

## Book review

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### Concrete: Neville's insights and issues

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*Thomas Telford, 2006, ISBN 0 7277 3468 7, £65, 314 pp.*

Many technical books are written in order to present information in such a way that the reader may understand and increase in knowledge. This style can be distant if not sterile. However, if information relates to real problems and some of these problems have enjoyed (if that is the right term) exposure in Courts of Law with winners and losers it has an edge and sharpness that is difficult to resist. This is such a book written by an eminent authority that makes compulsive and profound reading. It is surprising how the practical use of concrete results in problems giving yet another twist to understanding and successfully applying concrete. New ideas from established procedure provide sustenance for the receptive and open mind. This book stimulates and generates ideas—the application of understanding.

Neville admits to the book being valedictory in nature but in motive it is sharp and non-apologetic and we should take heed.

The book comprises some 314 pages including an appendix and index. Within these pages there are 273 references, 18 tables and 17 figures but what is special are the opinions and viewpoints that stem from Neville's publications over the period 2002–2006—some 22 in all. This averages over four a year—better than many aspiring and much younger engineers and scientists. Perhaps Neville's retirement is just notional—I do hope so. If I may misquote Lord Kitchener, “our concrete needs you”.

Each chapter, with the exception of the introduction, addresses issues that are encountered every day, including water : cement ratio, high alumina cement (HAC), durability and behaviour in service. The two final chapters cover general issues and an overview and are, despite the titles, focussed and particularised identifying how we can improve and the threats if we ignore the many points made. The chapters are a combination of text and discussion with response and conclusions

from the author. It is a conversational style that engages the reader and maintains attention.

Chapter two deals with the matter of water : cement ratio. The merit of keeping it low whilst maintaining workability is recognised but it is also acknowledged that most problems with concrete occur after it has hardened. Determining water : cement ratio in hardened concrete is still a problem and yet is often the cornerstone of complaints. Understanding the true role of water invokes micro-mechanisms and chemistry. The micro issues become macro and that is the regime of the engineer. Interfacing the two can be difficult.

Chapter three deals with HAC and reinstates the inappropriateness of using the material in structural situations. Renaming the material calcium aluminate cement has not changed the likely consequences associated with its use. Conversion always reduces strength and water is needed for conversion. Converted HAC is, according to Neville, liable to attack from alkalis that can be derived from ordinary Portland cement (OPC) and/or plaster that maybe adjacent to it. The once novel potential answer to conversion was BRECEM—a mixture of high alumina cement and granulated blastfurnace slag but was compromised by poor strength/time properties.

A search for a solution to the HAC problem may still be worthwhile and the combination of added calcium sulpho aluminate (ref. P. K. Mehta, USA patent 1966) may be a good starting point. Always work back from the problem and work forward from the understanding and bring the two together. Conversion not only reduces strength, it increases porosity along with greater access to the mass of material. On balance, be wary—the onus of proof of fitness is on the design engineer.

Chapter four covers durability issues and is the longest in the book (82 pages); it includes cracking, carbonation, sulphate attack and alkali–silica reaction. The situation concerning sulphate attack is described as

'topsy-turvy' or utterly confused. Sulphate may be present but that alone does not constitute attack. However, its presence has become associated with attack and the link between laboratory data and what happens in real structures in practical situations leaves something to be desired—good litigation territory this. After all, an army parading is not an attack, although there is potential for such. Neville is of the view that the problem of sulphate and its consequences has been exaggerated by litigations and publicity. If we are seeking absolute answers interfacing the science with the engineering can be difficult but unavoidable—this is a recurring thread throughout the book.

As with so many degradation processes the role of water is fundamental and yet remains elusive from a research point of view. Attention is drawn to the special case of magnesium sulphate forming magnesium silicate hydrate and gypsum. Determining the actual sulphate content can be a problem and can cause ambiguities in litigations since a universally accepted method of measuring sulphate is still to be devised. Until it is lawyers may have a field day. Researchers please note.

The text moves on from sulphate attack to alkali-silica reaction and its engineering consequences and possible control. Distinguishing between the effects of the cations (sodium and potassium) and anions (hydroxyl) is necessary. Understanding the chemistry and the physics is essential to underpinning the engineering. Time and again Neville emphasises the need for realistic data reflecting field/in-service conditions and such an emphasis cannot be denied but it should be underwritten and corroborated by sound science and not anecdotal simulation.

Chapter five deals with behaviour in service and whilst sustainability is on the agenda, it should be realistic and not idealistic. Considerable attention is given to stress-induced cracking rather than shrinkage. The nature of the interfacial zone (Duplex film) comprising calcium hydroxide and calcium silicate hydrate layers adjacent to the aggregate (0.5  $\mu\text{m}$  thick) is highlighted.

'Concrete should be only as durable as it needs to be,' says Neville—the 'horses for courses' approach. Performance specification should help this trend and that seems to be evolving via the newer standards and codes. My concern over this approach is it pre-supposes that concrete will be correctly placed, compacted and cured and that raises issues of site control, skills and audits. Should the contractor or ready-mixed supplier ensure conformance with a design code? Perish the thought!

The wider use of pulverised fuel ash is encouraged resulting in better performance-based derivatives. What was once a waste product that was given away freely from point of making has become a 'value-added' product that could justify a premium.

Chapter six is concerned with general issues and is a

mixture of readily recognisable situations that are not as complete as we imagine. The ultimate objective is to achieve a satisfactory structure and in some ways that is more attainable by way of precasting or off-site reflecting the latter's greater control. Perhaps this trend is inevitable as cements become multi-component materials, for instance ternary blends of silica fume, fly ash and OPC.

There is considerable support for self-compacting concrete that currently is not widely used in the UK, perhaps due to cost—value is a better measure.

Whilst cement is judged somewhat ironically to be the cause of most of the problems with concrete we cannot do without it, despite its production being allegedly responsible for 8% of the carbon dioxide produced by man. However, this pales into the background when one hears that 50% of all CO<sub>2</sub> is due to transportation and most developing countries are likely to aspire to parity on that aspect with what we currently enjoy. Is such a situation sustainable?

The realisation of good design resulting in a good structure requires good workmanship. Workmanship and competency are often equated, but the latter is what you should be able to achieve while the former is what you actually achieve on the site on the day. Should there be more training of operatives and recognition of such skills? I suspect there should. Time and again the author brings us back to practical realities highlighted by examples from various litigations.

The final chapter (seven) looks back over 40 years and concludes we have better concrete, stronger and chemically more durable. Innovatory changes to concrete have been and arguably always will be ahead of codified practice. In this modern and changing world a ubiquitous material such as concrete should relate back to unified terms understood and used by all. Is it therefore not strange that in the USA the non-use of SI units still prevails endorsed by the ACI (an international body of considerable influence)?

Admixtures have come of age although the UK would still appear to be behind other industrialised countries in their use if not their development. Telling comments are made about safe limits for sulphate, nitrate, aluminium, lead and zinc as well as workability and curing.

As to a prognosis, there will be an increase in ready mixed concrete use, pumped concrete and super-plasticiser use. I recall when super-plasticisers came into play it actually stimulated awareness of and greater use of normal plasticisers—a pull-through effect. There is also likely to be increased use of recycled concrete aggregate, but that will depend as much on the commitment to the logistics of provision as the materials themselves. We may well see their use in structural as well as non-structural situations. Life cycle design will influence choices. However, I suspect the claims in favour of concrete will have to take greater regard of its physical appearance over time. The technology to

maintain appearances is to hand but is there a will to use it? After all, it is what the public sees that registers—shape, form and appearance.

The book is, by the author's admission, valedictory and Neville quotes Hilaire Belloc,

'When I am dead, I hope it maybe said  
his sins were scarlet, but his books were read.'

May I be permitted to add two further lines,

'and as for concrete, in the round  
his comments and influence were profound'?

I salute this book and recommend its addition to the books used (not collected) by engineers, architects, researchers and concrete technologists.

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