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Fire in a vertical town: Could modern tall buildings cope when the unthinkable happens?

David Sugden, Chairman of the Passive Fire Protection Federation, on the fire safety issues in tall buildings.

Tall buildings are back in vogue. Barely a week goes by without talk of a new development in one of our major cities, particularly London. But the debate about design and construction is fine but phoney. The real debate must be fire safety.

Current fire safety regulations Approved Document B (AD B) for tall buildings are really not up to the job. As things stand, the guidance for the construction of a building 31m in height and one which stands 331m is the same. Yet clearly buildings of very different heights represent very different propositions – particularly in the event of a fire. Modern multi-storey buildings tend to offer a complex mix of occupation. Many include offices, a hotel, residential, retail and leisure areas. AD B places a building's function into a neat box which is simply not good enough. It is unrealistic to class a tall building as having one function, such as residential, office or recreational. While the current recommendations for these are based on the same principles, they will differ according to the building's function. We can no longer take this simplistic view.

Would you sit tight while smoke billows past your window?

Public safety has to be the start of any discussion on a new set of building regulations. AD B contains detailed recommendations for the safe vertical evacuation of a 30m building. Indeed, section B1 accepts that simultaneous escape plans for very tall buildings may not be possible. It also includes a section on "Phased Evacuation" (PE) with the management of the evacuation being of paramount importance, even including a requirement for an "Emergency Voice Communication System" from the outstations on each floor to the master control station. Such evacuation plans are expected to follow a pattern of clearing two floors at a time according to the location of the fire.

This "phased evacuation" (PE) works well in any fire drill. It prevents the stairs becoming crowded with 10,000 or more people leaving at the same time. PE allows the stair numbers and widths to be calculated on a reasonable scale in proportion to the floor area, but it relies on people sticking with a queuing system. Could you see yourself sitting tight in your office or apartment when smoke is billowing past your windows?

How do we design for safe evacuation from a tall building?

There are no easy solutions, but we shouldn't ignore the problem and hope it never happens, because it will. What is needed is industry wide thought. 9-11 showed that getting fire fighting equipment to a high floor when the occupants are leaving is difficult to achieve. Designated fire fighting shafts and fire fighting lifts, running in secure shafts are already included as part of any design. Evacuation plans for tall buildings have to be discussed at an early stage with the Fire Authority. If the fire lift is to be used to evacuate disabled people the brigade has to agree to that in advance.

Tall buildings must have sprinklers under the present guidlines and may have dry and wet risers. Perhaps some floors should be designed as fire breaks where people can feel secure while waiting for evacuation. How far should such large and complex buildings have multiple cores, and be capable of vertical fire separation, as well as separation between floors? These questions require serious thought about the overall stability of the structure. What we are building are 'vertical towns', perhaps with safe havens and fire breaks at intervals as the building climbs.

Is the standard two hour stability during fire requirement sufficient for such a vertical town?

All floors in tall buildings are required to be "fire compartments" and this includes the outer walls which need two hour integrity and load bearing capacity. This requirement may be met by the frame of the building and cladding systems hung from the frame. It is essential that fire sealing between floor edges and the cladding system is rated at two hours, even under current regulations. Occupants of upper floors are likely to

expect any fire outbreak on lower floors to be contained and for the load bearing capacity of the steel or concrete frame not be compromised. It has been shown that fire can break out of a building, and then break back in higher up the structure. Integrity requirements for external walls are rated from one side only, the inside. Is this adequate? Is two hours long enough?

Outer non-load bearing walls also need fire resistance properties to prevent fire transfer from floor to floor, or on the same level across re-entrant corners via the façade, limiting the possibilities of radiant heat transfer. Practice on the continent, for example, is to require 90 minutes insulation plus integrity for defined key areas in a glazed façade.

Tall buildings are not the place for economic or experimental design principles

Due to the complex nature of tall buildings they get special attention by the regulators and require specialist 'Fire Engineering' that has to be agreed by the Building Control Body and the Fire Authority. This fire strategy development is an organic process that will change according to a building's use. It must be at the heart of the Risk Assessment required by the Regulatory Reform Order [1]. Fire engineering normally uses a trade-off of one precaution against another, but without more detailed guidance in either AD B or BS 5588[2] the safety of buildings around the country may be very different. In reality this process is one of compromise which can only lead to a shaving of the safety margins, as limits on what is achievable with designs is approached. In many cases that design limit will not be recognised until a fire breaks out, and then it is too late. Tall buildings are not the place to be economic or experimental with design principles.

[1] The Regulatory Reform Order, Fire Safety (RRO), which came into force in October 2006. RRO requires all businesses in the UK to nominate one person with specific responsibility for all aspects of fire safety. This individual must conduct a thorough risk assessment of the business' premises – including an appraisal of passive fire protection measures.

[2] BS 5588 is for Fire precautions in the design, construction and use of buildings. Code of practice for shops, offices, industrial, storage and other similar buildings

Buildings have been constructed where expected failure of cladding elements has been used to provide a cooling effect on the heat from a fire and so delay the process that leads to the collapse of the frame. This is placing more of a reliance on chance and circumstance than is really justified where numbers of lives are at stake. Much reliance is placed on computer modelling for fire engineering of these structures to prove such a point and we really need to be sure of the verification of the models and the experience and qualifications of the drivers of such equipment if the lives of many thousands of people is to rely on the outcome.

Fire-fighters have to use 19th century methods when faced with 21st century designs – does this represent the right approach for such high value investments?

Senior fire-fighters who experienced and survived the 9/11 disaster pointed out that fire-fighters have to use 19th century methods when faced with 21st century designs. The only way to fight fires in tall buildings is from inside the building. This is far from the traditional picture of a fire-fighter on a ladder spraying water into the interior from a safe position. The fire-fighter in these modern complex buildings has no choice but to go face-to-face with the fire. This means that special attention has to be given not only to the layout and design of escape and access ways, but also to the fire resilience of the structure and its ability to contain fire.

Tall buildings have an imposing presence and influence on their surrounding environment. They represent high value investments with high value contents. If fire occurs then it is not simply a question of getting people out. What are the financial implications? There is the cost of destruction, disruption and business continuity as well as the environmental impact from the major fires that could develop. It is clear that the trend towards taller and more complex multifunctional buildings presents significant challenges for fire safety. This needs to be resolved at the point of construction – so debate has to happen now.

ENDS

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Issued on behalf of:

David Sugden, **Passive Fire Protection Federation,** AGM, Tournai Hall, Evelyn Woods Road, Aldershot, Hampshire, GU11 2LL
Email: pfpf@associationhouse.org.uk

Press enquiries to:
Gareth Brough, Michael Rigby Associates, 15 Market Street, Wotton-under-Edge, GL12 7AE
Tel: 01453 521621 Email: gareth@521621.com

Editors notes: The Passive Fire Protection Federation (PFPF - www.pfpf.org) is dedicated to growing awareness and giving advice on fire protection, and the Regulatory Reform (Fire Safety) Order 2005 (RRO). Our members include the Chief Fire Officers Association, the Department of Communities and Local Government (previously the ODPM), the Royal Institute of Chartered Surveyors and the Building Research Establishment. Our website carries advice on what to check and best practice in all passive fire protection measures