Cite this article

Robery P (2019)

Book review.

Proceedings of the Institution of Civil Engineers – Forensic Engineering **172(2)**: 86,
<https://doi.org/10.1680/jfoen.19.00009>

Book Review

Paper 1900009

Received 02/08/2019; Accepted 05/08/2019

Published online 17/09/2019

ICE Publishing: All rights reserved

Book review

Design of Fire-resistant Concrete Structures

Kristian Dahl Hertz. ICE Publishing, London, UK, 2019, ISBN 978-0-7277-6444-7, £59.50, 264 pp.

As can be judged from the title, this book is principally intended for designers tasked with finding effective designs for concrete structures that are intended to resist predicted high temperatures in service. However, there is also a considerable amount of data on the properties of steel and concrete when exposed to heat that will assist the forensic engineer when trying to assess the extent, duration and severity of a fire following an incident.

While written by a Danish author, the book is highly relevant to UK design practice and provides a useful update to the 2011 guidance from the Concrete Centre on the fire performance design for concrete structures, updating it with the latest Eurocode recommendations. It will also be very useful for an international readership.

The book begins with a thorough treatment of the effects of fire on the short-term and long-term properties of concrete and embedded steel reinforcement, including bar and prestressing wire. Much of the source references on materials will be new to UK engineers, being taken from Professor Hertz's own research, as well as other Scandinavian, German and Russian sources – for example, this can be seen by comparing references in the aforementioned Concrete Centre publication.

In the first chapter, the author discusses the fundamental properties of the materials used in structural concrete and the changes in performance as they are heated. For the forensic engineer, a substantial amount of reference material is presented on the performance of different concrete mixes, with variables including compressive strength and aggregate type. A method is given to show how certain aggregates will affect the strength and elastic modulus of structural concrete more than others. The author considers the properties of concrete during a fire (the hot condition), as well as its residual properties after it has cooled down (the cold condition). Examples include the possible permanent change in the yield strength of

high-yield reinforcing bars above certain temperatures and the decomposition of hydrated cement phases. The text is supported by extensive graphics and photographs, drawing from published research across Europe.

The second chapter examines heat distribution and methods of modelling heat transfer into structural sections, comparing, for example, flat surfaces and square and round sections. The analysis examines temperature distributions with fire duration. This is followed by consideration of structural effects, including anchorage reduction of reinforcement from concrete splitting and reduction in bond strength. There is an excellent section about temperature profiles and resulting stress distributions as elements heat up and cool down again. Again, the treatment of the data will be very useful at the forensic engineering stage, allowing modelling of temperature effects in real structures.

The remaining two-thirds of the book is dedicated to design methods for combatting fire, including extensive worked examples, which are perhaps less relevant at the forensic engineering stage, but may provide opportunities to back-calculate from actual performance. The book finishes at Chapter 6, with a design guide based on required parameters, such as the duration, temperature and type of fire, including resistance to a fully developed fire scenario, and gives strength reduction parameters depending on the materials used in the design. The author also examines explosive spalling and tunnel design, including the effects of using high-strength concrete, and common mitigation measures, including use of polymer microfibres to reduce steam pressures in particular.

Overall, this book provides a valuable and detailed source of reference material for forensic engineers about the effects of heat from fires on concrete structures, presented in an accessible style. It enhances, rather than replaces, the current UK guidance on fire performance.

Peter Robery