Editorial

[**doi:** 10.1680/stco.2008.9.1.1]

Pietro G. Gambarova
Milan University of Technology, Italy

Fires in our time

Wild fires have been summer 2007's dramatic leitmotiv in many countries, from Peloponnesos in Southern Greece to Coronado Hills close to San Diego in southern California, USA, but other regions were affected as well, in southern Italy, France, Spain, the Balkans and Australia. Like in the past, or even more than in the past, some may argue! The various places were markedly different, with little and dispersed population in southern Greece and Italy, and with millions of recently-built homes packed on mountain slopes and in valleys in southern California, where the population has more than tripled in the past 60 years, with the highest concentration in the relatively narrow strip between the densely-populated coast, the mountains and the desert.

There are several reasons to explain such a scourge as wild fires: strong winds, droughts, heatwaves (all of them in some ways related to global warming), but – according to several scholars – the most critical fire trigger is represented by isolated homes, buildings and roadways surrounded by natural vegetation. In other terms, external fires – that often become internal fires – are favoured by today's development pattern, which brings in people, infrastructures and traffic in many areas that were wilderness only a few years ago. (More people also implies more arsonists, since one feeble-minded person – to say the least – cannot be ruled out among the thousands!)

New infrastructures, increasing traffic, industrial development and spreading housing mean also a higher probability for confined fires, like those inside a building or a tunnel. (Residential fires account for 26% of all fires, 80% of fire fatalities and 60% of financial losses in the USA, according to a recent study on 2004 fires[1]) The danger of severe fires is also multiplied by our energy-hungry society, that requires more oil rigs, off-shore platforms, refineries, chemical plants, pipelines, super tankers, heavy railways, and so on: all fire-sensitive systems!

The variety of these fire triggers explains the increasing interest for fire engineering, that is a three-pronged discipline based on: (a) fire design, (b) fire control and (c) post-fire assessment, all of them requiring detailed and up-to-date provisions in structural codes.

Dutifully, the Eurocodes[2] have taken to heart fire design (that is a part of fire engineering), and the treatment of concrete, steel and composite structures is now quite satisfactory, while masonry structures are still waiting for some code refinements.

The high level of fire-design provisions in the Eurocodes has convinced several countries – among them Italy, to cite one example – to extensively renovate their fire-design codes. However, there are at least two critical points that need to be considered: (a) the inertia of many designers, that are used to thinking fire design as a mere set of checks to be performed once the structure has been designed; and (b) the extreme variety of the structural materials, whose behaviour at high temperature is still open to investigation, in terms of hot/residual mechanical and thermal properties. This is the case of ordinary and high-/ultra high-performance cementitious composites, whose mechanical decay may vary between -30% and -80% ($T = 20–600^\circ C$), and whose mean thermal diffusivity may vary from one to three/four ($T = 200–600^\circ C$), as shown by the findings of the recently-completed European Project UPTUN.[3] Aggregate and cement type, water-binder ratio, pozzolanic and hydraulically active additives, fibre type and content not only control concrete mechanical and thermal behaviour, but affect also the sensitivity of some specific concretes to spalling, that is a tricky and dangerous phenomenon, still highly debated within the scientific community, and still a nightmare for fire designers and tunnel managers.

Within *fib*, fire design has been actively dealt with by Task Group 4·3 'Fire Design of Concrete Structures', that has worked in the last five years through two working parties (WP 4.3.1 on materials, and WP 4.3.2 on structures), has organised three workshops (Malta, March 2001; Milan, Italy, December 2004; and Coimbra, Portugal, November 2007), has published a first bulletin (No. 38, April 2007,[4] on cementitious materials at high temperature and under fire) and is finalising a second bulletin (on structural behavior under fire, Spring 2008[5]).

The debate within TG 4·3 is well represented by the six papers published in this special issue, that are about: (a) the most relevant topics in fire design and on performance-based codes; (b) the methodologies for concrete spalling assessment; (c) the transport phenomena across concrete walls subjected to high temperature and pressure; (d) the properties of concrete at high temperature and past cooling – including their role in sectional behavior and column stability; (e) the nonlinear and plastic analysis of axially-restrained continuous RC beams; and (f) the role of various parameters in the flexural response of simply-supported RC beams exposed to fire (different fire scenarios, load levels, concrete covers, aggregate types, span lengths and failure criteria).

It is a 'mix' of materials and structural topics, that synthesises both the complexity and the potential of the modern approach to structural fire design.

References

1. See http://www.nfpa.org/index.asp.
2. Comité Européen de Normalisation (CEN). *Eurocode 4. Design of Composite Steel and Concrete Structures. General Rules. Structural Fire Design*. British Standards Institute, Milton Keynes, 2005, BS EN 1994-1-2:2005.
3. See http://www.uptun.net/.
4. fib. *Fire Design of Concrete Structures—Materials, Structures and Modeling*. fib, Zurich, 2007, fib Bulletin No. 38.
5. *fib*. Technical report currently under development by *fib* Task Group 4·3