BUREAU VERITAS

Fire Safety Strategy Report
for
Belgrove House

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Issue No: 02

Revision History

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Client Details

Client:	Access Self Storage Ltd
Client Address:	93 Park Lane, London, W1K 7TB
Project:	Belgrove House

Validity

This report is produced on the basis of the information and experience available at the time of preparation. It is applicable to the above-mentioned project only in accordance with the client's instructions. It is only valid provided no other modifications are made other than those for which a formal opinion has been sought and given by Bureau Veritas UK.

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1 Introduction

1.1 Description

Allford Hall Monaghan Morris has been appointed to design Belgrove House, a new ten-storey mixed use building, located in the King's Cross Station area. Bureau Veritas has been appointed to provide the fire safety design for the development.

The development will replace the existing three-storey self-storage building and it will comprise laboratories, offices and retail areas. Two basement levels will be included in the proposal. It is noted several laboratories will be included within levels above ground next to office areas.

The ground floor layouts consist mainly of event spaces, a reception and a retail unit. From first floor to ninth floor the majority of the spaces will consist of offices while basement levels will include plants, changing rooms, retail and offices.

The design of the retail unit will not be included in this review. It is currently shown escape from the retail area will be shared with the rest of the building, however this should be kept separate and independent.

The top occupied storey height is 37m and the building will be served by two firefighting stairs.

1.2 Purpose of Report

The objective of this report is to present a fire safety strategy which satisfies the functional requirements of the Building Regulations 2010 whilst maintaining an acceptable level of life safety, protection of adjacent property and adequate provisions for fire service intervention.

The fire safety principles have been developed in line with BS 9999:2017, which is purely for life safety purposes although it will also provide a degree of property protection. Therefore, this report details the fire safety strategy and is intended to highlight the key design issues and the proposed solutions to meet the challenges of compliance with the Building Regulations 2010.

1.3 Sources of Information

The information within this report is taken from correspondence with the Design Team and drawings supplied by AHMM up to the date of this report.

Table 1: Drawing List

Drawing title	Drawing number	Revision
PLAN L00_SITE PLAN	(P)_101	02
PLAN L00	(00)_101	02
PLAN L01	(00)_102	02
PLAN L02	(00)_103	02
PLAN L03	(00)_104	02
PLAN L04	(00)_105	02
PLAN L05	(00)_106	02
PLAN L06	(00)_107	02
PLAN L07	(00)_108	02
PLAN L08	(00)_109	02
PLAN L09	(00)_110	02
PLAN L10	(00)_111	02
PLAN TOP OF PLANT	(00)_112	02
PLAN LG	(00)_113	02
PLAN B1	(00)_114	02
GA ELEVATIONS	(00)_201	02
GA ELEVATIONS	(00)_202	02
GA ELEVATIONS	(00)_203	02
GA SECTIONS	(00)_301	02
GA SECTIONS	(00)_302	02
GA SECTIONS	(00)_303	02

2 Statutory Requirements

2.1 The Building Regulations

The building will be subject to the statutory requirements of the Building Regulations 2010. It is, therefore, necessary for the building to meet the functional requirements of Part B of Schedule 1 of these Regulations. These requirements relate to:

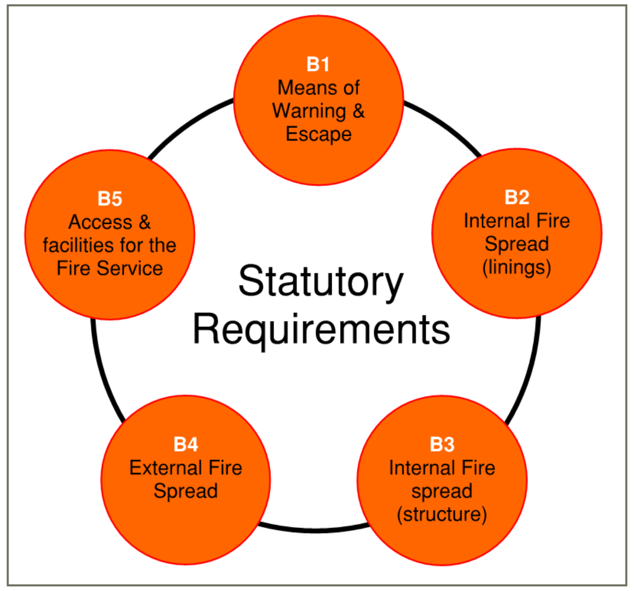

Figure 1: Part B of The Building Regulations

2.2 Guidance

For the building, compliance with the above requirements will be achieved by following the guidance of BS 9999:2017 where appropriate and supplementing this with fire engineering solutions when necessary to ensure that the key fire safety objectives for the design are achieved.

This legislation is primarily concerned with life safety, and property protection is not specifically considered although the fire protection provisions to be provided for the building will offer some degree of property protection.

Furthermore, other issues such as insurer's requirements, cultural heritage, environmental, or continuity issues have not been specifically addressed or included within the development of the fire safety strategy.

2.3 The Regulatory Reform (Fire Safety) Order 2005

Once the building is completed and occupied, the Regulatory Reform Fire Safety Order 2005 [RR(FS)O] becomes the controlling fire safety legislation.

It is necessary, among other things, under this order for the owner/occupier of the building to carry out and maintain a fire safety risk assessment. The building's management team will also be responsible under this order to ensure that the building's fire safety provisions are appropriately managed, maintained and tested over the whole life of the building.

2.4 Construction, Design and Management Regulations

Projects undertaken within the UK are subject to the requirements of the Construction, Design and Management Regulations (CDM).

This report defines the strategy for meeting the functional and performance requirements for fire safety in the finished building. Where any conclusions or recommendations have been arrived at which specify particular materials, products or forms of construction these will have been assessed, in accordance with CDM Regulation 9 (Duties for Designers). In the event that these involve significant residual risks or health and safety critical assumptions, this information will be made available, to the Principal Designer. Where the architect or other consultants use the standards put forward in this report to specify works, they are understood to be competent in alerting the Client, Principal Designer, Contractor and Building Occupiers of CDM issues.

3 Risk Profile

BS 9999:2017 is a risk based document and requires a risk profile to be established in order to determine the appropriate means of escape and design features for the building. The risk profile is a key measure of the potential for fire risk to people. This reflects the occupancy characteristics and the fire growth rate for the building, and is derived within the following subsections.

3.1 Occupancy Characteristic

Predominately the occupants of the building will be people who are awake and familiar with the building, therefore the occupancy characteristic would be A. However an occupancy characteristic B has been considered for the ground floor and lower ground floor , where people awake but not familiar with the remises is likely to be.

3.2 Fire Growth Rate

BS 9999:2017 defines the Fire Growth Rate as the rate at which a fire in the building is estimated to grow. BS 9999:2017 has four categories of fire growth rate, see below;

- Slow (1) – evenly distribute low level fire load, small discrete packets of fuel or material of limited combustibility;
- Medium (2) – evenly distributed low to mid-level fire load comprising a mix of combustible materials;
- Fast (3) – stacked combustibles (on or off racking and shelving but exclude high rack storage), of some small materials other than materials of limited combustibility (or where larger quantities are stored in separate fire-resisting enclosures), process, manufacturing or storage of combustible materials;
- Ultra-Fast (4) – medium to large quantities of materials other than materials of limited combustibility, high racked storage, flammable liquids and gases or where rapid uncontrolled fire growth could occur.

The applicable fire growth rate for the majority of the building will be a Medium (2) category, but Fast (3) for the laboratories.

However, due to the sprinkler provision throughout the building, BS 9999:2017 allows for reduction of fire growth rate by one level. Therefore, the fire strategy will be based on a **Slow (1)** category for most of the scheme and on a **Medium (2)** category for the labs.

3.3 Risk Profile

The risk profile of majority of the building is classed as A1, while A2 has been considered for the laboratories' areas.

Table 2: Risk Profiles (including effect of sprinkler provision)

Accommodation	Occupancy Characteristic	Characteristic Description	Fire Growth Rate[1]	Risk Profile
Office	A	Awake & familiar	Slow (Category 1)	A1
Laboratories	A	Awake & familiar	Medium (Category 2)	A2
Multi-Use Events Spaces	B	Awake & unfamiliar	Slow(Category 1)	B1

[1]include consideration of sprinkler protection

4 Means of Warning & Escape

4.1 Evacuation Strategy

It is proposed to adopt a phased evacuation strategy. This means that when the fire alarm system is activated the first people to be evacuated are all those on the storey most immediately affected by the fire, and those on other floors with impaired ability to evacuate, unless their PEEP has determined otherwise. The remaining floors are then evacuated, usually two floors at a time, at phased intervals.

The following conditions should be met in the scheme:

- The stairways should have a protected lobby or protected corridor (except a top storey consisting exclusively of plant rooms).
- Every floor should be a compartment floor.
- The building should be protected throughout by an automatic sprinkler system conforming to BS EN 12845.
- The building should be fitted with a fire detection and fire alarm system, conforming to at least the L3 standard given in BS 5839-1:2013, incorporating a voice alarm in accordance with BS 5839-8:2013.
- An emergency voice communication system should be provided in accordance with BS 5839-9:2011, with outstations at each floor level which communicate with a master station located in the building control room (where one exists) or some other suitable control point at fire and rescue service access level.

  NOTE 1 This may be linked to the communication system required for refuges.

  NOTE 2 Recommendations for communication systems for fire and rescue service use are given in Clause 23 within BS 9999:2017.
- Lifts should be approached through a protected lobby.

4.2 Fire Detection & Alarm Systems

For all the three risk profiles, A1, A2 and B1, the minimum detection and alarm system required in BS9999 is a manual system.

However, it is recommended to increase the level of the system to L2 considering the complexity of the building and adding flexibility for future developments. The fire detection and alarm system is to be designed and installed in accordance with BS 5832-6. The use of the automatic detection and alarm system will support a 15% increase in travel distance and reduction in escape width.

It is recommended to provide sounders and beacons on terraces to allow occupants to be aware in case of a fire within the building and escape properly.

4.3 Suppression Systems

As the building is over 30 m in height an Automatic Water Fire Suppression System designed in accordance with BSEN 12845:2014 will be provided to all parts of the building.

The design of the system will need to be addressed by the project team in conjunction with the sprinkler system designer to confirm specific design parameters to provide effective protection to all areas including retail and ancillary areas.

Once a system specification is proposed consultation with other interested parties (client, insurer, etc.) is advisable.

4.4 Emergency Lighting

Emergency lighting will be provided to the following areas and in accordance with BS 5266-1: 2016.

Table 3: Emergency Lighting

Occupancy Characteristic	Areas requiring Emergency lighting
A	Underground or windowless accommodation
	Internal corridors more than 30 m long
	Open plan areas more than 60 m^2
	Stairways in a central core or serving storey(s) more than 18 m above ground level
Any Use	All sanitary accommodation with a floor area over 8 m^2
	Windowless sanitary accommodation with a floor area not more than 8 m^2
	Electricity and generator rooms
	Switch room/ battery room for emergency lighting
	Emergency control room

4.5 Emergency Signage

Every doorway or other exit providing access to a means of escape, other than exits in ordinary use (e.g. main entrances), should be distinctively and conspicuously marked by an exit sign in accordance with BS 5499-1 and BS 5499-4.

4.6 Occupancy

The expected occupancy has been assessed through calculations based on a floor space factor of 6 m^2/person throughout the building has recommended by the architect. The total expected occupancy of the building is 2594 persons. The table below shows a breakdown of the calculated occupancy per floor, where NIAs, excluding stair and lift cores and WCs, are based on July 2020 figures provided by AHMM. The total occupancy above ground floor is estimated to be 2233.

Table 4: Estimated Occupancy Figures

Floor	FSF [m^2/person]	Net Internal Area [m^2]	Occupancy
Basement B1	N/A*	915	N/A*
Lower Ground	6	1070	133**
Ground	6	1547	228**
First	6	2287	381
Second	6	2221	370
Third	6	2186	364
Fourth	6	1537	256
Fifth	6	801	134
Sixth	6	1090	182
Seventh	6	1090	182
Eighth	6	1090	182
Ninth	6	1090	182

*Plant rooms only at this level. Limited and sporadic occupancy expected.

**Retail and Tenant Ancillary areas excluded.

4.7 Horizontal Evacuation

4.7.1 Travel Distances

Travel distances are limited to the figures given in table below.

Table 5: Travel Distances (incorporating enhanced automatic detection and alarm system)

Risk Profile	One direction of travel	More than one direction of travel
A1	29.9 m	74.75 m
A2	25.3 m	63.25 m
B1	27.6 m	69 m

Without the fit out plan, direct distance limit based on 2/3 of those should be used.

See below longest travel distances noted in the drawings.

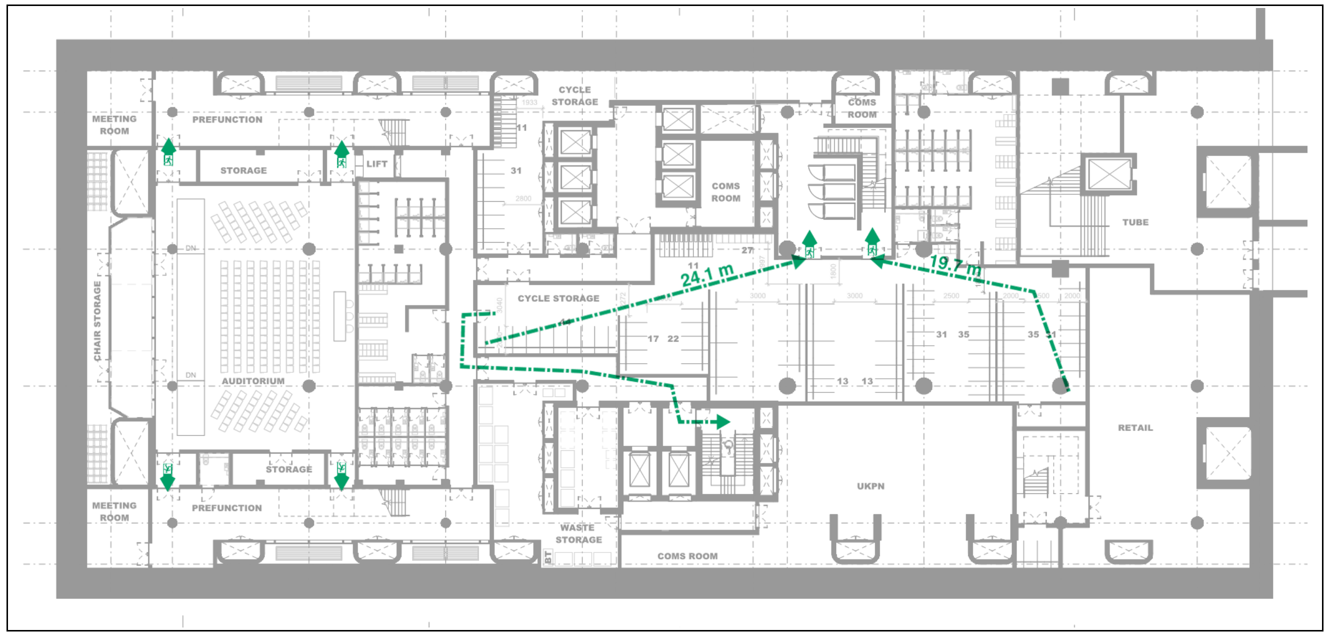

Figure 2: Lower Ground Floor Escape Routes

The cycle stores on the lower ground floor are provided with more than 1 escape route. The travel distances of the initial part of the escape with only one direction do not exceed the limits shown in Table 5:

The auditorium on the lower ground floor is provided with 4 escape doors leading to two dedicated stairs which discharge to outside directly at ground floor.

On each of the office levels, 2 storey exits are provided, one into the lobby of each stair. Where the floor plate is divided into 2 tenant offices, the arrangement should be in such a way that one of the escape route should access the storey exit and the other may go through the neighbour office in order to access the other storey exit.

Levels 1, 2 and 3 are connected by an open stair. Fire curtain should be provided on Level 3 separating the open stair from the rest of the storey. On confirmation of fire on either Level 1 or Level 2, the 2 floors will be evacuated in the first instance in the managed phased evacuation. Level 3 will evacuate on its own or with Level 4 in the same phase.

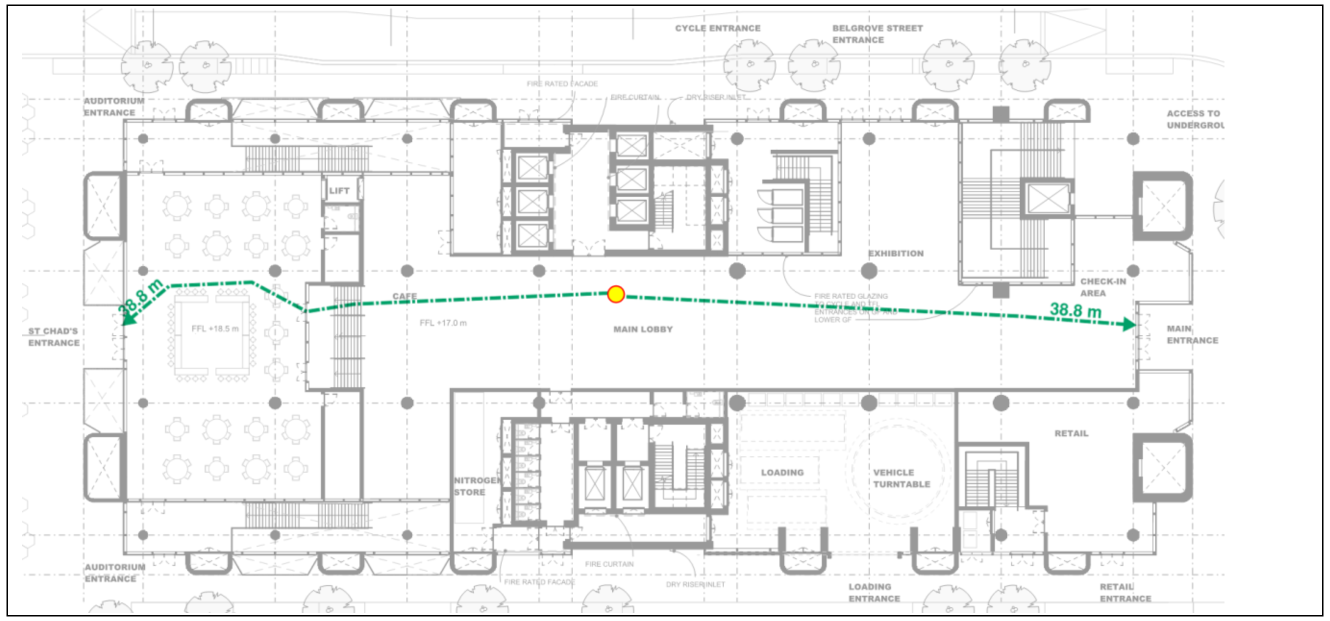

Figure 3: Ground Floor escape routes

Travel distances shown above are in line within limits set in Table 5.

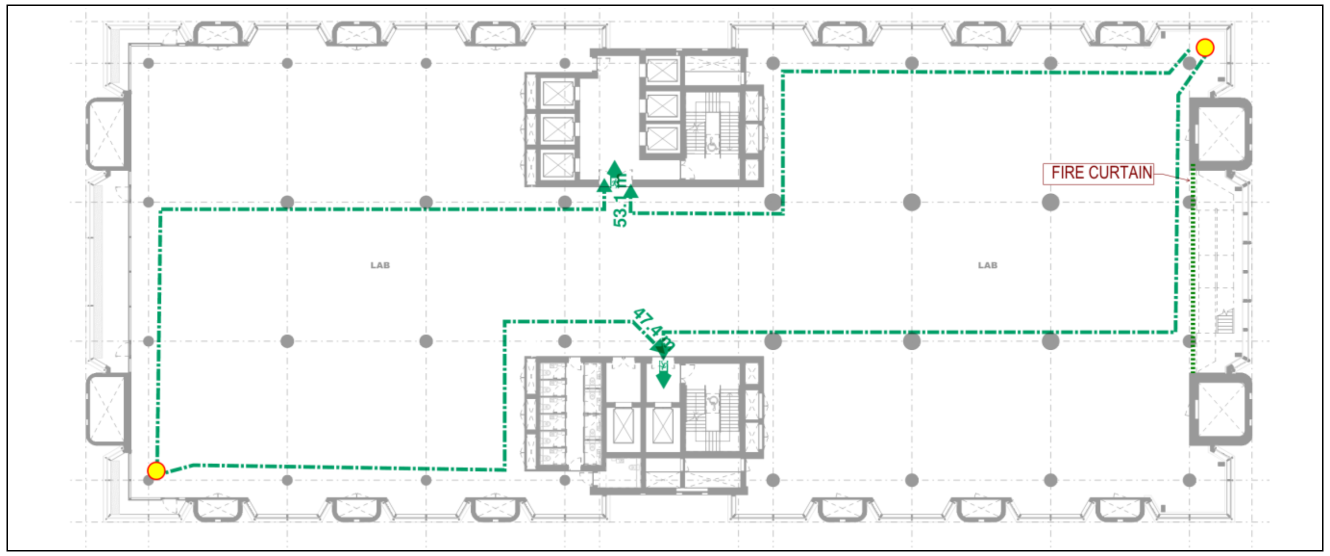

Figure 4: Office/Labs areas escape routes –3rd Floor

Travel distances shown above are in line within limits set in Table 5.

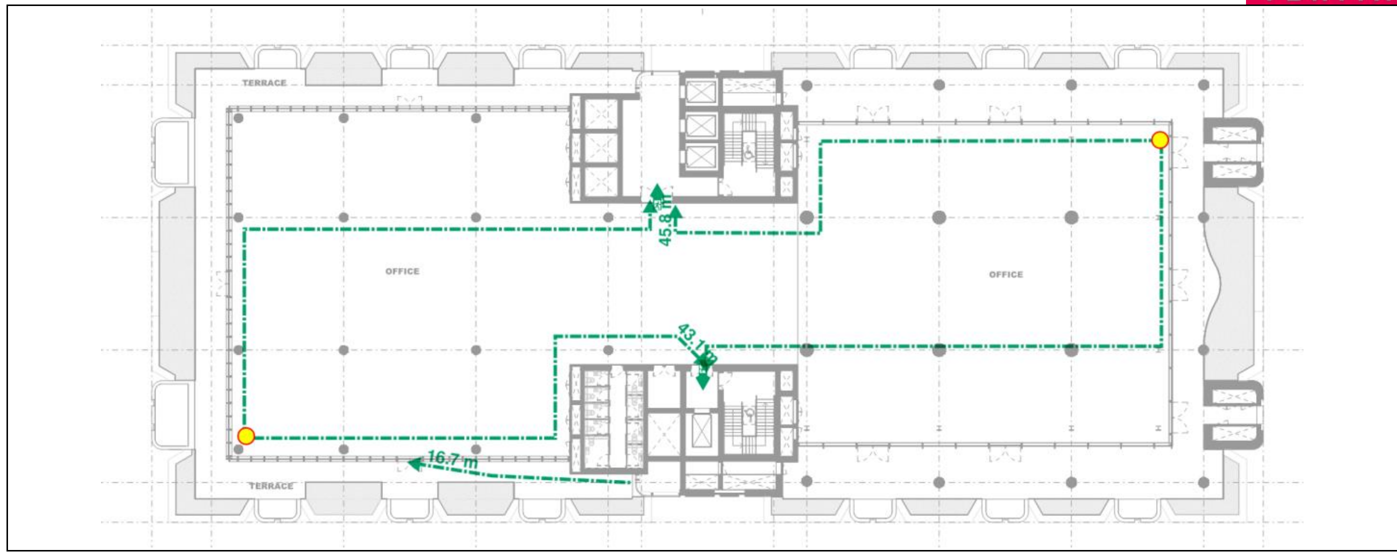

Figure 5: 4th Floor Escape Routes

Travel distances shown above are in line within limits set in Table 5.

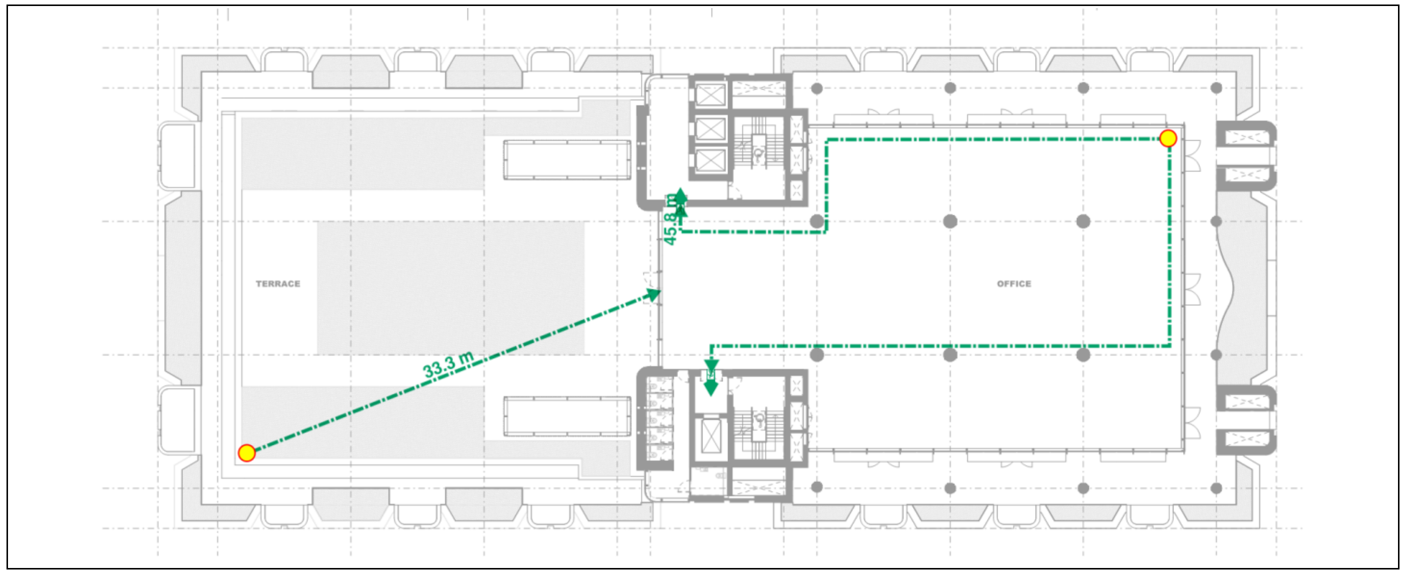

Figure 6: Office and terrace areas escape routes – 5th Floor

Travel distances shown above are in line within limits set in Table 5.

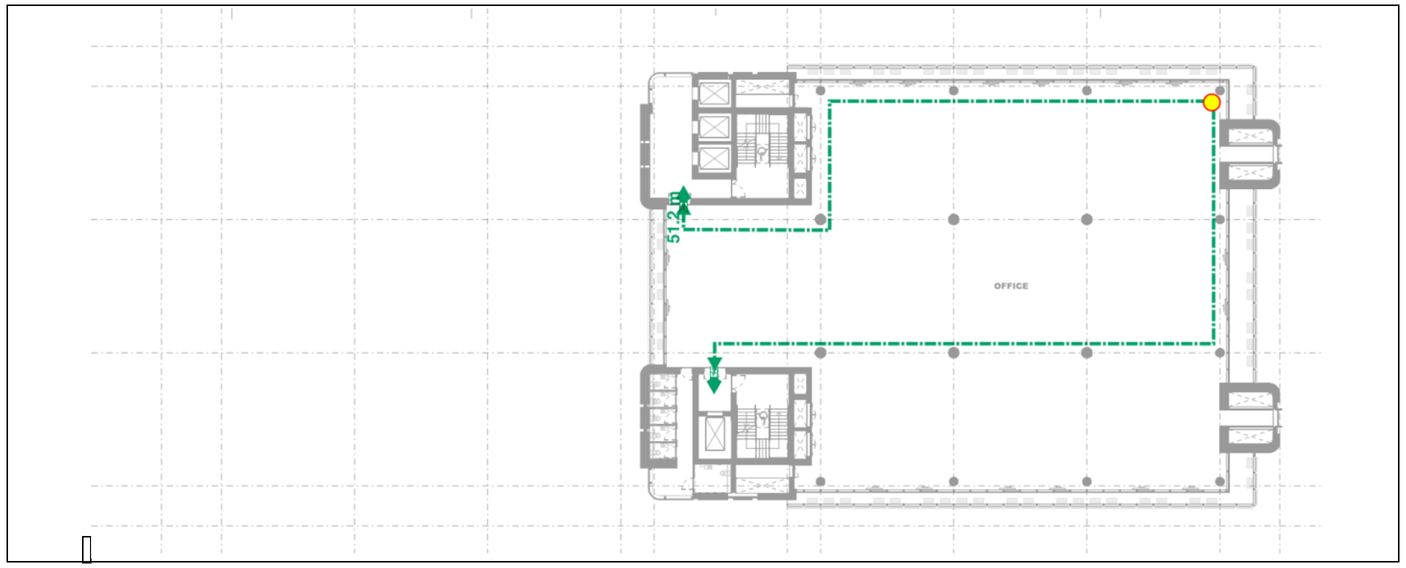

Figure 7: Office areas escape routes – From 6st to 9th Floor

Travel distances shown above are in line within limits set in Table 5.

All overall travel distance shown in Figure 2:, Figure 3:, Figure 4:, Figure 5:, Figure 6: and Figure 7: are within the prescriptive limit of 55m on office floors where alternative escape routes are available. The actual travel distance should be re-assessed when internal layout is available.

All the doors accessing the stair core and specifically the stair must open outwards as this not reflected everywhere in the plans.

Travel distances from the open terrace at 4th and 5th floors has assessed in line with recommendations within AD B Vol.2 2019, that states the limit is set to 60m in a single direction and 100m when two alternative escape routes are provided. Therefore the proposal is fine. However, it is strongly recommended to provide additional alarm in the terrace in case of a fire in the building.

4.7.2 Escape Door Widths

For occupants, escaping off a floor plate, the largest storey exit must be assumed to be blocked by fire or smoke. BS 9999: 2017 advises an absolute minimum width of 800 mm regardless of risk profile and not less than 850 mm where unassisted wheelchair access is necessary.

Exit widths shown in the drawings will be assessed against occupancy numbers calculated above in table 4. **However, the maximum occupancy allowed will be subject to the stair capacity clarified in the following paragraphs**. Tables below are filled considering the following:

- When only one storey exit is available, occupancy is limited to 60 persons.
- If alternative exits are provided, the largest exit should be discounted in case of a fire obstructing passage through it. Therefore the remaining exits will set the benchmark for the allowed occupancy on that storey.
- Where a door width is less than 1050 mm, including cases where the minimum width has been reduced by the provision of additional fire protection measures, the number of persons safely accommodated by that exit width should be calculated using following equation:
  - $n = 500/m$

  where:
  - n is the number of persons safely accommodated by the door width;
  - m is the minimum door width per person, taken from Table 12 of BS 9999:2017.

The minimum exit width per person is linked to the risk profile, as stated in Table 12 within BS 9999:2017. Basement and Ground floor has been considered B1, from 1st to 3rd A2 (to account labs) and the rest A1.

The escape width per person of the 3 different risk profiles are shown in Table 6:

Table 6: Escape Widths (mm/person)

(incorporating enhanced automatic detection and alarm system)

Risk Profile	Door width	Width of stair serving	
		1 storey	2 storey
A1	2.8	3.3	2.89
A2	3.06	3.83	3.23
B1	3.06	3.57	3.06

Table 7: Storey exits capacity

Floor	Horizontal exit width available	Occupancy estimated	Exit Width per person (mm/person)	Stair width per person (mm/person)	Occupancy allowed based on storey exits	
					Storey exit	Stair width (1400mm)
Lower Ground	2 exits at 1400 mm	133	3.06	3.57	457	392
Ground*	2 exits at 1900 mm 1 exit at 1600 mm 1 exit at 1400 mm	228	3.06	3.57	1601	N/A
First	2 exits at 1400 mm	381	3.06	3.83	457	365
Second	2 exits at 1400 mm	370	3.06	3.83	457	365
Third	2 exits at 1400 mm	364	3.06	3.83	457	365
Fourth	2 exits at 1400 mm	256	2.8	3.3	500	424
Fifth	2 exits at 1400 mm	134	2.8	3.3	500	424
Sixth	2 exits at 1400 mm	182	2.8	3.3	500	424
Seventh	2 exits at 1400 mm	182	2.8	3.3	500	424
Eighth	2 exits at 1400 mm	182	2.8	3.3	500	424
Ninth	2 exits at 1400 mm	182	2.8	3.3	500	424

**No merging flow considered at final exits from the firefighting stairs.*

Basement Levels

Only one of the two firefighting stairs continues down to basement levels in line with Guidance, but an alternative means of escape is provided via a stair serving only basement levels up to ground floor. This results in 392 persons maximum allowed at lower ground level, while occupancy at basement level 2 has been considered negligible due to the presence of plant rooms only.

Ground Floor

Plenty of independent storey exits are provided straight to outside, therefore the proposal is well compliant. No merging flow at final exits from the stairs is expected.

From 1st to 3rd Floor

One door 1400 mm wide is provided into each of the stair lobbies. If one of the doors is affected by fire, occupants can only use the other storey exit into the stair lobby and the escape stair. Therefore 1 storey exit door (1400 mm) and one stair (1400 mm) are available for escape. The real maximum allowable occupant numbers per floor is calculated to be 365 (dictated by the stair width), as explained better in the vertical evacuation section afterwards. This is less than the occupant numbers at these 3 levels. Occupancy number on these floor should be controlled to those allowed in Table 7.

4th floor

One door 1400 mm wide is provided into each of the stair lobbies. In the event of a fire that affects the approach to one of these doors, the stair becomes not accessible. The maximum number of occupants allowed on this floor is dictated by the width of one stair and is calculated to be 424 which is more than the 256 estimated above based on its NIA.

5th Floor

The terrace is considered served only by one storey exits leading into the office area as discussed at the last workshop. This restricts the occupancy on the terrace to 60 people. Door to be at least 850 mm wide.

Two storey exits both 1400 mm wide are shown leading to the firefighting stairs 1400 mm wide from the office area. After discounting one exit in case of a fire obstructing it, the maximum allowed occupancy per this floor is 424. Therefore, the estimated figure calculated above is fine, considering people on the terrace are the same persons occupying the building, to avoid redundancy in calculations.

From 6th to 9th Floor

Two storey exits both 1400 mm wide are shown leading to the firefighting stairs 1400 mm wide from the office area. After discounting one exit in case of a fire obstructing it, the maximum allowed occupancy per floor is 424. Therefore, the estimated occupant figures calculated above are fine.

For the purposes of this report, the width of a doorway is the clear width of the opening between the door leaf and frame (or projecting building hardware or the width between two opening door leaves in the case of double doors) assuming that the door leaf is free to open 90 degrees or more.

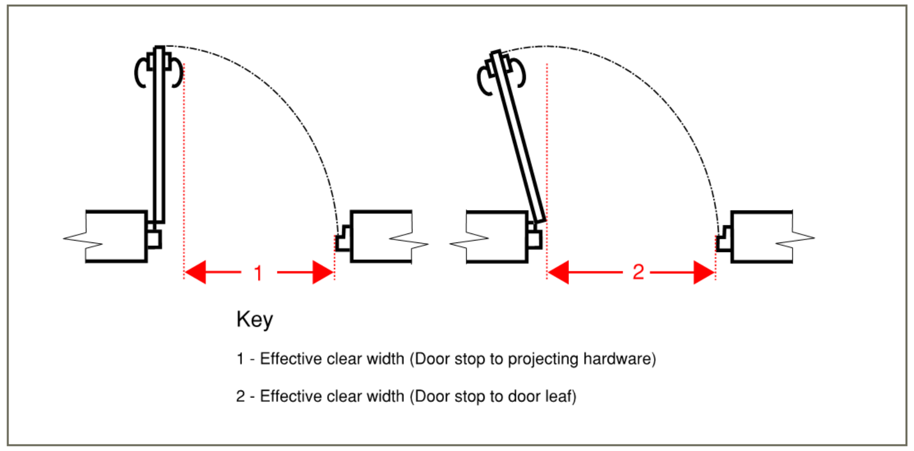

Figure 8: Exit door clear width calculation

The width of an escape route is the width at 1500 mm above the pitch line when defined by the walls or the minimum width of passage available between any fixed obstruction (hand rails fixed to the wall are ignored if less than 100mm).

All doors used for the escape of more than 60 occupants are to open in the direction of escape and all doors are to be provided with appropriate ironmongery for escape.

Fire doors should incorporate self-closing mechanisms (or be kept locked shut when not in use), and cold smoke seals should be provided where the suffix (S).

Fire doors on circulation routes may be held open by devices that release automatically when the fire alarm operates. The control of such hold-open devices should conform to BS 7273-4.

4.8 Vertical Evacuation

4.8.1 Strategy

Phased evacuation strategy will be adopted in this building. This means that when the fire alarm system is activated the first people to be evacuated are all those on the storey most immediately affected by the fire, and those on other floors with impaired ability to evacuate, unless their PEEP has determined otherwise. The remaining floors are then evacuated, usually two floors at a time, at phased intervals.

4.8.2 Stairs

An escape stair should not exceed 1400 mm if its vertical extent is more than 30 m, unless, for reasons of safety in use, the stair is provided with a central handrail, in which case there should be not less than 1 000 mm space each side of the central handrail. In such a case the stair width on each side of the central handrail should be assessed separately for the purpose of determining the stair capacity.

Based on the information shown on plans, the upper levels are served by two firefighting stairs both 1400 mm wide, see below.

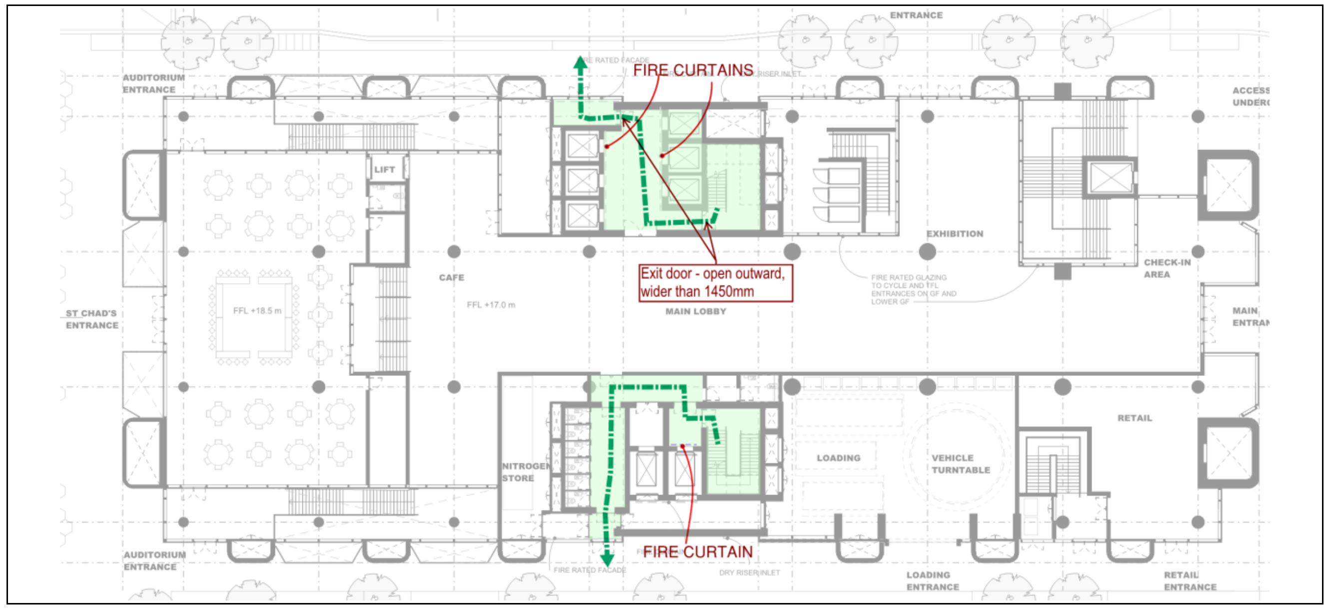

Figure 9: Stairs' location

Both stairs discharge into the firefighting lobby leading straight to outside.

Basement levels are served by one firefighting stair continuing downward and an independent 1450mm wide stair serving basement only. Only the firefighting stair is lobbied at all levels, therefore the other stair shall be discounted in case of a fire affecting its access. For a risk profile B1 (3.57mm/person for 1 storey), one stair 1400 mm wide can serve up to 392 persons, less than the expected occupancy at these levels.

Adopting a phased evacuation approach, both stairs will need to be wide enough to serve the most occupied couple of floors, i.e. 1st and 2nd floors. As they are both lobbied at all levels, no stair needs to be discounted in case a fire or smoke obstructs escape through it. Therefore the whole upper levels' capacity can be served by both stairs.

For a 1400 mm wide stair serving two floors, and due to the A2 risk profile (labs are present at 1st and 2nd floors), vertical escape capacity is calculated on the basis of 3.23 mm per person. In this case, every stair 1400 mm wide can accommodate up to 433 persons over two floors, therefore both of them can serve up to 866 persons per phase, less than the aggregate occupancy at 1st and 2nd levels.

For Level 5 and upward, the maximum total estimated number of occupants on 2 consecutive floor is 364. They are served by 2 stairs. The minimum stair width, based on 2.89mm/person for A1 profile, is 526mm per stair. However, the minimum stair width in line with BS 9999: 2017 is 1000 mm for a stair leading downwards and 1200 mm for upward travel, and 1100mm for firefighting stair. As the two stairs are also firefighting stairs, the minimum width is therefore 1100mm.

The width of the stair should be measured as the clear width between the walls or balustrades, at the narrowest point up to 1500 mm above pitch line.

4.8.3 Final Exits

All stairs should lead to a final exit. The escape route leading from the stair to the final exit should be a minimum of the same width as the stair it serves. Both final exits and all doors between the stair and the final exit should be at least 1400 mm wide, not less than that of the stair.

4.9 Disabled Evacuation

Disabled refuges should be included within protected stairs and are to be provided with an area accessible to a wheelchair of at least 900 mm x 1400 mm and be designed to comply with Annex G of BS 9999:2017. The refuge should not reduce the width of the escape route and access to the space should not obstruct the flow of persons escaping. The refuge should be clearly identified by a blue mandatory sign worded "Refuge – keep clear".

An emergency voice communication system (EVC) should be provided in each refuge to allow contact with building management. This EVC system should comply with BS 5839-9:2003 and consist of Type B outstations which communicate with a master station located in the building control room or adjacent to the fire alarm panel or an alternative approach such as wireless technology.

5 Internal Fire Spread (Linings)

5.1 Wall and Ceiling Linings

The interior wall and ceiling surfaces in a building may have a significant influence on how fast a fire may develop. Building Regulations require that internal linings shall adequately resist the spread of flame over their surfaces and, if ignited, have either, a heat release rate or a rate of fire growth, which is reasonable in the circumstances.

It is particularly important that in circulation spaces, where the rapid spread of fire is most likely to prevent occupants from escaping, the surface linings are restricted, by making provision for them to have low rates of heat release and surface spread of flame.

The surface finishes should satisfy the following classifications shown in Table 6 below, when tested under either the National Classifications (in accordance with BS 476) or under the European Classifications (in accordance with BS EN 13501-1:2002).

Table 8: Wall and Ceiling Lining Requirements

Location	National Class	European Class
Small rooms not more than 30m^2	3	D-s3, d2
Other rooms	1	C-s3, d2
Circulation spaces	0	B-s3, d2

Note: *When a classification includes "s3, d2" this means that there is no limit set for smoke production and/ or flaming droplets/ particles.*

The surface linings of the walls and ceilings should generally conform to the classification recommended above for the appropriate location. However, parts of walls in rooms may be of a lower class but not lower than Class 3 (or European Class D-s3, d2) provided that the total area of those parts in any one room does not exceed one half of the floor area of the room, subject to a maximum of 20 m^2.

6 Internal Fire Spread (Structure)

6.1 Elements of Structure

Load bearing elements of structure i.e. structural frames, load bearing walls and floors, are required to maintain stability in fire conditions for sufficient time to allow escape of occupants. It is also necessary to ensure that fire fighters dealing with a serious fire are not at risk from early building collapse. The structure of the roof and structure that supports only the roof does not require fire resistance.

The height of the building is over than 30m, therefore elements of structure should achieve 120 minute standard of fire resistance following the guidance of BS 9999: 2017.

Table 9: Fire Resistance Ratings

Construction Element	Load bearing Capacity	Integrity	Insulation	Test exposure
Structural frames, columns or beams	120	Not applicable	Not applicable	Exposed faces
Load bearing walls	120	Not applicable	Not applicable	Each side separately
Compartment floors	120	120	120	From underside
Compartment walls	120	120	120	Each side separately
Structure supporting only a roof	Not applicable	Not applicable	Not applicable	Not applicable
External Wall				
1. Any part less than 1 m away from any point on the relevant boundary	120	120	120	Each side separately
2. Any part 1 m or more from any point on the relevant boundary[1]	120	120	15	From inside the building
Enclosure of places of special fire hazard	As per table 9 below			Each side separately
Cavity barriers	Not applicable	30	15	Each side separately
Construction separating fire-fighting shaft from rest of building	120	120	120	From side remote from shaft
	60	60	60	From shaft side
Construction separating fire-fighting stair, firefighting lift well and fire-fighting lobby	60	60	60	Each side separately

Note: *All figures stated in this table are in minutes. The extent of fire resisting protection necessary for elements of structure is dependent on the potential severity of a fire that the structure is expected to withstand.*

1: *Clause 35 within BS 9999:2017 allows such walls to contain areas which need not be fire-resisting (unprotected areas).*

Walls which are required to be fire resisting are treated as elements of structure, although they may not necessarily be load bearing i.e. walls enclosing escape stairs, places of special fire hazard and those areas of external walls required to be fire resisting with regard to external fire spread considerations.

6.2 Compartmentation

Sprinklered office areas have an A1 risk profile and they are over 30 m in height. There is, in general, no requirement for compartmentation of the horizontal floor plate; however compartment floors are required in this case because of the adoption of phased evacuation and the height of the top occupied storey being over 30 m.

Fire separation should be provided achieving 120 minutes fire resistance betweeen the office areas and the shop. Same principle applies to fire- separation needed between the development and the LUL entrance.

6.3 Ancillary Accommodation

Areas of ancillary accommodation should be separated from all other parts of the building in accordance with table below.

Table 10: Structural Fire Protection for Areas of Ancillary Accommodation

Area of Ancillary Accommodation	Type of Construction Required
Storage areas not greater than 450 m^2 (other than refuse storage areas)	Robust construction having a minimum standard of fire resistance of 30 minutes.
Kitchens (separately or in conjunction with an associated staff restaurant or canteen)	
Repair and maintenance workshops where flammable or highly flammable liquids are not used or stored	
Transformer, switchgear, and battery rooms for low-voltage or extra-low-voltage equipment	
Engineering services installation rooms (other than those covered by other items in this table)	
Dressing rooms or changing rooms	
Storage areas greater than 450 m2 (other than refuse storage areas)	Robust solid non-combustible construction having a minimum standard of fire resistance of 60 minutes.
Service installation rooms (other than those covered by other items in this table)	
Places classified as high fire risk areas	
Repair and maintenance workshops where flammable or highly flammable liquids are used or stored	
Covered loading bays and storage areas other than those covered in other items in this table	Robust solid non-combustible construction having a minimum standard of fire resistance equivalent to that required for the elements of construction of the building and in no case less than 60 minutes.
Refuse storage areas	
Boiler rooms	
Fuel storage spaces	
Transformer and switchgear rooms for equipment above low voltage	
Rooms housing fixed internal combustion engine(s)	
Scene docks	
Any electrical substation or enclosure containing any distribution board, generator, powered smoke control plant, pressurization plant, communication equipment, and any other equipment associated with life safety and fire protection systems	Robust solid non-combustible construction having a minimum standard of fire resistance of not less than 120 min

Any openings in the required construction should be protected by doors having a similar standard of fire resistance.

6.4 Atria

Several open stairs are shown connecting different levels of the scheme. The building has to be provided with compartment floors, therefore these stairs should be treated as atria. However, these are restricted only to some floor, not all the way up through the building.
Bearing in mind phased evacuation will be in place, the following requirements will need to be met:

- Sprinkler protection within floor adjoining atria.
- Atria to be enclosed in smoke-retarding construction or provided with atrium pressurization system or smoke to be controlled within floors adjoining atria.
- Provide voice alarm system throughout building.
- Provide natural or mechanical smoke clearance system from the atria.
- No combustible content on atria base.

The Laboratories on L01, L02 and L03 are connected by an open stair. With the use of phased evacuation, it is recommended to provide smoke/fire curtain activated on fire confirmation on any of the 3 connected levels. This is subject to Building Control's approval.

6.5 Concealed Spaces

Concealed spaces or cavities in the construction of a building provide a ready route for smoke and flame spread. This is particularly so in the case of voids in, above and below the construction of a building, e.g. walls, floors, ceilings and roofs. As the smoke or flames would be concealed, it presents a greater danger.

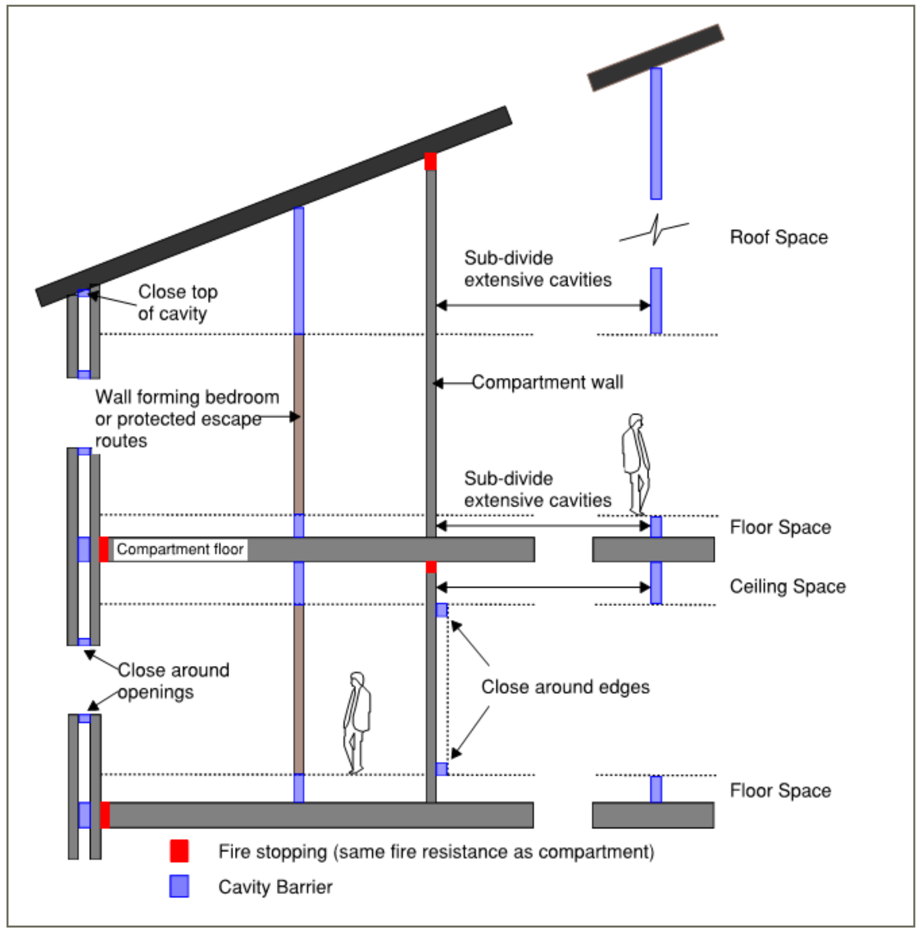

Figure 10: Cavity barrier locations

Cavity barriers should be provided to close the edges of cavities, including around new openings. The figure above shows where cavity barriers should be provided.

Cavities that may exist above or below any fire resisting construction because the construction is not carried to full storey height or, (in case of the top storey) to the underside of the roof covering should be either:

- Fitted with cavity barriers on the line of the partitions (as indicated within Figure 5); or
- For cavities above the partitions, enclosed on the lower side by a fire resisting ceiling which extends throughout the building, compartment or separated part.

Every cavity barrier should be constructed to at least 30 minutes fire resistance. It may be formed by any construction provided for another purpose if it meets the provisions for cavity barriers. Cavity barriers in a stud wall, or provided around openings may be formed of the following;

- Steel at least 0.5 mm thick;
- Timber at least 38 mm thick;
- Polythene-sleeved mineral wool, or mineral wool slab, in either case under compression when installed in the cavity
- Calcium silicate, cement based or gypsum-based boards at least 12 mm thick.

The cavity barriers where ever possible be tightly fitted to a rigid construction and mechanically fixed in position. Where this is not possible the junction should be fire stopped.

6.6 Extensive Cavities

Cavity barriers should be used to subdivide any new cavity, including any roof space, so that the distance between cavity barriers does not exceed the dimensions given in table below.

Table 11: Maximum Dimension of Cavities

Location of Cavity	Class of surface /product exposed in cavity (excluding the surface of any pipe, cable or conduit, or any insulation to any pipe)		Maximum dimension in any direction in metres
	National Class	European Class	
Between a roof and ceiling	Any	Any	20
Any other cavity	Class 0 or class 1	Class A1; or Class A2-s3, d2; or Class B-s3, d2; or Class C-s3, d2.	20
	Not class 0 or class 1	Not any of the above classes	10

Note: *The national classification do not automatically equate to the equivalent classifications in the European column, therefore products cannot typically assume a European class unless they have been tested accordingly.*

When a classification includes "s3, d2", this means that there is no limit set for smoke production and/or flaming droplets/particles.

6.7 Protection of Openings and Fire-stopping

If the fire separating element is to be successful, every joint or imperfection fit, or opening to allow services to pass through the element, should be adequately protected by sealing or fire stopping so that the fire resistance of the element is not impaired. Pipes that pass through a fire separating element, should meet either of the following provisions;

- **Proprietary seals** - Provide a proprietary sealing system which has been shown by test to maintain the fire resistance of the wall, floor or cavity barrier,
- **Restricted pipe diameter** - Where a proprietary sealing system is not used, fire stopping may be used around the pipe, keeping the opening as small as possible. The nominal internal diameter of the pipe should not be more than the relevant dimension given in the table below.

Table 12: Maximum nominal internal diameter of pipes passing through compartments

Situation	Pipe material and maximum nominal internal diameter (mm)		
	Non-combustible material	Pb, Al, Al alloy, uPVC, fibre cement	Any other material
Structure enclosing a protected shaft which is not a stairway or lift	160	110	40
Any other situation	160	40	40

6.8 Ductwork

Fire protection of ventilation ductwork is needed as an integral part of compartmentation and to ensure that means of escape from the building are not prejudiced. There are three basic methods, which are listed below. The three methods are not mutually exclusive and in most ductwork systems a combination of two, and occasionally all three, will best combat the potential fire dangers.

- Method 1 Protection using fire dampers;
- Method 2 Protection using fire resisting enclosures;
- Method 3 Protection using fire resisting ductwork.

Note: *Method 1 is not suitable for ductwork serving kitchens.*

If dampers are the chosen form of stopping smoke and flame spread the type of damper required would be fire dampers. The fire damper should meet the fire integrity criterion for not less than 60 minutes when tested in accordance with BS 476 Part 20, BS EN 1366 Part 2 or BS ISO 10294 Part 5.

Any air transfer grilles required as part of the ventilation system should not be provided within compartmentation. Air transfer grilles located in any fire hazard rooms should be provided with both fire and smoke containment. Any transfer grilles fitted in fire doors will need to be accompanied by a test certificate provided by the door manufacturer.

7 External Fire Spread

7.1 External Wall Construction – Surface Flame Spread

External surfaces of the walls should be constructed in order to adequately resist the spread of fire across the facade of the building.

The building is over 30 m in height and the relevant boundaries are more than 1 m away from the every facade of the scheme. The external wall surfaces should achieve Class 1 (national class) or Class C-s3, d2 or better (European class) up to 18m from ground. However, they should achieve Class 0 (national class) or Class B-S3, d2 or better (European class) for the portion of the façade over 18m from ground.

In a building with a storey 18 m or more above ground level, any insulation product, filler material (not including gaskets, sealants and similar), etc. used in the external wall construction should be of limited combustibility, i.e. achieving a minimum of class A2-s3, d2 or better (European Class).

As mentioned in the new Building Control Circular Letter issued on 01/07/19:

"It is strongly recommended the use of non-combustible material for the facades, i.e. A1 in accordance with the European Standard."

7.2 Roof Coverings

Roof coverings must meet minimum fire resistance requirements based on distance from the boundaries, as detailed in Table 36 of BS 9999:2017.

Table 13: Roof Coverings

Designation of covering of roof or part of roof [a]	Minimum distance from any point to relevant boundary			
National Class	Less than 6 m	At least 6m	At least 12 m	At least 20 m
AA, AB or AC	Acceptable	Acceptable	Acceptable	Acceptable
BA, BB or BC	Not acceptable	Acceptable	Acceptable	Acceptable
CA, CB or CC	Not acceptable	Acceptable[b, c]	Acceptable[b]	Acceptable
AD, BD (or CD[b])	Not acceptable	Acceptable[c]	Acceptable	Acceptable
DA, DB, DC (or DD[b])	Not acceptable	Not acceptable	Not acceptable	Acceptable[c]

Note:

a: *The performance is designated by reference to the test methods given in BS 476-3 (or DD ENV 1187).*

b: *Not acceptable in the following buildings:*

- *Occupancy characteristic A;*
- *Buildings with a volume of more than 1500 m^3.*

c: *Acceptable on buildings not listed in note b, if part of the roof is no more than 3 m^2 in area and is at least 1500 mm from any similar part, with the roof between the parts covered with a material of limited combustibility.*

7.3 Space Separation between Neighbouring Buildings

To prevent the risk of external fire spread to and from buildings opposite, the amount of unprotected area that is allowed on an elevation should be limited or the separating distance to relevant boundary increased such that the risk is reduced. The relevant boundary is usually the site boundary, however where a wall faces onto a space that is unlikely to be developed such as a road then the boundary can be assumed to be at the mid-point of the road.

Compartment floors are proposed, therefore the external flame spread can be assessed for the height of one floor per time, (i.e. one compartment at a time).

It is necessary to calculate the amount of unprotected area that is allowed on the building's façades using the enclosing rectangle method from BR 187 (Second Edition).

The space separation calculations are based on the following information;

- Compartment floors;
- The more onerous compartment height is 5 m.

- Relevant boundaries in correspondence of the middle of public roads.
- Sprinkler provision allows for reduction of boundary distance required by half.

  Office use of the scheme.

Boundary distances are shown in the figures below.

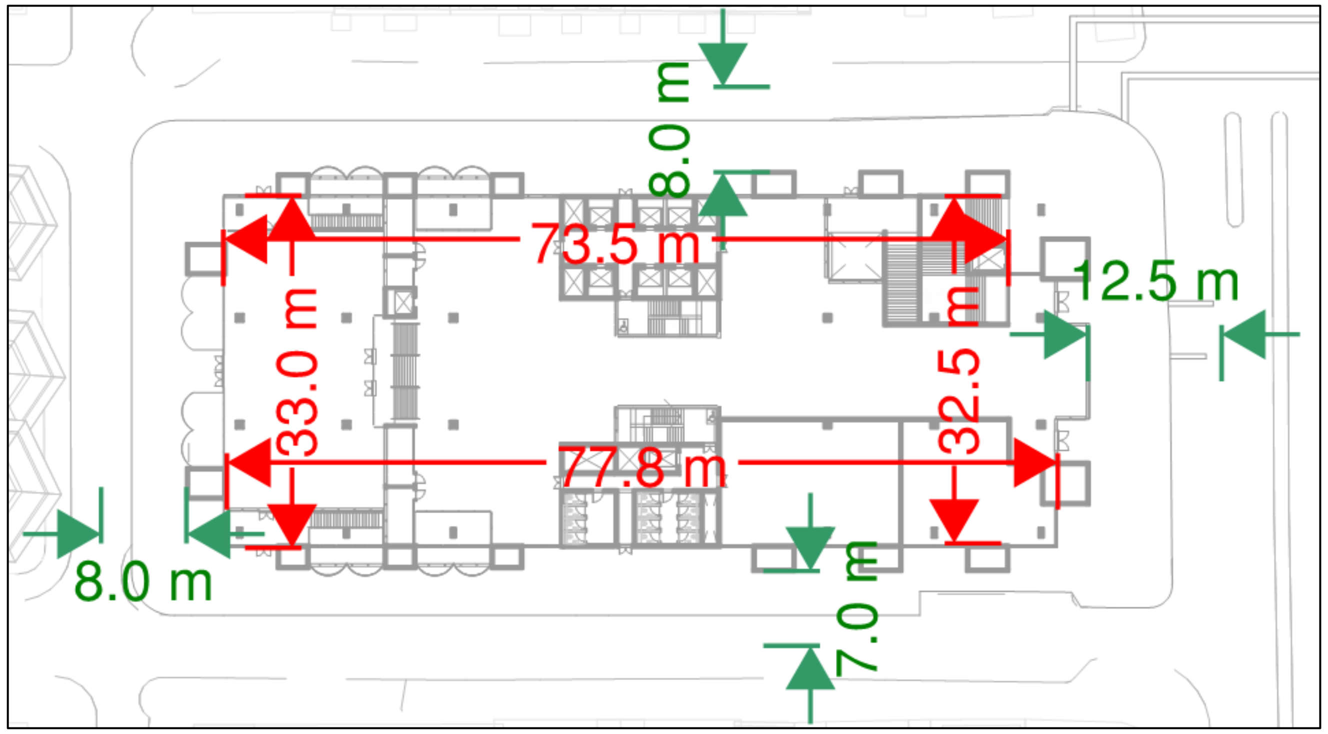

Figure 11: Relevant boundary distances from facades including unprotected areas and widths of the compartments

Table 14: External Fire Spread Calculations and results

Elevation	Compartment Size (per floor) w x h	Enclosing Rectangle Size (per floor)	Boundary Distance (per floor) [Req. Distance for 100%]	Actual Boundary Distance	Actual Unprotected Area Allowed (per floor)
North Elevation	73.5 m x 5 m	80 m x 6 m	4.75 m	8 m	100%
East Elevation	32.5 m x 5 m	40 m x 6 m	4.25 m	12.5 m	100%
West Elevation	33 m x 5 m	40 m x 6 m	4.25 m	8 m	100%
South Elevation	77.5 m x 5 m	80 m x 6 m	4.75 m	7 m	100%

Based on the above calculations, there are no limits to the total amount of unprotected area on every facade, therefore the proposal is compliant.

8 Access & Facilities for Fire-fighting

8.1 Fire Fighting Stairs

As the building is over 18m in height at least one fire-fighting shaft is required. However, due to the presence of at least one storey wider than 900 m^2, both escape stairs will need to be firefighting stairs. These shafts will include:

- Fire-fighting stair
- Fire-fighting lobbies provided with a fire main
- Firefighters lift installation

The firefighting shaft at access level will need to be designed as shown below in figure 21a) extracted from BS 9999:2017:

Figure 21 **Typical fire-fighting shaft layout at fire and rescue service access level – Fire and rescue service access directly from open air ground level in a building with basements**

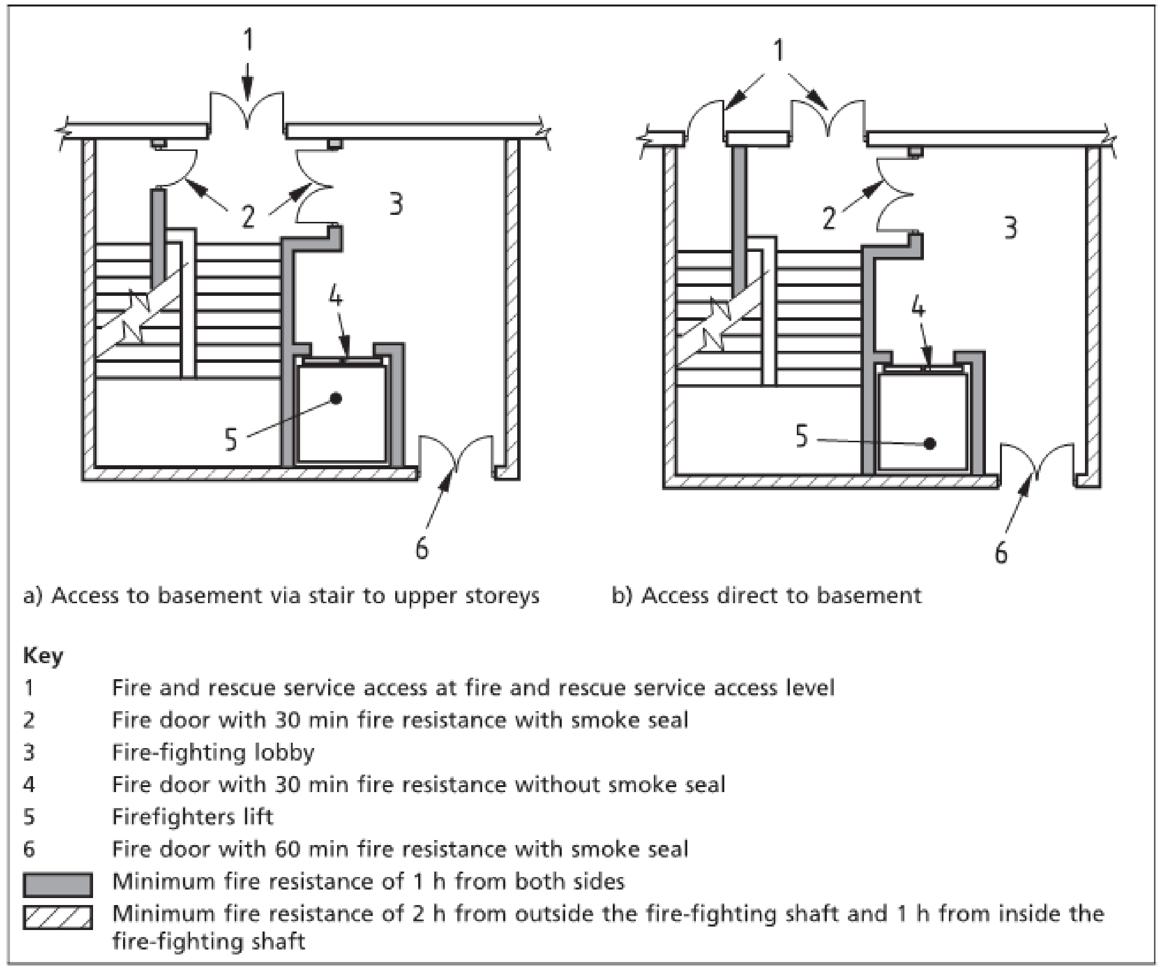

Figure 12: Firefighting shafts – Access level layout

The plans currently shown no fire separation within the stair going down to basement at access level that needs to be provided. To prevent smoke from basement storeys penetrating the stair enclosure above ground level, fire-fighting stairs serving floors both above and below ground level should be separated at ground floor level by a fire door.

Lifts are shown opening into the final escape route at access level. This is a deviation from guidance that can be justified through use of fire curtains for the lifts. Building Control Officer's approval is required for this item.

Ground floor plan shows a room opening into the protected corridor leading to outside from the Southern stair core. This needs to be removed.

The firefighting shafts at all other levels should be designed as shown below:

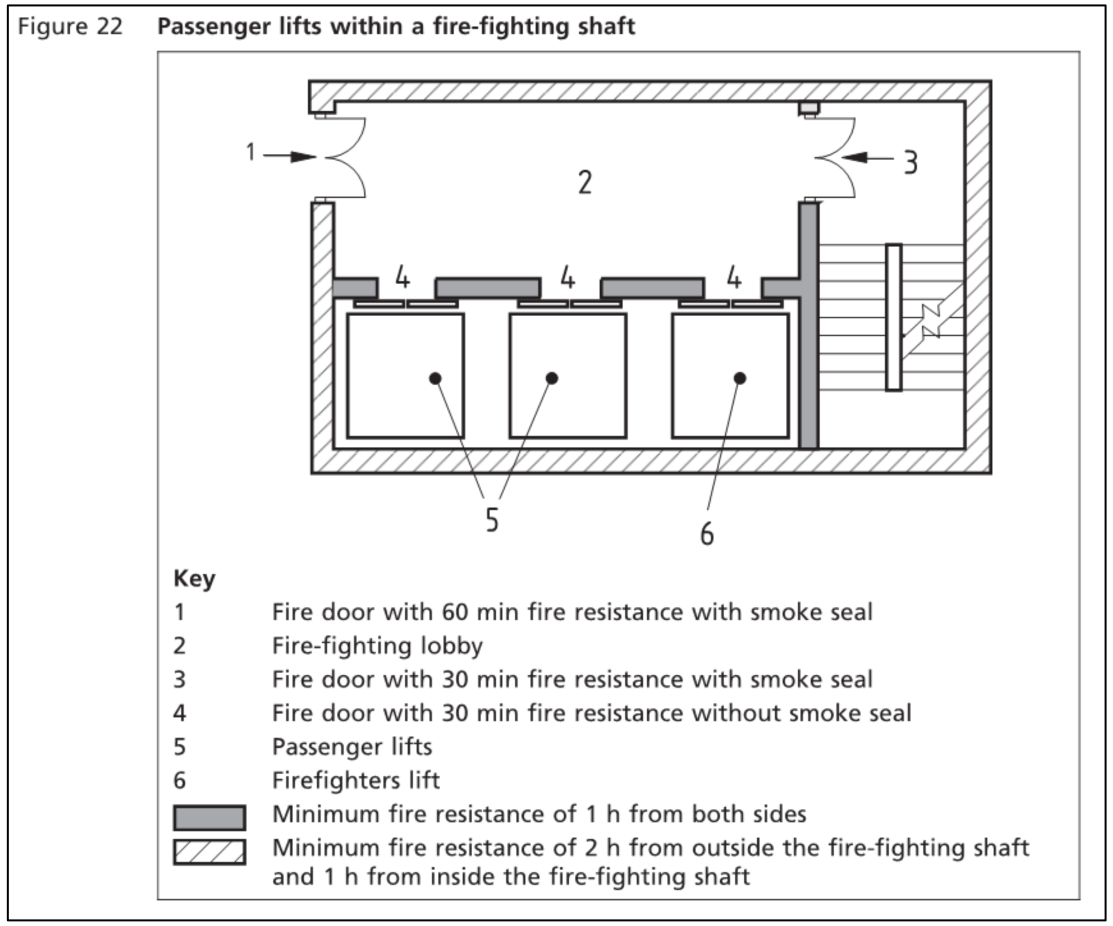

Figure 13: Firefighting shafts – All other levels layout

8.2 Smoke control for fire-fighting shafts

The head of the firefighting stair should be open to the roof via an Automatic Openable Vent at least 0.7 m^2 wide in aerodynamic free area.

The firefighting lobbies above ground should be smoke vented via a natural shaft meeting the following:

- The smoke shaft should be fully open to the external air at the top only. The opening at the top of the smoke shaft should not be located where it could be subjected to adverse wind effects (i.e. it should always have negative wind pressure coefficients).
- The opening at the top of the smoke shaft should be located at least 0.5 m above any surrounding structures that fall within a 2m radius on a horizontal plane so that it is not subject to adverse wind effects (i.e. it should always have negative wind pressure coefficients).
- The cross-sectional area (free area) of the smoke shaft should be at least 3 m^2, with a minimum dimension of 1 m.
- The opening at the head of the lobby or corridor vent shaft should be an automatic smoke ventilator in accordance with BS EN 12101-2 and have an aerodynamic free area of at least 2.0 m^2.
- All internal restrictions within the shaft such as safety grilles should have a minimum geometric free area of 2.5 m^2.
- Both the width and the height of the lobby ventilator should be not less than 0.75 m.
- The top of the lobby vent should be located as close to the ceiling of the lobby as is practicable, and should be at least as high as the top of the door connecting the lobby to the stairwell.
- The lobby vents, in the closed position, should either:

  1) have a minimum fire and smoke resistance performance of 60 min and a leakage rate no greater than 200 $m^3/h/m^2$ when tested in accordance with BS EN 1366-2; or

  2) be in accordance with BS EN 12101-8.
- The smoke shaft should be constructed of materials classified as A1 in accordance with BS EN 13501-1:2007+A1, 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.
- Any smoke shaft which penetrates fire compartments should, as a minimum, maintain the same level of fire compartmentation as that which has been breached.
- No services other than those relating to the smoke shaft should be contained within the smoke shaft.

Smoke shafts serving basements should discharge direct to open air at or above ground level where the exits from the building and fire service access would not be affected by the smoke discharge.

The smoke shaft should either serve a single basement level or, where the shaft serves more than one basement level, be a suitably fire-resisting shaft with fire and smoke dampers configured to vent smoke from only one basement level at a time.

A smoke shaft should be covered with either a metal grille designed to prevent blockage of the shaft by rubbish, or breakable material, easily accessible from the appropriate fire service access level.

In addition, the following recommendations should be met:

- The top of the lobby vent should be located as close to the ceiling of the lobby as is practicable, and should be at least as high as the top of the door connecting the lobby to the stairwell.
- The lobby vents, in the closed position, should either:

  1) have a minimum fire and smoke resistance performance of 60 min and a leakage rate no greater than 200 $m^3/h/m^2$ when tested in accordance with BS EN 1366-2; or

  2) be in accordance with BS EN 12101-8.
- The smoke shaft should be constructed of materials classified as A1 in accordance with BS EN 13501-1:2007+A1, 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.
- Any smoke shaft which penetrates fire compartments should, as a minimum, maintain the same level of fire compartmentation as that which has been breached.
- No services other than those relating to the smoke shaft should be contained within the smoke shaft.

A mechanical smoke ventilation system is proposed as an alternative option, however equivalent or better conditions in the lobby and stairs are to be demonstrated, compared to a natural shaft conforming to requirements above, and as described in BRE Project Report 79204 [N1]. This is usually shown by a comparative computational fluid dynamics (CFD) analysis.

Plans show a fire rated duct passing through the firefighting stair and connected to the mechanical smoke shaft. The duct is proposed to be fire resisting and achieving at least 120 minutes fire resistance.

The whole firefighting shaft smoke ventilation system is subject to Building Control's approval.

8.3 Vehicle Access

Access to the perimeter of the building is provided from every elevation.

Dry risers are proposed within the firefighting lobbies, therefore there should be access for a pumping appliance to within 18 m of each fire main inlet connection point, typically on the face of the building, and the inlet should be visible from the appliance.

Every elevation to which vehicle access is provided should have a suitable door(s) not less than 750 mm wide giving access to the interior of the building. Doors should be provided such that there is no more than 60 m between each door and/or the end of that elevation (e.g. a 150 m elevation would need at least two doors).

All access routes for fire appliances should comply with the table below.

Table 15: Example Measurements for Typical Vehicle Access Route

Appliance Type	Min. width of road between kerbs	Min. width of gateways	Min. clearance height	Min carrying capacity	Min. turning circle	
					Between kerbs	Between walls
Pump	3.7 m	3.1 m	3.7 m	12.5 tonnes	16.8 m	19.2 m
High reach	3.7 m	3.1 m	4.0 m	17 tonnes	26 m	29 m

8.4 Venting of smoke and heat from basements

Basement levels should be provided with means of smoke ventilation via natural or mechanical systems.

In case of a natural solution smoke vents will provide a route for smoke to escape to the open air from the basement levels. These smoke vents should:

- be not less than 2.5% of the floor area of each storey;
- be sited at high level, either in the ceiling or in the wall of the space they serve;
- be as evenly distributed as possible around the perimeter of the building with no less than half the total vent area provided on two opposing walls, with the remaining half provided equally wherever possible, to discharge into the open air outside the building;
- not be placed where they would prevent the use of escape routes from the building.

If a powered solution is preferred (this is possible due to the presence of sprinklers in every area of the building), it should:

- provide ten air changes per ho1ur;
- be capable of handling gas temperatures of 300 °C for not less than 60 min;
- come into operation automatically either on activation of the sprinkler system or by an automatic fire detection system conforming to BS 5839-1:2013 (at least L3 standard).

8.5 Water Supplies for Fire and Rescue Service

The existing provision of fire hydrants will need to be assessed by the Design Team. If there are existing hydrants located within 90 m of an entrance to the building new private hydrants will not be required.

If a hydrant is not located within 90 m of an entrance to the building it is advised to install a new hydrant within 90 m of an entrance to the building.

8.6 First-aid Fire-fighting

First-aid fire-fighting equipment should be provided in accordance with end user requirements in accordance with the fire risk assessment and with guidance taken from BS 5306-0, BS 5306-1 or BS EN 671, and BS 5306-3. It should be of a type appropriate to the risks and for the users of the building, and placed in locations where it can be readily deployed.

Portable fire extinguishers should be selected and installed in accordance with BS 5306-8.