Beyond the means of escape

Building owners, occupiers and insurance companies are increasingly asking for more than the minimum fire resistance as specified by the Building Regulations. A report from The Concrete Centre, *Concrete and Fire: How concrete can help achieve safe and efficient structures*, explains how concrete construction, which is well suited to the new performance-based fire safety approach, can minimise the impact of fire upon a building and allow a fast return to business as usual

Insurers pay out some £800 million in commercial fire claims every year. Business interruption claims following fire damage adds a further £220 million. Costs like these have led to growing concerns about fire risks among building owners, occupiers and, of course, insurers. Of particular concern is the need for a burning building to provide a level of structural integrity that goes beyond the means of escape times required by the Building Regulations. It is a concern that is also shared by fire fighters.

In a fire, concrete performs better than any other structural material – both as an engineered structure and as a material in its own right. It can, therefore, play a central role in maintaining the integrity of a structure, preventing the spread of a fire and protecting both lives and property. The fact that this is all down to its inherent fire resistance means that concrete can provide this protection 'free' without the need for additional fire protection, for the lowest initial cost while requiring the least in terms of ongoing maintenance.

This inherent fire resistance of concrete is underlined by EN 13501-1 which classifies materials into seven grades (A1, A2, B, C, D, E, and F). Concrete is awarded the highest designation of A1 because it is effectively non-combustible and can be described as being virtually 'fireproof'.

As an inert material, concrete has a very low thermal conductivity. This means that rate of temperature increase through concrete is slow with the internal zones of the concrete not reaching the same high temperatures as the surface exposed to the fire. A standard ISO 834/BS 476 fire test on 160mm wide x 300mm deep concrete beams showed that after one hour of fire exposure a temperature of 900oC was reached on the surface of the concrete. However, at 16mm from the surface, the temperature was 600°C, whilst at 42mm from the surface the temperature was just 300°C. This gave a decreasing temperature gradient of 300 degrees in only 26mm of concrete. Even after a prolonged period of fire exposure, the lower internal temperature of concrete means that it retains its structural integrity and fire shielding ability.

This inherent fire resistance of concrete means that it is well suited to structural fire engineering. This involves the knowledge of fire behaviour, heat transfer and the structural response of the proposed building structure in a performance-based approach. The result can be the design and construction of more economical, robust and complex buildings than those using the traditional prescriptive rules.

In fire-safety design, the functions of a structural element can be designated as loadbearing, separating and/or fireshielding. These elements are typically given a numerical value in minutes to represent how long they can perform these functions in the event of a fire.

Concrete frames often exceed these performance expectations. The combination of concrete's non-combustibility and low internal temperature levels means that its strength will not be significantly affected by a typical building fire and that it can offer long-lasting passive protection. This means that concrete does not have to rely on active firefighting measures such as sprinklers or additional passive fire protection, both of which can fail during a fire.

"THE MOVE FROM PRESCRIPTIVE TO PERFORMANCE-BASED DESIGN HAS BEEN ONE OF THE MOST SIGNIFICANT CHANGES IN FIRE DESIGN"

The move from prescriptive to performance-based design has been one of the most significant changes in fire design. Performance-based structural analyses have come to the fore with modelling techniques that are capable of simulating structural conditions that would be otherwise difficult to study even as part of a full-scale test. Since the 1990s, the performance-based approach has permeated into national building code.

The concrete Eurocode – Eurocode 2 – is based on such an approach to fire safety design and is therefore inherently more flexible and well-founded in its methodology. Although prescriptive data continues to have a role to play, performance-based design offers greater flexibility. The inherent fire resistance of concrete provides the confidence of structural integrity in the event of fire. Integrity that reduces potential fire damage and that allows companies to get back to business sooner rather than later.

To download a copy of *Concrete and fire: How concrete can help achieve safe and efficient structures*, visit: www.concretecentre.com/publications.