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Barbican Residential Committee

APPENDICES TO THE ARUP SURVEY REPORT

Date: **FRIDAY, 30 SEPTEMBER 2022**

Time: **11.00 am**

Venue: **COMMITTEE ROOMS, 2ND FLOOR, WEST WING, GUILDHALL**

8. **ARUP SURVEY**
Report of the Director of Community and Children's Services.

For Decision
(Pages 3 - 8)

a) **Cromwell Tower** (Pages 9 - 52)

b) **Andrewes House** (Pages 53 - 100)

c) **Mountjoy House** (Pages 101 - 252)

d) **Action Plan** (Pages 253 - 262)

John Barradell
Town Clerk and Chief Executive

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Committee(s): Barbican Residential Committee	**Dated:** 30/09/2022
Subject: Arup Fire Strategy Report – Barbican Estate	**Public**
Which outcomes in the City Corporation's Corporate Plan does this proposal aim to impact directly?	**1, 2, 12**
Does this proposal require extra revenue and/or capital spending?	**N**
If so, how much?	**N/A**
What is the source of Funding?	**N/A**
Has this Funding Source been agreed with the Chamberlain's Department?	**N/A**
Report of: Andrew Carter, Chief Officer/Executive Director Community and Children's Services	**For Decision**
Report author: Paul Murtagh Assistant Director Barbican & Property Services	

Summary

The purpose of this report is to update Members on the outcome of the Arup Fire Strategy Report and, the subsequent proposed Action Plan on a representative sample of residential blocks on the Barbican Estate.

Recommendations

Members are asked to:

1. Note the contents of this report.
2. Consider and discuss the Fire Strategy Reports produced by Arup in respect of Cromwell Tower, Andrewes House, and Mountjoy House on the Barbican Estate.
3. Consider and discuss the Proposed Action Plan, noting the progress that has already been made against some of the recommendations contained in the Arup Fire Strategy Reports.
4. Subject to available funding, to agree the proposal to procure the services of a suitably qualified Fire Engineer to carry out a wider review of the whole of the Estate based on the key findings and principles set out in the three Arup Fire Strategy Reports.

Main Report

Background

1. Due to the unique nature of the Barbican Estate, some Members have previously suggested that a more detailed specialist fire safety survey be undertaken on a representative sample of flat blocks on the Barbican Estate. The purpose of this specialist survey would be to review and assess specific fire safety precautions such as:

    - Communal fire doors;
    - Smoke control measures;
    - Levels of compartmentation;
    - Fire alarm and fire detection measures;
    - Escape routes;
    - Ventilation provisions.

2. This specialist survey would also satisfy some of the recommendations of the FRA's that were carried out by Frankham Risk Management Services Limited in January/February 2018 and, will help fill in some of the 'gaps' in our understanding of how the residential buildings will perform in the event of a fire.

3. In November 2020, following the approval of the Barbican Residential Committee (BRC), Arup, a specialist firm of engineering consultants, was appointed to carry out a detailed fire strategy report on a representative sample of four residential blocks on the Barbican Estate.

4. Members will be aware from previous reports, that Arup's progress with the fire strategy report has been significantly delayed by COVID-19 and associated resource issues. At its last meeting on 17 June 2022, the BRC received an update report on progress.

5. Arup has now completed its surveys at Cromwell Tower, Andrewes House and Mountjoy House and, has submitted its final reports for the three blocks. The Arup Fire Strategy Reports for Cromwell Tower, Andrewes House and Mountjoy House are included at Appendix 'A', Appendix 'B' and Appendix 'C' to this report.

6. Due to the additional costs incurred in producing the three Fire Strategy Reports and, the delays in producing the reports, it has been decided that the representative sample should be restricted to the three blocks that are now completed.

Considerations

7. As set out in the 'Executive Summary' at the beginning of each of the three reports, as part of its review of Cromwell Tower, Andrewes House and Mountjoy House, Arup has:

    - compared the existing fire safety precautions of each building with the requirements in Building Regulations 2010 (as amended) by benchmarking against the current standards including BS 9991 and BS 9999.

- considered the recommended improvements to existing residential buildings in Phase 1 of the Grenfell Tower Enquiry Report by Sir Martin Moore-Bick.

8. It is inevitable that buildings that are more than 50 years old (even though they were fully compliant when they were built) will simply not meet the requirements of modern-day standards and regulations, as is the case with Cromwell Tower, Andrewes House and Mountjoy House and, undoubtedly, with all other blocks on the Barbican Estate. What is important however, is that where there are gaps in the existing fire safety precautions compared against the current standards, fire safety improvements are carried out to remediate the risk on an 'as nearly as practicable basis'.

9. As can be seen from the Cromwell Tower, Andrewes House and Mountjoy House reports, Arup has identified several 'gaps' in the existing, 'as-built' fire safety precautions and, has set out its recommendations for remedial actions to address those gaps. These are set out and addressed in turn as part of the Proposed Action Plan attached at Appendix 'D' to this report.

10. As Members will see from the Proposed Action Plan, several of the recommendations made by Arup for remedial actions to address the identified 'gaps' in the 'as-built' fire safety precautions are already included in current workstreams including:

    - identifying persons with restricted mobility across the Barbican Estate.
    - upgrading/replacing existing fire safety signage.
    - survey of existing emergency lighting and necessary remedial works to ensure compliance with current regulations and British Standards.
    - replacement of flat entrance doors and fire doors to service cupboards with new fire doors that comply with current regulations and British Standards.
    - regular inspection and testing of fire doors to ensure that they remain in good working order.
    - further specific targeted compartmentation surveys.
    - regular estate inspections to ensure fire safety measures are maintained to the required standard.

11. Members attention is drawn to the 'Fire Safety Update' report that is also included in the agenda for this meeting, that updates Members on the progress that has been made in relation to fire safety matters across the Barbican Estate since January this year. This report contains more detail on the various workstreams that will go some way to addressing the identified 'gaps' in the 'as-built' fire safety precautions identified in the Arup Fire Strategy Reports.

12. Some of the recommendations proposed by Arup may simply not be achievable due to the constraints on the building including its construction, its listed status, and the feasibility of the recommendations. Arup has acknowledged this in its report when it says:

    "The recommendations may take some time to be fully implemented. Constraints on site may affect the feasibility of some of the solutions and further option development may occur".

13. Further work is still required to analyse some of the recommendations in detail and develop workable solutions. Officers continue to work with colleagues in Building Control, Planning, and the CS Fire Safety Team to progress this matter and, further update reports will be brought back to this Committee at regular intervals.

Installation of Sprinklers in the Barbican Tower Blocks

14. As reported at the last meeting of this Committee on 17 June 2022, the most significant recommendation in the Arup Fire Safety Strategy Report for Cromwell Tower, is the installation of a sprinkler system. For a high-rise, single stair building that adopts a stay-put policy, effective compartmentation is essential. Arup has concluded that as the condition of the compartmentation is unknown and, with the extended travel distances within the flats and, the potential number of persons with restricted mobility living in the block, the installation of a sprinkler system is strongly recommended. The installation of a sprinkler system will not only enhance life safety but will also significantly improve the overall fire safety of the building.

15. At its meeting on 17 June 2022, Members of this Committee noted the strong recommendation from the Executive Director of Community & Children's Services, that sprinklers are fitted in the three Barbican high-rise tower blocks, based on the assumption that Lauderdale Tower and Shakespeare Tower are similarly constructed and, the same deficiencies are present.

16. An initial outline feasibility study has been undertaken by officers and, has concluded that the retrofitting of sprinklers in the three Barbican high-rise tower blocks can be achieved at an estimated cost of between £3,000,000 and £4,000,000 (for all three towers).

Resident Consultation

17. Unfortunately, this report could not be completed in time for inclusion in the Agenda for the Barbican Residents Consultation Committee (RCC) meeting on 20 September 2022. However, the report was subsequently circulated to the members of the RCC on 22 September.

18. It is clear and fully accepted, that there needs to be meaningful consultation and engagement with residents of the Barbican Estate on the outcome of the Arup Fire Strategy work particularly, with regard to recommendations and proposals that will impact on their homes and, the block in which they live. It should be noted however, that at this stage, Members of this Committee are not being asked to make decisions on matters that will have a direct impact on residents.

19. It is hoped and expected that the RCC will provide feedback to officers on the Arup Fire Strategy Reports for the three blocks and, the Proposed Action Plan. It is intended that officers will work closely with the RCC to collectively agree a consultation strategy for taking this matter forward. This will be submitted to the respective meetings of the RCC and the BRC for consideration and approval.

Summary

20. Arup has now completed its commission to provide Fire Strategy Reports at Cromwell Tower, Andrewes House and Mountjoy House. However, it should be noted that these reports are 'live' working documents. As we continue to carry out further investigative works such as, for example, site specific compartmentation surveys, we will provide such information to Arup to enable the relevant Fire Strategy Report to be reviewed, revised, and updated.

21. Now that we have Arup's representative sample Fire Strategy Reports for the three blocks, consideration must be given to how we use the information contained in the reports to establish the position of the remaining 18 blocks on the Barbican Estate. The key findings and principles set out in Arup's Fire Strategy Reports will likely be consistent across all blocks on the Estate and, that being the case, it may be prudent and more cost effective, to procure the services of a suitably qualified Fire Engineer to carry out a wider review of the whole of the Estate.

Appendices

Appendix 'A' – Fire Safety Strategy Report Cromwell Tower
Appendix 'B' – Fire Safety Strategy Report Andrewes House
Appendix 'C' – Fire Safety Strategy Report Mountjoy House
Appendix 'D' – Proposed Action Plan

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Barbican Estate

Barbican Residential Blocks

Cromwell Tower - Fire Strategy Report

Rev A | 7 September 2022

Job number 279095-00

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Executive Summary

Arup have been appointed by the Barbican Estate (BE) to undertake a fire safety review of Cromwell Tower, an existing building which is part of the Barbican Residential Development, located in the City of London. The purpose of the review is to determine the existing intent of the fire safety design and to document this intent in a fire strategy document (this report). The purpose of this report is as follows:

- To provide a single document that describes the fire safety precautions for Cromwell Tower, including the fire safety principles and fire safety measures within the existing building;
- To compare the existing fire safety precautions with the requirements in Building Regulations 2010 (as amended) by benchmarking against the current standards including BS 9991 and BS 9999;
- To consider the recommended improvements to existing residential buildings in Phase 1 of the Grenfell Tower Inquiry Report by Sit Martin Moore-Bick;
- Where there are gaps in the existing fire safety precautions against the current standards and if those gaps present a risk to the life safety of the occupants, recommend fire safety improvements to remediate the risk on an as nearly as reasonably practicable basis; and
- Where the gaps in the existing fire safety precautions present a low/negligible risk to life safety, the existing precautions are proposed to be retained (on the assumptions that they are maintained in good operational order).

Cromwell Tower was constructed in 1973 and contains 108 flats and 3 penthouse maisonettes. The building consists of one firefighting stair and a lift lobby with a wet riser. The building consists of 39 residential floors above Podium level with a building height of 108 m (assuming floor to floor height of 2.7m) measured from street level (L01) to the floor level of the topmost occupied storey.

An open Podium level which is located above street level serves as the final discharge location from the firefighting stair. The street level (L01) serves as the main firefighting access level to enter Cromwell Tower. Basement levels L02 and L03 are storage and plant rooms below street level.

The balconies on L7-L39 are connected by stairs that lead down to the lift lobbies located one or two storeys below. These stairs provide alternative means of escape from the flats on those levels. However, these stairs do not exist on L1-L6. These are described in detail in the subsequent sections in the report.

Existing Fire Safety Precautions – Overview

The key elements of the existing fire safety precautions for the Cromwell Tower can be summarised as:

- **Stay put strategy:** The building adopts a stay put evacuation strategy. In the event of a fire, only the occupants in the flat of fire origin evacuate the building. The rest of the building occupants will remain in place. This is proposed to be retained.
- **Single stair**: The stair functions as both means of escape for the occupants and means of access for firefighters. It is a priority to protect the stair from being affected by a fire in the building.
- **Risers in stair:** There are three risers that are accessed via the stair and the fire rating of the doors are unknown. The electrical riser (on L37 and above) is connected to the small lobby (at every level) that opens into the stair – this is a risk as a fire in the electrical riser may spread to the small lobby and the stair, affecting the escape route from the building.
- **Flats on L7-L39:** Each flat has alternative means of egress via the balcony or the flat main entrance to reach the single stair. However, for wheelchair-bound residents (Persons with Reduced Mobility – PRM), escape is only possible via the flat entrance and the travel distance to the entrance is greater than the limit within the current guidance.
- **Flats on L1-L6**: Flats in Wings B and C have alternative means of egress via the balconies or the flat main entrances, with the exception of PRMs. The flats in Wing A are only served by a single means of escape via the flat entrance, and the travel distance to reach the entrance is greater than the limit within the current guidance.
- **PRM evacuation**: For the PRM needing assistance with evacuation, there is no safe refuge nor communication system to call for assistance. The procedure for evacuation of PRM is also unclear. This presents a risk to the life safety of the occupants.
- **Exit signage and emergency lighting**: There are existing provisions however, the existing exit signage are not compliant and both systems will need to be inspected.
- **Fire detection and alarm system:** The storage and plant areas in L02 and L03, lift shafts and the upper floor plant rooms are provided with Category LD3 detection and alarm system. However, there is no detection or alarm system within the flats nor in the common areas of the building. Considering the extended travel distances for occupants who can only use the flat entrance as their escape route, the lack of early detection and warning in the flat presents a life safety risk.
- **Fire suppression system**: The building is not sprinkler protected. Considering other gaps that have been identified in the building, this presents a risk to the life safety of the occupants.
- **Structural fire protection**: The existing protection nominally meets the required fire rating in the current standard, based on a desk-top review.
- **Fire compartmentation**: Each flat, services riser, stair, lift shaft and storage area should form separate fire compartments, to support the stay-put strategy. However, the Fire Risk Assessment (FRA) states that there have been structural alterations made in the building, compromising the compartmentation between the flats and risers. This is a risk to life safety as it may compromise the stay-put strategy and the integrity of the single stair.
- **Shunt duct arrangement (kitchen extract and toilet extract risers):** It is considered an acceptable solution for the toilet extract riser. However, the use of

shunt duct for kitchen extract presents a risk of fire/smoke spread between the flats and may compromise the stay-put strategy.

- **Flat entrance, refuse storage/post box and stair fire doors:** Assuming that these are the same as the tested fire door in the Shakespeare Tower, they do not achieve the required 60 minutes fire rating. The failure to maintain fire separation between the flat, lift lobby and single stair may compromise the stay-put strategy and the use of the stair for means of escape and firefighting.
- **Separation with neighbouring buildings:** There is adequate separation distances to adjacent properties to minimise the risk of external fire spread between buildings.
- **Façade system:** There appears to be no combustible materials in the façade system, based on the information provided.
- **Lift lobby:** The lift lobby also acts as a firefighting lobby with a manually operated smoke ventilation system.
- **Firefighting lift:** The existing firefighting lift and other lifts have been identified with a programming issue which will not allow it to ground upon detection of a fire. The firefighting lift will only ground upon arrival of the fire service when they manually activate the lift to ground. This is not in line with the current guidance.
- **Wet riser main:** All the inlet points are within 18 m of the fire service vehicle access routes. A wet riser outlet is located within each level of the firefighting shaft and within 45 m of coverage of the hose length.

Recommendation for remedial actions

Recommendations for remedial actions are provided throughout the report (in green boxes) to mitigate the identified life safety risks due to the gaps in the existing fire safety precautions. A summary of the known gaps and the associated recommendations is provided in Table 1. The table will be reviewed and revised accordingly when further information becomes available e.g. emergency lighting system, exit signage.

Interim measures

The recommendations may take some time to be fully implemented. Constraints on site may affect the feasibility of some of the solutions and further option development may occur. However, there are existing features in Cromwell Tower that present unacceptable risks to the life safety of the building occupants. Some immediate actions are recommended to address these risks.

These immediate actions are temporary measures to address the risks, while permanent solutions are being developed and implemented. These interim measures are not meant to replace the need for permanent solution. The aim of the interim measures is to reduce hazards that may affect the use of the single stair in the event of a fire, so that occupants can safely evacuate from the Tower. The recommended interim measures are:

- Preparing a Personal Emergency Evacuation Plan (PEEP), so that the evacuation arrangement in the event of a fire is clear to each PRM occupant;
- Remove all storage and rubbish within riser spaces that opens into the stair (note: the External Fire Risk Assessment prepared by Frankham Risk Management Services in January 2018 states that discarded trade materials and general waste were identified in riser cupboards).
- Consider providing a fire detector within the electrical riser above L37, so that BE receives early warning of a potential fire in the electrical riser. If necessary, evacuation can then be initiated before the stair is affected.

Next Steps

In addition to implementing the interim measures, it is recommended for BE to review the feasibility or implementation of the permanent remedial actions.

Once this has been completed, it is recommended for the CoL District Surveyor and the London Fire Brigade to be consulted, to seek their early agreement in principle.

Table 1: Identified gaps and recommended actions

Identified Gaps	Recommended Action	Benefits of the recommendation	Implementation constraints as defined by BE
No internal hallway in the flats Extended travel distance (for single direction of escape) Duplex and triplex layout with open internal stair	• Provide early warning to occupants within the flat by installing a minimum Grade D1 Category LD1 within the flats; • Review the internal layout of the duplex and triplex in terms of alternative egress and internal hallway against the current guidance;	• Early warning through automatic detection and alarm system will serve to alert occupants of a fire in their flat during the early stages of the fire and initiate evacuation before conditions in the flat becomes untenable. • Occupants will be made aware of the escape routes and procedures in the event of a fire, minimising time to evacuate the building.	
Sprinkler protection	For a high-rise single stair building that adopt a stay-put strategy, it is recommended to maintain the fire compartmentation across the building. The condition of the compartmentation is unknown. There are extended travel distances within in the flats and there is a relatively high percentage of PRM occupants in the building. As such, this presents a risk to the life safety of occupants and the installation of a sprinkler system in the building is strongly recommended .	Provision of sprinklers will enhance the overall fire safety of the building, limiting the fire growth and enhance both life safety and property protection of the building.	

L1 – L6 Wing A flats provided with a single means of escape	For Wing A flats from L1 to L6, it is recommended to provide one of the following options:
	• Retain the existing arrangement of escaping via neighbour's flat from Wing A, provided that there are regular inspection in place to check that the means of escape route via the adjacent flat (Wing B) is available, including checking the keys are in place and the escape paths within the flats are available, or
	• Providing compartmentation to kitchen area as this is the high risk area, or
	• Provision of a protected internal hallway.
	The provision of sprinkler system will also address the risk of the single means of escape from the flat being compromised by the fire.
		• Provision of one of the recommendations will enhance the current arrangement due to the following:
		  • Regular inspection to enforce and to check that the escape paths through neighbouring flats remain available. This option presents the least change to the flat, but will increase staff responsibility on regular inspections.
		  • Enclosing the kitchen in fire rated construction or providing protected internal hallway will reduce the risk of the single escape route being compromised by a fire in the flat (likely to be within the kitchen).
		  • Limit fire growth by provision of sprinklers	

Evacuation of PRMs/ smoke control	• Preparation of Personal Emergency Evacuation Plan (PEEP) for PRMs. • Replacing existing manually operated ventilation system to automatic ventilation system in the lift lobbies. • Provision of Emergency Voice Communication (EVC) system to all of the lift lobbies.	• PRMs are well informed about their evacuation arrangement in the event of a fire. • Automatic smoke ventilation to all lift lobbies will create a safe refuge for PRMs to wait for assistance. • The detection system in the lift lobby will operate the automatic smoke ventilation system and raise an alarm to alert BE staff to investigate the incident.	
Exit signage	A survey is recommended to inspect and replace existing exit signage to comply with BS 5499-4, BS ISO 3864-1 and the additional recommendations from the Grenfell Tower Inquiry: Phase 1 report	Correct signage will serve to identify the stair discharge level and the route out of the building.	
Emergency lighting	A survey is recommended to inspect and replace existing emergency lighting to comply with BS 5266-1.	Emergency lighting will allow occupants to evacuate safely, especially when traversing up/down the stairs.	

Compartmentation – structural alterations made to the building between flats and risers.	It is recommended to carry out a sitewide survey to inspect breach in compartmentation, and to undertake works to maintain the compartmentation in accordance with BS 9991.	This will maintain the stay-put strategy and minimise the risk of the single stair being compromised by a fire in the building.	
Connection between small lobby, ventilation shaft and electrical riser.	It is recommended to provide one of the following: • Provide fire separation between the small lobby and the ventilation shaft (removing all the vents) and remove the fire door between the small lobby and the lift lobby on L37 and above, or • Provide a fire and smoke damper at each vent to maintain fire separation and to only vent the floor of fire incident. Also provide a wall to separate the smoke shaft and the electrical riser from L38 and above.	Either of the recommendations will adequately separate the small lobby from the electrical riser. This will reduce the risk of smoke and fire spread from the electrical risers.	
Fire doors at flat entrance, lift lobbies, firefighting stairs and refuse storage/post box.	• It is recommended to replace all the fire doors to the stair, small lobby, flat entrances and the refuse storage/post box. • Doors to all the risers to be inspected and repaired/replaced to maintain fire separation from the stair or lift lobbies. • Keep records of inspection and testing of fire doors in the future, at not less than three-monthly intervals to ensure that all fire doors are in working order.	• This will serve to maintain the availability of the stair for means of escape and firefighting activities. • Maintaining the stay put evacuation regime.	
Kitchen extract shunt duct system	Replace the existing extract hoods with recirculation type hoods, and implemented one of the followings: • Smoke and fire damper at the shunt duct riser activated by the fire alarm/detectors within the flat (this maintains the use of the riser for normal ventilation of the flat); or • To block off the shunt ducts and provide a fan on the external wall to draw out air from the flat into the balconies. Maintain the existing extract hoods and shunt duct arrangement by increasing the reliability of the main extract fan. This will require an additional duty standby fan (the fans to be rated at 400 ˚C for 90 minutes in accordance with BS EN 13501-4), with secondary power supply. The fans need to be adequately maintained to keep the main riser under negative pressure;	• The provision of fire and smoke damper or blocking off the shunt ducts will serve to significantly reduce the risk of fire spread between compartments through the kitchen shunt ducts. • Maintaining the stay-put evacuation regime. • The option of increasing the reliability of the main extract fan allows the day-to-day ventilation within the flat can be maintained.	

1 Introduction

1.1 Appointment and scope

Arup have been appointed by Barbican Estate (herein referred to as BE) to provide a fire engineering review of Cromwell Tower, an existing building which is part of the Barbican Residential Development, located in the City of London.

This report provides a fire strategy for the existing building and captures the current fire safety measures and strategy as Arup understand it from recent reviews of documents, discussions with the BE management team and through a non-intrusive site visit undertaken on 20/08/2021.

Although Cromwell Tower is an existing building, there is limited documentation available to explain the current fire safety information for the building. There is currently no fire strategy report for the building nor documentation which provides a cohesive record of the fire safety measures in the building. As such this fire strategy has been developed to act as a cohesive and detailed record of the current fire safety provisions (and can act as a benchmark for future building work).

1.2 Purpose of this report

Having a single documented fire safety strategy for Cromwell Tower provides the required information to understand the fire safety principles and fire safety measures within the existing building.

It should also be noted that this fire strategy covers the residential floors, Street level (L01) and storage/plant areas (L02-L03) of Cromwell Tower. This report does not cover the services subway (L04).

This report will assist the BE when they wish to undertake future improvement and alterations to the building. It will also act as a benchmark in recording the fire safety strategy and enables anyone undertaking works on the building to understand what implications these may have in terms of fire safety.

Furthermore, this report documents any potential shortfalls in fire safety measures and enables BE to address these where necessary and document them in their Fire Risk Assessment (FRA) for the building where required.

The purpose of the report is to provide the following:

- Identify any tests that should be undertaken to create evidence of building operation where that is missing;
- Identify potential remediation measures, where current fire safety systems do not provide adequate fire safety for occupants;
- A retrospective fire strategy report and associated fire safety drawings and recommended remediation measures.

These goals are identified to be provided for four different typologies of buildings to give an overall fire strategy for all 22 buildings within the Barbican Residential Development.

Areas that require more information/ confirmation is required from BE are identified by brown text throughout this report.

1.3 Barbican Residential Development

The buildings in the Barbican Residential Development were constructed from 1960 to 1982. There are 22 buildings in total as shown in Figure 1. There is a distinctive design feature across the Barbican Residential Development, which is the provision of a podium. It was constructed with an intention of providing a liveable urban environment for pedestrians and acts as ground level for the buildings[1].

In terms of fire safety design, the podium level throughout the Barbican Residential Development is considered as an access level for all of the buildings. Access level is defined in BS 9991 as ‘level used for normal access to the building that either incorporates, or leads directly to, a place of ultimate safety’. Therefore, the podium is considered a place of ultimate safety, serving as the exit discharge level for the stairs.

[1] Barbican Estate, *Barbican Living*, *https://www.barbicanliving.co.uk/*, *(accessed 16 March 2021)*

Figure 1: Overview of the Barbican Residential Development (Image courtesy Barbican Living)

Arup in conjunction with BE have identified four different block typologies which are common across the residential development. The typologies are as follows:

- High rise tower – Cromwell Tower;
- Terrace block type 1 – Andrewes House;
- Terrace block type 2 – Ben Jonson House;
- Terrace block type 3 – Mountjoy House.

Flats across Cromwell Tower are generally privately owned by leaseholders with a small portion of the flats being owned by the BE and let out to tenants.

2 Fire Safety Goals

2.1 Statutory and policy goals

The legislation, regulations and relevant standards contained within the following sub-sections have been referenced as part of Arup's review of the existing building. These are the requirements that are applicable to the existing building.

2.1.1 Regulatory Reform (Fire Safety) Order 2005

The Regulatory Reform (Fire Safety) Order 2005 (RR(FS)O) places a general duty of fire safety care on employers, occupiers and owners of almost all premises and requires them to take such fire precautions as may be reasonably required to ensure that premises are safe for the occupants and those in the immediate vicinity.

The responsible person has a duty to carry out a fire risk assessment which must focus on the safety in case of fire of all 'relevant persons'. The risk assessment should pay particular attention to those at special risk, such as the disabled and those with special needs, and must include consideration of any dangerous substance likely to be on the premises.

A fire risk assessment (FRA) was undertaken in January 2018 by Frankham Risk Management Services. A number of risks have been identified and need to be resolved in order to comply with RR(FS)O. Reference to these items has been included in the relevant sections of the fire strategy.

2.1.2 Building Regulations 2010 (as amended)

The fire safety review is undertaken to establish compliance against the functional requirements of Part B of the Building Regulations 2010 (as amended), using the recommendations in BS 9991:2015 (see Section 2.1.3) as the basis of the review. Where applicable, BS 9999:2017 Fire safety in the design, management and use of buildings – Code of practice and the Approved Document B Volume 1: Dwellings 2019 Edition Incorporating 2020 Amendments – For use in England, which has been updated recently to reflect the latest requirements for residential buildings has also been referenced.

2.1.3 BS 9991:2015

The existing building has been assessed against BS 9991:2015 - Fire safety in the design management and use of residential buildings – Code of practice. A guidance document which provides a means of demonstrating compliance with the life safety requirements of Part B of the Building Regulations 2010 (as amended) (herein referred to as "BS 9991"). This is used as the benchmark in developing the fire strategy for the building.

2.1.4 Barbican Estate fire safety goals

Through meetings with the BE, Arup has identified that the main objective of this fire safety review is the life safety of the building occupants. Arup is not aware of any additional requirements for property protection, either from BE or their insurer. This is to be confirmed by BE.

2.2 Proposed methodology

The existing fire safety precautions of Cromwell Tower are compared with the current recommendations in BS 9991. Where the provisions and recommendations align, no further action is required, and the existing provisions are recorded in this report to form the building fire strategy.

Where the provisions are not deemed to comply with the recommendations of BS 9991, a qualitative risk assessment will be carried out to identify the life safety risks to the building occupants due to those non-compliances or gaps in the fire safety precautions. The outcomes of the assessment will result in one of the following:

1. Where considered acceptable to remain as existing, recommend retaining the current provisions; or
2. Recommendations on possible options for enhancements/upgrades where the current fire safety provisions are considered inadequate.

It should be noted that as the building is existing, it is not feasible for all provisions to be in line with current fire safety standards. Where appropriate, the relevant guidance documents at the time of construction of the building have been used as reference.

2.3 Referenced documentation

The following information has been used to inform the Andrewes House fire strategy and fire safety systems provisions:

- Meetings between Arup Fire and BE between August 2021 to February 2022;
- Barbican Living website;
- Various email correspondence between Arup Fire and BE between August /2021 to February 2022;
- Referenced documents and drawings listed in Table 2;
- Visual non-intrusive site visit undertaken on 20/08/2021;
- Visual non-intrusive site visit undertaken on 17/01/2022.

Table 2: Referenced documents and drawings

Document title	Produced by	Date	Revision
Cromwell Tower External Fire Risk Assessment	Frankham Risk Management Services	Jan 2018	-

Document title	Produced by	Date	Revision
CP 114:1957 *British Code of Practice, The Structural Use of Reinforced Concrete in Buildings*	British Standards Institution	1957	-
CP 3: 1962 *British Code of Practice Chapter IV Precautions against fire Part 1. Fire precautions in flats and maisonettes over 80 ft in height*	British Standards Institution	1962	-
BS EN 1992-1-2-2004: Eurocode 2 *Design of Concrete Structure Part 1-2: General rules – Structural fire design*	British Standards Institution	2004	-
The fire resistance performance of a single leaf single acting door set with side screen and over panel, when tested in accordance with BS 476:Part 20/22: 1987	Exova Warringtonfire	23rd Oct 2018	-
Drawing no. 33 517 Block Three Wall elevations Levels 77' – 95'	Ove Arup & Partners	May 1964	Rev D
Drawing no. 33 550 Block Three	Ove Arup & Partners	Feb 1968	Rev H
Drawing no. 33 F12 Block Three Plan of Floor 39 finishes	Ove Arup & Partners	July 1968	Rev A
Drawing no. 33 F9 Block Three Plan of Floor 36 finishes	Ove Arup & Partners	July 1968	-
Drawing no. 33 507 Block Three 95' level plan	Ove Arup & Partners	May 1964	Rev E
Abridged results from the test of 86 Thomas More House (double leaf door and single leaf door)	CTO S.A	2020	Issue

2.4 Limitations and assumptions

2.4.1 Limitations of report

This document summarises the findings of our work carried out to date. It does not attempt to quantify actual elements of fire performance, such as fire resistance periods, across the building in its existing state as physical intrusive works would be required to do this. It is Arup's understanding that intrusive investigations into the building is not planned to be carried out.

There are no architectural layouts of the building. Structural plans of Cromwell Tower have been obtained through Arup Archive and used to better understand the building layout. However, this is not a complete set covering the building and are limited to some levels of the building only. The fire strategy drawings provided as part of this report are based on those published in the Barbican Living website. In using these documents, it is assumed that the layouts remain representative of the current arrangement in Cromwell Tower.

BE should undertake the necessary tests/inspections to confirm that the fire safety systems will operate as intended in a fire event.

The information documented in this fire strategy is limited to the amount of information covered through the following:

- Desktop review;
- Consultation with the BE;
- Visual non-intrusive site visit undertaken on 20/08/2021, where the areas visited included outside and inside of Cromwell Tower
  - Street (L01) and Podium level;
  - Common area (lift lobby, stairs) on some of the Residential levels (L1 – L39);
  - Common corridors including a few storage and plant rooms (L02 – L03);
  - Car park (L02);
  - Shakespeare Tower - Internal flat layout for Wing C

The fire strategy does not represent the condition for the entire building.

2.4.2 Summary of key assumptions

The following key assumptions have been made to form a basis of the fire strategy for Cromwell Tower. BE should confirm if these assumptions are suitable for the project.

- Any current or future building works and their impact on the fire strategy are outside the scope of this document;
- No further inspection/survey is planned such as intrusive investigation on the building;
- The building is not undergoing any changes at all, with no change in occupancy nor material alterations;
- The fire strategy drawings within the report are in line with the current building layout;
- Structural drawings are only available for apartment levels L36 and L39. It is assumed that all other levels have a layout that is in line with the two levels and follow the same fire safety principles throughout the building;
- The information from the document 'The fire resistance performance of a single leaf single acting door set with side screen and over panel, when tested in accordance with BS 476 Part 20/22:1987' on the doors from Shakespeare are assumed to be the same as the ones from Cromwell Tower. E – 30mins achieved, I – 24mins;
- All elements shown in the structural drawings are assumed to be elements of structure and therefore loadbearing;
- The thickness of structural elements (i.e. slab depth or wall thickness) are assumed to be the same throughout the building;
- All structural elements are reinforced concrete;

- The concrete covers over the reinforcement bars meet the values stated in the relevant guidance at the time of construction (CP114); there is no information on the depth of the existing concrete covers for this aspect to be assessed;
- Floor slabs are simply supported one-way slabs throughout the building;
- No structural calculations are available and therefore the utilisation factor of the structural members is unknown. When checking against the requirements of Eurocode 2 (Section 4.3.1) a utilisation factor of 0.7 has been assumed for conservatism;
- The fire resistance requirements given in CP114 cover loadbearing capacity, integrity and insulation;
- There is no fire stopping register for the building. The condition of the fire stopping at penetrations on fire rated construction is unknown. It is assumed that fire stopping remediation actions will be undertaken as part of ongoing maintenance;
- Boundary distances have been taken to the middle of Beech Street and Silk Street as there is no site boundary information available;
- The single enclosed stair that connects Podium level to L39 is a firefighting stair;
- The layout of the flats in Cromwell Tower is identical to the flats in Shakespeare Tower.

3 Cromwell Tower

Cromwell Tower was completed in January 1973. It is a high-rise residential tower which sites between Ben Jonson House and Frobisher Crescent. The building contains 108 flats and 3 penthouse maisonettes[1].

The building consists of a single stair where the stair is connected to the lift lobby containing three lifts with one being the firefighting lift (installed in accordance with BS 5588-5:1986 as confirmed by Steve Clarke on 08/04/2021 via email correspondence). As the stair is fully enclosed and considering the height of the building being over 30 m, it is likely to be a firefighting stair and therefore, it is known as such in the report.

There are two internal stairs (referred to as '1 down stair' or '2 down stair') in the building that connects between the balcony and the lift lobby in the lower levels. One example of 1 down stair is shown in Figure 4.

The flats in the building have access to the following:

- All levels - Main flat entrance connected to the lift lobby with access to the firefighting stair and lifts;
- L6 – L39 - Balcony which leads directly to stair (either the firefighting stair, 1 down stair or 2 down stair depending on the wing type/location) – See Figure 3;

The building consists of 41 floors with a building height of 108 m (assuming floor to floor height of 2.7 m, drawing number 33 550) measured from ground to the bottom of the topmost occupied storey. The *Grenfell Tower Inquiry: Phase 1 report* defines high-rise buildings as buildings over 18 m in height and hence Cromwell Tower is considered a high-rise building. The building comprises of the following:

- Roof level;
- L40 – L41: ventilation plant (L40) and lift machine room (L41);
- L1 – L39: Residential flats (3 flats in each level) and duplex or triplex at the top level of each wing:
    - Duplex on L39 and L40;
    - Triplex on L37 – L39;
    - Triplex on L35 – L37.
- Podium level: Circulation space;
- L01 (Street level): reception and main entrance;
- L02 – L03: Plant/storage area in addition to a car park;
- L04 Subway level.

The roof level is only accessible to BE staff via the external helical stair extended from the firefighting stair.

L04 which is known as the 'subway' is connected to Cromwell Tower via one of the plant rooms in L03. It contains services and extends throughout the Barbican Estate. The area is excluded from the scope of this document.

The building comprises three wings (Wing A, B and C) with a single flat in each of the wings on every floor above L1. There are three balconies in the tower, one for each of the wings that are connected to one of the three stairs (one firefighting stair, 1 down stair or 2 down stair). Each of the stairs are connected as follows:

- Firefighting stair: runs through all of the residential floors (L1 – L39) and provides a final exit at Podium level;
- 1 down stair (stair between Wing A and B): connects the Wing B balcony with the lift lobby one level below, for L7 – L39;
- 2 down stair (stair between Wing A and C): connects Wing A balcony with the lift lobby two levels below, for L7 – L39;
- From L6 to L01, the protected stair is the only available stair;
- The exit via dining room leads to adjacent flat's balcony to enter either the firefighting stair or one of the 1 down stair or 2 down stair(L7 – L39).

As there is one stair (firefighting stair) which runs through the residential floors of the tower, the building is considered to be a single stair building.

The main entrance which is used by the occupants on a day-to-day basis, can be accessed from Beech Street. It also acts as the main firefighting access point into the building. It should however be noted that whilst fire service access to the building is considered to be at Street Level, the firefighting shafts can only be accessed at podium level. Therefore, fire service will enter the building at Beech Street level via the reception, walk up the internal open stair (which is separated from the residential levels above) and transfer to the firefighting stair at podium level. This is shown in Figure 2.

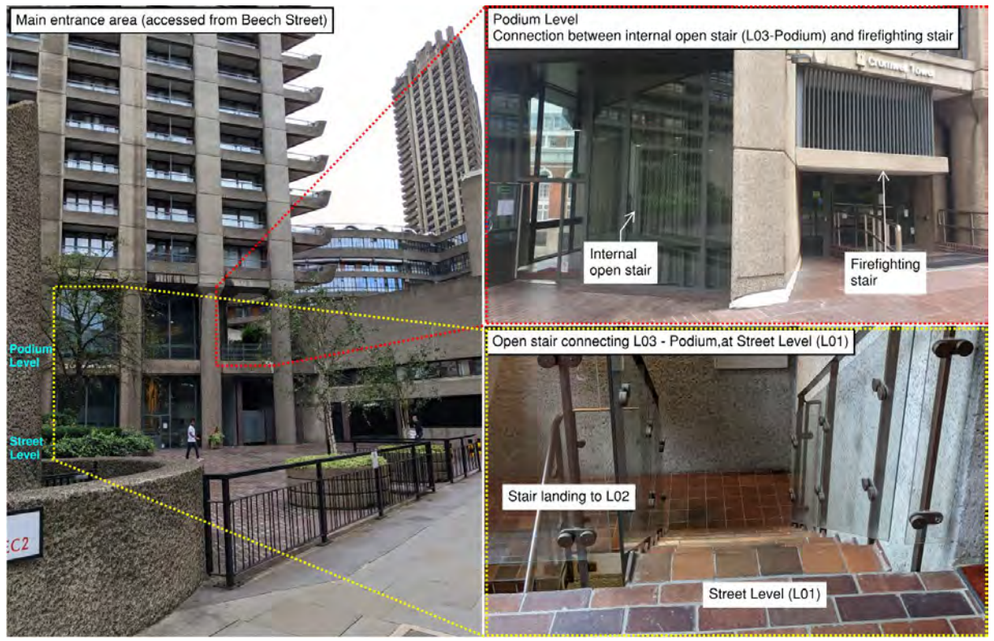


Figure 2: Access to Cromwell Tower from Street Level and Podium Level

The layout of residential floors (L1 – L39) of Cromwell Tower is as shown in Figure 3 and section of part of Cromwell Tower in Figure 4.

Figure 3: Layout of Cromwell Tower

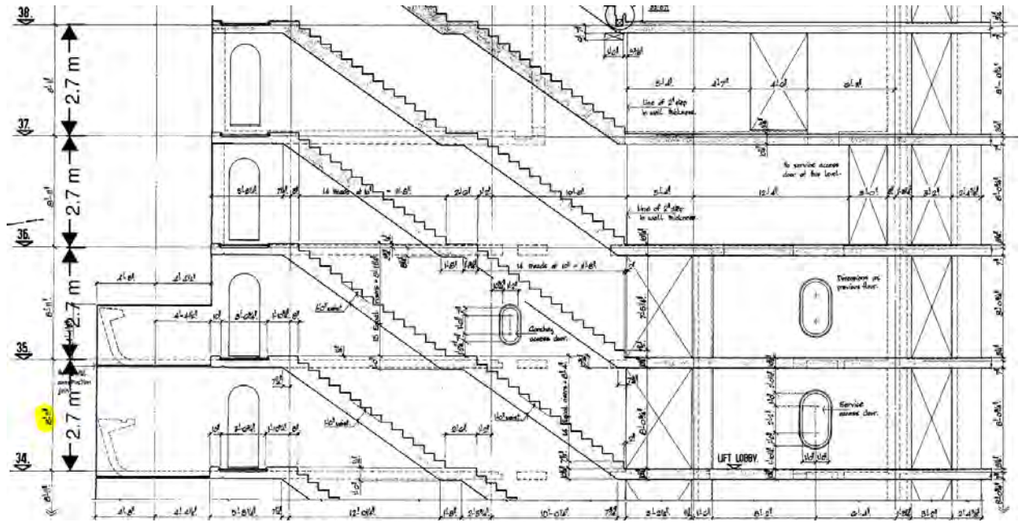


Figure 4: Section of Cromwell Tower from L34 to L38

4 Fire Strategy Summary

This section of the report provides an overview of the fire strategy of Cromwell Tower. It provides the following:

- The recommendations of current guidance;
- The current provisions in Cromwell Tower;
- Identification of non-compliances against the current provisions;
- If there are non-compliances identified, three possible solutions through a risk assessment:
    1. The non-compliance is considered to present life safety risk and requires remediation. Recommendations are made to improve the current provisions to comply with the Building Regulations on an as near as reasonably practicable basis;
    2. The non-compliance is not considered to be high risk to require additional safety measures to the existing system. It is considered acceptable to be retained; OR
    3. More information/confirmation is required from BE (brown text)

Where a non-compliance has been identified and a recommendation has been made after a risk assessment, these have been highlighted in green box.

4.1 Means of warning and escape

4.1.1 Evacuation strategy

Cromwell Tower operates under a defend in place/stay put strategy where only the occupants in the flat of the fire origin evacuate the building. The rest of the building occupants will remain in place. The defend in place strategy is a common strategy for residential buildings in the UK.

It is recommended that information is given to residents regarding the meaning of the stay put strategy and the arrangements for means of escape is available to them if a fire were to affect their flat. It is noted from the Frankham's FRA that fire action notices are not definitive enough in communal areas. It is recommended for signage to be replaced with clear instructions to residents, explaining their fire actions, including the stay put policy and their nearest escape routes.

Whilst the above approach is compliant with the recommendation of BS 9991, the *Grenfell Tower Inquiry: Phase 1 report* recommends that all high-rise residential buildings, existing and new, are provided with facilities to allow the fire and rescue service to simultaneously evacuate the building. This is recommended to be implemented for Cromwell Tower considering the height and the single stair serving the building. Refer to Section 4.1.9 for additional details on the fire detection and alarm system.

4.1.2 Means of escape within flats

From BS 9991, flats having an entrance on the same level as the flats should have all habitable rooms to be accessible from an internal hallway and have an alternative exit from the flat. There are no maximum travel distance recommendations in this arrangement.

As shown in Figure 5, the original intention of the flat layout was to provide an internal hallway to separate all habitable rooms from the internal corridor. However, it has been confirmed by BE that most of the flats no longer have the door separating the internal hallway from habitable rooms which is a non-compliance to the current recommendations.

For able-bodied occupants (refer to Section 4.1.6 for evacuation of Persons with Reduced Mobility, PRM), this is considered acceptable if automatic fire detection and alarm system of Grade D1 Category LD1 is installed within the flats (refer to Section 4.1.9 for further details on the recommended fire detection and alarm system) and under the basis that the flats are provided with alternative escape routes as follows:

- Through the balcony which is accessible through all habitable rooms;
- Through the dining room to enter neighbour's balcony.

Figure 5: Available egress routes for a typical flat layout

The current layout of duplex and triplex layouts is different to the typical residential levels with three flats in each level. The layout shows that some habitable rooms open directly into the open stair leading to the living room; the open stair, which is the

escape route, could be compromised by a fire in the living room. It is therefore recommended to review the internal layouts of the duplex and triplex in terms of exit provisions and travel distances against the current regulations.

Recommendations:

- Provide automatic detection and alarm system of Grade D1 Category LD1 within the flats – refer to Section 4.1.9 for further details.
- Review the internal layout of the duplex and triplex in terms of exit provisions and travel distances.

4.1.3 Means of escape in common areas

BS 9991 recommends that for a building with a lobby approach, either of the following should be adopted:

- The travel distance between the exit doors from the dwellings and a smoke free area should be limited to 7.5 m, and the amount of smoke and other combustion products in the internal lobby kept to a minimum by providing either cross corridor fire doors and ventilation, or a mechanical smoke ventilation system, or
- An independent alternative escape route should be provided from each dwelling either by way of a corridor at another level or through an external common balcony meeting the following recommendations:
  - Structure including the floor is to be protected to achieve 30 minutes fire rating.
  - Walking surface should be imperforate.
  - The balcony to be open-sided and the opening to achieve at least 50% of the vertical plan.

Lobby approach: L7 – L39

The horizontal means of escape from each flat consist of the flat main entrance leading to the passenger lift lobby and into the firefighting stair as the primary means of escape. Alternatively, there is a route via the balconies to access one of the three stairs provided in the building (where only one is a firefighting stair). The escape routes are as follows:

- **Flat entrance –** There are three stairs (one firefighting stair, 1 down stair and 2 down stair) connected to the lift lobby, where each of the flat entrances directly open into. From the lift lobby, occupants can use the firefighting stair through the small lobby to evacuate the building.
- **Balcony exit –** All habitable rooms have a door which leads directly to the balcony. Once on the balcony, occupants can escape to one of the stairs connected to the balcony
  - Firefighting stair: occupants can use the stair to exit the building (Wing C);
  - 1 down stair and 2 down stair: occupants will reach the lift lobby either one or two levels below the flats, where they can then pass through the lift lobby to reach the firefighting stair to reach the final exit (Wing A & B).
- **Dining room exit** – All flats have a door in the dining room which leads to the adjacent wing's balcony where they can use the stair connected in an identical way as the balcony exit.
  - Firefighting stair: as above in Balcony exit (Wing B);
  - 1 down stair and 2 down stair: as above in Balcony exit (Wing A & C).

As shown in **Error! Reference source not found.** the travel distance within the unventilated lobby is greater than 7.5 m and exceeds the recommended travel distance.

Figure 6: Travel distance in the unvented lift lobby to the firefighting stair

The width of the balconies is 830 mm. It was identified during the site visit, that furniture is located along the balcony in certain levels of the tower as shown in **Error! Reference source not found.**. These should be removed so that the escape route remains unobstructed.

Figure 7: Furniture along the balcony

However, all of the flats are provided with balconies as an alternative escape route and therefore is not restricted by maximum travel distance of 7.5 m. Based on the photo of the balcony in **Error! Reference source not found.** and structural drawings, the balcony achieves the following:

- The floor slab of the balcony achieves a nominal fire rating of 120 minutes – refer to Section 4.3.1 for further details);
- The walking surfaces are solid concrete pavers and imperforated;
- The balconies appear to achieve the opening to be at least 50% of the vertical plane and uniformly spread across the surface.

And therefore, meets the recommendations of BS 9991.

Lobby approach: L1 – L6

From L1 to L6, there are no 1 down stair and 2 down stair that leads to the lift lobby in the lower levels. For Wing A, the only means of escape is from the flat entrance, through the lift lobby and the small lobby to the firefighting stair. Wing B and C have an alternative escape route where they can use the balcony to enter the firefighting stair directly either from the dining room exit (Wing B) or the balcony (Wing C).

The current evacuation procedure includes an escape route from Wing A to escape via the dining room to enter Wing B where they can use the provided key to enter Wing B to access the firefighting stair.

In order to ensure safe egress route is provide in all flats in L1 to L6, there are following options recommended:

- Retain the existing arrangement of escaping via neighbour's flat from Wing A, provided that there is regular inspection in place to check that the means of escape route via the adjacent flat (Wing B) is available, including checking the keys are in place. The inspection should include both the provisions in the common areas and maintaining the escape paths within the flats, or
- Providing compartmentation to kitchen area as this is the highest risk, or
- Provision of a protected internal hallway.

As the existing means of escape strategy for Wing A occupants between L1 to L6 to evacuate from their flat to neighbouring flat is unconventional, if the existing strategy is to be retained, it is required to be maintained otherwise travel distances are excessive, unless other recommendations listed above are provided to the flats.

The provision of sprinkler system will also address the risk of the single means of escape from the flat being compromised by the fire.

Podium and Street level (L01)

Both Podium and Street level (L01) have direct exit to outside. Podium level to L02 is connected by an internal open stair (950 mm in width).

This complies with the current guidance as there are direct exits to outside on both levels where occupants can use an alternative exit if one is discounted.

During the site visit, it has been confirmed that the lift lobby on Podium level is currently not being used. The facility management team should ensure that there are no stored goods within these areas as it may increase the risk of fire starting in the area and lead to smoke/fire spread to the lift shafts.

Below Street level (L02 – L03)

Both L02 and L03 are provided with two escape routes as follows:

- Internal open stair adjacent to the lift lobby which can be separated from occupied areas by a manually operated fire shutter. The internal open stair leads to the reception on L01 Street level and on to the final exit;
- Helical stairs (750 mm in width) located on the far end of the storage/plant corridor as an alternative means of escape in the event of the shutters close due a fire in the vicinity.

This complies with the current guidance as there is always an alternative means of escape from L02 and L03.

Plant area (L40 – L41)

The ventilation plant (L40) and the lift machine room (L41) both have two means of egress from the room to reach the firefighting stair and is considered compliant.

Recommendations:

- A management procedure should be put in place to keep the balconies clear of any obstacles at all times. This is to provide a clear escape route for occupants to evacuate in an emergency.
- A management procedure should be put in place to keep the lift lobbies clear of any stored goods at all times. This is to ensure the area is kept as a low risk area to prevent fire from starting.
- It is recommended to for L1 – L6 to be provided with one of the following options:

- Retain the existing arrangement of escaping via neighbour's flat from Wing A, provided that there is regular inspection in place to check that the means of escape route via the adjacent flat (Wing B) is available, including checking the keys are in place. The inspection should include both the provisions in the common areas and maintaining the escape paths within the flats, or
- Providing compartmentation to kitchen area as this is the highest risk, or
- Provision of a protected internal hallway.

- Provision of sprinkler system will also address the risk of the single means of escape from the flat being compromised by the fire.
- Refer to Section 4.1.6 for additional recommendations for single means of escape.

4.1.4 Vertical means of escape (stairs)

Minimum width

1 down stair and 2 down stair are required by BS 9991 to be no less than 750 mm, measured between the walls and/or balustrade (if protruding less than 100 mm from the walls). A minimum 2 m clear height shall be maintained. BS 9991 also states firefighting stairs should have an unobstructed width of 1100 mm.

Cromwell Tower is provided with the following stairs across different levels:

- L7 – L39: Three stairs where one is a firefighting stair, and additional 1 down stair and 2 down stair. The width of the firefighting stair is 1000 mm and the two other stairs have been measured (during the site visit) as 760 mm;
- L1 – L6: Only the firefighting stair is provided;
- L02 – L03: Three helical stairs (width of 750 mm) to Street Level (L01)
- L03 – Podium Level: An internal open stair (width of 950 mm) connecting basement levels to Reception on Street level and on to Podium level.

Refer to 4.5.3.1 for details of the firefighting stairs.

Protected lobby

Each apartment opens directly into the protected lift lobby which is connected to the 1 down stair and 2 down stair. The firefighting stair is provided with an additional lobby between the lift lobby and the firefighting stair as shown in Figure 5.

Ventilation to lift lobby

There are currently manually openable vents in the lift lobby. There are two different types of vents across different levels of Cromwell Tower which are as follows:

- L1 – L6: There are two vents (in the same location where the 1 down stair and 2 down stair are located in the upper floors) within the lift lobby which have manually openable louvres, operated by winding handles at the bottom of both sloped shafts as shown in Figure 8;
- L7 – L39: There are 1 down stair and 2 down stair doors (which open to the flat balconies) as shown in Figure 9 that can be opened by striking off heads of cast securing bolts.

The current arrangement is not considered acceptable in terms evacuation of PRMs. Refer to Section 4.1.6 for further details and recommended actions.

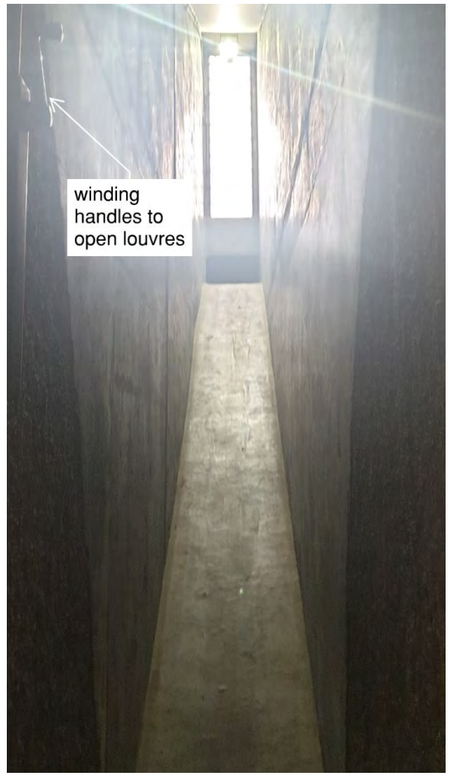


Figure 8: L1 - L6 sloped ventilation shaft

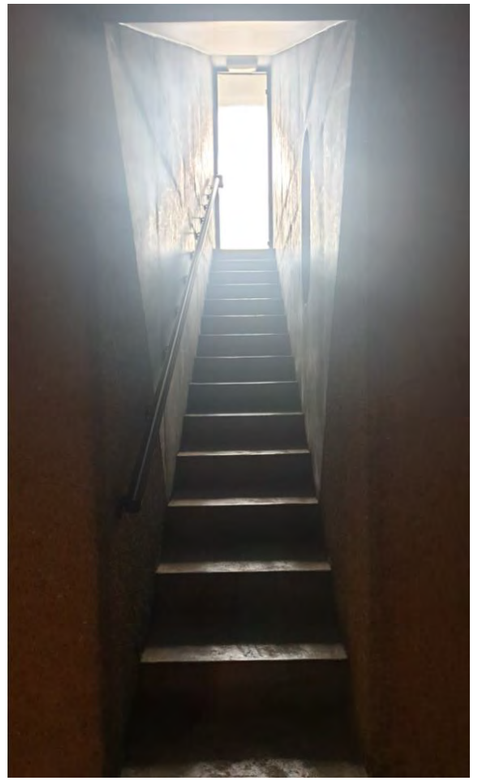


Figure 9: L7 - L39 1 down stair and 2 down stair

4.1.5 Final exits

Level of discharge

Final exits are available on both Podium and Street (L01) levels. All residential levels will exit via the Podium level using the firefighting stair.

In accordance with BS 9991, discharge from final exits should meet the following recommendations:

- Protected stairs should discharge directly to a final exit;
- Final exits should discharge directly to a walkway or open space that allows for the rapid dispersal of persons away from the vicinity of the building, which is achieved by the Podium and Street level;
- Final exits should have a level threshold;
- Final exits should be sited such that they are clear of any risk from fire or smoke

It has been confirmed during the site visit that both the Podium and Street level is levelled and an open public walkway, mainly of non-combustible construction and with very low fire load content. The reception in the Street level (L01) should be managed as a low fire load area as it forms part of an escape route.

Place of ultimate safety

The Podium level is an external walkway which runs along Cromwell Tower and connects to other buildings in the Barbican Residential Development and adjacent developments. The Street level main entrance is open to pedestrian accessway on Beech Street. The Podium and Street level final exits act as a place of ultimate safety (a place where there is no immediate or future danger from fire). The area in front of the main entrance acts as a point of access for fire service.

The internal open stair, which is not part of the firefighting stair, connects the Podium to Street level as shown in Figure 10. The occupants from above Podium level must exit the firefighting stair to outside of Podium level. The occupants from below Podium level can exit the building on L01 Street level. Both final exits on each level allows for the dispersal of occupants away from Cromwell Tower in the event of a fire.

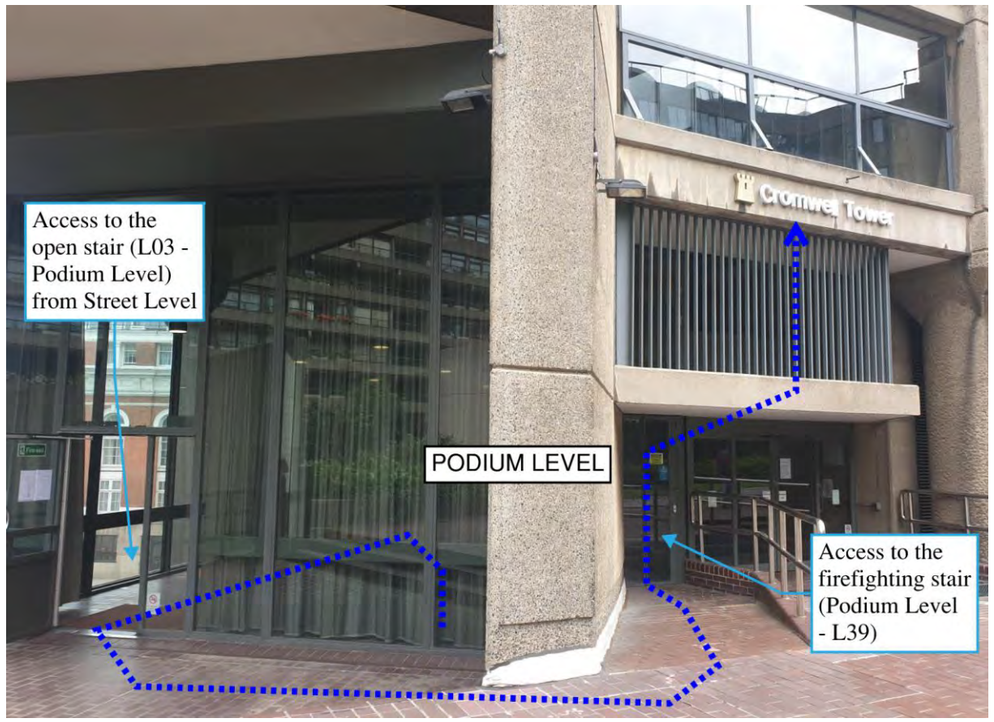


Figure 10: Access to Cromwell Tower on Podium level

Recommendations:

- BE should ensure the reception area is kept as a low fire load area at all times as it forms part of an escape route for occupants from L02-L03.

4.1.6 Evacuation of PRMs

Cromwell Tower currently does not have an evacuation strategy or Personal Emergency Evacuation Plan (PEEP) for PRMs. In this report, the term PRM is used to mainly refer to occupants who are wheelchair bound, but the term is applicable to occupants with varying levels of mobility.

As discussed in Section **Error! Reference source not found.**, each flat in the residential levels between L7 to L39 has alternative escape routes including access to balconies. However, there is a small change in level between the flats and the balconies. As such, the balconies will not be accessible to PRMs. In addition to this, the only route from the balconies to the lift lobby is via the 1 down stair and 2 down stair which is not step free. Therefore, for PRMs there is only a single means of escape using the flat entrance.

Existing provisions

Extended travel distance

BS 9991 recommends maximum travel distance of 9 m for single means of escape within flats protected by automatic detection system.

As there is only a single means of escape for PRMs, the travel distances within the flat should be limited to 9 m from the furthest point in the flat. As the flats do not have a common internal corridor serving all rooms, the current travel distance within the flats to the entrance door ranges between 14.9 m to 18.2 m which exceeds the recommendations of BS 999, as shown in Figure 11 below.

Figure 11: Extended travel distance for single means of escape for PRMs

Lack of safe refuge

All flats open directly into the lift lobby. Smoke from a fire in the incident flat could spread into the lift lobby during evacuation when the entrance door to the lobby is opened. There is no automatic smoke ventilation in the lift lobby nor emergency voice communication (EVC) system in the building.

The firefighting stair could serve as the safe refuge as it is separated from the lift lobby by a small lobby. However, the small lobby (floor area of 1.6 m^2) is very restricted in space with two consecutive doors that must be opened to enter the firefighting stair. It may not be possible for PRMs to reach the safe refuge in the stair. It is also challenging for PRMs to be assisted down the stair from a building of such height.

The lack of automatic smoke ventilation within the lift lobby, potentially causing the lobby to be smoke logged in addition to the difficulty of PRMs to access the firefighting stair (potential space for safe refuge) presents a life safety risk to the building occupants.

Lifts grounding system

The current lift mechanism and whether they ground upon activation of detectors within the lift shafts is unknown. There are currently no evacuation lifts in the building and hence the only area where PRMs can wait for assistance to evacuate is the lift lobby.

Doors to firefighting stair

BS 9999 recommends the total door width should be not less than 850 mm where unassisted wheelchair access is necessary.

During the site visit, it was confirmed that the doors to the firefighting stair were 760 mm.

Proposed improvements

There are a number of non-compliances in the existing arrangement which poses additional risk for PRMs means of escape provision. It is therefore recommended to provide the following:

- Automatic ventilation system within the lift lobby to prevent smoke logging to allow PRMs to wait in a safe area.
- To install EVC system in the lift lobby for PRMs to notify the security or the fire service that there is fire and for them to be assisted to evacuate the building.
- Personal Emergency Evacuation Plan (PEEP) for each PRM resident should be prepared so that they are clear about their evacuation arrangement in the event of a fire. This should be done as a first priority.

Refer to Section 4.3.3 for further details and recommendations on fire doors.

Recommendations:

- Provide an emergency voice communication (EVC) system on each lift lobby, for the PRMs to call for assistance.
- Provide an automatic fire detection and alarm system for each flat (Section 4.1.9 for details).
- BE to put in place management plan and evacuation strategy for the evacuation of occupants, in particular for PRMs which includes preparing PEEP as an immediate action.
- Clear briefing to all occupants of Cromwell Tower on available escape routes.
- Clear briefing to PRMs on the evacuation procedures and the use of emergency voice communication system to call for assistance.
- Replace the manually operated smoke vents to automatically openable vents upon activation of a detection system

4.1.7 Exit signage

BS 9991 recommends exit signage to be in accordance with BS 5499-4 and BS ISO 3864-1. In particular, for stairs that serve storeys both above and below the point of final exit, the final exit should be immediately apparent by the provision of additional signage.

In addition, the Grenfell Tower Inquiry: Phase 1 report recommends that in all high-rise residential buildings, floor numbers are clearly marked on each landing within the stairways and in a prominent place in the lobbies such that they can be seen in normal conditions and in low lighting and smoky conditions.

Existing provisions

BE confirmed emergency exit signage are unlit in Cromwell Tower.

BE advised that there is a sitewide inspection (currently paused) to examine the condition of existing signage and to replace them where necessary.

Proposed Improvements

All exit signage provided in Cromwell Tower is recommended to be in line with BS 5499-4, BS ISO 3864-1 and the additional recommendations from Grenfell Tower Inquiry Phase 1 report.

Recommendations:

- BE to carry out a sitewide inspection and provide exit signage in accordance with BS 5499-4, BS ISO 3864-1 and the additional recommendations from the Grenfell Tower Inquiry: Phase 1 report.

4.1.8 Emergency lighting

In accordance with BS 9991, emergency lighting should be provided in accordance with BS 5266-1.

Existing provision

Cromwell Tower is provided with an emergency lighting system with battery back-up. During the site visit, it was not possible to determine the light fittings that are part of the emergency lighting system.

Proposed Improvements

A full survey on emergency lighting is recommended and to remediate any of the non-compliances throughout the building for emergency lighting to be in line with BS 5266-1.

Recommendations:

- BE to carry out a sitewide survey and provide emergency lighting in accordance with BS 5266-1.

4.1.9 Fire detection and alarm

BS 9991 recommends that flats in multi-storey buildings shall be provided with an alarm and detection system in line with BS 5839-6. The recommended system for an existing flat with no alternative means of escape is Grade D1 Category LD1, where Grade D1 is a provision of one or more mains powered detection system each with a sealed in standby supply consisting of a battery and Category LD1 system is where full coverage is provided giving earliest practicable warning of fire to occupants, wherever ignition occurs.

In addition to the recommendations of BS 9991, the Grenfell Tower Inquiry: Phase 1 report recommends that all high-rise residential buildings, existing and new, are provided with facilities to allow the fire and rescue service to simultaneously evacuate the building. High-rise buildings are defined as buildings over 18 m in height and hence Cromwell Tower is considered a high-rise building.

Existing provisions

The External Fire Risk Assessment prepared by Frankham Risk Management Services in January 2018 states that different flats have different levels of fire alarm and detection varying from Grade D Category LD2 to having no means of providing detection and alarm.

During the site visit it was confirmed that the flats and common areas are not provided with a fire detection and alarm system. The storage and plant areas in L02 and L03, lift shafts and the upper floor plant rooms (L40 ventilation plant, L41 lift machine room) are provided with Category LD3 detection and alarm system.

In the case of privately owned flats, it is the responsibility of the owners to install an alarm and detection system. It should be noted that this is only a recommendation by BE as the freeholder, and not compulsory. BE has no record of the flats that are equipped with such system within the flats.

Proposed improvements

A Grade D1 Category LD1 system in line with BS 5839-6 is recommended for all the flats and in the lift lobbies in Cromwell Tower, due to the following reasons:

- An improvement to the flats with extended travel distances due to the lack of an internal hallway within the flat. The system provides an early warning to occupants so that they quickly evacuate from their flat.
- An improvement to evacuation of PRMs, with a single means of escape and requiring assistance to evacuate to the place of ultimate safety.
- Due to the potential risk of fire/smoke spread via the kitchen extract shunt duct arrangement (see Section 4.3.6), the detection and alarm system provides improvement by providing early warning in case of breach of compartmentation.
- BS 5839-6 gives recommendations to the new and existing premises separately. There are specific systems identified for existing premises which shows the importance of providing adequate fire detection and alarm system for existing buildings and not just for new builds.
- Provision of detection system in the lift lobby will allow activation of automatic ventilation systems within the lift lobby to allow PRMs to wait in without smoke logging in the lift lobby.

Recommendations:

- Provide a Grade D1 Category LD1 system in line with BS 5839-6 is recommended for all the flats in Cromwell Tower
- Provide detection in the lifts lobbies to automatically active the ventilation systems within the lift lobbies.

- The facility to simultaneously evacuate the Tower should be considered in conjunction with the recommendations above, as the additional infrastructure or cost to implement such facility may be minimal.

4.1.10 Fire suppression

Based on BS 9991, sprinkler protection is required for buildings with a floor higher than 30 m above ground level. However, the recent revision of ADB Volume 1: 2020 amendment states that the threshold building height (for residential buildings) for the provision of sprinklers has been reduced from 30 m to 11 m.

Existing provisions

Cromwell Tower is not provided with sprinkler protection, with the floor to floor height being 2.7 m, the building height from ground to the topmost occupied storey is 108 m. (drawing number 33 550).

Proposed Improvements

British Standard Code of Practice CP3: Chapter IV (1962) which was the relevant code at the time Cromwell Tower was built (1973) does not require any sprinkler protection to high-rise residential buildings. There is no requirement in the Building Regulations for existing buildings to comply with the current guidance, except where building works have taken place.

Sprinklers were not required at the time of construction.

However, the building adopts a stay-put policy, which relies on maintaining compartmentation between each flat and between the flat and the common areas. From the findings in the External Fire Risk Assessment prepared by Frankham Risk Management Services in January 2018, it has been identified that unauthorised structural alterations have been undertaken by/on behalf of the residents in several instances, causing breach in compartmentation between the flats.

In addition, this is a high-rise building with a single stair, extended travel distances within the flat and some of the residents have mobility impairment.

Due to these factors, it is recommended that a sprinkler system is provided.

BE have confirmed that insurers (from their consultation on the 23/07/2021) have no requirement to install sprinklers anywhere within the Barbican Residential.

Recommendations:

- Install sprinklers, as a solution to mitigate multiple risks including compartmentation, single means of egress etc.

4.1.11 Smoke control

BS 9991 recommends one of the following to be provided as a smoke control system for buildings with a floor level over 11 m above ground level served by a single stair:

- AOVs to the exterior of the building with a minimum free area of 1.5 m^2 fitted in the common corridor or lobby directly adjacent to the stair and an AOV on top storey of the stairway with a minimum free area of 1.0 m^2 both located as high a level as is practicable;
- A smoke shaft that is fitted in the protected lobby and an AOV that is sited on top storey of the stairway with a minimum free area of 1.0 m^2 located as high a level as is practicable;
- A mechanical smoke ventilation system that is fitted in the protected lobby directly adjacent to the stair enclosure, and an AOV that is sited on top storey of the stairway with a minimum free area of 1.0 m^2 located as high a level as is practicable;
- A pressure differential system.

Existing provisions

Cromwell Tower comprises of two lobbies between the flats and the firefighting stair. The lift lobby which is open to flats and a small lobby between the lift lobby and the firefighting stair. The current smoke control system in each lobby is as follows:

- Lift lobby (approximate area of 34 m^2):
  - L1 – L6: Two vents with a dimension of 1.95 m x 0.46 m each, within the lift lobby which have openable louvres by winding handles at bottom of both sloped shafts
  - L7 – L39: Two doors with a dimension of 2.34 m x 0.66 m each, to the 1 down stair and 2 down stair (in the same location where the two vents are in the lower floors) opened by striking off heads of cast securing bolts.
- Small lobby (approximate area of 1.6 m^2): BE confirmed there is an electrical riser/ventilation shaft adjacent to the small lobby and connected by louvres (approximate area of 0.76 m^2) as shown in Figure 12 below.
- Electrical riser: There is a concrete floor on each level of the riser from L37 and below. Fire stopping around cables penetrating the concrete floor appear to be missing. Above L37, the electrical riser is connected to the ventilation shaft, which is opened to the small lobby.

Figure 12: Louvre connecting the small lobby and the electrical riser

The current arrangement of small lobby, firefighting stair, ventilation shaft and electrical riser is as shown in Figure 13.

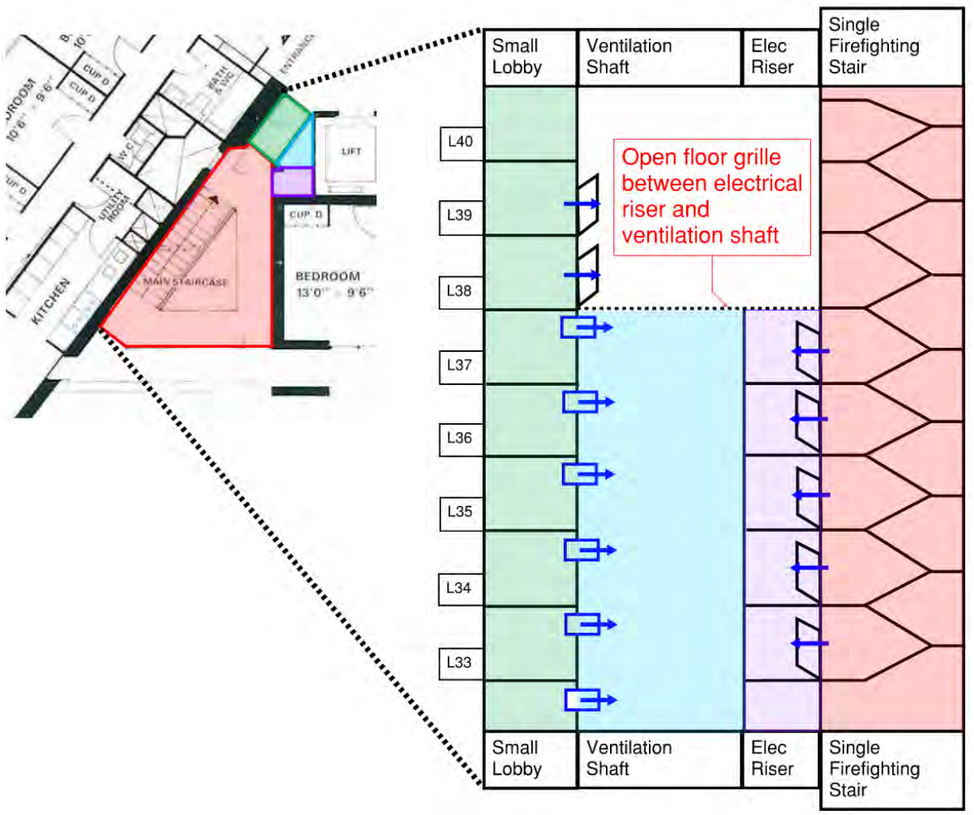


Figure 13: Current arrangement of small lobby, ventilation shaft, electrical riser and firefighting stair

As shown Figure 13, the small lobby is connected to the ventilation shaft on each floor, which is connected to the electrical riser on L37 and above. This is a risk as a fire in the electrical riser could result in smoke spread to the small lobby and the single stair. This will affect the availability of the stair for means of escape and firefighting access.

Proposed Improvements

In order to ensure the escape route is protected from risk of smoke and fire spread from other areas, the following is recommended:

- Provide fire separation between the small lobby and the ventilation shaft (removing all the vents) and remove the fire door between the small lobby and the lift lobby on L37 and above, or
- Provide a fire and smoke damper at each vent to maintain fire separation and to only vent the floor of fire incident. Also provide a wall to separate the smoke shaft and the electrical riser from L38 and above.

Recommendations:

- Provide fire separation between the small lobby and the ventilation shaft (removing all the vents) and remove the fire door between the small lobby and the lift lobby on L37 and above, or
- Provide a fire and smoke damper at each vent to maintain fire separation and to only vent the floor of fire incident. Also provide a wall to separate the smoke shaft and the electrical riser from L38 and above.

4.1.12 Refuse storage cupboard and post box

BS 9991 recommends refuse rooms provided for the storage of refuse should be separated from other parts of the building and should not be located within or accessed directly from the lift lobby. Rooms provided for the storage of refuse should be approached only by way of a protected lobby having not less than 0.2 m^2 of permanent ventilation or a suitable mechanical alternative.

There is no recommendation in BS 9991 for post box. Considering the fire load content such as parcels, even though not to the same scale as refuse, it is recommended to not locate the post box within the lift lobby.

Existing provisions

Every flat in Cromwell Tower is provided with a refuse storage cupboard and a post box adjacent to the flat entrance door, for the use of the flat occupants only. The refuse storage and post box are accessible from both the lift lobby outside the flat and within the flat for Wing A and C, and only accessible from the lift lobby outside for Type B. BE confirmed the material build-up of the cupboards are mostly wood with asbestos backing as shown in Figure 14.

There is no ventilated lobby provided and no other mitigation measures provided in Cromwell Tower for refuse storage areas.

Proposed Improvements

The current arrangement does not comply with the recommendations of BS 9991. Refuse storage is considered a high fire hazard area and the location within the lift lobby poses a risk to the occupants. A fire involving the refuse can cause fire and smoke to affect the use of the lift lobby and compromise the stay-put strategy. As the lift lobby is not ventilated, smoke may spread into the small lobby and then the stair, affecting the single means of escape from the building. It is therefore recommended for the door separating the refuse storage and post box from the lift lobby to be fire rated door.

As a recommendation to this non-compliance, the doors to the refuse storage from the lift lobby should be fire rated to 60 minutes with smoke seals. Although this does not fully meet the current recommendations of BS 9991, this is considered an improvement to the current arrangement. The recommended additional detection and alarm system in each flat will serve to provide early warning in the in the event of a fire in the flat. The new fire rated door separating the refuse storage and post box from the lift lobby will serve to limit fire and smoke spread, maintaining the use of the lift lobby for means of escape and protected refuge area.

Figure 14: Refuse storage cupboards in the lift lobby

Recommendations:

- The fire doors to refuse storage and post box cupboard should be inspected and reviewed. If not able to provide fire separation, it is recommended for new fire doors (FD60S) to be provided.

4.1.13 L02 – L03 Storage/ plant area

BS 9991 states no storeroom should open directly to a stair. Instead, there should be a ventilated lobby between the storeroom and the stair.

BS 9999 states storage areas greater than 1 m^2 in area but not greater than 450 m^2 (other than refuse storage areas) need to be separated from other parts of the building with a minimum standard of fire resistance of 30 minutes.

Existing provisions

There are storage and plant areas on L02 and L03 of Cromwell Tower, they are located below the footprint the flats in the residential levels. Each of the large storerooms is provided with a corridor which provides access to smaller storage rooms which are also further subdivided into smaller rooms/cupboards which are designated to each of the flats. There is fire separation between the storage/plant rooms and the corridors serving the rooms. The corridors lead to the internal open

stair and are separated by fire shutters which activate via a fusible link. [Note: the internal open stair is not the only egress route for L02 and L03 and there is an additional stair on the opposite end of the storage areas].

There are three additional escape stairs (stair width of 750 mm) at the end of each of the storage corridors which all directly discharge to outside on Street Level (L01).

There is exit signage and Category LD3 automatic detection and alarms within the storage areas. It has been confirmed by BE that there is no emergency lighting within the storage levels.

Both L02 and L03 is connected to the car park space which are separated by fire shutters.

In L03, the area is shared between storage areas and plant rooms. One of the plant rooms in L03 is connected to the L04 Subway level via a fixed ladder.

Proposed Improvements

Refer to Section 4.1.8 for recommendation on emergency lighting.

4.1.14 Back-up power supplies

BS 9991 states life safety systems are to be provided with a secondary power supply. The primary power source should generally be taken from the public electricity supply, with secondary power being supplied from an alternative utility supply from another substation, a generator or uninterruptable power supply (UPS) or batteries.

Where practicable, power supplies should be provided via two separate intakes into the building from the same external substation or via a single intake and a standby generator.

Existing provisions

Cromwell Tower is provided with a number of life safety systems including emergency lighting, firefighting stair ventilation and firefighting lifts. Secondary power supply to the life safety systems is provided and have been identified by BE as follows:

- Emergency lighting – UPS and generator (in good working order)
- Firefighting lifts – generator (in good working order)
- Emergency exit signage – currently, the exit signage is unlit in Cromwell Tower

Proposed improvements

Refer to Section 4.5.3.3 for recommendation on firefighting lifts.

Recommendations:

- The secondary power supply systems are to be maintained in good operation condition and in accordance with the relevant standards. It is recommended for BE to establish the compliance of the secondary power supply provisions against the relevant standards.

4.2 Internal fire spread (linings)

BS 9991 recommends the following for wall and ceiling linings:

- Circulation spaces / common corridors – Class 0 in line with BS 476-7 (national class) or Class B-s3, d2 or better in line with BS EN 13501-1 (European class);
- Within apartments – Class 1 in line with BS 476-7 (national class) or Class C-s3, d2 or better in line with BS EN 13501-1 (European class).

Existing provisions

There is no information on the wall and ceiling linings across the common areas of Cromwell Tower as well as within the flats. Based on the site visit, the walls appear to be concrete for the common areas including the firefighting stair and the 1 down stair and 2 down stair and have been confirmed by BE.

As concrete finish is expected to achieve Class A1, it meets the recommendations of BS 9991. However, this is based on the assumption that wall and ceiling linings are concrete finishes throughout all areas of the building. If there are areas within the building where the above requirements are not likely to be achieved, they will need to be discussed and addressed separately.

4.3 Internal fire spread (structure)

4.3.1 Structural fire resistance

Under the BS 9991 guidance, buildings over 30 m in height needs to be provided with sprinkler protection as well as 120 minutes fire resisting construction for load bearing capacity. Elements of structure supporting the firefighting shafts are required to achieve 120 minutes.

Elements of structure are required to achieve a loadbearing capacity (R) only, however when certain elements also act as separating elements (i.e. walls) integrity (E) and insulation (I) are also required.

Existing provisions

Information on the existing building structure is based on the structural drawings in the Arup Archive. It has been assumed that all elements (i.e. walls, slabs, etc.) shown in the structure drawings are elements of structure and therefore loadbearing.

Based on the structural drawings (drawing numbers 33 F9 & 33 F12) the following information on structural elements was obtained:

- Wall separating flats from the lift lobby: 305 mm
- Walls separating flats from firefighting stair: 305 mm
- Walls separating flats from 1 down stair and 2 down stair: 305 mm
- Floor slab thickness (excludes balcony slabs): 178 mm

The wall and slab thickness varies from one location in the building to another; the above dimensions represent the smallest (and therefore most conservative) of those

observed from the drawings reviewed. The above dimensions have not been verified through site inspections.

The following guidance documents have been used to assess the potential fire rating offered by the dimensions of the walls and slabs:

- BS EN 1992-1-2-2004: Eurocode 2 Design of Concrete Structure Part 1-2: General rules – Structural fire design (Eurocode 2), which is the current guidance; and
- CP 114:1957 British Code of Practice, The Structural Use of Reinforced Concrete in Buildings, which is the relevant code at the time of construction.

In assessing the potential fire rating, the following assumptions are made:

- The thickness of structural elements stated above apply throughout the building;
- All structural elements are reinforced concrete;
- The concrete covers over the reinforcement bars meet the values stated in the relevant guidance at the time of construction (CP 114); there is no information on the depth of the existing concrete covers for this aspect to be assessed;
- Floor slabs are simply supported one-way slabs throughout the building;
- No structural calculations are available and therefore the utilisation factor of the structural members is unknown. When checking against the requirements of Eurocode 2 a utilisation factor of 0.7 has been taken as conservatism;
- The fire resistance requirements given in CP 114 cover loadbearing capacity, integrity and insulations;
- Structural drawings for all levels of Cromwell Tower are not available and only L36 and L39 structural drawings and section drawings were used as referenced in Table 2.

The table below compares the existing dimensions of the structural elements with the requirements from the two guidance documents.

Table 3: Summary of structural element thickness against code requirements

Existing structural element	Existing element thickness	Eurocode 2 requirements	CP 114 requirements	BS 9991 requirements	Comments
1 down stair and 2 down stair wall	305 mm	140 mm (REI 60) 220 REI120	70.6 mm (REI 60) 101.6 REI120	R 120	Achieving both the Eurocode 2 and CP 114 for REI 60 rating
Walls between flats	305 mm	140 mm (REI 60)	70.6 mm (REI 60)	R 60	Achieving both the Eurocode 2 and CP 114 for REI 60 rating
Firefighting shaft wall	305 mm	160 mm (REI 120)	101.6 mm (REI 120)	R 120	Achieving both the Eurocode 2 and CP 114 for REI 120 rating
Floor slab	178 mm	120 mm (REI 120)	127 mm (REI 120)	R 120	Achieving both the Eurocode 2 and CP 114 for REI 120 rating
Lift riser wall	200 mm	160 mm (REI 120)	101.6 mm (REI 120)	R 120	Achieving both the Eurocode 2 and CP 114 for REI 120 rating

The thickness of the structural elements to meet the required fire ratings appear to meet both the current guidance and the relevant guidance at the time of construction.

4.3.2 Fire compartmentation

Fire compartmentation is required to limit fire spread within the same building and protect means of escape. BS 9991 recommends the following fire ratings:

- Compartment walls between flats: 60 REI
- Compartment floor:120 REI;
- Passenger lift shaft: 120 REI;
- Firefighting shafts:120 REI;
- Any risers penetrating compartment floors: 120 REI;
- Fire stopping – same level of fire resistance as the compartment wall it passes.

Note: Load bearing capacity (R) only required for load bearing elements.

Existing provisions

There is currently no drawing or information available on the material of the riser construction in Cromwell Tower (kitchen risers, bathroom risers). BE confirmed there are mixture of concrete and asbestos panels that form riser walls and that there is no additional information available on the risers within the lift lobbies and the firefighting stair.

Based on the External Fire Risk Assessment prepared by Frankham Risk Management Services in January 2018, it has been identified that unauthorised structural alterations have been undertaken by/on behalf of the residents in several instances. This has resulted in compromised standards of compartmentation

between individual flats and the communal risers. This has been confirmed by BE during the site visit.

Recommendations:

- BE to carry out a building wide survey to inspect breach in compartmentation, and to undertake works to maintain compartmentation to the areas in accordance with BS 9991.

4.3.3 Fire doors

BS 9991 recommends the specification, installation and maintenance of hinged or pivoted pedestrian fire doors to be based on BS 8214. This standard recommends fire rating of doors to be tested in accordance with either BS 476-22 or BS EN 1634-1.

The following fire rating requirements are based on Table 12 of BS 9991:

- Fire door separating firefighting stair and firefighting lobby: FD30S;
- Passenger/firefighting lift landing door: FD30S;
- Fire door separating a flat from a space in common use; FD60S*;
- Enclosing a protected shaft forming a lift well or service shaft: FD60S.

*Note: BS 9991 requires that the fire door separating a flat from a space for common use is to be FD30S. In the case of Cromwell Tower, this has been upgraded to FD60S to enhance protection of the lift lobby to create a safe refuge for PRMs.

In addition, the Grenfell Tower Inquiry: Phase 1 – report recommends that all residential building containing separate dwellings (whether or not they are high-rise buildings) to:

- Carry out an urgent inspection of all fire doors to ensure they comply with applicable legislative standards; and
- To be required by law to carry out checks at not less than three-monthly intervals to ensure that all fire doors are fitted with effective self0closing devices in working order.

Existing provisions

There is currently no information on the existing doors for Cromwell Tower. However, based on the information provided on the document ‘The fire resistance performance of a single leaf single acting door set with side screen and over panel, when tested in accordance with BS 476: Part 20/22: 1987’ issued by Exova Warringtonfire on 02/06/2018, the fire doors in Shakespeare Tower have not satisfied the requirements for 30 minutes (EI30) class door.

Although the test was not carried out specifically for the fire doors in Cromwell Tower, it is assumed that Shakespeare Tower and Cromwell Tower have identical fire doors as they are part of the Barbican Residential Development as agreed by BE.

There are currently multiple doors connecting different risers onto either the lift lobby or the firefighting stair as shown in Figure 16. There is no information on the fire rating of the doors to the risers within the lift lobbies and firefighting stairs. During the site visit, it was noted by Andrew Woods (CoL District Surveyor) that some risers have compartmentation issues as a result of the asbestos firestopping having been removed and not replaced and is therefore a fire risk.

During the site visit, the following issues were observed:

- The doors to the risers within the lift lobby and firefighting stairs were not labelled ‘fire door’ nor they appeared to be provided with smoke seals;
- It was unclear if the doors were being maintained to provide fire separation between the riser and the lobby/firefighting stair as shown in Figure 15.

As Cromwell tower is provided with a single stair, it is recommended to ensure adequate compartmentation is provided to the stair. This is to ensure occupants can evacuate via the stair as well as fire service to use the stairs to enter the building.

Figure 15: Risers within the lift lobbies

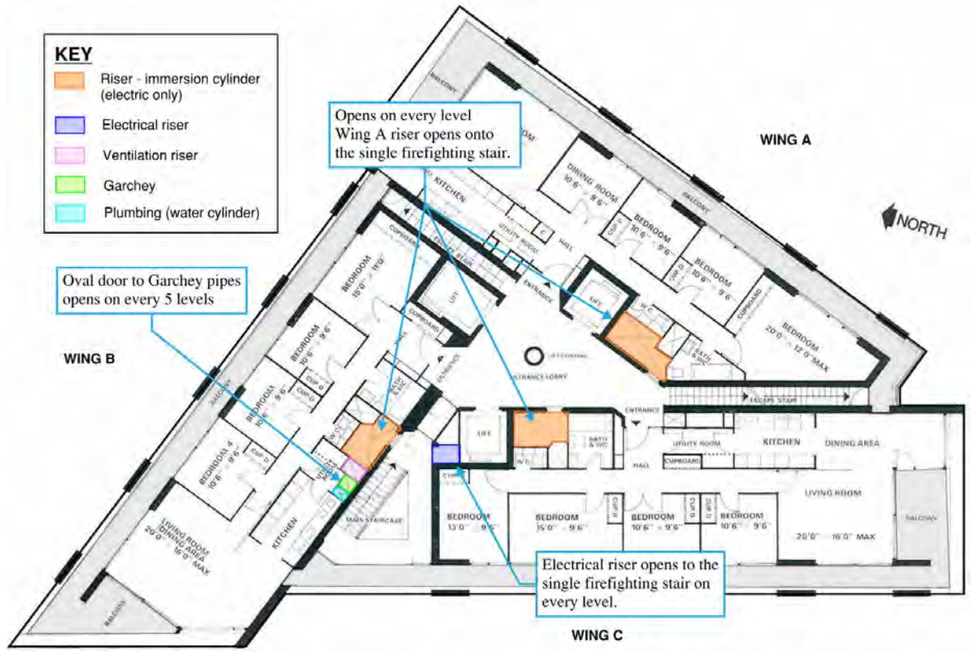


Figure 16: Risers opening onto the firefighting stair and lift lobby

Recommendations:

- It is recommended to replace all the fire doors to the stair, small lobby, flat entrances and the refuse storage/post box.
- Doors to all the risers to be inspected and repaired/replaced to maintain fire separation from the stair or lift lobbies.
- Keep records of inspection and testing of fire doors in the future, at not less than three monthly intervals to ensure that all fire doors are in working order.

4.3.4 Cavity barriers

Clause 33.1. of BS 9999 recommends that cavity barriers should be provided to close the edges of cavities, including around openings. Cavity barriers should be provided at the junction between an external cavity wall and every compartment floor and compartment wall. It also needs to be provided at the junction between an internal cavity wall and every compartment floor, compartment wall or other wall or door assembly which forms a fire resisting barrier.

Existing provisions

BE have confirmed that there are no cavity barriers in Cromwell Tower due to the build-up of the walls not having any cavities (identical to Andrewes House).

There is no information on any other cavities across Cromwell Tower. BE to advise.

4.3.5 Fire stopping

BS 9991 (Clause 24.4 and Figure 24) recommends where a building service passes through a compartment wall or floor it shall be adequately fire stopped in line with the compartment fire resistance.

Existing provisions

There is currently no information on the provision of fire stopping for Cromwell Tower. Based on the External Fire Risk Assessment prepared by Frankham Risk Management Services in January 2018, fire stopping registers are not in place.

Recommendations:

- BE to carry out a sitewide inspection of fire stopping and undertake fixing of the fire stopping to ensure fire compartmentation is maintained.

4.3.6 Kitchen and toilet shunt duct risers

In accordance with BS 9991, vertical ventilation ducts should be enclosed throughout their height with fire resisting construction. Where a horizontal ventilation duct penetrates the fire resisting construction, BS 9999 recommends four different methods of maintaining the fire separation at the penetration:

- Method 1: thermally actuated fire dampers;
- Method 2: fire resisting enclosures e.g. fire rated plasterboards;
- Method 3: protection using fire-resisting ductwork;
- Method 4: automatically actuated fire and smoke dampers triggered by smoke detectors.

BS 9999 Section 32.5.2.2 also states that Methods 1 and 4 should not be used for extract ductwork servicing kitchens and this is due to the likely build-up of grease within the duct which can adversely affect the effectiveness of any dampers.

In the Barbican Residential Development, it is understood that a common approach to maintain fire separation between flats is to use shunt duct arrangement for the kitchen and toilet extract ventilation ducts. The purpose of shunt duct is to avoid the need for fire protection using the Methods described above. A shunt duct arrangement comprises of branch ductwork (‘s’ or inverted ‘s’ shaped) that are connected to the main extract ductwork as shown as Figure 17. In addition to the downward bend of the shunt duct, a fan at the top of the main extract ductwork maintains a negative pressure that stops smoke from spreading out of the ductwork.

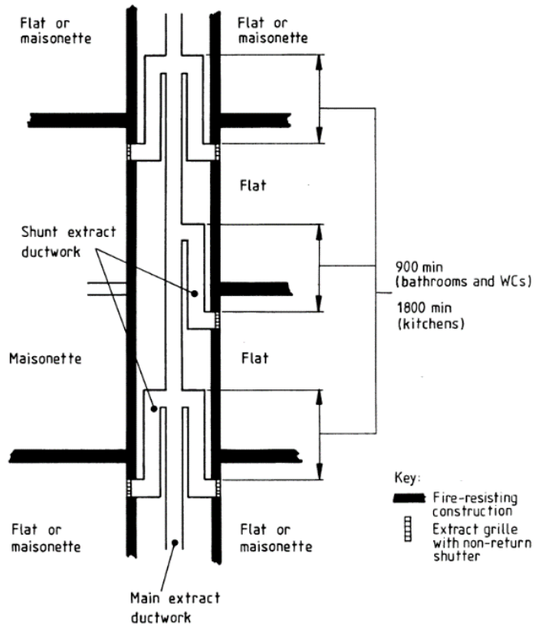


Figure 17: Layout of shunt duct system (BS 5588 Part 9)

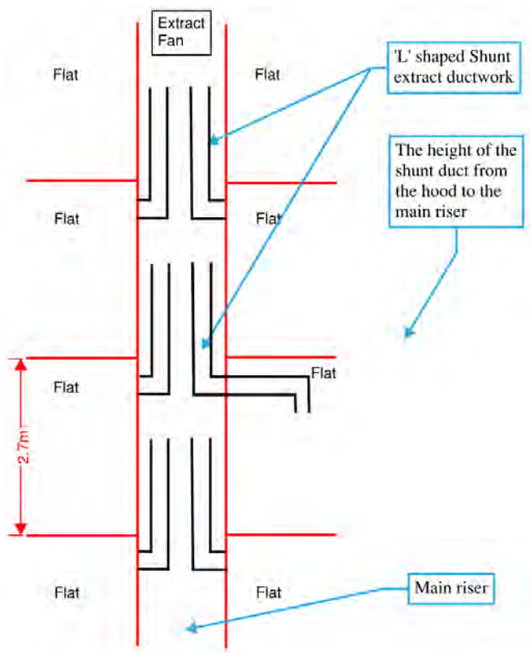


Figure 18: Existing layout of shunt duct system in Cromwell Tower

Shunt duct arrangement is a recognised approach in BS 5588-9:1999 – *Fire precautions in the design, construction and use of buildings Part 9: Code of practice for ventilation and air conditioning ductwork*, for extract ductworks serving toilets. However, it is not normally acceptable for use in kitchen extraction because of the fire risk inherent in kitchens. The guidance mentioned that if shunt duct is used for kitchen extraction, careful consideration should be given to possible pressure differentials within the system to avoid the transfer of smoke and other products of combustion from one dwelling to another by means of the ductwork system. This guidance has been withdrawn and is no longer referenced in other current standards including the Approved Document B.

Existing provisions

BE confirmed during the site visit that Cromwell Tower uses shunt ducts for both kitchen and bathrooms each provided with a separate main extract ductwork.

BE confirmed the shunt ducts in Cromwell Tower have the same arrangement and material as Andrewes House. However, the dimensions of the shunt ducts are currently unknown.

In Cromwell Tower, it is understood that the main kitchen extract riser and the shunt ducts are of concrete construction. Dimensions of the concrete construction are unknown, but likely to have some inherent fire rating. The kitchen extract riser is located within the kitchen and serves all the flats on the same vertical stack. The extract fan is located at the top of the main riser and on continuous operation (BE confirmed the capacity of the current fans are 10 cbm/s). BE also confirmed that the shunt ducts are 'L' shaped as shown in Figure 18 instead of the more common 'S' shaped as shown in Figure 17. The frequency of maintenance and cleaning, and the internal grease builds up within the vertical portion of the shunt ducts and within the main extract risers are unknown.

The toilet extract riser is located within the toilet of each flat and serves all the flats on the same vertical stack. The side backing on to the toilet wall contains asbestos and the rest of the walls are concrete.

Proposed Improvements

Whilst the use of shunt duct in lieu of other forms of fire protection is no longer in line with current UK guidance, their use for toilet extract risers is still allowed in other countries (Australia – AS 1688.1; USA – International Building Code). Considering the low risk nature of toilets and provided that the installations are in line with the details of the guidance, the use of shunt duct for toilet extract riser is considered acceptable provided improvement is made to increase the reliability on the extract fan.

However, it is not recommended to use shunt duct for kitchen extract riser. The presence of grease in the duct may affect the effectiveness of the shunt system in maintaining fire and smoke separation. Failure of compartmentation between the flats presents a life safety risk to the occupants, especially as the kitchen extract riser is located opposite the flat entrance, which is the only means of escape for the PRMs and flats below the Podium level.

Provision of fire detection and alarm system is one of the improvements, providing early warning before the single escape route via the flat entrance is compromised. In addition, the risk of fire spread via the shunt duct can be reduced by replacing the existing extract hoods with recirculation type extract hoods and maintaining the compartmentation between the flats.

BE confirmed that the kitchen shunt duct is also used as a day-to-day ventilation system and an alternative way to ventilate the area will be required if the current kitchen extract is closed off.

Recommendations:

Replace the existing extract hoods with recirculation type hoods, and implemented one of the followings:

- Smoke and fire damper at the shunt duct riser activated by the fire alarm/detectors within the flat (this maintains the use of the riser for normal ventilation of the flat); or
- To block off the shunt ducts and provide a fan on the external wall to draw out air from the flat into the balconies.

Maintain the existing extract hoods and shunt duct arrangement by increasing the reliability of the main extract fan. This will require an additional duty standby fan (the fans to be rated at 400 ˚C for 90 minutes in accordance with BS EN 13501-4), with secondary power supply. The fans need to be adequately maintained to keep the main riser under negative pressure.

4.4 External fire spread

4.4.1 Fire spread to neighbouring buildings

Buildings must maintain the minimum separation distance from the site boundary to protect itself and adjacent buildings against external fire spread. A building that is located less than the required separation distance from the site boundary will be required to be provided with mitigation measures to prevent fire spread such as fire rated external walls. In accordance with BS 9991, there are four methods used to determine the maximum permissible amount of unprotected façade. In this case, the most appropriate method is the enclosing rectangle in line with BR 187.

Existing arrangement

There is no information available on the location of the site boundary in relation to Cromwell Tower. If there are no site layout available, the building boundaries or the relevant boundaries will be measured using Google Maps as shown in Figure 19 and as follows:

- North: 21 m (to the middle of Beech Street);
- East: 7.2 m (to the middle of Silk Street);
- West: 10.5 m (mid-way between Cromwell Tower and Frobisher Crescent).

An external fire spread calculation has been undertaken for a single flat using the above assumed boundary distances and Figure 19. The enclosing rectangle method in line with BR 187 was carried out. The results show that no protection is required to the facades. Please refer to Appendix B for the calculation.

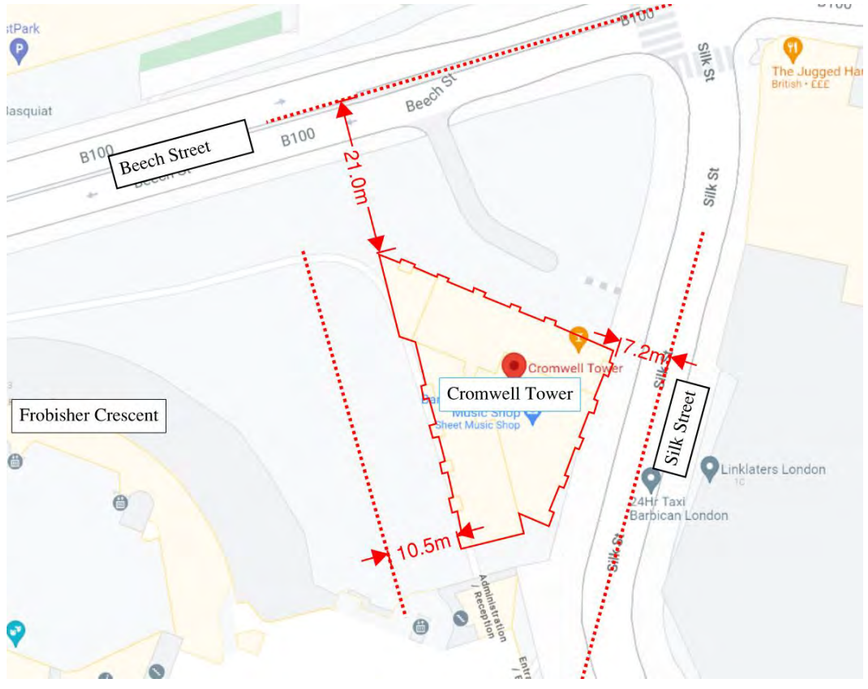


Figure 19: Existing arrangement for Cromwell Tower and adjacent buildings

4.4.2 Façade material

BS 9991 recommends the following material classifications for external areas of the façade of buildings greater than 18 m in height:

- Areas < 1 m from the boundary – Class 0 (National class) or Class B-s3, d2 or better (European class);
- Areas > 1 m from the boundary and > 18 m in height – Class 0 (National class) or Class B-s3, d2 or better (European class).

The Building Regulations also require materials which become part of an external wall (i.e. cladding material, insulation product, filler material – not including gaskets, sealants and similar) and specified attachment (e.g. balcony) of a residential building with a storey at least 18 m above ground level to achieve European classification A2-s1, d0 or Class A1, classified in accordance with BS EN 13501-1:2007+A1:2009 entitled ‘Fire classification of construction products and building elements. Classification using the test data from reaction to fire tests’.

In addition, the Grenfell Tower Inquiry: Phase 1 report recommends that the owner and manager of every high-rise residential building be required by law to provide their local fire and rescue service with information about the design of its external walls

together with details of the materials of which they are constructed and to inform the fire and rescue service of any material changes made to them.

Existing provisions

BE confirmed all elevations of Cromwell Tower are provided with solid concrete construction.

The concrete panel is considered to achieve Class A1, and therefore it meets the recommendations of BS 9991.

In the case of balconies, BE confirmed the build-up consists of concrete paving slabs sitting on top of a felt membrane. The felt is a membrane and therefore under Regulation 7(3) of Approvement Document B, is exempt from having to meet the requirements for a European Classification of A2-s1, d0 or better.

It is also recommended to provide information about the design of external walls and details of the materials in the Fire notice box for the fire and rescue service to be able to have access to the information when they arrive on site.

Recommendations:

- Include information about the design and materials of the external walls in the Fire Notice Box, to be located by internal open stair landing on Street Level reception area.

4.4.3 Roof materials

BS 9991 recommends buildings where the roof is at least 6 m away from any point on the relevant boundary needs to be provided with a roof covering designation of minimum AD or BD in line with BS 476-3 (equivalent to $E_{roof}(t4)$ classification in line with BS EN 13501-5 European classifications)

Existing provisions

The roof of Cromwell Tower consists of either felt with insulation or a liquid membrane as advised by BE. The material specification of the roof material has not been defined. BE to confirm to carry out further review on the roof material.

4.5 Access and facilities for the fire service

4.5.1 Fire main inlet

BS 9991 recommends buildings fitted with wet fire mains should have fire appliance access:

- within 18 m of, and within sight of, a suitable entrance giving access to the wet fire main; and;
- within sight of the inlet for the emergency replenishment of the suction tank for the wet fire main.

Existing provisions

Cromwell Tower is provided with one wet riser main with outlets that can be accessed from the following locations:

- Street level (L01) to L39: within the lift lobby and adjacent to the front door of the Type B flats as shown in Figure 20;
- L02 – L03: adjacent to the lift lobby.

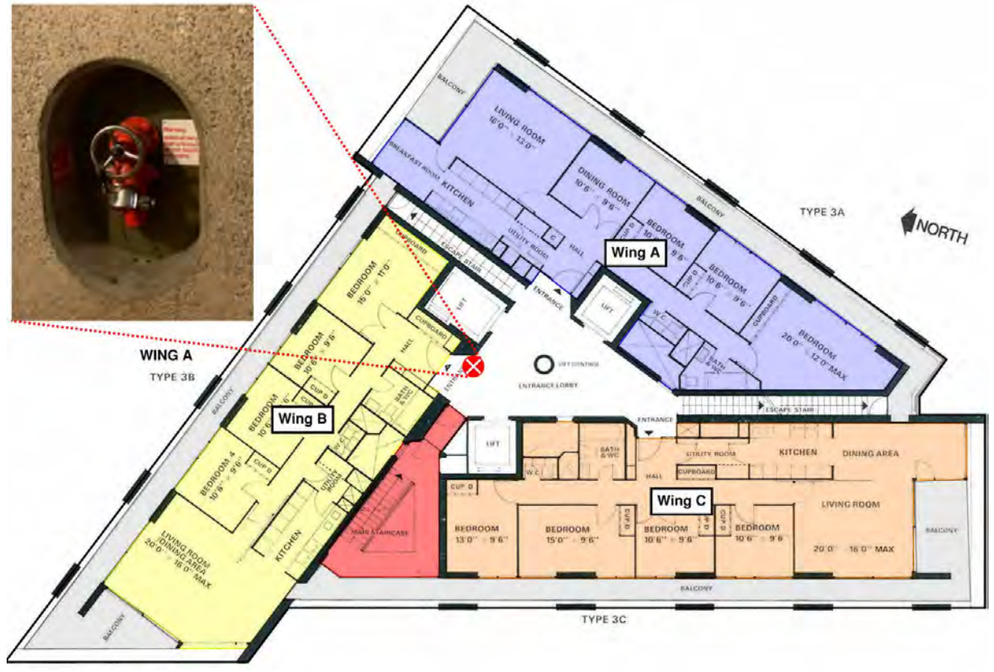


Figure 20: Wet riser outlet within the lift lobby for residential levels

4.5.2 Fire service access

BS 9999 recommends that the distance between the fire vehicle parking location to the firefighting entry point of the building to not exceed 18 m in length. In addition, the entry of the firefighting access shaft at rescue service access (vehicle access level) level should be directly from open air or by way of a protected corridor not exceeding 18 m in length.

Existing arrangement

Firefighting access into the building is directly from the main entrance of Cromwell Tower on Street level (L01) accessed via Beech Street where the firefighting vehicle has space to park in front of Cromwell Tower as shown in Figure 21.

Figure 21: Open area in front of the main entrance to Cromwell Tower

For the firefighting personnel to access the residential levels, they must use the internal open stairs on Street level (L01) to travel to the Podium level (refer to Figure 10 above), then exit the tower in order to enter the firefighting stair of Cromwell Tower (connecting Podium level to Roof level). There is no direct firefighting vehicle access on to the Podium level and the travel distance from the fire service access point to the entrance of the firefighting shaft on Podium level exceeds 18 m. However, this is considered acceptable due to the following:

- The firefighting lift is accessible from Street level (L01) and is within 18 m of the fire vehicle parking location. The lift lobby at ground can be used as a muster point for service before travelling to the floor of fire origin. However, there is no connection between the firefighting stair and the lift lobby on the ground floor;
- Alternatively, firefighters can use the internal open stairs to travel from Street level to access the firefighting stair from the Podium level.

For the firefighting personnel to access the lower storage/plant levels (L02 – L03), they can travel through the internal open stair as shown in Figure 22.

Recommendations:

- Engagement with London Fire Brigade to ensure the access arrangement is clear.

Figure 22: Internal open stair (L03 - Podium level) on Street level

4.5.3 Facilities for the fire service

BS 9991 recommends buildings with a floor higher than 18 m above fire and rescue service access level should be provided with firefighting shaft(s) containing firefighting lifts. A sufficient number of firefighting shafts should be provided to meet the maximum hose distance of 60 m to cover all parts of the building.

Firefighting shafts should be constructed in accordance with the recommendations given in BS 9999.

Cromwell Tower is provided with one firefighting shaft with a firefighting stair, wet riser, firefighting lift and firefighting lobby.

4.5.3.1 Firefighting stairs

BS 9999 recommends a firefighting stair should have an unobstructed width (measured between the walls and / or balustrades) of 1.1 m. the width should be kept clear for a vertical distance of 2.0 m.

BS 9999 also recommends only services associated with the firefighting shaft should pass through or be contained within the firefighting shaft.

Existing provisions

The firefighting stair in Cromwell Tower connects Podium level to Roof level with a width of 1000 mm. From L39, the firefighting stair extends to the Roof level (plant space only) as a helical stair as shown in Figure 23 below.

There are no firefighting stairs in the lower levels (L01 to L03) of Cromwell Tower.

There are risers directly opening onto the firefighting stairs. Refer to recommendations in Section 4.3.3 for management procedures when there are works being done on the riser, refer to Table 4.

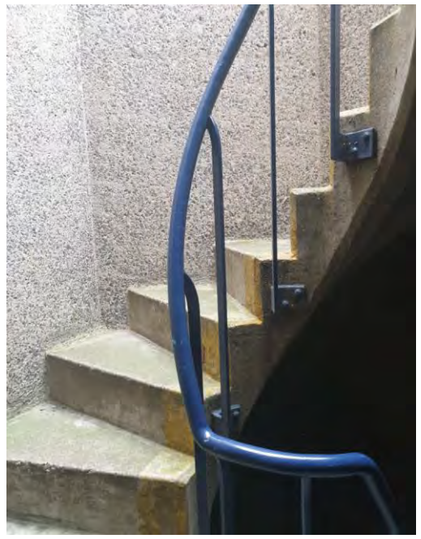


Figure 23: Helical stairs extending from the firefighting stairs to Roof level

Recommendations:

- Engagement with London Fire Brigade to discuss the firefighting access routes and the reduced stair width.

4.5.3.2 Firefighting lobby

BS 9999 recommends firefighting lobby to have a clear floor area of not less than 5 m^2 and not exceed 20 m^2 for lobby serving up to four lifts. All principal dimensions should not be less than 1.5 m. The purpose of not allowing large lobby area (exceeding 20m^2) is to avoid the lobby being used for storage.

There are risers directly opening onto the lift lobby. Refer to recommendations in Section 4.3.3.

Existing provisions

There are currently two lobbies separating the flats from the firefighting stair. The lift lobby has approximate area of 34.2 m^2 and the small lobby has an approximate area of 1.6 m^2.

Although the lift lobbies exceed the recommended protected lobby area of 20 m^2, it is considered acceptable due to the following reasons:

- During the site visit, it was observed that the lift lobbies (only those inspected during the visit) are generally not used for storage;
- The lift lobby only contains the lift control at its centre with no other furniture;
- The lift lobby connects all flats and lifts and therefore is very frequently used by residents. It is unlikely for residents to store goods in a shared area;
- Adequate management of the area will prevent lobbies from being used for storage.

There are risers directly opening onto the firefighting stairs. Refer to recommendations in Section 4.3.3.

Recommendations:

- Inspection of the lift lobbies should be carried out at regular intervals to prevent residents from using the lift lobby as storage area.

4.5.3.3 Firefighting lifts

In line with BS 9991 and BS 9999, new firefighting lifts installations should be in accordance with BS EN 81-72:2020.

In addition, the Grenfell Tower Inquiry: Phase 1 report recommends that the owner and manager of every high-rise residential building be required by law to carry out:

- Regular inspections of any lifts that are designed to be used by firefighters in an emergency and to report the results of such inspections to their local fire and rescue service at monthly intervals;
- Regular tests of the mechanism which allows firefighters to take control of the lifts and to inform their local fire and rescue service at monthly intervals that they have done so.

Existing provisions

It has been confirmed by the lift consultant via email correspondence on 08/04/2021 that the firefighting lift in Cromwell Tower was installed to BS 5588-5:1986.

During the site visit, it has been confirmed that the lift control system is on Street level (L01), but there is no connection to the stair at this level.

The lift consultant ‘Butler & Young’ have notified that the lifts are unable to operate correctly under generator power. In the event of a fire and if there is a mains supply failure, the building will not have an effective firefighting lift working on secondary supply.

The lifts can operate on mains power. However, there is an issue with the sequential control which is when the lifts need to ground one at a time upon activation of the secondary power supply. This is due to the age of the equipment as they are no longer fully supported as they have been manufactured and installed by Otis over 20 years ago.

Recommendations:

- The current sequential control system should be upgraded for the lifts to be able to ground upon detection of fire within the lift shafts and also for the firefighting lift to operate under secondary power supply for firefighting purposes.
- Carry out inspections of the firefighting lift at monthly intervals to report the results of every inspection to the local fire and rescues service.

4.5.3.4 Smoke control for firefighting lobby and stair

BS 9991 recommends that all firefighting shafts should be provided with smoke ventilation system – and recommends only natural smoke shafts or mechanical pressure differential systems are suitable for buildings over 30 m in height. For buildings with a floor level over 11 m above ground served by a single stair, the smoke control system should have one of the following:

- AOVs to the exterior of the building with a minimum free area of 1.5 m^2, fitted in the common corridor or lobby directly adjacent to the stair at as high a level as is practicable, and an AOV that is sited at as high a level as is practicable on the top storey of the stairway, having a minimum free area of 1 m^2, or
- A smoke shaft fitted in the protected lobby and an AOV that is sited at as high a level as is practicable on the top storey of the stairway, having a minimum free area of 1 m^2, or
- A pressure differential system.

Existing provisions

The firefighting stair has two louvred doors (approximate total area of louvres are 3.52 m^2) on L39 as indicated as Door 1 and Door 2 in Figure 24. It was not possible to determine the free area of the louvre from visual inspection. The firefighting stair leads to an open helical stair to the Roof level.

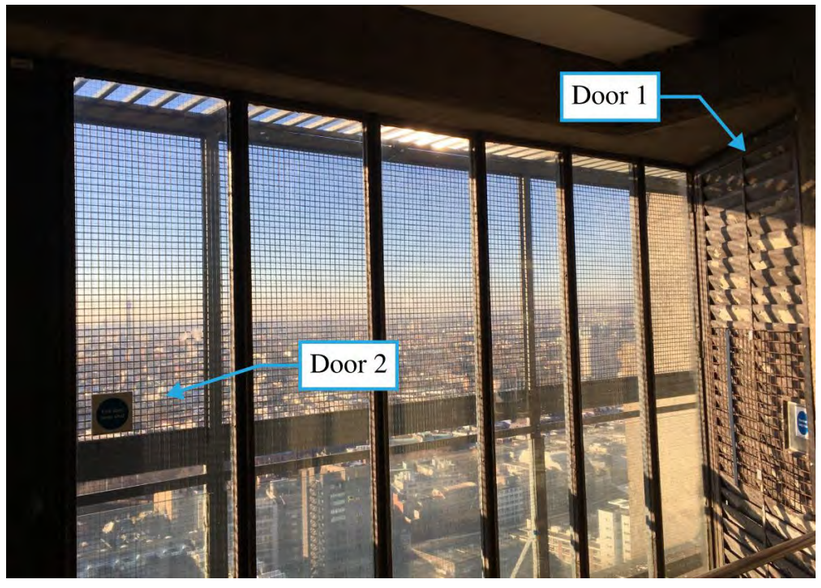


Figure 24: Louvred door at the top of the firefighting stair on L39

The current AOV provided by the louvred door is considered acceptable as fire service can open the door to increase ventilation to the staircase. Opening of the doors will require keys and BE should ensure that the keys are made available upon arrival of the fire service.

There is a permanently open grill at the bottom of the firefighting stair as shown in Figure 25 to provide make up air.

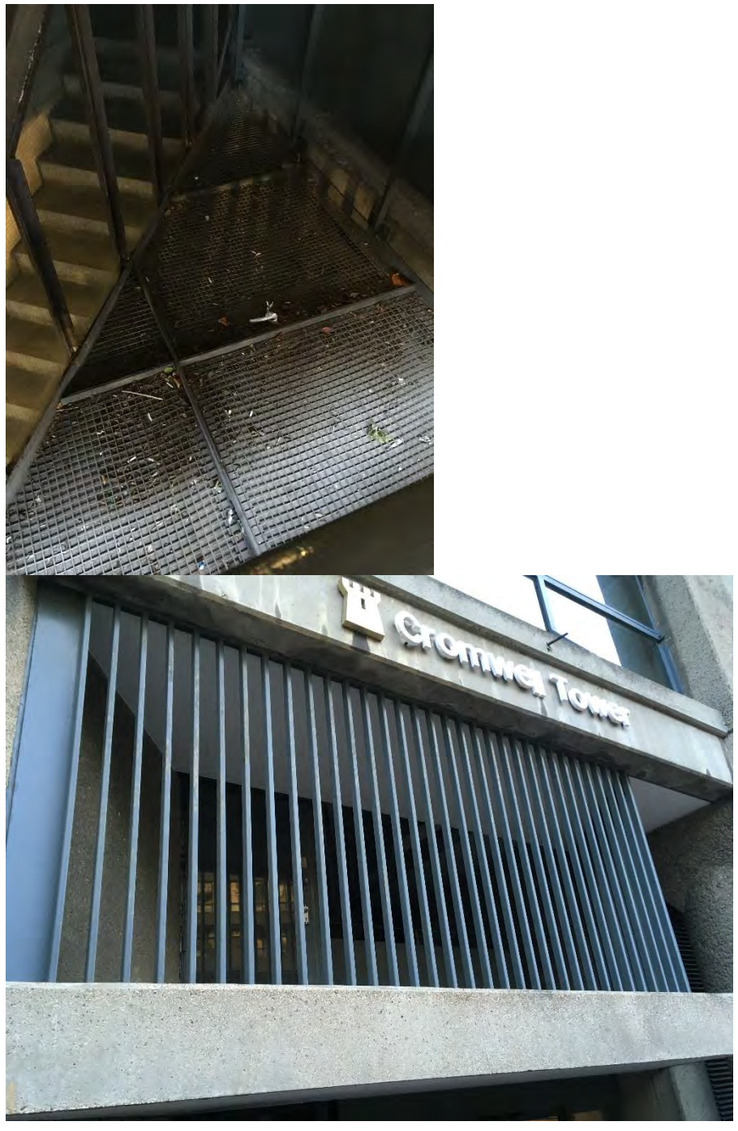


Figure 25: Permanent opening at the bottom of the firefighting stair at Podium Level

There is no ventilation available in the small lobby and the lift lobby is provided with manually openable vents in all levels that can be opened by firefighters upon arrival.

The lift lobby is provided with manually openable ventilation by either of the following:

- L1 – L6: There are two vents (1.95 x 0.46 m = 0.90 m^2 each) - in the same location where the 1 down stair and 2 down stair are located in the upper floors,

within the lift lobby which have openable louvres by winding handles at bottom of both sloped shafts;

- L7 – L39: There are 1 down stair and 2 down stair doors (2.34 x 0.66 m = 1.54 m^2 each) - which open to the flat balconies, that can be opened by striking off heads of cast securing bolts.

The existing vents meet the minimum required free area of 1.5 m^2 (area of 1.8 m^2 for L1 – L6 and 3.08 m^2 for L7 – L39). However, these vents are only manually operated vents and can only be operated upon arrival of firefighters.

Recommendations:

- Engagement with London Fire Brigade to ensure their familiarity with the ventilation arrangement to the firefighting lobby.
- Include a notice to open the ventilation louvres on L1-L06 and to open the 1 down stair and 2 down stair doors L7-L39 in the Fire Notice Box.

4.5.4 Wet riser and hose coverage

BS 9991 recommends buildings greater than 50 m in height should be provided with a wet riser system. In the case of unsprinklered building, no part of a storey should be more than 45 m from a riser outlet located in the firefighting shaft.

Existing provisions

There is a wet riser outlet located within the lift lobby as shown in Figure 26 from Street level (L01) to L39. For L02 – L03, the outlet is located adjacent to the lift lobby within the internal open stair landing. All areas of the tower are within 45 m limit of hose coverage.

BE confirmed the building is provided with 2 x 10,000-gallon cross linked tanks on L03.

Figure 26: Hose coverage in Cromwell Tower

4.5.5 Water supply for firefighting operations

The location of an external hydrant is to be confirmed by BE.

4.6 Fire safety management

In addition to the active and passive fire safety precautions described in the previous sections, robust fire safety management plan and procedures are important for maintaining the fire safety of a building in a holistic manner. In preparing a fire safety management plan (Arup is not aware of an existing plan), the relevant items to be included in the plan are listed and described in Table 4 below. These are based on the recommendations in BS 9991.

Table 4: Fire safety management

Item	Proposed Design
RR(FS)O	Under the Regulatory Reform (Fire Safety) Order legislation, the owner of the building (BE) is fully responsible for fire safety. This includes on-going fire risk assessment, appropriate maintenance of fire safety systems and training of staff. Although not required by fire safety guidance, it is recommended for the fire risk assessment to include the internal areas of the apartments (for example a spot check of vacant apartments). This will serve to mitigate the risk of any amendments to the building which may have an adverse impact on the fire strategy safety (e.g. breaches in compartmentation).
Fire awareness of residents	Due to the nature of residential premises whereby it is difficult to enforce fire safety management within the apartments, there is risk of the residents' actions affecting the implementation of the fire strategy – e.g. by covering smoke detectors or creating penetrations in compartment walls. To minimise the risk of occupants affecting the performance of the fire safety features in the building, all residents must be made aware of their responsibilities in regard to fire safety at the beginning of their residence. It is recommended for all relevant fire safety information should be provided in a tenant handbook. It is the responsibility of the building operators to inform the residents of the defend-in-place evacuation strategy. Residents should also be informed that they are always provided with the option to leave and that they do not have to stay in place in the event of a fire.
Evacuation of PRMs	The evacuation of PRMs will need to be carried out by the BE staff or the fire and rescue service. The responsible person for fire safety (as defined under the RR(FS)O) will need to ensure that each PRM has a personal emergency evacuation procedure (PEEP), and where required, sufficient training and equipment are provided to staff to assist with the evacuation. The EVC (Emergency Voice Communication) system in the lift lobbies should be regularly maintained to ensure they are in working order.
Staff training	Sufficient number of BE staff should be adequately trained in fire prevention, fire protection and evacuation procedures including evacuation of PRMs.
Maintenance and testing	An accurate record of fire precautions, and procedures for operating and maintaining any fire protection measures within the building, are necessary to enable the owner or end user to plan, document and implement control processes for maintenance and testing of fire safety systems to ensure that they operate effectively in the event of a fire. The External Fire Risk Assessment prepared by Frankham Risk Management Services in January 2018 states that maintenance records have not been recorded up to date and requires to be updated. This includes systems such as: • Firefighting lifts; • Fire alarm and fire detection system; • Fire doors; • Emergency lighting and signage; • Fire stopping registers; • Records of fire brigade attendance.
Control of work on site	The means to control work on site should be determined (e.g. repairs to structure, hot work, cleaning of ductwork). A work control system should include clear lines of responsibility communicated to contractors. **Work within the single stair** When work is being carried out in the single stair (e.g. works associated with services in the risers), staff working in the area must be trained to ensure evacuation down the stair is still allowed in case of emergency and that it does not block the stair.
Emergency planning	A good relationship with the fire and rescue service has benefits as it ensure that the fire and rescue service is able to have an appropriate pre-determined response strategy for Cromwell Tower and enables the owner to seek advice where appropriate. Any changes affecting the layouts, fire safety systems, fire growth characteristics, and other relevant factors should be communicated to the fire service.
Fire safety documentation	Fire safety information that sets out the basis on which the fire safety design was planned (i.e. this Fire Strategy Report), the fire safety management plan, the staff responsibilities etc. should be kept up to date and stored in a document management system that allows the information to be easily retrieved in the future.

General housekeeping	The External Fire Risk Assessment prepared by Frankham Risk Management Services in January 2018 states that discarded trade materials and general waste were identified in riser cupboards. Good housekeeping is essential to reduce the likelihood of a fire starting or developing, and escape routes being blocked. This includes: • Maintaining all escape routes free from obstruction/ or combustibles; • Fire doors to perform as intended; • Arrangement for waste control and disposal or accumulation of waste; • Floor surface of escape routes to be maintainable, even and slip-resistant. The Fire Risk Assessment also states that fire extinguishers should be removed from the building as it could be mishandled by the residents who are not trained. The management team sure ensure there are no fire extinguishers in the common areas of the building.

5 Conclusion

The purpose of the fire safety review on Cromwell Tower is to determine the existing intent of the fire safety design and to record the findings in a fire strategy report (this document).

This report describes the existing fire safety precautions in the building and compare them with the requirements in the Building Regulations 2010 (as amended) The current standards BS 9991 and BS 9999, and where applicable the latest update of the Approved Document B Volume 1, have been used as the benchmark for the review.

Where the fire safety precautions comply with the current standards, no further action is proposed and the fire information forms part of the building fire strategy. Where the precautions are not deemed to comply with the current standards, qualitative risk assessments have been carried out to identify the life safety risks to the building occupants due to those non-compliances. The outcomes of the assessment will result in one of the following:

- Where considered acceptable to remain as existing, recommend retaining the current provisions as long as the provisions are being maintained in good operation conditions; or
- Recommendations on possible options for enhancements/upgrades where the current fire safety provisions are considered inadequate.

Refer to Table 1 for the full list of recommendations and the reasons/benefits behind those recommendations.

Interim measures

From our review, it is found that there are existing features in Cromwell Tower that present considerable risks to the life safety of the building occupants. Some immediate actions are strongly recommended to address these risks.

These are temporary measures, while permanent solutions (as recommended on Table 1) are being developed and implemented. These interim measures are not meant to replace the need for permanent solution. The aim of the interim measures are to reduce hazards that may affect the use of the single stair in the event of a fire, so that occupants can safely evacuate from the Tower. The recommended interim measures are:

- Preparing a Personal Emergency Evacuation Plan (PEEP), so that the evacuation arrangement in the event of a fire is clear to each PRM occupant;
- Remove all storage and rubbish within riser spaces that opens into the stair (note: the External Fire Risk Assessment prepared by Frankham Risk Management Services in January 2018 states that discarded trade materials and general waste were identified in riser cupboards).
- Consider providing a fire detector within the electrical riser above L37, so that BE receives early warning of a potential fire in the electrical riser. If necessary, evacuation can be initiated before the stair is affected.

These measures are to be implemented as soon as possible to maintain the life safety of the building occupants.

Appendix A

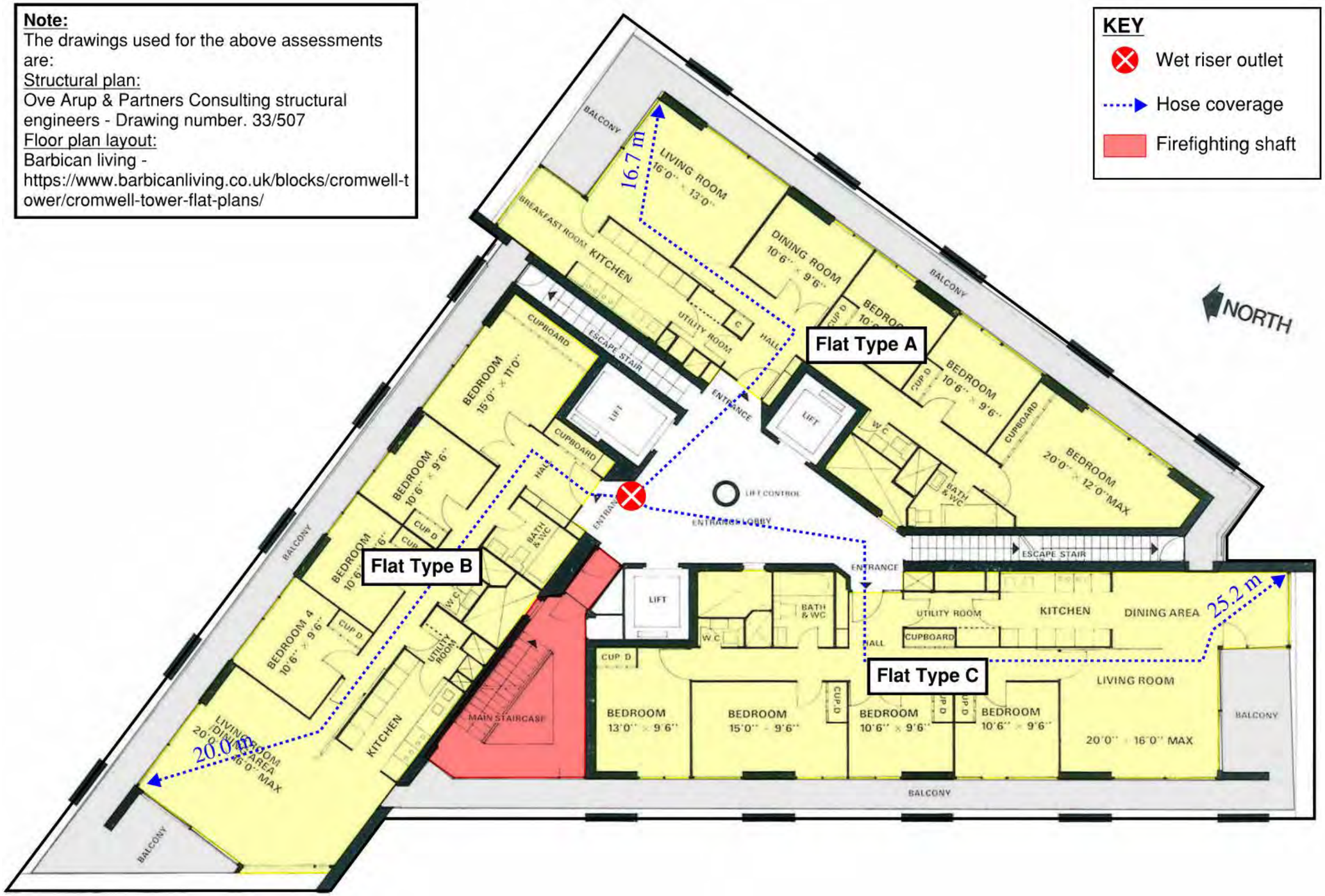
Fire strategy mark-ups

A1 Means of warning and escape

Note:
The drawings used for the above assessments are:
Structural plan:
Ove Arup & Partners Consulting structural engineers - Drawing number. 33/507
Floor plan layout:
Barbican living - https://www.barbicanliving.co.uk/blocks/cromwell-tower/cromwell-tower-flat-plans/

A2 Firefighting access

Note:
The drawings used for the above assessments are:
Structural plan:
Ove Arup & Partners Consulting structural engineers - Drawing number. 33/507
Floor plan layout:
Barbican living - https://www.barbicanliving.co.uk/blocks/cromwell-tower/cromwell-tower-flat-plans/



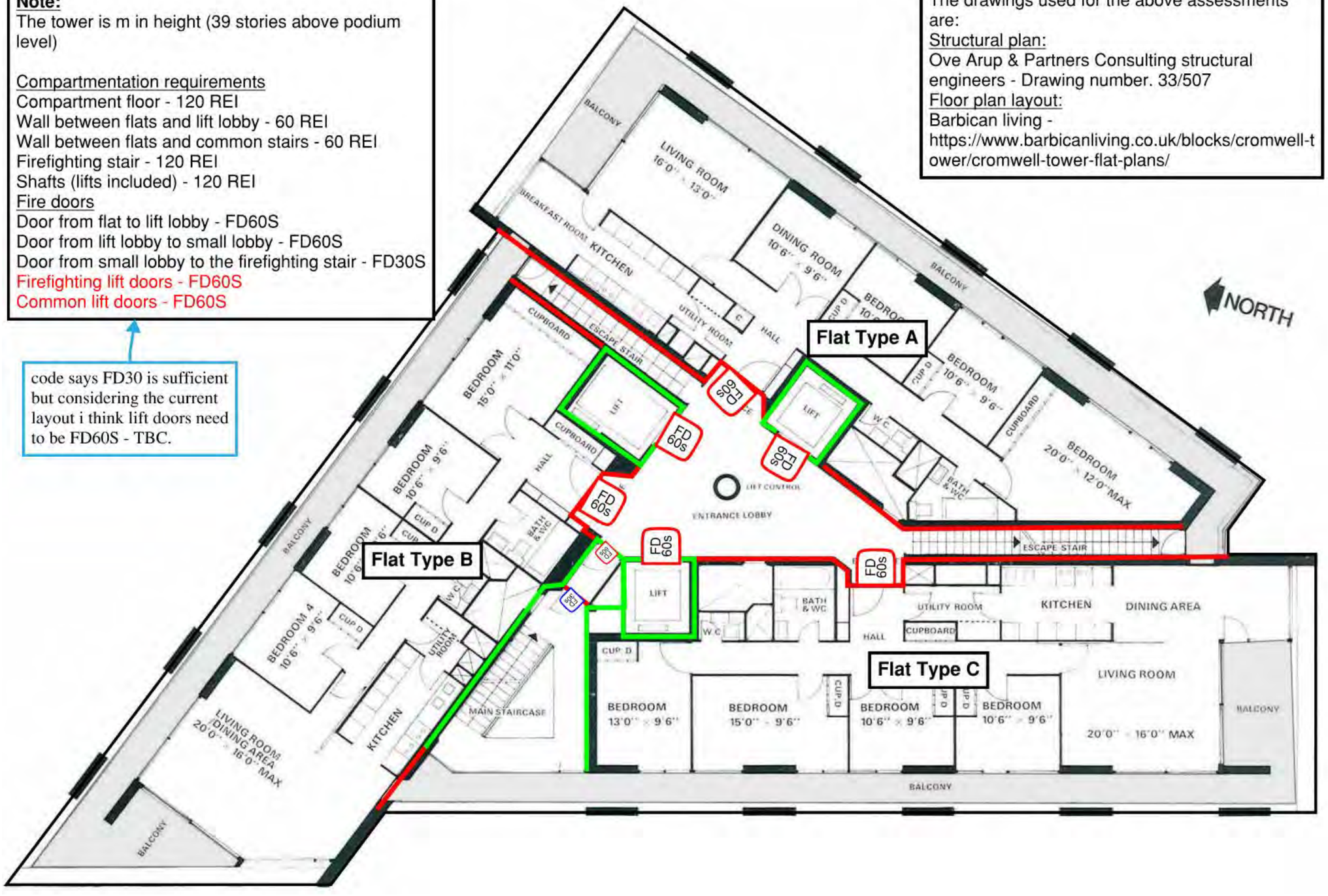
A3 Compartmentation

Note:
The tower is m in height (39 stories above podium level)

Compartmentation requirements
Compartment floor - 120 REI
Wall between flats and lift lobby - 60 REI
Wall between flats and common stairs - 60 REI
Firefighting stair - 120 REI
Shafts (lifts included) - 120 REI
Fire doors
Door from flat to lift lobby - FD60S
Door from lift lobby to small lobby - FD60S
Door from small lobby to the firefighting stair - FD30S
Firefighting lift doors - FD60S
Common lift doors - FD60S

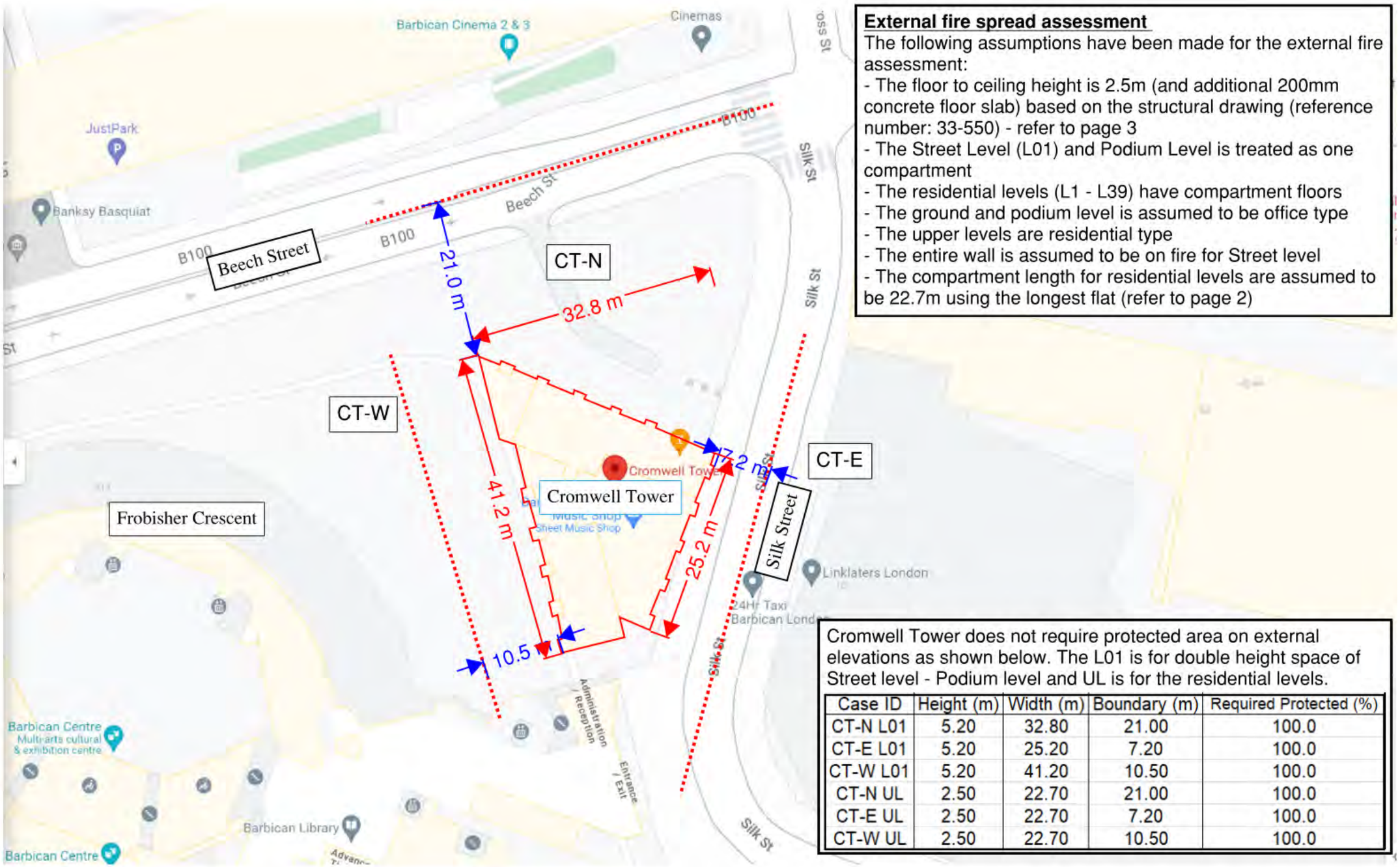
code says FD30 is sufficient but considering the current layout i think lift doors need to be FD60S - TBC.

The drawings used for the above assessments are:
Structural plan:
Ove Arup & Partners Consulting structural engineers - Drawing number. 33/507
Floor plan layout:
Barbican living - https://www.barbicanliving.co.uk/blocks/cromwell-tower/cromwell-tower-flat-plans/



Appendix B

External Fire Spread



External fire spread assessment

The following assumptions have been made for the external fire assessment:

- The floor to ceiling height is 2.5m (and additional 200mm concrete floor slab) based on the structural drawing (reference number: 33-550) - refer to page 3
- The Street Level (L01) and Podium Level is treated as one compartment
- The residential levels (L1 - L39) have compartment floors
- The ground and podium level is assumed to be office type
- The upper levels are residential type
- The entire wall is assumed to be on fire for Street level
- The compartment length for residential levels are assumed to be 22.7m using the longest flat (refer to page 2)

Cromwell Tower does not require protected area on external elevations as shown below. The L01 is for double height space of Street level - Podium level and UL is for the residential levels.

Case ID	Height (m)	Width (m)	Boundary (m)	Required Protected (%)
CT-N L01	5.20	32.80	21.00	100.0
CT-E L01	5.20	25.20	7.20	100.0
CT-W L01	5.20	41.20	10.50	100.0
CT-N UL	2.50	22.70	21.00	100.0
CT-E UL	2.50	22.70	7.20	100.0
CT-W UL	2.50	22.70	10.50	100.0

Barbican Estate

Barbican Residential Blocks

Andrewes House - Fire Strategy Report

Rev C | 7 September 2022

Job number 279095-00

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Contents

Appendices

Executive Summary

Arup have been appointed by the Barbican Estate (BE) to undertake a fire safety review of Andrewes House, an existing building which is part of the Barbican Residential development, located in the City of London. The purpose of the review is to determine the existing intent of the fire safety design and to document this intent in a fire strategy document (this report). The purpose of this report is as follows:

- To provide a single document that describes the fire safety precautions for Andrewes House, including the fire safety principles and fire safety measures within the existing building;
- To compare the existing fire safety precautions with the requirements in Building Regulations 2010 (as amended) by benchmarking against the current standards including BS 9991 and BS 9999;
- To consider the recommended improvements to existing residential buildings in Phase 1 of the Grenfell Tower Inquiry Report by Sir Marin Moore-Bick;
- Where there are gaps in the existing fire safety precautions against the current standards and if those gaps present a risk to the life safety of the occupants, recommend fire safety improvements to remediate the risk on an as nearly as reasonably practicable basis; and
- Where the gaps in the existing fire safety precautions present a low/negligible risk to life safety, the existing precautions are proposed to be retained (on the assumption that they are maintained in good operational order).

Andrewes House was constructed in 1969 and contains 192 flats. The building consists of 12 stairs, three of which are firefighting stairs with firefighting lobby, firemen's lift and dry riser. The remaining nine stairs are common stairs with passenger lifts. The building consists of 11 floors with a building height of 27 m measured from street level to the bottom of the topmost occupied story.

An open Podium level which is located two storeys above street level serves as the final discharge location. The carpark level (L03) located one storey below street level is used as the firefighting access level for two firefighting shafts, while the Podium level is used as the firefighting access level for the remaining firefighting shaft. Due to the presence of the open balconies serving the flats above the Podium and not the flats below the Podium, there are some differences in the means of escape and firefighting access strategies between the floors above and below the Podium. These are described in subsequent sections in the report.

Existing Fire Safety Precautions – Overview

The key elements of the existing fire safety precautions for the Andrewes House can be summarised as:

- Stay put strategy: The building adopts a stay put evacuation strategy. In the event of a fire, only the occupants in the flat of fire origin evacuate the building. The rest of the building occupants will remain in place. This is proposed to be retained.
- Podium: The Podium is considered a place of ultimate safety for discharge of escape stairs.
- Horizontal exit (above Podium): Each flat is served by 3no. escape routes – (1) common stair via the flat entrance, (2) north balcony, (3) south balcony. The widths of these balconies (460m – 690mm) are narrower than the minimum requirement for an escape route and too narrow for wheelchair-based occupants (see item below on evacuation of persons with reduced mobility). From the open-sided balcony, occupants can access any of the 3no. firefighting stairs that discharge at street or Podium level.
- Horizontal exit (below Podium): Flats on L02 and four flats on L01 have access to two escape routes – (1) common stair via the flat entrance, (2) outside via gardens through to Willoughby carpark. The other flats on L01 have only a single means of escape via the flat entrance creating a slight extended travel distance within the flat – there is no balcony (note: means of escape via the neighbouring flat or using the ladder to the garden are not considered an acceptable escape route). The common stairs discharge at the Podium level above.
- Escape stairs: The width of the stairs (1000 mm) is adequate for the expected low number of occupants. However, a protected lobby is missing between the stair and each apartment, which presents a risk to life safety as the use of the stair for escape may be compromised.
- Evacuation of Persons with Reduced Mobility (PRM): There is currently no procedure in place to evacuate PRMs if a fire were to occur in their flat. There are also inadequate provisions for safe evacuation of the PRMs. These present an unacceptable risk to the life safety of the occupants.
- Exit signage and emergency lighting: There are existing provisions however, these are not compliant with current standards.
- Fire detection and alarm system: There is no provision in the building, except for the flats owned by BE. Considering the gaps in the existing fire safety precautions compared to current norms, the lack of detection and alarm in the flat presents a life safety risk.
- Fire suppression system: The building is not sprinkler protected. On 23/07/2021, BE confirmed the building insurers have no requirement for sprinkler system to be retrospectively installed in the Barbican Residential buildings.
- Structural fire protection: The existing protection nominally meets the required fire rating in the current standard, based on a desk-top review. Intrusive surveys have not been performed.
- Fire compartmentation: Each flat, services riser, stair, lift shaft and storage area form separate fire compartments. The existing construction nominally meets the required fire rating in the current standard, based on a desk-top review. However, the condition of fire stopping at penetrations is unknown.
- Shunt duct arrangement (kitchen extract and toilet extract risers): It is considered an acceptable solution for the toilet extract riser. However, it presents risk of fire/smoke spread between compartments at the kitchen extract riser.
- Flat entrance and refuse storage/post box fire doors: Assuming that these are the same as the tested fire door in the Thomas More building, they do not achieve the required 60 minutes fire rating. The failure to maintain fire separation between the

stair and each flat, refuse storage and post box will compromise the availability of the stair for means of escape.

- Separation with neighbouring buildings: There is adequate separation distances to adjacent properties to minimise the risk of external fire spread between buildings. Fire rated construction separate Andrewes House from the adjacent Gilbert House and Willoughby House.
- Façade system: There appears to be no combustible materials in the façade system, based on the information provided.
- Firefighting shafts: The access to SC49 meets the guidance in the current standard. However, SC38 and SC44 are accessed via the carpark level which is a basement level and not directly accessed from open air. However, this is considered acceptable due to the large openings (to the atmosphere) provided throughout the carpark level and the familiarity of London Fire Brigade with the layout of the building (as advised by BE).
- Firefighting stairs, lobby and north balcony: The width of the stair (1000 mm) and balcony (690 mm) are narrower than the 1100 mm width based on current standard. The smoke ventilation to the lobby is inadequate in area, which can be addressed by fire service opening the balcony door before undertaking firefighting activities. It is understood that this is the current operational procedure to address the under sized lobby ventilation.
- Firemen's lift: The existing lift is not served by secondary power supply.
- Dry rising mains: All the inlet points are within 18 m of the fire service vehicle access routes. A dry riser outlet is located within each level of the firefighting shaft. However, some areas of the building are outside the 45 m coverage of the hose length.

Conclusion and findings

From benchmarking the existing fire safety provisions in Andrewes House against the current relevant guidance, it is concluded that there are several aspects that are not compliant with those guidance. The findings are not unexpected because of the age of Andrewes House and the updates in the fire safety guidance in the interim years. Hence, Arup has taken a pragmatic approach by qualitatively assessing the risks of those non-compliances against occupant life safety.

The risk assessment found that several of the non-compliances present life safety risk to the building occupants. In particular, the flats on L01 that have only a single means of escape and the lack of provisions for the evacuation of persons with mobility impairment, especially residents on wheelchairs.

The findings from the risk assessment include:

- No protected lobby between each flat and the common stair, entrance doors and post/refuse store enclosures are not fire rated – smoke/fire from the fire incident flat could spread into the stair and compromise the use of the stair for evacuation. This will particularly affect the L01 flats and PRMs, who rely on the stair as the only escape route.
- PRM evacuating from their flat onto the stair landing has no safe refuge to wait for assistance, no provisions to call for assistance and no means of evacuating from the building without assistance.
- The shunt duct arrangement for kitchen extract system, which could compromise compartmentation between the flats and compromise the stay-put evacuation strategy.
- No provision for fire detection and alarm in majority of the flats as well as within common areas.

Recommendations for remedial actions are provided throughout the report (in green boxes) to mitigate the identified life safety risks due to the gaps in the existing fire safety precautions. A summary of the known gaps, associated recommendations, its benefits and comments from BE (refer to meeting minutes in Appendix C) are provided in Table 1.

It is recommended for BE to explore the feasibility or implementation of the recommended remedial actions. Once this has been completed, it is recommended for the CoL District Surveyor and the London Fire Brigade to be consulted, to seek their early agreement in principle.

Table 1: Identified gaps and recommended actions

Identified Gaps	Recommended Action	Benefits of the recommendations	Works undertaken and constraints identified by BE (during meeting on the 23/07/2021)
Narrow escape routes along the balconies Extended travel distances in flats with single direction of egress and flats without hallway Lack of protected lobby between each flat and the escape stair	It is important to upgrade the fire protection and the availability of the escape stairs for fire evacuation. The following improvements are recommended to achieve this: • Provide early warning to occupants by installing a Grade D1 Category LD2 detection and alarm system in all the flats; • Provide smoke ventilation to all the common stairs with appropriate means of activation (e.g. smoke detectors); and • Clear briefing to all occupants of Andrewes House on the available escape routes.	• Early warning through automatic detection and alarm system will serve to alert occupants of a fire in their flat during the early stages of the fire and initiate evacuation before conditions in the flat becomes untenable. • Smoke ventilation to all common stairs will serve to maintain the availability of the stair for egress, especially for occupants who rely on the stair as their single escape route. It also provides a refuge space where PRMs can wait for assistance. • The detection system in the common stair will operate the smoke ventilation system and raise an alarm to alert BE staff to investigate the incident. • Occupants will be made aware of the escape routes and procedures in the event of a fire, minimising time to evacuate the building.	Challenge to get all of the lease owners to install the system.
Evacuation of PRMs	The following improvements to provisions for PRM evacuation are recommended: • Provide an emergency voice communication (EVC) system on each stair landing, for the PRMs to call for assistance. • BE to put in place a management plan and evacuation strategy for the evacuation of occupants including personal emergency evacuation procedures for the PRMs; and • Clear briefing to PRMs on the evacuation procedures and the use of the EVC system to call for assistance.	• EVC system will allow PRMs to communicate with BE or LFB and notify where they are so they can be assisted on their evacuation from the building. This will also aid the search of BE or LFB. • Management plan will provide clear information and instruction to all occupants in the building.	Staff on site are currently not trained to assist the evacuation of PRMs nor to investigate a fire incident.
Exit signage	A survey is recommended to inspect and replace existing exit signage to comply with BS 5499-4, BS ISO 3864-1 and the additional recommendations from the Grenfell Tower Inquiry: Phase 1 report	Correct signage will serve to identify the stair discharge level and the route out of the building.	BE confirmed works on exit signage is ongoing. This includes the survey and upgrade of provisions to meet the current relevant standards.
Emergency lighting	A survey is recommended to inspect and replace existing emergency lighting to comply with BS 5266-1.	Emergency lighting will allow occupants to evacuate safely, especially when traversing up/down the stairs.	BE confirmed works on emergency lighting is ongoing. This includes the survey and upgrade of provisions to meet the current relevant standards.
Storage areas in L03 Carpark level	The storage areas on L03 of Andrewes House are recommended to be provided with the following: • Minimum L2 automatic fire detection and alarm system in accordance with BS 5839-1; • Provide adequate exit signage and emergency lighting within the area; • Provide 120 minutes fire resisting construction, including FD60S doors, to separate storage areas from the firefighting stairs (SC38, 44 and 49)	• Early warning through automatic detection and alarm system will allow residents more time to evacuate to a place of safety. • Exit signage and emergency lighting will provide occupants with clear direction of escape. • Fire doors will serve to limit smoke and fire from the storage areas (high risk area) affecting the stairs that also serve the occupants on the above levels. This is	• BE confirmed works on exit signage and emergency lighting works will include L03 storage area to meet the current relevant standards. • BE confirmed that all relevant doors in Andrewes House will be replaced by certified fire doors

Identified Gaps	Recommended Action	Benefits of the recommendations	Works undertaken and constraints identified by BE (during meeting on the 23/07/2021)
	• Provide 60 minutes fire resisting construction, including FD30S doors, to separate storage areas from the common stairs	important for occupants whereby the stair is their single means of escape.	
Fire doors at flat entrance, refuse storage/post box and service risers within stairs	• It is recommended to replace all the fire doors to all the escape stair and firefighting shaft enclosures and service risers within the stairs, to maintain the fire and smoke integrity of the stair • Keep records of inspection and testing of fire doors in the future, at not less than three-monthly intervals to ensure that all fire doors are in working order.	• This will serve to maintain the availability of the stair for means of escape (in particular for occupants in which the stair is the only means of escape) and firefighting activities. • The stair landing can be used as a refuge space for PRMs awaiting assistance for evacuation. • Maintaining the stay-put evacuation regime.	• BE confirmed that all relevant doors in Andrewes House will be replaced by certified fire doors
Kitchen extract shunt duct system	Replace the existing extract hoods with recirculation type hoods. In addition, one of the following options should be implemented to maintain the compartmentation between the flats: • Smoke and fire damper at the shunt duct riser activated by the fire alarm/detectors within the flat (this maintains the use of the riser for normal ventilation of the flat); • Maintain the shunt duct arrangement and increase the reliability of the main extract fan. This will require an additional duty standby fan (the fans to be rated at 400 ˚C for 90 minutes in accordance with BS EN 13501-4), with secondary power supply. The fans need to be adequately maintained to keep the main riser under negative pressure; • To block off the shunt ducts and provide a fan on the external wall to draw out air from the flat into the balconies.	• This will serve to eliminate the risk of fire spread between compartments through the kitchen shunt ducts which have higher risk of fire spread due to grease build up. • Maintaining the stay-put evacuation regime. • The day-to-day ventilation within the flat can be maintained.	Challenge to get all of the lease owners to modify their kitchen extract, especially those who have recently refurbished their kitchens.
Firefighting stairs (SC38 and SC44) at L04	Services in firefighting stairs SC38 and 44 at L04 that are not part of the firefighting stairs or facilities should be enclosed in a fire rated box or be re-routed.	This will serve to reduce the fire hazard in the firefighting shafts and reduce the risk of the firefighting stair being unusable.	BE confirmed the existing services will be enclosed in a fire rated box with metal trays and metal cables holding the services.
Firefighting access distance, width of access routes, firemen's lift, lobby smoke ventilation and extended hose coverage	BE advised that London Fire Brigade is familiar with the configuration of Andrewes House. It is recommended to address the gaps in firefighting access and facilities through consultation and agreement with the London Fire Brigade. • Discuss and record firefighting procedures that are specific to Andrewes House in this document. • Carry out inspections of the three firemen's lifts (including lift control system) at monthly intervals to report the results of every inspection to the local fire and rescue service • Update the Fire Notice Box (FNB) to include information about the design and materials of the external walls, extended hose coverage, and any relevant information following the consultation.	• Confirmation of the procedure and current provision of fire safety systems in the building with the LFB will allow the LFB to better understand the building and identify any gaps that need to be addressed. • Regular inspection and maintenance of firemen's lift will reduce the risk of them not working in an event of a fire. • Updating the FNB will provide firefighters with up-to-date fire information about the building.	BE stated that LFB visit the site often and are familiar with Andrewes House layout and have not raised any concerns on the building. Hence, CoL and BE confirmed that additional consultation is not necessary.
Others	• It is recommended to establish the compliance of the back-up power supply provisions against the relevant standards. • Consult with the insurers regarding any additional requirements for property protection.	• Back-up supply will allow life safety systems to operate in the event the primary power supply fails/ is compromised. • Consultation with insurers may raise additional protection measures in terms of fire safety.	CoL advised that insurers are not interested in installing sprinklers anywhere within the Barbican Residential Estate.

Identified Gaps	Recommended Action	Benefits of the recommendations	Works undertaken and constraints identified by BE (during meeting on the 23/07/2021)
	• The sitewide inspection of exit signage (by others) to take into consideration to recommendations in this document.		

1 Introduction

1.1 Appointment and scope

Arup have been appointed by Barbican Estate (herein referred to as BE) to a provide fire engineering review of Andrewes House, an existing building which is part of the Barbican Residential Development, located in the City of London.

This report provides a fire strategy for the existing building and captures the current fire safety measures and strategy as Arup understand it from recent reviews of documents, discussions with the BE management team and through a non-intrusive site visit undertaken on 10/05/2021.

Although Andrewes House is an existing building, there is limited documentation available to explain the current fire safety information for the building. There is currently no fire strategy report for the building nor documentation which provides a cohesive record of the fire safety measures in the building. As such this fire strategy has been developed to act as a cohesive and detailed record of the current fire safety provisions (and can act as a benchmark for future building work).

1.2 Purpose of this report

Having a single documented fire safety strategy for Andrewes House provides the required information to understand the fire safety principles and fire safety measures within the existing building.

It should also be noted that this fire strategy covers the residential floors of Andrewes House and L03 residential storage units. This report does not cover the carpark (L03) or the services subway (L04).

This report will assist the BE when they wish to undertake any future improvements and alterations to the building. It will also act as a benchmark in recording the fire safety strategy and enables anyone undertaking works on the building to understand what implications these may have in terms of fire safety.

Furthermore, this report documents any potential shortfalls in fire safety measures and enables BE to address these where necessary and document them in their Fire Risk Assessment (FRA) for the building where required.

The purpose of the report is to provide the following:

- Identify any tests that should be undertaken to create evidence of building operation where that is missing;
- Identify potential remediation measures, where current fire safety systems do not provide adequate fire safety for occupants;
- A retrospective fire strategy report and associated fire safety drawings and recommended remediation measures.

These goals are identified to be provided for four different typologies of buildings to give an overall fire strategy for all 22 buildings within the Barbican Residential Development.

1.3 Barbican Residential Development

The buildings in the Barbican Residential Development were constructed from 1960 to 1982. There are 22 buildings in total as shown in Figure 1. There is a distinctive design feature across the Barbican Residential Development, which is the provision of a podium. It was constructed with an intention of providing a liveable urban environment for pedestrians and acts as ground level for the buildings[1].

In terms of fire safety design, the podium level throughout the Barbican Residential Development is considered as an access level for all of the buildings. Access level is defined in BS 9991 as ‘level used for normal access to the building that either incorporates, or leads directly to, a place of ultimate safety’. Therefore, the podium is considered a place of ultimate safety, serving as the exit discharge level for the stairs.

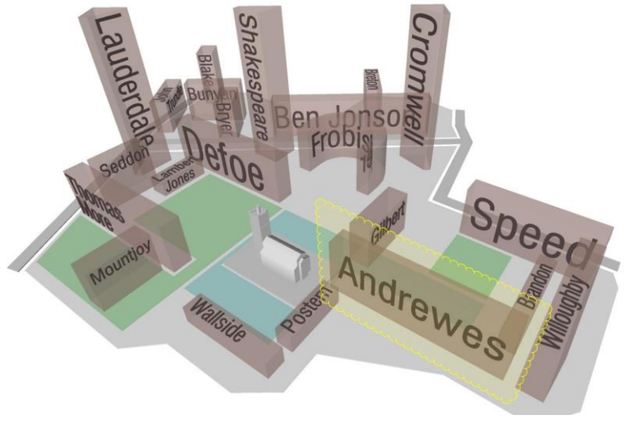

Figure 1: Overview of the Barbican Residential Development (Image courtesy Barbican Living)

Arup in conjunction with BE have identified four different block typologies which are common across the residential development. The typologies are as follows:

- High rise Tower – Cromwell Tower;
- Terrace Block type 1 – Andrewes House;
- Terrace Block type 2 - TBC;
- Terrace Block type 3 - TBC.

[1] Barbican Estate, *Barbican Living, http://www.barbicanliving.co.uk/, (accessed 16 March 2021).*

Andrewes House and Cromwell Tower have been confirmed as two of the four blocks which will be used as a base for the fire strategy for each block typology. The other two are to be confirmed in due course.

Flats across Andrewes House are generally owned by BE (i.e. the freeholder) however, a proportion of the flats are privately owned by leaseholders with a small portion of the flats being owned by the BE and let out to tenants.

2 Fire Safety Goals

2.1 Statutory and policy goals

The legislation, regulations and relevant standards contained within the following sub-sections have been referenced as part of Arup's review of the existing building. These are the requirements that are applicable to the existing building.

2.1.1 Regulatory Reform (Fire Safety) Order 2005

The Regulatory Reform (Fire Safety) Order 2005 (RR(FS)O) places a general duty of fire safety care on employers, occupiers and owners of almost all premises and requires them to take such fire precautions as may be reasonably required to ensure that premises are safe for the occupants and those in the immediate vicinity.

The responsible person has a duty to carry out a fire risk assessment which must focus on the safety in case of fire of all 'relevant persons'. The risk assessment should pay particular attention to those at special risk, such as the disabled and those with special needs, and must include consideration of any dangerous substance likely to be on the premises.

A fire risk assessment (FRA) was undertaken in March 2018 by Frankham Risk Management Services. A number of risks have been identified and need to be resolved in order to comply with RR(FS)O. Reference to these items has been included in the relevant sections of the fire strategy.

2.1.2 Building Regulations 2010 (as amended)

The fire safety review is undertaken to establish compliance against the functional requirements of Part B of the Building Regulations 2010 (as amended), using the recommendations in BS 9991:2015 (see Section 2.1.3) and BS 9999:2017 Fire safety in the design, management and use of buildings – Code of practice. Where applicable, Approved Document B Volume 1: Dwellings 2019 Edition Incorporating 2020 Amendments – For use in England, which has been updated recently to reflect the latest requirements for residential buildings has also been referenced.

2.1.3 BS 9991:2015

The existing building has been assessed against BS 9991:2015 - Fire safety in the design management and use of residential buildings – Code of practice. A guidance document which provides a means of demonstrating compliance with the life safety requirements of Part B of the Building Regulations 2010 (as amended) (herein referred to as "BS 9991"). This is used as the benchmark in developing the fire strategy for the building.

2.1.4 Barbican Estate fire safety goals

Through meetings with the BE, Arup has identified that the main objective of this fire safety review is the life safety of the building occupants. Arup is not aware of any additional requirements for property protection, either from BE or their insurer. This is to be confirmed by BE.

2.2 Proposed methodology

The existing fire safety precautions of Andrewes House are compared with the current recommendations in BS 9991. Where the provisions and recommendations align, no further action is required, and the existing provisions are recorded in this report to form the building fire strategy.

Where the provisions are not deemed to comply with the recommendations of BS 9991, a qualitative risk assessment will be carried out to identify the life safety risks to the building occupants due to those non-compliances or gaps in the fire safety precautions. The outcomes of the assessment will result in one of the following:

1. Where considered acceptable to remain as existing, recommend retaining the current provisions; or
2. Recommendations on possible options for enhancements/upgrades where the current fire safety provisions are considered inadequate.

It should be noted that as the building is existing, it is not feasible for all provisions to be in line with current fire safety standards. Where appropriate, the relevant guidance documents at the time of construction of the building have been used as reference.

2.3 Referenced documentation

The following information has been used to inform the Andrewes House fire strategy and fire safety systems provisions:

- Fortnightly progress review meetings between Arup Fire and BE between 12/01/21 to 09/03/21;
- Barbican Living website;
- Various email correspondence between Arup Fire and BE between 12/01/21 to 10/03/2021;
- Referenced documents and drawings listed in Table 2;
- Visual non-intrusive site visit undertaken on 10/05/2021.

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Table 2: Referenced documents and drawings

Document title	Produced by	Date	Revision
Andrewes House External Fire Risk Assessment	Frankham Risk Management Services	March 2018	Issue
CP 114:1957 *British Code of Practice, The Structural Use of Reinforced Concrete in Buildings*	British Standards Institution	1957	-
CP 3: 1962 *British Code of Practice Chapter IV Precautions against fire Part 1. Fire precautions in flats and maisonettes over 80 ft in height*	British Standards Institution	1962	-
BS EN 1992 – 1 -2 – 2004: Eurocode 2 *Design of Concrete Structure Part 1-2: General rules – Structural fire design*	British Standards Institution	2004	-
Abridged results from the test of 86 Thomas More House (double leaf door and single leaf door)	CTO S.A	2020	Issue
Grenfell Tower Inquiry: Phase 1 report overview	UK Government	October 2019	-
Form EWS1: External wall fire review – Andrewes House	City of London Corporation	December 2020	Issue
Post clean report for cleaning of kitchen extract ventilation system	HMAC Ventilation Services LLP	February 2021	Issue
Blocks VIII & IX Plan Level 50.30 Electrical distribution	Lee Beesley & co Ltd electrical engineers	Feb 1969	-
Drawing no. 37 527 Phase 3 Block VIII Section at 2467E looking west	Ove Arup & Partners	Apr 1965	-
Drawings 37 523 Block VIII Layout plan at 83.91	Ove Arup & Partners	Apr 1964	Rev C
Drawings 37 518 Block VIII 68.17 layout	Ove Arup & Partners	Mar 1964	Rev E
Drawing no. 37 517 Block VIII Floor layout at 69.17 level	Ove Arup & Partners	Feb 1964	Rev G
Drawing no. 37 516 Block VIII Floor layout at 59.08 level	Ove Arup & Partners	Feb 1964	Rev F
Drawing No. 37 515 Block VIII Layout plan at 59.08 level	Ove Arup & Partners	Mar 1964	Rev C
Drawing number 37/1807 Blocks VIII & IX Plan level 50.30 Electrical distribution	G.H. Buckle & Partners Consulting Engineers	Feb 1969	-

2.4 Limitations and assumptions

2.4.1 Limitations of report

This document summarises the findings of our work carried out to date. It does not attempt to quantify actual elements of fire performance, such as fire resistance periods, across the building in its existing state as physical intrusive works would be required to do this. It is Arup's understanding that intrusive investigations into the building is not planned to be carried out.

There are no architectural layouts of the building. Structural plans of Andrews House have been obtained through Arup Archive and used to better understand the building layout. The structural plans do not include the entire building and are limited to some levels of the building only. The fire strategy drawings provided as part of this report are based on floors 1 to 6 above Podium level. There are no plan layouts showing below Podium level nor floor 7.

BE should undertake the necessary tests/inspections to confirm that the fire safety systems will operate as intended in a fire event.

The information documented in this fire strategy is limited to the amount of information covered through the following:

- Desktop review;
- Consultation with the BE;
- Visual non-intrusive site visit undertaken on 10/05/2021, where the areas visited included outside and inside of Andrewes House (L03 – Floor 7) and one empty flat (on Level 2 above the podium).

The fire strategy does not represent the condition for the entire building.

2.4.2 Summary of key assumptions

The following key assumptions have been made to form a basis of the fire strategy for Andrewes House. BE should confirm if these assumptions are suitable for the project.

- Any current or future building works and their impact on the fire strategy are outside the scope of this documents;
- No further inspection/survey is planned such as intrusive investigation on the building;
- The building is not undergoing any changes at all, with no change in occupancy nor material alterations;
- The fire strategy drawings within the report are in line with the current building layout;
- Structural drawings are only available for apartment levels above Podium (Floor 1 to 6). There are no information/drawings for levels below the Podium (L01-L02) or Floor 7. Below Podium level floors (L01 to L02) and Floor 7 are assumed to have

a layout that is in line with Floors 1 to 6 (with little variation) and follow the same fire safety principles throughout the building;

- Flat 19H is assumed to be a mirror image of flat 19. There are currently no layouts available.
- All flats other than flat types 19 and 19H are assumed to have an internal hallway which is connected to all habitable rooms.
- Fire and rescue service will use the North facing balcony (bedroom side) to enter the flat on fire. It is assumed the South facing balcony (living room side) may not provide enough width due to the privacy screens for fire and rescue service to travel with the necessary firefighting equipment.
- The doors from Thomas More (which have undergone fire testing) are assumed to be the same as the ones from Andrewes House.
- All elements shown in the structural drawings are assumed to be elements of structure and therefore loadbearing.
- The thickness of structural elements (i.e. slab depth or wall thickness) are assumed to be the same throughout the building;
- All structural elements are reinforced concrete;
- The concrete covers over the reinforcement bars meet the values stated in the relevant guidance at the time of construction (CP114); there is no information on the depth of the existing concrete covers for this aspect to be assessed;
- Floor slabs are simply supported one-way slabs throughout the building.
- No structural calculations are available and therefore the utilisation factor of the structural members is unknown. When checking against the requirements of Eurocode 2 (Section 4.3.1) a utilisation factor of 0.7 has been assumed for conservatism.
- The fire resistance requirements given in CP114 cover loadbearing capacity, integrity and insulation.
- There is no fire stopping register for the building. The condition of the fire stopping at penetrations on fire rated construction is unknown. It is assumed that fire stopping remediation actions will be undertaken as part of ongoing maintenance.
- Boundary distances have been taken to the middle of Fore Street and the middle of the Barbican Water Gardens as there is no site boundary information available.

3 Andrewes House

Andrewes House was completed in 1969. It is a terrace block which sits between Gilbert House and Willoughby House. The building contains 192 flats in total[1].

The building consists of 12 stairs (Staircase 38 to Staircase 49) where three of the stairs are firefighting stairs, each with a firefighting lobby and firemen's lift. The other remaining nine are common stairs with a passenger lift. All flats in the building are served by a stair and a lift from the main flat entrance door.

The building consists of 11 floors with a building height of 27 m measured from ground to the bottom of the topmost occupied storey. The *Grenfell Tower Inquiry: Phase 1 report* defines high-rise buildings as buildings over 18 m in height and hence Andrewes House is considered a high-rise building. There are three floors below podium level (L01 and L02 contain flats whilst L03 contains the carpark and residential storage areas) and seven residential floors above podium level (1-7) with a roof above that. The roof level is only accessible to BE staff via the top of each of the firefighting shafts.

L04 which is known as the 'subway' is below L03. It contains services and extend throughout the Barbican Estate. The carpark at L03 extends beyond Andrewes House, connecting with the carparks of adjacent buildings. As such, these areas are excluded from the scope of this document.

There are balconies on two sides of the building – South facing (living room side) and North facing (bedroom side) balcony that is connected to three firefighting shafts across the building. These balconies serve each residential floor above the podium only, but not the levels below the podium.

There are three main firefighting access points into the firefighting shafts serving the building. For firefighting shaft 38 and 44, the main access is from the L03 carpark, either via the vehicle ramp on Fore Street or the external stair on Moor Lane. For firefighting shaft 49, the access is via St. Giles Terrace.

On a day to day basis, occupants from street level (L02) must take the passenger lift or stairs up to the podium and then use the respective stair or passenger lift to access their flats.

The layout and the section of Andrewes House is as shown in Figure 2 and Figure 3.

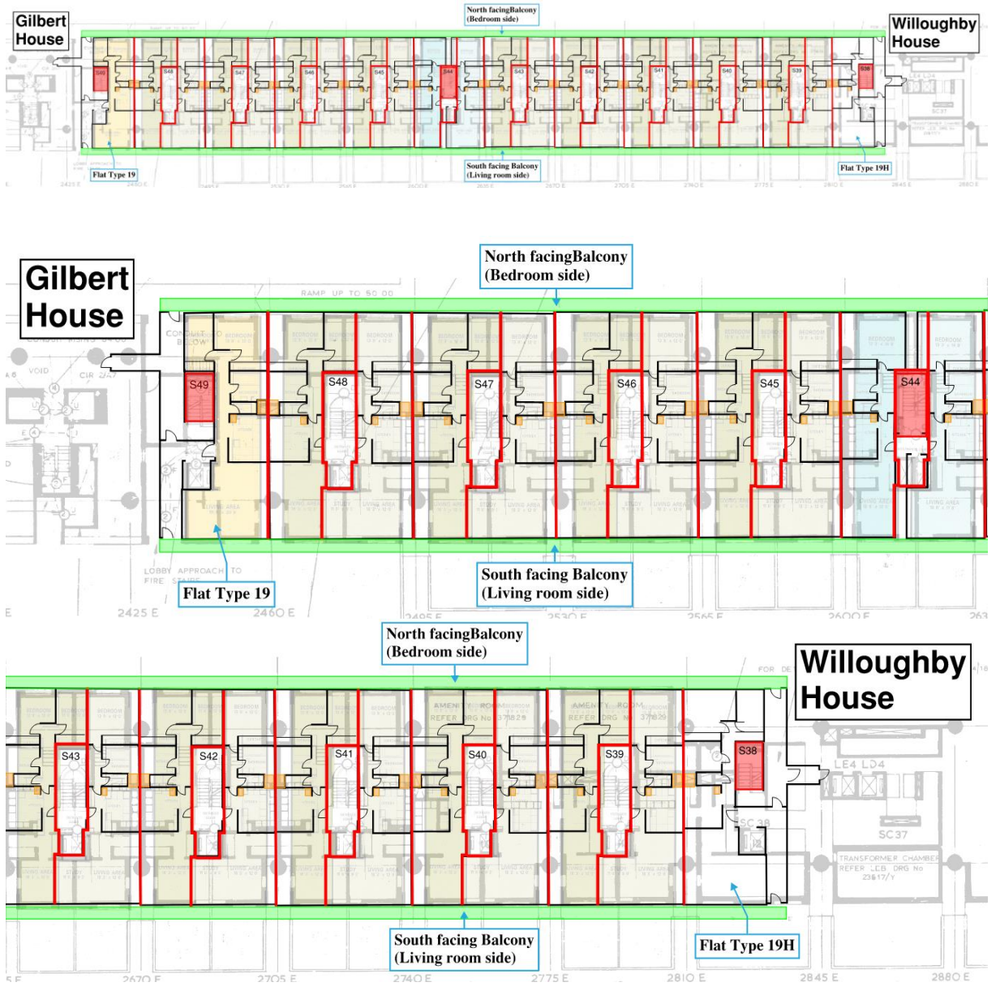


Figure 2: Layout of Andrewes House (Above Podium level: 1-6)

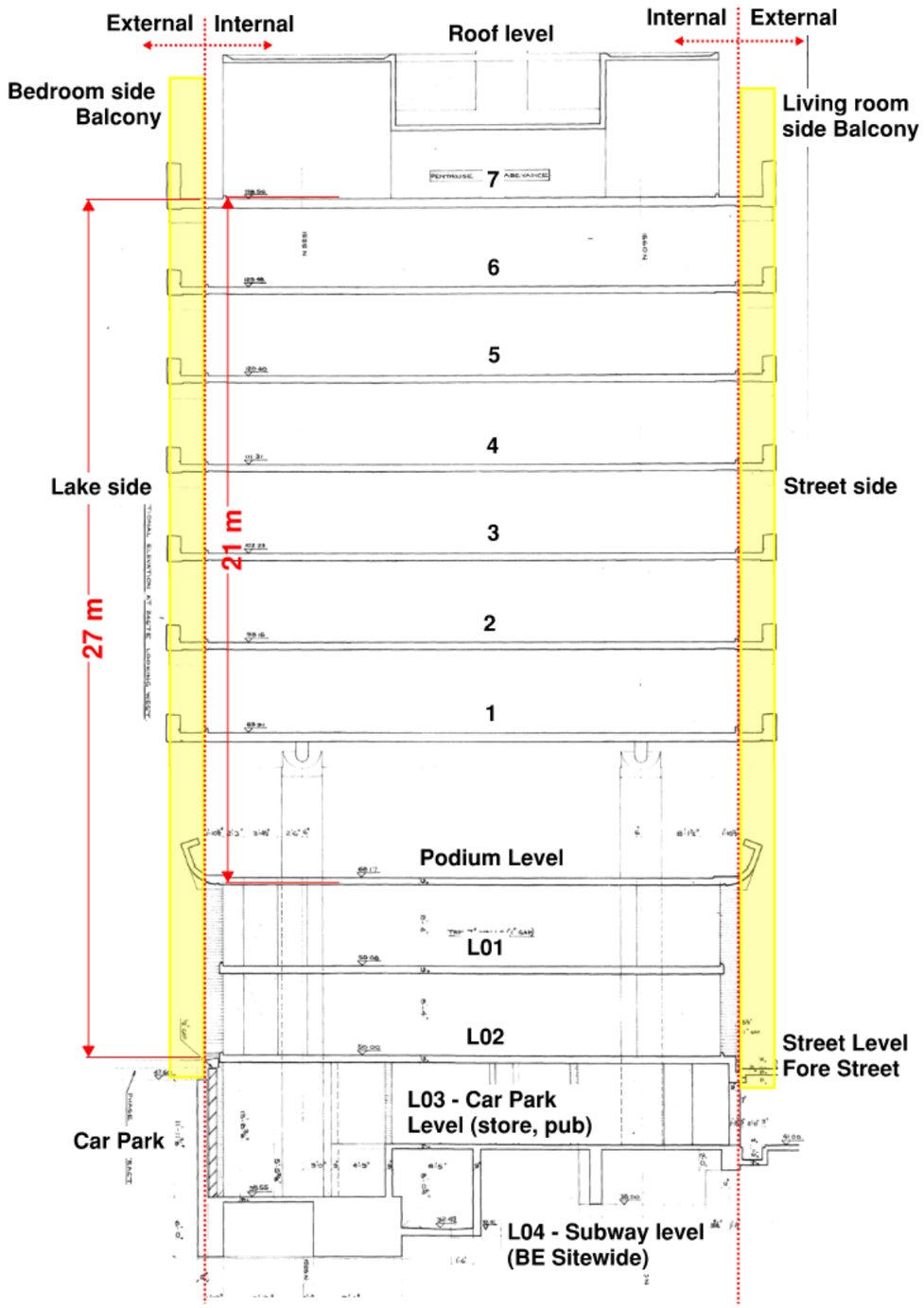


Figure 3: Section of Andrewes House and Level naming convention

4 Fire Strategy Summary

This section of the report provides an overview of the fire strategy of Andrewes House. It provides the following:

- The recommendations of current guidance;
- The current provisions in Andrewes House;
- Identification of non-compliances against the current provisions;
- If there are non-compliances identified, three possible solutions through a risk assessment:
    1. The non-compliance is considered to present life safety risk and requires remediation. Recommendations are made to improve the current provisions to comply with the Building Regulations on an as near as reasonably practicable basis;
    2. The non-compliance is not considered to be high risk to require additional safety measures to the existing system. It is considered acceptable to be retained; OR
    3. More information/confirmation is required from BE (brown text).

Where a non-compliance has been identified and a recommendation has been made after a risk assessment, these have been highlighted in green box.

4.1 Means of warning and escape

4.1.1 Evacuation strategy

Andrewes House operates with a defend in place/stay put strategy where only the occupants in the flat of the fire origin evacuate the building. The rest of the building occupants will remain in place. The defend in place strategy is a common strategy for residential buildings in the UK and this is recommended to be retained for Andrewes House.

It is important that information is given to residents regarding the meaning of the stay put strategy and the arrangements for means of escape is available to them if a fire affects their flat. It is note from the Frankham's FRA that fire action notices are inconsistently displayed in communal areas and the guidance is ambiguous in respect of a stay put evacuation strategy. It is recommended for signage to be replaced with clear instructions to residents, explaining their fire actions, including the stay out policy and their nearest escape routes.

If deemed necessary by the fire brigade, the building may undergo simultaneous evacuation where all of the occupants in the building will evacuate. Presently, the fire brigade and/or BE staff will have to notify each occupant by knocking on each flat door. There is no formal procedure for carrying out a simultaneous evacuation.

Whilst the above approach is compliant with the recommendation of BS 9991, the *Grenfell Tower Inquiry: Phase 1 report* recommends that all high-rise residential buildings, existing and new, are provided with facilities to allow the fire and rescue service to simultaneously evacuate the building. Please refer to Section 4.1.9 for additional details on the fire detection and alarm system.

4.1.2 Travel distance within flats

From BS 9991, there is no limitation on travel distance within flats where all habitable rooms are accessible from an internal hallway (not fire rated construction) and have an alternative exit from the habitable rooms. Where a flat is not provided with a protected corridor or alternative exits, travel distances from anywhere within the flat to the flat entrance door should be limited to 9 m.

For occupants who are able-bodied (refer to Section 4.1.6 for evacuation of Persons with Reduced Mobility, PRM) and above the Podium, the flats are provided with three escape routes; via the South facing balcony, North facing balcony and the flat entrance.

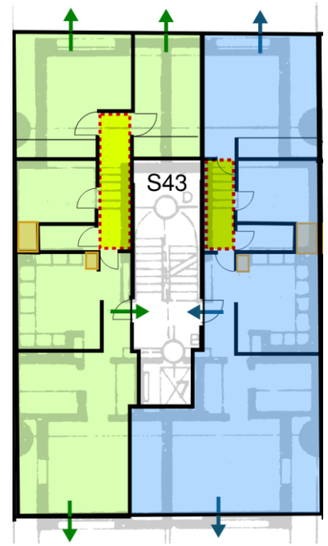


Figure 4: Available egress routes and internal hallway for typical flat layout

All flats, with exception of the end flats (flat type 19 and 19H) as indicated in Figure 2 have an internal hallway where all habitable rooms are accessible from. As such, these flats do not have a travel distance limit and meet the BS 9991 guidance.

BE advised that flat types 19 and 19H whilst provided with alternative exits, are not currently provided with an internal hallway. In addition, the flats below the Podium level are only served by the stair as means of escape, creating an extended travel distance. These are therefore non-compliances against the recommendations of BS 9991.

The omission of an internal hallway in flats 19 and 19H and the extended travel distances in flats below the Podium level are considered acceptable based on the following:

- The travel distances from the furthest away point in the flat to the flat front door is ~10.1 m. The travel distance extension of 1.1 m above the recommendations unlikely to negatively impact the evacuation time.
- For flats above the Podium level, they are provided with alternative means of escape which result in travel distances to a place of relative safety (i.e. balconies) of less than 9 m.
- At the same time, due to other non-compliances in fire safety precautions, an automatic fire detection and alarm system (see Section 4.1.9) is recommended for all the flats. This will provide early warning to the occupants within the flat and an improvement to the current provision.

It is Arup's understanding that only Flat type 19 and 19H are not provided with an internal hallway. If there are other flat types without an internal hallway, the assessment and recommendations above will apply to those flats.

4.1.3 Horizontal means of escape

This section describes the horizontal means of escape provisions for able-bodied occupants. PRM evacuation is further detailed in Section 4.1.6.

Balcony approach – L1 to L7

There are no specific recommendations in BS 9991 on minimum exit widths. BS 9999 recommends 800 mm minimum width for doors regardless of risk profile.

Andrewes House is a multi-stair building with balcony approach on Level 1 to 7. The horizontal means of escape from each flat consists of the two balconies (North and South) and the flat entrance, leading to a stairwell. The escape routes are as follows:

- **South facing balcony (living room side) exit** – The living room has a large sliding door which leads directly to the balcony. Once on the balcony, occupants can choose to escape in two directions and use one of the firefighting stairs to reach the final exit.

  Due to privacy screens, the width of the South balcony varies between 460 mm to 510 mm with the privacy screens in the open position. These are narrow compared to the minimum width recommended by BS9991. However, considering the limited number of occupants and the alternative exit routes (the wider balcony and the stair), the balcony width is recommended to be retained.

  In addition to the above, it was identified during the site visit, that furniture is located along the South balcony as shown in Figure 5 below**Error! Reference source not found.**. These should be removed so that the escape route remains unobstructed.

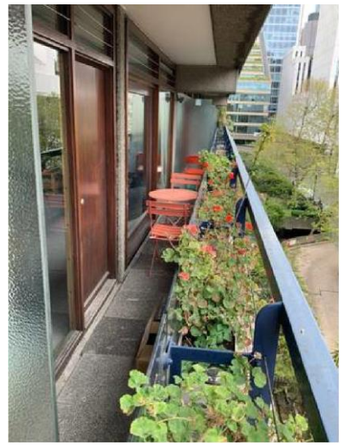


Figure 5: Furniture along the South balcony

- **North facing balcony (bedroom side) exit –** The master bedroom has a sliding door and the second bedroom has a large sliding window to enter the balcony. The sliding window is approximately 800 mm in height, where the occupants will have to climb over in order to access the balcony. Alternatively, the occupants from the second bedroom can escape via the internal hallway to the master bedroom. Once on the balcony, occupants can escape in two directions, and use one of the firefighting stairs to reach the final exit.

  The width of the North facing balcony is 690 mm. Similar to the South facing balcony, this is recommended to be retained.

- **Flat entrance** – There are 12 stairs across the building and every flat entrance leads directly onto the stair landing. From there, occupants can use the stairs to evacuate the building. During the site visit, it was been confirmed that the flat entrance door (on the inspected flat) has a width of 880 mm.

BS 9991 recommends that for multi-stair building with balcony approach, the balconies should meet the following recommendations:

- Structure including the floor is to be protected to achieve 30mins fire rating. Based on the available structural drawings, the floor slab of the balcony achieves a nominal fire rating of 120 minutes – refer to Section 4.3.2 for further details.
- Walking surface should be imperforate. Based on the photos of the balconies (refer to Figure 5 and Figure 12) the walking surfaces are solid concrete pavers and imperforated.
- The balcony be open-sided and the opening to achieve at least 50% of the vertical plan. From the photo evidence, this criteria appears to be achieved but further confirmation on the height of the opening will be required. Refer to Section 4.1.11 for further details

After consultation with BE on 23/07/2021, it has been confirmed that there are following provisions to keep the balcony free of obstacles:

- Balcony inspection occurs on annual basis,
- Window cleaners report to BE on any hazards or obstructions after completing their work every 6 weeks.

Below Podium levels – L01 and L02

Below the Podium level (L01 and L02), the horizontal means of escape from the flats are as follows:

- Flat entrance – onto the same stair serving Level 1 to 7 above.
- Willoughby carpark via the gardens – all L02 flats each have a garden that is open to adjacent gardens. Occupants can evacuate through the gardens and travel to the Willoughby carpark to reach the final exit.
- There are also four L01 flats (SC49 end of Andrewes House) with external ladders leading down to L02 (refer to Figure 6). BS 9991 states that ladders should not form part of a means of escape route from any dwelling. Therefore, the ladder that connects L01 to L02 cannot be considered as an alternative means of escape.

Figure 6: Ladder from L01 to L02 leading to Willoughby Carpark through L02 garden.

The door that leads to the Willoughby carpark from the gardens is currently locked and can only be opened by a key. The lock should be changed so that it can be opened without the use of a key or other devices.

The horizontal means of escape for the remainder of the L01 flats is only via the flat entrance door (i.e. single means of escape). It is understood that means of escape to the neighbouring flat was part of the original provisions; however, this is not considered appropriate as there may be cases where:

- Furniture may be blocking the door to adjacent flat;
- Neighbouring flat may not be occupied/empty and the front door may not be openable from the inside;
- Change in door locks or new locks to the door by the tenants, blocking the means of escape route.

Recommendations:

- Maintaining the management procedure in place to keep the balconies (North and South) clear of any obstacles at all times. This is to provide a clear escape route for occupants to evacuate in an emergency.
- The door which leads from L02 gardens to Willoughby carpark should be openable by occupants without the use of a key or other devices.
- Refer to Section 4.1.6 for additional recommendations for single means of escape.

4.1.4 Vertical means of escape (stairs)

Minimum width

Common stairs are required by BS 9991 to be no less than 750 mm, measured between the walls and/or balustrades (if protruding less than 100 mm from the walls). A minimum 2 m clear height shall be maintained.

Andrewes House is provided with 12 stairs evenly spaced along the building (SC 38 to 49 – see Figure 7). Three of these stairs are part of the firefighting shafts (SC38, 44 and 49). The widths of all the stairs have been measured (during site visit) as 1000 mm each, although it is currently not known how much the handrails protrude into the stairs. Due to the stay-put policy and the low number of occupants served by each stair, the vertical exit capacity provided by the stair is considered to be sufficient.

Refer to Section 4.5.3 for details of the firefighting stairs.

Figure 7: Typical stair in between two flats, viewed from the passenger lift

Protected lobby

Except for the firefighting stairs, the other common stairs do not have protected lobby. Each apartment opens directly into the stair. This is not an issue for able-bodied occupants in flats above the Podium level due to the multiple escape routes via the balconies. However, the lack of protected lobby presents a risk to flats below the Podium level and PRMs anywhere in the building. Refer to Section 4.1.6 below describing the potential risk caused by the lack of protected lobby to PRMs and the mitigation measures.

Ventilation to common stairs

There is currently no means for smoke ventilation in the common stairs (SC 39 to 43 and SC 45 to 48). Due to the common stair being the single means of escape and firefighting access for the flats below the Podium level and the use of the stair as protected refuge for PRMs (refer to Section 4.1.6), it is recommended to provide means for smoke ventilation to the common stairs. This could be in the form of automatically openable vents/doors to outside or a mechanical smoke ventilation system.

4.1.5 Final exits

Level of discharge

All stairs, with exception of SC49, discharge at Podium level. Occupants in flats above the Podium level will evacuate down to the Podium, while occupants in flats below the Podium level will evacuate in the upward direction.

In the case of SC49, discharge is available at both Podium level and street level, adjacent to fire service vehicle access point. Refer to Figure 8 below.

Figure 8: Final exit for firefighting shaft SC49 at St Giles Terrace

Final exit requirements

In accordance with BS 9991, discharge from common stairs and final exits should meet the following recommendations:

- Protected stairs should discharge directly to a final exit – all the stairs at Andrewes House discharge to a final exit either at Podium level of street level (for SC49).
- Final exits should discharge directly to a walkway or open space that allows for the rapid dispersal of persons away from the vicinity of the building, which is achieved by the Podium.
- Final exits should have a level threshold. It has been confirmed during the site visit that the Podium level is levelled/step free. The final discharge from the garden (at Level 02) to the Willoughby carpark and exit via the vehicle ramp are also step free (the gradient of the ramp has not been assessment for compliance with BS 9999 nor Approved Document M).
- Final exits should be sited such that they are clear of any risk from fire or smoke – the Podium is an open public walkway, mainly of non-combustible construction

and with very low fire load content. The final exit of the stairs discharge onto the Podium, which is a low fire risk area. Refer to Figure 9 for the condition of the podium.

Place of ultimate safety

The Podium level (ground + 2 storeys – see Figure 9) is an external walkway which runs along the length and beneath Andrewes House and also connects to other buildings in the Barbican Residential Development and adjacent developments. The Podium acts as a place of ultimate safety (a place where there is no immediate or future danger from fire) and it is also used as the point of access for fire brigade.

The nearest stair linking the Podium to street level for Andrewes House is an external stair adjacent to The Postern building on St Giles Terrace (see Figure 10). There are other stairs/lifts serving the Podium from street level across the Estate. This will allow for the dispersal of occupants away from Andrewes House in the event of a fire.

Figure 9: Podium underneath Andrewes House

Figure 10: Stair down to St Giles Terrace, across a pedestrian bridge

4.1.6 Evacuation of PRMs

Andrewes House currently does not have an evacuation strategy for PRMs.

As discussed in Section 4.1.3, each flat above the Podium level has a number of means of escape including access to the balconies. However, there is a step up and down (about 10mm) from the flat to both balconies. In addition, the balcony widths (410 mm to 690 mm) do not provide enough width for wheelchair access which has an average width of 700 mm. Therefore, there is only a single means of escape for PRMs in Andrewes House.

Lack of protected lobby and refuge

As there is only a single means of escape for PRMs in Andrewes House, BS 9991 recommends that a protected lobby for single stair buildings with a floor level more than 11 m above ground.

Apart from the three firefighting stairs, the remaining nine common stairs are not provided with a protected lobby – each flat opens directly into the common stair.

Smoke from a fire in the incident flat is likely to spread into the common stair during evacuation when the entrance door to the stair is opened.

For able-bodied occupants, the risk of the stair being smoke logged can be mitigated by using the balconies. However, if a fire were to occur in a flat occupied by PRM, the stair is the only escape route. The stair is also a protected refuge for the PRM to wait for assistance, as the passenger lifts are not evacuation lifts. Presently, there is no provisions in the stair for the PRM to call for assistance.

The lack of protected lobby, potentially causing the stair to be smoke logged and the lack of means to ventilate smoke from the stair present a life safety risk to the building occupants. The lack of any communication system in the stair for the PRM to call for assistance is unacceptable in terms of safe means of escape provisions.

Extended travel distance

The flat does not have a common internal corridor serving all rooms. This means the travel distances within the flat should be limited to 9 m from the furthest point in the flat,

The current travel distance within the flat to the entrance door is approximately 10.1 m which exceeds the recommendations of BS 9991 (maximum travel distance of 9 m for single means of escape within flats protected by automatic detection system), as shown in Figure 11 below.

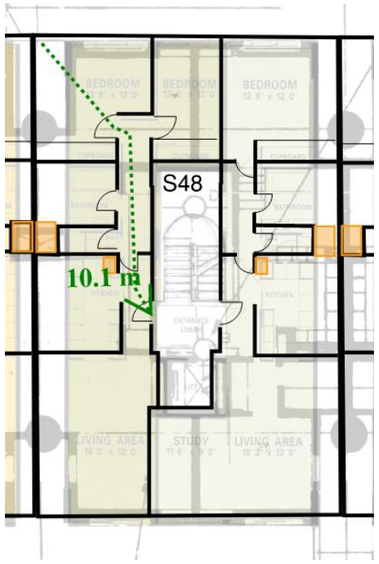


Figure 11: Extended travel distance for single means of escape for PRMs

Flat entrance width

BS 9991 has no specific recommendations for means of escape for PRMs. However, BS 9999 recommends the total door width should be not less than 850 mm where unassisted wheelchair access is necessary. During the site visit, it was confirmed that the flat entrance doors have a width of 880 mm.

Evacuation strategy for PRMs

BE confirmed that there is currently no evacuation management plan for PRMs and that the leaseholder of the flats is responsible for their own evacuation. It is strongly recommended for BE to have in place a strategy and management plan for the evacuation of PRMs. It is a recommendation in the Grenfell Tower Inquiry: Phase 1 report that '*the owner and manager of every high-rise residential building be required by law to prepare personal emergency evacuation plans (PEEPs) for all residents whose ability to self-evacuate may be compromised (such as persons with reduced mobility or cognition)*'.

Recommendations:

- Provide an emergency voice communication system on each stair landing, for the PRMs to call for assistance.
- Provide smoke ventilation to all the common stairs, e.g. by means of openable vent at the top of the stairs.
- Provide means for activating the smoke ventilation system in the common stairs – this could be in the form of smoke detectors, which could raise an alarm for BE staff to investigate the incident.
- Provide a system for lifts to ground when smoke is detected in the common stairs.
- Provide an automatic fire detection and alarm system for each flat (Section 4.1.9 for details).
- BE to put in place management plan and evacuation strategy for the evacuation of occupants, in particular personal emergency evacuation plans for PRMs.
- Clear briefing to all occupants of Andrewes House on the available escape routes.
- Clear briefing to PRMs on the evacuation procedures and the use of the emergency voice communication system to call for assistance.

4.1.7 Exit signage

The External Fire Risk Assessment FRA prepared by Frankham Risk Management Services in March 2018 states that there are suitable and sufficient exit and directional signs in place in Andrewes House.

BS 9991 recommends exit signage to be in accordance with BS 5499-4 and BS ISO 3864-1. In particular, for stair that serves storeys both above and below the point of final exit, the final exit should be immediately apparent by the provision of additional signage.

In addition, the Grenfell Tower Inquiry: Phase 1 report recommends that in all high-rise residential buildings, floor numbers are clearly marked on each landing within the stairways and in a prominent place in the lobbies such that they can be seen in normal conditions and in low lighting and smoky conditions.

Existing provisions

BE advised that there is a sitewide inspection (currently paused) to examine the condition of existing signage and to replace them where necessary.

During the site visit it was confirmed that the exit signage is not adequately provided. All are non-illuminated wall mounted signs and without an adjacent emergency light. Below are some examples of the gaps in provisions:

- Exit signage indicating discharge level on the final exit level is not provided;
- Inadequate exit signage along the balconies;
- Missing signage inside the stairs for flats on L01 and L02 to escape in the upward direction;
- No signage in the storage areas; and
- Signs directing to firefighting shafts (SC44) are not conspicuous.

Proposed Improvements

All exit signage provided in Andrewes House is recommended to be in line with BS 5499-4, BS ISO 3864-1 and the additional recommendations from the Grenfell Tower Inquiry: Phase 1 report.

Recommendations:

- BE to carry out a sitewide inspection and provide exit signage in accordance with BS 5499-4, BS ISO 3864-1 and the additional recommendations from the Grenfell Tower Inquiry: Phase 1 report.

4.1.8 Emergency lighting

In accordance with BS 9991, emergency lighting should be provided in accordance with BS 5266-1.

Existing provisions

Andrewes House is provided with an emergency lighting system with battery back-up. During the site visit, it was not possible to determine the light fittings that are part of the emergency lighting system. The stairs on the middle floors are relatively dim and the lighting was limited to the fittings around the lift door.

Proposed Improvements

A full survey on emergency lighting is recommended and to remediate any of the non-compliances throughout the building for emergency lighting to be in line with BS 5266-1.

Recommendations:

- BE to carry out a sitewide survey and provide emergency lighting in accordance with BS 5266-1.

4.1.9 Fire detection and alarm

BS 9991 recommends that flats in multi-storey buildings shall be provided with an alarm and detection system in line with BS 5839-6. The recommended system for an existing flat is Grade D1 Category LD2, where Grade D1 is a provision of one or more mains powered detection system each with a sealed in standby supply consisting of a battery and Category LD2 system is where detection is only provided at points where the fire risk is high or where combustion products would present a significant hazard to life.

In addition to the recommendations of BS 9991, the Grenfell Tower Inquiry: Phase 1 report recommends that all high-rise residential buildings, existing and new, are provided with facilities to allow the fire and rescue service to simultaneously evacuate the building. High-rise buildings are defined as buildings over 18 m in height and hence Andrewes House is considered a high-rise building.

Existing provisions

Andrewes House is currently not provided with a fire detection and alarm system with exception of the BE owned flats. These flats, on tenancy lets, are provided with an LD2 alarm and detection system, with a 10-year battery backup. The proportion of these flats are small compared with the privately owned leasehold flats.

In the case of privately owned flats, it is the responsibility of the tenants and owners to install an alarm and detection system. It should be noted that this is only a recommendation by BE, as the freeholder, and not compulsory. BE has no record of the flats that are equipped with such system within the flats.

There is no fire detection and alarm system in the common areas.

There is also no facility to allow the fire and rescue service to simultaneously evacuate the building.

- it is unlikely for one fire incident to compromise all the stairs in the building;
- It is equally unlikely for a fire incident to compromise both the balconies, which are escape routes for flats above the Podium level.
- Andrewes House is a concrete building, with concrete construction between the flats and around each stair. The external walls are also concrete construction and mainly non-combustible. BE advised that there is no combustible insulation within the walls. Hence, the risk of rapid fire spread across the building is low.
- There are three firefighting shafts, separated from one another by distance and fire rated construction. It is unlikely for all the shafts to be compromised by one fire incident.

Therefore, it is not recommended to provide a facility to initiate simultaneous evacuation of the building. This is to be discussed and agreed with London Fire Brigade.

Proposed Improvements

A Grade D1 Category LD2 system in line with BS 5839-6 is recommended for all the flats in Andrewes House, due to the following reasons:

- An improvement to the flats with extended travel distances due to the single means of escape and/or the lack of an internal hallway within the flat. The system provides an early warning to occupants so that they quickly evacuate from their flat.
- An improvement to evacuation of PRMs, with a single means of escape and requiring assistance to evacuate to the place of ultimate safety.
- Due to the potential risk of fire/smoke spread via the kitchen extract shunt duct arrangement (see Section 4.3.6), the detection and alarm system provides improvement by providing early warning in case of breach of compartmentation.

Recommendations:

- Provide a Grade D1 Category LD2 system in line with BS 5839-6 is recommended for all the flats in Andrewes House
- Provide automatic detection to activate the staircase AOV and to ground the passenger lifts in case smoke enters the lift shaft.

4.1.10 Fire suppression

Based on BS 9991, sprinkler protection is required for buildings with a floor higher than 30 m above ground level. However, the recent revision of ADB Volume 1: 2020 amendment states that the threshold building height (for residential buildings) for the provision of sprinklers has been reduced from 30 m to 11 m.

Existing provisions

Andrewes House is not provided with sprinkler protection. The building height from ground to the topmost occupied storey is 27 m (drawing number 37 527).

Proposed Improvements

British Standard Code of Practice CP3: Chapter IV (1962) which was the relevant code at the time Andrewes House was built (1969) does not require any sprinkler protection to high-rise residential buildings. Also, the recent change of trigger height from 30 m to 11 m in ADB has been made in the 2020 amendments.

It is considered acceptable for Andrewes House to remain as existing due to the following reasons:

- Andrewes House is a concrete building, with concrete construction between the flats and around each stair. The external walls are also concrete construction and mainly non-combustible. BE advised that there is no combustible insulation within the walls. Hence, the risk of rapid fire spread across the building is low.
- The stairs for means of escape and firefighting access are of concrete construction. Provided that the fire doors are rectified (refer to Section 4.3.3), the integrity of the stairs are unlikely to be compromised by a fire incident in a flat.
- The flats above the Podium level (a larger proportion of the building) have multiple escape routes along the external balconies. A fire incident in a flat is unlikely to compromise the use of both balconies as escape route.
- Andrewes House complies with the recommendations of the relevant guidance at the time of construction CP3;
- Andrewes House complies with relevant codes until the recent changes made in ADB 2020 amendments;
- The building is not undergoing change in use nor material alteration and therefore does not require by the Building Regulations to be upgraded to meet the current guidance.

In terms of life safety, sprinklers will not be required as the current provision is considered to provide adequate life safety features for safe evacuation of the building. However, without an automatic means of suppressing a fire (such as a sprinkler system) may pose a significant threat to the property protection of the building. As Andrewes House is part of the Barbican Residential Development with heritage and culture significance, there may be requirements from insurers that are in addition to the Building Regulations.

After consultation with BE on 23/07/2021, BE have confirmed that their insurers have no requirement for sprinkler system to be retrospectively installed in the Barbican Residential buildings.

4.1.11 Smoke control

In order for fire and smoke to be directed outwards and upwards, BS 9991 recommends the balcony to be open sided. The opening to be at least 50% of the vertical plane and uniformly spread across the surface. The opening should be at least between the top of the balustrade at 1.1 m and the soffit to the balcony above.

Balcony existing provisions

BE confirmed the distance from the balcony surface to top of the balustrade glazing is 960 mm and from the top of the balustrade glazing to the soffit is 1430 mm which is compliant as it is more than 50% of the vertical plane across the surface as shown in Figure 12.

Figure 12: Photos of both South and North facing balconies

4.1.12 Refuse storage cupboard and post box

BS 9991 recommends refuse rooms provided for the storage of refuse should be separated from other parts of the building and should not be located within or accessed directly from common stairs. Rooms provided for the storage of refuse should be approached only by way of a protected lobby having not less than 0.2 m^2 of permanent ventilation or a suitable mechanical alternative.

There is no recommendation in BS 9991 for post box. Considering the fire load content such as parcels, even though not to the same scale as refuse, it is recommended to not locate the post box within the common stairs.

Existing arrangement

Every flat in Andrewes House is provided with a refuse storage cupboard and a post box adjacent to the flat entrance door, for the use of the flat occupants only. The refuse storage and post box are accessible from both the stair landing outside the flat and within the flat; they comprise of a metal frame cupboard with asbestos backed doors on both the stair landing side and the flat side.

There is no ventilated lobby provided and no other mitigation measures provided in Andrewes House for refuse storage areas.

Proposed Improvements

The current arrangement does not comply with the recommendations of BS 9991. Refuse storage is considered a high fire hazard area and the location within the common stair poses a risk to the occupants. A fire involving the refuse can cause fire and smoke to affect the use of the stair and to spread into the flat. It is therefore critical for the door separating the refuse storage and post box from the stair to be fire rated door.

As a recommendation to this non-compliance, the doors to the refuse storage from the common area should be fire rated to 60 minutes with smoke seals. Although this does not fully meet the current recommendations of BS 9991, this is considered an improvement to the current arrangement. The recommended additional detection and alarm system in each flat will serve to provide early warning in the event of a fire in the flat. The new fire rated door separating the refuse storage and post box from the stair will serve to limit fire and smoke spread, maintaining the use of the stair for means of escape and protected refuge.

Recommendations:

- If doors to the refuse storage and post box cupboard on the stair landing are not fire doors meeting the current standard, it is recommended for new fire doors (FD60S) to be provided.

4.1.13 L03 Storage area

BS 9991 states no storeroom should open directly to a common stair. Instead, there should be a ventilated lobby between the storeroom and the stair.

BS 9999 states storage areas greater than 1 m^2 in area but not greater than 450 m^2 (other than refuse storage areas) need to be separated from other parts of the building with a minimum standard of fire resistance of 30 minutes. Storage area have a risk profile of A3 (occupants who are aware and familiar with the building, fast fire growth rate) where the actual travel distance (where the layout is known) is limited to 18 m one way and 45 m two way.

Existing provisions

There are storage areas on L03 of Andrewes House which open directly into corridors leading to the common stairs and firefighting stairs. The storage areas are in separate rooms, designated to each of the flats. There is no fire separation between the storage rooms and the corridors serving the rooms. The corridors lead to the stairs and are only separated by glazing partitions and doors (Figure 13)

There is no exit signage, emergency lighting, automatic detection or alarms within the storage areas. This is a non-compliance against the current standards.

During the site visit, it was not possible to check the travel distances nor the dead end distances for compliance with BS 9999. It is understood from BE that there are some dead end corridors.

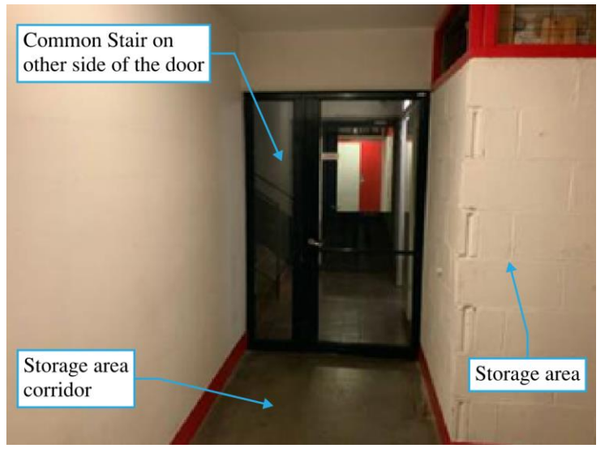


Figure 13: Storage area directly accessible from the stairs

Proposed Improvements

As a recommendation to the above non-compliance, all of the storage areas should be provided with a minimum L2 fire alarm and detection system as recommended under Table 7 of BS9999, as well as exit signage and emergency lighting in accordance with the relevant standards. Refer to Section 4.1.7and 4.1.8 for recommendations on exit signs and emergency lighting.

A survey should be undertaken or floor plan to be provided to assess the compliances of the travel distances within the storage area.

The stairs are directly accessible from the corridors (that are connected to the storage rooms). This is a non-compliance as lobbies should be provided in between the two areas. However, the current arrangement is considered acceptable due to the following:

- All common stairs are recommended to be provided with openable vents. Refer to Section 4.1.6;
- Minimum L2 system of automatic detectors and alarms will be installed within the storage areas to provide early warning to escape in case of fire. As such, when occupants are evacuating during the early stages of the fire, smoke spread into the stairs should be minimum.

Recommendations:

- Provide a minimum L2 automatic fire detector and alarm throughout the storage areas.
- Provide adequate exit signage and emergency lighting.
- If the partitions between the storage areas and stairs are not fire rated, they should be replaced by:
    - 120 minutes fire resisting construction, including FD60S doors, to separate storage areas from the firefighting stairs (SC38, 44 and 49)
    - 60 minutes fire resisting construction, including FD30S doors, to separate storage areas from the common stairs
- Assess the compliance of the travel distances within the storage areas.

4.1.14 Back-up power supplies

BS 9991 states life safety systems are to be provided with a secondary power supply. The primary power source should generally be taken from the public electricity supply, with secondary power being supplied from an alternative utility supply from another substation, a generator or uninterruptible power supply (UPS) or batteries.

Where practicable, power supplies should be provided via two separate intakes into the building from the same external substation or via a single intake and a standby generator.

Existing provisions

Andrewes House is provided with a number of life safety systems including emergency lighting, firefighting stair ventilation and firemen's lifts. Secondary power supply to these life safety systems is provided as follows:

- Emergency lighting – provided with battery as the secondary power supply;
- Firefighting stair smoke ventilation – provided with battery as the secondary power supply;
- Fireman lifts - no secondary power supply;
- Emergency exit signage – BE confirmed the emergency exit signs are standalone, the signs will need emergency lighting to provide enough light to the signs. Refer to Section 4.1.7 and 4.1.8 for recommendations.

The condition of the back-up power supply system is unknown.

BE confirmed that there are no additional life safety systems in the building requiring back-up power supplies.

Proposed Improvements

The lack of back-up power supply to the firemen's lifts has been confirmed by BE and is a non-compliance against the current standards. Refer to Section 4.5.3 for further recommendations on the firemen's lifts.

Recommendations:

- BE to ensure that secondary power supply systems are in good operation condition and maintained in accordance with the relevant standards. It is recommended for BE to establish the compliance of the secondary power supply provisions against the relevant standards.

4.2 Internal fire spread (linings)

BS 9991 recommends the following for wall and ceiling linings:

- Circulation spaces/ common corridors – Class 0 in line with BS 476-7 (national class) or Class B-s3, d2 or better in line with BS EN 13501-1 (European class);

- Within apartments – Class 1 in line with BS 476-7 (national class) or Class C-s3, d2 or better in line with BS EN 13501-1 (European class).

Existing provisions

There is no information on the wall and ceiling linings across the common areas of Andrewes House as well as within the flats. Based on limited number of site photographs received from BE, the walls appear to be concrete for the common areas including the firefighting stair and the common stair areas.

As concrete finish is expected to achieve Class A1, it meets the recommendations of BS 9991. However, this is based on the assumption that wall and ceiling linings are concrete finishes throughout all areas of the building as shown on the photographs provided by BE. If there are areas within the building where the above requirements are not likely to be achieved, they will need to be discussed and addressed separately.

4.3 Internal fire spread (structure)

4.3.1 Structural fire resistance

Under BS 9991 guidance, un-sprinklered buildings greater than 18m but less than 30 m in height shall be provided with 90 minutes fire resisting construction for load bearing capacity. Elements of structure supporting the firefighting shafts are required to achieve 120 minutes.

Elements of structure are required to achieve loadbearing capacity (R) only, however when certain elements also act as separating elements (i.e. walls) integrity (E) and insulation (I) are also required.

Existing provisions

Information on the existing building structure is based on the structural drawings in the Arup Archive. It has been assumed that all elements (i.e. walls, slabs, etc.) shown in the structural drawings are elements of structure and therefore loadbearing.

Based on the structural drawings (drawing numbers: 37 515 and 37 516) the following information on structural elements was obtained:

- Common stair wall thickness: 197 mm
- Walls between flats (Wall 2 as shown in Figure 14): 360 mm
- Firefighting stair wall thickness: 178 mm
- Floor slab thickness (excludes balcony slabs): 229 mm

The wall and slab thickness varies from one location in the building to another; the above dimensions represent the smallest (and therefore most conservative) of those observed from the drawings reviewed. The above dimensions have not been verified through site inspections.

The following guidance documents have been used to assess the potential fire rating offered by the dimensions of the walls and slabs:

- BS EN 1992-1-2-2004: Eurocode 2 Design of Concrete Structure Part 1-2: General rules – Structural fire design (Eurocode 2), which is the current guidance; and
- CP 114:1957 British Code of Practice, The Structural Use of Reinforced Concrete in Buildings, which is the relevant code at the time of construction.

In assessing the potential fire rating, the following assumptions are made:

- The thickness of structural elements stated above apply throughout the building;
- All structural elements are reinforced concrete;
- The concrete covers over the reinforcement bars meet the values stated in the relevant guidance at the time of construction (CP 114); there is no information on the depth of the existing concrete covers for this aspect to be assessed;
- Floor slabs are simply supported one-way slabs throughout the building;
- No structural calculations are available and therefore the utilisation factor of the structural members is unknown. When checking against the requirements of Eurocode 2 a utilisation factor of 0.7 has been taken as a conservatism;
- The fire resistance requirements given in CP 114 cover loadbearing capacity, integrity and insulations;
- Structural drawings are only available for apartment levels above Podium (Floor 1 to 6). There are no information/drawings for levels below the Podium (L01-L02) or Floor 7.

The table below compares the existing dimensions of the structural elements with the requirements from the two guidance documents.

Table 3: Summary of structural element thickness against code requirements

Existing structural element	Existing element thickness	Eurocode 2 requirements	CP 114 requirements	BS 9991 requirements	Comments
Common stair wall	197mm	170mm (REI90)	101.6mm (REI90)	R90	Achieving both the Eurocode 2 and CP 114 for REI90 rating
Walls between flats	360mm	170mm (REI90)	101.6mm (REI90)	R90	Achieving both the Eurocode 2 and CP 114 for REI90 rating
Firefighting shaft wall	178mm	160mm (REI120)	101.6mm (REI120)	R120	Achieving REI90 under the Eurocode 2 and R120 under the CP 114.

Floor slab	229 mm	100mm/120mm (REI90/REI120)	127mm (REI90 and REI120)	R90	Achieving both the Eurocode 2 and CP 114 for R90 and R120

The thickness of the structural elements to meet the required fire ratings appear to meet both the current guidance and the relevant guidance at the time of construction.

4.3.2 Fire compartmentation

Fire compartmentation is required to limit fire spread within the same building and protect means of escape. BS 9991 recommends the following fire ratings:

- Compartment walls (non-load bearing) between flats (Wall 1 as shown in Figure 14): FR60 EI. If the compartment walls are also part of the load-bearing elements (Wall 2 as shown in Figure 14), then the fire rating increases to FR90 REI;
- Compartment floor: FR90 EI (refer to Section 4.3.1 above);
- Passenger lift shaft: FR90 REI;
- Common stair shaft: FR90 REI;
- Firefighting shafts: FR120 REI;
- Any risers penetrating compartment floors: FR90 REI;
- Fire stopping – same level of fire resistance as the compartment wall it passes.

Existing provisions

Information on the existing construction is also based on the structural drawings in the Arup Archive. For elements that are not shown on the structural drawings but are required to be of fire rated construction in accordance with BS 9991, dimensions were provided by BE through site measurements.

Similar to the structural elements, the Eurocode 2 and CP 114 guidance are used to establish a nominal fire rating of the compartmentation.

There compartment walls separating the flats are (refer to Figure 14 below):

- Wall 1 has a thickness of 178 mm (drawing number 37 516) and verified on site by BE to be 180 mm. Such wall thickness is expected to achieve a nominal fire rating of 90 REI;
- Wall 2 has a thickness of 360 mm, as measured by BE. Such wall thickness is expected to achieve a nominal fire rating of FR120 REI.

There is currently no drawing or information available on the material nor the thickness of the riser construction in each of the flats (kitchen risers and bathroom risers). BE confirmed there are mixture of concrete and asbestos panels that form riser walls and that there is no additional information available on the risers within the flats.

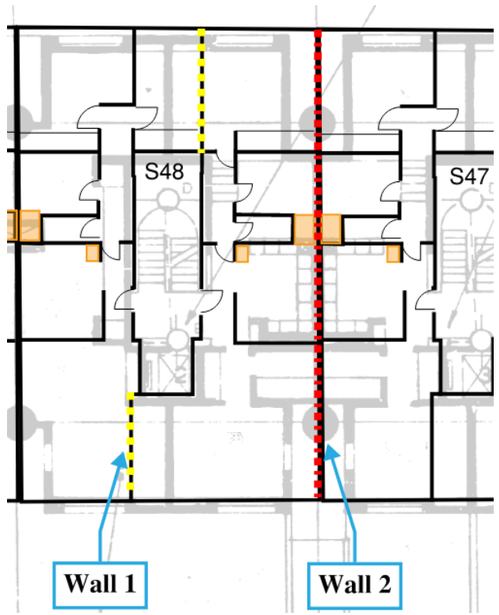


Figure 14: Compartment walls separating the flats

Lift shaft has a thickness of 178 mm (drawing number reference 37 516) which is expected to nominally achieve FR90 REI. Refer to Section 4.3.1 above for the common stairs and firefighting shaft walls.

4.3.3 Fire doors

BS 9991 recommends the specification, installation and maintenance of hinged or pivoted pedestrian fire doors to be based on BS 8214. This standard recommends fire rating of doors to be tested in accordance with either BS 476-22 or BS EN 1634-1.

The following fire rating requirements are based on Table 12 of BS 9991:

- Fire door separating firefighting stair and firefighting lobby: FD30S;
- Passenger/firemen's lift landing door: FD30;
- Fire door separating a flat from a space in common use: FD60S*;
- Enclosing a protected shaft forming a lift well or service shaft: FD60S.

*Note: BS 9991 requires that the fire door separating a flat from a space is common use is to be FD30S. In the case of Andrewes House this has been upgraded to FD60S as a result of the stair landing being used as a refuge space for PRMs, the single means of escape and the lack of protected lobby at each level.

In addition, the *Grenfell Tower Inquiry: Phase 1* – report recommends that all residential building containing separate dwellings (whether or not they are high-rise buildings) to:

- Carry out an urgent inspection of all fire doors to ensure they comply with applicable legislative standards; and
- To be required by law to carry out checks at not less than three-monthly intervals to ensure that all fire doors are fitted with effective self-closing devices in working order.

Existing provisions

There is no information on the existing doors for Andrewes House. However, based on the information provided on the document 'Abridged results from the test of 86 Thomas More House (double leaf door and a single leaf door)' issued by CTO S A on 21/01/2020, the fire doors in Thomas More have not satisfied requirements for 30 minutes (EI30) class door. The fire doors were tested in accordance with PN EN 1363-1:2012 and PN EN 1634-1+A1:2018.

Although the test was not carried out specifically for the fire doors in Andrewes House, it is assumed that Thomas More and Andrewes House have identical fire doors as they are part of the Barbican Residential Development. BE confirmed that the doors in Andrewes House are identical to those in Thomas More.

The fire door separating each flat from the common stair or the firefighting shaft is critical for maintaining the availability of the stair for means of escape. In particular, PRM evacuation relies on the stair landing as the protected refuge, while awaiting assistance.

There is no information on the fire rating of the lift landing doors. The risk of a fire starting in the lift shaft is low, provided that the lift machine room is fire separated from the lift shaft as recommended by BS 999. In line with Clause 15.8 of BS 9999, where lifts are located within a protected stair enclosure (which is the case for the common stairs as they are the only means of escape for PRMs), the lift machine rooms should be separated from the lift shaft to prevent fire and smoke spreading into the lift shaft and into the stairs. It is therefore, recommended that the separation between the lift machine room and lift shaft is inspected to understand if it is likely to achieve a level of fire resistance.

During the site visit, the doors to services risers within the stairs were not labelled fire doors and were not being maintained properly to provide separation between the riser and the stairs. Figure 15 shows one of the doors for service risers.

Figure 15: Service shaft door within one of the common stairs

After consultation with BE on 23/07/2021, BE have confirmed that City of London carries out monthly door inspections and London Fire Brigade does an inspection every 6 months.

Recommendations:

- Install new FD30S fire doors separating the firefighting stairs and lobbies.
- Install new FD60S fire doors at each flat entrance.
- A full survey should be carried out to inspect the existing doors to service risers that are located within the stair enclosure and replace them with new FD60S fire doors where required.
- BE to keep records of inspection and testing of fire doors in the future, at not less than three-monthly intervals to ensure that all fire doors are in working order.
- Separation between the lift machine room and lift shaft to be inspected to understand if it is likely to achieve a level of fire resistance.

4.3.4 Cavity barriers

Clause 33.1.1 of BS 9999 recommends that cavity barriers should be provided to close the edges of cavities, including around openings. Cavity barriers should be provided at the junction between an external cavity wall and every compartment floor and compartment wall. It also needs to be provided at the junction between an internal cavity wall and every compartment floor, compartment wall or other wall or door assembly which forms a fire resisting barrier.

Existing provisions

BE have confirmed that there are no cavity barriers in Andrewes House due to the build-up of the walls not having any cavities. It is also noted that there are no voids in

the balconies. Figure 16 illustrates an aperture where a balcony door frame has been removed showing no cavity within the structure.

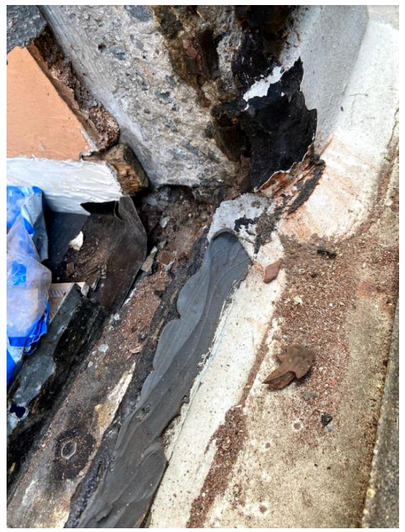


Figure 16: Aperture of a balcony door frame showing no cavity

4.3.5 Fire stopping

BS 9991 (Clause 24.4 and Figure 24) recommends where a building service passes through a compartment wall or floor it shall be adequately fire stopped in line with the compartment fire resistance.

Existing provisions

There is currently no information on the provision of fire stopping for Andrewes House. Based on the External Fire Risk Assessment FRA prepared by Frankham Risk Management Services in March 2018, fire stopping registers are not in place.

4.3.6 Kitchen and toilet shunt duct risers

In accordance with BS 9991, vertical ventilation ducts should be enclosed throughout their height with fire resisting construction. Where a horizontal ventilation duct penetrates the fire resisting construction, BS 9999 recommends four different methods of maintaining the fire separation at the penetration:

- Method 1: thermally actuated fire dampers;
- Method 2: fire resisting enclosures e.g. fire rated plasterboards;
- Method 3: protection using fire-resisting ductwork;
- Method 4: automatically actuated fire and smoke dampers triggered by smoke detectors.

BS 9999 Section 32.5.2.2 also states that Methods 1 and 4 should not be used for extract ductwork servicing kitchens and this is due to the likely build-up of grease within the duct which can adversely affect the effectiveness of any dampers.

In the Barbican Residential Development, it is understood that a common approach to maintain fire separation between flats is to use shunt duct arrangement for the kitchen and toilet extract ventilation ducts. The purpose of shunt duct is to avoid the need for fire protection using the Methods described above. A shunt duct arrangement comprises of branch ductwork (‘s’ or inverted ‘s’ shaped) that are connected to the main extract ductwork as shown as Figure 17. In addition to the downward bend of the shunt duct, a fan at the top of the main extract ductwork maintains a negative pressure that stops smoke from spreading out of the ductwork.

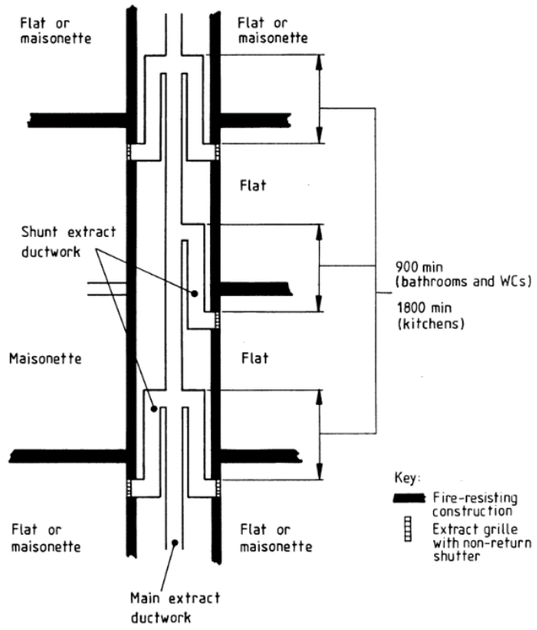


Figure 17: Layout of shunt duct system (BS 5588 Part 9)

Shunt duct arrangement is a recognised approach in BS 5588-9:1999 – *Fire precautions in the design, construction and use of buildings Part 9: Code of practice for ventilation and air conditioning ductwork*, for extract ductworks serving toilets. However, it is not normally acceptable for use in kitchen extraction because of the fire risk inherent in kitchens. The guidance mentioned that if shunt duct is used for kitchen extraction, careful consideration should be given to possible pressure differentials within the system to avoid the transfer of smoke and other products of combustion from one dwelling to another by means of the ductwork system. This guidance has been withdrawn and is no longer referenced in other current standards including the Approved Document B.

Existing provisions

In Andrewes House, it is understood that the main kitchen extract riser and the shunt ducts are of concrete construction. Dimensions of the concrete construction are unknown, but likely to have some inherent fire rating. The kitchen extract riser is located within the kitchen and serves all the flats on the same vertical stack. The extract fan is located at the top of the main riser and on continuous operation (BE confirmed the capacity of the current fans are 10m^3/s). The height of the shunt duct from the kitchen hood to the main extract riser has been assumed by BE to be approximately 2.2 – 2.3 m as it is 200 – 300mm below the flat above. BE also confirmed that the shunt ducts are 'L' shaped instead of the more common 'S' shaped as shown in Figure 17. The internal grease builds up within the vertical portion of the shunt ducts and within the main extract risers are unknown.

The toilet extract riser is located within the toilet of each flat and serves all the flats on the same vertical stack. The side backing on to the toilet wall contains asbestos and the rest of the walls are concrete. The vertical section of the toilet riser is assumed to be approximately 1.5m in height with metal galvanized construction. The remaining dimensions of shunt duct and the operation of the extract fan are unknown.

Proposed Improvements

Whilst the use of shunt duct in lieu of other forms of fire protection is no longer in line with current UK guidance, their use for toilet extract risers is still allowed in other countries (Australia – AS 1688.1; USA – International Building Code). Considering the low risk nature of toilets and provided that the installations are in line with the details of the guidance, the use of shunt duct for toilet extract riser is considered acceptable.

However, it is not recommended to use shunt duct for kitchen extract riser. The presence of grease in the duct may affect the effectiveness of the shunt system in maintaining fire and smoke separation. Failure of compartmentation between the flats presents a life safety risk to the occupants, especially as the kitchen extract riser is located opposite the flat entrance, which is the only means of escape for the PRMs and flats below the Podium level.

Provision of fire detection and alarm system is one of the improvements, providing early warning before the single escape route via the flat entrance is compromised. In addition, the risk of fire spread via the shunt duct can be reduced by replacing the existing extract hoods with recirculation type extract hoods and maintaining the compartmentation between the flats.

BE confirmed that the kitchen shunt duct is also used as a day-to-day ventilation system and the air path through the kitchen extract riser needs to be maintained.

Recommendations:

- Use closed circuit/recirculation kitchen extract system for all future kitchen refurbishment.
- Maintain compartmentation between flats by one of the options below:
  - Provide smoke and fire damper between the flat and the shunt duct riser activated by the fire alarm/detectors within the flat;
  - Maintain the shunt duct arrangement and increase the reliability of the main extract fan. This will require an additional duty standby fan (the fans to be rated at 400 ˚C for 90 minutes in accordance with BS EN 13501-4), with secondary power supply. The fans need to be adequately maintained to keep the main riser under negative pressure;
  - Closed off the opening to the shunt ducts (with appropriate fire rated construction) and provide a fan on the external wall to extract air from the flat to outside.

4.4 External fire spread

4.4.1 Fire spread to neighbouring buildings

Buildings must maintain the minimum separation distance from the site boundary to protect itself and adjacent buildings against external fire spread. A building that is

located less than the required separation distance from the site boundary will be required to be provided with mitigation measures to prevent fire spread such as fire rated external walls. In accordance with BS 9991, there are four methods used to determine the maximum permissible amount of unprotected façade. In this case, the most appropriate method is the enclosing rectangle in line with BR 187.

Existing arrangement

There is no information available on the location of the site boundary in relation to Andrewes House. The building boundaries or the relevant boundaries are as follows:

- North – To the middle of the Barbican water gardens, 17 m;
- South – To the middle of Fore Street, 28 m;
- The Postern (South) – To the mid-point between the two buildings, 7.5 m.
- East – Directly adjacent to Willoughby House, < 1 m;
- West – Directly adjacent to Gilbert House, < 1 m.

An external fire spread calculation has been undertaken for a single flat using the above assumed boundary distances. The enclosing rectangle method in line with BR 187 was carried out. The results show that no protection is required to the facades. Please refer to Appendix B for the calculation.

BRE 187 states unprotected areas can be discounted where the boundary and the building are at an angle of more than 80˚ to each other. As shown in Figure 18 below, both Gilbert House and Willoughby House are at an angle of more than 80˚ from Andrewes House and therefore it is not required to consider external fire spread.

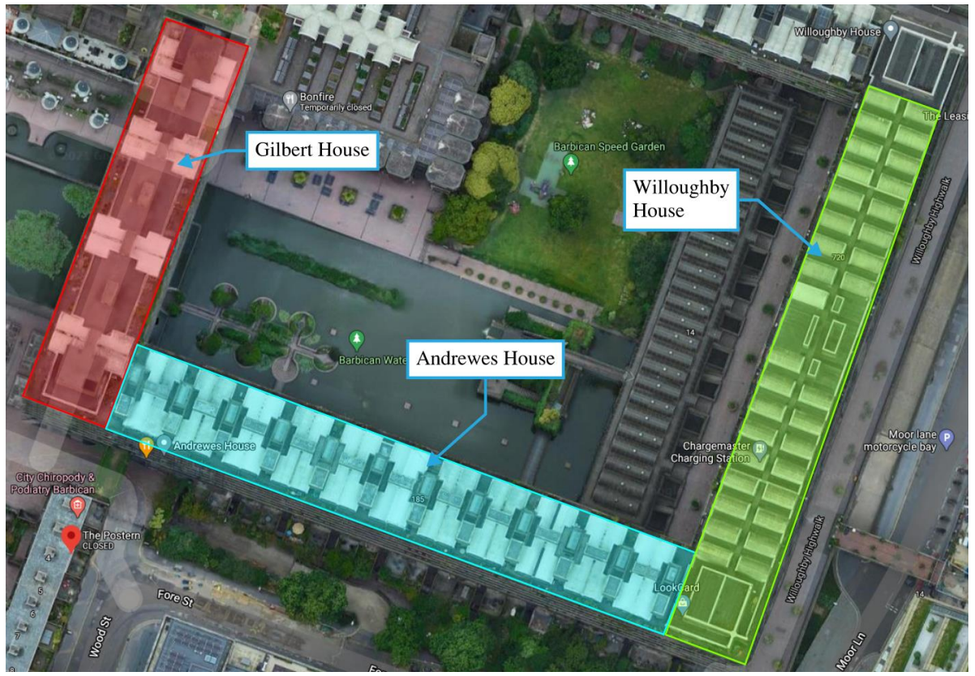


Figure 18: Existing roof arrangement for Andrewes House and adjacent blocks

4.4.2 Façade material

BS 9991 recommends the following material classifications for external areas of the façade of buildings greater than 18 m in height:

- Areas < 1 m from the boundary – Cass 0 (National class) or Class B-s3, d2 or better (European class);
- Areas > 1 m from the boundary and > 18 m in height – Class 0 (National class) or Class B-s3, d2 or better (European class).

The Building Regulations also require materials which become part of an external wall (i.e. cladding material, insulation product, filler material – not including gaskets, sealants and similar) and specified attachment (e.g. balcony) of a residential building with a storey at least 18m above ground level to achieve European Classification A2-s1, d0 or Class A1, classified in accordance with BS EN 13501-1:2007+A1:2009 entitled ‘Fire classification of construction products and building elements. Classification using the test data from reaction to fire tests’.

In addition, the *Grenfell Tower Inquiry: Phase 1 report* recommends that the owner and manager of every high rise residential building be required by law to provide their local fire and rescue service with information about the design of its external walls together with details of the materials of which they are constructed and to inform the fire and rescue service of any material changes made to them;

Existing provisions

As stated in Section 3.4.1, the East and West elevations which are directly connected to Willoughby House and Gilbert House have been confirmed by BE to be provided with solid concrete construction.

In the case of the North and South facades, the walls have been confirmed as concrete (based on the information provided in the EWS1 form by City of London Corporation issued in 2020).

The concrete panel is considered to achieve Class A1, and therefore it meets the recommendations of BS 9991.

In the case of balconies, the build-up consists of concrete paving slabs sitting on top of a felt membrane. The felt is a membrane and therefore under Regulation 7(3) of Approved Document B, is exempted from having to meet the requirements for a European Classification of A2-s1, d0 or better.

It is also recommended to provide information about the design of external walls and details of the materials in the Fire notice box for the fire and rescue service to be able to have access to the information when they arrive on site.

Recommendations:

- Include information about the design and materials of the external walls in the Fire Notice Box, to be located by the fire service access point at St Giles Terrace.

4.4.3 Roof materials

BS 9991 recommends buildings where the roof is less than 6 m away from any point on the relevant boundary needs to be provided with a roof covering designation of AA, AB or AC in line with BS 476-3 (equivalent to Broof(t4) classification in line with BS EN 13501-5 European classifications).

Existing provisions

The flat roof building of Andrewes House consists of either felt with insulation or a liquid membrane with concrete paving slab on top. Arup is not aware of any information available to confirm the fire performance of these materials. BE confirmed that there is no information available on roof material.

As shown in Figure 18, Willoughby House and Gilbert House are within 6 m of Andrewes House. There is a risk of fire igniting on the roof through the exposed felt layer. However this is considered acceptable to remain as existing due to the following:

- The top layer of the roof is formed by concrete paving slabs which are non-combustible and unlikely to contribute to surface spread of flame.
- Even if the felt layer ignites, it is unlikely for the fire to grow into a significant fire as there are concrete paving slabs on top which will smother the fire;
- Fire does not spread easily down a vertical surface and therefore a fire on the flat rooftop of the building is unlikely to spread down to the flats on the lower levels via the facade. In addition to this, building façade is also made out of concrete so even if fire on the roof was to grow it would not ignite the façade and would remain contained to the roof.

4.5 Access and facilities for the fire service

4.5.1 Fire main inlet

BS 9991 recommends buildings fitted with dry fire mains should have access for a fire appliance to within 18 m of each fire main inlet connection point, with the inlet visible from the fire appliance.

Existing provisions

Andrewes House is provided with three dry risers – one for each firefighting stair. The dry riser inlets serving each firefighting stair is as follows:

- SC38 - On the Willoughby House end on the corner of Fore Street and Moor Lane.
- SC44 – Adjacent to the basement ramp entrance on Fore Street.
- SC49 – On the Gilbert House end and adjacent to the stair entrance at ground floor on St. Giles Terrace.

For a mark-up showing the locations of the dry riser inlets please refer to Appendix A2. The dry riser inlets are all within 18 m of a vehicle parking area.

4.5.2 Fire service access

BS 9999 recommends that the entry of the firefighting access shaft at rescue service access (vehicle access level) level should be directly from open air or by way of a protected corridor not exceeding 18 m in length.

Existing arrangement

Firefighting access into the building is provided at carpark level (L03) for SC38 and SC44. For SC44, the firefighting personnel access will be via the carpark ramp on Fore Street, down to L03. For SC38, access to the carpark is via an external stair by Moor Lane. For SC49, firefighting access is provided at ground level on St Giles Terrace.

The carpark has large openings along the top and runs the entire length of Andrewes House, where fire service will be able to access the two firefighting shafts SC38 and SC44 as shown in Figure 19.

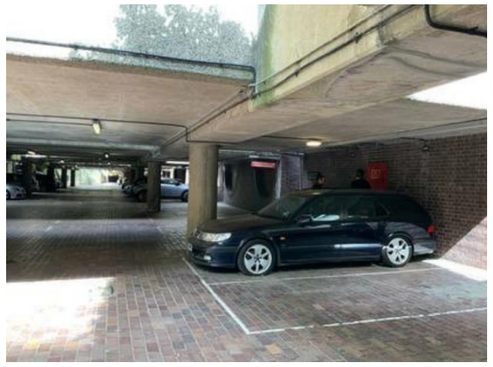


Figure 19: L03 Carpark level access to SC44

All three firefighting shafts are connected to both North and South facing balconies through firefighting corridors. This arrangement applies between Podium Level to the top storey. However, it has been assumed that the Fire and Rescue Service will only use the North facing balcony (bedroom side) to reach the fire incident flat. The South facing balcony (living room side) may not provide enough width due to privacy screens for the Fire and Rescue Service to travel with the necessary firefighting equipment.

The levels below Podium Level do not have balconies on either side of the building. Fire and Rescue Service will be likely to use the common stair to access the fire incident flat. BE to consult with the London Fire Brigade.

Apart from SC49, the firefighting access to SC38 and SC44 is through L03 carpark which is a basement level. Considering that this is an existing site with very limited scope to change the firefighting access arrangement, the firefighting access from L03 car park level is considered acceptable on the following basis:

- As shown in Figure 19, there are large openings across the carpark to provide ventilation to the basement carpark level. This is not a basement in the traditional sense (i.e. enclosed underground space).
- BE advised that The London Fire Brigade is familiar with the Andrewes House configuration and firefighting access arrangement. This will help the firefighters to plan the most efficient access and set up, to suit the location of the fire.
- The access routes via the carpark involve shorter travel distances to the lifts, compared with access via the podium.
- As discussed in Section 4.1.6 above, it is recommended to provide smoke ventilation to all the common stairs. This is an improvement that may also benefit firefighting activities.

After consultation with BE on 23/07/2021, CoL and BE stated that LFB visit the site often and are well aware of Andrewes House layout and have not raised any concerns on the building. Hence, CoL/BE confirmed that a meeting with LFB is not necessary. The recommendation below is retained for information purpose.

Recommendation:

- Consultation with London Fire Brigade to discuss and agree the access arrangement.

4.5.3 Facilities for the fire brigade

BS 9991 recommends buildings with a floor higher than 18 m above fire and rescue service access level should be provided with firefighting shaft(s) containing firefighting lifts. A sufficient number of firefighting shafts should be provided to meet the maximum hose distance of 60 m to cover all parts of the building and at least two firefighting shafts should be provided in buildings with a storey of 900 m^2 or more in area.

Firefighting shafts should be constructed in accordance with the recommendations given in BS 9999.

Andrewes House is provided with three firefighting shafts (SC38, 44 and 49) with a firefighting stair, dry riser, firemen's lift and firefighting lobby/corridor.

Firefighting stairs

BS 9999 recommends a common stair which is a firefighting stair should have an unobstructed width (measured between the walls and/or balustrades) of 1.1 m. The width should be kept clear for a vertical distance of 2.0 m.

BS 9999 also recommends only services associated with the firefighting shaft should pass through or be contained within the firefighting shaft.

Existing provisions: the width of the stairs has been measured by BE and have been confirmed to have a clear width of 1000 mm (between handrails). It is currently unknown how much the handrails protrude into the stairs.

The width of the three firefighting stairs in Andrewes House is non-compliant with the current recommendations of BS 9999. Considering the stay-put policy and the firefighting stairs are unlikely to be congested, the reduced width of the stair is considered acceptable. The effort and cost associated with increasing the width of the are considered to outweigh the benefits gained from a wider stair. Therefore, the current arrangement is proposed to be retained.

It has also been confirmed during the site visit that SC38 and SC44 extend down to L04 subway level. There are services going through the stair as shown in Figure 20. As this is a non-compliance to the relevant standards, it is recommended to either:

- Re-route the services to prevent the services going through the firefighting shafts, or
- Enclose the services in a fire rated box (120 minutes) and the fire doors adequately separate L04 from the firefighting shafts SC38 and SC44. However, enclosing the services in a fire rated box may result in impinging on and reducing the width of the firefighting stair. This will need to be reviewed further.

Figure 20: Service not related to firefighting shaft passing through the firefighting stair

After consultation with BE on 23/07/2021, CoL and BE stated that LFB visit the site often and are well aware of Andrewes House layout and have not raised any concerns on the building. Hence, CoL/BE confirmed that a meeting is not necessary. The recommendations below are retained for information purpose.

Recommendations:

- Consultation with London Fire Brigade to discuss and agree the reduced firefighting stair width.
- To either re-route the services away from the firefighting shaft or provide fire rated enclosure (120 minutes) to the services running through the firefighting stair. If the services are to be boxed in fire rated enclosure, it will need to be further reviewed to ensure it does not reduce the stair width of the firefighting stair.
- Doors separating the subway from the firefighting shafts shall be FD120S (increased fire rating due to the lack of firefighting lobby). Carry out inspection on the fire doors to maintain adequate level of fire separation.

Firefighting lobby/corridor

BS 9999 recommends firefighting lobby to have a clear floor area of not less than 5m^2 and not exceed 20 m^2 for lobby serving up to four lifts. All principal dimensions should not be less than 1.5 m.

Existing provisions: the firefighting shaft layouts are shown in Figure 21 and Appendix A2 The current firefighting lobbies have approximate areas of 13.1 m^2 for SC38 and 49, and 7.6 m^2 for SC 44. These exceed the minimum 5m^2 recommended in BS 9999.

The width of the corridors/lobby is 960 mm, which is less than the 1.5 m minimum width. The width of the northern balcony is only 690 mm. Due to space constraint, there is very limited scope to increase the width of the corridors/lobbies/balconies, without adversely affecting the adjoining flats. In addition, the reduced width may delay firefighting activities but not considered to present a significant risk to life safety. Therefore, the current arrangement is proposed to be retained.

After consultation with BE on 23/07/2021, CoL and BE stated that LFB visit the site often and are well aware of Andrewes House layout and have not raised any concerns on the building. Hence, CoL/BE confirmed that a meeting is not necessary. The recommendations below are retained for information purpose.

Recommendations:

- Consultation with London Fire Brigade to discuss and agree the reduced lobby/corridor width.

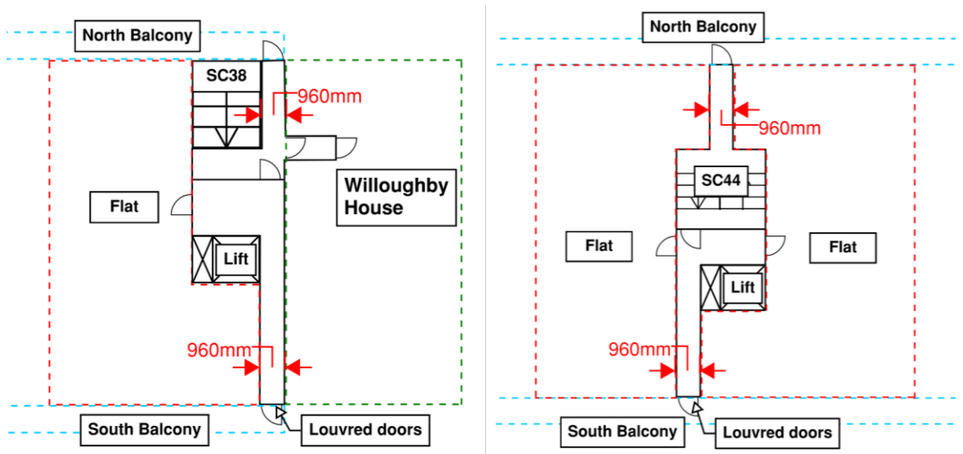


Figure 21: Current layout of firefighting shafts (not to scale)

Firefighting lifts

In line with BS 9991 and BS 9999, new firefighting lifts installations should be in accordance with BS EN 81-72:2020.

In addition, the *Grenfell Tower Inquiry: Phase 1 report* recommends that the owner and manager of every high-rise residential building be required by law to carry out:

- Regular inspections of any lifts that are designed to be used by firefighters in an emergency and to report the results of such inspections to their local fire and rescue service at monthly intervals;
- Regular tests of the mechanism which allows firefighters to take control of the lifts and to inform their local fire and rescue service at monthly intervals that they have done so.

Existing provisions: It has been confirmed by the lift consultant on 08/04/2021 that the lift installations are in line with the following:

- The lifts are firemen's lift and were installed to BS 5655-1:1979;
- The lift has a fire switch located at the fire services access level. The switch, when activated returns the lift to that floor and stops the landing buttons from calling the lift, rendering it under the control of the fire service;

- There is no back-up or secondary power supply to the lift;

At the time the lifts are believed to have been refurbished, BS EN 81-72 had not yet come into effect (the first revision was released in 2003) and therefore, it is unlikely that the current lift installation meets the recommendations of BS EN 81-72.

It is currently unclear what specification of the firemen's lift is, with exception of lifts not being provided with secondary power supply. There is no other information available.

During the site visit, it has been confirmed that the lift control systems are on L03 carpark level for SC38 and 44, and on Podium level for SC49.

Recommendations:

- Carry out inspections of the three firemen's lifts (including lift control system) at monthly intervals to report the results of every inspection to the local fire and rescue service

Smoke control for firefighting lobbies and stairs

BS 9999 recommends that all firefighting shafts should be provided with smoke ventilation system – this can be natural or mechanical ventilation.

In buildings with balcony approach, the firefighting stair should be provided with an openable vent with a free area of 1 m^2 at the top of the stair, which can be remotely operated at fire and rescue service access level. In addition, a minimum ventilation opening of 1.5 m^2 (free area) is to be provided for the firefighting lobby at each level.

Existing provisions: all firefighting stairs are provided with automatically opening vents at the top of the stairs (see Figure 22 below). Each vent is operated by a switch located on the fire service access level, by the firemen's lift. During the site visit, the dimensions of the vents were measured to be approximately 1.1 m by 0.8 m, which is less than the required ventilation opening.

Figure 22: Staircase 49 opening vent

There is a louvred vent above the door connecting each firefighting lobby to the balcony. The vents have been measured as:

- SC 38: 790 mm by 340 mm = 0.27 m^2;
- SC 44: 860 mm by 340 mm = 0.29 m^2;
- SC 49: 790 mm by 3400 mm = 0.27m^2.

The area of ventilation serving the firefighting lobbies are less than the minimum 1.5 m^2 recommended. As a compensatory measure, it is recommended that before undertaking firefighting activities, the fire brigade should open the door between the firefighting lobby and the balcony to allow sufficient air to flow into the firefighting shaft.

After consultation with BE on 23/07/2021, CoL and BE stated that LFB visit the site often and are well aware of Andrewes House layout and have not raised any concerns on the building. Hence, CoL/BE confirmed that a meeting is not necessary. The recommendations below are retained for information purpose.

Recommendations:

- Consultation with London Fire Brigade to discuss and agree the ventilation arrangement to the firefighting lobby.
- Include a reminder to open the door between the firefighting lobby and the South Balcony in the Fire Notice Box.

4.5.4 Dry riser and hose coverage

BS 9991 recommends buildings greater than 18 m and less than 50 m in height should be provided with a dry riser system. In the case of un-sprinklered building, no part of a storey should be more than 45 m from a riser outlet located in the firefighting shaft.

Existing provisions

There are dry riser outlets located within each of the firefighting stair enclosure as shown in Figure 23 below.

It should also be noted that due to the provision of privacy screens along the Southern balcony which limit the width of the fire brigade route (width ranges from 460 to 510 mm wide), hose coverage has only been measured along the Northern balcony. This is shown in Figure 23 below.

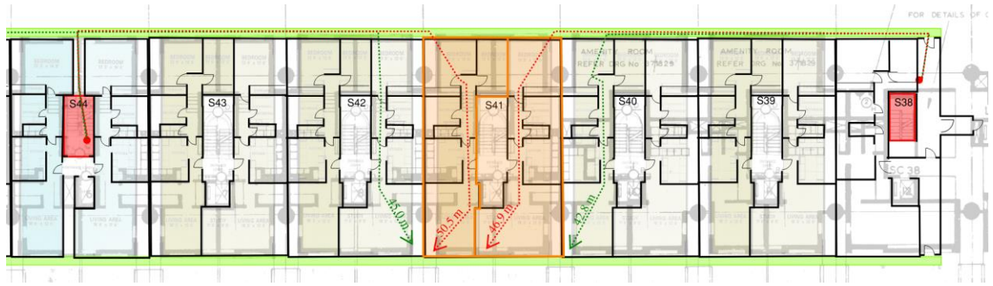


Figure 23: Hose coverage shortfall area shown in orange

There is a hose coverage shortfall affecting the flat on either side of SC41. The furthest point from a dry riser outlet is 50.5 m, which is 5.5 m over the 45 m limit. As the firefighters are likely to approach the fire incident via the open balcony, it is possible for firefighters to connect additional hose length in a safe and open environment. Hence, the existing dry riser provisions are proposed to be retained.

The arrangement for flats that are below Podium level is to be further discussed with London Fire Brigade.

After consultation with BE on 23/07/2021, CoL and BE stated that LFB visit the site often and are well aware of Andrewes House layout and have not raised any concerns on the building. Hence, CoL/BE confirmed that a meeting is not necessary. The recommendations below are retained for information purpose.

Recommendations:

- Consultation with London Fire Brigade to discuss and agree the dry riser provisions and the extended hose coverage.
- Consultation with London Fire Brigade on the firefighting arrangement to flats below the Podium level.
- Include the extended hose coverage and the flat numbers in the Fire Notice Box.

4.5.5 Water supply for fire-fighting operations

External hydrants should be provided within 90 m of a dry fire main inlet. Based on Google Maps information (accessed on 22.03.2021) there are two hydrants within 90 m of Andrewes House – one on Fore Street nearby the basement ramp entrance and another Moor Lane.

4.6 Fire safety management

In addition to the active and passive fire safety precautions described in the previous sections, robust fire safety management plan and procedures are important for maintaining the fire safety of a building in a holistic manner. In preparing a fire safety management plan (Arup is not aware of an existing plan), the relevant items to be included in the plan are listed and described Table 4 below. These are based on the recommendations in BS 9991.

BE advised that there are existing management procedures in place to address specific fire safety issues. These are included on Table 5 for information.

Table 4: Fire Safety Management

Item	Proposed Design
RR(FS)O	Under the Regulatory Reform (Fire Safety) Order legislation, the owner of the building (BE) is fully responsible for fire safety. This includes on-going fire risk assessment, appropriate maintenance of fire safety systems and training of staff. Although not required by fire safety guidance, it is recommended for the fire risk assessment to include the internal areas of the apartments (for example a spot check of vacant apartments). This will serve to mitigate the risk of any amendments to the building which may have an adverse impact on the fire strategy safety (e.g. breaches in compartmentation).
Fire awareness of residents.	Due to the nature of residential premises whereby it is difficult to enforce fire safety management within the apartments, there is risk of the residents' actions affecting the implementation of the fire strategy – e.g. by covering smoke detectors or creating penetrations in compartment walls. To minimise the risk of occupants affecting the performance of the fire safety features in the building, all residents must be made aware of their responsibilities in regard to fire safety at the beginning of their residence. It is recommended for all relevant fire safety information should be provided in a tenant handbook. It is the responsibility of the building operators to inform the residents of the defend-in-place evacuation strategy. Residents should also be informed that they are always provided with the option to leave and that they do not have to stay in place in the event of a fire.
Evacuation of PRMs	The evacuation of PRMs will need to be carried out by the BE staff or the fire and rescue service. The responsible person for fire safety (as defined under the RR(FS)O) will need to ensure that each PRM has a personal emergency evacuation procedure (PEEP), and where required, sufficient training and equipment are provided to staff to assist with the evacuation. The EVC (Emergency Voice Communication) system in the stair landings and firefighting lobbies should be regularly maintained to ensure they are in working order.
Staff training	Sufficient number of BE staff should be adequately trained in fire prevention, fire protection and evacuation procedures including evacuation of PRMs.
Maintenance and testing	An accurate record of fire precautions, and procedures for operating and maintaining any fire protection measures within the building, are necessary to enable the owner or end user to plan, document and implement control

	processes for maintenance and testing of fire safety systems to ensure that they operate effectively in the event of a fire. This includes systems such as: • Firemen's lifts; • Fire alarm and fire detection system; • Fire doors; • Emergency lighting and signage.
Control of work on site	The means to control work on site should be determined (e.g. repairs to structure, hot work, cleaning of ductwork). A work control system should include clear lines of responsibility communicated to contractors.
Emergency planning	A good relationship with the fire and rescue service has benefits as it ensure that the fire and rescue service is able to have an appropriate pre-determined response strategy for Andrewes House and enables the owner to seek advice where appropriate. Any changes affecting the layouts, fire safety systems, fire growth characteristics, and other relevant factors should be communicated to the fire brigade
Fire safety documentation	Fire safety information that sets out the basis on which the fire safety design was planned (i.e. this Fire Strategy Report), the fire safety management plan, the staff responsibilities etc. should be kept up to date and stored in a document management system that allows the information to be easily retrieved in the future.
General housekeeping	Good housekeeping is essential to reduce the likelihood of a fire starting or developing, and escape routes being blocked. This includes: • Maintaining all escape routes free from obstruction/or combustibles; • Fire doors to perform as intended; • Arrangements for waste control and disposal or accumulation of waste; • Floor surface of escape routes to be maintainable, even and slip-resistant;

Table 5: Existing management procedures to address specific fire safety issues

Procedures	**Details**
Balcony inspection	After consultation with BE on 23/07/2021, it has been confirmed that there are following provisions to keep the balcony free of obstacles: • Balcony inspection occurs on annual basis, • Window cleaners report to BE on any hazards when completing work every 6 weeks. This is to be maintained.
Fire door inspection	After consultation with BE on 23/07/2021, BE have confirmed City of London carries out monthly door inspections and fire departments does an inspection every 6 months. This is to be maintained.
L03 Storage management	BE to ensure all residents have been provided with the store licence to prevent residents to store hazardous material within the storage space.

5 Conclusion

The purpose of the fire safety review on Andrewes House is to determine the existing intent of the fire safety design and to record the findings in a fire strategy report (this document).

This report describes the existing fire safety precautions in the building and compare them with the requirements in the Building Regulations 2010 (as amended). The current standards BS 9991 and BS 9999, and where applicable the latest update of the Approved Document B Volume 1, have been used as the benchmark for the review.

Where the fire safety precautions comply with the current standards, no further action is proposed and the fire information forms part of the building fire strategy. Where the precautions are not deemed to comply with the current standards, qualitative risk assessments have been carried out to identify the life safety risks to the building occupants due to those non-compliances. The outcomes of the assessment will result in one of the following:

- Where considered acceptable to remain as existing, recommend retaining the current provisions; or
- Recommendations on possible options for enhancements/upgrades where the current fire safety provisions are considered inadequate.

The outcome of the review in terms of the identified gaps and the recommended improvement actions are summarised on Table 6 below.

Table 6: Summary of identified gaps and recommended actions

Identified Gaps	Recommended Action
Narrow escape routes along the balconies Extended travel distances in flats with single direction of egress and flats without hallway Lack of protected lobby between each flat and the escape stair	It is important to upgrade the fire protection and the availability of the escape stair for fire evacuation. The following improvements are recommended to achieve this: • Provide early warning to occupants by installing a Grade D1 Category LD2 detection and alarm system in all the flats; • Provide smoke ventilation to all the escape stairs; and • Clear briefing to all occupants of Andrewes House on the available escape routes.
Evacuation of PRMs	The following improvements to provisions for PRM evacuation are recommended: • Provide an emergency voice communication system on each stair landing, for the PRMs to call for assistance; • Barbican Estate to put in place a management plan and evacuation strategy for the evacuation of occupants, in particular for PRMs; and • Clear briefing to PRMs on the evacuation procedures and the use of the emergency voice communication system to call for assistance.
Exit signage	A survey is recommended to inspect and replace existing exit signage to comply with BS 5499-4, BS ISO 3864-1 and the additional recommendations from the Grenfell Tower Inquiry: Phase 1 report
Emergency lighting	A survey is recommended to inspect and replace existing emergency lighting to comply with BS 5266-1.
Storage areas in L03 Carpark level	The storage areas on L03 of Andrewes House are recommended to be provided with the following: • Minimum L2 automatic fire detection and alarm system in accordance with BS 5839-1; • Provide adequate exit signage and emergency lighting within the area; • Provide 120 minutes fire resisting construction, including FD60S doors, to separate storage areas from the firefighting stairs (SC38, 44 and 49) • Provide 60 minutes fire resisting construction, including FD30S doors, to separate storage areas from the common stairs.
Fire doors at flat entrance, refuse storage/post box and service risers within stairs	It is recommended to replace all the fire doors to all the escape stair and firefighting shaft enclosures and service risers within the stairs, to maintain the fire and smoke integrity of the stair Keep records of inspection and testing of fire doors in the future, at not less than three-monthly intervals to ensure that all fire doors are in working order.
Kitchen extract shunt duct system	In order to mitigate the risk of fire/smoke spread across compartments. It is recommended to close the connection from the current kitchen extracts with fire resisting construction and replace the existing extract hoods with recirculation type hoods
Firefighting stairs (SC38 and SC44) at L04	Services running through and along the firefighting stairs SC38 and 44 at L04 should be enclosed in a fire rated box to separate them from the firefighting stairs.
Firefighting access distance, width of access routes, firemen's lift, lobby smoke ventilation and extended hose coverage	BE advised that London Fire Brigade is familiar with the configuration of Andrewes House. It is recommended to address the gaps in firefighting access and facilities through consultation and agreement with the London Fire Brigade. • Discuss and record firefighting procedures that are specific to Andrewes House in this document. • Carry out inspections of the three firemen's lifts (including lift control system) at monthly intervals to report the results of every inspection to the local fire and rescue service • Update the Fire Notice Box to include information about the design and materials of the external walls, extended

Identified Gaps	Recommended Action
	hose coverage, and any relevant information following the consultation.
Others	• It is recommended to establish the compliance of the back-up power supply provisions against the relevant standards. • Consult with the insurers regarding any additional requirements for property protection. • The sitewide inspection of exit signage (by others) to take into consideration to recommendations in this document.

The review is based on a list of limitations and assumptions. Some of these will be addressed as further information is provided by BE.

It recommended for BE and Arup to explore the feasibility or implementation of the recommended remedial actions for improvement.

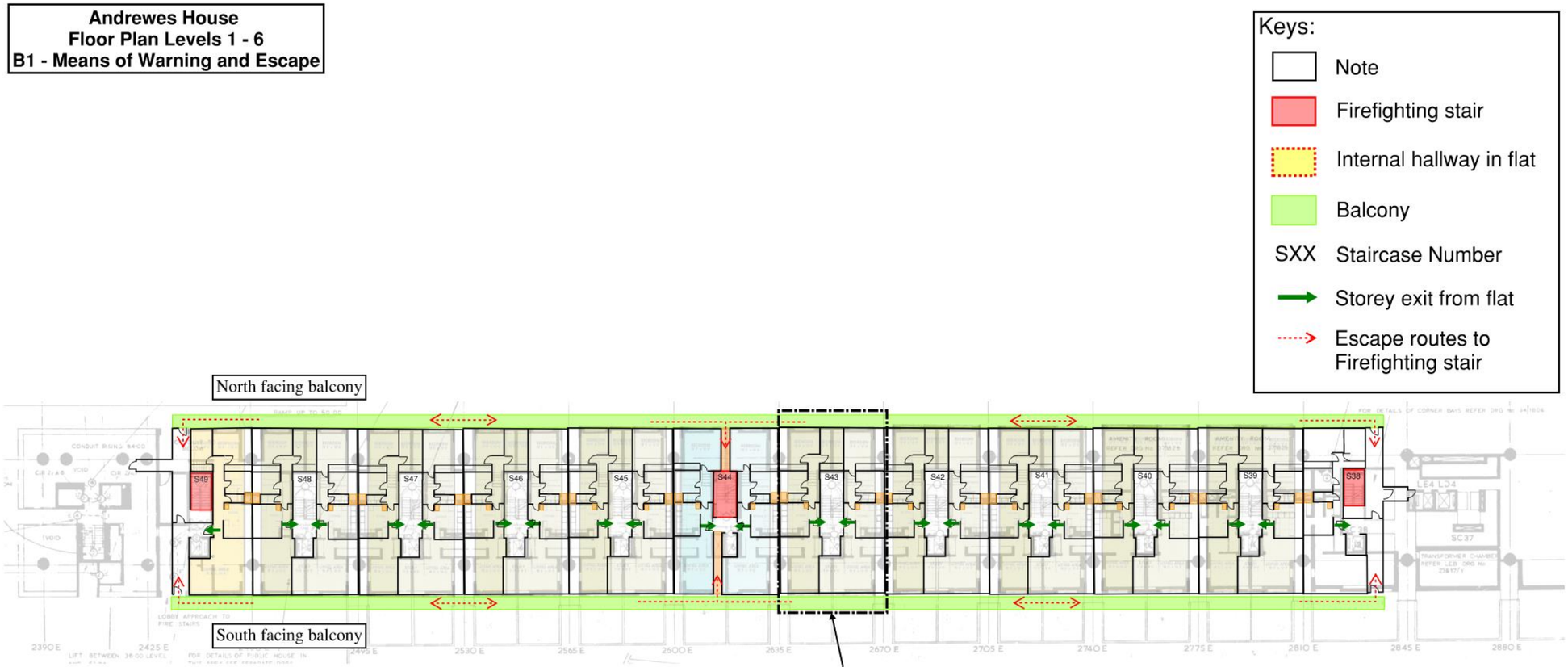
Once this has been completed, it is recommended for the CoL District Surveyor and the London Fire Brigade to be consulted, to seek their early agreement in principle.

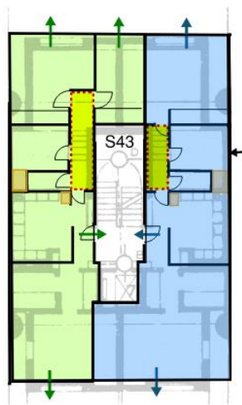
Appendix A

Fire Strategy Mark-ups

A1 Means of Warning and Escape

Andrewes House
Floor Plan Levels 1 - 6
B1 - Means of Warning and Escape





Means of Escape from a typical flat layout
3 available escape routes from each flat:
- South facing balcony
- North facing balcony
- Flat entrance

Keys:
- Note
- Firefighting stair
- Internal hallway in flat
- Balcony
- SXX Staircase Number
- Storey exit from flat
- Escape routes to Firefighting stair

Barbican Residential
Andrewes House Fire comments
Barbican Residential
(279095-00)
01/04/21 | Prepared by: TP, VEC | Checked by: VC
SK-F-001
ARUP

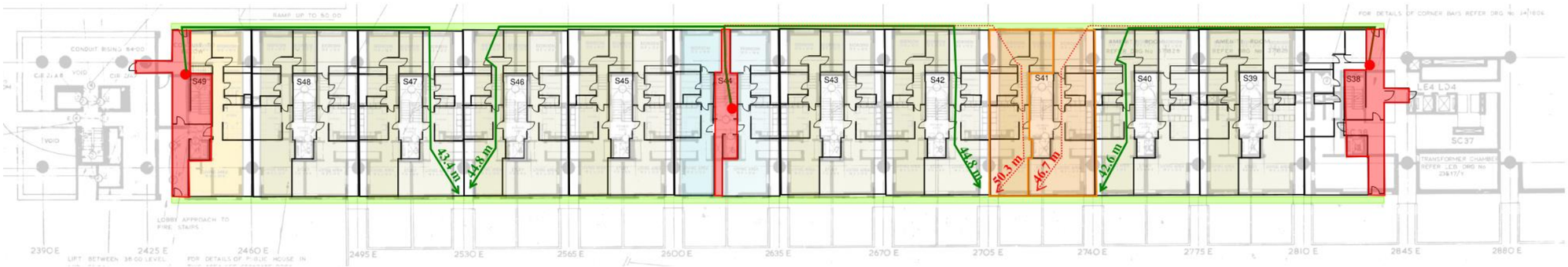
Note:
The drawings used for the above assessment are:
Structural plans:
G H Buckle & Partners Consulting Engineers - Drawing no. 37/1807
Floor plan layout**:**
Barbican living - https://www.barbicanliving.co.uk/blocks/andrewes-house/andrewes-house-flat-plans/
The structural drawings are only available for apartment levels above Podium (Floor 1 to 6).

A2 Fire Fighting Access

Andrewes House
Floor Plan Levels 1 - 6
B5 - Firefighting access & facilities

Keys:

- Note
- Firefighting Shafts
- SXX Staircase Number
- Fire main
- 3.0 m — Compliant hose coverage (within 45m)
- 3.0 m — Non-compliant hose coverage (over 45m)
- Hose coverage shortfall areas



Barbican Residential
Andrewes House Fire comments
Barbican Residential
(279095-00)
01/04/21 | Prepared by: TP, VEC | Checked by: VC
SK-F-003
ARUP

Note:
The drawings used for the above assessment are:
Structural plans:
G H Buckle & Partners Consulting Engineers - Drawing no. 37/1807
Floor plan layout**:**
Barbican living - https://www.barbicanliving.co.uk/blocks/andrewes-house/andrewes-house-flat-plans/
The structural drawings are only available for apartment levels above Podium (Floor 1 to 6).

A3 Compartmentation

Andrewes House
Floor Plan Levels 1 - 6
B3 - Internal Fire Spread (Structure)

Fire Resistance (FR)

- 60 mins FR
- 90 mins FR
- 120 mins FR

Fire Doors

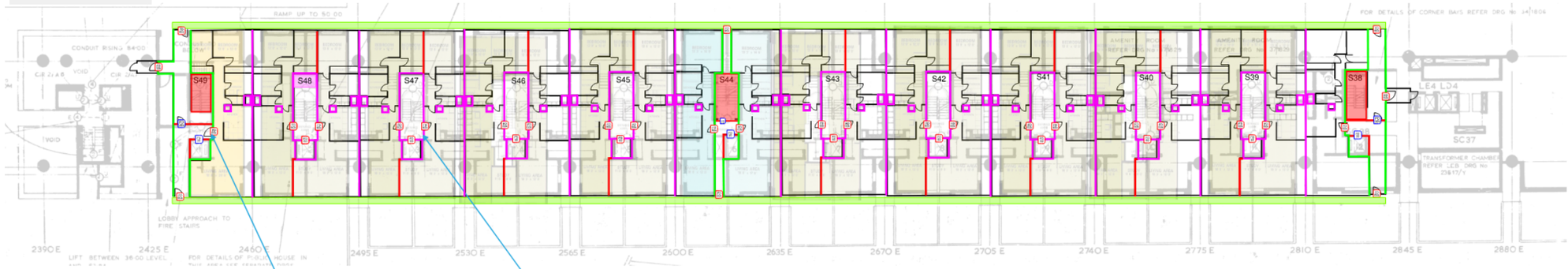
- FD 30
- FD 30 S
- FD 60
- FD 60 S

Note: The building is 27m in height (7 stories above podium level)

Compartmentation requirements
Compartment floor - 90 REI
Common Stair - 90 REI
Wall between flats (load bearing) - 90 REI
Walls between flats (non-load bearing) - 60 EI
Firefighting Stair (S38, 44, 49) - 120 REI
Shafts (passenger lifts included) - 90 REI
Firefighting lifts - 120 REI

Fire Doors
Door from flat to common stair FD60S
Door from flat to firefighting stair lobby FD60S
Door between fire fighting stair and fire fighting lobby - FD30S
Fire fighting lift doors FD30
Common lift doors FD60

Keys:
- General comment
- Note
- Firefighting Shafts
- SXX Staircase Number



Refuse and post box lockers - Fire fighting lobbies
The doors between the fire fighting lobbies and the rubbish lockers should be in line with the flat front doors in terms of fire resistance (i.e. 60 minutes).

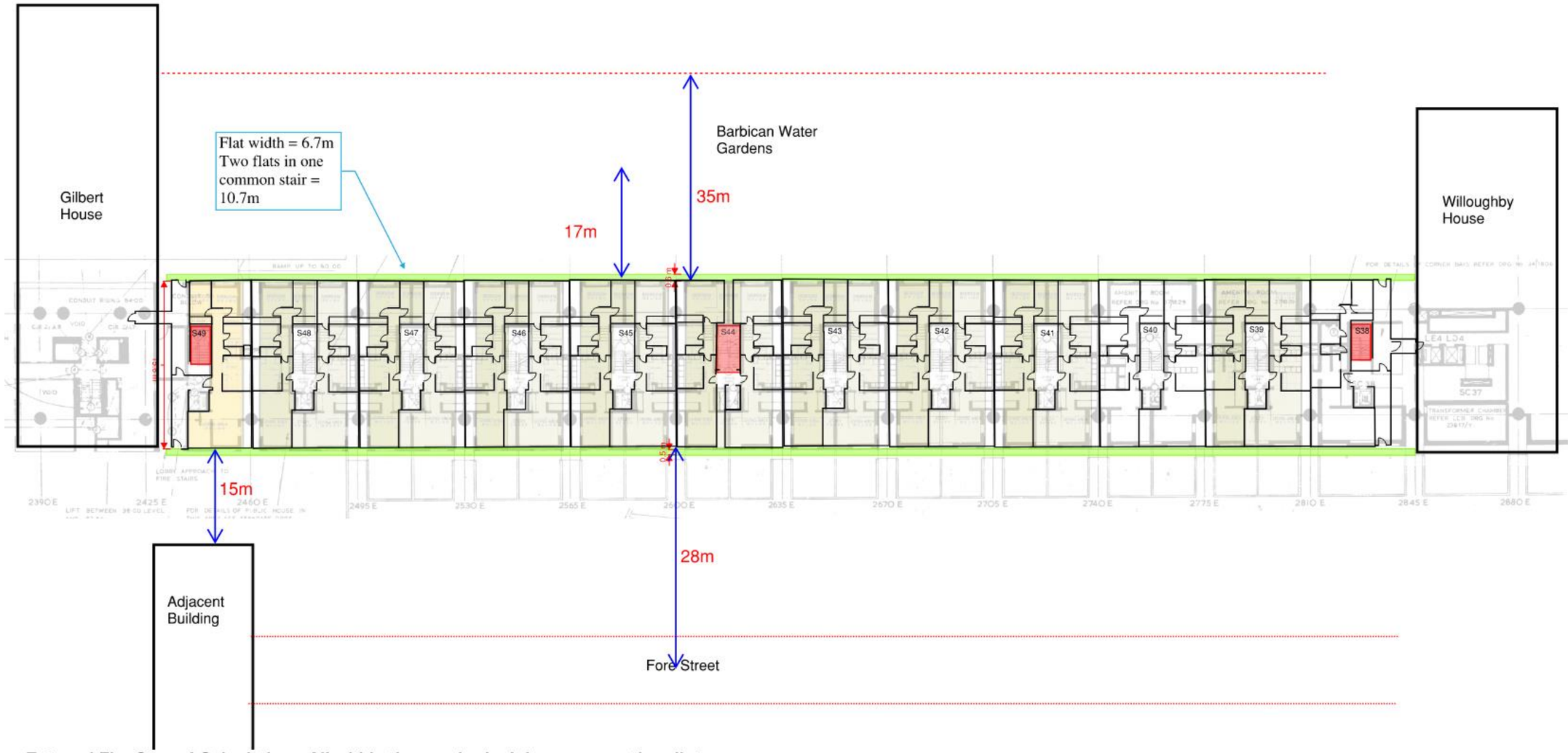
Refuse and post box lockers - Common stairs
The doors between the stairs and the rubbish lockers should be in line with the flat front doors in terms of fire resistance (i.e. 60 minutes).

Barbican Residential
Andrewes House Fire comments
Barbican Residential
(279095-00)
01/04/21 | Prepared by: TP, VEC | Checked by: VC
SK-F-002
ARUP

Note:
The drawings used for the above assessment are:
Structural plans:
G H Buckle & Partners Consulting Engineers - Drawing no. 37/1807
Floor plan layout**:**
Barbican living - https://www.barbicanliving.co.uk/blocks/andrewes-house/andrewes-house-flat-plans/
The structural drawings are only available for apartment levels above Podium (Floor 1 to 6).

Appendix B

External Fire Spread



External Fire Spread Calculation - All within the required minimum separation distance.

Case ID	Group ID	Purpose Group	Method ID	Calculation Method	Height (m)	Width (m)	Boundary (m)	Unprotected (%)
Top floor - two fla	1	Residential (Dwellings)	2	Minimum Separation Distance	4.60	10.70	4.55	100.0
Top floor - one fla	1	Residential (Dwellings)	2	Minimum Separation Distance	4.60	6.70	3.69	100.0
Mid floor - two fla	1	Residential (Dwellings)	2	Minimum Separation Distance	2.80	10.70	3.36	100.0
Mid floor - one fla	1	Residential (Dwellings)	2	Minimum Separation Distance	2.80	6.70	2.80	100.0
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Appendix C

Meeting minutes - Meeting with Barbican Estate (23/07/2021)

C1 Meeting with Barbican Estate – 23/07/2021

Please find below the notes from the call on 23/07/2021.

Attendees
Helen Davison
Shaun Moore
Terence Short

Arup
Valerie Chan
Tony Park
Ella Nicholson

Note below, actions on BE are in blue and actions on Arup are in green.

The purpose of the meeting is to go through the recommendations suggested by Arup on the fire strategy report for Andrewes House.

Means of escape - Balconies
The balconies need to be managed as an alternative means of escape from the flats. The primary means of escape (through the flat entrance to the common stairs) is not sufficient as a single means of escape due to its lack of a protected lobby and extended travel distance within the flat.
BE confirmed balcony inspections occur on an annual basis and window cleaners (every 6 weeks) report to BE on any hazards when completing work.
Arup suggested a fire safety management report for Andrewes House.
BE confirmed that this is part of their plan but Andrewes House is down the list in terms of priority. In the meantime, Arup can capture these existing fire management procedures in Section 4.6 of the fire strategy report.

Means of escape – L02 gardens to carpark
The door which leads from L02 gardens to Willoughby Carpark should be openable by Andrewes House occupants without the use of a key or other devices.
BE stated this also acts as a means of escape from the car park to the gardens area.
BE to send the layout of the carpark. *Post meeting: carpark layout has been received.*
Arup to review if the door is required for means of escape from the car park.
The current signage within the car park is incorrect. The area of ultimate safety for the residents of Andrewes House is outside the car park on to Moore Lane. BE confirmed to fix this.

Means of escape – PRMs
For PRMs in Andrewes House, they are only provided with a single means of escape as the balconies are not level access. There isn't currently a plan to evacuate PRMs to a place of safety.
Arup recommended providing Emergency Voice Communication (EVC) system, smoke ventilation at the top of the common stairs and fire alarm and detection within each of the flats. In terms of management, BE should have in place a Personal Emergency Evacuation Plan (PEEP) for occupants requiring assistance to evacuate.
BE confirmed residents on 7th floor will be unlikely to have wheelchair users due to accessibility.
BE stated providing EVC on every stair landing may not be practical as there are no staff on site available to help PRMs to evacuate.
BE stated the current PEEP is to notify LFB of the residents in Andrewes House who are PRMs. It would then be up to the LFB to take action when they arrive on site. However, CoL advised that LFB do not currently accept evacuation of PRMs as part of their responsibility when attending a fire. Arup recommended BE to train their staff to aid PRMs during evacuation.
CoL suggested another option would be to install alarms in the stair landings which will activate the AOVs at the top of the stairs and also send an alarm to the LFB or BE. If BE is notified instead of LFB, they will need at least two trained staff on site at all times due to CoL policy or not allowing staff to work alone. Arup will include this option in the report.

Exit signage and emergency lighting
BE confirmed ongoing projects on exit signage and emergency lighting, to survey and upgrade provisions to meet the current relevant standards.

Fire detection and alarm
As majority of the flats are currently not provided with fire alarm and detection system, all flats in Andrewes House should be provided with Grade D1 Category LD2 system. Residents in L01 and PRMs in the building who only have a single means of escape, will benefit from the provision of alarm and detectors as they will be able to evacuate earlier.
BE is concerned on the possibility of providing alarm and detection system to all the flats as it is easy for them to be tampered with by the residents. A hardwired system is preferred in that sense. However, it will still be a challenge to get all of the lease owners to install the system.
BE explained that installing and maintaining alarm and detection in front of each of the flats on the stair landing area will be easier than within the flats.

Fire suppression
CoL advised that insurers are not interested in installing sprinklers anywhere within the Barbican Residential.

L03 Storage area
BE confirmed L03 will be looked at as part of Andrewes House exit signage works and be in accordance with the relevant standards.
BE to confirm if the area is already provided with emergency lighting
BE to send the store licence agreement which states what should not be stored. *Post meeting note: The store licence has been received.*

Fire doors
The doors in Andrewes House will be replaced by certified fire doors, in accordance with the recommendations provided in the fire strategy report. This includes the refuse storage cupboards, post box and risers doors.

BE confirmed City of London carries out monthly door inspections and the fire department does an inspection every six months.

Fire stopping/ Shunt ducts

BE do not agree with the suggestion of closing the shunt ducts and replacing them with closed circuit/recirculation kitchen extract as this is also used for daily air circulation.
This is to be discussed further with Andrew Wood on the day of site visit by Arup to Cromwell Tower planned on 09/08/2021.

Facades

Provision of façade information in the fire notice box of Andrewes House was suggested.
CoL stated that the fire notice box should only have primary information for LFB and suggested the information on facades to be with the concierge instead.

Firefighting stairs

The stair extends down to L04 subway level and there are services from the subway level which goes through to the firefighting stairs. It is recommended to reroute or enclose them in a fire rated box.
BE confirmed that it is not practical to reroute these services but will be able to provide metal trays and metal cable ties and enclose them in a fire rated box.
BE is aware that this may reduce the stair width but this is the most practical option.

Firefighting access and facilities

Arup recommended discussing the non-compliances on firefighting access and facilities with LFB. However, CoL and BE stated that LFB visit the site often and are well aware of Andrewes House layout and have not raised any concerns on the building. Hence, CoL/BE confirmed that a meeting is not necessary.

Fire strategy report for Andrewes House

Arup to include pros and cons for the recommendations.
Arup to include current fire safety management procedures that may mitigate some of the risks in the building (as advised by BE) in the report.

Next steps

Meeting to be arranged for next week to discuss how this will be incorporated in the updated report for Andrewes House. *Post meeting note: A meeting was held on 28/07/2021 to confirm the changes to be made in the report.*

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Barbican Estate

Barbican Residential Blocks

Mountjoy House – Fire Strategy Report

Rev A | 7 September 2022

Job number 279095-01

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ARUP

Contents

Appendices

Executive Summary

Arup have been appointed by the Barbican Estate (BE) to undertake a fire safety review of Mountjoy House, an existing building which is part of the Barbican Residential Development, located in the City of London. The purpose of the review is to determine the existing intent of the fire safety design and to document this intent in a fire strategy document (this report). The purpose of this report is as follows:

- To provide a single document that describes the fire safety precautions for Mountjoy House, including the fire safety principles and fire safety measures within the existing building;
- To compare the existing fire safety precautions with current standards including BS 9991 and BS 9999, and where applicable the latest update of the Approved Document B Volume 1.
- To consider the recommended improvements to existing residential buildings in Phase 1 of the Grenfell Tower Inquiry Report by Sir Martin Moore-Bick;
- Where there are gaps in the existing fire safety precautions against the current standards and if those gaps present a risk to the life safety of the occupants, recommend fire safety improvements to remediate the risk on an as nearly as reasonably practicable basis; and
- Where the gaps in the existing fire safety precautions present a low/negligible risk to life safety, the existing precautions are proposed to be retained (on the assumptions that they are maintained in good operational order).

BE as the Responsible Persons under the Regulatory Reform (Fire Safety) Order 2005 (RR(FS)O) has the duty to undertake remediation woks, as far as is reasonably practicable, to ensure the safety of the building and the occupants.

Mountjoy House was constructed in 1971 and contains 64 flats including six penthouses at the top of the building. The building consists of 7 residential floors above Podium level with a building height of 27m (assuming floor to floor height of 2.7 m) measured from the L03 floor level (firefighting access level at grade) to the floor level of the topmost occupied storey L7.

An open Podium level and L03 serves as the final discharge locations for the escape/firefighting stairs. The L03 is also the main firefighting access level to enter Mountjoy House. The building does not have any accommodation from L03 up to and including the Podium level.

A balcony runs around the perimeter of the building from L1 to L7 and connects to Thomas More House.

Existing Fire Safety Precautions – Overview

The key elements of the existing fire safety precautions for Mountjoy House can be summarised as follows (refer to Table 1 for Arup's recommendations):

- **Stay put strategy:** The building adopts a stay put evacuation strategy. In the event of a fire, only the occupants in the flat of fire origin evacuate the building. The rest of the building occupants will remain in place.
- **Available stairs**: There are two stairs (Staircase 24 and 26) that can be used for both means of escape for the occupants and means of access for firefighters. It is a priority to protect the stairs from being affected by a fire in the building. Staircase 24 which is part of Thomas More House serves as a means of escape for Mountjoy House as the two buildings are connected on every residential level. Note that Staircase 25 is not enclosed and not suitable as a protected escape route.
- **Plant/storeroom in stairs:** There is a storeroom within Staircase 25 (common stair) and a plant room within Staircase 26 (firefighting stair) on every level. The rooms are separated from the stairs by masonry/concrete walls but it is not possible to establish the fire rating of the door. This is a risk as a fire within these rooms may affect the use of Staircase 26 for means of escape, or cause smoke to spread to all levels via Staircase 25.
- **Flats on L1 – L7:** Each flat has alternative means of egress via the balcony or the flat main entrance to reach either one of the two firefighting stairs. However, for wheelchair-bound residents (Persons with Reduced Mobility – PRM), escape is only possible via the flat entrance and the travel distance to the entrance is greater than the limit within current guidance. This presents a risk to the life safety of the PRM occupant in the fire incident flat.
- **Duplexes on L6-7:** The duplex flats (603 – 608) extend up to L7 and are provided with alternative means of egress via the balcony on both L6 and L7 as well as the flat main entrance on L6.
- **PRM evacuation (in common area)**: For PRMs needing assistance with evacuation, there is no refuge area nor communication system to call for assistance. The procedure for evacuation of PRMs is also unclear. This presents a risk to the life safety of the all the PRM occupants in the building.
- **Exit signage and emergency lighting**: There are existing provisions however, the locations and types of existing exit signage is not compliant with the current standards. There are also locations with missing signage – this will need to be surveyed and amended where necessary. It is currently unclear whether emergency lighting is provided in the building. This is to be confirmed by BE.
- **Fire detection and alarm system**: Based on the site visit and the existing fire risk assessment, there is no detection or alarm system within the flats nor in the common areas of the building. Considering the extended travel distances for occupants (such as PRM occupants) who can only use the flat entrance as their escape route, the lack of early detection and warning in the flat presents a life safety risk to the occupant in the fire incident flat.
- **Structural fire protection**: Assuming all structural elements are reinforced concrete, the existing protection nominally meets the required fire rating in the current standard, based on a desktop review.
- **Flat entrance, refuse storage/post box and stair fire doors:** Assuming these are the same as the tested fire door in Thomas More House, they do not achieve

the required fire rating. The failure to maintain fire separation between the flat, stairs and plant rooms may compromise the stay-put strategy and the use of the stair for means of escape and firefighting. These issues present a life safety risk to occupants in the building.

- **Fire compartmentation**: Each flat, services riser, stair, lift shaft and storage room should form a separate fire compartment, to support the stay-put strategy. However, it has been confirmed by BE during the site visit that there is breach of compartmentation between the corner flats (X01, X02, X09 and X10 of every level) at the kitchen risers that span the entire building height. There is a risk of fire spread between flats on multiple floors. As the flat entrance doors do not achieve the required fire rating, there is a risk of fire spreading to the common corridor at every level affecting the means of escape for the entire building. This presents a life safety risk to occupants in the building. A sitewide survey to inspect any breaches in compartmentation is recommended. In addition, sprinkler provision is recommended to mitigate the risk of fire spread.
- **Fire suppression system**: The building is not sprinkler protected. Considering the breach of compartmentation sprinkler provision is recommended to mitigate the risk of fire spread.
- **Shunt duct arrangement (kitchen extract and toilet extract risers):** The use of a shunt duct for the toilet extract riser is considered an acceptable solution. However, the use of shunt duct for kitchen extract presents a risk of fire/smoke spread between the flats, breaching compartmentation (see above) and compromise the stay-put strategy. This presents a life safety risk to occupants in the building.
- **Separation from neighbouring buildings:** There is adequate separation distance to adjacent properties to minimise the risk of external fire spread between buildings.
- **Façade system:** There appears to be no combustible materials in the façade system, this is to be confirmed by BE.
- **Firefighting lift:** The specification of existing firemen's lifts is to be confirmed by BE.
- **Firefighting lobby ventilation:** the lobby to Staircase 26 opens at every level into a vent shaft, via a window. Some of these are in the open position and forms a route for smoke to spread between levels, affecting the use of Staircase 26 as means of escape. This presents a life safety risk to occupants in the building.
- **Dry riser main:** A dry riser outlet is located within each level of the firefighting stair or the firefighting lobby and all areas appear accessible within 45 m hose length from the outlets.

Recommendation for remedial actions

Recommendations for remedial actions are provided throughout the report (in green boxes) to mitigate the identified life safety risks due to the gaps in the existing fire safety precautions. A summary of the known gaps and the associated recommendations is provided in Table 1. The table will be reviewed and revised accordingly when further information becomes available e.g. emergency lighting system, lift specification.

These recommendations are provided prior to any considerations of existing site constraints and impact on the heritage aspects of the building. These may affect the feasibility of the recommended solutions, resulting in different options being explored. These activities should form one of the next steps in the project.

Interim measures

The recommendations may take some time to be fully implemented due to constraints on site. There are existing features in Mountjoy House that present unacceptable risks to the life safety of the building occupants. Some immediate actions are recommended to address these risks.

These immediate actions are temporary measures to address the risks, while permanent solutions are developed and implemented. These interim measures are not meant to replace the need for permanent solutions. The recommended interim measures are:

- BE to prepare Personal Emergency Evacuation Plan (PEEP) for residents with restricted mobility or on wheelchair as they are not able to evacuate via the balconies or down the stairs, so that the evacuation arrangement in the event of a fire is clear to each of them;
- BE to ensure balconies are kept clear of any stored goods to provide safe egress route for occupants.
- BE to keep all the windows in the SC26 protected lobby shut on every floor to reduce the risk of smoke entering the lobby and spread to other floors.

Next Steps

In addition to implementing the interim measures, it is recommended for BE to review the feasibility for implementation of the permanent remedial actions.

Once this has been completed, it is recommended for the CoL District Surveyor and the London Fire Brigade to be consulted, to seek their early agreement in principle.

Table 1: Identified gaps and recommended actions

Identified Gaps	Recommended Action	Benefits of the recommendation	Implementation constraints as defined by BE
Extended travel distance (for single direction of escape)	• Provide early warning to occupants within the flat by installing a minimum Grade D1 Category LD2 within the flats; • Provide detection and alarm system in common areas of the building; • Provide fire action notices throughout the common areas of the building for residents to be aware of the evacuation procedure.	• Early warning through automatic detection and alarm system will serve to alert occupants of a fire in their flat during the early stages of the fire and initiate evacuation before conditions in the flat becomes untenable. • Occupants will be made aware of the escape routes and procedures in the event of a fire, minimising time to evacuate the building.	
Evacuation of PRMs	• Preparation of Personal Emergency Evacuation Plan (PEEP) for PRMs. • As part of the PEEP, it may be necessary to provide refuge area and Emergency Voice Communication (EVC) system to Staircase 24 and Staircase 26 (firefighting stairs with firemen's lift).	• PRMs are well informed about their evacuation arrangement in the event of a fire. • Refuge area will create a safe refuge for PRMs to wait and to call for assistance.	
Sprinkler protection	For a building that adopts a stay-put strategy, it is recommended to maintain the fire compartmentation across the building. It has been confirmed by BE during the site visit that there are kitchen risers in the corner flats (X01, X02, X09 and X10) which span the entire building height. There are extended travel distances within the flats for PRM occupants in the building. As such this presents a risk to the lift safety of occupants and the installation of a sprinkler system in the building is recommended.	Provision of sprinklers will enhance the overall fire safety of the building, limiting the fire growth and enhance both life safety and property protection	
Exit signage	A survey is recommended to inspect and replace existing exit signage to comply with BS 5499-4, BS ISO 3864-1 and the additional recommendations from the Grenfell Tower Inquiry: Phase 1 report	Correct signage will serve to identify the stair discharge level and the route out of the building.	
Emergency lighting	A survey is recommended to inspect and replace existing emergency lighting to comply with BS 5266-1.	Emergency lighting will help allow occupants to evacuate safely, especially when traversing up/down the stairs.	
Compartmentation – corner flats with risers in the kitchen running through the building height.	BE confirmed there are currently risers in the kitchens of the corner flats that are not separated between the floors. It is unknown whether the riser is separated from the kitchen of every flat. It is recommended that BE commission a sitewide survey to inspect any breaches in compartmentation associated with these risers, and to undertake works to maintain the compartmentation in accordance with BS 9991.	This will help maintain the stay-put strategy and minimise the risk of fire spreading between the flats.	
Fire doors at flat entrance, firefighting stairs, plant/store rooms and storage/post box.	• It is recommended to replace all the fire doors to the stair, lobby, flat entrances, storeroom and the refuse storage/post box. • Doors to risers/plantrooms within the stair enclosures are to be inspected and repaired/replaced to maintain fire separation from the stair. • Keep records of inspection and testing of fire doors in the future, at not less than three-monthly intervals to ensure that all fire doors are in working order.	• This will serve to maintain the availability of the stair for means of escape and firefighting activities. • Maintaining the stay put evacuation regime.	
Kitchen extract shunt duct system	Replace the existing extract hoods with recirculation type hoods, and implement one of the followings:	• The provision of fire and smoke dampers or blocking off the shunt ducts will serve to significantly reduce the risk of fire spread between compartments through the kitchen shunt ducts. • Maintaining the stay-put evacuation regime.	

Identified Gaps	Recommended Action	Benefits of the recommendation	Implementation constraints as defined by BE
	• Smoke and fire damper at the shunt duct riser activated by the fire alarm/detectors within the flat (this maintains the use of the riser for normal ventilation of the flat); or • To block off the shunt ducts and provide a fan on the external wall to draw out air from the flat into the balconies; or • Maintain the existing extract hoods and shunt duct arrangement by increasing the reliability of the main extract fan. This will require an additional duty standby fan (the fans to be rated at 400 ˚C for 90 minutes in accordance with BS EN 13501-4), with secondary power supply. The fans need to be adequately maintained to keep the main riser under negative pressure;	• The option of increasing the reliability of the main extract fan allows the day-to-day ventilation within the flat can be maintained.	

1 Introduction

1.1 Appointment and scope

Arup have been appointed by Barbican Estate (herein referred to as BE) to provide a fire engineering review of Mountjoy House, an existing building which is part of the Barbican Residential Development, located in the City of London.

This report provides a fire strategy for the existing building and captures the current fire safety measures and strategy as Arup understand it from recent reviews of documents, discussions with the BE management team and through a non-intrusive site visit undertaken on 07/03/2022.

Although Mountjoy House is an existing building, there is limited documentation available to explain the current fire safety information for the building. There is currently no fire strategy report for the building nor documentation which provides a cohesive record of the fire safety measures in the building. As such this fire strategy has been developed to act as a cohesive and detailed record of the current fire safety provisions (and can act as a benchmark for future building work).

1.2 Purpose of this report

Having a single documented fire safety strategy for Mountjoy House provides the required information to understand the fire safety principles and fire safety measures within the existing building.

It should also be noted that this fire strategy covers the residential floors, Level 1 to Level 7 of Mountjoy House. This report does not cover the services subway (L04).

This report will assist the BE when they wish to undertake future improvement and alterations to the building. It will also act as a benchmark in recording the fire safety strategy and enables anyone undertaking works on the building to understand what implications these may have in terms of fire safety.

Furthermore, this report documents any potential shortfalls in fire safety measures and enables BE to address these where necessary and document them in their Fire Risk Assessment (FRA) for the building where required.

The purpose of the report is as follows:

- Identify any inspections/tests that should be undertaken to create evidence of building operation where that is missing;
- Identify potential remediation measures, where current fire safety systems do not provide adequate fire safety for occupants;
- Provide a retrospective fire strategy report and associated fire safety drawings.

These goals are identified to be provided for four different typologies of building to give an overall fire strategy for all 22 buildings within the Barbican Residential Development.

Areas that require more information/ confirmation is required from BE are identified by brown text throughout this report.

1.3 Barbican residential Development

The buildings in the Barbican Residential Development were constructed from 1960 to 1982. There are 22 buildings in total as shown in Figure 1. There is a distinctive design feature across the Barbican Residential Development, which is the provision of a podium. It was constructed with an intention of providing a liveable urban environment for pedestrians and acts as ground level for the buildings[1].

In terms of fire safety design, the podium level throughout the Barbican Residential Development is considered as an access level for all of the buildings. Access level is defined in BS 9991 as ‘level used for normal access to the building that either incorporates, or leads directly to, a place of ultimate safety’. Therefore, the podium is considered a place of ultimate safety, serving as the exit discharge level for the stairs.

Figure 1: Overview of the Barbican Residential Development (Image courtesy Barbican Living)

Arup in conjunction with BE have identified four different block typologies which are common across the residential development. The typologies are as follows:

- High rise tower – Cromwell Tower;
- Terrace block type 1 – Andrewes House;
- Terrace block type 2 – Ben Jonson House;
- Terrace block type 3 – Mountjoy House.

[1] Barbican Estate, *Barbican Living*, *https://www.barbicanliving.co.uk/*, *(accessed 16 March 2021)*

Flats across Mountjoy House are generally privately owned by leaseholders with a small portion of the flats being owned by the BE and let out to tenants.

2 Fire Safety Goals

2.1 Statutory and policy goals

The legislation, regulations and relevant standards contained within the following sub-sections have been referenced as part of Arup's review of the existing building. These are the requirements that are applicable to the existing building.

2.1.1 Regulatory Reform (Fire Safety) Order 205

The Regulatory Reform (Fire Safety) Order 2005 (RR(FS)O) places a general duty of fire safety care on employers, occupiers and owners of almost all premises and requires them to take such fire precautions as may be reasonably required to ensure that premises are safe for the occupants and those in the immediate vicinity.

The responsible person has a duty to carry out a fire risk assessment which must focus on the safety in case of fire of all 'relevant persons'. The risk assessment should pay particular attention to those at special risk, such as the disabled and those with special needs, and must include consideration of any dangerous substance likely to be on the premises.

A fire risk assessment (FRA) was undertaken in January 2018 by Frankham Risk Management Services. A number of risks have been identified and need to be resolved in order to comply with RR(FS)O. Reference to these items has been included in the relevant sections of the fire strategy.

2.1.2 BS 9991:2015

To benchmark compliance with the RR(FS)O, the existing building has been assessed against the guidance in BS 9991:2015 - Fire safety in the design management and use of residential buildings – Code of practice (see Section 2.1.2). This is a guidance document which provides a means of demonstrating compliance with the life safety requirements of Part B of the Building Regulations 2010 (as amended) (herein referred to as "BS 9991"). This is used as the benchmark in developing the fire strategy for the building.

BS 9999 and ADB Volume 1 will also be referenced where applicable.

2.1.3 Barbican Estate fire safety goals

Through meetings with the BE, Arup has identified that the main objective of this fire safety review is the life safety of the building occupants. Arup is not aware of any additional requirements for property protection, either from BE or their insurer. This is to be confirmed by BE.

2.2 Proposed methodology

The existing fire safety precautions of Mountjoy House are compared with the current recommendations in BS 9991. Where the provisions and recommendations align, no

further action is required, and the existing provisions are recorded in this report to form the building fire strategy.

Where the provisions are not deemed to comply with the recommendations of BS 9991, it has been qualitatively assessed to identify the life safety risks to the building occupants due to those non-compliances or gaps in the fire safety precautions. The outcomes of the assessment will result in one of the following:

1. Where considered acceptable to remain as existing, recommend retaining the current provisions; or
2. Recommendations on possible options for enhancements/upgrades where the current fire safety provisions are considered inadequate.

It should be noted that as the building is existing, it is not feasible for all provisions to be in line with current fire safety standards. Where appropriate, the relevant guidance documents at the time of construction of the building have also been used as reference.

2.3 Referenced documentation

The following information has been used to inform the Mountjoy House fire strategy and fire safety systems provisions:

- Meetings between Arup Fire and BE between February 2022 to March 2022;
- Barbican Living website;
- Various email correspondence between Arup and BE between February 2022 to March 2022;
- Referenced documents and drawings listed in Table 2;
- Visual non-intrusive site visit undertaken on 07/03/2022;

Table 2: Referenced documents and drawings

Document title	Produced by	Date	Revision
Mountjoy House External Fire Risk Assessment	Frankham Risk Management Services	Jan 2018	-
CP 114:1957 *British Code of Practice, The Structural Use of Reinforced Concrete in Buildings*	British Standards Institution	1957	-
CP 3: 1962 *British Code of Practice Chapter IV Precautions against fire Part 1. Fire precautions in flats and maisonettes over 80 ft in height*	British Standards Institution	1962	-
BS EN 1992-1-2-2004: Eurocode 2 *Design of Concrete Structure Part 1-2: General rules – Structural fire design*	British Standards Institution	2004	-
Abridged results from the test of 86 Thomas More House (double lead door and single leaf door)	CTO S.A.	Jan 2020	-
Drawing no 22 5588 Corner blocks X & XI Level 120 23 layout	Ove Arup & Partners	Jan 1964	Rev B
Drawing no. 22 509 Block X Layout plan at 120 40	Ove Arup & Partners	May 1963	Rev B
Drawing no. 22 520 Block X Crosswalls 1210 N 1245 N 1315 N	Ove Arup & Partners	April 1964	Rev A

2.4 Limitations and assumptions

2.4.1 Limitations of report

This document summarises the findings of our work carried out to date. It does not attempt to quantify actual elements of fire performance, such as fire resistance periods, across the building in its existing state as physical intrusive works would be required to do this. It is Arup's understanding that intrusive investigations into the building are not planned to be carried out.

There are no architectural layouts of the building. Structural plans of Mountjoy House have been obtained through Arup's archive and used to better understand the building layout. However, this is not a complete set covering the building and is limited to some levels of the building only. The fire strategy drawings provided as part of this report are based on those published on the Barbican Living website. In using these documents, it is assumed that the layouts remain representative of the current arrangement in Mountjoy House.

BE should undertake the necessary tests/inspections to confirm that the fire safety systems will operate as intended in a fire event.

The information documented in this fire strategy is limited to the amount of information covered through the following:

- Desktop review;
- Consultation with the BE;
- Visual non-intrusive site visit undertaken on 07/03/2022, where the areas visited included outside and inside of Mountjoy House
  - Car park level L03 (fire service access level);
  - Podium level;
  - Common area (lift lobby, stairs) on some of the Residential levels (L1 – L7);
  - Flat 210.

The fire strategy does not represent the condition for the entire building.

2.4.2 Summary of key assumptions

The following key assumptions have been made to form a basis of the fire strategy for Mountjoy house. BE should confirm if these assumptions are suitable for the project.

- Any current or future building works and their impact on the fire strategy are outside the scope of this document;
- No further inspection/survey is planned such as intrusive investigation on the building;
- The building is not currently undergoing any changes, with no change in occupancy nor material alterations;
- The fire strategy drawings within the report are in line with the current building layout;
- Structural drawings are only available from the drawings referenced in Table 2. It is assumed that all other levels have a layout that is in line with the two levels and follow the same fire safety principles throughout the building;
- The doors from Thomas More House (which have undergone fire testing) are assumed to be the same as the ones from Mountjoy House;
- All elements shown in the structural drawings are assumed to be elements of structure and therefore loadbearing;
- The thickness of structural elements (i.e. slab depth or wall thickness) are assumed to be the same throughout the building;
- All structural elements are reinforced concrete;
- The concrete covers over the reinforcement bars meet the values stated in the relevant guidance at the time of construction (CP114); there is no information on the depth of the existing concrete covers for this aspect to be assessed;
- Floor slabs are simply supported one-way slabs throughout the building;
- No structural calculations are available and therefore the utilisation factor of the structural members is unknown. When checking against the requirements of Eurocode 2 (Section 4.3.1) a utilisation factor of 0.7 has been assumed for conservatism;
- The fire resistance requirements given in CP114 cover loadbearing capacity, integrity and insulation;
- There is no fire stopping register for the building. The condition of the fire stopping at penetrations on fire rated construction is unknown. It is assumed that fire stopping remediation actions will be undertaken as part of ongoing maintenance;
- Boundary distances have been taken to the mid point from Mountjoy House to adjacent buildings;
- Staircase 24 in Thomas More House serves as a means of escape for Mountjoy House as the two buildings are connected;
- Staircase 24 and 26 are firefighting shafts (provided with a protected lobby, firefighting stair and firemen's lift).

3 Mountjoy House

Mountjoy House was completed in April 1971. It is a terrace block which is attached to Thomas More House and runs at 90 degrees built above Mountjoy Close. The building contains 64 flats in total.

The building consists of two stairs (Staircase 25 and Staircase 26) where Staircase 25 is a common open stair and Staircase 26 is a firefighting stair provided with a firefighting lobby and fireman's lift. The building is connected to Staircase 24 (which is part of Thomas More House, refer to Figure 2) via a protected lobby accessed from Staircase 25. Staircase 24 in Thomas More House is considered an alternative escape route from Mountjoy House. Staircase 25 is not considered a compliant escape route as it is not fire separated from the common corridor (with entrances to two flats) at every floor.

The building consists of seven floors (above Podium level) with a building height of 27 m measured from fire service access level (L03) to the bottom of the topmost occupied storey. The *Grenfell Tower Inquiry: Phase 1 report* defines high-rise buildings as buildings over 18 m in height and hence Mountjoy House is considered a high-rise building. There are no floors below Podium level.

The building comprises of the following:

- Roof level (plant rooms);
- L1 – L7: Residential flats (10 flats on each residential level, and 6 duplex maisonettes in L6 – L7);
- Podium level (resident main entrance);
- L03: Fire service access via car park from Aldersgate Street;
- L04 Subway level.

The roof level is only accessible to BE staff via fixed ladders within the Staircase 26 protected lobby.

L04 which is known as the 'subway' is connected to Mountjoy House via Staircase 26. It contains services and extends throughout the Barbican Estate. The area is excluded from the scope of this document.

There are balconies that runs along the entire perimeter of the building connecting to Staircase 24 and 26. These balconies serve from L1 to L7, but not from Podium levels and below.

The two firefighting shafts (Staircase 24 and 26) are accessed from the L03 carpark, from Aldersgate Street into the car park. Staircase 24 which is in Thomas More House, can also be used for Mountjoy House as the two buildings are connected through a protected lobby.

On a day to day basis, occupants from L03 or Podium level take the lifts or stairs to access their flats.

The building comprises a central corridor with flats on either side. The balcony that is accessible from each flat ‘wraps’ around the building. The layout and the section of Mountjoy House is as shown in Figure 2 and Figure 3.

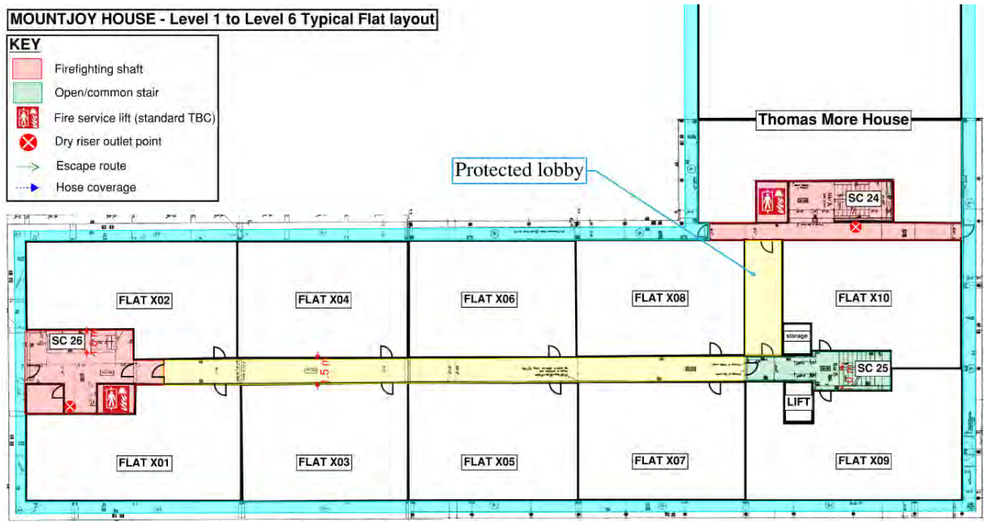


Figure 2: Typical flat layout of Mountjoy House (balcony indicated in blue)

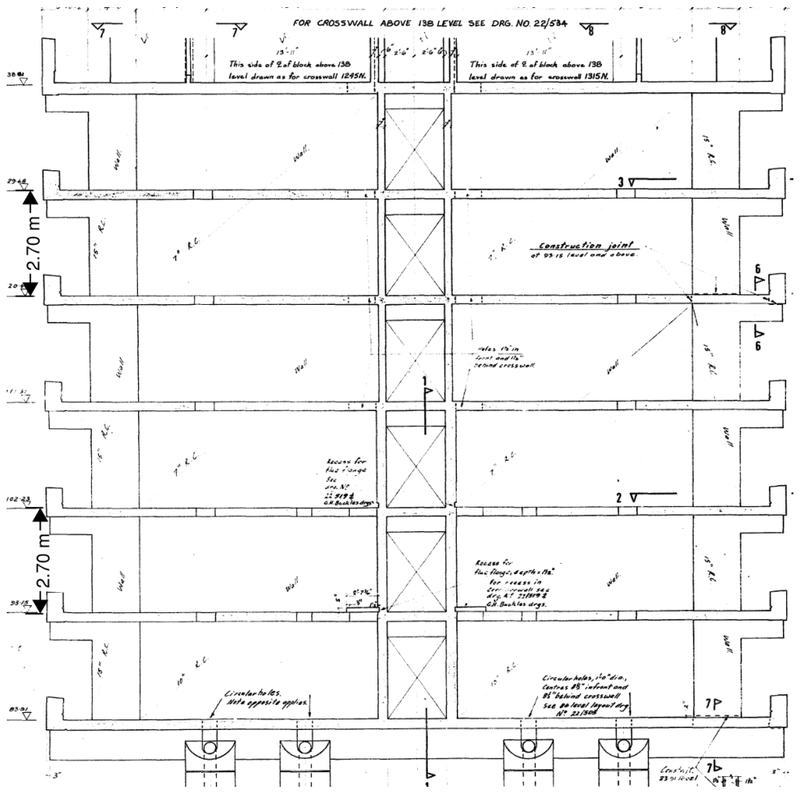


Figure 3: Section of Mountjoy House

4 Fire Strategy Summary

This section of the report provides an overview of the fire strategy for Mountjoy House. It provides the following:

- The recommendations of current guidance;
- The current provisions in Mountjoy House;
- Identification of non-compliances against the current provisions;
- If there are non-compliances identified, three possible solutions through a qualitatively assessing the risks:
    1. The non-compliance is considered to present a life safety risk and requires remediation. Recommendations are made to improve the current provisions to bring them more into line with current prescriptive guidance; OR
    2. The non-compliance is not considered to represent a high life safety risk such that it requires additional safety measures to what is already provided. It is considered acceptable to be retained; OR
    3. More information/confirmation is required from BE (brown text) to confirm any further actions needed.

Where a non-compliance has been identified and a recommendation has been made after a risk assessment, these have been highlighted in green box.

4.1 Means of warning and escape

4.1.1 Evacuation strategy

Mountjoy House operates under a defend in place/ stay put strategy where only the occupants in the flat of the fire origin evacuate the building. The rest of the building occupants are not alerted to the fire and can remain in place while the fire brigade deal with the incident. The defend in place strategy is a common strategy for residential buildings in the UK.

It is recommended that information is given to residents regarding the meaning of the stay put strategy and the arrangements for means of escape are available to them if a fire were to affect their flat. It was noted from the site visit that fire action notices are not definitive enough in communal areas. It is recommended for signage to be replaced with clear instructions to residents, explaining their fire actions, including the stay put policy and their nearest escape routes.

Whilst the above approach is compliant with the recommendation of BS 9991, the *Grenfell Tower Inquiry: Phase 1 report* recommends that all high-rise residential buildings, existing and new, are provided with facilities to allow the fire and rescue service to simultaneously evacuate the building. Mountjoy House has two protected stairs (concrete construction) at opposite ends of the building. The building is of concrete construction and the façade mainly consists of timber doors, timber framed windows and concrete construction (does not appear to be combustible cladding). Hence, the facility to simultaneously evacuate the building is a lower priority recommendation, compared to other remedial works for Mountjoy House. However, this should be considered in conjunction with the provision of automatic detection and alarm system in the flats, if the additional infrastructure to implement the simultaneous evacuation facility is minimal. Refer to Section 4.1.9 for additional details on the fire detection and alarm system.

4.1.2 Means of escape within flats

From BS 9991, flats having an entrance on the same level should have all habitable rooms to be accessible from an internal hallway and have an alternative exit from the flat. There are no maximum travel distance recommendations in this arrangement. Where a flat is not provided with a protected corridor or alternative exits, travel distance from anywhere within the flat to the flat entrance door should be limited to 9 m.

For occupants who are able-bodied (refer to Section 4.1.6 for evacuation Persons with Reduced Mobility, PRM), the flats are provided with two escape routes; via the flat entrance and via the balcony connected to the flat as shown in Figure 4.

The current means of escape arrangement is considered acceptable.

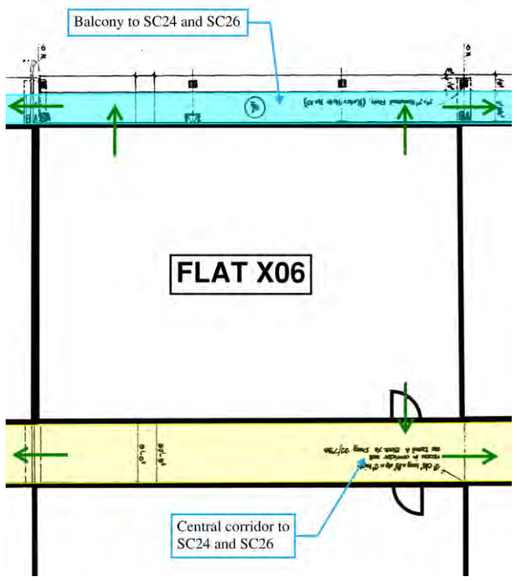


Figure 4: Means of escape from a flat

All flats are provided with alternative escape routes from the habitable rooms via the balcony.

There are six duplex layouts in Level 6 to Level 7 (Flats 603 – 608) which have open stairs connecting two levels. It has been confirmed by BE that the duplex flats have flat entrance in Level 6 and are provided with access to balconies on each Level 6 and Level 7 and hence there will always be alternative means of escape for both levels.

4.1.3 Means of escape in common areas

Residential levels (L1 – L7)

BS 9991 provides recommendations for building scenarios where the flats are provided with a single means of escape either via a balcony or via internal corridors.

For Mountjoy House, the horizontal means of escape from each flat consists of the flat main entrance leading to either Staircase 24 or Staircase 26 via the central corridor as the primary means of escape. Alternatively, there is a route via the balconies to access one of the two staircases. As all flats are provided with alternative means of escape, the current arrangement is considered acceptable.

The width of the balcony is 560 mm at pinch point with privacy screens fully open. It was identified during the site visit that stored goods are located along the balcony in certain levels of the building as shown in Figure 5. These should be removed so that the escape route remains unblocked.

Figure 5: Stored goods in balconies

Recommendations:

- It is recommended to maintain the management procedure in place to keep the balconies clear of any obstacles at all times. This is to provide a clear escape route for occupants to evacuate in an emergency.

Plant area

BE confirmed the plant rooms are located above L7 and can be accessed by the fixed ladders provided within the protected lobby of Staircase 26 as shown in Figure 6.

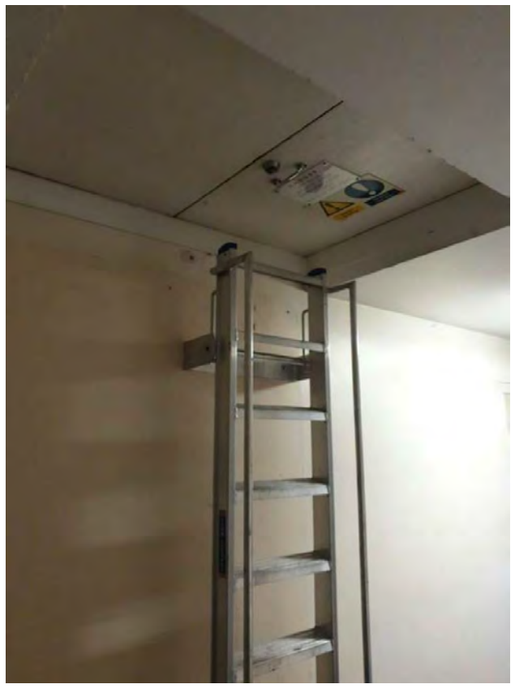


Figure 6: Fixed ladder to plant area in L7 Staircase 26

4.1.4 Vertical means of escape (stairs)

Minimum width

The stairs are recommended by BS 9991 to be no less than 750 mm, measured between the walls and/or balustrade (if protruding less than 100 mm from the walls). A minimum 2 m clear height shall be maintained. BS 9991 also states firefighting stairs should have an unobstructed width of 1100 mm.

Mountjoy House is provided with three stairs as follows:

- Staircase 24 & Staircase 26: firefighting stairs with a width of 1000 mm from L03 to L7;
- Staircase 25: Common open stair width a width of 1000 mm from L03 to L7.

Staircase 25 is not considered a compliant escape route as it is not fire separated from the common corridor, which has entrances to two flats at every floor.

Refer to Section 4.5.3.1 for details of the firefighting stairs.

Central corridor

Flats X01 to X08 opens into the central corridor, with Staircase 25 and 26 at either ends of the corridor. Both stairs are separated from the corridor by a door. However, Flats X09 and X10 opens directly into the Staircase 25. There is access to Staircase 24 from the landing of Staircase 25 via a protected lobby, as shown in Figure 7 below. The furthest travel distance to reach a protected stair from any of the flats is 21.4m (Flat X05 & 06 to Staircase 24).

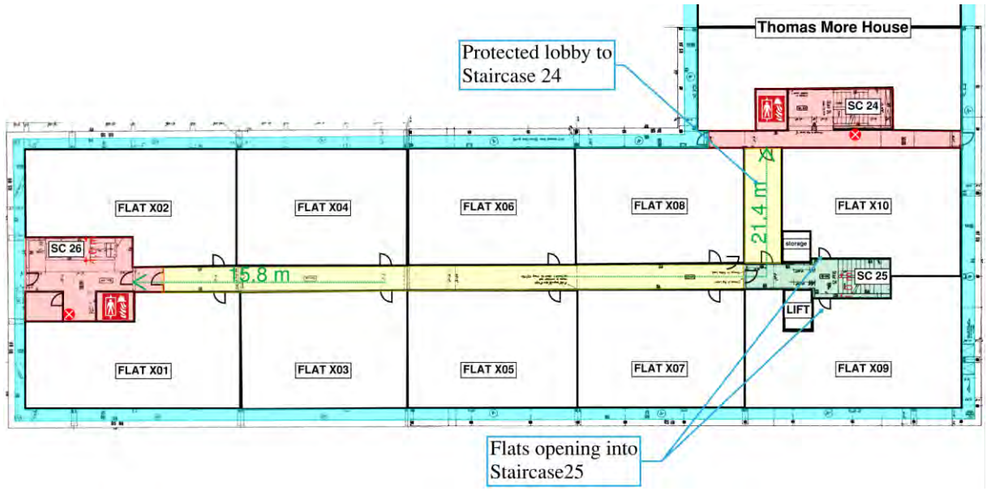


Figure 7: Connection to the stairs from the flats in Mountjoy House

4.1.5 Final exits

Level of discharge

Final exits are available on both Podium Level and L03 (carpark level). All residential levels will exit via the Podium level using firefighting stairs.

In accordance with BS 9991, discharge from final exits should meet the following recommendations:

- Protected stairs should discharge directly to a final exit;
- Final exits should discharge directly to a walkway or open space that allows for the rapid dispersal of persons away from the vicinity of the building, which is achieved by the Podium level and L03;
- Final exits should have a level threshold;
- Final exits should be sited such that they are clear of any risk from fire or smoke.

It has been confirmed during the site visit that Podium level is an open public walkway and L03 is an open car park as shown in Figure 8 where both areas are mainly non-combustible construction. Both Podium level and L03 is levelled/step free.

Figure 8: Final exit on to Podium Level (left) and L03 Carpark level (right)

The Podium level is an external walkway which runs along Mountjoy House and connects to other buildings in the Barbican Residential Development and adjacent development.

4.1.6 Evacuation of PRMs

Mountjoy House currently does not have an evacuation strategy or Personal Emergency Evacuation Plan (PEEP) for Persons with Restricted Mobility. In this report, the term PRM is used to mainly refer to occupants who are wheelchair bound, but the term is applicable to occupants with varying levels of mobility.

As discussed in Section 4.1.2, each flat in the residential levels (L1 – L7) have alternative escape routes via the balconies. However, there is a change in level between the flats and the balconies. As such, the balconies will not be accessible to PRMs. Therefore, for PRMs there is only a single means of escape using the flat entrance to enter the central corridor to reach either Staircase 24 or 26.

Existing provisions

Travel distance

BS 9991 recommends maximum travel distance of 9 m for single means of escape within flats protected by automatic detection system that do not have a protected entrance hall.

As there is only a single means of escape for PRMs, the travel distances within the flat should be limited to 9 m from the furthest point in the flat. It is Arup's understanding that there are different internal layouts throughout the building. The flat with the greatest internal travel distance is Flat type 28 with 13.7 m which exceeds the recommendations of BS 9991, as shown in Figure 9 below.

Figure 9: Flat type 28 with greatest travel distance within the flat

Safe refuge

The occupants can travel to Staircase 26 which is a protected area separated from the central corridor by a fire door. The occupants travelling towards Staircase 25 and flats opening on to Staircase 25 can travel to Staircase 24 via a protected lobby. Staircases 24 and 26 are both provided with ventilation at the top of the stairs, by way of louvred doors to outside (roof terrace). The adequacy of the vent in maintaining a safe environment in the stair for PRMs to seek refuge is not reviewed.

The occupants can use the lift (if safe to do so) to Podium level or L03 to evacuate from the building. There is no emergency voice communication (EVC) system in the building.

Lift grounding system

The current lift mechanism is not programmed for grounding as there are no detectors within the lift shafts. BE to confirm what standard the lifts were installed to.

Recommendations:

- BE to put in place management plan and evacuation strategy for the evacuation of occupants, in particular for PRMs which includes preparing PEEP as an immediate action. Consider whether the lifts in Staircase 24 and 26 will be used for evacuation.
- As part of the PEEP, it may be necessary to provide refuge area and Emergency Voice Communication (EVC) system to Staircase 24 and Staircase 26 (firefighting stairs with firemen's lift)
- Review the adequacy of the vents at the louvred doors in maintaining a safe environment in the stair for PRMs to seek refuge – if not, consider opening the doors automatically for smoke venting.
- Provide an automatic fire detection and alarm system for each flat (Section 4.1.9 for details).
- Clear briefing to all occupants of Mountjoy House on available escape routes.

4.1.7 Exit signage

BS 9991 recommends exit signage to be in accordance with BS 5499-4 and BS ISO 3864-1. In particular, for stairs that serve storeys both above and below the point of final exit, the final exit should be immediately apparent by the provision of additional signage.

In addition, the Grenfell Tower Inquiry: Phase 1 report recommends that in all high-rise residential buildings, floor numbers are clearly marked on each landing within the stairways and in a prominent place in the lobbies such that they can be seen in normal conditions and in low lighting and smoky conditions.

Existing provisions

BE to confirm if emergency exit signage is lit in Mountjoy House.

During the site visit, it has been identified that there is currently no signage within the protected stairs to notify occupants where the discharge level is. BE advised that there is a sitewide inspection (currently paused) to examine the condition of existing signage and to replace them where necessary.

Recommendations:

- BE to carry out a sitewide inspection and provide exit signage in accordance with BS 5499-4, BS ISO 3864-1 and the additional recommendations from the Grenfell Tower Inquiry: Phase 1 report.

4.1.8 Emergency lighting

In accordance with BS 9991, emergency lighting should be provided in accordance with BS 5266-1.

Existing provisions

BE to confirm if Mountjoy House is provided with emergency lighting system and what back up power supply is provided. During the site visit, it was not possible to determine the light fittings that are part of the emergency lighting system.

Proposed Improvements

A full survey on emergency lighting is recommended and to remediate any of the non-compliances throughout the building for emergency lighting to be in line with BS 5266-1.

4.1.9 Fire detection and alarm

BS 9991 recommends that flats in multi-storey buildings shall be provided with an alarm and detection system in line with BS 5839-6. The recommended system for an existing flat with no floor greater than 200 m^2 is Grade D1 Category LD2, where Grade D1 is a provision of one or more mains powered detectors each with a sealed in standby supply consisting of a battery. Category LD2 is a system incorporating detectors in all circulation areas that form part of the escape routes from the premises, and in all specified rooms that present a high fire risk to occupants, including kitchen and the principal habitable room.

In addition to the recommendations of BS 9991, the Grenfell Tower Inquiry: Phase 1 report recommends that all high-rise residential buildings, existing and new, are provided with facilities to allow the fire and rescue service to simultaneously evacuate the building. High-rise buildings are defined as buildings over 18 m in height and hence Mountjoy House is considered a high-rise building.

Existing provisions

The External Fire Risk Assessment prepared by Frankham Risk Management Services in January 2018 states that some flats were provided with smoke detectors however did not function when tested.

During the site visit it was confirmed that the common areas are not provided with a fire detection and alarm system.

In the case of privately owned flats, it is the responsibility of the owners to install an alarm and detection system. It should be noted that this is only a recommendation by BE as the freeholder, and not compulsory. BE has no record of the flats that are equipped with such system within the flats.

It is recommended to provide a detection and alarm system for all the flats of Mountjoy House, due to the following reasons:

- Provision of a detection and alarm system is a basic fire safety expectation in almost all buildings in order to provide early detection of fire which will result in early evacuation of residents in residential areas, particularly considering the sleeping risks.
- An improvement to evacuation of PRMs, with a single means of escape and requiring assistance to evacuate to the place of ultimate safety.
- Due to the potential risk of fire/smoke spread via the riser in the kitchen are for corner flats (X01, X02, X09 and X10 flats) arrangement (see Section 4.3.2) the detection and alarm system provides improvement by providing early warning in case of breach of compartmentation.

Note that BS 5839-6 gives recommendations for new and existing premises separately. There are specific systems identified for existing premises which shows the importance of providing adequate fire detection and alarm system for existing buildings and not just for new builds.

Recommendations:

- Provide a Grade D1 Category LD2 system in line with BS 5839-6 is recommended for all the flats of Mountjoy House.
- If automatic ventilation to staircases 24 and 26 are necessary (subject to a review of the ventilation by the louvred doors), provide detection system in the lift lobby to activate the vent system.
- If the lift is used for evacuation as part of the PEEP arrangement, provide detection system in the lift shaft.
- The facility to simultaneously evacuate the building should be considered in conjunction with the recommendations above, as the additional infrastructure to implement such facility may be relatively minimal.

4.1.10 Fire suppression

Based on BS 9991, sprinkler protection is required for buildings with a floor higher than 30 m above ground level. However, the recent revision of ADB Volume 1: 2020 amendment states that the threshold building height (for residential buildings) for the provision of sprinklers has been reduced from 30 m to 11 m.

Existing provisions

Mountjoy House is not provided with sprinkler protection. The building height from L03 to the topmost occupied storey is 27 m.

Proposed improvements

British Standard Code of Practice CP3: Chapter IV (1962) which was the relevant code at the time Mountjoy House was built (1971) did not require any sprinkler protection to high-rise residential buildings. There is no requirement in the Building Regulations for existing buildings to comply with the current guidance, except where building works have taken place.

Sprinklers were not required at the time of construction.

However, the building adopts a stay-put policy, which relies on maintaining compartmentation between each flat and between the flat and the common areas. It has been confirmed by BE during the site visit that there is breach of compartmentation between the corner flats (X01, X02, X09 and X10 of every level) at the kitchen risers that span the entire building height. It is unclear if there is compartmentation between the flats and the risers. This is a risk to life safety as it compromises the stay-put strategy. There is a higher risk on fire spread between the flats which compromises the stay put strategy. As the flat entrance doors do not achieve the required fire rating, there is a risk of fire within the flat spreading to the common corridor for every level affecting the means of escape for the entire building.

Due to these factors, it is recommended that a sprinkler system is provided.

BE have confirmed that insurers (from their consultation on the 23/07/2021) have no requirement to install sprinklers anywhere within the Barbican Residential.

Recommendations:

- Install sprinklers, as a solution to mitigate multiple risks including compartmentation and flat entrance doors.

4.1.11 Smoke control

In order for fire and smoke to be directed outwards and upwards, BS 9991 recommends the balcony to be open sided. The opening should be at least 50% of the vertical plane and uniformly spread across the surface. The opening should be at least between the top of the balustrade at 1.1 m and the soffit to the balcony above.

Balcony existing provisions

From visual inspection during the site visit, the balcony appears (refer to Figure 5) to be open for at least 50% of the vertical plan.. As Mountjoy House is provided with alternative means of escape from the flat, the current arrangement is considered acceptable.

4.1.12 Refuse storage cupboard and post box

BS 9991 recommends refuse rooms provided for the storage of refuse should be separated from other parts of the building and should not be located within or accessed directly from common stairs. Rooms provided for the storage of refuse should be approached only by way of a protected lobby having not less than 0.2 m^2 of permanent ventilation or a suitable mechanical alternative.

Existing arrangement

Every flat in Mountjoy House is provided with a refuse storage cupboard and a post box adjacent to the flat entrance door, for the use of the flat occupants only. The refuse storage and the post box is accessible from both the common area outside the flat and within the flat; they comprise of a metal frame cupboard with asbestos backed doors on both the common area side and the flat side.

There is no ventilated lobby provided and no other mitigation measures provided in Mountjoy House for refuse storage areas.

Proposed improvements

The current arrangement does not comply with the recommendations of BS 9991. Refuse storage is considered a high fire hazard area and the location within the common areas poses a risk to the occupants. A fire involving the refuse can cause fire and smoke to affect the use of the common areas. It is therefore critical for the door separating the refuse storage and common areas to be a fire rated door.

As a recommendation to this non-compliance, the doors to the refuse storage and post box from the common area should be fire rated to 30 minutes with smoke seals. Although this does not fully meet the current recommendations of BS 9991 (which would require a ventilated lobby), this is considered an improvement to the current arrangement. The recommended additional detection and alarm system in each flat will serve to provide early warning in the event of a fire in the flat. The new fire rated door separating the refuse storage from the common area will serve to limit fire and smoke spread, maintaining the use of the stairs for means of escape and protected refuge.

Recommendations:

- If doors to the refuse storage and post box on the common areas are not fire doors meeting the current standard, it is recommended for new fire doors (FD30S) to be provided.

4.1.13 Storeroom in Staircase 25

BS 9991 states that no storeroom should open directly to a common stair. Instead, there should be a ventilated lobby between the storeroom and the stair.

BS 9999 states storage areas greater than 1 m^2 in area but not greater than 450 m^2 (other than refuge storage areas) need to be separated from other parts of the building with a minimum standard of fire resistance of 30 minutes.

Existing provisions

There is a storeroom within Staircase 25 on every landing between L1 to L7 as shown in Figure 10. There are also two flats (corner flats, type X09 and X10) on every floor that also open directly onto the staircase 25.

The site visit did not include the storeroom (resident private store and locked) but from the structural drawings, the room appears to be of concrete construction. In case of a fire in the storeroom, smoke may spread out of the room and affect the escape routes of the corner flats on every floor. Able bodied residents are able to evacuate using the balconies, but PRM residents will not be able to evacuate using their flat entrance. This scenario should be considered in the planning of the PEEP.

Similar to the flat entrance door, the door to the storeroom should maintain fire separation between the room and the common corridor.

Proposed improvements

Refer to Section 4.3.3 for recommendation on fire door.

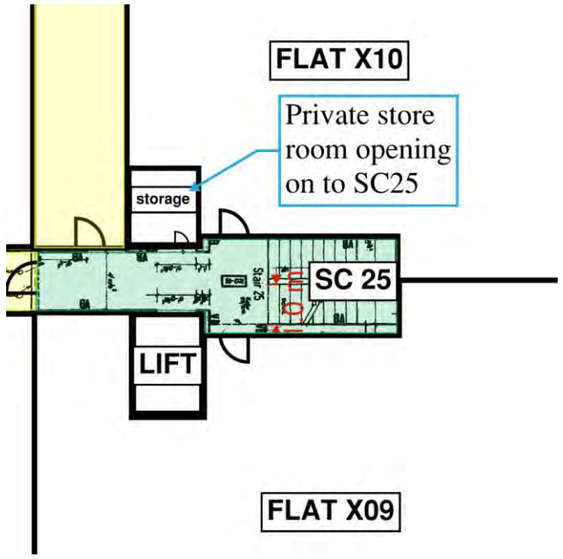


Figure 10: Current layout of storeroom opening on to Staircase 25

4.1.14 Back-up power supplies

BS 9991 states that life safety systems are to be provided with a secondary power supply. The primary power source should generally be taken from the public electricity supply, with secondary power being supplied from an alternative utility supply from another substation, a generator or uninterruptable power supply (UPS) or batteries.

Where practicable, power supplies should be provided via two separate intakes into the building from the same external substation or via a single intake and a standby generator.

Existing provisions

Mountjoy House is provided with a number of life safety systems including emergency lighting, firefighting stair ventilation and firemen's lifts. Secondary power supply to the following life safety systems should be confirmed by BE:

- Emergency lighting
- Firefighting lifts
- Automatic vent for firefighting stairs
- Illuminated emergency exit signage

4.2 Internal fire spread (linings)

BS 9991 recommends the following for wall and ceiling linings:

- Circulation spaces / common corridors – Class 0 in line with BS 476-7 (national class) or Class B-s3, d2 or better in line with BS EN 13501-1 (European class);
- Within apartments – Class 1 in line with BS 476-7 (national class) or Class C-s3, d2 or better in line with BS EN 13501-1 (European class).

Existing provisions

There is no information on the wall and ceiling linings across the common areas of Mountjoy House as well as within the flats. Based on the site visit, the walls appear to be concrete for the common areas including the firefighting stair. BE to confirm.

As concrete finish is expected to achieve Class A1, it meets the recommendations of BS 9991. However, this is based on the assumption that wall and ceiling linings are concrete finishes throughout all areas of the building. If there are areas within the building where the above requirements are not likely to be achieved, they will need to be reviewed and addressed separately.

4.3 Internal fire spread (structure)

4.3.1 Structural fire resistance

Under BS 9991 guidance, unsprinklered buildings greater than 18 m but less than 30 m in height shall be provided with 90 minutes fire resisting construction for load bearing capacity. Elements of structure supporting the firefighting shafts are required to achieve 120 minutes.

Elements of structure are required to achieve loadbearing capacity (R) only, however when certain elements also act as separating elements (i.e. walls) integrity (E) and insulation (I) are also required.

Existing provisions

Information on the existing building structure is based on the structural drawings in the Arup archive. It has been assumed that all elements (i.e. walls, slabs, etc.) shown in the structural drawings are elements of structure and therefore loadbearing.

Based on the structural drawings (drawing number 22 509) the following information on structural elements was obtained:

- Common stair wall thickness: 0.18 m;
- Walls between flats: 0.35 m;
- Firefighting stair wall thickness: 0.25 m;
- Floor slab thickness (excludes balcony slabs): 0.22 m.

The above dimensions have not been verified through site inspections.

The following guidance documents have been used to assess the potential fire rating offered by the dimensions of the walls and slabs:

- BS EN 1992-1-2-2004: Eurocode 2 Design of Concrete Structure Part 1-2: General rules – Structural fire design (Eurocode 2), which is the current guidance; and
- CP 114:1957 British Code of Practice, The Structural Use of Reinforced Concrete in Buildings, which is the relevant code at the time of construction.

In assessing the potential fire rating, the following assumptions are made:

- The thickness of structural elements stated above apply throughout the building;
- All structural elements are reinforced concrete;
- The concrete cover over the reinforcement bars meet the values stated in the relevant guidance at the time of construction (CP 114); there is no information on the depth of the existing concrete covers for this aspect to be assessed;
- Floor slabs are simply supported one-way slabs throughout the building;
- No structural calculations are available and therefore the utilisation factor of the structural members is unknown. When checking against the requirements of Eurocode 2 a utilisation factor of 0.7 has been taken as conservatism;
- The fire resistance requirements given in CP 114 cover loadbearing capacity, integrity and insulation;
- Structural drawings used are only for one floor and it is assumed the dimensions are consistent throughout the building height.

Table 3: Summary of structural element thickness against code requirements

Existing structural element	Existing element thickness	Eurocode 2 requirements	CP 114 requirements	BS 9991 requirements	Comments
Common stair wall (Staircase 25)	180 mm	170 mm (REI 90)	101.6 mm (REI90)	R90	Achieving both the Eurocode 2 and CP 114 for REI90 rating
Walls between flats	350 mm	170 mm (REI 90)	101.6 mm (REI90)	R90	Achieving both the Eurocode 2 and CP 114 for REI90 rating
Firefighting shaft wall	305 mm	160 mm (REI 120)	101.6 mm (REI 120)	R120	Achieving both the Eurocode 2 and CP 114 for REI120 rating
Floor slab	220 mm	100 mm /120 mm	127 mm	R90	Achieving both the Eurocode 2 and
		(REI 90/120)	(REI 90 and 120)		CP 114 for REI 120 rating

The thickness of the structural elements to meet the required fire ratings appear to meet both the current guidance and the relevant guidance at the time of construction.

4.3.2 Fire compartmentation

Fire compartmentation is required to limit fire spread within the same building and protect means of escape. BS 9991 recommends the following fire ratings:

- Compartment walls between flats: FR60 REI;
- Compartment walls that are also part of the load-bearing elements: FR90 REI;
- Compartment floor: FR90 EI (refer to Section 4.3.1 above);
- Firefighting shafts: FR120 REI;
- Any risers penetrating compartment floors: FR90 REI;
- Fire stopping – same level of fire resistance as the compartment wall / floor through which it passes.

Note: Load bearing capacity (R) only required for load bearing elements.

Existing provisions

Information on the existing construction is based on the structural drawings in the Arup Archive.

There is currently no drawing or information available on the material nor the thickness of the riser construction in each of the flats.

Kitchen risers in corner flats

During the site visit it has been informed by BE that the kitchen risers for all corner flats (X01, X02, X09 and X10) are not provided with any separation between the floors and run through the entire building height. Each flat type is served by one riser. It is not known whether there is adequate compartmentation/separation between the riser and each flat. This poses a risk as fire and smoke in one flat could spread to other flats through the riser.

Compartmentation should be maintained between each flat, to align with the stay-put evacuation strategy. Depending on the type of services within the riser (no information provided), the following are the options in maintaining compartmentation:

- Provide fire separation at the vertical riser construction and each flat – any services penetrations between the flats and the riser are to be fire-stopped;

- Provide fire separation at each floor within the riser – services within the riser are to be fire stopped at each floor.

Recommendations:

- Carry out an intrusive survey to assess the current compartmentation between each flat and the riser. New compartmentation should be installed if the current provision does not achieve fire resistance of 90 minutes.

4.3.3 Fire doors

BS 9991 recommends the specification, installation and maintenance of hinged or pivoted pedestrian fire doors to be based on BS 8214. This standard recommends fire rating of doors to be tested in accordance with either BS 476-22 or BS EN 1634-1.

The following fire rating requirements are based on Table 12 of BS 9991:

- Fire door separating firefighting stair and firefighting lobby: FD30S;
- Passenger/firefighting lift landing door: FD30
- Fire door separating a flat from a space in common use; FD30S;
- Enclosing a protected shaft forming a lift well or service shaft: FD60.

In addition, the Grenfell Tower Inquiry: Phase 1 report recommends that owners of all residential buildings containing separate dwellings (whether or not they are high-rise buildings):

- Carry out an urgent inspection of all fire doors to ensure they comply with applicable legislative standards; and
- Be required by law to carry out checks at not less than three-monthly intervals to ensure that all fire doors are fitted with effective self-closing devices in working order.

Existing provisions

There is no information on the existing doors for Mountjoy House. However, based on the information provided in the document 'Abridged results from the test of 86 Thomas More House (double leaf door and a single leaf door)' issued by CTO S A on 21/01/2020, the fire doors in Thomas More House have not satisfied requirements for 30 minutes (EI 30) class door. The fire doors were tested in accordance with PN EN 1363-1:2012 and PN EN 1634-1+A1:2018.

Although the test was not carried out specifically for the fire doors in Mountjoy House, BE confirmed that the doors in Mountjoy House are identical to those in Thomas More.

The fire door separating each flat from the central corridor and onto the stairs is critical for maintaining the availability of the stairs for means of escape. In particular, PRM evacuation relies on the corridors as a single means of escape to enter a place of relative safety (protected stairs).

Recommendations:

- A survey should be carried out to inspect the existing doors that should be fire doors throughout the building. This includes flat entrance doors, doors to the storeroom, all doors to and within Staircase 24 and 26, stair lobby doors, doors to refuse and post box cupboards.
- Where found not to provide the required standard of fire resistance, they are recommended to be replaced to be in accordance with current standards.
- BE to keep records of inspection and testing of fire doors in the future, at not less than three-monthly intervals to ensure that all fire doors are in working order.

4.3.4 Cavity barriers

Clause 33.1. of BS 9999 recommends that cavity barriers should be provided to close the edges of cavities, including around openings. Cavity barriers should be provided at the junction between an external cavity wall and every compartment floor and compartment wall. It also needs to be provided at the junction between an internal cavity wall and every compartment floor, compartment wall or other wall or door assembly which forms a fire resisting barrier.

Existing provisions

BE to confirm if there are any cavity barriers in the building. This is outside the scope of this report.

4.3.5 Fire stopping

BS 9991 (Clause 24.4 and Figure 24) recommends that where a building service passes through a compartment wall or floor it shall be adequately fire stopped in line with the compartment fire resistance.

Existing provisions

There is currently no information on the provision of fire stopping for Mountjoy House. BE to advise.

Recommendations:

- It is recommended for BE to carry out a sitewide inspection of fire stopping and undertake fixing of any defective fire stopping to ensure fire compartmentation is maintained.

4.3.6 Kitchen and toilet shunt duct risers

In accordance with BS 9991, vertical ventilation ducts should be enclosed throughout their height with fire resisting construction. Where a horizontal ventilation duct penetrates the fire resisting construction, BS 9999 recommends four different methods of maintaining the fire separation at the penetration:

- Method 1: thermally actuated fire dampers;
- Method 2: fire resisting enclosures e.g. fire rated plasterboards;

- Method 3: protection using fire-resisting ductwork;
- Method 4: automatically actuated fire and smoke dampers triggered by smoke detectors.

BS 9999 Section 32.5.2.2 also states that Methods 1 and 4 should not be used for extract ductwork servicing kitchens and this is due to the likely build-up of grease within the duct which can adversely affect the effectiveness of any dampers.

In the Barbican Residential Development, it is understood that a common approach to maintain fire separation between flats is to use shunt duct arrangement for the kitchen and toilet extract ventilation ducts. The purpose of shunt duct is to avoid the need for fire protection using the methods described above. A shunt duct arrangement comprises of branch ductwork (‘s’ or inverted ‘s’ shaped) that are connected to the main extract ductwork as shown as Figure 11. In addition to the downward bend of the shunt duct, a fan at the top of the main extract ductwork maintains a negative pressure that stops smoke from spreading out of the ductwork.

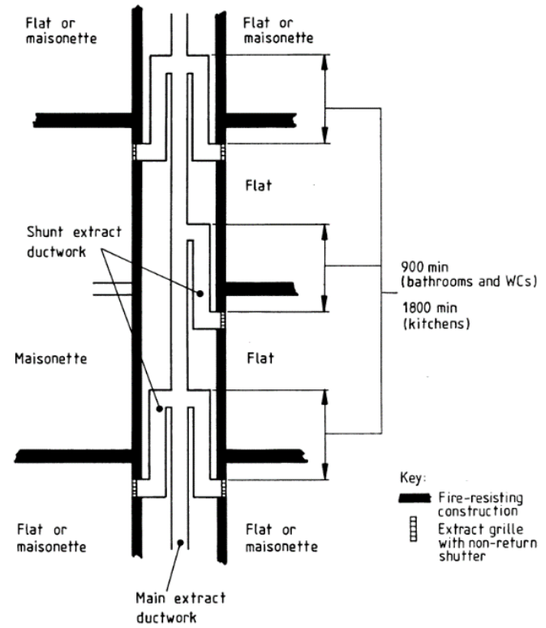


Figure 11: Layout of shunt duct system (BS 5588 Part 9)

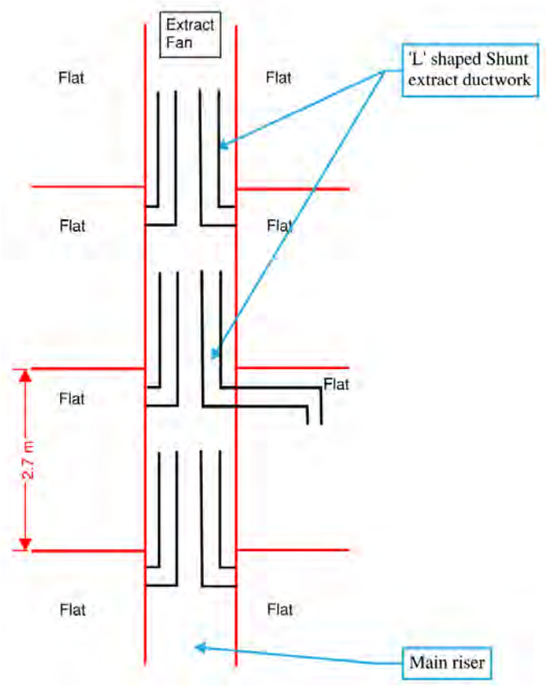


Figure 12: Existing layout of shunt duct system in Mountjoy House

Shunt duct arrangement is a recognised approach in BS 5588-9:1999 – *Fire precautions in the design, construction and use of buildings Part 9: Code of practice for ventilation and air conditioning ductwork*, for extract ductworks serving toilets. However, it is not normally acceptable for use in kitchen extraction because of the fire risk inherent in kitchens. The guidance mentions that if a shunt duct is used for kitchen extraction, careful consideration should be given to possible pressure differentials within the system to avoid the transfer of smoke and other products of combustion from one dwelling to another by means of the ductwork system. This guidance has been withdrawn and is no longer referenced in other current standards including the Approved Document B.

Existing provisions

BE confirmed during the site visit that Mountjoy House uses shunt ducts for both kitchens and bathrooms, each provided with a separate main extract ductwork.

BE confirmed the shunt ducts in Mountjoy House have the same arrangement and material as Andrewes House. However, the dimensions of the shunt ducts are currently unknown.

In Mountjoy House, it is understood that the main kitchen extract riser and the shunt ducts are of concrete construction. Dimensions of the concrete construction are unknown, but likely to have some inherent fire rating. The kitchen extract riser is located within the kitchen and serves all the flats on the same vertical stack. The extract fan is located at the top of the main riser and on continuous operation (BE confirmed the capacity of the current fans are 10 cbm/s). BE also confirmed that the shunt ducts are 'L' shaped as shown in Figure 12 instead of the more common 'S' shaped as shown in Figure 11. The frequency of maintenance and cleaning, and the internal grease builds up within the vertical portion of the shunt ducts and within the main extract risers are unknown.

The toilet extract riser is located within the toilet of each flat and serves all the flats on the same vertical stack. The side backing on to the toilet wall contains asbestos and the rest of the walls are concrete.

Proposed Improvements

Whilst the use of shunt duct in lieu of other forms of fire protection is no longer in line with current UK guidance, their use for toilet extract risers is still allowed in other countries (Australia – AS 1688.1; USA – International Building Code). Considering the low risk nature of toilets and provided that the installations are in line with the details of the guidance, the use of shunt ducts for toilet extract risers is considered acceptable provided improvement is made to increase the reliability on the extract fan.

However, those standards that recognise allow the use of shunt ducts do not recommend them for kitchen extract risers. The presence of grease in the duct may affect the effectiveness of the shunt system in maintaining fire and smoke separation. Failure of compartmentation between the flats presents a life safety risk to the occupants.

Provision of a fire detection and alarm system is one of the improvements, providing early warning before the single escape route via the flat entrance is compromised. In addition, the risk of fire spread via the shunt duct can be reduced by replacing the existing extract hoods with recirculation type extract hoods and maintaining the compartmentation between the flats.

Recommendations:

It is recommended to replace the existing kitchen extract hoods with recirculation type hoods, and implement one of the following:

- Smoke and fire damper at the shunt duct riser activated by the fire alarm/detectors within the flat (this maintains the use of the riser for normal ventilation of the flat); or
- To block off the shunt ducts and provide a fan on the external wall to draw out air from the flat into the balconies; or
- Maintain the existing extract hoods and shunt duct arrangement by increasing the reliability of the main extract fan. This will require an additional duty standby fan (the fans to be rated at 400 ˚C for 90 minutes in accordance with BS EN 13501-4), with secondary power supply. The fans need to be adequately maintained to keep the main riser under negative pressure.

4.4 External fire spread

4.4.1 Fire spread to neighbouring buildings

Buildings must maintain the minimum separation distance from the site boundary to protect themselves and adjacent buildings against external fire spread. A building that is located less than the required separation distance from the site boundary will be required to be provided with mitigation measures to prevent fire spread such as fire rated external walls. In accordance with BS 9991, there are four methods used to determine the maximum permissible amount of unprotected façade. In this case, the most appropriate method is the enclosing rectangle in line with BR 187.

Existing arrangement

There is no information available on the location of the site boundary in relation to Mountjoy House. If there are no site layout available, the building boundaries or the relevant boundaries will be measured using Google Maps as shown in Figure 13 and as follows:

- North: 118.3 m
- East: 33.1 m
- South:42.6 m
- West: 13.8 m

An external fire spread calculation has been undertaken for a single flat using the above assumed boundary distances and Figure 13. The enclosing rectangle method in line with BR 187 was carried out. The results show that no protection is required to the facades. Please refer to Appendix B for the calculation.

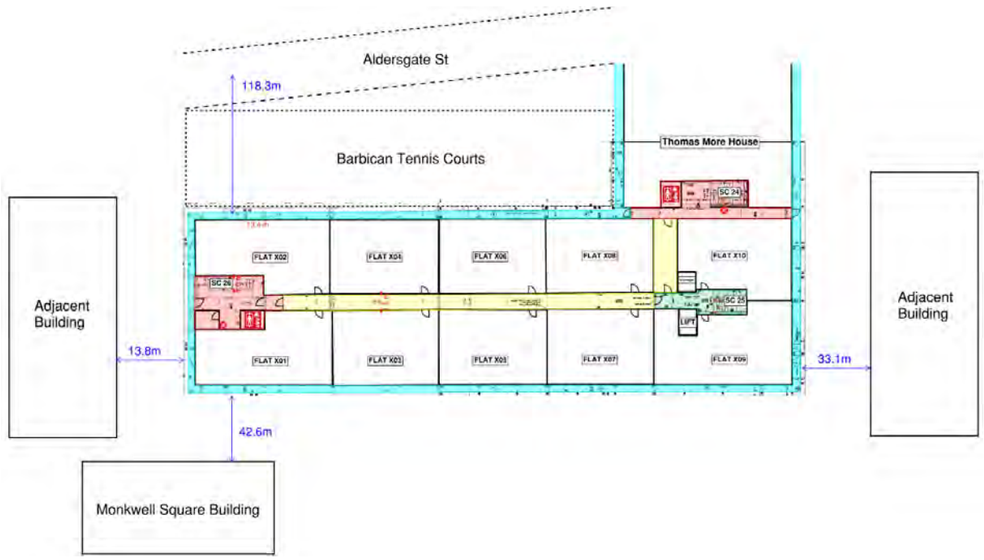


Figure 13: Existing arrangement for Mountjoy House and adjacent buildings

4.4.2 Façade materials

BS 9991 recommends the following material classifications for external surfaces of the façade of buildings greater than 18 m in height:

- Areas < 1 m from the boundary – Class 0 (National class) or Class B-s3, d2 or better (European class);
- Areas > 1 m from the boundary and > 18 m in height – Class 0 (National class) or Class B-s3, d2 or better (European class).

The Building Regulations also require materials which become part of an external wall (i.e. cladding material, insulation product, filler material – not including gaskets, sealants and similar) and specified attachment (e.g. balcony) of a residential building with a storey at least 18 m above ground level to achieve European classification A2-s1, d0 or Class A1, classified in accordance with BS EN 13501-1:2007+A1:2009 entitled 'Fire classification of construction products and building elements. Classification using the test data from reaction to fire tests'.

In addition, the Grenfell Tower Inquiry: Phase 1 report recommends that the owner and manager of every high-rise residential building be required by law to provide their local fire and rescue service with information about the design of its external walls together with details of the materials of which they are constructed and to inform the fire and rescue service of any material changes made to them.

Existing provisions

It is assumed all elevations of Mountjoy House are provided with solid concrete construction. This is to be confirmed by BE.

The concrete panel is considered to achieve Class A1, and therefore it meets the recommendations of BS 9991.

In the case of balconies, BE confirmed the build-up consists of concrete paving slabs sitting on top of a felt membrane. The felt is a membrane and therefore under Regulation 7(3) of Approvement Document B, is exempt from having to meet the requirements for a European Classification of A2-s1, d0 or better.

It is also recommended to provide information about the design of external walls and details of the materials in the fire notice box for the fire and rescue service to be able to have access to the information when they arrive on site.

4.4.3 Roof materials

BS 9991 recommends buildings where the roof is at least 6 m away from any point on the relevant boundary needs to be provided with a roof covering designation of minimum AD or BD in line with BS 476-3 (equivalent to $E_{roof}(t4)$ classification in line with BS EN 13501-5 European classifications)

Existing provisions

No information provided. BE to confirm roof material to carry out further review.

4.5 Access and facilities for the fire service

4.5.1 Fire main inlet

BS 9991 recommends buildings fitted with dry fire mains should have fire appliance access:

- within 18 m of, and within sight of, a suitable entrance giving access to the dry fire main; and;
- within sight of the inlet for the emergency replenishment of the suction tank for the dry fire main.

Existing provisions

Mountjoy House is provided with one dry riser main inlet point for Staircase 26 and another inlet point for Staircase 24 located within the car park area in L03, with outlets that can be accessed as shown in Figure 14.

The dry riser inlet for Staircase 24 is labelled for Thomas More House, even though it also serves as the second firefighting shaft for Mountjoy House.

Recommendations:

- Engagement with London Fire Brigade to familiarise them with the firefighting access and facilities to Mountjoy House, in particular the sharing of Staircase 24 with Thomas More House.
- Amend the label for the dry riser inlet for Staircase 24, to include the name for Mountjoy House.

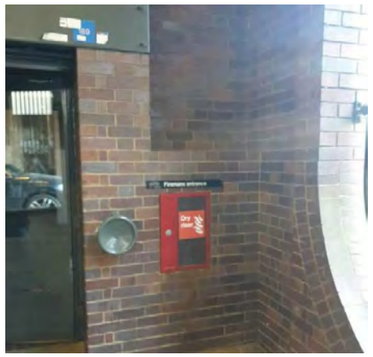


Figure 14: Fire inlet points for Staircase 26 (left) and Staircase 24 (right)

4.5.2 Fire service access

BS 9999 recommends that the distance between the fire vehicle parking location to the firefighting entry point of the building should not exceed 18 m in length. In addition, the entry to the firefighting shaft at fire and rescue service access level (vehicle access level) should be directly from open air or by way of a protected corridor not exceeding 18 m in length.

Existing arrangement

Firefighting access into the building is directly from the carpark area at L03, accessed via Aldersgate Street where the firefighting vehicle has space to park in front of either Mountjoy House or Thomas More House as shown in Figure 15. The distance between the fire service vehicle parking location and the inlet point needs to be confirmed by BE.

Figure 15: Fire vehicle parking location

4.5.3 Facilities for the fire service

BS 9991 recommends buildings with a floor higher than 18 m above fire and rescue service access level should be provided with firefighting shaft(s) containing firefighting lifts. A sufficient number of firefighting shafts should be provided to meet the maximum hose distance of 45 m to cover all parts of the building.

Firefighting shafts should be constructed in accordance with the recommendations given in BS 9999.

Mountjoy House is provided with one firefighting shaft (Staircase 26) and an additional firefighting shaft from Thomas More House (Staircase 24). Both are provided with a firefighting stair, dry riser, fireman's lift and firefighting lobby.

4.5.3.1 Firefighting stairs

BS 9999 recommends a firefighting stair should have an unobstructed width (measured between the walls and / or balustrades) of 1.1 m. the width should be kept clear for a vertical distance of 2.0 m.

BS 9999 also recommends only services associated with the firefighting shaft should pass through or be contained within the firefighting shaft.

Existing provisions

The firefighting stair in Mountjoy House connects L03 (car park level) to L7 with a width of 1000 mm.

There is a plant room within the firefighting stair landing areas as shown in Figure 16 below. The door should be inspected to determine the fire rating and to maintain fire separation from the firefighting stair.

Figure 16: Plant room within Staircase 26

Recommendations:

- Refer to Section 4.3.3 for fire doors.
- Engagement with London Fire Brigade to discuss the firefighting access routes and the reduced stair width.

4.5.3.2 Firefighting lobby

BS 9999 recommends the firefighting lobby to have a clear floor area of not less than 5 m^2 and not exceed 20 m^2 for lobby serving up to four lifts. All principal dimensions should not be less than 1.5 m. The purpose of not allowing a large lobby area (exceeding 20m^2) is to avoid the lobby being used for storage.

Existing provisions

There is a protected lobby which separates the Staircase 26 from central corridor leading to the rest of the flats. Staircase 24 is also separated from Staircase 25. The current arrangement is considered acceptable as there is an additional layer of separation between the protected stairs from the flats.

During the site visit, it was noted that the central corridor and the Staircases 24 and 26 are relatively free from storage and decorative items.

4.5.3.3 Firefighting lifts

In line with BS 9991 and BS 9999, new firefighting lifts installations should be in accordance with BS EN 81-72:2020.

In addition, the Grenfell Tower Inquiry: Phase 1 report recommends that the owner and manager of every high-rise residential building be required by law to carry out:

- Regular inspections of any lifts that are designed to be used by firefighters in an emergency and to report the results of such inspections to their local fire and rescue service at monthly intervals;
- Regular tests of the mechanism which allows firefighters to take control of the lifts and to inform their local fire and rescue service at monthly intervals that they have done so.

Existing provisions

There are firemen's override switch for each lift, located at the fire service access level. However, BE advised that the lifts do not meet the current standard for firefighting lift and do not have any backup power supply.

BE to confirm specification for lifts in Staircase 24 to 26, and the design standards for those lifts.

4.5.3.4 Smoke control for firefighting lobby and stair

BS 9991 recommends that all firefighting shafts should be provided with a smoke ventilation system.

In buildings with balcony approach, the firefighting stair should be provided with an openable vent with a free area of 1 m^2 at the top of the stair, which can be remotely operated at fire and rescue service access level. In addition, a minimum ventilation opening of 1.5 m^2 (free area) is to be provided for the firefighting lobby at each level.

Existing provisions

Staircase 24 has a vent at the top of the stair (dimensions not available) that is manually activated from a switch at the fire service access level (Level 03). At each level, the stair lobby (also the lift lobby) has a vent that opens onto the external balcony. Refer to the Figure 17 below.

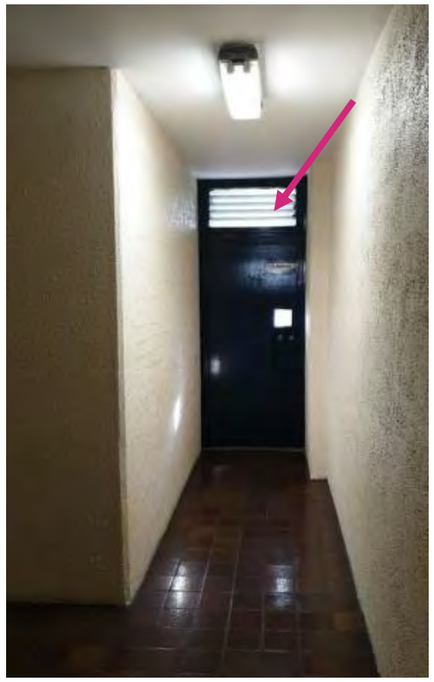


Figure 17: Stair/lift lobby vent (red arrow) for Staircase 24

Staircase 26 has a louvred door (louvre area is 1.5m x 0.55 m – unlikely to achieve 1m^2 free area) at the top of the stair that opens onto the external balcony. The lift is within the stair enclosure. A lobby separates the stair from the common corridor at each level. The lobby opens into a vent shaft at every level via an openable window as shown in Figure 18 (with Georgian-wired glass). Some of these windows were in the open position and will cause smoke to spread between the floors if smoke were to enter the lobby.

Figure 18: Openable vents in the firefighting lobby to Staircase 26 upper portion (left), open position (right)

Recommendations:

- Keep the windows at the vent shaft (Staircase 26) shut.
- Engagement with London Fire Brigade to inform them of the ventilation arrangement for the shafts.

4.5.4 Dry riser and hose coverage

BS 9991 recommends buildings greater than 18 m and less than 50 m in height should be provided with a dry riser system. In the case of unsprinklered buildings, no part of a storey should be more than 45 m from a riser outlet located in the firefighting shaft.

Existing provisions

There are dry riser outlets located within each of the firefighting stair enclosures as shown in Figure 19. All areas of the building are within 45 m.

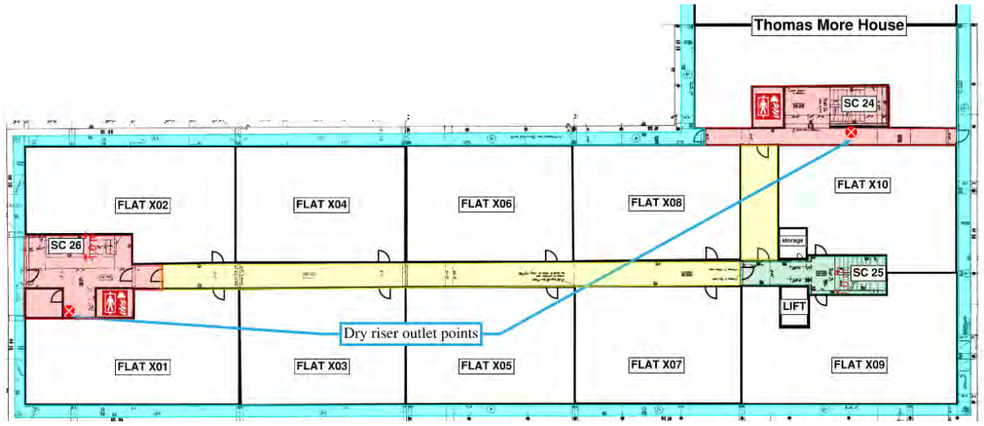


Figure 19: Dry riser outlet points in the building

4.5.5 Water supply for firefighting operations

External hydrants should be provided within 90 m of a dry fire main inlet. Based on the information provided from BE, existing hydrant is within 90 m of Mountjoy House.

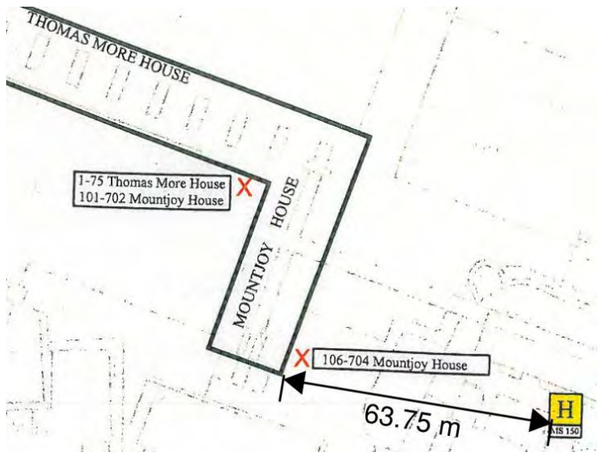


Figure 20: Location of existing fire hydrant

4.6 Fire safety management

In addition to the active and passive fire safety precautions described in the previous sections, robust fire safety management plan and procedures are important for maintaining the fire safety of a building in a holistic manner. In preparing a fire safety management plan (Arup is not aware of an existing plan), the relevant items to be included in the plan are listed and described in Table 4 below. These are based on the recommendations in BS 9991.

Table 4: Fire safety management

Item	Proposed Design
RR(FS)O	Under the Regulatory Reform (Fire Safety) Order legislation, the owner of the building (BE) is fully responsible for fire safety. This includes on-going fire risk assessment, appropriate maintenance of fire safety systems and training of staff. Although not required by fire safety guidance, it is recommended for the fire risk assessment to include the internal areas of the apartments (for example a spot check of vacant apartments). This will serve to mitigate the risk of any amendments to the building which may have an adverse impact on the fire strategy safety (e.g. breaches in compartmentation).
Fire awareness of residents	Due to the nature of residential premises whereby it is difficult to enforce fire safety management within the apartments, there is risk of the residents' actions affecting the implementation of the fire strategy – e.g. by covering smoke detectors or creating penetrations in compartment walls. To minimise the risk of occupants affecting the performance of the fire safety features in the building, all residents must be made aware of their responsibilities in regard to fire safety at the beginning of their residence. It is recommended for all relevant fire safety information should be provided in a tenant handbook. It is the responsibility of the building operators to inform the residents of the defend-in-place evacuation strategy. Residents should also be informed that they are always provided with the option to leave and that they do not have to stay in place in the event of a fire.
Evacuation of PRMs	The evacuation of PRMs will need to be carried out by the BE staff or the fire and rescue service. The responsible person for fire safety (as defined under the RR(FS)O) will need to ensure that each PRM has a personal emergency evacuation procedure (PEEP), and where required, sufficient training and equipment are provided to staff to assist with the evacuation.
Staff training	Sufficient number of BE staff should be adequately trained in fire prevention, fire protection and evacuation procedures including evacuation of PRMs.
Maintenance and testing	An accurate record of fire precautions and procedures for operating and maintaining any fire protection measures within the building, are necessary to enable the owner or end user to plan, document and implement control processes for maintenance and testing of fire safety systems to ensure that they operate effectively in the event of a fire.

Item	Proposed Design
	The External Fire Risk Assessment prepared by Frankham Risk Management Services in January 2018 states that maintenance records have not been recorded up to date and requires to be updated. This includes systems such as: • Firefighting lifts; • Fire alarm and fire detection system; • Fire doors; • Emergency lighting and signage; • Fire stopping registers; • Records of fire brigade attendance.
Control of work on site	The means to control work on site should be determined (e.g. repairs to structure, hot work, cleaning of ductwork). A work control system should include clear lines of responsibility communicated to contractors.
Emergency planning	A good relationship with the fire and rescue service has benefits as it ensure that the fire and rescue service is able to have an appropriate pre-determined response strategy for Mountjoy House and enables the owner to seek advice where appropriate. Any changes affecting the layouts, fire safety systems, fire growth characteristics, and other relevant factors should be communicated to the fire service.
Fire safety documentation	Fire safety information that sets out the basis on which the fire safety design was planned (i.e. this Fire Strategy Report), the fire safety management plan, the staff responsibilities etc. should be kept up to date and stored in a document management system that allows the information to be easily retrieved in the future.
General housekeeping	Good housekeeping is essential to reduce the likelihood of a fire starting or developing, and escape routes being blocked. This includes: • Maintaining all escape routes free from obstruction/ or combustibles; • Fire doors to perform as intended; • Arrangement for waste control and disposal or accumulation of waste; • Floor surface of escape routes to be maintainable, even and slip-resistant. The Fire Risk Assessment also states that fire extinguishers should be removed from the building as it could be mishandled by the residents who are not trained. The management team sure ensure there are no fire extinguishers in the common areas of the building.

5 Conclusion

The purpose of this fire safety review of Mountjoy House has been to determine the existing intent of the fire safety design and to record the findings in a fire strategy report (this document).

This report describes the existing fire safety precautions in the building and compares them with current standards BS 9991 and BS 9999, and where applicable the latest update of the Approved Document B Volume 1.

Where the fire safety precautions comply with the current standards, no further action is proposed and the fire information will form part of the building fire strategy. Where the precautions are not deemed to comply with the current standards, they have been qualitatively assessed to identify the life safety risks to the building occupants due to those non-compliances. The outcomes of the assessment will result in one of the following:

- Where considered acceptable to remain as existing, recommend retaining the current provisions as long as the provisions are being maintained in good operation conditions; or
- Recommendations on possible options for enhancements/upgrades where the current fire safety provisions are considered inadequate;

BE will then consider any constraints to implement the recommendations made by Arup.

Refer to Table 1 for the full list of recommendations and the reasons/benefits behind those recommendations.

Appendix A

Fire Strategy Mark up

A1 Means of warning and escape

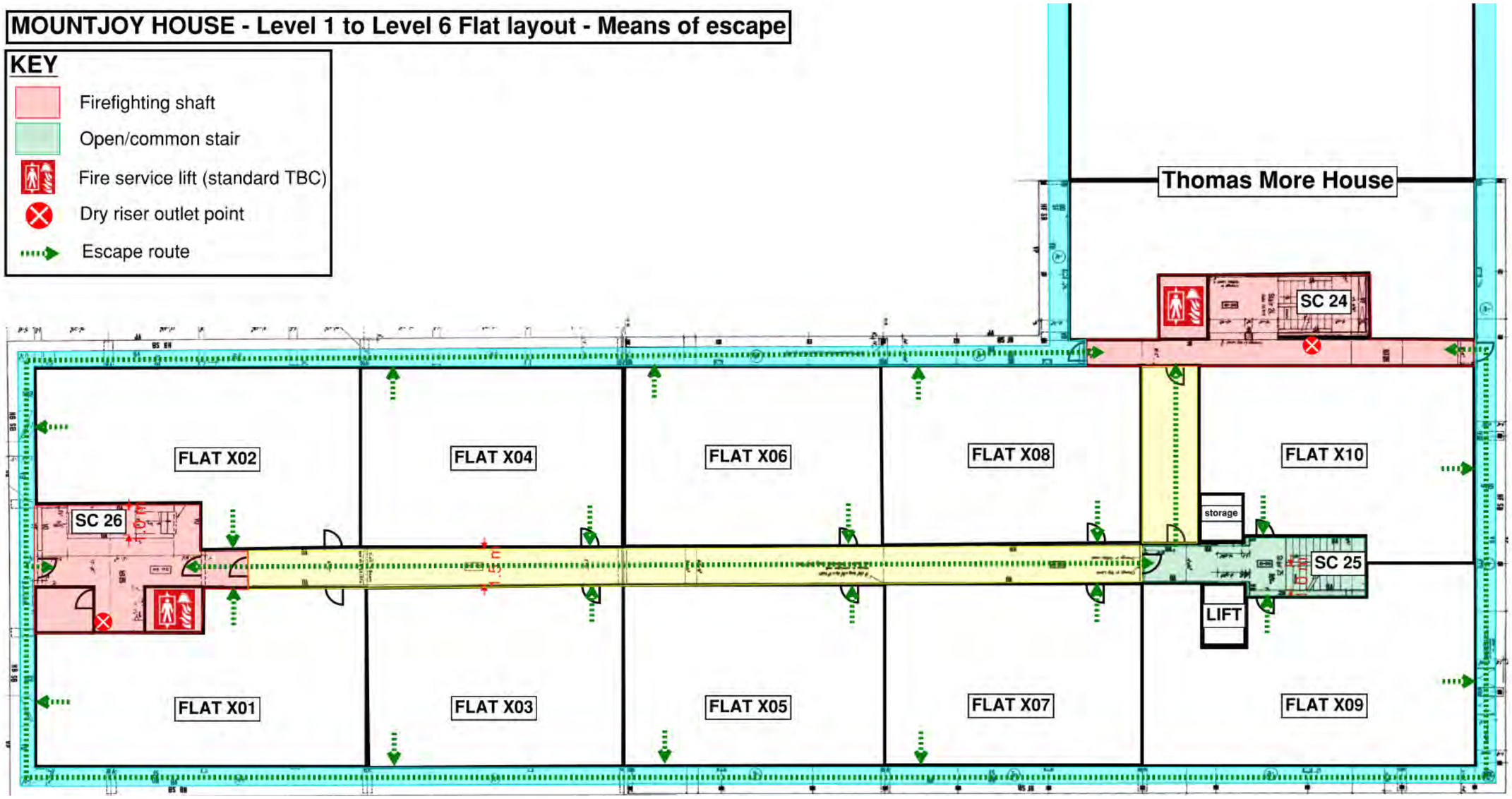


Figure 21: Means of warning and escape for typical residential level (L1 - L6)

A2 Firefighting access and facilities

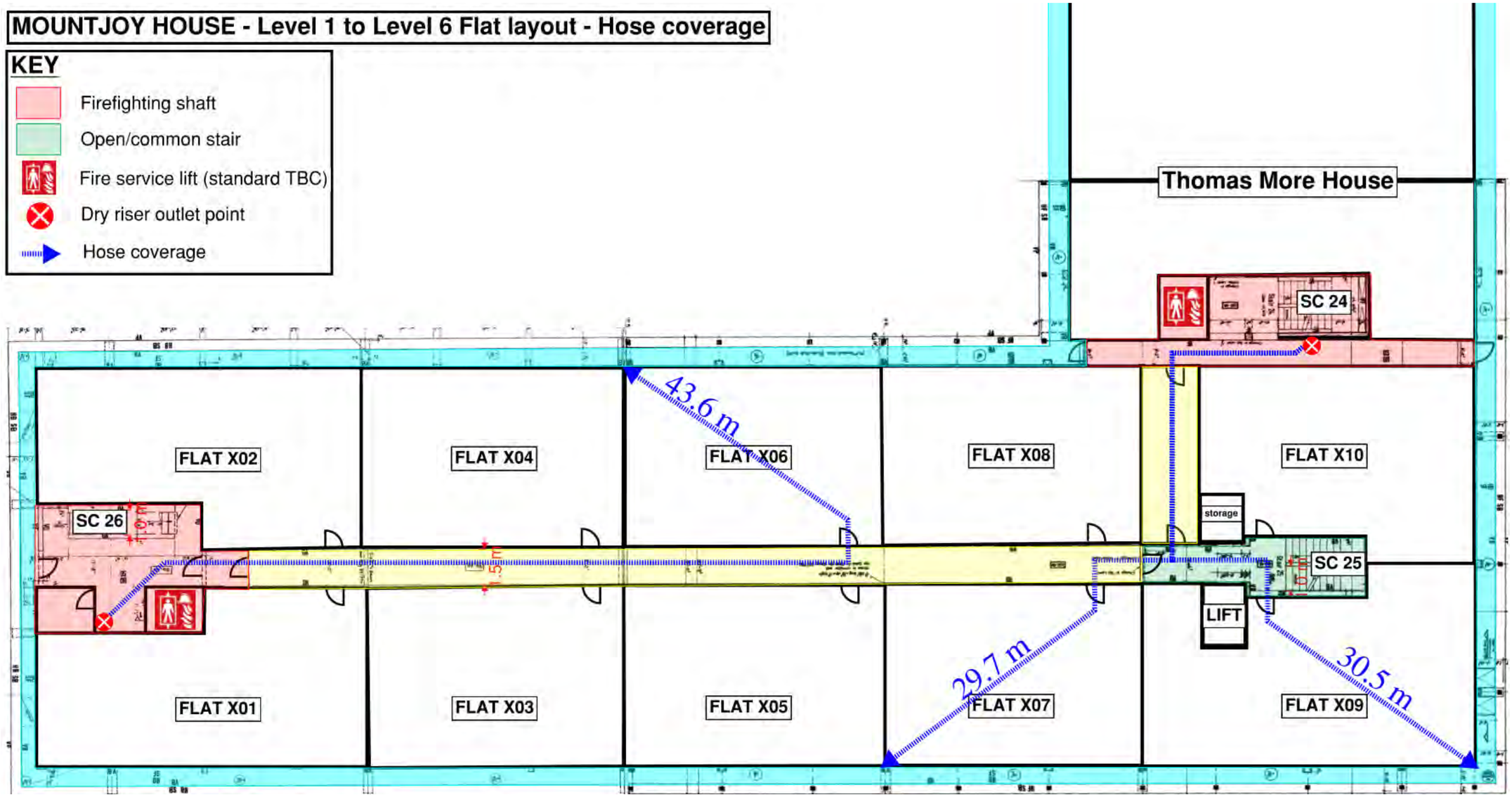
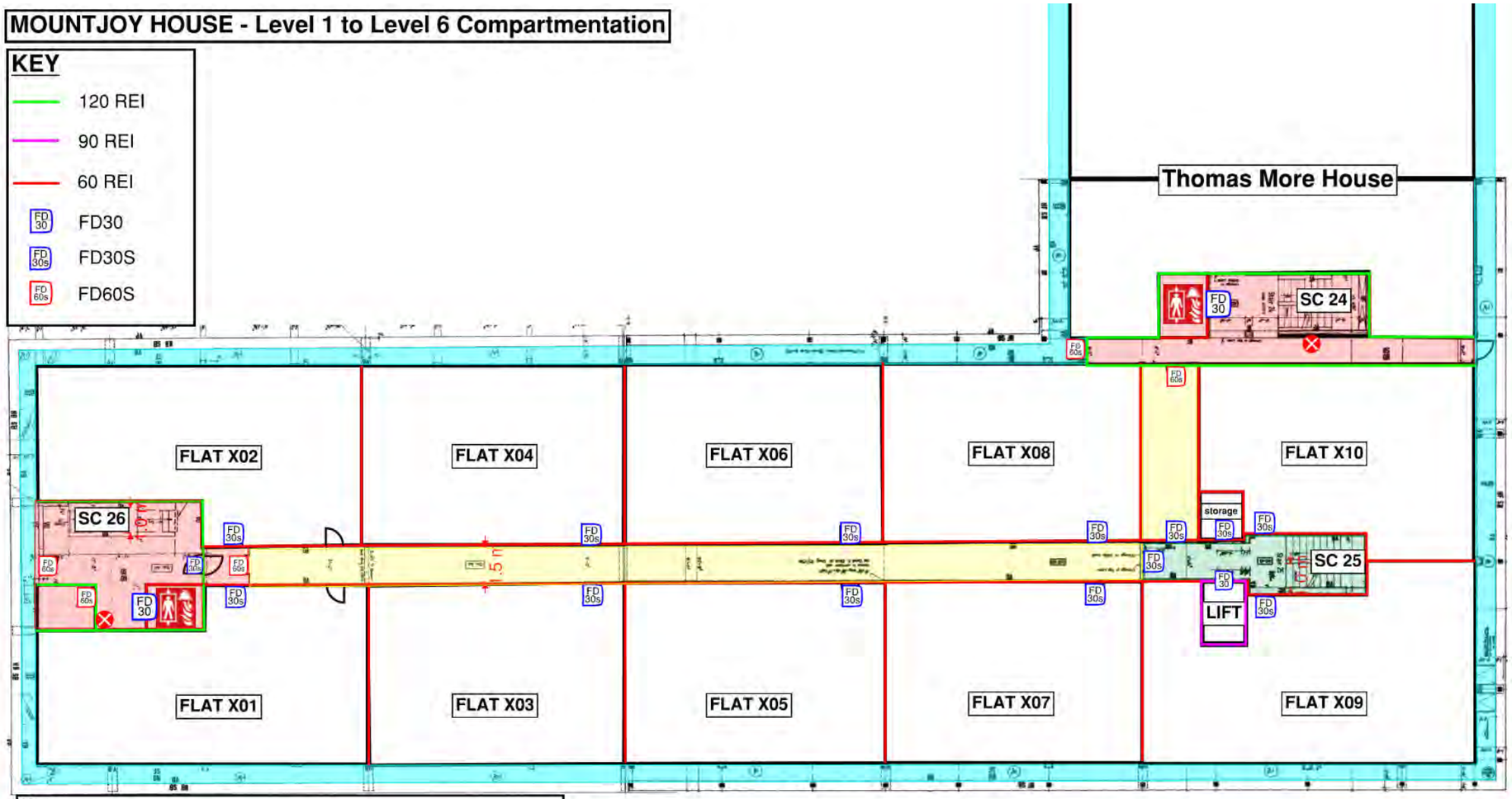


Figure 22: Firefighting facilities and access for Mountjoy House for typical residential level (L1 - L6)

A3 Compartmentation



Note:

Compartmentation requirements

Compartment floor: 90 REI

Wall between flats: 60 REI

Wall between flats and common areas: 60 REI

Firefighting stairs: 120 REI

Shafts (lifts included): 90 REI

Fire Doors

Doors from flat to central corridor: FD30S

Door from central corridor to firefighting stairs: FD60S

Door from central corridor to common stair: FD30S

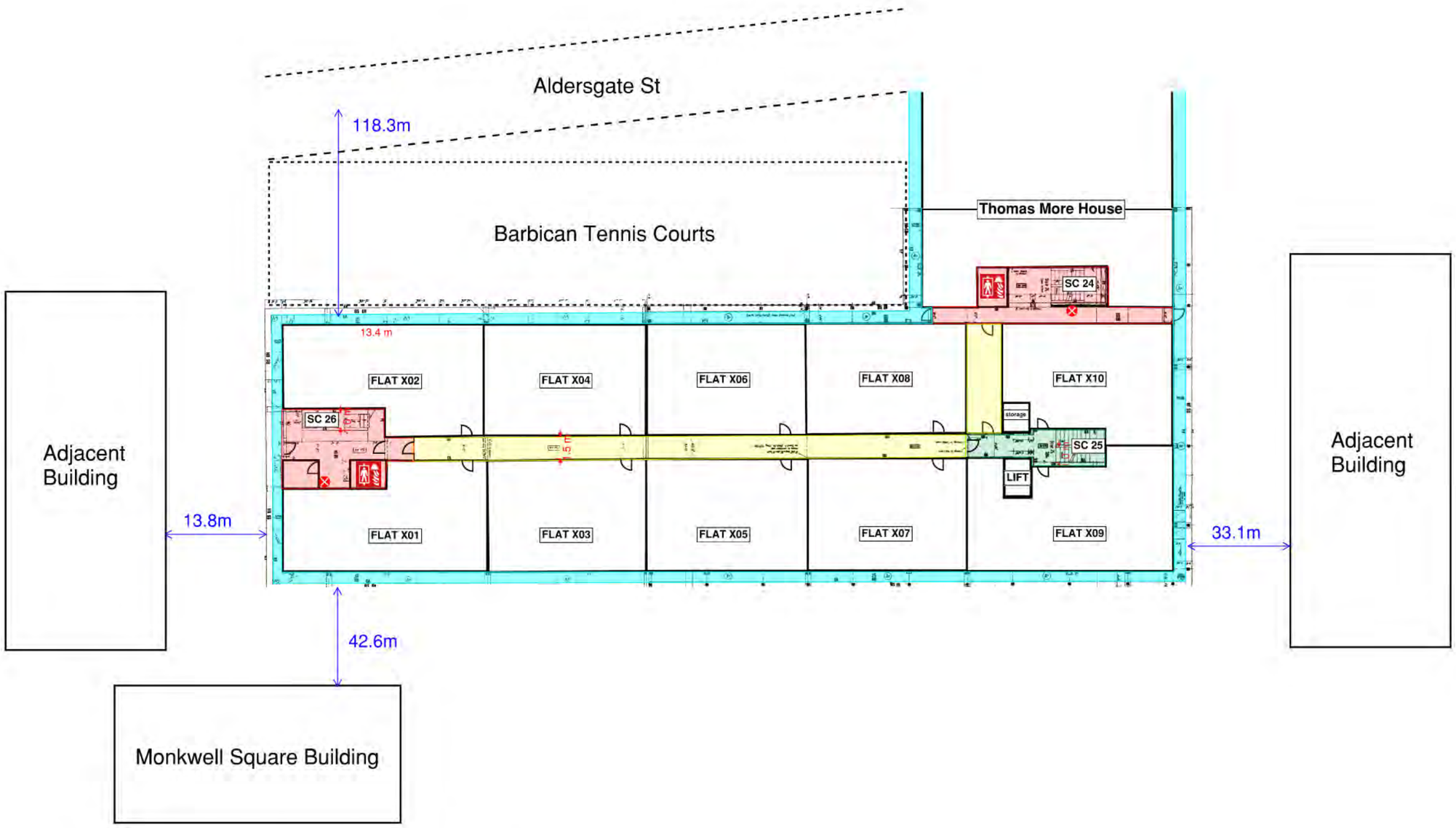
Firefighting lift doors: FD30

Common lift doors: FD30

Figure 23: Mountjoy House compartmentation

Appendix B

External Fire Spread Assessment



External Fire Spread Calculation - All within the required minimum separation distance

Case ID	Group ID	Purpose Group	Method ID	Calculation Method	Height (m)	Width (m)	Boundary (m)	Unprotected (%)
Flat X01_S	1	Residential (Dwellings)	2	Minimum Separation Distance	2.70	13.40	3.53	100.0
Flat X01_W	1	Residential (Dwellings)	2	Minimum Separation Distance	2.70	5.40	2.50	100.0
Flat X09_E	1	Residential (Dwellings)	2	Minimum Separation Distance	2.70	8.30	2.99	100.0
Flat X02_N	1	Residential (Dwellings)	2	Minimum Separation Distance	2.70	13.40	3.53	100.0

Figure 24: EFS assessment calculation for Mountjoy House

Appendix C

PlanRadar Report

BARBICAN RESI - MOUNTJOY HOUSE

Created on: 08/03/2022 10:33 AM
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Project code: 279095-00
Project start: 07/03/2022
Project end:

Country:
Client Name: Barbican Estate
All tickets: 17

Created by: Arup Fire Plan Radar 9
Street:

Zip code:
City:
Project description: Barbican Residential Retrospective fire strategy
Project website:

Open tickets: 17

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Number of extensions: 0
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Non compliant with the Fire Strategy: No

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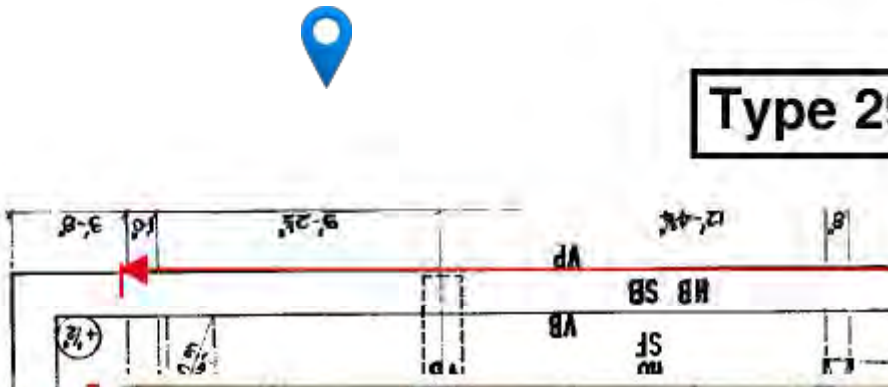
Updated: 07/03/2022 02:11 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



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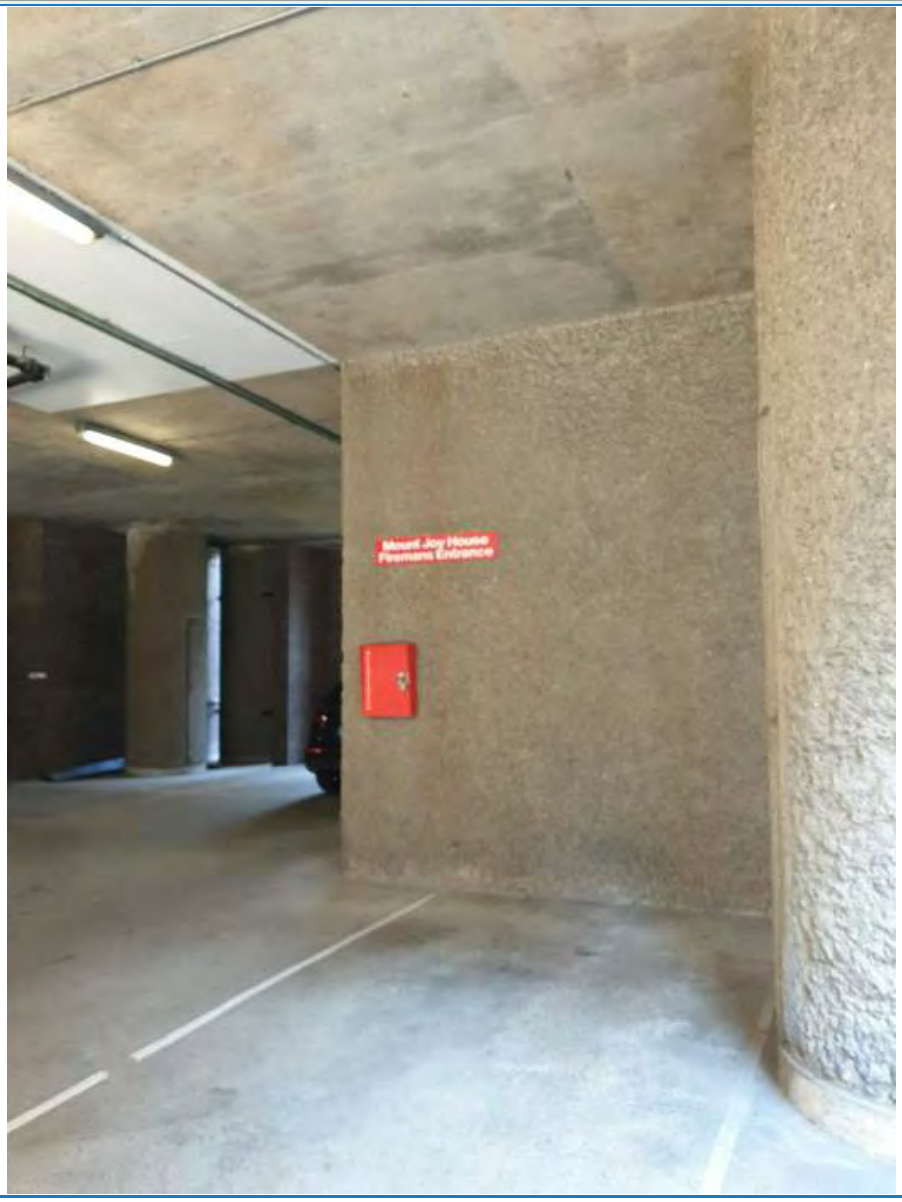

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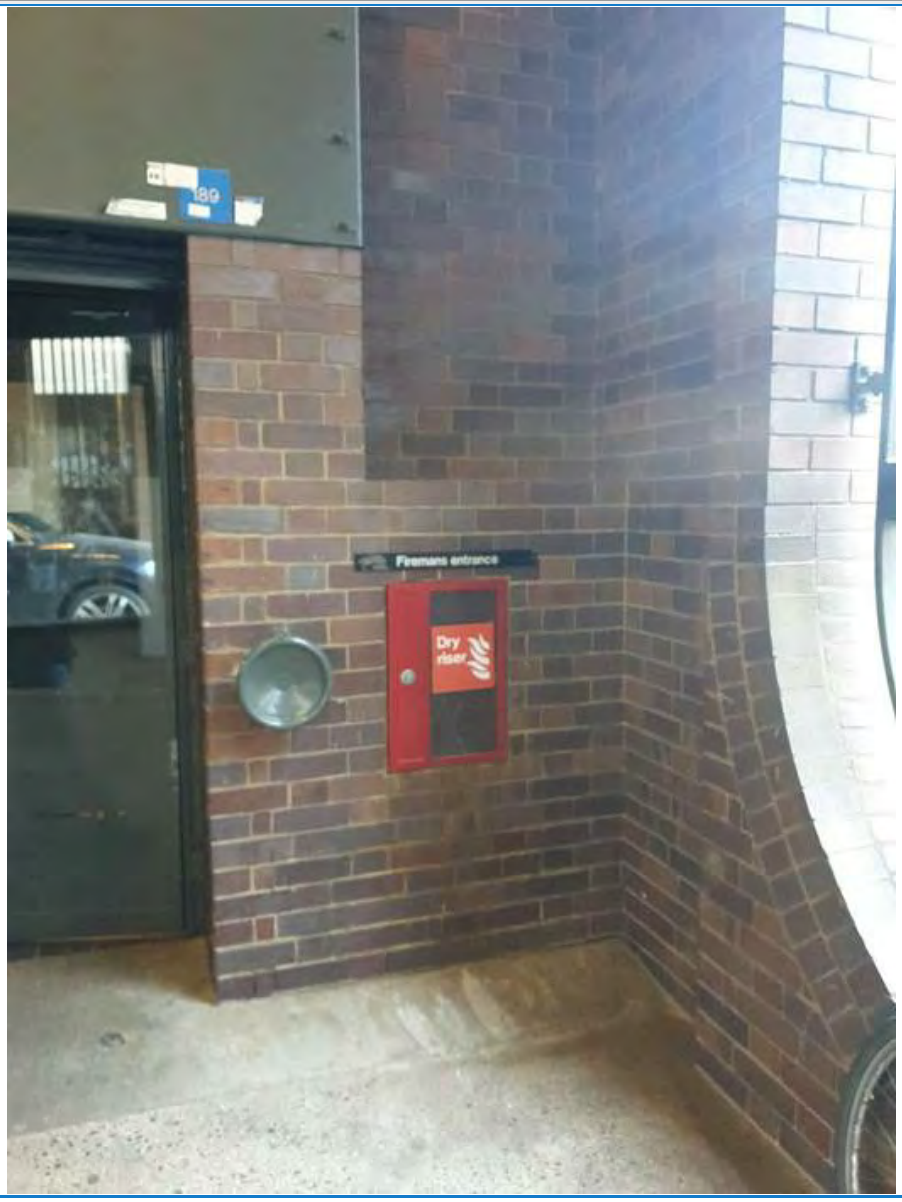
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:



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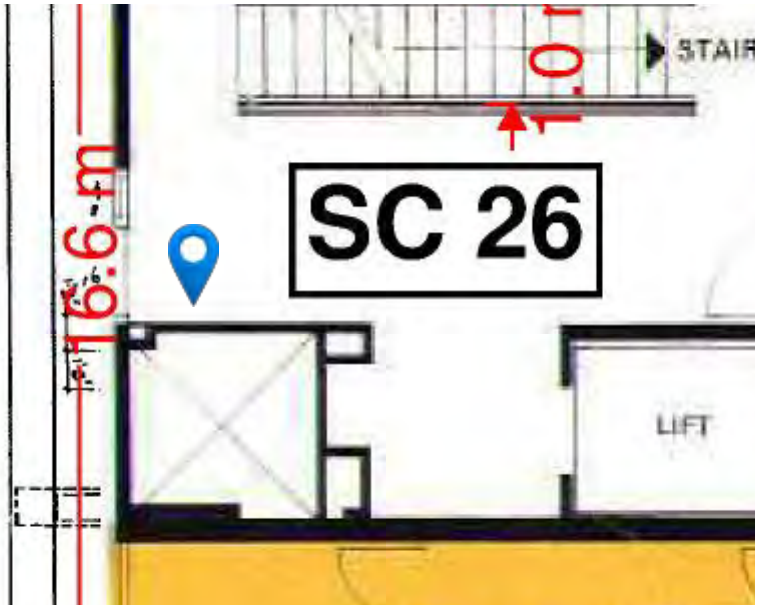
Compliant with the Fire Strategy?: No
Details:

Plan:



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Updated: 07/03/2022 02:15 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:

1. 07/03/2022 02:14 PM

Form: General

Title: podium level stair separated on the right and lift on the left, stair on the right is separated for l01 -l03 and above podium levels

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Number of extensions: 0
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Created on: 07/03/2022 02:17 PM
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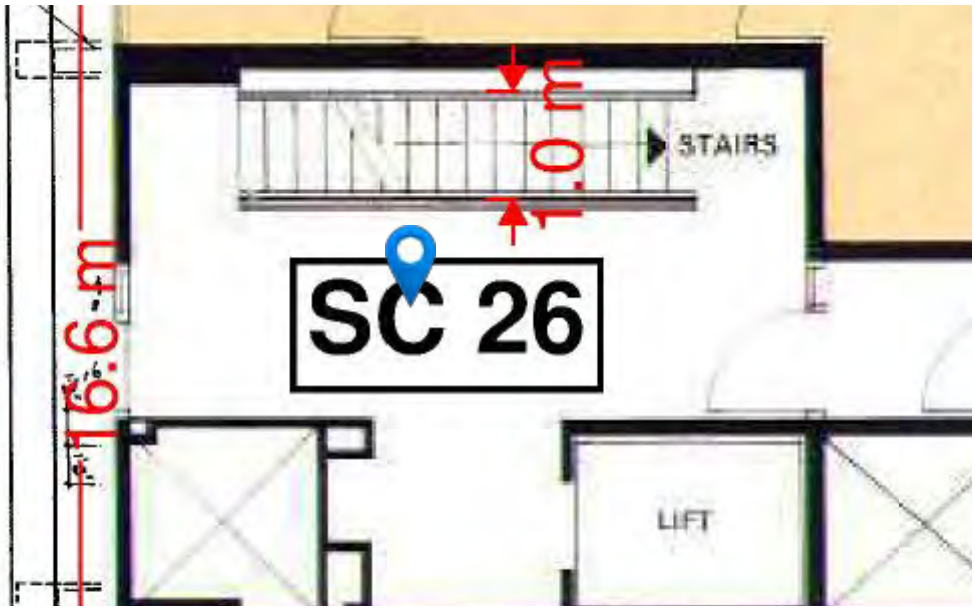
Non compliant with the Fire Strategy: No
Details:

Plan:



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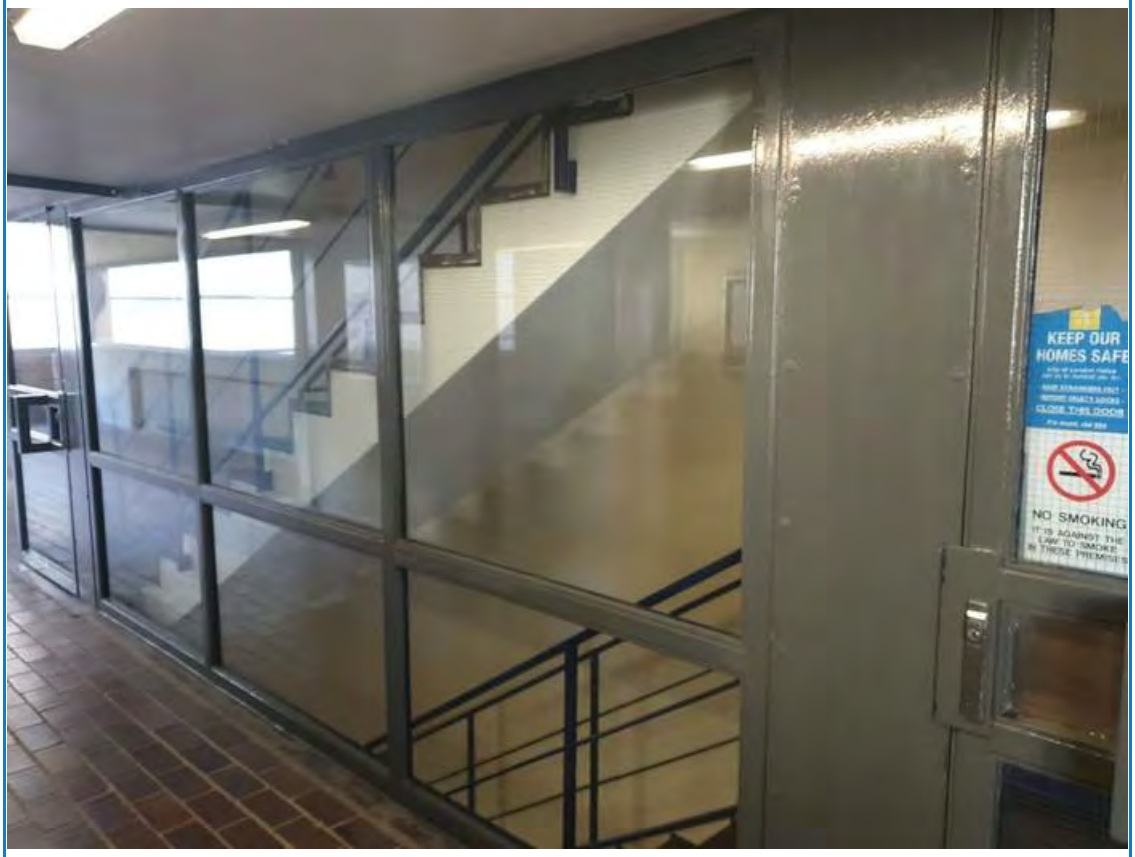

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Date:
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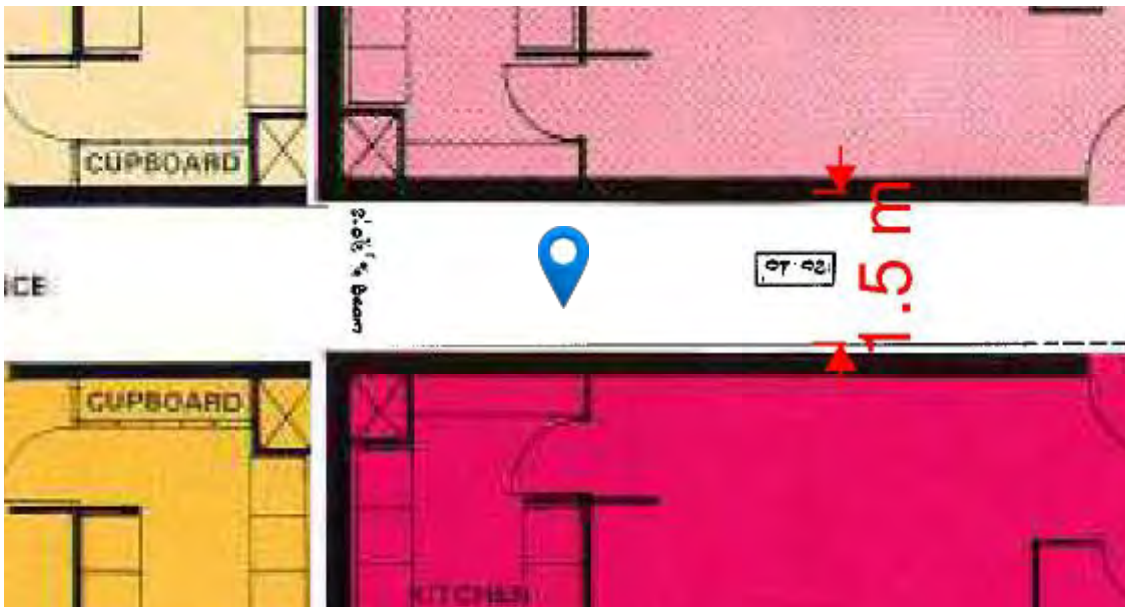
Details:

Plan:



Images:

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Non compliant with the Fire Strategy: No

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ID: 8
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Updated: 07/03/2022 02:21 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:

1. 07/03/2022 02:20 PM

Form: General

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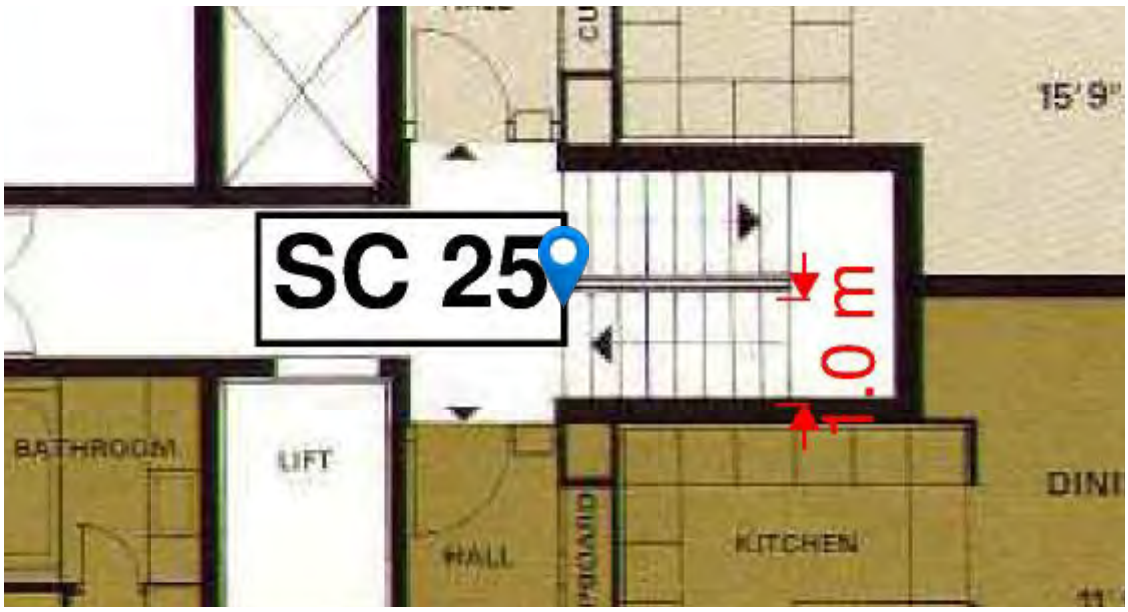
Created on: 07/03/2022 02:24 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Title: open stair with no doors for the next to flats
ID: 9
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:24 PM
Time:
Non compliant with the Fire Strategy: No

Plan:



Form: General

Layer: GF
Number of extensions: 0
Created on: 07/03/2022 02:29 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Title: infirmation on lift 24 25 26 will be sent through
ID: 10
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:29 PM
Time:
Non compliant with the Fire Strategy: No

Plan:

Form: General

Layer: GF
Number of extensions: 0
Created on: 07/03/2022 02:31 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Title: l7 to use ladder to go up the roof level with all plant rooms
ID: 11
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:31 PM
Time:
Non compliant with the Fire Strategy: No

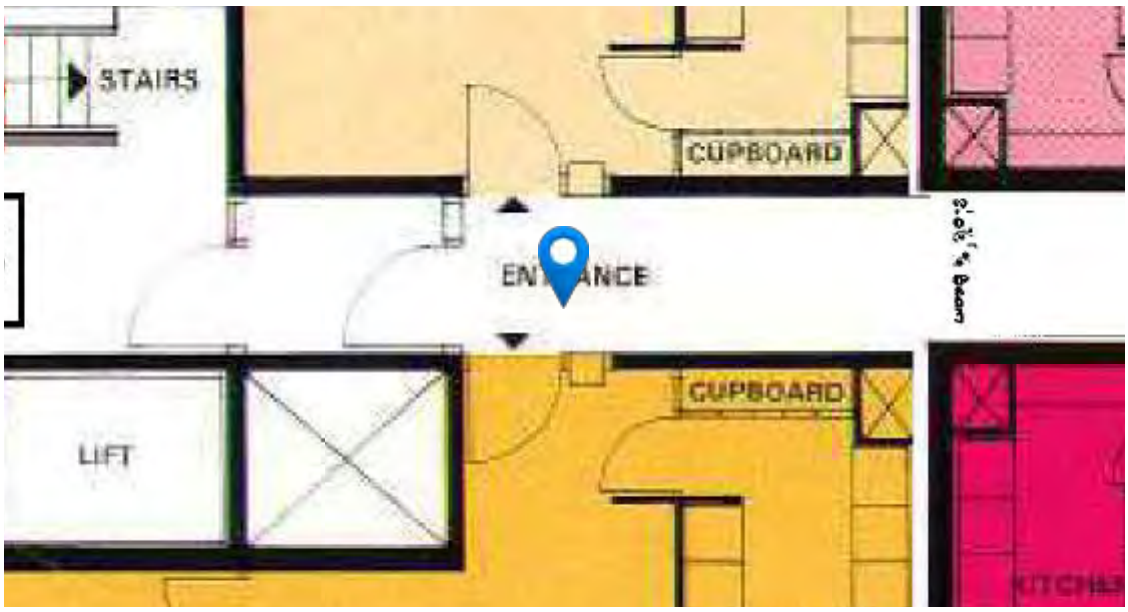
Plan:

Form: General

Layer: GF
Number of extensions: 0
Created on: 07/03/2022 04:13 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Title: sign to be provided to show access level
ID: 44
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 04:13 PM
Time:
Non compliant with the Fire Strategy: No

Plan:



Form: General
Layer: GF
Number of extensions: 0
Created on: 07/03/2022 04:14 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: l03 lift sc 25 doesnt have fire control
ID: 45
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 04:14 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

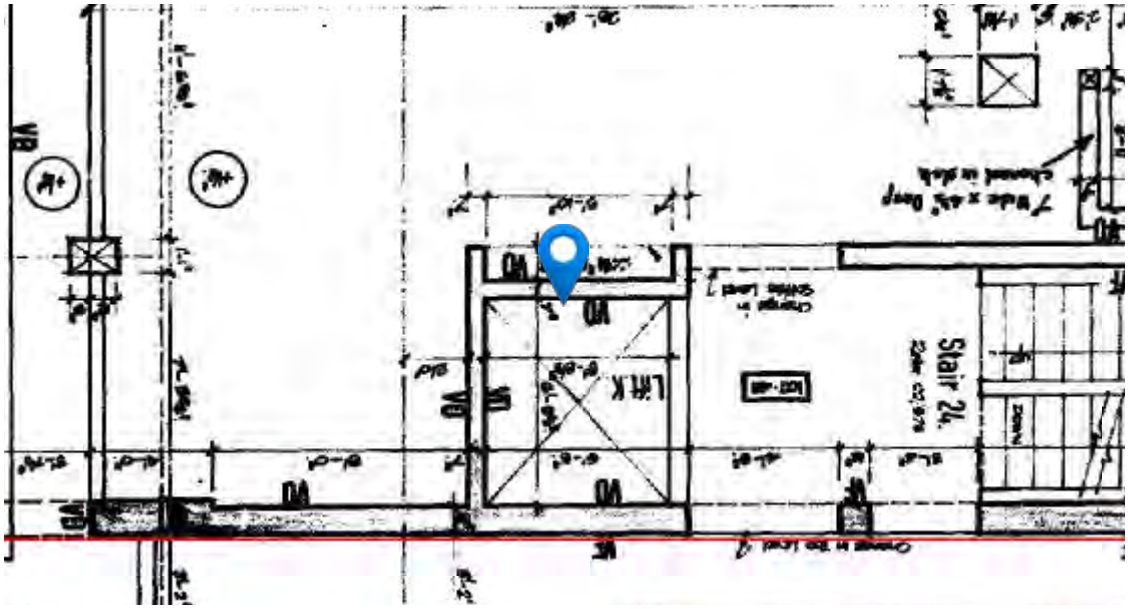
Images:

1. 07/03/2022 04:14 PM

Form: General
Layer: GF
Number of extensions: 0
Created on: 07/03/2022 04:16 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: l03 sc 24 smoke vent and ff lift
ID: 46
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 04:16 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



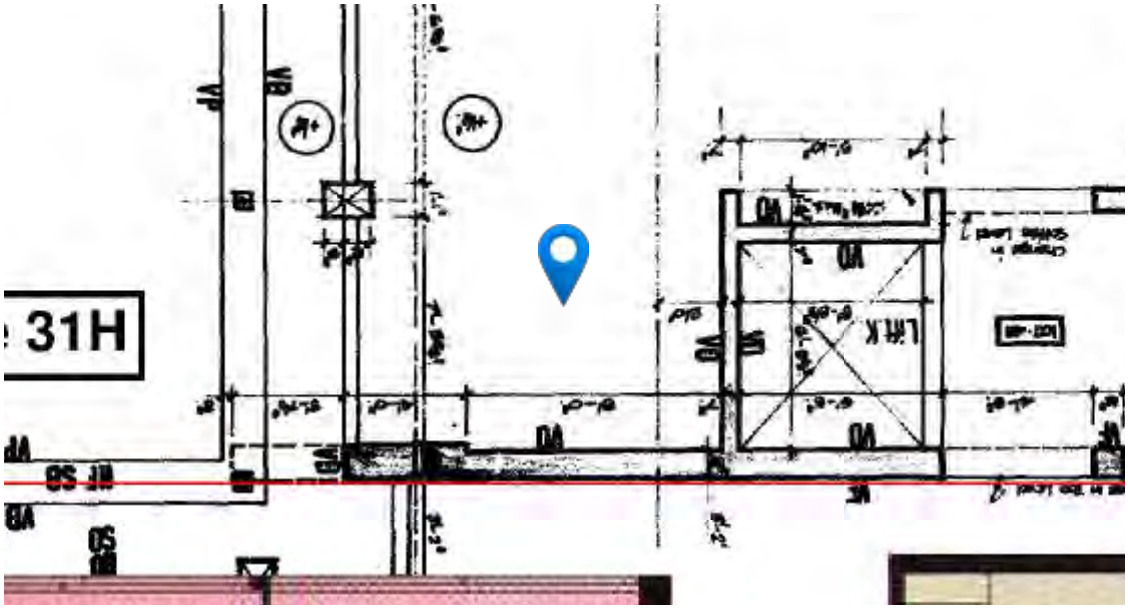
Images:

1. 07/03/2022 04:16 PM

Form: General
Layer: GF
Number of extensions: 0
Created on: 07/03/2022 04:17 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: sc 24 l03 entrance
ID: 47
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 04:17 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



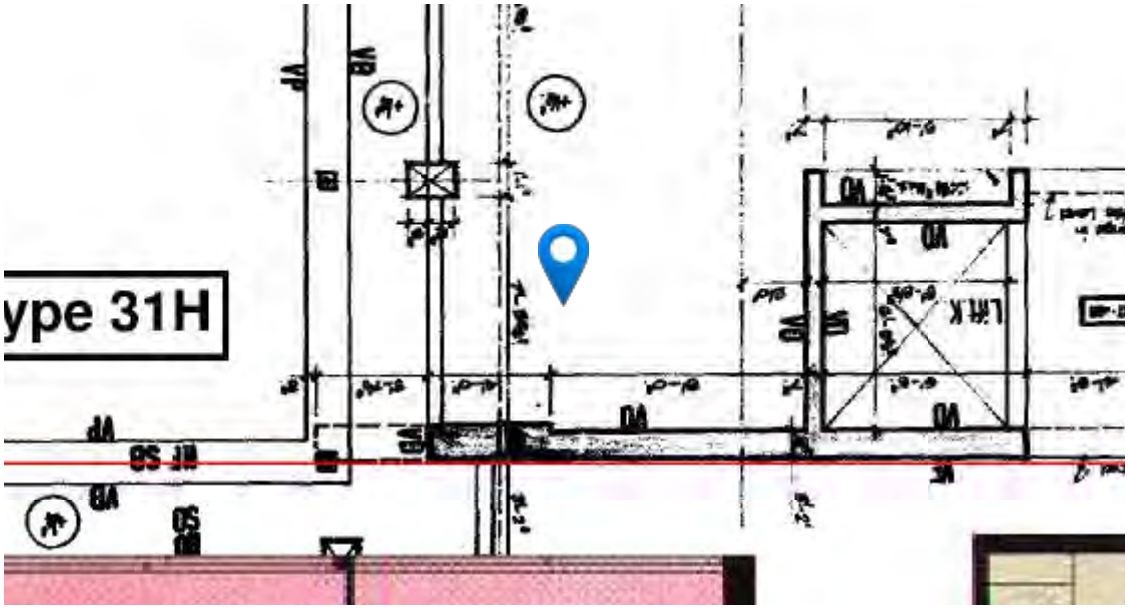
Images:

1. 07/03/2022 04:16 PM

Form: General
Layer: GF
Number of extensions: 0
Created on: 07/03/2022 04:18 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: dry riser inlet point for fireman in sc24
ID: 48
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 04:18 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



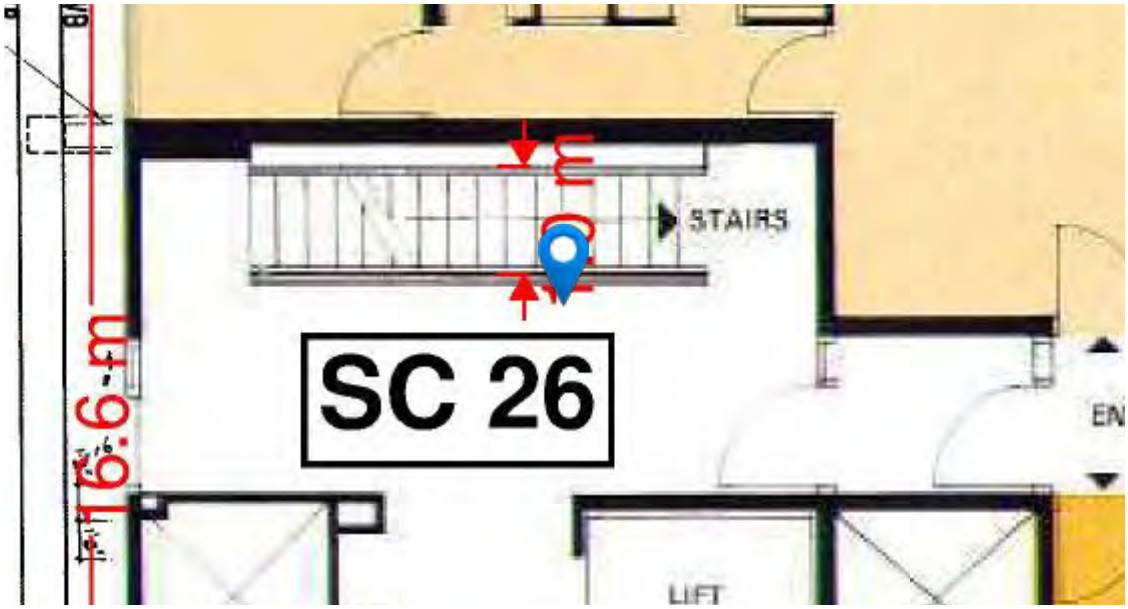
Images:

1. 07/03/2022 04:18 PM

Form: General
Layer: GF
Number of extensions: 0
Created on: 07/03/2022 04:20 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: l03 sc 26 width 1m
ID: 49
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 04:20 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:

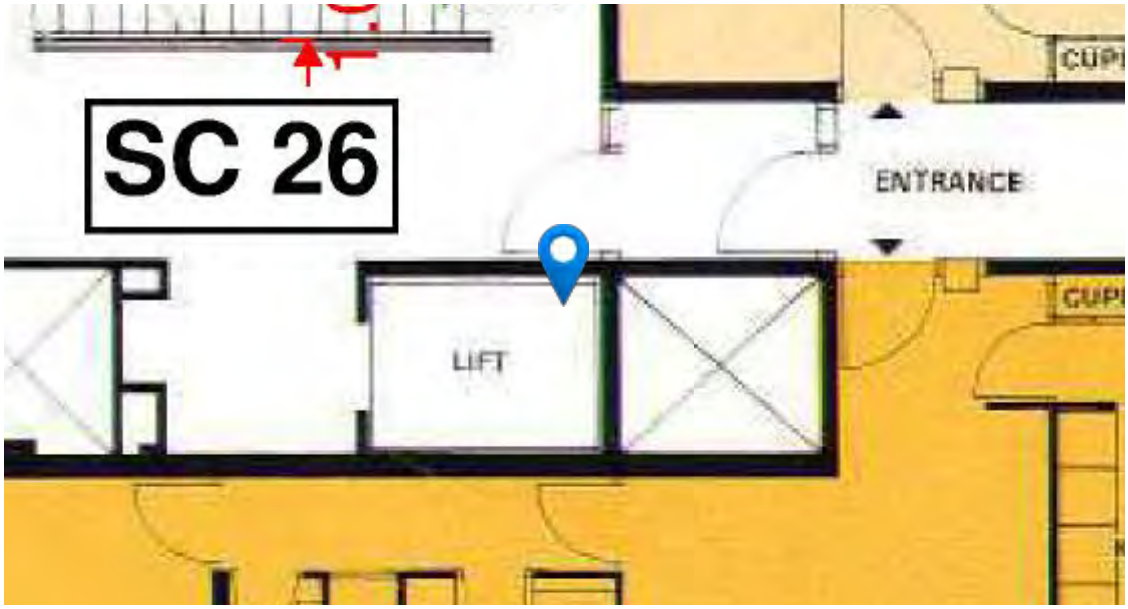
2. 07/03/2022 04:19 PM

1. 07/03/2022 04:19 PM

Form: General
Layer: GF
Number of extensions: 0
Created on: 07/03/2022 04:20 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: sc26 down to l04
ID: 50
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 04:20 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:

1. 07/03/2022 04:20 PM

BARBICAN RESI - MOUNTJOY HOUSE

Created on: 08/03/2022 10:33 AM
Project name: Barbican Resi - Mountjoy House
Project code: 279095-00
Project start: 07/03/2022
Project end:

Country:
Client Name: Barbican Estate
All tickets: 18

Created by: Arup Fire Plan Radar 9
Street:

Zip code:
City:
Project description: Barbican Residential Retrospective fire strategy
Project website:

Open tickets: 18

Form: General
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:10 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: lift 24 in l6
ID: 24
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:10 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:

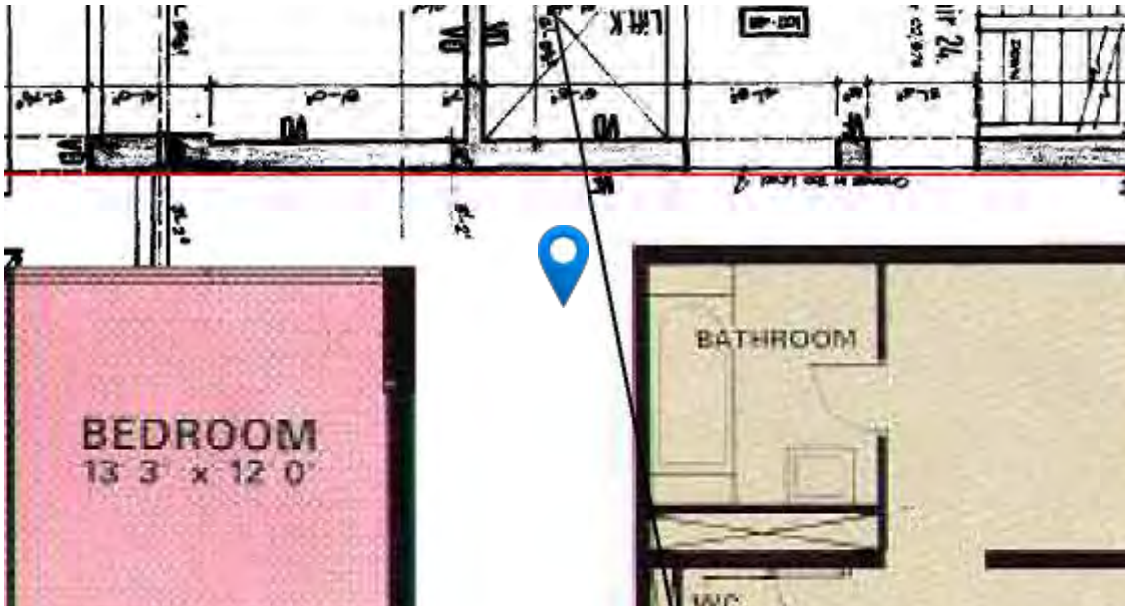
1. 07/03/2022 03:10 PM

Form: General

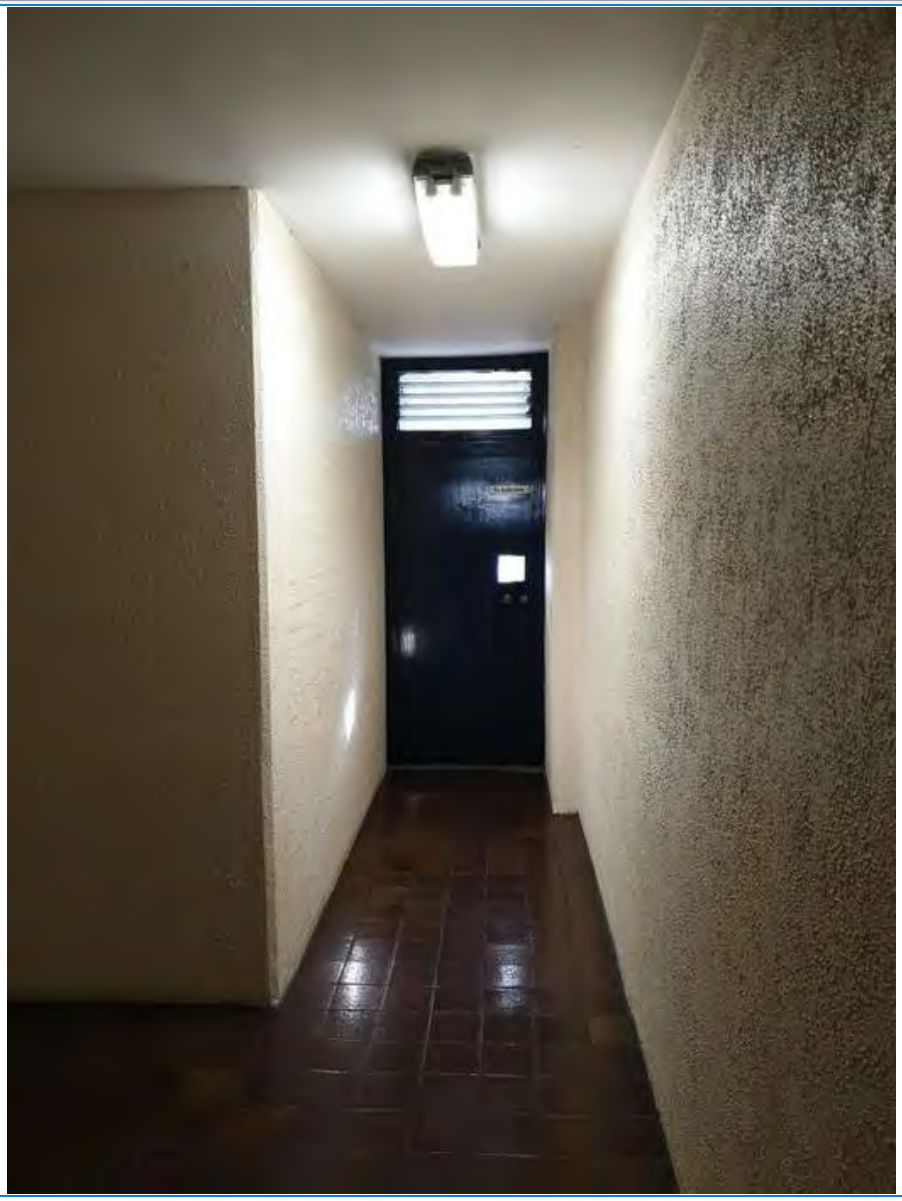
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:12 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: L6 1. door to mountjoy balcony 2. corridor from sc24 to sc25 3. lift to sc24 4. door to behind the mountjoy balcony
ID: 25
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:12 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

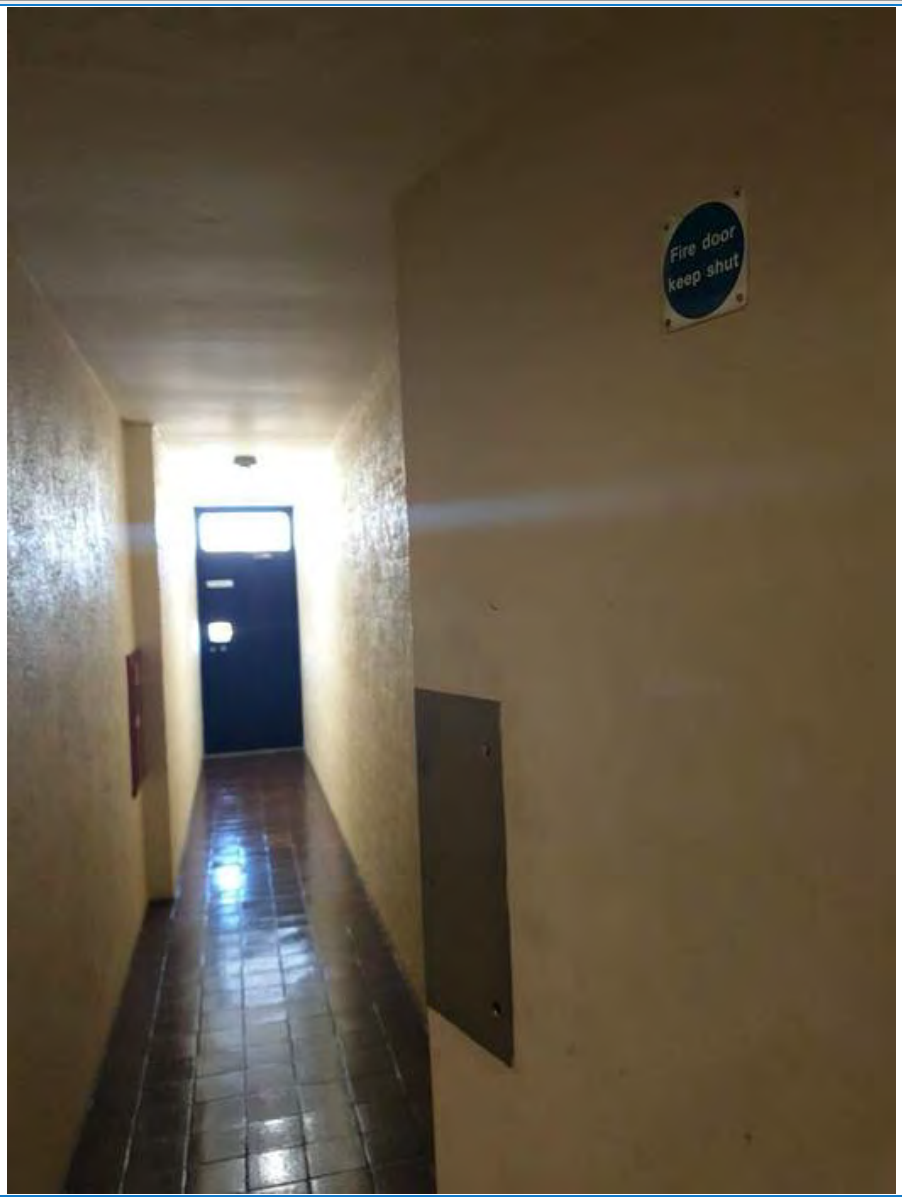


Images:



4. 07/03/2022 03:11 PM

1. 07/03/2022 03:12 PM



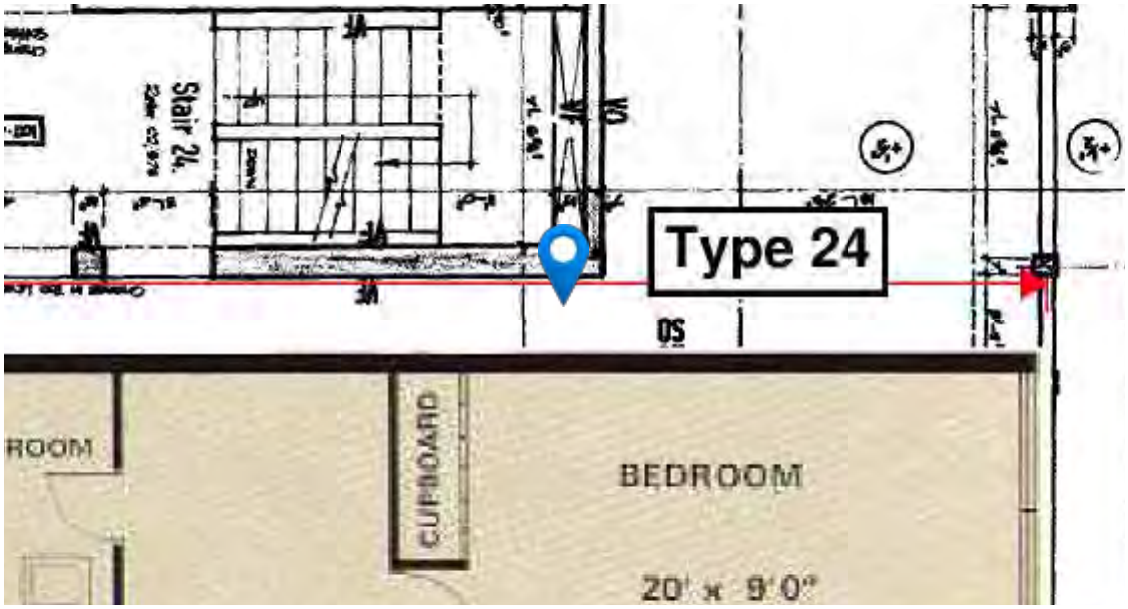
2. 07/03/2022 03:12 PM

3. 07/03/2022 03:12 PM

Form: General
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:13 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: l6 dry riser outlet for sc24
ID: 26
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:13 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



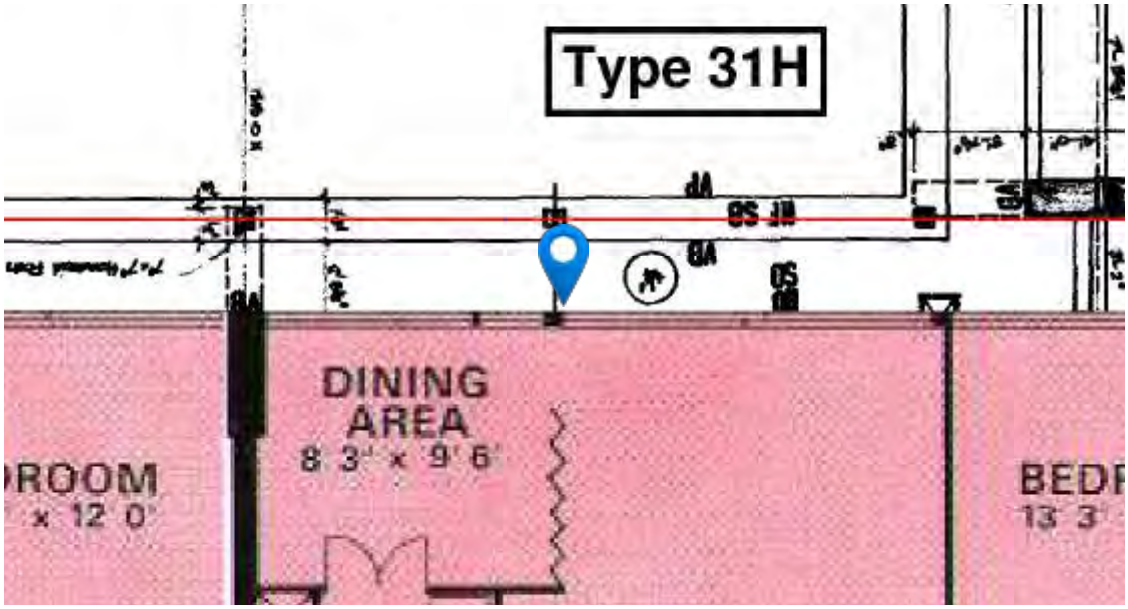
Images:

1. 07/03/2022 03:13 PM

Form: General
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:15 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: balcomy widths 560 privacy screen
ID: 27
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:15 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:

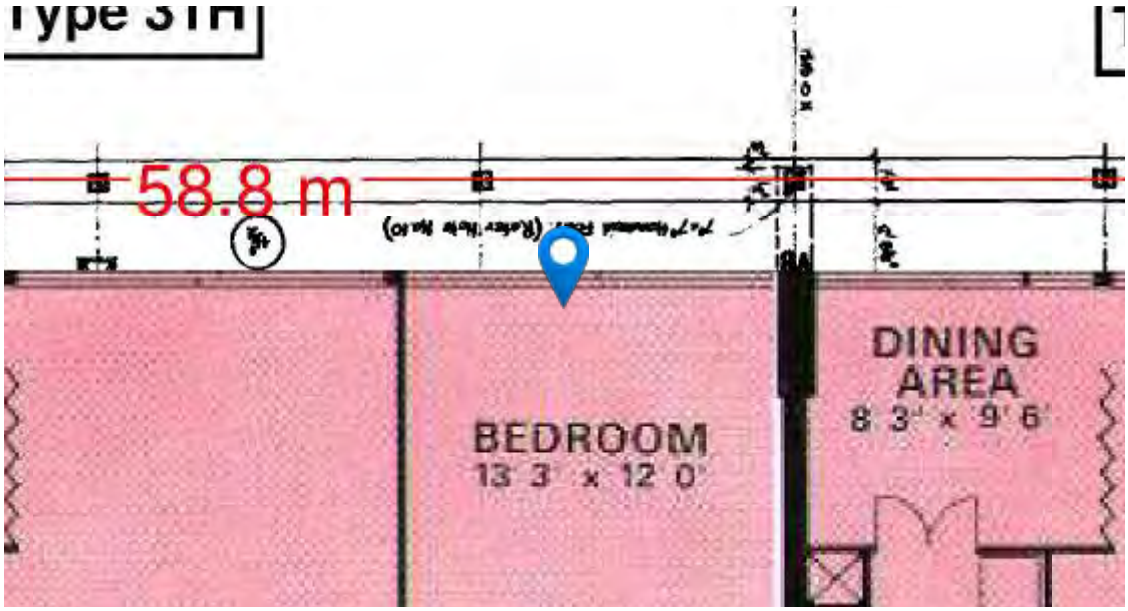
1. 07/03/2022 03:14 PM

2. 07/03/2022 03:15 PM

Form: General
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:16 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: level change between balcony and flat
ID: 28
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:16 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:

1. 07/03/2022 03:16 PM

Form: General

Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:21 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

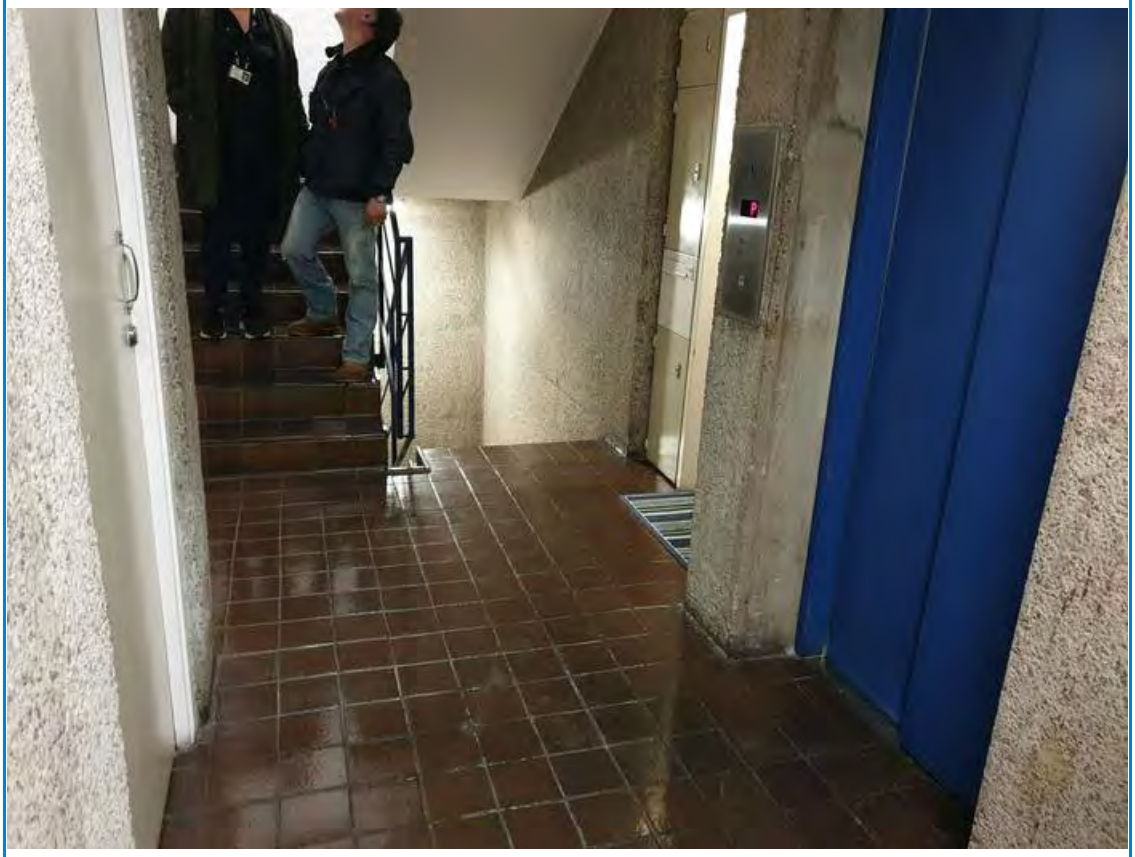
Title: l6 1. lobby from sc24 to sc25 2. fire door to central corridor 3. lift and sc 25
ID: 29
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:21 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:

1. 07/03/2022 03:20 PM

2. 07/03/2022 03:20 PM



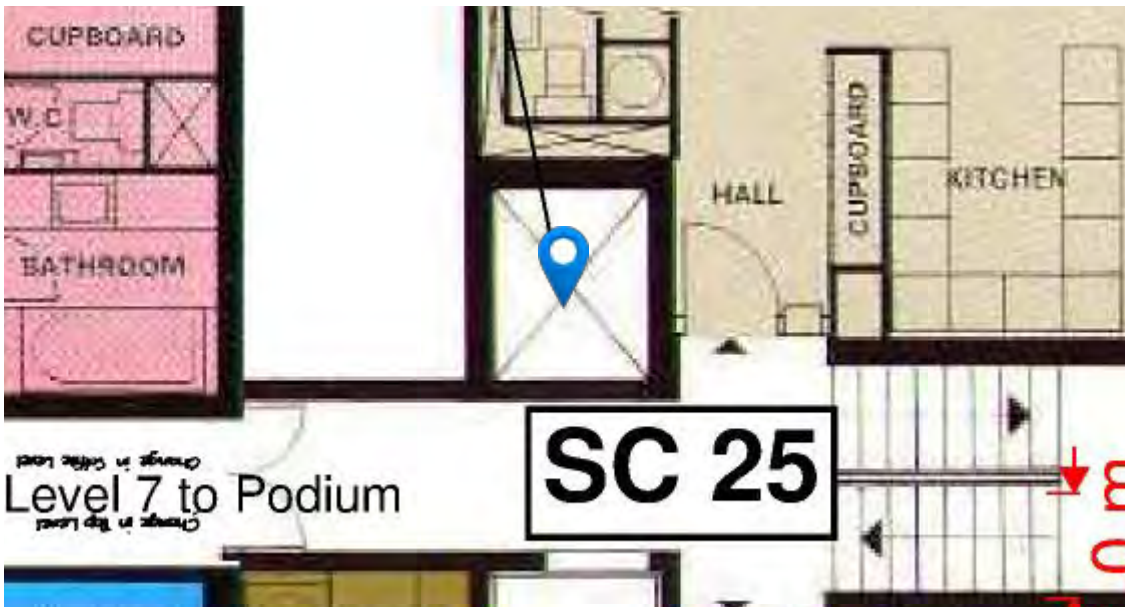
3. 07/03/2022 03:20 PM

Form: General

Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:22 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: residential store room from l1 to l6 in sc 25
ID: 30
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:22 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:

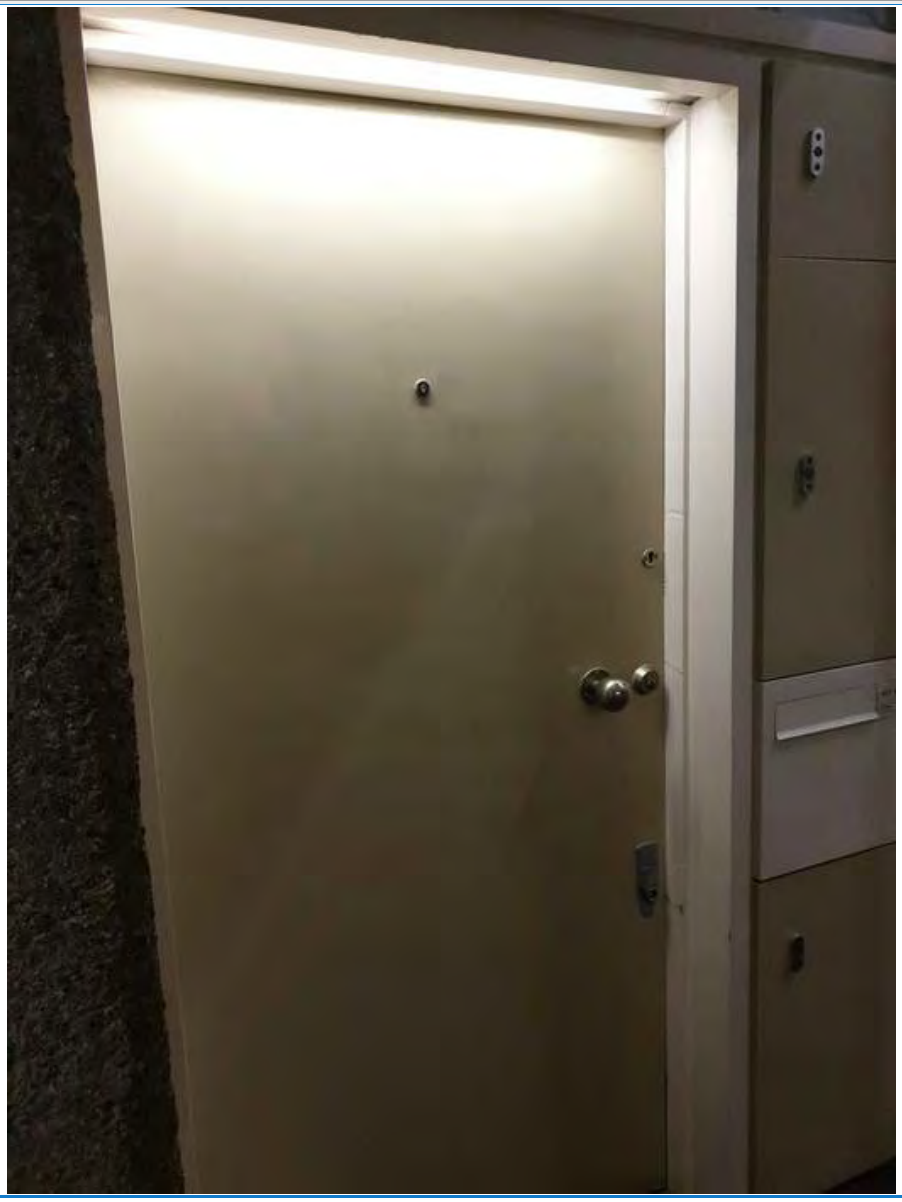
1. 07/03/2022 03:22 PM

Form: General
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:23 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: flats open on to sc25
ID: 31
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:23 PM
Date:
Compliant with the Fire Strategy?: No
Details:

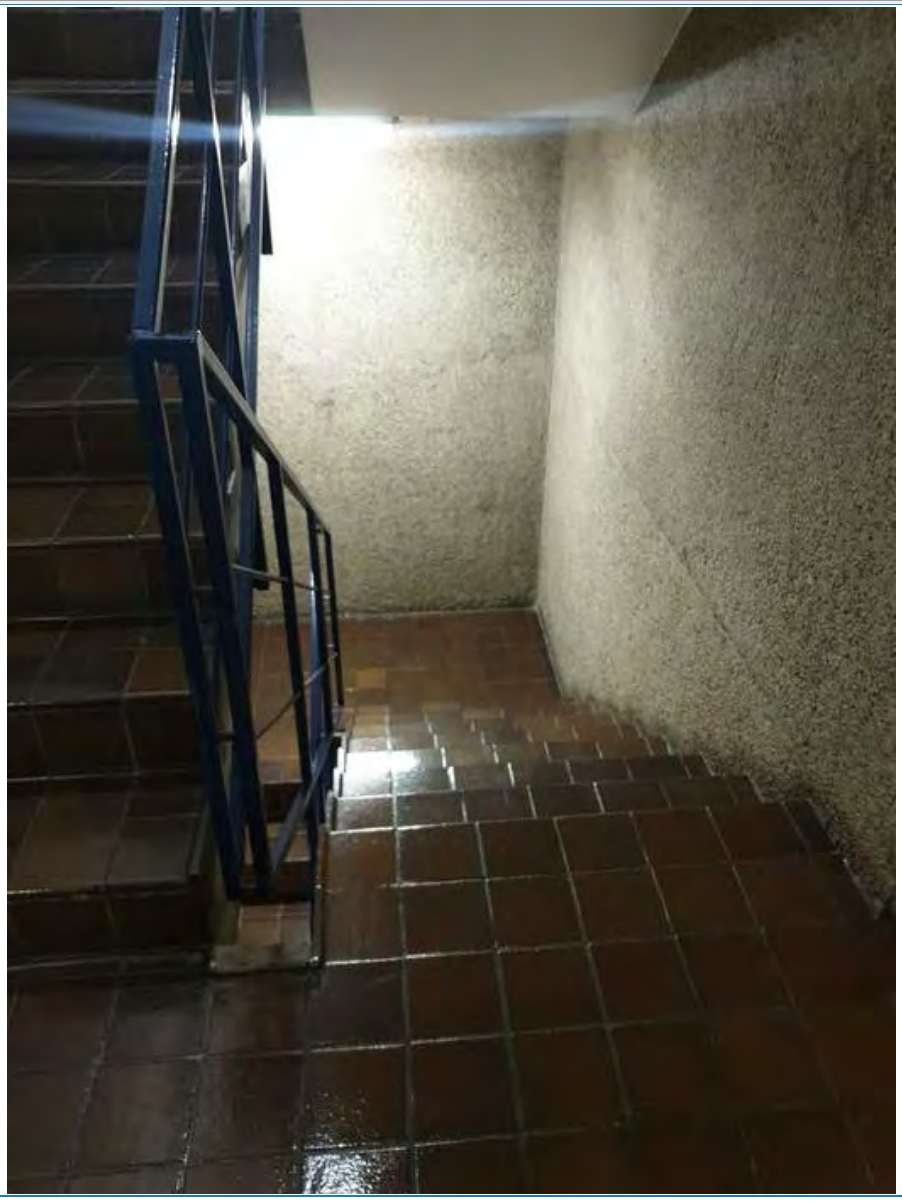
Plan:

Images:



1. 07/03/2022 03:23 PM

2. 07/03/2022 03:23 PM



3. 07/03/2022 03:23 PM

Form: General
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:24 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: sc 25 lift
ID: 32
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:24 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:

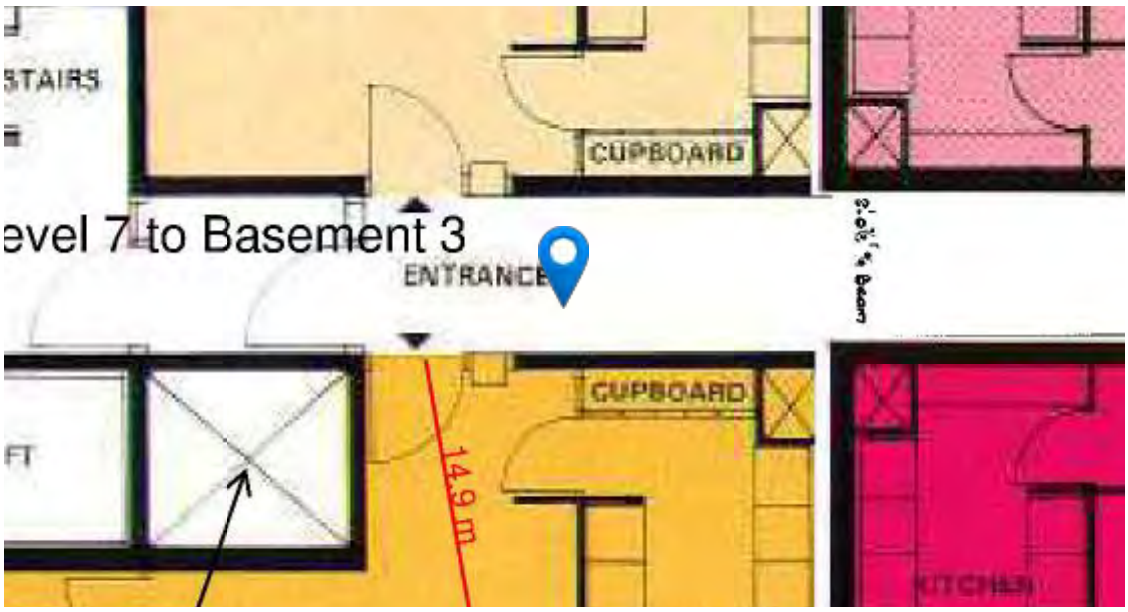
1. 07/03/2022 03:24 PM

Form: General

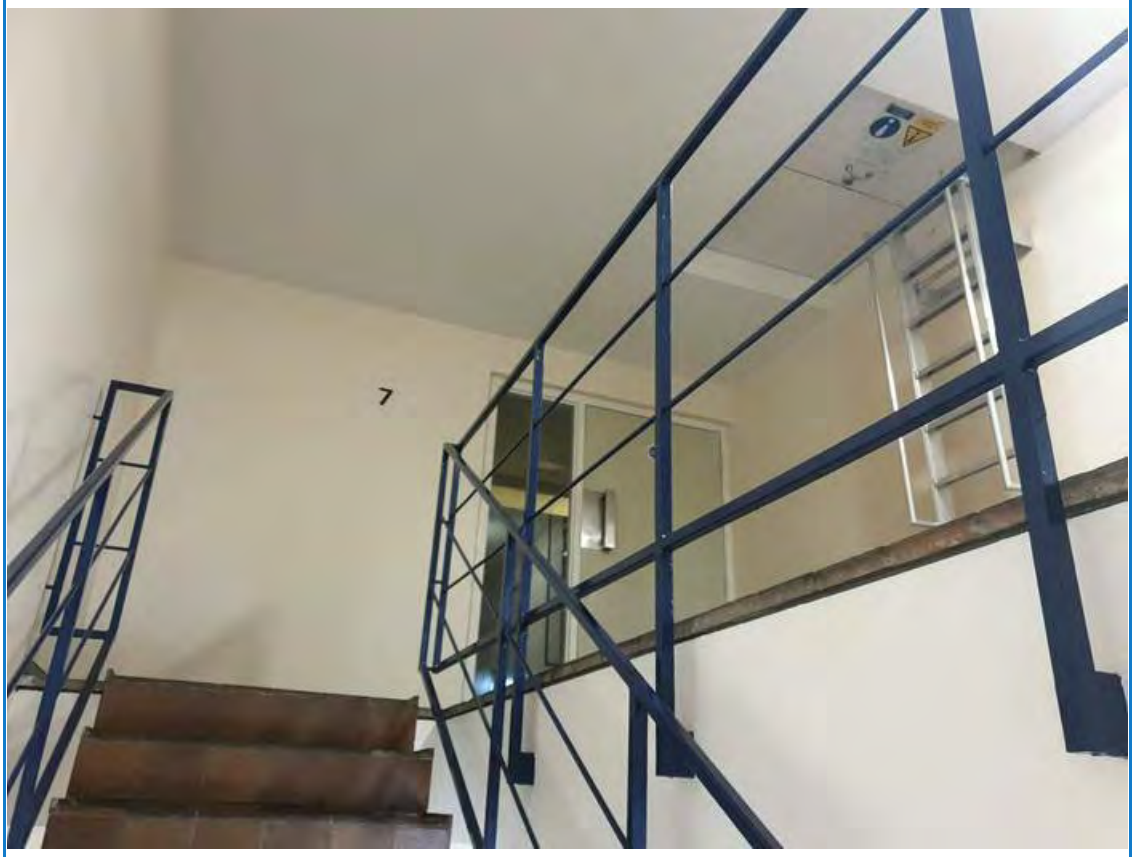
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:29 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: from l6 to l7 it is separated by the door as it is a ff stair
ID: 35
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:29 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:



1. 07/03/2022 03:29 PM

Form: General
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:36 PM
Date:
Compliant with the Fire Strategy?: No
Details:

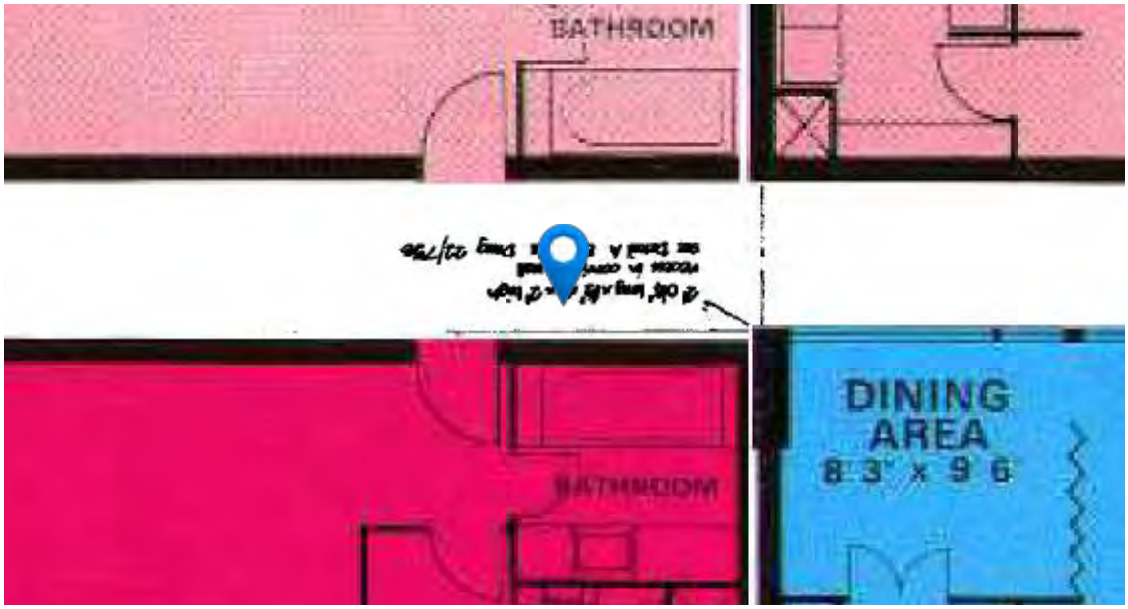
Title: sc 24 25 26 lifts do not ground
ID: 36
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:36 PM
Time:
Non compliant with the Fire Strategy: No

Plan:

Form: General
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:44 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: corridor width 1480
ID: 37
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:44 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



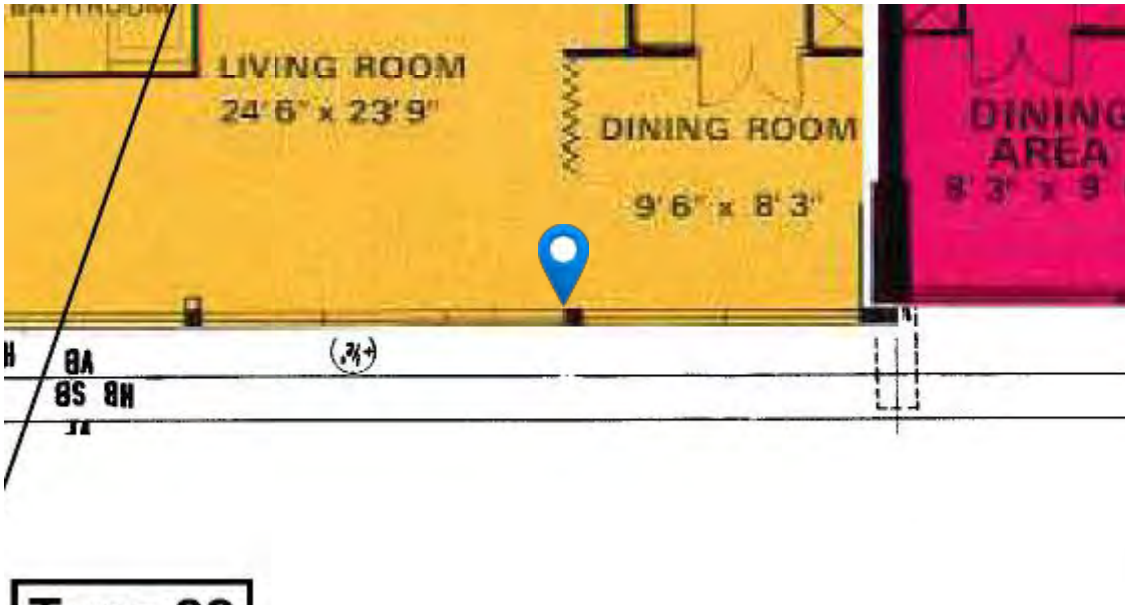
Images:

1. 07/03/2022 03:43 PM

Form: General
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 03:57 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: level change in flat 210
ID: 39
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:57 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:

1. 07/03/2022 03:57 PM

Form: General

Title: corner flats have issues with comparmentation in the kitchen areas with risers going through the entire building, no vertical separation 1, 2 9, and 10 flats

Layer: 220218 Mountjoy_Site drawings (1)
ID: 40
Number of extensions: 0
Created by: Arup Fire Plan Radar 9
Created on: 07/03/2022 04:02 PM
Updated: 07/03/2022 04:02 PM
Updated by: Arup Fire Plan Radar 9
Date:
Time:
Compliant with the Fire Strategy?: No
Non compliant with the Fire Strategy: No
Details:

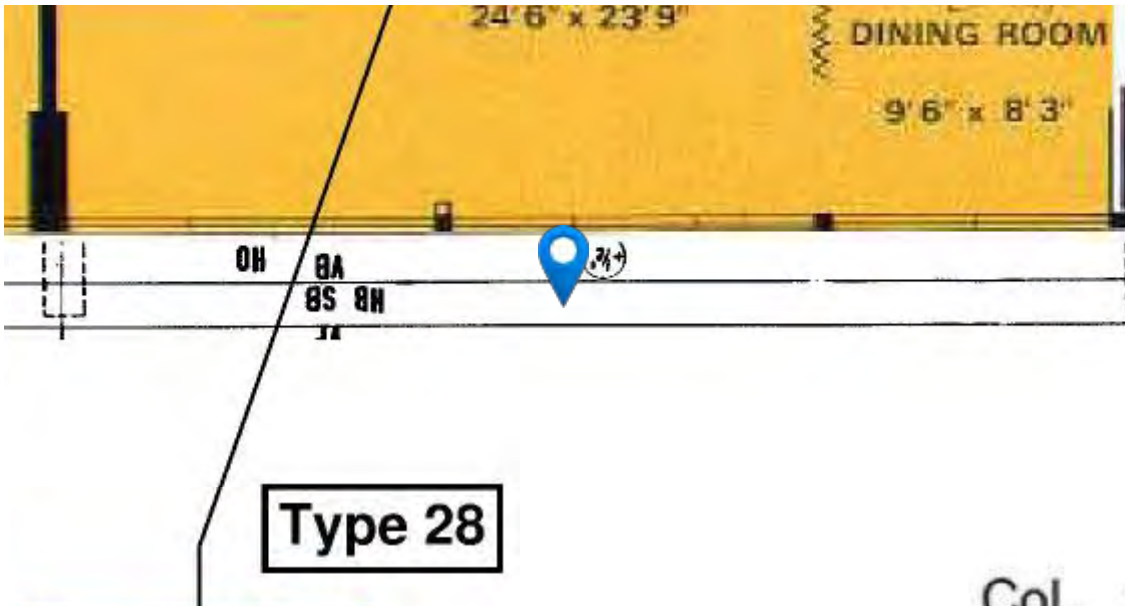
Plan:

Form: General

Title: flat 210 access to balcomy from the bedroom available through a window. the different flats are windows and doors mixture access

Layer: 220218 Mountjoy_Site drawings (1)
ID: 41
Number of extensions: 0
Created by: Arup Fire Plan Radar 9
Created on: 07/03/2022 04:03 PM
Updated: 07/03/2022 04:04 PM
Updated by: Arup Fire Plan Radar 9
Date:
Time:
Compliant with the Fire Strategy?: No
Non compliant with the Fire Strategy: No
Details:

Plan:



Images:

1. 07/03/2022 04:03 PM

Form: General
Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 04:07 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: flat 210 kitchen duct to shunt duct
ID: 42
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 04:08 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:

1. 07/03/2022 04:07 PM

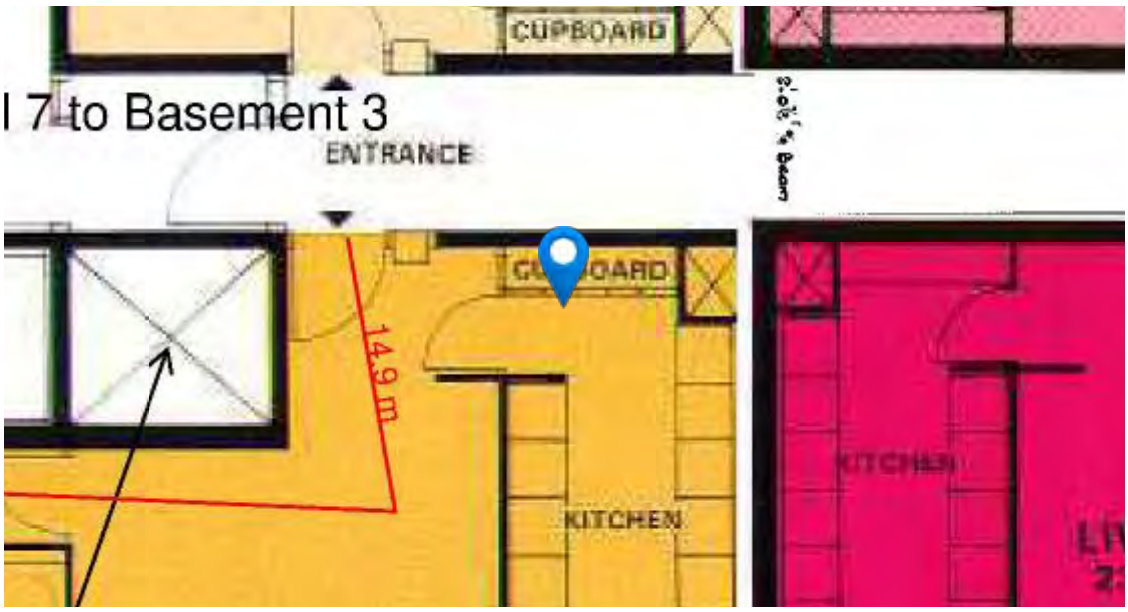
2. 07/03/2022 04:07 PM

Form: General

Layer: 220218 Mountjoy_Site drawings (1)
Number of extensions: 0
Created on: 07/03/2022 04:10 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: main entrance with louvred cent on top
ID: 43
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 04:10 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:

1. 07/03/2022 04:10 PM

BARBICAN RESI - MOUNTJOY HOUSE

Created on: 08/03/2022 10:20 AM
Project name: Barbican Resi - Mountjoy House
Project code: 279095-00
Project start: 07/03/2022
Project end:

Country:
Client Name: Barbican Estate
All tickets: 15

Created by: Arup Fire Plan Radar 9
Street:

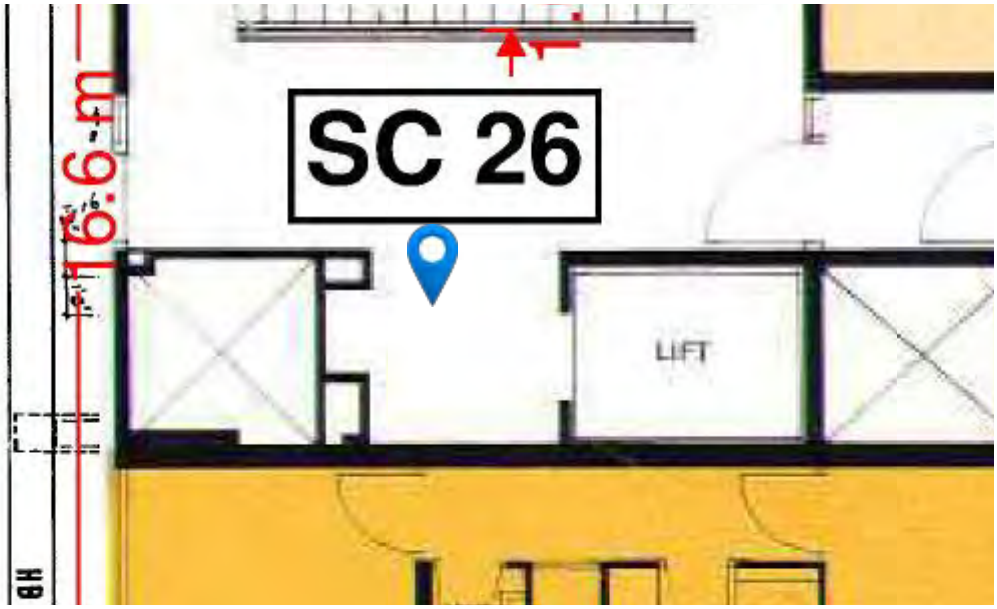
Zip code:
City:
Project description: Barbican Residential Retrospective fire strategy
Project website:

Open tickets: 15

Form: General
Layer: L7
Number of extensions: 0
Created on: 07/03/2022 02:42 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: L6 lift sign for sc26
ID: 12
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:49 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:

1. 07/03/2022 02:41 PM

Form: General

Layer: L7
Number of extensions: 0
Created on: 07/03/2022 02:43 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

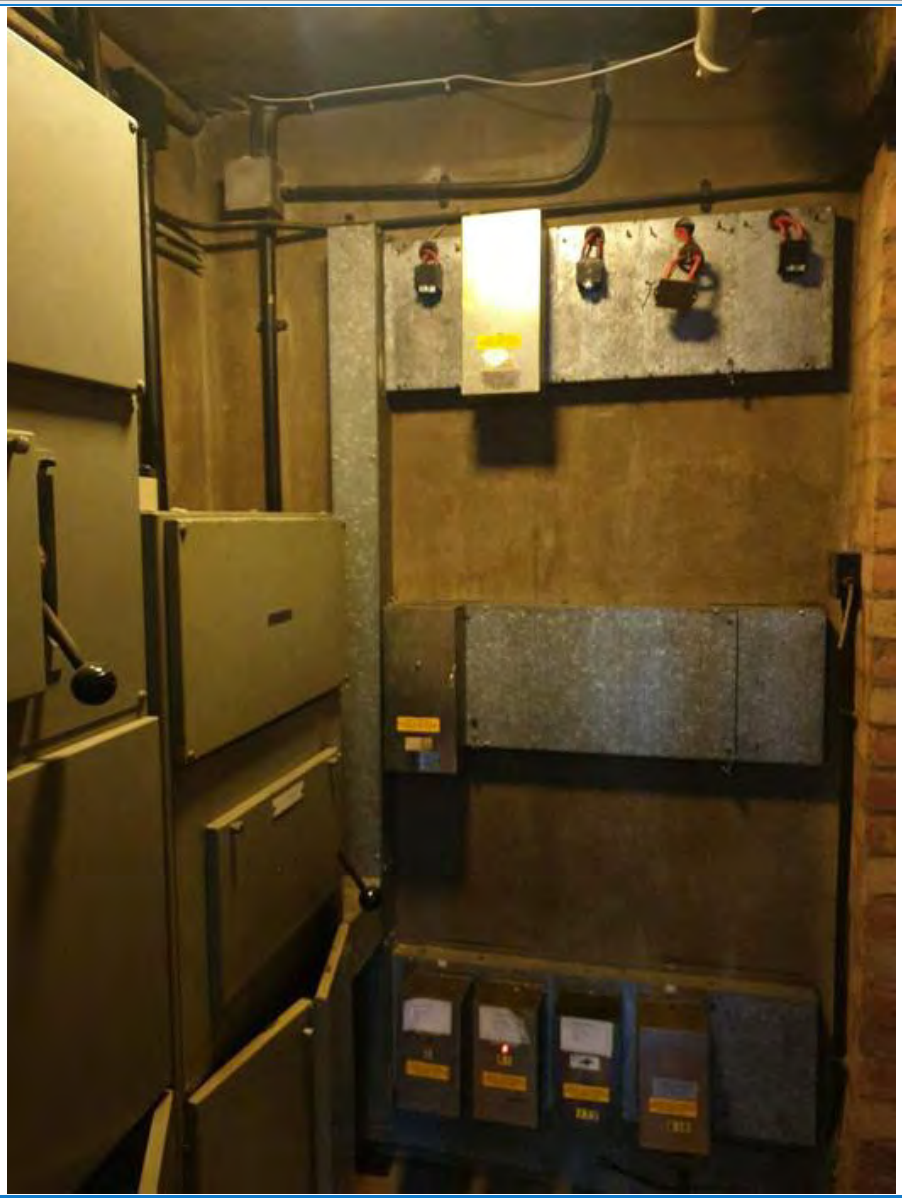
Title: l6 dry riser outlet in front of the lift with EDB electric distribution board plant room

ID: 13
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:49 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:

1. 07/03/2022 02:42 PM



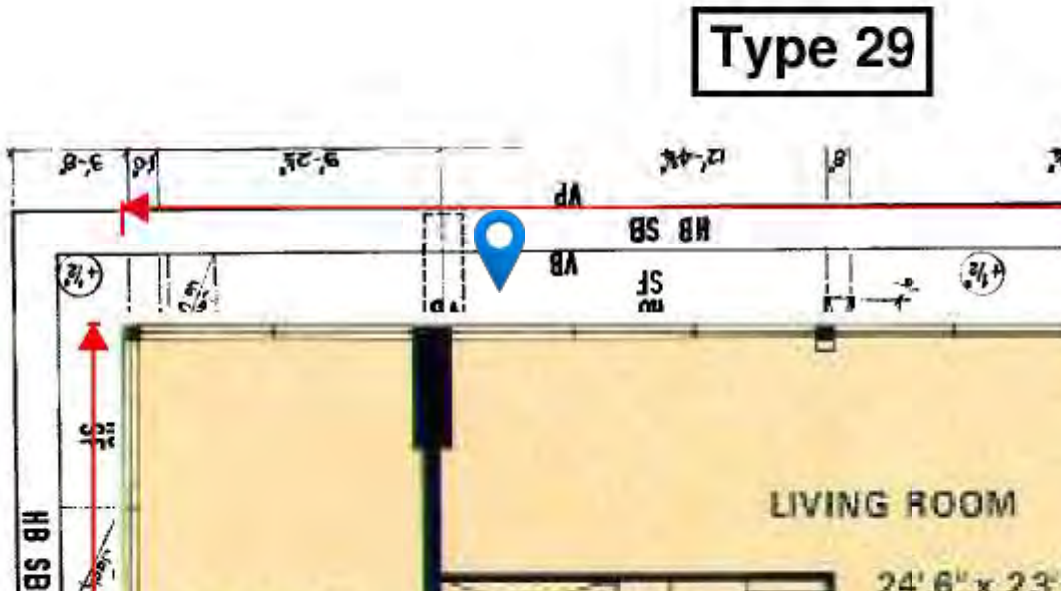
2. 07/03/2022 02:43 PM

Form: General

Layer: L7
Number of extensions: 0
Created on: 07/03/2022 02:46 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

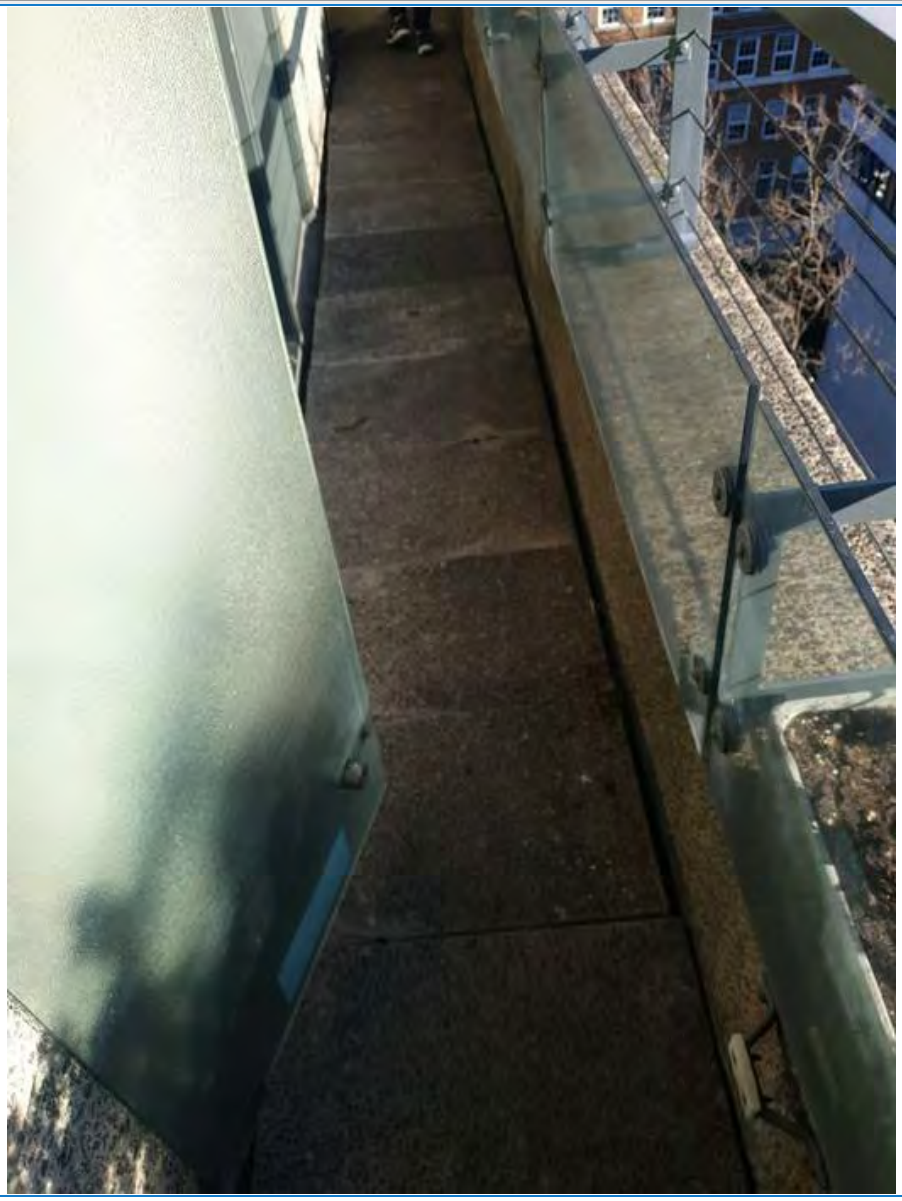
Title: L6 balconies around the buildong perimeter like andrewes with panels
ID: 14
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:47 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:

2. 07/03/2022 02:45 PM



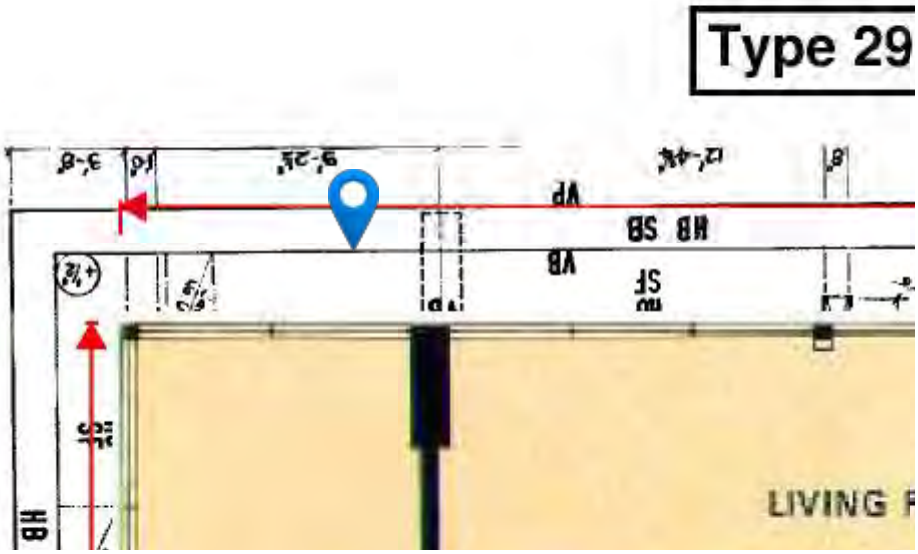
1. 07/03/2022 02:45 PM

Form: General

Layer: L7
Number of extensions: 0
Created on: 07/03/2022 02:48 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: l7 fire door from stair 26 to outside balcony
ID: 15
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:48 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



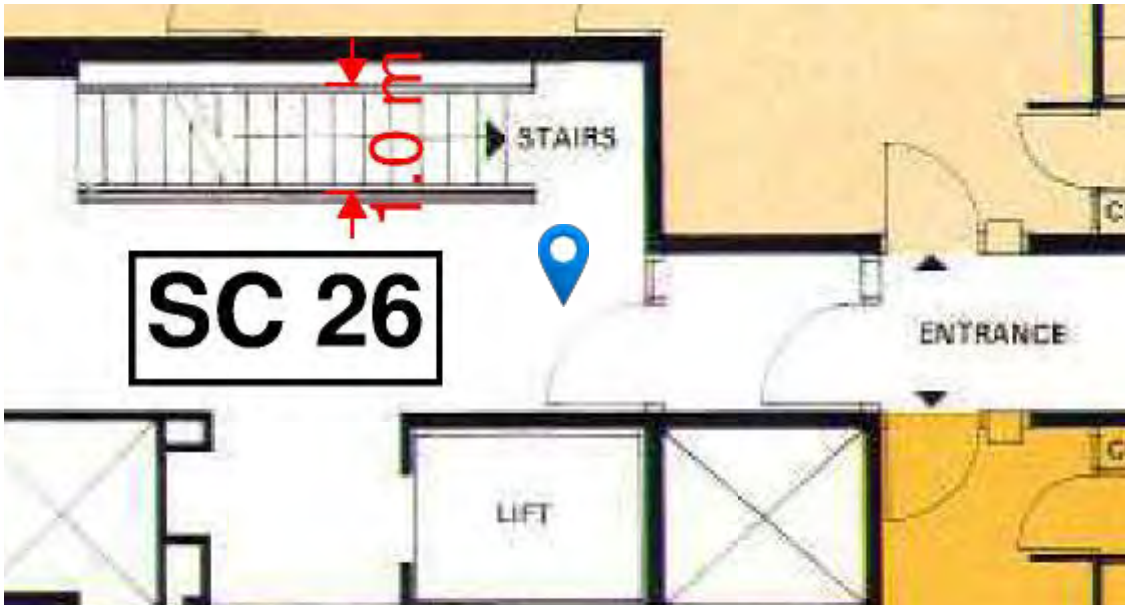
Images:

1. 07/03/2022 02:48 PM

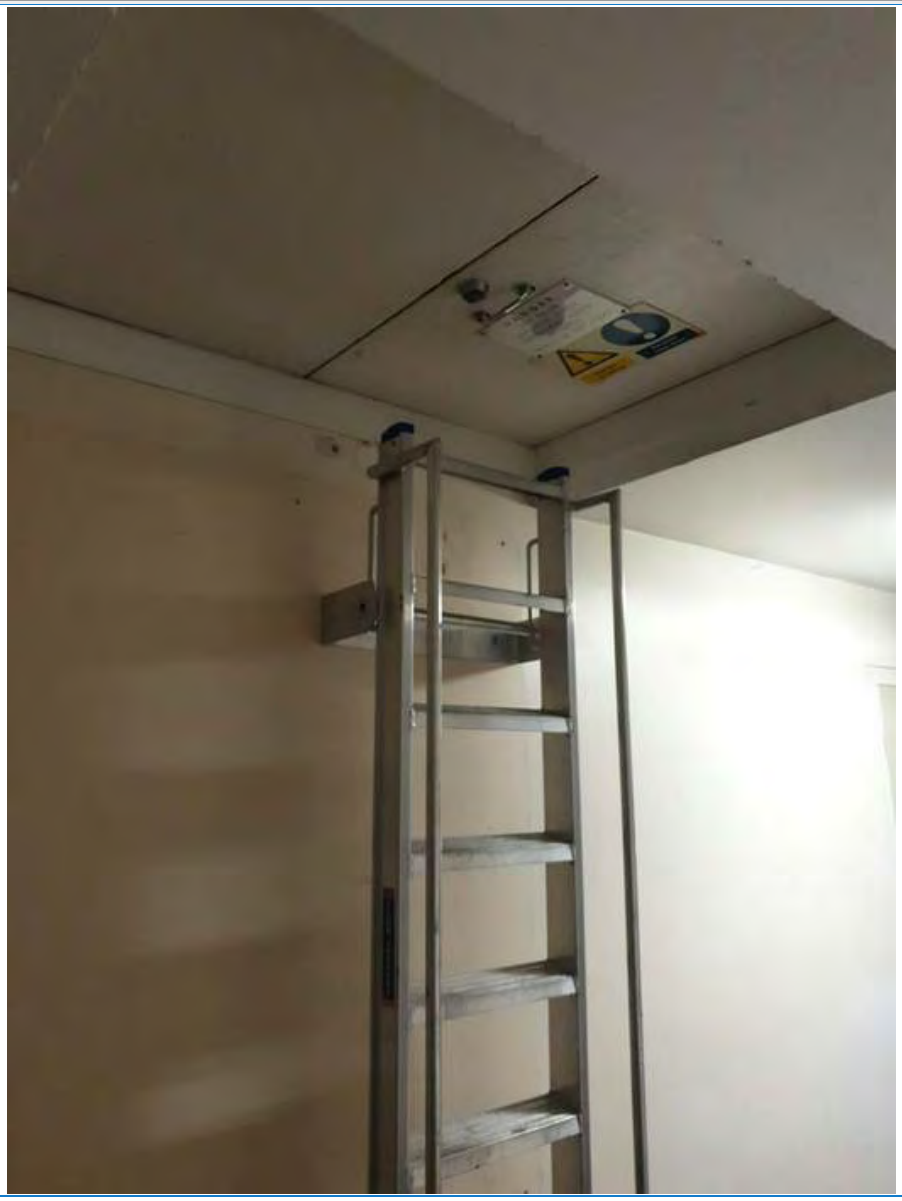
Form: General
Layer: L7
Number of extensions: 0
Created on: 07/03/2022 02:50 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: l7 access to roof plant area
ID: 16
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:50 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:



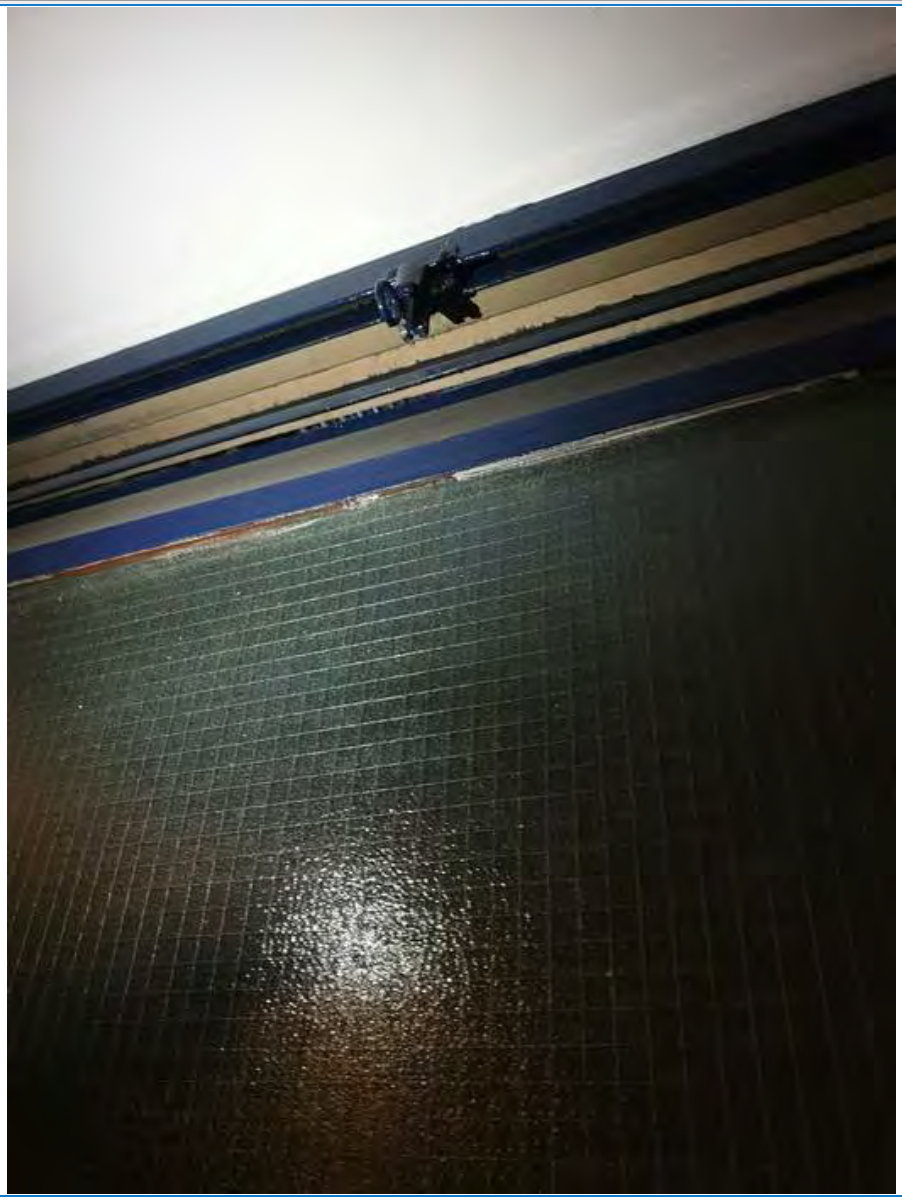
1. 07/03/2022 02:49 PM

Form: General
Layer: L7
Number of extensions: 0
Created on: 07/03/2022 02:52 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: l7 vent shaft for the stair lobby
ID: 17
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:52 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:



2. 07/03/2022 02:50 PM

1. 07/03/2022 02:52 PM

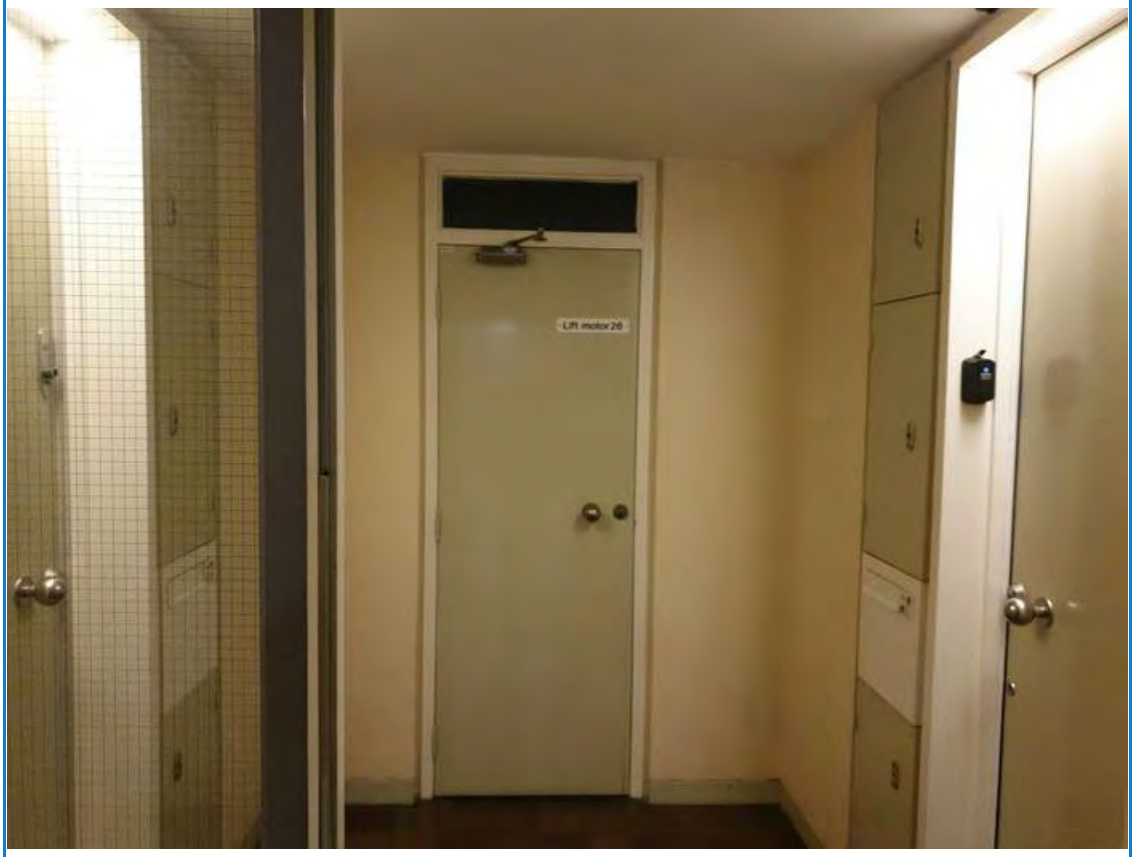
Form: General

Layer: L7
Number of extensions: 0
Created on: 07/03/2022 02:53 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: L7 access doors to two flats and no central corridor
ID: 18
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:53 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:



1. 07/03/2022 02:52 PM

2. 07/03/2022 02:53 PM

Form: General
Layer: L7
Number of extensions: 0
Created on: 07/03/2022 02:56 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: plant lift motor room for lift 26
ID: 19
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:56 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

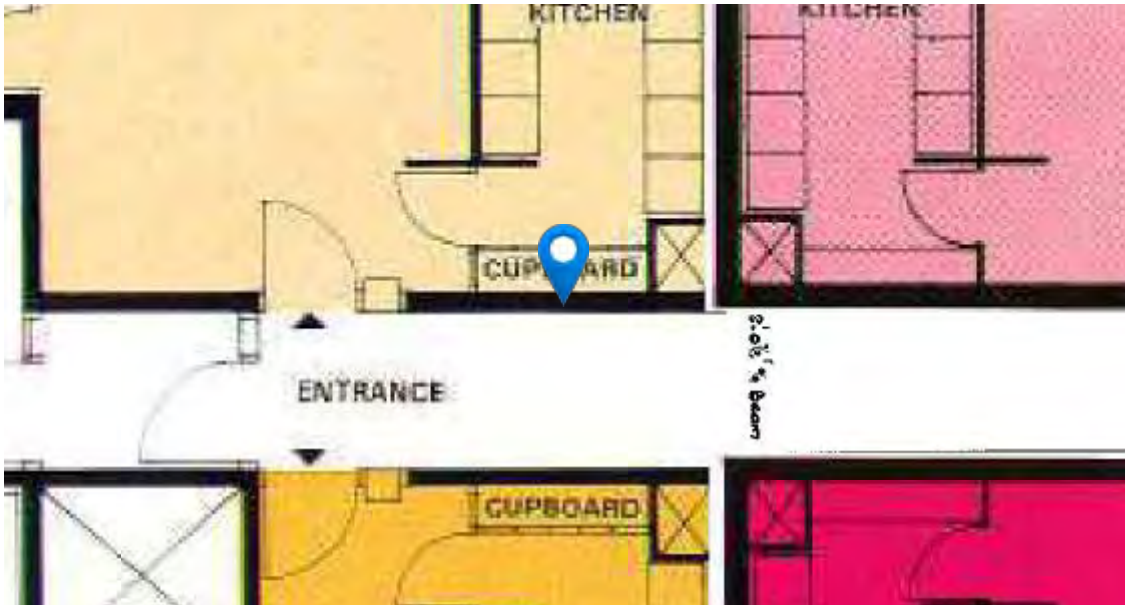
Images:

1. 07/03/2022 02:56 PM

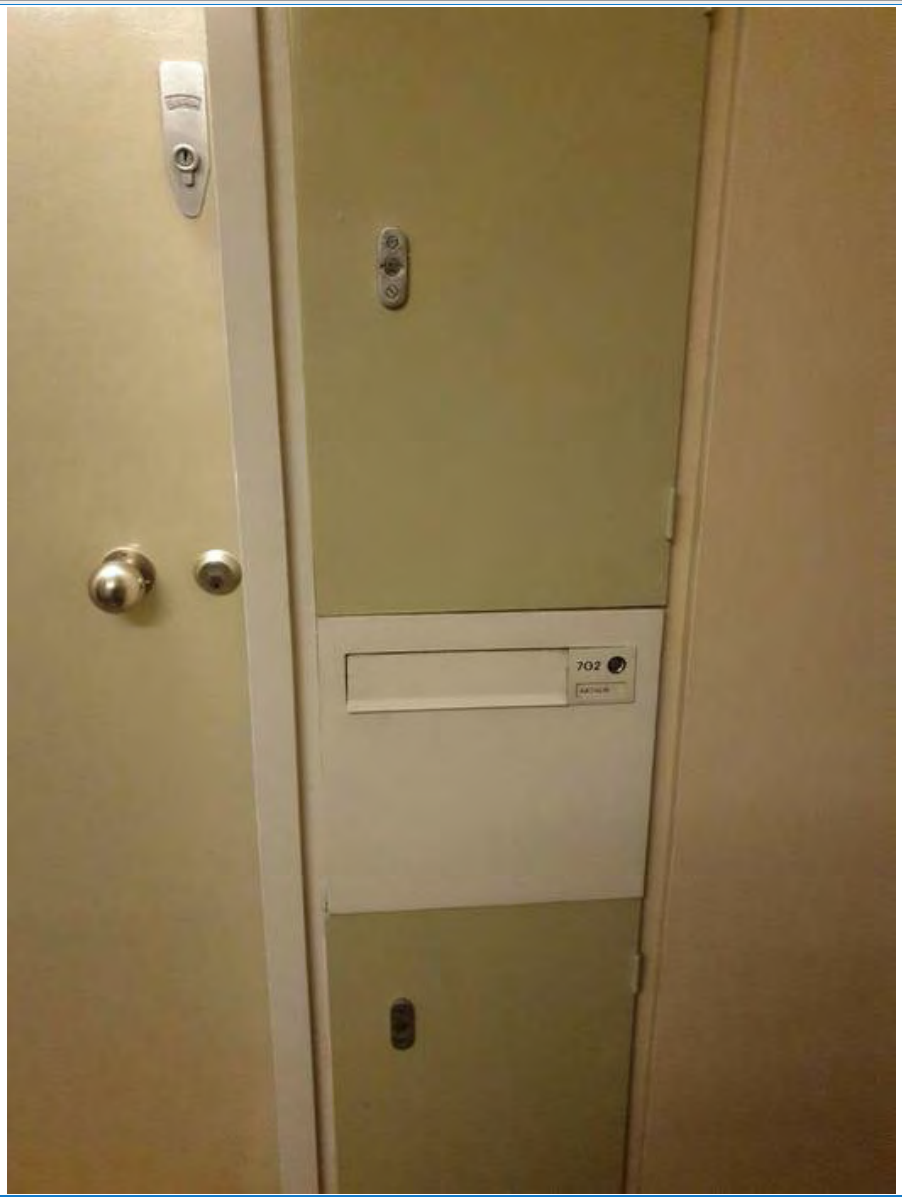
Form: General
Layer: L7
Number of extensions: 0
Created on: 07/03/2022 02:57 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: l7 rubbish lockers
ID: 20
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 02:57 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:



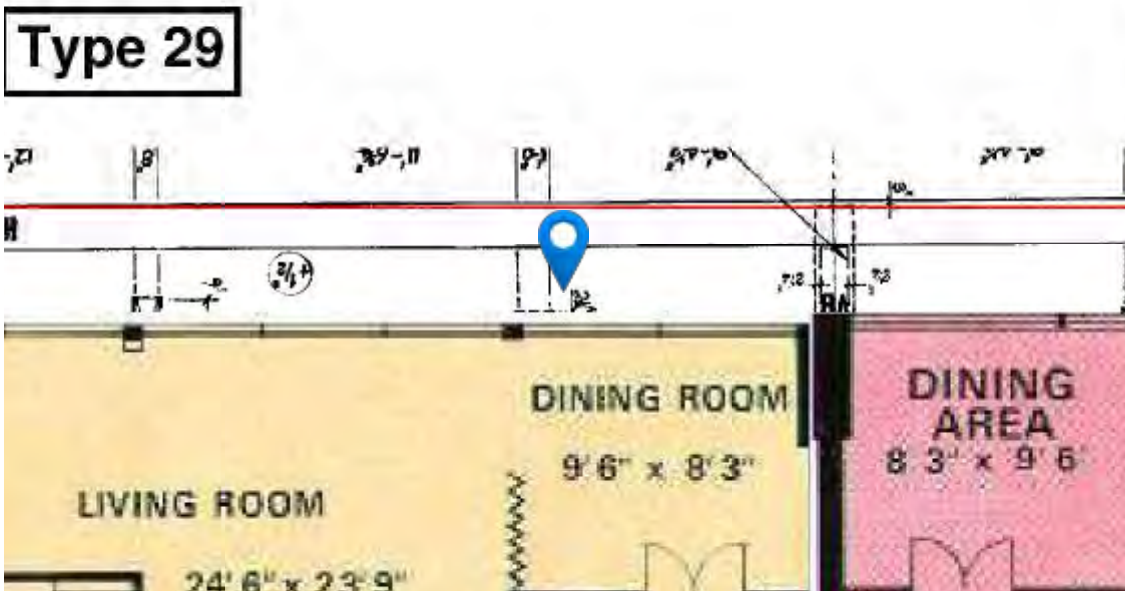
1. 07/03/2022 02:57 PM

Form: General

Layer: L7
Number of extensions: 0
Created on: 07/03/2022 02:59 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: L7 balcony width 830mm and at pinch point 500mm
ID: 21
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:00 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:

1. 07/03/2022 02:59 PM

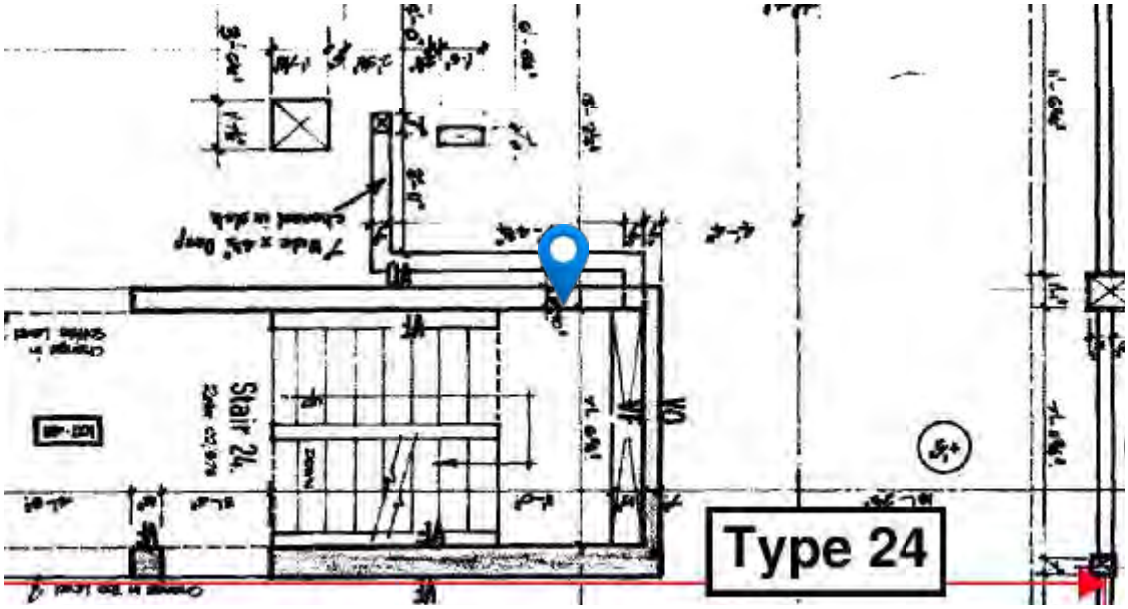
2. 07/03/2022 02:59 PM

3. 07/03/2022 02:59 PM

Form: General
Layer: L7
Number of extensions: 0
Created on: 07/03/2022 03:05 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: L7 sc24 dry riser inlet
ID: 22
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:05 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



Images:

1. 07/03/2022 03:04 PM

Form: General
Layer: L7
Number of extensions: 0
Created on: 07/03/2022 03:08 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: sc24 width 1100mm
ID: 23
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:08 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:

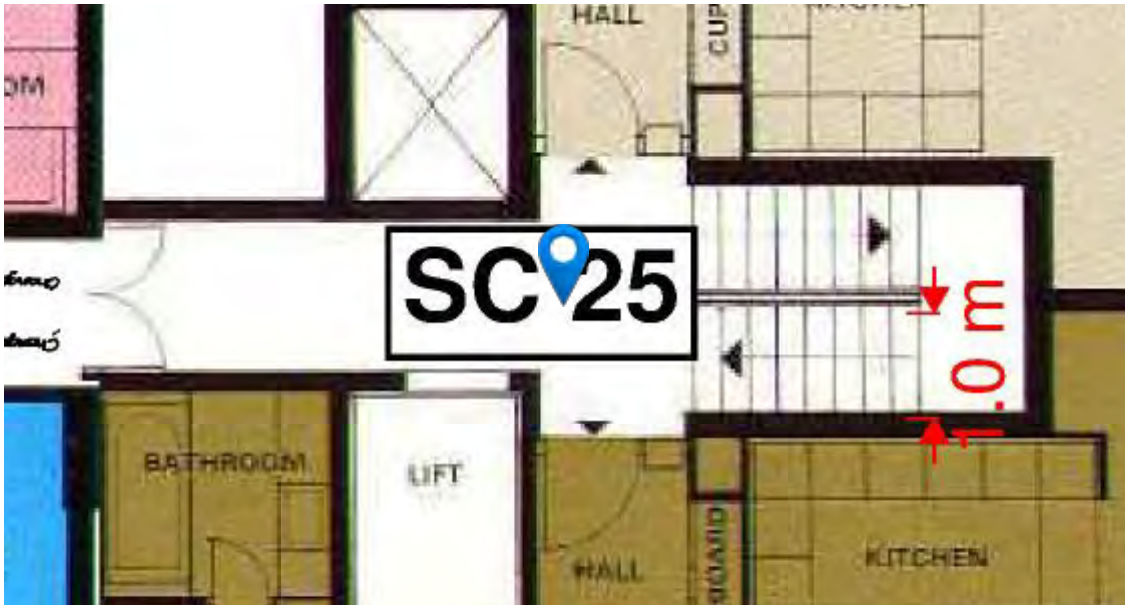
1. 07/03/2022 03:08 PM

2. 07/03/2022 03:08 PM

Form: General
Layer: L7
Number of extensions: 0
Created on: 07/03/2022 03:26 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: open 2 flats on l7 and on l6
ID: 33
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:26 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:



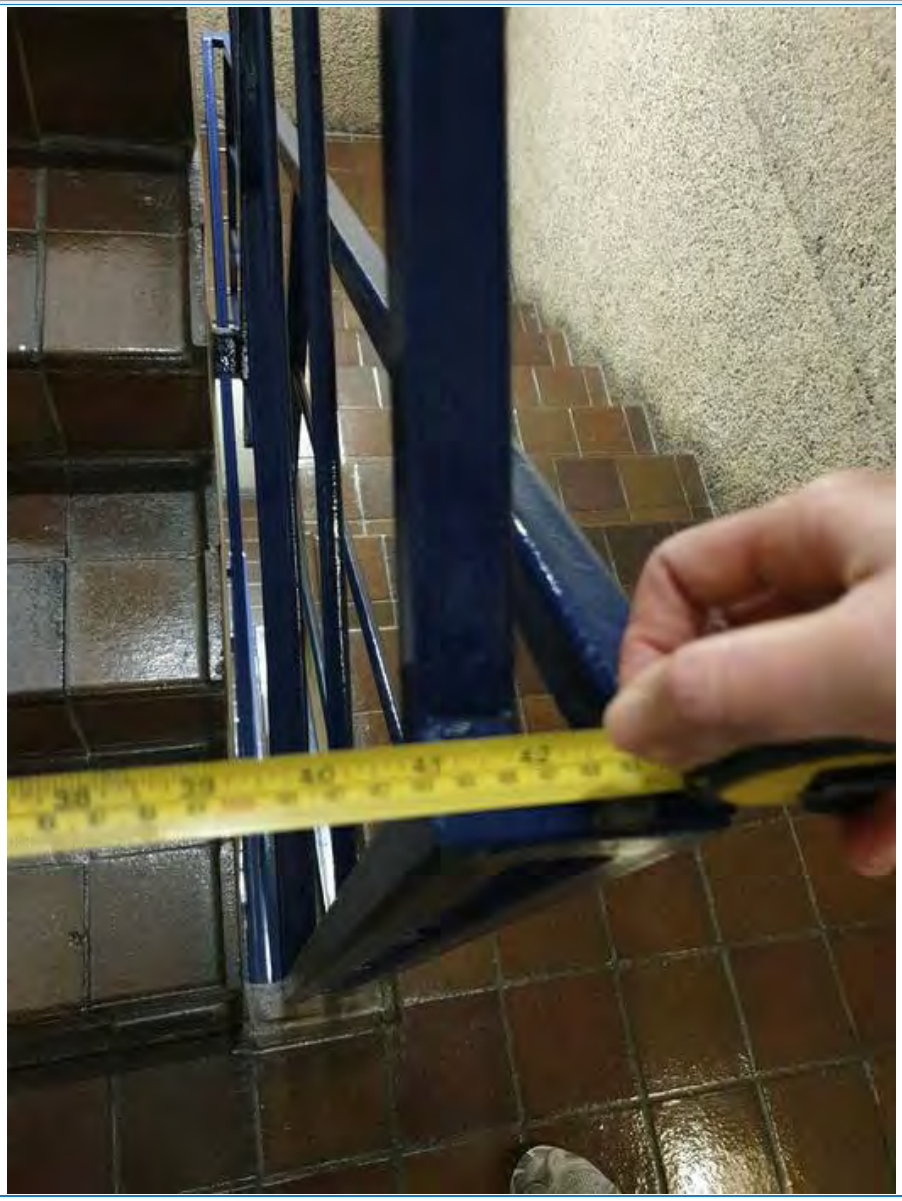
Images:

1. 07/03/2022 03:26 PM

Form: General
Layer: L7
Number of extensions: 0
Created on: 07/03/2022 03:27 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No
Title: 1.03m staor 25
ID: 34
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:27 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:



1. 07/03/2022 03:27 PM

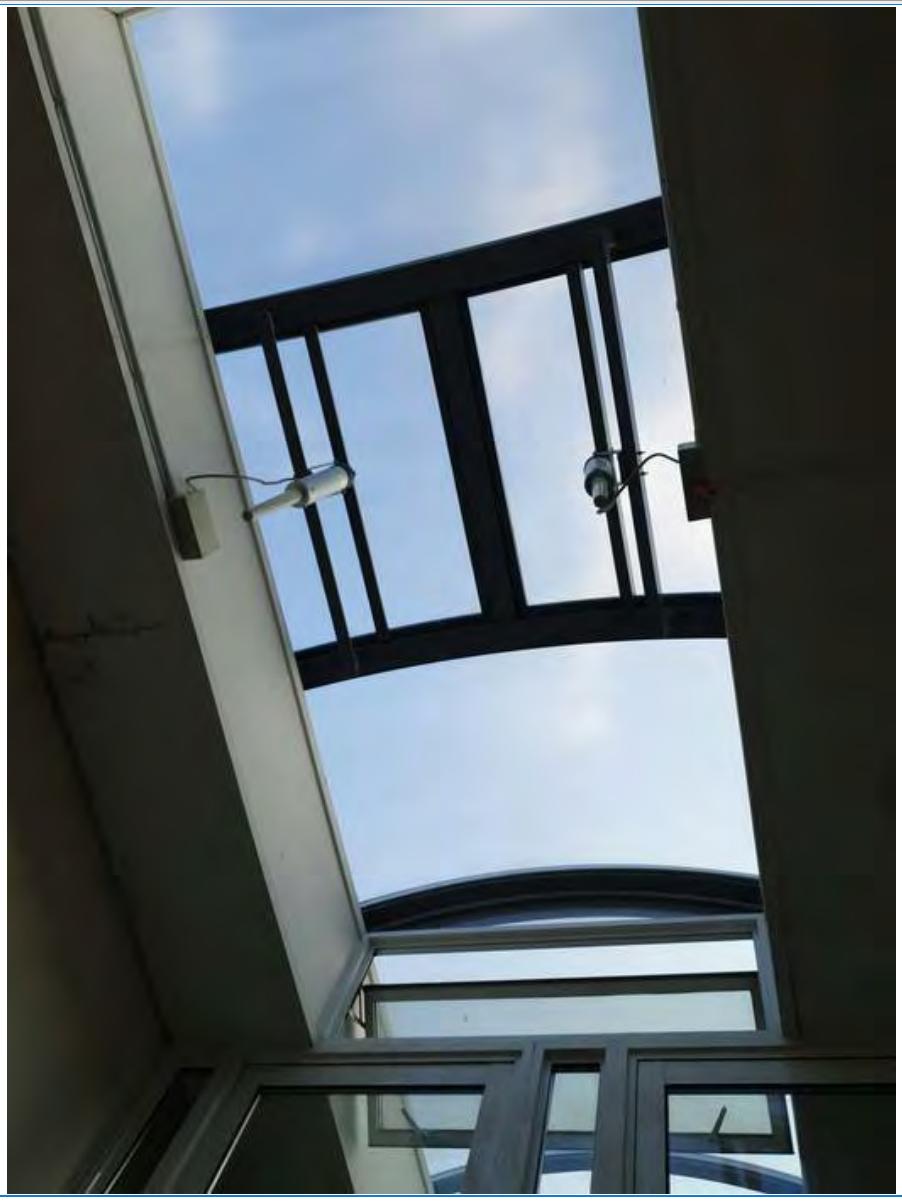
Form: General

Layer: L7
Number of extensions: 0
Created on: 07/03/2022 03:48 PM
Updated by: Arup Fire Plan Radar 9
Time:
Non compliant with the Fire Strategy: No

Title: Thomas More staircase 24 1. 2. top of the stair above l7 3. l7 permanently open vent door 1.5m by 0.55m
ID: 38
Created by: Arup Fire Plan Radar 9
Updated: 07/03/2022 03:48 PM
Date:
Compliant with the Fire Strategy?: No
Details:

Plan:

Images:



1. 07/03/2022 03:47 PM

2. 07/03/2022 03:47 PM

3. 07/03/2022 03:48 PM

APPENDIX D – PROPOSED ACTION PLAN

Identified Gaps	Recommendation	Management Response/Mitigation	Action
	Cromwell Tower		
	Interim Measures		
Page 2	Prepare a Personal Emergency Evacuation Plan (PEEP), so that the evacuation arrangement in the event of a fire is clear to each PRM occupant.	We have introduced a new procedure for assessing vulnerable residents who, may need help evacuating in an emergency or, who may benefit from further help and advice on fire safety issues in their homes.	Continue to work with the 67 households who have informed us that they (or a member of their household) may be vulnerable.
	Remove all storage and rubbish within riser spaces that opens into stair.	This relates to the FRA finding from January 2018, which was addressed immediately at the time. The issue arose because of a leaseholder carrying out internal refurbishment works.	New process introduced in 2018 for Home Improvements requires landlord's post inspection and approval that prevents this happening again.
	Consider providing a fire detector within the electrical riser above L37, so that the BE receives early warning of a potential fire in the electrical riser	Following discussions with Building Control, we feel that this is unnecessary. The load within the electrical riser is negligible. Due to the chimney effect, smoke from any floor may end up setting this off.	No further action proposed at this stage.
	Recommended Actions (Table 1)		
No internal hallway in the flats. Extended travel distances (for single direction of escape). Duplex and triplex layout with open internal stair.	Provide early warning to occupants within the flats by installing a minimum Grade D1 Category LD1 within the flats.	This is considered a leaseholder responsibility and, our Home Improvements booklet recommends to leaseholders the installation of a fire alarm system during refurbishment work.	Further promotion of the installation of fire detection systems through the Estate Wide Bulletin and other publications. For our tenanted homes on the Estate, this work is planned for completion by March 2023 (dependent upon residents granting access).

APPENDIX D – PROPOSED ACTION PLAN

	Review the internal layout of the duplex and triplex in terms of alternative egress and internal hallway against the current guidance.	We have referred this back to ARUP as, it is our view that this forms part of its original commission.	ARUP to review and report back.
Sprinkler protection.	The installation of a sprinkler system is strongly recommended to address inherent risks to the life safety of occupants.	The Executive Director of Community & Children's Services has previously recommended that sprinklers are fitted in the three Barbican high-rise tower blocks.	Members of the BRC to further consider and decide on the recommendation to install sprinklers in the three Barbican high-rise tower blocks.
L1 – L6 Wing A flats provided with single means of escape.	For Wing A flats from L1 to L6: Retain the existing arrangement of escaping via a neighbour's flat from Wing A provided, that there are regular inspections in place to check that the means of escape route via the adjacent flat (Wing B) is available.	This is the most practical and achievable option of the three presented. The BEO sends out advice to leaseholders about these escape routes. Regular inspection is difficult due to access arrangements.	BEO staff to work with residents to develop practical arrangements for inspection and maintaining escape routes.
Evacuation of PRM's/smoke control.	Preparation of Personal Emergency Evacuation Plans (PEEP) for PRM's.	We have introduced a new procedure for assessing vulnerable residents who, may need help evacuating in an emergency or, who may benefit from further help and advice on fire safety issues in their homes.	Continue to work with the 67 households (estate wide) who have informed us that they (or a member of their household) may be vulnerable.
	Replacing existing manually operated ventilation to automatic ventilation system in the lift lobbies.	Early research suggests that this will be a huge and intrusive task. The existing arrangements do function and the benefits do not seem to justify the task.	Further work to complete an options appraisal and, assess the benefits/risks against the scope, nature, and cost of the recommendation.
	Provision of Emergency Voice Communication (EVC) system to all the lift lobbies.	We are looking to incorporate this into the proposed Lift Refurbishment Works.	Review as part of the proposed Lift Refurbishment Works.
Exit signage.	A survey is recommended to inspect and replace existing fire signage to comply with current standards.	Fire signage replacement project is in place but, has been suspended to enable Listed Building Consent to be achieved.	Complete the current fire signage replacement project.
Emergency lighting.	A survey is recommended to inspect and replace existing emergency lighting to comply with current standards.	Existing emergency lighting is inspected and tested regularly and remains functional. A survey is being carried out to identify the works required to bring the installation up to current standards.	Complete the survey and implement subsequent project to bring the installation up to current standards.
Compartmentation	A sitewide survey is recommended to inspect breach in compartmentation and to undertake works to maintain the	The BEO has completed this survey for the three Barbican towers.	Discussions with qualified Fire Engineer regarding findings from survey, proposed

APPENDIX D – PROPOSED ACTION PLAN

	compartmentation in accordance with BS9991.		reinstatement works and process for inspection.
Connection between small lobby, ventilation shaft and electrical riser.	Provide fire separation between the small lobby and the ventilation shaft (removing all the vents) and remove the fire door between the small lobby and the lift lobby on L37 and above, or Provide a fire and smoke damper at each vent to maintain fire separation and to only vent the floor of fire incident. Also provide a wall to separate the smoke shaft and the electrical riser from L38 and above.	There are concerns that these recommendations are simply not achievable due to the constraints on the building including its construction and its listed status.	Further work is required to analyse the recommendations in more detail. Officers are working with Arup, colleagues in Building Control, Planning, and the CS Fire Safety Team to progress this matter.
Fire doors at flat entrances, lift lobbies, firefighting stairs and refuse storage/post box.	It is recommended to replace all fire doors to the stair, small lobby, flat entrances, and the refuse storage/post box.	This is part of the £20m Replacement Door Programme across the Barbican Estate.	Included in the Replacement Door Programme across the Barbican Estate.
	Doors to all the risers to be inspected and repaired/replaced to maintain fire separation from the stair or lift lobbies.	The existing PDA doors are concrete, and the EDA doors are asbestos and are deemed to be compliant.	No further action required at this stage.
	Keep records of inspecting and testing of fire doors in future, at not less than three-monthly intervals to ensure that all fire doors are in working order.	Relevant staff have had training in the inspection of fire doors and, this is no incorporated into the Estate inspection process.	Incorporated into the Estate inspection process.
Kitchen extract shunt duct system.	Replace the existing extract hoods with recirculation type hoods and, implement one of the following: (a) smoke and fire damper at the shunt duct riser activated by the fire alarm/detectors within the flats. (b) maintain the shunt duct arrangement and increase the reliability of the main extract fan. This will require an additional duty standby fan. (c) to block off the shunt ducts and provide a fan on the external wall to draw out air from the flat into the balconies.	There are concerns that these recommendations are simply not achievable due to the constraints on the building including its construction and its listed status. The current Leaseholder Home Improvements Pack contains up-to-date recommendations for installing fire dampers. The existing fans are inspected and maintained at six-monthly intervals.	Further work is required to analyse the recommendations in more detail. Officers are working with Arup, colleagues in Building Control, Planning, and the CS Fire Safety Team to progress this matter.

APPENDIX D – PROPOSED ACTION PLAN

	Andrewes House		
	Recommended Actions (Table 1)		
Narrow escape routes along the balconies. Extended travel distances in flats with single direction of egress and flats without hallway. Lack of protected lobby between each flat and the escape stair.	Provide early warning to occupants within the flats by installing a minimum Grade D1 Category LD2 within the flats.	This is considered a leaseholder responsibility and, our Home Improvements booklet recommends to leaseholders the installation of a fire alarm system during refurbishment work.	Further promotion of the installation of fire detection systems through the Estate Wide Bulletin and other publications. For our tenanted homes on the Estate, this work is planned for completion by March 2023 (dependent on residents granting access).
	Provide smoke ventilation to all the common stairs with appropriate means of activation (e.g. smoke detectors).	There are concerns that these recommendations are simply not achievable due to the constraints on the building including its construction and its listed status.	Further work is required to analyse the recommendations in more detail. Officers are working with Arup, colleagues in Building Control, Planning, and the CS Fire Safety Team to progress this matter.
	Clear briefing to all occupants of Andrewes House on the available escape routes.	The Resident Handbook includes relevant information on fire safety and, further regular reminders are included in the Barbican weekly email bulletin.	Covered by current processes and procedures.
Evacuation of PRM's.	Provision of Emergency Voice Communication (EVC) system to all the lift lobbies.	Need to check on feasibility of this recommendation. If feasible, we will obtain estimate of costs from approved contractor.	
	BE to put in place a management plan and evacuation strategy for the evacuation of occupants including Personal Emergency Evacuation Plans (PEEP) for PRM's.	We have introduced a new procedure for assessing vulnerable residents who, may need help evacuating in an emergency or, who may benefit from further help and advice on fire safety issues in their homes.	Continue to work with the 67 households (estate wide), who have informed us that they (or a member of their household) may be vulnerable.

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	Clear briefing to PRM's on the evacuation procedures and the use of the EVC system to call for assistance.	Included in the procedure above.	Will be included in the above if and when EVC system is installed).
Exit signage.	A survey is recommended to inspect and replace existing fire signage to comply with current standards.	Fire signage replacement project is in place but, has been suspended to enable Listed Building Consent to be achieved.	Complete the current fire signage replacement project.
Emergency lighting.	A survey is recommended to inspect and replace existing emergency lighting to comply with current standards.	Existing emergency lighting is inspected and tested regularly and remains functional. A survey is being carried out to identify the works required to bring the installation up to current standards.	Complete the survey and implement subsequent project to bring the installation up to current standards.
Storage areas in LO3 car park level.	Provide minimum LD2 automatic fire detection and alarm system in accordance with BS5839-1.	Further discussion with Arup in light of restrictions on use included in the stores licence outlined below.	
	Provide adequate signage and emergency lighting within the area.	Included in existing fire signage and emergency lighting projects.	Included in existing fire signage and emergency lighting projects.
	Provide 120 minutes fire resisting construction, including FD60S doors to separate storage areas from firefighting stairs.	Stores licence includes the following provisions: (a) no petrol, paint or other explosive or inflammatory oils or illegal substances shall be kept or taken into the store. (b) the store shall be used as a personal domestic store only and the Licensee shall not do or suffer to be done in the store or on the premises of which the store forms part anything which in the opinion of the City may be a nuisance to them or any occupier of the premises of which the store forms part or other Licensees of stores. (c) the Licensee shall not use the Store or permit or suffer it to be used for the purpose of any trade or business.	Review the store licence and inspect the use of the stores.
	Provide 60 minutes fire resisting construction, including FD30S doors to separate storage areas from the common stairs.	As above.	As above.

APPENDIX D – PROPOSED ACTION PLAN

Fire doors at flat entrances, refuse storage/post box and service risers within stairs.	It is recommended to replace all the fire doors to all the escape stair and firefighting shaft enclosures and service risers within the stairs, to maintain the fire and smoke integrity of the stair.	This is part of the £20m Replacement Door Programme across the Barbican Estate.	Included in the Replacement Door Programme across the Barbican Estate.
	Keep records of inspection and testing of fire doors in the future, at not less than three-monthly intervals to ensure that all fire doors are in working order.	Relevant staff have had training in the inspection of fire doors and, this is now incorporated into the Estate inspection process (refer to replacement door programme)	Incorporated into the Estate inspection process.
Kitchen extract shunt duct system.	Replace the existing extract hoods with recirculation type hoods and, implement one of the following: (a) smoke and fire damper at the shunt duct riser activated by the fire alarm/detectors within the flats. (b) maintain the shunt duct arrangement and increase the reliability of the main extract fan. This will require an additional duty standby fan. (c) to block off the shunt ducts and provide a fan on the external wall to draw out air from the flat into the balconies.	There are concerns that these recommendations are simply not achievable due to the constraints on the building including its construction and its listed status. The current Leaseholder Home Improvements Pack contains up-to-date recommendations for installing fire dampers. The existing fans are inspected and maintained at six-monthly intervals.	Further work is required to analyse the recommendations in more detail. Officers are working with Arup, colleagues in Building Control, Planning, and the CS Fire Safety Team to progress this matter.
Firefighting stairs (SC38 and SC44) at Level 04.	Services in firefighting stairs SC38 and SC44 at L04 that are not part of the firefighting stairs or facilities should be enclosed in a fire rated box or be re-routed.	Works order raised.	Works due to be completed by the end of September 2022.
Firefighting access distance, width of access routes, fireman's lift, lobby smoke ventilation and extended hose coverage.	Discuss with the London Fire Brigade (LFB), and record, firefighting procedures that are specific to Andrewes House in this document.	The LFB is familiar with the layout of the various blocks on the Barbican Estate and, in the past, we have had regular inspections and 'drills' across the Estate.	Further meetings to be held with the LFB to discuss the peculiarities of the Barbican Estate.
	Carry out inspections of the three fireman's lifts (including lift control system)	The LFB has advised that they do not want this information. We currently carry	Requested written confirmation from the LFB.

APPENDIX D – PROPOSED ACTION PLAN

	at monthly intervals to report the results of every inspection to the local fire and rescue service.	out annual inspections as recommended by our lift consultant.	
	Update the Fire Notice Box (FNB) to include information about the design and materials of the external walls, extended hose coverage, and any relevant information following the consultation.	Information on wall construction included in FNB and, ARCGIS also updated.	Completed.
Others	Establish the compliance of the back-up power supply provisions against the relevant standards.	Service contract in place for the inspection and maintenance of the emergency lighting. The lifts are not 'firefighting' lifts and, there is no secondary 'back-up' supply.	Completed.
	Consult with Insurers regarding any additional requirements for property protection.	Insurance colleagues consulted and confirmation received that our Insurer does not require the installation of sprinklers in our residential buildings.	Completed.
	Mountjoy House		
	Interim Measures		
Page 2	BE to prepare Personal Emergency Evacuation Plan (PEEP) for residents with restricted mobility or in a wheelchair as, they are not able to evacuate via the balconies or, down the stairs, so that the evacuation arrangement in the event of a fire is clear to each of them.	We have introduced a new procedure for assessing vulnerable residents who, may need help evacuating in an emergency or, who may benefit from further help and advice on fire safety issues in their homes.	Continue to work with the 67 households (estate wide), who have informed us that they (or a member of their household) may be vulnerable.
	BE to ensure balconies are kept clear of any stored goods to provide safe egress route for occupants.	Window cleaning is done across the Estate every six weeks. Window cleaners are instructed to immediately report any obstructions to the balconies to the BE. The House Officer team carries out a full inspection of the nine miles of estate balconies every year. Items are labelled and removed within a prescribed period.	Process in place.

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		The Residents Handbook sets out the respective responsibilities of landlord and leaseholder in terms of fire safety. Regular reminders included in our weekly email bulletin to residents.	
	BE to keep all the windows in the SC26 protected lobby shut on every floor to reduce the risk of smoke entering the lobby and spread to other floors.	Staff are aware of this and, check the windows as part of the Estate inspection process.	Process in place.
	Recommended Actions (Table 1)		
Extended travel distance (for single direction of travel).	Provide early warning to occupants within the flats by installing a minimum Grade D1 Category LD2 within the flats.	This is considered a leaseholder responsibility and, our Home Improvements booklet recommends to leaseholders the installation of a fire alarm system during refurbishment work.	Further promotion of the installation of fire detection systems through the Estate Wide Bulletin and other publications. For our tenanted homes on the Estate, this work is planned for completion by March 2023.
	Provide detection and alarm system in common areas of the building.		
	Provide fire action notices throughout the common areas of the building for residents to be aware of the evacuation procedure.	Fire signage replacement project is in place but, has been suspended to enable Listed Building Consent to be achieved.	Complete the current fire signage replacement project.
Evacuation of PRM's.	Preparation of Personal Emergency Evacuation Plan (PEEP) for PRM's.	We have introduced a new procedure for assessing vulnerable residents who, may need help evacuating in an emergency or, who may benefit from further help and advice on fire safety issues in their homes.	Continue to work with the 67 households who have informed us that they (or a member of their household) may be vulnerable.
	As part of the PEEP, it may be necessary to provide refuge area and Emergency Voice Communication System to SC24 and SC26 (firefighting stairs with firemen's lift).	At the time of the survey, it was confirmed that the lift in SC24 (Thomas More House) can be used. Arup to review in light of mitigation recently submitted.	

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Sprinkler protection.	The installation of a sprinkler system is recommended to address risks to the life safety of occupants.	It is felt that this recommendation should be reviewed once a detailed compartmentation survey of the block is completed.	Review upon completion of compartmentation survey.
Exit signage.	A survey is recommended to inspect and replace existing fire signage to comply with current standards.	Fire signage replacement project is in place but, has been suspended to enable Listed Building Consent to be achieved.	Complete the current fire signage replacement project.
Emergency lighting.	A survey is recommended to inspect and replace existing emergency lighting to comply with current standards.	Existing emergency lighting is inspected and tested regularly and remains functional. A survey is being carried out to identify the works required to bring the installation up to current standards.	Complete the survey and implement subsequent project to bring the installation up to current standards.
Compartmentation – corner flats with risers in the kitchen running through the building height.	A sitewide survey is recommended to inspect breach in compartmentation and to undertake works to maintain the compartmentation in accordance with BS9991.	Specific representative compartmentation surveys are underway on the Estate. Mountjoy House will completed by the end of December this year.	Compartmentation survey to be carried out by December 2022.
Fire doors at flat entrances, lift lobbies, firefighting stairs and refuse storage/post box.	It is recommended to replace all fire doors to the stair, small lobby, flat entrances, and the refuse storage/post box.	This is part of the £20m Replacement Door Programme across the Barbican Estate.	Included in the Replacement Door Programme across the Barbican Estate.
	Doors to all the risers to be inspected and repaired/replaced to maintain fire separation from the stair or lift lobbies.	This is part of the £20m Replacement Door Programme across the Barbican Estate.	Included in the Replacement Door Programme across the Barbican Estate.
	Keep records of inspecting and testing of fire doors in future, at not less than three-monthly intervals.	Relevant staff trained in the inspection of fire doors and, this is no incorporated into the Estate inspection process.	Incorporated into the Estate inspection process.
Kitchen extract shunt duct system.	Replace the existing extract hoods with recirculation type hoods and, implement one of the following: (a) smoke and fire damper at the shunt duct riser activated by the fire alarm/detectors within the flats. (b) maintain the shunt duct arrangement and increase the reliability of the main extract fan. This will require an additional duty standby fan.	There are concerns that these recommendations are simply not achievable due to the constraints on the building including its construction and its listed status. In respect of option (c), this is not relevant or appropriate to Mountjoy House as, the external wall in this case is all glass.	Further work is required to analyse the recommendations in more detail. Officers are working with Arup, colleagues in Building Control, Planning, and the CS Fire Safety Team to progress this matter.

	(c) to block off the shunt ducts and provide a fan on the external wall to draw out air from the flat into the balconies.	The current Leaseholder Home Improvements Pack contains up-to-date recommendations for installing fire dampers. The existing fans are inspected and maintained at six-monthly intervals.	