

Barbican Estate

Barbican Residential Blocks

Andrewes House - Fire Strategy
Report

Rev A | 11 June 2021



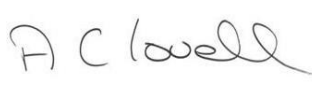
This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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Appendix A

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External Fire Spread

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 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 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 (460mm – 690mm) are narrower than the minimum requirement for an escape route, although the common stairs that they lead to are compliant in width. 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 – 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. The building insurers should be consulted to establish any requirements with respect to property protection.
- 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.
- Shunt duct arrangement: 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 separates 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.
- 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. We understand 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.

Recommended 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.

Table 1: Identified gaps and recommended actions

Identified Gaps	Recommended Action
Narrow escape routes along the balconies	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: <ul style="list-style-type: none">• 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.
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	
Evacuation of PRMs	The following improvements to provisions for PRM evacuation are recommended: <ul style="list-style-type: none">• 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.

Identified Gaps	Recommended Action
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: <ul style="list-style-type: none">• 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 fire fighting 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 or re-routed.
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. <ul style="list-style-type: none">• 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 hose coverage, and any relevant information following the consultation.
Others	<ul style="list-style-type: none">• 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.

Identified Gaps	Recommended Action
	<ul style="list-style-type: none">The sitewide inspection of exit signage (by others) to take into consideration to recommendations in this document.

Next Steps

It is recommended for BE and Arup 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.

1 Introduction

1.1 Appointment and scope

Arup have been appointed by Barbican Estate (herein referred to as BE) to 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 buildings¹.

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.

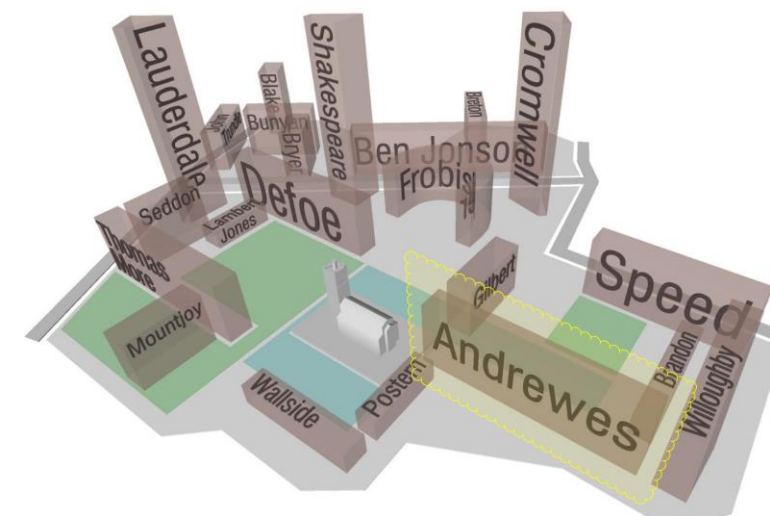


Figure 1: Overview of the Barbican Residential Development (Image courtesy Barbican Living)

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.

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.

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

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.

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 <i>British Code of Practice, The Structural Use of Reinforced Concrete in Buildings</i>	British Standards Institution	1957	-
CP 3: 1962 <i>British Code of Practice Chapter IV Precautions against fire Part 1. Fire precautions in flats and maisonettes over 80 ft in height</i>	British Standards Institution	1962	-
BS EN 1992 – 1 -2 – 2004: Eurocode 2 <i>Design of Concrete Structure Part 1-2: General rules – Structural fire design</i>	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 Andrewes 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 total¹.

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 fire fighting 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.

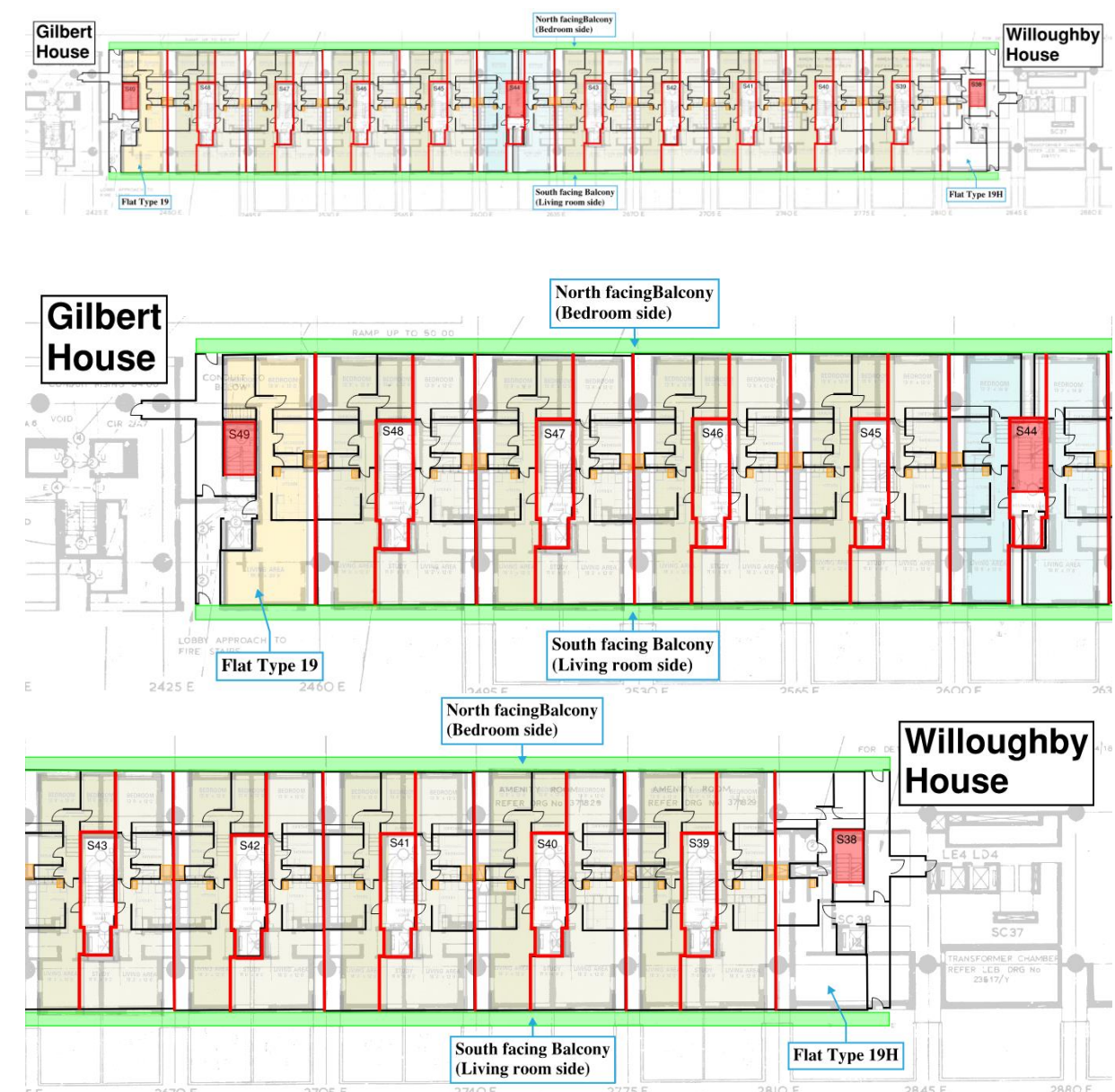


Figure 2: Layout of Andrewes House (Above Podium level: 1-6)

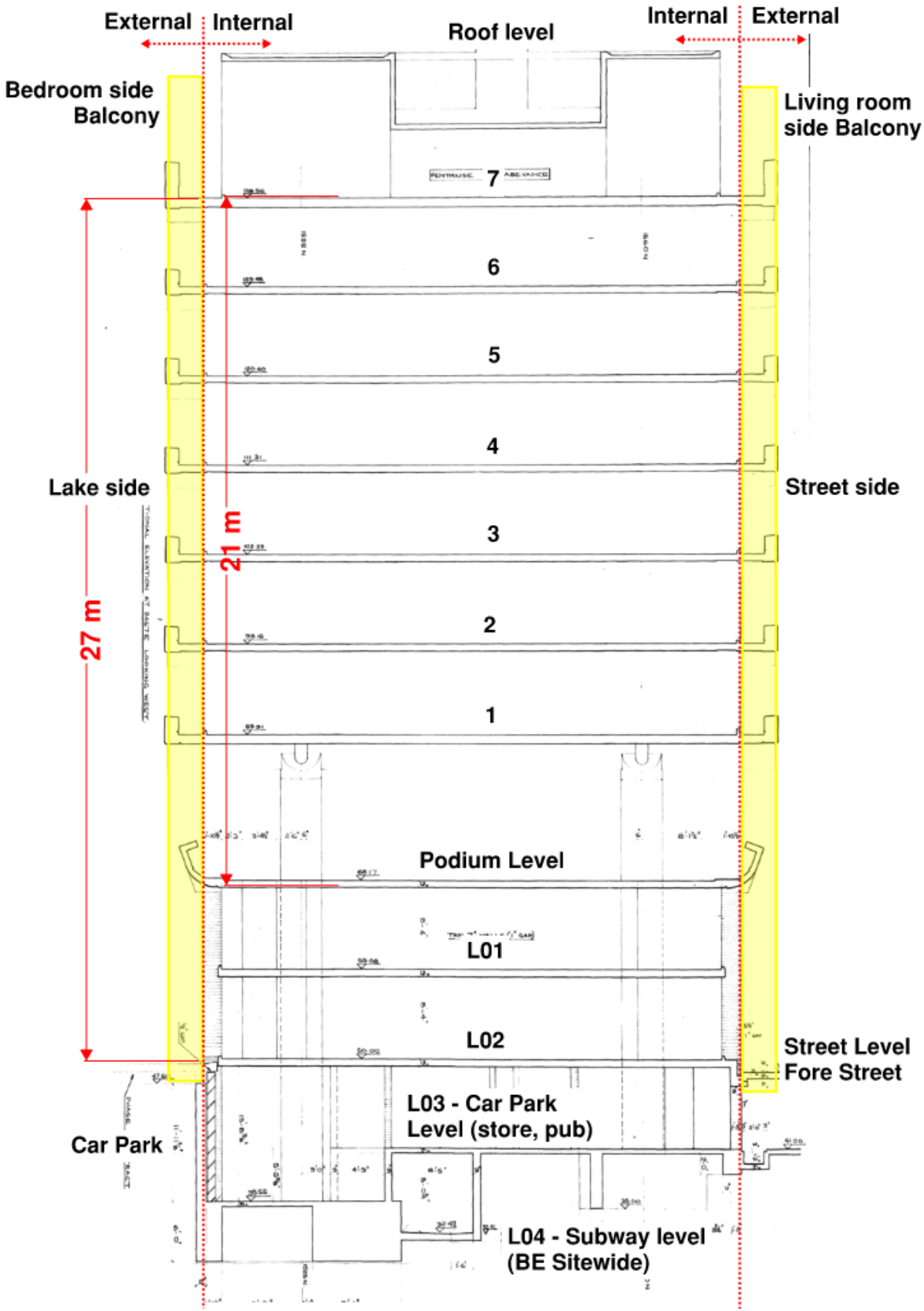


Figure 3: Section of Andrewes House and Level naming convention

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 noted 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.

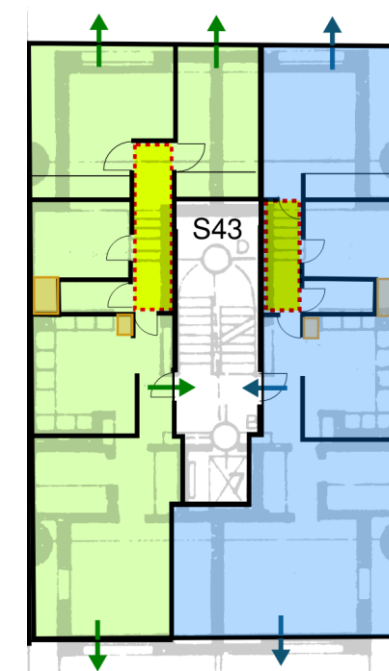


Figure 4: Available egress routes and internal hallway for typical flat layout

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. 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 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 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

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:

- A management procedure should be put 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 or 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 assessed 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), as shown in Figure 11 below.

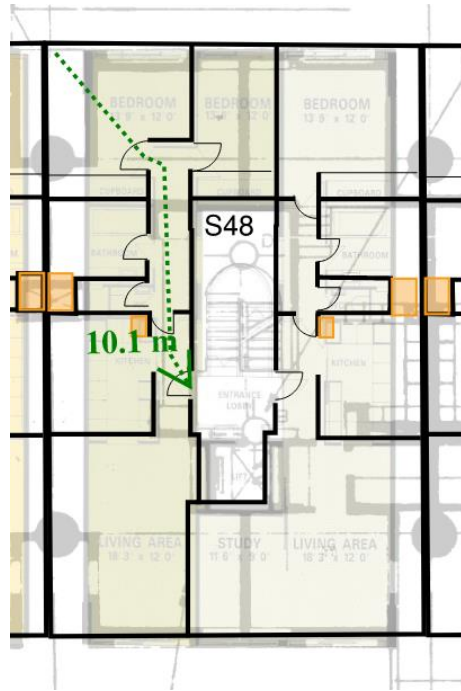


Figure 11: Extended travel distance for single means of escape for PRMs

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 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.
- 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

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.

Recommendations:

- BE to consult with the insurers regarding any additional requirements for property protection.

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 960mm and from the top of the balustrade glazing to the soffit is 1430mm 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 m² 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 m² in area but not greater than 450 m² (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 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.

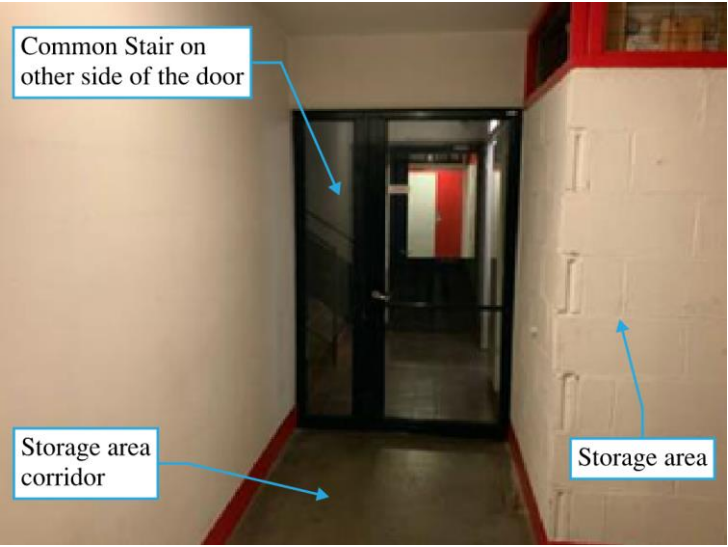


Figure 13: Storage area directly accessible from the stairs

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 4.1.7 and 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 fire fighting 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, unsprinklered 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.

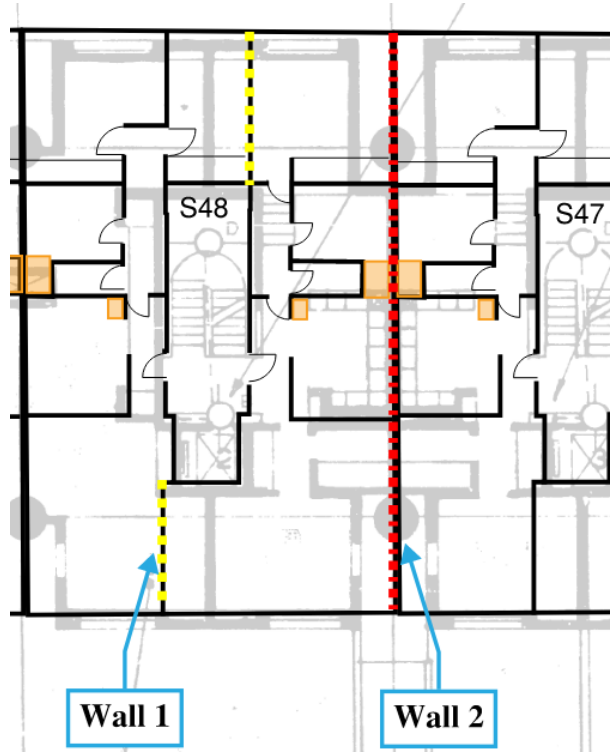


Figure 14: Compartment walls separating the flats

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.

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.

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

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.

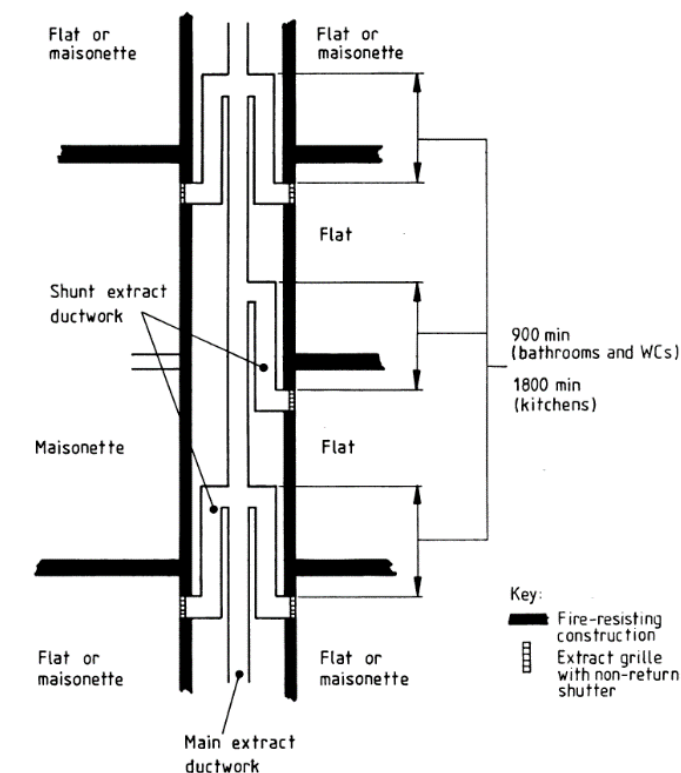


Figure 17: Layout of shunt duct system (BS 5588 Part 9)

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. 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 build 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.

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 closing the connection from the current kitchen extracts with fire resisting construction and replace the existing extract hoods with recirculation type extract hoods.

It is not recommended to install fire dampers in the kitchen extract duct because it is not a recommended practice and there is no fire damper product that has been tested for use in such environment (Arup has consulted different fire damper manufacturers in the UK).

Recommendations:

- Replace existing shunt duct arrangement with closed circuit/recirculation kitchen extract. The remaining shunt duct opening into the service riser is to be closed with fire resisting construction.

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.

Recommendations:

- 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 m² 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

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 fire fighting shafts shall be FD120S (increased fire rating due to the lack of fire fighting 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 5m² and not exceed 20 m² 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 m² for SC38 and 49, and 7.6 m² for SC 44. These exceed the minimum 5m² 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.

Recommendations:

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

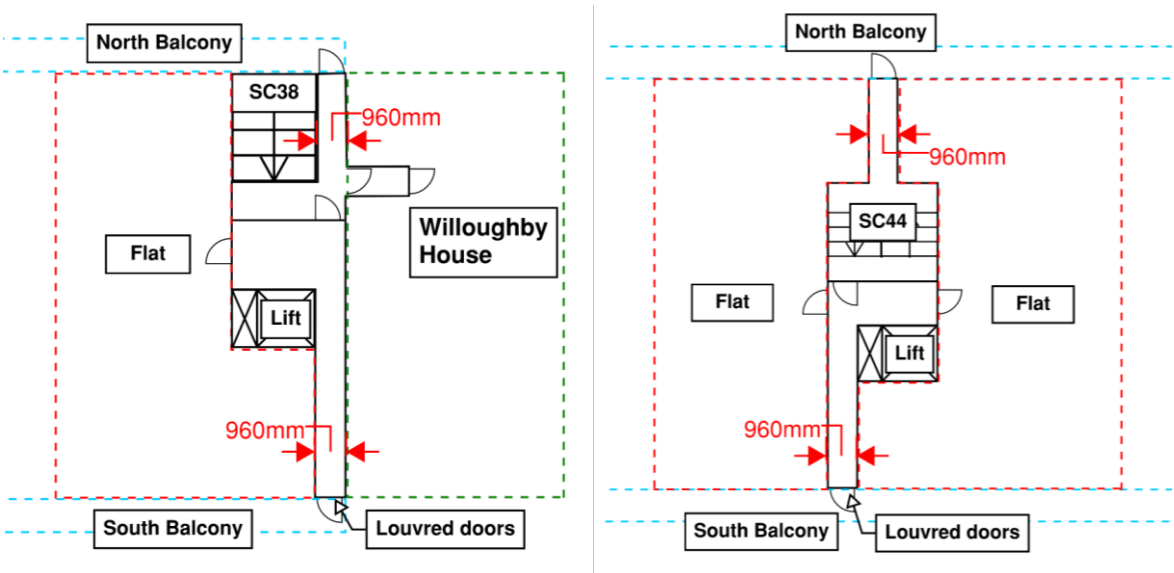


Figure 21: Current layout of firefighting shafts (not to scale)

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 m² 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 m² (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 m²;
- SC 44: 860 mm by 340 mm = 0.29 m²;
- SC 49: 790 mm by 3400 mm = 0.27m².

The area of ventilation serving the firefighting lobbies are less than the minimum 1.5 m² 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.

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 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 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.

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 90m of a dry fire main inlet. Based on Google Maps information (accessed on 22.03.2021) there are two hydrants within 90m 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.

Table 4: Fire Safety Management

Item	Proposed Design
RR(FS)O	<p>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.</p> <p>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).</p> <p>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).</p>
Fire awareness of residents.	<p>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.</p> <p>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.</p> <p>It is recommended for all relevant fire safety information should be provided in a tenant handbook.</p> <p>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.</p>
Evacuation of PRMs	<p>The evacuation of PRMs will need to be carried out by the BE staff or the fire and rescue service.</p> <p>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.</p>

	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	<p>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:</p> <ul style="list-style-type: none">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	<p>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.</p> <p>Any changes affecting the layouts, fire safety systems, fire growth characteristics, and other relevant factors should be communicated to the fire brigade</p>
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	<p>Good housekeeping is essential to reduce the likelihood of a fire starting or developing, and escape routes being blocked. This includes:</p> <ul style="list-style-type: none">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;

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 5 below.

Table 5: Summary of identified gaps and recommended actions

Identified Gaps	Recommended Action
Narrow escape routes along the balconies	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: <ul style="list-style-type: none">• 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.
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	
Evacuation of PRMs	The following improvements to provisions for PRM evacuation are recommended: <ul style="list-style-type: none">• 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

Identified Gaps	Recommended Action
	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: <ul style="list-style-type: none">• 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 fire fighting 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. <ul style="list-style-type: none">• 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 hose coverage, and any relevant information following the consultation.
Others	<ul style="list-style-type: none">• 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

Keys:

Note

Firefighting stair

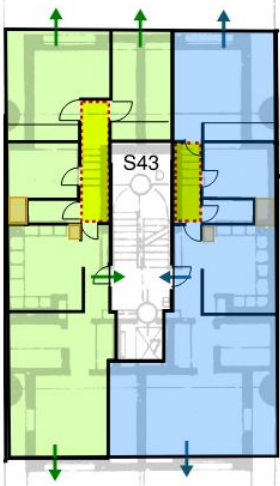
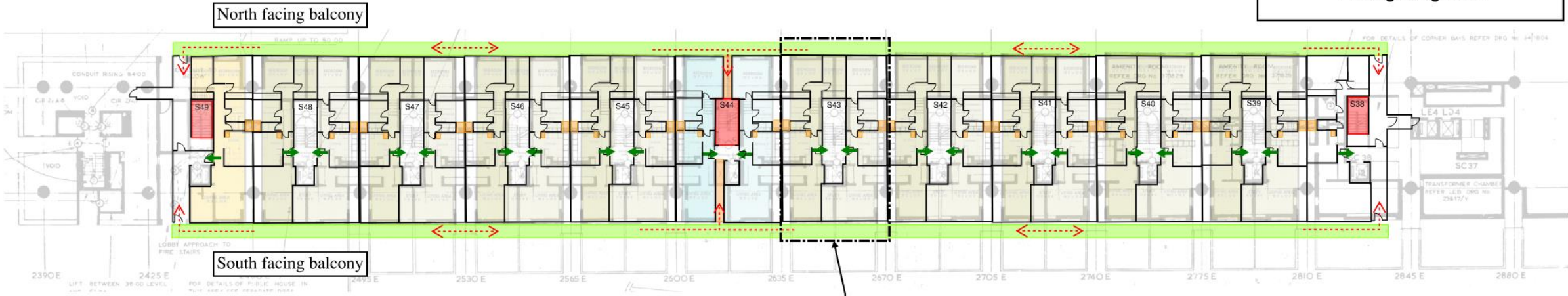
Internal hallway in flat

Balcony

SXX Staircase Number

Storey exit from flat

Escape routes to Firefighting stair



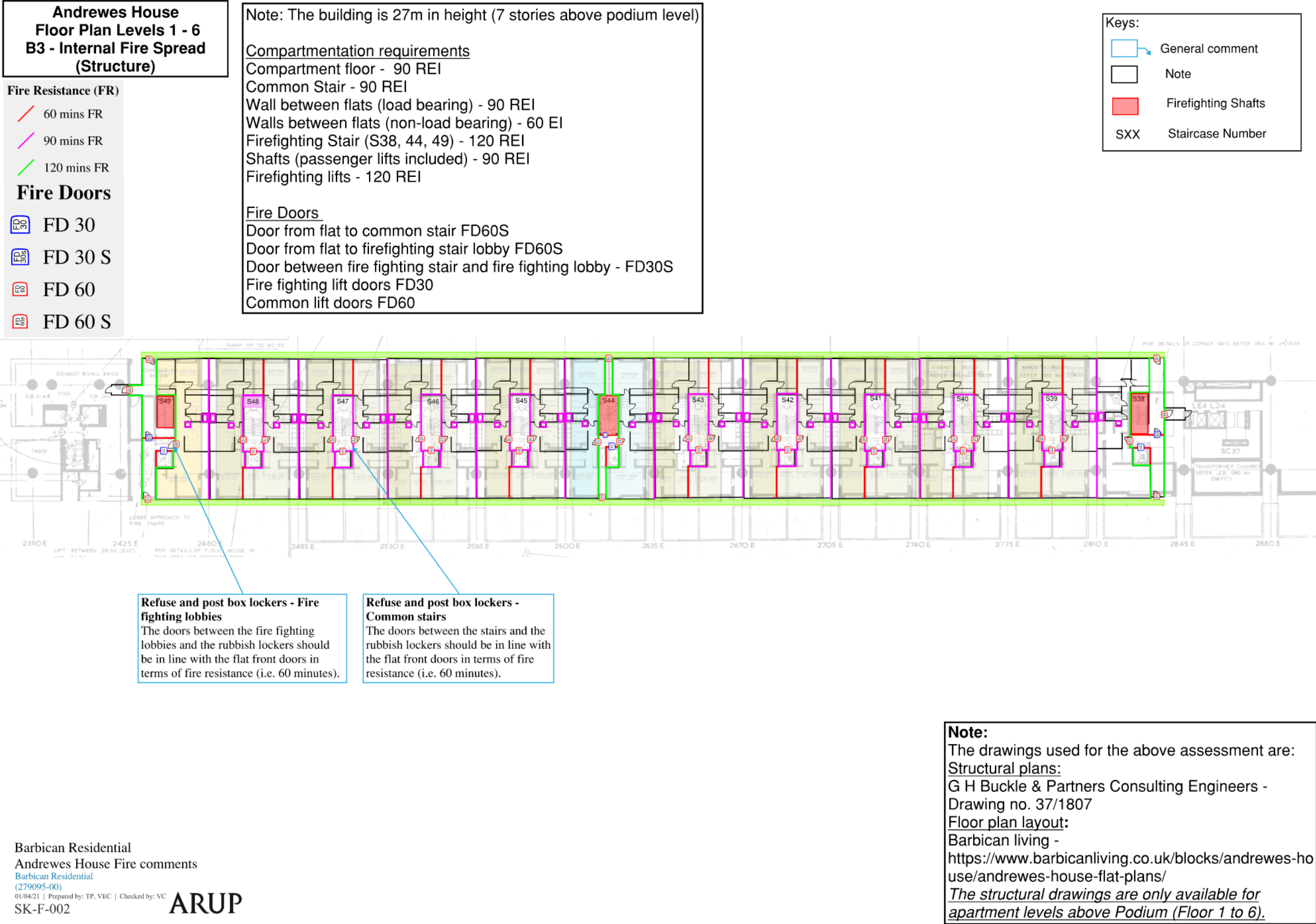
Means of Escape from a typical flat layout
3 available escape routes from each flat:
- South facing balcony
- North facing balcony
- Flat entrance

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).

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

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A2 Fire Fighting Access



A3 Compartmentation

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

Keys:

Note

Firefighting Shafts

SXX

Staircase Number

Fire main

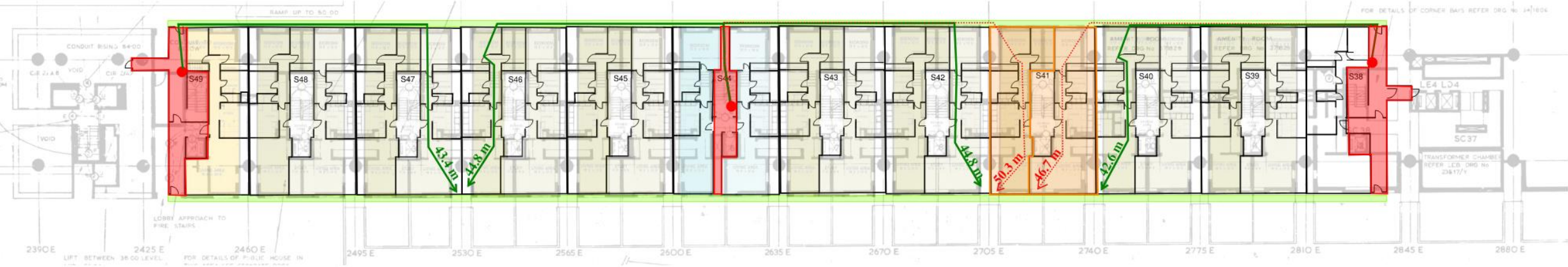
3.0 m

Compliant hose coverage (within 45m)

3.0 m

Non-compliant hose coverage (over 45m)

Hose coverage shortfall areas



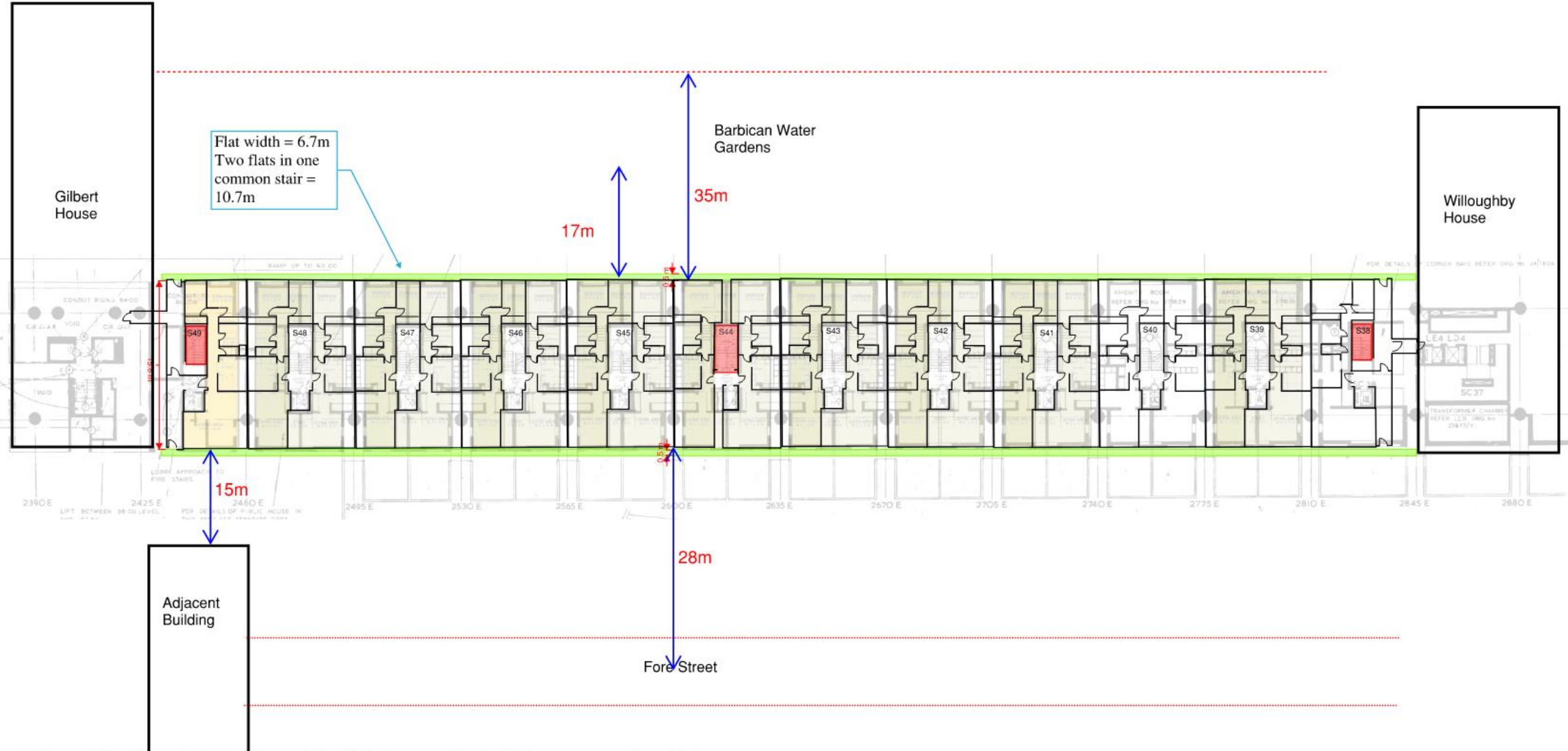
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Barbican Residential
Andrewes House Fire comments
Barbican Residential
(279095-00)
01/04/21 | Prepared by: TP, VEC | Checked by: VC
SK-F-003

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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 flats	1	Residential (Dwellings)	2	Minimum Separation Distance	4.60	10.70	4.55	100.0
Top floor - one flat	1	Residential (Dwellings)	2	Minimum Separation Distance	4.60	6.70	3.69	100.0
Mid floor - two flats	1	Residential (Dwellings)	2	Minimum Separation Distance	2.80	10.70	3.36	100.0
Mid floor - one flat	1	Residential (Dwellings)	2	Minimum Separation Distance	2.80	6.70	2.80	100.0