

New guidance supports design of building structures for fire

The IStructE has published a new guide aiming to clarify the role of the structural engineer in designing building structures for fire and explain how compliance with the functional requirements of the Building Regulations can be achieved.

A number of fire incidents in recent years, most notably the Grenfell Tower tragedy in 2017, have led to an increased focus on fire safety in the UK construction sector. This has been driven by the increasing complexity of modern buildings, the use of new materials, and the evolution of fire engineering. Questions have arisen both about the correct approach to take in designing the structure of a building to resist fire exposure, and the role of the structural engineer in the process.

The Grenfell Tower Inquiry highlighted a number of significant issues in fire safety design, including unclear responsibilities, misuse of prescriptive guidance, and gaps in competence. These themes were explored in the recent CROSS topic paper, *Mind the gap* (see [page 6](#)).

The Phase 2 Inquiry report recommended that designers should i) be able to clearly understand the applicability of prescriptive methods or statutory guidance to their designs; and ii) be clear of their responsibilities regarding fire engineering.

In response to these developments, the Institution has published a new guide, *Design of building structures for fire: Compliance approach and the role of the structural engineer*.

The guide has been developed to support demonstration of compliance with Parts A and B of the Building Regulations in England and Wales in relation to fire safety of a building structure. It does this by:

- outlining the methods available to demonstrate compliance
- providing a framework to support designers in their selection of appropriate methods to demonstrate compliance
- defining the role of the structural

engineer regarding the performance of the structure

- laying down criteria for when a fire engineer and/or 'structural fire engineer' are recommended due to the nature of the structure
- advising on how the structural engineer and other parties should interact.

Although the guide has been developed for the regulatory framework in England and Wales, the principles may also be relevant in other jurisdictions.

Who is the new guidance aimed at?

The guide is primarily aimed at structural engineers, but is also relevant to the wider building design team, including architects, fire engineers, principal designers, contractors and building control authorities.

Given the complex nature of modern construction projects, with multiple stakeholders and overlapping responsibilities, the guide may also be relevant to clients, regulators and project managers who need clarity on roles, responsibilities and competencies in fire safety design.

What does the guide cover?

Regulatory context and objectives

The guide begins by explaining the legal and regulatory framework in England and Wales, noting that the key aim of the Building Regulations is to ensure a reasonable standard of life safety in a fire. It highlights that regulations are largely performance-based (functional requirements) rather than prescriptive, meaning designers must demonstrate that outcomes are achieved.

Approaches to compliance

The guide distinguishes between two main design approaches:

- **Prescriptive approaches**, based on standard guidance such as Approved Documents, utilise nominal fires to generate thermal actions.
- **Performance-based approaches**, involving fire engineering analysis, take into account thermal actions based on physical and chemical parameters.

Within these approaches, the fire resistance design of structures can be evaluated using one of three analysis methods:

- **Member analysis** involves evaluating each individual member of the structure, which is assessed by considering it fully separated from other members, with the connection condition with other members replaced by appropriate boundary conditions.
- **Part-structure analysis** involves assessment of multiple elements of the structure and uses appropriate boundary conditions to reflect their links with other parts of the structure.
- **Global structural analysis** assesses the whole structure.

The guide emphasises that Approved Documents are suitable for 'common building situations', but may not be adequate for large, complex or innovative structures – which may require more advanced analysis methods.

Roles and responsibilities

A key aim of the guide is to define the role and scope of the structural engineer, and structural fire engineer



tse@istructe.org



@IStructE
#TheStructuralEngineer



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(where appointed), in relation to fire safety. This should be done at the beginning of a project and reviewed regularly through its life cycle.

The scope of the structural engineer in relation to the fire performance of the structure is dependent on the nature of the structure and whether:

- | the fire resistance is inherent to the structure (masonry, concrete) or applied
- | the structure can add to the fire load (e.g. mass timber)
- | part of the structure is designed by a specialist subcontractor.

The guide sets out proposed minimum duties for the structural engineer, based on the IStructE Structural Plan of Work 2020 and additional requirements for higher-risk buildings (HRBs) in the UK SPEC-HRB fire-related recommended competences for structural engineers. It explains that the structural engineer's actual role should be agreed with the client and made aware to the Principal Designer to ensure that no scope gaps exist on a project-by-project basis.

Where the structure, building or route to demonstrate compliance are complex, the guide notes that reviews carried out by the fire engineer and structural engineer may identify gaps in design competence between them. This may necessitate the appointment of a structural fire engineer to carry out detailed analysis and design of the structure and/or the fire protection strategy under the fire limit state load case.

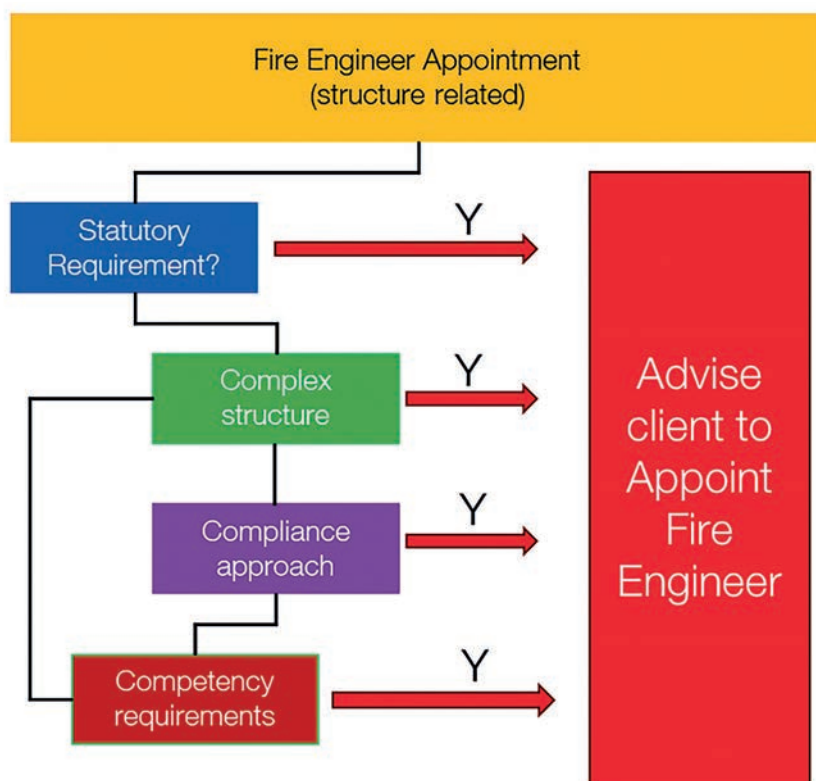
(Note that the term 'structural fire engineer' is not formally recognised but is used to describe an engineer with specialist skills in the complex analysis of structures subject to fire actions, including the derivation of fire loading and understanding of material and frame performance in fire.)

Other important aspects relating to roles and responsibilities that the guide highlights include interfaces with other parties, specialist contractors and manufacturers, and other packages.

Involvement of specialists

When commissioned, a fire engineer usually prepares the fire strategy, oversees the design, and possibly construction, for fire safety and compliance with fire regulations. It is recommended that a fire strategy is always prepared for non-domestic projects.

Where statute does not dictate that a fire engineer is appointed, the



➤ **FIGURE 1:** Decision tree for advising whether structural design requires specialist

guide recommends that a risk-based approach is adopted to determine the necessity to appoint one (Figure 1). This decision should be based on the compliance approach, complexity of the building (or structure) – as judged by the structural engineer, and competence of the design team in relation to the project. The decision should be revisited at key stages as the design progresses.

In determining the complexity of the structural performance in fire, and therefore the appropriate compliance approach and, in turn, the need for a structural fire engineer, structural engineers should seek expert advice when:

- | fire hazards due to use are complex (e.g. storage of flammable materials)
- | the structural form results in an unusual compartmentation strategy (e.g. modular construction)
- | non-conventional materials or section shapes are utilised (e.g. exposed mass timber)
- | highly rigid structures, or structures relying on global-frame load paths are adopted (e.g. modular construction).

A competency test will determine the need to employ a fire engineer to

assist in the design of the structure based on:

- | the complexity of the structural performance in fire
- | the compliance approach
- | the competency of the structural engineer relevant to the structural design for fire.

Summary

Design of building structures for fire is an important piece of guidance that helps structural engineers and the wider design team navigate the complex intersection of structural design and fire safety. By clarifying responsibilities, promoting appropriate methods and emphasising competence, it will play a key role in improving the safety and reliability of modern buildings in fire conditions.

The new guide is available as a free download at www.istructe.org/Resources/Guidance/Design-of-building-structures-for-fire-compliance.

The drafting of this article was supported by the use of generative AI to summarise key aspects of the guidance. The article was written by members of the Institution's Editorial and Technical departments and reviewed by the Technical department.