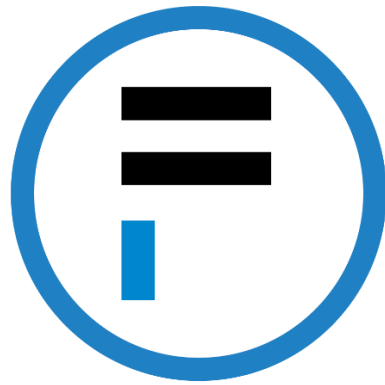


Twickenham Riverside Fire Strategy Report



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Accessibility Consultant	Lord Consultants
Fire Consultant	FDS Consult UK
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Arboricultural Consultant	Thomson Environmental Consultants
Daylight & Sunlight Consultant	GIA Chartered Surveyors
Acoustic Consultant	TetraTech
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fds consult uk

Twickenham Riverside



RIBA Stage 3 Fire Strategy Report

Issue 2



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Issue	Date	Amendment Details	Author	Checked
1	23-Jun-2021	Issue for client comment.	LG	MY
2	21-Jul-2021	Incorporate design team comments.	LG	MY
Distribution				
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This report is formulated based on the information and experience available at the time of preparation. It is applicable to the above-mentioned project only in accordance with the client's instructions. It is only valid provided no other modifications are made other than those for which a formal opinion has been sought and given by FDS Consult Limited.

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1. Introduction

1.1 Scope

1.1.1 FDS Consult has been appointed to produce the Stage 3 Fire Strategy for the two buildings in the Twickenham Riverside development located in the London Borough of Richmond upon Thames (LBRuT).

1.1.2 The description of the proposed development is:

“Demolition of existing buildings and structures and redevelopment of the site comprising residential (Use Class C3), ground floor commercial/retail/cafe (Use Class E), and public house (Sui Generis), boathouse locker storage and floating pontoon with associated landscaping, restoration of Diamond Jubilee Gardens and other relevant works.”

1.1.3 The intention of the Fire Strategy is to promote further discussion between the design team and to assist the design team in obtaining approval in principle from LBRuT.

1.1.4 This report is based on the guidance provided in BS 9991 and BS 9999.

1.1.5 Since this document forms a conceptual fire protection basis, the design team must ensure that the contents of the report are incorporated into the buildings.

1.2 Description of the development

1.2.1 Figure 1 below indicates the two buildings as part of the Twickenham Riverside development i.e. the Wharf Lane building highlighted in magenta and the Water Lane building in orange.

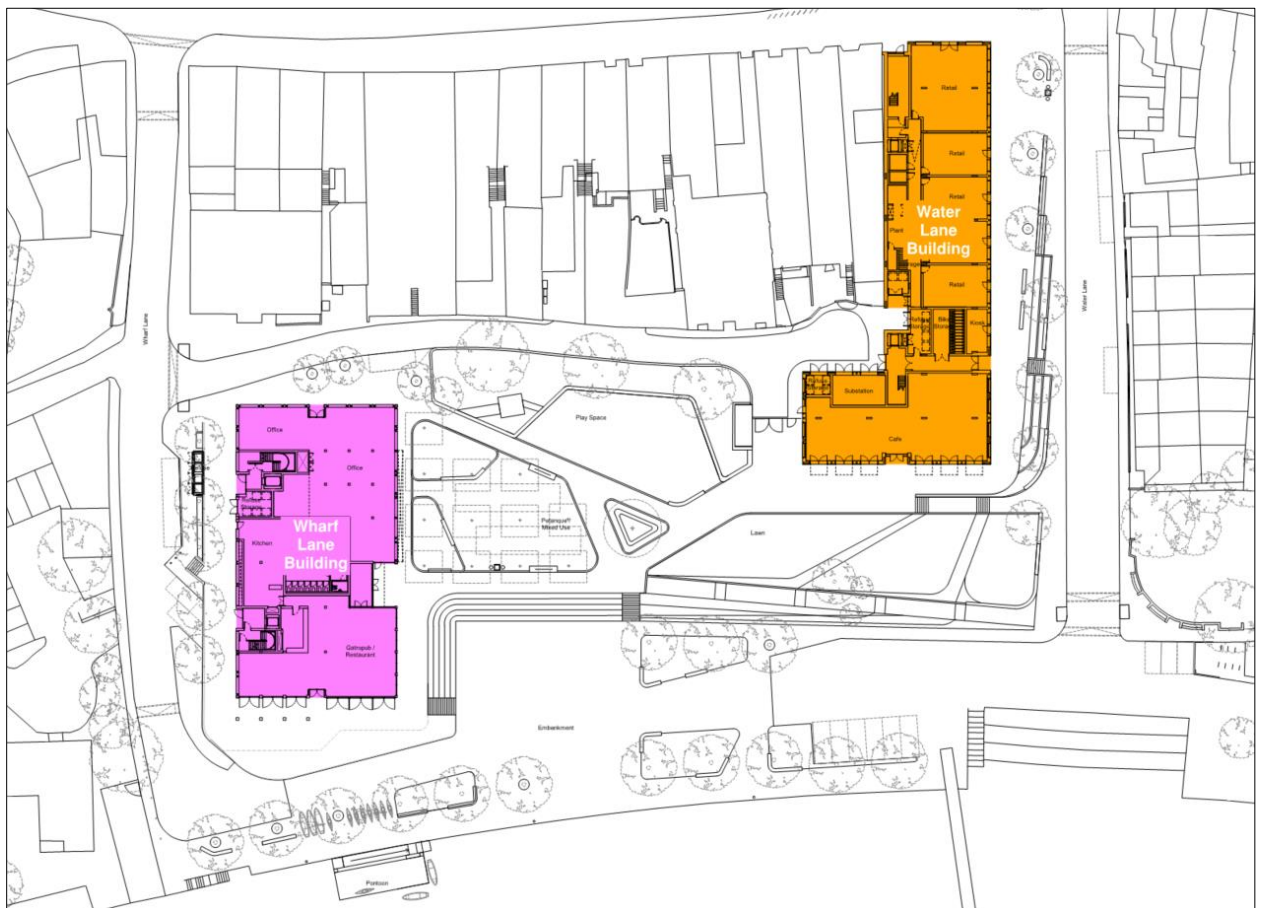


Figure 1 Twickenham Riverside

1.2.2 Wharf Lane will include a basement, ground floor and four storeys above ground. The basement will comprise plant rooms and a bicycle store. The ground level will have an office unit, a gastro pub/restaurant, public toilets, and a refuse store. The upper levels of the building will have single and duplex level flats.

- 1.2.3 Water Lane will include a ground floor and three storeys above ground. The ground floor will have shops, a café, plant rooms and refuse stores. The upper levels will have additional plant rooms and residential units made up of single and duplex level flats.
- 1.2.4 The upper levels of both buildings will have internal communal corridors and lobbies to access the flats.
- 1.2.5 Car parking for the development will be on the adjoining public streets.
- 1.2.6 Table 1 indicates the floor heights within each building. The heights are estimated relative to the lowest adjoining ground level from which the Fire Service will access to the buildings:

Floor	Approximate floor heights relative to the adjoining Fire Service access level (m)	
	Wharf Lane	Water Lane
4 th	15.45	
3 rd	12.15	11.50
2 nd	8.85	8.35
1 st	5.25	5.05
Ground	1.25	1.23
Basement	-3.20	

Table 1 Summary of floor heights

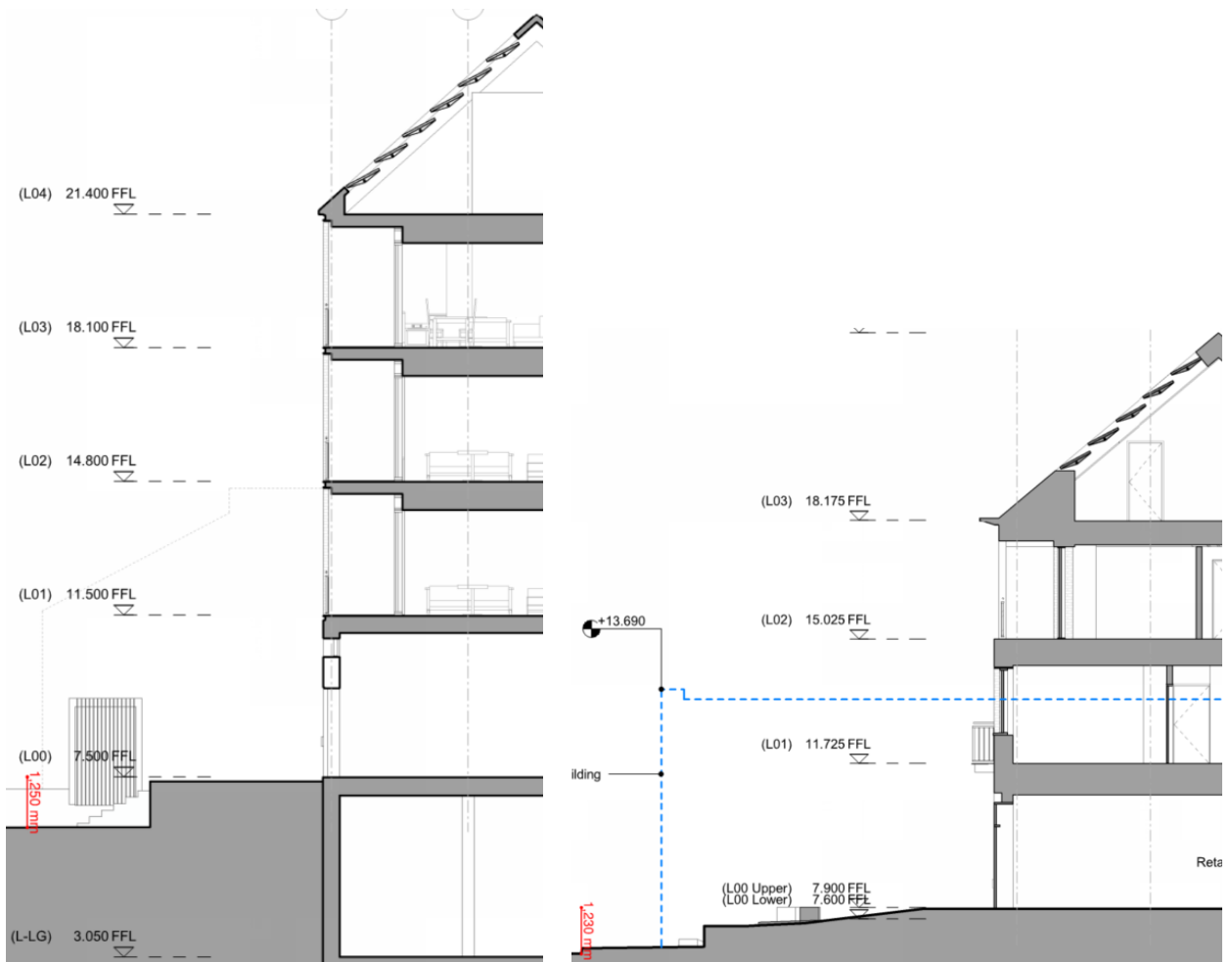


Figure 2 Floor heights of Wharf Lane (l) and Water Lane (r)

1.2.7 The basis for the fire protection strategy presented in this document is listed below.

Drawing		Drawing No.	Revision
Twickenham Riverside Ground floor plan		TRS-HAL-ZZ-00-DR-A-2500	P07
Wharf Lane Building	Basement	TRS-HAL-ZZ-00-DR-A-2549	P03
	Ground floor	TRS-HAL-ZZ-00-DR-A-2550	P03
	1 st floor	TRS-HAL-ZZ-00-DR-A-2551	P02
	2 nd floor	TRS-HAL-ZZ-00-DR-A-2552	P02
	3 rd floor	TRS-HAL-ZZ-00-DR-A-2553	P02
	4 th floor	TRS-HAL-ZZ-00-DR-A-2554	P02
	Elevations	TRS-HAL-ZZ-00-DR-A-2650	P02
		TRS-HAL-ZZ-00-DR-A-2651	P02
Sections	TRS-HAL-ZZ-00-DR-A-2604	P02	
Water Lane Building	Ground floor	TRS-HAL-ZZ-00-DR-A-2560	P02
	1 st floor	TRS-HAL-ZZ-00-DR-A-2561	P02
	2 nd floor	TRS-HAL-ZZ-00-DR-A-2562	P02
	3 rd floor	TRS-HAL-ZZ-00-DR-A-2563	P02
	Elevations	TRS-HAL-ZZ-00-DR-A-2660	P02
		TRS-HAL-ZZ-00-DR-A-2661	P02
	Sections	TRS-HAL-ZZ-00-DR-A-2605	P02

Table 2 Schedule of drawings

1.3 Fire strategy overview

1.3.1 The proposals outlined in this document demonstrate a level of fire safety equivalent to or greater than the minimum compliance measures recommended in the guidance documents. The functional requirements of the Building Regulations with respect to fire safety are therefore deemed to be satisfied. The fire strategy proposed in this report is summarised below.

1.3.2 Residential:

1.3.2.1 The flats will be designed for a conventional 'stay-put' strategy where only the flat in which a fire occurs will evacuate in the first instance.

1.3.2.2 All flats will be protected with a Grade D1/D2, Category LD1 automatic fire detection and alarm system (AFDAS) as per BS 5839-6. Grade D1 detectors are recommended in rented flats since the grade makes provision for tamper-proof batteries in the detectors.

1.3.2.3 Communal residential corridors will be protected with a Category L5 AFDAS as per BS 5839-1.

1.3.2.4 All flats will be protected with a Category 2 automatic water fire suppression system (AWFSS) as per BS 9251.

1.3.2.5 Extended communal corridors will be provided with smoke control systems.

1.3.2.6 Residential escape stairs will be provided with a 1m² automatic opening vent (AOV) at the head of the stairs.

1.3.3 Non-residential:

1.3.3.1 The non-residential areas of the buildings will be designed for simultaneous evacuation of the fire affected compartment.

1.3.3.2 The commercial units (offices, shops, pub/restaurant) will be protected with a minimum Category L3 AFDAS as per BS 5839-1.

- 1.3.3.3 Landlord areas (plant rooms, stores, stairs, and back-of-house corridors) will be protected with a Category L3 as per BS 5839-1.
- 1.3.3.4 The offices and pub/restaurant will be protected with a Class OH1 AWFSS as per BS EN 12845.
- 1.3.3.5 The plant rooms, refuse stores, and shops will be protected with a Class OH3 AWFSS as per BS EN 12845.
- 1.3.4 Refuges with emergency voice communication (EVC) systems as per BS 5839-9: 2011 will be provided in each stair on all floors except ground level.
- 1.3.5 Elements of structure will be a minimum of 60 minutes fire resistance.
- 1.3.6 The buildings will be separated into compartments with a minimum of 60 minutes fire resisting construction.
- 1.3.7 The buildings are not over 18m in height and are therefore not required to comply with Regulation 7(2) of the Building Regulations. Accordingly, the surfaces of the external walls will achieve a rating of European Classification B-s3, d2 or better.
- 1.3.8 Firefighting access to the upper levels of the buildings will be via the protected stair shafts. There is no requirement to provide firefighting shafts since the buildings are less than 18m.
- 1.3.9 Dry rising mains will be provided in all stair cores.

1.4 Normative references

- 1.4.1 Approved Document 7, Materials and workmanship, The Building Regulations, 2018.
- 1.4.2 BS 9991 Code of practice for fire safety in the design, management and use of residential buildings, 2015.
- 1.4.3 BS 9999 Code of practice for fire safety in the design, management and use of buildings, 2017.
- 1.4.4 The Building Regulations, 2010.
- 1.4.5 The Regulatory Reform (Fire Safety) Order, 2005.

1.5 Informative references

- 1.5.1 Approved Document B, Fire Safety – Volume 2, The Building Regulations, 2010.
- 1.5.2 BR 187 External Fire Spread: Building separation and boundary distances, 2014.
- 1.5.3 BS 476 Fire tests on building materials and structures, Part 21 Methods for determination of the fire resistance of loadbearing elements of construction, 1987.
- 1.5.4 BS 476 Fire tests on building materials and structures, Part 22 Methods for determination of the fire resistance of non-loadbearing elements of construction, 1987.
- 1.5.5 BS 5266 Emergency lighting, Part 1 Code of practice for the emergency lighting of premises, 2016.
- 1.5.6 BS 5839 Fire detection and fire alarm systems for buildings, Part 1 Code of practice for the design, installation, commissioning, and maintenance of systems in non-domestic premises, 2017.
- 1.5.7 BS 5839 Fire detection and fire alarm systems for buildings, Part 6 Code of practice for the design, installation, commissioning and maintenance of fire detection and fire alarm systems in domestic premises, 2019.
- 1.5.8 BS 5839 Fire detection and fire alarm systems for buildings, Part 9 Code of practice for the design, installation, commissioning, and maintenance of emergency voice communication systems, 2011.
- 1.5.9 BS 8519 Code of practice for the selection and installation of fire-resistant power and control cable systems for life safety, fire-fighting and other critical applications, 2020.
- 1.5.10 BS 9251 Code of practice for fire sprinkler systems for domestic and residential occupancies, 2014.
- 1.5.11 BS 9990 Code of practice for non-automatic firefighting systems in buildings, 2015.
- 1.5.12 BS EN 12101 Smoke and heat control, Part 2 Specification for natural smoke and heat exhaust ventilators, 2017.

- 1.5.13 BS EN 12845 Design, installation, and maintenance of fixed firefighting systems - automatic sprinkler systems, 2015.
- 1.5.14 BS EN 13501 Fire classification of construction products and building elements, Part 1 Classification using data from reaction to fire tests, 2018.
- 1.5.15 BS EN 13501 Fire classification of construction products and building elements, Part 2 Classification using data from fire resistance tests, excluding ventilation services, 2016.
- 1.5.16 BS EN 13501 Fire classification of construction products and building elements, Part 3 Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers, 2009.
- 1.5.17 BS EN 13501 Fire classification of construction products and building elements, Part 4 Classification using data from fire resistance tests on components of smoke control systems, 2016.
- 1.5.18 BS EN 81 Safety rules for the construction and installation of lifts, Lifts for the transport of persons and goods, Part 20, Passenger and goods lifts, 2020.
- 1.5.19 BS EN 81 Safety rules for the construction and installation of lifts, Particular applications for passenger and goods passenger lifts, Part 70, Accessibility to lifts for persons including persons with disability, 2021.
- 1.5.20 Gas Safety (Installation and Use) Regulations, 1998.
- 1.5.21 Guidance Note 29, Access for fire appliances, London Fire Brigade, 2012.
- 1.5.22 Pipelines Safety Regulations, 1996.
- 1.5.23 Smoke Control Association, Guidance on smoke control to common escape routes in apartments buildings (flats and maisonettes), Revision 3.1, July 2020.

1.6 Abbreviations

Abbreviation	Clarification
ADB-2	Approved Document B, Fire Safety – Volume 2
AFDAS	Automatic fire detection and alarm system
AOV	Automatic opening vent
ASHP	Air source heat pump
AWFSS	Automatic water fire sprinkler system
BS	British Standard
CDM	Construction (Design and Management) Regulations 2015
EVC	Emergency voice communication
FSO	The Regulatory Reform (Fire Safety) Order
LBRuT	London Borough of Richmond upon Thames
MHCLG	Ministry of Housing, Communities and Local Government
OV	Openable vent
PEEP	Personal emergency evacuation plan
SCA	Smoke Control Association

Table 3 Abbreviations

2. Legal framework

2.1 Requirements

- 2.1.1 The main fire safety legislations applicable to the Twickenham Riverside development are The Building Regulations and The Regulatory Reform (Fire Safety) Order (FSO), 2005.
- 2.1.2 This document is the conceptual basis of the fire safety measures for the development. Once accepted and approved, the design team must ensure that the provisions outlined in this report are incorporated into the buildings' design.
- 2.1.3 The conceptual fire strategy outlines passive and active design provisions. This strategy is primarily concerned with evacuating occupants from the dwellings safely and providing measures, where necessary, to assist the firefighters in their operations.
- 2.1.4 The concept will not prevent a fire from occurring. It is only valid where the protection systems are designed; installed; commissioned and maintained to acceptable industry standards.
- 2.1.5 Until this report is agreed with the approving authorities, the content should only be used 'As Preliminary Information'.

2.2 Building Regulations

- 2.2.1 The construction or modification of any building in England and Wales must comply with the statutory requirements of the Building Regulations. The Building Regulations forms the framework for the legal, administrative, and technical requirements around all construction work.
- 2.2.2 Regulations 4 and 6 relate to the requirements for the construction of all new buildings and changing the use of existing buildings, respectively. Schedule 1 provides detailed functional requirements with respect to Regulations 4 and 6 under 16 separate parts.
- 2.2.3 For each part, detailed specifications are available under the Approved Documents. The Approved Documents provide detail on the minimum appropriate standards required for compliance with the Building Regulations, and the methods and materials which may be used to achieve these.
- 2.2.4 In the case of fire safety, the requirements are dealt with under the functional requirements B1 to B5 of Schedule 1 of the Building Regulations.
- 2.2.5 Approved Document B (ADB) provides practical, deemed-to-satisfy recommendations on how to achieve compliance with the Building Regulations.
- 2.2.6 Other standards (e.g. BS 9991 and BS 9999) also provide recommendations which are acceptable guidance documents to demonstrate compliance.
- 2.2.7 An alternative approach is to adopt Fire Safety Engineering, which integrates fire engineering calculations, life safety systems, inherent building features and professional judgement, to produce a fire strategy that achieves appropriate levels of safety specific to a building and its use.
- 2.2.8 The responsibility for deciding if the functional requirements of the regulations have been met lies with the building control body (a Local Authority Building Control Officer or an Approved Inspector).

2.3 Regulatory Reform (Fire Safety) Order

- 2.3.1 The Fire Safety Order (FSO) is designed to provide a minimum standard of fire safety in all buildings.
- 2.3.2 The FSO imposes a duty on the person responsible for premises to carry out certain fire safety tasks including ensuring the general fire precautions are satisfactory and conducting a fire risk assessment. If more than five persons are employed, it must be a written fire risk assessment.
- 2.3.3 The responsible person has a duty to take action to prevent fires and protect against death and injury of employees and relevant persons, should a fire occur.

2.3.4 To support the FSO, the Ministry of Housing, Communities and Local Government (MHCLG) have published several guidance documents to assist responsible persons undertake fire safety risk assessments. The guides provide advice on typical premises to which the FSO applies.

2.4 Construction, Design and Management Regulations

2.4.1 Projects undertaken in the UK are subject to the requirements of Regulation 7 of The Building Regulations and the Construction (Design and Management) Regulations 2015 (CDM).

2.4.2 This report defines the strategy for meeting the functional and performance requirements for fire safety in the finished building. It is intended to form part of the submission for approval under the Building Regulations, Part B.

2.4.3 Where any conclusions or recommendations contained within this report specify materials, products, or forms of construction, it is anticipated that these will be assessed, in accordance with CDM 11 (Duties of Designers) and CDM 15 (Duties of Contractors).

2.4.4 The Principal Designer will be informed where residual risks are anticipated, or critical health and safety assumptions have been made.

2.4.5 Where the architect or other consultants use all or part of this report to specify works, it is understood that they are competent in alerting the Client, Principal Designer, Designers, Contractors and Building Occupier of issues arising under the CDM Regulations.

3. Provision of means of warning and escape

Schedule 1 of the Building Regulations' functional requirements with respect to B1 reads:

B1 Functional Requirement

The building shall be designed and constructed so that there are appropriate provisions for the early warning of fire, and appropriate means of escape in case of fire from the building to a place of safety outside the building capable of being safely and effectively used at all material times.

Limits on Application

Requirement B1 does not apply to any prison provided under section 33 of the Prison Act 1952^(a) (power to provide prisons, etc.).

(a) 1952 c. 52; section 33 was amended by section 100 of the Criminal Justice and Public Order Act 1994 (c. 33) and by S.I. 1963/597.

The following discusses the implications of the proposed building design and seeks to demonstrate compliance with B1 of the regulations as well as a satisfactory standard of fire safety.

3.1 General principles

- 3.1.1 The intent of the regulation is that occupants should have a means to be alerted when there is a fire. In general, the principle when specifying an AFDAS is to achieve a balance between the requisite level of fire safety and a system which remains effective by not generating spurious alarms.
- 3.1.2 The intent of the regulation is also that occupants should be able to egress their dwelling unassisted via a route which does not pose any new or greater risks to them.
- 3.1.3 Where possible, when faced with a fire, escaping occupants should have the option to use an alternative route to reach safety (e.g. fire protected stair core). Alternative escape paths should provide a fire protected route all the way to a place of safety i.e. at ground level in fresh air away from the building.
- 3.1.4 The requirements for the satisfying a single means of escape depend on the building occupancy and its features.
- 3.1.5 The means of escape strategy for flats does not initially require the evacuation of neighbouring flats but only the fire affected flat. The degree of compartmentation between flats ensures that the occupants of adjoining flats should remain safe and unaffected by a neighbouring fire. If necessary, the Fire Service will initiate and coordinate evacuation of other flats.
- 3.1.6 The means of escape strategy from all non-residential areas is based on all occupants evacuating the fire affected compartment simultaneously.

3.2 Travel distances

- 3.2.1 Travel distances within all parts of the building should meet the recommendations in BS 9991 and BS 9999.
- 3.2.2 Additional guidance is provided in the Smoke Control Association (SCA) guide (Rev 3.1) where there are extended travel distances within residential communal corridors. The guide's recommendations are based on the buildings' features and fire safety objectives. A combination of fire engineering and active fire protection systems are incorporated to achieve these objectives.
- 3.2.3 The assessment of travel distances within the building has been carried out on the above mentioned basis and are summarised in the relevant tables in each discussion.

3.3 Escape from within the flats

3.3.1 Table 4 summarises the travel distance limits within flats.

Occupancy	Area	Maximum travel distance (m)	
		In one direction	More than one direction
Residential (dwellings) Flats	Within a fire protected entrance hall	9	n/a
	From any point within a habitable room in an open plan flat to the entrance door	9	n/a
	From any point within a habitable room to the entrance door within an open plan flat protected by an AWFSS and Category LD1 AFDAS	20	n/a

Table 4 Limitations on travel distances within flats

3.3.2 Single level flats:

3.3.2.1 All the single level flats within Wharf Lane and Water Lane buildings are considered open plan dwellings since the bedrooms are inner rooms off an open plan kitchen and living area.

3.3.2.2 It is not proposed to provide fire protected entrance halls within the flats which are all less than 192m².

3.3.2.3 BS 9991 specifies requirements for the layout of open plan flats as follows:

- Occupants must be capable of unassisted egress.
- The dimensions of the open plan flat should not exceed 16m x 12m.
- Open-plan flats should only be a single level.
- The minimum height of ceilings within the open plan flat should be 2.25m.
- Cooking appliances in open-plan flats having an area smaller than 8m x 4m should not be located adjacent to the main entrance.
- Open-plan flats exceeding 8m x 4m should have the kitchen enclosed.
- AFDAS: Grade D1/D2 Category LD1 as per BS 5839-6 (see §3.14 for more details)
- AWFSS: Category 2 as per BS 9251(see §3.15 for more details)

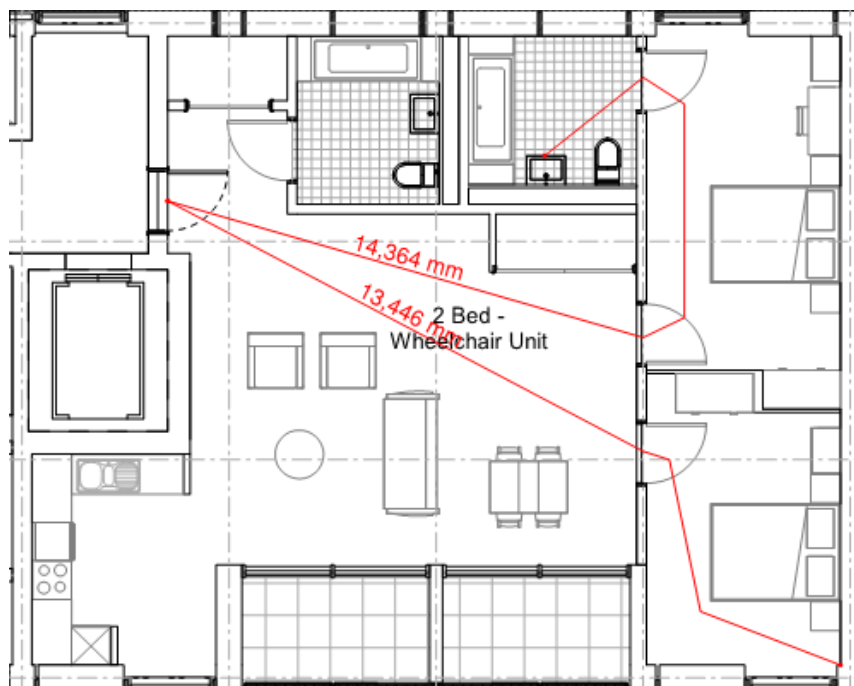


Figure 3 Large open plan flat (≈97m²)

3.3.2.4 Figure 3 has an indicative furniture layout in one of the larger units (≈97m²) and shows travel distances that are less than 20m.

- 3.3.2.5 All the open plan flats within the development are over 32m², which would require the cooking facilities to be enclosed.
- 3.3.2.6 It is not proposed to enclose the kitchen area since we consider the upgraded active fire protection systems provide an enhanced level of fire safety and demonstrates compliance with the intent of the regulations.
- 3.3.2.7 The location of cooking hobs in relation to escape routes is discussed further in §3.3.5 and Appendix B.

3.3.3 Duplex flats:

- 3.3.3.1 The fire protection design for the duplex flats will incorporate the following:
 - AFDAS: Grade D1/D2 Category LD1 as per BS 5839-6 (see §3.14 for more details)
 - AWFSS: Category 2 as per BS 9251(see §3.15 for more details)
 - A 30-minute fire protected stair enclosure (shaded in green in Figure 4) with FD30 fire doors (orange dots).
 - Where a cupboard is located under the internal stair, the underside of the stair will be underdrawn with 30 minutes fire resisting construction, the cupboard will be enclosed with 30 minutes fire resisting construction and fitted with a 30 minutes fire door (FD30).



Figure 4 Typical entrance level (l) and upper level (r) of duplex flat

- 3.3.3.2 The bathroom may be included within the fire protected stair enclosure without a fire door provided the bathroom contains only conventional sanitary features i.e. no appliances and the construction between the bathroom and adjoining rooms should be at least 30 minutes fire resistance.
- 3.3.4 Utility cupboards:
 - 3.3.4.1 The utility cupboards are designed to house a range of services including electrical distribution boards, heat pumps and ventilation heat recovery.
 - 3.3.4.2 Some of the utility cupboards will be designed with dedicated power supply and plumbing to accommodate appliances.
 - 3.3.4.3 The utility cupboards will be enclosed in 30 minutes fire resisting construction with a 30 minute fire door (FD30) and provided with smoke detection.
 - 3.3.4.4 All service penetrations through the utility cupboard will be fire-stopped.

3.3.5 Location of cooking hobs:

- 3.3.5.1 A cooker has the potential for unattended accidental fires, cooker hood grease fires, spilled oil fires, etc. which are fast growing fires that present the greatest fire risks. Under such circumstances, it is vital that the escape route for occupants is not impeded due to the proximity to the cooker.
- 3.3.5.2 The fit-out layouts of all flats need to ensure that the edge of the hob is at least 1.8m from the escape route whilst still maintaining a clear exit width of at least 750mm.
- 3.3.5.3 Appendix B discusses the minimum separation distance required between the hob and the escape route in greater detail.
- 3.3.5.4 Figure 5 below shows the indicative furniture layout in a studio unit. The layout does not show the location of appliances including the hob. The installation location of the hob must take into consideration the requirements in §3.3.5.2 to ensure that there is sufficient clearance between the hob whilst maintaining an escape path.

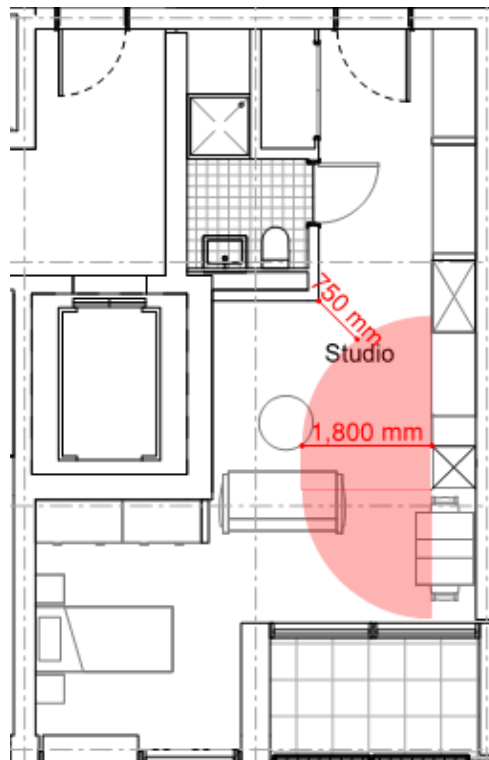


Figure 5 Consideration of hob location and escape route

3.3.6 Balconies:

- 3.3.6.1 The flats are provided with balconies from which the escape route passes through a kitchen.
- 3.3.6.2 As discussed in §3.3.4, the hob's location should not prejudice the escape route through a kitchen. The proximity of the hob from the escape route should meet the requirements in §3.3.5.2.
- 3.3.6.3 Most of the balconies are modest in size where the furthest part of the balcony is less than 7.5m from the balcony door. The AFDAS detector/sounder in the lounge will be located near the balcony door and should be audible on the balcony when all the doors and windows are closed.
- 3.3.6.4 There are flat layouts where the travel distance from the furthest point on the balcony to the flat entrance door is more than 20m. The travel distance will depend on the number and locations of the balcony doors. An example of a layout is shown in Figure 6. In such a situation, a sounder, interconnected with the flat's AFDAS, should be installed on the balcony.

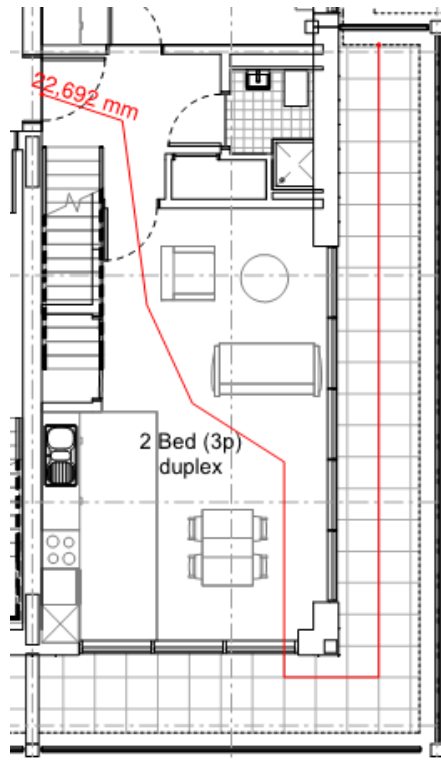


Figure 6 Travel distance from balcony to flat entrance door

3.4 Residential communal escape

Occupancy	Area	Maximum travel distance (m)	
		In one direction	More than one direction
Residential (dwellings) Flats	Within communal lobby/corridor with natural smoke ventilation system	7.5	30
	Within communal lobby/corridor with a natural smoke control system and automatic sprinkler protection within the flats	15	60
	Within communal lobby/corridor with a mechanical smoke control system and automatic sprinkler protection within the flats	30	

Table 5 Limitations on travel distances within communal escape routes

- 3.4.1 The lobby and corridor arrangements provide a single route (i.e. from a dead-end) to the stair. The escape routes from flat entrance doors requires travel in a single direction to access an escape stairway.
- 3.4.2 Each lobby/corridor arrangement has a minimum ventilation requirement. Smoke control systems are required in dead end corridors depending on the travel distance from the most remote flat entrance door to the stair (or sterile lobby). The design of the smoke control system in each case must satisfy specific fire protection design objectives, which are discussed below.

- 3.4.3 Where travel distances are up to 7.5m in a single direction within the communal corridor, the primary objective of the smoke control system is to maintain the stair free from smoke. There are several ways to achieve the smoke control objectives:
- Naturally ventilate the flats' communal lobby directly to the outside through an AOV (minimum 1.5m² free area) and install an AOV (minimum 1m² free area) at the head of the stair.
 - Naturally ventilate the corridor's communal lobby directly to the outside through an AOV (minimum 1.5m² free area) and install an AOV (minimum 1m² free area) at the head of the stair.
 - Naturally ventilate the corridor via an AOV (minimum 1m² free area) which opens into a smoke shaft (minimum free area 1.5m²) and install an AOV (minimum 1m² free area) at the head of the stair.
- 3.4.4 BS 9991 allows extended dead-end corridors up to 15m when an AWFSS is installed in all the flats opening off the corridor. An AWFSS helps to control fire size, reduces smoke production, and mitigates the risk of fire spread beyond the room of fire origin. The primary objective of the smoke control system in this case will be to protect the staircase enclosure for firefighting. The design options to achieve the smoke control objectives are the same as those mentioned in §0 above.
- 3.4.5 The buildings do not have significantly extended dead-end corridors over 15m and consequently there is no requirement for mechanical smoke ventilation systems.
- 3.4.6 The requirements for the communal escape routes for each building will be discussed separately based on the preceding criteria.
- 3.4.7 It is not proposed to use natural smoke shafts in the buildings but instead ventilate corridors directly to the outside via AOV's.
- 3.4.8 The measurement of the communal corridors is taken from the floor plans to the best estimation.
- 3.4.9 The annotation convention adopted for the discussion of communal escape routes is indicated below:








Fire protection aspect	Colour	Sample / symbol
Above ground residential escape stair	Green	
Area that requires revision		
Basement escape stair	Magenta	
Corridor/lobby with natural smoke control	Cyan	
Corridor/lobby with no smoke control provisions	no shading	
Northern escape stair	-	
Refuge	-	
Southern escape stair	-	

Table 6 Communal escape annotation legend

3.5 Wharf Lane residential communal escape

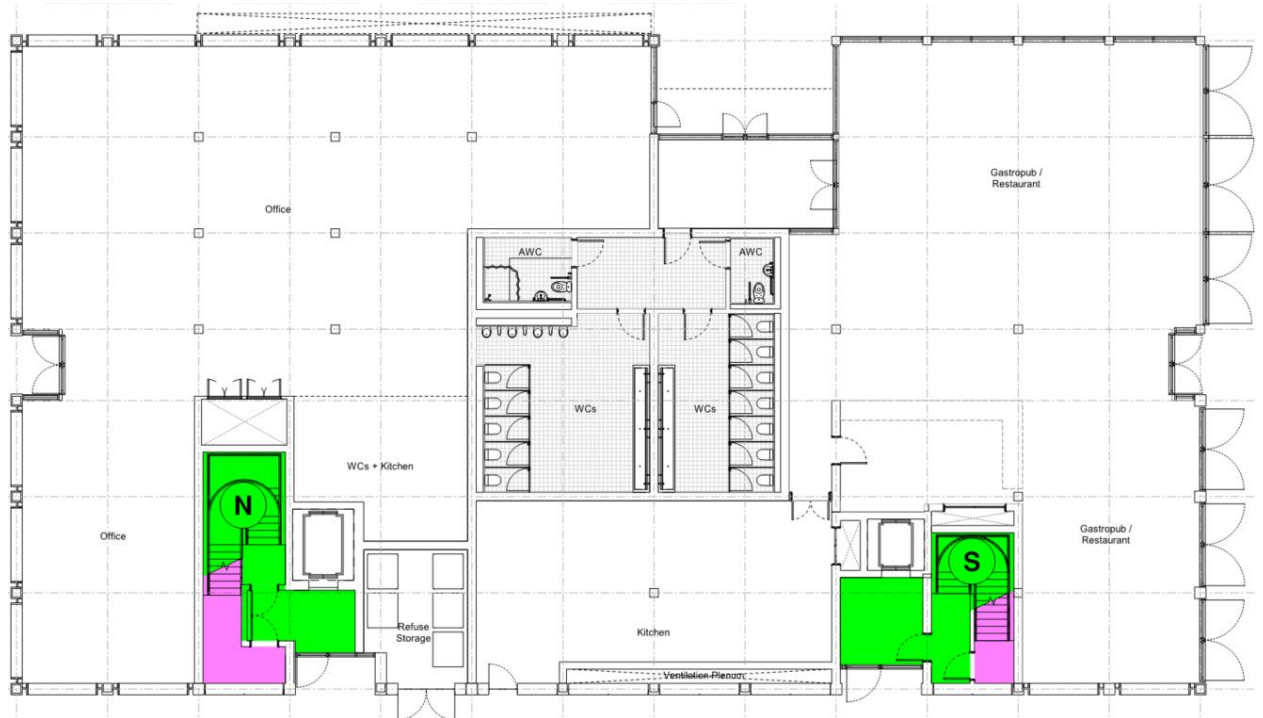


Figure 7 Wharf Lane ground floor

3.5.1 The escape routes from the flats discharge at ground floor. The ground floor exit arrangements from the escape stairs satisfies the principles illustrated in Figure 7.5.C of the SCA Guidance as illustrated below:

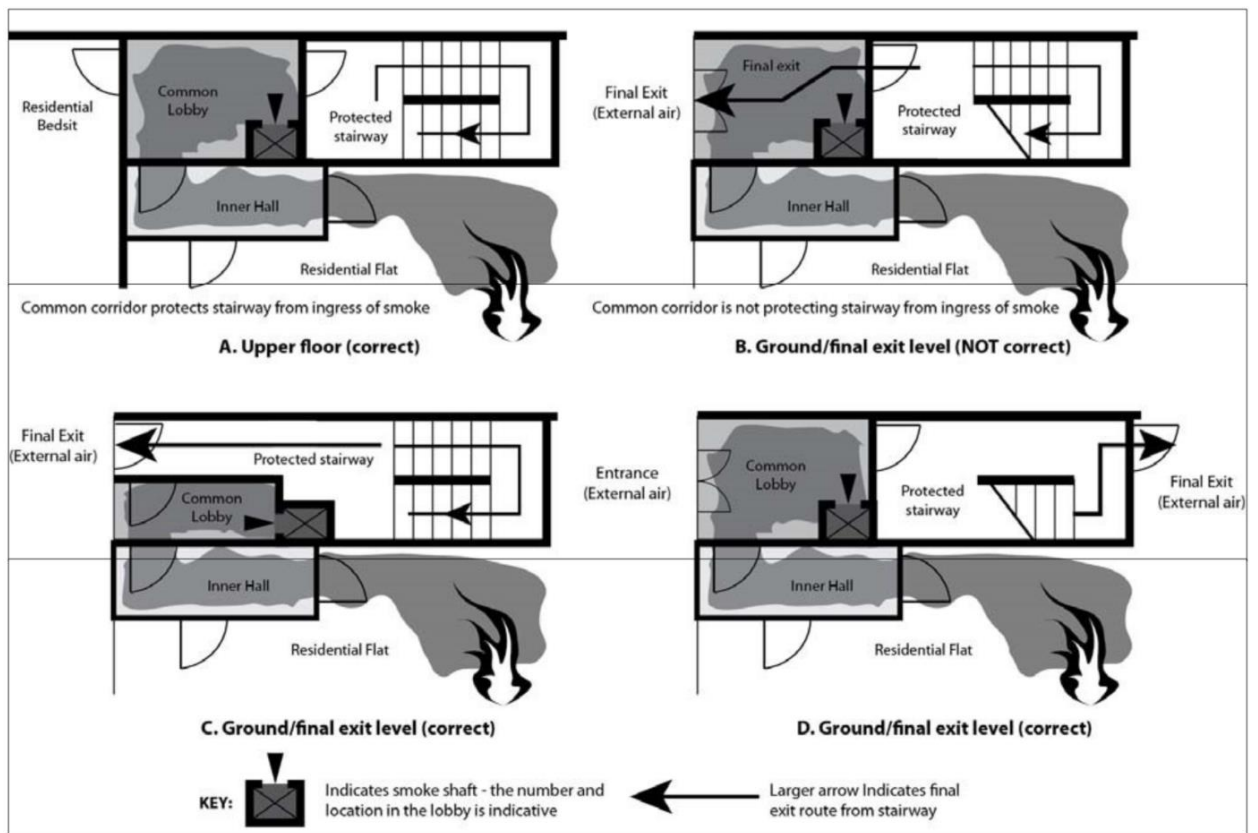


Figure 8 SCA Guidance on ground floor exit arrangements

3.5.2 The northern residential escape stair is separated from the basement stair by fire rated construction, a ventilated basement lobby (see Figure 19) and a fire door at ground level.

3.5.3 The southern residential escape stair is separated from the basement stair by fire rated construction which discharges directly to the outside.



Figure 9 Wharf Lane 1st floor

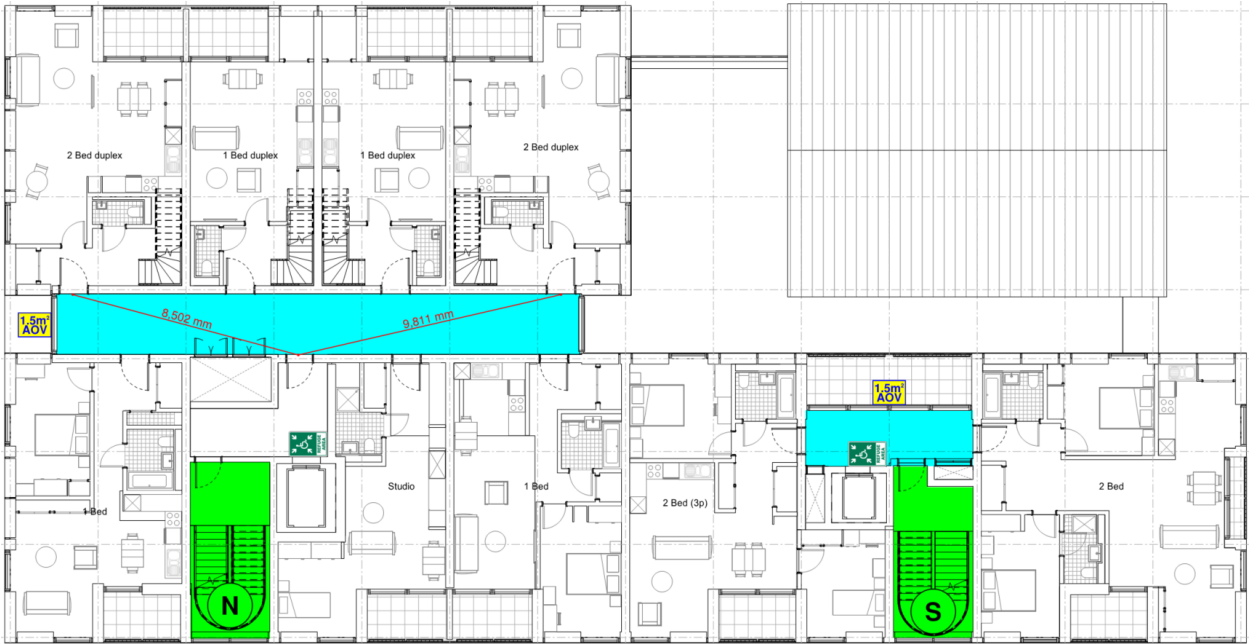


Figure 10 Wharf Lane 2nd floor



Figure 11 Wharf Lane 3rd floor

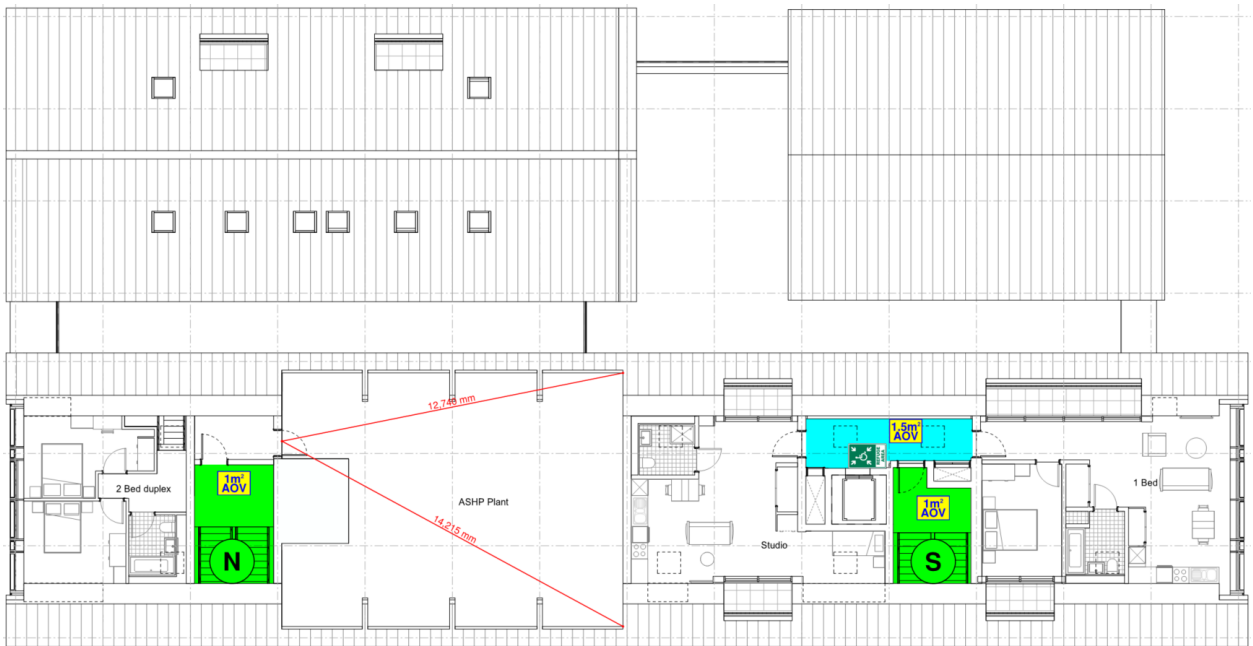


Figure 12 Wharf Lane 4th floor

- 3.5.4 The residential units in Wharf Lane are on the first to fourth floors. On each floor level, there is a single direction of escape from all flats within the communal corridor.
- 3.5.5 The travel distance from the furthest flat to the protected lift lobby or stair is less than 15m. The communal corridors and lobbies will be provided with natural smoke control via AOV's (minimum 1.5m² free area).
- 3.5.6 Upon smoke detection in a corridor or lobby, the building's AFDAS will be programmed to open the AOV's in the fire affected corridor.
- 3.5.7 The southern escape stair has lobbies on each level which provides access to a communal balcony. The use and contents of the balconies needs to be controlled so that it does not introduce a fire risk to the escape lobby. There is a potential for this space to be used by residents as uncontrolled storage space.
- 3.5.8 On the fourth floor, the northern escape stair would normally be required to be separated from the air source heat pumps (ASHP) plant room by a naturally ventilated (0.4m² free area) fire protected lobby. It is proposed to provide only a fire protected lobby (without natural ventilation) between the plant room and the stair.

The reasons being:

- Firstly, the plant room is at the topmost level of the stair and not along the residential escape route.
- Secondly, the plant room's access door will be immediately adjacent the escape stair AOV which will provide at least 1m² natural ventilation.
- Lastly, because of the process ventilation requirements for the ASHP plant room, the room may be considered an external space rather than an enclosed plant room due to the permanent natural ventilation which will be provided. See Figure 17 and Figure 18.

This proposal is subject to Building Control approval.

3.5.9 A minimum 1m² AOV will be installed at the head of each escape stair. The opening of the AOV will be activated by the corridor/lobby smoke detection. The AOV will be capable of remote operation from the ground floor.

3.6 Water Lane residential communal escape

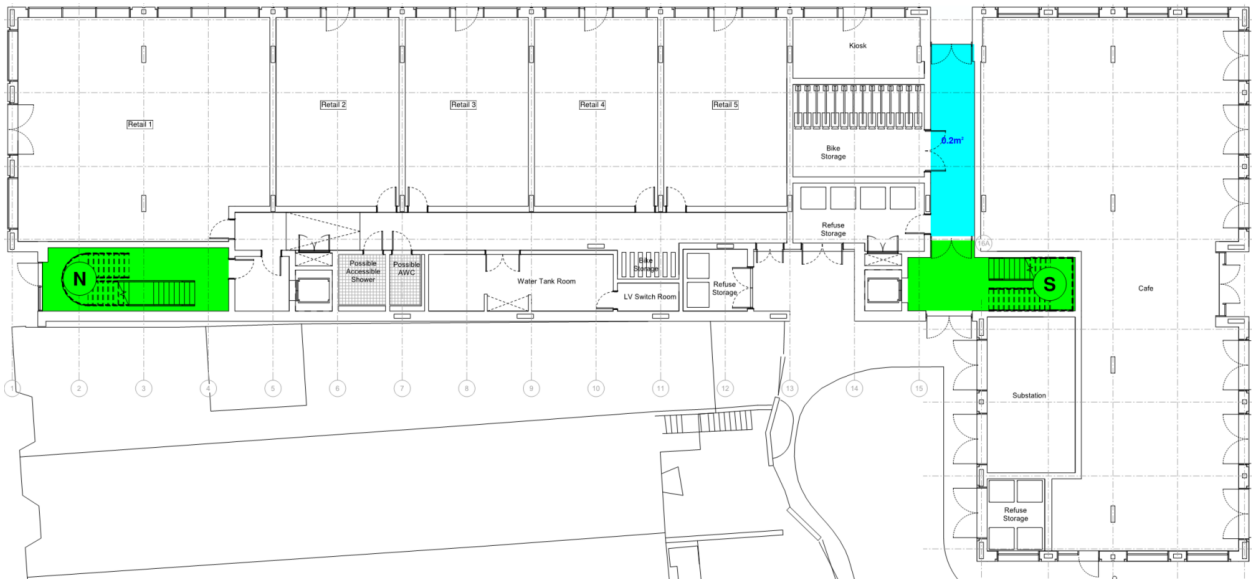


Figure 13 Water Lane ground floor

3.6.1 The escape routes from the flats discharge at ground floor. The ground floor exit arrangements from the escape stairs satisfies the principles illustrated in Figure 7.5.C of the SCA Guidance as illustrated earlier in Figure 8.

3.6.2 The southern stair will be separated from the refuse and cycle stores, which are ancillary to the residential, by a naturally ventilated (0.2m² free area) fire protected lobby.



Figure 14 Water Lane 1st floor

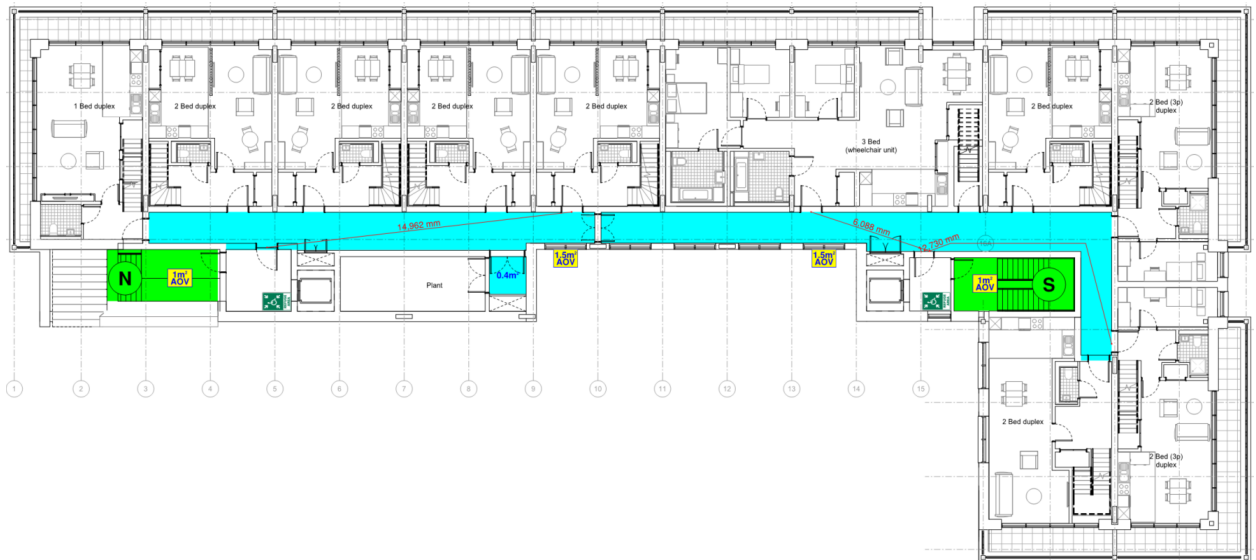


Figure 15 Water Lane 2nd floor

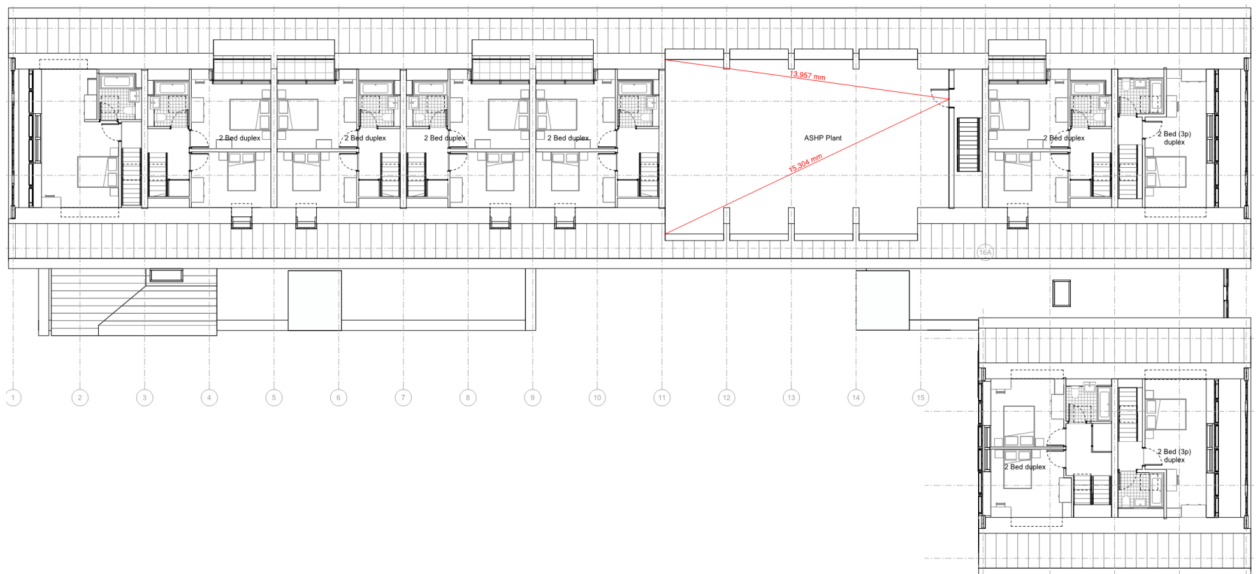


Figure 16 Water Lane 3rd floor

- 3.6.3 The residential units in Water Lane are on the first to third floors. On each floor level, there is a single direction of escape from all flats within the communal corridor.
- 3.6.4 The travel distance from the furthest flat to the protected lift lobbies is less than 15m. The communal corridors will be provided with natural smoke control via AOV's (minimum 1.5m² free area).
- 3.6.5 Upon smoke detection in the corridor, the building's AFDAS will be programmed to open the AOV's in the fire affected corridor.

The ASHP plant room will be separated from the second floor residential corridor by an unventilated fire protected stair. The ASHP plant room may be considered an external space rather than an enclosed plant room due to the process ventilation requirements and the permanent natural ventilation which will be provided. See Figure 17 and Figure 18. This proposal is subject to Building Control approval.

- 3.6.6 A minimum 1m² AOV will be installed at the head of each escape stair. The opening of the AOV will be activated by the corridor smoke detection. The AOV will be capable of remote operation from the ground floor.

3.7 Residential communal escape general requirements

- 3.7.1 A Category L5 AFDAS as per BS 5839-1 (detection only) will be installed to protect the communal corridor escape routes which require automatic smoke control. The detection system will be used to actuate the AOV's. The AFDAS is discussed further in §3.14.
- 3.7.2 The AOV's required at the head of the escape stairs should provide at least 1m² free air.
- 3.7.3 All natural smoke ventilators should comply with BS EN 12101-2 which are required be designed, tested and manufactured as a single entity. All natural ventilators should carry the CE product mark.
- 3.7.4 The minimum clear width of stairs shall be at least 800mm.
- 3.7.5 Where the discharge from an escape stair is not directly to the outside, the onwards escape route must be fire protected to the same standard as the stair and be separated by fire protected lobbies from adjoining accommodation.
- 3.7.6 Stairs and communal escape routes will be managed and kept sterile of fire loads and clear of obstacles which may impede escape.

3.8 Residential ancillary accommodation

Occupancy Group	Area		Maximum travel distance (m)	
			In one direction	More than one direction
Residential ancillary areas	Bicycle store Plant room Refuse store	Place of special fire hazard	9 (6)	18 (12)
		Within normal hazard room	18 (12)	45 (30)
		Within enclosed escape route	18 (12)	45 (30)
		In open air	60 (40) ⁽¹⁾	100 (66) ⁽¹⁾
Distances indicated in brackets are direct distances.				
(1) Travel distances obtained from Table 2.1 of ADB-2.				

Table 7 Limitations on travel distances in ancillary areas

- 3.8.1 The buildings have bicycle stores and refuse stores which are ancillary to the residential use.
- 3.8.2 The refuse stores are designated engineering services and are considered places of special fire hazard.
- 3.8.3 The direct distances measured in the ASHP plant rooms exceed the recommended limits for escape distances within an enclosed plant room. The ASHP plant requires permanent natural ventilation to satisfy the process requirements. Due to the extent of permanent natural ventilation provided for each plant room, the rooms may be considered external spaces rather than enclosed plant rooms. Under such circumstances, the direct travel distances are considered acceptable. A typical section and elevation of the plant room roof is indicated in Figure 17 and Figure 18 respectively.
- 3.8.4 In other ancillary areas, the escape distances measured to a relatively safe place (fire protected corridor or directly outside) are deemed acceptable.
- 3.8.5 The previous sections of this report discussed the requirements where communal routes interconnect with ancillary rooms within the buildings.

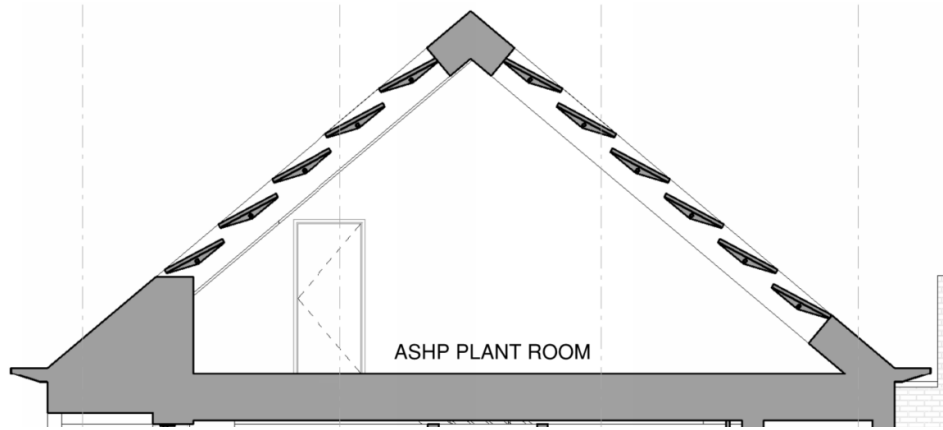


Figure 17 ASHP Plant Room roof section

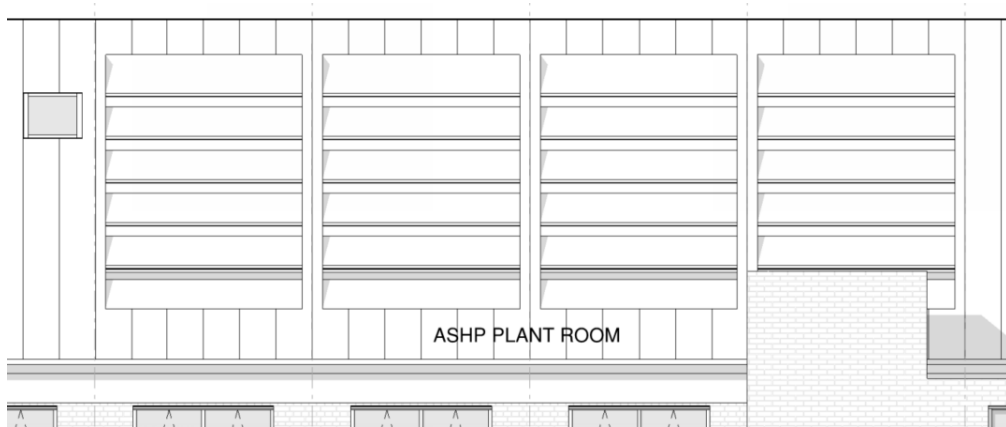


Figure 18 ASHP Plant Room roof elevation

3.9 Residential escape widths

3.9.1 Table 8 below lists the minimum exit widths required for the residential areas.

Residential building	Minimum clear width (mm) ⁽¹⁾
Communal escape stair	800 ⁽²⁾
Duplex flat internal stair	800 ⁽²⁾
Final exit door from residential core	800 ⁽³⁾
Internal door – communal	750
Internal door – flat	750
Storey exit door	750

(1) Clear widths satisfy fire safety requirements. Architect to ensure compliance with Part M of the Building Regulations.
 (2) Assuming that handrails do not protrude more than 100mm into the stair.
 (3) The same width as the stair.

Table 8 Minimum exit widths

3.10 Non-residential escape strategy

3.10.1 The non-residential parts of the buildings are at basement and ground level in Wharf Lane and at ground level in Water Lane.

3.10.2 The non-residential parts of the buildings will be assessed using the guidance in BS 9999.

3.10.3 Risk profiles:

3.10.3.1 BS 9999 categorises the occupants of buildings into risk profiles to help understand the characteristics of building users based on a combination of their alertness, familiarity with the building and the potential rate at which a fire could develop.

3.10.3.2 The buildings will be occupied by several different occupancy groups in separate areas of the buildings and may be classified as follows:

Parameter		Occupancy characteristic		
		Occupants who are awake and familiar with the building (A)	Occupants who are awake and unfamiliar with the building (B)	Occupants who are likely to be asleep (C)
Fire growth rate	Slow (1)			
	Medium (2)	Plant Offices	Café Pub/restaurant	
	Fast (3)	Kitchen	Retail	

Table 9 Risk profiles

3.10.4 Variation of risk profiles:

3.10.4.1 The buildings will be protected throughout by AWFSS. All non-residential accommodation will be protected by AWFSS in accordance with BS EN 12845.

3.10.4.2 BS 9999 permits a reduction in the fire growth rate where AWFSS is provided. This results in a reduction in the risk profile.

Parameter		Occupancy characteristic		
		Occupants who are awake and familiar with the building (A)	Occupants who are awake and unfamiliar with the building (B)	Occupants who are likely to be asleep (C)
Fire growth rate	Slow (1)	Plant Offices	Café Pub/restaurant	
	Medium (2)	Kitchen	Retail	
	Fast (3)			

Table 10 Variation of risk profiles

3.10.5 Travel distances:

3.10.5.1 The travel distances within all parts of the building should meet the recommendations in BS 9999. The travel distance limits are based on the appropriate risk profile.

3.10.5.2 Where additional fire protection measures are provided, BS 9999 allows travel distances to be increased. The minimum fire detection required for all the risk profiles identified in the development, is a manual system i.e. no automatic detection.

- 3.10.5.3 It is proposed to install automatic detection throughout the non-residential occupancies. BS 9999 permits a 15% increase to the travel distance limits which would normally apply when the minimum fire protection measures are provided.
- 3.10.5.4 BS 9999 recommends that the travel distance limits be reduced by 25% within premises where alcohol is consumed. This recommendation will apply to the Pub/restaurant areas.
- 3.10.5.5 The travel distances indicated in Table 11 are the direct travel distance limits since the design is at a shell and core stage.

Risk profile	Direct travel distance (m)	
	One direction	More than one direction
A1	19	50
A2	17	42
B1	18	46
B1 (Pub/restaurant)	13.5	34.5
B2	15	38

Table 11 Travel distance limits per risk profile

3.10.6 Exit widths:

- 3.10.6.1 Exit capacities are based on the risk profiles with guidance from BS 9999.
- 3.10.6.2 Similarly, because of the enhanced AFDAS to be provided, the exit width factors have been reduced by 15% compared that which would apply when the minimum fire protection measures are provided.

Design aspect	Risk profile			
	A1	A2	B1	B2
Exit width per person (mm) for a door with clear width > 1050mm	2.8	3.1	3.1	3.5
Exit capacity of a door with clear width < 1050mm	178 persons	163 persons	163 persons	143 persons

Table 12 Exit widths

- 3.10.6.3 Generally door widths will not be less than 850mm where unassisted wheelchair access is necessary and not less than 800mm regardless of risk profile.

3.10.7 Design populations:

- 3.10.8 Guidance on floor space factors have been taken from BS 9999 to estimate the design populations in the non-residential areas and from ADB-2 (as indicated below) since BS 9999 does not address all the areas being discussed. Since the design is at shell and core stage, the conservative approach is to apply the most onerous factors.

Area	Design floor space factor (persons per m ²)
Pub/restaurant and café	1
Retail	2
Office	4
Kitchen	7 ⁽¹⁾
Plant room	30
Storeroom	30

(1) Floor space factor obtained from Table D1 of ADB-2.

Table 13 Occupancy load factors

3.11 Wharf Lane basement

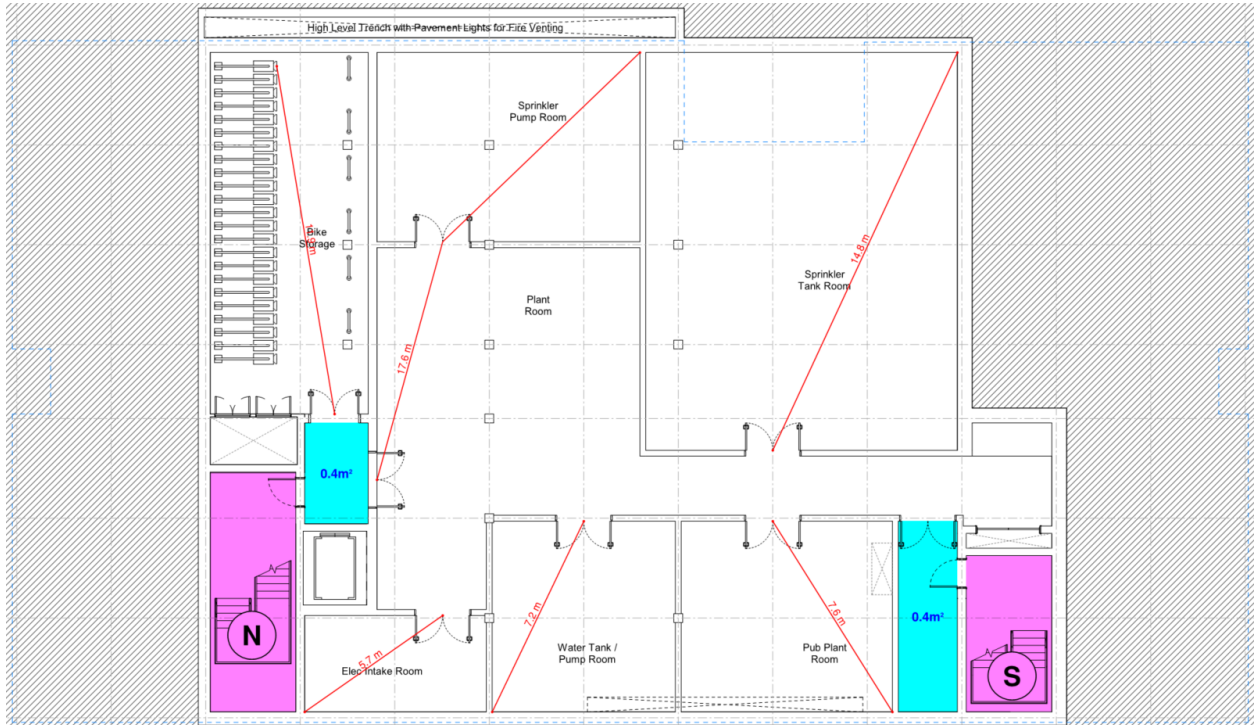


Figure 19 Wharf Lane basement

Compartment	Area (m ²)	Design occupancy (persons)	Minimum no. of exits required	Minimum exit width required (mm)
Sprinkler pump room	57	2	1	850
Sprinkler tank room	142	5	1	850
Pub/restaurant plant room	47	1	1	850
Water tank and plant room	40	1	1	850
Electric intake room	19	1	1	850
Open plan plant room	63	3	1	850

Table 14 Wharf Lane basement exit provisions

- 3.11.1 The travel distances within all basement areas and within the individual plant rooms and onwards to storey exits are acceptable.
- 3.11.2 The minimum width of the escape stairs serving the basement will be 1200mm.
- 3.11.3 The individual enclosed plant rooms are inner rooms within the open plan main plant room. The equipment and the processes within the open plan plant area will not be a high fire risk i.e. will not be classified as explosive, oxidising, highly or extremely flammable. The landlord AFDAS will protect the basement plant room and once activated, the fire alarm will sound throughout the basement.
- 3.11.4 The door widths into the escape stairs will not be less than 850mm.

3.12 Wharf Lane ground floor

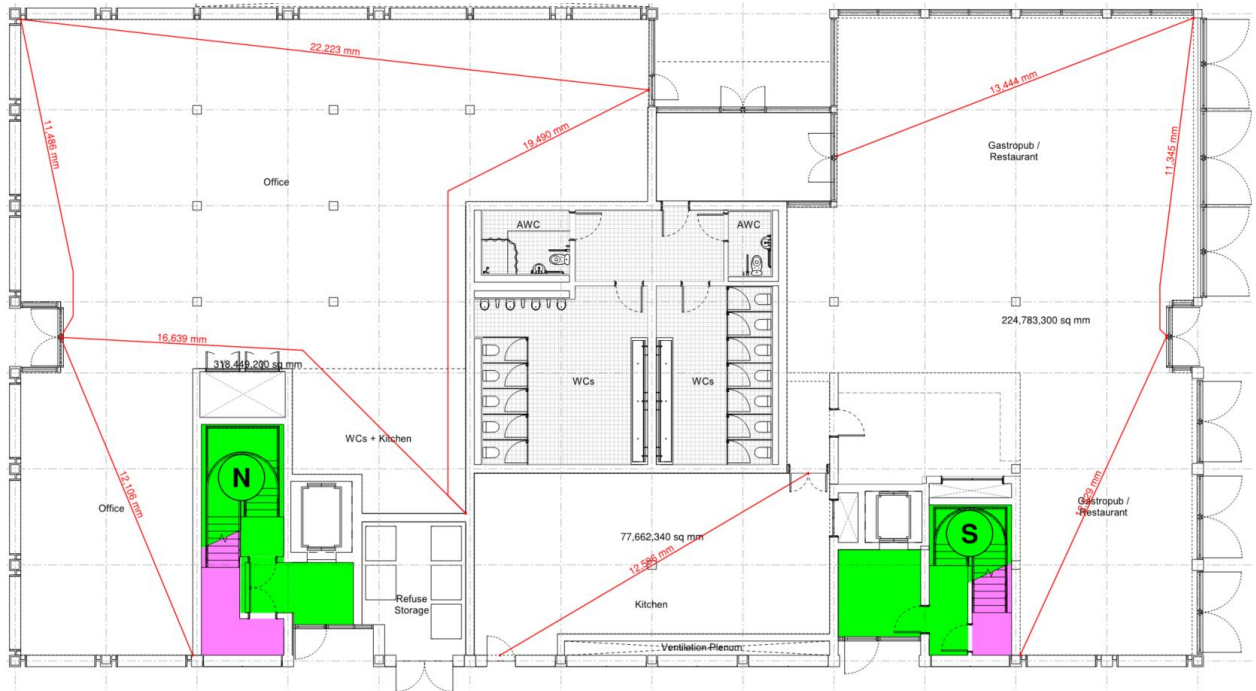


Figure 20 Wharf Lane ground floor

Compartment	Area (m ²)	Design occupancy (persons)	Minimum no. of exits required	Minimum exit width required (mm)
Office	319	80	2	850
Kitchen	78	12	1	850
Pub/restaurant	225	225	2	1050

Table 15 Wharf Lane basement exit provisions

3.12.1 Within the large office space, the two exits provided and the travel distances to them are acceptable albeit the minimum provision. Should further subdivision of the office be considered, the exit provisions will need to be re-examined.

3.13 Water Lane ground floor

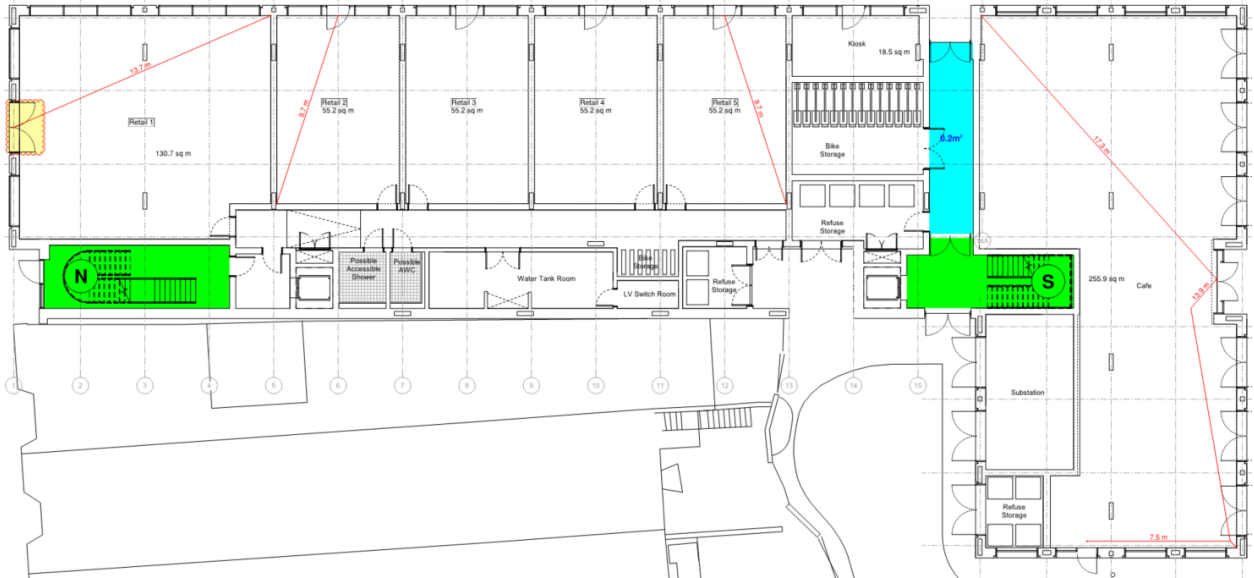


Figure 21 Water Lane ground floor

Compartment	Area (m ²)	Design occupancy (persons)	Minimum no. of exits required	Minimum exit width required (mm)
Retail 1	131	66	2	850
Retail 2	56	28	1	850
Retail 3	56	28	1	850
Retail 4	56	28	1	850
Retail 5	56	28	1	850
Kiosk	19	10	1	850
Café	256	256	2	1050

Table 16 Wharf Lane basement exit provisions

- 3.13.1 Retail 1 requires two exits since the design population marginally exceeds 60 persons. In BS 9999 the floor space factors for a shop may vary between 2m² (e.g. clothing shop) and 7m² (e.g. showroom) per person depending on the shop being considered. The most onerous floor space factor (2m² per person) has been used to calculate the design population in Retail 1. The design shows only a single exit from Retail 1.
- 3.13.2 The single exit may be considered acceptable subject to a fitout layout being provided which demonstrates that that occupiable floor area together with a floor space factor which is appropriate to the shop that results in a design population which is less than 60 persons.
- 3.13.3 The calculation of the design population and exit provisions will be subject to Building Control approval.
- 3.13.4 The retail back-of-house (BOH) corridor is not a designated escape route from the shops. Access to the corridor will be restricted to staff only. The corridor will be separated from adjoining rooms by fire rated construction.
- 3.13.5 Within the Café, the furthest direct travel distance is just within the maximum which is allowable for the risk profile. The fitout and furniture layout will need to ensure that the actual travel distances are satisfied.

3.14 Automatic fire detection and alarm systems

3.14.1 Residential flat system:

3.14.1.1 The AFDAS within the flats will be designed, installed, and commissioned as per BS 5839-6. The minimum recommended system specification is:

3.14.1.2 Grade D1/D2 detectors i.e. mains powered detectors, each with integral standby supply (either tamper proof or replaceable). Grade D1 is recommended for rented accommodation.

3.14.1.3 Category LD1 coverage as follows:

- Smoke detectors installed within all rooms except the toilets, bathrooms, or shower rooms.
- Smoke detector in utility cupboard housing services and appliances.
- A heat detector installed in the kitchen area.
- Sounders should be capable of delivering 85dB(A) through the open doorway to each habitable room and the balcony.
- Where required, as per §3.3.6.4, a sounder which is interconnected with the flat's AFDAS, will be installed on the balcony. The sounder will be appropriate for external installation.

3.14.2 Residential smoke control system:

3.14.2.1 The AFDAS within the residential communal escape routes will be designed, installed, and commissioned in accordance with the BS 5839-1. The system specification is:

- Addressable smoke detectors.
- Category L5: detectors installed in communal corridors and lobbies.
- Standby power supply of at least 24 hours.

3.14.3 Commercial tenant system:

3.14.3.1 Each non-residential commercial unit (shops, office, pub/restaurant, café) will have a standalone tenant AFDAS which will be designed, installed, and commissioned in accordance with the BS 5839-1. The minimum system specification is:

- Addressable detectors.
- Category L3.
- Standby power supply of at least 24 hours.

3.14.4 Landlord system:

3.14.4.1 Both buildings contain areas which within the Landlord's control and will be managed by the building's management.

3.14.4.2 The location of the Landlord AFDAS control panel should be agreed with Building Control and Fire Service.

3.14.4.3 The Landlord's AFDAS will be designed, installed, and commissioned in accordance with the BS 5839-1. The minimum system specification is:

- Addressable detectors.
- Category L3.
- Standby power supply of at least 24 hours.

3.14.5 Where inner rooms exist, the access room's alarm sounder should be audible within the inner room.

3.14.6 Areas with high ambient noise levels should have a visual alarm beacon to supplement the audible alarm.

3.14.7 Manual call points are not recommended in the residential communal areas since there is high likelihood of spurious alarm activations.

3.14.8 The public toilets should be protected by the Landlord AFDAS. Normally toilets would not require automatic fire detection, but in public areas, toilets may not be considered low fire risk due to the potential for malicious ignition.

3.14.9 Cause and effect scenarios:

- 3.14.9.1 Twickenham Riverside will have active fire protection systems (AOV smoke control and AWFSS) which will require competent, authorised intervention in the event of activation or fault detection.
- 3.14.9.2 It is not proposed to have 24-hour on-site management presence. Off-site notification is recommended for activation signals and fault notifications. The off-site destination to which AFDAS messages will be relayed has not been finalised in the design.
- 3.14.9.3 Table 17 summarises the response of the fire protection systems.

Location	System	Input Signal	Effect
Flat	Residential Category LD1 BS 5839-6	Detector	Sound the fire alarm in affected flat only
Communal corridor or lobby	Smoke control Category L5 BS 5839-1	Detector	Open the corridor or lobby AOV. Open the stair AOV. Return the lifts to the ground floor. Deactivate exit door security measures. Visual and audible notification at the AFDAS control panel. Notify the off-site supervisory station.
Commercial unit	Tenant Category L3 BS 5839-1	Detector	Sound the fire alarm within the unit. Visual and audible notification at the AFDAS control panel. Notify the off-site supervisory station.
Ancillary room	Landlord Category L3 BS 5839-1	Detector	Sound the fire alarm within the room. Visual and audible notification at the AFDAS control panel. Return the lifts to the ground floor. Notify the off-site supervisory station.
Flat	Landlord Category L3 BS 5839-1	Flow switch ⁽¹⁾	Visual and audible notification at the AFDAS control panel. Notify the off-site supervisory station.
Commercial unit	Tenant Category L3 BS 5839-1	Flow switch ⁽²⁾	Visual and audible notification at the AFDAS control panel. Notify the off-site supervisory station.
Ancillary room	Landlord Category L3 BS 5839-1	Flow switch ⁽¹⁾	Visual and audible notification at the AFDAS control panel. Notify the off-site supervisory station.
Communal corridor or lobby	Smoke control Category L5 BS 5839-1	Fault	Visual and audible notification at the AFDAS control panel. Notify the off-site supervisory station.
AWFSS	Landlord Category L3 BS 5839-1	Fault	Visual and audible notification at the fire pump control panel and the AFDAS control panel. Notify the off-site supervisory station.
<p>(1) Each floor should be a separate zone. There should be at least one flow switch per zone.</p> <p>(2) Each tenant should be a separate zone. There should be at least one flow switch per zone.</p>			

Table 17 Cause and effect scenarios

3.15 Automatic water fire sprinkler system

3.15.1 The buildings will be protected by AWFSS throughout except for corridors and stair enclosures. The AWFSS proposed for the buildings is listed in Table 18.

Location	Design specification	System classification
Bicycle store	BS EN 12845	Class OH1
Café	BS EN 12845	Class OH1
Commercial kitchen	BS EN 12845	Class OH3
Flat	BS 9251	Category 2
Office	BS EN 12845	Class OH1
Plant room	BS EN 12845	Class OH3
Pub/restaurant	BS EN 12845	Class OH1
Public toilets	BS EN 12845	Class OH1
Refuse store	BS EN 12845	Class OH3
Retail unit	BS EN 12845	Class OH3

Table 18 AWFSS protection

3.15.2 The installation of sprinkler protection within the electrical rooms should be agreed with Building Control and the electricity supply utility. Where sprinklers are installed in electrical rooms, the minimum ingress protection (IP) rating of all cabinets, panels and equipment should be at least IP55.

3.15.3 A minimum of 60 minutes fire resisting construction is required to separate the electrical rooms from the remainder of the building. Considering the degree of compartmentation required, the modest room sizes and the nature of the equipment in the rooms, sprinkler protection is not recommended in electrical rooms.

3.16 Provision of refuges

3.16.1 It is intended to provide evacuation lifts in the building which will comply with the requirements of Policy D5(B5) of the London Plan.

3.16.2 The provision of evacuation lifts will comply with the recommendations of BS 9999. The design and installation of the evacuation lifts will be in accordance with the relevant provisions of BS EN 81-20 and BS EN 81-70.

3.16.3 Evacuation lifts are intended to allow authorised persons to use the lifts to evacuate persons requiring assistance and are not intended to be used for self-evacuation. The design of the evacuation lifts should be in accordance with BS EN 81-76.

3.16.4 Every storey (except ground floor level) will have a wheelchair accessible refuge which will be at least 900mm x 1400mm in the fire protected lift lobby. This will serve as a waiting area while residents wait for assistance.

3.16.5 Each refuge will be provided with a Type B EVC system in accordance with BS 5839-9. All refuges will be labelled with a unique identifier (e.g. building name and floor level) to enable an evacuee requiring assistance to identify their location.

3.16.6 'All hour's' on-site assistance is not proposed at Twickenham Riverside. Therefore, activating the refuge EVC will alert an off-site supervisory station.

3.16.7 The refuge EVC will also communicate with a refuge communication panel (RCP) located at the stair cores main entrance on the ground floor.

3.16.8 The detailed design of the EVC system should comply with BS 5839-9.

3.16.9 The locations, access routes and information on the use of the ECV should be included in the personal emergency evacuation plan (PEEP) for residents of the buildings.

3.17 Service risers

- 3.17.1 All levels are provided with service risers which open into the communal escape routes.
- 3.17.2 The service risers will be constructed as fire protected shafts throughout their height i.e. enclosed in robust, non-combustible construction with fire rated access doors or hatches (see Table 21).
- 3.17.3 It is recommended that all service shaft penetrations between the basement and ground floor level in Wharf Lane are fire-stopped to enhance the fire separation between the floors.
- 3.17.4 The service risers will contain low voltage electrical, heating and water services.
- 3.17.5 Piped flammable gas services and its pipework, if installed, should be installed in accordance with the Pipelines Safety Regulations 1996 and the Gas Safety (Installation and Use) Regulations 1998.

3.18 First aid firefighting equipment

- 3.18.1 There are no requirements to provide first aid firefighting equipment under the Building Regulations. However, the Fire Safety Order (FSO) requires that manual firefighting equipment be provided in places of work.
- 3.18.2 The provision of fire extinguishers should be appropriate for the fire risk being protected.
- 3.18.3 A detailed fire risk assessment of the protected area should be conducted to ensure that the extent and provision of first aid firefighting equipment is appropriate.

3.19 Escape signage

- 3.19.1 Escape signage should be provided above storey exits and final exit doors within the buildings. Signage should meet the recommendations of BS 5499-4 and should be located as follows:
 - 3.19.1.1 Along all designated escape routes, especially staircases and changes in level and direction.
 - 3.19.1.2 At the location of all doors and other exits sited on escape routes, including storey exits and final exits will be identified by signs.
 - 3.19.1.3 Where an escape route from a room is not conspicuous or confusion could occur, the route will be indicated by a sign, including intermediate signs where necessary.
 - 3.19.1.4 All changes of direction in corridors and stairways forming part of an escape route should be marked with intermediate signs. Each intermediate door or junction should be similarly signed.
- 3.19.2 It is recommended that the provision of signage be assessed and agreed with Building Control.

3.20 Artificial and emergency lighting

- 3.20.1 Except for within flats, the buildings will be provided with an emergency lighting system in accordance with BS 5266-1. The emergency lighting system will cover:
 - All communal escape routes including stairs, corridors and lobbies.
 - Bar and café areas.
 - Offices.
 - Plant rooms.
 - Retail units.
 - Toilet facilities.
 - Underground and windowless rooms.
- 3.20.2 All areas of the building should be provided with adequate artificial lighting.

4. Control of internal fire spread (linings)

Schedule 1 of the Building Regulations' functional requirements with respect to B2 reads:

B2 Functional Requirement	Limits on Application
1. To inhibit the spread of fire within the building, the internal linings shall – <ol style="list-style-type: none"> adequately resist the spread of flame over their surfaces; and have, if ignited, either a rate of heat release or a rate of fire growth, which is reasonable in the circumstances. 	
2. In this paragraph “internal linings” means the materials or products used in lining any partition, wall, ceiling, or other internal structure.	

The following discusses the implications of the proposed building design and seeks to demonstrate compliance with B2 of the regulations as well as a satisfactory standard of fire safety.

4.1 General principles

- 4.1.1 The aim of the regulation is to inhibit the spread of fire over internal linings of buildings.
- 4.1.2 This is achieved by ensuring that designers specify lining materials which satisfy the minimum requirements of the guidance.
- 4.1.3 In addition, lining materials which are to be incorporated into the project should be tested to a recognised standard and certified as satisfying the minimum requirements of the guidance.
- 4.1.4 Whilst the guidance does not address the upper surfaces of floors and stairs, professional judgement needs to be applied to ensure that the specification of linings for these areas does not introduce a new risk within the development.
- 4.1.5 Similarly, the guidance does not address furniture and fittings. Industry practice has moved towards safety testing and certifying of products for use in the home.

4.2 Linings

- 4.2.1 The surface linings of walls and ceilings should meet the minimum classifications in Table 19.

Location	European classification of lining material ⁽¹⁾
Circulation spacings within a dwelling Other rooms	C-s3, d2
Communal residential circulation spaces Other circulation spaces	B-s3, d2
Small rooms: < 4m ² in residential accommodation < 30m ² in non-residential accommodation	D-s3, d2
(1) Classification based on BS EN 13501-1	

Table 19 Classification of linings

5. Control of internal fire spread (structure)

Schedule 1 of the Building Regulations' functional requirements with respect to B3 reads:

B3 Functional Requirement	Limits on Application
1. The building shall be designed and constructed so that, in the event of fire, its stability will be maintained for a reasonable period.	
2. A wall common to two or more buildings shall be designed and constructed so that it adequately resists the spread of fire between those buildings. For the purposes of this subparagraph a house in a terrace and a semi-detached house are each to be treated as a separate building.	
3. Where reasonably necessary to inhibit the spread of fire within the building, measures shall be taken, to an extent appropriate to the size and intended use of the building, comprising either or both of the following – <ul style="list-style-type: none"> a) sub-division of the building with fire-resisting construction. b) installation of suitable automatic fire suppression systems. 	Requirement B3(3) does not apply to material alterations to any prison provided under section 33 of the Prison Act 1952.
4. The building shall be designed and constructed so that the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited.	

The following discusses the implications of the proposed building design and seeks to demonstrate compliance with B3 of the regulations as well as a satisfactory standard of fire safety.

5.1 General principles

- 5.1.1 There are several separate objectives within this regulation.
- 5.1.2 The guidance is to safeguard the structure of the building from premature collapse. This is not only during occupation of the building but also during firefighting activities when a building may have been evacuated.
- 5.1.3 There needs to be adequate fire separation between all occupancies. This is the basis of the residential 'stay-put' evacuation strategy within the building.
- 5.1.4 The degree of compartmentation should not be compromised through the unseen spread of fire in cavities.

5.2 Structural fire resistance

- 5.2.1 The structural fire resistance of an element of structure refers to its ability to maintain its loadbearing capacity when exposed to a fire. It is determined by testing materials to either BS EN 13501, Parts 2 to 4, or BS 476-21. The requisite structural fire resistance is a function of a building's occupancy, geometry, and physical features.
- 5.2.2 The minimum structural fire resistance required for the building is 60 minutes.

5.3 Compartmentation

- 5.3.1 Compartmentation refers to sub-division within a building into separate fire resisting compartments to limit the unrestricted spread of fire. The form of construction to achieve compartmentation should have fire resistance properties for loadbearing capacity, integrity, and insulation.
- 5.3.2 The minimum compartmentation required is 60 minutes fire resistance.

5.3.3 Openings in compartment walls and floors should be limited to the passage of service ducts and risers which are fitted with fire doors. Fire doors fitted into service ducts and risers should be normally locked shut.

5.4 Summary of provisions

5.4.1 Table 20 below summarises the minimum structural and compartmentation requirements for the building features as per BS EN 13501. Products tested to BS 476-21 and BS 476-22 may also provide acceptable fire resistance performance.

Feature	Minimum fire resistance (min)
All floors above ground storey	60 REI (from underside)
Compartment wall between ancillary rooms	60 REI (from each side separately)
Compartment wall between flats	60 REI (from each side separately)
Compartment wall between flat and communal escape route (corridor, lobby or stair)	60 REI (from each side separately)
Compartment wall between different occupancies	60 REI (from each side separately)
Escape stair enclosure	60 REI (from each side separately)
Floor between basement and ground level	60 REI (from underside)
Floor of upper storey of duplex flat	30 REI (from underside)
Loadbearing external wall (<1m from relevant boundary)	60 REI (from each side separately)
Loadbearing external wall (>1m from relevant boundary)	60 RE (from inside)
Service riser	60 REI (from each side separately)
Structural frame for the building	60 R (exposed faces)
Utility cupboard enclosure	30 EI (from each side separately)
R = loadbearing capacity E = integrity I = insulation	

Table 20 Minimum structural and compartmentation fire resistance requirements

5.4.2 Fire doors installed within fire resisting enclosures should meet the minimum specifications in Table 21.

Location	Minimum fire rating
Corridor separation door	FD30S
Door forming a fire protected lobby enclosure	FD30S
Door forming service shaft enclosure (not opening into a communal escape route)	FD30
Door forming service shaft enclosure (opening into a communal escape route)	FD30S
Door into a bathroom, toilet, or washroom (not forming a fire protected entrance hall)	no requirement
Door to a utility cupboard inside a flat	FD30
Entrance door into a flat	FD30S
Entrance door into an escape stair	FD30S
Lift landing door	FD30

Table 21 Fire door schedule

5.4.3 Figure 22 to Figure 26 indicate the compartmentation strategy incorporating the requirements of this section.

Fire protection aspect	Colour	Sample / symbol
60 minute fire resisting construction	Red	
30 minute fire resisting construction	Blue	
30 minute fire door (FD30)	Orange	
30 minute fire door with smoke seal (FD30S)	Orange and blue	
60 minute fire door (FD60)	Red	
60 minute fire door with smoke seal (FD60S)	Red and black	

Table 22 Compartmentation annotation legend

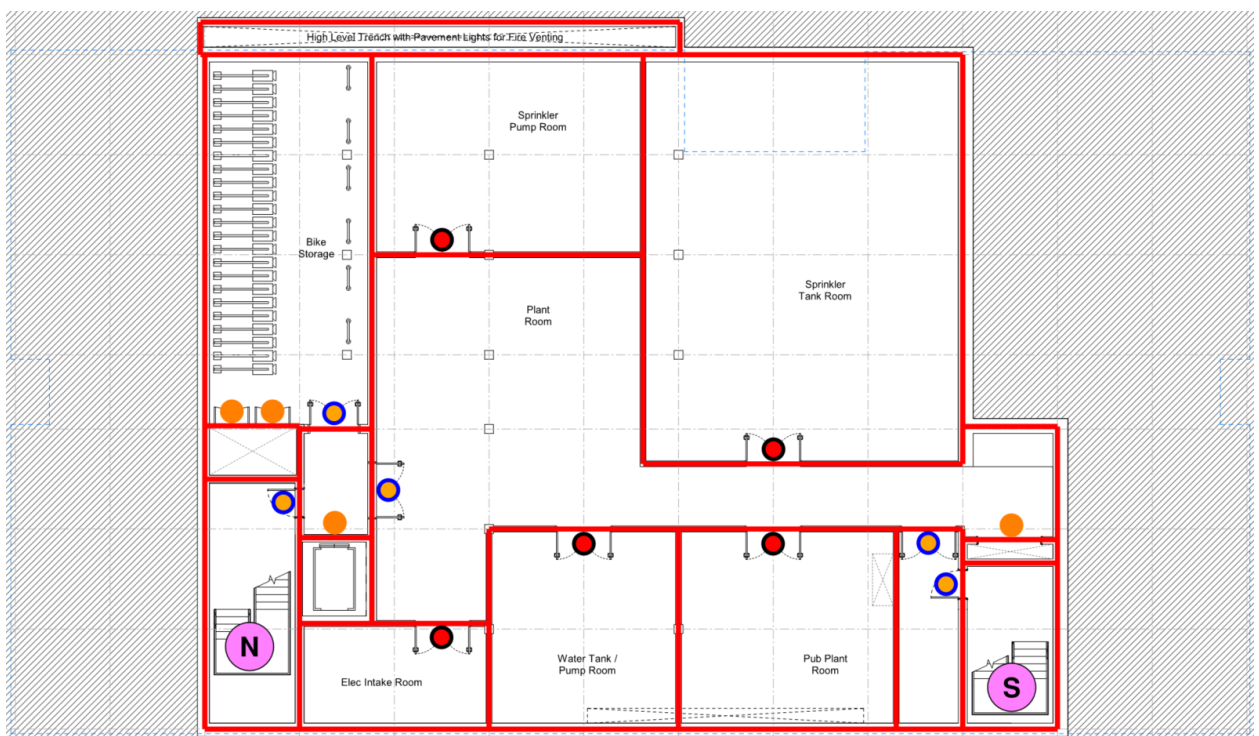


Figure 22 Wharf Lane basement compartmentation strategy

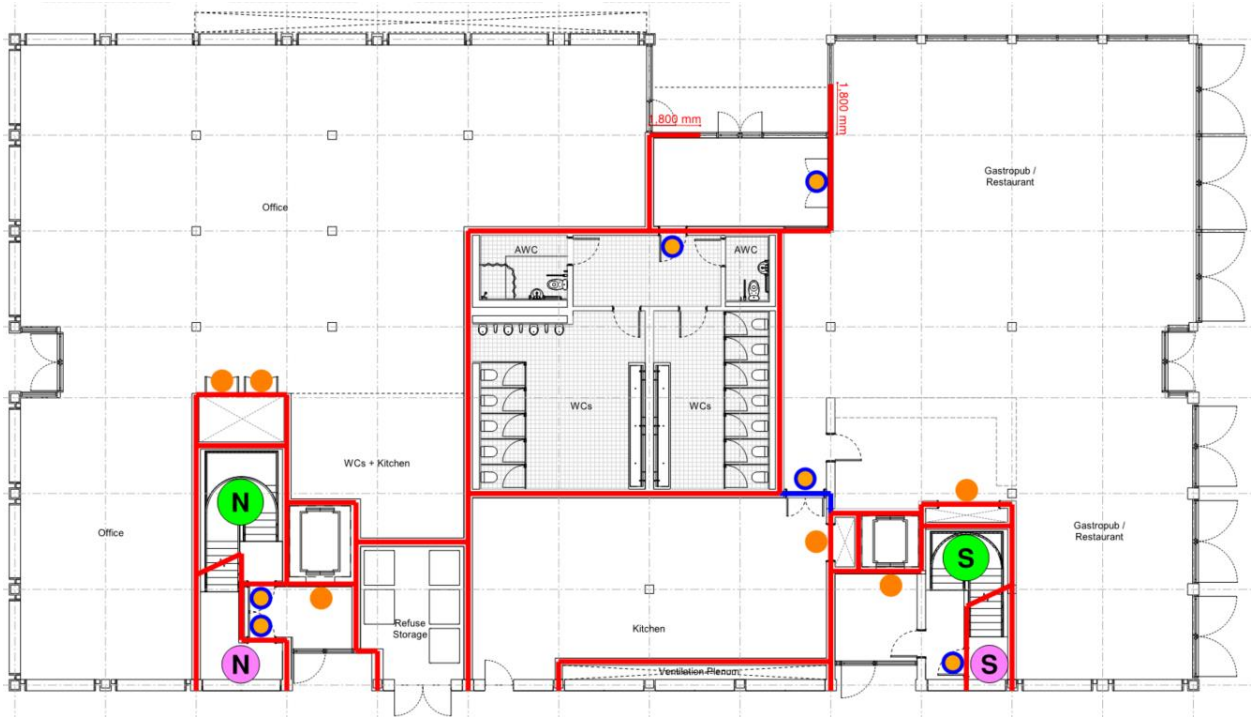


Figure 23 Wharf Lane ground floor compartmentation strategy



Figure 24 Wharf Lane typical upper floor residential compartmentation strategy

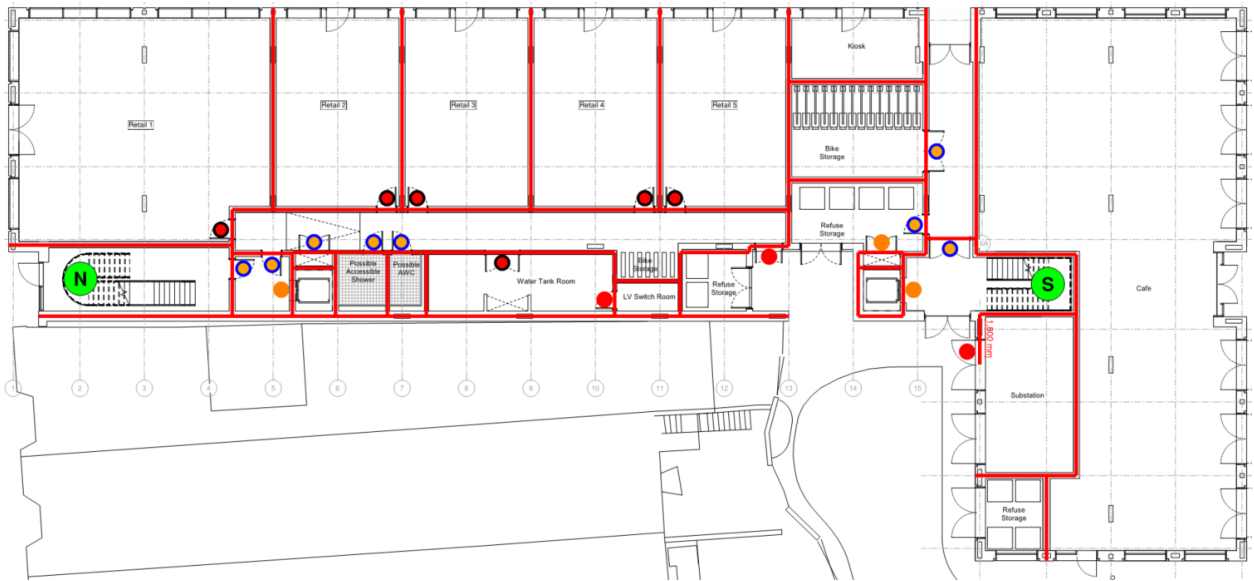


Figure 25 Water Lane ground floor compartmentation strategy



Figure 26 Water Lane typical upper floor residential compartmentation strategy

5.5 Fire-stopping

- 5.5.1 Fire-stopping installed correctly, inhibits the spread of smoke and delays fire spread.
- 5.5.2 Openings for pipes, ducts, conduits, and cables through compartment walls should be fire-stopped preferably with non-combustible material to ensure that the integrity of the compartmentation is maintained.
- 5.5.3 Joints between elements of structure should be fire-stopped to prevent the passage of fire and smoke.
- 5.5.4 Proprietary fire-stopping materials and sealing systems should be selected appropriate to the application.
- 5.5.5 Table 23 indicates the maximum pipe sizes allowable for passing through compartmentation.

Situation	Pipe material and maximum nominal internal diameter (mm)		
	(a)	(b)	(c)
	High melting point metal ⁽¹⁾	Lead, aluminium, aluminium alloy, uPVC, ⁽²⁾ fibre cement	Any other material
1. Structure (but not a wall separating buildings) enclosing a protected shaft that is not a stair or a lift shaft	160	110	40
2. Compartment wall or compartment floor between flats	160	160 (stack pipe) ⁽³⁾ 110 (branch pipe) ⁽³⁾	40
3. Wall separating dwellinghouses	160	160 (stack pipe) ⁽³⁾ 110 (branch pipe) ⁽³⁾	40
4. Wall or floor separating a dwellinghouse from an attached garage	160	110	40
5. Any other situation	160	40	40

NOTES:

- Any metal (such as cast iron, copper or steel) which, if exposed to a temperature of 800°C, will not soften or fracture to the extent that flame or hot gas will pass through the wall of the pipe.
- uPVC pipes that comply with either **BS 4514** or **BS 5255**.
- These diameters are only in relation to pipes that form part of an above-ground drainage system and are enclosed as shown in Diagram 91. In other cases, the maximum diameters given for situation 5 apply.

Table 23 Maximum allowable pipe sizes passing through compartmentation

5.5.6 Figure 27 presents fire-stopping options for services and between elements of structure.

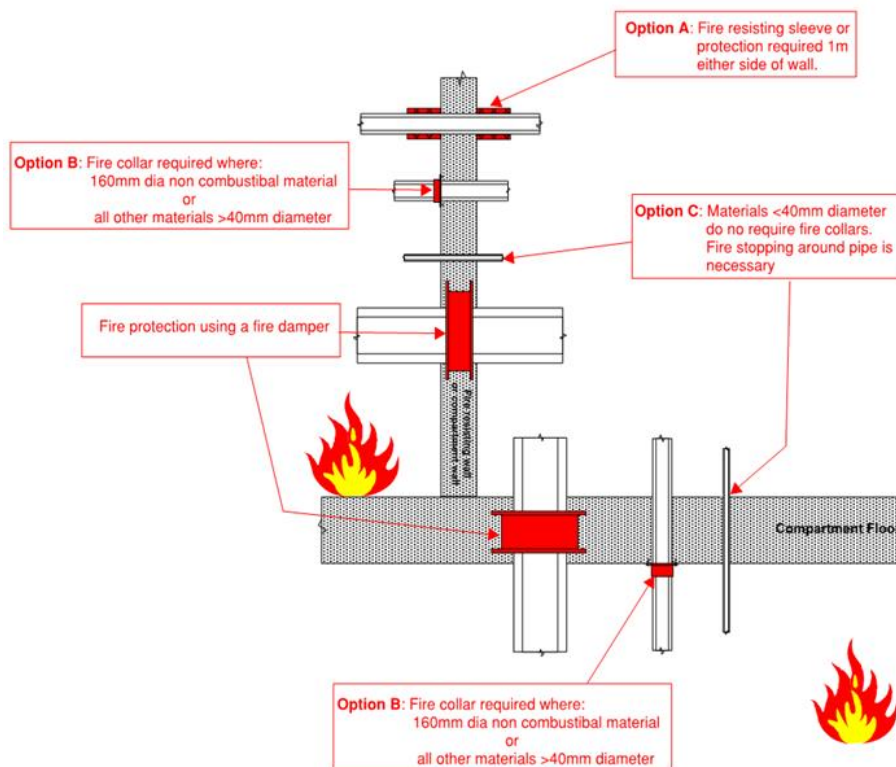


Figure 27 Fire-stopping options

5.6 Cavity barriers

5.6.1 Cavity barriers are required to sub-divide and close off hidden cavities. The guidance for the provision of cavity barriers is prescriptive and includes the following locations:

- At the edges of cavities, including around openings (such as windows, doors, and exit/entry points for services).
- At the junction between an external cavity wall and every compartment floor and compartment wall.
- At the junction between an internal cavity wall and every compartment floor, compartment wall or other wall or door assembly forming a fire resisting barrier.
- Within a fire protected escape route, above and below any fire-resisting construction which is not carried full storey height.

5.6.2 The minimum fire resistance of cavity barriers should be at least 30 minutes integrity and 15 minutes insulation assessed from each side of the barrier separately.

5.6.3 Figure 28 below illustrates the guidance on the provision of cavity barriers.

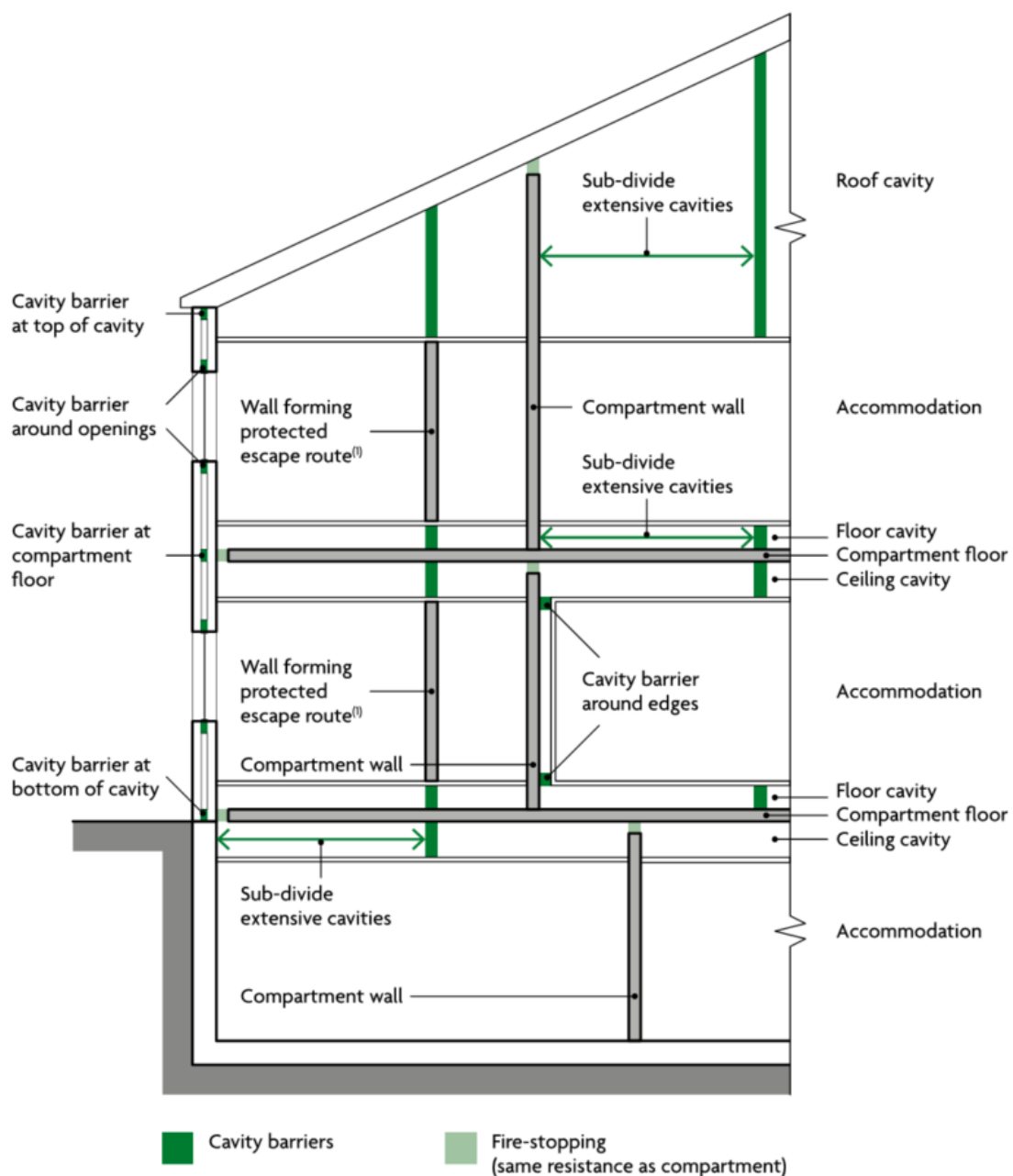


Figure 28 Guidance on the provision of cavity barriers

6. Control of external fire spread

Schedule 1 of the Building Regulations' functional requirements with respect to B4 reads:

B4 Functional Requirement	Limits on Application
1. The external walls of the building shall adequately resist the spread of fire over the walls and from one building to another, having regard to the height, use and position of the building.	
2. The roof of the building shall adequately resist the spread of fire over the roof and from one building to another, having regard to the use and position of the building.	

The following discusses the implications of the proposed building design and seeks to demonstrate compliance with B4 of the regulations as well as a satisfactory standard of fire safety.

6.1 General principles

- 6.1.1 The two main objectives of this regulation are to prevent fire spread over the external walls of a building and to prevent fire spread between buildings.
- 6.1.2 The first objective is achieved by ensuring that materials specified for the external surfaces of walls are tested to a recognised standard and certified as satisfying the minimum requirements of the guidance.
- 6.1.3 The second objective is achieved by planning the layout of buildings on the site to ensure adequate separation between buildings and neighbouring sites.

6.2 Construction of external walls

- 6.2.1 The buildings at Twickenham Riverside are not considered relevant buildings and therefore the construction of the buildings' external walls are not required to be non-combustible.
- 6.2.2 Except for areas which can be unprotected, the external wall construction should satisfy the requirements for compartment walls i.e. have at least 60 minutes fire resistance as indicated in Table 20.

6.3 Surfaces of external walls

- 6.3.1 The requirements of Regulation 7(2) are not applicable. Therefore the façades of the buildings will satisfy the minimum flame spread guidance in Table 24.

Height of the building	Classification of lining material ⁽¹⁾	
	< 1000mm from boundary	> 1000mm from boundary
< 18m	B-s3, d2 or better	no provision

(1) Classification based on BS EN 13501-1

Table 24 Classification of external surfaces

6.4 Minimum separation distances

- 6.4.1 An unprotected area is a portion of the building's façade which is not fire-rated, through which there is a risk of incident thermal radiation exposure from a fire within the building.
- 6.4.2 The Enclosing Rectangle method as per BR 187 will be used to calculate the minimum acceptable separation distance based on the unprotected area in external walls.
- 6.4.3 The assessment of the requisite minimum separation distance from a façade is based on the site ground floor layout and elevation drawings provided in Table 2.
- 6.4.4 A conservative approach is adopted for the assessment where the entire enclosing rectangle of the largest compartment on each elevation (which represents the largest fire risk) is considered unprotected. This allows for design flexibility when minor alterations are required to the elevations.

6.4.5 Table 25 summarises the assessment of minimum space separation requirements for all elevations.

Building	Elevation	Unit	Unprotected area (%)	Maximum enclosing rectangle (Hm x Wm)	Minimum separation distance required (m)	Minimum separation distance required with AWFSS (m)
Wharf Lane	North	Office	100	6 x 24	7.5	3.8
	East	Office	100	6 x 24	7.5	3.8
	South	Pub/restaurant	100	6 x 24	7.5	3.8
	West	Pub/restaurant	100	6 x 6	4.0	2.0
Water Lane	North	Retail 1	100	6 x 12	5.5	2.8
	East	Café	100	6 x 15	6.0	3.0
	South	Café	100	6 x 18	6.5	3.3
	West	Café	100	6 x 9	5.0	2.5

Table 25 Minimum space separation distances

6.4.6 It is accepted that where a building is fitted with AWFSS, the minimum separation distance may be halved to take into the account that AWFSS helps reduce compartment temperatures which reduces thermal incidence radiation.

6.4.7 The design separation distances between the buildings' elevations and the relevant boundaries satisfy the minimum separation distances required in the last column in Table 25.

6.4.8 In Wharf Lane, the Pub/restaurant and Office have opposing elevations. Each elevation may be enclosed by a rectangle which is 6m high and 3m wide. For an entire enclosing rectangle of that size which is unprotected and when the effect of AWFSS is considered, the minimum separation distance required is 1.5m. The Pub/restaurant and Office façades are at least 6m apart and therefore the risk of external fire spread is acceptably low.

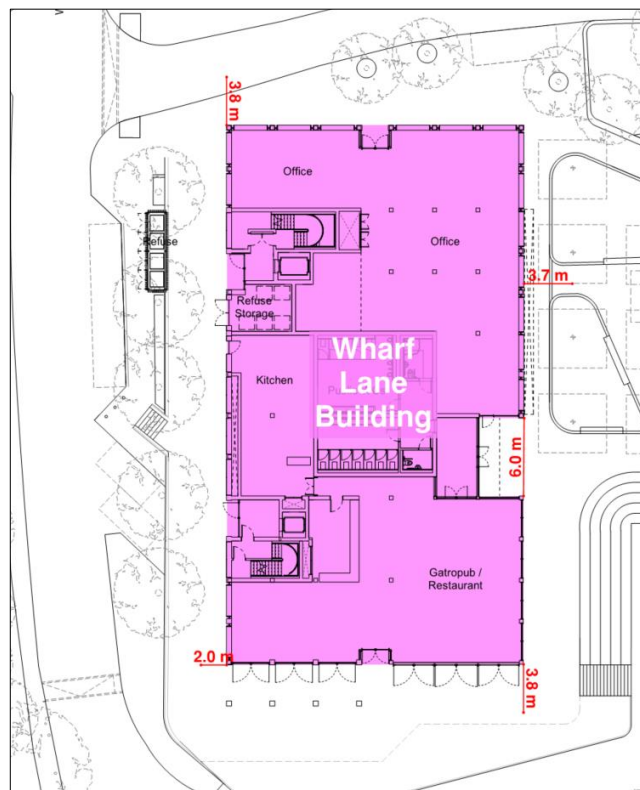


Figure 29 Wharf Lane building minimum requisite separation distances

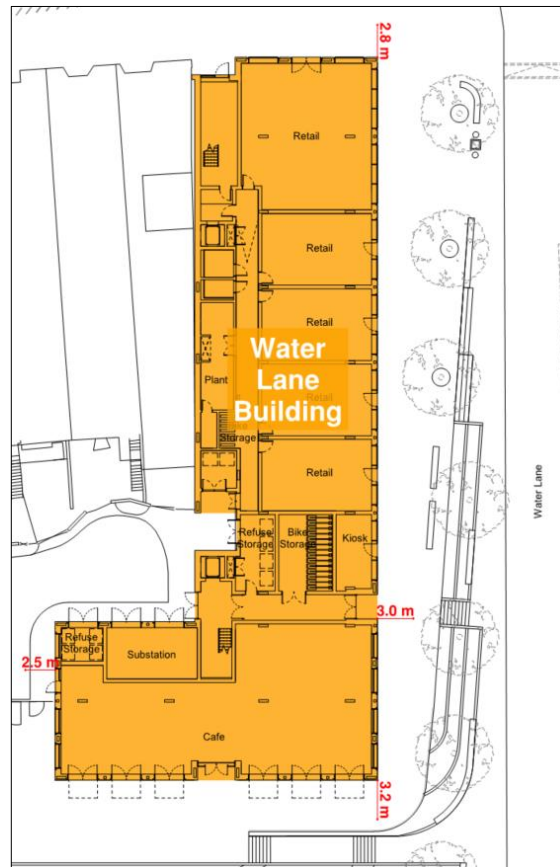


Figure 30 Water lane building minimum requisite separation distances

7. Fire service access and facilities

Schedule 1 of the Building Regulations' functional requirements with respect to B5 reads:

B5 Functional Requirement	Limits on Application
<ol style="list-style-type: none"> The building shall be designed and constructed so as to provide reasonable facilities to assist fire fighters in the protection of life. Reasonable provision shall be made within the site of the building to enable fire appliances to gain access to the building. 	

The following discusses the implications of the proposed building design and seeks to demonstrate compliance with B5 of the regulations as well as a satisfactory standard of fire safety.

7.1 General principles

7.1.1 The main objectives of this regulation are to provide adequate facilities for the fire service to enable them to carry out their duties safely and efficiently.

7.1.2 This entails satisfying minimum requirements for the provision of both personnel and vehicle access in and around buildings, internal and external water mains and means to ventilate smoke.

7.2 Vehicle access

7.2.1 Access to the buildings will be via public roads (see Figure 31).

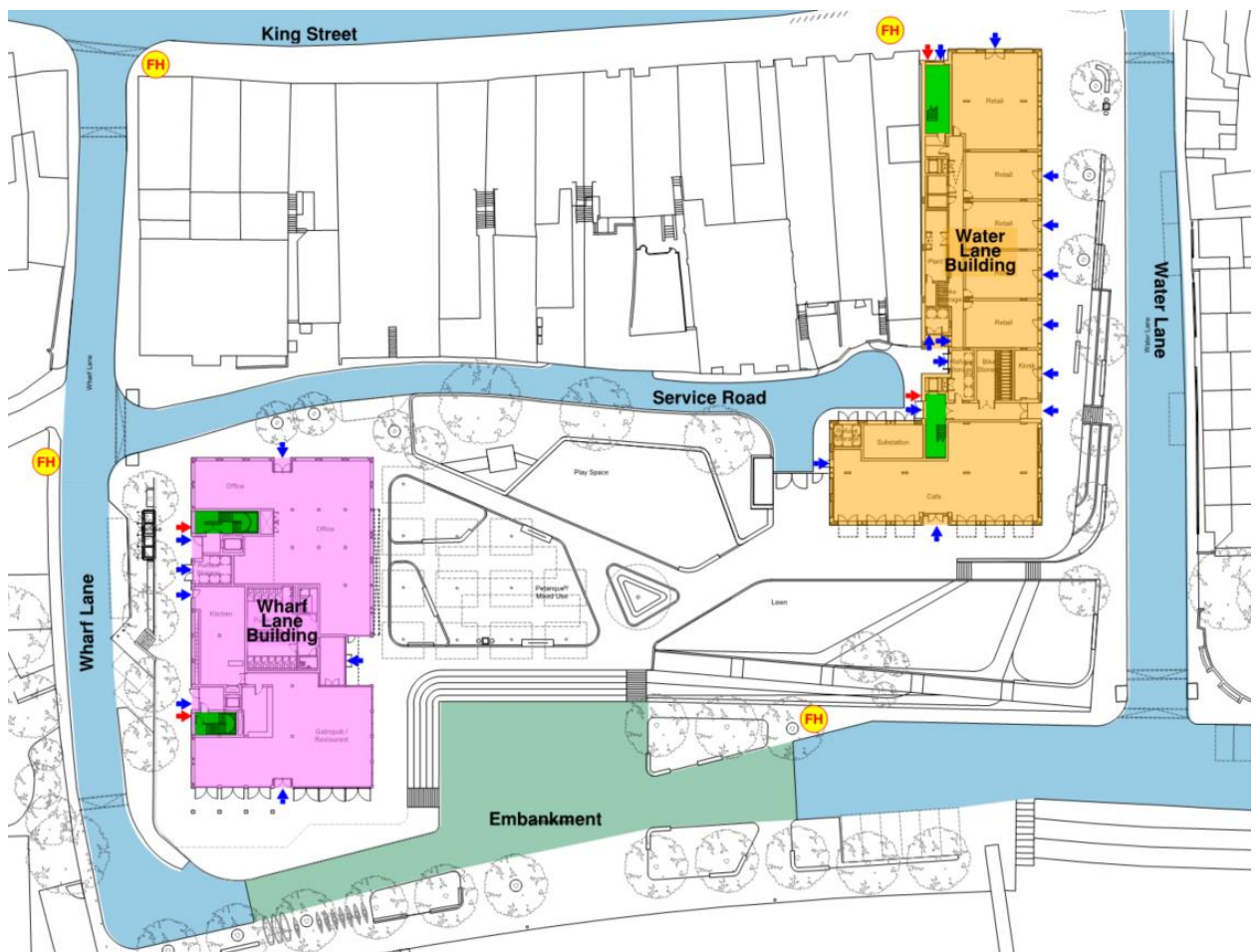


Figure 31 Fire tender access

7.2.2 Wharf Lane and Water Lane are dead-end streets. General vehicle access along the river embankment will be restricted through control measures yet to be finalised. Emergency vehicles however, will have access

to the embankment from Wharf Lane and Water Lane. Water Lane will also have a hammerhead turning arrangement.

7.2.3 The typical access route specifications for a pumping appliance (which is listed in Table 26) is taken from Guidance Note 29 published by the London Fire Brigade. The public roads servicing the buildings and embankment will satisfy the requirements.

Type of Appliance	Minimum width of road between kerbs (m)	Minimum width of gateways (m)	Minimum turning circle between kerbs (m)	Minimum turning circle between walls (m)	Minimum clearance height (m)	Minimum carrying capacity (tonnes)
Pump	3.7	3.1	16.8	19.2	3.7	14

Table 26 Pump appliance access route specifications

7.2.4 Wharf Lane building is more than 11 metres high. The escape stairs in both buildings will be provided with dry rising mains in lieu of providing high reach appliance access.

7.2.5 Where it is intended to provide access-controlled security measures for the building, the emergency access arrangements will be agreed with the local attending fire brigade.

7.2.6 Figure 31 shows the public access roads, drivable embankment, building entry points (blue arrows) and dry riser inlet locations (red arrows).

7.3 Hydrants and fire mains

7.3.1 All escape stairs in both buildings will be provided with dry rising mains in accordance with BS 9990. The dry riser inlets will be conspicuously signed on the outside of the buildings and within 18m of the fire tender hardstanding.

7.3.2 Based on the buildings' designs, it is estimated that access to the furthest point on each storey is less than 45m measured along the route a fire hose would be laid from the dry riser landing valves.

7.3.3 Statutory hydrants are provided along King Street, Wharf Lane, and the embankment, which are indicated in Figure 31. Hydrants are within 90m of all the building entrances.

7.4 Firefighting shaft

7.4.1 The buildings are not over 18m in height and therefore there is no requirement for the provision of firefighting shafts incorporating firefighting lifts and firefighting stairs.

7.5 Ventilation of heat and smoke

7.5.1 The basement in Wharf Lane is approximately 548m². It is proposed to naturally ventilate the basement. The minimum requirements in this regard are:

7.5.1.1 The minimum free area of the smoke outlets should be 2.5% (13.7m² free area) of the total basement floor area.

7.5.1.2 Smoke outlets should be evenly distributed around the perimeter. Where smoke outlets are located only on opposing elevations, each side should be at least 1.25% (6.85m² free area) of the total basement floor area.

7.5.1.3 Compartments which are considered places of special fire risk, should be provided with separate smoke outlets. Places of special fire risk include transformer rooms, switchgear rooms, boiler rooms, rooms that store fuel and rooms that house internal combustion engines.

7.5.2 The locations of the natural ventilation openings will be on the eastern and western basement walls as indicated in blue in Figure 32. The ventilation of the Electrical Room will rely on opening connecting doors.

7.5.3 The openings indicated are about 7.1m² (free area) on the west and 11.2m² (free area) on the east. The ventilation openings at ground level will be hinged or removable panels which will not reduce the available ventilation free area.

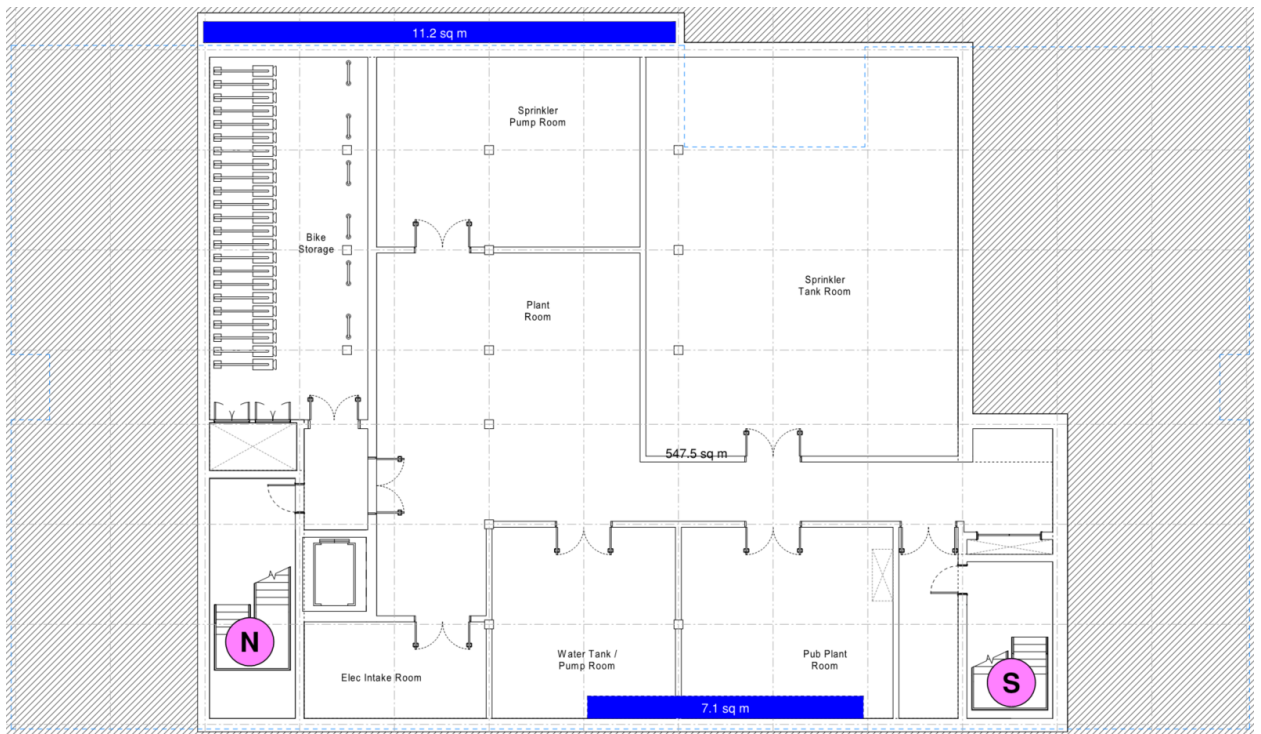


Figure 32 Wharf Lane basement ventilation

8. Fire safety management

8.1 General

- 8.1.1 The buildings have communal areas which are protected by active fire protection systems.
- 8.1.2 The fire protection systems and the communal areas should be managed to maintain fire safety within the development.
- 8.1.3 Good housekeeping standards should be enforced to ensure that the effectiveness of the fire safety provisions is not reduced.
- 8.1.4 Maintenance schedules and procedures should be developed to ensure that all safety systems within the buildings can operate effectively.

8.2 Regulation 38

- 8.2.1 To comply with Regulation 38 to the Building Regulations, it is proposed that a full package of building design information is passed on to the end user for the development.
- 8.2.2 It is proposed that the following package of information is provided to the end users:
 - The fire strategy report.
 - Management information proposed in addition to that contained in this strategy.
 - Specifications of all passive fire safety systems.
 - Specifications of all fire safety equipment.
 - Specification of the AFDAS.
 - Specification of the AWFSS.
 - Final construction plans for the building.
 - Installation certification and commissioning information for all fire safety systems.
 - Operations and maintenance manuals for all the fire safety systems.
- 8.2.3 This information should form part of the building's handover package by the main contractor.

9. Conclusions

- 9.1.1 This document outlines the fire safety strategy for Twickenham Riverside.
- 9.1.2 The objective of the strategy is to make recommendations on the proposed design and present a suite of fire protection measures which demonstrate compliance with the functional requirements of the Building Regulations.
- 9.1.3 Our recommendations for the buildings include:
- Install AFDAS in all flats to a Grade D1/D2, Category LD1 as per BS 5839-6.
 - Install a Category 2 AWFSS in all flats as per BS 9251.
 - Provide natural smoke control to communal escape routes.
 - Provide 60 minute fire protected escape stairs.
 - Provide refuges in all escape stairs.
 - Install AFDAS in all non-residential areas to at least Category L3 as per BS 5839-1.
 - Install a Class OH1 and OH3 AWFSS in non-residential areas as per BS EN 12845.
 - Provide 60 minute compartmentation between separate occupancies.
 - Install dry rising mains within escape stairs.
 - Provide a 1m² AOV at the head of each escape stair.
- 9.1.4 Based upon the strategy documented in this report, we believe that adequate measures are proposed to meet the functional requirements of the Building Regulations.

10. Appendix A: Record of end user responsibilities

- 10.1.1 The following record identifies the key fire safety strategy elements that should be highlighted to the end user or occupier of the buildings to assist them with managing and maintaining the fire safety strategy.
- 10.1.2 These items should be incorporated into all fire risk assessments and management procedures that consider fire safety within the buildings.
- 10.1.3 A crucial element of the means of escape strategy for the building relies on the operation of the automatic fire detection and alarm system. It is essential that once the building is occupied that both the residential and common fire alarm systems are regularly tested and maintained.
- 10.1.4 The building relies on both passive and active fire safety systems to maintain the integrity of the fire strategy proposals. All elements should undergo regular inspection, testing, and maintenance to ensure that an acceptable level of safety is maintained throughout the life of the building.
- 10.1.5 Under the FSO, it is required that building owners or occupiers carry out a Fire Risk Assessment for the building or accommodation. The outcome should be the development of management procedures to assist with the safe operation and evacuation of the building (including the evacuation of any disabled occupants).
- 10.1.6 On-going management involvement will be needed to ensure that all common areas and escape routes remain sterile of fire loads.

11. Appendix B: Discussion on hob location

11.1 Introduction

- 11.1.1 As part of the Fire Safety Strategy, it is recommended that the open plan flats are provided with a Grade D1/D2, Category LD1 automatic fire detection and alarm system to BS 5839-6.
- 11.1.2 This system should provide an alarm notification to occupants of a fire in the affected apartment only.
- 11.1.3 In addition, it is recommended that the apartments are provided with a Category 2 automatic water fire sprinkler system to BS 9251.
- 11.1.4 When it comes to the internal planning of open plan flats, the guidance in both ADB and BS 9991 recommend that the cooking facilities are located remote from the main entrance door so as not to impede the escape route from anywhere in the flat. However, there is no guide as to a minimum distance that would satisfy the requirement.
- 11.1.5 A common cause of cooker fires is unattended oil fires. We will consider this scenario for discussion. We will assume a practical separation distance between the hob and the escape route. Upon this basis, we will estimate the impact on the escape route from an oil fire on the cooker.

11.2 Discussion

- 11.2.1 There are numerous factors that could affect an occupant's escape in the early stages of a cooker fire from within an open plan flat. We will focus on the smoke produced and heat generated at this stage of the fire.
- 11.2.2 The smoke point of cooking oils range between 107°C and 270°C, with sunflower oil being around 227°C and olive oil around 210°C. The autoignition temperature, like for most fuels, being higher at around 400°C to 435°C for cooking oils. From this we would expect that the smoke detector should activate the flat's alarm before the oil ignites. Smoke obscuration is not considered a tenability factor at the early stages since there are not significant quantities of smoke being generated at this stage. The alarm should notify the occupant to intervene.
- 11.2.3 Additionally, occupant exposure to thermal radiation should also be considered. The reason being that if the situation escalates rapidly from the point of initial smoke to an ignited pan fire, the occupant should be provided with a means to circumvent the fire and exit.

11.3 Calculations

- 11.3.1 We recommend 1.8m as a minimum separation distance between the edge of the hob and an escape route. The basis for this, in the absence of any other guidance, is ADB's guidance for the minimum horizontal separation distance for the protection of external escape routes.
- 11.3.2 Table I.4 of PD 7974-6 indicates the exposure tolerance tenability limits from thermal radiation and convection.

Mode of heat transfer	Intensity	Tolerance time
Radiation ^{A)}	<2.5 kW·m ⁻²	>5 min
	2.5 kW·m ⁻²	30 s
	10 kW·m ⁻²	4 s
Convection	<60 °C 100% saturated	>30 min
	100 °C <10% H ₂ O ^{B)}	8 min
	110 °C <10% H ₂ O	6 min
	120 °C <10% H ₂ O	4 min
	130 °C <10% H ₂ O	3 min
	150 °C <10% H ₂ O	2 min
	180 °C <10% H ₂ O	1 min

^{A)} Representing a thermal dose limit of 1.33 (kW·m⁻²)^{4/3}·min or 80 (kW·m⁻²)^{4/3}·s.

^{B)} v/v.

Table I.4 of PD 7974-6

11.3.3 Following the calculation process outlined in 'Principles of Fire Behaviour' by James Quintiere, we can estimate the incident heat flux at 1.8m.

11.3.4 The total heat release rate is calculated as follows:

$$Q = m'' \cdot A \cdot H$$

Where:

m'' is the mass burning rate for cooking oil from experimental data which is around 22 g/m²·s

A is the area of the fire source is taken to be equal to $\pi(L/2)^2$ based on a flame height of (L) of 0.5m

H is the heat of combustion for cooking oil, which is 42 kJ/kg

Q is the total heat release rate, which is calculated to be around **181 kW**

11.3.5 Where the distance to the observer is much larger than the pool fire diameter, the incident heat flux at 1.8m may be calculated as follows:

$$q'' = \frac{\chi \cdot Q}{4 \cdot \pi \cdot d^2}$$

Where:

χ is the radiative fraction (energy released as thermal radiation), assumed conservatively as 0.5.

d is the distance to the escaping occupant which is 1.8m.

q'' is the incident heat flux, which is estimated as being around **2.3 kW/m²**.

11.3.6 Table I.4 in PD 7974-6 suggests that this level of radiation would be tolerable for periods of more than five minutes. It is unlikely that an occupant escaping would be exposed for this length of time.

11.3.7 The above formulas were derived from empirical data based on the study of pool fires of various sizes and fuels. A very conservative approach has been adopted. A sensitivity analysis on the size of the frying pan demonstrates that it has significant impact since it is a square function. It is very conservative to assume a radiative fraction of 0.5 since the fire will be governed by convective forces, especially in the early stages.

11.3.8 An additional benefit is the installation of an automatic sprinkler system. It is not proposed that the sprinkler system will extinguish the fire, but once activated it will help reduce the intensity of incident thermal radiation.

11.3.9 Depending on the flat layout there may also be benefit from physical shielding from cupboards, furniture, and appliances.

- 11.3.10 There are no open plan flats with travel distances which exceed 20m. Table I.1 of PD 7974-6 indicates estimated walking speeds base on smoke tenability limits. As a worst-case scenario, if occupants have ignored the fire alarm and sprinkler activation, and if faced with low visibility of 2m, they will be able to manoeuvre around the cooker and exit in about a minute.

Smoke density and irritancy	Approximate visibility	Reported effects
$D \cdot m^{-1}$ (extinction coefficient)	Diffuse illumination	
None	Unaffected	Walking speed 1.2 m/s
0.5 (1.15) non irritant	2 m	Walking speed 0.3 m/s
0.2 (0.5) irritant	Reduced	Walking speed 0.3 m/s
0.33 (0.76) mixed	3 m approx.	30% of people turn back rather than enter

Suggested tenability limits for buildings with:

- small enclosures and travel distances: $D \cdot m^{-1} = 0.2$ (visibility 5 m)
- large enclosures and travel distances: $D \cdot m^{-1} = 0.08$ (visibility 10 m)

Table I.1 of PD 7974-6

11.4 Conclusion

- 11.4.1 This discussion estimates the incident radiant heat flux from the burning oil frying pan on the cooker that an occupant escaping from an open plan flat may be exposed to.
- 11.4.2 The discussion proposes a separation distance of 1.8m as a basis for evaluation.
- 11.4.3 The approach of the estimation is conservative.
- 11.4.4 The design of the open plan flats aligns with the guidance in that travel distances do not exceed 20m in flats which are provided with sprinkler protection.
- 11.4.5 From the discussion and the estimations, we conclude that the provision of a 1.8m clearance between the edge of the hob and escape route within the flat is reasonable and affords occupants an acceptable means of escape.

11.5 References

- 11.5.1 <https://culinarylore.com/food-science:how-hot-before-cooking-oil-ignites/>.
- 11.5.2 https://en.wikipedia.org/wiki/Template:Smoke_point_of_cooking_oils.
- 11.5.3 PD 7974, Application of fire safety engineering principles to the design of buildings, Part 6 Human factors: Life safety strategies - Occupant evacuation, behaviour, and condition, 2019.
- 11.5.4 Principles of Fire Behaviour, James Quintiere, 1998.