



Brill Place Detailed Fire Strategy

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BB7 Trading as Omega Fire

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1. Design Principles Summary

1.1 Introduction

- 1.1.1 BB7 Fire has been commissioned by Henry Construction to produce a Detailed Fire Strategy for the proposed Brill Place development, London. Brill Place is a proposed new build tower, primarily consisting of residential accommodation with ground floor commercial units..
- 1.1.2 This report outlines the recommendations for fire safety features to satisfy the functional requirements of Part B of the Building Regulations on the basis of fire engineering principles.

1.2 Legislation

- 1.2.1 Under the Building Regulations a building owner is required to provide an adequate level of life safety to the building by providing suitable means of escape, means of warning occupants of a fire, limiting internal fire spread, protecting adjacent property from fire, and facilitating Fire Service operations. This can be achieved by the adoption of standard guidance as documented within Approved Document B (ADB Volume 1/2) 2019 Edition (May 2020 update). However, ADB further recognises that alternative solutions may provide a more appropriate design. The use of an alternative approach is detailed in ADB, Use of Guidance page 3/4:

"The fire safety requirements of the Building Regulations will probably be satisfied by following the relevant guidance in this approved document. However, approved documents provide guidance for some common building situations and there may be alternative methods of complying with the Building Regulations' requirements.

If alternative methods are adopted, the overall level of safety should not be lower than the approved document provides. It is the responsibility of those undertaking the work to demonstrate compliance.

If other standards or guidance documents are adopted, the relevant fire safety recommendations in those publications should be followed in their entirety. However, in some circumstances it may be necessary to use one publication to supplement another. Care must be taken when using supplementary guidance to ensure that an integrated approach is used in any one building."

- 1.2.2 The Brill Place development will adopt "BS 9991 – Fire safety in the design, management and use of residential buildings" will be used as the basis of the fire safety design of the residential accommodation. BS 9991 superseded BS 5588-1 in December 2011.
- 1.2.3 This report provides the minimum level of protection required regarding compliance for Part B of the Building Regulations. If additional items are required due to property protection, this will need to be advised as soon as possible because changes may be required to the fire strategy.
- 1.2.4 Where no reference is made within this report with regards to a certain element, all aspects of the building are to be in full accordance with the recommendations of BS 9991 and/or the appropriate British Standard. Where the design deviates from BS 9991 a fire engineered approach will be used.
- 1.2.5 The draft London Plan Policy D12(B) and D5(B)(5) have also be considered within this outline report.

1.3 Important Information

- 1.3.1 This report provides the minimum level of protection required regarding compliance for Part B of the Building Regulations. If additional items are required due to property protection or due to the nature of the building, this will need to be advised as soon as possible because changes may be required to be made to the fire strategy.
- 1.3.2 Unless explicitly stated otherwise in this report, all aspects of the building are to be in full accordance with the recommendations of BS 9991 and/or the appropriate British Standard.

- 1.3.3 The validity of this report is dependent upon the recommendations being implemented in full and as described. Any subsequent changes to the design by any party which are not agreed with BB7 invalidate the report.
- 1.3.4 It should be noted that all recommendations made in this report are of equal critical importance for life safety and compliance and the report should be read in its entirety. If you have any queries or do not understand anything within this report, please contact us.
- 1.3.5 This report is developed on the basis traditional construction methods i.e. conventional steel or concrete structure being used.
- 1.3.6 Any proprietary systems or product used should be confirmed by the manufacturer and installer as appropriate for the use in the application to meet the performance specification of this report.
- 1.3.7 On-going maintenance is critical to life safety systems and all systems referenced in this performance specification should be maintained in full accordance with the manufacturers' recommendations.
- 1.3.8 It is considered that the recommendations in this report will provide sufficient guidance to obtain approval from the relevant authorities and achieve a satisfactory level of safety commensurate with the risks of the occupied premises.
- 1.3.9 This report will be based on compliance with Part B to the Building Regulations as of the date of this report and does not intend on advising on possible changes to the Building Regulations.
- 1.3.10 This report has not yet been approved and should not be used for construction until it is fully approved by the relevant approval bodies. It should be noted that the principles detailed in this report must be discussed and agreed with Building Control and the Fire Service.

1.4 Building Description

- 1.4.1 The Brill Place development comprises of primarily residential accommodation over 25 stories with a height of c.71m when measured from the lowest adjacent ground to the topmost occupied storey. The development consists of a basement level, ground & mezzanine, and first to 23rd storeys.



Figure 1. Brill Street Concept Image12

1.4.2 The basement level consists of;

- Chillers & BCWS
- Main Comms Room
- LS Room
- Accessible WCWC
- Main LV Switch room
- Bin Store
- Bike Store
- LTHW Pump Room
- Generator Room
- Wet Riser Plant Room
- Sprinkler Plant Room
- Goods lift

1.4.3 The Ground and Mezzanine Floors consist of;

- Commercial Unit
- Residential Lobby
- Stair Lobby
- Goods lift
- Substation

1.4.4 The first to twenty second floors contain residential accommodation. However, there is a small plant room on the seventeenth floor and a BMU garage on the 21st – 23rd(roof) levels.

1.5 Project Information

1.5.1 Table 1.1 provides a summary of the information that has been considered to develop this fire strategy. Where the design of the building is referred to in this report, it is based on the drawings listed below only.

Table 1.1 Drawing Schedule

Architect	Drawing Number	Description	Revision
Stiff & Trevillion	4451-ST-XX-B1-DR-A-02-099	Basement Plan	3G
	4451-ST-XX-00-DR-A-02-100	Ground Floor Plan	3H
	4451-ST-XX-0M-DR-A-02-100M	Mezzanine Floor Plan	3F
	4451-ST-XX-01-DR-A-02-101	First Floor Plan	3G
	4451-ST-XX-02-DR-A-02-102	Second Floor Plan	3G
	4451-ST-XX-03-DR-A-02-103	Levels 03,05,07,09,11,13 Plans	3G
	4451-ST-XX-04-DR-A-02-104	Levels 03,06,08,10,12,14 Plans	3G

Architect	Drawing Number	Description	Revision
	4451-ST-XX-15-DR-A-02-115	Fifteenth Floor Plan	3G
	4451-ST-XX-16-DR-A-02-116	Sixteenth Floor Plan	3J
	4451-ST-XX-17-DR-A-02-117	Seventeenth Floor Plan	3I
	4451-ST-XX-18-DR-A-02-118	Eighteenth Floor Plan	3J
	4451-ST-XX-19-DR-A-02-119	Nineteenth Floor Plan	3I
	4451-ST-XX-20-DR-A-02-120	Twentieth Floor Plan	3I
	4451-ST-XX-21-DR-A-02-121	Twenty-first Floor Plan	3I
	4451-ST-XX-22-DR-A-02-122	Twenty-second Floor Plan	3I
	4451-ST-XX-23-DR-A-02-123	Roof Plan	3I
	4451-ST-XX-XX-DR-A-03-100	North Elevation	3B
	4451-ST-XX-XX-DR-A-03-101	East Elevation	3B
	4451-ST-XX-XX-DR-A-03-102	South Elevation	3B
	4451-ST-XX-XX-DR-A-03-103	West Elevation	3C

2. Emergency Escape Strategy

2.1 Evacuation Principle

Apartments

- 2.1.1
- The principal mode of evacuation for the residential accommodation is a 'safe to stay' evacuation strategy whereby only the occupants of the apartment of fire origin will evacuate. This standard approach reflects the high degree of compartmentation present and minimises the impact of false alarms - an important consideration in residential accommodation.

- 2.1.2
- The means of escape from the apartments relies on automatic fire detection and fire protection measures incorporated in the common escape route design.

- 2.1.3
- Further evacuation of apartments will not take place automatically and relies on the fire service, management or the independent action of the occupants. As the scheme is a high-rise residential building it should be equipped with facilities for use by the fire and rescue services enabling them to send an evacuation signal to the whole or a selected part of the building by means of sounders or similar devices". This can be achieved by adopting the latest guidance on evacuation alert systems which has been published and provides bespoke recommendation for blocks of flats (BS 8629: Code of practice for the design, installation, commissioning and maintenance of evacuation alert systems for use by fire and rescue services in buildings containing flats).

Non-Residential Areas

- 2.1.4
- The evacuation procedure within the non-residential areas will follow a simultaneous evacuation policy, whereby on fire alarm activation anywhere in the non-residential areas, the occupants of the non-residential areas will evacuate simultaneously, without the fire alarm sounding in the residential or commercial accommodation.

Commercial Unit

- 2.1.5
- The evacuation procedure within the commercial unit will follow a simultaneous evacuation policy, whereby on fire alarm activation anywhere in the commercial unit, the occupants of the commercial unit will evacuate simultaneously, without the fire alarm sounding in the residential or non-residential accommodation.

2.2 Building Population

Apartments

- 2.2.1
- Given that only a single apartment would be expected to evacuate at any one time, the maximum predicted number of occupants would be less than 60 including considerations for guests.

Non-residential Areas

- 2.2.2
- The areas listed below are considered transient spaces, where a limited number of occupants would be present for a limited period of time or accounted for in other areas of the development. Thus, it is deemed acceptable additional occupancy is not accounted for in these areas.
 - Bin Store;
 - Bike Store;
 - Stair Lobby
- 2.2.3
- The areas listed below are considered as low occupancy, low use spaces which would only be used by maintenance personnel and therefore, will not be considered in the overall occupancy of the building.
 - Plant rooms;
 - Comms room;
 - Switch rooms

- Substation
- Goods Lift
- Generator room

- 2.2.4
- It is envisaged that the Residential lobby area will be occupied by a single concierge.

Commercial Unit

- 2.2.5
- The commercial unit has an area of 60m², which equates to 30 people, when a floor space factor of 2m² per person is applied in accordance with a shop floor area.

2.3 Building's Automatic Fire Detection & Alarm System (AFDAS)

- 2.3.1
- A summary of the fire detection and alarm recommendations for the building has been provided in Table 2.1 below, with details on each system listed below. Where referred to in this section, a "Category L" system is a life safety detection system designed in accordance with BS 5839-1 for use in non-domestic areas; a "Category LD" system is a life safety system designed in accordance with BS 5839-6 for use in domestic areas.

Table 2.1 Fire Detection and Alarm Systems

Occupancy	Alarm Performance	Design Standard	Sounders?	Manual Call Points?
Apartments	LD1	BS 5839-6	Yes	No
Common Corridors	L5	BS 5839-1	No	No
Non-Residential Areas	L2	BS 5839-1	Yes	Yes
Commercial Unit (shell & core only)	M	BS 5839-1	Yes	Yes

Residential

- 2.3.2
- Due to the provision of open plan apartments, the residential accommodation is to be provided with a Grade D1 Category LD1 alarm system. This will permit a single sprinkler flow alarm per level, rather than one being required per flat.
- 2.3.3
- A Category L5 detection and alarm system should be provided to the common corridors and stairs of the building. The system is provided to actuate the smoke ventilation only and will not act as a means of warning occupants of a fire. The system will consist of smoke detectors only, with no manual call points or sounders. The smoke detectors should be spaced along the corridor in accordance with the recommendations of BS 5839-1 in that all areas of the corridors must be no more than 7.5m from a smoke detector. Additionally, it should be ensured a detector on the corridor is provided within 1m of the apartment doorway that is closest to the escape stair. The detector should be located between the apartment doorway and the nearest stair.

Non-residential Areas

- 2.3.4
- A Category L2 detection and alarm system should be provided to the non-residential areas ground floor ancillary areas of the building.
- 2.3.5
- The plant room on the seventeenth floor and the BMU garage on the on the 21st – 23rd(roof) levels should form part of the non-residential areas fitted with an L2 alarm system.
- 2.3.6
- Manual call-points are to be located in the non-residential areas on escape routes and at all storey exits. All doors to fresh air should be provided with manual call points, including where exits are not specifically designed as fire exits. The distribution of the manual call points should be such that no occupant has to travel more than 45m to reach the nearest one. It should be noted that the activation of a manual call point should not trigger any sounders in the residential areas to facilitate the stay-put evacuation policy.

2.3.7 If the fire alarm is to interface with other systems e.g. plant shut down and lift installations these interfaces should be designed in accordance with BS 7273-6. Door release mechanisms, free-swing closers and hold open devices should be interfaced in accordance with BS 7273-4.

Commercial Unit

2.3.8 The commercial unit will be designed as shell and core only and are subject to separate Building Regulations applications upon fit out. The minimum alarm and detection required for such premises is a manual system containing no automatic detectors. The alarm system should be designed and installed in accordance with BS 5839-1.

Fire Alarm Control Panel

2.3.9 The fire alarm control panel (separated for the commercial and residential) should be located at an appropriate location for both key staff and firefighters. They should normally comprise an area on the ground floor close to the main entrance of building likely to be used by the Fire Service. It is recommended that the position of the fire alarm control and indicating panel is located in such a place that it can be easily and readily accessible to the Fire Service.

2.4 Directions of Escape

2.4.1 The directions of escape requirements have been highlighted in Table 2.2. These have been met throughout the development.

Table 2.2 Direction of Escape Requirements

Maximum Population	Directions of Escape Required	Door Opening Direction
60	1	No requirement
600	2	In direction of escape
More than 600	3	In direction of escape

2.5 Escape Widths

2.5.1 The escape widths should be in accordance with Table 2.3. This report only addresses the minimum in Part B of the Building Regulations and does not address Part M requirements. Conformance with other parts of Building Regulations should be confirmed by others (standard wheelchair users require doors of 850mm in width).

2.5.2 Where a single escape route is provided or the exit opens against the direction of escape, the occupancy will be limited to a maximum of 60 through that exit.

Table 2.3 Widths of Escape Routes and Exits

Maximum Number of Occupants	Minimum Escape Width (mm)
60	750
110	850
220	1050
More than 220	5mm per person

Residential

2.5.3 Due to the safe to stay evacuation policy, the maximum envisaged occupancy making an escape is below 60, therefore the residential exit widths are deemed acceptable.

Non-residential Areas

2.5.4 Due to the transient nature and small size of the non-residential areas the maximum envisaged occupancy making an escape is below 60, therefore the non-residential exit widths are deemed acceptable.

Commercial Unit

2.5.5 the maximum envisaged occupancy within the commercial unit is below 60, therefore the proposed exit widths are deemed acceptable.

2.6 Travel Distances

2.6.1 Recommendations for limitations on travel distances can be seen in Table 2.4.

Table 2.4 Travel Distance Limitations

Location	One direction	More than one direction
Apartments	9m*	N/A
Common Corridor	7.5m*	30m*
Bins Storage	9m	18m
Bike Storage	25m	45m
Plant Room	9m	35m
Commercial Unit	18m	45m

Note: * Where sprinklers are provided in accordance with BS 9251 in the apartments, the single direction travel distance within the ventilated common corridors can be increased to 15m and 20m within the apartments. Where there is an alternative direction of escape the common corridor travel distances can be increased to 60m.

Residential Apartment Layouts

2.6.2 Due to the height of the building and the provision of open plan apartments a BS9251 sprinkler system will be provided to the residential apartments. Travel distances in apartments fitted with sprinklers should be limited to 20m from the furthest point in the room to the apartment entrance door.

Residential Duplex Apartment

2.6.3 The travel distance in a Duplex apartment when measured from any point of the apartment to the head of a protected stair should be limited to 9.0m. This limit may be extended to 20m if a residential sprinkler system is incorporated into the design and a Grade D Category LD1 AFDA is also provided.

2.6.4 The stair and hallway within the duplex apartment should be constructed of materials achieving a 30min fire rating and also doors should be FD30 rated.

Location of Cooking Facilities (Open-Plan Apartments)

2.6.5 The cooking facilities must be located such that they will not prejudice the escape from any point within the apartments. The cooking facilities are on the escape routes for open plan apartments, and so to ensure that their location is acceptable, an analysis has been undertaken to determine the likelihood of the egress route being affected by the radiant heat from a cooking fire. The analysis will seek to determine that an appropriate separation distance can be maintained between the cooking area and the egress route such that the escaping occupants are not exposed to excessive radiation, see Table 2.5.

2.6.6 The analysis will seek to determine that an appropriate separation distance can be maintained between the cooking area and the egress route such that the escaping occupants are not exposed to excessive radiation. In accordance with PD7974-6 (British Standards Institution, 2004) Table G.3 the tenability limits for received radiation are as follows.

- <2.5kW/m² for 5 over minutes

- 2.5kw/m² for 30 seconds
- 10kW/m² for 4 seconds

2.6.7 Generally, a tenability criterion of 2.5kW/m² will be adopted as a received radiant heat flux on the basis that any received thermal radiation less intense than that value is tolerable for over 5 minutes. Detailed calculations for the locations of the cooking facilities, and the impact that various fire protection devices have on the potential fire size have been provided in Appendix 1 of this report. A summary of the results has been provided below in Table 2.5.

Table 2.5 Calculated Definition of "Remote" for Means of Escape

Fire Protection System Provided	Dimension of R ₀
None	Greater than 1250 mm ^[1]
Category B Cut-off Device (BS 50615)	Greater than 660mm

Note 1: This is based on a 2.5kW hob as a conservative estimate. Details on the specific cooking facilities are required to ensure this separation distance is accurate.

2.6.8 The "dimension of R₀" as given in Table 2.5 refers to the R₀ dimension indicated in Figure 2 below.

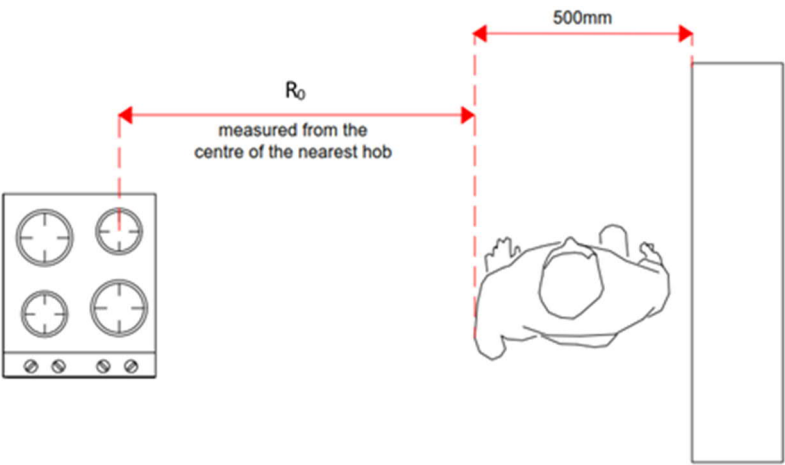


Figure 2. Separation distance from Hobs to Escape Route

2.6.9 The location of the cooking facilities within all open plan apartments should achieve the minimum separation distance stated in Table 2.5 and Figure 2. It appears that the cooking hobs in all apartments are located more than 1750mm from the escape route. Therefore, no additional fire protection system is required to the cookers.

Non-Residential Areas

2.6.10 The travel distances within the generator room (15.3m), wet riser plant room (14.8m) and BCWS plant room (13.8m) exceed the allowable limit of 9m. It is proposed these slight extensions are deemed acceptable due to the following;

- Provision of a BS9251 sprinkler system
- Provision of an L2 AFDA system
- They are all transient areas that would be usually unoccupied and locked and would only be accessed by maintenance personnel for a short period.

- The most onerous extension is 6.3m, which at a walking speed of 1.2m/s would take an additional 5.25 seconds.

2.6.11 The recommendations made in 2.6.10 is a deviation and would require Building Control and Fire Service approval and would remain a design risk until this is achieved.

Commercial Unit

2.6.12 Due to the small size of the commercial unit and alternative means of escape the travel distances within the commercial unit are compliant as per the limits set out in Table 2.4.

2.7 Common Corridors

2.7.1 Where a development is served by a BS 9251 sprinkler system, the recommendations of BS 9991 permit a travel distance of 15m in a single direction within a ventilated corridor, from an apartment door to the protected stair.

2.7.2 Additionally, under BS 9991 a travel distance of 7.5m is permitted in an unventilated corridor where the corridor provides direct access to a ventilated stair lobby, this configuration is used on floor 18 and 19.

2.7.3 It is proposed that the development is served by a mechanical smoke shaft for the purpose of smoke ventilation within the common corridors, the mechanical smoke shaft requirements are detailed in section 2.8.

2.7.4 The mechanical smoke shaft will serve all stories including ground and basement. Through the provision of the smoke shaft, the common corridor travel distances within the ground – 22nd floor are compliant.

Basement Common Corridor

2.7.5 The allowable 7.5m travel distance within the basement common corridor to the stair is exceeded in the areas highlighted in green in Figure 3. See section 6.4 for basement vent details.

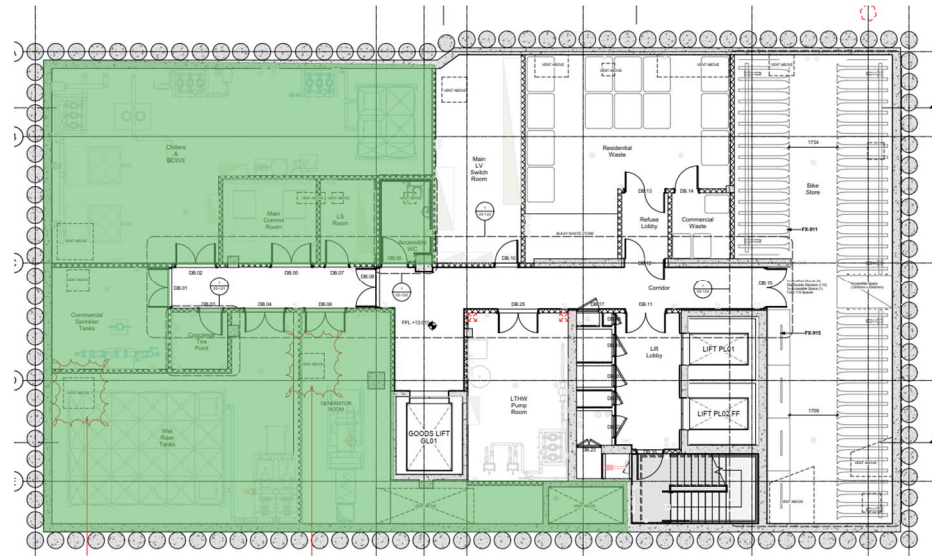


Figure 3. Basement Level Travel Distances

2.7.6 It is proposed that the extended travel distances within the BCWS plant room, generator room, wet riser plant, commercial sprinkler plant, tea room, WC, comms room and life safety mains room are acceptable based on the following;

- The lift lobby area is to be provided with a mechanical extract system;
- Provision of a BS9251 sprinkler system (except life safety mains room);
- Provision of an L2 AFDA system;

- They are all transient areas that would be usually unoccupied and locked and would only be accessed by maintenance personnel for a short period;
- The most onerous extension is 8m (23m from commercial sprinkler plant room), which at a walking speed of 1.2m/s would take an additional 6.7 seconds.

2.7.7 The recommendations made in 2.7.6 is a deviation and would require Building Control and Fire Service approval and would remain a design risk until this is achieved.

2.8 Ventilation Provisions

2.8.1 In buildings above 30m, where the common corridors/lobbies have travel distances within the recommendation in BS 9991, the ventilation can be achieved by either:

- An AOV of 1.0m² in area which discharges into a vertical natural smoke shaft with a clear internal area of 1.5m²; or
- A 0.8m² mechanical ventilation shaft with a pressure sensor in the corridor/lobby to prevent excessive depressurisation; or

Mechanical Smoke Shaft

2.8.2 The scheme is proposed to adopt a mechanical smoke shaft approach. The mechanically assisted smoke shafts should meet the following criteria:

- Have a minimum cross-sectional geometric free area of 0.8m² and 1.0m² geometric free area AOV into the corridor.
- The operation of the mechanical shaft would be upon a smoke detector activating in the corridor/lobby. The extract rate for the 0.8m² mechanical shaft is to be confirmed by the smoke shaft designer.
- The smoke shafts are to include duplicate fans (duty and standby) with alternative power supplies. The fans in the extract shafts are to be fire rated in accordance with the recommendations of BS EN 12101.

2.8.3 The mechanical smoke shaft extract fan will be required to be linked to pressure sensors in the common corridors to control the smoke extract rate. The sensor will control the ramp up of the fan extract rate when the stair door opens, for example, to ensure the pressure within the corridor isn't too great

2.8.4 Upon detection of smoke in the common corridor, the vents on the fire floor, the vents in the fire floor, the vent at the top of the smoke and the stair are to open simultaneously. The vents from the corridor/lobbies on all the other storeys will remain closed and locked shut i.e. they cannot open upon a second detector activating on another floor.

2.8.5 The smoke shafts should be constructed of materials classified as A1 in accordance with BS EN 13501-1; or of materials determined to be non-combustible when tested in accordance with BS 476-4, or of any material which when tested in accordance with BS 476-11 does not flame or cause any rise in the temperature on either the centre of the specimen or the furnace thermocouples. It is proposed to skim the walls of the smoke shaft to ensure that the required fire rating is achieved.

2.8.6 As the smoke shafts penetrate compartment floors, as a minimum the shafts should maintain the fire rating of the respective compartment floor it runs through.

2.8.7 No services other than those relating to the smoke shaft should be contained within the smoke shafts.

2.8.8 Fans should be capable of handling gas temperatures of 300 °C for a continuous period of not less than 60 min and tested in accordance with BS EN 12101-3.

- Exhaust points outlets should be located not create recirculation with the stair "inlet vent".

- Smoke dampers configured to vent smoke from only one level at a time.

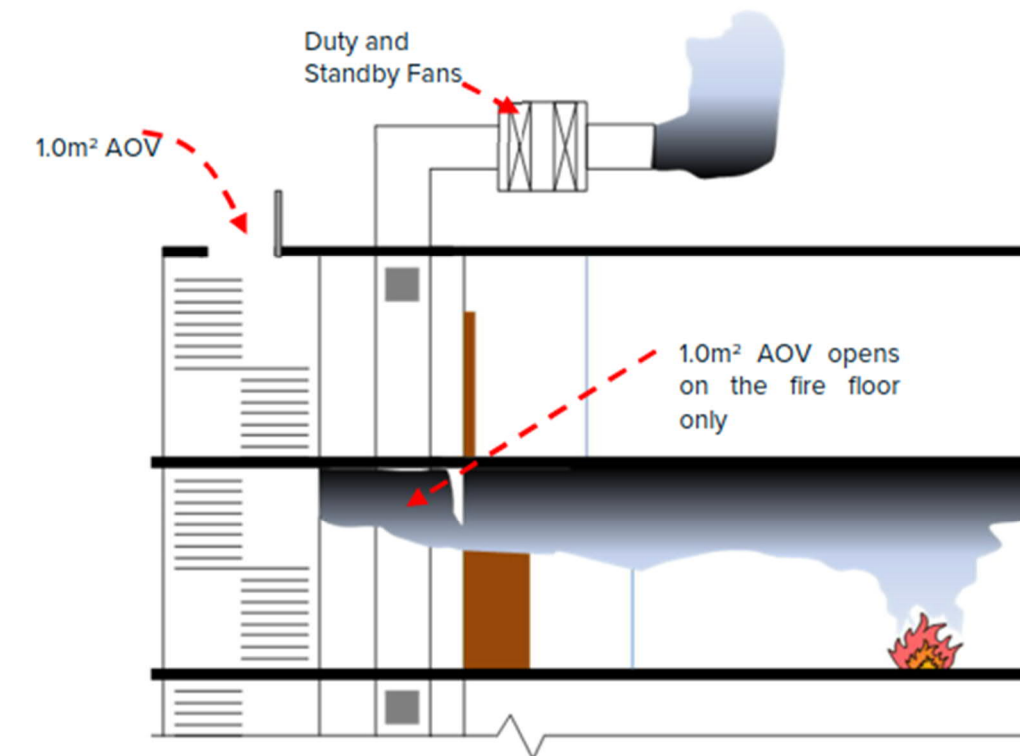


Figure 4. Mechanical Smoke Extraction System

2.8.9 The typical smoke shaft ventilation layouts have been highlighted in Figure 5 - Figure 9.

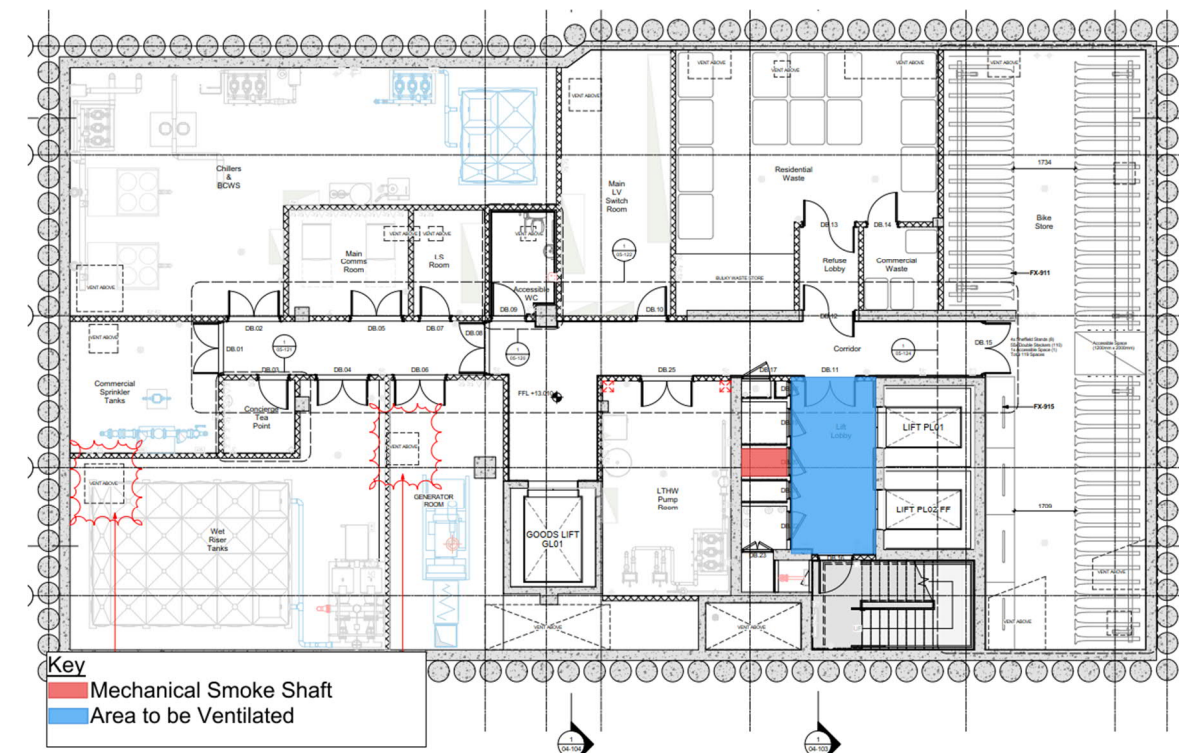


Figure 5. Basement Mechanical Smoke Shaft Arrangement

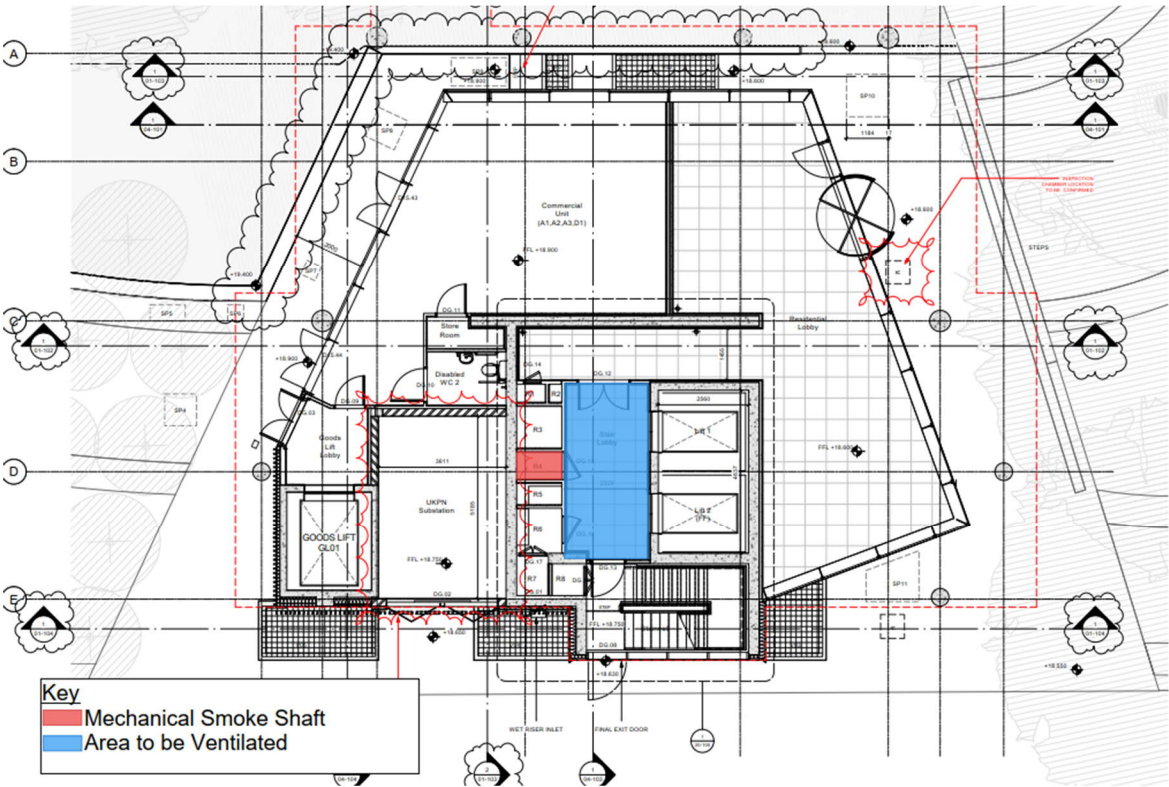


Figure 6. Ground & Mezzanine Floor Mechanical Smoke Shaft Arrangement

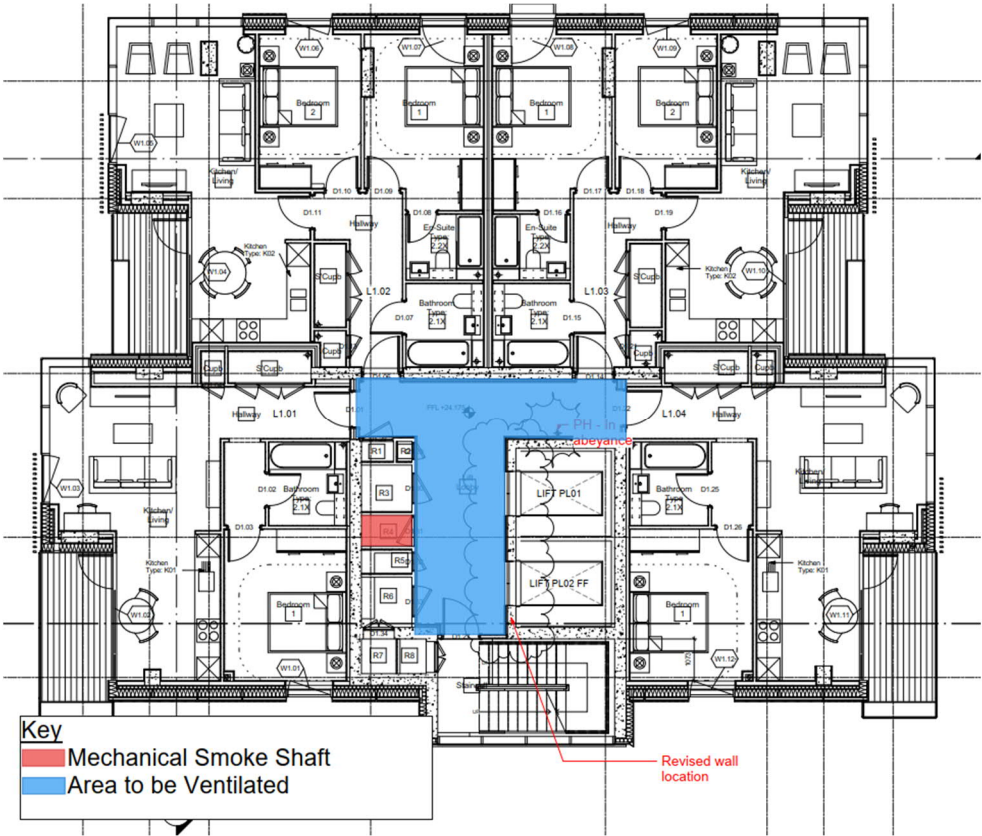


Figure 7. Typical Upper Floor Mechanical Smoke Shaft Arrangement

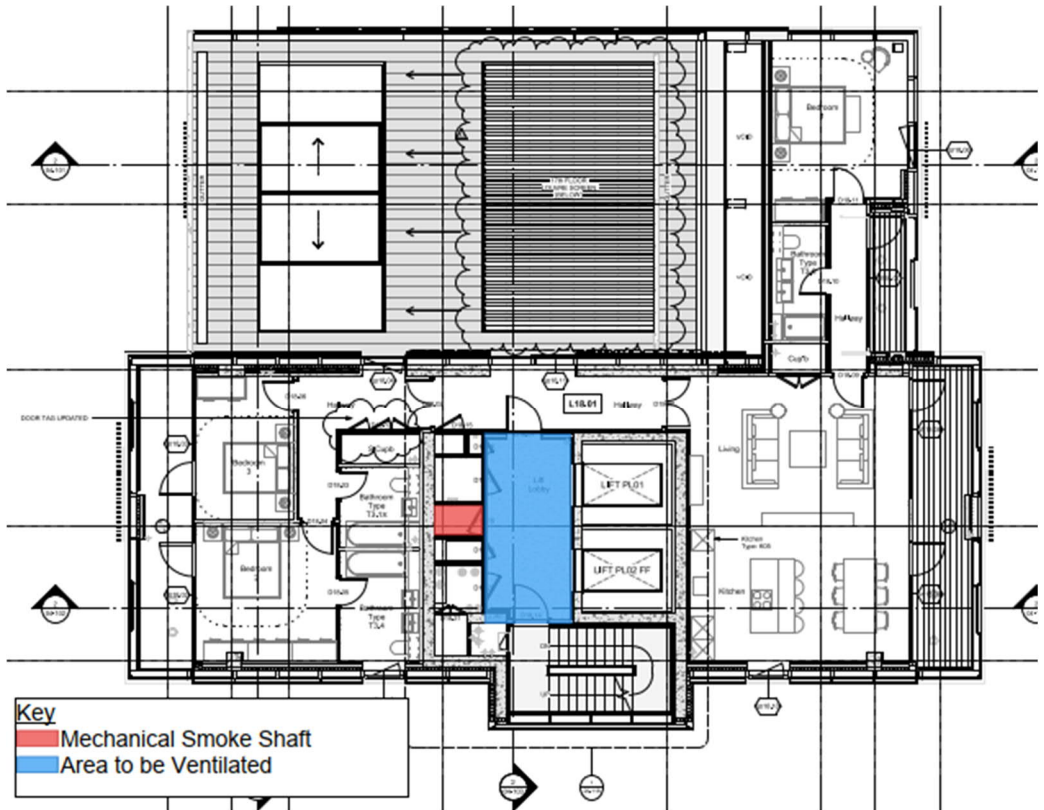


Figure 8. 18th – 19th Floor Typical Smoke Shaft Arrangement

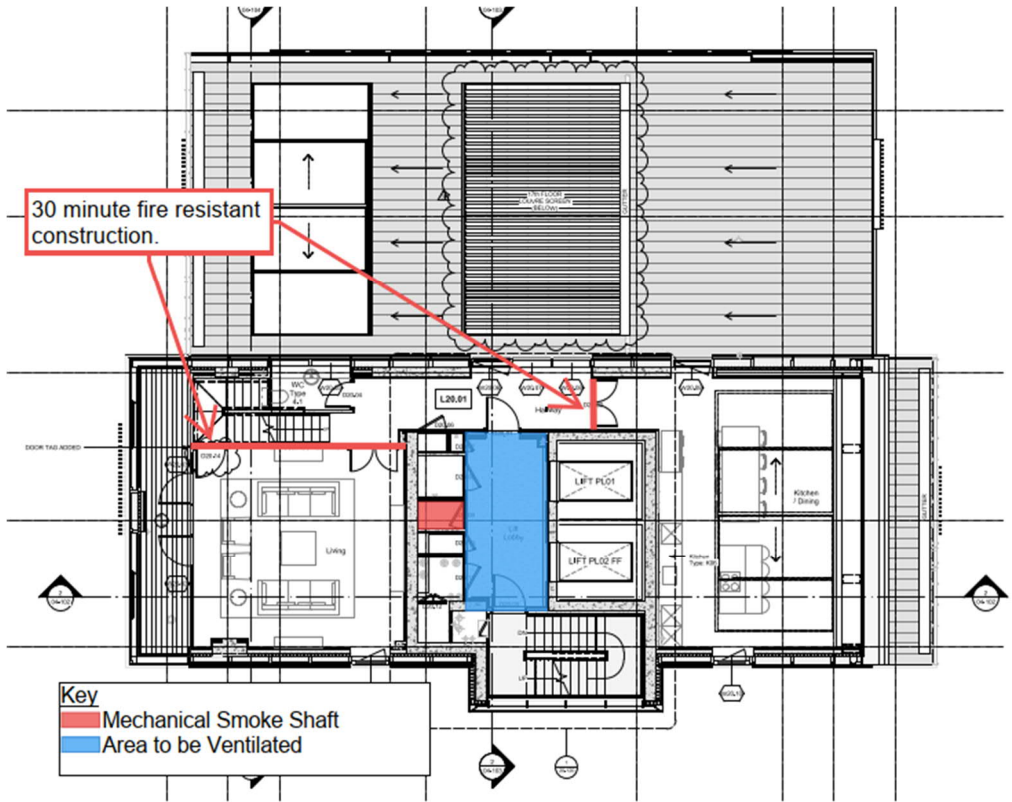


Figure 9. 20th Floor Smoke Shaft Arrangement

- 2.8.10 Additionally, a 1.0m² AOV should be provided at the head of the stair cores. AOVs should also be provided with a manual switch at ground floor level for use by the fire brigade.
- 2.8.11 The automatic openable vents (AOV's) play no part in the initial residential apartment evacuation but are intended to limit the spread of smoke to the stair. Additionally, the vents also aid in relieving smoke and heat from the common corridors during firefighting and allow firefighters to vent smoke. Vents designed to open automatically from the top storey of the stairs in buildings other than small single-stair buildings should be configured to operate upon smoke detection within any of the protected corridors or protected lobbies directly adjacent to the staircase enclosure.
- 2.8.12 The method to calculate the free area of the Automatic openable vents (AOV's) is highlighted in Figure 10. This is applicable for the AOV at the head of the head of the stair.

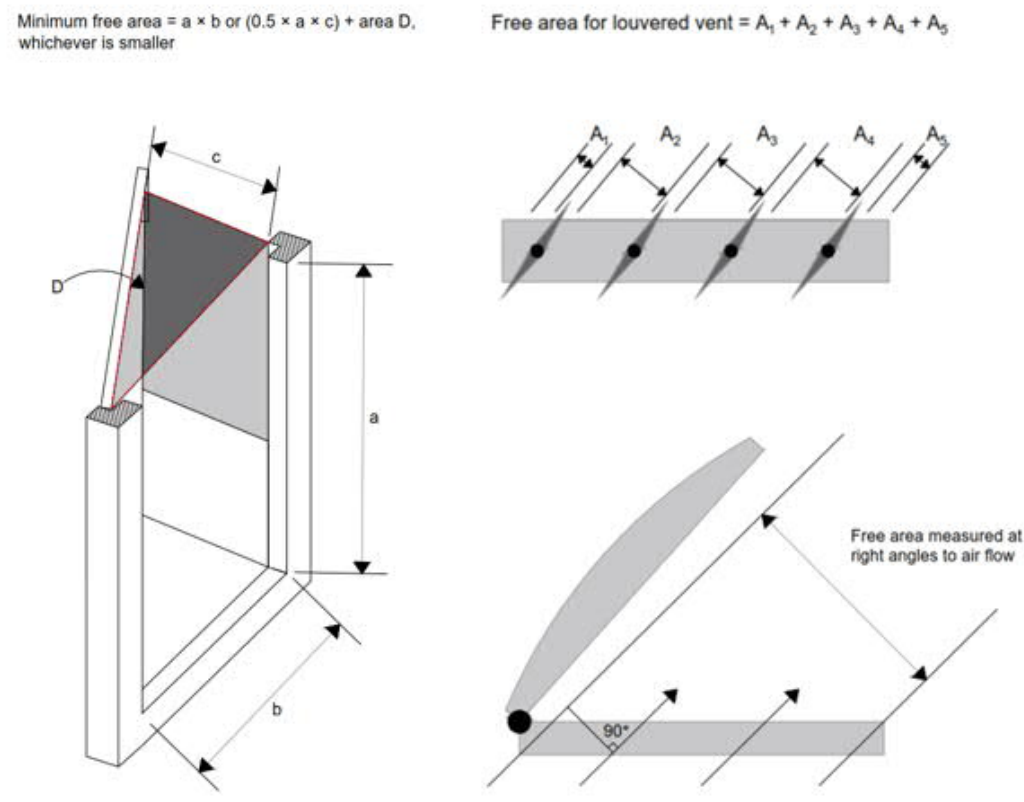


Figure 10. Free Area of Smoke Ventilation

2.9 Vertical Evacuation

- 2.9.1 BS 9991 states that a stair of acceptable width for everyday use will be sufficient for escape purposes from residential apartments. However, due to the height of the building, the stairs will be designed as firefighting stairs. Firefighting stairs will require to will have a minimum width of 1100mm (Note that this is the Part B requirement, and the Part M requirement may be greater). Further detail on the design of firefighting shafts can be found in Section 6.2.
- 2.9.2 The stair will be vented at the head via a 1.0m² AOV (Automatic Opening Vent).
- 2.9.3 Egress from the stair is provided direct to the external at the lowest adjacent ground level no extra provision are recommended as the final exit is in line with the recommendations of BS 9991.
- 2.9.4 Any final exit doors from the stairs would need to provide an equivalent clear width of the stair they serve. However, due to the stay put evacuation principal and low number (less than 60) of occupants escaping

at any given time, it is proposed that the final exit widths could be reduced to a minimum of 850mm. This is to be discussed and agreed with Building Control.

2.10 Evacuation Lifts

- 2.10.1 It should be noted that the draft London Plan Policy D5(B5) requires a minimum of one lift per core suitably sized (or more subject to capacity assessments) should be used to evacuate people who require level access from the building to be an evacuation lift. The provision of evacuation lifts may be utilised to propose alternative evacuation methods to mitigate the risks involved with any failure of the stay-put strategy.
- 2.10.2 The evacuation lift should be in accordance with BS EN 81-76 and BS EN 81-72.

2.11 Doors on Escape Routes

- 2.11.1 Access control measures incorporated into the design of the building which restrict access or egress from the building should not adversely affect the means of escape.
- 2.11.2 When the building is occupied, all electrically powered locking mechanisms are to return to the unlocked position on operation of the fire alarm system or loss of power. The door is also provided with a manual door release unit complying with BS 7273-4 in the side approached by people making their escape.
- 2.11.3 Exit widths are to be measured in accordance with Figure 11.
- 2.11.4 Doors on escape routes should:
- Be hung to open not less than 90 degrees
 - Should be sufficiently recessed to prevent its swing from encroaching in the required egress route of the escape route or stair
 - Provided with vision panels if they are provided to sub-divide corridors or where doors are hung to swing in both ways.
 - Only fitted with lock or fastenings which are readily operated, without the use of a key and without having to manipulate more than one mechanism.
- 2.11.5 Doors on escape routes servicing more the 60 people should:
- Be provided with panic fastenings in accordance with BS EN 1125 if locks are required.
 - Should be hung to swing in the direction of escape, if escape is available in both directions these doors should be double swing door sets.

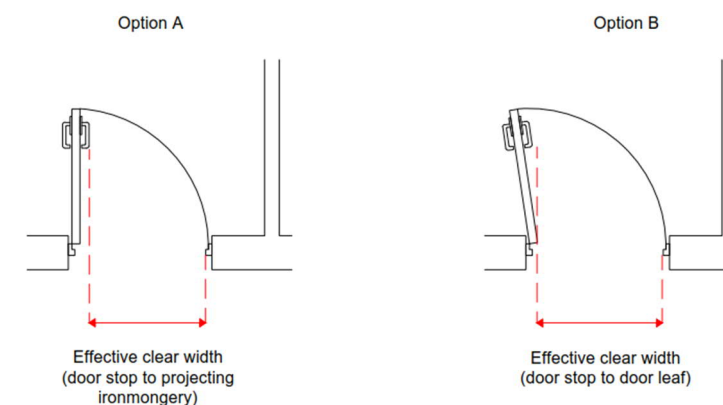


Figure 11. Door Widths

2.12 Evacuation of Non-Ambulant Persons

Residential

- 2.12.1 While not required for Building Regulations but part of the fire safety management plan, it is critical that adequate provisions are provided for the evacuation of any disabled users. The fire safety for the building needs to take account of the disabled occupants who may have access to the premises.
- 2.12.2 In the event of a fire, the building is afforded with enhanced levels of compartmentation which allows occupants to remain in the non-fire affected apartment.
- 2.12.3 On occupation, residents may be present with any combination of disabilities throughout the premises. Visitors to the flats will be the responsibility of the tenants. It is recommended the client informs the future responsible person for the premises (under the Regulatory Reform (Fire Safety) Order 2005) [RRO] to undertake an assessment towards a tenant's ability to react to a fire within the premises on taking up residence.
- 2.12.4 The responsible person under the RRO should provide information and regularly remind tenants on the fire procedures by providing leaflets and where necessary encouraging new tenants to have a home fire safety check by the local fire service. Specific measures regarding tenants with any disabilities identified can be discussed and implemented following the home fire safety check in conjunction with relevant local community services. It is advisable that details of any residents who would require assistance in an evacuation by the Fire and Rescue Service should be kept in a premises information box in the entrance foyer which can be obtained on their arrival to allow immediate prioritisation of the affected person(s). The corridors and stair landings would be suitable as a temporary refuge for persons with severe mobility impairment to wait for assistance due to the layout and fire resisting construction (very few occupants should be using the stairs for evacuation at any one time, such that the implications of restrictions in the escape routes would be minimal).

Commercial

- 2.12.5 The ground floor is access directly to the external. Therefore, it may be reasonable to assume that occupants with mobility impairment can easily escape to the external on the accessible levels of the commercial unit.

2.13 Emergency Lighting

- 2.13.1 Emergency lighting should be provided in accordance with BS EN 1838 and BS 5266 to meet the recommendations of BS 9991.
- 2.13.2 The escape lighting should be sited to provide an appropriate luminance near each exit door and where it is necessary to emphasise potential danger or safety equipment. The following bullet points indicate some of the critical areas:
- At each exit door intended to be used in an emergency
 - Full length of stair to ensure good visibility
 - Near stairs so that each flight of stairs receives direct light
 - Near any other change in level
 - Mandatory emergency exits and safety signs
 - At each change of direction
 - At each intersection of corridors
 - Outside or near to each final exit
 - Near each first aid post

- Near each piece of firefighting equipment, call point and fire alarm panel.

2.14 Emergency Escape Signage

- 2.14.1 Fire escape signs are to be provided to guide occupants from any point in a building via a place of relative safety (the escape route) to the place of ultimate safety (outside the building). Exit and directional signage should be provided in accordance with the requirements of:
- BS ISO 3864-1, BS 5499-4 and BS EN ISO 7010:2012+A7:2017.
- 2.14.2 Signage is provided to identify the primary escape route from each location within the building. To achieve this, the following principles have been adopted.
- At least one escape route or doorway leading to an escape route should be visible from any place within every room or enclosure (with the exception of the internal apartments).
 - Where direct sight of the escape route is obstructed, additional signage to be considered.
 - Escape route signage is to take precedence over all other signs.
 - All changes of direction in corridor, stairways and open spaces forming part of an escape route will be marked with intermediate signs. Each intermediate door or junction will also be similarly signed.
 - Signs are not to be fixed to doors or sited where they are obscured by open doors.
- 2.14.3 Escape route signs are to be sited conspicuously within the normal field of vision. The following principles, which will assist the evacuating occupants to predict the location of successive signs, should be applied:
- Signs above doors or open spaces should be mounted between 2m and 2.5m from floor level, measured to the base of the sign and be sited as close to the centre line of the escape route as practicable.
 - Signs sited on walls should be mounted between 1.7m and 2m from floor level to the base of the sign.
- 2.14.4 Signs should be sited at the same height throughout the escape route, so far as is reasonably practicable.

3. Internal Fire Spread

- 3.1.1 The choice of materials for walls and ceilings can significantly affect the spread of a fire and its rate of growth, even though they are not likely to be the materials first ignited. It is particularly important in circulation spaces where the rapid spread of fire is most likely to prevent occupants from escaping. The surface linings are restricted by limiting the surface spread of flame and minimising heat release rates.
- 3.1.2 All surface finishes are to achieve the classification in Table 3.2 when tested under then National Classifications in accordance with BS 476 or the European Classifications in accordance with BS EN 13501-1.

Table 3.2 Classification of Internal Linings

Location	National Class	European Class
Rooms not more than 30m ² in non-residential areas	3	D-s3, d2
Other rooms	1	C-s3, d2
Escape routes and stairs	0	B-s3, d2

- 3.1.3 Parts of walls in rooms may be of poorer performance than specified in Table 3.2 (but not less than Class 3/Class D-s3, d2) provided that the total area of those parts in any one room does not exceed half of the floor area of the room and is subject to 60m² in non-residential accommodation.

3.2 Structural Requirements

- 3.2.1 Premature failure of the structure can be prevented by the provisions of load bearing elements of structure to have a minimum standard of fire resistance, in terms of resistance to collapse or failure of load bearing capacity.
- 3.2.2 The purpose of providing the structure with fire resistance is:
- To minimise the risk to occupants
 - To reduce the risk to firefighters who may be engaged on search and rescue operations
 - To reduce the danger to people in the vicinity of the building
- 3.2.3 As the height of the development is greater than 50m all elements of structure are to achieve 120 minutes structural fire resistance when tested in accordance with the appropriate parts of BS 476 for load bearing elements of structure.
- 3.2.4 All elements supporting the firefighting shafts are to achieve 120 minutes structural fire resistance when tested in accordance with the appropriate parts of BS 476 for load bearing elements of structure
- 3.2.5 All penetrations through fire resisting construction are to be enclosed in fire resisting construction or fire stopped.
- 3.2.6 The periods of fire resistance refer to the performance achieve by the structural elements when tested in accordance with the appropriate parts of BS 476 for load bearing elements of structure. Elements of structure require fire protection to all exposed faces.

3.3 Elements of Structure

- 3.3.1 Elements of structure are defined as follows:
- A member forming part of the structural frame of a building or any beam or column
 - A load bearing wall or load bearing element of a wall

- A floor
 - A gallery
 - An external wall structure supporting fire rated elements for the prevention of external fire spread
 - A compartment wall
- 3.3.2 The following are excluded from the definition of elements of structure
- A structure that supports a roof unless
 - The roof performs the function of a floor such as parking vehicles or as a means of escape
 - The structure is essential for the stability of an external wall that need to be fire resisting (e.g. to achieve the compartmentation or for the proposes of preventing fire spread between buildings
 - The lowest floor of the building
 - A platform floor
 - A loading gallery, fly gallery, stage grid, lighting bridge or any gallery provided for similar purposed or for maintenance and repair
 - External walls, such as curtain walls or other forms of cladding, which transmit only self-weight and wind loads and do not transmit floor load
- 3.3.3 Where an element of structure forms part of more than one building or compartment, that element should be constructed to the standard of the greater of the relevant provisions
- 3.3.4 Where one element of structure support, carries or give stability to another, the fire resistance of the supporting element should be no less than the minimum period of fire resistance for the other element (whether that element is load bearing or not).

3.4 Sprinkler System

Residential & Non-Residential

- 3.4.1 All apartments and non-residential areas at ground and basement levels (excluding common corridors) should be provided with sprinkler protection. Due to the development being greater than 45m from the lowest adjacent ground floor level to the topmost occupied storey it is recommended the following criteria are met;
- A BS 9251 Category 3 sprinkler system should be provided;
 - The water supply duration should be extended to 60 minutes;
 - A secondary back up pump is to be provided,
 - A secondary power supply is to be available to each pump.
- 3.4.2 Sprinkler protection should be provided in all areas with the exception of the following:
- Bathrooms with a floor area less than 5m²;
 - Cupboards and pantries with a floor area less than 2m² or where the least dimension does not exceed 1m and the walls and ceilings are covered with non-combustible materials or materials of limited combustibility;
 - Crawl spaces, ceiling voids, uninhabited loft/roof voids;
 - Common Corridors.

- 3.4.3 Additionally, due to the high degree of electrical items it is deemed acceptable to omit sprinkler protection to the following areas;
- Comms Room;
 - Life Safety Distribution Board Room;
 - Main Low Voltage Switch Room;
 - Ground Floor Substation.
- 3.4.4 The minimum operating pressure at any sprinkler should not be less than 0.5 bar.
- 3.4.5 As LD1 detection is provided to all apartments, only one sprinkler alarm value is required per floor, providing the following conditions are met;
- The alarm zone should cover no more than a single floor.
 - The LD1 alarm system should have a minimum of a grade D power supply, designed, installed and maintained in accordance with BS 5839-6:2013.
 - The sprinkler alarm device should be connected to suitable control and indicating equipment so that management are alerted and the emergency action plan can be initiated.
 - In multi-staircase buildings, the control equipment should clearly indicate the floor level and appropriate staircase.
- 3.4.6 The sprinkler system can be combined with the domestic water tank providing both the sprinkler flow demand and the domestic peak flow demand are met simultaneously. However, a priority demand valve can be used to close the domestic supply in the event of sprinkler activation, allowing the full capacity of the tank to be used for firefighting purposes.
- [Commercial](#)
- 3.4.7 In line with BS 19625 areas of the building that are not residential occupancies but not greater than Ordinary Hazard as defined in EN 12845 may be protected with quick response type sprinklers in accordance with EN 12259-1 providing the following conditions are met;
- The total area is more than 50m² but less than 100 m²;
 - The design density is increased to 5mm/min;
 - The area of operation shall be taken as the smaller of the area defined in EN 12845 for Ordinary Hazard or that area of the building if less.

4. Provisions of Compartmentation

- 4.1.1 The spread of a fire within a building can be restricted by subdividing the building into compartments separated from one another by walls and/or floors of fire resisting construction. This is to restrict rapid fire spread which could trap occupants of the building and to reduce the risk of a fire becoming large.
- 4.2 Compartmentation Requirements
- 4.2.1 Each apartment is to be a separate compartment and all partition walls (and walls to common areas) are to be compartment walls. As the building provides residential accommodation all floors are to be constructed as compartment floors.
- 4.2.2 Where a fire separating element is required, this element of construction should provide the minimum level of fire resistance as stated when tested in accordance with the appropriate European Standard and classified to the relevant part of BS EN 13501 or tested to the relevant part of BS 476.
- 4.2.3 Fire-resisting doors should be specified as complete fire door sets and should achieve the minimum level of fire resistance when tested in accordance with either BS 476-22 or the appropriate European Standard and classified in accordance with BS EN 13501-2.
- 4.2.4 A fire door that is needed to resist the passage of smoke at ambient temperate conditions i.e. fire doors having suffix S/Sa should either:
- Have a leakage rate not exceeding 3 m³/h per metre, when tested in accordance with BS 476-31.1 with the threshold taped and subjected to a pressure of 25 Pa; or
 - Meet with the classification requirement of Sa when tested in accordance with BS EN 1634-3.
- 4.2.5 Threshold gaps for timber doors should be in accordance with BS 8214. Threshold gaps for all other door types should be based on the principles of BS 8214.
- 4.2.6 Table 4.2 and Table 4.2 provides a summary of the specific fire compartmentation requirements

Table 4.1 Compartmentation Summary

Floor/Wall Location	Fire Rating (minutes)	European Standard (minutes)
Compartment Floors	120	REI 120
Firefighting stairs	120	REI 120
Firefighting Lifts	120	REI 120
Common corridor	60	REI 60
Walls separating apartments	60	REI 60
Bin stores	60	REI 60
Service Risers (if <u>not</u> fire stopped at floor level)	120	REI 120
Service Riser (if fire stopped at floor level)	30	REI 30
Storage and Plant	30	REI 30
Firefighting Lifts	120	REI 120

Table 4.2 Fire Door Requirements

Locality of the door	Fire Rating (minutes)	European Standard (minutes)	Self-closing device required?
Apartment entrance doors	FD30s	E30Sa	Yes
Doors into firefighting stairs	FD60s	E60Sa	Yes
Firefighting Lift doors	FD60	E60	N/A
Riser Doors (if <u>not</u> fire stopped at floor level)	FD60s	E60Sa	No (to be kept locked shut)
Riser Doors (if fire stopped at floor level)	FD30s	E30Sa	No (to be kept locked shut)
Smoke Shaft Doors	FD120s	E120Sa	No (to be kept locked shut)

4.3 Automatic Hold Open Devices

- 4.3.1 Where automatic hold open devices are to be installed in the development it is essential that these hold open devices release automatically on activation of the fire alarm system and failsafe to release the door in the event of a power failure. The hold open devices should comply with BS 5839-3.

4.4 Protection of Openings and Fire Stopping

- 4.4.1 To ensure all fire separating elements are effective, every joint or imperfection of fire, or opening to allow services to pass through the element suitable fire protection is to be provided by sealing or fire stopping so that the fire resistance of the element is not impaired. If there are any bathroom pod risers these should be fire stopped at floor level and the pod walls themselves should not be used to provide any fire-resistance for either compartmentation or structural fire protection.
- 4.4.2 Fire stopping/sealing should be undertaken with suitable products to maintain the standard of fire resistance of the surrounding structure in accordance with BS 476 Pt 22 or BS EN 1364 Pt 1 to 6.

4.5 Fire Stopping

- 4.5.1 All openings for pipes, ducts, conduits or cables that pass through and/or any joints between fire separating elements should be appropriately fire stopped with consideration for a potential thermal movement of pipes and ducts. Where non-rigid materials are adopted or unsupported spans exceeding 100mm are adopted, the fire stopping material should be reinforced with materials of limited combustibility.

4.6 Openings of Pipes

- 4.6.1 Where services pass through a fire separating element, the following three fire stopping measures will need to be considered to evaluate the most appropriate fire protection measure.
- Method 1 – Proprietary Seals
- 4.6.2 Provide a proprietary sealing system e.g. intumescent collar which has been tested to maintain the fire resistance of the walls, floor or cavity barrier for a pipe of any diameter.
- Method 2 – Pipes with a restricted diameter
- 4.6.3 On the provision that the type and internal diameter dimension satisfies the requirements in Table 4.3, fire stopping such as cement mortar or intumescent mastic may be used around the pipe.
- Method 3 – Sleeving
- 4.6.4 A pipe of lead, aluminium alloy, fibre cement or uPVC with a maximum nominal internal diameter of 160mm may be used with a sleeving of non-combustible pipes. The specification for non-combustible and uPVC are given in Table 4.3.

Table 4.3 Maximum nominal internal diameter of pipes passing through a compartment wall/floor

Situation	Pipe material and maximum nominal internal diameter (mm)		
	High melting point metal ⁽¹⁾	Lead, aluminium, aluminium alloy, uPVC, ⁽²⁾ fibre cement	Any other material
Structure (but not a wall separating buildings) enclosing a protected shaft that is not a stair or a lift shaft	160	110	40
Compartment wall or compartment floor between apartments	160	160 (stack pipe) ³ 110 (branch pipe) ³	40
Any other situation	160	40	40

Note 1: Any metal (such as iron, copper or steel) which if exposed to a temperature of 800 degrees will not soften or fracture to the extent that flame or hot gas will pass through the wall of the pipe.

Note 2: uPVC pipes complying with BS 4514 and uPVC pipes complying with BS 5255

Note 3: These diameters are only in relation to pipes forming part of an above ground floor drainage system and enclosed in Method 3. In other cases, the maximum diameters against situation 3 apply.

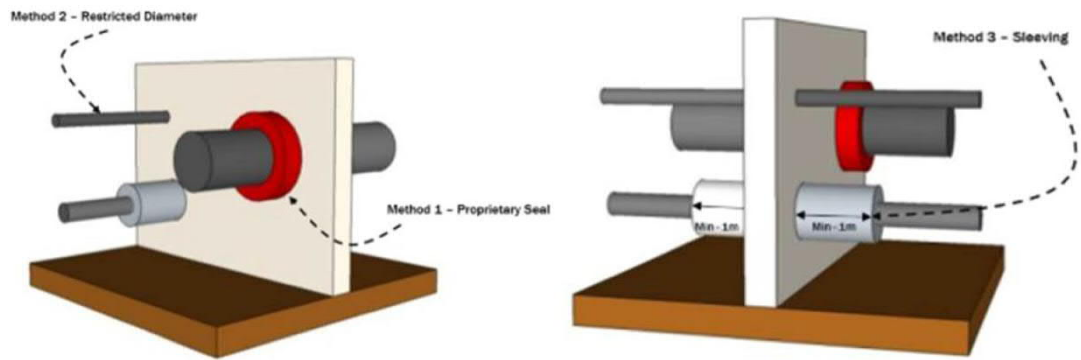


Figure 12. Service Breaches to Compartment Walls

4.7 Fire/Fire and Smoke Dampers

- 4.7.1 Where necessary, fire/ fire and smoke dampers should be provided in accordance with BS 9991, BS 9999 and ASFP Grey Book: Fire and smoke resisting dampers. The fire/ fire and smoke dampers should be appropriate for the duct and location as recommended in the above guidance documents. Fire dampers should have an E classification (integrity) and leakage-rated fire dampers should be provided with an ES classification (integrity and smoke).
- 4.7.2 Fire dampers are to be operated by smoke detection and thermal fusible link if ducts access or leave a compartment (corridor/stair/riser/etc.)
- 4.7.3 All fire dampers are to be tested to BS EN 1366-2 and be classified to BS EN 13501-3. The dampers are to have the same fire resistance as the wall or compartment floor they penetrate (subject to a minimum fire resistance of 60 minutes). All such dampers should be accessible for maintenance.
- 4.7.4 In ancillary accommodation or other non-residential accommodation, fire/ fire and smoke dampers should be provided on compartment boundaries. Where ductwork crosses an escape route, fire dampers should be actuated by automatic smoke detection.

- 4.7.5 Where dampers cannot be provided in general ductwork for any reason, the duct should be fire-rated or enclosed in fire-resisting construction (integrity and insulation) to the highest period of fire-rated construction through which it passes. The ductwork would need to be fire rated from the point it penetrates the compartment wall of the compartment it serves (or furthest compartment it serves if multiple compartments are served) to the point it terminates.

4.8 Services

- 4.8.1 The routing of building services through the common residential corridor introduces a fire risk in the space and BS 9991 recommends against this where possible. However, where the routing of services through the corridor is unavoidable, the services should be run in separating construction or in a secured fire-resisting method. There are two options available in this regard:
1. Construct a fire resisting ceiling that achieves 30 minutes fire resistance as required by the location of the riser with all services being above the ceiling line & risers in the corridor; or
 2. Control the fire load in the ceiling and riser space through the specification and selection of low-risk materials. This approach will require a fire risk assessment and agreement from Building Control; and should include but not limited to the following aspects as a minimum:
 - a. Minimising the number of electrical connections within the residential corridor
 - b. Correctly sized cables and follow up with comprehensive on-site testing and inspection
 - c. The surfaces of materials exposed to the corridor (i.e. ceiling void) will be of Class 0 (National Class) or Class B-s3, d2 or better (European Class)
 - d. The materials within the corridor (inclusive of any insulation) will be of limited combustibility (National Class) or Class A2-s3, d2 or better (European Class)
 - e. The services to be located within the corridor ceiling void will be of low fire risk
 - f. Any electrical cabling will be laid in metal trays or metal conduit
 - g. Access panels into ceiling voids to be secured (this can be by releasing devices or screw fixings to close)
 - h. Any material or equipment located within the common corridor which have not been fire tested will have been fire risk assessed to demonstrate its low risk items in terms of ignition, combustibility and flammability by the system designer and system manufacturer
 - i. Methods of cable support should be non-combustible (such as cable clips, cable ties or trunking)

4.9 Fixing of Cables – Fire-resisting Cable Supports

- 4.9.1 It is noted the latest edition of the IET Wiring Regulations (BS 7671:2018) has been release and came into force in January 2019. The previous version includes a requirement that wiring systems in escape routes shall have fire-resisting supports and in the latest edition this extends the requirement to all areas, i.e. any wiring in the building that could fall prior to fire service arrival should be restrained to prevent entanglement. All wires need to be supported such that they wouldn't present an entanglement risk to firefighters, it's not just a requirement for wires serving life safety equipment. Cables run along walls should be fixed with metallic ties/clips rather than plastic.

4.10 Cavity Barriers

- 4.10.1 Concealed spaces or cavities in the construction of a building provide a route for smoke and flame spread. This is particularly in the voids above and below the construction of the building e.g. walls, floors, ceilings, roofs, around the windows and compartment walls. The provision of cavity barriers within the voids is intended to restrict the spread of smoke and flames.

- 4.10.2 Fire resistant cavity barriers are to be installed in cavity spaces exceeding 20m in any direction. The cavity barriers will offer a minimum of 30 minutes fire resistance and 15 minutes fire resistance insulation (European standard E30 and EI15)
- 4.10.3 See Table 4.4 for a summary of cavity barrier locations and the differentiation between cavity barriers and fire stopping.
- 4.10.4 Table 4.4 indicates the maximum dimensions of undivided concealed spaces for the different classifications of cavity barriers.

Table 4.4 Maximum Dimensions of Cavities

Location of Cavity	Class of surface / product exposed in cavity	Maximum dimensions in any direction (m)
	European	
Between roof and ceiling	Any	20
Any other cavity	Class C-s3, d2 or better	20
	Not any of the above classes	10

- 4.10.5 Any exclusion from Table 4.4 should be in full accordance with the recommendations and specifications with BS 9991.
- 4.10.6 Cavity barriers are required at all floors, compartment walls and openings (e.g. windows and doors). Additional cavity barriers are required where a compartment walls meets an external wall of the building.
- 4.10.7 Where a concealed space is undivided area which exceeds 40m in either or both directions on plan there is no limit to the size of the cavity if:
- The room and the cavity together are compartmented from the rest of the building
 - An automatic detection system compiling to BS 5839-1 is installed. Detectors are only required in the cavity to satisfy BS 5839-1.
 - The cavity is used as a plenum and the recirculation air distribution systems in BS 5588-9 are followed.
 - The surface of the material/product used on the construction of the cavity is Class 0 (National class) or Class B-s3, d2 or better (European class) and the supports and fixings on the cavity are non-combustible.
 - The flame spread rating of any pipe insulation system is Class 1 (National class) or Class C-s3, d2 or better (European class)
 - Any electrical wiring in the voids is laid in metal trays, or in a metal conduit
 - Any other materials in the cavity are of limited combustibility or Class A2 or better (European class)

4.11 Construction and Fitting of Cavity Barriers

- 4.11.1 The cavity barriers should be tightly fitted to a ridged construction and mechanically fixed in position. Where this is not possible (e.g. junctions with slates, tiles, corrugated etc.) the junction should be fire stopped in accordance with Section 4.12 of this report. Cavity barriers should also be fitted so that their performance is unlikely to be made ineffective by movement of the building due to subsidence, temperature change etc. failure of their fixings, material or construction they abut or collapse of any services penetrating them.
- 4.11.2 Cavity barriers in a stud wall or partition or provided around openings may be constructed from:
- Steel at least 0.5mm thick

- Polythene sleeved mineral wool slab, in either case under compression when installed in the cavity; or
 - Calcium silicate, cement-based or gypsum-based boards at least 12mm thick
- 4.11.3 It should be noted that cavity barriers provided around openings may be formed by the window or door frame if the frame is constructed of steel or timber of the minimum thickness above. Any openings in a cavity barrier should be limited to those for:
- 30-minute fire rated doors
 - The passage of pipes which meet the provisions set out in section 4.4 of this report.
 - The passage of cables or conduits
 - Openings or ducts (unless fire rated) fitted with a suitable automatic fire damper where they pass through the cavity barrier.
- 4.11.4 Cavity barriers should not be provided above party walls between flats. The party walls should be taken up to the underside of the slab and fire stopped.

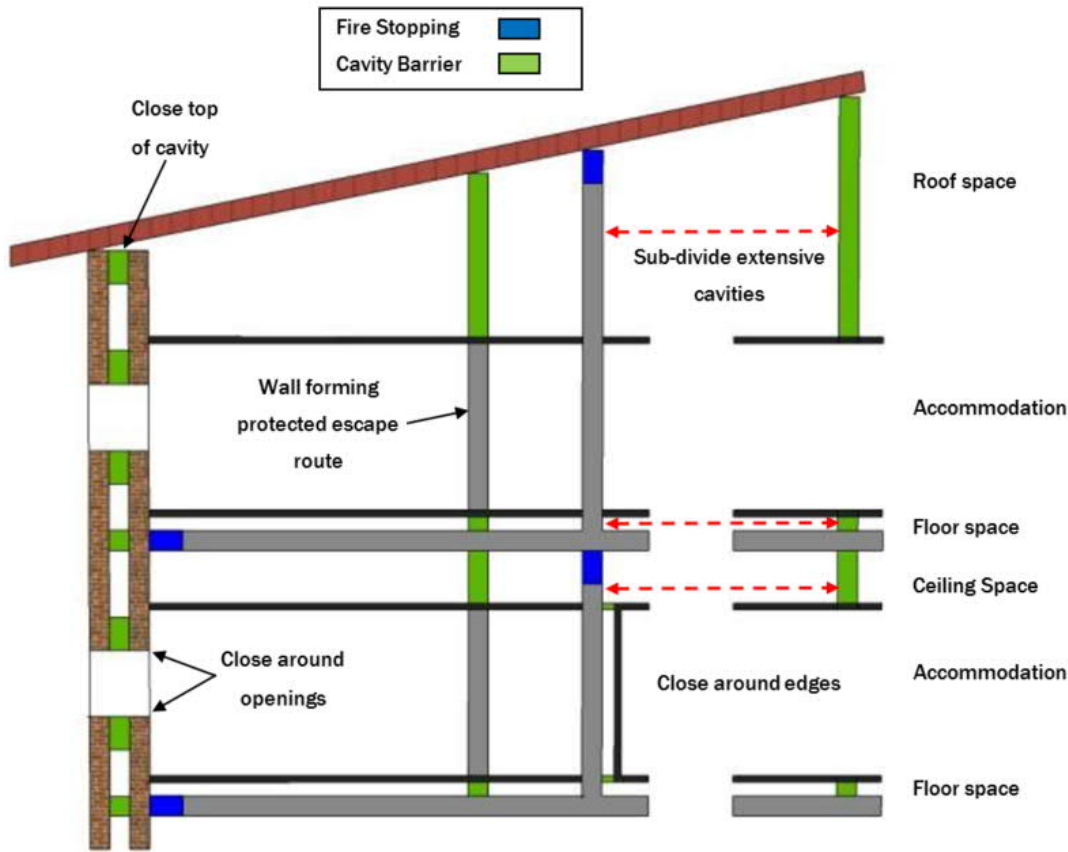


Figure 13. Typical Provision of Cavity Barriers

4.12 Junction of Compartment Wall with the Roof

- 4.12.1 A compartment wall should achieve both of the following:
- Meet the underside of the roof covering or deck, with fire-stopping to maintain the continuity of fire resistance.
 - Be continued across any eaves.

- 4.12.2 Partition walls to flats should continue through the roof void to the underside of roof covering, common voids within roof spaces are not permitted.
- 4.12.3 To reduce the risk of fire spreading over the roof from one compartment to another, a 1500mm wide zone of the roof, either side of the wall, should have a covering classified as AA (BROOF(t4)), on a substrate or deck of a material rated class A2-s3, d2 or better, as set out in Figure 14a.
- 4.12.4 As an alternative to the provisions of paragraphs above, the compartment wall may extend through the roof for a minimum of either of the following (see Figure 14c).
- Where the height difference between the two roofs is less than 375mm, 375mm above the top surface of the adjoining roof covering.
 - 200mm above the top surface of the adjoining roof covering where either of the following applies.
 - The height difference between the two roofs is 375mm or more.
 - The roof coverings either side of the wall are of a material classified as B_{ROOF}(t4).
- 4.12.5 The requirements for junction of compartment walls with the roof has been highlighted below in Figure 14.

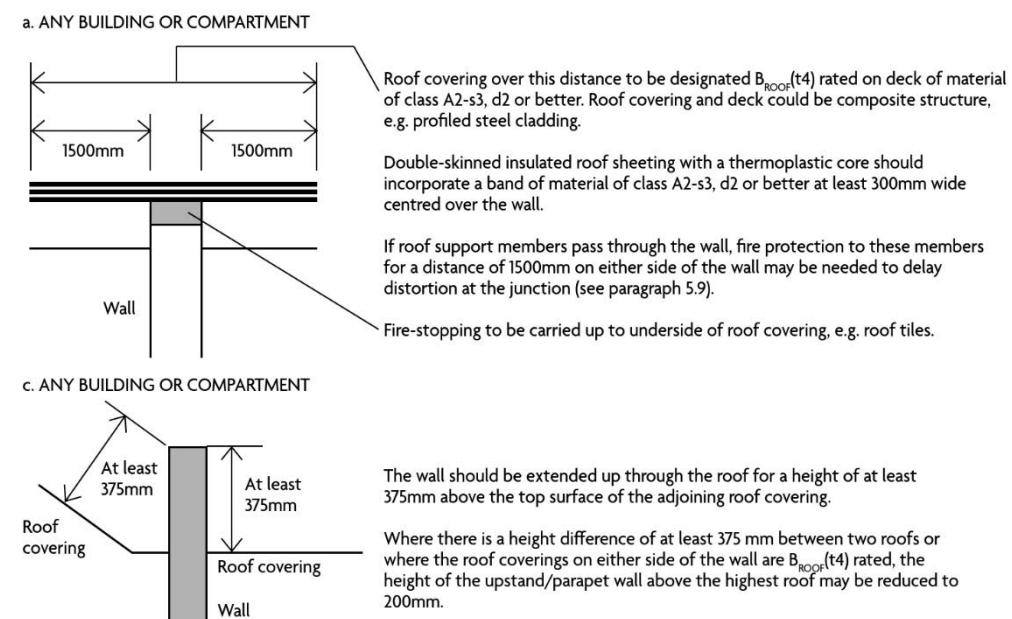


Figure 14. Junction of Compartment Wall with the Roof

5. External Fire Spread

5.1.1 The relevant site boundary for the scheme has been highlighted in red on Figure 15. Where the site opposes an area unlikely to be developed upon, the relevant boundary has been taken as halfway across that boundary. Areas unlikely to be developed upon include roads, railways and rivers.

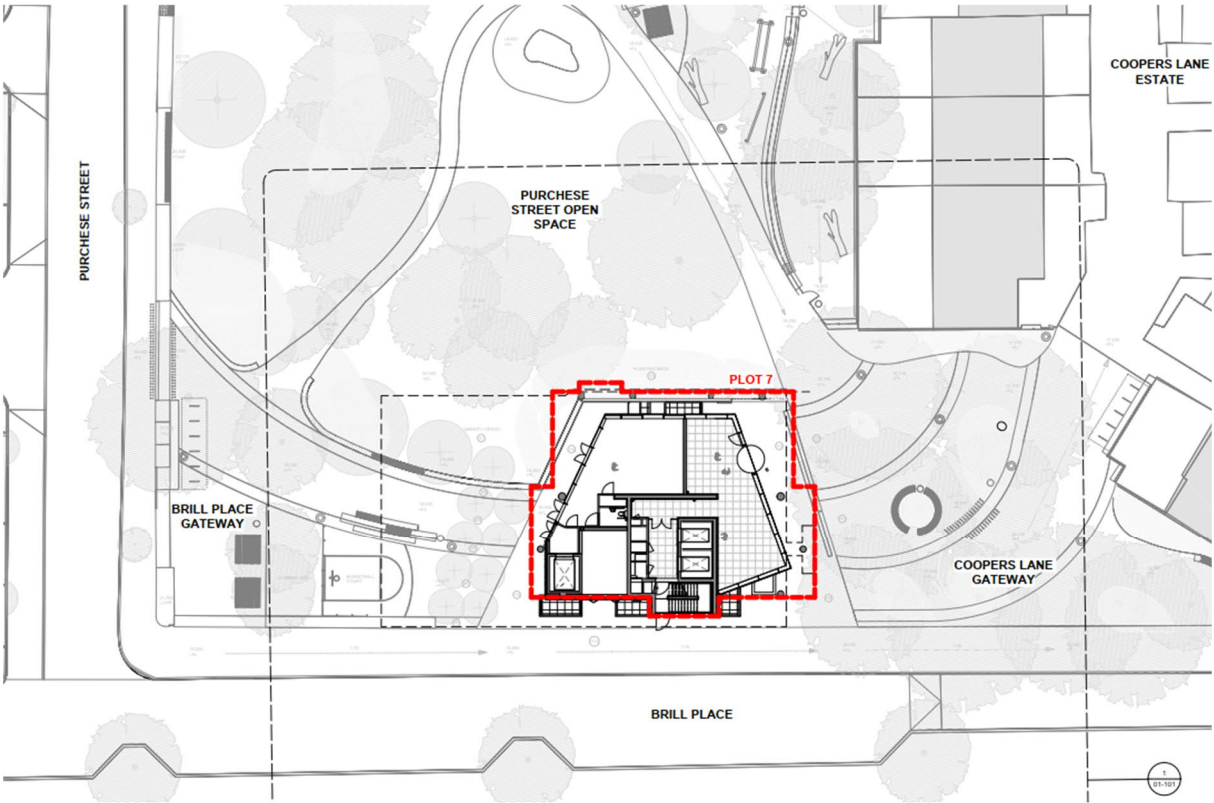


Figure 15. Brill Place Relevant Boundary

5.2 Space Separation

- 5.2.1 The space separation of the building from its relevant boundaries has been assessed in relation to preventing external fire spread. This is achieved by limiting the area of non-fire rated elements of the façade where the separation is less than the minimum requirement within BR 187 – External Fire Spread, Building Separation and Boundary Distances.
- 5.2.2 External fire spread, calculations are based on the alternative approach included in Appendix A of BR 187, 1st edition (now 2.2.4 & 2.2.5 in the 2nd edition) which uses specific calculation rather than indicative tables to provide a precise measurement of unprotected area. An example of the calculation performed for each compartment can be seen below.

$$u = \frac{(d/f)^2}{(wh)}$$

Where:

- d = distance to boundary
- h = height of compartment
- w = width of compartment

– f = factor from Table 3 (in BR 187)

- 5.2.3 The Unprotected Area (UPA) for each type of compartment within the building was calculated considering the distance from the relevant boundary, the compartment height and width along with the occupancy profile, with the results tabulated in Table 5.2.
- 5.2.4 Sterile areas such protect stairs and corridors have not been included in the analysis as these areas have little fire load and therefore would not contribute to a fire.

Table 5.1 External Fire Spread Analysis

Elevation	Use	Width of Panel (m)	Height of Panel (m)	Distance to Boundary (m)	Unprotected Area (%)	Protected Area (%)
L1.01 South Facade	Residential	5.96	3.13	8.7	100%	0%

- 5.2.5 The southern façade apartment L1.01 represents the largest compartment on the southern façade, therefore, L1.01 was analysed in terms of external fire spread. Based on the large separation distances and high degree of compartmentation, the assessment has found that there is no requirement for protected areas in relation to external fire spread in this apartment. It can also be assumed that all other compartments on the southern façade can be afforded 0% protected areas.
- 5.2.6 Areas that are less than 1.0m from the relevant boundary, will require 100% protected areas, which will need to be fire resistant from the outside and inside face (both sides) and achieve 120 minutes fire resistance for integrity, loadbearing capacity, and insulation (REI 120). This would apply to the north, east and west façades.
- 5.2.7 However, It is understood that an agreement has been reached with the council that will prohibit and building works on the surrounding park area and therefore the boundary distances can be increased. It should be confirmed that this agreement has been reached and the extents to which the non-development agreement applies – i.e the distance the relevant boundary can be taken.

5.3 Unprotected Area

- 5.3.1 Small, unprotected areas in an otherwise protected area of wall construction are considered to pose negligible risk of fire spread and may be disregarded. Figure 16 highlights the permitted openings in relation to each other and to the lines of compartmentation inside the building.

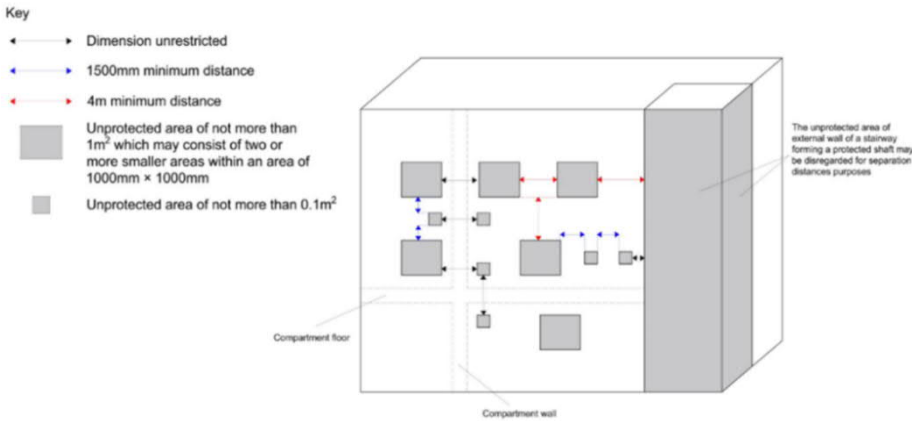


Figure 16. Unprotected Areas

5.4 Cladding, Insulation Material/Products

- 5.4.1 In a building with a storey 18m or more in height (when measured from the lowest adjacent side of the building to the upper floor surface of the topmost storey, excluding any floors consisting exclusively of

plant), any insulation product, filler material (not including gaskets, sealants and similar) etc, used in the construction of an external wall and walls between heated and unheated spaces (such as refuse/plant rooms) should be of European Class A2-s1, d0 or better. Note, due to the use of some of the proposed buildings on site, Regulation 7(2) and 7(3) would be applicable and it prevails over the provisions stated within this paragraph.

- Note 1: Whilst the guidance above applies to any insulation product, filler material (not including gaskets, sealants and similar) etc. used in the construction of an external wall, consideration should be given to the choice of material used for any other parts of an external wall or attachments to the wall which could impact on the risk of fire spread over the wall.
- Note 2: Best practice guidance for green walls, if provided, (also called living walls) can be found in Fire Performance of Green Roofs and Walls, published by the MHCLG.

5.5 Regulation 7(2) of Building Regulations 2010

- 5.5.1 Regulation 7(2) applies to any building with a storey at least 18m above ground level (when measured from the lowest adjacent side of the building to the upper floor surface of the topmost storey, excluding any floors consisting exclusively of plant), and provides/is designed as residential accommodation.
- 5.5.2 Subject to exclusions stated in Regulation 7(3), building work shall be carried out so that materials which become part of an external wall, or specified attachment, of a relevant building are of European Classification A2-s1, d0 or Class A1, classified in accordance with BS EN 13501-1 entitled “Fire classification of construction products and building elements. Classification using test data from reaction to fire tests” (ISBN 978 0 580 59861 6) published by the British Standards Institution on 30th March 2007 and amended in November 2009. Therefore, materials achieving limited combustibility cannot be deemed to meet the requirement using an alternative classification method.

5.6 Regulation 7(3) of Building Regulations 2010 – Exclusions

- 5.6.1 Regulation 7(2) does not apply to the following (but not limited to):
 - j. Cavity trays when used between two leaves of masonry;
 - k. Any part of a roof (other than any part of a roof which falls within the definition of Building Regulations 2010) if that part is connected to an external wall;
 - l. Door frames and doors;
 - m. Electrical installations;
 - n. Insulation and water proofing materials used below ground level;
 - o. Intumescent and fire stopping materials where the inclusion of the materials is necessary to meet the requirements of Part B of Schedule 1;
 - p. Membranes;
 - q. Seals, gaskets, fixings, sealants and backer rods;
 - r. thermal break materials where the inclusion of the materials is necessary to meet the thermal bridging requirements of Part L of Schedule 1; or
 - s. Window frames and glass.
- 5.6.2 A summary of the information above has been tabulated in Table 5.2. Note, please refer to Section 5.6.3 for further considerations on additional provisions, depending on the building type.

Table 5.2 Exclusions from Regulation 7(2)

Products	Definition
Membranes	Membranes is a common term used in the industry and does not need any specific definition.
Roofing Materials	Components of a roof that extends to the junction of the external wall.
Internal Decorative Finish	Internal wall finish - inner most surfaces directly exposed to the interior of the building on the external wall.
Windows	Windows made out of glass and transparent and associated window frame including glazing, features, fixings and ironmongery.
Doors	Doors and door sets located on the external wall including associated frames and ironmongery.
Thermal Breaks	Thermal breaks where they are necessary to prevent thermal bridging and meet the requirements of Schedule 1 Paragraph L.
Cavity Trays	Cavity trays as part of a masonry wall systems including two leaves of masonry construction.
Seal, Fixings, Gaskets, Sealants and Backer Rod	Seal, fixings, gaskets, sealants and backer rod.
Electrical Installations	All electrical installations as defined in the Building Regulation already, i.e. fixed electrical cables or fixed electrical equipment located on the consumer’s side of the electricity supply meter.
Fire Stopping and Intumescent Materials	Fire stopping and intumescent materials where they are necessary to meet the requirements of paragraph B of Schedule 1.
Insulation Used Under Ground Location	Insulation used where it is located underground.

- 5.6.3 In addition to the above, where a building type is in either category stated in Regulation 7(2) & requirement B4 – Exclusions, the following should also be considered:
 - a. Membranes used as part of the external wall construction should achieve a minimum classification of European Class B-s3, d0;
 - b. Internal linings should comply with the guidance provided in Section 6 of ADB;
 - c. Any part of a roof should achieve the minimum performance as detailed in Section 14 of ADB.
 - d. As per Regulation 7(3), window frames and glass (including laminated glass) are exempted from Regulation 7(2). Window spandrel panels and infill panels must comply with Regulation 7(2).
 - e. Thermal breaks are small elements used as part of the external wall construction to restrict thermal bridging. There is no minimum performance for these materials. However, they should not span two compartments and should be limited in size to the minimum required to restrict the thermal bridging (the principal insulation layer is not to be regarded as a thermal break).
 - f. Regulation 7(2) only applies to specified attachments. Shop front signs and similar attachments are not covered by the requirements of Regulation 7(2), although attention is drawn to paragraph below.
 - g. Whilst Regulation 7(2) applies to materials which become part of an external wall or specified attachment, consideration should be given to other attachments to the wall which could impact on the risk of fire spread over the wall.

- 5.6.4 Note, specified attachments referenced below are defined as follows:

- A balcony attached to an external wall;
- A device for reducing heat gain within a building by deflecting sunlight which is attached to an external wall; or
- A solar panel attached to an external wall.

5.6.5 Any balconies must be constructed of materials achieving at least a Class A2-s1, d0 rating.

5.6.6 External elements which are over 70 degrees to the horizontal are considered a wall rather than part of roof. i.e. lift overruns, upstands, parapets etc. These should also be constructed to meet A2-s1, d0 or Class A1.

5.7 Roof Coverings

5.7.1 Part of a roof is defined as having a slope less than 70°. As such, any part of a roof greater than 70° will be classified as forming part of the wall and should meet the provisions set out above.

5.7.2 The provisions limit the use, near a boundary of roof which will not give adequate protection against the spread of fire over them. The term roof covering is used to describe constructions which may consist of one or more layers of material but does not refer to the roof structure as a whole. The provisions in this section are principally concerned with the performance of roofs when exposed to a fire from outside.

5.7.3 Limitations of roof coverings are to be in accordance with the BS 9991. As the building comprises of apartments on the uppermost storey, the compartmentation walls/fire stopping are to be provided up to the underside of the roof. The roof construction within 1500mm of the compartment wall/fire stopping should achieve a rating of AA ($B_{ROOF}(t4)$) in accordance with Figure 14. Therefore, it is considered practical to provide the whole roof with a rating of AA ($B_{ROOF}(t4)$).

6. Access & Facilities – Fire Service

6.1 Vehicle Access

- 6.1.1 Access to the site should be designed in such way that the fire service can easily access the site upon a fire situation. Provisions should be made at the design stage to ensure any scheme is provided with adequate and sufficient means for the fire service to enter the site. The proposed fire service access arrangement within this report has not yet been consulted with the Fire Service. As such, further development of firefighting provisions may be required in order to satisfy the local Fire Authority.
- 6.1.2 Any works to the roads needs to be constructed in accordance with Table 6.1. It should be ensured that all access roads around the site will be adequate to accommodate the local fire service pump appliance.

Table 6.1 Typical Fire & Rescue Service Vehicle Access Route Specification

Appliance	Minimum Width of Road Between Kerbs (m)	Minimum Width of Gateways (m)	Minimum Turning Circle Between Kerbs (m)	Minimum Turning Circle Between Walls (m)	Minimum Clearance Height (m)	Minimum Carrying Capacity (tonnes)
Pump	3.7	3.1	16.8	19.2	3.7	12.5

Notes: This table is subject to agreement with the fire service as some fire services have appliances of greater weight or different sizes.

- 6.1.3 It will need to be ensured that the fire service do not reverse more than 20m. Where this distance is extended, a turning circle or hammerhead would need to be provided to facilitate the fire appliance to turn around. This should be designed within the requirements of Table 6.1.

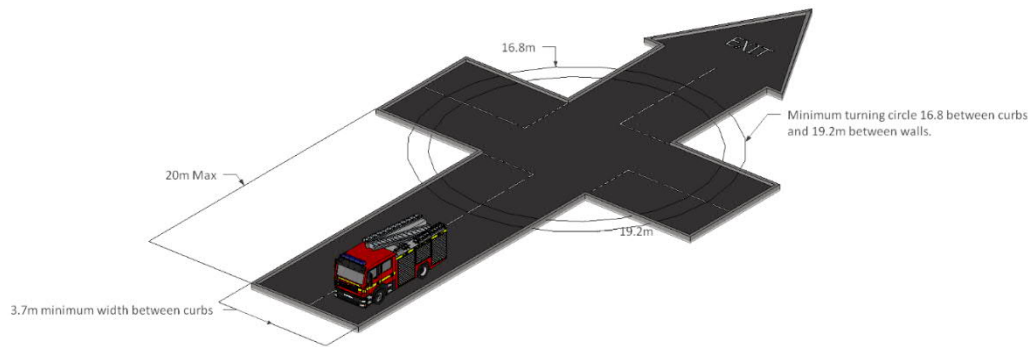


Figure 17. Turning Facility Diagram

- 6.1.4 Due to the height and size of the building it is not possible to meet the maximum 45m hose laying distance to the most remote point of the most remote dwelling. Therefore, it is required that the building is provided with a wet rising main.
- 6.1.5 The firefighting provision have been highlighted in Figure 18.

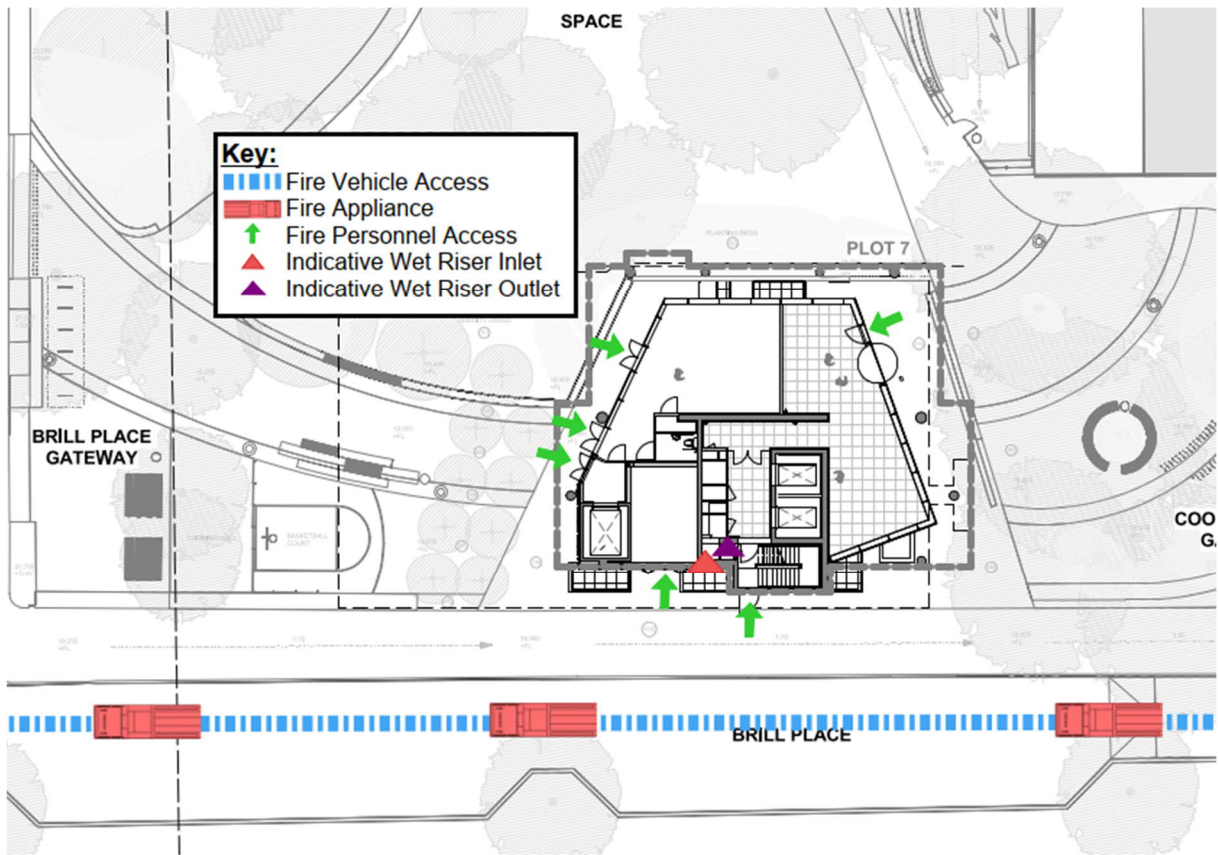


Figure 18. Fire Service Provisions

6.2 Firefighting Shaft

- 6.2.1 The development is to be provided with a firefighting shaft which serves all levels of the development and should contain the following:
- A 120-minute fire rated enclosed stair
 - A 1100mm clear width in the stair
 - A 1.0m² AOV at the head of the stair
 - A Ventilated lobby/corridor
 - A firefighting lift in accordance with BS EN 81-72
 - A wet rising main with outlets within the stair at each level
- 6.2.2 The firefighting lift is to be installed in accordance with BS EN 81-72 and BS EN 81-2 as appropriate for the particular type of lift.
- 6.2.3 Where it is not feasible to utilise passive means to prevent water ingress into the lift well (such as a ramped access), a sump pump needs to be provided at the base of the lift well. The minimum flow rate of the sump pump should be agreed with the M&E consultant/Fire Officer.
- 6.2.4 Flooring and floor coverings within the firefighting shaft are to be provided in accordance with the recommendations of BS 9999. All floorings and floor coverings should be chosen so as to minimise loss of traction when wet, as resilient floor surfaces should be maintained in accordance with BS 6263-2, with only emulsion-based polishes used.

6.2.5 It is to be noted as the slip resistance of resilient floor surfaces is reduced by contamination by dust or materials such as oils or grease, it is essential that they are cleaned frequently. The flammability of any textile floor coverings needs to be low.

6.2.6 Textile floor coverings should:

- When tested together with any underlay, in accordance with BS 4790, using the test procedure reflecting the method used for securing the floorcovering to the floor, either:
- Not ignite; or
- Have effects of ignition on both the use-and-under surfaces not exceeding beyond a circle of radius 35mm centred on the central point of application of the nut.
- Be firmly secured to the floor, with any adhesive being used non-water soluble; and
- Be interruptible at all doors to and within the firefighting shaft along the line of the threshold of the doorway with a metal or other non-combustible strip not less than 50mm in wide.

6.3 Wet Rising Mains

- 6.3.1 Wet rising mains are to be installed in buildings with an uppermost floor height in excess of 50m. This is due to pressure loss over the extended height.
- 6.3.2 Systems should be designed such that the maximum system pressures serving a fire main outlet do not exceed 20-bar.
- 6.3.3 Wet rising mains should not be located against or near external walls unless they are adequately insulated or otherwise satisfactorily protected against frost.
- 6.3.4 Wet risers should have an adequate water supply. A tank should be formed of two interconnected tanks with a combined minimum capacity of 45,000L (45m³). The tanks should be sized to supply two firefighting jets for at least 45minutes at 1500L/min, i.e. 67,500L (67.5m³) total capacity. The minimum tank size has been adopted therefore it should be ensured that the mains supply is sufficient to provide the additional water capacity, i.e. 500L/min.
- 6.3.5 Two automatic pumps should be installed to feed the wet fire main, one of which should act as duty pump and the other as standby. The standby pump should be configured to operate automatically on failure of the duty pump.
- 6.3.6 Landing valves in wet rising mains should comply with BS 5041-1 and be installed on all floors including the ground and basement.
- 6.3.7 The wet riser inlet connection point should be provided within 18m and will be required to be visible from the fire appliance parking position. The indicative wet riser inlet locations have been illustrated in Figure 18.

6.4 Basement Ventilation

- 6.4.1 Where a basement storey exceeds 200m² in area or is greater than 3m below the adjacent ground level, a smoke and heat ventilation system should be provided. Basement smoke and heat ventilation systems may be either natural or mechanical.
- 6.4.2 It is proposed to provide a natural smoke outlet in the basement of the Brill place scheme. Where natural smoke outlets are proposed the following recommendations should be met;
- If a basement is compartmented, each compartment should have direct access to smoke outlet vents;
 - The outlets should have a combined area of not less than 2.5% of the basement floor area;
 - Sited at the highest level practicable, either in the ceiling or in the wall of the space they serve;

- Evenly distributed around the perimeter of the building, to discharge into the open air outside the building;
- Located such that they would not prevent the use of escape routes from the building.
- If an outlet terminates at a point that is not readily accessible, it should be unobstructed, and should be covered only with a non-combustible grille or louvre.
- If an outlet terminates in a readily accessible position, it may be covered by a panel, stallboard or pavement light that can be broken out or opened, the position of such covered outlets should be suitably marked;
- Separate outlets should be provided from places of special fire hazard.

6.4.3 The proposed basement outlet positions have been highlighted in Figure 19.

Additionally, the refuse store should be provided with a lobby complete with 0.2m² permanent ventilation ducted to the external, for the purpose of the prevention of the build-up of combustible gases. This area has been highlighted in Figure 19.

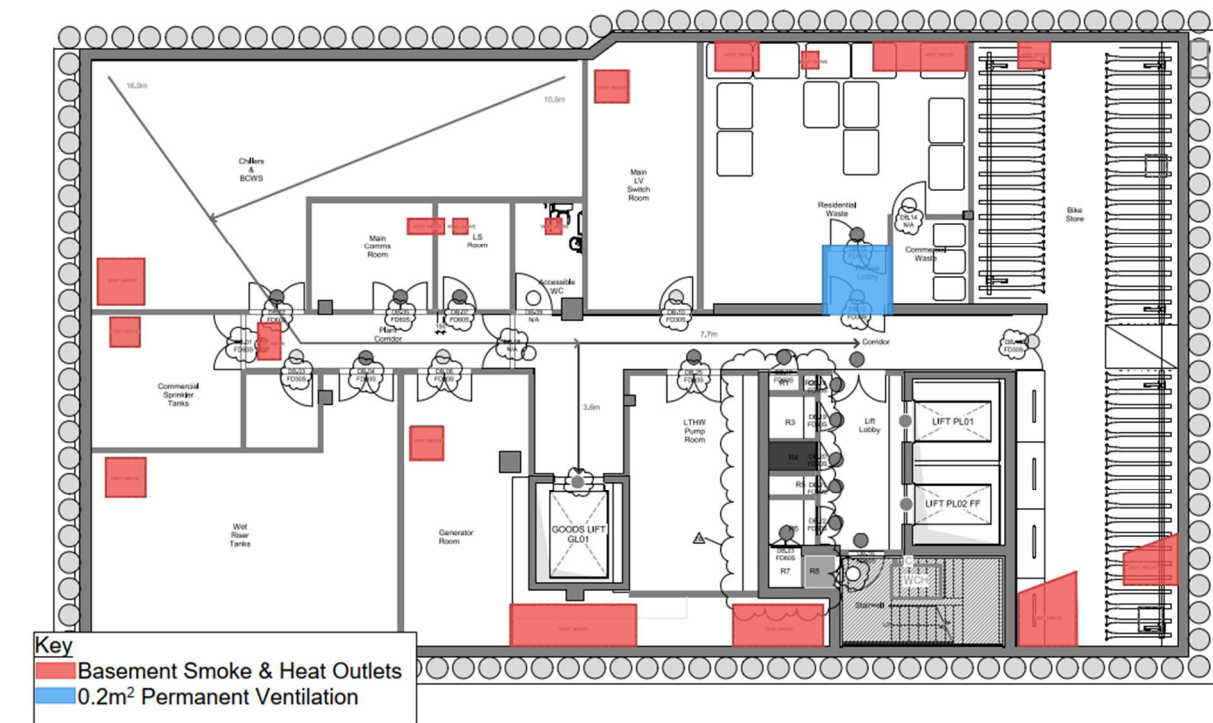


Figure 19. Basement Smoke Outlet Arrangement

6.5 Wayfinding Signage for the Fire Service

- 6.5.1 As part of the May 2020 amendments to ABD, guidance for wayfinding signage to assist firefighters is now provided; these amendments will come into force on 26/11/20. For blocks of flats with top floors more than 11m above the Ground floor, floor identification signs and flat indicator signs should be provided.
- 6.5.2 Floor identification signs denote which floor the reader is currently on, and flat indicator signs provide information regarding the flats accessed from that floor; the flat number for any multi-storey flats with two or more entrances should only be indicated on the normal access storey. Requirements for floor identification and flat indication signs are summarized in Table 14.

6.5.3 The floor closest to the mean Ground level should be designated as either Floor 0 or Ground Floor, and each floor above the Ground floor should be numbered sequentially, beginning with Floor 1. A lower Ground floor should be designated as either Floor -1 or Lower Ground Floor, and each floor below the Ground floor should be numbered sequentially beginning with Floor -1 or Basement 1.

6.7.5 The contents of the box should be kept up to date and kept under regular review

Table 6.2 Wayfinding Signage Summary

	Floor identification sign	Flat indication sign*
Signage text	"Floor X", where X is a numeral.	"Flats Y-Z", where Y and Z are numerals. Lower number first; text supplemented by arrows if flats are in more than one direction.
Text height	≥50 mm, and ≥75mm for the floor numeral.	At least half that of the floor sign.
Text typeface	Sans serif.	Sans serif.
Mounting	Mounted 1.7m–2.0m above floor level; where practicable, all the signs should be mounted at the same height.	Directly below the floor signs, such that its top edge is no more than 50mm below the bottom edge of the floor sign
Visibility	Visible from the top step of a firefighting stair and, where possible, from inside a firefighting lift when the lift car doors open. Text (and any arrows) should be on a contrasting background, easily legible and readable in low level lighting conditions or when illuminated with a torch.	

6.6 Fire Fighting Hydrants

6.6.1 Hydrants should be located in positions that are near to the building entry points. In buildings provided with dry rising mains a fire hydrant should be located within 100m of the dry riser inlet. If an existing hydrant is not within 100m of the building of the building a new hydrant would be required within 90m of the building.

6.7 Premises Information Box – For Fire Brigade Use

6.7.1 It is advisable the end-user ensures a Fire Service Information Box is provided adjacent to entrance to the building. It is preferable that only fire service information is stored in the box. The following are essential items:

- Operational Contingency Plans
 - Evacuation plans
 - Simple single line plans and/or schematic representations of the building and any relevant information relating to equipment/fixed installations design and operation provided for means of escape or firefighting operations (fire resistance, access, firefighting facilities, equipment, services, hazards etc.).
 - Information about the nature of any lifts intended for use by the Fire and Rescue Service
 - Basic operating instructions for fire protection and fixed firefighting equipment.
- 6.7.2 The systems on any of these plans should be labelled. Where plan symbols are to be used they should follow the system outlined by the local Area Fire Safety Team and include a key with a suitable description alongside.
- 6.7.3 When one or more of the same type of system is installed they should be individually identified.
- 6.7.4 The responsible person on occupation should liaise further with the local Area Fire Safety Team and Fire Station(s) with regards to the preferred format and content of the information to be provided within this.

7. Emergency Power

- 7.1.1 Fire protection systems designed to operate in a fire require enhanced provisions to ensure a secure supply is available. Specific recommendations are detailed within BS 9999 Section 38.2.3, but the main aspects are detailed below.

7.2 Secondary Power Supply

- 7.2.1 To reduce the risk of the loss of the electrical supply to critical fire safety systems a secondary power system is required to maintain a continuous power supply during a fire condition in accordance with BS 9991.
- 7.2.2 The secondary power supplies will be provided to the following:
- AOV's
 - Sprinkler System
 - Mechanical Smoke Shaft
 - Emergency lighting
 - Fire detection and alarm systems
 - Firefighting lift
 - Firefighting shafts (associated equipment and lighting)
- 7.2.3 Where secondary power supplies are recommended, these should have a primary supply taken from a public supply and a secondary supply from either
- An alternative utility supply from another substation
 - A generator
 - An uninterruptible power supply (UPS)
 - Batteries
- 7.2.4 Alternative utility supplies and a second substation is not always possible due to the onerous requirements of the utility providers; as dual supplies can cause other safety risks relating to isolation. Generators, UPS and batteries may also not be considered feasible by the Electrical Engineer due to the low reliability of the systems. Due to the infrequent use, only during an emergency, it is often found that these systems are not functional when called upon. Regular testing and maintenance is required to keep the systems operational, however testing is not always effective as a system is rarely assessed for its full duration of operation.
- 7.2.5 This issue has been addressed in the updated version of BS 9991. The update provides an alternative arrangement for where the primary and secondary power supplies can originate from. The document states that the two power supplies can emanate from the same substation provided that a number of recommendations are met. This sentiment is echoed in the guidance of BS 9999 which states that two separate intakes from an external substation may be used in some residential buildings where regular maintenance of a generator would not be expected.
- 7.2.6 The recommendations in BS 9991 – Section 15: Power supplies, Cabling and Installation- are outlined as follows:

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.

Where neither of these options is technically viable, e.g. a risk assessment has been undertaken by the M&E which concludes that a life safety generator would not be suitable, a single intake from the external substation may be provided as the only alternative option remaining, provided that the following recommendations are met.

a) The life safety system should be connected to an independent distribution board used exclusively for that system.

b) The life safety distribution board should be clearly marked at the point of isolation with a warning explaining that isolation would switch off the life safety system.

c) The life safety distribution board should be located in a separate fire-resisting enclosure (with a minimum of 60 min fire-resisting construction) to the primary main electrical distribution board and should not be accessible directly from the communal areas of the building or from a part of the building where dual supply is required (such as a shaft serving an evacuation lift).

d) The enclosure surrounding the primary main electrical distribution board should be provided with a minimum of 60 min fire-resisting construction.

e) The substation or transformer room should be either located outside the building or separated by 120 min fire-resisting construction and directly accessible from the outside.

- 7.2.7 The diverse (primary and secondary) power cables should only come together in the fire compartment housing the control panel by means of an automatic change-over switch, unless the cable route is via a fire compartment which does not open onto areas requiring protection via the relevant life safety system.

7.3 Compliance with BS 9991-Section 15 Recommendations

- 7.3.1 It is stated that a single intake from a substation can be provided as long as the recommended criteria listed [a-e] are adhered to. The basis of the design for the development is outlined by the following key elements:

- The primary and secondary power supplies will be diversely routed. They will be routed in separate fire compartments that will correspond to the required item of life safety equipment.
- The two supplies will be terminated at an automatic change over switch device. This ensures that in the event of the primary power supply failing, the secondary power supply will be able to automatically take over. The automatic take over device must be designed in accordance with the relevant Standard (BS EN 60947-6) and must be located in an enclosure that is fire rated and houses the life safety equipment that its serving.
- Protective devices such as circuit breakers and fuses will be required to be discriminated. This ensures that if there is a fault on the primary power supply cable it won't affect the secondary power supply cable.
- Failure of the life safety systems could only occur from a fire in the intake room which is fire separated from the rest of the building. A fire in the intake room would be fought externally and would not rely on any systems within the building.

- 7.3.2 Note: A Fire Risk Assessment is to be undertaken by the M&E Subcontractor.

7.4 Wiring

- 7.4.1 The wiring systems (for both primary and secondary power supply) for the smoke control systems, fire-fighting shaft systems, motorised fire shutters and/or data communication systems that link fire safety systems are required to conform with the following specifications:

- The wiring should consist of either

1. Mineral-insulated, copper-sheathed cables conforming to BS EN 60702-1 and meeting the relevant life safety and/or fire safety performance objectives given in BS7346-6; or
 2. Cables meeting the relevant life safety and/or fire safety performance objectives given in BS 8491; or
 3. Be protected against exposure to the fire by separation from any significant fire risk by a wall, partition or floor with a fire resistance of not less than that required of the building.
- The wiring systems should be separate from any circuit provided for any other purpose;
 - Jointing and termination methods for cables conforming to BS EN 60702-1 should in addition conform to BS EN 60702-2;
 - The wiring systems should be protected from mechanical damage.
 - Any wiring in the building that could fall prior to fire service arrival should be restrained with metal fittings to prevent entanglement.

8. Fire Strategy Management

8.1 Regulatory Reform (Fire Safety) Order 2005

- 8.1.1 The Regulatory Reform (Fire Safety) Order 2005 places a general duty of fire safety care on employees, occupiers and/or owners of businesses to provide and maintain adequate fire precautions.
- 8.1.2 The legislation is supported by requiring a fire risk assessment and a fire safety plan.
- 8.1.3 The Order places a responsibility on the responsible person to carry out a fire risk assessment on the premises. This process looks to:
- Identify potential fire hazards.
 - Evaluate the risk from the hazards
 - Identify who would be at risk
 - Identify an adequate level of fire precautions to compensate for the risk
- 8.1.4 The significant findings of the fire risk assessment should be recorded if the responsible person employs five or more employees.
- 8.1.5 The fire safety management plan details the arrangements to implement, control, monitor and review fire safety standards and to ensure those standards are maintained. The plan describes the arrangements for effectively managing fire safety so as to prevent fire occurring and, in the event of fire, to protect people and property.
- 8.1.6 A fire safety management plan should be completed on occupation of the building and a fire risk assessment should be undertaken following the occupation of the premises to comply with Article 9 of The Regulatory Reform (Fire Safety) Order 2005.
- 8.1.7 The responsible person on occupation should provide adequate fire safety information to all eventual residents of the flats. This could be in the form of a home user guide to include basic prevention measures and the fire evacuation strategy and procedures. Further information on advice to occupiers of dwellings in residential buildings including an example fire evacuation plan is provided in Annex F of BS 9991:2015.
- 8.1.8 The fire emergency plan ought to be communicated to each resident on occupation. Residents ought to have a clear understanding of what actions to take should a fire situation change, and they need to evacuate the building.

8.2 Regulation 38

- 8.2.1 Regulation 38 requires that, where work involves the erection or extension of a relevant building, or relevant changes of use of a building, fire safety information shall be given to the responsible person at the completion of the project or when the building or extension is first occupied. The information will facilitate the production of the risk assessment, a requirement under the Regulatory Reform (Fire Safety) Order 2005.the adjacent table provides a precis of the active and passive systems provided within the building.
- 8.2.2 It will need to be ensured that the building fabric and fire protection measures are maintained throughout the life cycle of the premises. All fire safety systems, installations and equipment should be maintained in accordance with the manufactures recommendations.

Table 8.1 Passive & Active Systems

Passive System	Provision	Reference in Strategy
Compartmentation	In accordance with the recommendations of BS 9991	Section 4
Fire Doors	In accordance with the recommendations of BS 9991	Section 4.2
Internal Linings	In accordance with BS 9991 Section 31	Section 3
Structural Elements	120 minutes fire resistance	Section 3.2
Cavity Barriers	In accordance with BS 9991. Cavity barriers are to be provided at all junctions or apartment walls and floors with the external wall and are to be provided around all windows and doors in the external façade.	Section 4.10 & 4.11
Roof Coverings	Designation rating of AA (B _{Roof} (t ₄)).	Section 5.7
Signage	In accordance with BS 5499-4, BS 5499-5 and BS ISO 3864-1	Section 2.14
Façade& attachments	To achieve a minimum of Class A2 or better.	Section 5.4
Active System	Provision	Reference in Strategy
Alarm & Detection	Grade D1 Category LD1 to all apartments in accordance with BS 5839-6, Category L5 to BS 5839-1 in the stair/stair lobby Category L2 to BS 5839-1 to the ancillary accommodation Category M to the commercial unit	Section 2.3
Emergency Lighting	In accordance with BS 5266 and BS EN 1838.	Section 2.13
Ventilation	0.8m ² mechanical smoke extract shaft controlled via L5 detection and a pressure sensor in the common corridors. 1m ² AOV at the head of the stair	Section 2.8
Fire and Smoke Dampers	All fire dampers are to be tested to BS EN 1366-2 and be classified to BS 13501-3. The dampers are to have the same fire resistance (integrity) as the wall or floor they penetrate (subject to a minimum of 60 minutes)	Section 4.7
Sprinklers	BS 9251 Category 3 sprinkler system with a minimum supply duration of 60 minutes to be provided to all areas except common corridors. 5mm/min in the commercial unit. 16925.	Section 3.4
Secondary power	In accordance with BS 9999 and Supplementary 9991 guidance that is specific to residential buildings.	Section 7
Firefighting system	Provision	Reference in Strategy
Wet Risers	wet rising mains to be provided within the firefighting stair.	Section 6.3
Fire Hydrants	It should be ensured than an existing hydrant is within 100m of the building or an additional hydrant will be required within 90m of the development.	Section 6.6
Fire Fighting Lift	In accordance with BS 9991 and BS EN 81	Section 6.2
Basement Ventilation	combined area of not less than 2.5% of the basement floor area	Section 6.4

9. Conclusion

- 9.1.1 The design of the building, in general, meets with prescriptive requirements at the time this report was produced. The key prescriptive requirements have been stated within this report as a performance specification and shall be adhered to by the design team in the design of the project. Unless explicitly stated otherwise all aspects are to be in full accordance with the relevant British Standards and codes of practice. Where codes of practice are restrictive to the design, an alternative (fire engineering solution) has been considered.
- 9.1.2 The drawings used in Table 1.1 have been used in the production of this report and no other drawings have been reviewed. If you feel additional information should be considered or may have an impact on this report, we are to be informed as it may have a bearing on the conclusion of this report.
- 9.1.3 The fire engineering design is based on first principles and utilises accepted design practice and tools for assessment. The fundamental criteria set were to ensure that occupants would be exposed to conditions commensurate or improved to that of the prescriptive requirements.
- 9.1.4 It is considered that between a culmination of the prescriptive requirements and fire engineering approach, a solution will be provided which is adequate to address the risk, therefore providing a detailed strategy how compliance with the functional requirements of the Building Regulations can be met if the strategy is adopted in full by all design team members.
- 9.1.5 The engineered solutions presented within this report are a deviation from the accepted guidance and represent an approvals risk, as such these should not be relied upon for design until approved by the relevant approvals body, be this the Fire Service and Building Control.
- 9.1.6 This report will be discussed with the appointed Building Control representative and should be issued for agreement in principle with the Fire and Rescue Service.

Appendix 1. Cooking Facilities Fire Separation Calculations

- A1.1.1 It is assumed that the cooking hobs will not exceed 2.5 kW per ring. This is conservative as this will be assuming that the hob is on full power and that the heat transfer process from the hob into the pan is 100% efficient and all the heat is transferred straight to the fuel, without accounting for any energy lost. Calculations will be made based on a worst-case scenario pool fire based on the hob. A pool fire is chosen as this will allow for accurate estimations of pan fires. The scenario calculated will be of a 0.25m diameter pan containing cooking oil (data gathered is based on properties of olive oil as this has the highest heat of combustion).
- A1.1.2 In the absence of a specification for the cooking hob, the 2.5kW is considered a reasonable maximum heat output based on:
- a review of commercially available hobs;
 - the conservative assumptions discussed above; and
 - the apartment is fitted with a residential sprinkler system designed and installed in accordance with BS 9251. It is noted the benefit of sprinkler suppression has not been accounted for in the calculations thus further increasing the conservatism of the calculations.
- A1.1.3 It should be noted that while these calculations are theoretical rather than experimental, this will result in estimations higher than expected in real world cases. This is due to the fact that no consideration is given to heat loss from the pan etc. so it is assumed that the fire is 100% efficient and all heat that is not radiated outwards is radiated back into the base of the fire. It also assumes that all energy provided by the hob is transferred directly to the oil with no energy lost to the pan or surroundings. It is also to be assumed that the flame from the pan is conical.
- A1.1.4 To calculate the heat release rate of a self-sustaining oil fire i.e. the pan is on fire, but the hob is switched off the following properties of olive oil need to be considered:
- Heat of Combustion, ΔH_c – 39.6 MJ/kg
 - Regression Rate, m'' – 0.02 kg/m²s
- A1.1.5 For a 0.25m diameter, an area, A_f of 0.049m² can be calculated. The fire should be circular as it the fuel is held in shape by the pan. A radiative heat fraction of 0.35 has been selected for this case. 0.35 has been selected as a conservative value, as materials that produce more soot when they burn have higher radiative fractions, and the value of 0.35 was taking from a plastic and wooden crib (which produce more soot than olive oil).
- A1.1.6 Putting the data into the equation for heat release rate:
- $$\dot{Q} = \dot{m}'' \Delta H_f$$
- $$\dot{Q} = 0.02 * 39.6 * 0.049$$
- $$\dot{Q} = 0.0396 MW$$
- $$0.0396 MW = 38.8 kW$$
- A1.1.7 This calculated result of 38.8kW is similar to the experimental results recorded by a recent study on oil fires in woks by Chow (Experimental Evaluation on Performance of Open Kitchen Fire

Suppression Systems. Chow, W.K. & Ni, X. 2014), where a solution of multiple cooking oils was used. Olive oil was selected for this case as it has the highest heat of combustion as listed in the SFPE handbook. Using a wok of the same diameter of the theoretical frying pan used in these calculations, the control test from Chow and Xi's experiment resulted in a measured average HRR of between 24-27kW with peak HRR's nearer to the calculated value. However, the peak heat release rate from this experimental data may have only being recorded for a fraction of a second whereas the higher HRR acquired from the calculations is assumed to be constant which has resulted in a much higher HRR overall.

- A1.1.8 It is assumed that 50% of the thermal radiation travels towards the seat of the fire. This results in a worst-case scenario as all radiation that is not heading directly out of the fire is used to supply further energy to the liquid fuel. Thermal radiation to the fire bed, \dot{Q}_{Rf} can be calculated with the following equation:

$$\dot{Q}_{Rf} = \frac{F \dot{Q}_R}{2}$$

- A1.1.9 To calculate \dot{Q}_{Rf} , the configuration factor, F needs to be found, which has the equation:

$$F = \frac{1}{(1 + H^2)^{0.5}}$$

- A1.1.10 To calculate F, H needs to be found, which has the equation:

$$H = \frac{2L}{D}$$

- A1.1.11 To calculate H, Flame Length, L must be found, which has the equation:

$$L = 0.23 \dot{Q}_c^{\frac{2}{5}} - 1.02 D$$

- A1.1.12 Where \dot{Q}_c is the convective fraction of heat transfer from a pool fire. Heat generated in the flame will be partly convected away by smoke flow in the plume and partly radiated to the surrounding. The fraction of heat radiated out of the flame, as stated earlier, is 0.35 which is adequate for small pool diameter. This gives a convective fraction of 0.65.

$$L = 0.23 * (0.65 * 38.8)^{\frac{2}{5}} - 1.02 * 0.25$$

$$L = 0.5821 m$$

Now a value of H can be found:

$$H = \frac{(2 * 0.5821)}{0.25}$$

$$H = 4.657$$

NOTE: H has no units.

- A1.1.13 Now the configuration factor, F can be found:

$$F = \frac{1}{(1 + 4.657^2)^{0.5}}$$

$$F = 0.2010$$

NOTE: The configuration factor has no units.

- A1.1.14 The thermal radiation that transfers back into the fire bed can then be calculated using the configuration factor and the radiative fraction of heat transfer (0.35 multiplied by the overall heat release rate):

$$\dot{Q}_{Rf} = \frac{0.2010 * (0.35 * 38.8)}{2}$$

$$\dot{Q}_{Rf} = 1.428 \text{ kW}$$

- A1.1.15 This means that when there is a heat release rate of 38.8kW in the oil fire there is 1.428kW being radiated back into the bed of the fire. As the reaction is self-sustaining it can be said that 1.428kW is enough heat to evolve the liquid fuel into gas for combustion and result in the 38.8kW HRR.

- A1.1.16 In the worst-case scenario, the hob will still be active and so the 2.5kW from the hob to the pool needs to be accounted for. It is assumed that the heat from the hob is transferred entirely into the pool fire with no loss. The 2.5kW will be defined as \dot{Q}_s

- A1.1.17 Now that there are two heat sources available to evolve the liquid fuel into gas the original 1.428kW value changes to $(\dot{Q}_{Rf} + \dot{Q}_s)$. Only \dot{Q}_s is only known now because as the HRR rate increases, the fire size increases, and so more heat is available to be radiated back into the bed of the fire. To calculate the new \dot{Q}_{Rf} it can be assumed to be 1.428kW initially, this will result in a much lower value for HRR, but the answer will be improved to within 1% accuracy through further calculations. The accuracy increases inverse-exponentially each time the method is repeated with the new numbers.

- A1.1.18 The mass burning rate of this fire can be calculated with the follow equation:

$$\dot{m} = \frac{\dot{Q}_{Rf} + \dot{Q}_s}{L_t}$$

- A1.1.19 L_t is the specific latent heat of evaporation. The mass burn rate is linearly proportional to the heat input into the liquid. Using the values from the self-sustaining fire calculated earlier, as well as taking into account the additional 2.5kW heat source

$$\frac{1.428}{38.8} = \frac{\dot{Q}_{Rf} + \dot{Q}_s}{\dot{Q}}$$

- A1.1.20 Transpose equation to find \dot{Q}

$$\dot{Q} = \frac{38.8}{1.428}(\dot{Q}_{Rf} + \dot{Q}_s)$$

- A1.1.21 Using the initial 1.428 kW value for \dot{Q}_{Rf} the equation becomes:

$$\dot{Q} = \frac{38.8}{1.428}(1.428 + 2.5)$$

$$\dot{Q} = 106.9 \text{ kW}$$

- A1.1.22 Now that there is an initial estimate for HRR for the pan fire, which is being supplied with heat from the hob, it can be improved upon through repeating previous steps. Finding new values for the flame length to the heat release rate and calculating all values repeatedly until the change in magnitude is minimal.

Second Iteration:

New Flame Length:

$$L = 0.23 * (0.65 * 106.9)^{\frac{2}{5}} - 1.02 * 0.25$$

$$L = 0.9996 \text{ m}$$

New H:

$$H = \frac{2 * 0.9996}{0.25}$$

$$H = 7.997$$

New F:

$$F = \frac{1}{(1 + 7.997^2)^{0.5}}$$

$$F = 0.1241$$

New \dot{Q}_{Rf} :

$$\dot{Q}_{Rf} = \frac{0.1241 * (0.35 * 106.9)}{2}$$

$$\dot{Q}_{Rf} = 2.321 \text{ kW}$$

- A1.1.23 With the new \dot{Q}_{Rf} found, a new estimate of heat release rate can be calculated:

$$\dot{Q} = \frac{38.8}{1.428}(2.321 + 2.5)$$

$$\dot{Q} = 131.2 \text{ kW}$$

- A1.1.24 Then the method is repeated again to increase accuracy:

Third Iteration

New Flame Length:

$$L = 0.23 * (0.65 * 131.2)^{\frac{2}{5}} - 1.02 * 0.25$$

$$L = 1.107 \text{ m}$$

New H:

$$H = \frac{2 * 1.107}{0.25}$$

$$H = 8.854$$

New F:

$$F = \frac{1}{(1 + 8.854^2)^{0.5}}$$

$$F = 0.1122$$

New \dot{Q}_{Rf} :

$$\dot{Q}_{Rf} = \frac{0.1122 * (0.35 * 131.2)}{2}$$

$$\dot{Q}_{Rf} = 2.578 \text{ kW}$$

New Heat Release Rate:

$$\dot{Q} = \frac{38.8}{1.428} (2.578 + 2.5)$$

$$\dot{Q} = 138.2 \text{ kW}$$

Fourth Iteration

New Flame Length:

$$L = 0.23 * (0.65 * 138.2)^{\frac{2}{5}} - 1.02 * 0.25$$

$$L = 1.135 \text{ m}$$

New H:

$$H = \frac{2 * 1.135}{0.25}$$

$$H = 9.081$$

New F:

$$F = \frac{1}{(1 + 9.081^2)^{0.5}}$$

$$F = 0.1095$$

New \dot{Q}_{Rf} :

$$\dot{Q}_{Rf} = \frac{0.1095 * (0.35 * 138.2)}{2}$$

$$\dot{Q}_{Rf} = 2.647 \text{ kW}$$

New Heat Release Rate:

$$\dot{Q} = \frac{38.8}{1.428} (2.647 + 2.5)$$

$$\dot{Q} = 140.1 \text{ kW}$$

Fifth Iteration

New Flame Length:

$$L = 0.23 * (0.65 * 140.1)^{\frac{2}{5}} - 1.02 * 0.25$$

$$L = 1.143$$

New H:

$$H = \frac{2 * 1.143}{0.25}$$

$$H = 9.142$$

New F:

$$F = \frac{1}{(1 + 9.142^2)^{0.5}}$$

$$F = 0.1087$$

New \dot{Q}_{Rf} :

$$\dot{Q}_{Rf} = \frac{0.1087 * (0.35 * 140.1)}{2}$$

$$\dot{Q}_{Rf} = 2.665 \text{ kW}$$

New Heat Release Rate:

$$\dot{Q} = \frac{38.8}{1.428} (2.665 + 2.5)$$

$$\dot{Q} = 140.6 \text{ kW}$$

A1.1.25 After repeating enough times, the change in heat release rate starts to become negligible. In order to check if the newest one is accurate enough it is necessary to calculate how similar it is to the previous calculated heat release rate. In this particular case 140.6 kW and 140.1 kW. This can be done by calculating the percentage difference.

$$\text{Percentage Difference} = \frac{140.6 - 140.1}{140.6} * 100$$

A1.1.26 The result is 0.36%. This means that the most recent calculation of HRR is less than 1% larger than the previous one, the increase from here on will be negligible.

Radiation Calculations

A1.1.27 As calculated above for a 0.25 diameter pan fire on a 2.5 kW heat source, an HRR of 140.6 kW is estimated as a peak fire size.

A1.1.28 The analysis will seek to determine that an appropriate separation distance can be maintained between the cooking area and the egress route such that the escaping occupants are not exposed to excessive radiation. In accordance with PD7974-6 (British Standards Institution, 2004) Table G.3 the tenability limits for received radiation are as follows;

- <2.5kW/m² for 5 over minutes
- 2.5kw/m² for 30 seconds
- 10kW/m² for 4 seconds

A1.1.29 Generally, a tenability criterion of 2.5m kW/m² will be adopted as a received radiant heat flux on the basis that any received thermal radiation less intense than that value is tolerable for over 5 minutes. To work out the radiative intensity for this case we can use the HRR of the fire and the

distance to a specific point away from the pool fire. As well as the radiative fraction of heat transfer for the fire (which is still 0.35).

$$\dot{q}'' = \frac{X_r \dot{Q}}{4\pi R_0^2}$$

A1.1.30 Where X_r is the radiative fraction, \dot{Q} is the heat release rate of the fire and R_0 is the distance to the point where radiation is to be measured. This is taken as the distance to the nearest obstruction, less 500mm to allow an occupant room to escape. The method of measuring R_0 has been illustrated in Figure 1.

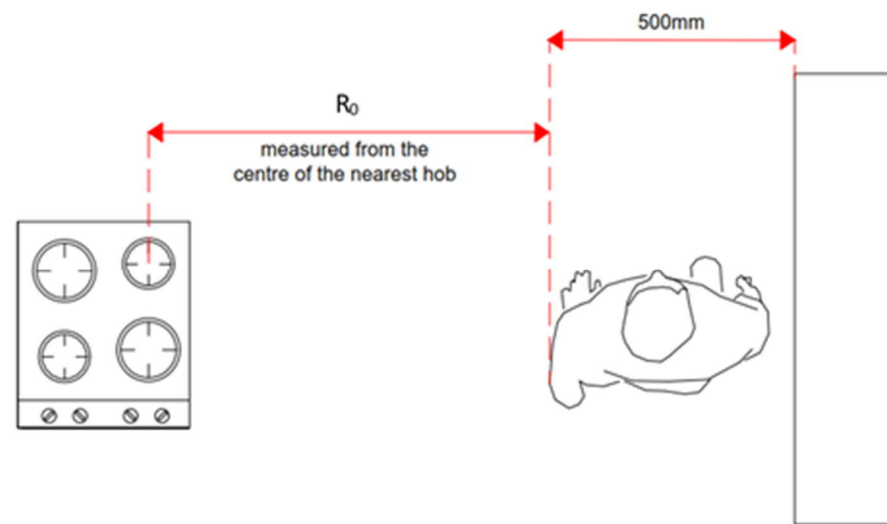


Figure 1: Separation distance from Hobs to Escape Route

A1.1.31 The equation can be rearranged to determine a minimum safe distance to achieve a received radiant heat flux of 2.5 kW/m² or less. This would result in the below equation:

$$R_0 = \sqrt{\frac{X_r \dot{Q}}{\dot{q}'' 4\pi}} = \sqrt{\frac{0.35 * 140.6}{2.5 * 4\pi}} = 1.252m$$

A1.1.32 Based on the above, any apartments with a separation distance exceeding 1.25m (i.e. 1.75m from the centre line of the hob to the nearest obstruction or the apartment entrance door) are deemed acceptable with no further assessment.

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9.1.7

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