of cellulose and lignin. Larch was found to have better durability compared to the other specimens tested and chemical treatment for wood preservation was a good option to increase durability. Further studies will be performed to see how the variations in durability can be applied for determining the service life of wood species.

This selected set of papers represents about half of those presented during the 2010 CIB World Building Congress that focused on durability. Further information on this topic can be obtained from the many conferences and workshops that have been organised over the years by those participating in the activities of the CIB W080 (www.cibworld.nl/site/databases/). For example, such topics are the focal point for the Triennial International Conference on the Durability of Building Materials and Components, last held in Porto, Portugal in April 2011 (www.fe.up.pt/12dbmc) and scheduled to be held in Sao Paulo, Brazil in 2014.

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