BUROHAPPOLD ENGINEERING

St Giles Circus

Fire Strategy

032930

29 November 2016

Revision 05

Revision	Description	Issued by	Date	Checked
00	Draft For Information	JH	06/12/2014	SD
01	Stage 4 Final	JM	15/05/2015	SD
02	Stage 4 – Zone 2 Update	JM	16/09/2015	SD
03	Construction Stage	JM	15/12/2015	SD
04	Including comments from MLM and LFB	SD	15/11/2016	JLM
05	Including comments from Orms and Skanska	JLM	29/11/2016	SD

\\srv-bath01\project filing\032930 St Giles' Circus New Urban Gallery - Post Planning\F19 FEDRA - Fire - Life Safety\03 Reports\Fire Strategy\161129 JLM 032930 Fire Strategy 05.docx

author	**Jamie Lee McQuillan**
date	29/11/16
approved	**Stewart Dabin**
signature	**By Email**
date	**29/11/16**

..

Contents

Table of Tables:

Table of Figures

1 Executive Glossary

1.1 Aim

This report outlines the proposed Construction Stage Fire Strategy for the St Giles Circus redevelopment. This report is intended to be issued to the approved inspector MLM and the London Fire Brigade. It is also intended to inform the design team and the contractors of the fire strategy.

1.2 Approvals

An initial meeting to agree fire strategy principles was held with MLM Building Control in the pre-planning phase of the project in 2012. A meeting has been held since planning approval was granted on 3rd April to review the fire strategy principles and gain preliminary approval from MLM on some issues. Further to this, a meeting was held with MLM and the Fire Brigade on 22nd April 2014 at which Buro Happold presented the fire strategy principles, which were agreed in principle by all parties. A further meeting was held on 17th March 2015 with MLM Building Control and representatives of the London Fire Brigade, during which, design details were discussed and agreed. The minutes are included in Appendix A. A follow up meeting was held with MLM building control on 19/07/16 where detailed queries on Structural Fire Engineering, CFD, and façade fire rating (external fire spread) were discussed and agreed.

1.3 Development Description

The St Giles redevelopment comprises several new buildings as well as renovation works to a number of existing buildings along Denmark Street. The new buildings (zone 1) are labelled as A,B,C and D whilst the remaining areas are grouped into North and South of Denmark Street (zones 2&3). This report details the fire strategy for the site excluding the South of Denmark Street.

Generally, the fire strategy will follow the guidance in BS9999[1], BS 9991[2] and AD B[3], where the design of the buildings does not meet the requirements of the code guidance, fire engineering will be used to design an alternative approach. This will allow the design team to deliver the building they desire whilst ensuring that the fire safety design of the building is as safe as, or safer than it would be if designed using the prescriptive code approach.

The following table summarises the proposed fire engineered solutions:

Area and recommendation	Fire Engineered Solution
Buildings A & B: Buildings over 11m should have 2 stairs	Single stair, upgraded to a firefighting stair, with lobby ventilation and lobby protection at all levels. Both these buildings will also be sprinkler protected.
North of Denmark Street – stair core shared between residential and other uses	Stair shared between residential and office, with mechanical venting and lobby protection at all levels.
Auditorium Basement 2 - Firefighting stairs greater than 10m deep should be pressurised	Lobbies have been vented mechanically (de-pressurised) as only just over 10m deep and only serving plant areas.
Open plan flats	Open plan flats are protected by LD1 alarm and detection and sprinklers in new buildings, no sprinklers are proposed for the existing buildings in North Denmark Street, however, watermist system has been provided, based on advice from MLM approved inspector. In all cases cookers are remote from escape routes.
Basement voids over 800mm should be sprinklered	Voids of 875mm proposed not to be sprinklered as they do not contain combustibles. Detection will however still be included.
Auditorium Evacuation	It is also intended to use the protected corridors to provide additional holding capacity
External Fire Spread between buildings A and B	Currently between buildings A and B there is an external fire spread requirement that a portion of the building B façade requires fire rating. In order to have an unprotected façade the fire alarm and detection systems will be linked so they become the same evacuation zone and an alert would be sent to the urban gallery if there is a fire in the restaurant.

Table 1—1: Fire Engineered Solutions

A series of meetings have been held with MLM Building Control, Buro Happold Fire and London Fire Brigade. As the design has developed there has been further engagement from all parties and the route of communication has been diverse, ranging from; meetings, telephone conversations and emails. Within these meetings and emails a number of principles were agreed, these have been detailed within this document. These meetings were held on:

- 2012 (pre-planning) with MLM Building Control and representatives from London Fire Brigade
- 3rd April 2014 with MLM Building Control
- 22nd April 2014 with MLM Building Control and representatives of the London Fire Brigade
- 17th March 2015 with MLM Building Control and representatives of the London Fire Brigade
- 3rd December 2015 with MLM Building Control and representatives of the London Fire Brigade
- 19th July 2016 with MLM Building Control Teleconference

A summary table of the building fire strategy is included overleaf.

For details on 22/23 Denmark Place, please see the St. Giles Circus – 22/23 Denmark Place New Bar & Venue Fire Strategy.

1.4 Changes Since Construction Stage (Revision 03):

The changes to the fire strategy since the Construction Stage issue (Revision 03) have been listed below. It is recommended that the fire strategy be considered holistically to ensure all performance criteria are adopted as is intended.

- Additional detail provided to mechanical ventilation to the fire fighting lobbies at Basement 1 to provide equivalent of the natural BRE shaft solution. The design of the mechanically ventilated shaft is to achieve the equivalent ventilation rate of the 3.0m² BRE shaft (for commercial buildings) as outlined in BRE 7920;
- Additional detail provided to the mechanically ventilated firefighting cores serving floors 1 to 6 of Building A. The fire fighting lobbies are to be mechanically ventilated to provide equivalent of the natural BRE shaft solution. The design of the mechanically ventilated shaft is to achieve the equivalent ventilation rate of the 3.0m² BRE shaft (for commercial buildings) as outlined in BRE 79204
- Basement Auditorium Structural Fire Resistance reduced from 120 minutes to 90 minutes, as agreed with MLM building Control.
- Building B Structural Fire Resistance reduced from 120 minutes to 90 minutes, as agreed with MLM Building Control.
- External Fire Spread Between Building A and Building B has been reconsidered based on agreement from MLM Building Control to link the fire alarm and detection and create one evacuation zone.
- External Fire Spread between Building A and the Café to the South, has been considered using Thermal Radiation Analysis.

[1] BS 9999:2008 - Code of practice for fire safety in the design, management and use of buildings
[2] BS 9991:2011 - Code of practice for fire safety in the design, management and use of residential buildings
[3] Approved Document B, Volume 2 – Buildings Other Than Dwellinghouses (2006)

1.5 Key Fire Strategy Aspects

Fire safety design element	Basement Auditorium	Building A (not urban gallery)	Building B	Building C	North of Denmark Street (Existing)	Building D
Height	-14.5m	25.3m	17.3m	17.7m	16.6m	13.7m
Use	Assembly - Venue	Hotel, Retail, Conference and Restaurant	Retail, Office and Restaurant	Office	Retail and Residential	Residential
Means of escape						
Base Population	2000 design population	Hotel – 2 per room Restaurant – 200 covers Other– floor space factors	Based on final exit widths and mm/person	Based on final exit widths and mm/person	Residential – 2 per bedroom Other– Based on final exit widths and mm/person	2 per bedroom
Evacuation	Simultaneous	Simultaneous	Simultaneous	Simultaneous	Apartments evacuate independently. (defend in place)	Apartments evacuate independently (defend in place)
Fire fighting						
Firefighting stairs	Provided (>10m deep)	Provided	Provided	Not Required	Not Required	Not Required
Firefighting lifts	Provided (>10m deep)	Provided (>18m)	Not Required (<18m)	Not Required (<18m)	Not Required (<18m)	Not Required (<18m)
Dry risers	Within FF shafts	Within FF shafts	Within FF shafts	Within Stair Core	Not Required	Not Required
Smoke Ventilation	Mechanical smoke extract to lobbies. Smoke Clearance throughout basement.	Mechanical extract to fire fighting lobbies	Stair lobby vented with AOV	Stair lobby vented with AOV	Mechanical ventilation to lobbies	Stair vented with AOV at head of stair.
Compartmentation	Single zone	Compartment floors	Compartment floors	Compartment between Ground and First floor.	Between occupancies and individual apartments	Residential in separate compartments
Structural protection	Box-in-box, independent of the main structure - 60 minutes Main structure – 90 minutes	90 minutes	60 minutes	60 minutes	60 minutes	60 minutes
Suppression	Sprinklers to BS EN 12845	Sprinklers to BS EN 12845	Sprinklers to BS EN 12845	None Required	Water Mist in residential apartments that do not meet BS9991 requirements.	Residential - Sprinklers to BS 9251

Table 1—2 Key Fire Aspects Summary

2 Introduction

2.1 Development Description

The St Giles Development is situated around Denmark Street, which is home to a number of culturally important music shops and the location of a number of historic music events. To facilitate the construction of the Crossrail tunnels a number of buildings in this area had to be demolished, however this brought rise to an opportunity to redevelop the area, while still maintaining the focus on music. The redevelopment comprises of the renovation and refurbishment of the buildings north of Denmark Street, as well as, the construction of a number of new buildings.

The new buildings (Zone 1) are labelled as A, B, C and D, whilst the remaining areas are grouped into North of Denmark Street (Zone 2) and South Denmark Street (Zone 3). The site has a number of different uses, spanning across; commercial, residential accommodation, and entertainment. In addition, there is a basement auditorium and a large open public space called the urban gallery.

This report details the fire strategy for both Zones 1 and 2. South Denmark Street has not been incorporated in this Fire Strategy.

As each of the buildings is largely independent, this report will assess each of these areas independently.

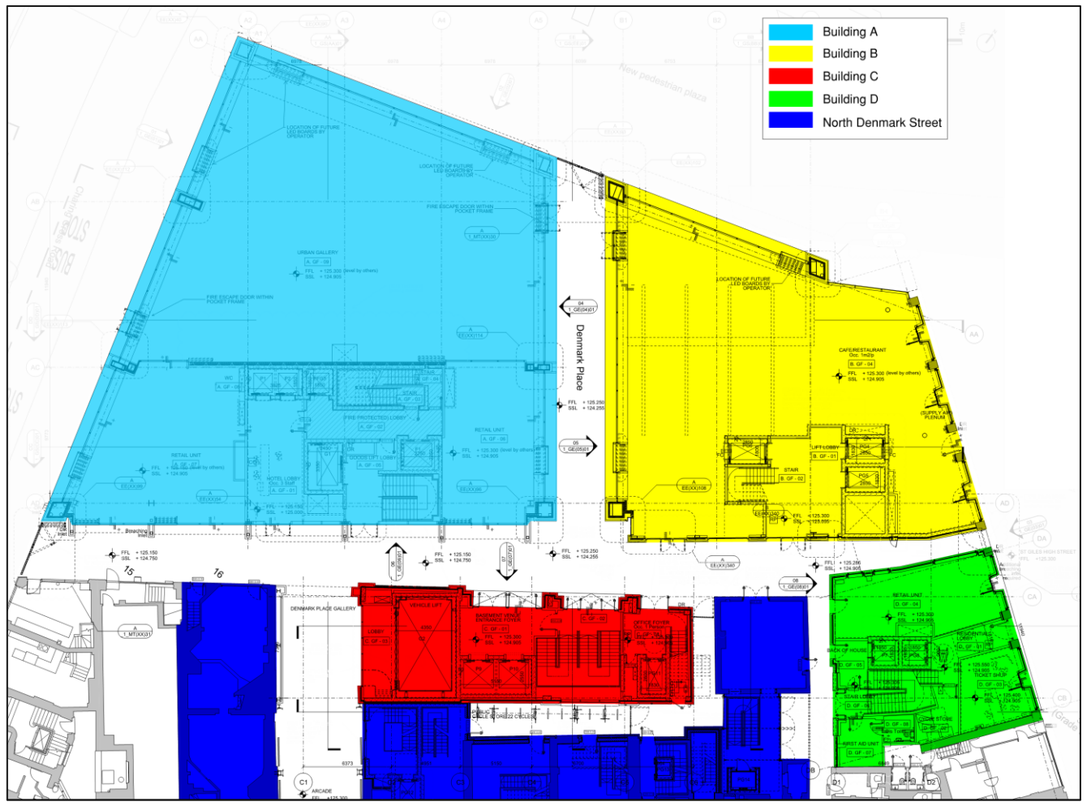


Figure 2—1: Site Plan

2.2 Legislative Requirements

In order to comply with the statutory functional life safety requirements of the Building Regulations 2000, the following guidance documents have been used as a basis for design:

- Approved Document B, Volume 2 – Buildings other than Dwellinghouses, 2006.
- BS 9991:2011 - Fire Safety in the design management and use of residential buildings- Code of practice
- BS 9999:2008 - Code of practice for fire safety in the design, management and use of buildings

Where the design of the buildings does not meet the requirements of the prescriptive code guidance fire engineering will be used to design an alternative approach.

2.2.1 BS9991

The residential section of the development will be designed in accordance with the recommendations of Approved Document B (ADB) and BS 9991, Fire Safety in the design, management and use of residential buildings – Code of practice.

BS 9991 permits open plan design but limits flat sizes to 12m x 16m (192m^2) and also recommends enclosing the kitchen in open plan flats greater than 10m x 8m (80m^2). BS 9991 also recommends open plan flats be situated on a single level and requires that kitchens are enclosed in open plan flats >80m^2 in area. It also recommends that cooking appliances are located remotely from escape routes in open plan flats. It is not proposed to put any restrictions on the openness of kitchens to the living spaces based on the provision of a linked automatic fire detection (AFD), a fire engineered justification is contained in Appendix B, for both sprinkler protected and non-sprinkler protected flats.

2.2.2 BS9999

BS9999 has been used as the basis for this fire strategy as the occupancy characteristics definable in BS9999 allow a more reflective representation of the development as opposed to those provided in Approved Document B.

As a general rule, the majority of the development is categorised as occupancy characteristic B (Awake and Unfamiliar). The exception to this is the hotel rooms and residential areas of the development which are category C and the kitchens which are category A. For the new build areas of the building: auditorium, offices, retail, restaurants, the proposed fire growth rate is medium, hence a B2 profile is applicable for these areas. It is noted however that sprinkler provision is included in a number of areas within the building. In these areas, the provision of sprinklers reduces the risk profile to B1 in accordance with BS9999. Similarly the hotel areas are a C2 profile, reduced to C1 due to sprinkler provision. The kitchen is an A3 risk profile, reducible to A2 with sprinklers.

2.3 Management

The site as a whole will be managed centrally through a 24/7 concierge, located in the hotel reception. This concierge is critical to ensuring the smooth operation and management of this development. The 24/7 concierge can also provide access for the fire brigade in the event of an emergency situation, although for robustness, it is recommended that a Gerda box be located at each of the access gates, supplying the Fire Brigade with an access key. The concierge will also be required to ensure the 'double-knock' alarm system is used as intended. There will be fire alarm repeater panels located at the entrance to each Block, the main panel, however, will be located in the hotel reception. At present; the Auditorium, Buildings A, B, and C are designed to enable simultaneous evacuation, while the residential components of Building D, and North Denmark Street will adopt a defend in place evacuation strategy. An evacuation of the Auditorium will be managed so that it does not conflict with Fire Brigade Access.

3 Site-wide Fire Fighting Provisions

3.1 Firefighting Facilities

Details of firefighting facilities within each of the buildings on the site is detailed in the relevant chapters below. This section covers site-wide firefighting access provisions such as the location of the fire rendezvous point and hydrant provision.

3.1.1 Firefighting Rendezvous Point

Due to the size and complex nature of the St Giles Circus redevelopment it is recommended that an area be provided behind the hotel reception desk where the fire panels can be located. This area should be capable of housing the following:

1. A fire panel that will receive all signals from the fire alarm and detection systems in the development;
    a. Commercial tenant fire alarm/sprinkler interface status;
    b. Disabled call points, repeater to all stations above and below ground;
    c. Status of all residential smoke control systems;
    d. Status of all basement smoke control systems;
    e. Status of main power supplies, all ATS switches; and
    f. Status of sprinkler systems.
2. Override for air-conditioning systems; and
3. Building Plans.

This location provides easy access from Charing Cross Road, which is the likely primary arrival point of the Fire Brigade. It is also linked directly to the site-wide management offices at level 3 of building A.

The main fire alarm panel, override for air-conditioning systems, and building plans will be accessed through the hotel entrance lobby (which will have a 24-7 concierge) as shown on Figure 3—2.

It was agreed in principle that this was the best placed location for the items listed above, as the venue would discharge away from the entrance to the site.

3.1.2 Fire Vehicle Access

Primary fire vehicle access is available to the west of building A along Charing Cross Road. This location provides direct access to the hotel reception where the main fire alarm panel is located. There are secure gates, as indicated in Figure 3—2, it is proposed that these gates may be opened by the 24/7 concierge, however, for robustness it is recommended that a Gerda box be provided at each gate, providing access for the fire brigade. Access is provided to within 18m of the Dry Riser Inlet points, and access is provided to within 60m of the dry risers measured on a route suitable for laying a hose.

Firefighting access is also available along Demark Street and St Giles High Street, with access to the site through the internal passageways between the buildings on the St Giles site. The north of buildings A/B is a pedestrian plaza which may also support a fire tender if required.

3.2 Fire Hydrants

Hydrants should be provided within 90m of an entry point to the building and not more than 90m apart. A hydrant plan is currently being sought to ensure that the whole site is within appropriate distance.

Figure 3—1 Gerda Box

3.3 Fire Alarm and Detection

All the separate alarm systems for the buildings will send a signal to a repeater panel at the Hotel reception area, which will have 24/7 monitoring by a concierge located in the hotel reception. The detection and alarm systems for the non-residential buildings shall operate on a 'double knock' principle whereby an investigation delay period will be incorporated when the warning of a fire is from a single automatic smoke detector. During the investigation period staff will be able to cancel the warning so that an evacuation signal is not given. The length of this delay is proposed to be 3 minutes to allow the person investigating the alarm to reach its source.

The system shall be put into full alert if:

- The alarm is confirmed as a real fire by the person investigating; or
- The alarm is not cancelled during the investigation period; or
- If a second detector is activated; or
- If a manual call point is activated.

3.4 Manual

Fire extinguishers will be provided in approved locations. A training programme for users will be required by the building operators.

3.5 Sprinkler System

A sprinkler system designed to BS EN 12845:2009 will be provided across zones 1 &2 in the new build elements. Access to the pump room will be via the firefighting stair to the basement auditorium.

The residential apartments in Building D will be covered by a BS 9251:2014 system.

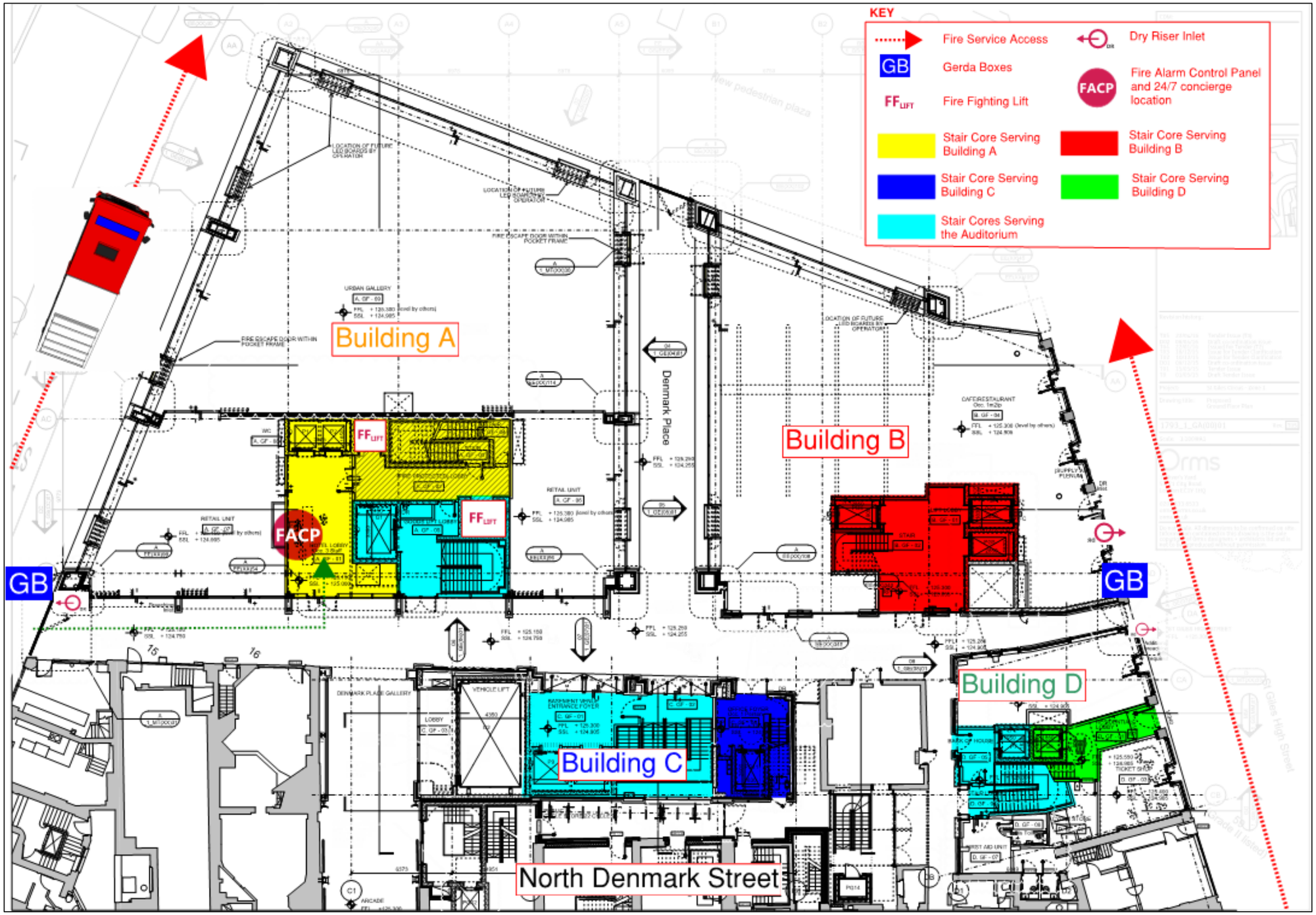


Figure 3—2: Locations for Dry Riser Inlets

3.6 Internal Fire Spread

3.6.1 Fire Stopping

Fire stopping should be provided on the line of compartment walls and floors where gaps exist that could allow smoke and flames to breach the compartment wall or floor. Joints between elements that serve as a barrier to the passage of fire should be fire stopped and all openings for pipes, ducts, conduits or cables to pass through any part of an element that serves as a barrier to the passage of fire should be:

- Kept as few as possible.
- Kept as small as practicable.
- Fire stopped (which in the case of a flue or duct should allow thermal movement).

3.6.2 Surface Linings

The internal linings for all walls and ceiling surfaces will achieve the following:

Table 10 Classification of linings

Location	National class (1)	European class (1)(3)(4)
Small rooms (2) of area not more than: a. 4m² in residential accommodation b. 30m² in non-residential accommodation	3	D-s3, d2
Other rooms (2) (including garages)	1	C-s3, d2
Circulation spaces within dwellings		
Other circulation spaces, including the common areas of blocks of flats	0	B-s3, d2

Figure 3—3 – Table 10 of Approved Document B

3.6.3 Cavity Barriers

Cavity barriers should be provided to close the edge of cavities including around openings. Cavity barriers should also be provided:

- At the junction between an internal cavity wall (except where the cavity wall conforms to Figure 33 of BS 9999) and every compartment floor, compartment wall, or other wall or door assembly which forms a fire resisting barrier. Provision of cavity barriers is shown in Figure 32 of BS 9999.

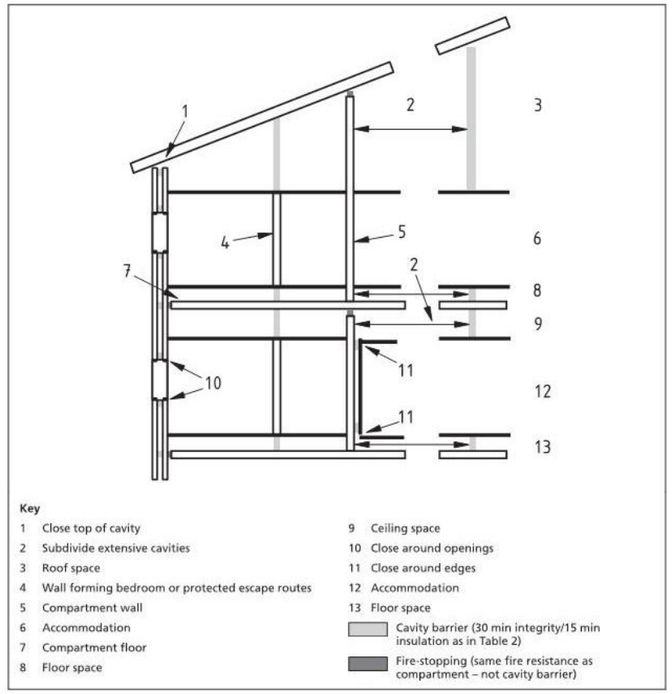


Figure 3—4 – Figure 32 of BS 9999 – Provisions for cavity barriers

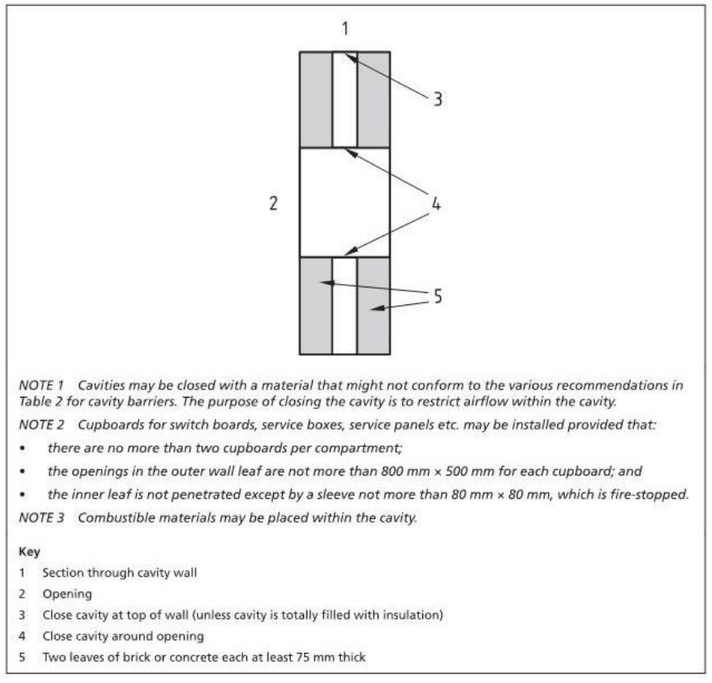


Figure 3—5 – Figure 33 of BS 9999 – Cavity wall excluded from provisions for cavity barriers

3.7 Emergency Power, Lighting and Signage

3.7.1 Power Supply

A secondary power supply will be provided to all life safety systems, with all cables being fire rated using BS 5819 rated cable systems. As a minimum the following systems will be supplied with secondary power, this list is not exhaustive, please consult the MEP report for further information:

- Fire fighting lift;
- Emergency lighting;
- Smoke control systems; and,
- Sprinkler pumps.

3.7.2 Emergency Lighting

Emergency lighting shall be designed in accordance with BS 5266 Part 1. All escape routes should have adequate artificial lighting and should be on a separate circuit from that supplying any other part of the escape route.

3.7.3 Emergency Signage

Escape routes shall be marked with suitable exit signage complying with the Health & Safety (Safety signs and signals) Regulations 1996. An exit sign will mark every doorway or other exit providing access to a means of escape. The position of such signs will be agreed between the architect, the fire service and MLM and will then be reviewed as part of the RRO fire risk assessment. Exit signs will comply with BS 5499: Part 1 and European sign directives.

4 Basement Auditorium

4.1 Introduction

The basement contains an auditorium, as well as ancillary rooms and plant areas. The deepest basement level is approximately 14m below ground level and is split in two by the Cross-rail tunnel which runs underneath the site.

Level	Land Use(s)
0	Urban Gallery, hotel reception, retail
-1LG	Residents Cycle Storage
-1BM	Auditorium gallery and ancillary rooms
-1B	Auditorium and ancillary rooms
-2B	Plant Rooms

Table 4—1: Basement Land Uses

4.2 Means of Escape

4.2.1 Basement 2

The northern half of basement level 2 (-2B) is served by a single stair case which connects to basement level 1 (-1B) and the basement mezzanine. At -1B a horizontal transfer (via a protected corridor) is available to the firefighting stair core D, which accesses the ground floor and a protected route to external. This firefighting core also provides access to the southern half of basement 2, providing a protected route to access the sprinkler pump room.

The occupancy of basement 2 (-2B) is limited, given it is only plant areas and hence the stair provision is acceptable. Travel distances at basement 2 has been classified as per the recommendations of BS 9999. The plant room is currently categorised as B3, (reduced to B2 with sprinklers). BS 9999 limits single-direction travel distances to 20m with a B2 risk profile. Travel distances in the plant room , with the addition of a protected corridor are compliant.

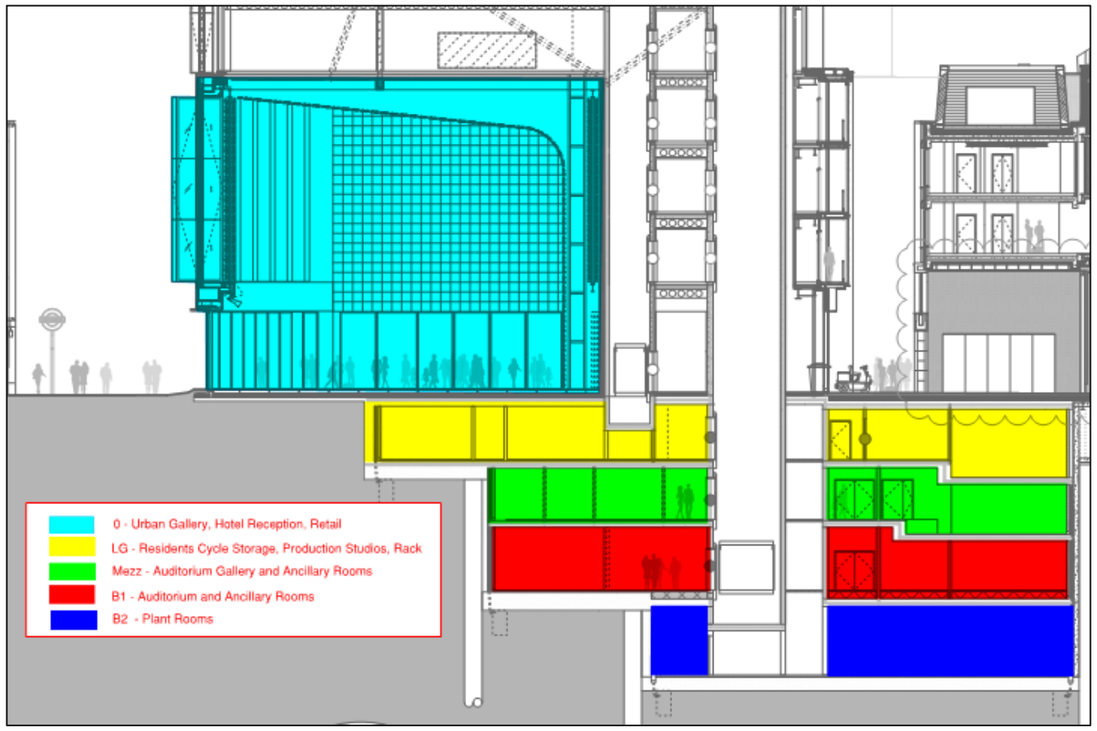


Figure 4—1 Basement Auditorium Section

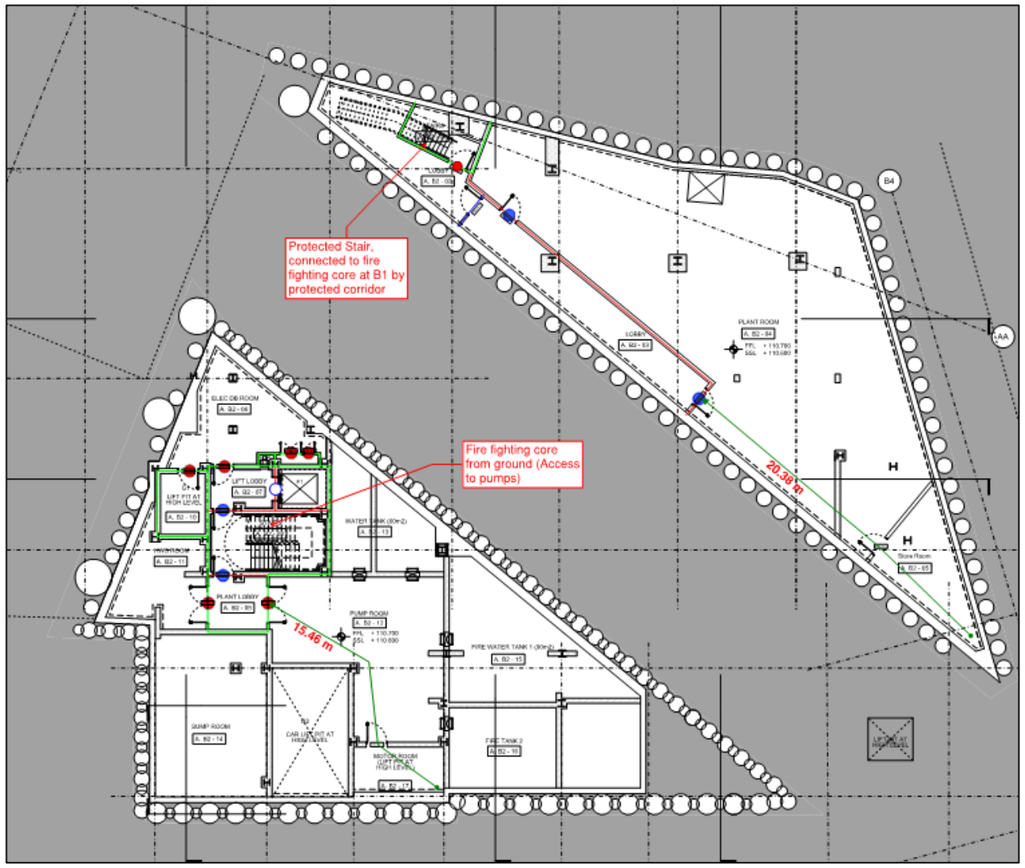


Figure 4—2: Level 2 Basement, showing protected stair and FF core

4.2.2 Basement 1 (Auditorium)

This space is an Auditorium, as described in Annex B, section B.1 clause 2) of BS 9999 these types of spaces are not considered to be atria. As such, the mechanical smoke clearance system providing 10ACH is appropriate.

Basement level 1 (-1B) has a maximum future capacity of 2,000 people. This has therefore been used as the design occupant capacity. The 2,000 person occupancy in the auditorium is likely to be spread over levels -1B and -1M, however, the assessment has be conducted based on a worst-case scenario, whereby it is assumed all occupants are at level -1B, the main auditorium space. Level -1B is served by four stair cases, as shown on Figure 4—3.

The majority of -1B has multi-direction travel distances due to the location of the stair cores around the perimeter of the performance space. One-way travel distances are minimal and within proposed limits (B1 profile allows 27.6m one-way travel distances including AFD), maximum two way travel distances for the same risk profile plus AFD is 69m. As such, travel distances in this area are compliant.

Currently, the smoke ventilation proposed to the fire fighting shaft in Building A and serving the basement venue is a depressurisation system serving the fire fighting lobbies. The reason for selecting a depressurisation system instead or pressurising the fire fighting shaft are as follows:

- There are floors that are designed and handed over as ''shell'' only, with a final fit-out by a tenant. This final fit out by the tenant can have significant implications for the leakage paths and air supply paths;
- Previous projects having issues with commissioning; and
- The stair will essentially be pressurised as the make-up air for the de-pressurisation is through the stair to the lobby.

The fire fighting lobbies are to be mechanically ventilated to provide equivalent of the natural BRE shaft solution. As the stairs are approached by two lobbies a solution is proposed using compartmentation so that the two lobbies never open into one fire compartment, therefore the system will protect one lobby in the event of a fire. The design of the mechanically ventilated shaft is to achieve the equivalent ventilation rate of the 3.0m² BRE shaft (for commercial buildings) as outlined in BRE 79204.

There are three stair cores which provide access from the basement to the ground floor, as shown on Figure 4—3 they are all lobbied, and therefore, none are discounted as part of the means of escape assessment. It is also intended to use the protected corridors to provide additional holding capacity during an evacuation scenario as agreed with MLM and the Fire Brigade at the commencement of the project.

The occupancy calculations are as follows:

Stair Capacity: - Stair Core A

- Width = 1500mm

- Occupancy Factor = 3.6mm/person reduced to 2.7mm/person through enhanced detection and alarm and high ceilings (reduction of 25%)

- Occupant Capacity = 555 people

Stair Core B

- Width = 1500mm

- Occupant Factor = 2.7mm/person (as previous)

- Occupant Capacity = 555 people

Stair Core C

- Width = 1400mm

- Occupant Factor = 2.7mm/person (as previous)

- Occupant Capacity = 518 people per stair (1036 in total)

Total Occupant Capacity = 555 + 555 + 1036 = 2146 people

Fire Scenario:

Each of the three stair cores has two separate entry points, such that no stair core can be completely discounted. As the corridors leading to the stairs will be protected it is assumed that the storey exit is into the corridor.

The worst-case position for a fire is shown in Figure 4—3, as this location blocks one of the routes into stair core A as well as one of the routes into stair core C. Stair core C is therefore only fed by a single entry point of 1900mm. Stair core A is now also only served through the single door of 1100mm. This means the occupancy calculations will be as follows:

Entrance to Stair Core A

- Width (door) = 1100mm

- Occupant Factor = 2.7mm/person

- Occupant Capacity = 407 people (This is less than the maximum capacity of the stair calculated previously)

Entrance to Stair Core C

- Width (door) = 1900mm

- Occupant Factor = 2.7mm/person

- Occupant Capacity = 703 people (This is less than the maximum capacity of the stair calculated previously)

Entrance to stair core B

Width of door - 2 x 1900mm

Occupant capacity of 1406 people (limited by stair capacity of 555)

Total Occupant capacity = 555 + 407 + 703 = 1665 people

While this is less than the predicted occupancy of 2,000 people, as mentioned above, there are large areas of protected space (lobbies, corridors and accommodation stairs) which can be used as holding areas. An indication of potential areas available is included below.

Level -1B: 95m^2. Assumed this can be filled at around 0.3m^2/person = capacity for 317 people

Mezzanine: 42 m^2 – up to 140 people based on 0.3 m^2/p

Lower Ground: 50 m^2 – up to 167 people based on 0.3m^2/p

This capacity for over 600 people does not include protected areas to the south of the mezzanine level as we are considering a worst-case scenario with all occupants at -1B only. In reality people will be spread over both levels and hence this additional protected space can be used. Overall this is considered sufficient for a 2,000 audience plus an allowance for staff (DJ/bar staff) and performers.

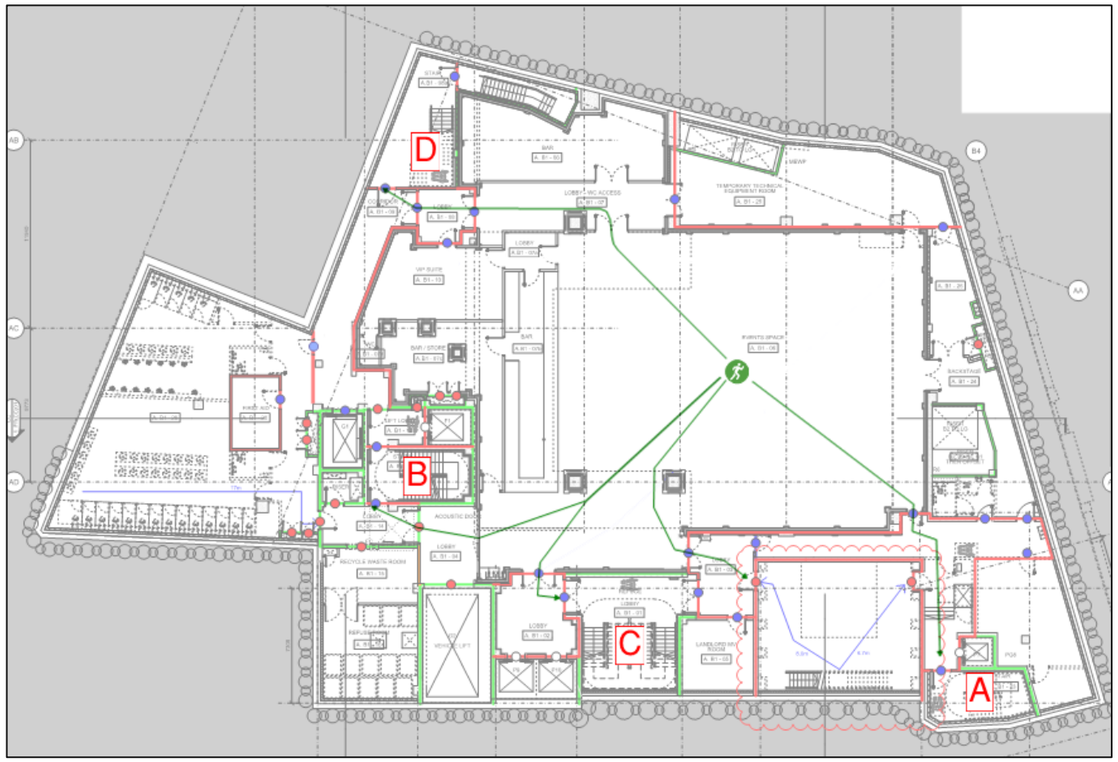


Figure 4—3: Level 1 Basement layout with egress routes and worst-case fire location

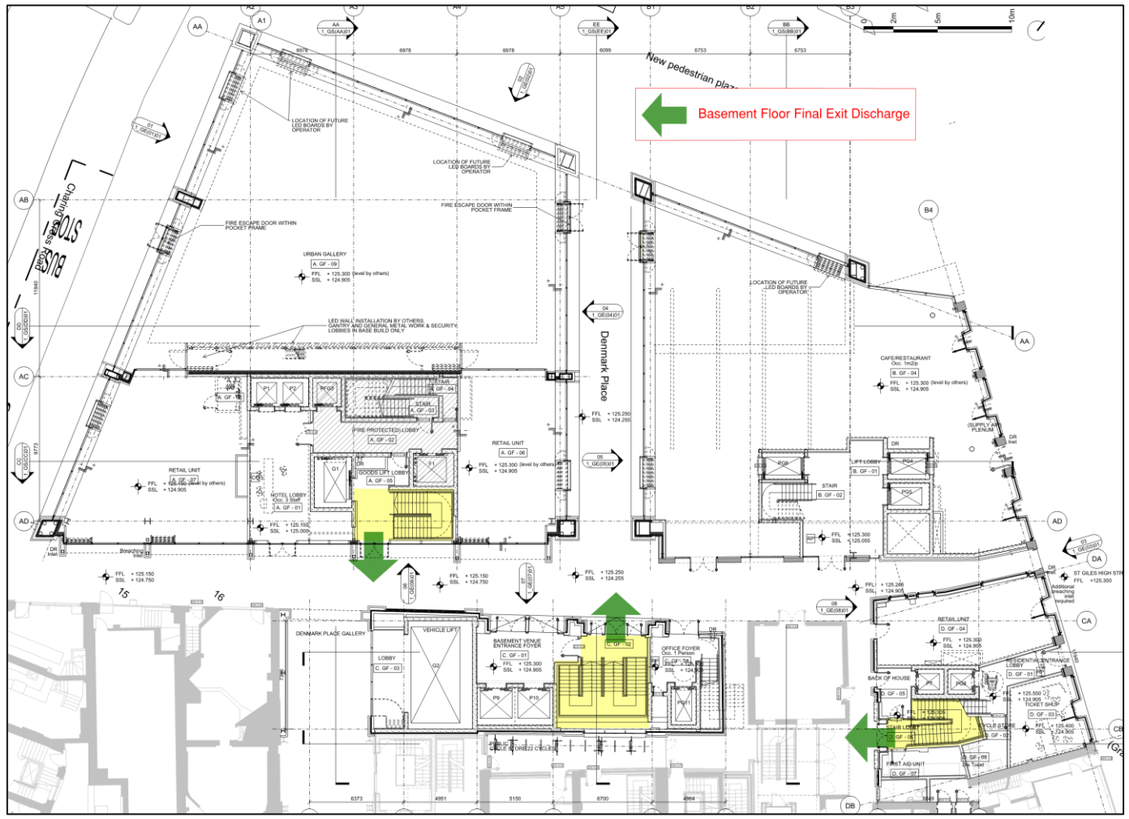


Figure 4—4: Ground Floor discharge points from basement stairs

4.2.3 Basement Mezzanine & Lower Ground

The basement mezzanine and lower ground floors provide back of house facilities for the auditorium, including a large toilet provision, VIP lounge, and preparation rooms. Additionally, at the lower ground floor there is cycle storage both for residents and visitors. All travel distances in these areas are within recommended limits set out in BS 9999. Additionally, rooms with a single egress point (notably the VIP lounge) have been limited to a maximum capacity of 60 people.

4.3 Disabled Occupants

Disabled refuges are proposed within the protected areas. Communication devices will be required at these points to allow the occupants to contact the 24/7 concierge (where the main fire panels will be located) if they required assistance.

4.4 Structural Fire Resistance

The following are the structural fire resistance requirements for the St Giles Circus redevelopment:

The auditorium box-in-box structure which is independent of the main structure should be provided with **60 minutes** structural fire protection, based on the recommendations set out in BS 9999 table 25 . The main structure, i.e. elements which do not contribute to the box-in-box construction, should be provided with **90 minutes** structural fire resistance.

4.5 Compartmentation

The following table summarises the requirements for compartmentation:

Compartmentation	Required Period of Fire Resistance (min)
Compartment Floors	60 (REI) Between the basement and the levels above ground - 90 (REI)
Service riser enclosures	90 (as passing through 90 minute floor separating ground from basement.) (REI)
Firefighting core	120 (REI)
Enclosure to storage/refuse rooms	30 (EI)
Enclosure to plant rooms	30 (may change depend upon utility provider) (EI)

Table 4—2 Basement Auditorium Compartmentation

R – Load bearing, E – Integrity, I - Insulation

4.6 Automatic Fire Detection

Based on BS 9999 Table 8, the minimum level of detection required in the basement is a Manual system, however the basement will have an enhanced automatic detection system throughout, to an L2 standard, in line with section 19.2 of BS 9999. Systems will be designed according to BS 5839-1 2013. This automatic detection will be extended to any ceiling voids which are over 800mm deep.

In addition to the automatic detection, manual call points will be installed in the building. These will be located in areas to prevent false alarms.

4.7 Sprinklers

The basement levels will be sprinkler protected, with the sprinkler tank being located at -2B. This sprinkler tank also serves the sprinkler systems for the remainder of buildings A, B, and D. This system will be designed to BS EN 12845.

It is noted that voids in the basement areas are approximately 875mm deep. It is proposed not to sprinkler these despite them being greater than 800mm, given there are no services running through them and they are empty of combustibles. Detection will still be provided.

4.8 Smoke Control

4.8.1 Basement

It is proposed to provide a smoke clearance system equivalent to 10 ACH for the auditorium and plant at Basement 2. The smoke extract duct work and fans will be capable of handling smoke temperatures of 300°C for not less than 1 hour. The smoke extract should activate upon confirmation of a fire by smoke detection, manual call point activation, or sprinkler activation. The purpose of this system is for smoke clearance during the fire fighting phase, this is not required for means of escape purposes.

The auditorium is excluded from Atria requirements as stated in BS 9999 Annex B.

4.8.2 Fire Fighting Lobby

The fire fighting core lobby (stair core B) from ground to basement -2 will be ventilated mechanically (de-pressurised). This system has been proposed as opposed to a pressurisation system, on the basis of the following challenges that are often encountered when implementing pressurisation systems, as defined by Simon Lay (2014), see appendix C and summarised below:

- A fundamental parameter is the estimation of air leakage from the core, which is notoriously hard to estimate, given the number of variables (doors, windows, gaps in walls, natural leakage through construction materials, lift doors etc.);
- The commissioning process cannot take place until the buildings construction is well progressed, as such significant problems identified at this stage cannot be resolved by fine tuning the existing equipment;
- The results of the commissioning process are very sensitive to weather conditions on the day of testing (wind, temperature etc.);
- The number of doors open at any one time is critical to determining the peak flow rate, normally in the design process a door at the foot of the stair and a door at the fire floor is assumed to be open. However, this may not take into account fully the practicalities of evacuation and fire fighting within a building such as this. Therefore the system may not perform as designed and could potentially lead to smoke entering the core; and,
- It is common for door opening forces to be increased when implementing a pressurisation system, in the worst case scenario pressures can increase to such an extent that occupants cannot open the door.

The fire fighting lobbies are to be mechanically ventilated to provide equivalent of the natural BRE shaft solution. As the stairs are approached by two lobbies a solution is proposed using compartmentation so that the two lobbies never open into one fire compartment, therefore the system will protect one lobby in the event of a fire. The design of the mechanically ventilated shaft is to achieve the equivalent ventilation rate of the 3.0m² BRE shaft (for commercial buildings) as outlined in BRE 79204

The detailed design of the mechanically assisted system will need to be carried out by a specialist supplier; however, some guidance on the design of the system is given below based on previous experience.

- The shaft sizes will be approximately 0.6m² in plan (geometric free) area.
- The aspect ratio of the shaft will be no greater than 2:1
- The shafts will terminate at roof level with a fan at the head of each. The extract/inlet fans set will comprise of duty and standby fans. The extract rate will be confirmed by the supplier of the system.
- A vent will be provided into the shafts from each lobby at each storey. The size of the vents will be confirmed by the suppler but are typically in the range of 0.6 – 0.8m² (geometric area).

4.9 Firefighting Shafts

The basement levels will be accessed via the firefighting core (stair core B) from ground level. Basement level 1 (-1B) also connects to the northern plant areas at basement level -2 (-2B) via a protected corridor and additional stair. A dry riser is included within the protected corridor adjacent to stair D to serve basement Level 2 (-2B) north, at B1 level, see Figure 4—5.

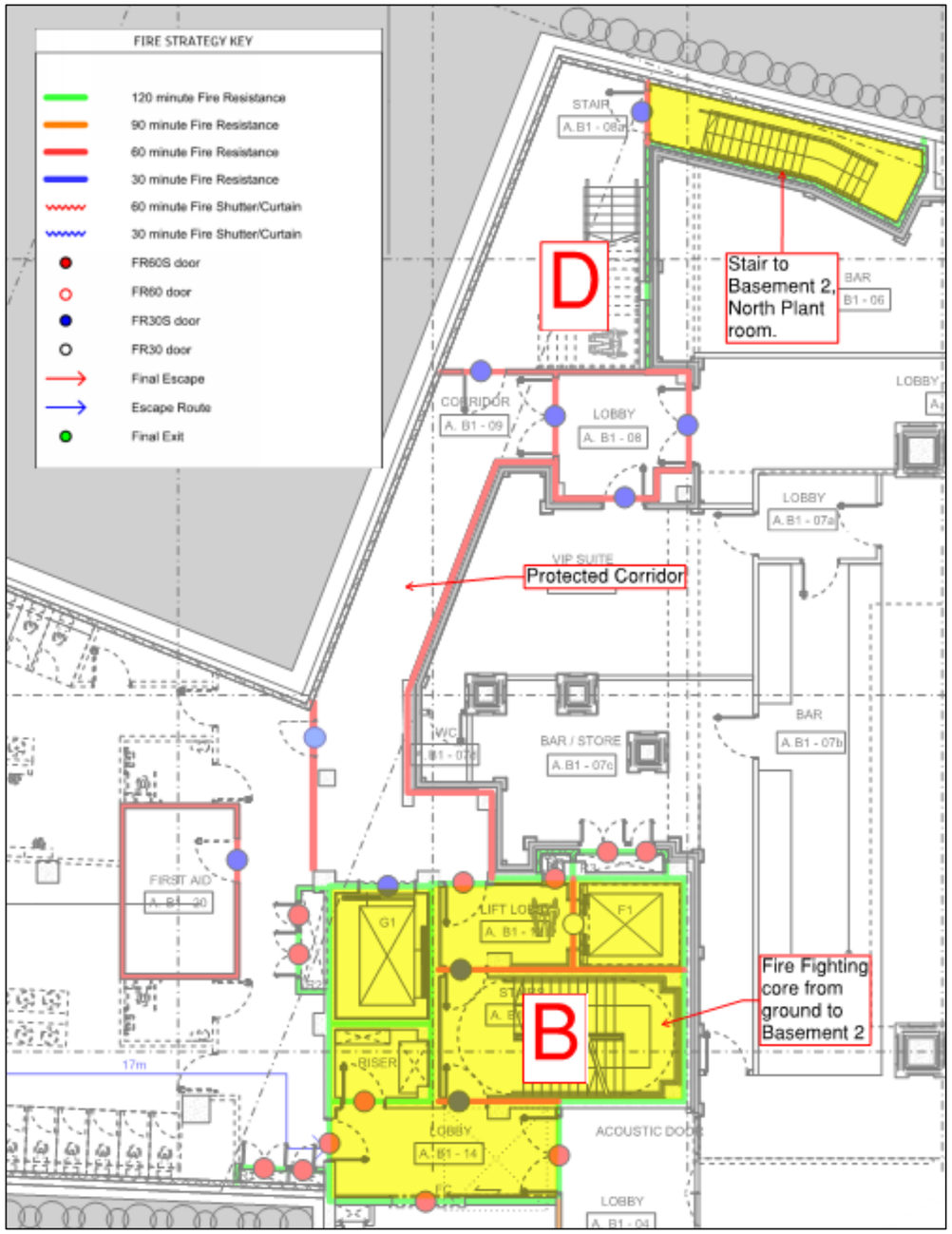


Figure 4—5: Firefighting core and connections (basement 1)

5 Building A

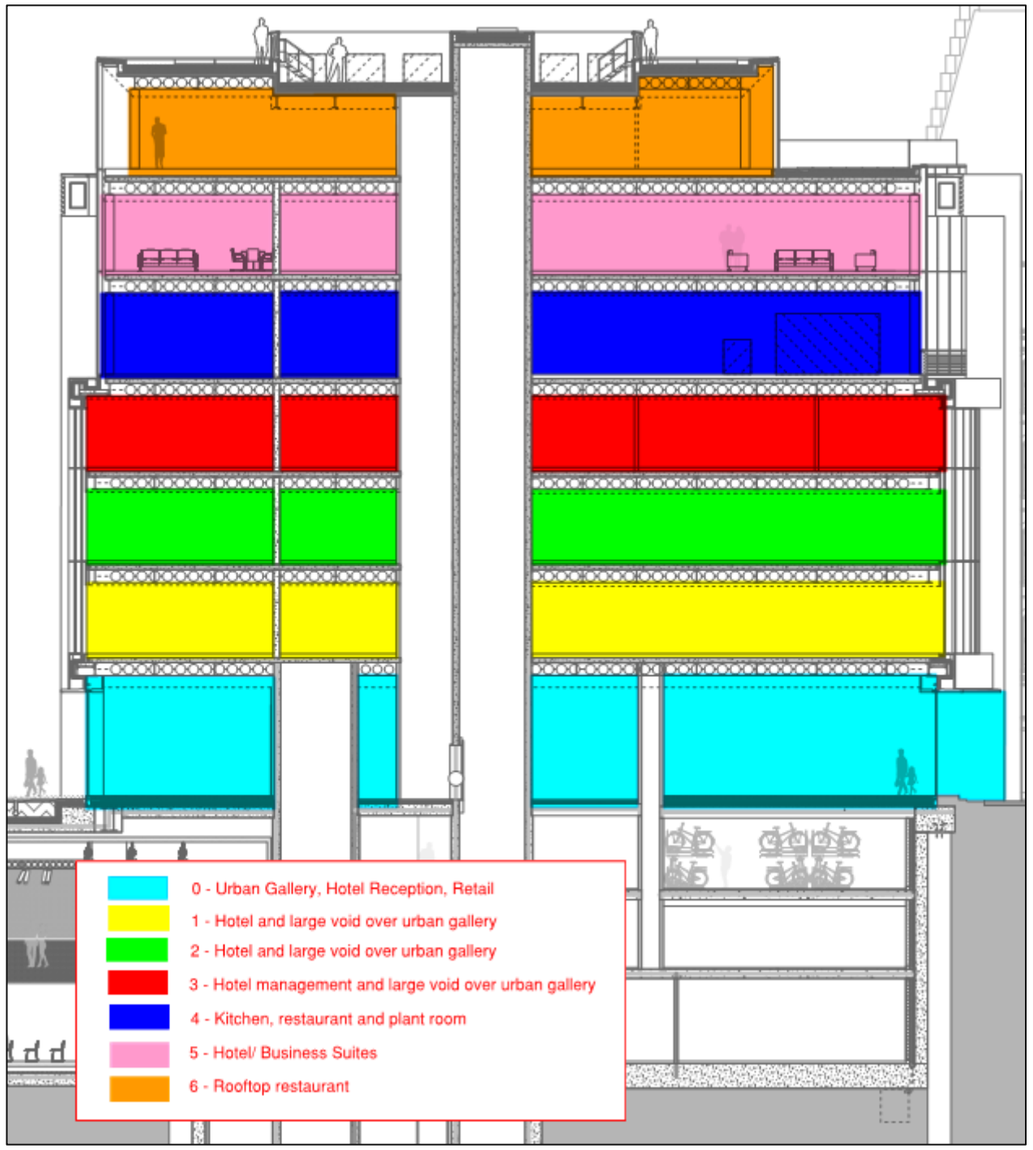
5.1 Introduction

Building A is a new construction that consists of ground floor, up to level 6. The top most occupied floor is 25.3m above the firefighting access level, hence, a firefighting core has been provided. The main features of the building include an external, triple-height space at ground floor which is available for public use (urban gallery) and a rooftop restaurant.

The land uses within the building are outlined below:

Level	Land Use(s)	Occupancy / Density
6	Rooftop restaurant	200 covers
5	Hotel/Business suites (tbc)	5m^2/person
4	Kitchen serving restaurant plant room Management Offices/staff room	7m^2/p 30m^2/p 5m^2/p
3	Hotel management and large void over urban gallery	5m^2/person
2	Hotel and large void over urban gallery	2p/room
1	Hotel and large void over urban gallery	2p/room
0	Urban Gallery, hotel reception, retail	Varies

Table 5—1: Building A Land Uses



`Figure 5—1 Building A Section

5.2 Means of Escape

The ground floor of building A is dominated by the urban gallery, a semi-external triple height space which is open along the north, east, and west sides. It is noted that should this area be closed (louvers at upper levels, shutters at lower levels), then sufficient door capacity will be included in the façade for anticipated occupancies.

Note: On the drawings currently two doors are shown and therefore the occupancy allowed would be 545 people.

The remainder of the ground floor comprises of the hotel lobby and two small retail units, which have independent means of escape and no concerns regarding travel distances. The retail units will also have openable shutters which will allow greater permeability for patrons. These shutters will be linked to the fire alarm and will default closed, whilst egress will be via fixed doors in the façade.

The detection and alarm system shall operate on a 'double knock' principle whereby an investigation delay period will be incorporated when the warning of a fire is from a single automatic smoke detector. During the investigation period staff will be able to cancel the warning so that an evacuation signal is not given. The length of this delay is proposed to be 3 minutes to allow the person investigating the alarm to reach its source.

The system shall be put into full alert if:

- The alarm is confirmed as a real fire by the person investigating; or
- The alarm is not cancelled during the investigation period; or
- If a second detector is activated; or
- If a manual call point is activated.

There is a link-bridge proposed between building A and B at level 4, however this is not used in means of escape calculations as each building will operate independently and means of escape from one is not reliant on the other. There will be fire doors (FD60S) on the link bridge separating the two buildings.

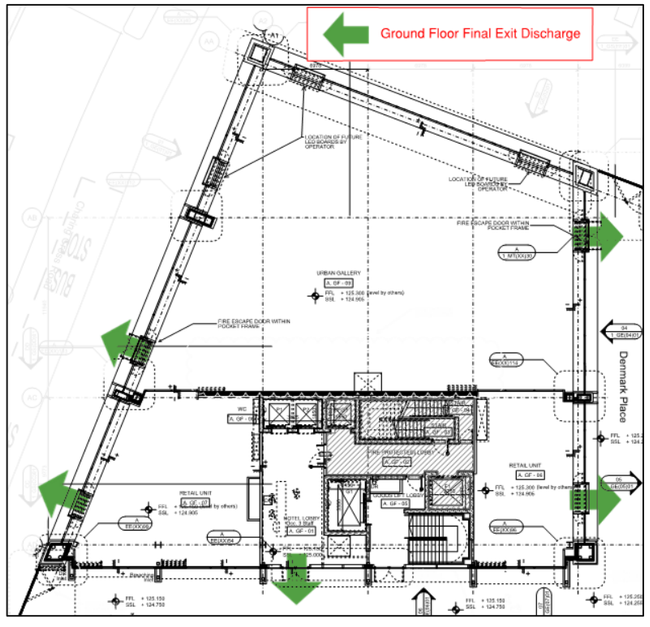


Figure 5—2: Ground Floor Layout

5.2.1 Occupant Capacity - Vertical

The building is served by a single stair core. The stair is lobbied at all levels and also a fire fighting stair and hence ventilation is provided at all levels to the lobbies.

The building has been designed to allow simultaneous evacuation of all floors. Based on a worst-case of either A1 or B1 for the building (including reduction due to sprinklers), a six-storey stair would operate at 2.1mm/person (1.785mm/p including AFD). The single 1.2m stair therefore provides capacity for 672 people.

The stairs are sized to allow a simultaneous evacuation, based on the calculated occupancies (see the following):

Level	Area (m^2, unless otherwise stated))	Usage	Floor Space Factor (m^2/ person, unless otherwise stated)	Occupants
6	N/A	Rooftop restaurant	N/A	281 (including staff)
5	450	Conference space	6.0	75
4	63	Kitchen serving restaurant	7.0	9
	210	plant room	30.0	7
	275	Management Offices/staff room	5.0	55
3	160	Hotel management and large void over urban gallery	5.0	32
2	7 rooms	Hotel and large void over urban gallery	2p/room	14
1	7 rooms	Hotel and large void over urban gallery	2p/room	14
			Total Occupant Load – Not including level 00	**487**

Total Occupant Load for Building = 487 people

This is significantly less than the capacity of the stair core (672 people) and provides sufficient flexibility for alternate uses. This includes potential additional restaurant space at level 4 linked to Building B via a foot bridge.

5.2.2 Hotel Floors (Levels 1&2)

Floors 1 & 2 are Hotel floors and have an occupancy of less than 60 people. Therefore one exit into the stair is adequate. The hotel is to be provided as shell and core, although an indicative layout has been provided for coordination purposes. The provisional layout has a protected corridor running through the middle serving all rooms and the stair core. As such single direction travel distances only occur within the rooms. Within the Hotel, travel distances after fit out should be no more than 9m from within the room to the protected corridor, and within 9m from the bedroom door to the protected lobby, as required under the provisions set out in Approved Document B.

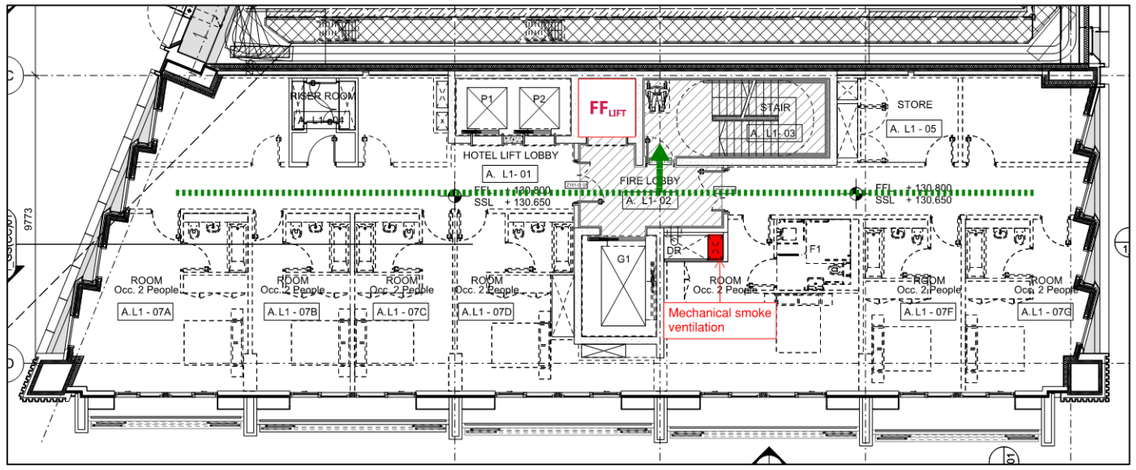


Figure 5—3: Indicative hotel layout (level 1 & 2)

5.2.3 Hotel Ancillary Areas (Level 3)

At level 3 there are single direction travel distances to the west of the stair lobby. These distances are approximately 18m. This area will house offices ancillary to the hotel, these offices have a B2 profile, reduced to B1 due to sprinkler provision. This allows single direction travel distances of 24m, extendable to 27.6m with the provision of AFD. Travel distances are therefore within limits and compliant.

5.2.4 Kitchen and Back of House (Level 4)

At level 4, single direction travel distances exist in the kitchen/back of house and plant areas. The plant room is a B3 risk profile reducible to B2 with sprinkler provision. This allows single direction travel distances of 20m, extendable to 23m with provision of AFD. Travel distances are within allowable limits. The kitchen/back of house area has a mixture of A3 and B2 risk profile (based on BS9999), reducible to A2/B1 due to sprinkler provision. The longest travel distances are in the B1 area, which has a recommended maximum travel distance of 24m, extendable to 27.6m with AFD. All travel distances are compliant.

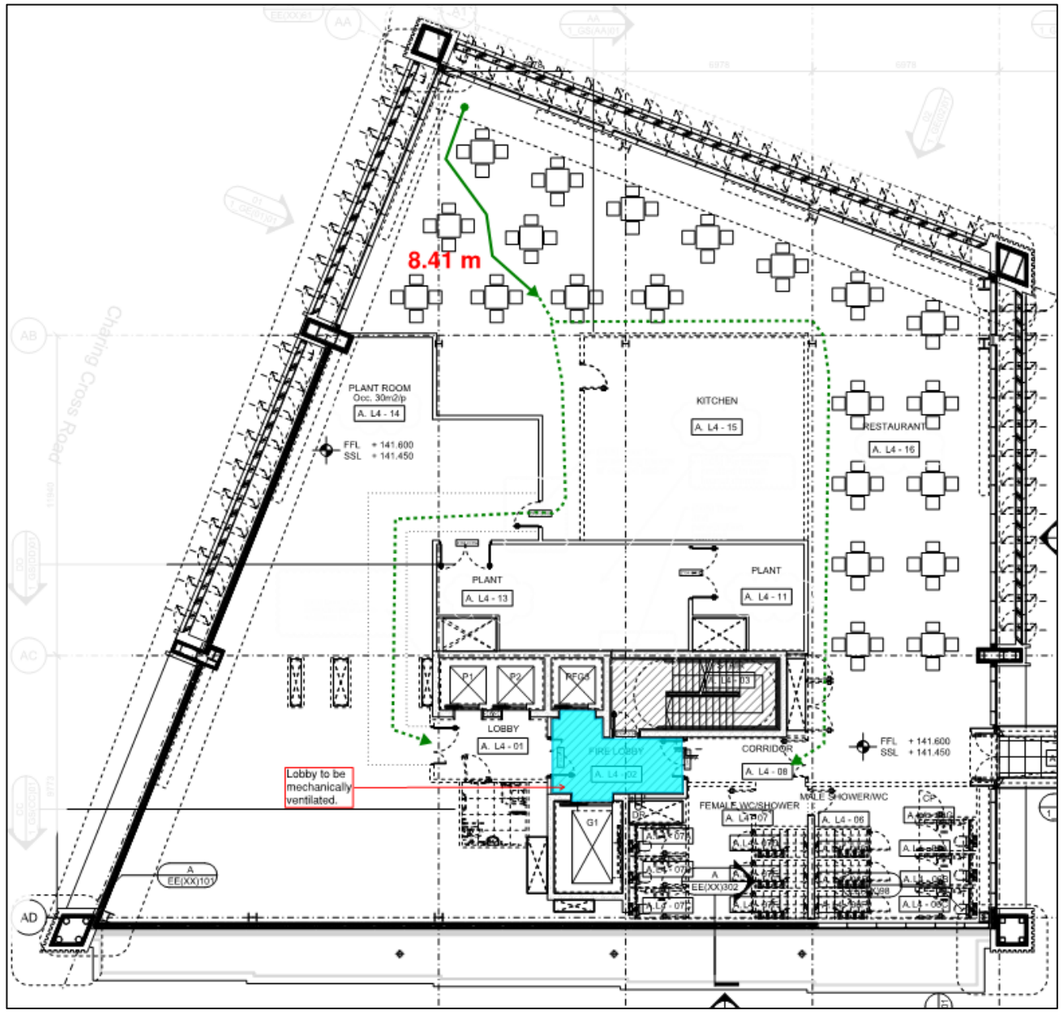


Figure 5—4: Travel Distances at Level 4

Note: This revision of the drawings show the secondary means of escape through the plant room, the secondary escape route through the plant room will need to be provide with a 60 minute fire protected corridor.

5.2.5 Conference Rooms (Level 5)

Floor 5 has an occupancy of greater than 60 people. As such, two separate routes have been provided into the stair core, via a protected lobby, such that a choice of routes is available and both stir entrances cannot be compromised simultaneously. As each room is served by inward opening doors, the occupancy of each room is limited to 60 people, this is true for the rooms provided with two exits as both doors are inward opening. In practice a shell and core will be provided until an operator is brought on board to confirm the internal fit out. As such, the internal walls won't be provided at this stage, but a lobby will be provided to protect the stair core.

At level 5, there are single direction travel distances within the conference rooms, although larger areas have two doors hence a choice of routes available once occupants reach this point. These areas are classed as category B2, reduced to B1 due to sprinkler provision as with level 3. All single direction travel distances are under 13m which is within allowable limits.

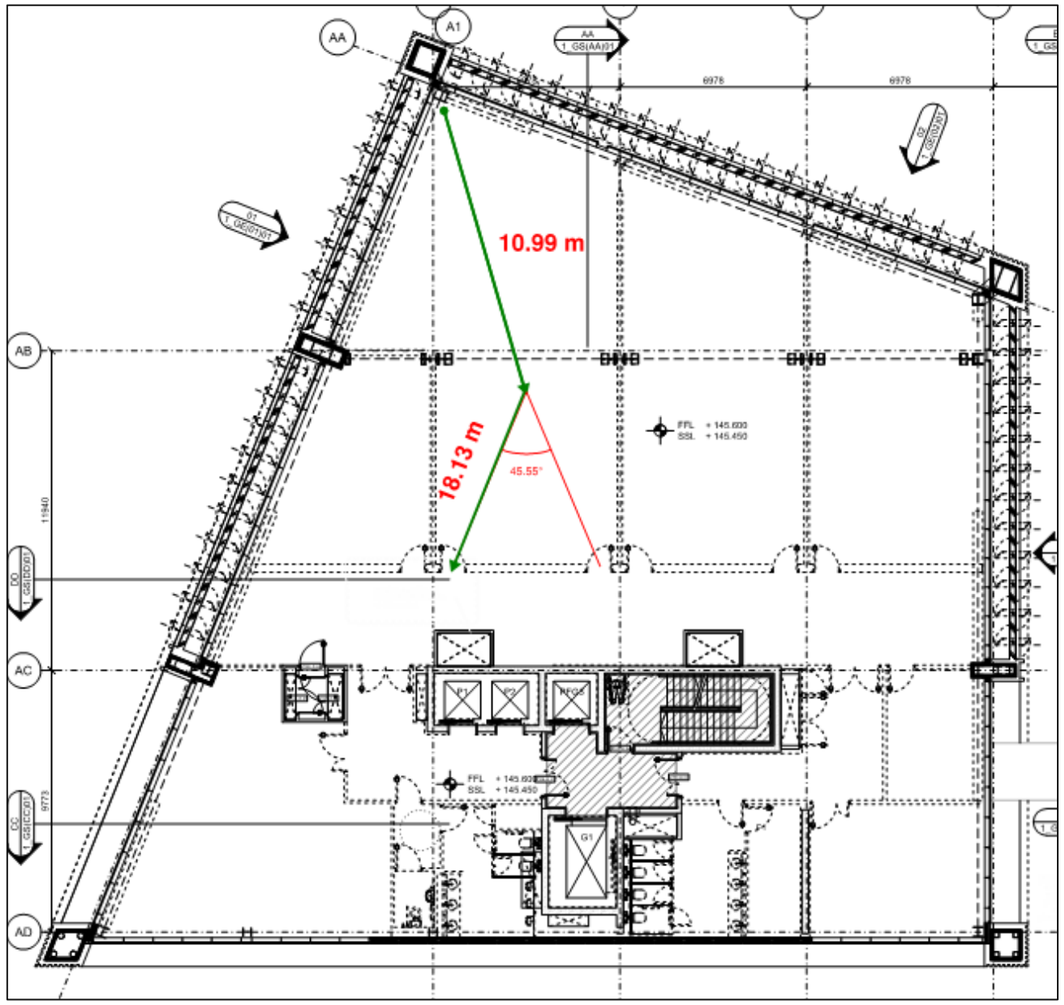


Figure 5—5: Travel Distances at Level 5

5.2.6 Restaurant (Level 6)

Level 6 is also predicted to have more than 60 people , hence two storey exits have been provided. The limiting storey exit at level 6 after discounting the largest is 850mm wide, which for a B1 profile with AFD operate at 3.06mm/person. This means the level 6 storey exit will have the capacity for 277 people. In practice a shell and core will be provided until an operator is brought on board to confirm the internal fit out. As such, the entire protected corridor won't be provided at this stage, but a lobby will be provided to protect the stair core. This lobby can be converted to a full protected core at a later point if required. The lobby will be mechanically vented to protected the stair, which is also a fire fighting core.

At level 6, a choice of routes is available for the majority of the floor plan with small areas in the corners which have a single-direction of travel only. These areas are limited to 27.6m, based on the B1 risk profile and provision of AFD. The longest single direction travel distance is about 3m which is within the recommended limits. All multi-direction travel distance are comfortably within limits.

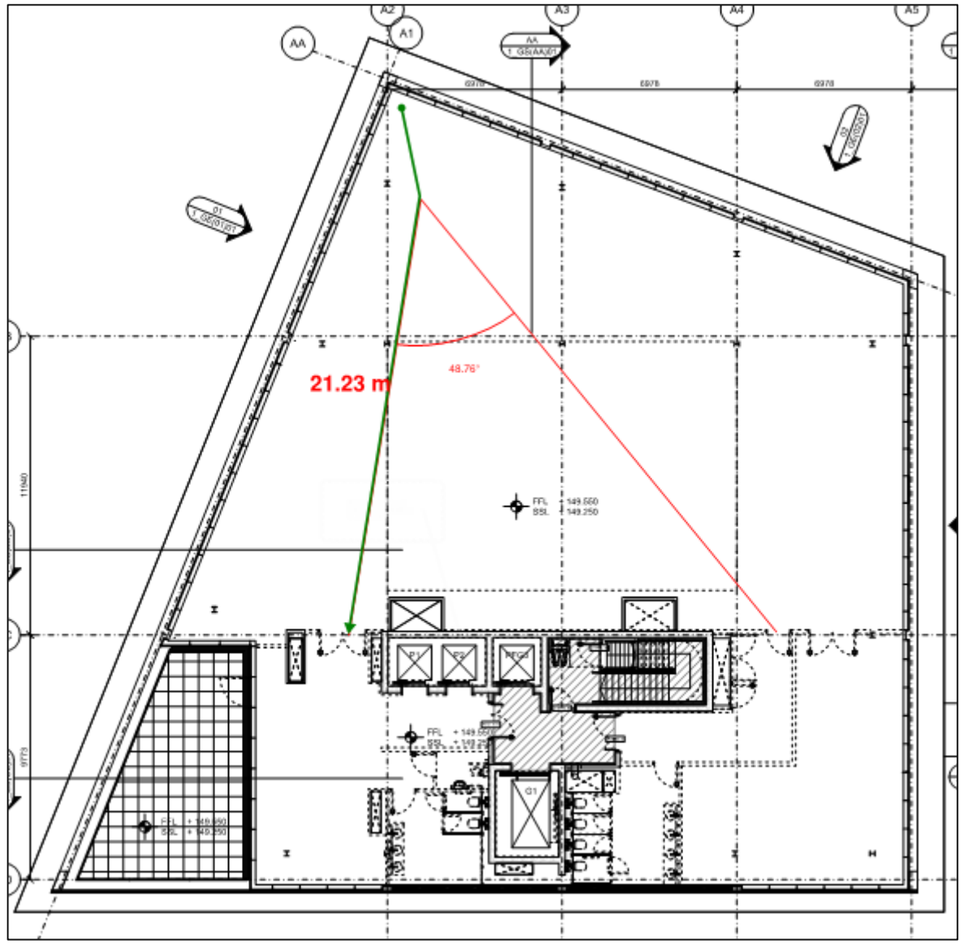


Figure 5—6: Travel Distances at Level 6 Restaurant

5.2.7 Disabled Occupants

Disabled refuges are proposed within the lobbies/protected corridors at each level. Communication devices will be required at these points to allow the occupants to contact the 24/7 concierge, sited in the hotel lobby, if they required assistance.

5.3 Structural Fire Resistance

The following are the structural fire resistance requirements for the St Giles Circus redevelopment:

- Basement and above ground levels will be separated by **90 minutes** fire resistance (based on an ordinary hazard assembly space) as discussed and agreed with MLM Building Control.
- The primary structural frame will require a **90 minute** fire rating based on BS9999

5.4 Compartmentation

The following table summarises the requirements for compartmentation. For further information please see Orms Architects Fire Strategy Drawings.

Compartmentation	Required Period of Fire Resistance (min)
Compartment Floors	90 (REI)
Compartment walls separating hotel rooms from common corridors	60 (REI)
Service riser enclosures	90 (RE)
Firefighting cores (in buildings >18m)	120 (REI)
Enclosure to storage/refuse rooms	30 (EI)
Enclosure to plant rooms	30 (EI)

Table 5—2 Building A Compartmentation

R – Load bearing, E – Integrity, I - Insulation

It has been proposed not to provide fire rating between the ground floor retail units and the urban gallery. Both of these spaces will be evacuating simultaneously and a spread of fire between the two spaces is not considered a concern. The urban gallery is a triple height space that will be largely sterile, particularly around the retail entrance, so the chance of a fire occurring close enough to the retail unit to spread fire is minimal. Similarly smoke will be filling the reservoir above so spill into the retail unit will be minimal is any. A retail fire near the urban gallery door will have no adjacent fire load to spread to. Any smoke will also rise to fill the smoke reservoir in the urban gallery, thereby not causing any concerns for evacuation.

5.5 Active Fire Fighting Systems

5.5.1 Automatic Fire Detection

Based on BS 9999 Table 8, the minimum level of detection required is building A is an L2 alarm system with individual detection in each of the hotel rooms. The building will have an enhanced automatic detection system throughout, to an L2 standard, in line with section 19.2 of BS9999. Systems will be designed according to BS 5839-1 2013.

In addition to the automatic detection, manual call points will be installed in the building.

5.5.2 Sprinklers

Building A will be sprinkler protected throughout (except for the urban gallery), with the sprinkler tank being located at basement -2 level. This sprinkler tank also serves buildings B, C and D sprinkler systems. This system will be designed to BS EN 12845.

5.5.3 Smoke Control

The firefighting core serving floors 1 to 6 will be vented mechanically. The fire fighting lobbies are to be mechanically ventilated to provide equivalent of the natural BRE shaft solution. As the stairs are approached by two lobbies a solution is proposed using compartmentation so that the two lobbies never open into one fire compartment, therefore the system will protect one lobby in the event of a fire. The design of the mechanically ventilated shaft is to achieve the equivalent ventilation rate of the 3.0m^2 BRE shaft (for commercial buildings) as outlined in BRE 79204

The detailed design of the mechanically assisted system will need to be carried out by a specialist supplier; however some guidance on the design of the system is given below based on best practice:

- The shaft sizes will be approximately 0.6m^2 in plan (geometric free) area.
- The aspect ratio of the shaft will be no greater than 2:1
- The shafts will terminate at roof level with a fan at the head of each. The extract/inlet fans set will comprise of duty and standby fans. The extract rate will be confirmed by the supplier of the system.
- A vent will be provided into the shafts from each lobby at each storey. The size of the vents will be confirmed by the suppler but are typically in the range of 0.6 – 0.8m^2 (geometric area)..

5.5.4 Firefighting Shafts

As building A is over 18m in height to the top occupied floor from fire service access level, firefighting access will be provided internally via a firefighting shaft.

The firefighting shaft will conform to the following:

- Have a firefighting stair (1200mm wide) firefighting lift designed in accordance with BS EN 81-72 and BS EN 81-1 or-2;
- Be enclosed in 120 minute fire rated construction;
- Have a 25mm flood lip, plus 600 cube dry sump at the base; and
- Dry riser outlets should be contained in the stair enclosure.

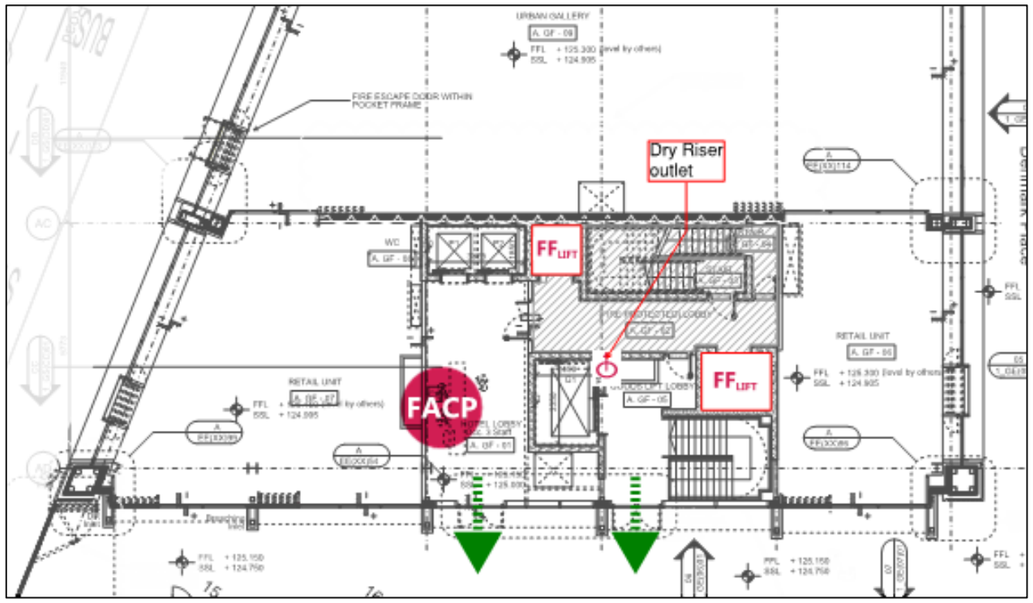


Figure 5—7: Ground Floor Fire Core Access

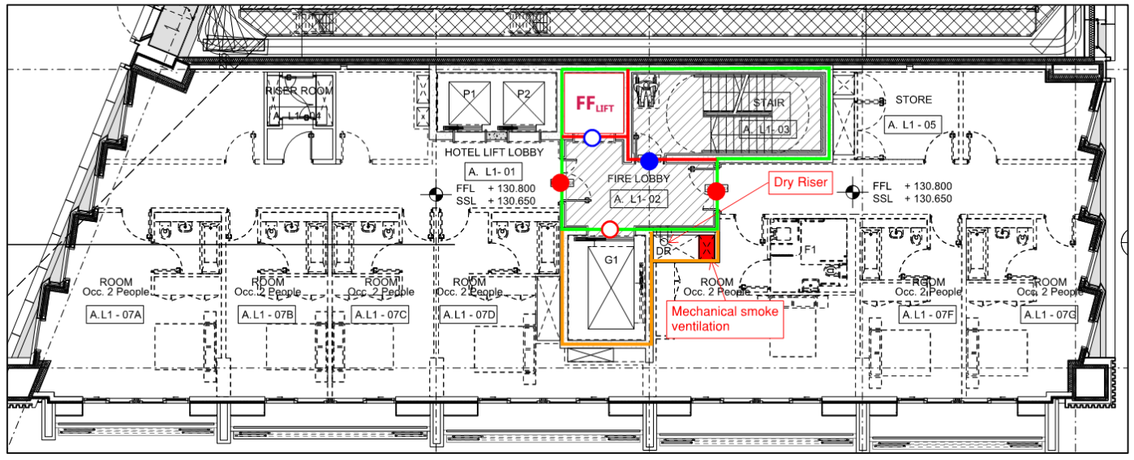


Figure 5—8: First Floor Fire Core Access

The fire core for Building A upper floors is accessed via the hotel lobby or via the fire lobby to the basement fire core. The hotel lobby is also the where the 24/7 concierge will be sided along with the main fire alarm panel. The fire lift is also accessed from this lobby. The fire core for the auditorium is adjacent to this and is accessed directly from outside.

6 Building B

6.1 Introduction

Building B is a new building that consists of ground floor up to level 4 above ground. The land uses within the building are outlined in Table. The height of this building, from Fire Brigade access level to the top most occupied floor, is 17.30m.

Level	Land Use(s)	Occupancy/Density
4	Rooftop Bar	140 people (target occupancy)
3	Office	5m^2/person
2	Office	5m^2/person
1	Restaurant/Kitchen	60 people (single storey exit limits)
0	Restaurant	1m^2/person

Table 6—1: Building B Land Uses

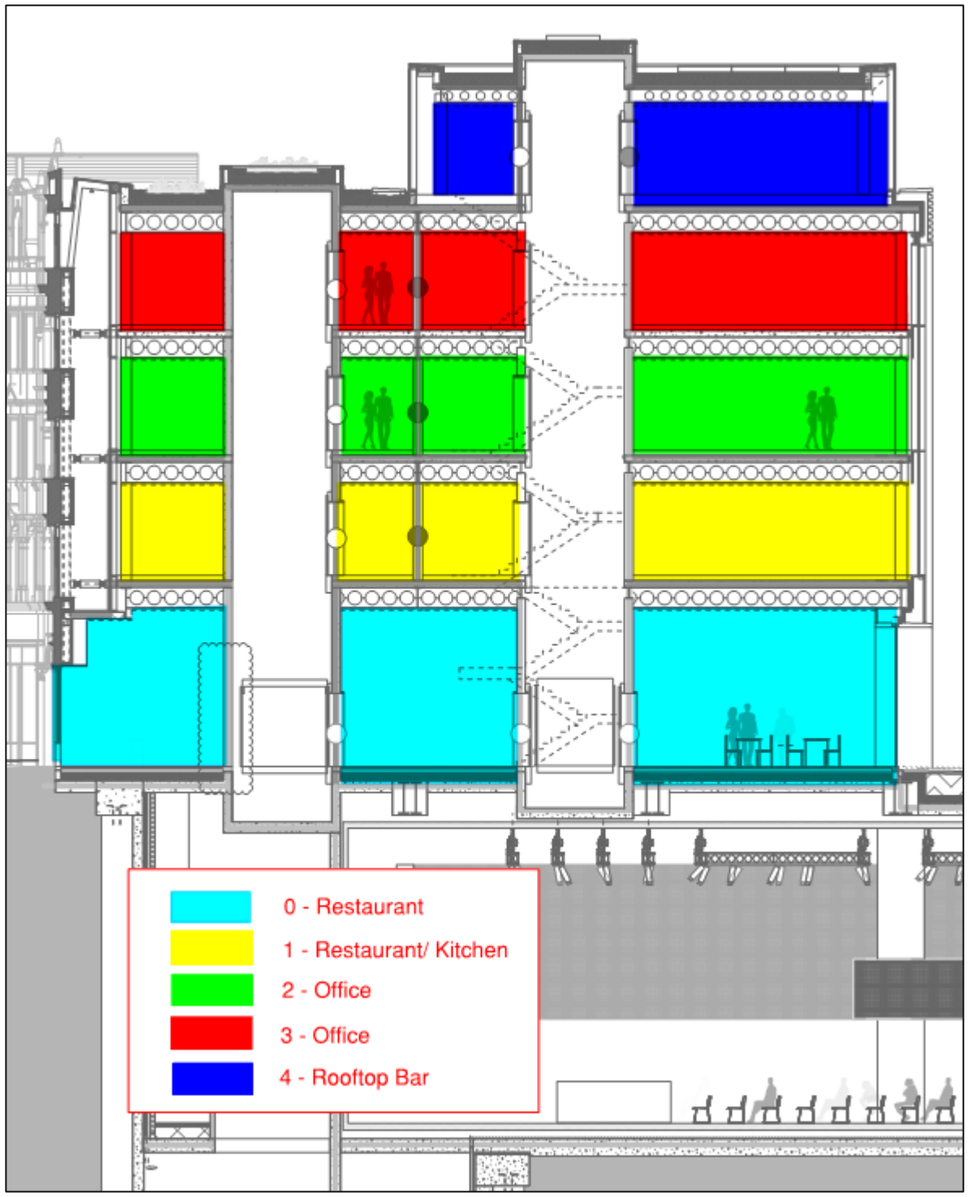


Figure 6—1 Building B Section

6.2 Means of Escape

The building has been designed to allow simultaneous evacuation of all occupants. There is a link-bridge proposed between building A and B at level 4, however, this is not required for means of escape, and therefore has not been considered in the calculation. Each building has been considered independently. As such, this link will have fire doors (FD60S) separating the buildings, such that a fire in one building cannot spread to the next. Management should ensure that occupants with the bar evacuate using the stair core only.

6.2.1 Ground

The ground floor is café/restaurant and has egress doors around the perimeter. In addition, when the building is in operation the building shutters will be open allowing two sides to be fully permeable. Based on floor space factors the capacity is approximately 380 people, which is served by 6 doors in the perimeter, this is considered sufficient.

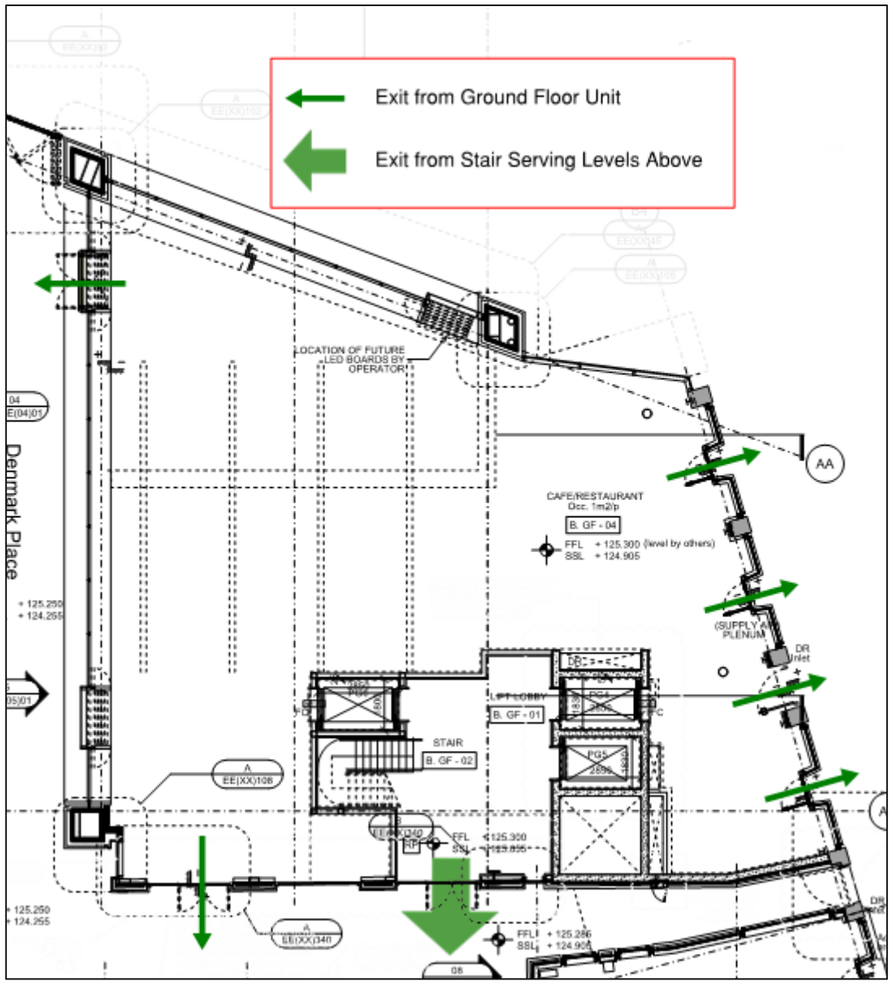


Figure 6—2: Ground Floor Final Exits

6.2.2 Level 1

Al level 1, one-way travel distance is around 21m. For a B2 profile (reduced to B1), the maximum allowable travel distance is 24m, extended to 27.6m due to AFD. Therefore travel distances in this area are compliant, it should be ensure that this is the case after fit-out.

- Restaurant (B2 reduced to B1 with sprinklers).

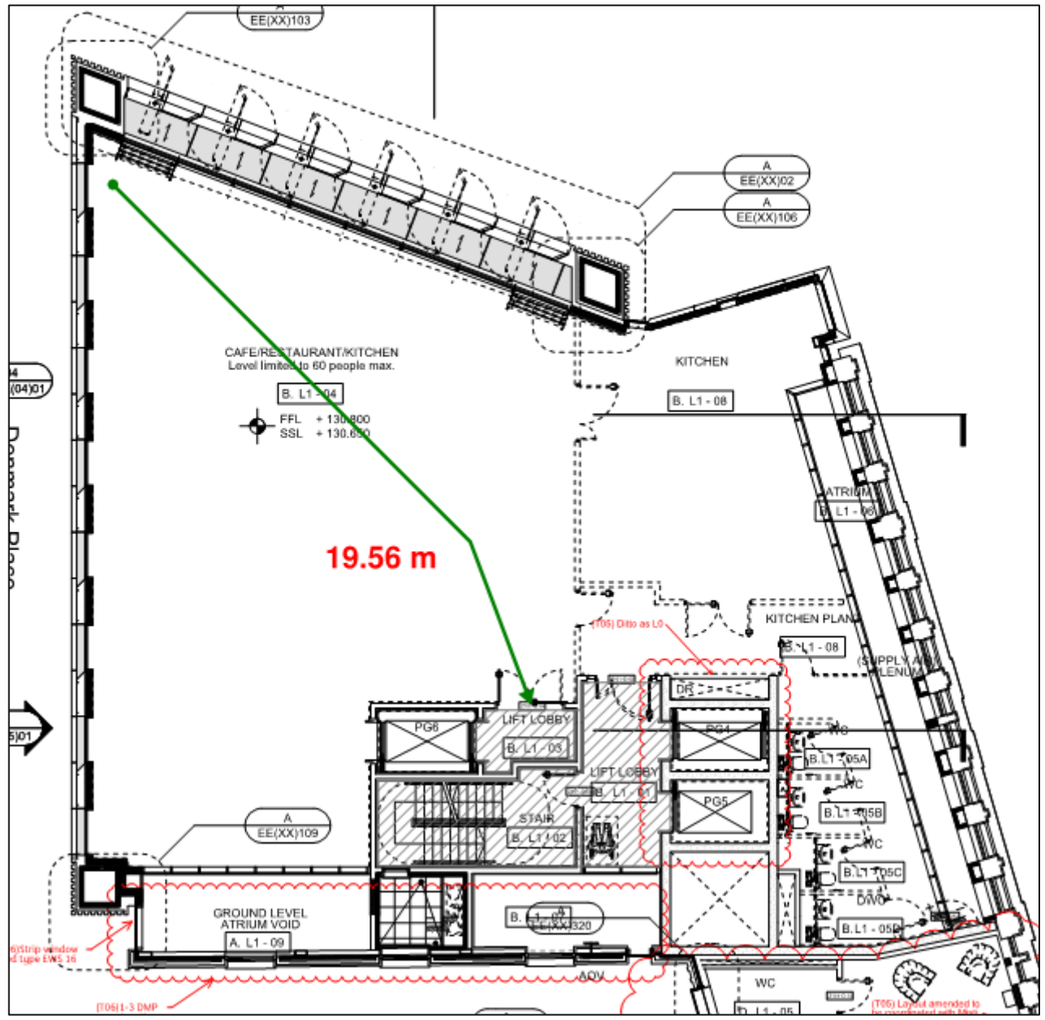


Figure 6—3: Level 1 Maximum Travel Distance

6.2.3 Level 2 & 3

There are no significant one-way travel distances in the offices and all two-way travel distances are within the limit of 69m (60m for B1 plus AFD). Therefore the travel distances in this area are also compliant.

- Office (B2, reduced to B1 with sprinklers)

Horizontal

- Width (door) – 850mm (discounting the largest, as per BS 9999)

- Occupant Factor - 3.6mm/person reduced to 2.7mm/person through enhanced detection and alarm and high ceilings (reduction of 25%)

- Capacity = 314 people

Therefore this is in excess of the occupancy at this level, so sufficient capacity is available.

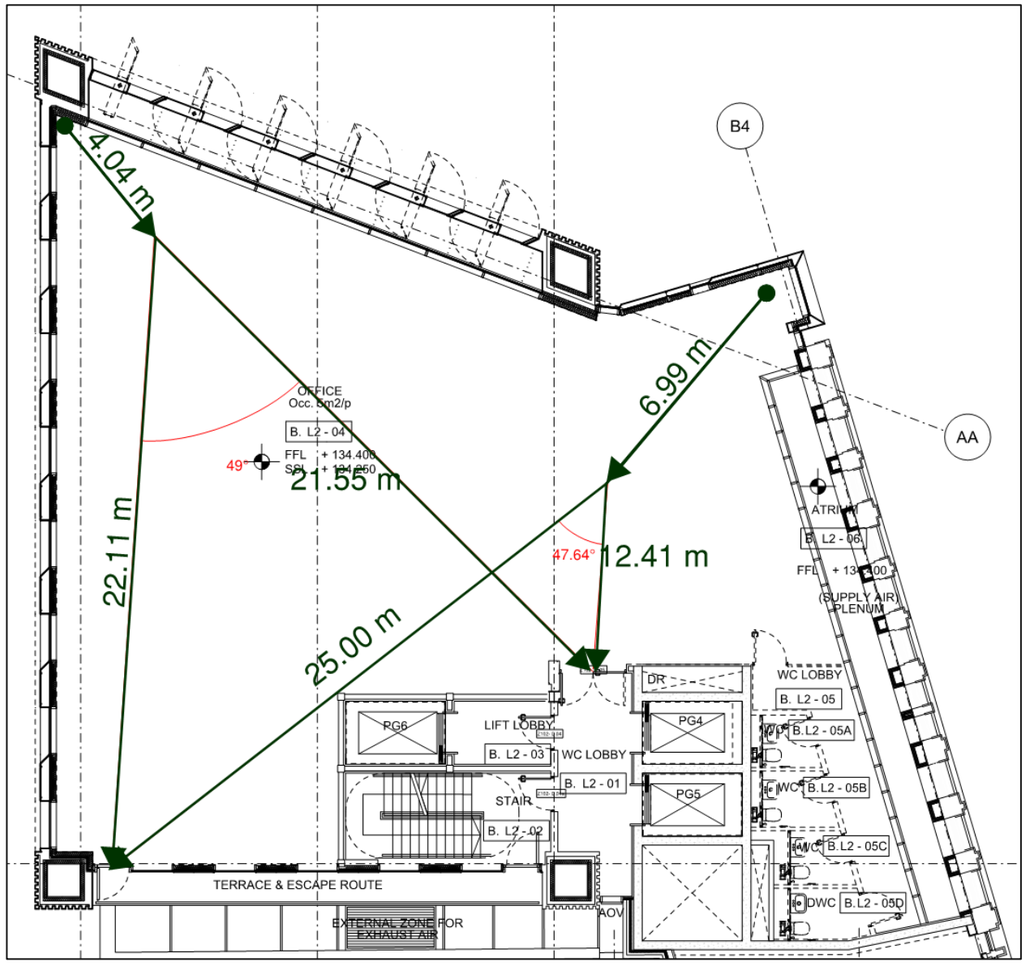


Figure 6—4: Level 2 multiple egress routes

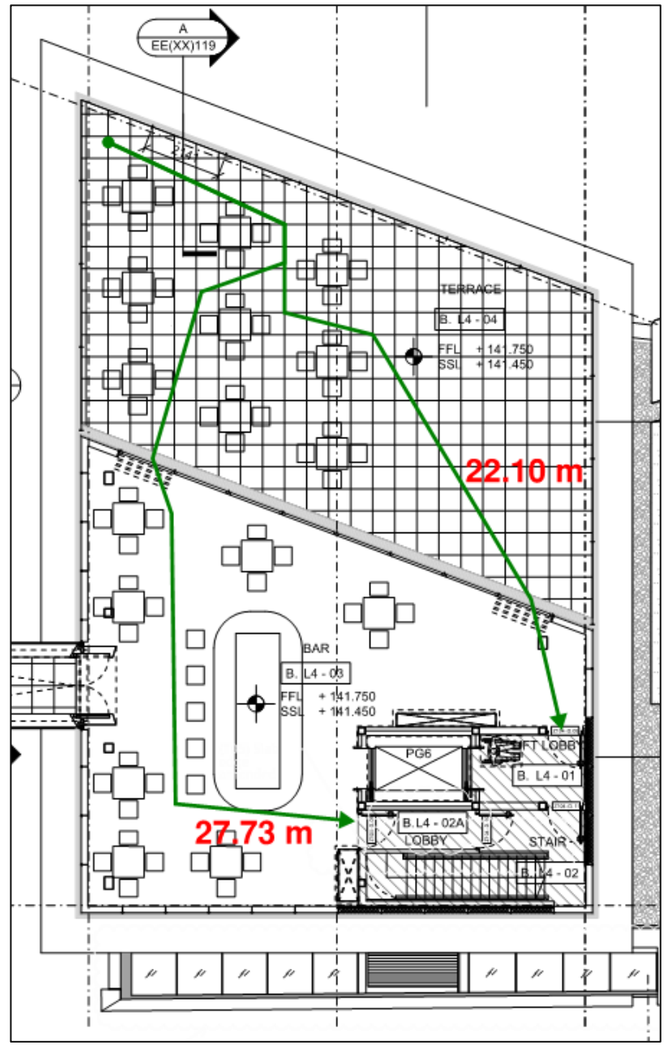


Figure 6—5 Level 4 Rooftop Bar- Egress Routes

6.2.4 Level 4

The rooftop bar is served by two storey exits and has a target capacity of 140 people including staff.

6.2.5 Vertical

The building is served by a single stair core. The stair is lobbied at all levels and ventilated by AOV's. The stairs are sized to allow a simultaneous evacuation, based on the calculated occupancies (see the following table):

Level	Area	Usage	Floor Space Factor (m2/ person)	Occupants
4	N/A	Rooftop Bar	N/A	140 people (target occupancy)
3	160	Office	5.0	32
2	315	Office	5.0	63
1	N/A	Restaurant Kitchen	N/A	60 people (single storey exit limits)
			Total Occupant Load – Not including level 00	**295**

Total Occupant Load = 215 (worst case assumptions)

Stair Capacity

- Width = 1100mm (B2 profile, reduced to B1 with sprinklers)

- Occupant Factor - 2.6mm/person, reduced to 2.21mm/person (AFD, as per BS 9999).

- Occupant Load = 497 people

Therefore there is sufficient capacity within the stairs to accommodate all occupants on the upper floors.

6.2.6 Disabled Occupants

Disabled refuges are proposed within the lobbies/protected corridors at each level. Communication devices will be required at these points to allow the occupants to contact the 24/7 concierge if they required assistance.

6.2.7 Structural Fire Resistance

The following are the structural fire resistance requirements for the St Giles Circus redevelopment:

- Basement and above ground levels will be separated by **90 minutes** fire resistance (based on an ordinary hazard assembly space) as discussed and agreed with MLM Building Control.
- The primary structural frame above ground will require a **60 minute** fire rating based on BS 9999.

6.2.8 Compartmentation

The following table summarises the requirements for compartmentation:

Compartmentation	Required Period of Fire Resistance (min)
Compartment Floors (between different occupancies)	60 (REI) Between the basement and the levels above ground - 90 (REI)
Service riser enclosures	60 (REI)
Firefighting cores (in buildings >18m)	120 (REI)
Enclosure to storage/refuse rooms	30 (EI)
Enclosure to plant rooms	30 (EI)

Table 6—2 Building B Compartmentation

R – Load bearing, E – Integrity, I – Insulation

Please refer to Orms Architects Fire Strategy Drawings for further detail.

6.3 Active Fire Fighting Systems

6.3.1 Automatic Fire Detection

Based on BS 9999 Table 8, the minimum level of detection required in building B is a Manual alarm system (based on A2/B1 risk profiles throughout). The building will an enhanced automatic detection system throughout, to an L2 standard, in line with section 19.2 of BS 9999. Systems will be designed according to BS 5839-1 2013.

In addition to the automatic detection, manual call points will be installed in the building.

6.3.2 Sprinklers

Building B will be sprinkler protected throughout, with the sprinkler tank being location at basement -2 level. This sprinkler tank also serves buildings A, C and D sprinkler systems. This system will be designed to BS EN 12845.

6.3.3 Smoke Control - Stairs

The firefighting core serving floors 1 to 4 will be using 1.5 m^2 AOVs in the external wall at each floor, as shown in Figure 6—6.

6.3.4 Firefighting Stair

As Building B contains assembly uses above 7.5m height, it is proposed to provide internal firefighting access via a firefighting stair. The firefighting stair should be 1200mm wide, enclosed in 120 minute fire rated construction. Within the fire fighting lobby there will be a dry riser outlet. The lobby will be ventilated by a 1.5m^2 AOV and a 1.0m^2 AOV will also be provided to the head of stair. See Figure 6—5:

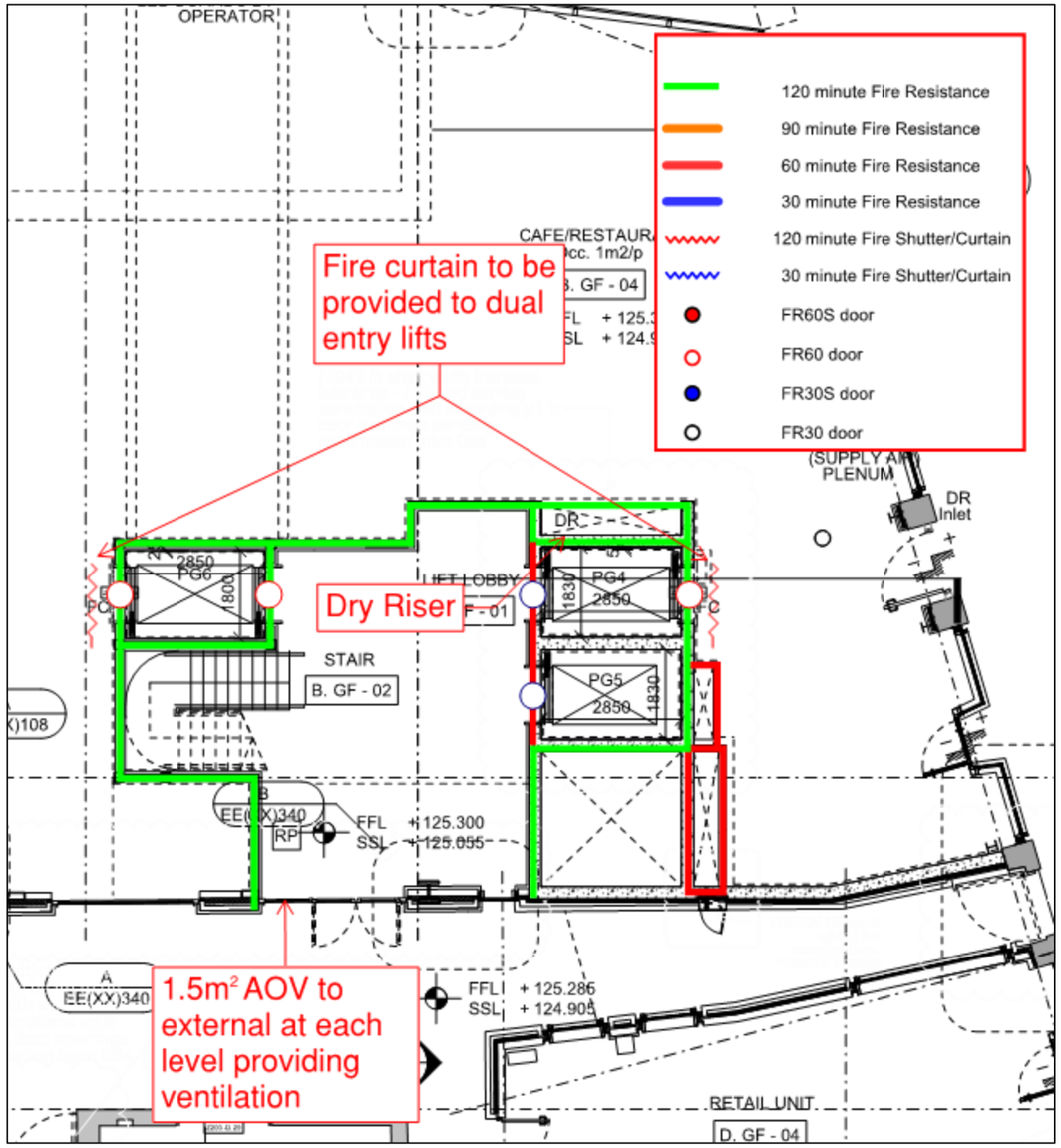


Figure 6—6: Fire core access at ground level

The firefighting stair will be accessed via a lobby from Denmark Place. This lobby will be a sterile space with only non-combustible furniture.

Lifts PG4 and PG6 are duel entry at ground floor level, and open directly into the accommodation, as such, a 120 minute fire curtain will be provided to each lift., This has been agreed in principle with MLM.

7 Building C and North of Denmark Street

7.1 Introduction

Building C is a new building that consists of ground floor up to level 4 above ground, that will be linked to the existing residential and shops to the North of Denmark Street, which are to be re-furbished. The height from Fire Brigade access level to the top most occupied floor is 17.70m.

The land uses within the building are outlined below in Table 7-1:

Level	Land Use(s)	Occupancy/Density
4	Rooftop Plant area	30m^2/person
3	Office	5m^2/person
2	Office	5m^2/person
1	Office	5m^2/person
0	Auditorium Foyer, Office Foyer	n/a

Table 7—1: Building C Land Uses

The refurbishment works to the north of Denmark Street cover a number of properties and include three-level retail units at basement/ground/first floor, offices at second floor and residential from 3rd to 5th floors. The height from Fire Brigade access level to the top most occupied floor is 16.60m, this is the height of the tallest building in North Denmark Street.

Level	Land Use(s)	Occupancy
5	Terrace	limited access
4	Residential	2p/bedroom
3	Residential	2p/bedroom
2	Office/Residential	limited to 60 people or 2p/bedroom
1	Upper floor retail	limited to 60 people
0	Retail	limited to 60 people
-1	Lower Floor Retail	limited to 60 people

Table 7—2: North of Denmark Street Land Uses

It is not intended to upgrade the existing portions of the building to meet the recommendations in current guidance documents. However, it is proposed that the new works will improve the safety of occupants within the building when complete.

Figure 7—1 Building C Section

7.2 Means of Escape

7.2.1 Office

It is proposed that the offices in Building C will evacuate simultaneously. The ground floor of Building C is located next to the main entrance to the auditorium and at ground there is just an entrance lobby.

Building C is served by a main stair core of 1.2m wide, which is lobbied at every level and the two existing stairs that also serve the residential above. This stair is located to the north of the building such that the entire office is in a dead end position. The longest travel distance is approximately 18m across the office to the protected lobby. A B2 profile allows one-way travel distances of 20m. It is noted that pre-fit out only 2/3 of this travel distance should be considered.

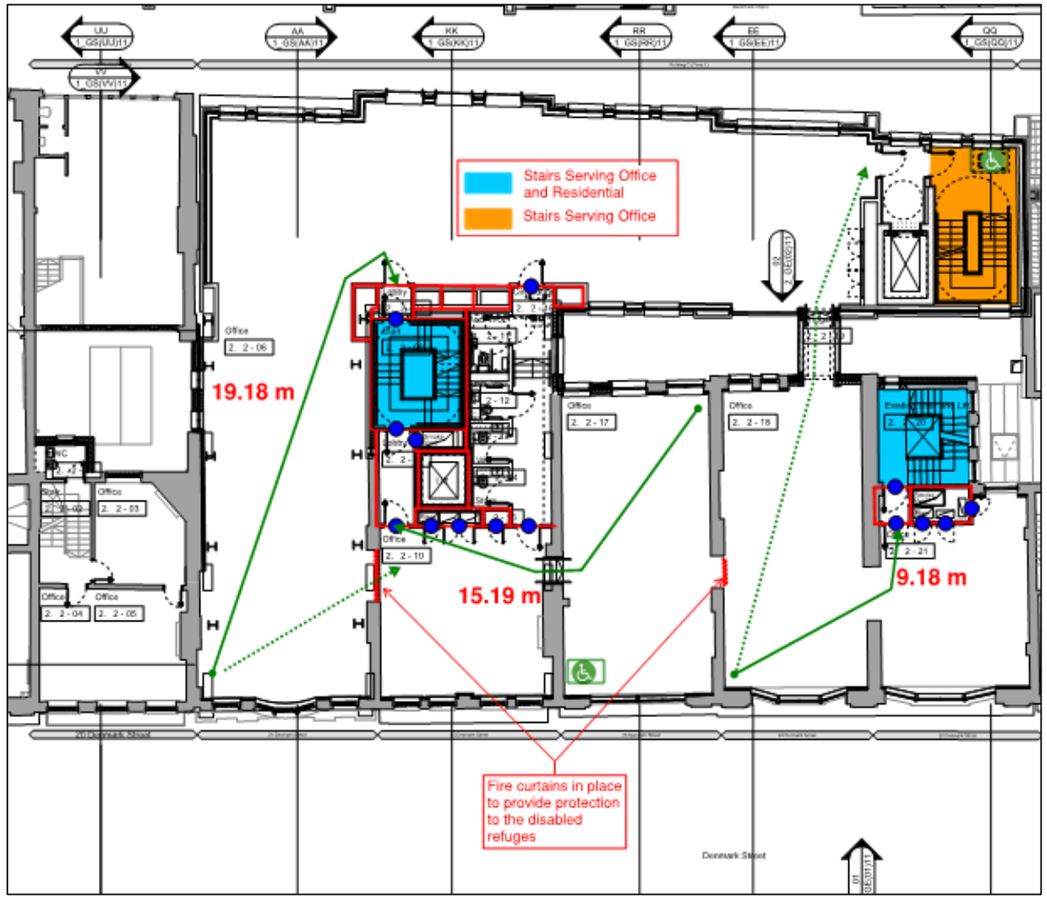


Figure 7—2: Level 02 Egress Routes

Level	Area (m2)	Floor Space Factor (m2/person)	Occupants
2	482	5.0	97
		Total Occupant Load	**97**

Table 7—3 Office Occupancy

A 3-storey stair for a B2 risk profile allows a total occupancy for the three office floors of 352 people (3.4mm/per person). The total occupancy of the building based on worst case assumptions is 97 people, which is comfortably within the storey capacity and the capacity of the stair.

The fourth floor of the building has a small rooftop plant area. The predicted occupancy of this area is minimal and there are no travel distance concerns. This area will evacuate simultaneously with the office.

Due to level changes on the floor plate, fire curtains have been used to create a place of safety for mobility impaired occupants, see Figure 7—2 for more details.

Any storage rooms attached to the stairs will be lobbied.

7.2.2 Residential

The residential units above the office will evacuate using a defend in place strategy. There will be a landlord system in the common areas that operates the smoke control systems. The office will share stairs with the flats above, however, the stair will be protected by ventilated lobbies.

The extension in travel distances within two of the flats, has been mediated with the addition of a Watermist system, it is proposed to install an 'I mist' system throughout the flats, as advised by MLM. As the residential accommodation and the office share a common stair, any fire detectors in the land lord's, office, or retail areas, will send a signal to the fire alarm panel located at the entrance of the stair. No sounders will be located within the stair core.

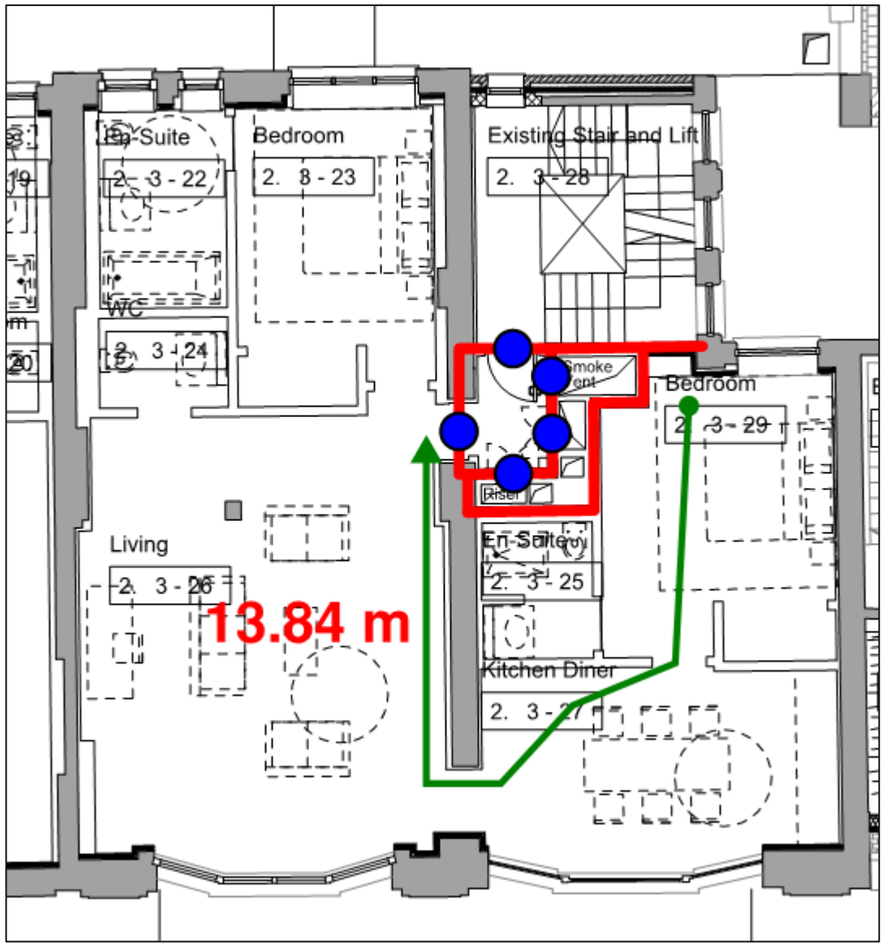


Figure 7—3 Residential Layout, Level 03

7.2.3 Existing Retail

The retail units are three-level units with an internal staircase providing access to the upper and lower levels. The retail units have been provided with rear doors to supplement the main entrances at the front of the shop. This alleviates any concerns with travel or occupancy limits which may have previously existing. The retail units are assumed to be a B2 risk profile and this cannot be reduced as sprinklers aren't proposed for the north of Denmark Street buildings. As such, single direction travel distances are limited to 20m, extendable to 23m due to the provision of AFD. The retail units at the lower levels have independent means of escape and are fire separated from the other occupancies and therefore have independent fire alarm systems. It is currently also noted that due to existing construction the egress point from 22 Denmark Street is into a protected corridor and then direct to outside. Given the existing construction and short travel distances this is not considered an issue.

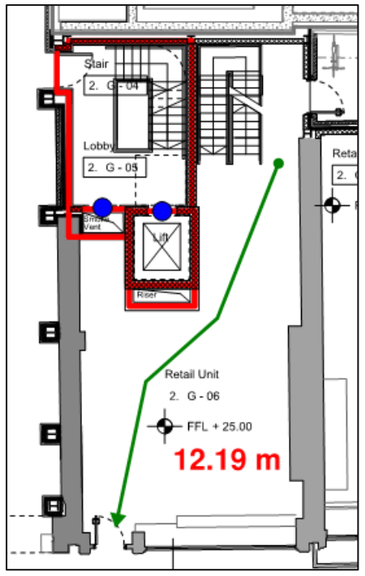


Figure 7—4: Egress from 22 Denmark Street

7.3 Structural Fire Resistance

The primary structure will require a **60 minute** fire rating based on BS 9999.

7.4 Compartmentation

The following table summarises the requirements for compartmentation:

Compartmentation	Required Period of Fire Resistance (min)
Enclosure to storage/refuse rooms	30 (EI)
Enclosure to plant rooms	30 (EI)

Table 7—4 Building C Compartmentation

R – Load bearing, E – Integrity, I - Insulation

7.5 Active Fire Fighting Systems

7.5.1 Automatic Fire Detection

Based on BS 9999 Table 8, the minimum level of detection required in building C is a Manual alarm system (based on B1/B2 risk profiles throughout). The building will have an enhanced automatic detection system throughout, to an L2 standard, in line with section 19.2 of BS 9999. Systems will be designed according to BS 5839-1 2013.

In addition to the automatic detection, manual call points will be installed in the new build, there will be no manual call points in residential areas.

All open plan apartments will be provided with linked fire detection and alarm in each habitable room to an LD1 standard. Fire detection and alarms will be linked within the apartments only and will not be linked to any landlords or off-site monitoring system.

A category LD1 system is defined in BS 5839 Part 6 as a system installed throughout the dwelling, incorporating detectors in all circulation spaces that form part of the escape routes from the dwelling, and in all rooms and areas in which fire might start, other than toilets, bathrooms and shower rooms.

7.6 Smoke Control

The main stair core lobbies in Building C will be vented using automatically opening vents (AOVs) direct to outside.

The lobbies for the stairs that serve the office and residential above will be mechanically ventilated. The detailed design of the mechanically assisted system will need to be carried out by a specialist supplier; however, some guidance on the design of the system is given below based on best practice:

- The shaft sizes will be approximately 0.6m^2 in plan (geometric free) area.
- The aspect ratio of the shaft will be no greater than 2:1.
- The shafts will terminate at roof level with a fan at the head of each. The extract/inlet fans set will comprise of duty and standby fans. The extract/inlet rate will be confirmed by the supplier of the system.
- A vent will be provided into the shafts from each corridor at each storey. The size of the vents will be confirmed by the supplying but are typically in the range of 0.6 – 0.8m^2 (geometric area).
- On detection of smoke in the common corridor/lobby, the vents on the fire floor and the vent at the top of the stair should open simultaneously. The vents from the corridors on all other storeys should remain closed.
- A secondary power supply will be available for the system as described in section 3.7.1.

7.7 Firefighting Access

As Building C is under 18m in height it is not proposed to provide a firefighting shaft. A dry riser will however be provided in the new build stair core, hose coverage has been provided to within 45m of all points on the plan, measured on a route suitable for laying a hose.

8 Building D

8.1 Introduction

Building D is a new building that consists of ground floor up to level 3 above ground. The height, from Fire Brigade access level, to the top most occupied floor is 13.70m.

The area uses within the building are outlined below in table 8-1:

Level	Land Use(s)	Occupancy/Density
3	Plant	30m²/person
2	Residential	2p/bedroom
1	Residential	2p/bedroom
0	Residential lobby, Cafe	n/a

Table 8—1: Building A Land Uses

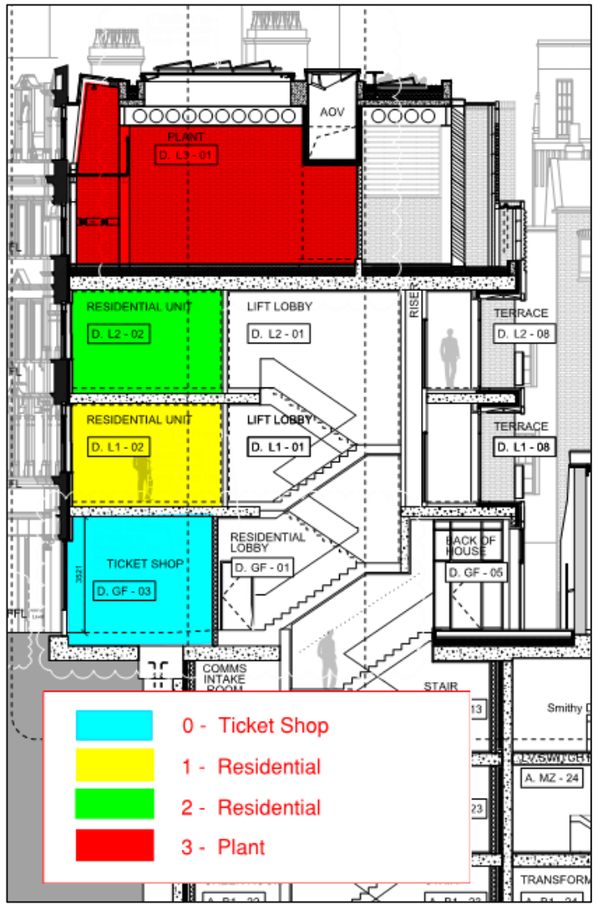


Figure 8—1 Building D Section

8.2 Evacuation Strategy

It is proposed that for the residential accommodation a 'defend in place' evacuation strategy will be implemented where only occupants from the dwelling of fire origin will evacuate and all other occupants will remain in place, unless directly affected by heat or smoke, or the fire and rescue service deems it necessary to evacuate other residents at a later stage. This strategy is achieved due to the high standard of fire compartmentation between flats.

8.3 Means of Escape

The ground floor of building D is split between the residential lobby, a small café and the ticket office for the auditorium. Levels 1 – 2 are residential, with plant at level 3. There will be compartment floors separating all floors, such that each level will evacuate independently. Building D is served by one stair core of 1.0m wide, which is lobbied at every level. Given residential apartments will operate a defend in place strategy storey exits and stair capacity are sufficient.

The flats will have open plan arrangements with a maximum travel distance of 15.8m from the bedroom to the final exit. As a residential sprinkler system (designed and installed to the recommendations set out in BS 9251) and an automatic alarm and detection to LD1 standard (designed and installed to the recommendations set out in BS 5839), it is considered reasonable to have extended travel distances over 9m. This is due to the fact that a sprinkler system will increase the available safe egress time for occupants within the flat of fire origin.

As part of the open plan layout justification, the apartments will be provided with quick response sprinklers and linked fire detection and alarm in all habitable rooms. This will ensure that occupants are quickly aware of a fire risk and that the fire is controlled during the early stages of development. Fire detection and sprinklers will not be directly linked to each other or any landlords offsite monitoring system.

BS 9991 guidance requires that open plan flats be limited to 16m x 12m in area (192m²), which these flats are within.

BS 9991 requires kitchens in open plan flats with an area greater than 80sqm to be enclosed. It also recommends that cooking appliances are located remotely from escape routes in open plan flats.

It is not proposed to put any restrictions on the openness of the kitchens to the living space based on the provision of sprinklers, linked automatic fire detection (AFD) and research carried out into the severity and likelihood of kitchen fires compared to fire elsewhere in a residential dwelling[4]. In general research shows that the severity of a sprinkler protected kitchen fire is no worse than that of a sprinklered lounge fire. Therefore, it is considered reasonable to place no restrictions on enclosure of kitchens. However, flats will be designed so that cooking appliances are located as remotely from the escape routes, to reduce the risk of occupants being exposed to radiant heat from a cooker fire during escape.

The plant room travel distance shown on level 3 is approximately 18m to a protected door. A plant room (A4 reduced to A3 would allow 22m, extendable to 25.3m with AFD. Currently travel distance is compliant, it should be ensured that 25.3m is not exceeded after fit out.

8.4 Common Corridor

As this building is less than 11m high, when measured from fire fighting access level to the finished floor level of the top most occupied floor (not including the plant floor as it will only be occupied for planned maintenance), and there are no more than 3 stories above ground storey. There is no requirement to ventilate the common corridor as they are under 4.5m long, an AOV to the head of the stair has been provided as such this arrangement is compliant to BS9991.

CLG Fire Research Technical Report 2/2007

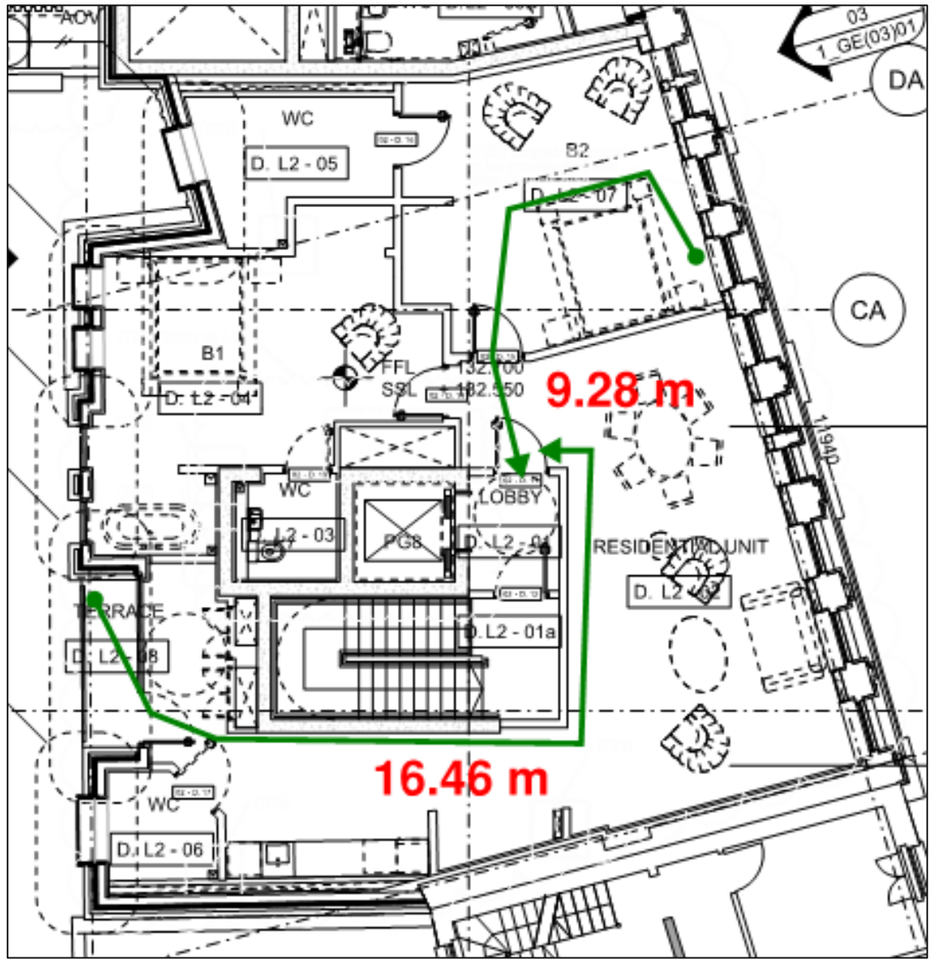


Figure 8—2: Typical Residential Travel Distances

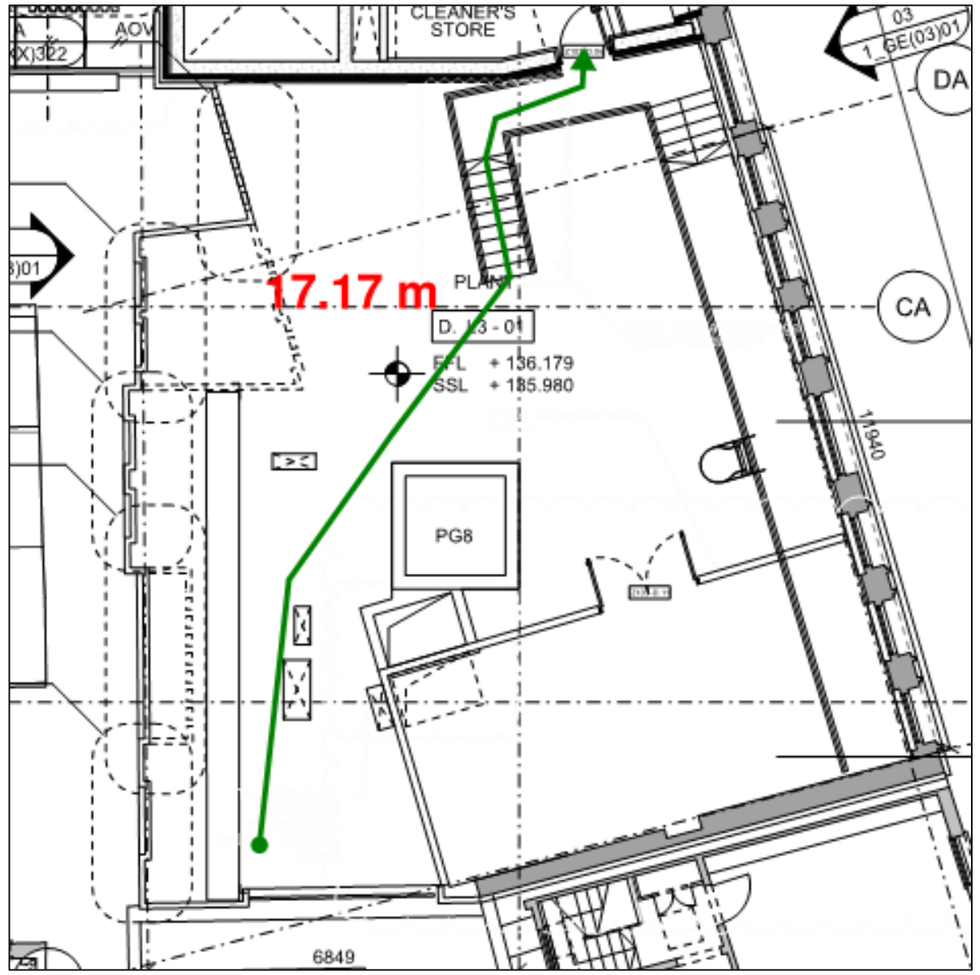


Figure 8—3: Level 3 plant room travel distance

8.4.1 Structural Fire Resistance

The primary structural frame will require a 60 minute fire rating based on BS 9999. 90 minutes fire resistance is proposed to separate the basement auditorium from the upper levels.

8.4.2 Compartmentation

The following table summarises the requirements for compartmentation:

Compartmentation	Required Period of Fire Resistance (min)
Compartment Floors (all floors)	60 (REI)
Compartment Floor separating the basement auditorium from the upper levels	90 (REI)
Service riser enclosures	60 (REI)
Enclosure to storage/refuse rooms	30 (EI)
Enclosure to plant rooms	30 (EI)

Table 8—2 Building D Compartmentation

R – Load bearing, E – Integrity, I - Insulation

8.5 Active Fire Fighting Systems

8.5.1 Automatic Fire Detection

A category LD1 system is defined in BS 5839 Part 6 as a system installed throughout the flats, incorporating detectors in all circulation spaces that form part of the escape routes from the dwelling, and in all rooms and areas in which fire might start, other than toilets, bathrooms and shower rooms.

8.5.2 Sprinklers

Building D will be sprinkler protected throughout, with the sprinkler tank being location at basement 2 level (-2B). This sprinkler tank also serves buildings A, B and C sprinkler systems. This system will be designed to BS EN 9251.

8.5.3 Smoke Control

The residential stair core will have a 1.0m^2 vent at the head of the stair. It has been agreed with MLM that as the stair serves only two sprinkler protected flats that the common corridor is not ventilated.

8.5.4 Firefighting Shafts

As Building D is under 18m in height no firefighting shaft is required.

9 Site-wide External Fire Spread

9.1 Introduction

The St Giles site is bordered by Charing Cross Road to the west, Andrew Borde Street and the pedestrian plaza to the North, St Giles High Street to the East and Denmark Street to the South. External fire spread has been undertaken using the enclosing rectangles method in BR187. This has identified which facades require analysing in more detail. Facades highlighted in red are those which have a significant reduction in allowable unprotected area. Given the provision of sprinklers throughout the new buildings, detailed analysis of these facades/buildings has been undertaken.

Figure 9—2 highlights the facades discussed in the following sections. All values for enclosed rectangle height and widths, as well as, site boundary distance measurements are in metres. This analysis was carried out on an earlier version of the site plan, however the conclusions remain valid.

9.2 Building A

Building A of the St Giles Circus redevelopment is adjacent to Charing Cross Road to the West, the plaza and Crossrail entrance to the North, and Buildings B and C of the St Giles development to the East and South. Table 9—1 outlines the key details for the external fire spread. External fire spread has not been conducted for the urban gallery as this is area is open to air and it is not considered likely a flashover fire could occur in this area.

Façade	Floors	Building Purpose Group	Height of Enclosed Rec	Width of Enclosed Rec	Distance to site boundary	Allowable %age of unprotected façade	Comments
East	Ground	1	4	10.6	2.95	92%	Fire Engineered Solution agreed see section 9.2.1
East	1,2,3	2	3.6	11.4	2.8	100%	-
East	4	2	4	22.8	2.9	100%	-
West	Ground	2	4	11.7	10.8	100%	-
West	1,2,3	2	3.6	11.7	10.8	100%	-
West	4	2	3.6	36.07	10.8	100%	-
South	Ground (Retail 1)	1	4	12.26	2.1	48%	TRA Proposed see section 9.2.2
South	Ground (Hotel Reception)	2	4	4.09	2.1	-	Protected lobby – no combustible content therefore not consider as part of the EFS assessments
South	Ground (Retail 2)	1	4	5.7	2.5	100%	-
South	1,2,3,4	2	3.6	33.3	1.9	96%	The 4% protected façade is likely to be achieved through the construction

Table 9—1: Building A External Fire Spread

9.2.1 Building A East (Between Buildings A and B)

Currently between buildings A and B there is an external fire spread requirement that a portion of the building B façade requires fire rating. In order to have an unprotected façade the fire alarm and detection systems will be linked so they become the same evacuation zone and an alert would be sent to the urban gallery if there is a fire in the restaurant. This has been agreed with MLM Building Control.

9.2.2 Building A South - Denmark Place

Thermal Radiation Analysis (TRA) has been completed for this elevation to determine the likelihood for external fire spread between these two buildings. The results demonstrate that a fire is unlikely to spread from the sprinkler protected retail unit in building A to the existing café south of Demark Place. Figure 9—1 illustrates the TRA output which shows that based on a heat flux of 168kW/m^2 as per BS 9999 for shop and commercial and an incident radiation acceptance criteria of 20 kW/m^2 a fire is unlikely to spread from one building to another. It should be noted that both buildings have alternative means of escape which do not pass via Denmark Place.

The acceptance criteria of 20kW/m^2 is considered to be appropriate based on guidance from CIBSE, Guide E, which states that this value is appropriate for most building materials. This is reinforced by Babrauskas (2010), who states that double-glazed windows can resist approximately 25kW/m^2, while tempered glass is able to resist fluxes of 43kW/m^2. Which is likely to be the most vulnerable portion of the construction of the opposing existing façade.

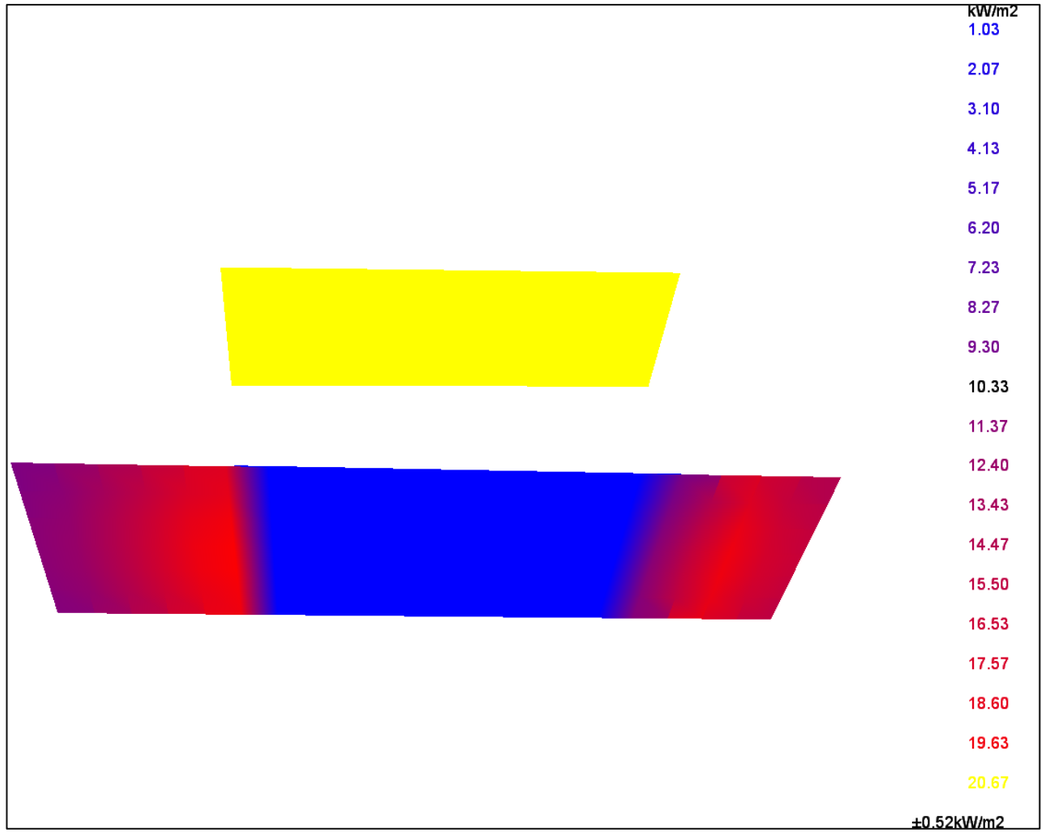


Figure 9—1 TRA Output – Building A South

9.3 Buildings B & D

Building B of the St Giles Circus redevelopment is adjacent to Andrew Borde Street to the North and Building D and St Giles High Street to the East. It is adjacent to Buildings A and D of the St Giles development to the West and South. Table 9—2 shows this:

Façade	Floors	Building Purpose Group	Height of Enclosed Rec	Width of Enclosed Rec	Distance to site boundary	Allowable %age of unprotected façade	Comments
Building B							
North	Ground & 1	2	10.1	21.7	4.5	99%	-
North	2 and 3	2	7	21.7	4.5	100%	-
East	Ground and 1	2	10.1	17.5	7.9	100%	-
East	2 and 3	2	7	17.5	7.9	100%	-
West	Ground and 1	2	10.1	24	2.95	53%	Fire Engineered Solution agreed see section 9.2.1
West	2 and 3	2	7	24	2.95	69%	Fire Engineered Solution agreed see section 9.2.1
South	Ground	2	4	7	2	100%	Portion less than 1m from boundary to be Fire rated as per figure 9-2.
South	1, 2 and 3	2	4	7	2	100%	Portion less than 1m from boundary to be Fire rated as per figure 9-2.
Building D							
East	Ground	2	2.9	12.2	7.8	100%	-
East	1, 2, 3	2	2.6	13.9	9.8	100%	-

Table 9—2: Building B & D External Fire Spread

9.4 Building C

Building C of the St Giles Circus redevelopment is opposite Buildings A and B of the St Giles development to the North. Its South façade overlooks a bike storage and is directly opposite the rear of the North Denmark Street buildings. However, with the addition of compartment floors and there will only be one occupier of the office space which can be simultaneously evacuated, it is proposed that no fire addition rating is required to any of the facades based on the inherent fire resistant properties of the brickwork, please see Figure 9—3 and Figure 9—4

Façade	Floors	Building Purpose Group	Height of Enclosed Rec (m)	Width of Enclosed Rec (m)	Distance to site boundary (m)	Allowable %age of unprotected façade	Comments
North	Ground	2	3.44	17.65	1.9	35%	This is likely to be achieved inherently by the construction of the existing buildings .
South	1 (largest compartment)	2	3.15	13.12	1.3	38%	

Table 9—3: Building C External Fire Spread

9.5 Denmark St

External Fire Spread Calculations for North Denmark Street have concluded that no fire rating is required, as there is sufficient distance between the buildings on North and South Denmark Street and the notional boundary. Additionally there are no concerns with external fire spread from the front of the Flitcroft Street building. Please see Figure 9—2 and Figure 9—3.

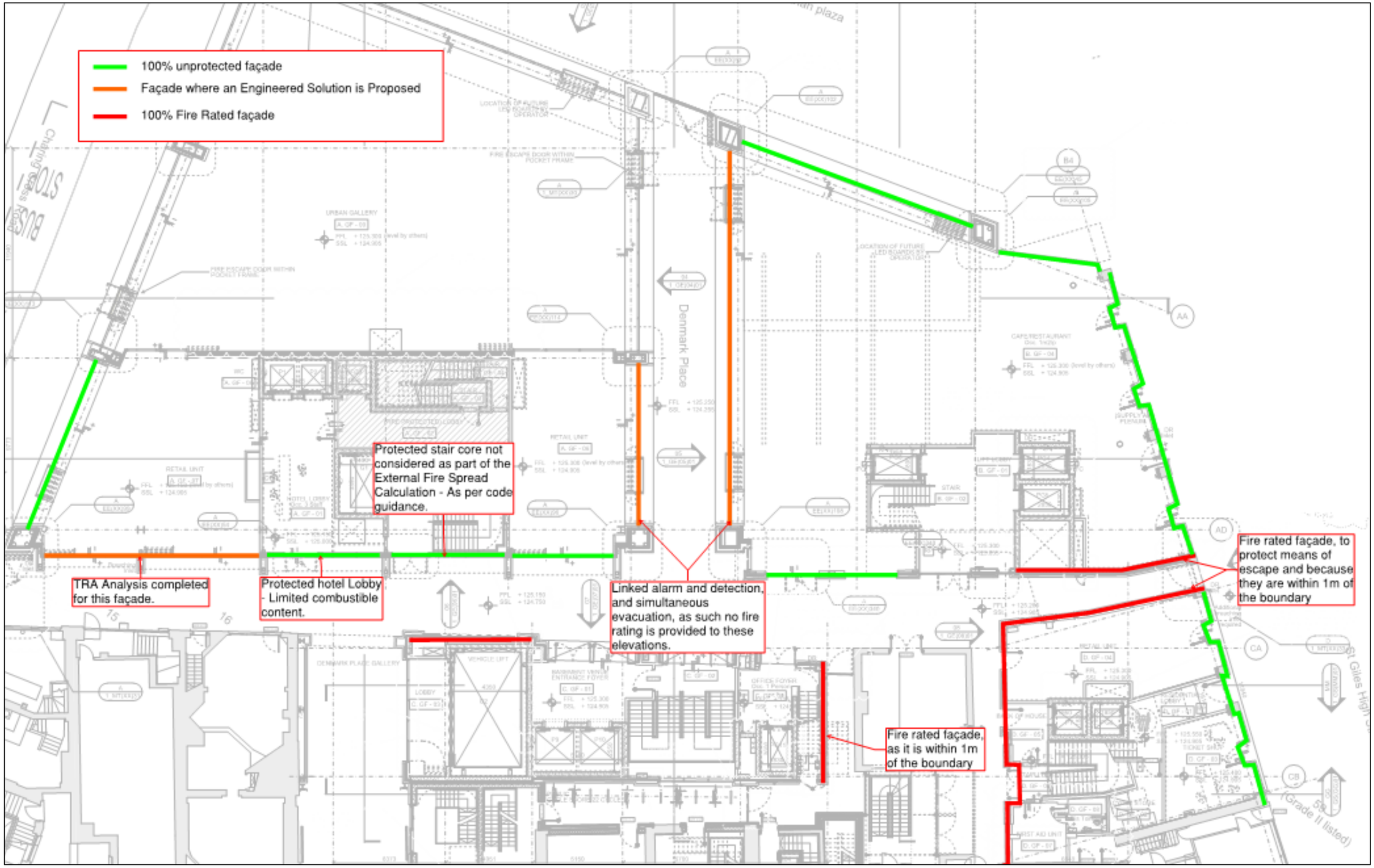


Figure 9—2: External Fire Spread Facades for Buildings A - D (Ground Floor)

Summary:

All windows shaded in green below can remain unprotected. This was either based on the results of a BR 187 enclosing rectangles calculation, or guidance from the same document about unprotected openings in protected shafts.

Assumptions:

Calculations are based on the provision of compartment floors at each level.

It is assumed that the brick façade has inherent fire resistance. This assumption is based on guidance from BS5628-3: 2005 table 15, which states that typically a single leaf masonry wall with overall thickness of 75mm should provide 60 minutes fire resistance (assuming the use of class 1 aggregates)

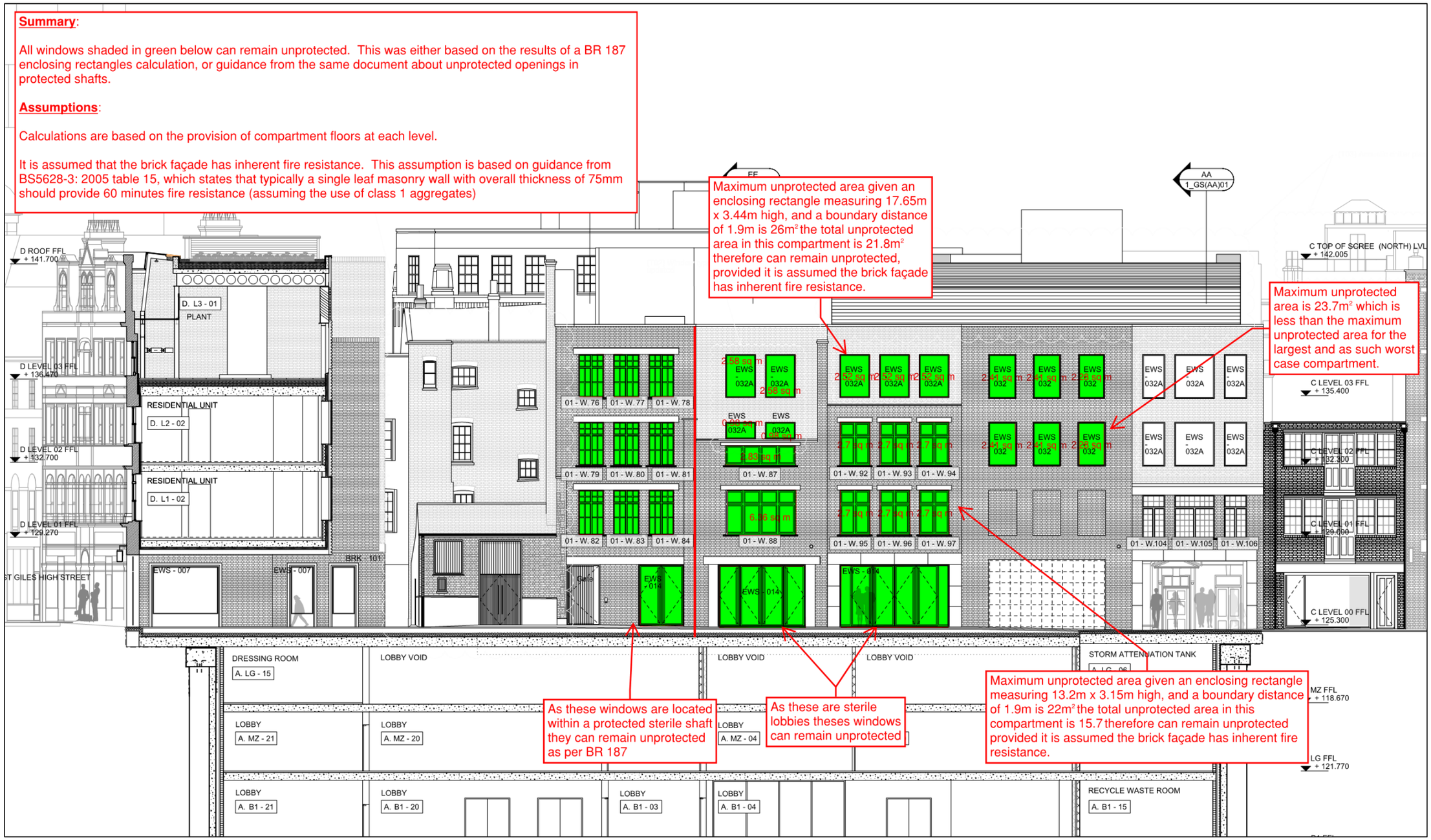


Figure 9—3 External Fire Spread – Block C North Elevation

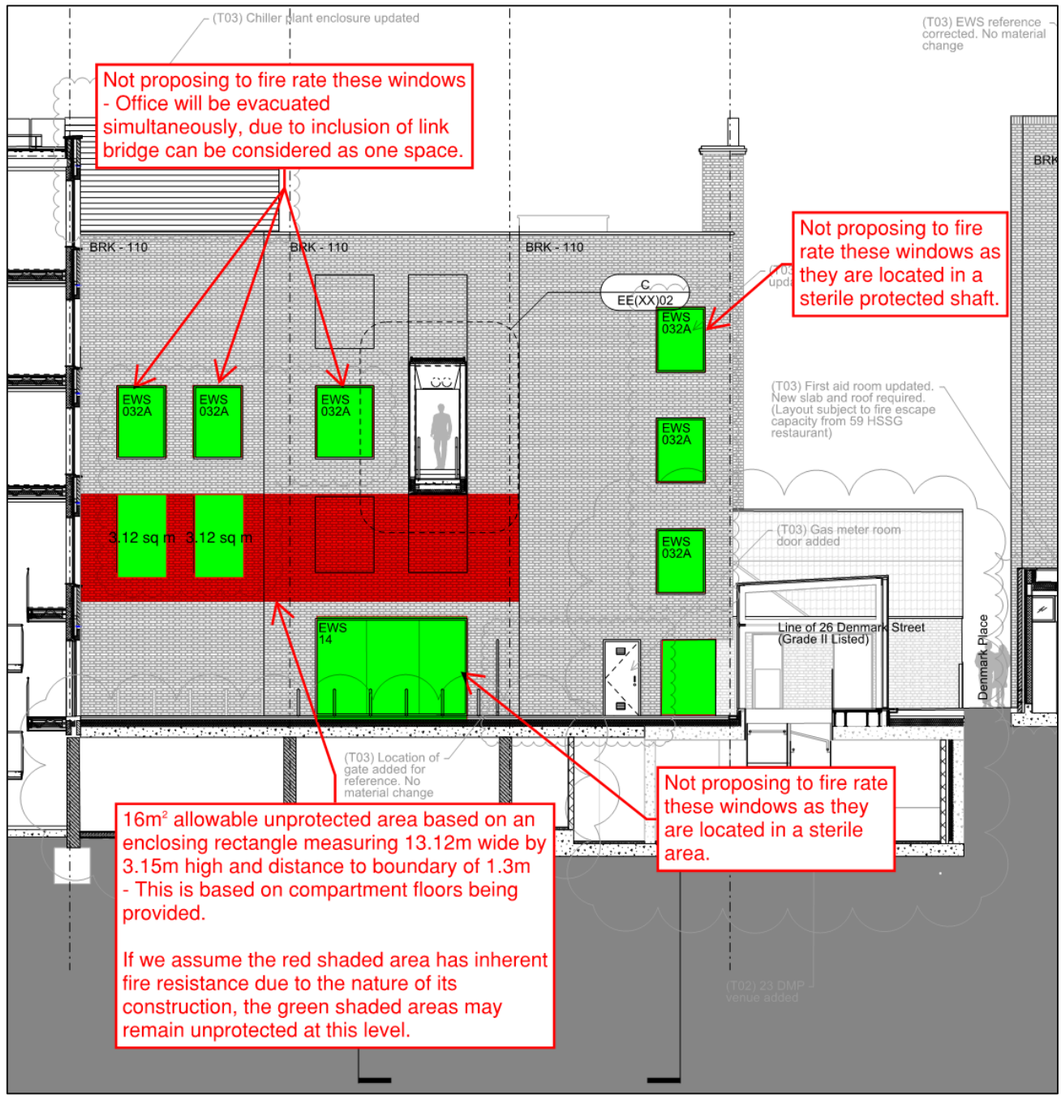


Figure 9—4 External Fire Spread – Block C South Elevation

9.6 External Faces of Buildings

9.6.1 Code Guidance

External wall should be constructed using material that does not support fire spread. Flame spread over or within an external wall construction should be controlled to avoid creating a route for rapid fire spread bypassing compartment floors or walls.

Combustible materials should not be used in cladding systems and extensive cavities.

The code guidance given in the BS 9999 states that the external walls should either meet the performance criteria given in BRE Report BR 135[N1] for cladding systems or meet the following recommendations:

- The external wall surfaces should meet the provisions of Figure 45 of BS 9999.
- In buildings with a storey 18m or more above ground level, any insulation product, filler material (not including gaskets, sealers and similar), etc. used in the external wall construction should be of limited combustibility. This restriction does not apply to masonry cavity wall construction that conforms to Figure 27 of BS 9991.
- Cavity barriers should be provided in accordance with Clause 30 of BS 9991.

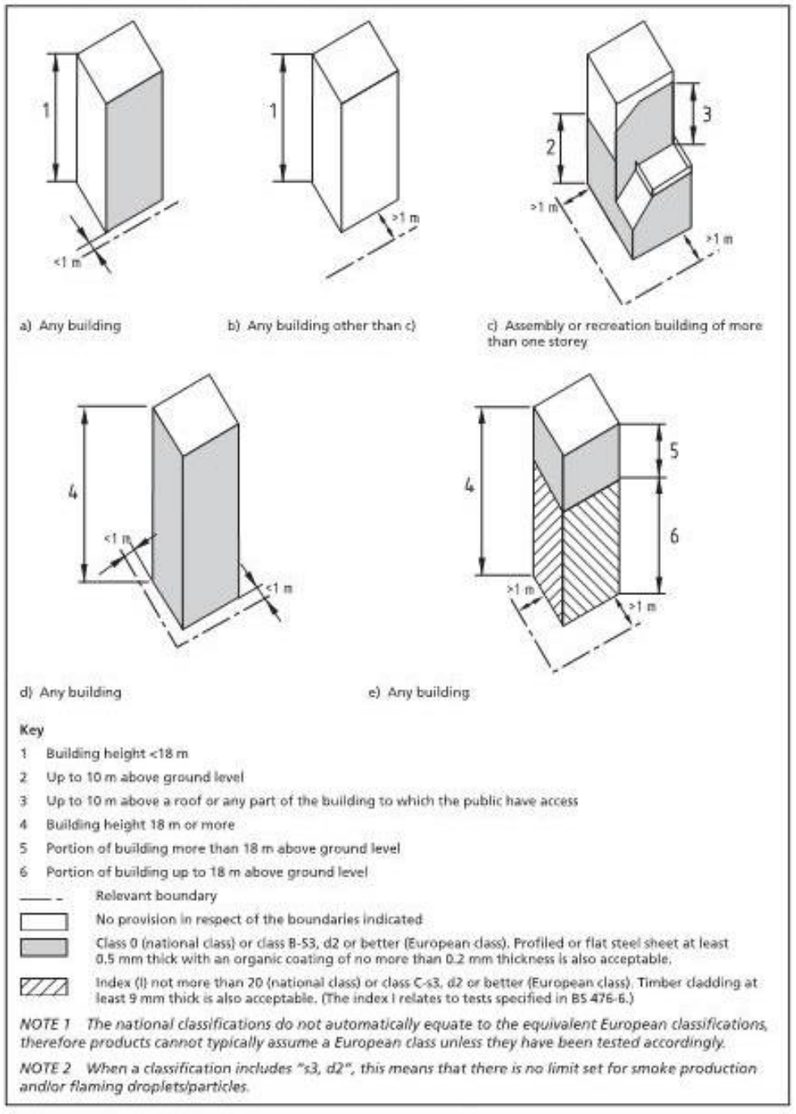


Figure 9—5 – Figure 45 of BS 9999 – Provisions for external surfaces of walls

Appendix A Fire Brigade/Building Control Meeting Minutes

Minutes

subject	St Giles Circus Redevelopment Fire Brigade Meeting	job no	032930
place	ORMS	date	22 April 2014
present	Ian Chalk (ORMS) Michael Wadood (MLM) Matthew Ryan (LFB) Alex Kitimer (LFB) Stewart Dabin (BH) Jonathan Hall (BH)	apologies	
distribution	As above		

Objective of meeting: Presentation of Fire Strategy Principles to Fire Brigade representatives.

Following an introduction to the site and scheme by ORMS, BH introduced the Fire strategy principles for each area on site. In general the principles were well received with no major concerns raised at this stage. Additional detail was requested on a number of items, which will be incorporated into the draft fire strategy currently under development. The following highlights key areas and any additional comments required

Item	Action
1.0 Site Wide	
1.1 SD explained the New build elements of the site would be sprinkler protected. This was to allow the BS9999 risk profile reduction and to justify the single stairs.	
1.2 SD explained the proposed firefighting access arrangements. This involved the fire command point (repeater panels and other facilities) to be housed in the reception of the hotel. IC explained that the site would be run by one operator. Breeching inlets would be on Charing Cross road. Block A requires a firefighting shaft as it is above 18m. Building B also requires a firefighting stair as it is an assembly building over 7.5m. The other blocks are under 18m so firefighting will be external or via dry risers in protected stairs.	
1.3 MR and AK commented on the fire brigade access to this area via Denmark Place. It was agreed that there were alternate routes from the basement escape that would not have to go via Charing Cross road entrance to Denmark place and therefore as long as this was properly managed the Hotel reception was the best place. AK Commented that it would be good to invite the end users to the next meeting.	
1.4 BH Fire to co-ordinate fire command centre requirements (such as repeater panels) with MEP engineers.	
2.0 Basement Levels	
2.1 SD described the fire strategy for the basement, based around 3 stair cores (including the firefighting core), with multiple storey exits to two cores and holding capacity in protected corridors used to supplement capacity. In principle there were no issues with this strategy.	
2.2 MR requested detail to be highlighted regarding disabled refuges and management	
2.3 Discussion continued onto the type of management plan for the development and the need to ensure the client/operator is signed up to the commitments of the strategy. AK suggested inviting a client representative to a future meeting. Also suggested to request a signed client document supporting the	

management proposals if required.

2.4 IC mentioned client aspiration regarding inclusion of a VIP room (or similar) in the sub-basement. Discussion that this could be made to work, but occupancy would need to come off total basement occupancy and would need a lot of additional provisions (toilets, VIP bar?, headroom provision). Preferred option may be to dissuade client from this.

2.5 Travel distances to be confirmed once plant layout is agreed. Inclusion of dry riser in accommodation stair to be confirmed but seems the best way forward.

2.6 Mechanical venting proposed for the fire core – detail to be provided on system (likely 3rd party supplier).

3.0 Building A

3.1 SD explained the fire strategy, based around a firefighting stair and lift with mechanical venting and a dry riser. The hotel will be provided shell and core so a lobby to the stair will be provided, however this may be extended to a protected corridor by the end user.

3.2 Means of egress calculations to be provided to support phased evacuation combined with thoughts on how the evacuation would be managed (linked to management plan above).

3.3 BH also asked to consider a simultaneous evacuation scenario for confirmation of stair capacities (noted that in this scenario the level 3 management offices can be assumed to evacuate horizontally through the bridge to building B). Also noted that in BS9999 a simultaneous evacuation would be based on the worst-case risk profile throughout the building (in this case the hotel is risk profile C). From a practicality perspective this should be reviewed (for example the category C relates to the sleeping risk – whilst the likelihood of sleeping occupants is significantly lower during periods when the restaurant/business suites are at full capacity)

4.0 Building B

4.1 SD explained the fire strategy, based around a firefighting stair with AOVs and a dry riser.

4.2 Plant escape distances to be checked when plant layout is available.

4.3 Occupancy of rooftop bar/terrace currently restricted to 60 – this is to be reviewed to see if a second storey exit can be provided.

5.0 Building C

5.1 The building is served by a single staircase with AOVs in the lobby.

5.2 No concerns raised at present.

6.0 Building D

6.1 The building is served by a single stair core lobbied at each level.

6.2 MW suggested the use of fire curtains instead of providing lobbies to the office. To be reviewed.

7.0 North of Denmark Street

7.1 Discussion re provision of mechanical venting of new core. Currently assumed the lobbies will be mechanically vented – details of system to be provided.

8.0 South of Denmark Street

8.1 BS9999 likely to be used for consistency

8.2 Basement restaurant travel distances to be reviewed and numbers using the accommodation stair to be identified.

8.3 AOV to be provided to residential stairs. Noted this cannot be directly above but can be to side of stair – size may be increased slightly.

Minutes

subject	St Giles Circus Redevelopment Fire Brigade Meeting	job no	032930
place	ORMS	date	17 March 2015
present	Richard Keating (ORMS) Ben Whitaker (MLM) Matthew Ryan (LFB) Stewart Dabin (BH) Jonathan Hall (BH)	apologies	
distribution	As above		

Item	Action
1.0 Auditorium	
1.1 JH ran through the fire strategy for the auditorium.	
1.2 The site wide fire fighting access was discussed. MR noted that the management of people egressing from the auditorium would need to be managed so that it did not conflict with fire fighting access.	
1.3 It was agreed that there would be fire alarm repeater panels at the entrance to each core with the main panel situated in the hotel reception.	
1.4 The office connected to the main auditorium store at basement level was discussed. JH explained that it was possible to lose this stair (this will be confirmed in the means of escape section in the updated fire strategy.	
1.5 MR noted that as the fire fighting core has two lobbies both will need to be ventilated and the dry riser indicated with signage.	
1.6 It was confirmed that the kitchen/bar area would only be used to re-heat food and therefore did not need fire rating to it.	
1.7 JH ran through the principle of using the protected corridors for means of escape. BW said that the licensing authority should be consulted to confirm the capacity.	
2.0 Block A	
2.1 MR mentioned dry riser position. This should be located so that doors to not clash with it. This needs to be checked for all blocks.	
2.2 JH confirmed that the blocks would know be simultaneously evacuated. This may result in some of the compartment floors being removed. This will be detailed in the update of the fire strategy report.	
2.3 The fit out requirements for the hotel floors are indicated in the Hotel Fire Strategy. BW noted that the travel distances may be difficult to achieve in the fit out.BH to investigate.	
2.4 BW noted that only detectors would be required in the Hotel before fit out.	
2.5 The 24 hour concierge was discussed for the Hotel. RK noted that this might not be available. This would not work with the fire fighting access to site and not allow for the double knock fire alarm system to be used and therefore needs to be discussed with the client.	
3.0 Block B	
3.1 Layout of core for block B was discussed with the open stair and lifts. Lifts will require fire curtains if dual entry to accommodation side. Only a podium and non-combustible seating will be allowed in this lobby. This will be detailed in the fire strategy.	

Minutes taken by: Jonathan Hall

3.2 The void adjacent the retained façade was discussed. This will require fire rating to the accommodation at the lower level. It was agreed that this could be 60 minute integrity and 30 insulation.

4.0 Block D

4.1 Block D residential layouts where discussed. As there are only two flats it was agreed that ventilation was not required to the common corridor. The flats are also sprinkler protected. BW required further justification of the flat layouts in the fire strategy but could see no issues with approvals.

5.0 Block C

5.1 JH described the changes to the layouts. Now that there is escape into two stair cores and no extended travel distances it was agreed that the sprinklers could be removed. The layouts need to be reviewed by BH in terms of ventilation of the lobbies and disabled access.

5.2 Fire fighting access to Block C will be via Denmark Street.MR asked if this could be closed during construction. RK confirmed that this is not the case.

6.0 Urban Gallery

6.1 The justification to not sprinkler the urban gallery and treat as external space should be detailed in the fire strategy.

6.2 It was agreed that the retail units connected to the urban gallery do not require fire separation.

7.0 North of Denmark Street

7.1 The residential layouts were reviewed. The duplex flat has access into the core on both levels and therefore is not an issue. The other flats are no longer duplex and therefore have extended travel distances and will need to be justified.

8.0 Other Comments

8.1 MR noted that sumps could be removed if the lift threshold was incorporated into the design. BH to send details to ORMS.

8.2 Breeching inlets were discussed for the dry risers and sprinklers. MR noted that there should be a sprinkler inlet on each side of the sight. Dry riser breeching inlets will need to be in the retained façade. BH to supply ORMS with details and discuss with suppliers. MR also noted that the dry riser outlets on the GRD floor will be important for this site.

Appendix B Open Plan Flat Justification – Sprinkler Protected Flats

As discussed above, the justification of deviation from code guidance falls into the following key issues:

- Extended travel distances.
- Inner bedrooms.
- Kitchen locations.

The justification is based on providing a package of measures which jointly address these issues:

- Detection and alarm throughout the properties – with the aim of reducing detection and pre-movement time.
- Sprinkler protection throughout the properties – with the aim of limiting fire size and extending tenability periods in the building.

These two first measures, the design seeks to either alert the occupants early so that they can evacuate during the early stage of a fire, or to provide suppression to allow escape later during a fire event.

Evacuation Time

The total evacuation time for occupants is composed of pre-movement time and travel time. As stated in BS7974, *"Although pre-movement behaviours may involve periods when occupants are inactive, they also include a range of behaviours involving movement, but these behaviours do not generally include movement to the escape routes. An important finding of behavioural research is that the pre-movement phase can often comprise the longest part of the total escape time"*. For a sleeping risk BS7974 states that pre-movement time could be greater than 20 minutes and therefore this is the a much larger part of the evacuation time than the travel time if you consider that even for a 20m travel distance taking a walking speed of 1.25 m/s, the travel time would be 16s. The travel distances in the flats which range from 15-20m are considered acceptable as the largest part of the evacuation time (the pre-movement time) has been reduced by the provision of sounders in the bedrooms and detection throughout.

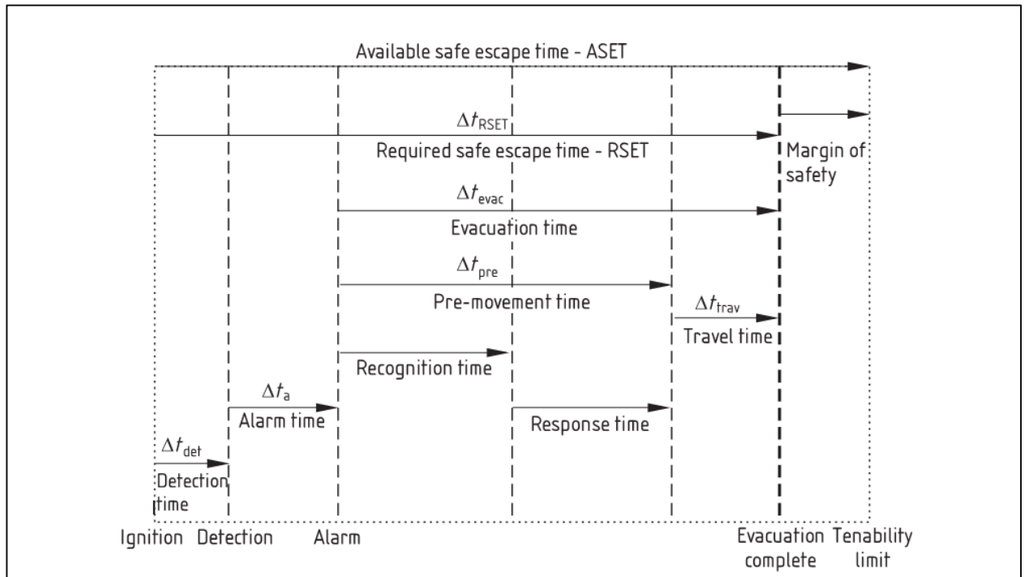


Figure 1 — Simplified schematic of processes involved in escape time compared to available safe escape time

Figure 9—6 Figure 1 of PD 7974-6:2004

Detection and Alarm

The key benefit of providing enhanced detection to the apartments is reduced detection time.

Findings from BRE Research 204505

With hallway doors shut it will take much longer for the alarm to be raised in a code compliant flat as the smoke alarm is in the hallway. To illustrate this issue, reference is made to BRE 204505, 'Effectiveness of Sprinklers in Residential Premises'. The room configuration and Table 9—4 from BRE 204505 below, show the detection times of a fire for a number of closed door scenarios.

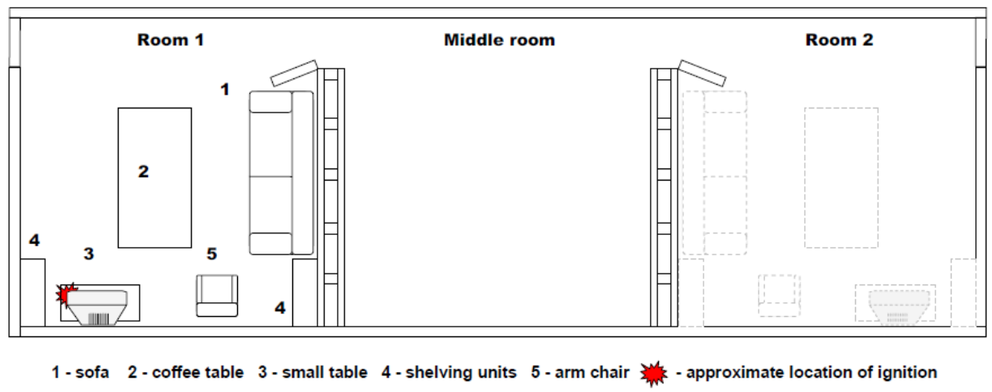


Figure 9—7 Room layout for BRE tests for 'Effectiveness of Sprinklers in Residential Premises'

The doors between the middle room and the perimeter rooms were closed; the table below shows the results.

Table 9—4 Summary of BRE results for 'Effectiveness of Sprinklers in Residential Premises'

Test No.	Set-up	Wet or dry	Room of origin	Alarm activation time						Sprinkler activation		OD limit reached (OD/m > 0.5)		FED_{AG} limit @ 1.6 m reached (room of origin)		FED_H limit reached		
				R1		MR		R2		Time	Temp	R1	R2	Uncon	Death	R1	MR	R2
				ion (s)	opt (s)	ion (s)	opt (s)	ion (s)	opt (s)	(s)	(°C)	(s)	(s)	(s)	(s)	(s)	(s)	(s)
Television fires																		
1	Standard	dry	1	227	292	343	410	-	-	n/a	n/a	474	598	835	988	733	(0.62)	(0.21)
8	Standard	wet	1	197	-	277	-	-	-	500	104	350	514	(0.60)	(0.60)	(0.26)	↓	↓
3	Door closed	dry	1	378	507	1233	-	-	-	n/a	n/a	734	(1238)	1451	1633	(0.96)	↓	↓
7	Door closed	wet	2	-	-	811	-	305	-	1391	93	(0.19)	414	1224	1504	↓	↓	(0.36)
28	Type B	wet	1	157	-	265 (LR ion)				431	108	315	418LR	(0.44)	(0.44)	↓	↓	↓
20	Low flow	wet	2	-	-	430	-	387	-	554	87	589	458	(0.27)	(0.27)	↓	↓	↓
19	Orientation	wet	1	197	-	267	-	-	-	713	123	335	580	(0.84)	(0.84)	(0.14)	↓	↓
21	Large room	dry	LR	275	-	238 (LR ion)				n/a	n/a	412	363LR	1217	1426	(0.68)	1190A	1107B
25	Large room	wet	LR	315	-	267 (LR ion)				683	105	595	532LR	(0.50)	(0.50)	↓	↓	↓
Table fires																		
11	Standard	dry	1	37	47	77	82	-	-	n/a	n/a	152	206	402	613	180	365	(0.85)
12	Standard	wet	1	62	-	107	-	-	-	156	112	219	309	413	550	↓	↓	↓
16	Door closed	dry	2	-	-	87	-	34	-	n/a	n/a	(1335)	132	201	243	↓	↓	137
14	Door closed	wet	1	34	-	112	-	-	-	179	100	115	(0.05)	356	529	↓	↓	↓
17	Type B	wet	1	37	-	75	-	-	-	118	109	138	214	418	667	(0.29)	↓	↓
22	Low flow	wet	1	22	-	62 (LR ion)				145	114	181	223	586	878	(0.74)	(0.14)	(0.17)
23	Large room	dry	LR	57	-	25 (LR ion)				n/a	n/a	179	162LR	398	588	310	185A	202B
24	Large room	wet	LR	57	-	29 (LR ion)				95	97	230	181LR	469	690	↓	↓	↓
Sofa fires																		
4	Standard	dry	2	-	-	390	414	285	337	n/a	n/a	972	741	1435	(1.3)	(0.22)	(0.42)	1192
9	Standard	wet	2	-	-	749	-	24	-	dno	n/a	1197	1002	(0.53)	(0.53)	↓	↓	↓
5	Door closed	dry	2	-	-	925	dna	240	252	n/a	n/a	(0.12)	578	1270	1426	↓	↓	1412
10	Door closed	wet	2	-	-	738	-	35	-	866	100	(0.07)	476	1297	(1.34)	↓	↓	(0.18)
Bed fires																		
2	Standard	dry	2	-	-	118	136	70	107	n/a	n/a	215	159	764	1011	300	620	300
15	Standard	wet	2	-	-	190	-	132	-	303	102	(364)	295	↓	↓	↓	↓	↓
6	Door closed	dry	1	59	-	1186	-	-	-	n/a	n/a	144	(0.07)	938	(1.34)	603	↓	↓
13	Door closed	wet	2	-	-	dna	-	87	-	156	105	↓	133	↓	↓	↓	↓	↓
Oil pan fires																		
26	Standard	dry	1	108	-	649	-	-	-	n/a	n/a	1165	1297	↓	↓	(0.62)	↓	↓
27	Standard	wet	1	449	-	619 (LR ion)				1202	102	1115	1251	↓	↓	↓	↓	↓
29	Type B	wet	1	18	745	430 (LR ion) 828 (LR opt)				1336	91	1238	1411	↓	↓	↓	↓	↓

The difference of detection times between room of origin and the adjacent room through a closed door are summarised below:

Table 9—5 Summary of Detection Times with Closed Door

Test Number	Detection Time Difference (S)	Time in Minutes
3	726	12.1
7	506	8.4
16	53	0.9
14	78	1.3
5	673	11.2
10	703	11.7
6	1127	18.8
Average Time	**552**	**9.2**

These results indicate that a closed door can add between 1 and 18 minutes detection time with an average of approximately 9 minutes. This would depend on the type of fire, growth rate and other factors. This code compliant arrangement is therefore likely to result in a fire growing to a larger size before occupants are alerted to it.

Early detection and alarm is, therefore vital for life safety in buildings with sleeping occupants. All open plan apartments will be provided with linked smoke alarms in each habitable room to an LD1 standard. This should ensure a fire is quickly detected and that occupants are alerted during the early stages of the fire's development.

The additional benefit of having linked smoke alarms in all habitable rooms is better audibility in remote areas as operation of one alarm would result in all alarms sounding. Therefore, it is less likely that an occupant would sleep through the alarm. This also provides resiliency should there be a failure with any one detector, as the chance of a fire not being detected by another detector head is small.

International Research into Relevance of Smoke Alarms being able to Wake Up Occupants

Research undertaken by D. Bruck at the University of Victoria, Australia[5] into the waking behaviour of people to alarms is very relevant in this context as she specifically studies the influence of factors such as age, sleep deprivation, signal frequency, background noise, hearing loss, time of night, stage of sleep, sex differences, dream incorporation, depression, signal meaningfulness, sleeping tablets, alcohol and marijuana on responsiveness during sleep on the ability for alarms to wake people up.

Her study is driven by statistics that show that while the over half of the fires in residential premises occur during the day, it is the fires at night that pose a greater threat to life. Bruck quotes statistics that show that about half of all residential fire deaths occur in the night hours, and refers to coronial reports on 114 fire fatalities which show that 81% of the fatal fires were at night (8pm to 8am) and in those 86% of victims were sleeping. Interestingly, even in fires during the day, 31% of the victims were asleep.

D. Bruck found that smoke alarms are able to show that an unimpaired sleeping adult will awaken quickly to a 55-60 dBA alarm in experimental studies – something that is usually expected in a hallway installation. Bruck suggests however that these levels cannot be expected to arouse children, those on sleep inducing medication, people with high frequency hearing loss as is often typical for the elderly, those who are sleep deprived or those under the influence of alcohol or marijuana. To improve the waking performance, she recommends a much higher sound level, equal to the maximum tolerable (90dBA) to ensure those that are most at risk have the best chance of waking up.

Installing fire alarms throughout habitable areas to LD1 standard and interlinking them to ensure activation of any one of these alarms is notifying occupants anywhere in the flat is a crucial aspect towards implementing the recommendations by Bruck.

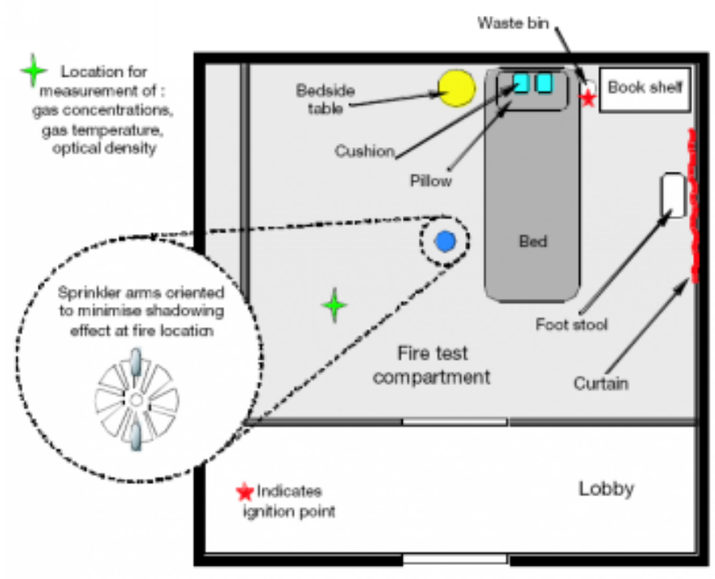
[5] Bruck, D.: The who, what, where and why of waking to fire alarms: a review, Fire Safety Journal - FIRE SAFETY J , vol. 36, no. 7, pp. 623-639, 2001

Sprinkler Protection and Location of Kitchens

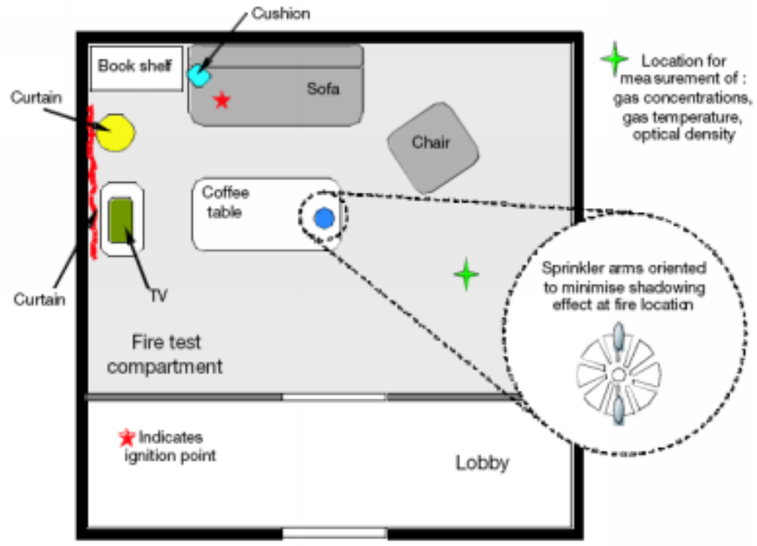
The FPA (Fire Protection Association) were commissioned to carry out research into providing a low cost residential fire suppression system for the UK housing sector. As part of this project a series of practical fire trials were carried out to demonstrate and assess the effectiveness of sprinkler systems under realistic conditions.

Bedroom & Lounge Fires

The bedroom tests were based on a fire occurring in a wastepaper bin adjacent to the bed and bookcase, which contained books and other combustibles. The arrangement of the fuel in relation to the fire was intended to encourage rapid fire spread to challenge the sprinkler system.



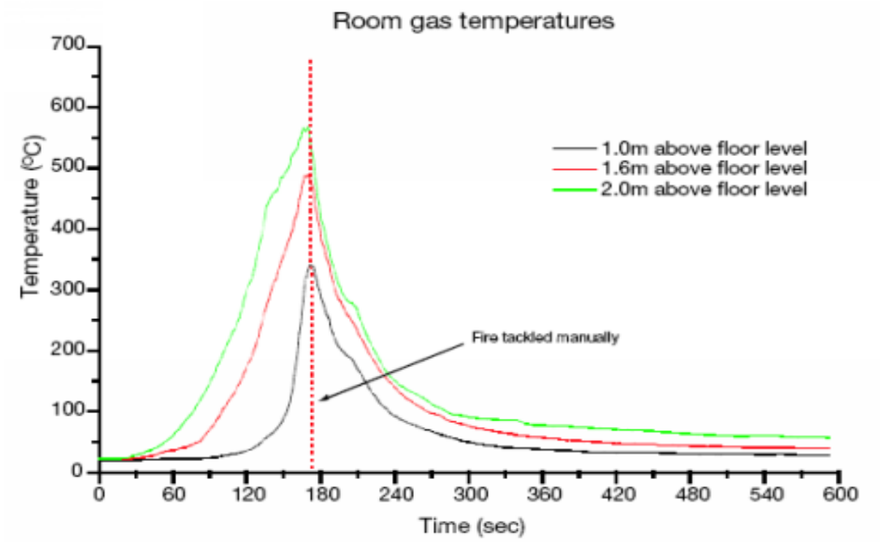
In the lounge the fire started on a sofa immediately adjacent to a bookcase. The sofa padding was constructed from non-modified foam.



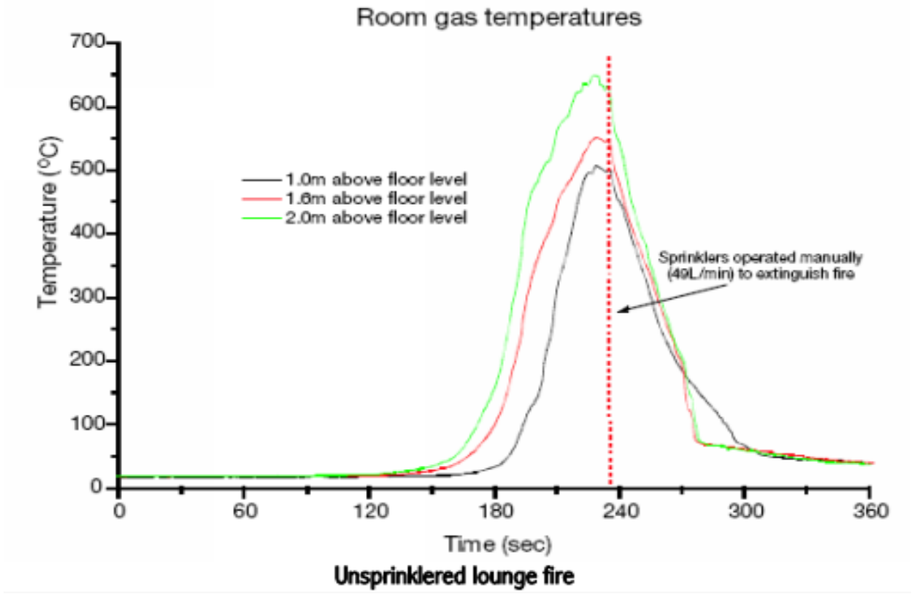
A concealed sprinkler was used in the tests. The results are summarised below:

Unsprinklered Bedroom and Lounge fires

- Rapid fire development occurred in the unsprinklered bedroom and lounge.
- Flashover occurred after 2 mins 30 secs in the bedroom and 3 mins and 15 secs in the lounge.



Unsprinklered bedroom fire

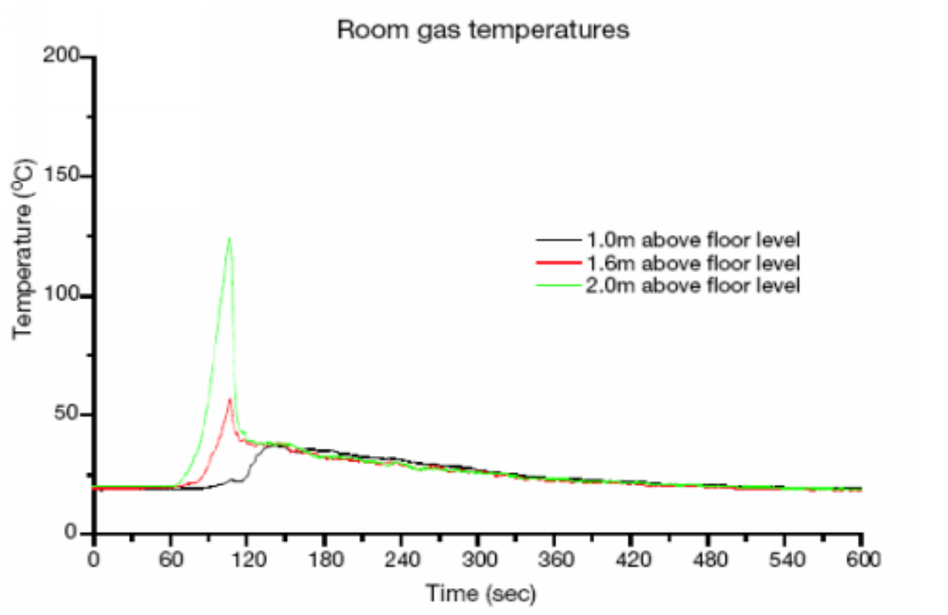


Unsprinklered lounge fire

Sprinklered Bedrooms

In both sprinklered bedroom tests the sprinklers activated after approximately 2 minutes.

- Fire was controlled and mostly suppressed although there is still some limited burning on the shelves.
- Room gas temperatures peaked at 125 deg C at 2m above floor level. At head height temperatures in the room were a maximum of approximately 60 deg C.

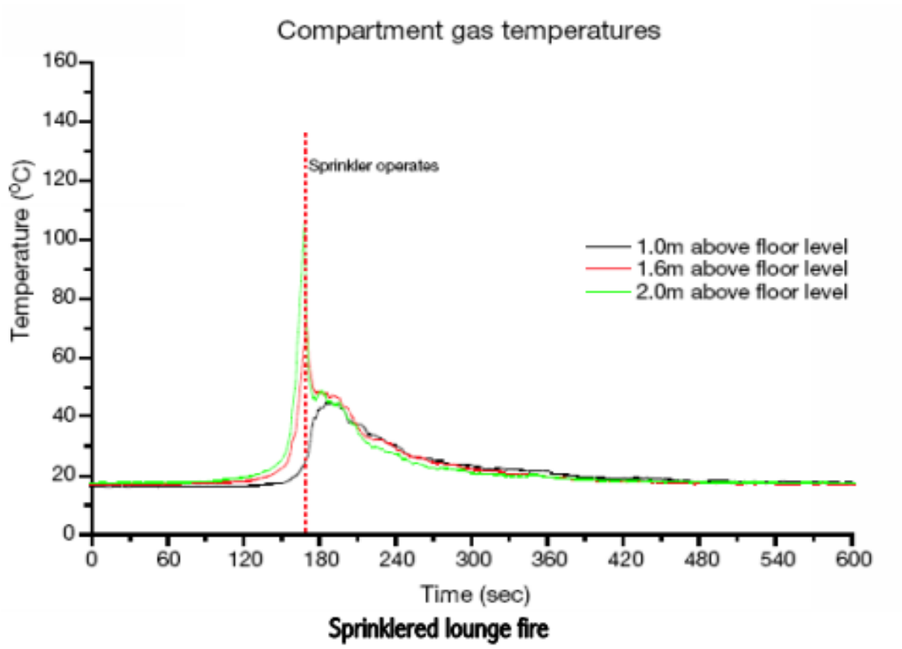


Sprinklered bedroom fire

Sprinklered Lounge

In both sprinklered tests the sprinklers operated after approximately 3 minutes.

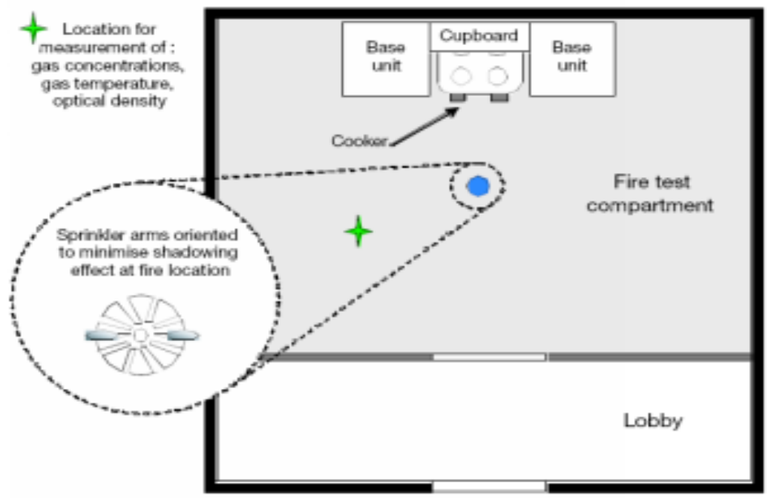
- The fires were controlled and mostly suppressed although there was some residual burning on the sofa cushions.
- Temperatures in the room peaked at approximately 120 deg C (2m above floor level) prior to sprinkler activation. At head height temperatures of up to 90 deg C occur. These were quickly reduced once sprinklers activated.



Sprinklered lounge fire

Kitchen Fire Scenario

The kitchen fire tests were based on a chip pan fire. A two litre pan was used filled with one litre of pure vegetable oil. Several tea towels were draped over the top of the cooker grill pan to provide an opportunity for flame spread from the chip pan (layout shown below). The pan was left on a lit stove to reach its auto ignition temperature. This occurred after approximately 50 minutes.

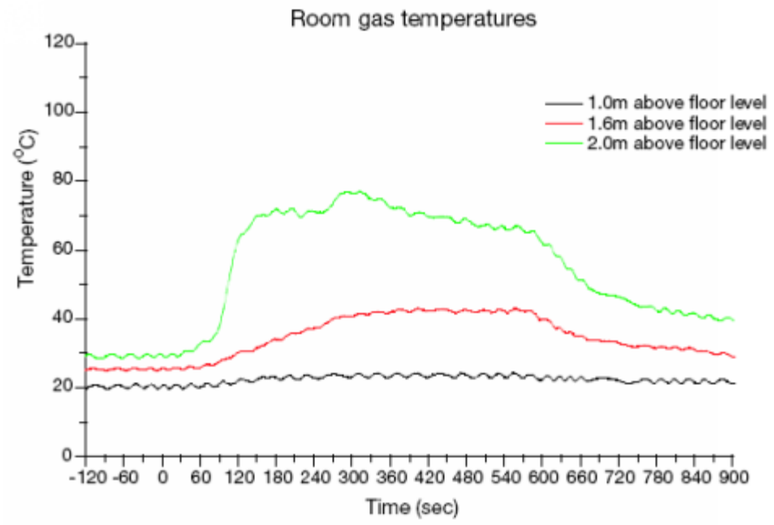


Layout of Kitchen Fire Scenario

Test observations and results for the unsprinklered test are shown below:

Table 44 Test details and observations for 1st kitchen test

Test No		K1
Scenario		Kitchen
Sprinklered?		No
Test details		Chip pan heated on gas cooker until 1 minute after auto-ignition of oil occurs. Tea-towels paced on cooker hood, above chip pan to propagate flames.
Time		**Event**
Minutes	Seconds	
-24	0	Lobby smoke alarm activated
0	0	Ignition (@ oil temperature of 361°C)
1	12	Towels ignite
1	33	Front towels fully burning
3	09	Burning of front of towels decreases
3	43	Side towels start burning
5	09	Burning of front of towels ceases
6	48	Sporadic flaming of towels ceases
Post test damage assessment		
Cooker		Grill pan cover scorched
Tea towels		All towels fully burned
Cupboards		Smoke damage and some charring of underside of cupboards
Work surfaces		No damage



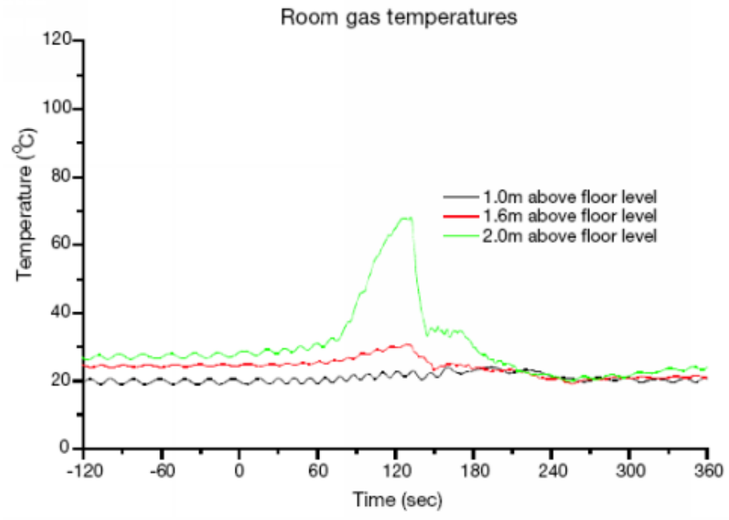
In the unsprinklered kitchen test:

- The flame produced by the burning oil eventually grew to a maximum height of approximately 0.5m.
- Just over a minute after ignition the towels above the chip pan ignited and continued to burn for approximately 7 minutes before dying out.
- There was insufficient flammable materials in close proximity for any further flame spread. However, the potential for flame spread beyond the relatively small fire in the chip pan was adequately demonstrated.
- The maximum room temperature at 2m above floor level was approximately 78 degC with the temperature staying above 70 degC for nearly 6 minutes.

Test observations and results for the sprinklered test are shown below:

Table 45 Test details and observations for 2nd kitchen test

Test No		K2
Scenario		Kitchen
Sprinklered?		Yes @ 60Lpm
Test details		Chip pan heated on gas cooker until 1 minute after auto-ignition of oil occurs. Tea-towels paced on cooker hood, above chip pan to propagate flames.
Time		**Event**
Minutes	Seconds	
0	0	Ignition (@ oil temperature of 355°C)
1	08	Tea-towels ignite
1	17	Tea-towels fully burning
2	12	Sprinkler operation
2	58	Flames extinguished
Post test damage assessment		
Cooker		Grill pan cover scorched Main cooker surface covered with water and blackened cooking oil.
Tea towels		Front facing towels partially burnt, side towels slightly charred
Cupboards		Smoke damage to wall cupboards.
Work surface		Spattered with water and blackened oil



In the sprinklered Kitchen test the ignition of the pan oil and towels progressed in the same manner and with similar timing as the unsprinklered test.

- Operation of the sprinkler occurred after 2 minutes 12 seconds and immediately caused the flame height to more than double in size. However, this stage lasted only briefly and did not result in any further flame spread.
- The fire was fully extinguished 46 seconds after sprinkler operation.
- The maximum room temperature at 2m above floor level was approximately 69 degC. However, this occurred shortly after sprinkler operation due to the increase in flame height and quickly decreased to less than 40 degC within 30 seconds.

It can be clearly seen that conditions in the sprinklered fire compartments are much better compared to the unsprinklered fire compartments.

The overall outcome of these tests was that sprinklers performed well both controlling the fire and improving the tenability conditions in the room of origin and beyond.

Compared with lounge and bedroom tests the severity of the fire in both the unsprinklered and sprinklered kitchen tests and the maximum temperatures reached were much less. This suggests that a fire in a kitchen is not any worse than a fire in any other room in a dwelling. Therefore, the apartments will be designed placing no additional restrictions on the enclosure of kitchens in apartments >80m² in area.

Cooker Locations

The issue was raised of the location of cookers in kitchens in relation to an occupants ability to escape past a cooker fire to the final exit. Exposure to radiation in the event of a kitchen cooker fire has been analysed to offer additional confidence that the tenability for means of escape will be maintained.

The distance from a cooker at which occupants are not subjected to levels in excess of 2.5kW/m² for in excess of 30 seconds (Table G.3, BS PD 7974-6, 2004) was assessed. This is a conservative estimation as people only need about 20s to evacuate based on a 20m travel distance.

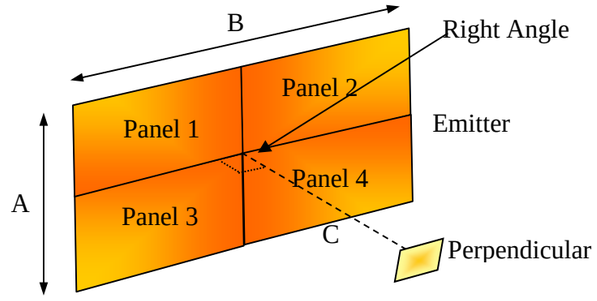
The analysis is based on the method outlined in BS7974-3 section 8.5.4, which considers the fire as a radiating panel, located in various locations in the kitchen, at 900mm above FFL (typical kitchen unit height), having a height of 1000mm (flame height) and a width of 600mm (standard kitchen unit width). The results show that at a distance 1100m from the cooker the occupants would be subject to a radiative heat of 2.4kW/m².

$$I = \phi \varepsilon \sigma T^4$$

Notes:

- Temperature of flame based on average temperature assuming a range of ca 550 to 800°C. This is considered a very conservative estimate given the fire will be sprinkler controlled.
- Flame height based on actual flame height in non sprinklered chip pan fire experiment by FPA.
- Flame width assumes large diameter chip pan fire.
- Flame size and temperature considered conservative given that the flames will be sprinkler controlled, please refer to actual test data which shows that sprinklered chip pan fire was extinguished at 46seconds with maximum upper layer temperatures of 69°C.

TEMP [K]	a= A/2[m] Flame Height	b=B/2 [m] Effective Width	C [m] Separation Distance	ϕ Configuration factor [-]	σ, Stefan Boltzmann [kW/m².K⁴]	ε [-]	Q received [kW/m²]
973	0.5	0.3	1.1	0.135	5.67×10^{-11}	0.35	2.4



Precedence in the UK

The approach proposed for this scheme is not unique. As described in the NHBC report, there are many precedence cases in the UK, a few of which are noted below:

- 2012 Athlete's Village, Stratford
- Strata Residential Tower, Elephant & Castle
- 336-337 The Strand, Aldwych
- Drill Hall, Bristol
- Lambs Passage, London

It should also be noted that many codes around the world allow longer travel distances, open plan layouts and inner bedrooms. These codes better acknowledge the influence of detection and suppression than the UK guidance, and in this respect are ahead of the UK in terms of fire engineering. Three examples are given in the following section.

International Fire Safety Guidance for Flats

NFPA Guidance

The guidance from the US (NFPA 101 – Life Safety Code) provides some useful insight into the design of open plan apartments. For example, NFPA 101 states that in sprinklered apartments it is acceptable for the escape route from the bedrooms to be through an open plan living room and kitchen. The travel distance measured to the front door from the furthest point in the apartment is limited to a maximum of 38m. Duplex apartments with open internal stair arrangements and a single means of escape are permissible provided the travel distance limit is met within the unit.

Scottish Guidelines

Guidance outlined in the 2010 Scottish Domestic Technical Handbook (Clause 2.9.7) allows open plan apartment layouts with inner bedrooms provided that any single storey area of an apartment does not exceed 200m² and the apartment is provided with residential sprinklers and enhanced smoke detection to an LD1 standard.

New Zealand Guidelines

Guidance outlined in the Compliance Document for New Zealand Building Code Fire Safety Acceptable Solutions for Part C – Fire Safety (2008) published by the Department of Building and Housing has no restrictions on kitchen layouts or bed room locations with the residential unit. The maximum permissible travel distance for 'dead end open path' travel is 24m, which may be increased by 50% for the provision of smoke detection throughout the unit and a further 50% for sprinklers, resulting in a total one way travel distance in a sprinklered apartment with detection throughout of 2x 24m = 48m (Table 3.3 C/AS1). Duplex apartments are permissible provided the travel distance limit is met.

Summary

The description and justification contained in this report is focussed on two key elements of the fire safety in apartments:

- Early detection.
- Extended tenability during later stages of a fire.

It is considered that the provision of detection and alarm and suppression throughout the apartments provides a level of life safety at least as high, if not higher, than that associated with a code compliant apartment. This view is reinforced by the referenced documents, in particular the BRE 204505 report, and the NHBC report regarding open plan apartments, extract below:

- Flat size/travel distance does not seem to be a significant factor.
- The open plan designs with enhanced detection have risks of death and injury similar to those for AD B compliant flats. At present it is not possible to reach a robust conclusion that enhanced detection can offer equivalent or better levels of safety compared with AD B compliant flats.
- The open plan flats with a sprinkler system (in accordance with BS 9251[4] or BS EN 12845,[13] as appropriate) and an enhanced detection system (LD1 system in accordance with BS 5839-6[3]) can provide a level of safety that is at least as good as that of a similar AD B compliant design.

The following table summarizes the key characteristics of the proposed fire safety strategy for the residential units:

Item	Engineered Solution
Fire safety provisions	Residential sprinklers + LD1 detection
Kitchen location	No restrictions
Cooker location	At least 1.1m away from escape routes
Bedroom location as inner rooms	Acceptable

Jamie Lee McQuillan
Buro Happold Limited
17 Newman Street
London
W1T 1PD
UK

T: +44 (0)207 927 9700
F: +44 (0)870 787 4145
Email: jamielee.mcquillan@burohappold.com