Open Plan Flats and Fire Safety

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Within the cities of the UK, blocks of flats are the easiest method of meeting the demand for housing. Reaching up into the sky, rather than spreading out, allows developers to get the most out of the space available to them. The 1950's and 60's saw housing blocks constructed from concrete being built around the country and we now seem to be seeing this repeated - albeit with better thought out designs and aesthetics, building on the significant advances in design and technology in the time since then.

The first Building Regulations came into effect in the 1960s and they have evolved over the years from prescriptive rules to a functional-based approach. However, even with the current degrees of flexibility, some developers claim that these regulations are preventing them make the full use of the space available to them.

Fire Safety

Blocks of flats, like all other residential buildings, need to comply with the current functional requirements of the Building Regulations. The easiest method of meeting these requirements is to follow the guidance within *"Approved Document B: Volume 2 (Buildings other than Dwellinghouses)"*, though alternatively, *"BS 9991: Fire safety in the design, management and use of residential buildings - Code of practice"* can be used. Both are recognised documents by Building Control Bodies as meeting the requirements of the Building Regulations.

These documents are both fairly prescriptive and some architects and developers feel that they constrain what can be done with each flat. In general, the UK approach consists of the flat door entering into a protected entrance hall - a hallway consisting of 30 minutes fire resisting construction and no longer than 9m in length. All rooms are accessed from this protected entrance hall and all doors into the hallway are required to be FD20 fire resisting doors.

Growing demand from investors, developers and customers has seen the introduction of the open plan flat, where bedrooms and rooms are accessed from a living area. Americans have long enjoyed open plan flats - one just has to watch a range of American TV shows, such as The Big Bang Theory, Friends, How I Met Your Mother and others to see that this open plan layout is extremely common. These layouts are becoming more sought after within the UK.

We have limited guidance on these open plan flats - work carried out by BRE on behalf of NHBC (*Open plan flat layouts - Assessing life safety in the event of fire - 2009*) studied open plan flats and this went on to influence BS 9991, which does contain a section on open plan flats. The guidance within BS 9991 only allows for open plan flats of 12m x 16m (and requires residential sprinklers to be installed), which for some developers may be sufficient, but for some high end residential units, bigger is better and therefore, these large open plan flats do not meet the guidance of BS 9991. There also appears to be a growing demand for duplex level flats as well as open plan dwelling houses (where the stair is not enclosed).

Exceeding the Guidance

What happens when the proposed open plan flat is outside of the scope of the guidance?

Building Control Bodies and Approved Inspectors still need to prove that these open plan flats that don't meet the guidance within the available documents still meet the functional requirements of the Building Regulations - i.e. that Part B can be safely satisfied. What proof do they need that these flats are safe?

It seems that the common approach at the minute to demonstrate compliance with the Building Regulations is to use Computational Fluid Dynamics (CFD) modelling. By using CFD models, fire engineers can create models that will mimic conditions within the proposed flat, allowing Building Control Bodies to understand how safe the proposed flat is likely to be.

These models can either go down a deterministic route, demonstrating for a given set of criteria what is likely to happen, whilst a comparative approach can be used to show how the proposed flat compares to a code compliant flat, again, testing against a set of agreed criteria. Both options are valid methods of demonstrating compliance, as set out within BS 7974 but a combination of both approaches can be used to help demonstrate to the Building Control body that the proposed flat design is safe.

The acceptance criteria should be agreed in advance between all parties - it should be noted that CFD models suffer from the "rubbish in, rubbish out" paradigm where incorrect input parameters will produce incorrect results. CFD models should also only be used as an indication of what is likely to happen within the flat in real life - there is a misconception amongst some consultants and professionals that what happens within the model is exactly what will happen if a fire occurs within the proposed flat. As we know all too well at BRE, based on our extensive in depth experience with large-scale experimental fires as well as fire investigations, it is extremely unlikely that any model can predict the exact location of a fire initiation event in a building, it can only be a representation of an agreed scenario.

The aim of the analysis is to come out with the Available Safe Evacuation Time (ASET) and compare that to the Required Safe Evacuation Time (RSET), a standard method of demonstrating compliance

with the Building Regulations. By comparing the required time to the available time (the CFD model is being run to determine the point at which conditions become untenable), the Building Control Body can see if occupants are likely to escape before conditions in the flat would prevent escape.

In comparison to the common CFD approach, BRE provides a unique approach that is quicker than CFD modelling based on probabilistic modelling. This approach models **thousands** of different combinations of fire locations, fire sizes, internal flat layouts, occupant escape times and other factors in the time it takes for a single CFD model to run, allowing Building Control Bodies to know with more certainty what is likely to happen within a flat. This probabilistic analysis was the basis for the NHBC research that formed the backbone of BS 9991.

Further Work

Building Control Bodies are being approached with an increasing number of open plan apartments by fire engineering consultants and architects. It is unlikely that this trend will decrease as foreign investors continue to fund developments within the UK and investors try to get the most from their money.

So what needs to be done?

There is a real demand for duplex and large open plan flats that fall outside of the scope of the current guidance. It is recognised that the guidance cannot cover every eventuality of layout, however, multi-level apartments are an area that is worthy of further research to see if these layouts could be taken forward without the need for costly and time consuming CFD modelling for every individual case.

Should the demand for open plan stairs within dwelling houses be something that developers wish to pursue on a regular basis, then further research should be undertaken to see if the installation of a residential sprinkler system can offset the open stair and deliver an equivalent level of safety.

In terms of the CFD modelling, experience tells us that this will almost always show that, in the event of a fire, the visibility within a flat fails any criteria that the consultant may specify - the amount of smoke generated even from a small fire that activates the sprinkler may be sufficient to cause failure according to the visibility tenability criteria. Further work should be undertaken on how this actually affects the occupants escape and the CFD modelling tool should, if possible, incorporate the direct interaction of the sprinklers with the smoke layer and therefore take into account any effects of the sprinklers.

Lastly, the addition of sprinklers to these open plan designs is essential to offset for the lack of the protected entrance hall and to keep the fire to a low level, allowing occupants to safely escape. However, statistical information on the reliability of residential sprinklers in the UK is currently lacking although it can be expected that this situation will improve as the number of residential buildings with sprinklers in Wales increases over the coming years.

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