LONDON FIRE BRIGADE

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Freedom of Information request reference number: 6729.1

Date of response: 24 August 2022

Request:

Can you please provide copy of any subsequent editions of the "Fire Engineering Thematic technical report. Identified trends from Building Regulations Consultations and fire engineering audits" since Quarter 4b January - March 2021 ? Could these preferably be in pdf format. If this report series is no longer being produced, can I have details as to whether there is a replacement document covering similar topics.

Response:

No further editions of the *Fire Engineering Thematic technical report* series of documents have been published since the Quarter 4b edition (covering 1 January – 31 March 2021).

We appreciate the benefit these reports have provided to the industry and are considering how we can provide similar information in the future.

We have attached all the edition up to and including Quarter 4b for reference.

I am sorry this is not the response you hoped for. Should you have any further questions please do let me know.

We have dealt with your request under the Freedom of Information Act 2000. For more information about this process please see the guidance we publish about making a request on our website

LONDON FIRE BRIGADE

Fire Engineering thematic technical report;

Identified trends from Building Regs Consultations and fire engineering audits

Quarter 1: Jan1st – March 31st 2020

30 April 2020

Fire Engineering Group – Quarter 1 2020 (January 1st – March 31st)

Introduction

This report is one of a new series of thematic reports produced by London Fire Brigade's Fire Safety department, with this being the first Fire Engineering report relating to Building Regulations Consultations and fire engineering audits. Thematic reports are one element of the department's work to ensure that learning relating to key issues is shared organisationally and with other stakeholders as appropriate.

Her Majesty's Inspectorate of Constabulary and Fire & Rescue Services have highlighted the importance supporting business and this may necessitate identifying fire safety concerns or trends, for example, sub-standard areas of building fire safety design or management. This can assist in identifying areas for improvement and efficiency in the relevant sector. From the Brigade's perspective, thematic reports will also contribute to the delivery of the Transformation Delivery Plan by supporting the strategic aims of being a learning organisation, understanding and communicating risk information and leading excellence in the national fire service.

Summary

This thematic report has been produced for informational purposes and may be of particular interest to stakeholders working within the building design and (fire) safety field. Poor building design, management or maintenance can increase the risk to residents, communities and emergency responders.

The report is split into two sections; Part A) relates to data collected in the design phase of the building and Part B) relates to the occupation phase of the building. As this is a technical report, various standards and guides are mentioned, but not referenced in detail.

It has been produced using data collected from Building Regulations Consultations (BRCs) received and reviewed by LFB Fire Engineering Group (FEG) during quarter 1 (Q1) in 2020. The report also captures data from any audits conducted through fire engineering group on buildings for which they have been consulted on previously.

Part A – Design phase

The data for this section does not include BRCs dealt with by Inspecting Officers but focusses solely on consultations received by the Fire Engineering Group.

In this period there was a total of 124 consultations received by Fire Engineering Group with 118 being responded to.

Of these 118 consultations 72% were issued a 'not satisfied' response, which raises concerns about the quality of the submissions and potential safety concerns. The reasons for a 'not satisfied' response can be varied from insufficient information presented to a fundamental concern with the design approach undertaken. This report aims to capture some of the trends from this quarter.

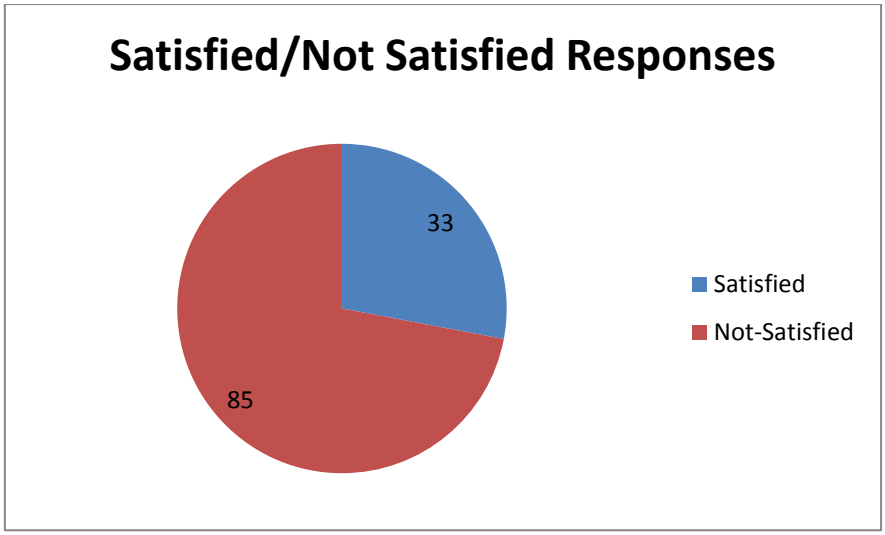

Figure 1 - Number of Satisfied and Not Satisfied Responses Issued in Q1

It can be seen from figure 1 that the overwhelming majority of consultation responses included a not satisfied statement.

Overview of technical issues and concerns

During Q4, fundamental and recurring issues were highlighted by fire engineers in 18 notable consultations. A breakdown of the pertinent points is provided below, which are further expanded upon within the main body of the report:

1) Apparent 'compliance by stealth[1]': Including for firefighting access and corridor ventilation.
2) Single stair offices over 11m.
3) One consultation and fire strategy to cover multiple (up to 12) blocks.
4) Single staircase for mixed occupancy types e.g. office and residential
5) Very tall single stair residential buildings to ADB with ancillary use and service risers within stair.
6) Single stairs continuing down to basement car park levels.
7) No dry riser outlets at ground floor levels.
8) Modern methods of construction (MMC) not fully justified.
9) Basement ventilation requirements misunderstood.
10) Transfer corridors at upper levels.

FEG are still seeing proposals **(1)** for tall, single stair residential buildings just under (or in one case exactly) 30m without sprinkler provision. In these cases the sprinkler threshold is rarely mentioned in the fire strategy as it is 'code compliant'. This type of 'compliance by stealth' has also been observed in projects just under 18m where a full firefighting shaft is not provided, this has recently included a large self storage warehouse. One method for achieving BS:9991 compliant corridor distances was to include an additional non-ventilated portion of dead end corridor beyond 15m from the stair door. FEG are also still seeing schools assessed to BS:9999 as opposed to BB100 to then avoid the additional sprinkler consideration.

[1] 'Compliance by stealth' indicates potentially wilful manipulation of the building regs. E.G, to avoid additional burdens or costs, height of building is 29.99/30 metres but still 10 floors, to avoid requirements for sprinklers.

FEG are increasingly seeing very tall single stair buildings >50m and in some cases >100m tall assessed to ADB and considered a 'common building situation'. Many tall designs **(5)** also include ancillary use on upper floors which is not appropriately considered in the fire strategy. One very tall project also proposed service risers within the single stair enclosure which BCB's have accepted before, despite FEG's fundamental disagreement with the approach. Despite FEG's responses highlighting clause 0.7 of BS:9991 and to the BS:7974 framework, FEG are finding that the Qualitative Design Review (QDR) process is often not adhered to, in particular for one project involving a very tall, single stair extra care premises where the Building control body (BCB) dismissed the QDR benefit.

Single stair offices over 11m **(2)** in height are still commonly proposed without suitable measures to mitigate the resiliency and redundancy normally provided by a second stair. Proposals are frequently only reliant on a single provision such as sprinklers or stair pressurisation rather than a package of measures to holistically address the risk. The single stair theme **(4)** continues through a number of consultations whereby the stair incorporates multiple uses e.g hotel and residential. Concerns were raised in two cases over the lack of competency shown by the fire engineer who failed to provide effective analysis and/or acknowledge the impact of opposing evacuation strategies and the management protocols necessary for such a design.

For sites whereby a large number of blocks are proposed FEG often see one large fire strategy **(3)**, particularly when all cores are linked by a 1st floor podium or basement car park. FEG have asked that developments such as this are addressed by a site wide fire strategy with individual 'as built' fire strategies for each block. This aids in FEG's review but also upon handover through the regulation 38 process. Furthermore, to link with car parks in basements **(6)**, FEG are increasingly seeing proposals for single stairs continuing down into basements. Reference is usually made in fire strategies to BS:9991 to then include a door at ground floor within the stairwell and a 0.4m^2 natural vent in the basement lobby. This approach should only be intended for small buildings <11m. FEG have found that no consideration is given to firefighting access into the basement which, in this scenario, would cause loss of tenability in the single stair.

Projects are negating the need for a rising main **(7)** outlet on the ground floor. This may not intuitive for firefighters as the fire may not be evident and the riser inlet is charged by the initial crews as part of high rise procedures, it would be very difficult to then plug into the rear of the appliance and take hose to the first floor as designers and fire engineers are proposing. This proposal could impact on firefighting operations. This type of expectation for crews to implement a range of firefighting tactics, depending on the fire location within a single building, is becoming common place within strategies.

FEG have observed that a number of projects refer to the basement level **(9)** as not requiring ventilation on the basis that the individual compartments are no bigger than 200m^2. This is poor interpretation of the guidance which clearly defines the entire basement storey size in this consideration.

A recent consultation **(8)** regarding a modular construction method has been presented with an apparent lack of a cohesive approach to the fire safety design. This project in question is regarding extremely tall residential towers of modular construction and lacked detail on how compliance can be demonstrated. No fire testing data was provided upon request, thus preventing FEG from fully understanding the risk in terms of structural fire performance. This approach appears to mirror other MMC projects (e.g. Cross Laminated Timber or CLT) across London whereby there is insufficient understanding on the building's fire performance.

Due to the desire to provide a centralised single stair to aid in shorter travel distances, FEG are seeing an increase in proposals for a **(10)** transfer corridor on upper levels of residential blocks to link a central

stair and a stair on a boundary line. The route to a central stair has historically been at ground floor level however FEG have seen some recent designs propose a protected corridor on an upper level.

For Q1, a number of consultation responses were recorded with a similar issue, thus allowing us to identify themes emerging. Figure 2 shows the number of times a particular issue was recorded by a Fire Engineer:

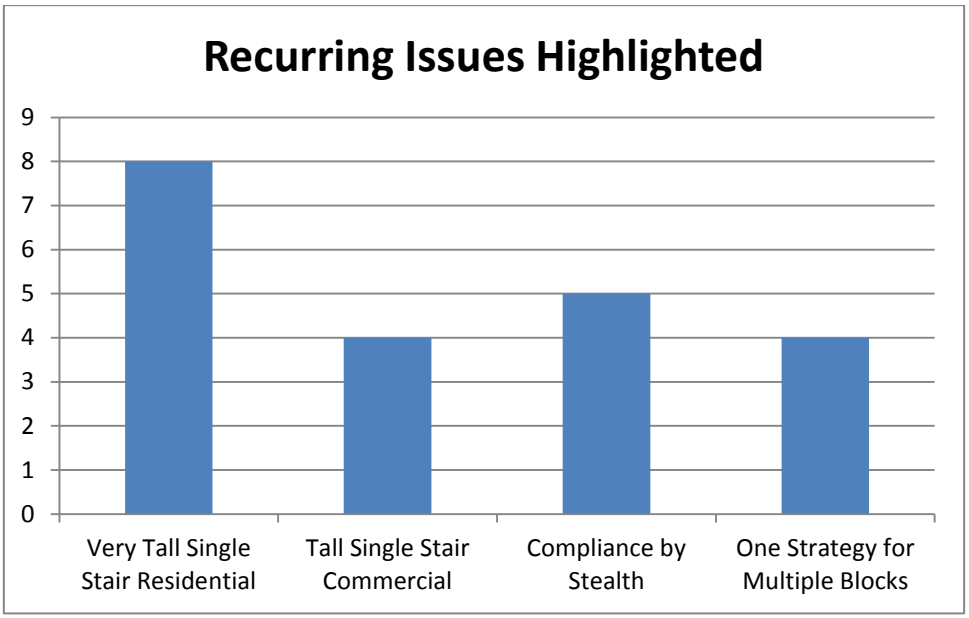

Figure 2 - Emerging Themes in Consultation Responses

Part B – Occupation phase

This part of the briefing note regards the progress and findings of the second phase of visits from the Fire Engineering Group (FEG) audit programme undertaken in the opening quarter of 2020. The audits were all undertaken by the same competent fire engineer who is qualified and experienced with fire engineering projects and is a competent fire safety inspecting officer. This section of the report has been authored by the referenced fire engineer.

Recent events (COVID-19) severely curtailed the intended audit programme however some useful information can still be gleaned and followed-up and expanded upon in due course; perhaps providing clearer avenues along which further audits can be directed in pursuit of FEG and Fire Safety Regulation objectives.

General methodology:

The audits themselves broadly followed the normal format with the focus principally on the history and management of the fire engineered solution itself. Deficiencies or non-compliances against the Regulatory Reform (Fire Safety) Order 2005 (whether engineered solution or not) were dealt with in the usual way, relative to the risk-critical nature of the contravention, including the issue of Enforcement Notices.

As a general guide, answers to the following questions were sought in respect of the fire engineered solution:

1. What is it?
2. Does it work?
3. Do they know it's there?

4. Do they know how it works?
5. Is it in the Fire Risk Assessment?
6. Is it in the Fire Strategy?
7. Is it being maintained?
8. Does it match the proposal?
9. Is it actual fire engineering or just difficult fire safety?
10. Clear link from design (start) to Responsible Person (finish)?

It should be noted that all questions, their analysis, and the 'failure rate' are based on the nominated fire engineer's professional opinion. Analysis and opinion by others may differ, but this initial review is meant as a useful guide and indicator for the potential issues that may arise.

This second phase of audits[2] concentrated solely on sleeping accommodation with mechanical smoke ventilation systems (MSVS) in the common parts, mostly flats and student accommodation. Some hotels were programmed but unable to be completed within the allotted time frame. One refurbished office building has been included; it was visited on a call-out basis and in any event met the FEG audit criteria.

From the target of circa 20 intended visits, 15 developments were visited, accounting for 36 individual cores, each served by a MSVS. The 'failure rate' percentages were calculated on a core-by-core basis as each core was essentially a stand alone building.

Broadly, this second phase of audits validated and were consistent with the findings, comments and observations from the first phase report. Compliance against the methodology questions was higher than previous and generally quite good; however, this is believed to be largely unintentional due to the nature of the developments themselves rather than representing a wider trend. Despite specifically concentrating on residential sleeping accommodation, the second phase audits were nonetheless randomly selected from a historical list of FEG referrals going back up to 10 years.

Anecdotally, the design and use of MSVS began largely with more exclusive private developments at the upper end of the housing market but has, over the intervening years, spread exponentially into almost all new residential flat buildings – presumably through a combination of a drive to both maximise usable space and meet environmental regulations. From past experience it is strongly suspected that if further FEG audits concentrated solely on social housing developments, which characteristically have more remote and fragmented management, the results would trend back down.

Brief numerical summary

A brief summary of the results of all 15 developments (36 individual cores) against standard questions follows, with a percentage failure rate (in the nominated engineer's professional opinion) where relevant. The percentages only reflect where the full information (positive or negative) was available. About 25% of the requested information was unavailable at time of writing due to current events but will be sought at a later time.

1. <u>What is it?</u> (i.e. what is the actual fire engineered solution.)
   97% Residential smoke control (MSVS/AOV); 3% Other.
   Residential common parts AOVs (natural ventilation by Automatic Opening Vents) or MSVSs (mechanical smoke ventilation systems) were specifically targeted during this phase of audits. The outlier relates to a refurbished office building referred to later.

[2] An initial pilot of fire engineering audits was conducted in 2019.

2. Does it work? (i.e. was the engineered solution fully operationally effective at the time of visit. Whether the design worked in theory was also considered.)
   20% failure rate.
   The relatively low failure rate compared to the first phase of audits is discussed elsewhere. All designs worked in theory as all were conventional (for a fire-engineered solution) and have been found to work adequately elsewhere.

3. Do they know it's there? (i.e. did the RP even know of the existence of the solution in their building.)
   0% failure rate.
   All RPs were aware of the existence of the solution if not the detail of its design or function.

4. Do they know how it works? (i.e. the RPs basic understanding of the solution and its importance.)
   20% failure rate.
   Most RPs knew in very general terms how the MSVS worked but, as before, few had any real understanding of how critical a properly functioning MSVS is to the continuing safe occupation of the premises.

5. Is it in the Fire Risk Assessment? (i.e. has the fire risk assessor identified there is a solution in place and/or referred to it in the fire risk assessment and/or referenced the original fire strategy during the course of the fire risk assessment.)
   55% failure rate.
   The comments on this aspect from the previous report remain valid and applicable here. The improved results from the earlier audits are more chance than good practice, considering the relative randomness of the premises chosen to be audited.

6. Is it in the Fire Strategy? (i.e. is the solution in-situ referred to in the fire strategy.)
   0% failure rate.
   Of the available information, the engineered solutions as proposed in the design fire strategies were found on site.
   Additional question: Does the RP have a copy of the Fire Strategy?
   50% failure rate.
   This will be a separate or alternative question in future FEG audits and more-or-less reflects the previous results. Based on previous experience, it is believed this percentage would worsen the more a change of RPs and/or management companies took place over the life of a building.

7. Is it being maintained? (i.e. is it subject to a suitable system of maintenance; are O&M manuals available.)
   20% failure rate.
   This was assessed more in line with the 'Does it work?' failure rate. Even though some RPs had a notional maintenance regime and/or O&M manuals in place, this made little difference to the 'as found' condition when visited.

8. Does it match the proposal? (i.e. there have been no unexplained changes.)
   3% failure rate.
   The sole instance where this occurred was a late change to the final exit design of a residential block of flats, about which the RP themselves had concerns and independently assessed and improved the design before occupation.

9. Is it actual Fire engineering or just difficult fire safety? (i.e. did it justify referral to FEG.)
   100% of the solutions, whether technically 'fire engineered' or not, were justified referrals to FEG.

10. Clear link from design (start) to Responsible Person (finish)? (i.e. can a 'golden thread' be established.)
    50% failure rate.
    An improved figure from previous, but again due more to chance than good practice, plus the author's somewhat generous assessment due to time constraints in producing this updated briefing.

Figure 3 on the following page provides a graphical summary of the results described above:

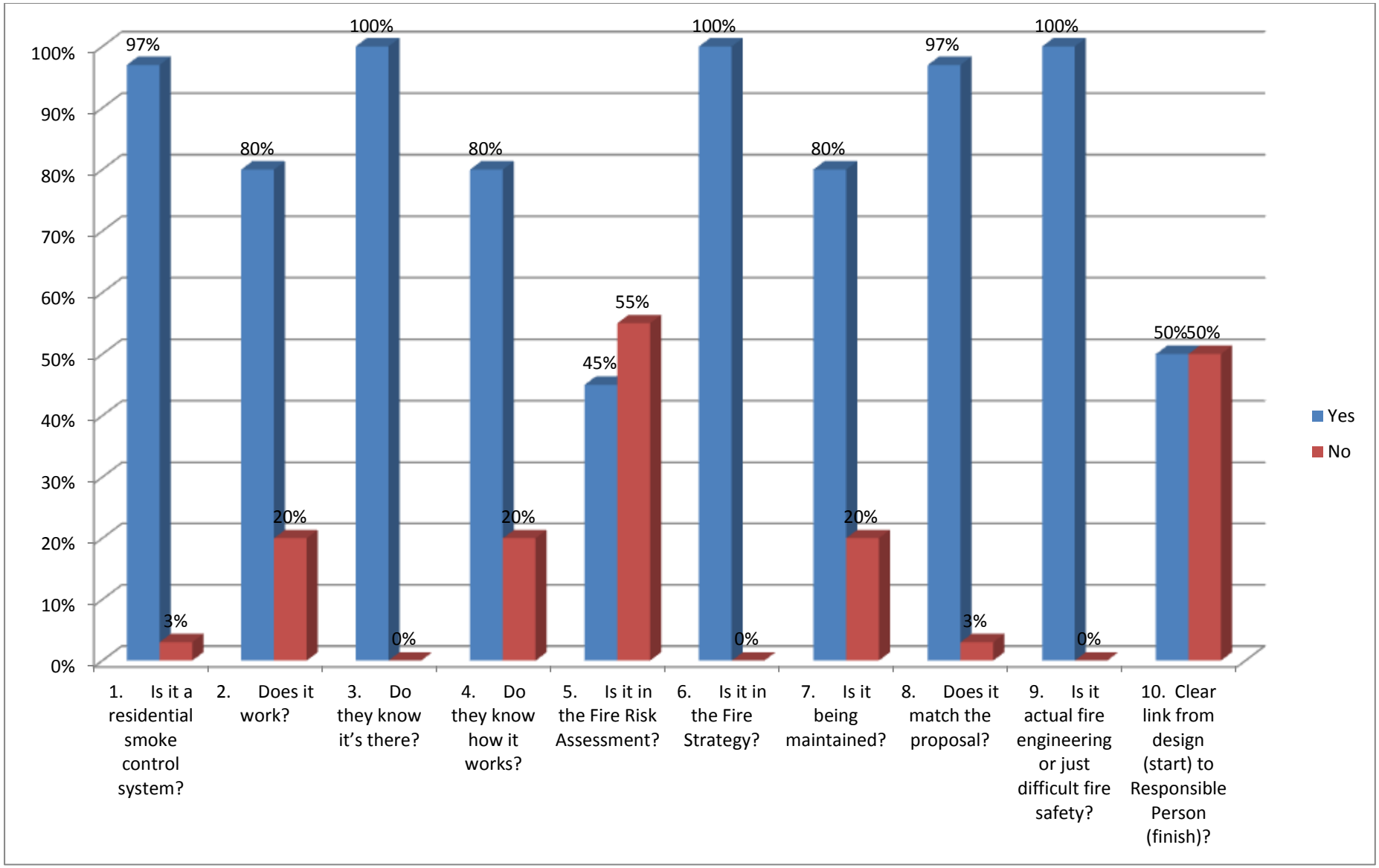

Figure 3 - Results Summary

Despite the improved failure rates, notable issues continue to surface similar to phase one failures. Some examples follow (all are residential blocks of flats >18m, except where stated otherwise):

- 'G Square'
    - Of the 4 x buildings inspected, numerous faults were found on 3 x MSVS panels; RP unable to determine what parts, if any, of the systems were working.
    - While a cursory check of the RP's management procedures suggested the development was well managed, further investigation disclosed the faults had been showing for several months, despite being reported regularly by on-site staff.
    - the MSVS Firefighter (FF) boost switches were unsigned and some were located such that it could not be determined which areas they likely served; this included FF boost switches adjacent to areas not covered by the MSVS and/or simply of unknown operation i.e. what were they supposed to do? The design fire strategy only covered the areas to be smoke ventilated in very general terms, lacking the above detail.
    - The 2013 fire strategy was vague and covered the whole development; nor was it mentioned by fire risk assessor.
    - The fire risk assessment indicated simultaneous evacuation was in place when in fact a 'stay-put' regime was (legitimately) in effect and the MSVS faults were rated 'low priority'.
    - An Enforcement Notice was issued as this development was also part of the most recent High Rise Task Force inspection program.
- 'B Heights'
    - Common parts smoke control was standard 'code-compliant' natural venting direct to open air via SD operated AOVs. However, the AOVs on all levels were found partially open at the time of inspection. It is still not clear if this was intentional for environmental purposes or simply poor or defective programming. In addition, the head-of-stair vent operating arm was broken.
- 'S Tower'
    - The MSVS FF boost switches were located on the half-landings in the stair i.e. it was unclear exactly which level they served – upper or lower?
    - A damper vent breached the fire resistant (FR) compartmentation between stair and corridor. It is mentioned in the O&M manual as a technical feature to be maintained but does not indicate its design purpose (the fire strategy was not available from the RP at time of report).
    - MSVS FF boost switch keys were not available (i.e. none in MSVS main panel control box in the ground floor entrance to the building).
- 'D court'
    - Some changes between design fire strategy and the 'as built' ground floor configuration took place after the RPs own assessment but before occupation; not recorded or appended in the design fire strategy.
- 'H Gardens'
    - 2 of 3 x MSVS not functioning correctly i.e. fans operated but dampers already open for environmental reasons on other floors, remained open in fire mode. This may or may not be a programming issue as the fans were tested manually rather than by smoke detection. The RP (a large property management company) stated that MSVS actuators were a constant substantial and continuing expense due to their high failure rate.
- 'CH' (student accommodation)
    - Reduced-width MSVS shaft opened correctly on activation but extract fans did not operate. Worryingly, there was no fault light (or any indication of power) showing on the MSVS panel at the time, despite the extract and inlet AOVs operating.
- 'B Street'
    - No common vented lobbies between flats and stair as usually expected for the height of building. The author dealt with this consultation and attended a joint design team &

building control (Approved Inspector) meeting. FEG's usual recommendation of a pressurised stair as an 'off-the-shelf' solution to this problem (as per BS EN 12101:6 para 4.5.1) was proposed and, at the time, seemed to be positively received. However, on this return visit several years later, only an AOV at the head of the open stair was found

- 'N Street' (un-sprinklered refurbished office building)
    - FF lift opens directly onto the floor plate, not into the FF lobby. 120minFR fire curtains drop on fire floor alarm activation but it is unclear if the 'as-built' cause and effect reflects this.
    - Colt-style MSVS to FF lobby but lobby is so small that it is unclear if smoke would be kept out of the stair during means of escape or fire fighting.
    - These and other issues were identified by FEG with a 'not satisfied' letter issued following referral.

It is the intention to return to most of these developments when circumstances permit, to ensure unresolved issues are properly settled. Some of the above examples would have been the subject of formal enforcement action had the engineer not been satisfied that the RP would rectify the most risk critical defects immediately (the engineer confirmed their repair shortly thereafter.

Going forward, there remain numerous buildings where FEG audits were intended and were more complex in nature but prematurely curtailed due to the present circumstances. These should be targeted when relative normalcy resumes. They include buildings where FEG highlighted serious concerns to the approving authorities but were never heard from or resolved; others where the potential issue of Alterations Notices should be considered; and still others where FEG were sceptical of the efficacy of the solution such as pressurised stairs, extensive use of fire curtains and atrium ventilation. It would be instructive to arrange on-site practical testing of some of these features in the next phase of FEG audits.

Themes

There are clear themes developing which could be further explored and disseminated, including:

1. For the coming building regulatory environment: sleeping accommodation smoke control and similar fire engineered solutions should be moved to the top of any 'Duty Holder' priority list; even above other life safety systems; so both the Duty Holder and Responsible Person are left in no doubt of the critical nature such systems play in the continued safe occupation of their buildings. Often the entire building's fire safety is designed around these systems.

2. For Fire Risk Assessors: if not already, it should be reinforced as part of their competency guidance that a building's design fire strategy is sought, digested and understood, as well as being referenced in the resulting Fire Risk Assessment. See the previous FEG audit briefing note for further comments on this subject.

3. For Responsible Persons: the monitoring, maintenance and repair of any sleeping accommodation MSVS should be given the highest priority in any building management system (BMS) or other management procedure; again, recognising the MSVS is often the central fire safety feature around which the rest of the building is designed. Of particular importance here is the follow-up to ensure the repair of this risk critical item has taken place. The nominated fire engineer found the best BMS automatically alerted senior management to the overdue repair of a risk critical item; the worst relied on the individual commitment of local staff (with varying degrees of success) or there was simply no such mechanism in place and nothing was checked or repaired until the yearly visit by the MSVS installer/maintainer.

4. For Smoke Control Association and similar industry bodies:

a) The location and useable signage of MSVS FF booster switches and the like (i.e. the yellow break-glass or key-operated boxes) was very poor and potentially would not be understood by attending firefighting crews with limited knowledge of such systems. Further guidance regarding this issue should be included in updated editions of relevant British Standards and other guidance in a similar fashion to LFB contributions in the past. In the meantime, this issue should be considered further by LFB FEG with a view to promulgating standard paragraphs for their own and wider LFB use.

b) In a number of instances there was no physical mechanism by which the Responsible Person could properly and easily test the routine operation of the MSVS in line with British Standard recommendations; the yearly installer/maintainer's engineer visit was often the only check if not prompted by a fault light, though even this was no guarantee.

c) The apparent high failure rate of MSVS/AOV actuators. Anecdotally, this seems a much higher probability than a fan failure.

There are other issues that could be further explored; the above is not an exhaustive list; however, the one standout issue that should be noted is regarding the 'Duty Holder' and the 'golden thread' of information is moving the knowledge, understanding (and crucially) the maintenance of any residential smoke control system to the top of the priority list; such systems being integral to the means of escape for occupants and firefighting operations and firefighter safety.

LONDON FIRE BRIGADE

Fire Engineering Thematic technical report

Identified trends from Building Regs Consultations and fire engineering audits

Quarter 2: April1st – June 30th 2020

14th July 2020

Fire Engineering Group – Quarter 2 2020 (April 1st – June 30th)

Summary

This thematic report has been produced for informational purposes and may be of particular interest to stakeholders working within the building design and (fire) safety field. Poor building design, management or maintenance can increase the risk to residents, communities and emergency responders.

The report is split into two sections; Part A) relates to data collected in the design phase of the building and Part B) relates to the occupation phase of the building. As this is a technical report, various standards and guides are mentioned, but not referenced in detail.

It has been produced using data collected from Building Regulations Consultations (BRCs) received and reviewed by LFB Fire Engineering Group (FEG) during quarter 2 (Q2) in 2020. The report also captures data from any audits conducted through fire engineering group on buildings for which they have been consulted on previously.

Part A – Design phase

The data for this section does not include BRCs dealt with by Inspecting Officers but focusses solely on consultations received by the Fire Engineering Group.

In this period there were a total of 86 consultations received by Fire Engineering Group with 113 responses issued.

Of these 113 consultations 68% were issued a 'not satisfied' response, which raises continued concerns about the quality of the submissions and potential safety concerns. The reasons for a 'not satisfied' response can be varied from insufficient information presented to a fundamental concern with the design approach undertaken. This report aims to capture some of the trends from this quarter.

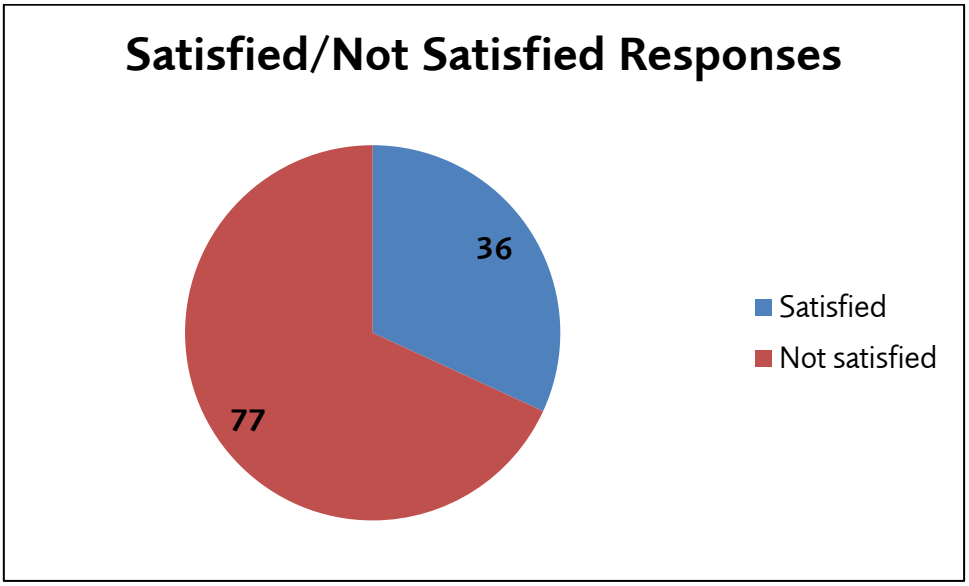

Figure 1 - Number of Satisfied and Not Satisfied Responses Issued in Q2

It can be seen from figure 1 that the overwhelming majority of consultation responses included a not satisfied statement.

Overview of technical issues and concerns

During Q2, fundamental and recurring issues were highlighted by fire engineers in 30 notable consultations. A breakdown of the pertinent points is provided below, which are further expanded upon within the main body of the report:

Continued Themes from Q1:

1) Apparent 'gaming the system[1]': Including for firefighting access and corridor ventilation.
2) Single stair commercial over 11m.
3) One consultation and fire strategy to cover multiple (up to 12) blocks.
4) Single staircase for mixed occupancy types e.g. office and residential.
5) Very tall single stair residential buildings with ancillary use.
6) Single stairs continuing down to basement levels.
7) Modern methods of construction (MMC) not fully justified.
8) Basement ventilation requirements misunderstood.

New Themes for Q2:

9) Omission of sprinklers.
10) Extended travel distance in flat entrance halls.
11) Lifts opening directly into flats.
12) Disabled evacuation: lack of consideration.
13) Extra care evacuation: lack of consideration.
14) Ground floor final exit routes connecting to covered car parks.
15) Residential smoke control for hotel corridors:
16) No qualitative design review (QDR).
17) Extension >18m without firefighting shaft provision.
18) Poor computational fluid dynamics (CFD) modelling.
19) No 3rd party reviews for CFD.

As highlighted at the forefront of the previous (Q1) report, FEG are still seeing proposals **(1)** for tall, single stair residential buildings just under 30m without sprinkler provision proposed. In these cases the sprinkler threshold is rarely mentioned in the fire strategy as it is considered to be 'code compliant'. This type of 'gaming the system' is also still being observed in projects just under 18m (but still may be 6 floors) where a full firefighting shaft is not provided. Furthermore, in Q2 we have observed projects whereby an extension above 18m is proposed but without firefighting shaft provision **(17).** Often the fire strategy observes this requirement but seeks to upgrade only some provisions without providing others such as a firefighting lift.

Where residential building heights exceed 30m, we are continually reviewing proposals to omit sprinklers within these developments so far as possible, such as for ancillary or commercial portions **(9)**. This may relate to a basement car park or ground floor commercial unit and is not, in our opinion, in accordance with the functional requirement B3 as unsprinklered elements of structure are not permitted in residential buildings >30m in height. There is little or often no consideration for the impact of an unsuppressed fire within these spaces on the structure or on aspects of design such as external fire spread, where there are connections between these spaces and means of escape for the residential areas. This aim to 'omit sprinklers so far as possible' has been clearly stated within fire strategies also

[1] 'Gaming the system' indicates potentially wilful manipulation of the building regs, e.g. to avoid additional burdens or costs, height of building is 29.99/30 metres but still 10 floors, to avoid requirements for sprinklers.

where their use is specified as a compensatory feature for departures from guidance within flat layouts. The provision is often misunderstood, in particular where a protected entrance hall exceeds the 9m permissible in guidance **(10)**. In 2 cases, the proposal was to provide suppression in the entrance hall only, which we view as fundamentally unacceptable as these spaces should be a relatively 'sterile' area, with the risk being attributed by the unsprinklered habitable rooms.

Another area whereby FEG are seeing an enhanced level of risk within residential blocks, is the proposal to include a lift opening directly into a flat **(11)**. This has been observed in consultations on projects proposing an additional top storey with luxury penthouse type apartments and also for one larger project in particular where each flat has its own lift connecting to basement amenity (leisure) spaces and individual car parking garages. These designs often don't consider how effective compartmentation is to be maintained. Furthermore FEG have raised concerns regarding the ability of the managing agent to effectively carry out their monitoring and maintenance duties to comply with the fire safety order in this scenario.

When focusing on tall building designs, we are seeing more assessed to BS:9991:2015, as opposed to ADB as highlighted under point 5 of the Q1 report. However, we are continuing to find that the QDR process is often not adhered to **(16)**. One engineer responded that because a QDR was only 'recommended' and that BS9991 was only guidance that they did not see the need to complete it despite the building in question being very tall. Furthermore, many tall designs **(5)** still include ancillary use (such as lounges, terraces etc.) on upper floors which is not appropriately considered in the fire strategy. Often we find that the fire strategy treats ancillary use similar to that of a flat which we fundamentally disagree with. We have asked for further consideration of the evacuation strategy (simultaneous) and introduction of what could be considered to be a different occupancy risk category in a building with a single stair over 11m. Where consideration is given to the evacuation strategy in this scenario, we have found that this only considers occupants reaching the stair and does not consider vertical evacuation for disabled occupants **(12)**. This aspect frequently remains unanswered in a residential setting due to a lack of adequate on site response and the difficulties in installing adequate measures such as an evacuation lift. When continuing on the theme of evacuation, consultation has also been received in Q2 for two separate 'extra care' premises where the evacuation to 'ultimate safety' was inadequate **(13)**. In both cases a stay put policy was proposed, with inadequate detail on the means for evacuating residents if required. Where this was considered, again the mechanical means and staffing necessary for vertical evacuation of residents was not detailed. This is critical in such a setting where occupants may be incapable of evacuating without assistance.

Single stair commercial projects over 11m **(2)** in height are still commonly proposed without suitable measures to mitigate the resiliency and redundancy normally provided by a second stair. Proposals are frequently only reliant on a single provision such as sprinklers or a smoke control system rather than a package of measures to holistically address the risk. The single stair theme **(4)** continues through a number of consultations whereby the stair incorporates multiple uses e.g. hotel and residential. In Q2 this was one of the most common themes reported by engineers as can be seen in figure 2. When reviewing some hotel consultations, FEG have observed residential mechanical smoke ventilation systems (MSVS) being applied to compensate for extended travel distances **(15)**. This approach appears to mirror that for residential corridors by cross referencing industry guidance for flats however we have highlighted in our responses that, as a hotel uses a simultaneous evacuation strategy this approach is not directly comparable.

Another common and recurring theme observed within FEG is the production of a single fire strategy for large site developments with multiple cores **(3)**. Our responses to Building Control Bodies (BCB) in Q1 have not yet seen a change in this regard in terms of design teams approaches to this. A site wide

fire strategy with individual 'as built' fire strategies for each block aids in the fire services review but also upon handover through the regulation 38 process to the Responsible person.

Another common theme still observed in Q2 is for single stairs continuing down into basements **(6)**. Reference is still made in fire strategies to BS:9991 to then include a door at ground floor within the stairwell and a 0.4m^2 natural vent in the basement lobby. FEG have again found a lack of consideration in fire strategies given to firefighting access into the basement which, in this scenario, could cause loss of tenability in the single stair. When considering links to car parks, in particular: the potential for firefighting intervention to impact on the protected route for escaping occupants. FEG are also seeing ground floor covered car parks linked to the stair/lift lobby areas at ground floor **(14).** Again, 0.4m^2 permanent ventilation is commonly proposed for the lobby, however this is not as prescribed in BS:9991:2015 guidance in the cases to which it has been applied (single stair situation). Furthermore, when the covered car park is mechanically ventilated, assessment is made regarding the ability of the system to perform as a 'smoke clearance system'. We highlight that the system should be designed and assessed as a 'smoke control' system as it fulfils a function of protecting the final exit routes. Furthermore, we view in this case that the design should either; have suitable redundancy and backup power supplies (Clause 15, BS 9991:2015) or; the systems performance is analysed at its lowest worst case specification e.g. 50%.

FEG are continuing to observe that a number of projects refer to the basement level **(8)** as not requiring ventilation on the basis that the individual compartments are no bigger than 200m^2. As stated in the Q1 report, FEG's view is that this is an incorrect interpretation of the guidance which clearly defines the entire basement storey size in this consideration. Aside from this aspect of ventilation, it has been observed in Q2 that for one project it was proposed that sprinkler protection is provided to compensate for a lack of basement ventilation. While sprinklers could provide certain advantages they do not perform the same role as a smoke clearance/control system and therefore, in our view, can not be used to compensate non provision of such a system.

In Q2 FEG were re-consulted **(7)** on a modular construction project where it was observed that the method remains with an apparent lack of a cohesive approach to the fire safety design. FEG raised fundamental concerns that the modular method of construction, in FEG's opinion, has not been appropriately evidenced to enable sufficient understanding of its structural performance in a fire incident. FEG therefore remain of the view that the approach appears to mirror several other MMC projects (e.g. Cross Laminated Timber or CLT) across London whereby there is insufficient understanding on the building's fire performance. Furthermore, it was observed that the fire strategy lacks clarity on the building methodology and fails to recognise the impact this has on the buildings fire performance, in particular its structural integrity. Where FEG find that MMC and/or very tall buildings are assessed to ADB, this may be viewed as inappropriate. FEG highlight the recent publication: The Manual to The Building Regulations (July 2020) which mirrors FEG's views that ADB may not be appropriate for such 'non-standard' conditions.

Where CFD modelling is utilised as a tool for demonstrating particular aspects of a design submission **(18)**, FEG request that the input and output files are provided along with any accompanying reports. This allows FEG to understand the input and output parameters, and more crucially the justification behind these. FEG are finding that this approach is very inconsistent and in some projects highlighted in Q2, this has led to both a poorly constructed CFD approach and invalid output data which has not been able to fulfil the aim of the CFD study. As this process of checking the CFD takes FEG some considerable time, we request that any CFD modelling is supplied with a third party review/accreditation. This is an area we have been lobbying building control bodies on for some time. However we are finding that this process is sometimes not followed **(19).** Where this is followed, we are also finding that the review does not include scrutiny of the input and output files, instead only the

CFD report. This cannot be considered a suitable review as a CFD report alone does not provide enough data to make a useful conclusion on whether the CFD approach is valid. This area would really benefit from industry guidance and a set standard on third party peer reviews which includes reference to who should be able to undertake them (in terms of competence) and what should be reviewed as part of the process i.e. both the model and report.

Again, for Q2, a number of consultation responses were recorded with a similar issue, thus allowing us to identify themes emerging. Figure 2 shows the number of times a particular issue was recorded by a Fire Engineer:

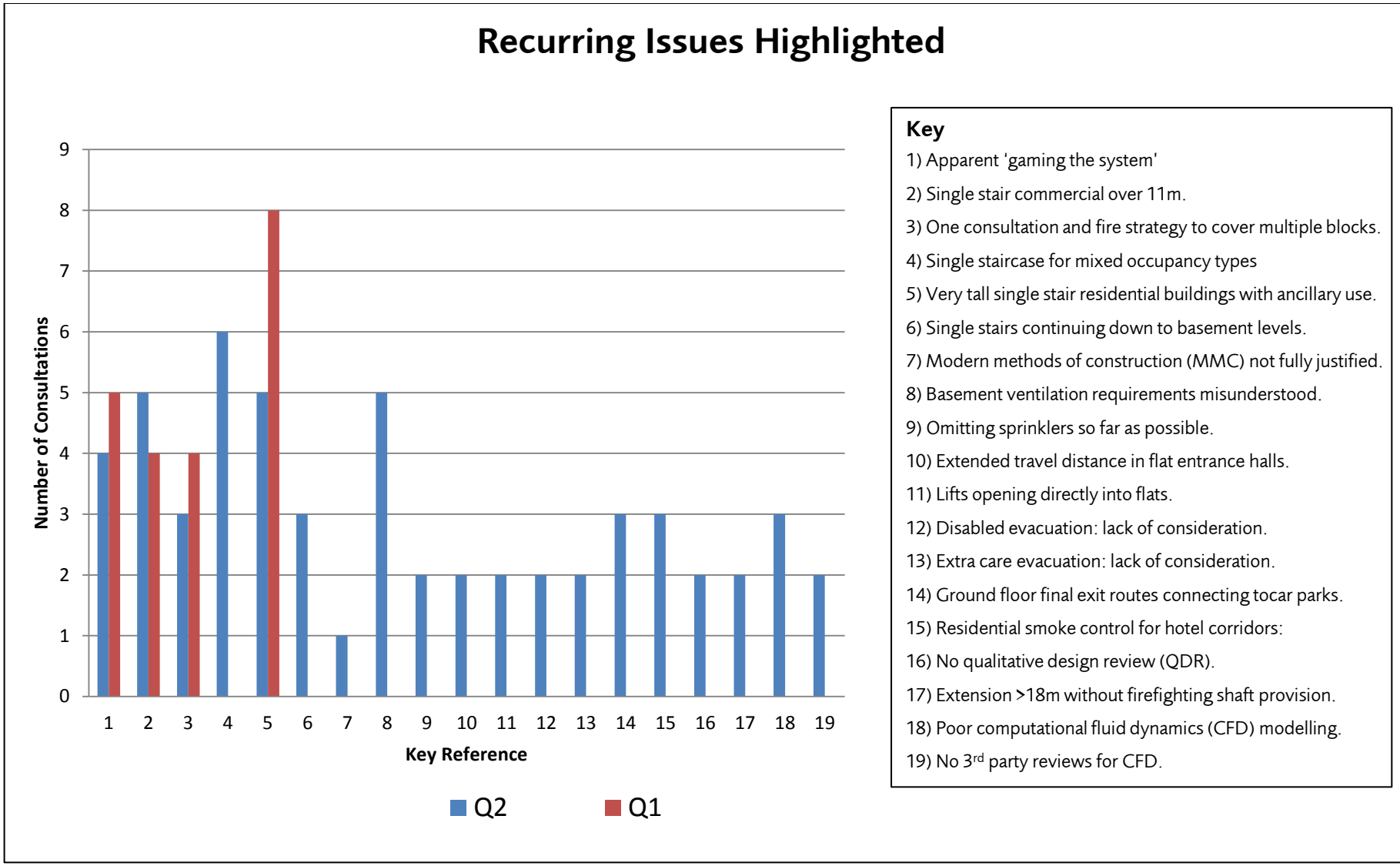

Figure 2 - Emerging Themes In Consultation Responses for Q1 and Q2

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Part B – Occupation phase

Due to the COVID-19 pandemic, no fire engineered audits were carried out in Q2.

LONDON FIRE BRIGADE

Fire Engineering Thematic technical report

Identified trends from Building Regulations Consultations and fire engineering audits

28 October 2020

Fire Engineering Group – Quarter 3 2020 (1 July – 30 September)

Introduction

This thematic report has been produced for informational purposes and may be of particular interest to stakeholders working within the building design and (fire) safety fields. Poor building design, construction, management or maintenance can increase the risk to residents, communities and emergency responders.

The report is split into two sections; Part A) relates to data collected in the design phase of the building life cycle and Part B) relates to the occupation phase of the building life cycle. As this is a technical report, various standards and guides are mentioned, but not referenced in detail.

It has been produced using data collected from Building Regulations Consultations (BRCs) received and reviewed by LFB Fire Engineering Group (FEG) during quarter 3 (Q3) of 2020. The report also captures data from any audits conducted by Fire Engineering Group on buildings for which they have been consulted on previously.

Part A – Design phase

The data for this section does not include BRCs dealt with solely by LFB Inspecting Officers in our area Fire Safety teams but focusses solely on those consultations sent to the LFB FEG.

In this period there were a total of 138 consultations received by FEG with 133 responses issued.

Of these consultations, 58% were issued with a response which raised concerns that FEG viewed as not satisfactory and therefore requiring further consideration/justification. It should be noted here that this represents an improvement in the Q2 outcome of 68%, however this still demonstrates continued concerns about the quality of the submissions and potential implications for safety. Figure 1 below illustrates this:

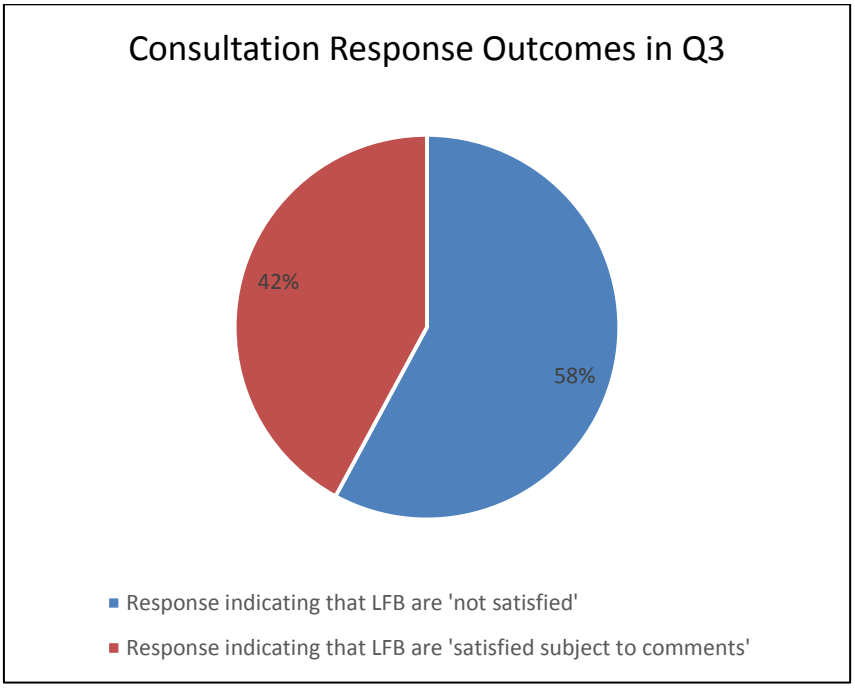


Figure 1 - Consultation response outcomes in Q3

Overview of technical issues and concerns

During Q3, fundamental and recurring issues were highlighted by fire engineers in 31 consultations. A breakdown of the pertinent points is provided below, which are further expanded upon within the main body of the report:

It was decided for the Q3 report that the points are categorised into the areas shown in the key below. This will hopefully enable the easier identification of the fields in which the themes relate to:

Table 1 - Themes for Q3

Means of escape **1.** Single staircase for mixed occupancy types e.g. office and residential; **2.** Single stairs continuing down to basement levels; **3.** Disabled evacuation: lack of consideration; **4.** Extra care evacuation: lack of consideration; **5.** Tall single stair extra care facility; **6.** Refurbishment leading to complex means of escape shared between purpose groups; **7.** Phased evacuation for hotel; **8.** Transfer corridors on upper levels to link between two firefighting shafts.	
Ventilation **9.** Basement smoke ventilation requirements misunderstood; **10.** Residential smoke control approach proposed for hotel corridors; **11.** Smoke ventilation via the ventilated stair lobby with refuge space.	
Design/Construction **12.** Apparent 'gaming the system[1]': Including for firefighting access and corridor ventilation; **13.** Single stair commercial over 11m. – One was 26m in height, current theme is to provide lobby extract systems as opposed to pressure differential systems (LFB preferred solution); **14.** Modern methods of construction (MMC) not fully justified. – More modular designs not fully considered; **15.** No qualitative design review (QDR) where warranted; **16.** Exposed cross-laminated timber (CLT) in office buildings >18m & >30m with insufficient justification; **17.** Schools assessed to BS 9999 as opposed to BB 100, which is the primary design guide; **18.** Classification as 'small single stair building' when above 11m; **19.** Residential approach to extra care (e.g. extended corridors);	
Firefighting Access **20.** Extension >18m without firefighting shaft provision;	

[1] 'Gaming the system' indicates potentially wilful manipulation of the building regs, e.g. to avoid additional burdens or costs, height of building is 29.99/30 metres to avoid requirements for sprinklers.

21. Single firefighting shaft for large office building with floor area >900m^2; **22.** Poor firefighting access route;	
Fire Suppression **23.** Omission of sprinklers; **24.** Use of watermist untested in its proposed application; **25.** Sprinkler coverage to enclosed balconies/winter gardens.	
Consultation **26.** Computational Fluid Dynamics (CFD) third party reviews do not assess input/output files; **27.** Varied approach to providing building control body comments; **28.** Third party review concerns submitted but remain unresolved; **29.** One consultation and fire strategy to cover multiple (up to 12) blocks;	

Refurbishment projects

The theme in Q3 has been heavily centred around refurbishment. As the layout of buildings, particularly heritage buildings, can be difficult and costly to alter, a change of purpose group (for example office to hotel) has led to complex layouts and/or an increased use of active fire protection systems such as mechanical smoke ventilation **(6)**. Active fire protection provisions/systems may then require a higher level of fire engineering analysis, due to variables in their design and operation, and subsequent maintenance following occupation. One office to residential conversion project proposed the use of an existing atrium for means of escape purposes where it was proposed that compartmentation was to be achieved by horizontal fire curtains. Such proposals lead to a design heavily reliant upon the performance of active measures where passive measures would have been anticipated when following the recommendations of guidance (i.e. no connections/voids between floors and protected common corridors). Those measures are then relied upon for protecting means of escape in case of fire, and for providing appropriate firefighting access.

Through LFB's audit regime, under the Regulatory Reform (Fire Safety) Order 2005, LFB Inspecting Officers have encountered situations, particularly in residential premises with less on-site management, whereby active provisions do not operate effectively when tested and/or are not maintained in accordance with the manufacturers' requirements. FEG have also observed that refurbishment/ conversion designs are limited by the existing number of stairwells and that additional (internal) stairwells can be difficult to incorporate **(1)**. This again leads to complex means of escape arrangements as well as a requirement to limit occupancy numbers on upper floors.

A management requirement/expectation is easily written in to a fire strategy to justify the use of a single stair or other departure from guidance, without the understanding of whether or not this will be a practicable and realistic measure post-occupation (in particular, it should be considered whether the responsible person will be willing to commit to any such increased requirements). This aspect is made clear in ADB in Paragraph 0.6.

FEG raised concerns in relation to one project in particular where, as part of a refurbishment project to alter the premises from non-sleeping to sleeping use (hotel), a phased evacuation strategy was proposed **(7)**. Where a phased evacuation strategy is proposed, FEG expect sound justification for this with reference made to the management of the building and passive and active fire safety provisions. FEG raised concerns which had been overlooked, such as the lack of a management plan, extended travel distances, excessive hose distances and hotel rooms opening directly onto firefighting stairs.

Third party (peer) reviews

FEG frequently receive consultation packages containing one or more secondary reviews of the fire engineering assessment(s) involved. Any such review, particularly where CFD analyses are involved, is typically carried out by a third party where the specialist competence is not available to the building control body (BCB) in-house and, in such cases, the review is intended to support them in their approval decision making. While this is a positive step change, FEG have observed in Q3 an increase in the number of consultations whereby concerns raised in such a review remain unresolved **(28)**. It can therefore appear as though the BCB considers that the purpose of the review is to satisfy the LFB and that the final decision over the suitability of the analyses sits with the fire and rescue authority rather than the BCB in their capacity as the approving authority for the Building Regulations. Furthermore, in regards to third party reviews, FEG have observed in Q3 that often such reviews consider only the CFD reports and not the input and output/results files comprising the model **(26)**. In these cases, FEG has questioned whether the third party reviews were able to fulfil their function of informing the BCB as to the suitability of the CFD modelling in intended to validate the proposed design. This is because there have been numerous cases where the input and output/results files have been reviewed by FEG and errors have been found in the models themselves. Thus the results can not necessarily be relied upon, dependent upon the extent and nature of the errors identified.

Consultation pro-forma use

FEG have observed a welcome increase in the use of the LFB pro-forma by BCBs. This assists FEG in being able to understand the proposals better, and may also account for the reduction in 'not satisfied' responses. However, FEG have also noticed that the supporting commentary from BCBs varies considerably in the level of detail provided **(27)**. On occasion, the response has been addressed directly to FEG by the fire engineer/design team, despite the initial/previous LFB consultation response letter addressing concerns to the BCB. On some projects FEG have observed that, despite the fire engineers' comments, the BCB have also provided their own detailed comments, which we very much support. The latter practice appears to be increasing, which is encouraging. FEG continues to work with the BCB liaison group (with ACAI and LDSA representation) to promote the submission of a pro-forma with consultations. From August 2021, it is our expectation that the pro-forma provided in Appendix J of the current Building Regulations and fire safety procedural guidance will be provided for all consultations submitted to LFB.

Fire and rescue service access and facilities

In Q3, FEG have observed projects whereby difficulties are faced in complying with functional requirement B5 at a late stage of project completion **(22)**. It was observed in one project that the dry rising main (DRM) inlet was located in a narrow side passage adjacent to the building. As the DRM could not be relocated, enhancements to the sprinkler provision were welcomed due to the potential delay incurred in implementing high-rise firefighting procedures. Further access issues in Q3 involved situations whereby the code expectation of siting a pumping appliance (fire engine) within 18m of the DRM inlet and/or 18m from the DRM inlet to the firefighting stair, was exceeded. One compensatory feature proposed for the project included a horizontal main, however FEG highlighted that the distance is not simply a matter of hydraulics but also the transportation of heavy firefighting equipment and the resulting physiological impact upon firefighters.

FEG have reviewed a number of consultations proposing only a single firefighting shaft in office buildings **(21)** despite having a floor plate >900m^2 in area. This departure from ADB/BS 9999 guidance is often justified only on the basis of compliant hose distances without acknowledging the additional resilience and redundancy provided by the second firefighting shaft. In one scheme, the BCB engaged with the LFB/FEG early in the design process, including through a pre-consultation, which led to an additional firefighting shaft being provided. This highlights the benefit of a pre-consultation, which is expanded upon further in a later section of this report.

Further on the subject of stair designs, in this case for tall buildings: FEG have been disappointed to observe a resurgence in proposals for use of 'transfer corridors' on upper levels to link two firefighting shafts **(8)**, as reported in the Q1 thematic report. It is highlighted in this scenario that FEG do not support, as a matter of principle, the utilisation of transfer corridors or similar as part of the firefighting access route but acknowledge that in certain, very limited circumstances they may be unavoidable (e.g. structural restrictions). In these specific instances, our expectations would be for them to be treated as an extension to the firefighting shaft, i.e. any adjoining area must be separated by a firefighting lobby (as defined in BS 9999: 2017) and for them to be short and intuitive in nature. However, basic principles of fire safety should be adopted such that, once occupants and firefighters are within protected routes, they should be able to remain within this protection until they egress the building. Some of the designs FEG have seen do not support this principle.

Similarly there has been an unwelcome return to scissor stairs being proposed for firefighting purposes. These are not appropriate for firefighting as they often discharge at different points on alternate floors which, depending on the layout, may require firefighters to utilise both stairs for firefighting purposes and/or take hose from a dry rising main outlet on a floor which is not the floor directly below the fire floor as per LFB policy.

Single stair developments

The single stair commercial theme has continued into Q3 **(13),** with one proposal in particular extending 63m to the uppermost storey with stairs merging at lower levels, which effectively created a single stair condition as a fire affecting the merged stair at that level could affect both the stairs simultaneously. Following comments FEG made on the consultation, the design team then agreed to the provision of two independent stairwells, albeit with a more complex layout at ground floor level. Where the single stair consultation concerned a hotel, as opposed to an office, FEG highlighted concerns regarding firefighting access upon crews attendance as this will likely occur whilst the evacuation of the hotel is still taking place due to the anticipated increase in pre-movement time. The flow of evacuating occupants may result in a significant delay in implementing firefighting operations.

Where ventilation is proposed as a compensatory feature to mitigate the single stair situation, FEG still see this specified as extract in the stair lobbies as opposed to our preference for the provision of a suitable pressurization system. FEG view the latter provision to be more robust in a typical single stair scenario, particularly where lobbies are small, may house the disabled refuge points in some instances and when considering the potential effect of access via full height doors. This is because pressurization systems are designed to prevent smoke from entering the stairs and lobbies altogether, whereas lobby extract systems by their design intent involve smoke being drawn into the lobby at the fire floor.

As highlighted in the Q1 and Q2 reports, FEG are also still seeing a single, common stair proposed for the use of multiple purpose groups **(1)**. In Q3, FEG observed one refurbishment project proposing a single stair for office and residential purposes with a complex network of corridors at ground floor and upper levels. The desire to omit fire suppression systems where possible has again continued into Q3 **(23),** as FEG still observe proposals to provide suppression coverage to only the residential areas of tall buildings >30m, despite ancillary commercial and/or car park areas proposed for the lower levels. The guidance in ADB Vol. 1 (2019), in FEG's opinion, is clear in this regard: unsprinklered elements of structure are not permitted for (part or all) purpose group 1 buildings >30m in accordance with Table B4. FEG have observed justification based upon time equivalence studies or a short reference to the tested levels of fire resistance and we have questioned the validity of this approach.

FEG have received a number of projects whereby subsequent concerns have been raised regarding the proposed method of fire suppression. With regard to watermist suppression: FEG have observed some projects whereby watermist is proposed but, in a similar vein to our concerns surrounding MMC, where it is untested in the specific application to which it is being proposed **(24)**. It is important to note here that, while the component test standard BS 8663-1:2019 can be complied with, BS 8458 and 8489 expect manufacturer specific testing to have taken place) to demonstrate that the system is fit for purpose in its

specific application. FEG highlight that there is no universality in design as there is with sprinkler systems and components tend to be 'manufacturer specific' which should be third party accredited to perform adequately as a system. Once such proposal was for a large hospital building which proposed high pressure watermist to justify significant variations from the recommendations of guidance, such as a reduction in the level of structural fire protection, which did not appear to be supported by suitable fire test data/reports. The design also included watermist proposed for an atria and a car park – both of which may involve ventilation conditions detrimental to the performance of a high pressure watermist system. In fact, the car park solution required firefighters to manually cease the watermist operation and manually actuate the smoke control system. Proposals to place reliance on fire crews to ensure fire protection measures are effective are inappropriate in FEG's opinion.

Further FEG concerns surrounding suppression were raised in Q3 regarding enclosed balconies, in particular those referred to as 'winter gardens' **(25)**. FEG observed designs which appeared to differ from the BS 9991 design intent as furnishings were proposed for these areas, effectively creating an inner habitable room. BS 9251 sprinkler provision was omitted in these areas due to concerns surrounding the maintenance of the system in the winter months and how this may effect the remainder of the system. FEG however maintain the opinion that the intent of the guidance is that sprinkler protection should be provided throughout the dwelling. Further to this, according to the ADB definition, this area is considered a *'habitable room'* and thus should be afforded the same level of sprinkler protection as the remainder of the flat. Additionally, given the apparent lack of storage options these apartments offer and the fact these balconies are able to offer a high degree of weather protection, it is foreseeable the enclosed winter balconies may be used to this end. An example of this is shown in Figure 2 below:

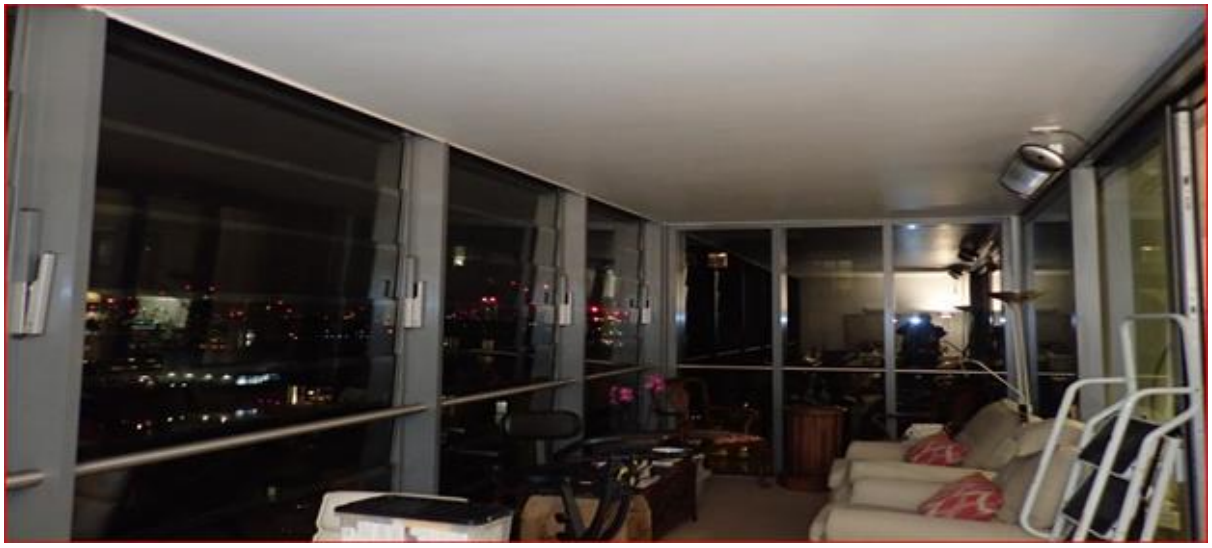


Figure 2 – Use of enclosed balcony as a habitable room

FEG highlighted in the Q3 published report that the danger of balcony fires are well known and made further reference to the LFB publication Fire Safety Guidance Note no. *95 Fires involving Balcones in Residential Premises*.

FEG have observed proposals for schools applying BS 9999 as opposed to BB 100, despite the clear design expectation (expressed in design guidance) that the latter document is used **(17)**. This prevents the use of the risk assessment tool to consider whether sprinkler provision is warranted. FEG highlight a position expressed by the LFB and NFCC: that schools are critical to their community and the provision of sprinklers can prevent significant disruption to learning following a fire incident. FEG also highlight that a property protection system may also provide a significant benefit in terms of the life safety performance of the design.

Smoke control systems

One consultation that FEG reviewed in Q3 involved both an unconventional application of a residential smoke ventilation solution to a hotel in combination with the use of the same smoke ventilation system to ventilate basement compartments via the common corridors **(9)(10)** . In this case, a form of scissor stair design was proposed without firefighting lobbies, instead utilising a mechanical smoke ventilation system within the hotel common corridors and adopting SCA guidance intended for purpose built blocks of flats. FEG raised fundamental concerns over the ability of the proposed system to provide adequate protection to the stair and requested that further consideration is given to the way in which the system can adequately support the simultaneous evacuation strategy. FEG highlighted that the SCA guidance considers a 2 to 3 minute time in the means of escape phase for the corridor conditions to be returned to a tenable environment, after the initial evacuation from the unit of fire origin. This criteria is not appropriate where occupants will be evacuating via the common corridor throughout these 2 to 3 minutes. Furthermore, in regards to basements, FEG do not support the use of smoke ventilation of basement compartments via corridors as the intent of guidance is for ventilation to be from within the fire compartment, protecting the access route for firefighters.

'Gaming the system'

FEG have observed more examples of attempts to 'game the system', as have been reported in Q1 and Q2 **(12)**. This quarter has highlighted residential schemes over 11m **(18)** where flats are proposed to open directly into the stair (as permitted in a small single stair building <11m in ADB guidance). These designs incorporate duplex or triplex flats on the top floors of a residential block, with access to the common stair on a floor <11m in height, however the top occupied storey is <11m in height. This creates a conflict which is often not addressed within the proposed design in regards to the 11m benchmark being coupled with external rescue by firefighters. Where the stair is internal, FEG have also observed that this can lead to a design whereby the AOV cannot be positioned at the head of the stair as required. One design even proposed ventilation of the common stair, through a stair within a dwelling, which FEG raised fundamental concerns with.

Modern methods of construction

In Q3 FEG were consulted **(14)** on two new modular construction projects where it was observed that there was an apparent lack of a cohesive approach to the fire safety design. FEG raised fundamental concerns that the modular method of construction, in FEG's opinion, had not been appropriately evidenced to enable sufficient understanding of its structural performance in a fire incident. This fundamental concern has been raised on modular projects in the past which is evidenced in the Q1 and Q2 reports. FEG are of the opinion that a modular project cannot be assessed holistically without this in place as the fire performance is critical to the decisions over whether the proposed fire safety provisions are adequate in supporting the design.

Continuing on the topic of MMC: a number of cross-laminated timber (CLT) pre-consultations and consultations have been received in Q3. One project in particular proposed that elements remain exposed in some areas **(16)**. FEG are aware that, for CLT, there is a current gap in available test evidence which must be acknowledged and accounted for in the fire safety design of CLT buildings. These projects also require specific competence within the design team and BCB. FEG observed for all CLT projects received, that the testing of CLT is limited only to the fire resistance of the CLT slab. This does not support FEG or the BCB/Approving Authority to understand the fire performance of the structure, including whether there is potential for other factors to occur such as delamination of the layers to name but one.

Specialised housing and disabled evacuation

FEG received a number of consultations in Q3 regarding 'extra care' premises. It was observed that the means of escape provision in many of these consultations was designed in the same way as a general needs premises therefore did not consider the potential for impaired mobility of residents **(5)**. FEG also

observed extended corridors in an extra care block **(19)** which, although possibly justifiable in a general needs setting, should warrant additional consideration and perhaps enhancements to fire safety provisions where occupants' travel to the relative safety of the stairwell may be significantly prolonged due to their mobility. The fire safety design should also consider the potential need, for the responsible person to carry out person centred risk assessments. Where this process results in occupants being unable to evacuate without assistance, the fire strategy should define the proposed measures required to mitigate this, such as enhanced staffing provision and/or mechanical aids, e.g. an evacuation lift(s). This aligns with the concerns raised in Q2 whereby the evacuation to 'ultimate safety' was inadequate **(13)**.

In Q3 consultations, FEG again observed that a stay put policy was proposed **(3) (4)** with inadequate detail on the means for evacuating residents where this was considered, the mechanical means and staffing necessary for vertical evacuation of residents was not detailed. This is critical in such a setting where occupants may be incapable of evacuating without assistance.

FEG have observed in Q3 however that the positioning of a disabled refuge space is not given sufficient consideration **(11)** in accordance with Annex G of BS 9999:2017. FEG have observed that, in more that one proposal for a single stair office premises, the refuge space is proposed within the ventilated lobby directly adjacent to the point at which mechanical smoke extraction will take place. FEG therefore questioned how this could be considered a place of relative safety. This is coupled with schemes FEG have reviewed whereby the location of the refuge has been placed within toilets and other unacceptable locations.

General matters

Other items which were again highlighted in Q3 and following on from the same detail provided in the Q2 report were: consultation and fire strategy covering multiple blocks **(29)**, single stairs continuing down to basement levels **(2)**, lack of QDR **(15)**, and lack of FF shaft provision in buildings >18m **(20).**

FEG have observed that, for item **(2)**, there appears to be an increased awareness of this issue within fire strategies when compared to earlier quarters, which is encouraging. However justification remains to be provided that the lobby ventilation (sometimes only a natural POV/AOV) will be able to cope with any demands placed upon it by a basement fire. FEG have observed that justification also commonly makes reference to the on-floor basement ventilation system without considering any conflict which then may occur with the lobby ventilation system, where all doors are propped open in the firefighting phase of an incident. It appeared, in many of these scenarios, that providing a separate basement stair at ground floor level would not be challenging to incorporate but that the stair continuation risk had only been realised well into the scheme when it could not be easily altered. This highlights the benefit of a 'pre-consultation' with the LFB and FEG early on into a design process and also highlights the need to raise awareness of this issue amongst BCB's and building designers.

A number of pre-consultation meetings were carried out in Q3 whereby positive changes where made by the design team as a result of the involvement of FEG, the BCB and the local fire safety team. This included:

- A proposal for a CLT building where the design team agreed to implement a programme of testing for CLT (although we are yet to ascertain the scope of the testing and whether this will allow sufficient understanding of the materials fire performance)
- A new-build tall single stair mixed-use building which, due to its height would require either a second stair or significant fire safety engineering design and features to mitigate the additional risk. In this case, at the pre-consultation meeting (at the request of the BCB) the client design team proposed smoke extract to the stair lobbies and provision of sprinklers. These were minimum features already required for buildings of this height. FEG therefore robustly challenged this and were later advised by the BCB that a second stair would now be part of the design.

- A new-build tall office building above an existing London Underground station. The means of escape provisions were generally satisfactory. However, the lack of standard firefighting provisions would have caused considerable complications for firefighting operations. This included complicated and restrictive appliance and firefighter approach, exceptionally excessive firefighter travel distances, and a single firefighting shaft when a minimum of two firefighting shafts are expected. FEG consistently challenged the design from the initial pre-consultation. The eventual formal building control consultation showed no change to the design and FEG again challenged the design, citing our pre-consultation comments and advice. An updated 2020 consultation was subsequently received in Q3 which showed that FEG advice and recommendations had been followed and the design had been amended.

FEG believe that many of these changes may not have occurred, had the original design not been robustly challenged and the LFB stance consistently held. Although this shows the benefit of a pre-consultation meeting, FEG have perceived a theme in some cases relating to the overall aim of the meeting which was: to gain LFB approval for a design which was potentially unsafe. Our anticipated aim from all parties involved in such a meeting would always be to work through a solution which would achieve the ultimate aim of providing a level of safety that was equal to or better than the code expectation.

It can be seen from Figure 3 below that the aim for this Q3 report and for the thematic report going forward is to highlight the number of occasions on which concerns were raised for each of the categories shown in Table 1 and expanded upon in the main body of the report:

It should be noted here that the results depicted in the pie chart in Figure 3 below are not indicative of the number of bullet points in Table 1 but the number of occasions a concern was raised relating to each category in Q3:

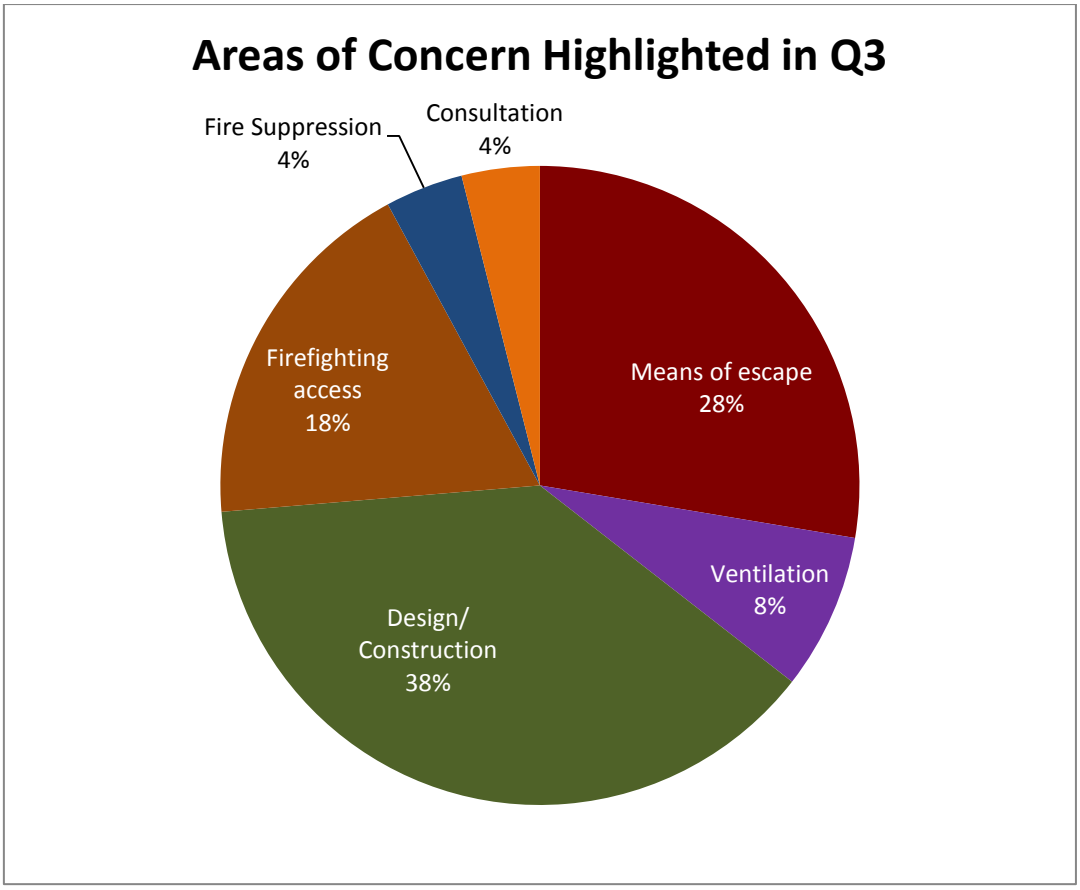


Figure 3- Areas of concern highlighted in Q3

Part B – Occupation phase

Due to the COVID-19 pandemic, no fire engineered audits were carried out in Q3.

LONDON FIRE BRIGADE

Fire Engineering Thematic technical report

Identified trends from Building Regulations Consultations and fire engineering audits

Ouarter 4a: 1 October – 31 December

4 January 2021

Fire Engineering Group – Quarter 4a 2020 (1 October – 31 December)

Introduction

This thematic report has been produced for informational purposes and may be of particular interest to stakeholders working within the building design and (fire) safety fields. Poor building design, construction, management or maintenance can increase the risk to residents, communities and emergency responders.

The report is split into two sections; Part A) relates to data collected in the design phase of the building life cycle and Part B) relates to the occupation phase of the building life cycle. As this is a technical report, various standards and guides are mentioned, but not referenced in detail.

It has been produced using data collected from Building Regulations Consultations (BRCs) received and reviewed by LFB Fire Engineering Group (FEG) during quarter 4a (Q4a) of 2020. The report also captures data from any audits conducted by Fire Engineering Group on buildings for which they have been consulted on previously.

Part A – Design phase

The data for this section does not include BRCs dealt with solely by LFB Inspecting Officers in our area Fire Safety teams but focusses solely on those consultations sent to the LFB FEG.

In this period there were a total of 127 consultations received by FEG with 112 responses issued.

Of these consultations, 84% were issued with a response which raised concerns that FEG viewed as not satisfactory and therefore requiring further consideration/justification. It should be noted here that this represents an increase in the Q3 outcome of 58%. This raises heightened concerns about the quality of the submissions and potential implications for safety. Figure 1 below illustrates this:

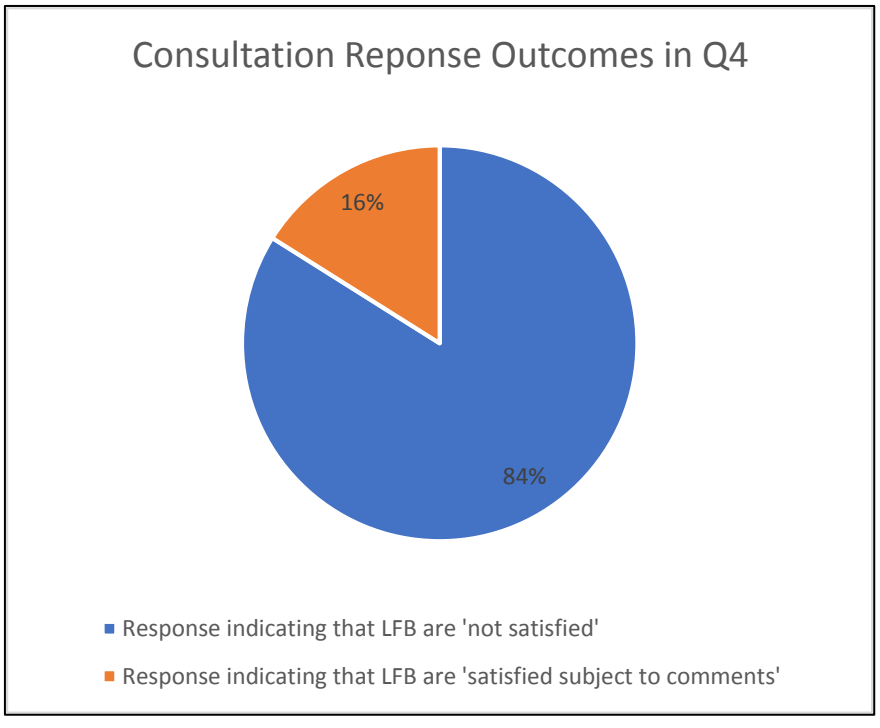


Figure 1 - Consultation response outcomes in Q4a

Overview of technical issues and concerns

During Q4a, fundamental and recurring issues were highlighted by fire engineers in 16 consultations. A breakdown of the pertinent points is provided below, which are further expanded upon within the main body of the report:

It was decided for the Q4a report that the categorisation of points is continued in the same way adopted in the Q3 report which is again shown in table 1 below. This will hopefully enable smoother identification of the fields in which the themes relate to:

Table 1 – Themes for Q4a

Means of escape **1)** Single staircase for mixed occupancy types e.g. office and residential; **2)** Single stairs continuing down to basement levels; **3)** Disabled evacuation: lack of consideration; **4)** Complex means of escape shared between purpose groups; **5)** Reliance on unprotected means of escape for evacuation; **6)** Phased evacuation strategy using manual fire alarm system; **7)** Residential care home (occupants elderly and those with dementia) 'delayed evac' as opposed to PHE. This included a 25m long corridor with a residential MSVS; **8)** Single stair, evacuation incomplete at fire service arrival time.	
Ventilation **9)** Basement smoke ventilation requirements misunderstood; **10)** Lack of ventilation provided to mixed use single staircase. Positive outcome as the proposal now includes a pressurised stairwell in accordance with BS EN 12101-6 (Class C); **11)** Unsuitable ventilation design in extended corridors >30m in length, single direction of travel; **12)** Portion of basement not provided ventilation, justification does not adequately consider firefighting (compartmentation).	
Design/Construction **13)** Apparent 'gaming the system[1]'; **14)** Single stair commercial over 11m; **15)** Exposed cross-laminated timber (CLT) in office buildings >18m & >30m with insufficient justification; **16)** Residential approach to extra care (e.g. extended corridors); **17)** Compartmentation not understood for refurbishment project; **18)** Fit-out fire strategy significantly alters key fire safety measures designed in the shell and core build such as structural fire protection.	
Firefighting Access **19)** Extension >18m without firefighting shaft provision; **20)** Single firefighting shaft for large office building with floor area	

[1] 'Gaming the system' indicates potentially wilful manipulation of the Building Regs, e.g. to avoid additional burdens or costs, height of building is 29.99/30 metres to avoid requirements for sprinklers.

>900m^2; **21)** Excess hose distances in hospital built to recommendations given in BS 9999 as opposed to HTM Firecode guidance; **22)** Extended horizontal dry rising main distance; **23)** Firefighters lift opening into residential apartments.	
Fire Suppression **24)** Omission of sprinklers; **25)** Basement hotel using watermist and 10 ACH ventilation system in corridors only.	
Consultation **26)** One consultation and fire strategy to cover multiple (up to 12) blocks; **27)** Consideration given to use of alterations notice upon occupation; **28)** Speculative fire strategy at late stage of build; **29)** Enforcement action taken upon occupation despite items being highlighted within the BCB consultation.	

Basements

A number of basement projects were observed in Q4a whereby fundamental concerns were raised. The means for venting the basement(s), as reported in previous 2020 reports, were in some cases highlighted by FEG as being unacceptable **(9)** in meeting the functional requirements of the Building Regulations as the intent of guidance is for ventilation to be from within the fire compartment, protecting the access route for firefighters. For one project, the proposal was to vent smoke from the corridor only, in the same way we would expect on the upper levels, to provide protection to the stair. Another project proposed venting some compartments but not others, with justification centred around the level of compartmentation provided in the basement **(12).** FEG highlighted the lack of consideration given to the firefighting access route in this example.

FEG observed one project which proposed a large, multi-level basement hotel with a watermist system and smoke ventilation system provided within the corridors only **(25)**. FEG questioned the effectiveness of watermist when restricted to these locations, particularly when the smoke ventilation system is activated automatically upon detection of smoke.

'Gaming the system'

As referred to in the thematic reports covering earlier quarters of 2020, FEG have continued to observe example of attempts to manipulate the guidance so as to avoid key fire safety provisions. One example of this in Q4a was an extension to office/retail premises to provide two additional floors (fifth, sixth) **(13)**. As this takes the building height (to topmost occupied storey) over 18m, the measurement was only taken to the fifth floor so as to then be considered outside of the requirement for provisions such as a firefighting shaft **(19)**. The sole justification then implied that an implicit assumption of guidance was that, as the sixth floor is partly open to the fifth, therefore forming part of a gallery, it then does not need to be considered as the uppermost occupied storey in line with BS 9999. FEG raised fundamental concerns over this justification, particularly as the sixth floor was served by the same protected stairwells. This is also proposed to be constructed of CLT with the design detail for the CLT yet to be provided **(15)**. FEG also therefore observed that the CLT provision would lead to combustible materials within the

external wall which perhaps provided further motivation to use a measurement of <18m for the height of the building.

Disabled evacuation

FEG continue to observe projects whereby the evacuation of vulnerable residents is not given suitable consideration **(3)**. In a basement hotel project FEG observed that the arrangements for the vertical evacuation of disabled occupants had not been adequately considered. The basement aspect makes this a more critical aspect as a increased level of staffing maybe necessary to enable occupants to ascend stairs.

For a residential care home 'delayed evacuation' was employed as opposed to PHE **(7)**. This was proposed via a 25m corridor where residential MSVS analysis had been applied **(16)**. FEG expressed concerns that the evacuation strategy involved complex arrangements with no consideration paid to the conflict in means of escape and firefighting operations. FEG highlighted the requirement for potential rescues in this scenario where firefighters may be required to lead evacuation which should not be the aim when designing a safe building.

Single stairs

Q4a saw a range of schemes proposed with a single stair proposed for design where the prescriptive guidance would advise two stairs and/or enhanced protection due to the building height **(14)**. One notable project greater than 30m in height proposed watermist, compartment floors and a Category L1 fire alarm system. Although the CFD modelling in this case demonstrated the stair was protected from ingress of smoke, evacuation modelling showed that evacuation will still be ongoing by the time crews have set up and are ready to enter **(8).** It should be noted here that, even where the evacuation modelling results demonstrate a relatively short evacuation time, this does not negate the importance of providing robust protection to the single stair such as sprinklers and a suitable class ofpressure differential system conforming to BS EN 12101-6. FEG raised concerns with one project which did just that: as the required safe egress time (RSET) was calculated at a time prior to anticipated fire and rescue service (FRS) arrival,the design team considered that no enhancements were appropriate.

In Q4a, FEG continued to received designs whereby the single stair is proposed to continue down into basement levels **(2)**. As reported in Q3, justification remains to be provided that the lobby ventilation (sometimes only a natural POV/AOV) will be able to cope with any demands placed upon it by a basement fire. FEG have observed that justification also commonly makes reference to the on-floor basement ventilation system without considering any conflict which then may occur with the lobby ventilation system, where all doors can reasonable be expected to be propped open in the firefighting phase of an incident. This aspect combined in Q4a with another project, which FEG have raised fundamental concerns with, whereby the basement car park is not proposed to be sprinklered **(24)**. This was despite linking to the residential building above with a top storey >30m. Fire resistance levels were used as justification without acknowledgement that unsprinklered elements of structure are not permitted in buildings >30m with residential use, in accordance with the recommendations given in ADB. FEG highlighted that the link to the single stair in this case increases the risk substantially.

The theme observed in Q3 of using a single stair for mixed occupancy types **(1)** continued into Q4a, including one project in particular which combined ADB Purpose Groups 3, 4 and 5 in a tall building with a single protected stair. The arrangements for means of escape were observed as complex **(4),** for example on the lower floors, where reliance was placed on a central accommodation stair **(5)**.

FEG observed a further proposal in Q4a to provide a mixed use single staircase without ventilation **(10)**. Following the initial consultation the proposal now includes a pressurised stairwell. However, FEG raised

concerns on the latest response that the latest revision of the fire strategy does not include suitable analysis for the provision including the classification of pressure differential system.

In justifying the use of a single stair for evacuation of a tall building, FEG have observed link to the evacuation strategy. One project in particular involved the proposed use of a phased evacuation strategy to design the stair capacity for a lesser amount of occupants evacuating at any one time. FEG raised concerns as the proposal lacked clarity on the means for supporting phased evacuation, in particular due to the proposed provision of a manual means of raising the alarm in the event of fire only **(6).**

Firefighting access

The provision of only a single firefighting shaft was observed in Q4a for buildings with a floor plate >900m^2 **(20)**. As reported in previous quarters, justification for this continues to be centred around compliant hose laying distances, without consideration of the redundancy afforded by an additional firefighting shaft. FEG observed that the only aspect missing on one project, to provide the additional firefighting shaft was a firefighters lift and therefore highlighted the importance of ensuring that the sole firefighters lift was operational at all times with no resilience if it were to become unavailable due to unanticipated faults or planned maintenance.

One project in particular in Q4a proposed more than one firefighters lift, but these were also proposed to open into apartments **(23).** FEG questioned how this could be considered adequate, particularly without having control over the use of the area adjacent to the lift on each floor.

In Q4a FEG responded to a hospital consultation assessed to BS 9999 as opposed to HTM Firecode guidance **(21)**. FEG overserved that the use of BS 9999 guidance led to a lesser standard of ventilation provision in the atrium. FEG raised concerns over the lack of information regarding the design fire used for CFD analysis supporting the means of smoke ventilation proposed for the atrium as well as large portions of the upper floor plates, which were in excess of 45m hose laying distance.

To achieve adequate hose laying distances with a single stair, FEG commonly observe designs which incorporate a central stair core as opposed to one close to or bordering an external wall. In previous thematic reports it has been highlighted that this can lead to either complex and long routes to the stair at ground floor level or a transfer on an upper floor, both of which require significant justification and/or additional protection. In Q4a FEG observed a project which was proposing a horizontal dry rising main of nearly 70m **(22)**. This is well over and above the 18m maximim required by BS 9990 and should be run internally to ensure the facility to drain and maintain the pipe. In this example it was also observed that the central stair core did not lead directly to a final exit which was only available via another core or a car park.

Shell and core vs fit-out

FEG commonly receive the shell and core consultation separately from the fit-out consultation. This has led to concerns whereby the shell and core fire strategy is not given due consideration in the fit-out phase, perhaps because a different BCB and design team are involved and/or due to the wishes of the client. In Q4a FEG raised concerns with a fit-out for a tall building **(18)** whereby the compartment floors were originally used as justification for reduced 90 mins fire resistance to some structural elements. The fit-out proposes atrium/accommodation stairs spanning 5 floors at lower and upper sections (10 total). No ventilation was proposed, as recommended in BS 9999 (Exemplar C.5). The proposal was instead to use the HVAC system for smoke clearance, which resulted in our fundamental concerns. ASET vs RSET analyses are underway to demonstrate suitability of the proposed design, which will be awaited in further consultation in the next calendar year.

Consultation

For refurbishment projects, FEG have often observed that the assessment of the current standard of compartmentation is not considered as part of the programme of works **(17).** FEG have highlighted on these occasions our assumption that a full compartmentation survey will be carried out. FEG view that the fire strategy should detail the method for achieving the required levels of fire resistance for elements of structure as opposed to merely stating what the requirements are, as pasted from the design guidance. This has been highlighted in previous quarters reports and was again evident in Q4a. Another previously highlighted concern observed in Q4a was having one fire strategy to cover multiple blocks **(26).**

FEG felt it necessary in one consultation to remind the recipient of the powers of LFB inspecting officers under Article 29 of the Regulatory Reform (Fire Safety) Order 2005 as FEG viewed that an alterations notice may be served upon occupation due to the fundamental concerns raised which had not been addressed **(27)**.

Following the completion of one particular project where FEG and the local LFB Fire Safety team raised fundamental concerns, in Q4a, an enforcement notice was issued by the local team to the responsible person who had just taken control of the premises after the completion stage of development **(29)**. This highlights that, where our concerns go unresolved, LFB may utilise powers under Article 30 of the Regulatory Reform (Fire Safety) Order 2005 to reduce/remove the risk posed to relevant persons where this risk is not sufficiently mitigated in the design and build phase. Consideration should be given here to other important factors which may impact upon building owners and occupiers. This may include both the cost implications of the delays and remedial works and the potential disruption to any occupation schedule.

In Q4a, FEG have raised concern on occasions whereby the project appears to be at a late stage of completion however the fire strategy provided is not a recent revision and remains speculative in nature **(28)**. FEG have observed phrases indicating there are unconfirmed areas/actions still to be decided upon despite the BCB stating their position to approve the design.

It should be noted here that the results depicted in the pie chart in Figure 3 below are not indicative of the number of bullet points in Table 1 but the number of occasions a concern was raised relating to each category in Q4a:

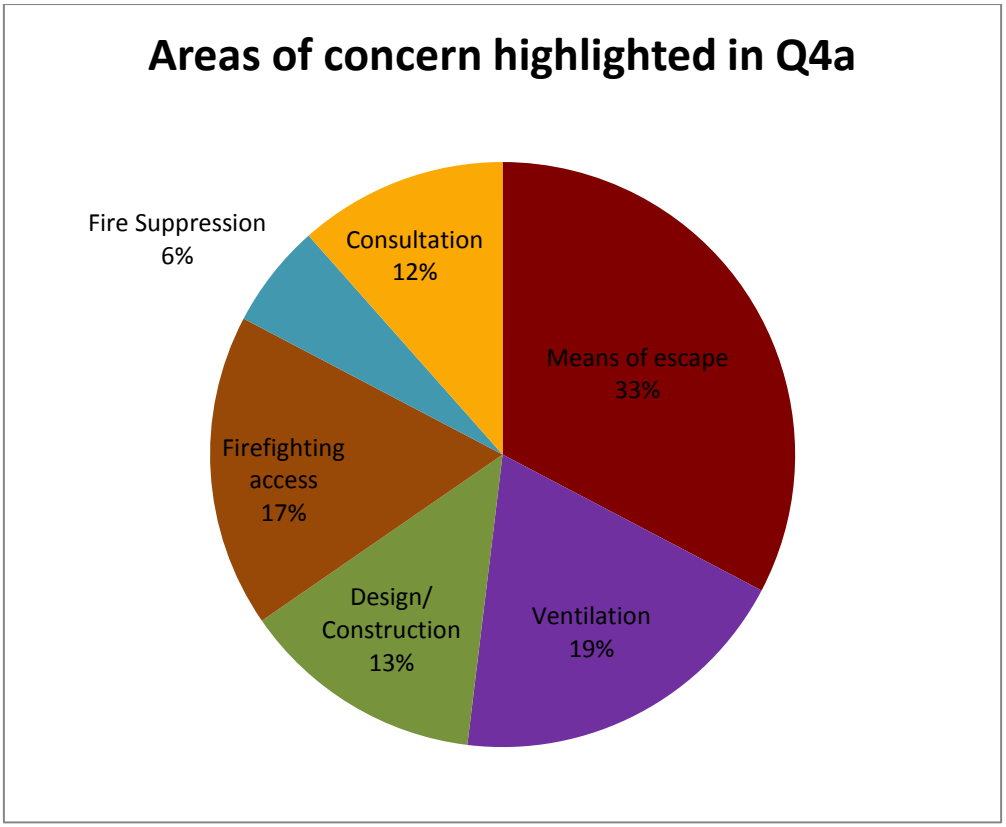


Figure 2- Areas of concern highlighted in Q4a

Part B – Occupation phase

Due to the CoVID-19 pandemic, no fire engineered audits were carried out in Q4a.

LONDON FIRE BRIGADE

Fire Engineering Thematic technical report

Identified trends from Building Regulations Consultations and fire engineering audits

Ouarter 4b: 1 Januarv– 31 March 2021

12 May 2021

Fire Engineering Group – Quarter 4b 2021 (1 January – 31 March)

Introduction

This thematic report has been produced for informational purposes and may be of particular interest to stakeholders working within the building design and (fire) safety fields. The report highlights a selection of the cases of poor building design which have been presented to LFB in this quarter. Poor building design, construction, management or maintenance can increase the risk to residents, communities and emergency responders.

The report is split into two sections: Part A) relates to data collected in the design phase of the building life cycle and Part B) relates to the occupation phase of the building life cycle. As this is a technical report, various standards and guides are mentioned, but not referenced in detail.

It has been produced using data collected from Building Regulations Consultations (BRCs) received and reviewed by LFB Fire Engineering Group (FEG) during quarter 4 of 2020. The report also captures data from any audits conducted by Fire Engineering Group on buildings for which they have been consulted on previously.

Please note that this report is provided for Q4 to align the reporting with the financial year. This differs from the previous reports which aligned with the calendar year. Therefore please note that this report covers the period 1 January 2021 – 31 March 2021. The next thematic report will be entitled: Quarter 1 2021 and will reflect trends from the period: 1 April – 30 June 2021. .

Summary

This report completes a one year cycle of data trend capture by LFB FEG. These reports are circulated to a number of external stakeholders and LFB plan to continue to issue these while there remain key areas of concern with submissions received for consultation.

It is evident that matters such as competence, 'gaming' of the system, the capture/sharing of critical design information with responsible persons coupled with the effective ongoing maintenance/ management of fire safety systems remain general areas of concern, as was highlighted in the Independent Review of Building Regulations and Fire Safety conducted by Dame Judith Hackitt.

That said, there have been some areas of improvement and these have been noted in regards of:

- the information provided within consultation packages e.g. the increased use of the consultation pro-forma (as detailed within the latest edition of Building Regulations and fire safety procedural guidance)
- Increased evidence of independent peer reviews being undertaken (albeit the quality of these reviews can be variable)

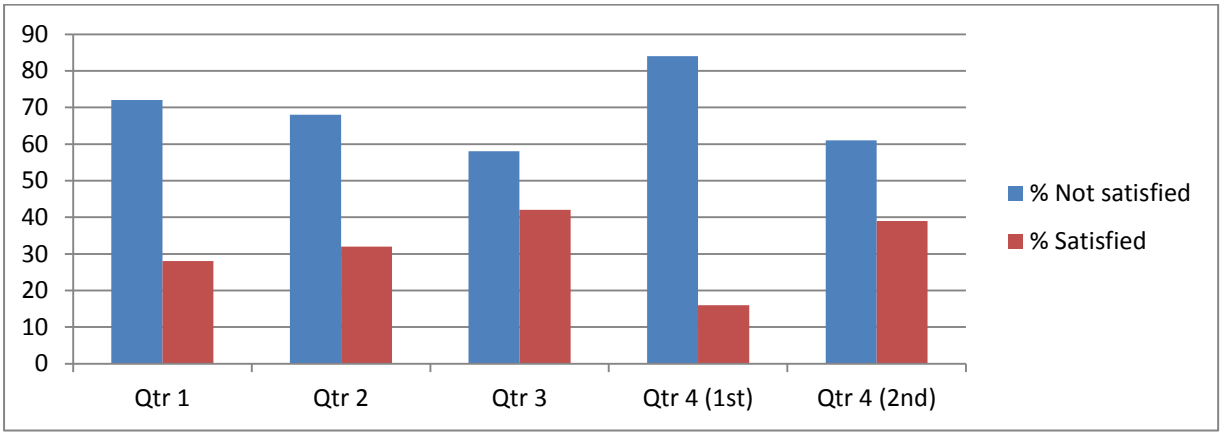
Part A – Design phase

The data for this section does not include BRCs dealt with solely by LFB Inspecting Officers in our area Fire Safety teams but focusses on those consultations sent to LFB FEG.

In this period there were a total of 115 consultations received by FEG, with 94 responses issued.

Of these consultations, 61% were issued with a response which raised concerns and indicated that FEG viewed the proposals as not satisfactory and therefore requiring further consideration/justification. It should be noted here that this represents improvement in the previous report outcome of 84%. This change could be as a result of a number of factors. Figure 1 below illustrates this and the data across the year for context:

Figure 1 - Consultation response outcomes between January 2020 and end-March 2021



Overview of technical issues and concerns

During this quarter, fundamental and recurring issues were highlighted by fire engineers in reviewing a number of consultations, of which 12 are selected and focused upon for the purposes of this report. A breakdown of the pertinent points is provided below, which are further expanded upon within the main body of the report:

It was decided for this report that the categorisation of points is continued in the same way adopted in the previous report which is again shown in Table 1 below. This will enable suitable identification of the fields to which the themes relate:

Table 1 – Themes for Q4(b)

Means of escape **1)** Shared single staircase for mixed occupancy types, e.g. office and residential; **2)** Single stairs continuing down to basement levels; **3)** Extended travel distance in hotel corridors; **4)** Glazed firefighting shaft; **5)** Potentially conflicting evacuation strategy for multi-purpose high rise building with single stair; **6)** Duplex open plan flat with open stair; **7)** Disabled evacuation: lack of consideration; **8)** Reliance on an unprotected means of escape for evacuation;	
Ventilation	

9) Residential smoke control proposed for hotel corridors; **10)** Localised pressure differential system (PPV) proposed; **11)** Computational fluid dynamics (CFD) for mechanical systems not following SCA guidance where the corridor travel distances are in accordance with ADB; **12)** Misunderstanding surrounding use of mechanical smoke ventilation systems (MSVS); **13)** CFD modelling: window breakage proposal without justification; **14)** CFD modelling: ventilation at incorrect location; **15)** CFD modelling: soot yield not considered to be a conservative value.	
Design/Construction **16)** Fire curtains at ground floor assumed to mitigate open plan layout; **17)** Inappropriate use of electromagnetic door hold open devices; **18)** Apparent 'gaming the system[1]'; **19)** Care home with unsuitable evacuation lift arrangements; **20)** Single stair commercial over 11m; **21)** Encapsulated cross-laminated timber (CLT) construction for firefighting shaft and upper floors of commercial premises; **22)** Lifts serving common parts opening directly into flats; **23)** Lifts opening directly into office floor plate; **24)** Living/'green' walls not adequately considered in line with ADB recommendations; **25)** Residential approach to extra care (e.g. extended corridors); **26)** Fit-out fire strategy not suitably justifying issues with the shell and core design;	
Firefighting Access **27)** Extension >18m without firefighting shaft provision; **28)** Services not associated with the firefighting shaft incorporated within the firefighting shaft; **29)** Compartmentation provided in lieu of basement ventilation.	
Fire Suppression **30)** Watermist proposed with no supporting information relevant to the proposed application/premises use.	
Consultation **31)** Third party review did not include an assessment of the input/output files for CFD modelling	

Whilst some of the points numbered 1-31 above represent new entries to the thematic report, a number of the themes were identified in previous reports most notably surrounding the following issues:

[1] 'Gaming the system' indicates potentially wilful manipulation of the building regs, e.g. to avoid additional burdens or costs, height of building is 29.99/30 metres to avoid requirements for sprinklers.

The single stair and the use of smoke control

FEG reviewed a new project for a single stair serving an office/hotel continuing down to two basement levels **(2)** which had not been adequately justified. This is a recurring theme and issue despite wider discussions/views of some parties about the ongoing use of single stair approach. Consideration had not been given to the impact on the single stair in the event of firefighting intervention in the basement. It would be likely that a number of doors would be propped open to the basement during firefighting, therefore smoke could migrate into the staircase and have the potential to impact upon the means of escape for occupants in a building with a floor level greater than 55m. Due to the height of the building, and key departures from Building Regulations guidance including extended travel distance within hotel corridors on upper floors **(3)** and a method of adopting a residential style smoke control for this hotel scenario **(9)**, FEG raised fundamental concern with the design. FEG requested that significant alterations were considered, particularly in respect of the approach to the means of escape design.

Smoke Control Association (SCA) guidance considers a 'stay put' evacuation strategy within the document and not a simultaneous evacuation strategy. FEG also highlighted that the SCA guidance considers a 2 to 3 minute time in the means of escape phase for the corridor conditions to be returned to a tenable environment after the initial evacuation from the unit of fire origin. We do not consider this criteria as appropriate where occupants would be reasonable expected to be evacuating via the common corridor throughout this time period and potentially beyond. This was previously highlighted in the Q3 thematic report so is a recurring theme, whereby a fundamental concern has been raised relating to the incorrect approach to the smoke control design. This highlights that there may be some misunderstanding within the industry over the expectations of the mechanical smoke ventilation system (MSVS) for certain scenarios (**12)**. Where a design relies on a corridor MSVS system to maintain tenable conditions within that corridor, for the purposes of a simultaneous evacuation this could be questionable in terms of achievability. FEG have highlighted the primary purpose of a residential corridor MSVS is to protect the staircase.

This project also involved a mixture of hotel use on upper levels and office use on lower levels **(1)**. The use of single stair for mixed occupancy types can be said to be another common theme due to its mention within previous versions of this report. A key consideration is the variation in the use of the stair for different occupiers. For the office use it can be said that, as occupants are awake and familiar, pre-movement time, and thus evacuation time, may be relatively short and well controlled due to the high level of staffing. However, for hotel occupants who may be asleep, will be unfamiliar with the building and/or under the influence of alcohol, this may be longer, with PD:7974-6:2019 referencing a potential pre-movement time of up to 30 minutes. This type of multi-purpose arrangement served by a single stair over 11m in height **(5)** falls outside of the scope of BS 9999 and BS 9991 and as such FEG expect that a fire engineering framework should be followed and the proposals carefully considered to ensure that the design will meet the functional requirements.

Another tall single stair design, which provides a new example of a continuing theme, was encountered in Q4(b), this time an office building of approximately 26m in height **(20)**. A mechanical system of depressurisation was proposed for the firefighting lobby as opposed to the preferred option of providing a pressure differential system in accordance with BS EN 12101-6 (Class B). FEG highlighted that, while one of the objectives is to keep the stair free of smoke in both means of escape and firefighting phases, it is not the only objective. The removal of the second means of escape removes the alternative option for both escape and firefighting, therefore the objective of the package of measures (including the smoke control), in FEG's view, should be to replicate the resilience and redundancy offered by an alternative stair(s). This therefore introduces additional objectives of the smoke control system in this scenario.

The proposed extract in the firefighting lobby means that the firefighting lobby at the fire floor will not be maintained free from heat and smoke, in the same way that a pressurisation system to BS EN 12101-6, Class B system would offer. The lobby extract will be drawing heat and smoke into the lobby and therefore into the path of firefighters when they open the lobby door to the accommodation area, versus a pressurisation system whereby the airflow direction is into the accommodation from the lobby. This is exacerbated when using a single stair as firefighters have no alternative route to enter the floorplate and attack the fire. In this specific case, FEG's opinion was that the airflow must be in the direction from the stair through the lobby to the floorplate. Furthermore, with a single stair design, the required disabled refuges are often located in the lobby. Therefore, there is also a need to maintain this area free from heat and smoke at all times in addition to the single stair.

FEG reviewed one consultation in this quarter whereby a localised pressure differential system (PPV) was proposed **(10).** The PPV unit does not work in accordance with this general principle. However, as the PPV unit proposes using the principles of positive pressurisation to provide smoke control, the design principles described in BS EN 12101-6 are relevant. Clause 8.2.3 of BS EN 12101-6 advises that "*The pressurized refuge or other space shall not be connected to an unpressurized stair…..*" . The risk is that smoke entering the lobby may be forced into the stair which will be at a lower pressure than the lobby. In the case of the PPV Unit, air is being drawn from the stair, effectively depressurising the stair. FEG have serious reservations regarding these largely untested units. They are not advocated as an 'off-the-shelf' design solution in any current guidance, such as Approved Document B Vol. 2, BS 9991:2015 or BS 9999:2017, nor has it been shown they conform to a recognised British Standard such as BS EN 12101-6:2005. FEG are of the opinion that this is a bespoke solution and should be supported by project specific CFD analysis.

The use of CFD to demonstrate smoke control design

In this quarter FEG have continued to review CFD modelling, often provided with consultation packages to demonstrate the suitability of a MSVS, for example, within the common corridor in a purpose built block of flats. On two occasions, FEG has observed an approach whereby the means of escape phase of a fire incident was not modelled **(11)**. The justification put forward in each case made reference to travel distances within the corridor in accordance with guidance for each project. However, FEG highlighted that this approach is not referenced within SCA guidance. BS 9991:2015, Annex A.3 'Considerations for the selection of an MSVS' (which does not solely apply to extended corridor designs) also clearly states that "*It is important that the ventilation rate of an MSVS is decided through an assessment of any specific risks within the building and verification through a computational fluid dynamics (CFD) analysis or mathematical calculation*." The MSVS should be demonstrated to perform equal to or better than a natural ventilation system (as recommended in BS 9991:2015, Clause 14.2.4) in any comparative analysis and, when undertaking a deterministic analysis, the acceptance criteria should include tenability in both the means of escape and firefighting phases, irrespective of corridor travel distance.

Another CFD modelling aspect which is commonly seen, and detailed on previous thematic reports, is regarding the provision of openings within the fire compartment. FEG have observed these being located at high level **(14)** to reflect the known geometry of the flat. Where a CFD model then includes simulation of breakage of this window, it can result in a large proportion of the simulated products of combustion leaving the fire compartment via the high level opening and therefore not influencing the corridor conditions. In this case, FEG highlight that the purpose of the CFD model should be to provide a robust and conservative verification of the MSVS design and should not necessarily attempt to simulate a particular fire scenario. This window breakage **(13)** is commonly simulated without suitable justification or reference within the CFD report. FEG have also observed assumptions that, when temperatures are simulated to reach 300°C in the fire compartment, as is commonly assumed to be

required for window breakage to occur, that the whole window will fail. FEG have questioned whether full (or even partial) failure in a sprinklered fire scenario would occur and whether this assumption allows for a conservative test in the CFD analysis.

Another common application of CFD analyses, and observed by FEG in this quarter, involves open plan flat designs whereby duplex flat design is proposed, without a protected stair **(6)** and/or combined with extended travel distances. For one open plan flat project, FEG highlighted the use of a soot yield value which was well below the default value for polyurethane and therefore may not provide a suitable level of conservatism **(15)**. The soot yield value is a critical input parameter as it impacts upon the toxicity of the smoke and ability of an occupant to see through smoke. Visibility is assessed in the means of escape phase to determine whether conditions are tenable for occupants to make their escape. The recommended value given in the recently published *SCA guidance on CFD analysis for Smoke Control design in Buildings (SCA, 2021)* is 0.1g/g (10% soot yield), which is intended to incorporate a level of conservatism and account for hydrocarbon based furnishings and contents in modern dwellings. This value has also been recommended in SCA guidance since 2012, derived from the inputs used in the research reported in BRE Project report no. 213719 (BRE, 2005). However, one CFD study that FEG reviewed involved only a 0.0325g/g (3.25% soot yield) input, which FEG argued was not appropriately justified and could not be considered to be suitably conservative. FEG have also seen strategies that have sought to justify poor visibility tenability criteria within flats as being comparable to occupants walking around the flat in the dark and arguing that occupants should be familiar with their flat layouts. Our view is that this comparison is not appropriate and that the impact of occupants being subject to a fire scenario and affected by both heat and irritant/toxic gases should not be ignored or underestimated.

For any package where CFD is utilised to support the validity of a design then it is our expectation that the BCB should ensure that all CFD information is thoroughly reviewed, either in-house or by a suitably competent third party peer reviewer (where in-house competence is not available). FEG have raised concern in this quarter that in some cases the review conducted only considers the CFD report and does not scrutinise the input and output/results data/files **(31).** This has been raised in the Q3 report so can be said to represent a current theme in the industry whereby the scope/quality of a CFD review is inconsistent. FEG anticipate that the recent publication of the aforementioned SCA CFD guide will help to address this, as guidance is provided on a suitable scope of a review under Appendix E of the document.

Basements

FEG continue to raise fundamental concerns with the approach to basement ventilation, as highlighted in this report for a number of basement projects. For one in particular, the proposal was to provide compartmentation within the basement as opposed to ventilation throughout, despite the guidance within Approved Document B for floor plates (such as this one) which was significantly larger than 200m^2 **(29)**. The fire engineer in this instance used the justification that the fire size would be limited by the compartment sizes propoesd. FEG highlighted that the 200m^2 criteria, as stated, and that in our opinion ADB guidance does not just consider the potential fire growth rate but also the impact of smoke and heat spread upon firefighting access. FEG expressed the view that firefighting access, to meet the functional requirement B5, and in particular B5(1), requires measures to remove smoke from each compartment within the basement. FEG do not consider that a compartment wall represents a reasonable facility in the context of the functional requirement or standard operating procedures for basement incidents. As firefighting operations commence, crews may be required to breach compartment lines, by opening doors, whereby they will then be required to travel further and way-find in potentially untenable conditions. In some schemes, the design team has suggested that the fire

service should leave the door shut to the compartment but this does not align with the intention of B5 as detailed within Approved Document B.

Evacuation

FEG have observed a number of projects in this quarter whereby an evacuation lift is proposed without suitable consideration being given to the management of the evacuation phase of an incident or the building design features required to support the safe evacuation of persons of restricted mobility. Annex G of BS:9999:2017 provides guidance on the measures necessary to support an evacuation lift. A key consideration should be the location in which an occupant would be expected to take refuge whilst waiting for the lift and any assistance required. For one project it was proposed that the occupant of a flat take refuge within the corridor without taking account of the period whereby untenable conditions that could reasonably be expected to be present whilst the MSVS works to clear smoke. Another care home project, containing vulnerable occupants some of which were identified as having limited mobility, proposed an evacuation lift lobby containing refuge spaces. However, this lobby was provided with the MSVS to protect the stair **(19)** and therefore the refuge area would not be maintained as a tenable environment**.** FEG raised further concerns in Q4b over a lack of consideration given to the means for supporting disabled evacuation **(7).** A theme remains whereby facilities may be specified in a fire strategy but the way in which the buildings design and management are proposed to support these facilities are not explicitly detailed or, in some cases, considered. This is critical as it informs the responsible person through the Regulation 38 package, as mentioned in previous reports.

The proposed reliance upon means of escape routes which are not provided with protection that meets typical design guidance requires robust justification. FEG observed one project whereby an external stair that descended into an enclosed courtyard was considered for means of escape purposes **(8)**. The courtyard space itself was limited in size and could be impacted by a fire located within the block. Also in this example, the occupants would be required to re-enter the building to reach the final exit leading to a place of ultimate safety. In other projects, where alternative, unprotected means of escape are proposed, FEG have observed that they have been considered as part of a qualitative justification for a relaxation of another aspect. Therefore close scrutiny must be given to whether they are able to provide adequate benefit.

Fit-out vs shell and core

In the previous report conflict between the shell and core design and the fit-out proposals was reported, as the fire engineering principles had to be revisited to ensure a safe design. In this quarter FEG observed on a different project that the fit-out fire strategy was unable to adequately justify the departures from guidance which were inherited from the shell and core build **(26)**. FEG had raised the same concerns in the shell and core consultation but had not been re-consulted on the matters which therefore remained unresolved. Where the BCBs differ between the shell and core stage and the fit-out stage, this often leads to discontinuities, particularly if the concerns raised with the shell and core have not been communicated to the fit-out design teams. This has led to LFB having to identify the issues and bridge the gap in communication.

Living/green walls/roofs

FEG are seeing living/green walls commonly proposed for buildings whereby the B4 guidance within ADB is not given suitable consideration (**24**). FEG have raised question over the ability of a green wall/roof to meet the Class 0 specification when required. It has been highlighted by FEG that roof coverings should be classified in accordance with BS EN:13501-5 or Table B2 of ADB with substrate depths provided as necessary. Some guidance is available within the industry such as: Department for Communities and Local Government document "Fire Performance of Green Roofs and Walls" and the GRO Guidelines (2014), which provide guidance on the make up of a green wall/roof, including: the

organic content, which should be peat free and limited to less than 20% of the growing medium subject to whether or not an irrigation system is used. There are also requirements for fire breaks on green roofs which should be provided around perimeters, openings and every 40 metres on larger roofs.

Passive protection vs active protection

The use of a fire engineered/performance-based approach, when utilising fundamental design features which are not in accordance with the recommendations of typical guidance, can be said to be essential. FEG observed one proposal to include a glazed firefighting shaft **(4)** without adequate consideration given to its use in a fire incident. It is a reasonable expectation that fire and rescue service (FRS) Incident Commanders should be able to have a level of confidence in the safety of their personnel when committing them to a fire scenario in a high rise building. Such reassurance is inherently provided for by the recommendations of guidance. FEG expressed the opinion, on this proposal, that a glazed firefighting core is unlikely to provide such reassurance.

FEG have seen an increase in the number of projects proposing active fire curtain barrier assemblies (fire curtains) in areas whereby passive fire protection would normally be anticipated. At FRS access level, FEG have observed that this is commonly proposed in order to reduce the size of a large compartment (open plan layout), as desired by the design team, to avoid a corridor layout as depicted in Diagram 20 of BS:9999:2017 **(16)**. FEG highlight the potential negative impact that, when reliance is placed upon such an active measure, this often requires an enhanced level of management and maintenance as it could be considered to be a potential single point of failure. Other areas where FEG observed the use of fire curtains in this quarter included: in front of lifts due to the lack of a lift lobby **(23)**, in front of lifts opening into flats **(22),** and in lieu of compartment walls adjoining the firefighting lobby. FEG are of the opinion that the firefighting lobby is critical to the successful outcome of means of escape and firefighting processes. The reliance upon a fire curtain can form a single point of failure and may therefore not be compatible with, in this case, a single stair/firefighting shaft design.

A common feature seen on self-closing fire doors is an electromagnetic door holding device (EMDH). These are used to hold open fire doors in circulation spaces, retaining the self-closing function in the event of fire alarm activation. FEG observed one proposal for the use of these devices on firefighting lobby doors leading to a single stair in a building >11m **(17)**. As enhanced protection should be afforded to the stair in such a design scenario, FEG questioned the suitability of such an active provision, as failure of the mechanism and/or delay in its operation could result in smoke spread into the single stair. Furthermore, an EMDH represents an active provision which requires regular maintenance/testing which may not be feasible in a residential premises. This includes releasing of the device periodically in accordance with the manufacturers recommendations to ensure the device continues to operate and to prevent warping of the door.

In this quarter, FEG observed that it cannot be assumed that, where means of passive protection are specified within a fire strategy/consultation package, e.g. a 120 minute fire resisting shaft, that the shaft is then protected in line with guidance. On a number of projects, it has been realised, through assessment of the plans (without being acknowledged within the fire strategy), that services are proposed to run within the firefighting shaft which are not provided for the sole purpose of serving the firefighting shaft **(28)**. This is not in accordance with ADB (Paragraph 15.8, ADB v1:2019, Paragraph 17.9, ADB, v2:2019), BS 9999 (Clause 20.2.3, BS 9999:2017) nor advocated by FRS.

In concluding this section, we refer to another active provision: watermist. FEG has raised concern around the proposed use of a watermist fire suppression system proposal for one consultation whereby the provision was specified without any supporting information relevant to the proposed application/premises use **(30)**. BS 8489-1:2016 confirms that watermist is a specific application solution which needs to be proven for each individual application and/or occupancy and to have

demonstrated performance against standardised fire and component tests. Tests should be carried out, simulating the volume or object to be protected in conjunction with the identified hazard. Bespoke testing may be appropriate if they can be shown to give acceptable fire performance and if the tests can be shown to be repeatable and to have clear pass/fail acceptance criteria.

'Gaming the system'

As referred to in the thematic reports covering earlier quarters of 2020, FEG have continued to observe examples of attempts to interpret the guidance in an apparent attempt avoid the requirement of providing a firefighting shaft. Two projects provided further similar examples of this in this quarter, this time in residential premises were an extension was proposed to provide two additional floors (fifth,sixth) **(27)**. In each case the top two floors were linked internally through duplex flats. Therefore, measurement was only taken to the fifth floor (under 18m) despite the uppermost occupied storey still being over 18m. FEG highlighted that the 18m requirement represents the minimum standard and that the fire strategy did not consider the potential delay incurred in firefighting due to the requirement for crews to ascend stairs to a floor over 18m, carrying firefighting equipment. FEG argued that the lack of common stair to the top floor could further hinder crews in this example as they would be required to negotiate a larger degree of belongings/furnishings within a narrower stair which was not directly vented.

Modern methods of construction

FEG observed one project where it was proposed to utilise encapsulated cross-laminated timber (CLT) on the top floors of the development **(21),** with the intention to address the CLT element by application of a risk assessment based approach. FEG made reference to the formal QDR process, whereby further consideration should be given to a number of key areas including: the competence of the design team, contractors and suppliers; quality assurance processes; the interaction between the CLT and other materials in fire and the potential need for bespoke testing and peer review of the specific system used.

Figure 2 below provides a clearer indication of the areas which have received the most focus in FEG responses. It should be noted here that the results are not indicative of the number of bullet points in Table 1 but the number of occasions a concern was raised relating to each category in this quarter:

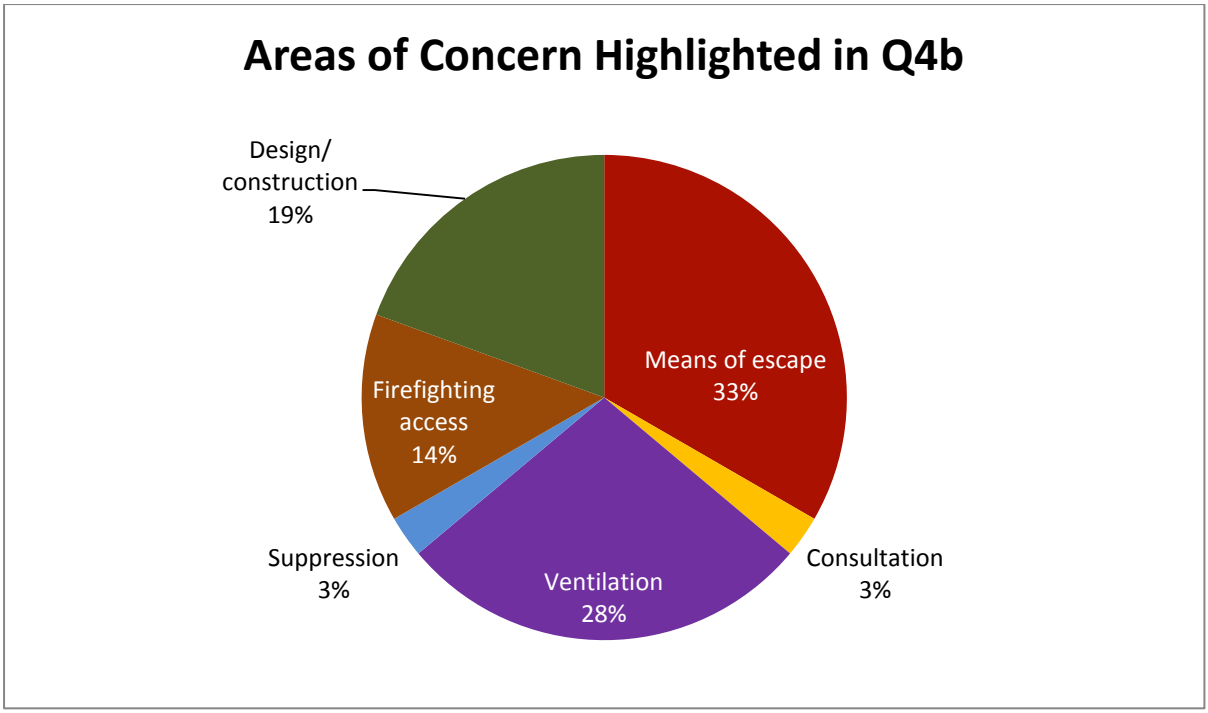


Figure 2 - Areas of concern highlighted in this quarter

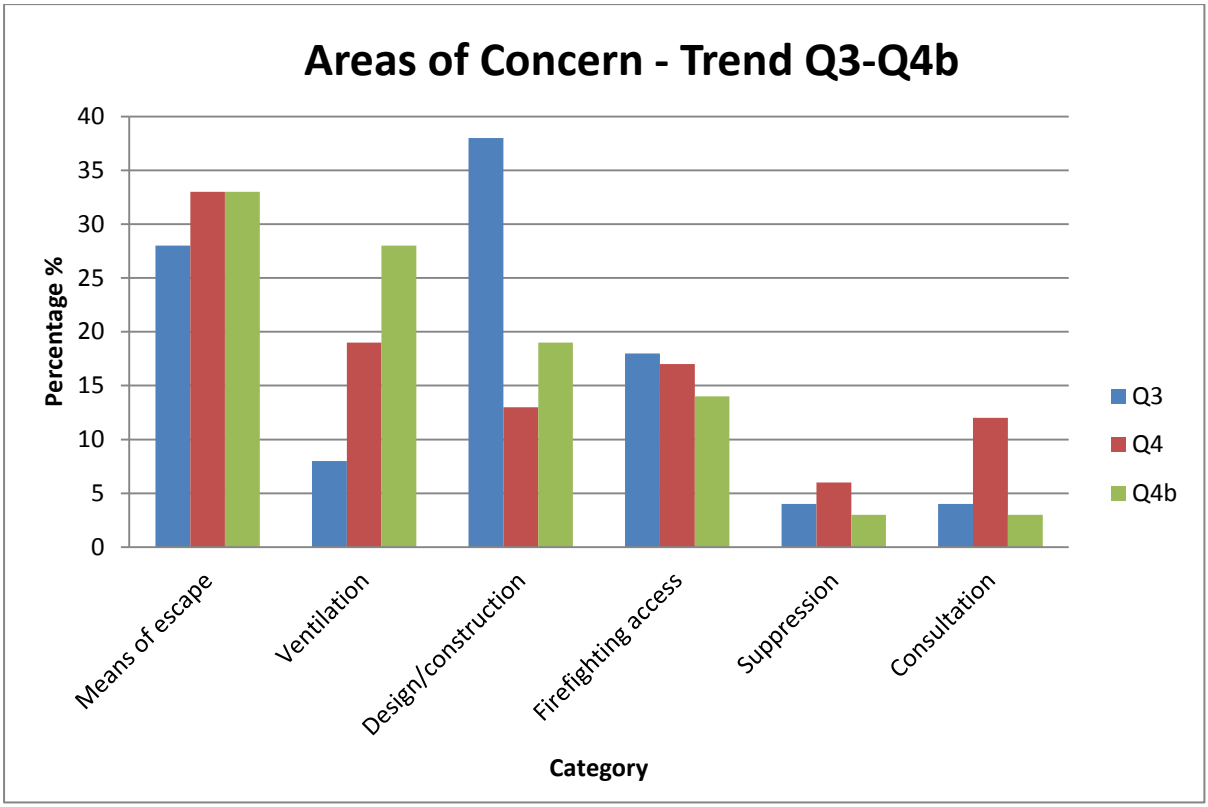


Figure 3 - Areas of concern trend for Q3 to Q4b

It can be seen from Figure 3 that the number of concerns surrounding ventilation has increased, whereas those regarding firefighting access have decreased slightly. The means of escape concerns have also increased slightly, with other concerns not showing any notable trend.

Part B – Occupation phase

Due to the continuing impact of the CoVID-19 pandemic and in lieu of the next anticipated series of fire engineering audits, FEG have provided two short case studies regarding recent premises that were subject to several 'not satisfied' building control consultation responses and subsequent LFB Fire Safety/FEG visits following occupation.

Short case study 1 – New-build circa 900 pupil school

This project was a completely new-build secondary school commissioned by the local authority. The local authority had an in-house designated project manager, but the detailed project oversight seemed to be essentially outsourced to the developer on a design and build basis.

The major continuing issues for LFB throughout the Building Regulations consultation process was the design team's insistence on:

- disregarding BB100 as the most appropriate guidance without any apparent reasoning or justification;
- the omission of sprinklers without any apparent reasoning, justification or risk analysis;
- the departure from standard atrium guidance by assertion the atrium was a 'void' (the reason for this interpretation by the design team was unclear;
- an unrealistic and severely limited evacuation time and margin of safety (via CFD analysis) imposed on the school due to the above.

In our view, these factors all resulted in a lower standard of fire safety and property protection, compared to standard guidance, rather than the equivalent or better standard usually expected in fire-engineered solutions.

After visiting the now-completed school, the issue also arose of the distinct lack of meaningful engagement by the developer/design team with the end-user/responsible person (i.e. the on-site school management team).

Our discussions revealed that:

- Did not fully understand or have knowledge of the fire safety issues and relied upon the expertise of others – in this case, the developer/design team;
- The school management team did not appear to have been considered a key stakeholder;
- The developer/design team asserted that sprinklers were not required – no other discussion with the school appears to have taken place;
- The smoke ventilation strategy was not adequately understood, if at all;
- There was very limited information and discussion about fire safety at design meetings, with greater focus on aesthetics and similar topics;
- There was a complete lack of awareness of the extremely limited required safe evacuation time;
- It was understood that the school was not for general community use but there was an expectation by the school management team for it to be used out-of-hours for after-school clubs and parents evenings etc., without any realisation that these uses were not accommodated for in terms of the risk profile which underpinned the fire strategy (i.e. awake and familiar vs. awake and unfamiliar occupancy characteristics);
- The school management team did not know the atrium/void base was to remain sterile or if any finite fire load was allowable – they assumed it was unrestricted and had planned to put a Christmas tree, decorations etc. in place.
- The school management team did was unaware of the use and criticality of the pass doors between the second floor classrooms as the sole means of evacuation from that area. No fixed signage, instructions etc. were in place at time of visit.

- No training or guidance had been provided to the school management team to support them in understanding Regulation 38 information (supplied electronically).Training was only provided on how to access the electronic Operation and Maintenance information;
- No apparent highlighting to the school management team of any risk-critical systems, restrictions or responsibilities placed upon the school in the Regulation 38 handover info (although it is believed that the fire strategy report formed part of the electronic package);
- It is not apparent that the fire risk assessor asked for or considered the building fire strategy.

From our discussions it was clear that, had the school management team been more meaningfully engaged and knowledgeable (with the requisite assistance to understand the technical information), they would likely not have agreed to being presented with the school as currently built and were effectively presented with a building they could not manage at the time of handover.

This particular project highlights the fact that, in our view:

- an initial unclear decision was made to omit sprinklers and the design then had to accommodate this;
- the design team did not have any practical appreciation of evacuation difficulties and forced the responsible person into an unrealistic evacuation regime contrary to the expectations of a design not relying upon an unrealistic or unsustainable management regime;
- there is little to no guidance on an acceptable margin of safety in respect of risk critical areas such as evacuation times; this can lead to designs and design teams applying too little room for error – an important factor when dealing with a 900 pupil school.

Short case study 2 – New-build 11 storey block of residential flats

This project was a completely new-build block of flats marketed as 'over 60's independent living' homes.

The major continuing issue for LFB throughout the Building Regulations consultation process was the interpretation and application of published smoke control guidance to the extended travel distances in the residential common corridors. The details need not be reproduced, here but the project took some years to complete with published smoke control guidance being updated in the meantime.

Despite the differing opinions between LFB and the developer/design team, the building was completed in line with the developer/design team's original proposal. On this basis a fire safety/engineering visit was deemed necessary to determine exactly what was in place.

In respect of the smoke control system, while LFB FEG did not agree with the smoke control design approach adopted, the layout and facilities did largely match those found in the fire strategy. However, important items that did not seem to be in the fire strategy and had to be highlighted to the responsible person included:

- Third floor: a portion of common corridor (16.5m) is ventilated by a dual-use AOV and access door to a roof terrace. This AOV/door had both an actuator arm and key lock installed. While the door was unlocked at the time of the visit, the two items are incompatible as the door could be locked, which results in non-availability of smoke control from this 16.5m length of corridor.
- First and second floors: a portion of common corridor (28m) is ventilated by a MSVS with an extract damper at the far end (opposite end of the corridor from the stairs), with inlet or make-up air supplied by the AOV in the lengthy 'sterile lobby'. This arrangement requires one of the heavy cross-corridor doors enclosing the 'sterile lobby' to be pushed open by an actuator arm to allow the make-up air to be drawn from the 'sterile lobby' AOV into the mechanically ventilated corridor. The cross-corridor doors were provided with electromagnetic holding devices. This is a somewhat counter-intuitive solution; upon actuation of the fire alarm system,

the hold-open devices release and the cross-corridor doors self-close; they are then immediately pushed open again by the actuator arm to enable introduction of make-up air. This also introduces potential additional failure or fault modes into the smoke control system and its management.

- Lower ground floor: a portion of common corridor (length unknown but circa 20m) is ventilated by a dual-use AOV and access door to a courtyard. This AOV/door had both an actuator arm and a snib lock installed. Again, the two items are incompatible unless the snib lock unlocks automatically on activation of the corridor smoke detection. While this section of corridor does have alternative escape (either via the courtyard at one end or the open-air car park at the other end) there was still confusion between the fire strategy, the responsible person and the FRS Primary Authority Partnership Scheme partner as to whether this feature was actually required or not, and on what basis. In any event, according to the fire strategy, it is required to perform as an AOV.

In our view, this level of detail should have been included in the final 'as-built' fire strategy so the responsible person (and fire risk assessor) understandood they are crucial components of the smoke control system. At the time, the responsible person was clearly not aware of this level of detail, nor is it likely the fire risk assessor or maintainer (other than perhaps the original installer) would identify the importance of these items in respect of the overall functioning of the smoke control system.

Overall, this was an example where the smoke control design may have met the desired objectives of the design team or developer but has nonetheless left the responsible person with a system that is difficult to understand and consequently to manage and maintain. Recent fires have highlighted the critical importance of smoke control as a life safety system.

In addition to the above specifics, other issues became apparent during our discussions with the responsible person, including:

- The fire risk assessment was believed to only indirectly reference the smoke control system and the extended common corridor travel distances; there was no apparent understanding and assessment of the importance the smoke control system played in allowing the continued occupation of the building, which operates under a stay put strategy (albeit LFB were advised that the fire risk assessor did ask for the fire strategy and plans for the premises and a separate contingency plan was in place);
- Only parts of the smoke control systems were tested weekly as a result of a weekly fire alarm call point test. Unless a fault was indicated and identified on the main smoke control panel, there would be an interval of 22 weeks between practical testing of all aspects of the smoke control system;
- Staff/management awareness of the operation and importance of the risk-critical life safety systems was somewhat vague. LFB were advised that training and knowledge of the buildings systems were provided at handover but it was unclear by whom or to what level of detail and importance;
- It was unclear how risk-critical life safety system faults were attended to or escalated and cleared, and if there were management protocols to alert management if this had not been done;
- Routine maintenance documents showed faults had been identified in both the automatic water fire suppression system and smoke control system as well as the compartmentation/fire stopping but it was again unclear if these had been rectified;
- The service level response time by the maintainer to risk-critical life safety systems was unclear and did not seem sufficiently prioritised by management protocols;
- It could not be confirmed if the responsible person had received the LFB 'not satisfied' correspondence to the BCB arising from the Building Regulations consultation process.

Conclusion

Rather than being exceptions, both case studies generally reinforced our findings from previous FEG audits and briefing notes and, moreover, have highlighted an important additional shortcoming we have long suspected – that early design decisions often seem to be unduly influenced by costs or other expedient design objectives without realistically considering how the premises will be maintained and managed over its entire life-cycle, and leaving the responsible person with this problem, who themselves usually have little understanding of the risk-critical nature of engineered solutions.

It is also clear that some design submissions appear to be focused on the short term goal of simply passing the Building Regulations process rather than the longer term goal of providing a building with a focus on both managing and maintaining the complex interaction of systems making up fire engineered solutions. In both cases LFB/FEG enquiries and actions are ongoing at the time of writing and the above findings only reflect the 'as found' conditions of both premises at the time of visit, not the LFB/FEG advice and action subsequently taken.