



STEEL INDUSTRY
GUIDANCE NOTES

Structural Fire Safety Engineering of Steel Structures

Fire safety engineering can be defined as the process of adopting a rational and scientific approach which ensures that fire precautions adopted in any situation are appropriate to the risk involved rather than accepting universal provisions which may over or underestimate the risk.

Over the past twenty years, the science of fire safety engineering has advanced rapidly, especially in the UK, which can now lay claim to the services of many of the world's leading practitioners. Structural fire safety engineering has progressed significantly, helped by an extensive programme of research and development carried out by the steel construction sector. Used appropriately, a structural fire safety engineering approach can deliver significant economies in building design.

The simplest solution to structural fire precautions in buildings

The standard approach to structural fire precautions in buildings is to design the frame in the cold state and then consider fire separately. The required fire resistance period for the building is most commonly determined from prescriptive rules contained in Government published documents such as Approved Document B in England & Wales and the Scottish Building Standards Building Handbooks. CIBSE Guide E: Fire Engineering states that: *"Where a building design is straightforward and conventional, then it would normally be expected that designers would apply the prescriptive approach of Approved Document B and the associated British Standards with little or no need to vary the detailed recommendations."*

Building Regulations and alternative approaches

The Building Regulations in England & Wales are functional in approach, i.e. they tell the building designer what to do but not how to do it. In terms of structural stability, the requirement is that the designer must ensure that: *"the building shall be designed and built so that, in the event of a fire, its stability will be maintained for a reasonable period."* The Building Regulations do not define what is a reasonable period but the requirements outlined in Approved Document B are generally considered to be adequate by most Local Authorities. Approved Document B states however that: *"There is no obligation to adopt any particular solution ... if you prefer to meet the requirement*

in another way." It goes on to suggest other ways: *"Fire safety engineering can provide an alternative approach to fire safety. It may be the only practical way to achieve a satisfactory standard of fire in some large and complex buildings."*

The standard for fire safety engineering?

BS7974 - Application of fire safety engineering principles to the design of buildings, contains guidance on the procedures for carrying out a fire safety engineering analysis. The standard is accompanied by a series of published documents giving detailed guidance on the principles of fire engineering, fire development, spread of smoke, structural response, fire detection, fire service intervention, evacuation and risk management. This guidance note concentrates on structural response.

Using a structural fire safety engineering approach

A fire safety engineering approach could be used in a number of situations:

- Where the building in question is innovative and/or complex and its functionality would be impaired by the requirements of prescriptive solutions.
- Where the use of the simple rules results in overly conservative solutions.
- Where a particular problem exists to which a solution is difficult or impossible using the prescriptive approach.

Buildings that benefit from a structural fire engineering approach

In general, large and complex buildings benefit most from a fire engineering approach. Case studies can be found at the university of Manchester one-stop shop for information on the behaviour of materials in fire: <http://www.mace.manchester.ac.uk/project/research/structures/strucfire/CaseStudy/steelComposite/>

These case studies range from highly complex solutions, requiring the expertise of specialist consultancies, to relatively simple solutions within the capable of any competent structural engineer. The feature they all have in common is economy of the design while retaining functionality.

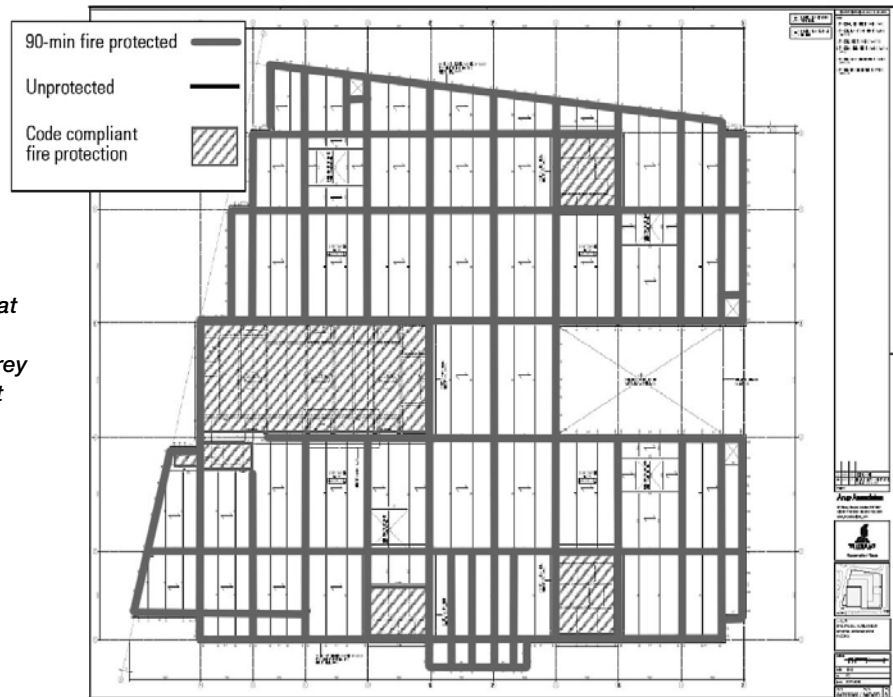


Figure 1: Floor arrangement at Ropemaker Place in London. Beams highlighted in thick grey are fire protected; beams not highlighted are unprotected. This solution represents the state of the art capability in structural fire engineering. Courtesy of Arup Fire.

Key Points

1. A fire safety engineering approach can offer an alternative, more economic and more robust solution for fire precautions in buildings to that found in sources such as Approved Document B.
2. Many of the world's leading fire engineers practice in the UK.
3. Alternative solutions to structural fire precautions can offer real value using methods validated by extensive fire testing carried out by the steel construction sector.
4. Not all buildings will benefit from a fire safety engineering approach. Straightforward and conventional buildings are unlikely to do so.
5. Most of the large and/or complex buildings in the UK now adopt a fire safety engineering approach.

Further sources of Information

For further information:

1. **Introduction to the fire safety engineering of structures. Published by the Institute of Structural Engineers.**
2. **Guide to the advanced fire safety engineering of structures. Published by the Institute of Structural Engineers**