FIRE ENGINEERING
DESIGN NOTE

Ref – F0132 77 Kingsway, London, WC2B 6SR
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Date: 16 11 2017

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1 INTRODUCTION

1.1 Report Scope & Objectives

CBFE have been appointed to provide a design strategy and to give additional guidance to the project and report outline requirements to achieve compliance with the building code objectives and design intent (in particular with respect for the use of a single stair means of escape).

This report is based on the guidance in Approved Document B (ADB) to The Building Regulations, April 2007 Edition, as well as other relevant guidance, such as British Standard BS 9999, BS 9991.

In this case ADB will generally be used for the fire safety analysis and design with reference to BS 9999 and BS 7974 where relevant.

This strategy provides key information for the production of a Fire Risk Assessment and if necessary a fire manual.

The findings and opinions expressed are based on the conditions encountered and / or the information reasonably available at the date of issue of this document, and shall be applicable only to the circumstances envisaged herein.

This document forms the approach for fire engineering, the design & construction teams must ensure the contents of the report are incorporated in the building. It is intended to provide the project team with an understanding of the requirements to reduce design approval risk leading to building approval.

It forms the basis of discussion with the design team and will form the basis of a complete fire strategy for discussion with the approving authorities. Until confirmed, all information should be treated as advisory only.

1.2 Building Description

The building is to be used as commercial offices, lower ground level to 8th floor, with floor levels above 18m from ground level.

The existing building purpose group is "office" and will remain so.

The building is classified in the following Purpose Groups under ADB:

The ADB propose groups is

GROUP TYPE	CLASSIFICATION
3	Office

Table 1 – Purpose Group

Note: Any plant, stores and cupboards have been considered "ancillary" to the main building use.

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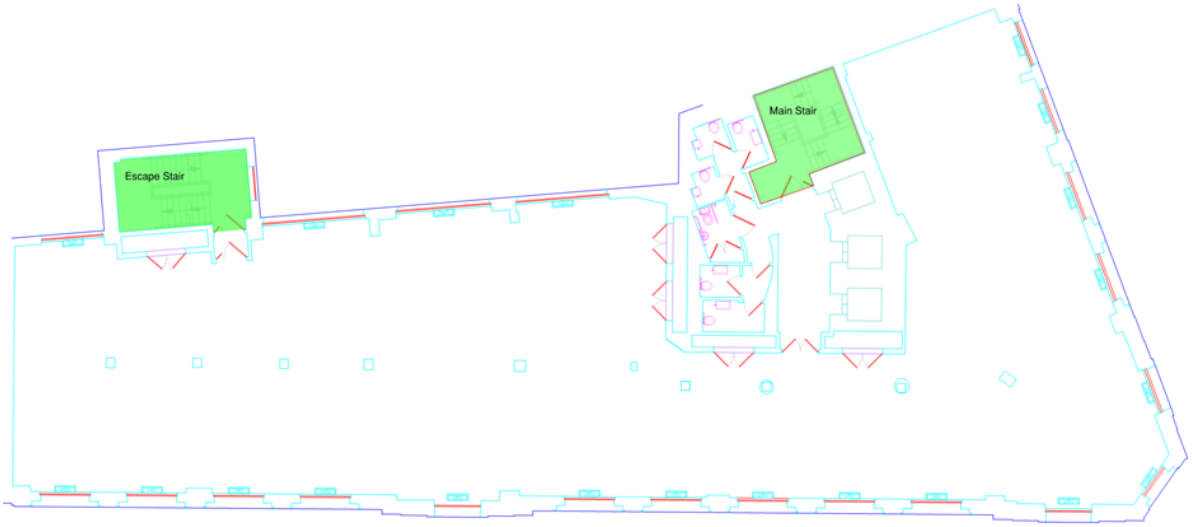

Figure 1 - Existing layout (5th and 6th)

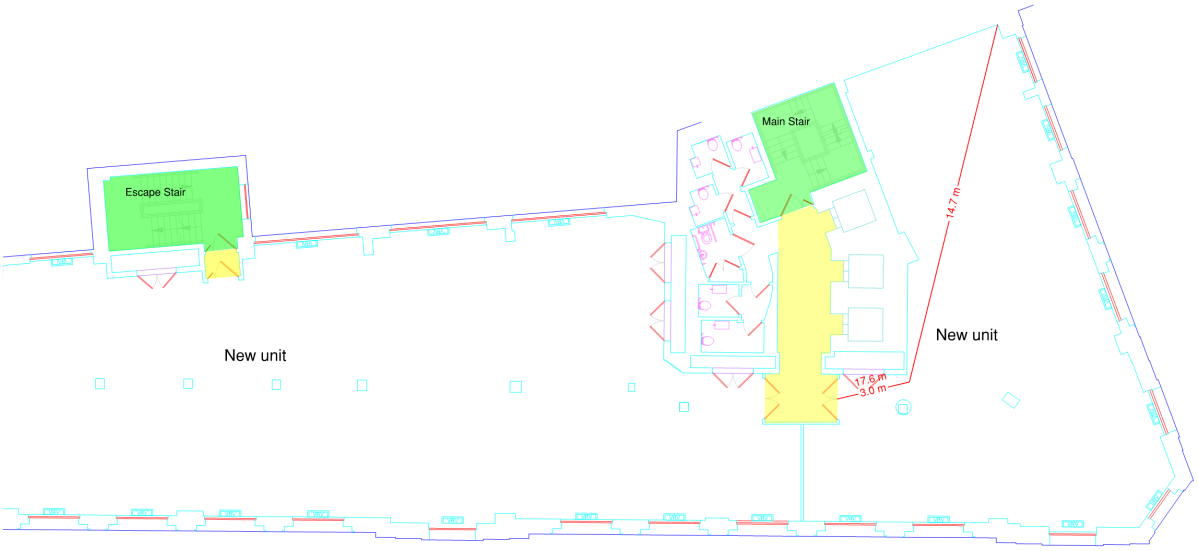

Figure 2 - Proposed 5th and 6th floor layout

The building will provide:

- Lower ground – Bike racks, WC's & showers
- Ground – Offices, reception & WC
- 1st - 8th floor – Offices, & WC's

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Figure 1 above shows an existing typical floor layout and Figure 2 shows the new proposed layout where one office unit only have a single means of escape.

1.3 Fire Strategy Overview

The proposals outlined in this document aim to demonstrate a level of fire safety equal to or greater than the general standard implied by compliance with the recommendation in Approved Document B. This level of safety will therefore, satisfy the functional requirements of The Building Regulations relating to fire safety.

Due to the proposal to sub divide the 5th & 6th floors, one of the sub divided areas at these levels will only have access to a single stair, making this a single stair means of escape, Figure 2 above.

The main elements of the fire strategy described in this report can be summarised as follows:

- Single staircase means of escape (from 5th & 6th floor areas)
- Smoke management of stair / lobby
- The escape strategy will be based on simultaneous evacuation
- Enhanced fire detection and early warning (category BS 5839 L1M)

Note: The building contains 8 storeys above ground floor of which, two single units will use a single stair MOE, as the building is over 11m it would typically require an alternative means of escape, this has been justified within this report by means of a pressurised stair and a high level of detection.

Several issues are clarified for Fire Safety compliance based on the use of a single stair as the means of escape (MOE):

ISSUE	CLARIFICATION
Code guidance requires alternative MOE for office buildings on storeys with a height over 11m	The use of a single stair means of escape, using a pressurised stair
Stair protection (lobby)	ADB 4.34 alternative method to lobbing by the use of smoke control such as stair Pressurisation
Means of warning & evacuation	Enhanced fire detection & alarms to L1

Table 2 – Compliance Issues

Code guidance requires two stairs for buildings with a height over 11m, however the use of a single stair is justified by providing a protected means of escape, which will encompass the following enhancements to ensure a maintained means of escape for occupants and access for firefighting services:

- Mechanical smoke control (pressurisation) of stairs, which has been CFD proven
- Automatic fire detection system upgraded to a L1 type (BS 5839)
- Simultaneous building evacuation
- Limited occupancy levels in the applicable areas (less than 60)
- Alternative exit from ground level
- Stair / exit capacity (minimum 1000mm above ground, 1200mm below ground)

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- Compartment floors
- Fire management approach (level 2 as per BS 9999)

As the building is over 18m in height there would be a requirement for a firefighting shaft to be provided, however as an existing building no firefighting shaft was provided. So, in this case the fire service will benefit from the stair pressurisation and a dry riser, which is also planned to be fitted into the building.

This method of MOE has been accepted in London previously in commercial buildings when supported by fire engineering, and is a recognised MOE used in residential buildings (as per BS 9991).

1.4 Legislation

The main fire legislation applicable to this building is The Building Regulations and The Regulatory Reform (Fire Safety) Order 2005.

This document forms a strategic approach for fire safety, the design and construction teams must ensure the contents of this report are incorporated in the building. This strategy will not prevent a fire occurring, but good housekeeping will help to reduce the risk. This strategy is mainly concerned with getting occupants out of the building safely and providing measures, where necessary, to assist the fire fighters in their operations.

The strategy is only valid where the systems are designed correctly and maintained in an operating condition. If there is a failure in the management approach and a fire occurs, this strategy will not reduce the impact on contents and building damage. The content status of this report is 'Preliminary Information' until agreed with the approving authorities.

Following occupation, the developer / management of the premises are required under current legislation to carry out a Fire Risk Assessment. This document will be developed following completion of the fit out works and will form part of the fire manuals developed for the premises (BS 9999 provides appropriate guidance in this area).

1.5 Building Regulations

The construction or modification of any building in England & Wales needs to comply with the statutory requirements of The Building Regulations. These regulations deal with the minimum standards of design and building work for the construction of domestic, commercial and industrial buildings. The Building Regulations contain a list of requirements, referred to as Schedules, which are designed to ensure the health and safety of people in and around buildings. There are 14 parts, which cover subjects such as structure, fire safety, ventilation, drainage, etc.

In the case of fire, the regulations are dealt with under the functional requirements B1 to B5 of Schedule 1 of The Building Regulations, produced under the Building Act 1984. There are a number of prescriptive documents, which can be adopted to show compliance with the Schedules. These include ADB and The British Standards BS 9999 and BS 9991 'Fire Precautions in the design, construction and use of buildings', which are considered as adequate to provide general guidance for the more common buildings.

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An alternative approach is to adopt Fire Safety Engineering, which integrates fire engineering calculations, life safety systems, building inherent features and professional judgement, to produce a fire strategy that achieves appropriate levels of safety to a specific building and use, this has been used to consider and adopt the use of a single stair means of escape.

Responsibility for deciding if the requirements of the Regulations have been met rests with the building control body (a Local Authority Building Control Officer or an Approved Inspector).

1.6 Regulatory Reform (Fire Safety) Order 2005

The Fire Safety Order is the primary piece of legislation relating to fire safety in existing, non-domestic premises, and is usually enforced by the local fire authority.

The duty of ensuring that the requirements of the Order are met rests with the Responsible Person, who must undertake a risk assessment for the purpose of identifying any necessary fire precautions and other duties within the common areas of this residential premises.

During The Building Regulations application process, the building control body is required to formally consult with the local fire authority. The purpose of this consultation is to give to fire authority the opportunity to make observations with respect to The Building Regulations and to provide an opportunity to make the applicant aware of action that may have to be taken to meet the requirements of the Fire Safety Order.

The consultation should allow both parties to reach mutually compatible views on whether the building meets the requirements of both pieces of legislation. In the exceptional event that the fire authority proposes to require physical changes to the building to meet the requirements of The Fire Safety Order, the building control body should make the applicant aware.

1.7 Construction, Design and Management Regulations

Projects undertaken in the UK are subject to the requirements of the Construction (Design and Management) Regulations 2015 (CDM), or within the European Union, that particular country's interpretation of the European Union Directive.

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 (Fire Safety). Where any conclusions or recommendations contained within this report specify particular materials, products or forms of construction these will have been assessed, in accordance with CDM Regulations 11 and 18 (duties for designers).

In the event that these involve significant residual risks or health and safety critical assumptions, this information will be made available to the Principal Designer. Where the architect or other consultants use all or part of this report to specify works, they are understood to be competent in alerting the Client, Principal Designer, Designers, Contractors and Building Occupier of issues arising under the CDM Regulations.

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2 MEANS OF ESCAPE

Schedule 1 of The Building Regulations requires the following functional requirements to be met in respect of B1, Means of warning and escape:

"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."

The following discusses the implications of this proposed building design and seeks to demonstrate that a satisfactory standard of fire safety is achieved.

The general philosophy for means of escape is that the occupants of a building should be able to turn their back on a fire and escape via the nearest exit without additional assistance from other occupants or fire fighters. This is achieved by providing alternative escape routes where necessary, limiting travel distances, providing sufficient exit width and escape routes that, depending upon the use of the building, will have specified periods of fire resistance.

There are a number of ways of evaluating escape capacity. ADB provides a methodology which is suitable.

Whilst this report will consider ADB for overall building design occupancy, the actual floor areas are relatively small and therefore the overall building design occupancy is likely to be determined in the main by the stair and / or exit capacities. The level of smoke control & management recommended to achieve a satisfactory evacuation will also be outlined.

If reviewed under BS 9999 the office purpose group / building would fall into an A2 (awake and familiar) risk categorisation simultaneous evacuation would be in place.

2.1 Horizontal Escape

Means of escape travel distances for the building are generally within the ADB recommendations of:

- 18m one way
- 45m two way

The above ground floor expected maximum travel distances will be for a single direction / dead end from each floor, as all floors are provided with one exit then all travel will be single direction.

The estimated occupancy capacity typically determines the required exit widths from each level, however ADB establishes where a minimum of one exit is provided then the number of occupants should be limited to 60 people, within the design. In the use of the newly created building areas on the 5th & 6th floors it is not anticipated that occupancy loads will exceed that detailed above, these levels should be reviewed and monitored under the building management and plan.

The anticipated occupancy of each floor is also shown in Table 3 below:

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FLOOR	OCCUPANCY	NOTE
6th	60	Single door
5th	60	Single door
Ground		Main entrance / exit & via stair / reception

Table 3 - Anticipated occupancy of each floor

The ground floor is provided with one exit off the stair lobby, occupants from the two units with the single escape will escape through the main reception entrance.

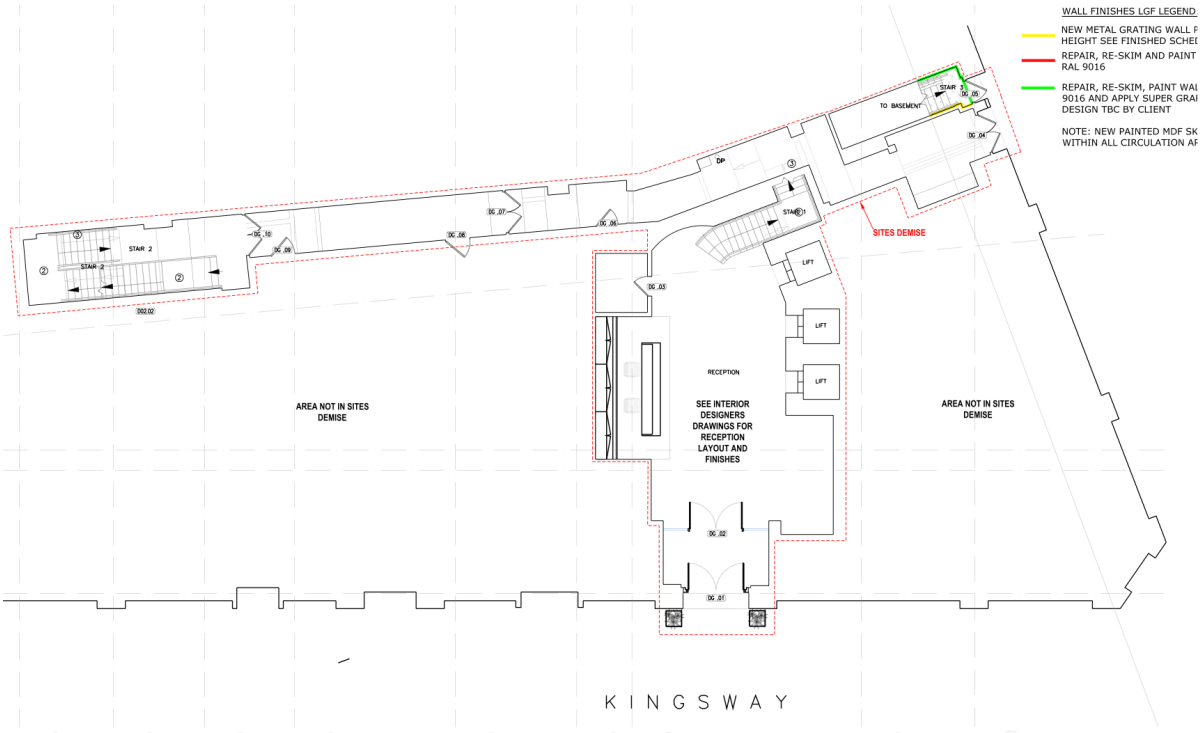

Figure 3 – Existing staircase arrangement - ground floor

2.2 Vertical Escape

Code guidance requires alternative MOE for office buildings on storeys with a height over 11m, however, the use of a single stair can be justified by providing a hardened means of escape with smoke ventilation to ensure escape tenability in the stair, which leads directly to the outside at ground level.

As the building is over 18m in height there would be requirement for a firefighting shaft (FFS) to be provided in new buildings, however in recognition of the single stair provision for the 5th & 6th floor areas the single stair will be protected by a smoke ventilation system via a pressurisation system.

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Based on simultaneous evacuation, a 1000mm stair will accommodate a floor capacity from the 1st to the 8th floor of 430 persons within the stair.

MAXIMUM NUMBER OF PERSONS	MINIMUM NUMBER OF ESCAPE ROUTES / EXITS
60	1
600	2
More than 600	3

Table 4 – Minimum number of escape routes and exits from a room, tier or storey

Note -Typically reference should be made to Part M of The Building Regulations, which recommends 1200mm for access where applicable.

On the floor level WC's are located within the stair / lobby but are permitted within a protected stair.

Both stairs will be enclosed within fire rated construction on all levels.

Final exits should be sized greater than the width of the stairs.

To summarise therefore:

As a result of this means of escape analysis, the recommendations are:

- Smoke ventilation to be provided to protect the stair for escaping occupants & fire fighters
- The Automatic Fire Detection systems will be upgraded to an L1 category

2.3 Smoke Control

The principle remains to prevent smoke from entering the escape staircases during the means of escape phase for occupants.

A mechanical system will be provided to assist the means of escape it also assists firefighters, who, as the building currently has is no stair ventilation benefit from the introduction of stair ventilation.

Pressure differential systems offer the facility of maintaining tenable conditions in protected spaces, for example escape routes, firefighting access routes, firefighting shafts, lobbies, staircases, and other areas that require to be kept free of smoke.

The aim therefore, is to establish a pressure gradient (and thus an airflow pattern) with the protected escape space at the highest pressure and the pressure progressively decreasing in areas away from the escape routes.

A pressurisation system consists of three main components:

- Supply Air (where air is injected into the area that is to be protected)
- Pressure Relief (to avoid overpressure when doors are closed)
- Air Release (air and smoke is released from the adjoining fire area)

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Combining these elements creates a positive pressure difference, which prevents lobbies and staircases from filling up with smoke.

Pressurisation systems should meet the recommendations of ADB and BS EN 12101-6 "Specification for Pressure Differential Systems" class C.

The design conditions for Class C systems assume that the occupants of the building will all be evacuated on the activation of the fire alarm signal, that is simultaneous evacuation.

In the event of a simultaneous evacuation it is assumed that the stairways will be occupied for the nominal period of the evacuation, and thereafter will be clear of evacuees. Consequently, the evacuation will occur during the early stages of fire development, and some smoke leakage onto the stairway can be tolerated. The airflow due to the pressurisation system shall clear the stairway of this smoke.

The occupants being evacuated are assumed to be alert and aware, and familiar with their surroundings, thus minimising the time they remain in the building.

However, the Class C system that is proposed shall be more than the specified 0.75m/s. During firefighting it is proposed to have an enhanced air flow through the open doors, including the firefighting access door, the aim of this is to aid firefighting operations and to assist in their safety.

Typically, this will be automatic in operation and consist of:

- Inlet Fans for introducing air into the designated area. The run and standby fans and control equipment
- Outlet Grilles, to provide distribution of air exactly where it is needed
- Pressure Relief Dampers, to release excess air in the closed-door condition from the stair area and office area (with the aid of AOV's)
- Automatic air release to prevent unwanted pressure build up
- The control system should operate automatically from the smoke detection system
- Detection at each level to activate the system
- Fire service controls at access level

To demonstrate the effectiveness of the system a fire engineering model has been provided using computational fluid dynamics (CFD) analysis, which has proved acceptable tenability of the escape route.

The mechanical smoke venting proposed on this development is designed to maintain tenable conditions at all levels within the stair during the escape period from the office accommodation.

The general objective of the system is to maintain the stair reasonably clear of the elements of combustion during firefighting, i.e. such that conditions are tenable.

This performance is therefore, considered to meet the performance criteria requirements of ADB for a lobbied stair (ADB 4.34).

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The system will be installed by a specialist installation contractor.

2.4 Fire Alarm and Detection Systems

The recommendations of office buildings is that they should be fitted with a BS 5839 - 1 Manually operated call point & alarm system (Type M) however, this report recommends an enhanced L1 fire alarm system to be installed throughout the building to the standard of BS 5839 – 1 category L1, to support with the principles of the single stair MOE. This will include detection, manual call points and sounders throughout all areas as necessary. The system will be arranged so that any detection causes a simultaneous evacuation of the alarms throughout the building. The enhanced L1 system will provided early detection and evacuation of the building:

2.5 Evacuation

The building will be evacuated on a simultaneous basis which, will require all occupants to leave the building at the same time, therefore there must be sufficient capacity in the stairs and at the exits to provide a safe and timely evacuation.

A management safety policy / strategy should be put into place to ensure these limits are observed.

2.6 Emergency Power Supplies

In the event of a failure of the mains power supply a secondary backup power supply will be provided to feed life safety systems. At this stage, the following life safety systems will include a backup power supply:

- Illuminated emergency signage
- Emergency lighting
- Automatic fire alarm and detection system
- Mechanical smoke venting systems
- Any fire alarm interlinked fire / smoke curtains or dampers

Diverse supplies will be provided for the smoke ventilation system.

3 CONCLUSION

It is recommended that a full Fire Risk Assessment should be carried out by the building owner / managing agent near to the building completion and be in place on occupation to meet the requirements of The Regulatory Reform Order 2005. The assessment should be maintained and act as a record of the provision and measures, passive and active, used to minimise fire risk within and around the building.

Based upon the above proposals it is considered that adequate measures are provided to meet the functional requirements of The Building Regulations.

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